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THE ATTACHED STANDARD PRACTICES MANUAL, ATA NO. 70-00-02, REVISION 2, SEPTEMBER 11, 2020, IS ISSUED FOR USE IN SUPPORT OF THE FOLLOWING GAS TURBINE ENGINES.

| ENGINE MODEL NO. | ENGINE PART NO. |
| --- | --- |
| 55-L-714A | 2-001-020-35 |
| T55-L-712 Series | 2-001-020-23/-25/-30/-41/-45 |
| AL5512 | 2-001-020-21 |
| T5508D | 2-000-030-28 |
| T55-GA-714A | 2-001-020-58 |
| T53-L-703 | 1-000-060-23 |
| T53-L-13B Series | 1-000-060-17/-22 |
| T53-L-13B/D | 1-000-060-28 |
| T5313B | 1-000-060-13 |
| T5317 Series | 1-000-060-21/-29/-30/-32 |
| LTS101-600A-3A | 4-001-000-31 |
| LTS101-700D-2 | 4-001-000-33 |
| LTS101-700D-2 | 4-001-000-43 |
| LTS101-650B-1 | 4-001-000-12 |
| LTS101-650C-3 | 4-002-000-05 |
| LTS101-750B-1 | 4-001-000-25 |
| LTS101-750C-1 | 4-002-000-06 |
| LTS101-850B-2 | 4-001-000-42 |
| LTP101-600A-1A | 4-003-000-05 |
| LTP101-700A-1A | 4-003-000-04 |
| HTS900-2-1D | 4-007-000-05 |
| HTS900-2-1D | 4-007-000-03 |

REVISION NO. 2 DATED SEPTEMBER 11, 2020

This is a PARTIAL revision. The pages revised are listed below, together with the Highlights of the revision. The pages of prior issues which are not affected retain previous revision dates. Please remove and discard the affected pages and replace with the pages of this revision. Enter on the Record of Revisions the date the pages are inserted.

## HIGHLIGHTS

| Chapter/Section/Pages | Description of Change |
|---|---|
| Title Page | |
| Page T-1 | Updated to reflect current revision and add T55-GA-714A engine models. |
| Page T-2 | Added LTS101 and HTS900 engine models. |
| Proprietary Information | |
| Pages T-3 thru T-6 | Updated to reflect current revision. |
| List of Effective Pages | |
| Pages LEP-1 thru LEP-8 | Updated to reflect current revision. |
| Record of Revisions | |
| Page RR-1 thru RR-2 | Updated to reflect current revision. |
| Record of Temporary Revisions | |
| Pages RTR-1 thru RTR-2 | Updated to reflect current revision. |
| 70-15-06 | |
| Page 1 | Updated to incorporate the requirements of TR 70-6. |
| 70-15-07 | |
| Page 1 | Updated to incorporate the requirements of TR 70-6. |
| 70-15-08 | |
| Page 1 | Updated to incorporate the requirements of TR 70-6. |
| 70-15-14 | |
| Page 4 | Updated to incorporate the requirements of TR 70-6. |
| 70-25-09 | |
| Page 1 | Updated to incorporate the requirements of TR 70-8. |
| 70-30-23 | |
| Page 1 | Updated to incorporate the requirements of TR 70-9. |
| 70-80-01 | |
| Page 8 | Added specification MIL-PRF-907 and added nickel base to group 02 item 01 Never Seeze. |
| Pages 17, 22, 39 thru 41 | Updated to incorporate the requirements of TRs 70-6, 70-7, and 70-9. |

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# STANDARD PRACTICES MANUAL

## GAS TURBINE ENGINES

| MODEL NUMBER | PART NUMBER |
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| T55-L-712 Series | 2-001-020-23/-25/-30/-41/-45 |
| AL5512 | 2-001-020-21 |
| T5508D | 2-000-030-28 |
| T55-GA-714A | 2-001-020-58 |
| T53-L-703 | 1-000-060-23 |
| T53-L-13B Series | 1-000-060-17/-22 |
| T53-L-13B/D | 1-000-060-28 |
| T5313B | 1-000-060-13 |
| T5317 Series | 1-000-060-21/-29/-30/-32 |

**JANUARY 30, 2007**

**REVISION 2, SEPTEMBER 11, 2020**

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ECCN: 9E991.

UP781957

| MODEL NUMBER | PART NUMBER |
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| LTS101-700D-2 | 4-001-000-33 |
| LTS101-700D-2 | 4-001-000-43 |
| LTS101-650B-1 | 4-001-000-12 |
| LTS101-650C-3 | 4-002-000-05 |
| LTS101-750B-1 | 4-001-000-25 |
| LTS101-750C-1 | 4-002-000-06 |
| LTS101-850B-2 | 4-001-000-42 |
| LTP101-600A-1A | 4-003-000-05 |
| LTP101-700A-1A | 4-003-000-04 |
| HTS900-2-1D | 4-007-000-05 |
| HTS900-2-1D | 4-007-000-03 |

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## INTRODUCTION

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# INTRODUCTION

1. General

A. This Standard Practices Manual provides those repetitive maintenance instructions in support of engine and aircraft maintenance manuals for T55 gas turbine engines manufactured by Honeywell Defense & Space, Phoenix, Arizona. This document has been prepared in accordance with ATA Specification 100.

NOTE: FAA regulations where applicable prohibit the flying of any aircraft unless it has been determined to be airworthy. The operator, owner, or any person charged with the responsibility for ascertaining the airworthiness of an aircraft must have and use the most recent technical information. This document, at the time of its initial delivery, is current and up to date, and the considerations of safety, legality, and economy demand that it be kept current.

B. This manual, as referenced in the applicable engine or aircraft maintenance manuals and supplemented by Honeywell service bulletins, constitute the authoritative statement of Honeywell approved and recommended maintenance procedures for the applicable gas turbine engines.

C. Unusual problems concerning engine maintenance should be presented to the Customer Support Department either through its field service representatives or by direct contact. All possible assistance will be provided toward solution of these problems.

D. Honeywell has a continuing program to develop and refine repair procedures, disassembly and assembly procedures, and inspection and test techniques, tools, etc, which will be issued as revisions to the manual. Data of a more urgent nature is supplied using Temporary Revisions that are keyed to the appropriate sections of the manual. Significant engine modifications are covered by issuing service bulletins.

2. Logbook Use

A. A logbook for each engine/module is packaged with each engine/module and is issued to provide a document for recording maintenance actions, operating time, and cycles, and to provide immediate summary of operating history. Instructions for using the logbooks are located on the first page.

B. At the completion of engine/module repair, entries recording these actions must be made in the appropriate logbook section. Be sure operating time and operating cycles accumulated on components replaced are entered in appropriate block and returned with any accessories or components sent for repair or overhaul. Missing information on parts that are returned for repair or overhaul could possibly result in parts being scrapped.

3. Notes, Cautions, and Warnings

A. Notes, cautions, and warnings are found throughout the manual. Notes follow the text to which each applies. Cautions and warnings precede the text to which each applies. Conditions for use are as follows.

WARNING: TO HIGHLIGHT PROCEDURES, ETC, WHICH WOULD RESULT IN PERSONAL INJURY OR LOSS OF LIFE, IF NOT CORRECTLY FOLLOWED.

CAUTION: TO HIGHLIGHT PROCEDURES, PRACTICES, ETC, WHICH IF NOT STRICTLY OBSERVED, WILL RESULT IN DAMAGE TO OR DESTRUCTION OF EQUIPMENT.

NOTE: To highlight essential procedures, conditions, information, etc.

4. Weights and Measures

Weights and measures are provided in both U.S. customary and SI–metric measurement systems. The SI–metric measurement value appears in parentheses immediately following the U.S. customary system equivalent.

5. Abbreviations

A. The use of abbreviations has been avoided as much as possible. However, in some instances such considerations as space limitations, common usage, etc, have made the use of abbreviations preferable to the use of longer terms. Abbreviations used are defined as follows:

(1) General abbreviations.

| Abbreviation | Definition |
|---|---|
| AC | Alternating Current |
| Act. | Actual |
| AMS | Aerospace Material Specification |
| ATA | Air Transport Association |
| CMM | Component Maintenance Manual |
| DC | Direct Current |
| Dia | Diameter |
| FOD | Foreign Object Damage |
| FPI | Fluorescent Penetrant Inspection |
| ID | Inside Diameter |
| INSP | Inspection |
| Max | Maximum |
| Min | Minimum |
| MPI | Magnetic Particle Inspection |
| $N_H$ | High Pressure System rotational speed |
| $N_L$ | Low Pressure System rotational speed |
| OD | Outside Diameter |
| Pm | Modulated Air Pressure |
| Ref | Reference |
| RPM | Revolutions per minute |
| SAE AMS | Society of Automotive Engineers Aerospace Material Specification |
| SP | Standard Practices |
| SPM | Standard Practices Manual |
| Typ | Typical |

1. A. (2) Weights and Measure Abbreviations.

| U.S. Customary System | | SI–Metric Measurement System | |
|---|---|---|---|
| Abbreviation | Definition | Abbreviation | Definition |
| °F | Degrees Fahrenheit | °C | Degrees Celsius |
| ft | Foot or Feet | m | Meter(s) |
| in. | Inch(es) | mm | Millimeter(s) |
| phr | pounds per hour | kg/hr | kilograms per hour |
| psi | pounds per square inch | kPa | kilopascal |
| psia | pounds per square inch absolute | $kN/m^2$ | kilonewtons per square meter absolute |
| psig | pounds per square inch gage | $kN/m^2$ | kilonewtons per square meter gage |
| psid | pounds per square inch differential | $kN/m^2$ | kilonewtons per square meter differential |

6. Dimensional Tolerances

A. Unspecified dimensional tolerances are defined as follows:

| | |
|---|---|
| X.X | ±0.050" |
| X.XX | ±0.010" |
| X.XXX | ±0.005" |
| angles | ±2° |

7. Metric Conversion

Metric conversion chart includes most of the conversion factors customarily used in manuals and is sufficiently accurate for use in all procedures described in this manual. When using small multiples, rounding up or down to the first or second decimal place is usually sufficient. For more detailed conversion tables, refer to 70–00–07.

## METRIC CONVERSIONS

### LENGTH

| | | |
|---|---|---|
| 1 inch (in.) | = | 2.54 centimeters (cm) (25.4 millimeters (mm)) |
| 1 foot (ft) | = | 0.3048 meters (m) (30.48006 cm) |
| 1 yard (yd) | = | 0.9144 meters (m) |
| 1 meter (m) | = | 39.37 inches (1.0936 yards) |
| 1 centimeter (cm) | = | 0.3937 inch |
| 1 millimeter (mm) | = | 0.03937 inch |

### AREA

| | | |
|---|---|---|
| 1 square–inch (in.$^2$) | = | 645.162 square–millimeters (mm$^2$)<br>6.4516 square–centimeters (cm$^2$) |
| 1 square–foot (ft$^2$) | = | 0.0929 square–meter (m$^2$) |
| 1 square–meter (m$^2$) | = | 1.196 square–yards (yd$^2$)<br>(10.764 square–feet) |
| 1 square–centimeter | = | 0.1550 square–inch |

### VOLUME

| | | |
|---|---|---|
| 1 cubic inch (in.$^3$) | = | 16.387 cubic centimeters (cc) |
| 1 cubic foot (ft$^3$) | = | 0.028 cubic meter (m$^3$) (28.316 liters) |
| 1 cubic centimeter (cc) | = | 0.061 cubic inch |
| 1 cubic meter (m$^3$) | = | 35.314 cubic feet (1.308 cubic yard) |
| 1 fluid ounce (fl oz) | = | 29.57 cubic centimeters (cc) |
| 1 quart (qt) | = | 0.946 liter (946.333 cc) |
| 1 gallon (gal) | = | 3.7854 liters |
| 1 gallon | = | 0.003785 cubic meters |
| 1 gallon | = | 231 cubic inches |
| 1 gallon | = | 32 gills |
| 1 liter (L) | = | 1.0567 quart<br>0.264 gallon |

### WEIGHT

| | | |
|---|---|---|
| 1 troy pound | = | 5760 grains |
| 1 troy pound | = | 21.6514 avoirdupois drams |
| 1 troy pound | = | 13.1657 avoirdupois ounces |
| 1 troy pound | = | 0.8229 avoirdupois pounds |
| 1 troy pound | = | 373.2417 grams |
| 1 ounce (oz) | = | 28.35 grams (g) |
| 1 pound (lb) | = | 0.4536 kilograms (kg) (453.5924 grams) |
| 1 gram | = | 0.035 ounce |
| 1 kilogram (kg) | = | 2.2046 pounds |

### PRESSURE

| | | |
|---|---|---|
| 1 pound/square inch (psi) | = | 6.90 kilonewton/meter$^2$ (kN/m$^2$)<br>6.90 kilopascal (kPa) |

### CONCENTRATION

| | | |
|---|---|---|
| 7.5 gram/liter | = | 1 ounce (avoirdupois) per gallon |
| 7.8 cc/liter | = | 1 fluid ounce/gallon |
| 1 pound/gallon | = | 0.1198 kg/L, or grams/cc (119.8 grams/liter) |

### TORQUE

| | | |
|---|---|---|
| 1 pound–foot (pd–ft) | = | 1.355818 Newton meter (Nm) |
| 1 pound–inch (lb–in.) | = | 0.1129848 Newton meter (Nm) |

### TEMPERATURE

| | | |
|---|---|---|
| °Fahrenheit (°F) | = | 9/5 (°C + 32) |
| °Centigrade (°C) | = | 5/9 (°F - 32) |
| °Kelvin (°K) | = | °C + 273.18 (centigrade absolute) |
| °Rankine (°R) | = | °F + 459.688 (Fahrenheit absolute) |

## METRIC CONVERSIONS (CONT)

### DISTANCE

| | | |
|---|---|---|
| 1 mile (U.S. Statute) | = | 1.609 kilometers (km) |
| 1 kilometer (km) | = | 0.621 miles (U.S. Statute) |
| 1 decimeter (dm) | = | 0.1 meter |
| 1 dekameter (dkm) | = | 10 meters |
| 1 hectometer (hm) | = | 100 meters |
| 1 hectometer (hm) | = | 100 meters |
| 1 mile (Nautical) | = | 1.853 kilometers |

### METRIC RELATIONSHIP

| | | |
|---|---|---|
| 1 micron (µ) | = | 0.000001 meter (0.001 millimeter) |
| 1 centimeter (cm) | = | 0.01 meter |
| 1 millimeter (mm) | = | 0.001 meter |
| 1 decimeter | = | 0.1 meters |
| 1 dekameter (dkm) | = | 10 meters |
| 1 hectometer (hm) | = | 100 meters |
| 1 gram | = | weight of 0.001 liter of water |
| 1 liter | = | 0.001 cubic meter |

## CHAPTER 70–00–00 - GENERAL

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1. Determination of Work Requirement - SP A001

   A. The Shop Repair activity will check all logbooks, tags, forms, and correspondence pertaining to the equipment to determine the following:

      (1) Reason for removal from service.

      (2) Mandatory modification not accomplished.

   B. A preinspection shall be accomplished to determine the extent of disassembly and repair required.

   C. Parts and assemblies that require shop repair may, with operator’s concurrence, be replaced with serviceable or new assemblies to expedite equipment return to service.

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1. Component Operating Hour/Cycle History - SP A002

A. Unless otherwise directed, the following procedures will be adhered to when component's operating hour/cycle or limited life histories are unknown.

B. When limited life equipment is received, and total hours or cycles since last overhaul or shop repair is not available, request shall be made to operator for such information. If information is not obtained, contact:

Honeywell Defense & Space
Customer Support Center
P.O. Box 29003
M/S 26–06/2102–323
Phoenix, AZ 85038–9003

C. Every effort shall be made to maintain accurate records of limited life parts. Refer to Time Coding SP A008, 70–05–02, and applicable service bulletins.

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1. Definition of Terms - SP A003

A. Table 1 defines the terms used to identify conditions sometimes found during inspection of engine parts.

Table 1. Definition of Terms

| Term | Definition | Probable Cause |
|---|---|---|
| Abrasion | Roughened surface, varying from light to severe. | Abrasive material hitting surface. |
| Bend | Distortion in a part (differs from local change in conformation). | Exposure to heat or excessive force. |
| Blister | Raised portion of a surface separated from the base. Generally found on surface treated parts, such as plated or painted surfaces. | Poor original bond or excessive heat or pressure. |
| Break | Separation of a part. | Severe force, pressure, or overload. |
| Buckling | Large scale deformation of part contour. | Pressure or impact with a foreign object, unusual structural pressures, excessive localized heating, or any combination of these causes. |
| Burning | Melting or loss of material. | Excessive heat. |
| Burnishing | The smoothing of a metal surface by mechanical action, but without loss of material. Surface discoloration is sometimes present around the outer edges of the burnished area.<br>NOTE: Normal burnishing from operational service is not detrimental if coverage approximates the carrying load and if there is no evidence of burns. | Rubbing. |
| Burr | A rough edge or sharp projection. | Excessive wear or poor machining. |
| Chipping | Breaking away of small metallic particles. | Heavy impact of foreign object. |
| Coking | Hard, black, brittle carbon deposits. | Formed from oil exposed to high temperatures or from incomplete combustion. |
| Corrosion | Surface chemical action that results in surface discoloration, a layer of oxide, or in the advanced stages, removal of surface metal. | Improper corrosion preventive procedures and excessive moisture. |
| Corrosion Pitting | Irregular surface depressions having ragged edges due to metal removal. | Corrosive substance adhering to exposed surfaces. |

Table 1. Definition of Terms (Cont)

| Term | Definition | Probable Cause |
|---|---|---|
| Crack | A break in material. | Severe stress from overloading or shock. |
| Crazing | Minute cracking which tends to run in all directions. It is often noticed on coated surfaces. | Uneven cooling or thermal shock. |
| Dent | A small, smooth depression. | A sharp blow or excessive pressure. |
| Distortion | A change from original shape. | Exposure to severe heat. |
| Erosion | Wearing away of metal and/or surface coating. | Hot gases, corrosive liquids, or grit. |
| Fatigue Pitting | Relatively deep irregular surface cavities resulting from the breaking away of portions of the surface. | Advanced corrosion condition or fatigue generated by high stress conditions. |
| Flaking | Loose particles of surface metal or surface covering. | Imperfect bond or severe load. |
| Fracture | Separation of a part. | Severe force, pressure, or overload. |
| Fretting | Discoloration of contacting parts resulting from the removal of original surface material. | Movement between two contacting surfaces. |
| Frosting | Minute indentations in a localized area. | Generally a wear–in process. |
| Gouging | Removal of surface metal, typified by rough and deep depressions. | Protruding object, misalignment. |
| Heat Discoloring | Characterized by a discoloring film. Color varies from light straw, tan, or light brown, changing to red–purple, purple, or blue. | High temperature operation. |
| Inclusion | Foreign matter enclosed in metal. | Occurs during manufacture of the metal. |
| Indenting | Smooth surface depressions. Evidenced by metal displacement, not metal removal. | Loose material flattened by rolling action will create smooth, shallow indents. |
| Lack of Braze | Interruption (air pocket) in braze which is not continuous through joint cross section. | Improper braze repair. |
| Lack of Bond | Area of braze joint where braze alloy has failed to adhere (bond) to base metal and produces a signal response when inspected ultrasonically. | Improper braze repair. |
| Metallization | Molten metal coating of a part. | Molten particles sprayed through the engine. |
| Nick | A sharp bottomed depression which may have rough outer edges. | Impingement of foreign object on surface. |

Table 1. Definition of Terms (Cont)

| Term | Definition | Probable Cause |
|---|---|---|
| Peening | Flattening or displacement of metal. | Repeated blows. A surface may be peened by continuous impact of foreign objects or loose parts. |
| Pickup | Transfer of one material onto another. | Insufficient unbroken edges of press–fitted parts and seizure of rotating parts during operation. |
| Pitting | Small indentations in a surface, usually smooth bottomed. | Chemical pitting: oxidation of surface or electrolytic action. |
| | | Mechanical pitting: chipping of surface caused by improper clearances and overloading, and by pressure of foreign material. |
| Scoring | Deep scratches following part’s path of travel. | Breakdown of localized lubrication between sliding surfaces or presence of foreign material. |
| Scratch | A very shallow furrow or irregularity, usually longer in length than in width. | Movement of a sharp object across the surface. |
| Stress Failure | Metal failure. | Compression, tension, shear, torsion, or shock. |
| | | Compression: action of two opposed forces that tend to squeeze a part. |
| | | Tension: action of two directly opposed forces that tend to stretch a part. |
| | | Shear: action of two parallel forces acting in opposite directions. |
| | | Torsion: action of two opposed forces around a common axis. |
| | | Shock: instantaneous applications of stress. |
| Stripped Thread | Nut, stud, bolt, or screw damaged by tearing away part of thread form. | Improper installation or mismatching thread size. |
| Sulfidation | Hot corrosion attack on turbine section base metals. | Sea salt in ingested air, contaminants in fuel. |
| Tear | Parting of parent material. | Excess tension, created by an external force. |
| Unbalance | A condition that usually results in vibration. | Unequal distribution of mass about a rotating axis. |
| Void | A continuous lack of braze material through a braze joint cross section. | Improper repair. |

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1. Safety Precautions - SP A004

WARNING: DISREGARDING THE FOLLOWING INSTRUCTIONS AND PRECAUTIONARY INFORMATION CAN CAUSE SERIOUS INJURY OR DEATH.

A. Motoring Engine. Disconnect 28 vdc power supply from ignition unit. After motoring an engine, do not attempt to start the engine until after residual fuel has drained from combustion chamber through the drain valve.

B. Use of Lubricating Oil. Prolonged contact with lubricating oil may cause a skin rash. All clothing that comes in contact with lubricating oil shall be removed and affected skin areas washed immediately. Areas in which lubricating oil is used shall be adequately ventilated to keep mist and fumes to a minimum. If lubricating oil is spilled on painted surfaces, these surfaces shall be washed to prevent softening of paint.

C. Removing Electrical System Components. Before removing any electrical system component, make sure that all electrical power is disconnected. Ground ignition leads when removing ignition unit.

D. Capping Fuel, Oil, and Air Lines. To prevent clogging or contamination, all exposed openings in fuel, oil, or air lines shall be capped immediately. Do not use tape to seal fuel or oil openings. Tape adhesive is soluble in fuel and/or oil and can cause contamination.

E. Starting Engine. During engine start or operation, personnel and vehicles shall remain clear of intake and exhaust areas of engine. Exhaust gases are extremely dangerous due to their high temperature and velocity.

F. Fuel Control Priming. To prevent accidental firing, disconnect the main wiring harness from the ignition unit when priming the fuel control.

G. Cleaning. Protective clothing shall be worn as required to prevent contact with cleaning agents. Adequate ventilation shall be provided. Accidentally spilled acids shall be treated immediately according to prescribed remedial instructions. Open flames shall not be employed within 50 feet (15.24 meters) of cleaning areas; firefighting and safety equipment shall be readily available.

H. Solvent Immersion Cleaning. When a carbon removing compound comes in contact with a person’s skin, eyes, or clothing, flush the affected area with running water. Observe all previously indicated cleaning precautions.

I. Vapor Blasting. After vapor blasting, it may be necessary to remove remaining contaminants by hand scrubbing with a stiff fiber brush. Due to the toxicity of some deposited materials, keep both part and brush wet with soap and water to prevent dust from becoming airborne.

J. Chrome Pickling. The solution used as a chrome pickle bath is poisonous. Do not allow this solution to touch the skin. When contact is made, use soap and water to immediately remove solution from the skin.

1. K. Handling Lead Contaminated Parts. When handling parts that have been exposed to fuels containing tetraethyl lead, make sure the byproduct (poisonous lead oxide) is not inhaled or taken into the body through cuts or other external openings. When exposure occurs, drench affected area with water and obtain immediate medical attention. Protective clothing shall be worn at all times when handling lead contaminated parts.

CAUTION: DO NOT USE CADMIUM PLATED TOOLS FOR ANY DISASSEMBLY OR ASSEMBLY PROCEDURES. CADMIUM PLATING HAS A TENDENCY TO CHIP. WHEN THESE CHIPS ENTER THE ENGINE, THEY WILL CONTAMINATE THE LUBRICATION SYSTEM AND CAUSE MAGNESIUM PARTS TO DETERIORATE.

L. Use of cadmium plated tools. Do not use cadmium plated tools for any disassembly or reassembly procedures.

M. Parts that have serial numbers or part numbers prefixed by a Ⓢ have been plasma or flame sprayed. These parts shall not be exposed to any process that could remove or be harmful to the sprayed surface, such as passivation, anodization, or heat treatment.

WARNING: PARTICLES OF MAGNESIUM/NICKEL ALLOYS CONTAINING RADIOACTIVE THORIUM ARE NOT HAZARDOUS UNLESS INGESTED OR OTHERWISE INTRODUCED INTO THE BODY. IF INJURY OCCURS NO MATTER HOW SLIGHT, SEEK MEDICAL ATTENTION IMMEDIATELY.

N. Blending or Sanding Magnesium/Nickel Alloys Containing Radioactive Thorium. The following alloys contain radioactive thorium, M3201, M3203, and SAE AMS5865. Positively no smoking, eating, or drinking is permitted in the area where these alloys are being worked on. Employee’s must wash hands and face before eating, always wear clean clothes, protective respirator mask, and proper eye protection. Scrap materials containing radioactive thorium must be segregated and stored in proper containers and be properly disposed of.

1. Stamping and/or Replacement of Data Plates - SP A007

A. The original engine data plate, installed at the time of engine manufacture, should remain on the engine. However, should the engine data plate become mutilated or otherwise unserviceable, a new engine data plate shall be installed. All data inscribed on the old plate shall be transcribed to the new plate, including the original date of engine manufacture. New engine data plates are available from Honeywell Defense & Space. Old engine data plates shall be returned to Honeywell Defense & Space.

NOTE: All pertinent data shall be transferred to the new plate. Data plates shall not be stamped while installed on any part, assembly or item of equipment.

B. Engines being overhauled for the first time, require the addition of an overhaul data plate. On subsequent overhauls, a new overhaul data plate shall be installed to replace the existing one. When installing an overhaul data plate, do not remove the engine data plate. Stamping of the overhaul data plate shall include the identity of the facility performing the overhaul or modification, date of overhaul or modification, and part number. Total operating time since new shall be included.

NOTE: All pertinent data shall be transferred to the new plate. Overhaul data plates shall not be stamped while installed on any part, assembly, or item of equipment.

(1) Installation of overhaul data plate. If the overhaul facility does not stock blank plates, proceed to the following steps:

(a) Fabricate overhaul data plate using aluminum alloy (08–05, 70–80–01).

(b) Stamp required information on overhaul data plate.

(c) Mount overhaul data plate adjacent to engine data plate, using epoxy adhesive (01–03, 70–80–01).

NOTE: When an engine is repaired and tested at an overhaul facility, a new overhaul data plate shall be added in accordance with Steps (a), (b), and (c) with entries for latest performance parameters.

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1. Identification of Metal Particles - SP A009

A. When unidentified particles of metal are found in an engine, they are likely to be steel, aluminum, magnesium, silver, or bronze. In some cases, the type of metal may be determined by its color and hardness. However, when particles cannot be positively identified by visual inspection and knowledge of the exact character of the metal is desired, a few simple tests will suffice.

B. The following equipment and chemicals are required for these tests:

WARNING: USE EXTREME CARE WHEN HANDLING ACIDS. CHEMICALS USED IN THE FOLLOWING TESTS ARE HAZARDOUS AND REQUIRE SPECIAL HANDLING.

SOLID AMMONIUM BIFLUORIDE IS CRYSTALLINE AND CAN BE CONVENIENTLY STORED IN A DRY PLACE.

| | | |
|---|---|---|
| (1) | A source of open flame | |
| (2) | Permanent magnet | |
| (3) | Ammonium nitrate (10%) | (04–13, 70–80–01) |
| (4) | Electric soldering iron | |
| (5) | Hydrochloric acid | (04–04, 70–80–01) |
| (6) | Concentrated nitric acid (50% by volume) | (04–07, 70–80–01) |
| (7) | Sodium hydroxide pellets | (04–25, 70–80–01) |
| (8) | Watch glass (DD–W–131) | |
| (9) | White porcelain spot plate (D–D–5–636) | |
| (10) | Ammonium bifluoride crystals | (04–12, 70–80–01) |
| (11) | Concentrated sulfuric acid (5 to 10%) | (04–10, 70–80–01) |
| (12) | Hydrogen peroxide (3 to 10%) | (10–31, 70–80–01) |
| (13) | Concentrated phosphoric acid | (04–08, 70–80–01) |

1. C. Test Procedures. The following test procedures are recommended for determining the character of unknown metal particles. For best results, follow steps as outlined below:

(1) Steel. Particles can be isolated by means of a permanent magnet. Steel or iron is attracted to the magnet.

WARNING: NEVER ATTEMPT TO BURN MORE THAN A FEW PARTICLES OF METAL SUSPECTED TO BE MAGNESIUM. MAGNESIUM POWDER OR DUST IS EXPLOSIVE. DO NOT USE WATER TO EXTINGUISH A MAGNESIUM FIRE.

(2) Magnesium. When particles of magnesium are placed over an open flame, they will burn with a bright white flash.

(3) Aluminum. When a particle of aluminum is placed in hydrochloric acid (50 percent by volume), it will fizz with rapid emission of gas bubbles and gradually disintegrate into a black residue. Silver and bronze do not noticeably react with hydrochloric acid.

(4) Aluminum paint. Use the following procedure to determine if a material is aluminum silicone paint, aluminum chips, or silver particles:

(a) Make a sodium hydroxide solution by adding 1 pellet of sodium hydroxide to 3 cubic centimeters of water.

(b) Place several drops of this solution on a watch glass and carefully drop in suspected particles.

1 When particles are aluminum silicone paint, there will be a mild reaction in the form of gas bubbles and some visible gas as particles change to sodium aluminate.

2 When particles are aluminum chips, the reaction will be much more active, with many more gas bubbles forming and more visible gas.

3 When particles are silver, there will be no reaction.

(5) Silver. When a silver particle is placed in nitric acid, it reacts rather slowly, producing a whitish fog in the acid. Adding a drop of hydrochloric acid produces a heavy white precipitate.

(6) Bronze. When a bronze (copper and tin) or copper particle is placed in nitric acid, a bright green cloud is produced.

1. C. (7) Titanium. Place the piece or pieces of metal to be identified on a white porcelain spot plate. A known piece of titanium or titanium bearing metal should be placed on another spot plate to observe and verify the test results.

WARNING: CHEMICALS USED IN THE FOLLOWING TESTS ARE HAZARDOUS AND REQUIRE SPECIAL HANDLING. SOLID AMMONIUM BIFLUORIDE IS CRYSTALLINE AND CAN BE CONVENIENTLY STORED IN A DRY PLACE.

(a) Add several crystals of ammonium bifluoride and 5 to 10 drops of water to the metal particles or 2 to 3 drops of a 5 to 10 percent hydrofluoric acid solution can be used.

(b) Let stand 20 to 30 minutes or until solution becomes slightly discolored.

(c) Add 2 to 3 drops of 1:1 sulfuric acid (1 part water to 1 part concentrated acid).

(d) Let stand 20 to 30 minutes or until solution becomes more discolored.

(e) Add 3 to 4 drops of 3 to 10 percent hydrogen peroxide. Solution must be fresh.

(f) When titanium is present, a yellowish color will develop. This yellow color will become progressively darker with time if solution is allowed to sit.

(g) Add 2 to 3 drops of concentrated phosphoric acid and stir to discharge any yellow color due to possible presence of iron. Any light yellow–to–orange coloration indicates the presence of titanium.

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1. Conversion Tables

A. In using conversion factors, it is possible to perform division as well as multiplication process shown here. Division may be particularly advantageous where more than significant figures published here are required. Division may be performed in lieu of multiplication by using reciprocal of any indicated multiplier as divisor. For example, to convert from centimeters to inches by division, use table headed "To Convert from Inches" and use factor listed as "centimeters" (2.54) as divisor.

Units of Length

| To Convert from Centimeters | |
|---|---|
| To | Multiply by |
| Inches | 0.3937 |
| Feet | 0.03281 |
| Yards | 0.01094 |
| Meters | 0.01 |

| To Convert from Meters | |
|---|---|
| To | Multiply by |
| Inches | 39.37 |
| Feet | 3.281 |
| Yards | 1.094 |
| Miles | 0.0006214 |
| Millimeters | 1000 |
| Centimeters | 100 |
| Kilometers | 0.001 |

| To Convert from Inches | |
|---|---|
| To | Multiply by |
| Feet | 0.08333 |
| Yards | 0.02778 |
| Centimeters | 2.54 |
| Meters | 0.0254 |

| To Convert from Feet | |
|---|---|
| To | Multiply by |
| Inches | 12 |
| Yards | 0.333 |
| Miles | 0.0001894 |
| Centimeters | 30.48 |
| Meters | 0.3048 |
| Kilometers | 0.000305s |

Units of Mass

| To Convert from Grams | |
|---|---|
| To | Multiply by |
| Grains | 15.43 |
| Avoirdupois Drams | 0.564 |
| Avoirdupois Ounces | 0.03527 |
| Troy Ounces | 0.03215 |
| Troy Pounds | 0.002679 |
| Avoirdupois Pounds | 0.002205 |
| Milligrams | 1,000 |
| Kilograms | 0.001 |

| To Convert from Grains | |
|---|---|
| To | Multiply by |
| Avoirdupois Drams | 0.03657 |
| Avoirdupois Ounces | 0.002286 |
| Troy Ounces | 0.002083 |
| Troy Pounds | 0.0001736 |
| Avoirdupois Pounds | 0.0001429 |
| Milligrams | 64.7989 |
| Grams | 0.06480 |
| Kilograms | 0.00006480 |

| To Convert from Avoirdupois Ounces | |
|---|---|
| To | Multiply by |
| Grains | 437.5 |
| Avoirdupois Drams | 16 |
| Troy Ounces | 0.9115 |
| Troy Pounds | 0.07595 |
| Avoirdupois Pounds | 0.0625 |
| Grams | 28.350 |
| Kilograms | 0.02835 |

Units of Mass (Cont)

To Convert from Avoirdupois Pounds

| To | Multiply by |
|---|---|
| Grains | 7,000 |
| Avoirdupois Drams | 256 |
| Avoirdupois Ounces | 16 |
| Troy Ounces | 14.583 |
| Troy Pounds | 1.2153 |
| Grams | 453.592 |
| Kilograms | 0.4536 |
| Short Hundredweights | 0.01 |
| Short Tons | 0.0005 |
| Long Tons | 0.0004464 |
| Metric Tons | 0.0004536 |

To Convert from Troy Ounces

| To | Multiply by |
|---|---|
| Grains | 480 |
| Avoirdupois Drams | 17.5543 |
| Avoirdupois Ounces | 1.0971 |
| Troy Pounds | 0.08333 |
| Avoirdupois Pounds | 0.06857 |
| Grams | 31.1035 |

To Convert from Troy Pounds

| To | Multiply by |
|---|---|
| Grains | 5,760 |
| Avoirdupois Drams | 210.6514 |
| Avoirdupois Ounces | 13.1657 |
| Troy Ounces | 12 |
| Avoirdupois Pounds | 0.8229 |
| Grams | 373.2417 |

Units of Capacity or Volume, Liquid Measure

To Convert from Milliliters

| To | Multiply by |
|---|---|
| Minims | 16.2307 |
| Liquid Ounces | 0.03381 |
| Gills | 0.008453 |
| Liquid Pints | 0.002113 |
| Liquid Quarts | 0.001057 |
| Gallons | 0.001264 |
| Cubic Inches | 0.06102 |
| Liters | 0.001 |

To Convert from Liquid Ounces

| To | Multiply by |
|---|---|
| Minims | 480 |
| Gills | 0.25 |
| Liquid Pints | 0.0625 |
| Liquid Quarts | 0.03125 |
| Gallons | 0.007812 |
| Cubic Inches | 1.8047 |
| Cubic Feet | 0.001044 |
| Milliliters | 29.5735 |
| Liters | 0.02957 |

To Convert from Liquid Pints

| To | Multiply by |
|---|---|
| Minims | 7,680 |
| Liquid Ounces | 16 |
| Gills | 4 |
| Liquid Quarts | 0.5 |
| Gallons | 0.125 |
| Cubic Inches | 28.875 |
| Cubic Feet | 0.01671 |
| Milliliters | 473.1765 |
| Liters | 0.4732 |

Units of Capacity or Volume, Liquid Measure (Cont)

To Convert from Cubic Inches

| To | Multiply by |
|---|---|
| Minims | 265.9740 |
| Liquid Ounces | 0.5541 |
| Gills | 0.1385 |
| Liquid Pints | 0.03463 |
| Liquid Quarts | 0.01732 |
| Gallons | 0.004329 |
| Cubic Feet | 0.0005787 |
| Milliliters | 16.3871 |
| Liters | 0.01639 |
| Cubic Meters | 0.00001639 |
| Cubic Yards | 0.00002143 |

To Convert from Liquid Quarts

| To | Multiply by |
|---|---|
| Minims | 15,360 |
| Liquid Ounces | 32 |
| Gills | 8 |
| Liquid Pints | 2 |
| Gallons | 0.25 |
| Cubic Inches | 57.75 |
| Cubic Feet | 0.003421 |
| Milliliters | 946.3529 |
| Liters | 0.9464 |

To Convert from Gallons

| To | Multiply by |
|---|---|
| Minims | 61,440 |
| Liquid Ounces | 128 |
| Gills | 32 |
| Liquid Pints | 8 |
| Liquid Quarts | 4 |
| Cubic Inches | 231 |
| Cubic Feet | 0.1337 |
| Milliliters | 3,785.4118 |
| Liters | 3.7854 |
| Cubic Meters | 0.003785 |

Units of Area

To Convert from Square–Centimeters

| To | Multiply by |
|---|---|
| Square–Inches | 0.1551 |
| Square–Feet | 0.001076 |
| Square–Yards | 0.0001196 |
| Square–Meters | 0.0001 |

To Convert from Square–Meters

| To | Multiply by |
|---|---|
| Square–Inches | 1,550.003 |
| Square–Feet | 10.7639 |
| Square–Yards | 1.19599 |
| Acres | 0.0002471 |
| Square–Centimeters | 10,000 |
| Cubic Yards | 0.004951 |

To Convert from Square–Inches

| To | Multiply by |
|---|---|
| Square–Feet | 0.006944 |
| Square–Yards | 0.0007716 |
| Square–Centimeters | 6.4516 |
| Square–Meters | 0.0006452 |

To Convert from Square–Feet

| To | Multiply by |
|---|---|
| Square–Inches | 144 |
| Square–Yards | 0.1111 |
| Acres | 0.00002296 |
| Square–Centimeters | 929.0304 |
| Square–Meters | 0.09290 |

| Units of Temperature | Units of Torque | | |
|---|---|---|---|
| | To Convert | | |
| | Unit | Multiply by | Equivalent Unit |
| °F = 9/5 (°C + 32) | in.–lb | 1152.128 | gram cm |
| °C = 5/9 (°F - 32) | ft–lb | 13,826 | gram cm |
| °R = °F + 459.69 | ft–lb | 0.1383 | Kp Meter* |
| °K = °C + 273.16 | in.–oz | 72.008 | gram cm |
| | in.–oz | 0.005208 | ft–lb |
| | *Kilopond – now used instead of Kg or Kilogram force. | | |

1. B. The following tables are conversions for different measures.

Table 1. Fractional Inches into Millimeters

| Inches | Millimeters | Inches | Millimeters |
|---|---|---|---|
| 1/64 | 0.3969 | 11/32 | 8.7312 |
| 1/32 | 0.793 | 23/64 | 9.1281 |
| 3/64 | 1.1906 | 3/8 | 9.5250 |
| 1/16 | 1.5875 | 25/64 | 9.9219 |
| 5/64 | 1.9844 | 13/32 | 10.3187 |
| 3/32 | 2.3812 | 27/64 | 10.7156 |
| 7/64 | 2.7781 | 7/16 | 11.1125 |
| 1/8 | 3.1750 | 29/64 | 11.5094 |
| 9/64 | 3.5719 | 15/32 | 11.9062 |
| 5/32 | 3.9687 | 31/64 | 12.3031 |
| 11/64 | 4.3656 | 1/2 | 12.7000 |
| 3/16 | 4.7625 | 33/64 | 13.0969 |
| 13/64 | 5.1594 | 17/327 | 13.4937 |
| 7/32 | 5.5562 | 35/64 | 13.8906 |
| 15/64 | 5.9531 | 9/16 | 14.2875 |
| 1/4 | 6.3500 | 37/64 | 14.6844 |
| 17/64 | 6.7469 | 19/32 | 15.0812 |
| 9/32 | 7.1437 | 39/64 | 15.4781 |
| 19/64 | 7.5406 | 5/8 | 15.8750 |
| 5/16 | 7.9375 | 41/64 | 16.2719 |
| 21/64 | 8.3344 | 21/32 | 16.6687 |

Table 1. Fractional Inches into Millimeters (Cont)

| Inches | Millimeters | Inches | Millimeters |
|---|---|---|---|
| 43/64 | 17.0656 | 27/32 | 21.4312 |
| 11/16 | 17.4625 | 55/64 | 21.8281 |
| 45/64 | 17.8594 | 7/8 | 22.2250 |
| 23/32 | 18.2562 | 57/64 | 22.6219 |
| 47/64 | 18.6531 | 29/32 | 23.0187 |
| 3/4 | 19.0500 | 59/64 | 23.4156 |
| 49/64 | 19.4469 | 15/16 | 23.8125 |
| 25/32 | 19.8437 | 61/64 | 24.2094 |
| 51/64 | 20.2406 | 31/32 | 24.6062 |
| 13/16 | 20.6375 | 63/64 | 25.0031 |
| 53/64 | 21.0344 | 1.0 | 25.4001 |

Table 2. Millimeters into Inches

| Milli–meters | Inches | Milli–meters | Inches | Milli–meters | Inches | Milli–meters | Inches | Milli–meters | Inches |
|---|---|---|---|---|---|---|---|---|---|
| 0.01 | 0.0004 | 0.21 | 0.0083 | 0.41 | 0.0161 | 0.61 | 0.0240 | 0.81 | 0.0319 |
| 0.02 | 0.0008 | 0.22 | 0.0087 | 0.42 | 0.0165 | 0.62 | 0.0244 | 0.82 | 0.0323 |
| 0.03 | 0.0012 | 0.23 | 0.0091 | 0.43 | 0.0169 | 0.63 | 0.0248 | 0.83 | 0.0327 |
| 0.04 | 0.0016 | 0.24 | 0.0094 | 0.44 | 0.0173 | 0.64 | 0.0252 | 0.84 | 0.0331 |
| 0.05 | 0.0020 | 0.25 | 0.0098 | 0.45 | 0.0177 | 0.65 | 0.0256 | 0.85 | 0.0335 |
| 0.06 | 0.0024 | 0.26 | 0.0102 | 0.46 | 0.0181 | 0.66 | 0.0260 | 0.86 | 0.0339 |
| 0.07 | 0.0028 | 0.27 | 0.0106 | 0.47 | 0.0185 | 0.67 | 0.0264 | 0.87 | 0.0343 |
| 0.08 | 0.0031 | 0.28 | 0.0110 | 0.48 | 0.0189 | 0.68 | 0.0268 | 0.88 | 0.0346 |
| 0.09 | 0.0035 | 0.29 | 0.0114 | 0.49 | 0.0193 | 0.69 | 0.0272 | 0.89 | 0.0350 |
| 0.10 | 0.0039 | 0.30 | 0.0118 | 0.50 | 0.0197 | 0.70 | 0.0276 | 0.90 | 0.0354 |
| 0.11 | 0.0043 | 0.31 | 0.0122 | 0.51 | 0.0201 | 0.71 | 0.0280 | 0.91 | 0.0358 |
| 0.12 | 0.0047 | 0.32 | 0.0126 | 0.52 | 0.0205 | 0.72 | 0.0283 | 0.92 | 0.0362 |
| 0.13 | 0.0051 | 0.33 | 0.0130 | 0.53 | 0.0209 | 0.73 | 0.0287 | 0.93 | 0.0366 |
| 0.14 | 0.0055 | 0.34 | 0.0134 | 0.54 | 0.0213 | 0.74 | 0.0291 | 0.94 | 0.0370 |
| 0.15 | 0.0059 | 0.35 | 0.0138 | 0.55 | 0.0217 | 0.75 | 0.0295 | 0.95 | 0.0374 |
| 0.16 | 0.0063 | 0.36 | 0.0142 | 0.56 | 0.0220 | 0.76 | 0.0299 | 0.96 | 0.0378 |
| 0.17 | 0.0067 | 0.37 | 0.0146 | 0.57 | 0.0224 | 0.77 | 0.0303 | 0.97 | 0.0382 |
| 0.18 | 0.0071 | 0.38 | 0.0150 | 0.58 | 0.0228 | 0.78 | 0.0307 | 0.98 | 0.0386 |
| 0.19 | 0.0075 | 0.39 | 0.0154 | 0.59 | 0.0232 | 0.79 | 0.0311 | 0.99 | 0.0390 |
| 0.20 | 0.0079 | 0.40 | 0.0157 | 0.60 | 0.0236 | 0.80 | 0.0315 | 1.00 | 0.0394 |

Table 3. Inches to Millimeters

| Inches | Milli–meters | Inches | Milli–meters | Inches | Milli–meters | Inches | Milli–meters | Inches | Milli–meters |
|---|---|---|---|---|---|---|---|---|---|
| 0.001 | 0.025 | 0.140 | 3.56 | 0.360 | 9.14 | 0.580 | 14.73 | 0.800 | 20.32 |
| 0.002 | 0.051 | 0.150 | 3.81 | 0.370 | 9.40 | 0.590 | 14.99 | 0.810 | 20.57 |
| 0.003 | 0.076 | 0.160 | 4.06 | 0.380 | 9.65 | 0.600 | 15.24 | 0.820 | 20.83 |
| 0.004 | 0.102 | 0.170 | 4.32 | 0.390 | 9.91 | 0.610 | 15.49 | 0.830 | 21.08 |
| 0.005 | 0.127 | 0.180 | 4.57 | 0.400 | 10.16 | 0.620 | 15.75 | 0.840 | 21.34 |
| 0.006 | 0.152 | 0.190 | 4.83 | 0.410 | 10.41 | 0.630 | 16.00 | 0.850 | 21.59 |
| 0.007 | 0.178 | 0.200 | 5.08 | 0.420 | 10.67 | 0.640 | 16.26 | 0.860 | 21.84 |
| 0.008 | 0.203 | 0.210 | 5.33 | 0.430 | 10.92 | 0.650 | 16.51 | 0.870 | 22.10 |
| 0.009 | 0.229 | 0.220 | 5.59 | 0.440 | 11.18 | 0.660 | 16.76 | 0.880 | 22.35 |
| 0.010 | 0.254 | 0.230 | 5.84 | 0.450 | 11.43 | 0.670 | 17.02 | 0.890 | 22.61 |
| 0.020 | 0.508 | 0.240 | 6.10 | 0.460 | 11.68 | 0.680 | 17.27 | 0.900 | 22.86 |
| 0.030 | 0.762 | 0.250 | 6.35 | 0.470 | 11.94 | 0.690 | 17.53 | 0.910 | 23.11 |
| 0.040 | 1.016 | 0.260 | 6.60 | 0.480 | 12.19 | 0.700 | 17.78 | 0.920 | 23.37 |
| 0.050 | 1.270 | 0.270 | 6.86 | 0.490 | 12.45 | 0.710 | 18.03 | 0.930 | 23.62 |
| 0.060 | 1.524 | 0.280 | 7.11 | 0.500 | 12.70 | 0.720 | 18.29 | 0.940 | 23.88 |
| 0.070 | 1.778 | 0.290 | 7.37 | 0.510 | 12.95 | 0.730 | 18.54 | 0.950 | 24.13 |
| 0.080 | 2.032 | 0.300 | 7.62 | 0.520 | 13.21 | 0.740 | 18.80 | 0.960 | 24.38 |
| 0.090 | 2.286 | 0.310 | 7.87 | 0.530 | 13.46 | 0.750 | 19.05 | 0.970 | 24.64 |
| 0.100 | 2.540 | 0.320 | 8.13 | 0.540 | 13.72 | 0.760 | 19.30 | 0.980 | 24.89 |
| 0.110 | 2.794 | 0.330 | 8.38 | 0.550 | 13.97 | 0.770 | 19.56 | 0.990 | 25.15 |
| 0.120 | 3.048 | 0.340 | 8.64 | 0.560 | 14.22 | 0.780 | 19.81 | 1.000 | 25.40 |
| 0.130 | 3.302 | 0.350 | 8.89 | 0.570 | 14.48 | 0.790 | 20.07 | — | — |

Example: Find 0.856 inch in millimeter: 0.850 inch = 21.59 millimeters; 0.006 inch = 0.152 millimeter. Hence 21.59 + 0.152 = 21.742 millimeters = 0.856 inch.

Table 4. Cubic Inches into Cubic Centimeters

| Cubic Inches | 0 Cubic Cm | 1 Cubic Cm | 2 Cubic Cm | 3 Cubic Cm | 4 Cubic Cm | 5 Cubic Cm | 6 Cubic Cm | 7 Cubic Cm | 8 Cubic Cm | 9 Cubic Cm |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | — | 16.38 | 32.77 | 49.16 | 65.55 | 81.93 | 98.32 | 114.71 | 131.09 | 147.48 |
| 10 | 163.87 | 180.26 | 196.64 | 213.03 | 229.41 | 245.80 | 262.19 | 278.58 | 294.88 | 311.35 |
| 20 | 327.73 | 344.12 | 360.50 | 376.89 | 393.27 | 409.66 | 426.05 | 442.44 | 458.74 | 475.21 |
| 30 | 491.60 | 507.99 | 524.37 | 540.76 | 557.14 | 573.53 | 589.92 | 606.31 | 622.61 | 639.08 |
| 40 | 655.46 | 671.85 | 688.23 | 704.52 | 721.00 | 737.39 | 757.78 | 770.17 | 786.47 | 802.94 |
| 50 | 819.33 | 835.72 | 851.10 | 868.49 | 884.87 | 901.26 | 917.65 | 934.04 | 950.34 | 966.81 |
| 60 | 983.20 | 999.59 | 1016.0 | 1032.4 | 1048.7 | 1065.1 | 1081.5 | 1097.9 | 1114.2 | 1130.7 |
| 70 | 1147.1 | 1163.5 | 1179.9 | 1196.3 | 1212.6 | 1229.0 | 1245.4 | 1261.8 | 1278.1 | 1294.6 |
| 80 | 1310.9 | 1327.3 | 1343.7 | 1360.1 | 1376.4 | 1392.8 | 1409.2 | 1425.6 | 1441.9 | 1458.4 |
| 90 | 1474.8 | 1491.2 | 1507.6 | 1524.0 | 1540.3 | 1556.7 | 1573.1 | 1589.5 | 1605.8 | 1622.3 |
| 100 | 1638.7 | 1655.1 | 1671.5 | 1687.9 | 1704.2 | 1720.6 | 1737.0 | 1753.4 | 1769.7 | 1786.2 |

Table 5. Cubic Centimeters into Cubic Inches

| Cubic Cm | 0 Cubic Inches | 1 Cubic Inches | 2 Cubic Inches | 3 Cubic Inches | 4 Cubic Inches | 5 Cubic Inches | 6 Cubic Inches | 7 Cubic Inches | 8 Cubic Inches | 9 Cubic Inches |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | — | 0.0610 | 0.1221 | 0.1831 | 0.2441 | 0.3051 | 0.3661 | 0.4272 | 0.4882 | 0.5492 |
| 10 | 0.6102 | 0.6712 | 0.7323 | 0.7933 | 0.8543 | 0.9153 | 0.9763 | 0.0374 | 0.0984 | 1.1594 |
| 20 | 1.2205 | 1.2815 | 1.3426 | 1.4036 | 1.4646 | 1.5256 | 1.5866 | 1.6477 | 1.7087 | 1.7697 |
| 30 | 1.8308 | 1.8918 | 1.9529 | 2.0139 | 2.0749 | 2.1859 | 2.1969 | 2.2580 | 2.3190 | 2.3800 |
| 40 | 2.4410 | 2.5020 | 2.5631 | 2.6241 | 2.6851 | 2.7461 | 2.8071 | 2.8682 | 2.9292 | 2.9902 |
| 50 | 3.0513 | 3.1123 | 3.1734 | 3.2344 | 3.2954 | 3.3564 | 3.4174 | 3.4785 | 3.5395 | 3.6005 |
| 60 | 3.6615 | 3.7225 | 3.7836 | 3.8446 | 3.9056 | 3.9666 | 4.0276 | 4.0887 | 4.1497 | 4.2107 |
| 70 | 4.2718 | 4.3328 | 4.3939 | 4.4549 | 4.5159 | 4.5769 | 4.6379 | 4.6990 | 4.7600 | 4.8210 |
| 80 | 4.8820 | 4.9430 | 5.0041 | 5.0651 | 5.1261 | 5.1871 | 5.2481 | 5.3092 | 5.3702 | 5.4312 |
| 90 | 5.4923 | 5.5533 | 5.6144 | 5.6754 | 5.7364 | 5.7974 | 5.8584 | 5.9195 | 5.9805 | 6.0415 |
| 100 | 6.1025 | 6.1635 | 6.2246 | 6.2856 | 6.3466 | 6.4076 | 6.4686 | 6.5297 | 6.5907 | 6.6517 |

Table 6. Pounds per Square–Inch into Kilograms per Square–Centimeter

| Pounds per Sq–Inch | 0 Kg per Sq–Cm | 1 Kg per Sq–Cm | 2 Kg per Sq–Cm | 3 Kg per Sq–Cm | 4 Kg per Sq–Cm | 5 Kg per Sq–Cm | 6 Kg per Sq–Cm | 7 Kg per Sq–Cm | 8 Kg per Sq–Cm | 9 Kg per Sq–Cm |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | — | 0.0703 | 0.1406 | 0.2109 | 0.2812 | 0.3515 | 0.4218 | 0.4921 | 0.5625 | 0.6328 |
| 10 | 0.7031 | 0.7734 | 0.8437 | 0.9140 | 0.9843 | 1.0546 | 1.1249 | 1.1952 | 1.2655 | 1.3358 |
| 20 | 1.4062 | 1.4765 | 1.5468 | 1.6171 | 1.6874 | 1.7577 | 1.8280 | 1.8983 | 1.9686 | 2.0389 |
| 30 | 2.1092 | 2.1795 | 2.2498 | 2.3202 | 2.3905 | 2.4608 | 2.5311 | 2.6014 | 2.6717 | 2.7420 |
| 40 | 2.8123 | 2.8826 | 2.9529 | 3.0232 | 3.0935 | 3.1639 | 3.2342 | 3.3045 | 3.3748 | 3.4451 |
| 50 | 3.5154 | 3.5857 | 3.6560 | 3.7263 | 3.7966 | 3.8669 | 3.9372 | 4.0075 | 4.0779 | 4.1482 |
| 60 | 4.2185 | 4.2888 | 4.3591 | 4.4294 | 4.4997 | 4.5700 | 4.6403 | 4.7106 | 4.7809 | 4.8512 |
| 70 | 4.9216 | 4.9919 | 5.0622 | 5.1325 | 5.2028 | 5.2731 | 5.3434 | 5.4137 | 5.4840 | 5.5543 |
| 80 | 5.6246 | 5.6949 | 5.7652 | 5.8356 | 5.9059 | 5.9762 | 6.0465 | 6.1168 | 6.1871 | 6.2574 |
| 90 | 6.3277 | 6.3980 | 6.4683 | 6.5386 | 6.6089 | 6.6793 | 6.7496 | 6.8199 | 6.8902 | 6.9605 |
| 100 | 7.0308 | 7.1011 | 7.1714 | 7.2417 | 7.3120 | 7.3823 | 7.4526 | 7.5229 | 7.5933 | 7.6636 |

Table 7. Kilograms per Square–Centimeter into Pounds per Square–Inch

| Kilo–grams per Sq–Cm | 0 Lbs per Sq–In. | 1 Lbs per Sq–In. | 2 Lbs per Sq–In. | 3 Lbs per Sq–In. | 4 Lbs per Sq–In. | 5 Lbs per Sq–In. | 6 Lbs per Sq–In. | 7 Lbs per Sq–In. | 8 Lbs per Sq–In. | 9 Lbs per Sq–In. |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | — | 14.22 | 28.45 | 42.67 | 56.89 | 71.12 | 85.34 | 99.56 | 113.78 | 128.01 |
| 10 | 142.23 | 156.43 | 170.68 | 184.90 | 199.12 | 213.35 | 227.57 | 241.79 | 256.02 | 270.24 |
| 20 | 284.46 | 298.69 | 312.91 | 327.13 | 341.36 | 355.58 | 369.80 | 384.03 | 398.05 | 412.47 |
| 30 | 426.70 | 440.92 | 455.14 | 469.36 | 483.59 | 497.81 | 512.03 | 526.26 | 540.48 | 554.70 |
| 40 | 568.93 | 583.15 | 597.37 | 611.60 | 625.82 | 640.04 | 654.27 | 668.49 | 682.71 | 696.94 |
| 50 | 711.16 | 725.38 | 739.61 | 753.83 | 768.05 | 782.28 | 796.50 | 810.72 | 824.94 | 839.17 |
| 60 | 853.39 | 867.61 | 881.84 | 896.06 | 910.28 | 924.51 | 938.73 | 952.95 | 967.18 | 981.40 |
| 70 | 995.62 | 1009.8 | 1024.1 | 1038.3 | 1052.5 | 1066.7 | 1081.0 | 1095.2 | 1109.4 | 1123.6 |
| 80 | 1137.8 | 1152.1 | 1166.3 | 1180.5 | 1194.7 | 1209.0 | 1223.2 | 1237.4 | 1251.6 | 1265.9 |
| 90 | 1280.1 | 1294.3 | 1308.5 | 1322.7 | 1337.0 | 1351.2 | 1365.4 | 1379.6 | 1393.9 | 1408.1 |
| 100 | 1422.3 | 1436.5 | 1450.8 | 1465.0 | 1479.2 | 1493.4 | 1507.7 | 1521.9 | 1536.1 | 1550.3 |

## CHAPTER 70–05–00 - MARKING OF PARTS

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1. Marking High Temperature Materials - SP A006

CAUTION: TO PREVENT SURFACE DAMAGE, DO NOT VIBROPEEN PARTS HAVING PROTECTIVE COATINGS, CRITICAL RADII, OR HIGHLY STRESSED AREAS.

A. When marking on materials subject to high temperature, only those marking materials listed below shall be used:

(1) Black Marking Ink (09–13, 70–80–01)

(2) Opco Marker (09–08, 70–80–01)

(3) Felt Tip Marker (09–06, 70–80–01)

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1. Time Coding - SP A008

A. Operating time and cycle–sensitive engine parts (identified in applicable rotating component service life limit service bulletin) shall be letter coded to indicate both operating hours and cycles. The code for operating time is the letter T, followed by code letters denoting the number of hours accumulated. The code for operating cycles is the letters CY, followed by code letters denoting the number of operating cycles accumulated. (Refer to Table 1 for Time/Cycle code letters.)

B. Marking equipment recommended for coding components shall be an air turbine grinder, Model 201, No. 910800 (ATRAX Company), or equivalent, using tip No. U5 (ATRAX Company) or equivalent.

CAUTION: TO PREVENT SURFACE DAMAGE, DO NOT VIBROPEEN PARTS NEAR CRITICAL RADII OR HIGH STRESS AREAS. AFTER ENGRAVING BEARING COMPONENTS, INSPECT FOR POSSIBLE RAISED EDGES. IF RAISED EDGES ARE EVIDENT, REMOVE BY USING GROOVED LAPPING PLATE LP080801 (CHALLENGE MACHINERY COMPANY), OR EQUIVALENT, AND THEIR RECOMMENDED ABRASIVE. TOUCH UP PARTS HAVING A SURFACE FINISH.

C. Using tool, mark code on part. (Refer to Paragraph B.) Marking shall be 0.060 to 0.160 inch (1.524 to 4.064 millimeters) in height, 0.001 to 0.006 inch (0.025 to 0.152 millimeter) in depth, and shall not be closer than 0.031 inch (0.787 millimeter) to any corner, fillet, or sharp edge, unless otherwise specified.

NOTE: In Paragraph C. the code shall be preceded by the appropriate prefix to prevent mistaking other markings and identification with the codes. In special cases, when governed by part size or configuration, marking may be 0.016 to 0.250 inch (0.406 to 6.350 millimeters) high. Special care shall be exercised to maintain legibility and to prevent damaging or weakening the part. Components shall be marked prior to inspection cleaning.

D. To update a previously coded part, etch a line through the old code and add the new code next to the old code.

Table 1. Time and Cycle Codes

| Code | Hours or Cycles | Code | Hours or Cycles |
|---|---|---|---|
| A | 10 | K | 700 |
| B | 25 | L | 800 |
| C | 50 | M | 900 |
| D | 100 | N | 1,000 |
| E | 200 | P | 2,000 |
| F | 300 | R | 3,000 |
| G | 400 | S | 4,000 |
| H | 500 | U | 5,000 |
| J | 600 | V | 10,000 |

Examples:

TNDC
T = Time
N = 1,000
D = 100
C = 50
Total Time = 1,150 hours
at Service Center Visit

CYPJC
CY = Cycles
P = 2,000
J = 600
C = 50
Total Cycles = 2,650
at Service Center Visit

# CHAPTER 70–10–00 - DISASSEMBLY

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1. Use of Penetrating Oils - SP B101

Apply penetrating oil (02–27, 02-28, 02-29 or 02-30, 70–80–01) as required to assist in removal of parts (especially parts exposed to high temperature) during disassembly. On parts to be reinstalled, remove all traces of penetrating oil with dry cleaning solvent. (Refer to SP C203, 70–15–03.)

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1. General Disassembly Procedures - SP B104

A. The following procedures shall be adhered to during disassembly operations:

(1) Check and record gear pattern and backlash when applicable.

(2) Check thickness and tag shims when applicable.

CAUTION: NEVER USE A LEAD (GRAPHITE) PENCIL TO MARK ON A HOT END PART.

(3) Before removal or disassembly, index all parts for reassembly in proper positions.

(4) Record and tag defective parts. Record reason for rejection (excluding parts that are normally replaced such as gaskets, packings, etc).

(5) When disconnecting electrical connectors or hose and tube fittings, remove clamps or brackets as required to gain slack and to avoid damage to connectors and fittings.

(6) Make sure all electrical power is OFF, and system air, fuel, and oil pressures are zero (0).

(7) Protect all hoses, fittings, and ports with clean caps or plugs. If plastic caps and plugs are used, make sure that no chips are generated during their installation.

(8) Disconnect ignition unit input connector before disconnecting igniter plugs. Ground igniter plug lead immediately after removal.

WARNING: PROLONGED CONTACT WITH PENETRATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

(9) Apply penetrating oil (02–27, 02-28, 02-29 or 02-30, 70–80–01) as required to assist in removal of parts (especially parts exposed to high temperature) during disassembly. (Refer to SP B101, 70–10–01.)

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(10) On parts to be reinstalled, remove all traces of penetrating oil with dry cleaning solvent. (Refer to SP C203, 70–15–03.)

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1. Bearing Removal and Handling - SP B106

A. Bearing Removal Areas. Whenever possible, bearing removal areas shall be kept clean and protected against exposure to abrasive materials and corrosive fumes.

B. Cleaning of Bearings Prior to Removal. This shall be limited to carefully wiping foreign material away from the bearing faces with clean lint free cloth (10–10, 70–80–01). If such cleaning is not accomplished, metal chips or other abrasives may be forced into the bearings during the removal operation.

CAUTION: WHEN REMOVING A BEARING, EXERCISE CARE TO ROTATE THE BEARING ONLY AS NECESSARY SINCE SUCH ROTATION WILL TEND TO GRIND DIRT OR GRIT INTO THE ROLLING ELEMENTS AND RACEWAYS. NEVER SPIN A BEARING BEFORE THE BEARING HAS BEEN THOROUGHLY CLEANED AND OILED. PRESS OR PULL ON THE RACE HAVING THE INTERFERENCE FIT. IF PRESSURE IS APPLIED AGAINST THE WRONG RACE OR AGAINST THE ROLLING ELEMENTS OR RETAINER, DAMAGE IN THE FORM OF BRINELLING, BENDING, OR FRACTURING MAY RESULT.

TOOLS, DRIFTS, ETC, SHOULD BE KEPT IN GOOD CONDITION. WORN OR SPLINTERED TOOLS MAY CAUSE DAMAGE OR FORCE FOREIGN MATERIAL INTO A BEARING.

C. Bearing Removal. Refer to bearing’s removal instructions. In general, an arbor press, bearing puller, or similar equipment that applies a firm, steady pressure to the bearing is recommended. If a drift must be used, employ a soft metal drift and leather or plastic hammer. Be careful that bearing is not cocked or canted.

D. Bearing Inspection Record. When removing a failed bearing, use care to preserve any evidence of the cause of failure, since this information may be used to isolate the cause of failure. Never mix bearing components. It is recommended that each bearing be tagged to show its orientation, position, and the date the bearing was removed from the engine. Tags may be made of cardboard or soft metal with fasteners made of nylon or string.

1. E. Preservation of Bearings. After initial processing described in Paragraphs B., C., and D., the following procedure will describe the minimum requirements necessary for the preservation of a bearing after inspection. The degree of preservation will vary depending on the period of anticipated time before a bearing is reinstalled into an engine.

(1) Bearings scheduled for immediate assembly, or up to 6 months storage after inspection, shall be processed as follows:

CAUTION: FAILURE TO PROPERLY RINSE BEARINGS CONTAINING COPPER ALLOY MAY CAUSE DISCOLORATION OR DETERIORATION.

(a) Inspect bearings for residual magnetism. (Refer to SP I311, 70–20–11.) If residual magnetism exceeds 3 gauss, demagnetize bearing in accordance with Paragraph F.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(b) Rinse bearings in tank containing dry cleaning solvent (07–63, 70–80–01).

(c) Immerse bearings in fingerprint remover (07–29, 70–80–01) for 2 minutes, then drain.

CAUTION: FROM THIS POINT ON, DO NOT HANDLE BEARINGS WITH UNPROTECTED HANDS. LINT FREE GLOVES ARE RECOMMENDED.

(d) Rinse bearings in tank containing dry cleaning solvent (07–63, 70–80–01) to remove residual fingerprint remover.

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

(e) Dip bearings in lubricating oil (02–21 or 02–24, 70–80–01). Rotate one revolution to coat all internal bearing components. Allow to drain.

(f) Package bearings in individual polyethylene bags (10–05, 70–80–01). Remove air and seal. Mark date of preservation on bag.

(g) Store and transport bearings in partitioned wooden, plastic, or aluminum containers.

1. E. (2) Bearings scheduled for storage for up to 5 years shall be preserved as follows:

CAUTION: BEARINGS PRESERVED IN ACCORDANCE WITH THE FOLLOWING PROCEDURES MUST BE DEPRESERVED AND LUBRICATED PRIOR TO THEIR USE.

FAILURE TO PROPERLY RINSE BEARINGS CONTAINING COPPER ALLOY MAY CAUSE DISCOLORATION OR DETERIORATION.

(a) Inspect bearings for residual magnetism. (Refer to SP I311, 70–20–11.) If residual magnetism exceeds 3 gauss, demagnetize bearing in accordance with Paragraph F.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(b) Rinse bearings in tank containing dry cleaning solvent (07–63, 70–80–01).

(c) Immerse bearings in fingerprint remover (07–29, 70–80–01) for 2 minutes, then drain.

CAUTION: FROM THIS POINT ON, DO NOT HANDLE BEARINGS WITH UNPROTECTED HANDS. LINT–FREE GLOVES ARE RECOMMENDED

(d) Rinse bearings in tank containing dry cleaning solvent (07–63, 70–80–01) to remove residual fingerprint remover.

WARNING: CORROSION PREVENTIVE COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

(e) Dip bearings in corrosion preventive compound (02–36, 70–80–01) heated to 150°F (65°C) for 10 to 15 minutes.

(f) Allow bearings to cool to room temperature.

(g) Package cool bearing in individual polyethylene bags (10–05, 70–80–01).

(h) Wrap packaged bearings in barrier material (10–06, 70–80–01) and seal in foil bag. (10–07, 70–80–01). Mark preservation date on bag.

(i) Store and transport bearings in partitioned wooden, plastic, or aluminum containers.

1. E. (3) Prior to installation, each bearing preserved in accordance with Step (2) shall be depreserved as follows:

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

AREAS IN WHICH LUBRICATING OIL IS USED SHALL BE ADEQUATELY VENTILATED TO KEEP MIST AND FUMES TO A MINIMUM.

(a) Immerse bearings in clean, lubricating oil (02–22 or 02–23, 70–80–01) heated to 185 to 215°F (85 to 102°C) for 10 to 15 minutes.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(b) Rinse bearings in tank containing dry cleaning solvent (07–63, 70–80–01).

(c) Immerse bearings in fingerprint remover (07–29, 70–80–01) for 2 minutes, then drain.

(d) Rinse bearings in tank containing dry cleaning solvent (07–63, 70–80–01) to remove residual fingerprint remover.

(e) Dip bearings in clean, lubricating oil (02–21 or 02–24, 70–80–01). Rotate one revolution to coat all internal bearing components. Allow to drain.

(f) Package bearings in individual polyethylene bags (10–05, 70–80–01). Remove air and seal. Mark date on bag.

(g) Store or transport bearings in partitioned wooden, plastic, or aluminum containers.

1. F. Demagnetization of Bearings. When bearings are magnetized, small foreign particles may be attracted to the balls, rollers or rings. The magnetic attraction can be so strong these particles will not be removed during soaking and cleaning operations.

(1) As necessary, completely demagnetize each bearing before cleaning (SP I311, 70–20–11) and as follows:

(a) Turn on demagnetizing coil. While rotating the bearing, pass it through the entire length of the demagnetization coil. Keep the axis of the bearing's rotation parallel to that of the coil winding.

(b) Withdraw bearing from demagnetizer with a straightaway motion for a distance of at least 3 feet (1 meter). Turn off demagnetizing coil.

(c) Inspect bearing for residual magnetism, making certain that the complete circumference of the bearing is inspected. (Refer to SP I311, 70–20–11.)

(d) Rotate inner ring 90 degrees with respect to outer ring and repeat Step (c).

(e) An adequately demagnetized bearing shall produce a reading of 3 gauss or less. If a reading of 3 gauss or less is not met, repeat Steps (a) through (d).

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## CHAPTER 70–15–00 - CLEANING

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1. Vapor Degreasing - SP C201 - Deleted

NOTE: Emulsion degreasing per SP C214, 70–15–14 is an approved alternate cleaning procedure for vapor degreasing per SP C201, 70–15–01, for all parts except bearings or parts that would be adversely affected by contact with water. Emulsion degreasing per 70–15–14 may be used whenever vapor degreasing per 70–15–01 is specified.

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1. Solvent Immersion - SP C202

A. Carbon removing compound is used to remove carbon, gum, grease, and other surface contaminants.

CAUTION: TO PREVENT DAMAGE TO PAINTED FINISHES, DO NOT CLEAN WITH CARBON REMOVING COMPOUND.

(1) Remove carbon by solvent immersion method as follows:

(a) Remove all loose grease, dirt, and oil by emulsion degreasing. (Refer to SP C214, 70–15–14).

(b) Fill cleaning tank with one of the three carbon removing compounds below. Make sure that an adequate water seal exists by the addition of water. This prevents the evaporation of carbon removing compound.

WARNING: TO PREVENT INHALATION OF CLEANING VAPOR, MAKE SURE THAT CLEANING AREA IS WELL–VENTILATED. IF CARBON REMOVING COMPOUND COMES IN CONTACT WITH SKIN, EYES, OR CLOTHING, THOROUGHLY FLUSH AFFECTED AREA WITH COLD WATER.

1 Carbon removing compound (07–46, 70–80–01) heated to 135 to 145°F (57 to 63°C). Use full strength as received and add water to create a 4 to 8 inches (102 to 203 millimeters) seal to make up for compound loss.

2 Carbon removing compound (07–47, 70–80–01) maintained at room temperature. Use full strength as received and add a minimum of 3 inches (76 millimeters) water seal to make up for compound loss.

NOTE: Cold solution requires more time to work than hot solution.

3 Carbon removing compound (07–44, 70–80–01) maintained at room temperature. Use as received with no mixing or dilution. Add a 3 inch (76 millimeters) minimum water seal to make up for compound loss.

NOTE: Solution in Step 3 is stronger than the solution specified in Step 2.

4 For alternate cleaning material. Carbon removing compound (07–45, 70–80–01) maintained at room temperature. Use as received with no mixing or dilution. Follow manufacturers instructions for usage and water content.

(c) Immerse parts in carbon removing compound below water seal. Allow parts to soak, as necessary, to remove contaminants.

1. A. (1) (d) Raise parts from tank and allow to drain.

(e) Rinse parts in cold water to remove foreign deposits, then rinse in water heated to 180°F (82°C).

(f) Allow parts to air dry.

(g) Flush parts with high pressure water.

(h) Rinse parts in water heated to 180°F (82°C) and air dry.

(i) If parts are not to be reassembled within a short period of time, coat with corrosion preventive oil (02–38, 70–80–01).

1. Dry Cleaning Solvent - SP C203

A. All nonferrous metal parts shall be cleaned with dry cleaning solvent (07–63, 70–80–01). Dry cleaning solvent is suitable for removal of heavy deposits of oil and grease from most parts, including flexible hoses and carbon seals. This process is safe on all ferrous metals.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Dry clean parts as follows:

(a) Immerse parts in tank containing dry cleaning solvent (07–63, 70–80–01). Scrub with fiber brush.

NOTE: Parts may be cleaned in a spray booth with atomized dry cleaning solvent under air pressure of 60 to 90 psig (414 to 621 kPa). Parts shall be sprayed and scrubbed in the booth, then sprayed a second time to remove residue loosened by scrubbing.

(b) Using moisture free compressed air, dry parts.

(c) When not in use, close tank cover.

NOTE: Dry cleaning solvent (Type II only) will leave an oily film that will protect steel parts from corrosion for a short period of time. Parts shall be completely immersed in solvent prior to overnight storage.

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1. Cleaning Aluminum Parts, Painted Aluminum Parts, and Parts Painted With Aluminum Paint - SP C204

A. The following process is safe for use on aluminum parts, painted aluminum parts, and parts painted with aluminum paint:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

(2) Prepare cleaning solution by mixing 2 to 6 ounces (59 to 177 milliliters) of cleaning compound (07–48, 70–80–01) to 1 gallon (3.785 liters) of water.

(3) Heat cleaning solution to 120 to 150°F (50 to 65°C). Immerse parts in solution for 1 to 5 minutes.

(4) Remove parts from cleaning solution and remove deposits using fiber bristle brush.

(5) Rinse parts thoroughly in clean water heated to 180°F (82°C). Allow parts to air dry.

(6) Flush parts with high pressure water.

(7) Rinse parts in clean water heated to 180°F (82°C). Allow parts to air dry.

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1. Vapor Blasting - SP C205

A. Vapor blasting (liquid honing) is a mechanical method of cleaning. In blast cleaning, abrasives do the actual work. Vapor blasting is used to clean combustor parts; however, care shall be used to prevent wearing away of metal. Make sure that cooling slots, holes, ridges, and overlap areas do not become clogged with slurry. This cleaning method may be used with care on various steel and stainless steel parts.

CAUTION: TO PREVENT DAMAGE, DO NOT VAPOR BLAST CERAMIC COATED, PLATED, OR PAINTED STEEL, AND MAGNESIUM OR ALUMINUM PARTS.

PARTS THAT HAVE SERIAL NUMBERS OR PART NUMBERS PREFIXED BY A S HAVE BEEN PLASMA OR THERMAL FLAME SPRAYED. THESE PARTS SHALL NOT BE EXPOSED TO VAPOR BLASTING, WHICH COULD REMOVE OR BE HARMFUL TO THE SPRAYED SURFACES.

(1) Vapor blast parts as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.) Refer to Cleaning and Conditioning of Metal Parts using Glass Beads. (Refer to SP C218, 70–15–18.)

WARNING: USE SEPARATE CLEANING UNIT AND FOLLOW PRESCRIBED SAFETY PRECAUTIONS TO CLEAN LEAD CONTAMINATED PARTS.

CAUTION: TO PREVENT DAMAGE, PROTECT CRITICAL DIAMETERS AND OTHER FINISHED SURFACES WITH MASKING TAPE (10–24, 70–80–01).

(b) Place parts in cleaning unit in a position suitable for blasting.

WARNING: BECAUSE OF TOXICITY OF SOME DEPOSITED MATERIAL, KEEP BOTH PART AND BRUSH WET WITH WATER TO PREVENT AIRBORNE DUST.

1. A. (1) (c) Use vapor blast slurry at a pressure of 40 psig (276 kPa) and a 0.250 inch (6.4 millimeters) (nominal) nozzle. Direct vaporizer stream back and forth across surface of parts being cleaned; best nozzle distance is 1.5 to 2.5 inches (38 to 64 millimeters) from surface.

NOTE: Abrasive solution shall consist of 40 percent water and 60 percent vapor blasting compound. Vapor blasting compound 200 grit (05–14, 70–80–01) is used for more aggressive cleaning. Vapor blasting compound 325 grit (05–14, 70–80–01) is recommended for use on delicate or rotating parts.

When vapor blast slurry is new, cleaning action is faster and cleaned surface rougher. As the slurry is used, natural wear of the abrasive material creates finer sizes that clean more slowly and leaves smoother surfaces.

(d) Remove part from cleaning unit; rinse thoroughly in cold water.

CAUTION: TO PREVENT DAMAGE, DO NOT SCRUB PARTS WITH A STEEL BRUSH.

(e) Remove all remaining contaminants by hand scrubbing with soft fiber bristle brush.

(f) Rinse parts in clean, running water heated to 190 to 212°F (88 to 100°C). Allow parts to air dry.

1. Hot Alkali Soak No. 1 - SP C206

A. Light hot alkali soak No. 1 is used to remove light carbon, gum, and grease deposits.

CAUTION: THIS PROCESS IS SAFE TO USE ON MAGNESIUM AND NON–ALUMINUM PAINTED PARTS. THIS PROCEDURE IS NOT SAFE FOR ALUMINUM PARTS, PAINTED ALUMINUM PARTS, OR PARTS PAINTED WITH ALUMINUM PAINT.

(1) Using a stainless steel or steel tank, mix 1 pound (434 grams) of alkaline cleaning compound (07–32, 70–80–01) with water to make 1 gallon (3.785 liters) of solution. Operating temperature shall be a minimum of 160°F (71°C).

(2) For alternate cleaning materials. Using a stainless steel or steel tank, follow manufacturers instructions (07-33 or 07-37, 70-80-01) for usage, operating temperature and water solution content.

(3) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(4) Soak parts in tank of alkaline solution as necessary, average time is 3 hours.

(5) Remove parts and brush away deposits with a stiff fiber bristle brush.

(6) Thoroughly rinse parts in clean water heated to 180°F (82°C). Allow parts to air dry.

(7) Flush parts with room temperature, high pressure water.

(8) Rinse parts in clean water heated to 180°F (82°C). Allow parts to air dry.

(9) If parts are not to be reassembled within a short period of time, coat with corrosion preventive oil (02–38, 70–80–01).

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1. Hot Alkali Soak No. 2 - SP C207

A. Regular hot alkali soak No. 2 is used to remove carbon heat scale and other surface contaminants from steel parts that have chrome plated or flame sprayed areas.

CAUTION: USE THIS METHOD ON STAINLESS STEEL AND HIGH TEMPERATURE ALLOYS ONLY. DO NOT USE THIS PROCESS ON ALUMINUM, MAGNESIUM, OR PAINTED PARTS.

NOTE: When a repair procedure allows stripping of aluminum polyester plasma sprayed material or aluminum based paints, the use of plastic bead blasting may be used as an alternate method, if the process meets the requirements of the repair specification. Refer to SP R408, 70–50–01, for aluminum polyester plasma sprayed material, SP P501 and SP502, 70–30–01 and 70–30–02, for aluminum based paints, and SP C215, 70–15–15, for plastic bead media blasting.

(1) Using a stainless steel or steel tank, mix 3 pounds (1361 grams) of alkaline derust compound (07–34 or 07–37, 70–80–01) with 1 gallon (3.785 liters) of water. Heat solution to 190 to 200°F (88 to 93°C).

(2) Using a stainless steel or steel tank, mix a 75 percent concentration of alkaline derust compound (07–36, 70–80–01) in water. Heat solution to 190 to 200°F (88 to 93°C).

(3) For alternate material. Using a stainless steel tank, mix solution of alkaline derust compound (07–39, 07–111, or 07–112, 70–80–01) according to manufacturers instructions. Follow manufacturers instructions for temperature and usage.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

NOTE: For cleaning of parts having complex geometries, or to accelerate immersion times, the solutions above may be used in an ultrasonic bath. Follow ultrasonic bath cleaner and cleaning solution manufacturers' instruction for any special precautions recommended for used in the application.

(4) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(5) Immerse parts in alkaline derust solution for 1 hour.

1. A. (6) Thoroughly rinse parts in clean water heated to 180°F (82°C).

(7) Flush parts with room temperature, high pressure water.

(8) Rinse parts in clean water heated to 180°F (82°C). Allow parts to air dry.

WARNING: CORROSION PREVENTIVE COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

(9) If parts are not to be reassembled within a short period of time, coat with corrosion preventive oil (02–38, 70–80–01).

1. Hot Alkali Soak No. 3 - SP C208

A. Heavy hot alkali soak No. 3 is used to remove carbon heat scale and other surface contaminants, including corrosion, from all stainless steel parts.

CAUTION: DO NOT USE THIS METHOD ON CHROME PLATED OR FLAME SPRAYED PARTS, LOW ALLOY STEEL, MAGNESIUM, ALUMINUM, OR PAINTED PARTS.

(1) Prepare alkali solutions as follows:

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(a) Using a stainless steel or steel tank, mix 3 pounds (1361 grams) of alkaline derust compound (07–34, 70–80–01) with 1 gallon (3.785 liters) of water, or mix a 75 percent concentration of alkaline derust compound (07–36, 70–80–01) in water. Heat solution to 190 to 200°F (88 to 93°C).

(b) In a separate tank, mix $2^{1}/_{2}$ pounds (1134 grams) of alkaline permanganate (07–40, 70–80–01) with 1 gallon (3.785 liters) of water. Heat solution to 190 to 200°F (88 to 93°C).

(c) For alternate cleaning material. Using a stainless steel tank, mix solution of alkaline derust compound (07–38 or 07–112, 70–80–01) according to manufacturers instructions. Follow manufacturers instructions for temperature and usage.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(2) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

(3) Immerse parts in alkaline derust solution for 1 hour.

(4) Thoroughly rinse parts in clean water heated to 180°F (82°C).

(5) Immerse parts in alkaline permanganate solution for 1 hour.

(6) Thoroughly rinse parts in clean water heated to 180°F (82°C). Allow parts to air dry.

(7) Repeat preceding Steps (2), (3), and (4).

(8) Flush part with clean, high pressure, room temperature water.

1. A. (9) Rinse parts in clean water heated to 180°F (82°C), then air dry.

WARNING: CORROSION PREVENTIVE COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

(10) If parts are not to be reassembled within a short period of time, coat with corrosion preventive oil (02–38, 70–80–01).

1. Periodic Reverse Cleaning - SP C209

A. Periodic reverse cleaning is effective on all degrees of deposit and is superior to the soaking method for removing heavy deposits of lead. Prepare solution by mixing 2 pounds (907 grams) of alkaline cleaning compound (07–32, 70–80–01), with 1 pound (454 grams) sodium cyanide (04–23, 70–80–01). Add water to make 1 gallon (3.785 liters) of solution.

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

CAUTION: CERAMIC COATED OR ALUMINUM COATED PARTS SHALL NOT BE SUBJECTED TO PERIODIC REVERSE CLEANING METHODS. STRONG ALKALI SOLUTIONS WILL DAMAGE THE COATING. DO NOT CLEAN CARBURIZED OR NITRIDED PARTS BY PERIODIC REVERSE CLEANING METHOD.

(1) Clean parts by periodic reverse method as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

(b) Mask all chrome and cadmium plated, phosphate and black oxide coated, and copper alloy parts.

(c) Suspend parts in stainless steel tank containing cleaning solution.

(d) Apply an electrical potential of 6 to 10 volts across the tank. Set cathode time for approximately 10 seconds and anode time for approximately 5 seconds.

(e) Allow parts to remain in tank for 10 minutes, then remove parts and brush away deposits with fiber bristle brush until clean.

(f) Repeat preceding Steps (c), (d), and (e) as necessary.

(g) Thoroughly rinse parts in alternate baths of clean water heated to 180°F (82°C) and cold water. Allow parts to air dry.

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1. Fingerprint Removal From Nonprotected Surfaces - SP C210

A. Fingerprints shall be removed from all machined surfaces to prevent corrosion.

(1) Remove fingerprints from parts as follows:

WARNING: AVOID PROLONGED INHALATION OF FINGERPRINT REMOVER/CORROSION PREVENTIVE COMPOUND VAPORS. WEAR RUBBER GLOVES AND USE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Immerse cleaned parts in fingerprint remover (07–29, 70–80–01) and agitate solution for minimum of 2 minutes.

CAUTION: WHEN REMOVING PARTS FROM FINGERPRINT REMOVER, DO NOT TOUCH THE MACHINED SURFACES.

(b) Remove parts from fingerprint remover. Rinse with dry cleaning solvent. (Refer to SP C203, 70–15–03.)

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

CAUTION: LUBRICATING OIL MAY SOFTEN PAINT UPON CONTACT. IF LUBRICATING OIL IS SPILLED ON PAINTED SURFACES, THESE SURFACES SHOULD BE THOROUGHLY WASHED.

(2) When parts are not to be reassembled within a short period of time, coat parts, except oil system components, with corrosion preventive oil (02–37 or 02–38, 70–80–01). Coat oil system parts with lubricating oil (02–22 or 02–23, 70–80–01) and package in polyethylene bags (10–05, 70–80–01).

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1. Corrosion Protection After Cleaning - SP C211

A. Cleaned parts destined for 48 hours or more of storage must be protected against corrosion. Such parts should be corrosion protected as follows:

NOTE: Cleaned parts are those parts that have been emulsion degreased or cleaned with dry cleaning solvents which leave no oil residue on the part.

(1) Coat cleaned parts, except oil system components that are to be stored, with corrosion preventive oil (02–37 or 02–38, 70–80–01).

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

AREAS IN WHICH LUBRICATING OIL IS USED SHALL BE ADEQUATELY VENTILATED TO KEEP MIST AND FUMES TO A MINIMUM.

CAUTION: LUBRICATING OIL MAY SOFTEN PAINT ON CONTACT. WHEN LUBRICATING OIL IS SPILLED ON PAINTED SURFACES, THESE SURFACES SHOULD BE THOROUGHLY WASHED.

(2) Coat oil system components with clean lubricating oil (02–22 or 02–23, 70–80–01).

(3) Cover all unprotected openings with caps, plugs, or other suitable covers. If plastic caps or plugs are used, make sure that no chips are generated during installation.

(4) Package all oil system parts in polyethylene bags (10–05, 70–80–01).

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1. Gears and Splined Parts Cleaning - SP C212

A. When cleaning gears and splines, make sure that root areas are completely free of foreign matter. Foreign matter has a tendency to lodge between internal and external splines and teeth of gears.

(1) Clean gears and splines as follows:

(a) Visually inspect each gear or spline to determine degree of cleaning required, then clean part by any of the following methods:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

CAUTION: TO PREVENT CONTAMINATION AFTER CLEANING, HANDLE PARTS AS LITTLE AS POSSIBLE.

1 When cleaning is required, emulsion degrease part. (Refer to SP C214, 70–15–14.)

NOTE: Light rust and other deposits shall be removed by scrubbing vigorously with a soft bristle brush while part is immersed in dry cleaning solvent.

2 Dry cleaning solvent. (Refer to SP C203, 70–15–03.)

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

CORROSION PREVENTIVE COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

B. Dry each part after cleaning, using compressed air 25 psig (172 $kNm^2$ maximum). Parts that are not to be inspected or used within 24 hours, are to be protected with corrosion preventive oil (02–37 or 02–38, 70–80–01).

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1. Bearing Cleaning - SP C213

A. The degree of cleaning of a bearing is dependent upon certain factors, i.e., prior operating time and conditions, type of material, and degree of exposure to contaminants after removal from the engine. Since a bearing may operate in a high temperature environment, it is subject to varying degrees of discoloration which are not normally removed during cleaning. For this reason, it is important to clean a bearing only as necessary for an adequate inspection.

CAUTION: THE CLEANING AREA SHALL BE IN AN ENCLOSED AND VENTED AREA. REASONABLE CARE IN DUST CONTROL SHALL BE MAINTAINED. PROTECTIVE APRONS, LINT FREE GLOVES, AND PROTECTIVE HAND CREAMS SHALL BE AVAILABLE.

B. Visually inspect bearing to ascertain degree of cleaning required. When cleaning bearings, use one or more of the following procedures.

CAUTION: BEARINGS SHALL BE DISASSEMBLED MANUALLY FOR CLEANING. THE USE OF HAND OR MACHINE TOOLS IS NOT RECOMMENDED. REMOVAL OF RIVETS, WELDMENTS, AND STAKES OR BENDING OF TANGS IS NOT PERMITTED. CERTAIN MAIN SHAFT BEARINGS HAVE REMOVABLE ROLLING ELEMENTS AND CAGE ASSEMBLIES. THESE ROLLING ELEMENTS AND CAGE ASSEMBLIES CANNOT BE INTERMIXED WITH ROLLING ELEMENTS FROM ANOTHER BEARING; KEEP ROLLING ELEMENTS AND CAGE ASSEMBLIES IN THE SAME BASKET AS OTHER COMPONENTS FROM EACH INDIVIDUAL BEARING.

C. Inspect bearing for residual magnetism. (Refer to SP I311, 70–20–11.) As necessary, completely demagnetize each bearing prior to cleaning. (Refer to SP B106, 70–10–03.)

D. Cleaning of bearings not subjected to carbon or varnish contamination or with light contamination. Visually inspect bearings to ascertain degree of cleaning required. Using the following methods, clean bearings as required:

NOTE: Surface discoloration due to varnish is acceptable on all bearing external surfaces.

(1) Preferred cleaning procedure - Light Contamination.

(a) Place parts in a fine wire mesh basket to minimize trapping air and maximize exposure to solvent.

(b) Agitate the part(s) in a aqueous cleaner Brulin 815GD (07–96, 70–80–01) or equivalent for 3 to 5 minutes.

(c) Remove part(s) from tank and drain to remove excess cleaner. Check part(s) to ensure they are contaminant free. Repeat cleaning as necessary.

(d) Immediately rinse parts in cold water for 3 to 5 minutes.

1. D. (1) (e) Remove parts and drain for 30 seconds.

(f) Immerse in hot water for 3 to 5 minutes.

(g) Drain parts for 30 seconds. Immediately dry parts in an oven for approximately 10 minutes at 170 to 180°F (77 to 82°C).

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(h) Without delay, as soon as parts are cool enough to handle, slush with clean engine oil (02–22 or 02–23, 70–80–01).

(i) Place in clean plastic bag (10–05, 70–80–01).

(2) Static soak bearings in accordance with one of the following cleaning methods, as applicable, using a suitable tank.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

NOTE: Soak time will depend on the type or degree of contamination. Tanks shall have false bottoms for sludge/contamination separation and be equipped with filtration.

(a) Remove light greases, preservatives, or oils using dry cleaning solvent procedure. (Refer to SP C203, 70–15–03.)

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

(b) Remove heavy greases, preservatives, or oils using hot oil soak with lubricating oil (02–24, 70–80–01) heated to 170 to 190°F (77 to 88°C).

(3) Emulsion degrease bearings. (Refer to SP C214, 70–15–14.)

CAUTION: NEVER ALLOW A BEARING TO SPIN FREELY UNDER SPRAY PRESSURE. DAMAGE TO BEARINGS MAY RESULT.

(4) Allow bearings to air dry for no longer than 10 minutes.

1. D. (5) Ultrasonically soak bearings in dry cleaning solvent (07–63, 07–64, 07–65, 70–80–01) in ultrasonic cleaning unit (Model DR500AH) (Acoustica Associates Inc, Los Angeles, CA) at room temperature for 2 to 5 minutes.

(6) Allow bearings to air dry for no longer than 10 minutes.

(7) Remove fingerprints. (Refer to SP C210, 70–15–10.)

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

AREAS IN WHICH LUBRICATING OIL IS USED SHALL BE ADEQUATELY VENTILATED TO KEEP MIST AND FUMES TO A MINIMUM.

(8) Oil slush with clean engine lubricating oil (02–22 or 02–23, 70–80–01).

(9) Place in polyethylene bag (10–05, 70–80–01.).

E. Cleaning of bearings subjected to carbon or varnish contamination. Visually inspect bearings to ascertain degree of cleaning required; then proceed as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

CAUTION: FINAL RINSE ON ALL BEARINGS SHALL BE MADE IN SOLVENT PREFILTERED TO REMOVE ALL PARTICLES THAT ARE 7 MICRONS OR LARGER IN SIZE.

NOTE: Surface discoloration due to varnish is acceptable on all bearing surfaces.

(1) Dip bearings in dry cleaning solvent (SP C203, 70–15–03) at room temperature for 5 minutes.

1. E. (2) Static soak bearings, using one of the following methods, as required.

WARNING: CARBON REMOVING COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

(a) Remove lightly attached carbon by cold soaking in carbon removing compound (07–44, 70–80–01).

(b) Remove medium–to–heavy carbonization and heavy varnish by hot soak at 160 to 180°F (71 to 82°C) in carbon removing compound (07–43, 70–80–01) for 30 minutes.

(c) Remove heavy carbonization by hot soaking at 160 to 180°F (71 to 82°C) in alkaline derust compound (07–34, 70–80–01).

(3) Repeat Steps D.(5) through (9).

1. Emulsion Degreasing - SP C214

NOTE: The use of Mirachem 500 (Step (2)) is a preferred alternate to Emul–Klene.

A. The emulsion degreasing method will remove oil, grease, and sludge. This process is safe for aluminum painted parts or elastomers.

CAUTION: TO AVOID PART DAMAGE, DO NOT USE THIS METHOD OR ANY ALTERNATE METHODS ON BEARINGS OR PARTS THAT WOULD BE ADVERSELY AFFECTED BY CONTACT WITH WATER OR AN AQUEOUS SOLUTION.

(1) Clean parts by using Emul–Klene as follows:

(a) Fill a suitable tank with water to one–half of operating capacity. Add required amount of emulsion degreasing solvent, Emul–Klene liquid (07–68, 70–80–01). Ratio of solution shall be 1 quart (0.946 liter) of Emul–Klene to 1 gallon (3.785 liters) of water. Add water to operating level of tank.

(b) Solution shall be used at a temperature of 75 to 140°F (24 to 60°C).

(c) Place parts in basket and completely immerse in Emul–Klene. Allow parts to soak for 1 hour.

(d) Raise parts from tank and allow to drain.

(e) Rinse parts in clean, cold water to remove foreign particles.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(f) Remove excessive moisture using clean, filtered, dry low pressure 20 psig (13.8 $kNm^2$) air.

(g) Oven dry at 230 to 270°F (110 to 132°C) for a minimum of 1 hour. Allow to air cool before attempting any additional procedure.

1. A. (2) As a preferred alternate, clean parts using Mirachem 500 as follows:

CAUTION: WHEN USED TO CLEAN MAGNESIUM, MAKE SURE TIME AND TEMPERATURE ARE MINIMIZED. EXCESSIVE TIME AND TEMPERATURE CAN RESULT IN ETCHING OF BARE MAGNESIUM.

NOTE: The use of Mirachem 500 is a preferred alternate for Emul–Klene.

(a) Fill a suitable tank with emulsion degreasing solvent, Mirachem 500 (07–70, 70–80–01), full strength or diluted to 50 percent with water.

NOTE: Solution shall be used at a temperature of 75 to 140°F (24 to 60°C); however, cleaning efficiency is greatly improved at temperatures above 100°F (38°C).

(b) Place parts in a basket and completely immerse in cleaning solution. Allow parts to soak for 1 hour.

(c) Skim oil from cleaning solution prior to removing cleaned parts.

(d) Raise parts from tank and allow to drain.

(e) Rinse parts in clean, cold water to remove foreign particles.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(f) Remove excessive moisture using clean, filtered, dry low pressure 20 psig (13.8 $kNm^2$) air.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(g) Oven dry at 230 to 270°F (110 to 132°C) for a minimum of 1 hour. Allow to air cool before attempting any additional procedure.

1. A. (3) As a preferred alternate procedure, parts may be aqueous degreased using Daraclean 282 as follows:

NOTE: Parts that show evidence of dry lube and/or graphite varnish should be cleaned using isopropyl alcohol and not the process outlined below.

(a) The aqueous degreasing method will remove oil, grease, and sludge.

1 Clean parts using Daraclean 282 (07–95, 70–80–01) as follows:

a Fill a suitable tank about half full with tap water. Heat tap water to 125°F (52°C). Begin agitating water and add Daraclean 282 to ensure final concentration of 8 percent to 12 percent. Fill remainder of tank with tap water and agitate for 30 minutes. Let solution reach working temperature of 150 ±10°F (66 ±5.5°C). Verify concentration to be 8 percent to 12 percent prior to use and make any necessary adjustments. A self contained agitation pressure spray system is an acceptable alternate cleaning apparatus to the soap tank as long as the proper 8 percent to 12 percent concentration is maintained.

b Wipe excessively soiled areas clean with solvent. (Refer to 07–63, 70–80–01.)

NOTE: Parts made of titanium that do not exhibit oil, immediately thoroughly dry parts and skip to Step i.

c Place parts in basket to maximize contact with solution and completely immerse in tank solution. Allow parts to soak with agitation for 5 to 30 minutes.

d Raise parts out of aqueous degreasing unit. Drain excess solution back into tank.

e Spray rinse parts with clean water for a minimum of 10 seconds.

f Rinse parts in double cascade rinse tank for 15 seconds minimum in each tank.

g Rinse parts in hot deionized water 140°F (60°C) minimum for approximately 15 seconds minimum.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

1. A. (3) (a) 1 h Remove excessive moisture using clean, filtered, dry low pressure 20 psig (13.8 $kNm^2$) air.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

i Oven dry at 230 to 270°F (110 to 132°C) for a minimum of 1 hour. Allow to air cool before attempting any additional procedure.

WARNING: ISOPROPYL ALCOHOL IS FLAMMABLE AND MAY AFFECT SKIN, EYES, AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. AVOID REPEATED OR PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT.

NOTE: Magnesium parts must be dried immediately to prevent corrosion.

j As necessary, wipe or dip part in isopropyl alcohol to remove any oil buildup that may remain. Any internal passages should be drained of alcohol and then blown dry with clean, oil free air.

(4) As a preferred alternate procedure, parts may be aqueous degreased using Ardrox-6376 (07-110, 70-80-01) according to manufacturers instructions.

1. Plastic Media Blasting - SP C215

A. The following procedure describes a mechanical method of removing coatings without harming the substrate. This method is an abrasive blasting process using a dry media of thermoset or thermoplastic plastic grit. Plastic media can be reused since it is not prone to break down and it retains its angular shape. It is necessary to clean the media before reuse.

NOTE: Plastic media can leave a film that can be detected during fluorescent penetrant inspection. Remove film with ethyl alcohol (07–23, 70–80–01).

B. Materials. Media used in plastic media blasting shall be fabricated from virgin plastic (Grade A) with a particle size (U.S. Standard Sieve) and shape with sharp edges and corners. Plastic media are classified by type which specifies the hardness and material composition. Definitions of the different media types are as follows:

Type I — A polyester plastic with a 3.0 mohs (34 to 42 Barcol) hardness. This media is recommended for use on delicate surfaces and is the least damaging of all media types.

Type II — A urea formaldehyde based plastic with a 3.5 mohs (54 to 62 Barcol) hardness. This material may be used if the Type I material produces a less than desirable removal rate.

Type III — A melamine formaldehyde plastic with a 4.0 mohs (64 to 74 Barcol) hardness. Type III media are very aggressive and are recommended for stripping iron based substances where residual stress is not a concern.

Type IV — A phenol formaldehyde plastic with a 3.5 mohs (54 to 62 Barcol) hardness. This media is similar to Type II.

Type V — An acrylic plastic with a 3.5 mohs (46 to 54 Barcol) hardness. Types I through IV are thermoset type plastics. This media is thermoplastic and tends to be softer and longer lasting.

(1) Media Particle Size. Each type of blast media is available in a wide variety of size distributions. Blending of the different types/sizes is not permitted.

1. B. (2) Media Material Restrictions. The media shall be manufactured in accordance with the best commercial practice and supplied in accordance to the following restrictions:

(a) No inorganic fillers are allowed in the media.

(b) Media shall not have or create an objectionable odor or affect the health of the personnel when used.

(c) Media shall not contain more than 0.1 percent of chlorine.

(d) Media shall be resistant to static electric build up. Antistatic agents are recommended.

(e) Media shall be free of any foreign matter detectable to the naked eye.

(3) Media Types I through V.

To obtain plastic abrasive media material (05–22, 05–25, or 05–26, 70–80–01).

C. Equipment Required

(1) Blast Equipment. Blast equipment shall be of proper type and adequately sized for the task. It must allow the operator ease of control over the intensity and targeting of the blast stream.

(2) Screening. Screening or filtering equipment is essential for media maintenance. It is mandatory to screen or filter new and used media prior to remove undersize, or broken abrasive particles, corrosion debris, coating debris, metal particles or any other media contamination.

WARNING: INHALING DUST PARTICLES IS HAZARDOUS. DUST PARTICLES CAN ALSO BE EXPLOSIVE. SUITABLE DUST COLLECTION AND VENTILATION SYSTEMS ARE ESSENTIAL TO PROTECT PERSONNEL FROM THESE HAZARDS.

(3) Dust Collection and Ventilation. Provisions must be made to collect the dust formed during blasting and provide adequate dust free ventilation to personnel. Filtering type respirators should be used.

1. D. Process Parameter Development

Test blast a small area using 30 psig (208 kPa), a 3/8 inch diameter nozzle, a 60 degree blast angle, Type I media, and 12 inch standoff distance. An acceptable removal rate is typically 0.50 to 0.75 square–feet (0.047 to 0.070 square–meters) per minute for metal substrates (approximately 0.30 square–feet (0.03 square–meters) per minute for organic matrix composites). If the removal rate requires improvement, adjust the following process parameters, Steps (1) through (4), and select the best combination that will provide an acceptable removal rate while not harming the substrate or the sub coatings. Record the process parameters giving the best results.

CAUTION: NOZZLES LARGER THAN 0.375 INCH (9.52 MILLIMETER) DIAMETER CAN PROVIDE SUCH A LARGE AMOUNT OF MEDIA THAT CAN DAMAGE ENGINE COMPONENTS AND ARE NOT RECOMMENDED.

NOTE: Nozzle sizes range from 0.25 to 0.625 inch (0.635 to 15.88 millimeter) diameter and each will have their own characteristic removal rate and blast energy.

(1) Plastic blast media are grouped according to increasing hardness and abrasiveness. (Refer to Paragraph B.) Therefore, if Type I removal rate is too slow, try Type II.

(2) Blast pressure at the nozzle directly affects the removal rate and may be varied from 25 to 45 psig (172 to 310 kPa) for pressure blast systems. Higher pressures are necessary for suction type blasters. Excessive pressure will damage the media. Pressures should be kept on the low side; in the range of 25 to 30 psig (172 to 207 kPa).

CAUTION: USING HIGH SPRAY ANGLES (75 TO 90 DEGREES) WILL IMPART MORE ENERGY TO THE SUBSTRATE THAT MAY CAUSE WARPAGE OR CRACKING.

NOTE: Use less pressure to avoid damaging delicate substrates.

(3) Blast angle has a proportional effect on removal rate. The higher the angle, the higher the removal rate. On delicate substrates, it is advisable to use low blast angles of 45 degrees or less.

(4) Standoff distance typically range from 6 to 24 inches (153 to 610 millimeters) and have a significant influence on removal rate. It is recommended that a range be selected and maintained as close as possible during the entire blasting operation.

1. E. Areas to be blasted must be dry and free of moisture, grease, oil, or any loose contaminants.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease (SP C214, 70–15–14) or wipe with a clean lint free cloth (10–10, 70–80–01) using dry cleaning solvent (07–63, 07–64, or 07–65, 70–80–01).

(2) Mask or plug all internal passages to prevent blasting materials from entering.

NOTE: Protect all areas adjacent to or near areas to be blasted with masking tape (10–24, 70–80–01) or equivalent.

(3) Using the appropriate process parameters (Paragraph D.), blast a small area using a circular motion until the desired removal has been achieved, then proceed to a new area. Never allow the blast stream to dwell on a single area at any time; always keep the impingement area moving. Try to work in a fluid manner maintaining continuous motion.

NOTE: When blasting, the blast stream must be smooth and continuous to prevent uneven erosion of coatings or damage to the substrate.

Plastic media blast cleaning exposes substrates to corrosion or potential contamination from the environment. Areas should be plastic media blast cleaned as preparation for a subsequent coating operation.

1. Hot Alkali Soak No. 4 - SP C216

A. Hot alkali soak No. 4 is used to remove heavy concentrations of rust and corrosion from low alloy steel parts.

CAUTION: DO NOT USE THIS METHOD ON CHROME PLATED, FLAME SPRAYED, ALUMINUM, OR MAGNESIUM PARTS.

B. Prepare solutions as follows:

(1) Alkaline Derust Compound

(a) In a stainless steel or steel tank, mix 3 pounds (1361 grams) alkaline derust compound (07–85, 70–80–01) with 1 gallon (3.785 liters) of water. Heat solution to 190 to 200°F (88 to 93°C).

(b) For alternate cleaning material. Using a stainless steel tank, mix solution of alkaline derust compound (07–86, 70–80–01) according to manufacturers instructions. Follow manufacturers instructions for temperature and usage.

WARNING: AVOID CONTACT WITH EYES AND SKIN. MAY CAUSE IRRITATION. IN CASE OF ACCIDENTAL CONTACT, FLOOD AREA WITH WATER. IF EYE IRRITATION PERSISTS, SEEK MEDICAL ATTENTION. AVOID BREATHING DUST AND SPRAY MIST. WEAR RESPIRATION, RUBBER GLOVES OR FACE SHIELD AND PROTECTIVE CLOTHING. DO NOT TAKE INTERNALLY. BATH MAY BECOME CORROSIVE IF OPERATED AT TEMPERATURES IN EXCESS OF 130°F (54°C).

(2) Acidic Descaler

(a) In a stainless steel or steel tank, mix 12 to 16 ounces (340 to 454 grams) Part A, acidic descaler (07–87, 70–80–01) and 3 percent Part B, by weight, with 1 gallon (3.785 liters) of water. Heat solution to 130 to 140°F (54 to 60°C).

(b) For alternate cleaning material. Using a stainless steel tank, mix solution of acidic descaler (07–88, 70–80–01) according to manufacturers instructions. Follow manufacturers instructions for temperature and usage.

NOTE: To determine concentration of bath or to replenish system, refer to manufacturers instructions.

1. C. Remove rust and corrosion from parts as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

(2) Immerse in alkaline derust solution (Step B.(1)) for 20 to 30 minutes minimum.

(3) Rinse in clean room temperature water.

(4) Immerse in acidic descaler solution (Step B.(2)) for 20 to 30 minutes.

(5) Rinse in clean water heated to 180°F (82°C).

(6) Rinse in clean room temperature water.

(7) Immerse in alkaline derust solution (Step B.(1)) for 15 to 30 minutes.

(8) Flush with clean, high pressure, room temperature water.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(9) Rinse in clean water heated to 180°F (82°C) and blow dry using clean, dry shop air.

WARNING: CORROSION PREVENTIVE COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

(10) Coat with corrosion preventive oil (02–38, 70–80–01).

1. Sodium Bicarbonate Media Blasting - SP C217

A. The following procedure describes the proper use for removing coatings using baking soda media. This method involves the use of dry media grit which will only be used once, due to particle breakdown after its initial use.

NOTE: This procedure may be used as an alternative to 70–15–15, unless specifically stated otherwise in the applicable engine manual.

B. Material. Media used in this process shall be Armex Maintenance Formula sodium bicarbonate media, or equivalent.

(1) Media material requirements. The media shall be manufactured in accordance with the best commercial practice and supplied in accordance to the following requirements:

(a) Media shall not have or create an objectionable odor or affect the health of personnel when used.

(b) Media shall not contain more than 1 percent of chlorine.

(c) Media shall be resistant to static electric buildup.

(d) Media shall be free of any foreign matter detectable to the naked eye.

C. Equipment Required

(1) The baking soda blast cabinet shall be used in conjunction with Armex Maintenance Formula sodium bicarbonate media, or equivalent.

(2) Screening or filtering of the media is mandatory. Screening/filtering must remove any paint chips, corrosion debris, metal particles, and any other media contamination.

WARNING: INHALING DUST PARTICLES IS HAZARDOUS. DUST PARTICLES CAN ALSO BE EXPLOSIVE. SUITABLE DUST COLLECTION AND VENTILATION SYSTEMS ARE ESSENTIAL TO PROTECT PERSONNEL FROM THESE HAZARDS.

(3) Dust collection and ventilation. Provisions must be made to collect the dust formed during blasting and provide adequate dust free ventilation to personnel. Filtering type respirators should be used.

(4) The interior of the blasting cabinet shall be dry. Wet blasting equipment is not permitted.

1. D. Process Parameter Development

Process parameters for each part shall be established and recorded on a process control card. Process parameters shall be selected to remove paint efficiently without removing or damaging the substrate in any way. Process parameters for magnesium parts shall allow for removal of paint with minimal removal of the HAE coating.

CAUTION: NOZZLES LARGER THAN 0.375 INCH (9.52 MILLIMETERS) DIAMETER CAN PROVIDE SUCH A LARGE AMOUNT OF MEDIA THAT CAN DAMAGE ENGINE COMPONENTS AND ARE NOT RECOMMENDED.

NOTE: Nozzle sizes range from 0.25 to 0.625 inch (0.635 to 15.88 millimeters) diameter and each will have their own characteristic removal rate and blast energy.

(1) The following are typical blasting parameters for sodium bicarbonate media blasting:

(a) Air pressure 10 to 100 psi (68.9 to 689.5 kPa), 0.7 to 7.0 bar

(b) Air volume 100 to 300 cfm (2.83 to 8.49 mx/min), 2828 to 8482 liters/min

(c) Media flow rate 0.50 to 3.0 lbs/min (0.23 to 1.36 kg/min)

(2) Blast pressure at the nozzle directly affects the removal rate and may be varied from 25 to 45 psig (172 to 310 kPa) for pressure blast systems. Higher pressures are necessary for suction type blasters. Excessive pressure will damage the media. Pressures should be kept on the low side, in the range of 25 to 30 psig (172 to 207 kPa).

CAUTION: USING HIGH SPRAY ANGLES (75 TO 90 DEGREES) WILL IMPART MORE ENERGY TO THE SUBSTRATE THAT MAY CAUSE WARPAGE OR CRACKING.

NOTE: Use less pressure to avoid damaging delicate substrates.

(3) Blast angle has a proportional effect on removal rate. The higher the angle, the higher the removal rate. On delicate substrates, it is advisable to use low blast angles of 45 degrees or less.

(4) Standoff distance typically range from 6 to 24 inches (153 to 610 millimeters) and have a significant influence on removal rate. It is recommended that a range be selected and maintained as close as possible during the entire blasting operation.

1. E. Areas to be blasted must be dry and free of moisture, grease, oil, or any loose contaminants.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease (SP C214, 70–15–14) or wipe with a clean, lint free cloth (10–10, 70–80–01) using dry cleaning solvent (07–63, 07–64, or 07–65, 70–80–01).

(2) Mask or plug all internal passages to prevent blasting materials from entering.

NOTE: Protect all areas adjacent to or near areas to be blasted with masking tape (10–24, 70–80–01) or equivalent.

When blasting, the blast stream must be smooth and continuous to prevent uneven erosion of coatings or damage to the substrate.

(3) Using the appropriate process parameters, blast a small area using a circular motion until the desired removal has been achieved, then proceed to a new area. Never allow the blast stream to dwell on a single area at any time, always keep the impingement area moving. Work in a fluid manner maintaining continuous motion.

1. F. Cleaning and removal of media from magnesium and aluminum parts.

CAUTION: TO AVOID MAGNESIUM PART DAMAGE, ENSURE THAT BARE MAGNESIUM DOES NOT SUSTAIN CONTACT WITH WET OR DAMP BLASTING MEDIA, OR AQUEOUS SOLUTIONS CONTAINING BAKING SODA.

(1) Remove media within 2 hours by means of a agitated hot water bath.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(2) Blow dry using clean, dry shop air.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(3) Oven dry at 150 to 300°F (66 to 149°C) for a minimum of 1 hour. Allow to air cool before attempting any additional procedure.

CAUTION: TO AVOID PART DAMAGE, ENSURE THAT ALL PARTS WITH OIL PASSAGES AND RESTRICTED AREAS ARE CLEAR OF ALL MEDIA.

(4) Inspect part for media. Clean as necessary.

1. G. Cleaning and removal of media from other alloys.

(1) Remove media within 2 hours by means of a water wash.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(2) Blow dry using clean, dry shop air.

(3) Emulsion degrease (SP C214, 70–15–14) or wipe with a clean, lint free cloth (10–10, 70–80–01) using dry cleaning solvent (07–63, 07–64, or 07–65, 70–80–01).

CAUTION: TO AVOID PART DAMAGE, ENSURE THAT ALL PARTS WITH OIL PASSAGES AND RESTRICTED AREAS ARE CLEAR OF ALL MEDIA.

(4) Inspect part for media. Clean as necessary.

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1. Cleaning and Conditioning of Metal Surfaces Using Glass Beads - SP C218

A. Classification

(1) Conditioning shall be of the following types:

(a) Type I - Wet or dry conditioning using glass beads for surface profile adjustment, cleaning, or producing a surface texture.

(b) Type II - Wet or dry conditioning using a 1:1 mixture of glass beads (05–03, 70–80–01) and garnet grit (05–18, 70–80–01) for producing a surface texture or cleaning.

(c) Type III - Wet or dry glass beads used for cleaning.

NOTE: If no type is specified, Type III shall apply.

(2) Conditioning shall be done using equipment suited to the purpose and having, as a minimum, the following features:

(a) Metal cabinet with sufficient mechanical exhaust capacity to clear the chamber during conditioning operations.

(b) Air regulator for control of blasting pressure in the 10 to 110 psig range.

(c) Suitable water rinse tank adjacent to the conditioning cabinet for removal of residual materials from finished parts. Water agitation capability is desirable.

(d) A suitably sized tank for immersion oiling (02–19, 70–80–01) of finished, processed parts.

(3) Conditioning media.

(a) Glass beads used in both Type I and Type II conditioning shall be in accordance with SAE AMS2431/6, AGB–12.

(b) Garnet shall be of commercial grade, 150 grit.

(c) Glass beads for cleaning (Type III) shall use commercial grade in the size range of 100 to 170 U.S. sieve (0.0059 to 0.0035 inch) or SAE AMS2431/6, AGB–12.

(d) Parts to be cleaned or conditioned shall be degreased to remove oils and greases.

(e) Parts shall be masked to restrict conditioning to surfaces as specified.

1. A. (3) (f) Blast pressure shall be set based on experience with the material and type of part to be conditioned. If such experience is lacking, a suitable test shall be performed using a production part; starting at low pressure and short time cycle, then increasing the pressure and time cycle as necessary to obtain desired results.

(g) Surface finish prior to conditioning shall be as specified.

(h) Conditioning shall be either wet or dry as specified.

NOTE: If unspecified, conditioning shall be dry. If conditioning method is dry, compressed air shall be used to remove residues. The air used as carrier shall be visibly dry and free of particulates and oil.

When wet conditioning, a water rinse shall be used to remove residues. The water used as carrier shall contain a suitable rust inhibitor. The mixture of solids and water shall consist of approximately 90 percent water, 10 percent solids (by volume).

(i) A systematic method of coverage shall be used so that all areas are equally conditioned.

(4) Process Control.

(a) All parts processed shall have a uniform surface appearance, free of scratches, nicks, and blemishes visible to the unaided eye. No magnification shall be used, unless otherwise specified.

(b) Prior to conditioning each lot of Type I parts, if fresh media is not used, the medium to be used shall be examined for deterioration as follows.

1 The particles used for Type I conditioning shall be examined for evidence of fractured or damaged glass beads at 15 to 25X magnification.

2 If more than 15 percent of the beads are defective, the equipment shall be cleaned and reloaded with fresh beads.

1. A. (5) Quality Assurance Provisions.

(a) The supplier shall provide samples for supplier's tests and shall be responsible for performing all required tests. Honeywell reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure processing conforms to the requirements of this specification.

(b) Tests to determine compliance with surface uniformity are classified as acceptance tests and shall be performed in accordance with Step (c).

(c) Acceptance tests (sampling) shall be performed on each part processed.

(d) Parts and conditioning media not in compliance with this specification shall be rejected.

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# CHAPTER 70–20–00 - INSPECTION

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1. <u>Seal Data - SP I301</u>

A. The following information applies when handling seals:

<u>CAUTION</u>: DO NOT IMMERSE CARBON SEALS IN LUBRICATING OIL.

(1) Regardless of the location or configuration, prior to its installation the carbon seal face shall be wiped with clean, room temperature lubricating oil (02–23, 70–80–01). All other surfaces are to be left clean and dry.

(2) All positive contact seals shall be stored in their original carton until time for assembly.

(3) Treat all seals with care.

B. Clean all parts per Dry Cleaning Solvent Method, SP C203. All parts must be cleaned prior to inspection.

C. Preinspection of carbon seals. Visually inspect intact seal assemblies to determine general condition. Decide which of the following categories describes the condition of the seal and treat the seal accordingly:

(1) Group A seals. Seals determined to be reusable. Use the following criteria as a guide:

(a) Seals with little or no coke deposits on the seal housing or carbon element.

(b) Seals without visual defects on housing, end plate, or carbon elements or defects within the following limits:

<u>1</u> Seal housing/end plate defect limits are as follows:

<u>a</u> Grooves on outside diameter are acceptable up to 0.001 inch (0.03 millimeter) deep.

<u>b</u> Damage on inside diameter. None allowed.

<u>c</u> Excessive coke on housing. (Refer to SP C206, 70–15–06.) Clean housing.

<u>2</u> Carbon element defect limits are as follows:

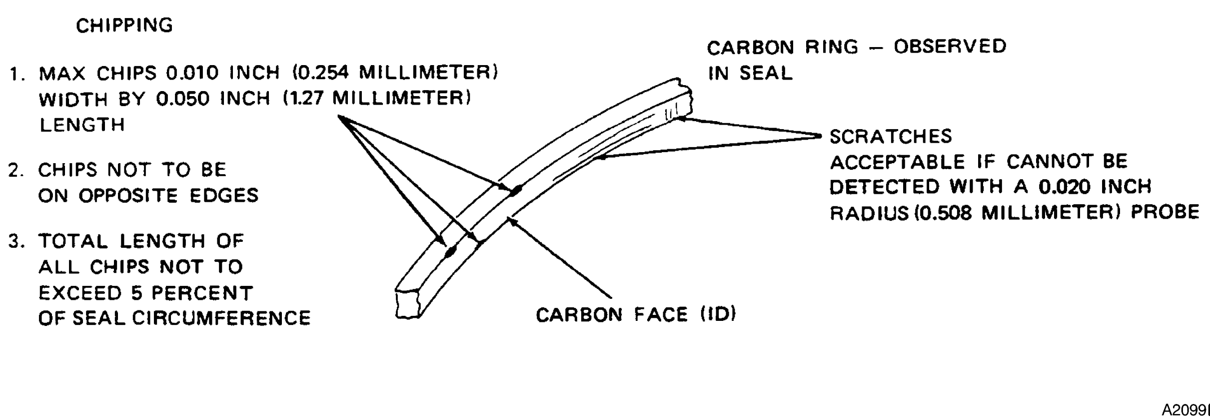
<u>a</u> Broken carbon element. None allowed.

<u>b</u> Minor chipping at carbon circumferential edges, as observed after seal cleaning, is acceptable when individual nicks or chips do not exceed 0.010 inch (0.25 millimeter) in width and 0.025 inch (0.64 millimeter) in length. Total length of all chips shall not exceed 5% of seal circumference measured circumferentially on each side. Chips shall not be opposite one another. (See Figure 1.)

CAUTION: SCRATCHES CAN LEAD TO CARBON CRUMBLING, CRACKING, OR CHIPPING. WHERE THERE IS DOUBT ABOUT THE MAGNITUDE OF A SCRATCH, CARBON ELEMENT SHALL BE REPLACED. WHEN USING AN INSPECTION PROBE, ENSURE THAT IT IS LIGHTLY PASSED OVER SCRATCH FOR DETECTION. DO NOT CAUSE CARBON ELEMENTS TO MOVE WHEN USING PROBE. DO NOT EXERT UNDUE FORCE ON CARBON ELEMENT WHEN INSPECTING. LAPPING OF SEAL CARBON RINGS IS ALLOWED, PROVIDED A REINSPECTION HAS BEEN PERFORMED.

c Scratch depth limit for carbon element. Light axial or circumferential scratches, as observed after seal cleaning, are acceptable provided that they cannot be detected with a 0.020 inch (0.51 millimeter) radius probe, as shown on Figure 1.

d Coke on carbon element that cannot be removed by cleaning. None allowed.




Carbon Face Chipping and Scratches
Figure 1

CAUTION: WHEN DEPRESSING CARBON ELEMENTS, CARE SHALL BE TAKEN TO AVOID DAMAGE TO ELEMENT OR SUPPORTING COMPONENTS. COKE AND/OR VARNISH MAY CAUSE CARBON BUILDUP WHICH MAY SCRATCH OR DAMAGE SEALING FACES. EXCESSIVE FORCE OR CARELESSNESS MAY CAUSE DAMAGE TO SEAL WHICH CANNOT BE DETECTED UNLESS SEAL IS COMPLETELY DISASSEMBLED.

3 Chipping limits are defined as follows:

| DAMAGE OF SEALING SURFACE WIDTH IN PERCENT | NUMBER OF CHIPS ALLOWED | REMARKS |
|---|---|---|
| 25 Maximum | 1 | Larger chips are not allowed. |
| 15 Maximum | 3 | Chips shall not be opposite each other. |
| Less than 20 | Unlimited | At least 85 percent of sealing surface edge shall be free of chips. |

NOTE: Chip size limits for carbon element nonsealing surfaces shall be 2X the active sealing surface width maximum. Chips shall not be detrimental to auxiliary functions such as strength, spring loading or physical positioning.

4 Dynamic sealing surfaces scratch limits are as follows:

a Radial or axial scratches shall be less than 50 percent of sealing surface width.

b Circumferential scratches shall be less than 10 percent of the total circumference. No more than two such adjacent scratches in the direction of leakage flow is allowed.

c Radial, axial, or circumferential components of random scratches cannot exceed limits defined in preceding Steps a and b.

5 Static sealing surfaces scratch length limits are as follows:

a No scratch shall extend over more than 50 percent of the land that restricts leakage flow in direction of scratch lay.

b No scratches are permitted on a packing sealing surface that will extend across packing contact area.

c There is no limit to number of scratches, provided criteria of preceding Steps a and b are met by any or all of the scratches considered in combination.

d There is no limit to scratch size or frequency on nonsealing surfaces.

6 Seal carbon elements shall be checked for free movement as follows:

CAUTION: WHEN DEPRESSING CARBON ELEMENTS, CARE MUST BE TAKEN TO AVOID DAMAGE TO ELEMENT OR SUPPORTING COMPONENTS.

a Radial seals with carbon assemblies shall have unrestrained radial movement. No binding is permitted.

b On face seals, ensure seal compresses approximately 0.04 inch (1.02 millimeter) under an axial load. No binding on interface is permitted.

c Dimensionally measure seal OD for fit. Replace seal if limits are not met. See individual seal inspection criteria for dimensions.

(2) Group B seals. Seals that do not meet requirements of Group A seals. Replace and store seal in bond areas for future rebuild.

1. Visual Inspection - SP I302

A. A thorough visual inspection of the engine and engine parts is important to ensure engine life and maximum performance. Such inspections should be performed in a brightly lighted room that is free of dust, dirt, and high levels of humidity. Work benches should be covered with clean, dry paper.

(1) The engine, and its parts should be visually checked for: loose or missing parts, cracks, distortion, wear, erosion, corrosion, damage to surface coating, nicks, dents, and burned areas.

(2) Defective parts should bear appropriately colored tags identifying the necessary repair or reason for rejection.

NOTE: Although many defects may be detected by naked eye observation, compliance with some required dimensional inspection(s) as directed by the applicable engine manual may be required.

(3) Suspected subsurface flaws may be detected by use of magnetic particle inspection. (Refer to SP I303, 70–20–03.)

(4) Remove fingerprints after inspection. (Refer to SP C210, 70–15–10.)

B. Visual Inspection Definitions

(1) General Visual Inspection (GVI) - A visual inspection of an area, installation, or assembly to detect obvious damage, failure, or irregularity. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight, or drop light. If no level of inspection is specified, GVI shall apply.

(2) Detailed Visual Inspection (DVI) - An intensive visual inspection of a specific area, system, installation, or assembly to detect damage, failure, or irregularity. Available lighting is supplemented with a direct source of good lighting at an intensity level deemed appropriate. Inspection aides such as mirrors, magnifying lenses, etc may be used. Surface cleaning and access procedures may be required.

(3) Special Detailed Inspection (SDI) - An intensive examination of a specific item(s), installation, or assembly to detect damage, failure, or irregularity. The examination is likely to make extensive use of specialized inspection techniques and/or equipment. Intricate cleaning and disassembly procedures may be required.

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1. Magnetic Particle Inspection - SP I303

A. Purpose

To provide instructions for performing fluorescent magnetic particle inspection on ferromagnetic steel alloys in an in–service condition.

B. Personnel Qualification

Personnel performing examinations or approving magnetic particle instructions in accordance with this procedure shall be qualified and certified in accordance with NAS410, or equivalent.

C. Written Procedure

Part specific instructions may be generated to supplement general requirements of this procedure. Specific procedure shall comply with SP I303 and contain the following as a minimum:

(1) Procedure identification number and date it was written.

(2) Part number.

(3) Area of part to be examined (include sketch or photo).

(4) Directions for positioning part with respect to magnetizing equipment.

(5) Type of magnetizing current and equipment to be used.

(6) Method of establishing magnetization (head, coil, etc).

(7) Method of particle application.

(8) Reference to central bar conductor size(s) used.

(9) Order in which magnetizing shots are to be applied.

(10) Current level for each shot applied.

(11) Acceptance requirements.

(12) Refer to SP I303.

1. D. Equipment and Material

As minimum, inspection facility shall use following equipment and materials:

(1) Bench magnetizing unit with coil: 1 or 3 phase full wave DC (rectified from AC), half wave DC (rectified from AC), or alternating current.

(2) Bath vehicle: Water or petroleum distillate.

(3) Fluorescent magnetic particles.

(4) Field indicator (capable of 1 gauss resolution).

(5) Black light.

(6) Black light meter.

(7) White light meter.

(8) Centrifuge tube and stand.

(9) Ketos ring or equivalent.

(10) Selection of central bar conductors.

(11) Hall effect gaussmeter (optional).

E. Part Preparation

(1) Surface of part to be inspected shall be essentially clean and dry, being free of oil, scale, or other contaminants or conditions which may interfere with efficiency of inspection. Clean part using appropriate method for contaminant prior to magnetic particle inspection.

(2) For component repair, magnetic particle inspection shall be done prior to reapplication of coating.

(3) All parts shall be checked for residual magnetization with field indicator prior to inspection. Parts containing magnetic field exceeding five gauss shall be demagnetized per Paragraph S. of this procedure.

(4) Small openings and oil holes leading to passages or cavities that could entrap or remain contaminated with inspection media shall be plugged with suitable nonabrasive material that can be removed readily.

1. F. Magnetic Field Direction and Technique

To ensure detection of discontinuities in any direction, each part must be magnetized in at least two directions at right angles to each other. Depending on part geometry, this may consist of circular and longitudinal magnetism, circular magnetism in two or more directions, or in longitudinal magnetization in two or more directions. Circular magnetization, when applied, shall always precede longitudinal magnetization to permit more effective demagnetization after inspection is completed.

(1) Direct magnetization. Direct magnetization is accomplished by passing current directly through part under testing. Electrical contact is made to part using head and tail stocks. Precaution shall be taken to ensure that electrical current is not flowing while contacts are being applied/removed and that excessive heating, as evidenced by discoloration, does not occur in contact area. Proper maintenance of head/tail stock copper pads, including replacement of frayed/torn pads, will help prevent arcing.

(2) Indirect magnetization. Indirect magnetization is accomplished using coils or central conductors.

(3) Toroidal field magnetization. Toroidal field magnetization is accomplished by inductively coupling part to an electrical coil using soft iron laminated core. This method is advantageous on ring shaped parts with central aperture and parts with L/D ratio less than two or where elimination of arcing or burning is of vital importance.

(4) Multidirectional magnetization. Multidirectional magnetization may be used to fulfill requirement for magnetization in two directions if it is demonstrated that it is effective in all critical areas. Artificial flaws that are etched or machined, e.g., QQIs (Quantitative Quality Indicators), shall be used to establish field directions. It is vitally important that field intensity be balanced in all directions so that one direction does not overwhelm another direction. In using this method, particle application must be timed so that magnetization reaches its full value in all directions during time particles are mobile on surface under testing.

G. Magnetization Current Determination

(1) Applied magnetic field shall have sufficient strength to produce satisfactory indications, but it must not be so strong that it causes masking of relevant indications by nonrelevant accumulations of magnetic particles. Current settings shall be preset prior to part magnetization, or with part in place, by proceeding from lower amperage to desired value. When lower amperage shot follows higher amperage shot, part shall be demagnetized between two operations per Paragraph S. of this procedure.

(2) For direct or indirect techniques, amperage values shall be determined by using Hall effect gaussmeter or supplied formulas. Preferred method is Hall effect gaussmeter. When using formulas to determine amperage values to be applied to part with alternating current, calculated value normally needs to be reduced by one–third to one–half. Reference equipment manufacturer's instructions for proper correction factor to be applied to convert meter reading to equivalent peak current. For toroidal field technique, Hall effect meter or QQIs shall be used to determine amperage values. For multidirectional technique, QQIs shall be used to determine amperage values.

1. H. Hall Effect Gaussmeter Parameters

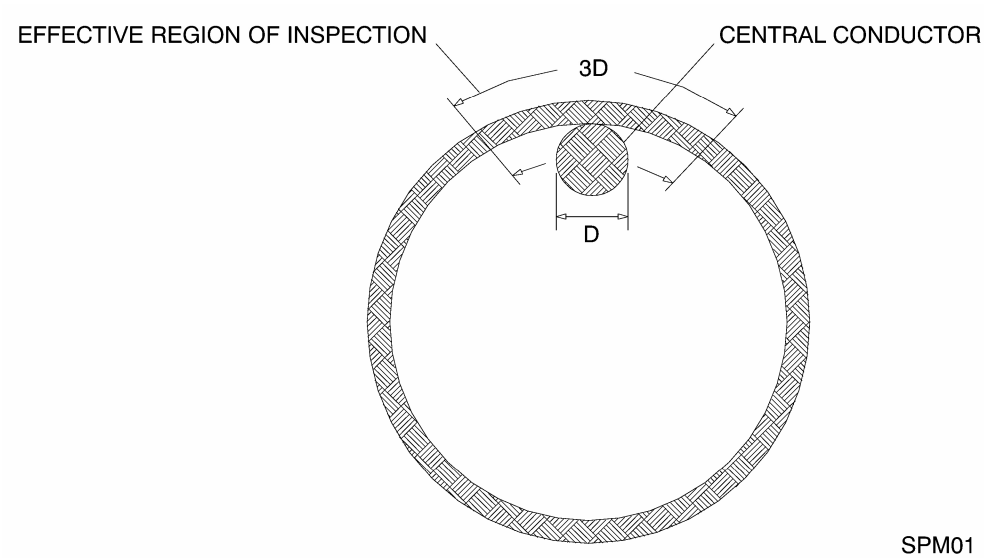
Hall effect gaussmeters shall be operated per manufacturer's instructions. Plane of probe shall be held perpendicular to part when measurements are taken, as angles greater than 5 degrees off normal will cause an erroneous reading. Plane of hall effect sensor shall be perpendicular to magnetic field being measured with specific probe orientation per manufacturer's instruction. All measurements are to be taken while current is being applied to part. When measuring magnetic field on gear tooth area, probe shall be placed at top of gear tooth, not in valley between gear teeth. On coil shots, reading shall be taken approximately 1 inch in from ends. This is to avoid saturated reading caused by flux leakage field created at ends when longitudinal field is induced into part. An applied field strength of between 30 to 60 gauss shall be present in all areas to be inspected.

I. Indirect Circular Magnetization

(1) Whenever possible, central conductor, either offset or centrally located, shall be used for circular magnetization. Central conductor of copper or aluminum, either solid or hollow, with as large diameter as possible, shall be used for central conductor shots.

(2) When using supplied formulas and alternating current, due to inherent penetration limitations, central conductor shot shall only be considered adequate coverage for inside of hole and not outside. However, when proper strength is verified through using Hall effect gaussmeter, alternating current may be used during central bar conductor shots for coverage of outside of hole.

(3) For offset technique, distance along part interior circumference that is effectively magnetized shall be taken as three times diameter of central conductor, as illustrated in Figure 1 (Sheet 1). Entire circumference shall be inspected by rotating part on conductor, allowing for approximately 10 percent magnetic field overlap.




Indirect Circular Magnetization
Figure 1 (Sheet 1 of 3)

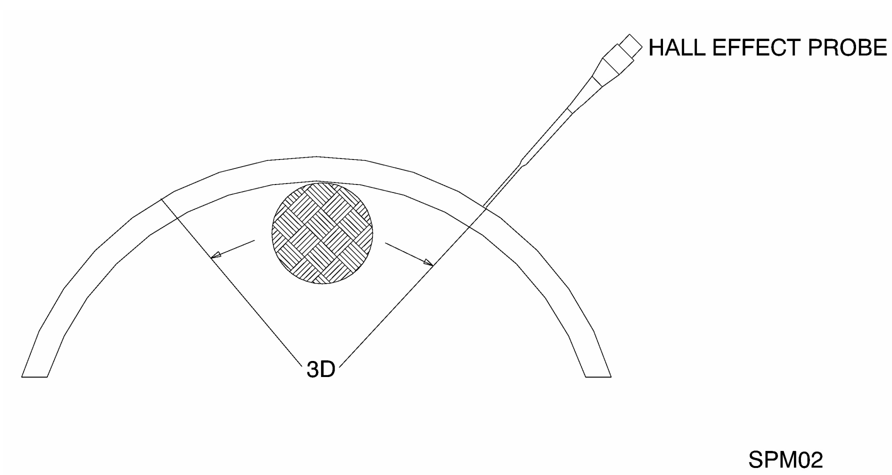
1. I. (4) When using Hall effect gaussmeter to determine amperage selection for an offset central bar conductor, initial measurement shall be taken at perimeter of effective region of inspection as illustrated in Figure 1 (Sheet 2). Follow up measurement shall be taken above central bar conductor to assure that both points fall within 30 to 60 gauss requirement.

(5) As an alternative to Hall effect gaussmeter, amperage may be determined by using Formula 1. First determine diameter of part and then insert that dimension into Formula 1. If only inside of part is to be inspected, diameter shall be greatest distance between two points, 180 degrees apart on inside circumference. If outside of part is to be inspected as well, diameter shall be determined by sum of outside diameter of central conductor and twice wall thickness.

<u>Formula 1</u>: I = 300 to 800 Amps/lnch x D

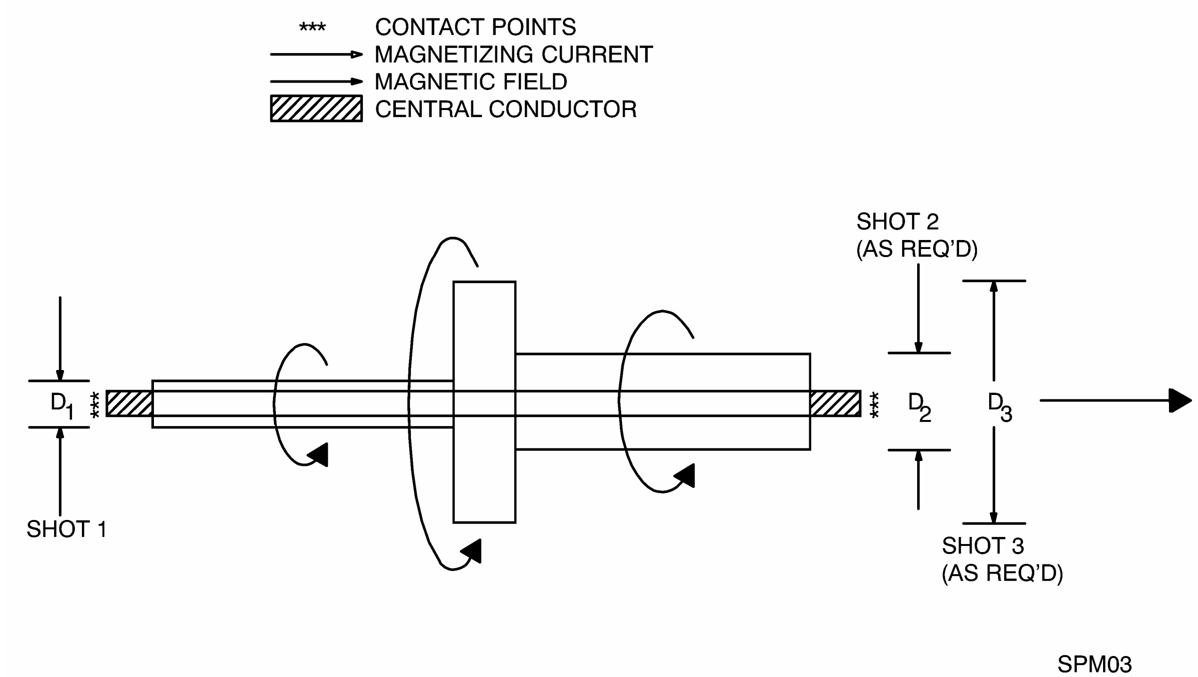
Where I = Magnetizing current
D= Diameter of part in inches

(6) For centrally located central bar conductor, wherein axis of central bar conductor is located near central axis of part, use Hall effect meter or Formula 1 to determine appropriate amperage.




Indirect Circular Magnetization
Figure 1 (Sheet 2)

1. I. (7) Figure 1 (Sheet 3) illustrates central bar conductor shot on multidiameter part and magnetizing current/magnetic field directions.

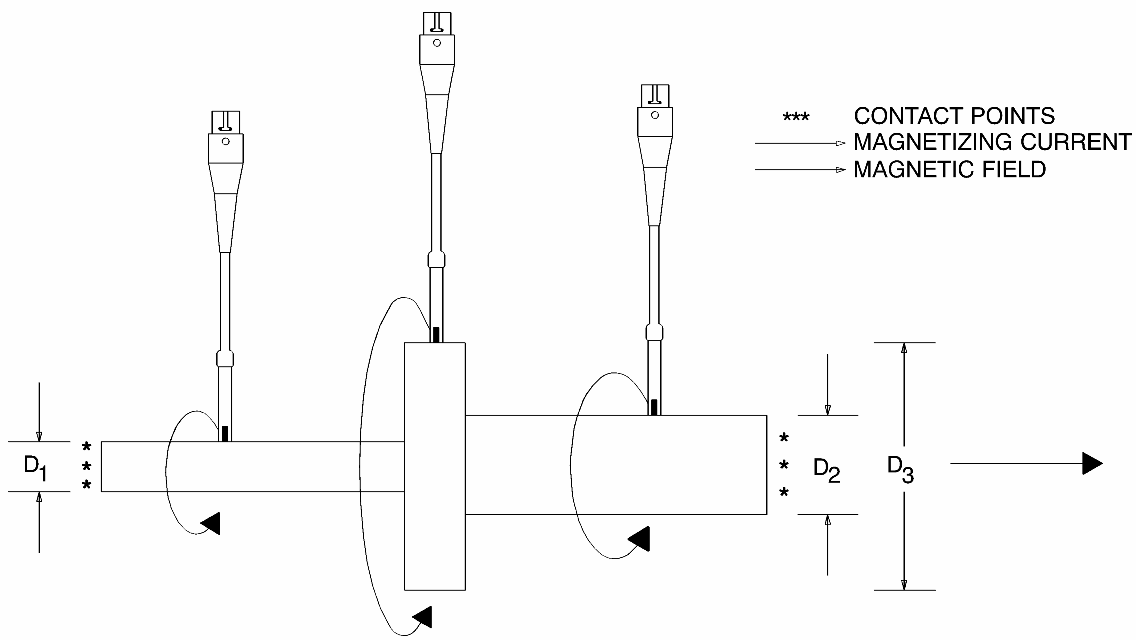



Indirect Circular Magnetization
Figure 1 (Sheet 3)

1. J. Direct Circular Magnetization

(1) Figure 2 illustrates proper probe positioning for Hall effect gaussmeter for direct circular magnetization and resultant current/field direction.

(2) As an alternative to Hall effect gaussmeter, amperage may be determined by using Formula 1. First determine diameter of part and then insert that dimension into Formula 1. Part diameter shall be taken as largest distance between any two points on outside circumference of part. Parts that would have minimal contact with headstocks, e.g., small compressor blades, should not be magnetized with direct contact due to potential for arcing part. This type of part may be successfully magnetized in coil in opposite orientations as verified by Hall effect gaussmeter.

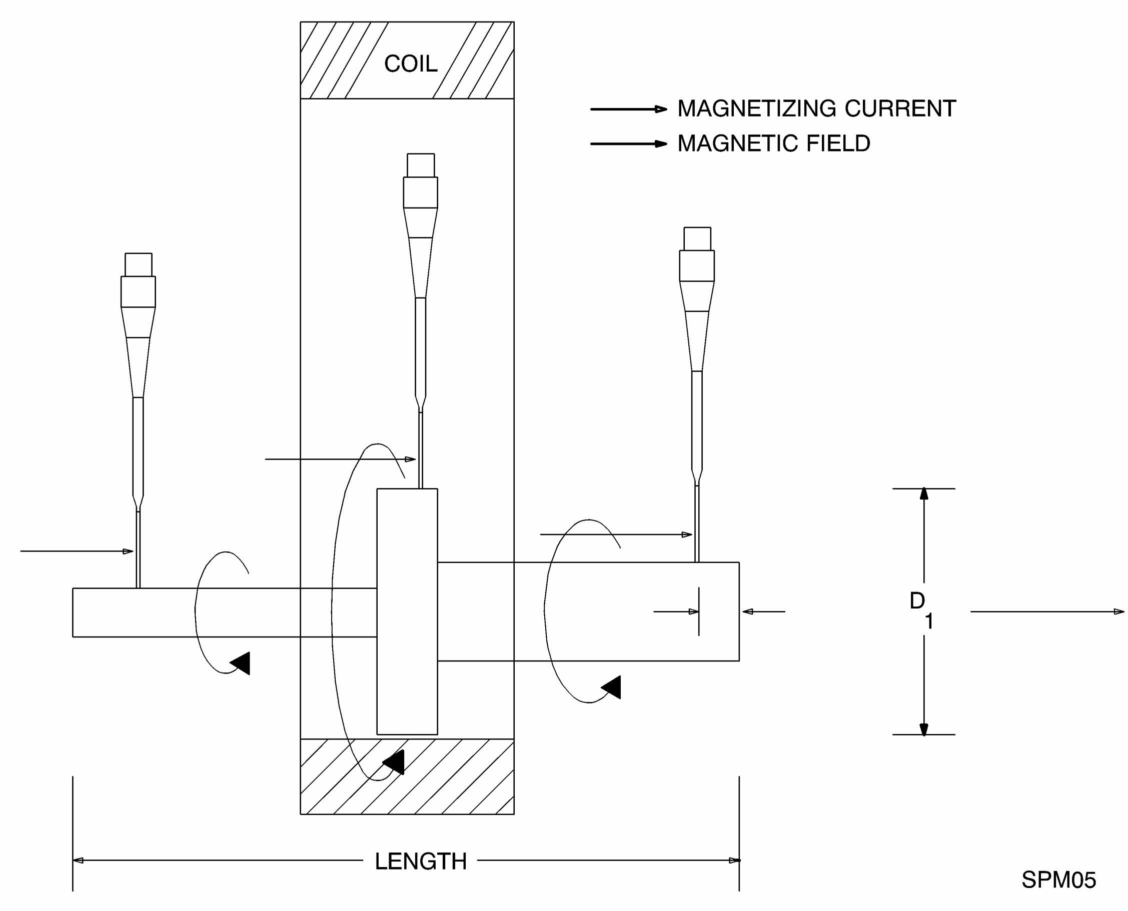



Direct Circular Magnetization
Figure 2

1. K. Coil Longitudinal Magnetization

(1) Longitudinal magnetization shall be induced by positioning part in coil with long axis of part parallel to central axis of coil. Figure 3 (Sheet 1) illustrates proper probe positioning for Hall effect gaussmeter for coil longitudinal magnetization and resultant current/field direction.

(2) Fill factor is defined as ratio of part diameter squared ($d^2$) divided by coil diameter squared ($D^2$). When cross sectional area of coil is 10 or more times cross sectional area of part being inspected, part is considered to be of low fill factor. When cross sectional area of coil is between two and ten times cross sectional area of part being inspected, part is considered to be of intermediate fill factor. When cross sectional area of coil is less than twice cross sectional area (including hollow portions) of part under test, part is considered to be of high fill factor. Table 1 relates part diameter limits for each category of fill factor for commonly used stationary coils.



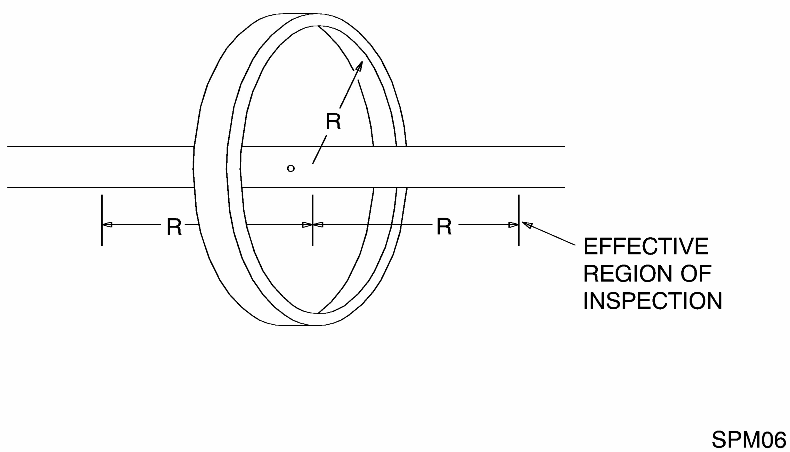

Coil Longitudinal Magnetization
Figure 3 (Sheet 1 of 3)

Table 1. Coil Longitudinal Magnetization

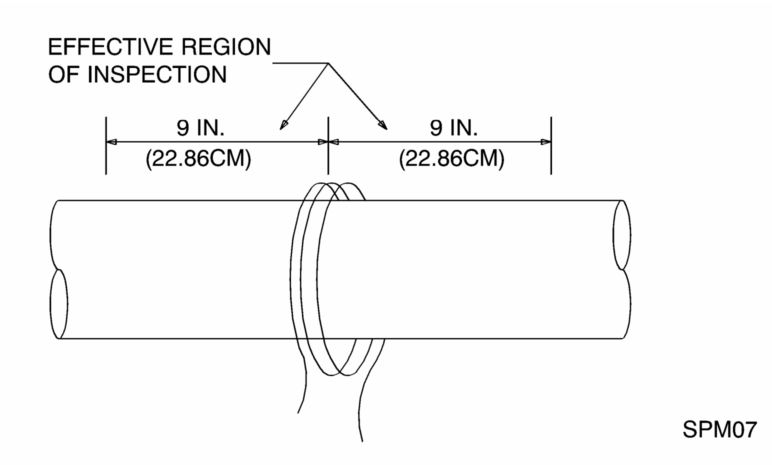
| Inside Coil Diameter | Low Fill Factor | Intermediate Fill Factor | High Fill Factor |
|---|---|---|---|
| 12 inches | < 3.80 inches | 3.80 to 8.48 inches | > 8.48 inches |
| 16 inches | < 5.06 inches | 5.06 to 11.30 inches | >11.30 inches |
| 20 inches | < 6.325 inches | 6.325 to 14.14 inches | > 14.14 inches |
| 25 inches | < 7.90 inches | 7.90 to 17.68 inches | > 17.68 inches |
| 30 inches | < 9.49 inches | 9.49 to 13.42 inches | > 13.42 inches |

1. K. (3) For low or intermediate fill factor coils, effective field extends distance on either side of coil center approximately equal to radius of coil as illustrated in Figure 3 (Sheet 2). For example, if bench unit has fixed coil of 12 inches diameter, effective field would extend 6 inches either side of center of coil. For parts longer than this effective distance, entire length shall be inspected by repositioning part within coil, allowing for approximately 10 percent effective magnetic field overlap.

(4) For cable wrap or high fill factor coils, effective distance of magnetization is 9 inches on either side of center of coil center as illustrated in Figure 3 (Sheet 3).




Coil Longitudinal Magnetization
Figure 3 (Sheet 2)




Coil Longitudinal Magnetization
Figure 3 (Sheet 3)

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1. L. Longitudinal Magnetization Part Length to Diameter Ratio

(1) When calculating L/D ratio for hollow part, D shall be replaced with “D Eff” as in Formula 2.

Formula 2: $D\ Eff = \sqrt{2(A_T - A_H)/3.14}$

Where AT = Total cross sectional area of part
$A_H$ = Cross sectional area of hollow portion of H part

(2) When calculating L/D ratio for cylindrical part, D shall be replaced with “D Eff” as in Formula 3.

Formula 3: $D\ Eff = \sqrt{(OD)^2 - (ID)^2}$

Where OD = Outside diameter of cylinder
ID = Inside diameter of cylinder

(3) Formulas 4 through 7 are only valid if L/D ratio is greater than 2 and less than 15. If L/D is less than 2 pole pieces (pieces of ferromagnetic material with similar diameter to part being tested) shall be placed on one or both sides of part under test in order to effectively increase L/D to 2 or greater. If L/D is greater than 15, value of 15 shall be substituted for L/D.

M. Longitudinal Magnetization Current Determination with Low Fill Factor Coils

(1) For parts positioned to side of low fill factor coil, use Hall effect gaussmeter or amperage Formula 4.

Formula 4: $NI = \dfrac{K}{(L/D)}$ (±10 percent)

Where N = Number of coil turns
I = Current in Amperes
K = 45,000 Ampere turns
L/D = Length/diameter in inches

(2) For parts positioned in center of low fill factor coil, use Hall effect gaussmeter or amperage Formula 5.

Formula 5: $NI = \dfrac{KR}{(6\ L/D) - 5}$ (±10 percent)

Where K = 43,000 ampere turns per inch
R = Radius

1. N. Longitudinal Magnetization Current Determination with High Fill Factor Coils

For parts positioned in high fill factor coil, use Hall effect gaussmeter or use amperage Formula 6:

Formula 6: $NI = \frac{K}{(L/D) + 2}$ (±10 percent)

Where N = Number of coil turns
I = Magnetizing current
K= 35 000 Amp turns

O. Longitudinal Magnetization Current Determination with Intermediate Fill Factor Coils

For parts positioned in intermediate fill factor coil, use Hall effect gaussmeter or use amperage Formula 7.

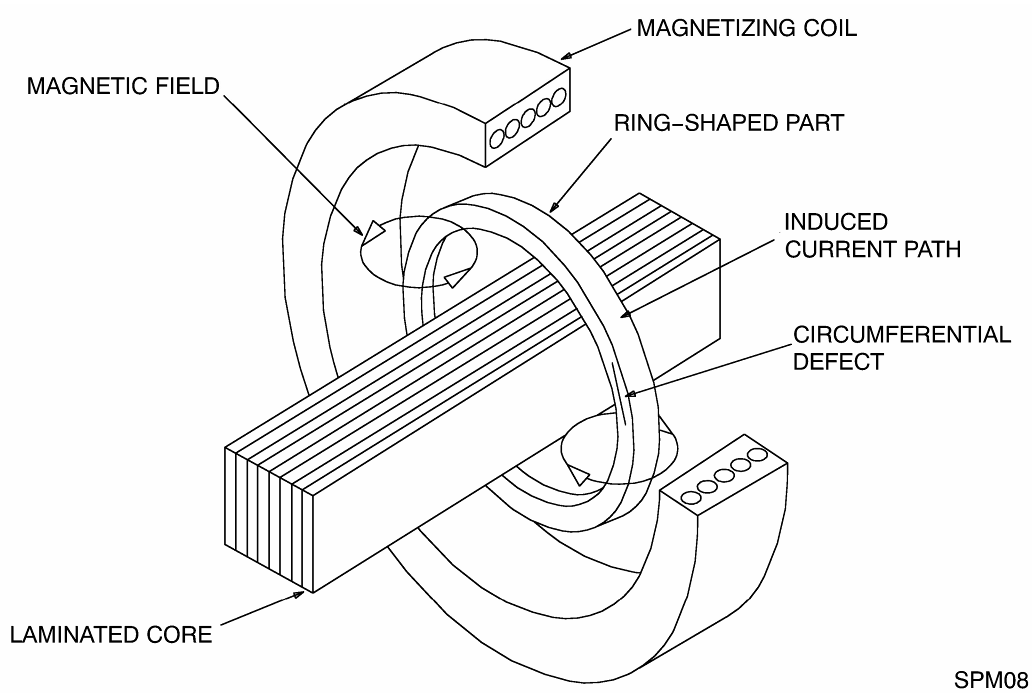
Formula 7: $NI = \frac{(NI)_h(10-\tau)}{8} + \frac{(NI)_l(\tau-2)}{8}$

Where: N = Number of coil turns
I = Amperage
$NI_h$ = Amperage derived from high fill factor coil formula
$NI_l$ = Amperage derived from low fill factor coil formula
$\tau$ = Ratio of cross sectional area of coil to cross sectional area of part, e.g., if coil is 16 inches in diameter and part is 2 inches in diameter, $\tau = (\pi \text{ x } 8^2)/(\pi \text{ x } {}_{l}^{2}) = 64$

P. Toroidal Field Inspection

(1) Toroidal field cores should be made of low retentivity/high permeability soft steel such as silicon transformer steel or ordinary hot rolled mild steel. Cores should be laminated in order to minimize flow of eddy currents within core that would slow down collapse of applied field. Cores should be long enough to make L/D ratio of core/part combination at least two or more. They may be rectangular or circular in shape and encased in plastic or nonmagnetic material such as aluminum. Figure 4 illustrates resultant current/field direction of toroidal field shot, but is dimensionally nonrepresentative of an ideal core part combination.

(2) Core maximum outside dimension should be as close to inside diameter of part being examined as possible, as application of current will tend to pull ring shaped part off axis. Care shall be taken when magnetizing current is applied that part does not slam against core as this can damage part. Note that nonrelevant indication will be generated at interface of where part rests upon core. Ring shaped part shown in Figure 4 would first be magnetized with central bar conductor, looking for transverse indications and then magnetized as illustrated to detect circumferential indications.




Toroidal Field Inspection
Figure 4

1. Q. Inspection

(1) Wet continuous method is preferred method of particle application. Residual method may be used on parts that have high retentivity or where, because of geometric constraints, continuous method cannot be used. Suspensions shall be circulated for minimum of 30 minutes prior to beginning inspection operation.

(2) Fluorescent particles suspended in liquid vehicle at required concentration shall be applied either by gently spraying or flowing suspension over area to be inspected. For continuous method, proper sequencing and timing of part magnetization and application of particle suspension are required to obtain proper formation and retention of indications. This generally requires that stream of suspension be diverted from part simultaneously with, or slightly before, energizing magnetic circuit. Magnetizing current shall be applied for duration of at least 1/2 second for each application, with minimum of two shots being used. Second shot should follow first in rapid succession. It should come after flow of suspension has been interrupted and before part is examined for indications. Weakly held indications on highly finished parts are readily washed away, hence care must be exercised to prevent high velocity flow over critical surfaces.

(3) When using residual magnetization method, apply wet bath immediately after magnetizing shots.

(4) Minimum black light intensity at inspection surface shall be 1000 µwatts/cm$^2$. Black light shall be positioned no greater than 12 inches from part under examination. Where lamps are physically too large to directly illuminate examination surface, special lighting shall be used. Internal features such as bores, holes, and passages less than 0.5 inch nominal diameter shall not require magnetic particle inspection.

(5) Darkened glasses or eye glasses with photochromic lenses shall not be worn by inspectors while performing interpretation. Inspectors shall allow sufficient time for their eyes to adapt to darkness in inspection booth. This time shall be at least 1 minute.

R. Acceptance Criteria

Components that have been subjected to arcing or burning through direct circular magnetization technique shall be rejected. For other acceptance criteria, consult applicable maintenance manual.

1. S. Demagnetization

(1) Whenever possible, parts that have been magnetized circularly shall be magnetized in longitudinal direction before being demagnetized. After completion of inspection, all accepted parts shall be demagnetized.

(2) When using AC demagnetization, part shall be subjected to field with peak value greater than, and in nearly same direction as, field used during examination. This AC field is then decreased gradually to zero. When using an AC demagnetizing coil, hold part approximately 1 foot (30 cm) in front of coil and then move it slowly and steadily through coil and at least 3 feet (100 cm) beyond end of coil. Repeat this process as necessary. Rotate and tumble parts of complex configuration while passing through field of coil.

(3) When using DC demagnetization, initial field shall be higher than, and in nearly same direction as, field reached during examination. Field shall then be reversed, decreased in magnitude, and process repeated (cycled) until an acceptably low value of residual field is reached.

(4) After demagnetization, test parts with field indicator at several locations including all significant changes in geometry and ends of rods, bars, and protrusions. Place meter as close as possible to surface of parts and check for fields both perpendicular and tangent to surface. Orient meter for maximum deflection from zero. Repeat demagnetization if maximum deflection at any place on part exceeds within 3 gauss.

T. Post Inspection Cleaning

Parts shall be cleaned and free of all magnetic particle residue after completion of inspection. Cleaning shall be done with suitable solvent, air blower, or by other means. Parts shall be inspected to ensure that cleaning procedure has removed magnetic particle residues from coolant holes, crevices, passageways, etc, since such residue could have an adverse effect on intended use of part. Care shall be taken to remove all plugs, masking, or other processing aids that may affect intended use of part. Parts shall be protected from any possible corrosion or damage during cleaning process and shall be treated to prevent occurrence of corrosion after final inspection.

1. U. Process Controls

Process control tests shall be as described herein. Table 2 lists required verification intervals. Components shall not be accepted before each applicable process control is completed and passed. Log of specific results, e.g., 1800 µwatts at 15 inches for black light intensity, shall be maintained for each process control and kept as record for minimum of 1 year.

(1) Black light intensity. All black lights shall be checked at interval specified in Table 2 and after bulb replacement for output using UV meter. Allow black light to warm up for minimum of 5 minutes prior to verification of intensity. Measure black light intensity at distance of 15 inches. Lamp shall measure minimum value of 1000 µwatts/cm$^2$. Black lights failing this requirement shall have their bulbs replaced.

(2) Ambient white light intensity. Ambient white light intensity shall be checked at interval specified in Table 2. Black light shall be on during measurement of ambient white light intensity. Avoid measuring UV light intensity when performing ambient white light measurements. Ambient white light intensity shall not exceed 2 foot–candles at inspection surface.

Table 2. Process Controls

| Process Control | Maximum Time between Verification |
|---|---|
| Black Light Intensity | 1 Day |
| Ambient White Light Intensity | 1 Day |
| System Performance Verification | 1 Day |
| Wet Particle Concentration | 8 Hours or Shift Change |
| Wet Particle Contamination | 1 Week |
| Water Break Test | 1 Day |
| Ammeter Accuracy | 6 Months |
| Timer Control | 6 Months |
| Quick Break Check | 6 Months |

1. U. (3) System performance.

(a) Overall performance of fluorescent magnetic particle system shall be verified at interval specified in Table 2 by using either Ketos ring, test part with cracks, or fabricated test part with artificial discontinuities. Ketos rings shall not be used for system performance test of an alternating current system.

(b) When using Ketos ring, ring shall be circularly magnetized using central conductor at least 16 inches in length with diameter of between 1.00 and 1.25 inches. Center ring on length of conductor. Examine ring within 1 minute after current application. Minimum number of holes indicated on outer diameter of ring at specified amperages shall be as listed in Table 3. Part shall be demagnetized, cleaned, and properly preserved for next use of ring.

(c) When using test part with cracks or artificial discontinuities, part shall contain defects rejectable in accordance with acceptance criteria.

(4) Wet particle concentration. Wet particle concentration shall be checked at interval specified in Table 2. Agitate particle suspension minimum of 30 minutes to ensure uniform distribution of particles throughout bath. Place 100 mL sample of agitated suspension in pear shaped centrifugal tube graduated to 1.00 mL in 0.05 mL increments. Demagnetize sample and allow tube to stand undisturbed for at least 60 minutes. Particle concentration shall be within range of 0.1 to 0.4 mL. If results were unacceptable, add particles or bath medium as necessary, and repeat test. If settled particles appear to be loose agglomerates rather than solid layer, take second sample. If second sample appears agglomerated, replace entire suspension.

(5) Wet particle contamination.

(a) Wet particle contamination shall be checked at interval specified in Table 2. Sample of most recently mixed bath shall be set aside in glass jar to be maintained for this test. In conjunction with wet particle concentration test, examine liquid above precipitate with black light. Liquid shall be comparable to lack of fluorescence of original liquid. Failure of this test necessitates bath replacement.

(b) In conjunction with wet particle concentration test, examine graduated portion of centrifugal tube for striations or bands different in color or appearance. Bands or striations may indicate contamination. If total volume of contaminants, including bands or striations exceeds 30 percent of volume of magnetic particles, bath shall be replaced.

Table 3. System Performance

| Amperages | Indicated Holes |
|---|---|
| 1400 | 3 |
| 2500 | 5 |
| 3400 | 6 |

1. U. (6) Water break. For water baths only, water break test shall be checked at interval specified in Table 2. Clean part with surface finish same as part to be tested is flooded with conditioned water. If continuous even film forms over entire part, sufficient wetting agent is present. If film of suspension breaks, exposing bare surface, insufficient wetting agent is present or part has not been cleaned adequately. Failure of test shall prompt that part be recleaned and retested. Failure of second test shall require that more wetting agent be added.

(7) Ammeter accuracy. Bench unit ammeter accuracy shall be checked at interval specified in Table 2. Calibrated ammeter shall be connected in series with output circuit. Comparative readings shall be taken at three output levels encompassing usable range of equipment. Equipment meter reading shall not deviate within 10 percent of full scale from current value shown by calibrated ammeter.

(8) Timer control. On equipment using timer to control current duration, timer control shall be checked at interval specified in Table 2. Timer used to check to pulse duration shall have an accuracy within 10 percent. Pulse length shall be 1/2 second minimum and shall not exceed 0.75 seconds.

(9) Magnetic field quick break check.

(a) On stationary magnetizing equipment which utilizes quick break feature, proper functioning of this circuit shall be verified at interval specified in Table 2. This test may be performed with suitable oscilloscope or test device. Operation of “quick break” tester is quite simple and positive. Neon lamp, built into tester will flash when magnetizing current decay rate is fast enough to produce desired “quick break” effect.

(b) Quick break test shall be done in accordance with test device manufacturer’s instructions. Typical testing device, as shown in Figure 5 uses the following directions:

1 Remove copper bus bar and bracket from tester.

2 Center coil between headstocks.

3 Remove all ferrous material from inside of coil.

4 Place tester on bottom ID surface of coil, studs up, aligned perpendicular to coil windings as shown in Figure 5.

5 Set magnetizing current between 2000 and 3000 amperes and current timer for approximately 0.5 seconds (if not preset).

6 Initiate current shot and observe testers indicating lamp as magnetizing current is terminated. Flash of lamp indicates “quick break”. Absence of flash is indicative of malfunction in “quick break” circuitry or absence of such circuitry in basic design.

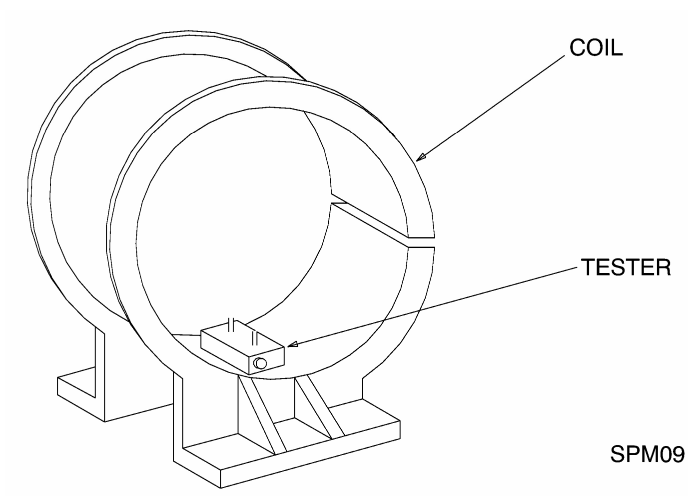
1. V. Calibration

The following instruments shall be calibrated every 6 months as minimum:

(1) Light meters (UV and white light).

(2) Field indicator.

(3) Hall effect gaussmeter.




Magnetic Field Quick Break Check
Figure 5

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1. Visible Dye Penetrant Inspection - SP I304

WARNING: PENETRANT INSPECTION INCLUDES EXPOSURE TO FLAMMABLES, CHEMICALS THAT MAY AFFECT SKIN, EYES, AND RESPIRATORY TRACT, ALSO THE USE OF BLACK LIGHT. WEAR NEOPRENE GLOVES AND KEEP INSIDES OF GLOVES CLEAN WHEN HANDLING PENETRANT MATERIALS. CHEMICAL GOGGLES, RUBBER APRON, AND GLOVES SHALL BE WORN WHEN SPRAYING PENETRANT OR WHEN PROCESSING PARTS. CARE SHALL BE EXERCISED WHEN USING HOT BLACK LIGHTS SO AS NOT TO BURN HANDS, ARMS, FACE, OR OTHER EXPOSED BODY AREAS. AN APPROVED RESPIRATOR SHALL BE WORN WHEN WORKING IN AREAS WHERE ADEQUATE VENTILATION CANNOT BE PROVIDED.

A. Visible dye penetrant inspection is a low sensitivity, localized, nondestructive test method used where higher sensitivity fluorescent penetrant inspections are not required, to detect discontinuities that are open to the surface. Such discontinuities include but are not limited to cracks, laps, shrinkage, porosity, etc in ferrous and nonferrous material. This standard practice addresses the use of Type II Method C (visible dye, solvent removable) inspection process which shall be in accordance with MIL–STD–6866.

CAUTION: UNLESS OTHERWISE SPECIFIED, TYPE II PENETRANT (VISIBLE DYE) SHALL NOT BE USED FOR FINAL ACCEPTANCE INSPECTION OF AEROSPACE COMPONENTS AND SHALL NOT BE USED PRIOR TO USE OF TYPE I (FLUORESCENT DYE) PENETRANTS UNLESS SUBSEQUENT OPERATIONS REMOVE THE AFFECTED SURFACES.

USE OF VISIBLE DYE PENETRANTS ON CRITICAL ROTATING COMPONENTS IS PROHIBITED.

(1) Ensure that the penetrant sensitivity to be used will satisfy the requirements of the specific part to be inspected. When use of visible dye penetrant inspection is not acceptable, fluorescent penetrant inspection (SP I305, 70–20–05) may be used.

NOTE: Inspection to a higher sensitivity shall be permitted. Visible dye penetrant inspection is classified as a low sensitivity inspection method.

Type III penetrant (dual type) shall not be used.

(2) Unless otherwise specified, Type I, Method D, Sensitivity 3 or 4, penetrants shall be used when performing inspection of critical rotating components. Method C may be substituted for localized inspections when Method D is impractical. (Refer to SP I305, 70–20–05.)

(3) It is recommended that personnel performing penetrant inspection shall be certified in accordance with MIL–STD–410 or equivalent.

1. B. Surfaces to be inspected shall be clean, dry, and free of surface contamination which could prevent the penetrant from entering discontinuities. The cleaning method selected shall be consistent with the contaminant being removed, and shall not be detrimental to the component. Refer to applicable standard practice for detail cleaning procedures.

(1) Solvent cleaning shall be the routine cleaning method for inspection preparation.

(2) Localized cleaning with a lint free cloth (10–10, 70–80–01), dampened with dry cleaning solvent (07–63 or 07–67, 70–80–01) is permitted when spot cleaning is to be performed.

NOTE: For dwell times greater than 2 hours, penetrant shall be reapplied as required to prevent drying.

C. The penetrant dwell time shall be a minimum of 10 minutes unless otherwise specified.

(1) Penetrant removal shall be performed under sufficient white light to ensure adequate removal of background.

(2) The component, penetrant, and ambient temperature shall all be in the range of 40 to 120°F (4 to 49°C).

(3) Remove excess surface penetrant by first wiping the surface with a clean, dry cloth or absorbent towel.

CAUTION: LINT FREE CLOTH SHALL NOT BE SATURATED NOR SHALL THE INSPECTION SURFACE BE FLOODED WITH EXCESSIVE SOLVENT. EXCESSIVE SOLVENT WILL WASH PENETRANT FROM DEFECTS.

(4) Remove remainder of surface penetrant with a lint free cloth (10–10, 70–80–01) or towel dampened with dry cleaning solvent (07–63 or 07–67, 70–80–01). If over removal of excess penetrant occurs, reprocess per Paragraph C.

NOTE: Do not flush component with dry cleaning solvent or wipe excess surface penetrant with a cloth saturated with solvent.

(5) Allow sufficient time for solvent to evaporate. Components shall be dry prior to the application of developer.

WARNING: SOLVENTS USED IN NONAQUEOUS DEVELOPERS MAY BE FLAMMABLE. KEEP ALL SOLVENTS AWAY FROM HEAT OR OPEN FLAME. VAPORS MAY BE HARMFUL, USE ADEQUATE VENTILATION. DO NOT TAKE INTERNALLY. AVOID CONTACT WITH SKIN AND EYES.

1. D. Apply nonaqueous developer as follows:

(1) Apply developer in a light uniform coating by spraying only.

(2) Allow developer to dry for a minimum of 10 minutes and a maximum of 1 hour.

NOTE: Nonaqueous developers shall be used with visible dye penetrants. Ensure that containers are frequently agitated during application.

E. Components shall be inspected after the minimum, but before the maximum developer dwell time specified. Components that are not inspected within the allotted dwell time shall be cleaned and reprocessed.

(1) Inspection areas shall be kept clean at all times. The lighting system shall provide a minimum of 100 foot–candles (1076 lux of white light at the surface of the component being tested).

(2) All relevant indications shall be evaluated against the appropriate accept/reject criteria. Linear indications are defined as those with at least a 4 to 1 ratio of length to width. Use of flat wire gages or templates are recommended for determination of defect size.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(3) Remove all traces of the penetrant process by emulsion degreasing (SP C214, 70–15–14) or other suitable process not detrimental to the part.

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1. Fluorescent Penetrant Inspection (FPI) - SP I305

WARNING: PENETRANT INSPECTION INCLUDES EXPOSURE TO FLAMMABLES, CHEMICALS THAT MAY AFFECT SKIN, EYES, AND RESPIRATORY TRACT; ALSO THE USE OF BLACK LIGHT. WEAR NEOPRENE GLOVES AND KEEP INSIDES OF GLOVES CLEAN WHEN HANDLING PENETRANT MATERIALS. CHEMICAL GOGGLES, RUBBER APRON, AND GLOVES SHALL BE WORN WHEN SPRAYING PENETRANT OR WHEN PROCESSING PARTS. CARE SHALL BE EXERCISED WHEN USING HOT BLACK LIGHTS SO AS NOT TO BURN HANDS, ARMS, FACE, OR OTHER EXPOSED BODY AREAS. AN APPROVED RESPIRATOR SHALL BE WORN WHEN WORKING IN AREAS WHERE ADEQUATE VENTILATION CANNOT BE PROVIDED.

CAUTION: FUEL MANIFOLDS AND OTHER DETAIL PARTS WHICH HAVE BEEN CLEANED OR RINSED WITH WATER OR AN AQUEOUS SOLUTION BEFORE FPI MUST BE OVEN DRIED TO AVOID PART DAMAGE. RETENTION OF WATER OR AQUEOUS SOLUTION WITHIN EXISTING CRACKS MAY OCCUR TO REDUCE FPL EFFECTIVENESS.

A. Fluorescent penetrant inspection establishes the minimum requirements for performing a liquid penetrant inspection of ferrous or nonferrous materials for cracks, laps, cold shuts, porosity, and other defects that are open to the surface.

B. Penetrant inspection materials are classified in accordance with SAE AMS2644 by type of penetrant used, method of penetrant removal, and the penetrant sensitivity. The type, method, and sensitivity of penetrant materials to be used, shall be in accordance with detailed instructions in the applicable manual. All penetrant or emulsifier combinations shall meet the requirements of SAE AMS2644 and shall be from the same manufacturer. Do not interchange product families.

Type

Type I - Fluorescent dye
Type II - Visible dye

Method

Method A - Water washable
Method B - Post emulsifiable lipophilic
Method C - Solvent removable
Method D - Post emulsifiable hydrophilic

Sensitivity

Level 1 - Low sensitivity
Level 2 - Medium sensitivity
Level 3 - High sensitivity
Level 4 - Ultra high sensitivity

1. B. (1) Type.

(a) Type I inspection is the most common used.

(b) Type II inspections are not covered in this standard practice. For Type II requirements, refer to SP I304, 70–20–04.

(c) Type II penetrant (visible dye) shall not be used for final acceptance of aerospace products nor shall they be used prior to Type I (fluorescent) penetrants. Visible dye is not compatible with fluorescent dye.

(2) Method.

(a) Method D may be substituted for Method A, B, or C.

(b) Method B may be substituted for A or C unless specifically prohibited.

(3) Sensitivity. Inspection to a higher sensitivity than specified is permitted. (Refer to Table 1.)

(a) The highest sensitivity that produces an acceptable background should be used.

(b) The use of a higher sensitivity level than specified can cause rejects due to unrelated indications and/or too much background fluorescence which can cover related indicators.

(c) Using too high a sensitivity level can result in unnecessary processing of parts through repeated cleaning cycles.

(4) Background fluorescence. Constant background fluorescence is permitted on porous material parts.

(a) When background fluorescence is apparent, the inspector shall read the part for indications which come out from the pattern behind. The inspector shall use the wipe/bleed back method and review the area during and after solvent dries without redeveloping. The areas of the component not effected by background fluorescence shall follow normal redeveloping requirements.

(b) Diffused aluminide coatings on turbine hardware will cause constant background fluorescence which is permitted, provided use of Step (4)(a) is adhered to and can not be eliminated through approved cleaning procedures.

(c) Background fluorescence is not permitted on rotating components such as disc bores, drum rotor bores, or on adjacent forward and aft surfaces.

1. B. (4) (d) Background fluorescence can typically be seen:

1 On as–cast surfaces.

2 On mating surface contact areas, such as splines, under bolt heads, and part to part contact surfaces.

3 On surfaces with corrosion coatings after engine operation.

(e) Background fluorescence is frequently the result of the following:

1 Incorrect cleaning.

2 Incorrect FPI procedure or sensitivity.

3 Surface oxidation/sulfidation deposits/staining/coloration.

4 Manufacturing or refurbishment processes, such as:

- Diffused aluminide or thermal barrier (TBC) coatings
- Edges of nickel plated areas
- Chromium plating
- Plasma spray coatings
- Anodizing

C. It is recommended that personnel performing penetrant inspection shall be certified in accordance with NAS410 or equivalent.

D. The inspection of critical rotating turbine engine components shall be performed only with Type I, Method D, Sensitivity level 3 or 4, penetrant process except when Method C is specified. Method C may be used in place of Method D and/or Method A for on wing inspection.

NOTE: Critical rotating turbine engine components are defined as any part that by design experiences rotary motion when in operation (e.g., blades, disks, wheels impellers, seal plates, spacers, couplings, shafts, and gears etc.).

When using fluorescent materials for detection of imperfections, inspectors shall not wear glasses equipped with light sensitive lenses that darken when exposed to ultraviolet light or sunlight.

1. E. Inspection areas shall be kept clean at all times. For the fluorescent inspection process, ambient white light background shall not exceed 20 Lx (2 foot–candles), and the black light(s) shall provide a minimum of 1000 microwatt/cm$^2$ when measured at a distance of 15 inches (380 millimeters) from the surface of the black light filter or bulb. Borescope black light sources shall provide a minimum illumination of 1600 microwatts/cm$^2$ at a distance of 1.5 inches (38 millimeters) from the probe end. Viewing areas for portable FPI shall be a dark canvas or other similar method of reducing white light.

NOTE: All penetrant shall be applied by either immersion, spraying, or brushing to fully cover all surfaces to be inspected. Electrostatic spray methods are recommended when processing assemblies or details such as bladed rotors, fabricated nozzles, and cored blades which would tend to entrap penetrant between component parts or within internal passages or cored areas. The component, penetrant, and ambient temperatures shall be in the range of 40 to 120°F (4 to 49°C), unless otherwise specified.

On parts being checked after repair, locally inspect reworked areas and record out–of–limit defects.

F. Fixed penetrant systems shall be checked daily for performance using known defect standards. The check shall be performed by processing the known standard through the working material using production processing and comparing the resulting indications to those produced by an unused sample of the same penetrant material and the same processing procedure. Any deviation observed from the sensitivity of the unused materials shall be corrected prior to performing any inspections.

Processing equipment shall provide for uniform and controlled operation. The equipment shall meet all applicable national and local safety requirements and all requirements specified herein.

G. Mechanical Evaluation/Blending

Where permitted, FPI indications may be removed by blending or grinding, followed by a reinspection to ensure the indications complete removal. Rotating components require a localized etch of the blend area to remove any smeared metal, followed by a thorough cleaning prior to reinspection. The process used for reinspection shall be at least as sensitive as the original inspection process.

NOTE: Penetrant inspection guidelines (Table 1) for general information only. The type, method, and sensitivity of penetrant materials shall be in accordance with detailed instructions in applicable manual.

(1) Chemical Etch Solutions for steel parts.

CAUTION: MIXING OF SOLUTIONS AND ETCHING OF PARTS MUST BE ACCOMPLISHED IN AN AREA WITH ADEQUATE VENTILATION TO PREVENT INHALATION OF TOXIC FUMES.

**Solution 1** - Determine maximum exposure time using sample material but should not exceed 4 minutes, rinse thoroughly with clean cold water.

| ETCH COMPONENT | Amount (100 gal) | Amount (Approx 1 liter) |
|---|---|---|
| Hydrochloric Acid (HCl), 20° Be´ | 80 gal | 757 ml |
| Anhydrous Ferric Chloride ($FeCl_3$) | 135 pounds | 154 g |
| Nitric Acid ($HNO_3$), 42° Be´ | 2 gal | 19 ml |
| Water | 11 gal | 106 ml |

**Solution 2** - Determine maximum exposure time using sample material but should not exceed 6 minutes, rinse thoroughly with clean, cold water.

| ETCH COMPONENT | Amount (100 gal) | Amount (Approx 1 liter) |
|---|---|---|
| Hydrochloric Acid (HCl), 20° Be´ | 70 gal | 897 ml |
| Hydrated Ferric Chloride ($FeCl_3$–6H2O) | 196 pounds | 57 ml |
| Nitric Acid ($HNO_3$), 42° Be´ | 1.5 gal | 45 ml |

**Solution 3** - Kallings Reagent (60% Hydrochloric acid, 37% Methanol, 2% Cupric chloride) Determine maximum exposure time using sample material. Neutralize with 10% solution of sodium bicarbonate and water, then rinse thoroughly with clean, cold water.

| ETCH COMPONENT | Amount (100 gal) |
|---|---|
| Hydrochloric Acid (HCl), 20° Be´ | 608 ml |
| Cupric Chloride ($CUCl_3$) | 20 g |
| Methanol ($CH_3OH$) | 370 ml |

**Solution 4** - Modified Kallings Reagent **-** Determine maximum exposure time using sample material. Neutralize with 10% solution of sodium bicarbonate and water, then rinse thoroughly with clean, cold water.

| ETCH COMPONENT | Amount (100 gal) |
|---|---|
| Hydrochloric Acid (HCl), 20° Be´ | 500 ml |
| Cupric Chloride ($CUCl_3$) | 100 g |
| Methanol ($CH_3OH$) | 500 ml |

1. H. Fluorescent Water Washable Penetrant - Type I, Method A (See Figure 1)

WARNING: WEAR RUBBER GLOVES WHEN PERFORMING FLUORESCENT PENETRANT INSPECTION. REPEATED CONTACT CAN CAUSE SKIN IRRITATION. AVOID BREATHING SOLVENT VAPORS, SPRAY MIST, OR DUST.

NOTE: Penetrant inspections should be performed prior to operations and operations and surface treatments which hide surface defects, such as sanding, grinding, buffing, polishing, peening, coating, plating, painting, etc.

Components shall be free of any contaminants that may inhibit capillary action during application of the penetrant. Refer to applicable standard practice to remove contaminants.

Fuel manifolds and other detail parts which have been cleaned or rinsed with water or an aqueous solution before FPI must be oven dried to avoid part damage. Retention of water or aqueous solution within existing cracks may occur to reduce FPI effectiveness.

(1) Clean all surfaces to be inspected using the applicable standard practice.

NOTE: The cleaning methods selected shall be consistent with the contaminants to be removed, and shall not be detrimental to the component. Chlorinated solvents are not to be used with titanium parts.

Table 1. Penetrant Inspection Guidelines

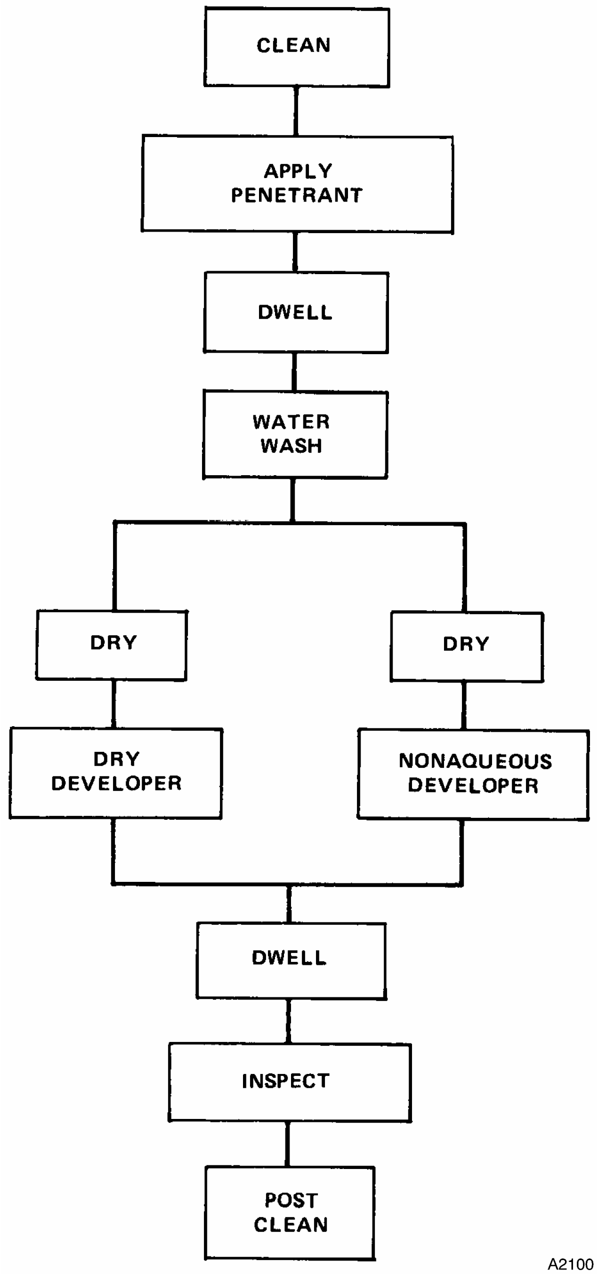
| Component | Type | Method | Sensitivity |
|---|---|---|---|
| Critical Rotating Components | | | |
| Blades | | | |
| Fan | I | D | 4 |
| Compressor | I | D | 4 |
| Turbine | | | |
| Etched | I | D | 3 or 4* |
| Nonetched | I | D | 4 |
| Discs | | | |
| Fan | I | D | 4 |
| Axial Compressor | | | |
| Cast | I | D | 3 or 4* |
| Forged | I | D | 4 |
| Impeller | | | |
| Cast | I | D | 3 or 4* |
| Forged | I | D | 4 |
| Turbine | | | |
| Cast | I | D | 3 or 4* |
| Forged | I | D | 4 |
| Miscellaneous | | | |
| Spacers | I | D | 4 |
| Bearings | I | D | 4 |
| Gears, shafts | | | |
| Primary power train | I | D | 4 |
| Noncritical Rotating Components | | | |
| Shafts, Miscellaneous | I | A | 3 |

*The highest sensitivity that produces an acceptable background shall be used.

Table 1. Penetrant Inspection Guidelines (Cont)

| Component | Type | Method | Sensitivity |
|---|---|---|---|
| Nonrotating Parts | | | |
| Structural Components | | | |
| Fan front frame | I | A | 2 |
| Inlet housing | I | A | 2 |
| Compressor housing | I | A | 3 |
| Air diffuser | I | A | 2 |
| Combustor housing | I | A | 3 |
| Intermediate turbine housing | I | A | 2 |
| Power turbine housing | I | A | 3 |
| Exhaust diffuser | I | A | 2 |
| Intermediate compressor housing | I | A | 3 |
| Nozzles | I | A | 3 |
| Stators | I | A | 2 |
| Miscellaneous Components | | | |
| Combustor liner assembly | I | A or D | 3 |
| Sheet metal details | I | A | 2 |
| Miscellaneous casting details | I | A | 2 |
| Fuel Manifolds | I | A | 3 |
| Tubing/piping | I | A | 3 |
| Bolts, special | I | A | 3 |
| Welds/brazed joints | | | |
| Class I | I | A | 2 |
| Class II | I | A | 2 |
| Class III | I | A | 2 |
| Class IV | I | A | 2 |

*The highest sensitivity that produces an acceptable background shall be used.




Water–Washable Penetrant Process, Method A Flow Chart
Figure 1

1. H. (2) Apply penetrant to the surfaces to be inspected. Penetrant may be applied by spraying, dipping, or brushing.

NOTE: A number of interacting factors influence the proper dwell time. In general, the smaller the defect to be found, the longer the required penetrant dwell. A dwell of 30 minutes or greater may be necessary for tight service induced defects.

(a) Allow a minimum of 10 minutes dwell time for fluorescent penetrant to enter any defect. For dwell times greater than 2 hours, the penetrant shall be reapplied every 2 hours to prevent drying.

CAUTION: IMMERSION IN AGITATED WATER SHALL BE PERMITTED ONLY WITH PERMISSION OF HONEYWELL.

(3) Water washable penetrant shall be removed from the inspection surface by water spray or manual wipe.

NOTE: Water soluble or suspended developers are not recommended.

(a) Use coarse spray at 40 psi (276 kPa) maximum while holding the spray nozzle approximately 12 inches (305 millimeters) from part. Water temperature shall be 50 to 100°F (10 to 38°C).

(b) Rinse under black light to prevent overwashing. If evidence of overwashing occurs, clean the component and reprocess.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(4) Oven dry at 160°F (70°C) for a minimum of 1 hour. Allow to air cool before attempting any additional procedure.

NOTE: Dry developer is recommended for Methods A and D.

(5) Apply dry developer powder by dusting or powder box immersion. Allow to develop for a minimum of 10 minutes to a maximum of 4 hours.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(a) Remove dry developer powder by light tapping, or the use of clean, filtered, low pressure shop air 5 psi (35 kPa) maximum.

(b) If components are not inspected within 4 hours after application of the dry developer, they shall be cleaned and reprocessed.

1. H. (6) Nonaqueous developers are recommended for inspection of specific areas of a component and for special applications such as defect evaluation and with Method C.

NOTE: Nonaqueous developer shall be applied by spraying only.

If components are not inspected within 1 hour after application of the nonaqueous developer, they shall be cleaned and reprocessed.

(a) Ensure the component is dry prior to applying the nonaqueous developer.

(b) Ensure the entire area of inspection has a uniform thickness of developer, do not over apply.

(c) Allow developer to remain on component for 10 minutes minimum and 1 hour maximum.

(7) Inspection shall be performed within the allotted dwell time. Components that are not inspected within the allotted dwell time must be reprocessed.

NOTE: Wearing or use of photochromic lenses or permanent darkened lenses by the inspector is prohibited.

(a) Examine part in a darkened enclosure under ultraviolet (black) light. Allow 1 minute for eyes to adapt to darkened environment prior to inspecting components.

(b) During inspection ensure the black light intensity is a minimum of 1200 microwatts/$cm^2$ at the component surface. This can be accomplished by positioning the black light as close as necessary to the inspection surface to achieve 1200 microwatts/$cm^2$. White light background shall not exceed 20 Lx (2 foot–candles).

(c) Components having no relevant indications are acceptable.

1. H. (7) (d) All relevant indications shall be evaluated against the appropriate accept/reject criteria. Linear indications are defined as those with at least a 3 to 1 ratio of length to width. Components with relevant indications that exceed the appropriate allowable limits shall be rejected. Templates or flat wire gages are recommended for defect size determination. Magnification (10x maximum) and/or white light may be used to determine discontinuity type. Indications on parts exhibiting fluorescent background which interferes with evaluation of questionable indications, shall be evaluated as follows:

1 Lightly wipe the area with a soft brush or cotton swab applicator (10–02, 70–80–01) dampened with ethyl alcohol (07–23, 70–80–01). Do not permit alcohol to flood the surface.

2 After the alcohol evaporates from the surface, reinspect. If an indication reappears, evaluate it immediately. If a relevant indication does not reappear, reapply developer. The redevelopment time shall equal the original development time. Reinspect.

(e) After inspection, the cleaning of residual penetrants and developers is required if their presence is detrimental to part use or subsequent operations and processes.

I. Fluorescent Post Emulsifiable, Lipophilic - Type I Method B

The Lipophilic Method is not covered in this manual. The Hydrophilic Method is preferred over the Lipophilic Method and is recommended in place of Lipophilic.

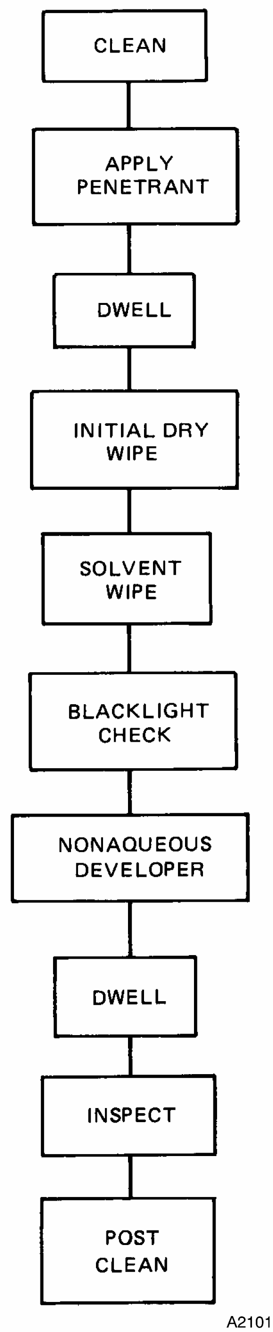
J. Fluorescent Solvent Removable - Type I, Method C (See Figure 2)

The Solvent Removable Method is intended to be used for localized inspections. When used in this type of application, it may be substituted in place of all other methods during on–wing inspections. Because of its potential for increased sensitivity, this method is specified for most applications in place of visible dye.

NOTE: The term “Solvent Removable” refers to the process of removing the penetrant material from the inspection surface. The penetrants used in this process are any of the Type I penetrants with post emulsified penetrant most commonly used.

(1) Cleaning: Clean all surfaces to be inspected in accordance with the applicable standard practice. Local areas of light contamination may be cleaned with a solvent wipe.

(2) Penetrant Application: Apply penetrant to the surface to be inspected by spraying, dipping, or brushing.




Solvent Removable Penetrant Process, Method C Flow Chart
Figure 2

1. J. (3) Penetrant Dwell: Allow a dwell of 10 minutes minimum. For dwell times exceeding 60 minutes the penetrant shall be reapplied to prevent drying.

NOTE: A number of interacting factors influence the proper dwell time. In general the smaller the defect to be found the longer the penetrant dwell required. A dwell of 30 minutes or greater may be necessary for tight service induced defects.

(4) Penetrant Removal: Remove all bulk surface penetrant by wiping with a clean, dry lint free cloth (10–10, 70–80–01) or paper towel. Make a single wipe and then fold the cloth or paper towel to provide a clean surface for succeeding wipes.

CAUTION: THE CLOTH SHALL NOT BE SATURATED NOR SHALL THE INSPECTION SURFACE BE FLOODED WITH SOLVENT. EXCESSIVE SOLVENT WILL WASH PENETRANT FROM DEFECTS.

(a) Solvent Wipe – After the bulk of the surface penetrant has been removed, moisten a fresh lint free cloth or paper towel with alcohol and again wipe the surface.

(b) During wiping, the inspection surface shall be illuminated with black light. Repeat the solvent wipe as necessary until no residual trace of penetrant remains on the inspection surface.

(5) Nonaqueous Developer (solvent suspended): Following the alcohol wipe, apply nonaqueous developer by spraying. Apply a thin uniform layer to the inspection surface. The optimum coating thickness is indicated by the visibility of the part surface. If the metallic luster cannot be seen, the developer is too thick.

(6) Dwell: Developer dwell is required to allow the developer time to draw entrapped penetrant from small defects. The minimum development time shall be 10 minutes. The maximum dwell time for nonaqueous developer shall be 60 minutes.

(7) Inspection shall be performed within the allotted dwell time. Components that are not inspected within the allotted dwell time must be reprocessed.

NOTE: Wearing or use of photochromic lenses or permanent darkened lenses by the inspector is prohibited.

(a) Examine part in a darkened enclosure under ultraviolet (black) light. Allow 1 minute for eyes to adapt to darkened environment prior to inspecting components processed using fluorescent dye penetrants.

(b) During inspection ensure the black light intensity is a minimum of 1200 microwatts/cm$^2$ at the component surface. This can be accomplished by positioning the black light as close as necessary to the inspection surface to achieve 1200 microwatts/cm$^2$. White light background shall not exceed 20 Lx (2 foot–candles.)

(c) Components having no relevant indications are acceptable.

1. J. (7) (d) All relevant indications shall be evaluated against the appropriate accept/reject criteria. Linear indications are defined as those with at least a 3 to 1 ratio of length to width. Components with relevant indications that exceed the appropriate allowable limits shall be rejected. Templates or flat wire gages are recommended for defect size determination. Magnification (10X maximum) and/or white light may be used to determine discontinuity type. Indications on parts exhibiting fluorescent background which interferes with evaluation of questionable indications, shall be evaluated as follows:

WARNING: ETHYL ALCOHOL IS FLAMMABLE AND MAY AFFECT EYES, SKIN, AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1 Lightly wipe the area once with a soft brush or cotton swab applicator (10–02, 70–80–01) dampened with ethyl alcohol (07–23, 70–80–01). Do not permit alcohol to flood the surface.

2 After the alcohol evaporates from the surface, reinspect. If an indication reappears, evaluate it immediately. If a relevant indication does not reappear, reapply developer. The redevelopment time shall equal the original development time. Reinspect.

(e) After inspection, the cleaning of residual penetrants and developers is required if their presence is detrimental to part use or subsequent operations and processes.

1. K. Fluorescent Post Emulsified, Hydrophilic Penetrant Type I - Method D (Refer to Table 1 and Figure 3)

CAUTION: PENETRANT INSPECTIONS SHOULD BE PERFORMED PRIOR TO OPERATIONS AND SURFACE TREATMENTS WHICH HIDE SURFACE DEFECTS, SUCH AS SANDING, GRINDING, BUFFING, POLISHING, PEENING, COATING, PLATING, PAINTING, ETC.

COMPONENTS SHALL BE FREE OF ANY CONTAMINANTS THAT MAY INHIBIT CAPILLARY ACTION DURING APPLICATION OF THE PENETRANT. REFER TO APPLICABLE STANDARD PRACTICE TO REMOVE CONTAMINANTS.

(1) Using the applicable standard practice, clean all surfaces of parts.

WARNING: WEAR RUBBER GLOVES WHEN PERFORMING FLUORESCENT PENETRANT INSPECTION. REPEATED CONTACT CAN CAUSE SKIN IRRITATION. AVOID BREATHING SOLVENT VAPORS, SPRAY MIST, OR DUST.

NOTE: The cleaning methods selected shall be consistent with the contaminants to be removed, and shall not be detrimental to the component.

(2) Apply penetrant to the surface to be inspected. Penetrant may be applied by spraying, dipping, or brushing as required.

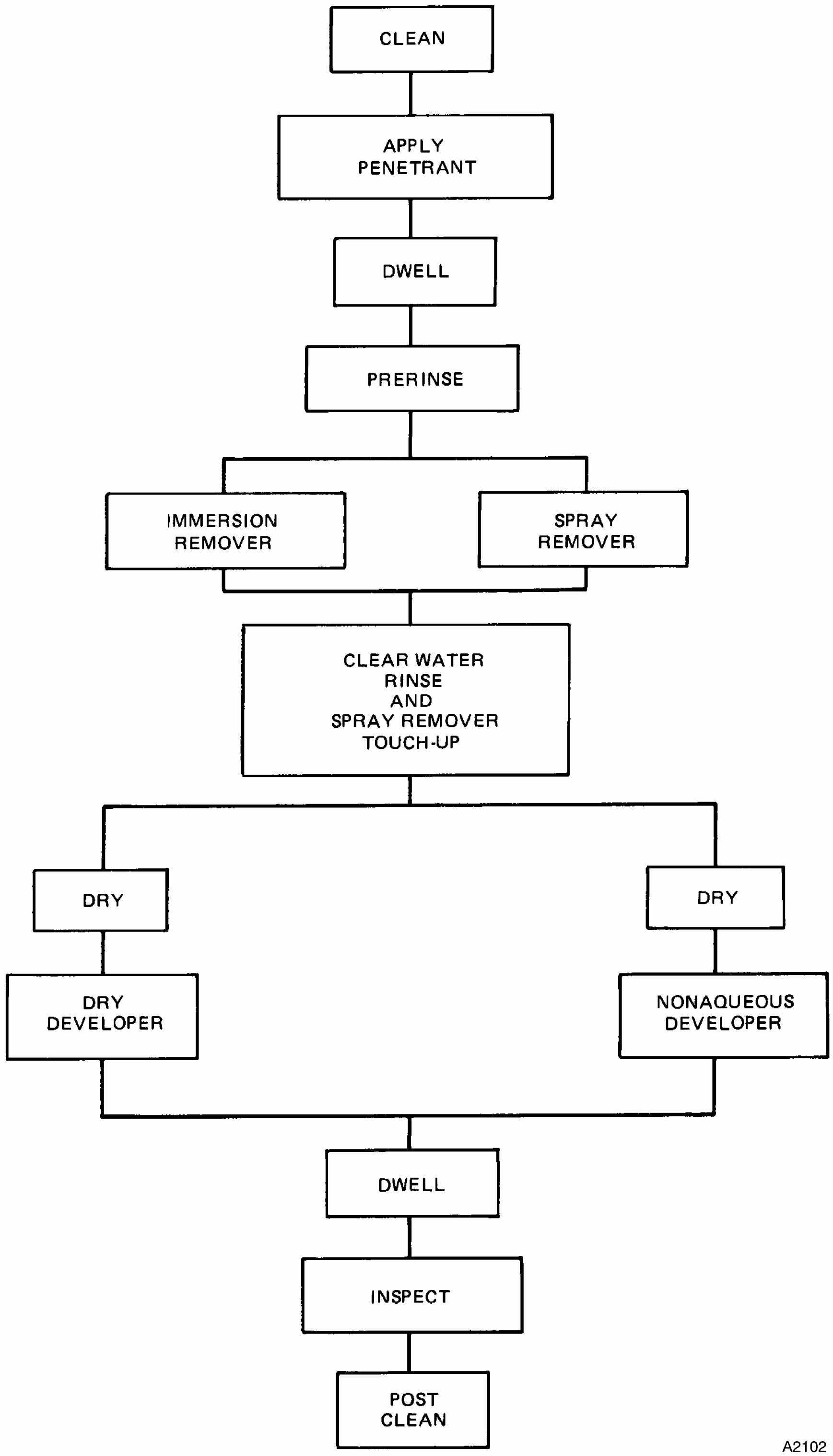
NOTE: In any penetrant inspection, all penetrant or emulsifier combinations shall meet the requirements of SAE AMS2644 and shall be from the same manufacturer. Do not interchange product families.

Method D may be substituted for any other method unless specifically prohibited.

(a) Minimum dwell time shall be 20 minutes unless otherwise specified. For dwell times greater than 2 hours, the penetrant shall be reapplied every 2 hours to prevent drying.

NOTE: A number of interacting factors influence the proper dwell time. In general the smaller the defect to be found the longer the penetrant dwell required. A dwell of 30 minutes or greater may be necessary for tight service induced defects.

(3) Bulk surface penetrant shall be removed by coarse water spray (prerinse). Use coarse spray while holding spray nozzle approximately 12 inches (305 millimeters) from part.




Post Emulsified (PE), Hydrophilic Penetrant Process, Method D, Flow Chart
Figure 3

1. K. (4) Apply the hydrophilic emulsifier remover by immersion, flowing, or spray. The emulsifier remover shall be left on the component for the minimum time required to produce a satisfactory background, but shall not exceed 2 minutes.

NOTE: Rinse under black light to ensure adequate penetrant removal.

(5) Rinse using immersion or spray, with clean, 50 to 100°F (10 to 38°C) water, with maximum water pressure not to exceed 40 psi (276 kPa). Excess background may be reduced by locally reapplying emulsifier remover. Rinse under black light illumination to prevent overwashing. If evidence of overwashing occurs, clean the component and reprocess.

(6) Components shall be air dried at room temperature or placed into a circulating hot air drying oven maintaining a temperature not to exceed 160°F (70°C).

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(7) Apply dry developer powder by dusting or powder box immersion. Parts shall be read no sooner than 10 minutes and no later than 4 hours after applying developer. Remove excess dry developer powder by light tapping, or the use of clean, filtered, low pressure shop air 20 psi (138 kPa) maximum.

NOTE: Ensure that component is dry prior to applying dry developer.

(8) Nonaqueous developers are recommended for inspection of specific areas of a component and for special applications such as defect evaluation or with Method C.

NOTE: Nonaqueous developer shall be applied by spraying only.

If components are not inspected within an hour after application of nonaqueous developer, they shall be cleaned and reprocessed.

(a) Ensure the component is dry prior to applying the nonaqueous developer.

(b) Ensure that the entire area of inspection has a light uniform thickness of developer. Do not over apply.

(c) Allow developer to remain on component for 10 minutes minimum, and 1 hour maximum.

1. K. (9) Inspection shall be performed after the minimum and before the maximum developing dwell time. Components that are not inspected within the allotted dwell time must be reprocessed.

NOTE: Wearing or use of photochromic lenses or permanent darkened lenses by the inspector is prohibited.

(a) Examine part in a darkened enclosure under ultraviolet (black) light. Allow 1 minute for eyes to adapt to darkened environment prior to inspecting components processed using fluorescent dye penetrants.

(b) During inspection ensure the black light intensity is a minimum of 1200 microwatts/cm$^2$ at the component surface. This can be accomplished by positioning the black light as close as necessary to achieve 1200 microwatts/cm$^2$. White light background shall not exceed 20 Lx (2 foot–candles).

(c) Components having no relevant indications are acceptable.

(d) All relevant indications shall be evaluated against the appropriate accept/reject criteria. Linear indications are defined as those with at least a 3 to 1 ratio of length to width. Components with relevant indications that exceed the allowable limits shall be rejected. Templates or flat wire gages are recommended for defect size determination. Magnification (10X maximum) and/or white light may be used to determine discontinuity type. Indications on parts exhibiting fluorescent background which interferes with evaluation of questionable indications, shall be evaluated as follows:

1 Lightly wipe the area with a soft brush or cotton swab applicator (10–02, 70–80–01) dampened with ethyl alcohol (07–23, 70–80–01). Do not permit alcohol to flood the surface.

2 After the alcohol evaporates from the surface, reinspect. If an indication reappears, evaluate it immediately. If a relevant indication does not reappear, reapply developer. The redevelopment time shall equal the original development time. Reinspect.

(e) After inspection, the cleaning of residual penetrant and developers is required if their presence is detrimental to part use or subsequent operations and processes.

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1. Seal Journals Inspection - SP I306

A. During disassembly of an engine or components, relative journals should be inspected for various possible defects.

NOTE: Most seal journals can be replated to blueprint dimension.

(1) Inspect for cracks or axial scoring. Neither is allowed.

(2) Inspect for circumferential tracking. Remove tracking. (Refer to SP R412, 70–25–06.)

(3) Inspect for residual coke, varnish, carbon, etc. Such deposits must be removed. (Refer to SP R412, 70–25–06.)

(4) Inspect for concentricity. Journal must be within the specified limits.

(5) Repair or replace parts as instructed.

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1. Bearing Data - SP I307

A. Selection of Adequate Inspection Facility

(1) Inspection and gaging rooms.

(a) Rooms shall be in an enclosed area.

(b) Temperature of the room shall be held to 65 to 75°F (18 to 24°C).

(c) Relative humidity shall not exceed 45 percent.

(d) Lighting of 100 to 150 foot–candles (1076 to 1615 Lux) shall be provided for inspection functions.

(e) The room, workbench, or table must be vibration free and maintained at a maximum practical level of cleanliness.

(f) Use of a rubber mat or pad is recommended for the top of the workbench or table to provide an added level of cleanliness and prevent impact damage to bearings.

(g) The inspection room should contain the following equipment to adequately disposition a bearing:

NOTE: If a bearing inspection facility or test equipment is not readily available, return all bearings to Honeywell Defense & Space or other facility capable of meeting these requirements.

1 A hardness tester, to determine if bearing meets manufacturer’s hardness requirements.

2 A Hall Effect Probe, or equivalent device, for determining residual magnetism. (Refer to SP I311, 70–20–11.) The Hall Effect Gaussmeter used in conjunction with the Hall Effect Probe shall be capable of detecting magnetic fields through a range of 1 to 10 gauss minimum. The probe shall be capable of withstanding magnetic fields up to 10,000 gauss. The following Hall Effect Probe and Gaussmeter Probe have demonstrated the capability of meeting the requirements of this procedure.

Transverse probe (No. 951) and Gaussmeter (No. 7303) (manufactured by Magnetic Instrument Co, 8350 E 48th St, Indianapolis, IN), or Gaussmeter Model 4048 (manufactured by F.W. Bell, 6120 Hanging Moss Rd, Orlando, FL 32807) or equivalent.

NOTE: All field detection equipment must be periodically calibrated in accordance with manufacturers recommendations.

1. A. (1) (g) 3 Radius probes 0.040 inch (1.02 millimeter) radius, used to determine the severity of visual defects. The probe should be guided lightly over any defect.

NOTE: The use of heavy pressure on any defect is not allowed.

4 Various hand tools may also be used in the inspection of bearings. A hard rubber or plastic tool is used to check the integrity of bearing cage rivets.

B. Bearings Inspection

CAUTION: BECAUSE OF UNFORESEEN DELAYS, REMOVED BEARINGS CAN REMAIN UNPROCESSED FOR SOME PERIOD OF TIME ALTHOUGH THE ORIGINAL INTENT WAS TO HAVE THE BEARINGS IMMEDIATELY CLEANED AND INSPECTED. ALL BEARINGS MUST BE GIVEN THE CARE AND ATTENTION OUTLINED IN THE FOLLOWING PROCEDURES TO PRECLUDE UNNECESSARY CORROSION, CONTAMINATION, OR MISHANDLING.

BEARINGS INTRODUCED INTO THE INSPECTION AND GAGING ROOM MUST BE ALLOWED TO STAND A MINIMUM OF 3 HOURS PRIOR TO INSPECTION. THIS WILL ALLOW FOR DIMENSIONAL STABILIZATION.

LINT FREE GLOVES SHALL BE WORN WHEN HANDLING BEARINGS DURING ALL INSPECTION OPERATIONS.

(1) Prior to any inspection, bearings shall be checked for magnetism using gages in Step A.(1)(g)2 above to determine magnetism level. If a bearing exceeds 3 gauss it shall be demagnetized. (Refer to SP B106, 70–10–03, Paragraph F., and SP I311, 70–20–11.)

(2) Visual inspection shall be accomplished without magnification. The indiscriminate use of magnification may result in unnecessary rejection of bearings. Defects, having been discovered without magnification, may be magnified to determine severity and correct categorization.

(3) Visual inspection may indicate that a bearing hardness inspection is required. Hardness inspection shall be performed at three locations on both the inner and outer ring faces. Limits are specified in the individual bearing inspection section of the manual. After hardness is checked, stone bearing faces to remove raised material left by indenter.

(4) Radius probes must be used to help the inspector determine the severity of the visual defect. The probe should be guided over the defect without applying pressure, as almost any irregularity can be felt if enough pressure is applied.

1. B. (5) Solvent cleaning, wiping, and handling of bearings during inspection removes protective oils. After inspection, ensure bearings are dipped in lubricating oil (02–21 or 02–24, 70–80–01), placed in polyethylene bags (10–05, 70–80–01), and evacuated of any air and sealed.

(6) For purposes of this inspection, active surfaces of each bearing detail (Figure 1) are defined as follows:

(a) Ball: The entire surface.

(b) Cages: The ball or roller pockets and ring piloting surfaces.

(c) Ring: The raceway ball grooves and roller path (excluding relief/undercut), guide flange faces, and cage piloting surfaces.

(d) Roller: The circumferential surface and roller ends excluding the corner radii.

(7) Bearings shall be inspected in the following order in accordance with Figure 3, Figure 4, and Figure 5. (See the following for definitions; Figure 1 for bearing orientation, terminology, and typical features; Figure 2 for typical bearing damage; and Figure 6 for typical cage configuration.)

C. Immediately following inspection, all bearings must be preserved, tagged, and stored. (Refer to SP B106, 70–10–03, Paragraph E.)

Table 1. Bearing Visual Inspection, Damage, and Probable Causes

| Condition or Damage | Description | Probable Cause |
|---|---|---|
| Banding | Typified by parallel bands of discoloration. Occurs on bearing component part rolling contact surfaces. Original surface is not broken. | Result of oil, varnish, or oxide film formation on bearing surfaces. Generally caused by high temperature bearing operation. |
| Brinelling, False | Occurs only at rolling contact surfaces of bearing rings. It is specialized form of fretting. Recognized by presence of series of surface blemishes in loaded side of ring at each ball or roller position. Indentations are usually polished or satin finished in appearance. Due to very slight rotational movement, indentation will frequently be flatter than roller or ball curvature. | Result of continuous nonrotational shaft oscillation. Vibration caused by engine transportation may cause false brinelling. Direct causes are varied, but result will appear as wear at point of contact. Does not occur when bearing is in operation. |
| Brinelling, True | Occurs at rolling contact surfaces of bearing rings. Recognized by presence of shallow, smooth indentations in ring at each ball or roller position on loaded side of bearing. Since original surface material has not been removed, indentations have same surface appearance as surrounding surface area. Indentation contour is same as roller or ball curvature. | Result of high shock loads, leaving permanent impression of roller or ball in ring contact surface. Usually occurs from shock loads when bearing is stationary. |
| Burring | Raised metal found along the edge of two or more intersecting surfaces. | Result of improper handling during maintenance procedures. |
| Corrosion Discoloration | Chemical discoloration of bearing surfaces without removal of surface metal. Recognized by red or black colored clusters (not to be confused with pitting corrosion which is actual metal removal). If not arrested, discoloration corrosion will advance to corrosion pitting. | Result of any adverse chemical action due to water, acid, lubricant, or corrosive atmosphere, and generally caused by improper preservation procedures or lack of precaution during installation, removal, inspection, or storage. |
| Click Sounds | Repetitive clicking noise whose frequency increases with speed while the bearing axis is horizontal. | Result of damaged race or bearing case. |
| Corrosion Pitting | Irregular surface depressions appearing in clusters and having ragged edges due to metal removal. Corrosion discoloration is early form of corrosion pitting. (Pitting should not be confused with indenting.) | Result of any adverse chemical action due to water, acid, lubricant, or corrosive atmosphere. |

Table 1. Bearing Visual Inspection, Damage, and Probable Causes (Cont)

| Condition or Damage | Description | Probable Cause |
|---|---|---|
| Cracks | Broken surface usually indicated by fine jagged lines. | Result of material fatigue. |
| Excessive Play | To much relative radial or axial movement between the inner and outer rings. | Result of lack of lubrication. |
| Fretting | Recognized by discoloration of nonactive contacting parts, rust deposit between surfaces and removal of original surface material. Occurs only between contacting surfaces with slight relative motion. (It will not occur between rolling contact members.) Examples of these surfaces are, inner ring and shaft, outer ring and housing, faces of rings, and retainer faces. Fretting will reduce fit between surfaces, causing looseness and rotation and resulting in polished contact surface. | Result of slight movement between two contacting surfaces resulting in removal of original surface material, may be caused by oscillating vibration or loose mounting fits. Rust on surfaces can act as lapping compound, further advancing fretting. |
| Frosting | Recognized by many minute indentations within localized areas on bearing rings. Usually frosting cannot be measured. | Generally wearing in process and is considered as early stage of superficial pitting or scoring. |
| Galling | Recognized by presence of metal from one part remaining attached to another. Occurs at poorly lubricated surfaces that are in sliding contact. | Result of localized breakdown of lubrication causing friction, intense heat, and part fusion. Continued use will tend to break weld, leaving portions of metal from seized parts attached to one or both parts. Galling of separator or retainer may be detected by removal of metal from separator and its deposit on roller, ball, or ring. |
| Gouging | Deep scoring associated with metal removal. | Result of localized lubrication breakdown between sliding surfaces. Also caused by deposits of hard particles resulting from lubricant breakdown or presence of foreign particles. Axial gouging may occur during assembly and disassembly when bearing is stationary. |

Table 1. Bearing Visual Inspection, Damage, and Probable Causes (Cont)

| Condition or Damage | Description | Probable Cause |
|---|---|---|
| Grooving | Found on rolling contact surface of ball or roller bearings. Recognized by presence of depressions in elements of rolling contact surfaces. | Results from overload, lubrication breakdown and skidding. |
| Heat Discoloration, Staining, Varnishing | Presence of discolored areas, ranging from straw color to dark brown (varnishing) to light brown, red–purple, purple, blue and blue–gray (heat). | Result of high temperature operation or lubrication breakdown with or without high temperature operation. |
| Indenting | Characterized by smooth bottomed random surface depressions occurring on rolling surfaces and ball paths, as evidenced by metal displacement but not metal removal. (See Figure 2.) | Result of dirt or foreign particles flattened into bearing surface by rolling action or improper mounting procedure. |
| Magnetism | Attraction of ferrous metal particles. | Result of improper MPI and storage. |
| Nicking | Sharp, well defined indentations occurring on any bearing surface struck by sharp objects. Nicks displace but do not remove material. Ridge is formed by displaced material next to nick. | Result of bearing components striking one another or being struck by sharp object. Nicks are not result of bearing operation. |
| Oxidation | Rust (Refer to Corrosion.) | |
| Pitting, Fatigue | Irregular surface depressions caused by stress concentration at roller contact areas. Fatigue pitting is characterized by metal removal, flaking, or cracking. | Result of isolated metal removal caused by slippage, lack of lubrication, wear, or eccentric mounting. Fatigue pitting concentrated at ends of rollers or roller pathway is evidence of misalignment. |
| Retainer Damage | Cracking of retainer, particularly in ball/roller pocket areas and tangs. Excessive wear of retainer lands and pocket areas through silver plating into retainer base metal. | Breakdown in lubrication, material fatigue, roller skidding, or skewing. |
| Roller End Wear | Occurs on random rollers on one or both ends. Condition may vary from slight, concentric, or deep concentric pattern to eccentric pattern. Roller end wear is best observed by comparing one roller end to another. (See Figure 2.) | Misalignment or skewing of roller within bearing. |

Table 1. Bearing Visual Inspection, Damage, and Probable Causes (Cont)

| Condition or Damage | Description | Probable Cause |
|---|---|---|
| Rough Rotation | Ratchety or catching feeling either constant, repetitive, or intermittent. | Result of internal damage or poor cleaning and lubrication procedures. |
| Scoring | Recognized by presence of parallel or concentric grooves penetrating original surface. Occurs at bearing component surface in sliding contact with scored surfaces. (See Figure 2.) | Result of localized lubrication breakdown between sliding surfaces. Also caused by deposits of hard particles resulting from lubricant breakdown or presence of foreign particles. Axial scoring may occur during assembly and disassembly when bearing is stationary.<br>Circumferential scoring occurs during bearing operation. |
| Scuffs and Scratches | Scuffs and worn spots usually occurring as dull patches. Scratches are marks that may appear in any form or size. | May appear in any area. Size and density of condition increases with handling and use. |
| Seizing | Advanced stages of galling. Recognized by welding of one bearing component to another, preventing rotation. | Result of localized breakdown of lubrications, causing friction, intense heat, and part fusion. |
| Spalling (pickout) | Material removal by pick out or chipping leaving a newly formed rough surface usually adjacent to shallow cracks. | Result of convergence of cracks or stress areas. |
| Wear | Material removal of surface by mechanical action that occurs on all rolling or contact surfaces. May be indicated by wavy path, slight discoloration, dull or shiny tracks, very finely pitted dull surface on roller path and internal bearing bore looseness. Inspection can reveal any one or combination of these conditions, which, if excessive, may be easily detected by internal looseness as well as excessive mounting fit looseness. (Refer to Excessive Play.) | Results of abrasive substances contacting rolling surfaces and acting as lapping compound. Gummed or insufficient lubricant, vibration in presence of abrasive particles, or movement caused by loose mounting. Excessive wear may also be caused by varying off square conditions of inner and outer ring, pressure on bearing retainer, and roller skewing. |

Table 2. Detail Bearing Inspection Limits (Mainshaft)

| Condition or Damage | Limits |
|---|---|
| Banding | Acceptable. |
| Brinelling, False | Acceptable. |
| Brinelling, True | Noticeable depressions unacceptable. Minor ring brinelling, so slight that it can only be detected in reflected light, will not be cause for rejection. |
| Corrosion Discoloration, Corrosion Pitting | Corrosion effectively removed by standard cleaning methods is acceptable. Remaining isolated pitting on active surfaces is acceptable, provided:<br>a. It cannot be felt with 0.020 inch radius probe.<br>b. No more than three visually evident individual pits exist in any 1/4 inch diameter area. |
| Fretting | Acceptable, provided rings do not have fretting on more than 20 percent of inactive areas. (NOTE 1 and limits for wear damage.) Fretting on ring faces may be removed by minor lapping rework, provided rings meet dimensional requirements. |
| Frosting | Acceptable, provided it cannot be felt with 0.40 inch radius bearing probe. |
| Galling | Not acceptable. |
| Grooving | Not acceptable. |
| Heat Discoloration, Staining, Varnishing | Varnishing is acceptable, provided any heavy varnish films can be removed by standard cleaning. Staining is acceptable, provided stain is not caused by acid etch as observed after standard cleaning. Heat discoloration, bearings discolored straw or brown color are acceptable. Bearings discolored red–purple, purple or blue are acceptable, provided hardness inspection at three locations on both inner and outer ring faces is within limits. (When there is any doubt as to tempered discoloration condition, replace bearing.) |
| Indenting | Isolated indenting is acceptable, provided it cannot be felt with 0.040 inch radius bearing probe. |
| Nicking | Small isolated nicks with no projections are acceptable on active surfaces if nicks cannot be felt with 0.040 inch radius bearing probe. Minor nicks on inactive surfaces are acceptable (NOTE 1). |
| Pitting, Fatigue | Not acceptable. |

Table 2. Detail Bearing Inspection Limits (Mainshaft) (Cont)

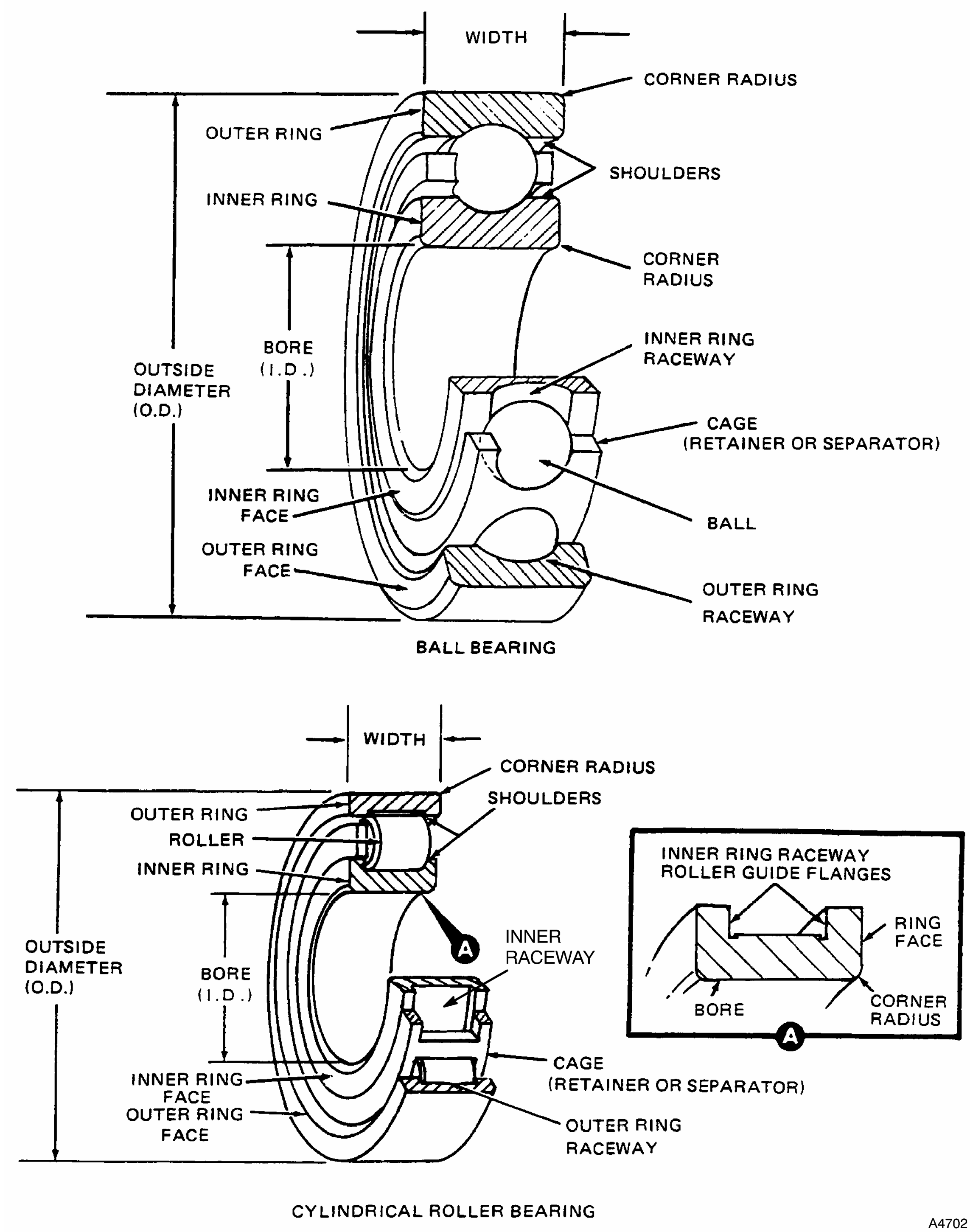
| Condition or Damage | Limits |
|---|---|
| Retainer Damage | a. Any cracking is unacceptable.<br>b. Overheating, as evidence by melting or flowing of silver plate, is unacceptable.<br>c. Wear of ball pocket and/or land riding surfaces exposing any base metal up to 1/16 inch measured in any direction (not depth) is acceptable. Wear beyond this limit is unacceptable. |
| Roller End Wear | Rollers that show slight burnishing or concentric polishing (no depth) are acceptable. (Inspect both ends.) Eccentric roller end wear is unacceptable. Rollers showing deep wear patterns, whether concentric or eccentric are unacceptable. |
| Scoring | Isolated axial scoring is acceptable, provided it cannot be felt with 0.040 inch radius bearing probe. |
| Scuffs and Scratches | Acceptable, provided scuffs and scratches cannot be felt with 0.040 inch radius bearing probe. Maximum of two scratches per square inch of active surface is allowed (NOTE 1). |
| Seizing | Not acceptable. |
| Wear | Determined by inspection of radial internal clearance and other dimensional inspection requirements.<br>NOTE: Minor scoring, fretting, or wear of outer ring OD may result from spinning or movement of bearing in its housing. This ring OD wear is acceptable, provided OD measurements taken at various locations (and in wear area) are within limits. |

NOTE 1: Active bearing surfaces are:

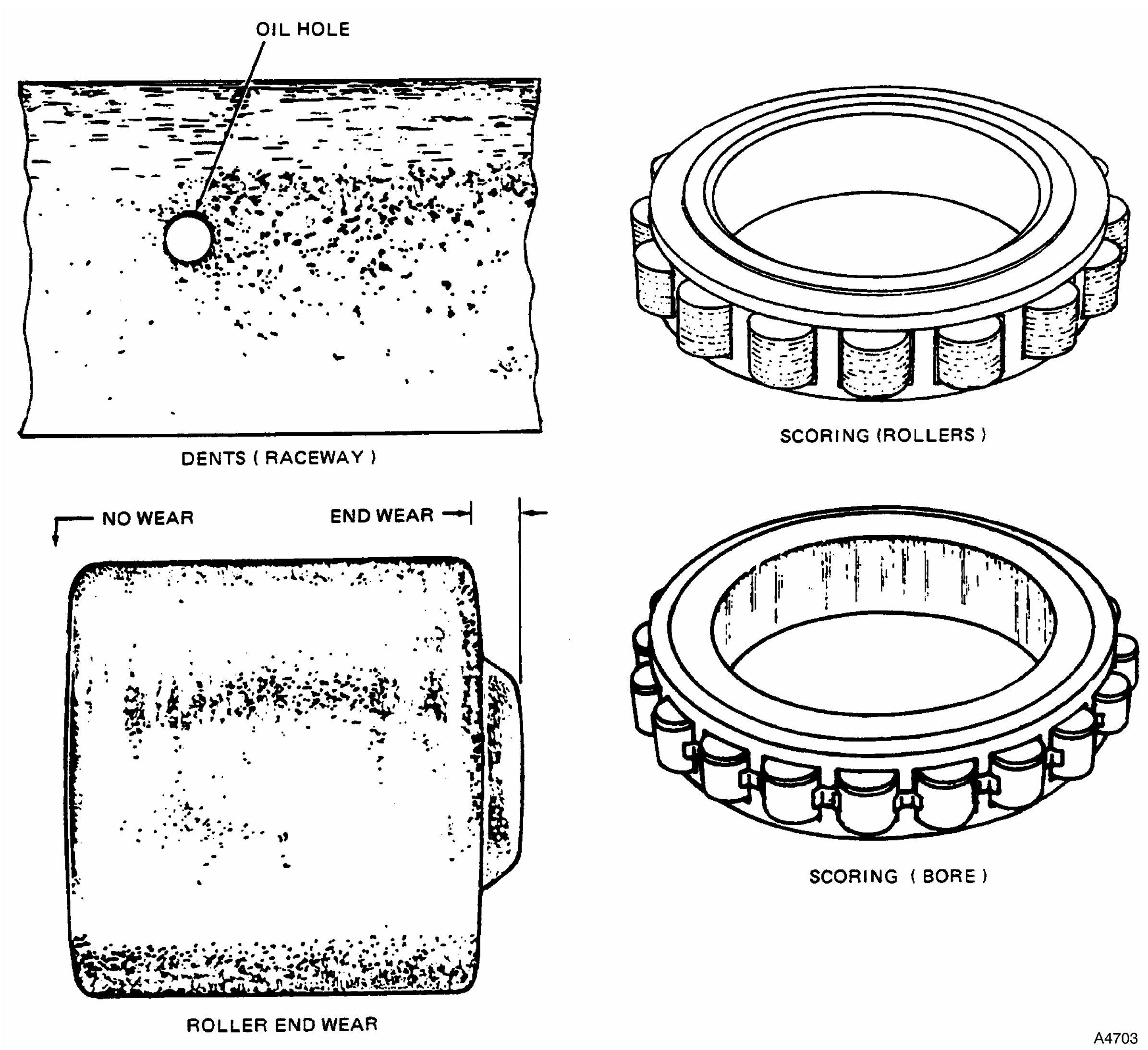
Inner and outer ring raceways.
Retainer pockets and lands and ring riding lands.
Rolling elements.

Inactive bearing surfaces are:

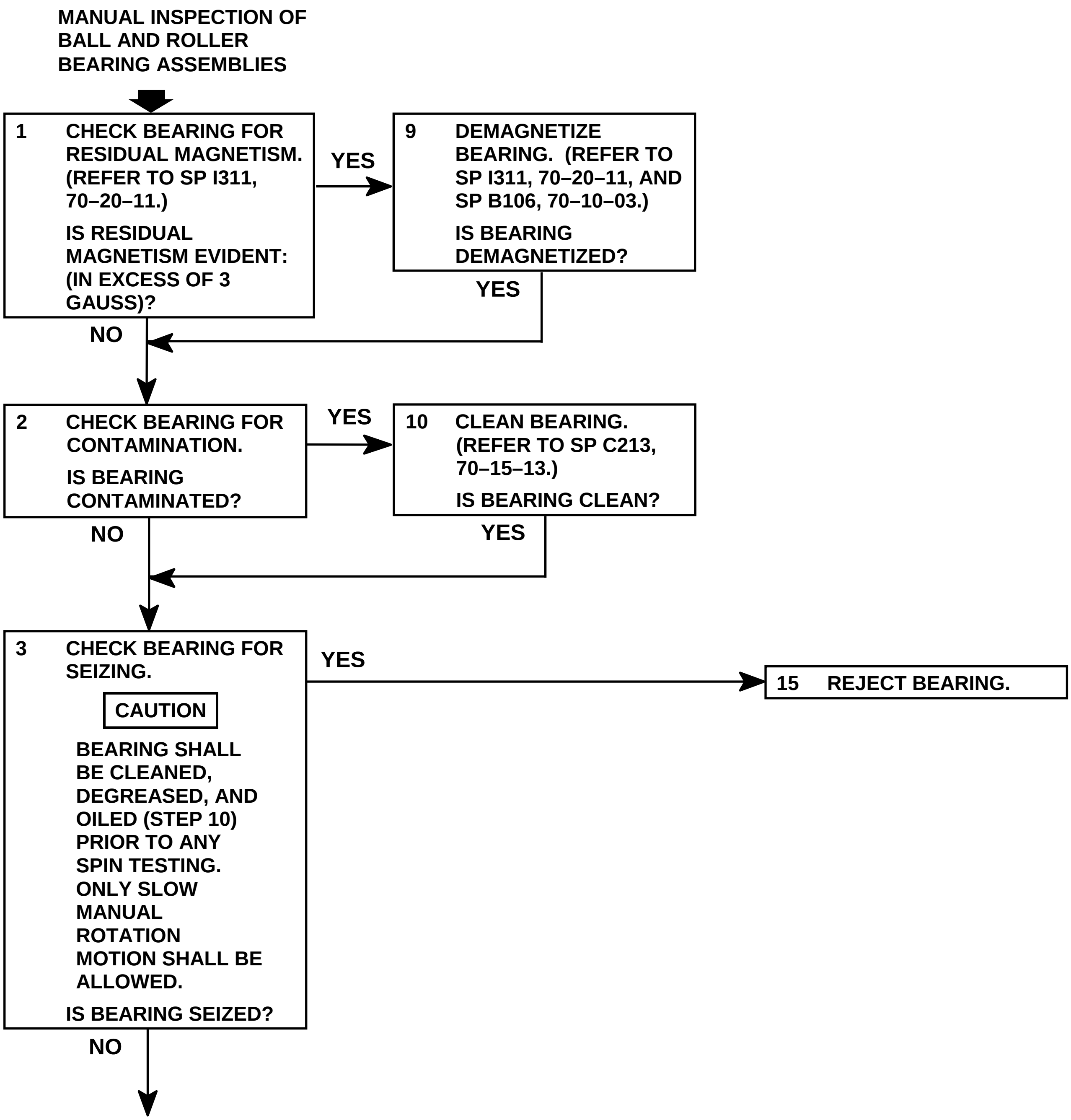
Ring ID/OD and faces.
Retainer faces.




Bearing Orientation Terminology - Typical
Figure 1




Bearing Damage
Figure 2




Manual Inspection of Ball and Roller Bearing Assemblies
Figure 3 (Sheet 1 of 3)

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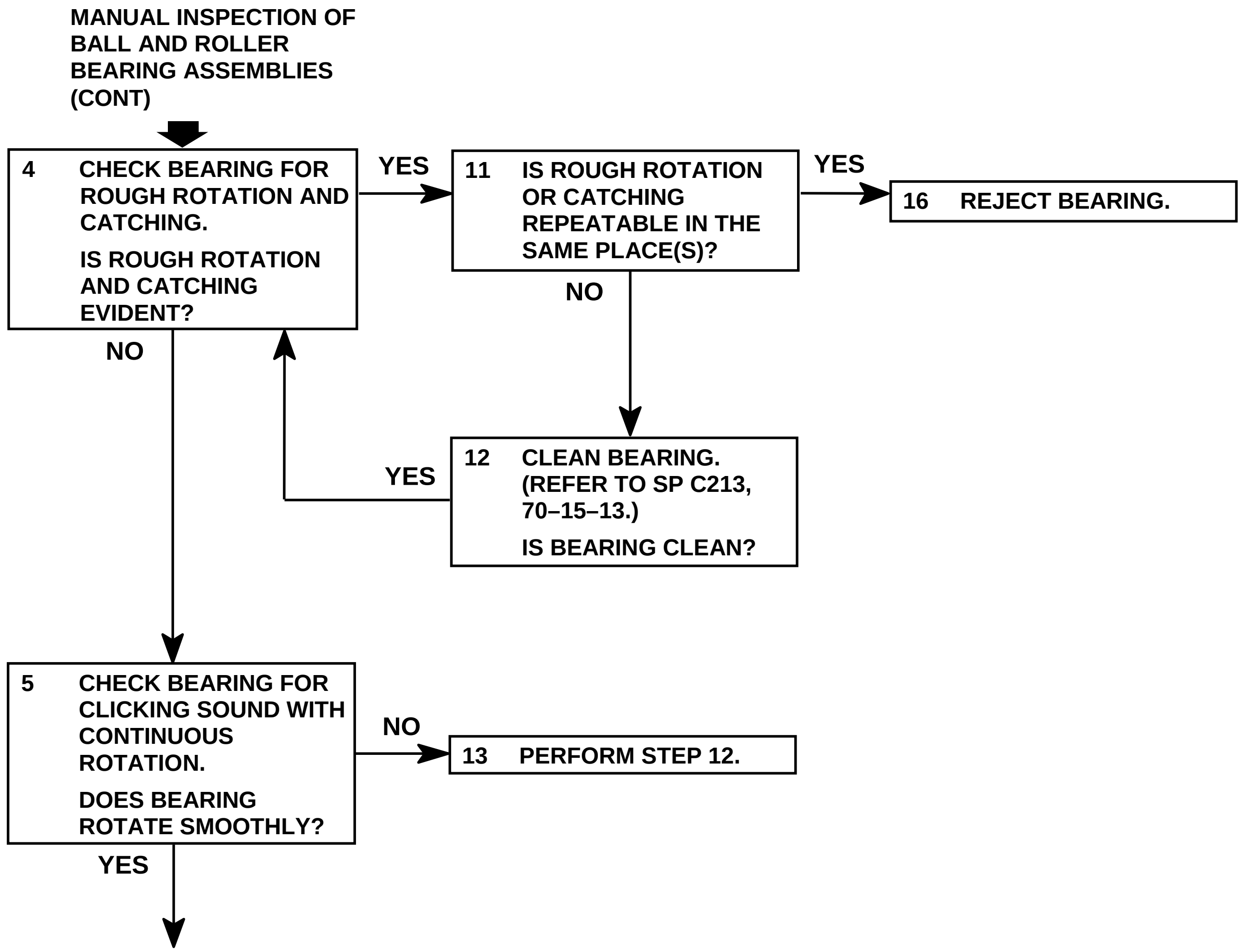


Manual Inspection of Ball and Roller Bearing Assemblies
Figure 3 (Sheet 2)

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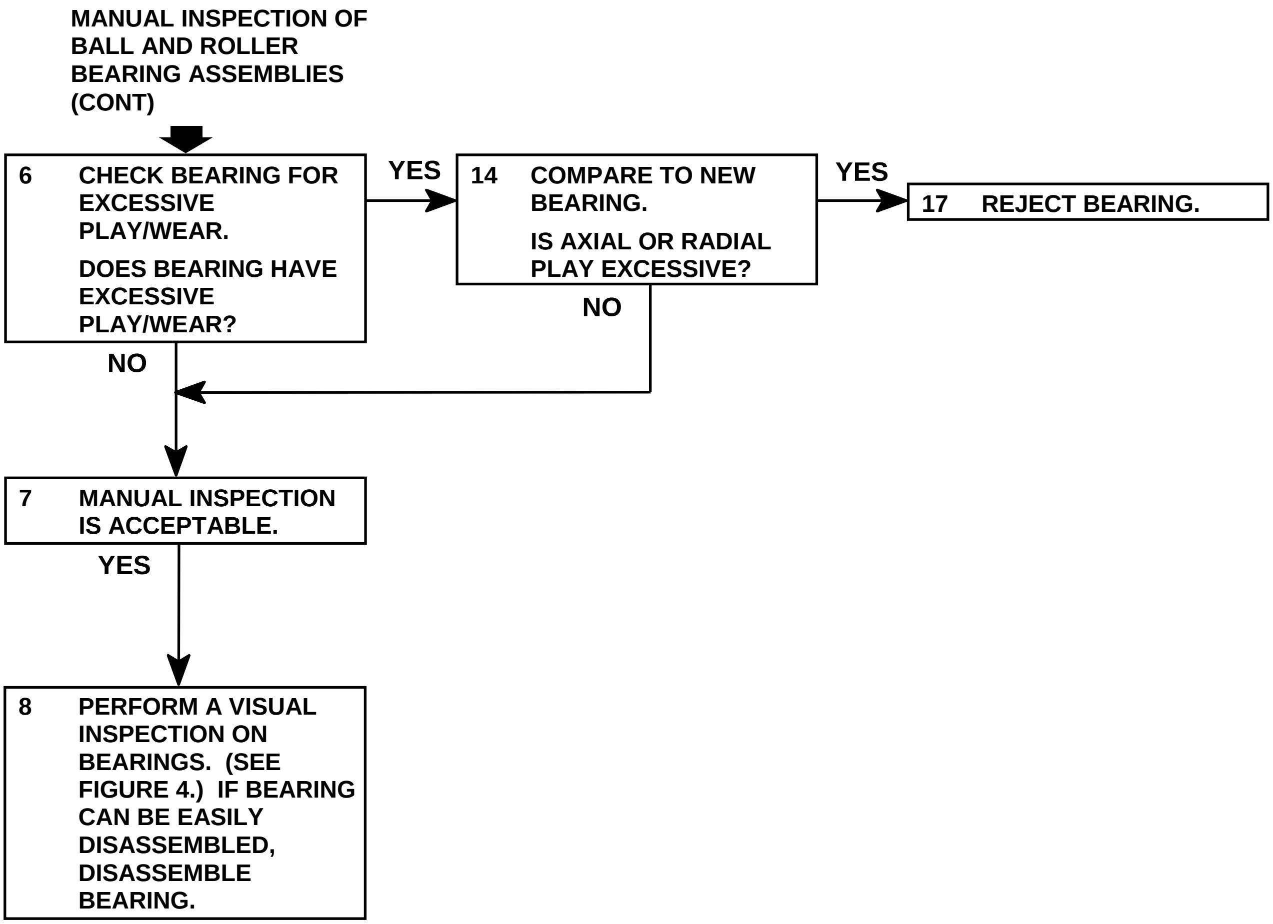


Manual Inspection of Ball and Roller Bearing Assemblies
Figure 3 (Sheet 3)

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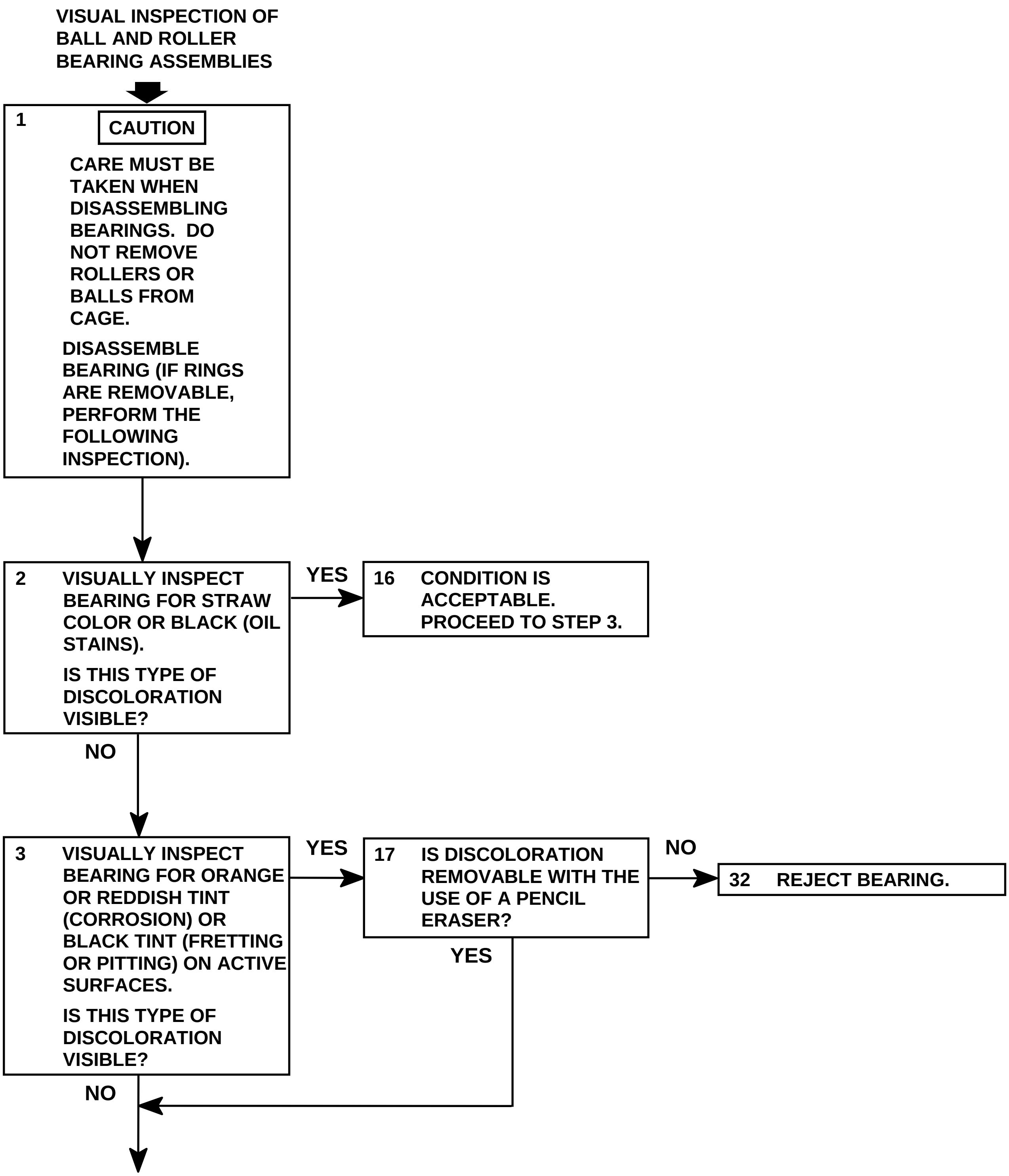


Visual Inspection of Ball and Roller Bearing Assemblies
Figure 4 (Sheet 1 of 6)

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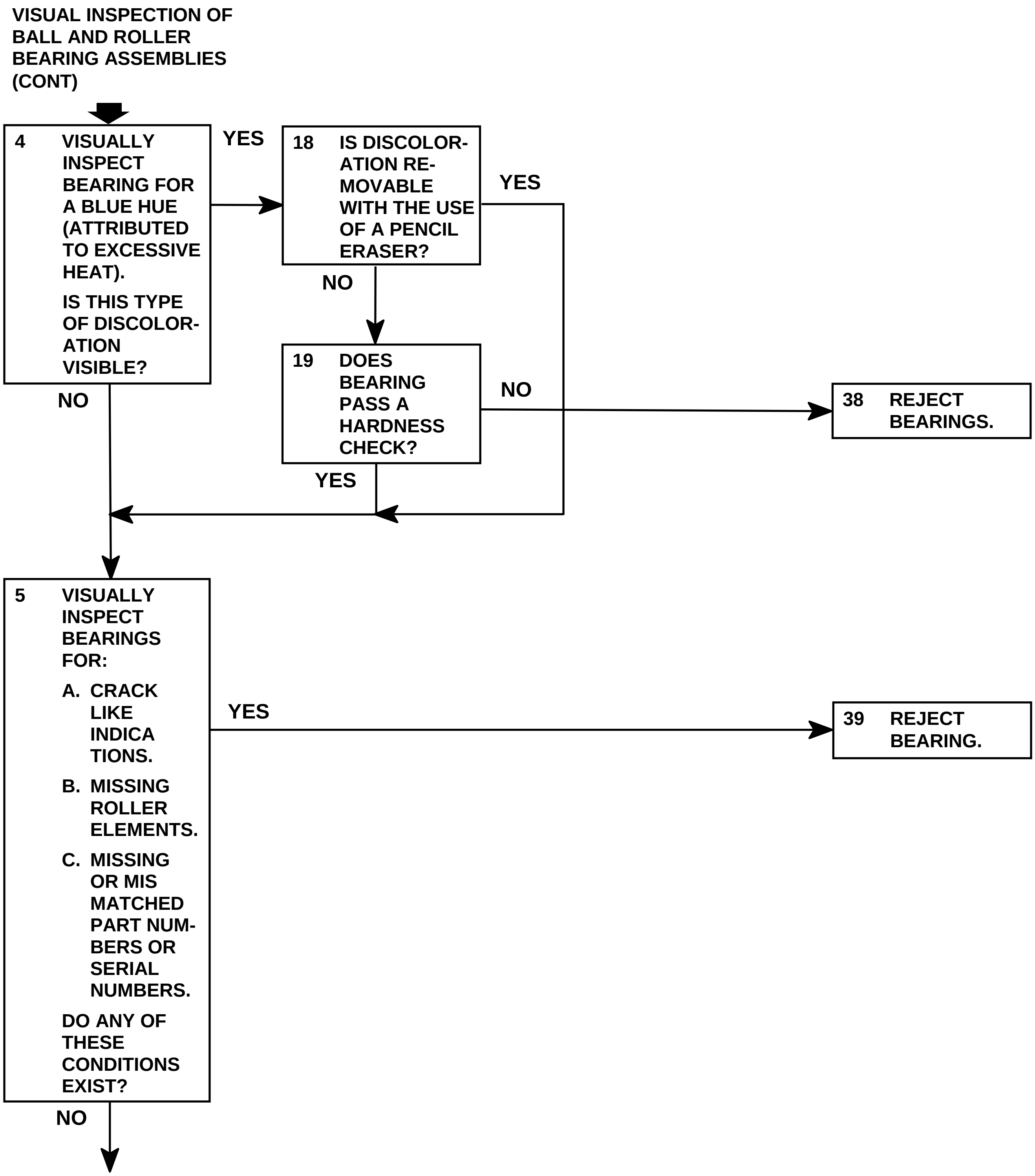


Visual Inspection of Ball and Roller Bearing Assemblies
Figure 4 (Sheet 2)

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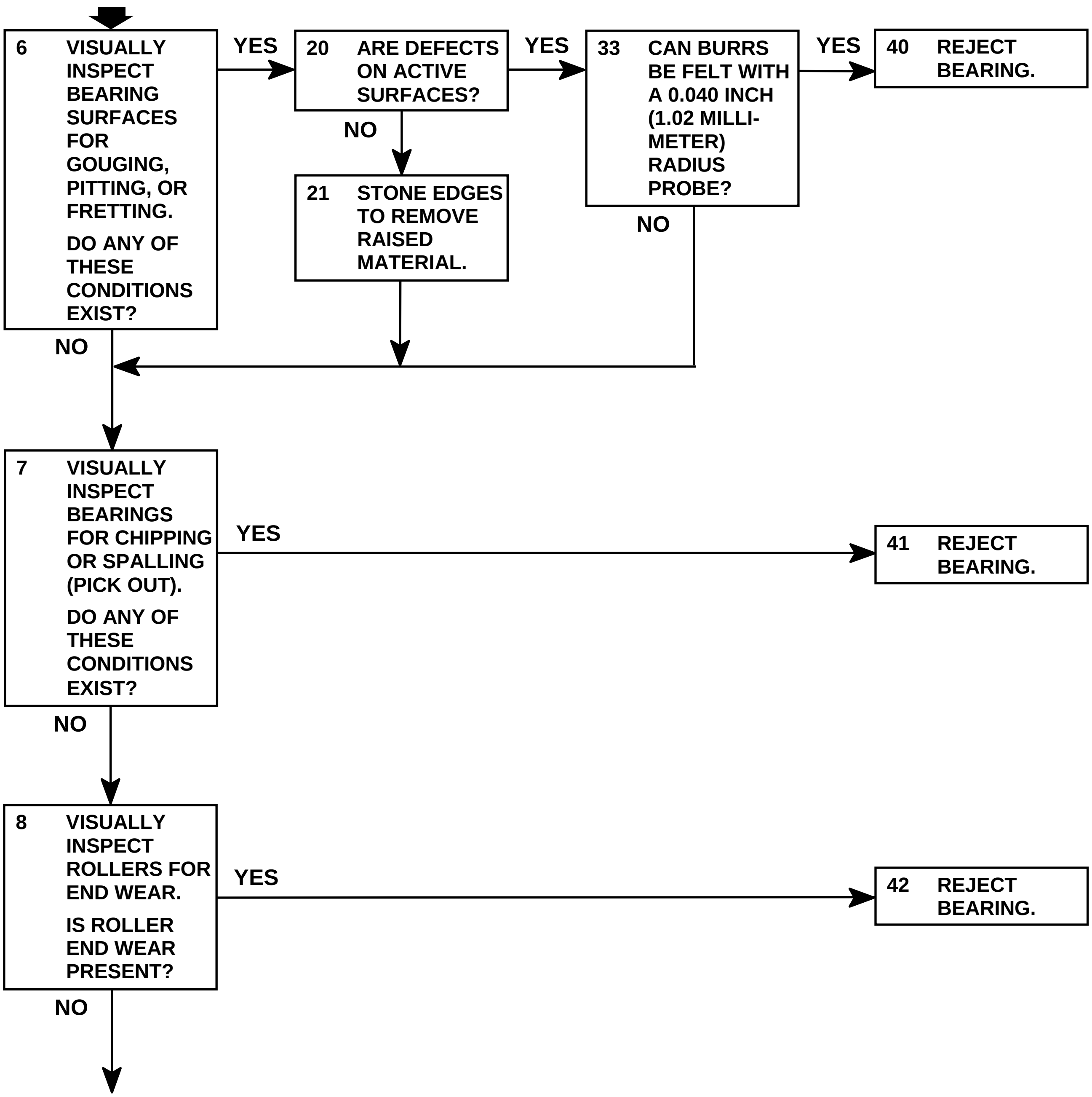
**VISUAL INSPECTION OF BALL AND ROLLER BEARING ASSEMBLIES (CONT)**




Visual Inspection of Ball and Roller Bearing Assemblies
Figure 4 (Sheet 3)

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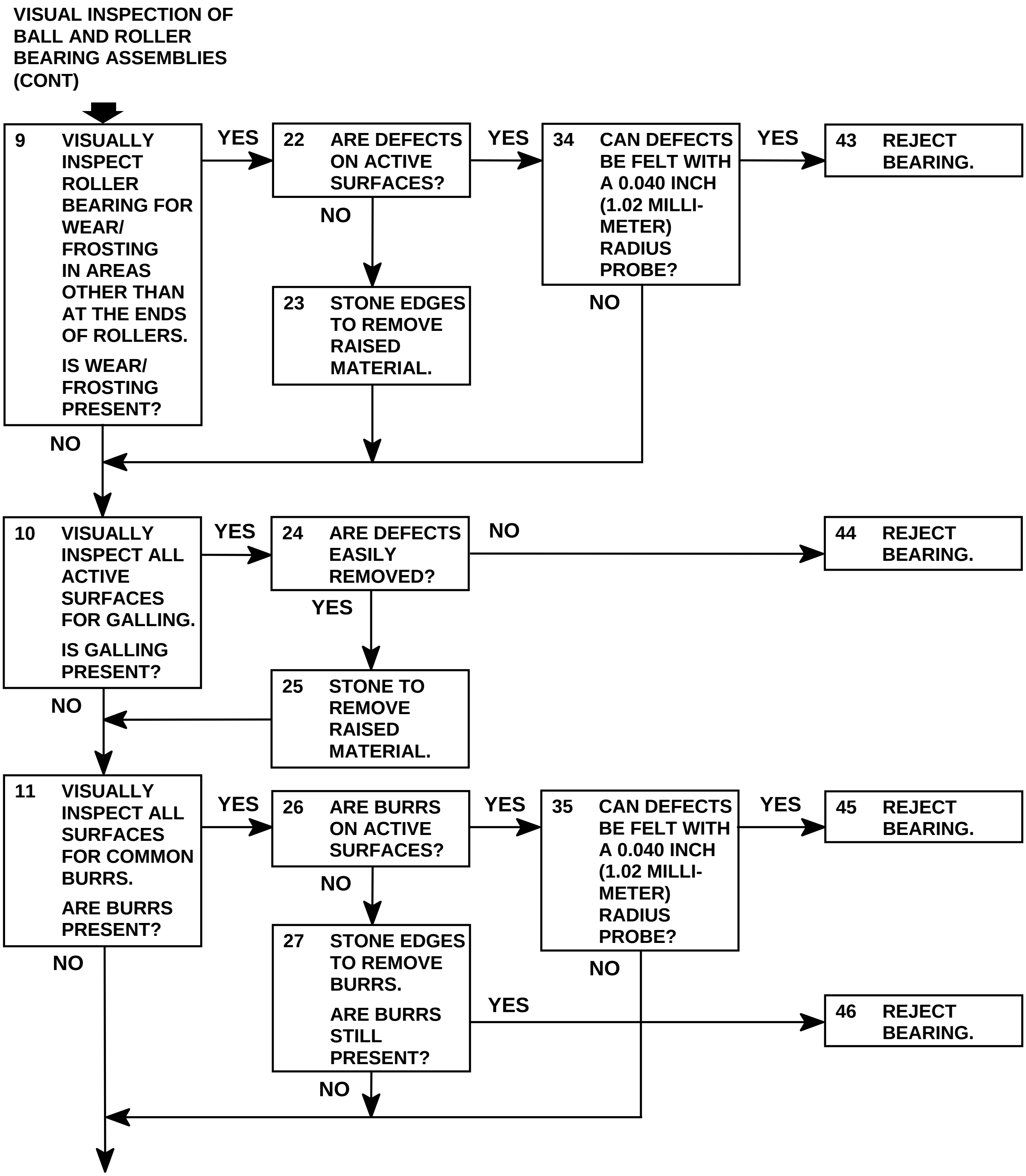


Visual Inspection of Ball and Roller Bearing Assemblies
Figure 4 (Sheet 4)

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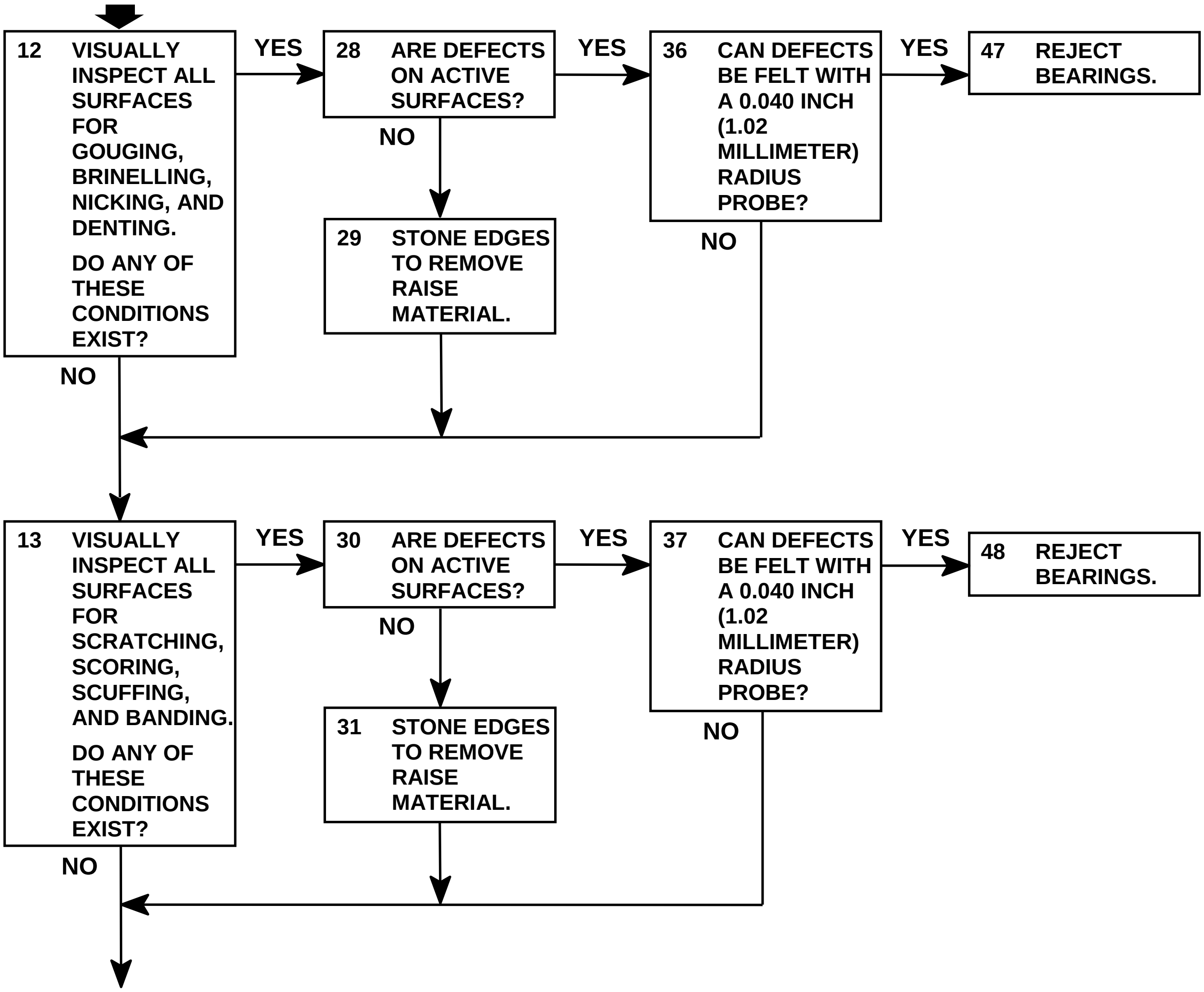
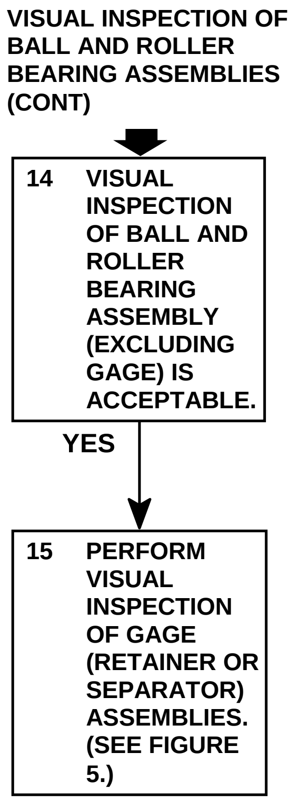
**VISUAL INSPECTION OF BALL AND ROLLER BEARING ASSEMBLIES (CONT)**




Visual Inspection of Ball and Roller Bearing Assemblies
Figure 4 (Sheet 5)




Visual Inspection of Ball and Roller Bearing Assemblies
Figure 4 (Sheet 6)

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**VISUAL INSPECTION OF CAGES (RETAINER OR SEPARATOR) ASSEMBLIES**

**1** INSPECT BEARING CAGES FOR THE FOLLOWING STRUCTURAL DEFECTS.

(1) CRACKS

(2) MISSING OR BROKEN BALL/ROLLER RETENTION (BALL/ROLLER FALLOUT)

(3) DEFORMED POCKETS

(4) WORN PILOT DIAMETER

(5) DENTS AND TOOL STRIKES.

DO ANY OF THESE CONDITIONS EXISTS?

YES → **6** REJECT BEARINGS.

NO ↓

**2** INSPECT CONRAD 2 PIECE BEARING CAGES FOR THE FOLLOWING ADDITIONAL DEFECTS. (SEE FIGURE 6.)

(1) LOOSE RIVETS.

**NOTE**

LOOSE RIVETS SHALL BE DETECTED WITH HARD RUBBER OR PLASTIC TOOL.

(2) MISSING RIVETS AND RIVET HEADS.

(3) FRETTING BETWEEN RIVETS AND CAGE (DARK STREAKS).

(4) UNCLINCHED FINGERS. (SEE FIGURE 6.)

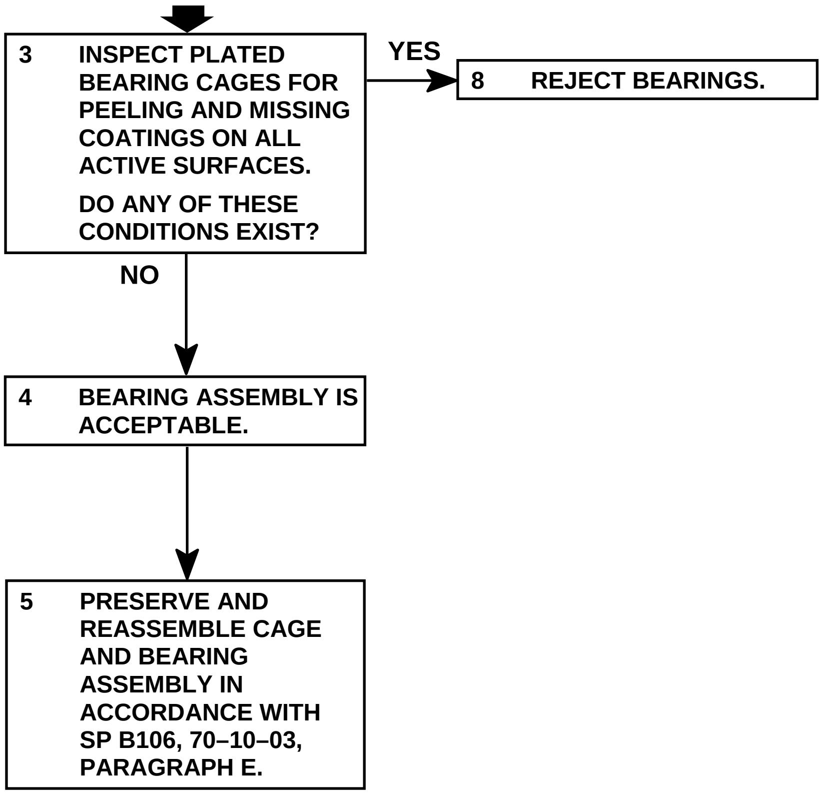
DO ANY OF THESE CONDITIONS EXIST?

YES → **7** REJECT BEARINGS.

NO ↓

Visual Inspection of Cages (Retainer or Separator) Assemblies
Figure 5 (Sheet 1 of 2)

**VISUAL INSPECTION OF CAGES (RETAINER OR SEPARATOR) ASSEMBLIES (CONT)**




Visual Inspection of Cages (Retainer or Separator) Assemblies
Figure 5 (Sheet 2)

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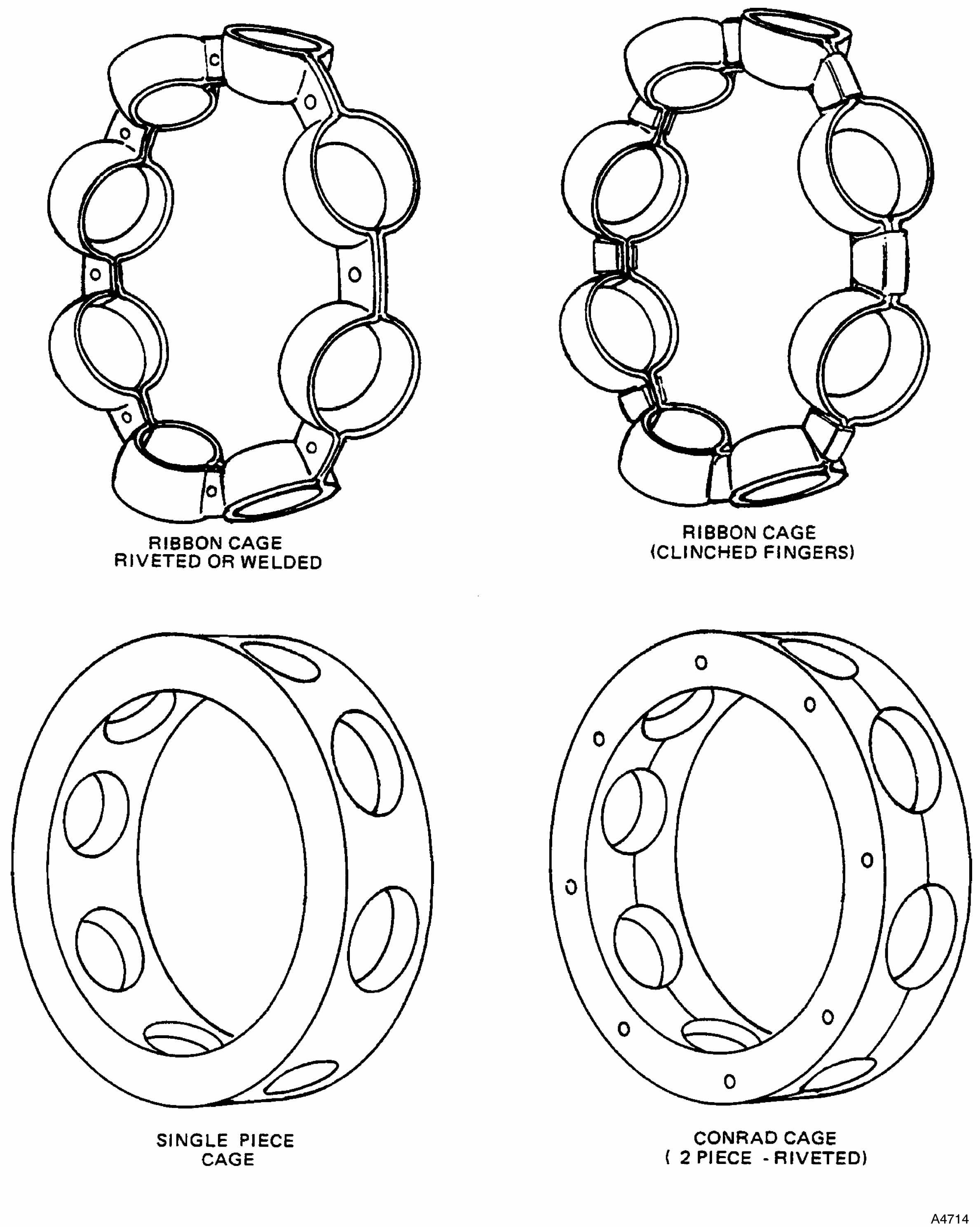


Bearing Assembly Cages (Retainer or Separator) - Typical
Figure 6

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1. Gears and Splined Parts Data - SP I308

A. Gears and splined parts shall be visually inspected for those conditions listed and defined in Table 1 and Table 2 and Figure 1 through Figure 64.

Table 1. Visual Inspection of Gears

| Condition | Limits | Figure |
|---|---|---|
| | Gears and Splines | |
| Wear: | | |
| Normal Contact | All normal contact and light wear is acceptable. | Figure 4 - Figure 20 |
| Excessive Wear | Tooth profile affected beyond light contact wear is unacceptable. | Figure 34 - Figure 48 |
| Micropitting (Frosting) | Light micro pitting is acceptable. Any other condition of micro pitting is unacceptable. | Figure 19, Figure 20 |
| Scuffing (Scoring) | Light scoring is acceptable. Any other condition of scoring is unacceptable. | Figure 23, Figure 45, Figure 46 and Figure 52 |
| Micropitting (Pitting) | Initial and light pitting is acceptable. Any other condition of pitting is unacceptable. | Figure 21, Figure 24, Figure 30, Figure 34, Figure 49 and Figure 54 |
| Spalling | Unacceptable. | Figure 22, Figure 24, Figure 31, Figure 41 and Figure 42 |
| End Loading | Light end wear is acceptable. All pitting or spalling due to end loading is unacceptable. | Figure 32, Figure 37, Figure 49, Figure 50 and Figure 53 |
| Cracking | Unacceptable. | |
| Corrosion | Any rust corrosion noted after cleaning is unacceptable. | |
| Fretting Corrosion | Fretting corrosion on adjacent gear surfaces is unacceptable. | Figure 33 |
| | Splines | |
| Scuffing (Scoring) | Light scoring is acceptable. Any other condition of scoring is unacceptable. | Figure 56, and Figure 57 |
| Fretting | Fretting is considered a form of wear with limits defined in Section 1B. | Figure 58 |
| Spalling | Spalling is unacceptable. | Figure 59 |
| Wear | Heavy wear is unacceptable. (Measurable wear limits are defined in Section 1B.) | Figure 60 - Figure 62 |
| Bent Teeth | Permanent deformation due to overload is unacceptable. | Figure 64 |
| Cracking | Unacceptable. | |
| Corrosion | Any rust corrosion noted after cleaning is unacceptable. | |
| Fretting Corrosion | Fretting corrosion on adjacent gear surfaces is unacceptable | Figure 33 |

Table 2. Gears and Splined Parts Damage - Definitions

| Gear Damage | Definition | Probable Cause |
|---|---|---|
| Wear (Normal, Excessive) | Normal wear is the slow loss of material from contacting surfaces of gear or spline teeth and is called a "normal contact pattern". Figure 7 shows the high points of the surface finish wearing away. Further running results in a polished finish. Moderate wear is usually seen as a pronounced pattern, surfaces appear rough and their may an unworn band that stands out at the pitch line. Excessive wear results in a wearing away of the tooth such that a step appears in the flank of the teeth. | Contacting surfaces abrading one another. |
| Fretting Corrosion | A form of wear noted on surfaces that remain in intimate contact such as spline teeth and bolted joints. This wear is characterized by the removal of particles and subsequent formation of oxides (rust colored powder or paste). | Relative motion between surfaces and/or lack of continual oil flow. Oxides formed from fretting corrosion are often abrasive and may cause rapid increase in wear. |
| Involute Interference | Gouging from tip of mating gear. See Figure 34, Figure 36, Figure 39, Figure 42 - , Figure 44 and Figure 51. | Not enough modification on tip of mating gear or, improper assembly |
| Micropitting (Frosting) | Microscopic pitting, less than 0.0001 inch deep, usually in the dedendum of the driver giving a frosted appearance. See Figure 35 - Figure 40. | Too thin a lubricant film. |
| Scuffing (Scoring) | A form of wear characterized by scratches, scuffing, and dragged or furrowed appearance with markings in the direction of sliding. Generally occurs at or near tip of the tooth. See Figure 23 and Figure 29. | A breakdown of the lubricant oil film permitting metal–to–metal contact. |
| Breakage, Dents | Failure by bending fatigue. See Figure 25.<br>Failure from foreign object damage. See Figure 27. | Exceeding the bending endurance limit of the material or from foreign debris. |
| Bent Teeth | Permanent deformation. See Figure 64. | Overload or foreign object damage. |
| Overheating | Discoloration and a loss of hardness. Ultimate failure is known as "corn cobbing". See Figure 63. | Results from the high temperature produced by excessive friction caused by overload, overspeed, lack of backlash, or faulty lubrication. |
| Cracking | Partial separation of metal resulting from residual stresses. | Severe stress from overloading or shock, a possible extension of a scratch. Improper grinding or heat treat treatment. |
| Corrosion | Discoloration, pitting or other forms of material removal on gear or splined shafts. A surface chemical action that results in surface discoloration or, in advanced stages, actual removal of surface metal. (Refer to Wear, Fretting, Corrosion.)<br>NOTE: Rust is a form of corrosion. | Exposure to corroding elements. |

Table 2. Gears and Splined Parts Damage - Definitions (Cont)

| Gear Damage | Definition | Probable Cause |
|---|---|---|
| Fretting | Similar in appearance to corrosive atmosphere but, occurring on surfaces in intimate contact. | Very small rubbing motion due to normal movement as in spline joints, see Figure 56, or loosing as in bolted joints, see Figure 33. |
| Assembly Damage | Damage to the teeth. See Figure 28. | Blind assembly. |
| Burrs | A rough edge or sharp projection. | Excessive wear. |
| Macropitting (Pitting) | Initial pitting is a type of surface pitting that usually occurs in a narrow band just below or at the pitch line. Such pitting is not serious, since it is self corrective and nonprogressive. Macropitting may initiate either at the surface of the gear tooth or at a shallow depth below the surface. When the cracks have grown long enough to separate a piece of the surface material, a pit is formed. See Figure 23, Figure 30, Figure 37 and Figure 38. | The wearing in process that occurs at the beginning of an operation and continues only until the overstressed local high areas of the surface have been reduced to provide a sufficient area of contact to carry the load without further impairment. This condition usually will occur on accessory gears where surface finish is coarser than on power gears. Pitting on power gears will usually become destructive. |
| | Destructive pitting usually starts below the pitch line, progressing increasingly in number and size of pits until smoothness of operation is impaired. The pitting will progress until the tooth shape is destroyed. Large pits, formed by joining of smaller pits are called spalls. | Chemical pitting: oxidation of surface by electrolytic action.<br>Mechanical pitting: Surface fatigue failure caused by exceeding the endurance limit of the material. |
| Spalling | Sporadic fatigue failure, characterized by large particles or chips that spall or flake out of tooth surfaces, usually along the flank area and near the ends. These cavities have a cleaner break than pits, although the distinction is primarily one of degree. | Originates with a surface or subsurface defect from excessive internal stresses due to the heat treatment, see Figure 41 or from overloads, see Figure 49. |
| Combined Distress | The majority of surface distress problems i.e. Frosting, Scuffing (scoring), Pitting, and Spalling do not always occur singularly. | Figure 37 show combinations resulting from multiple problems i.e. rough surface finish, low oil film, and overload distress. |
| End Loading | Defect on face of gear tooth near end of tooth resulting from engine operation. See Figure 49. | Lead of meshing gears or parallelism of bearing bores are incorrect. Localized overloading and/or misalignment. |

B. Perform visual inspection of gears as follows:

(1) Using 4–power magnification, inspect each gear or spline for conditions listed in Table 1 and Table 2. If gear is unacceptable, replace it.

(2) Inspect gear teeth for nicks, burrs, scratches, and chipped edges. See Figure 55 for guidelines. (Refer to SP R414, 70–25–08.)

(3) Inspect all gears and splines for discoloration due to overheating. Only light straw coloration is acceptable. If color is blue or purple, gear shall be rejected.

(4) Deleted.

(5) Inspect splines for wear (steps) or fretting corrosion depth as follows:

(a) Place part in V–block.

(b) Lubricate journals so the part can rotate easily.

(c) Secure part to prevent axial movement.

(d) Using a dial indicator as shown in Figure 1, measure splines (internal and external). Move dial indicator parallel toward spline (in a lead direction).

(e) Deleted

(6) Inspect the inner bevel of the accessory drive pinion gear for nicks in the forward chamfer area. (See Figure 2) Isolated nicking is acceptable on the chamfer only if there are no more than five nicks per gear and damage cannot be felt with a 0.070 inch (1.778 millimeter) probe. Blend repair raised defects. (Refer to SP R401, 70–25–01.)

(7) Inspect all gears and splines for assembly damage, deformation or impact damage (FOD). Minor defects on non-working surfaces may be repaired. (Refer to R401, 70-25-01). All other damage is cause for rejection of part.

CAUTION: DEFECTS ARE NOT ALLOWED ON GEAR FACE. TO PREVENT DAMAGE, CARE MUST BE TAKEN TO PREVENT METAL-TO-METAL CONTACT OF GEARS.

(a) Perform magnetic particle (SP I303, 70-20-03) or fluorescent penetrant (SP I305, 70-20-05) inspection as applicable.

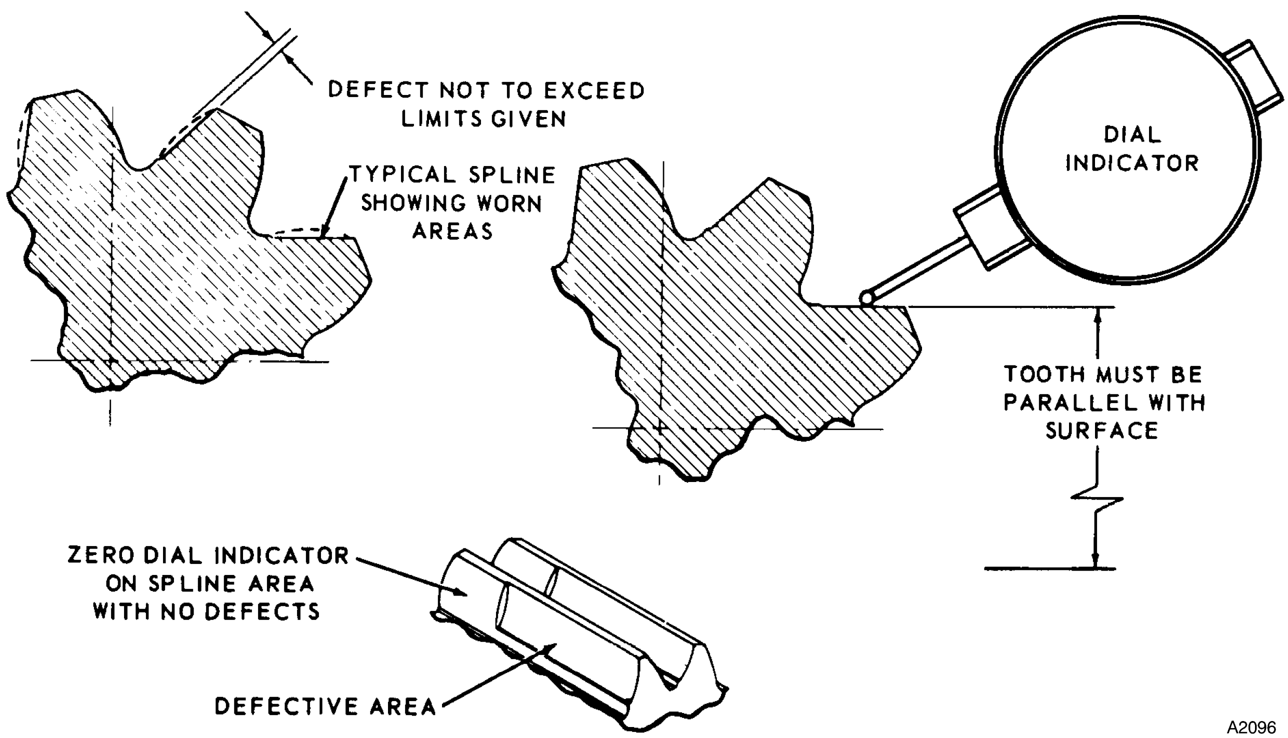
1 Magnetic particle or fluorescent penetrant inspection shall be performed by experienced and qualified personnel

2 All findings shall be entered in a gear and splined part inspection report similar to that shown in Figure 3.

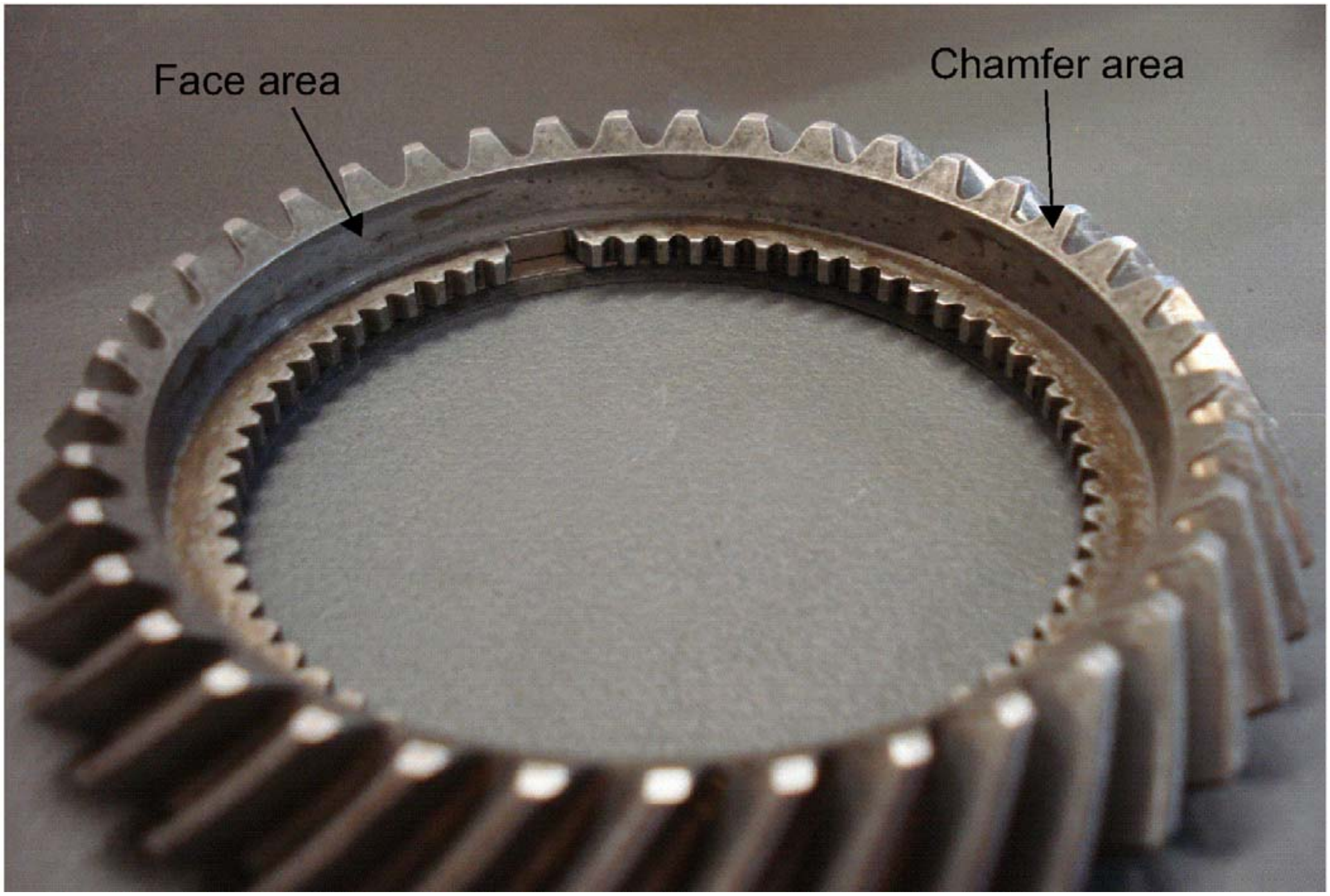
3 The report shall be the criterion for acceptance or rejection of parts.

(b) Following inspection, all serviceable gears and splined parts shall be protected with corrosion preventive oil (02-30, 70-80-01).

(8) The absence of silver plate in the contact zone in whole or part on sun gear teeth with greater than 25 hours of operation is acceptable. Discoloration, nicks, scratches, scoring and smearing of this silver plate on sun gear teeth is acceptable providing the defect is not present in the base metal. The base material can be inspected after local removal of the silver plating on the drive side of one tooth exhibiting the worst condition. This can be accomplished by lightly polishing with crocus cloth and inspecting the tooth's surface. (Refer to SP I308, 70-20-08.)

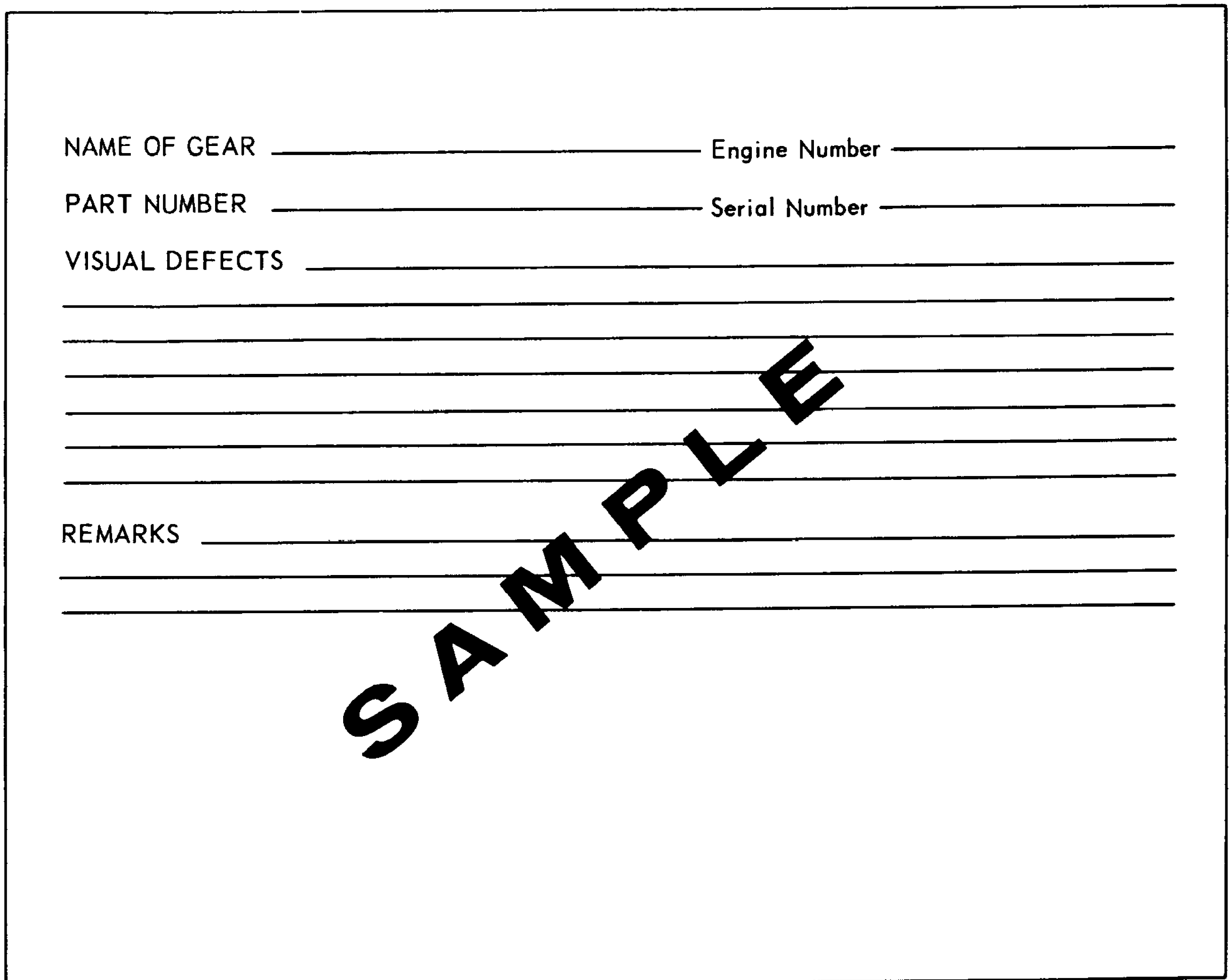



Measuring Spline Wear - Typical
Figure 1




Inner Bevel Accessory Drive Pinion Gear - Inspection Locations
Figure 2

UP781957


NAME OF GEAR ______ Engine Number ______
PART NUMBER ______ Serial Number ______
VISUAL DEFECTS ______
REMARKS ______
SAMPLE

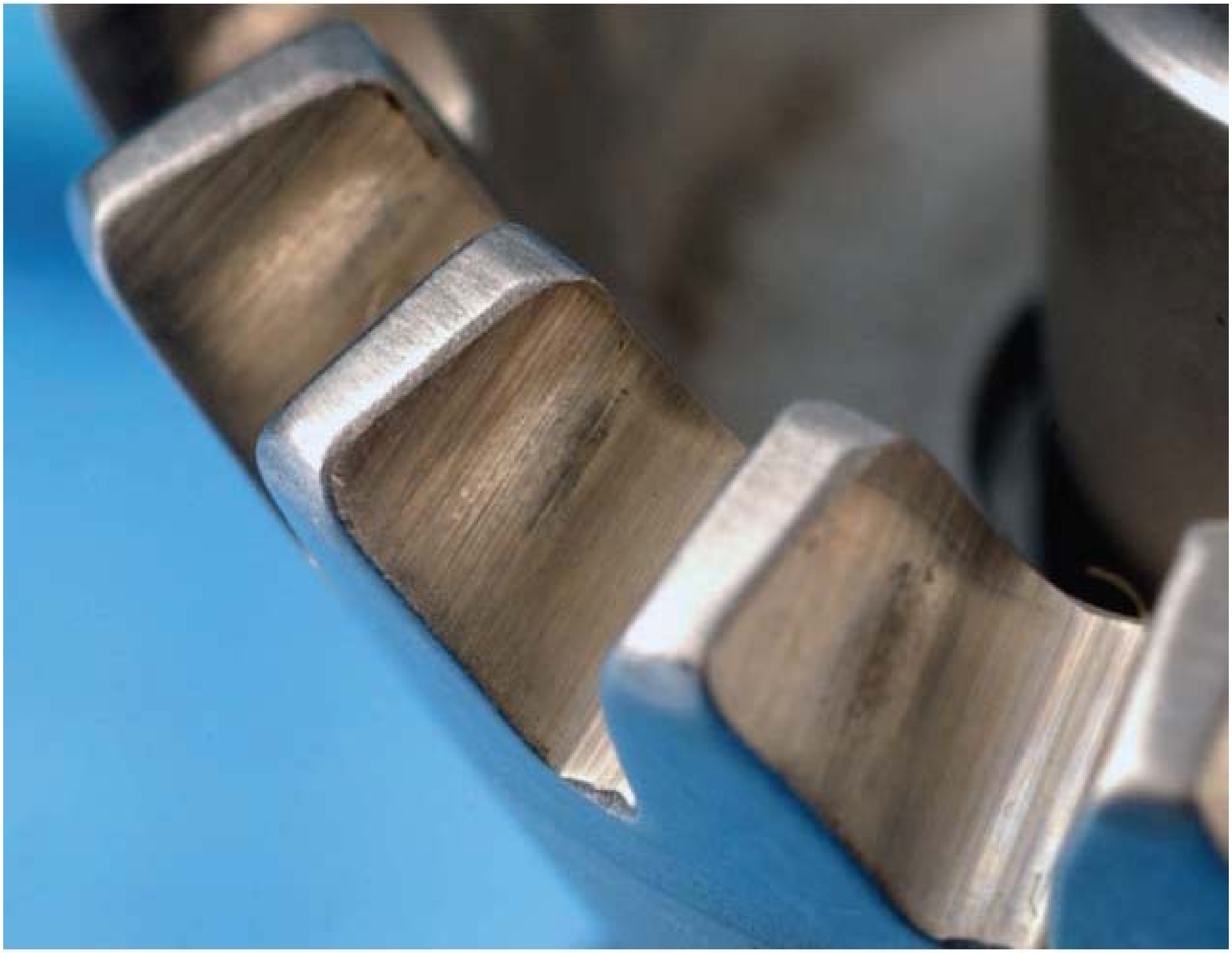
A2098

Gear and Splined Parts Inspection Report
Figure 3

No Wear, Grinding Lines (in Lead Direction) Still Visible.

Figure 4

UP781957



Grind lines visible across the contact area.  Lightly polished surface, good contact pattern.

Initial Light Wear In

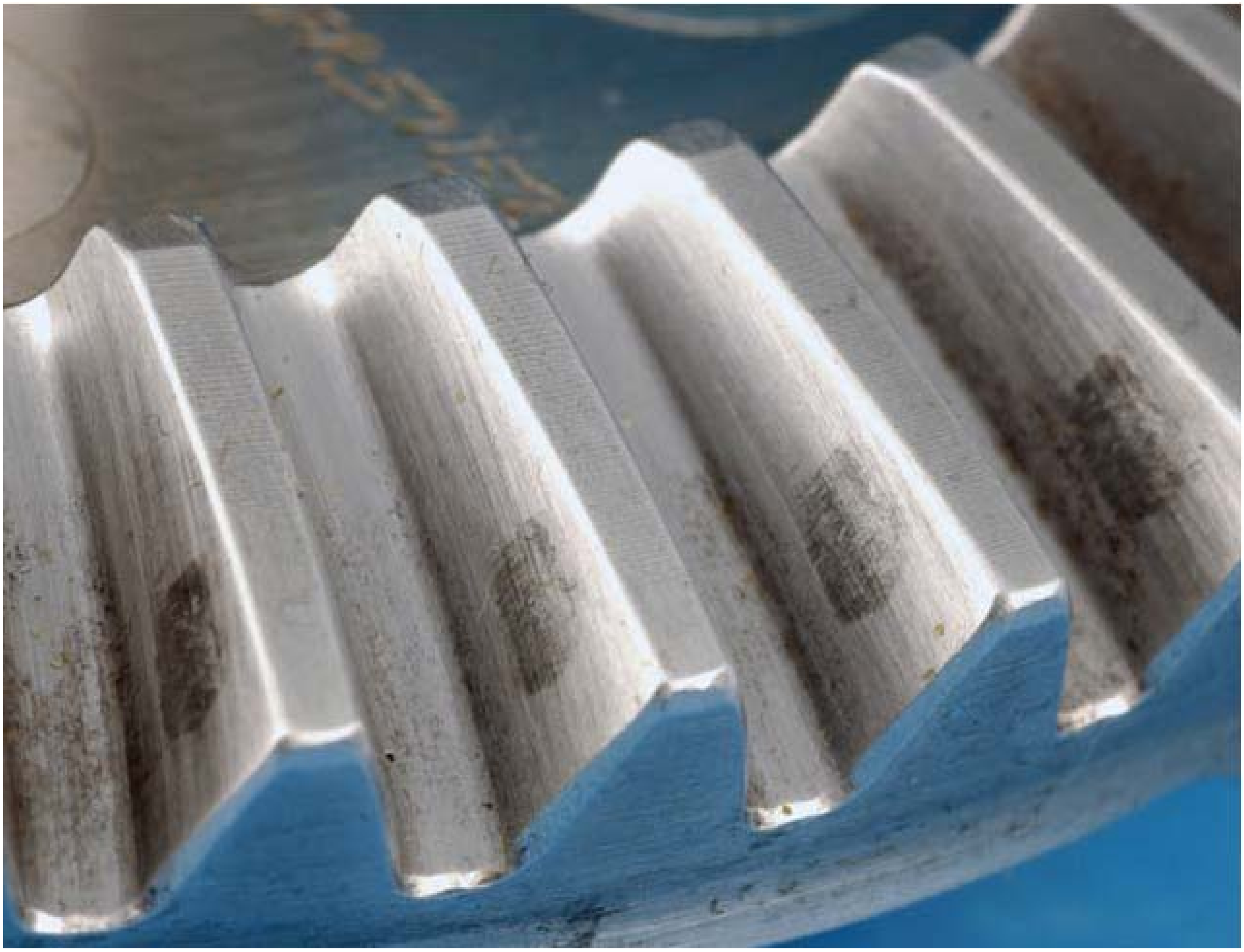
Figure 5  (Sheet 1 of 2)

UP781957

No significant amount of material removed from the tooth surface. Good contact pattern. The surface is smooth, no wear steps are present.

Initial Light Wear In

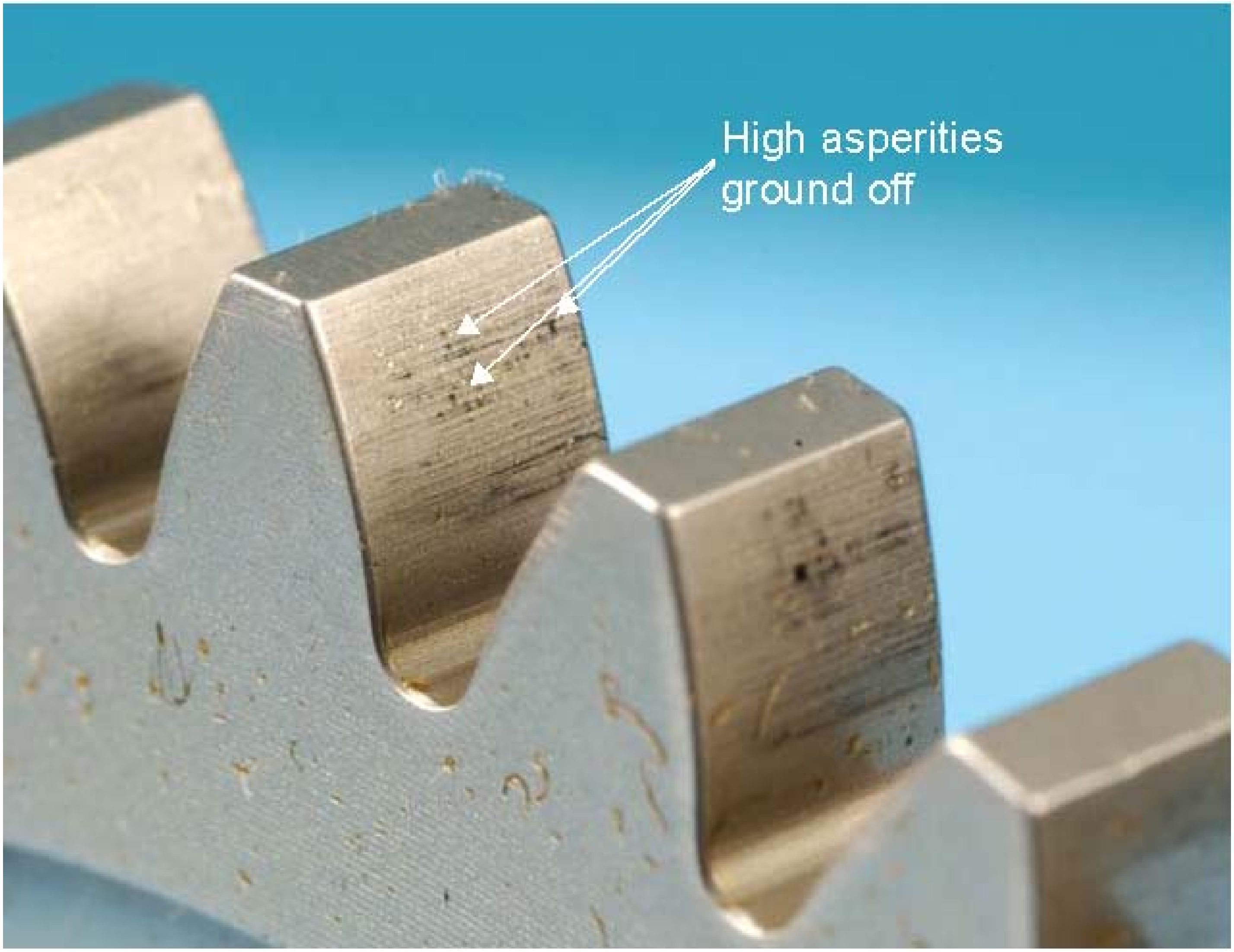
Figure 5 (Sheet 2 of 2)



Grinding lines are visible across the contact area.

Very Light Contact Pattern, No Wear

Figure 6

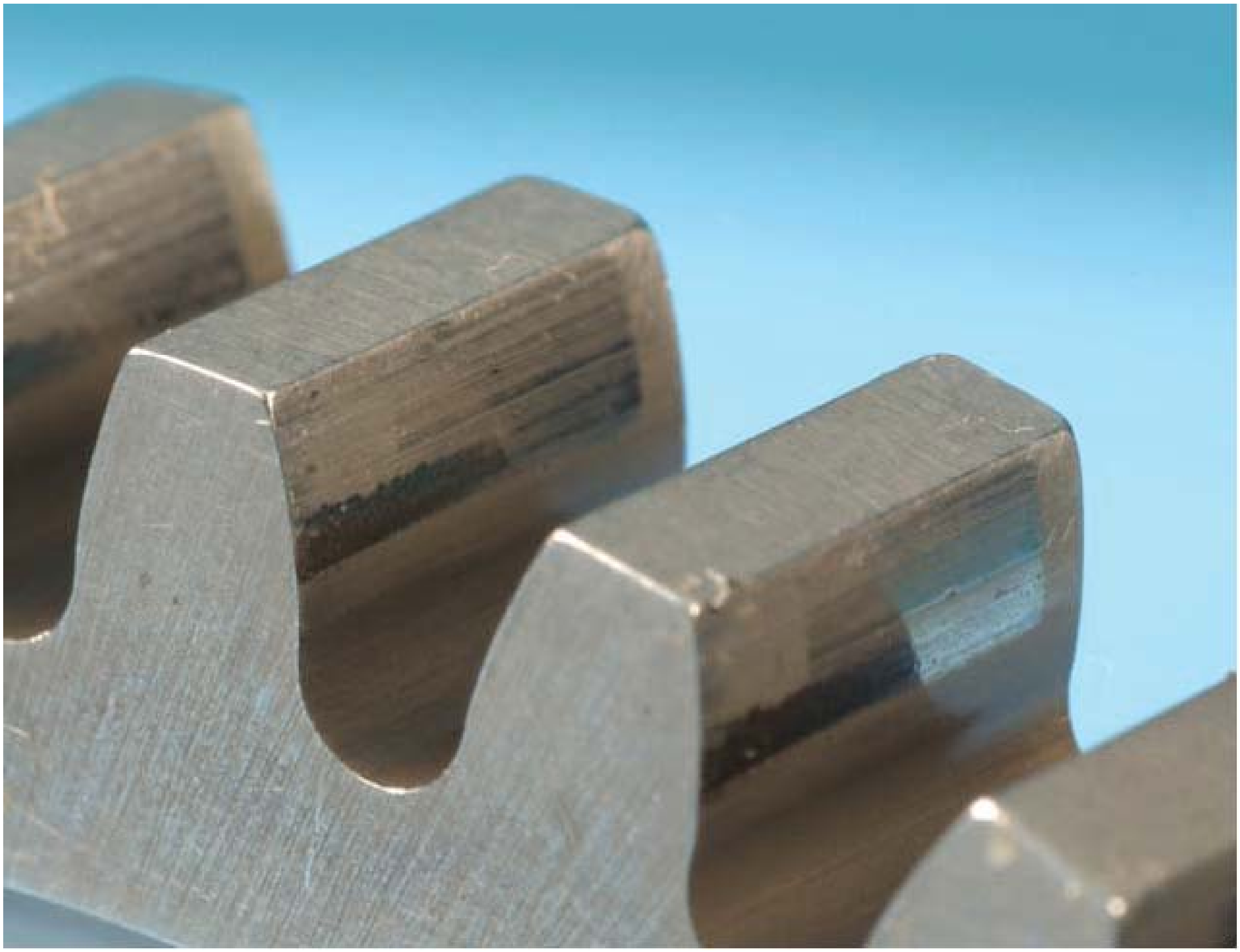



Shiny spots represent high asperities on the tooth surface that were polished off.

Very Light Initial Tooth Wear

Figure 7

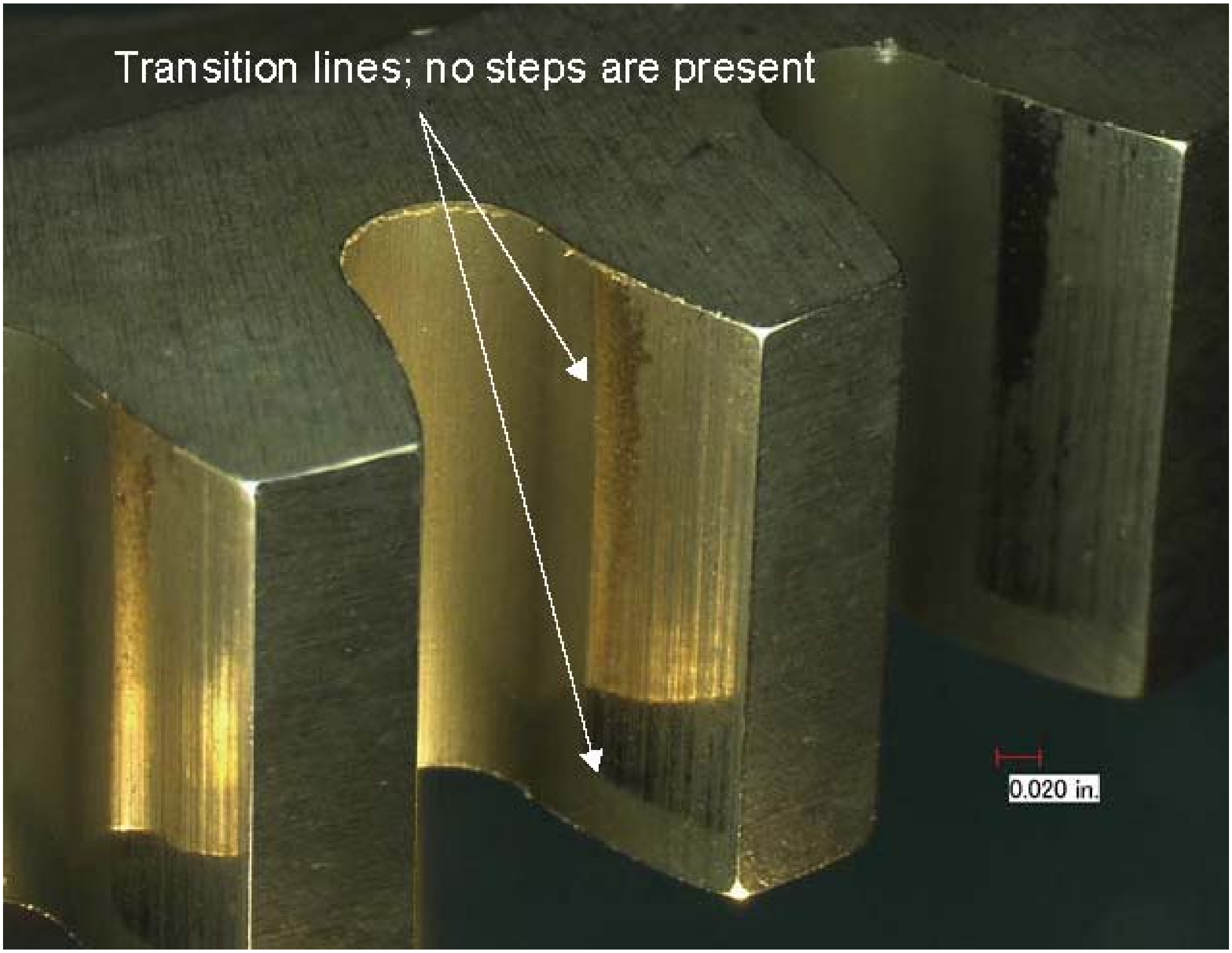
UP781957



Polished tooth surface, only high asperities removed from the surface. Grinding lines are visible.

Initial Very Light Wear In

Figure 8

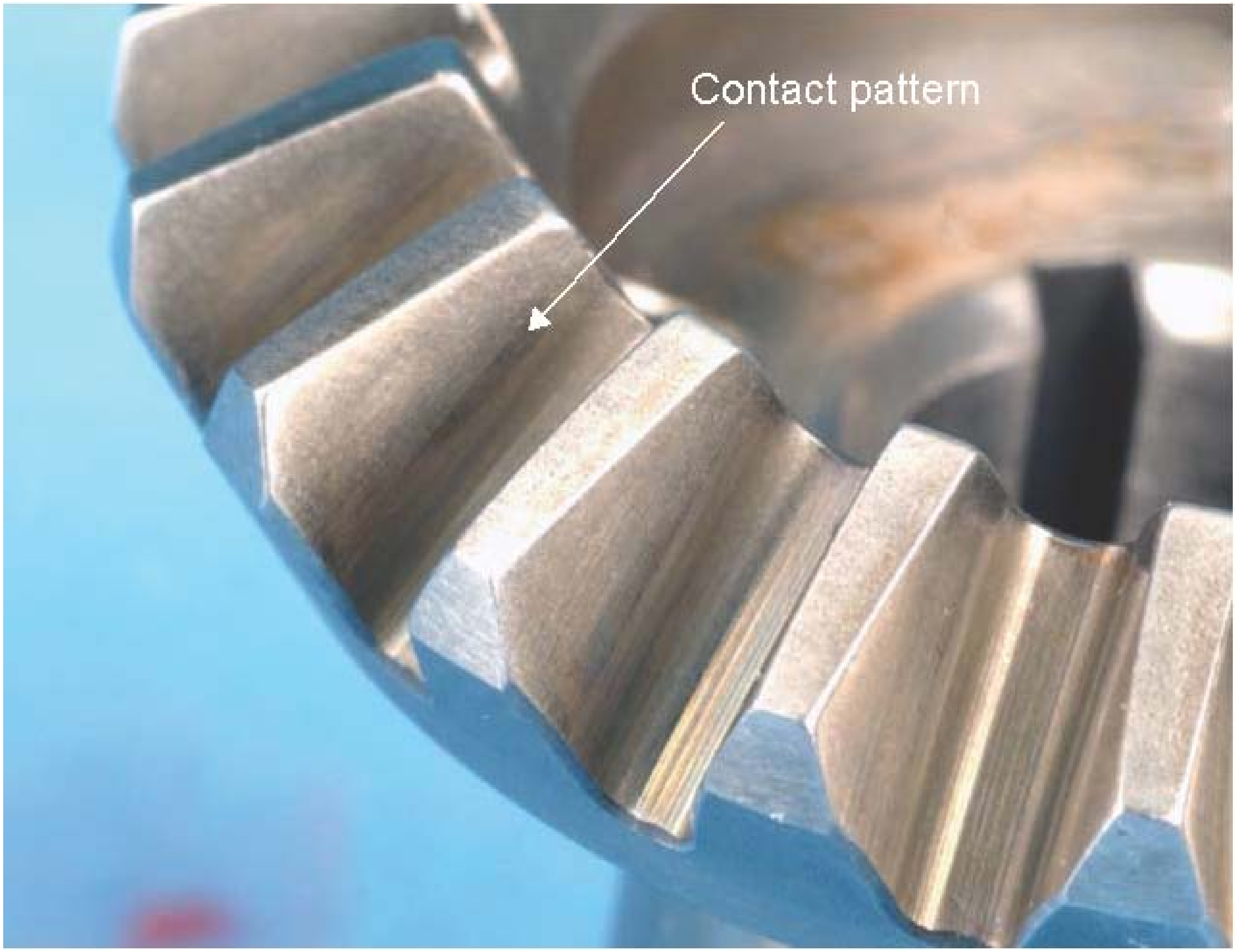



No wear on the tooth surface. Transition line between shiny, polished surface where contact with the mating gear occurs and the rest of the tooth is smooth. No step is present indicating a minimal amount of wear.

High Tooth Asperities are Polished Off
Revealing Contact Surface Area with Meshing Gear

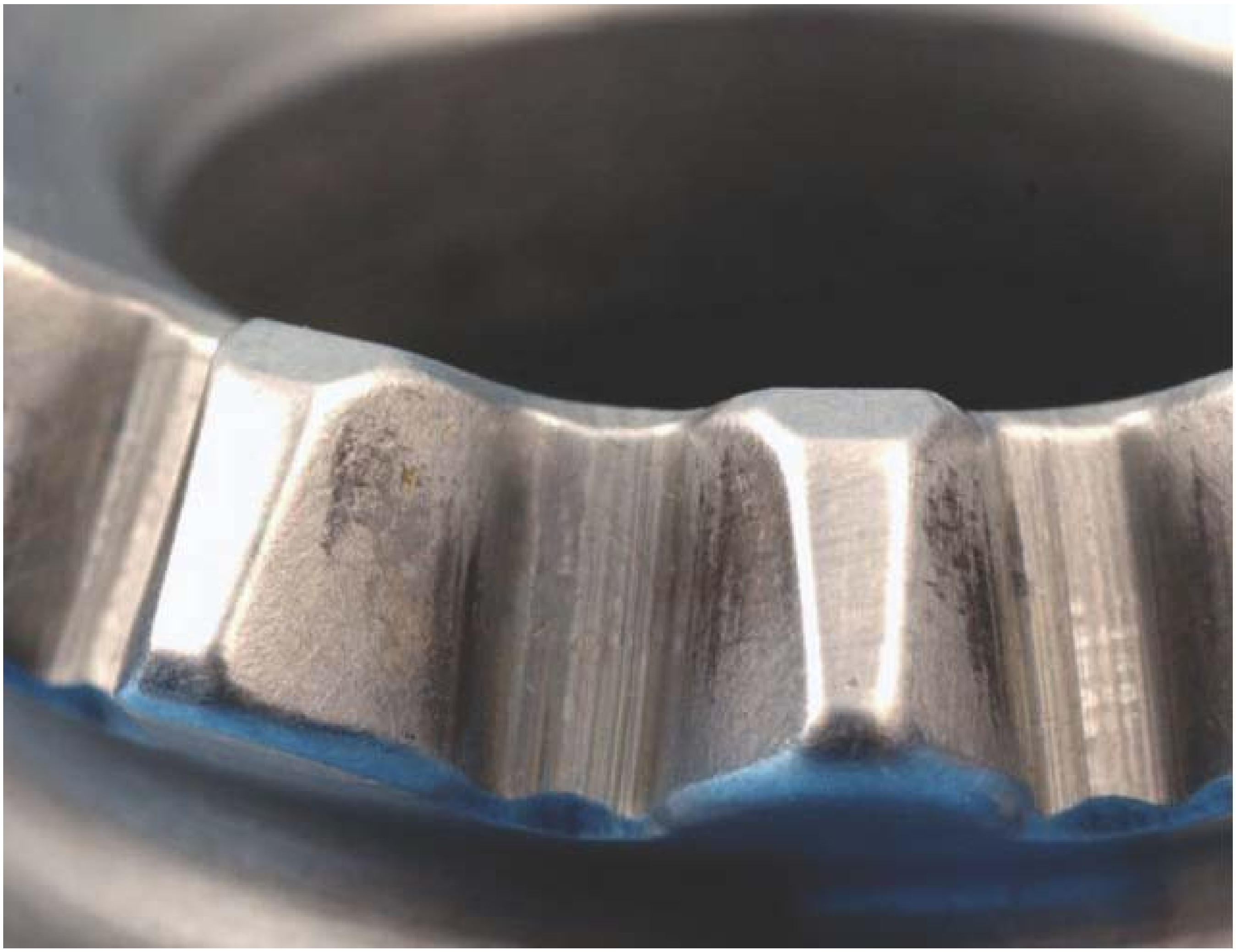
Figure 9

UP781957




Light Initial Wear, Good Contact Pattern

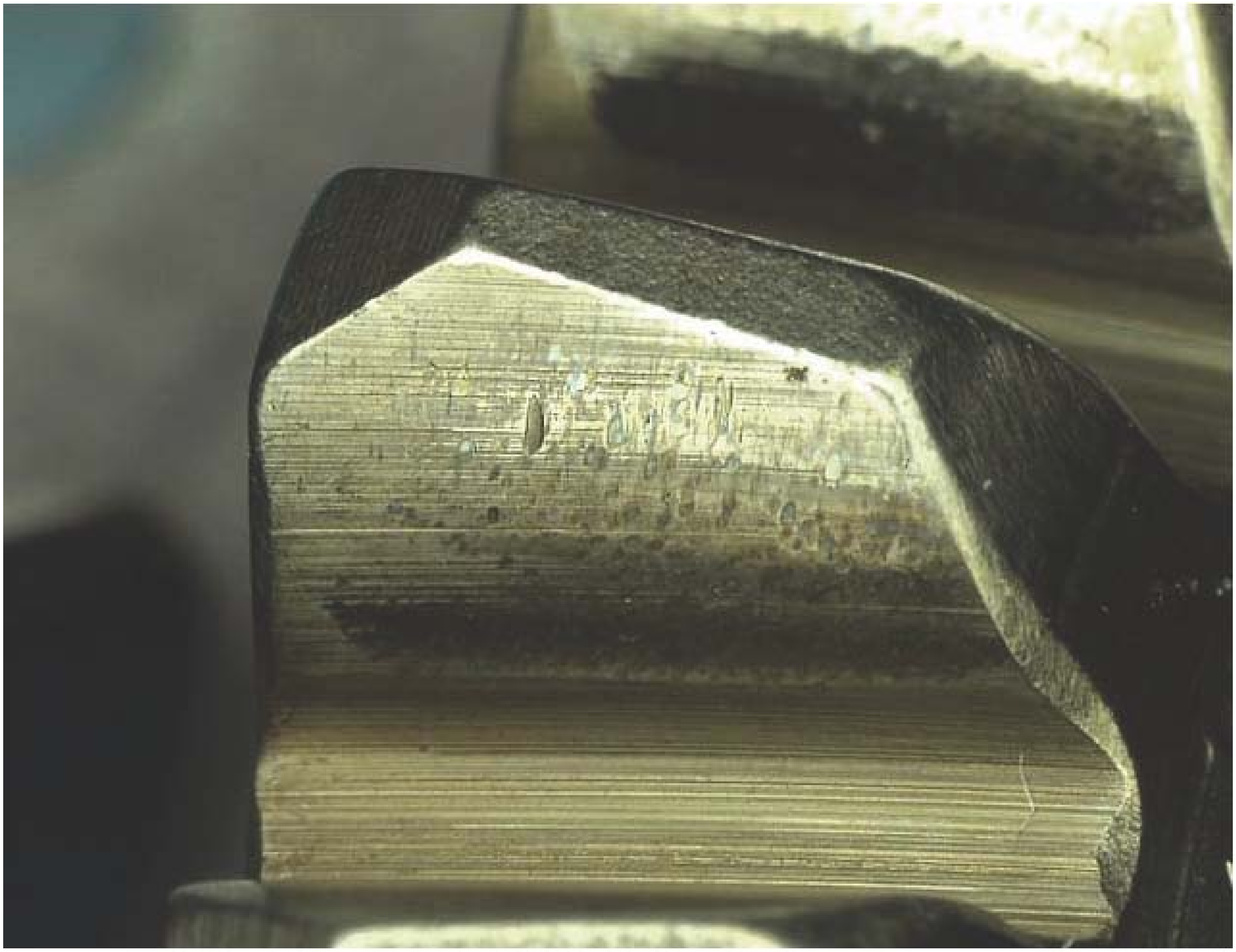
Figure 10



Good Tooth Pattern, High Asperities Polished Off

Figure 11

UP781957



Localized, Shallow Surface Imperfections, Light Wear

Figure 12

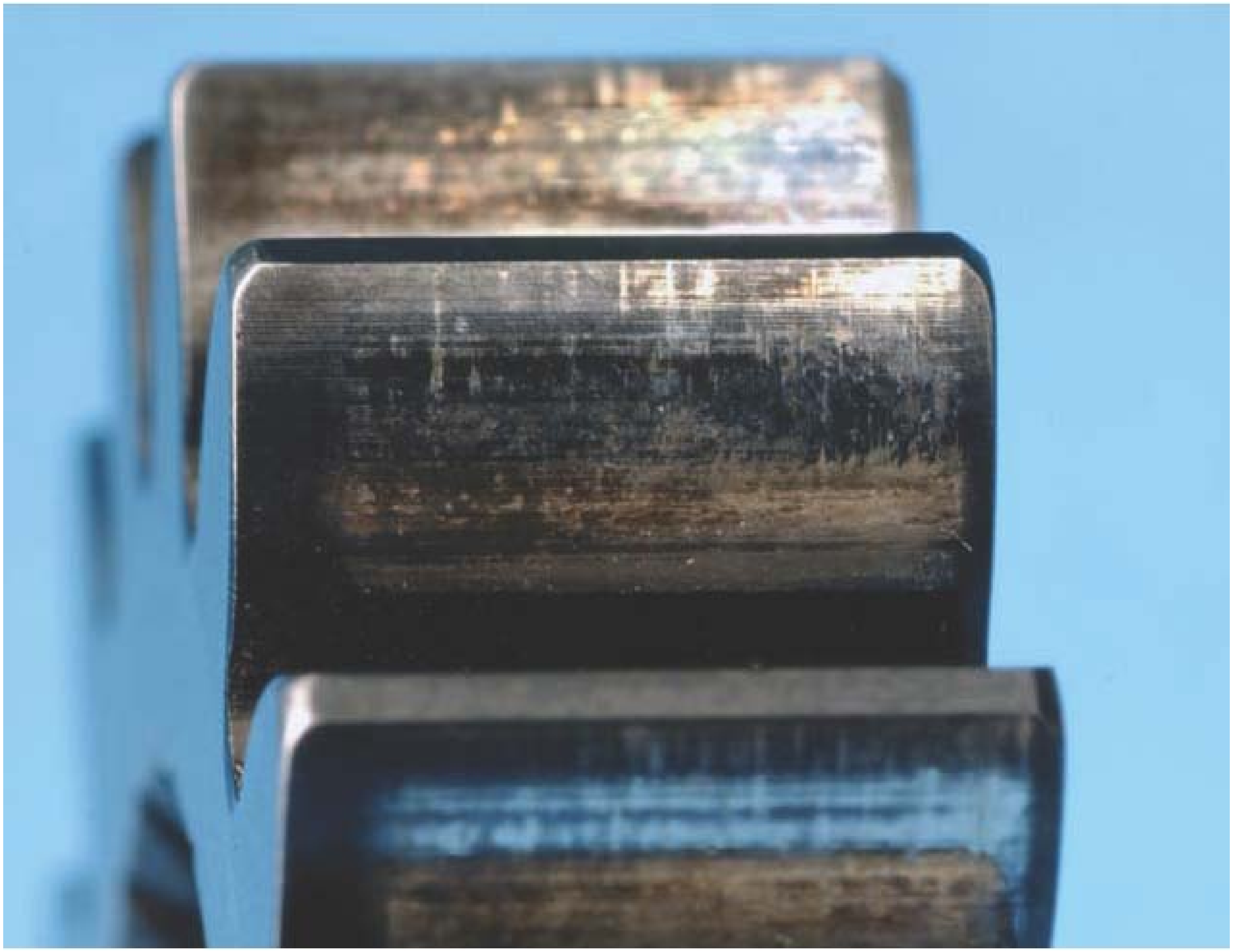
UP781957

Grind lines are visible across the entire tooth width.

Very Light Initial Wear, Good Contact Pattern

Figure 13

UP781957

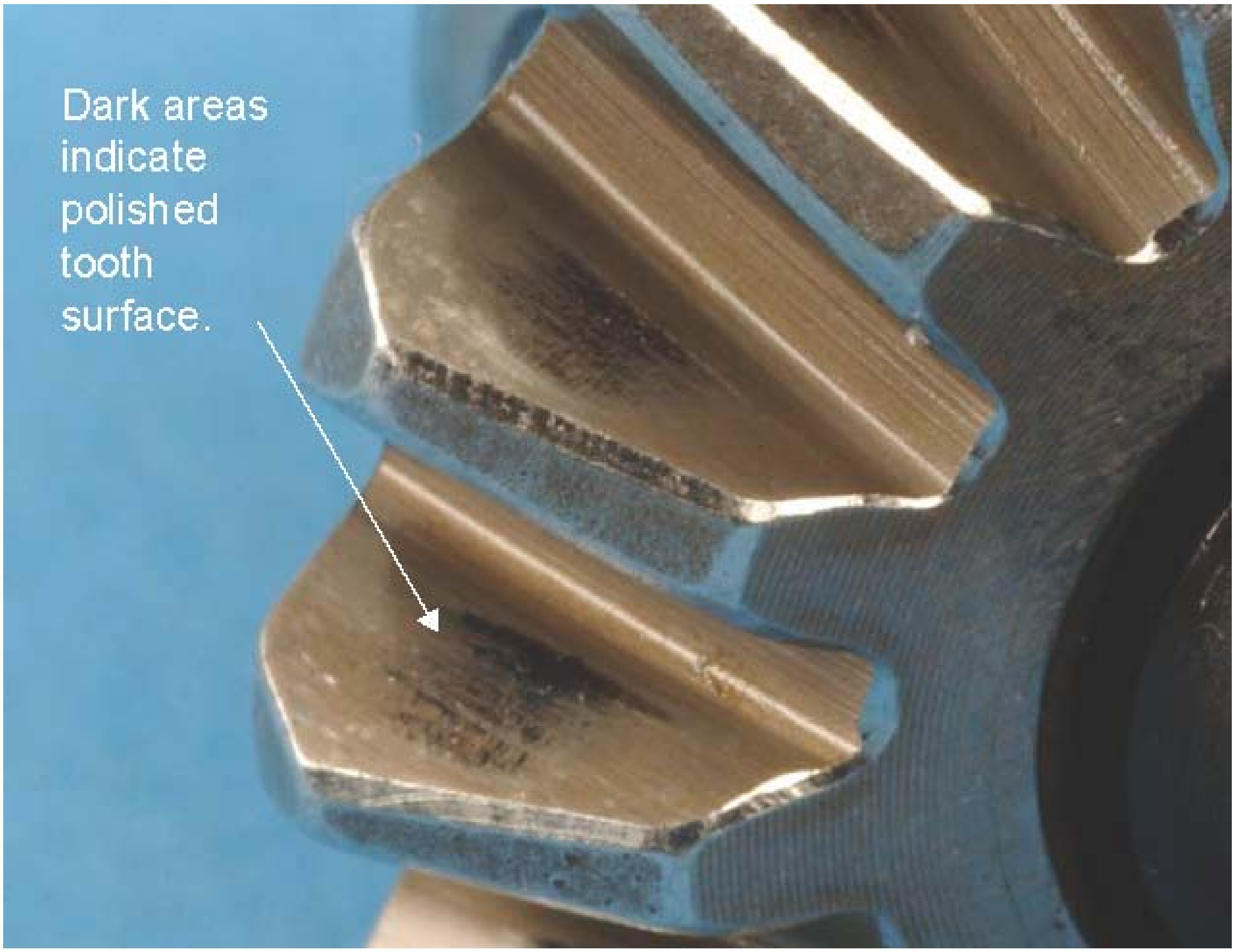


Black oxide is removed.

Very Light Wear; Grinding Pattern Lines Still Visible

Figure 14

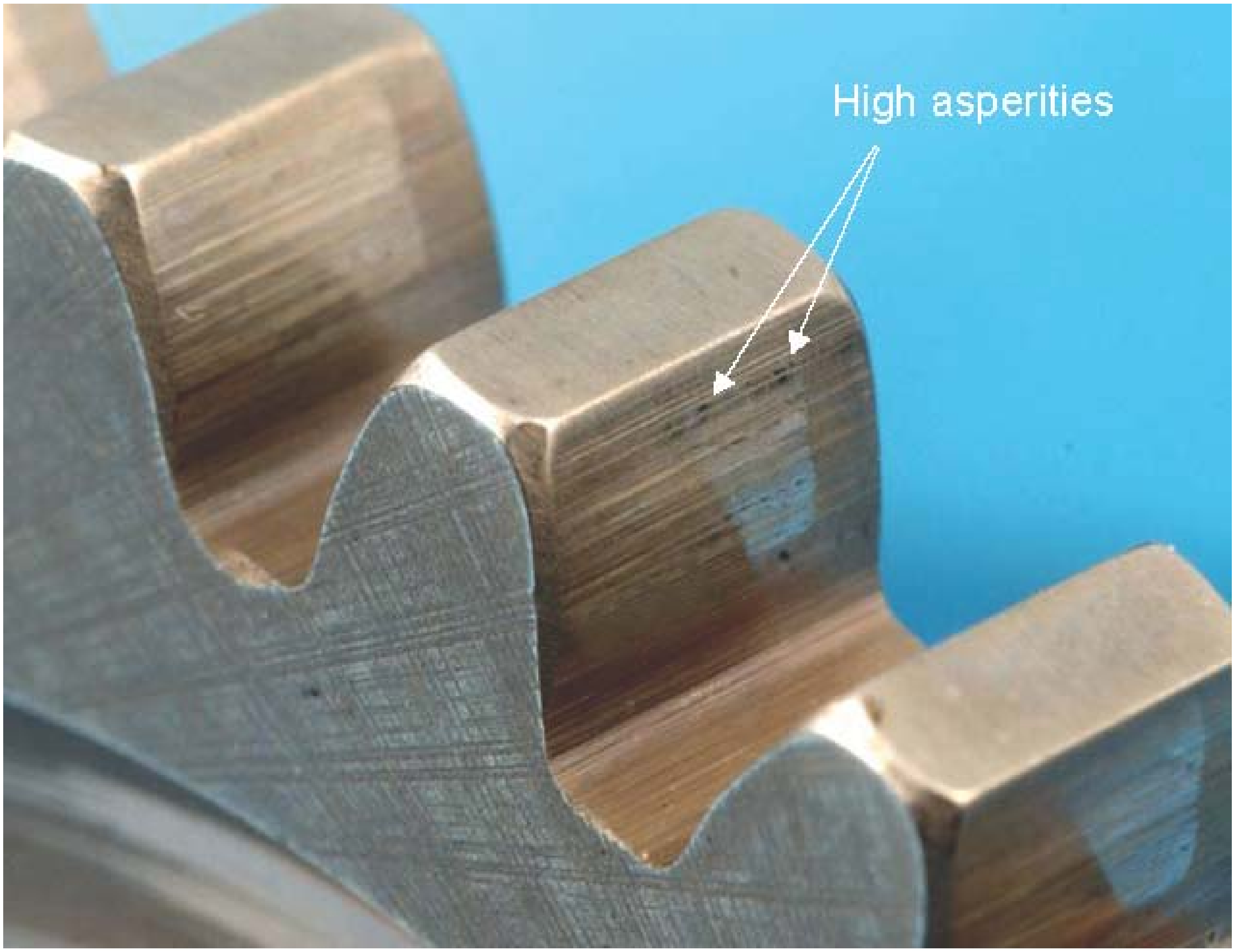
UP781957




Initial Wear In, Good Contact Pattern

Figure 15

UP781957

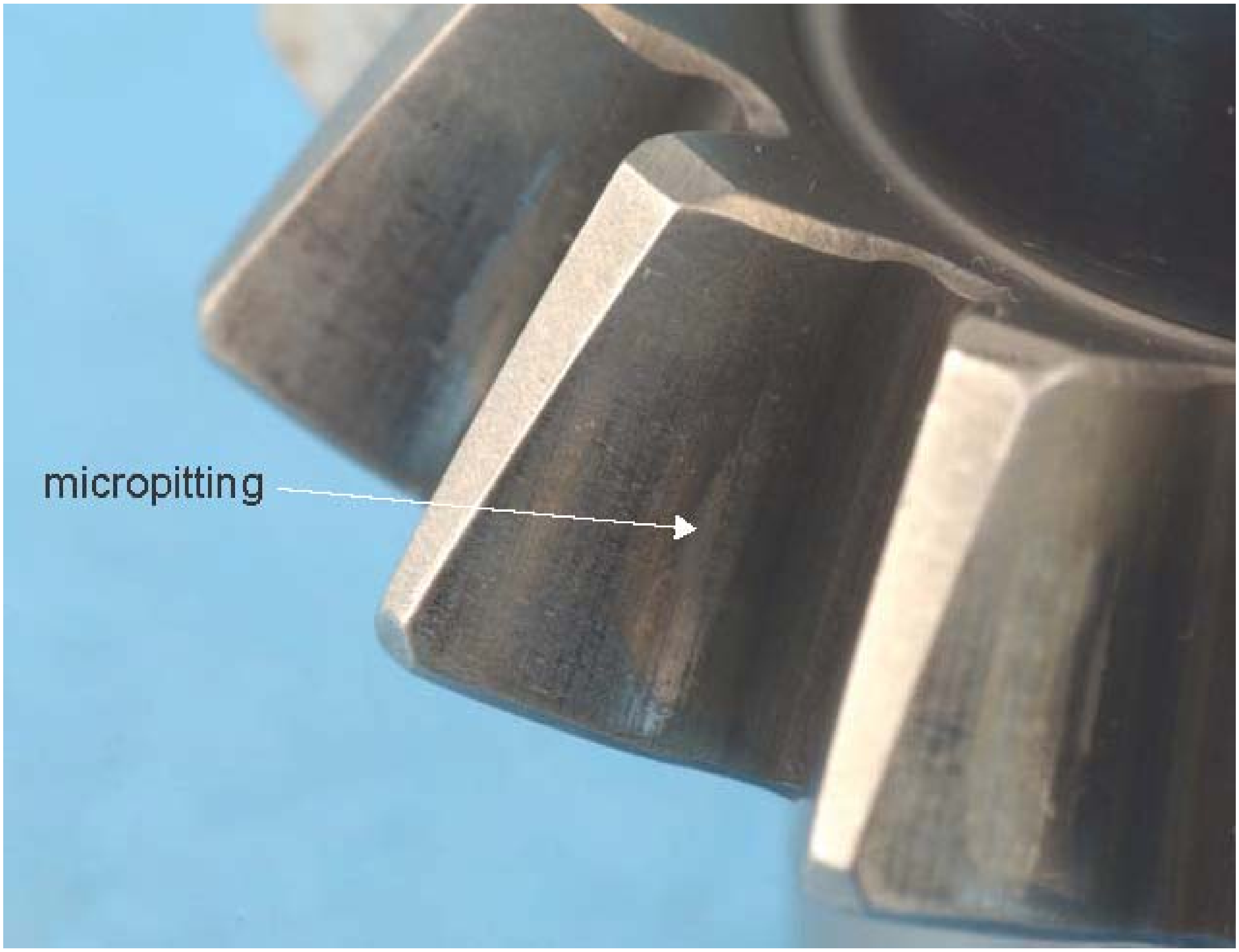



Shiny spots represent high asperities on the tooth surface that were polished off.
Grinding lines still visible (in the lead direction) across the tooth surface.

Very Light Initial Wear In

Figure 16

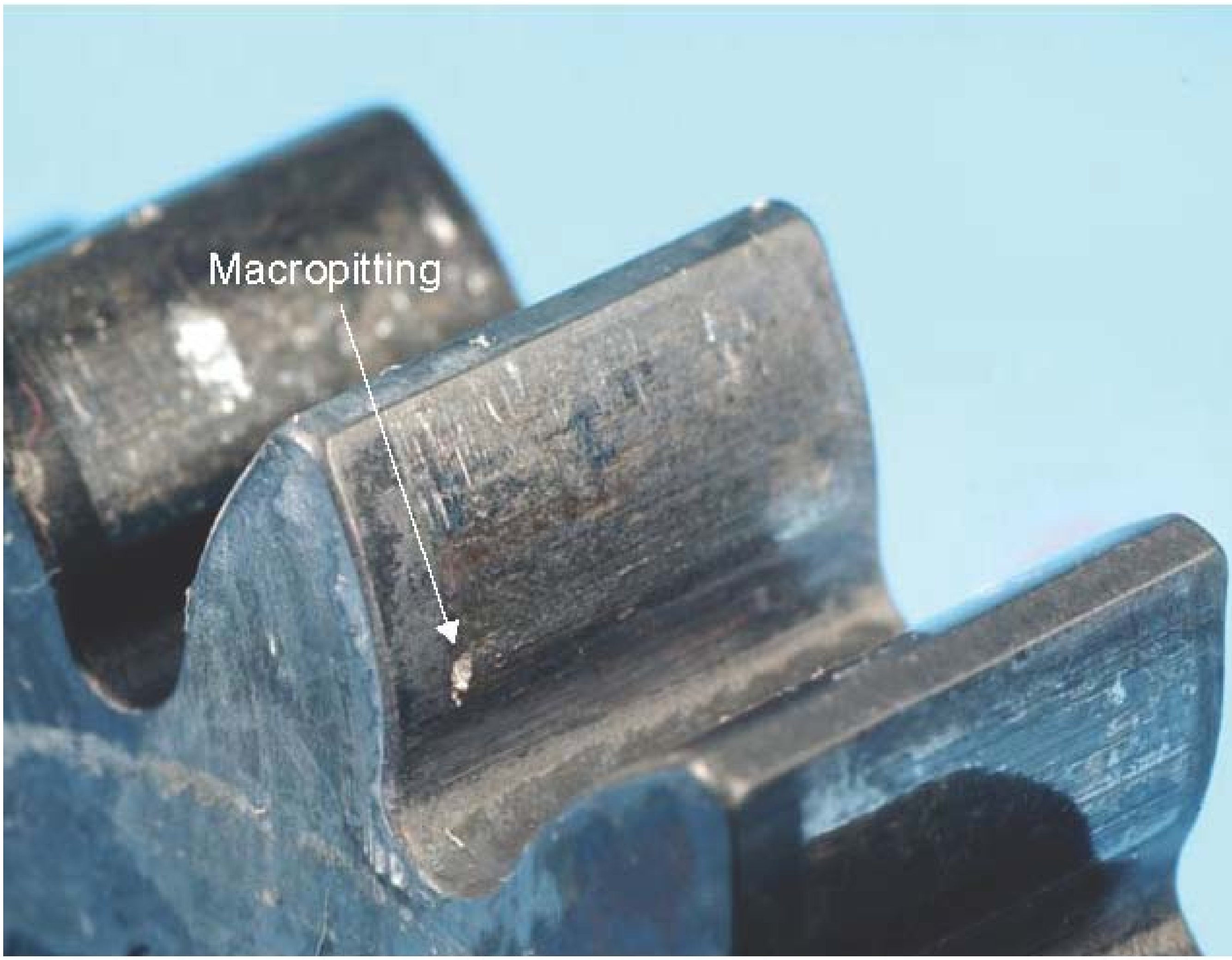
UP781957




Grind lines are still visible across the contact pattern area indicating minimal surface wear.

Light Micropitting, Good Contact Pattern

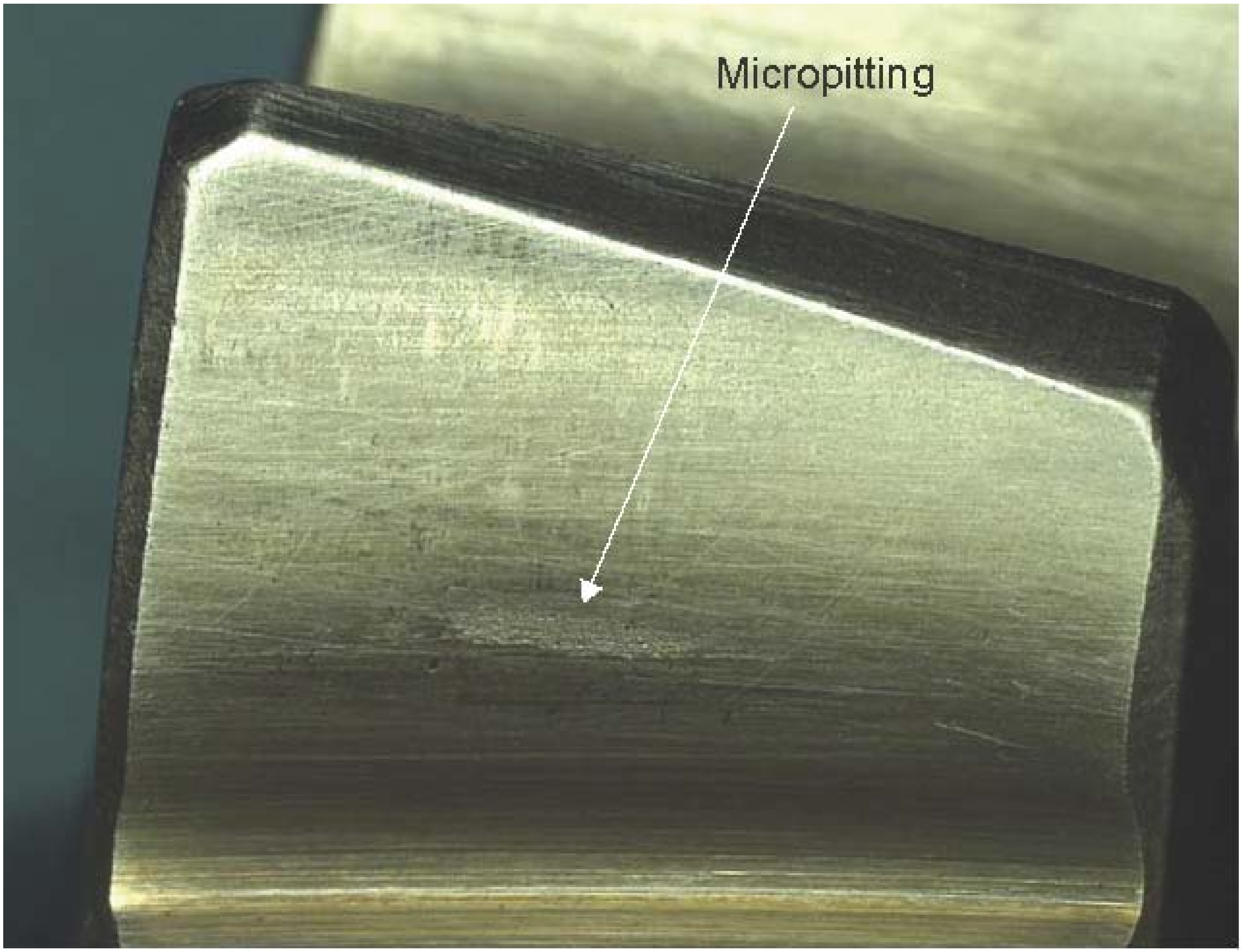
Figure 17




No Wear On Tooth Surface, Initial Light Macropitting

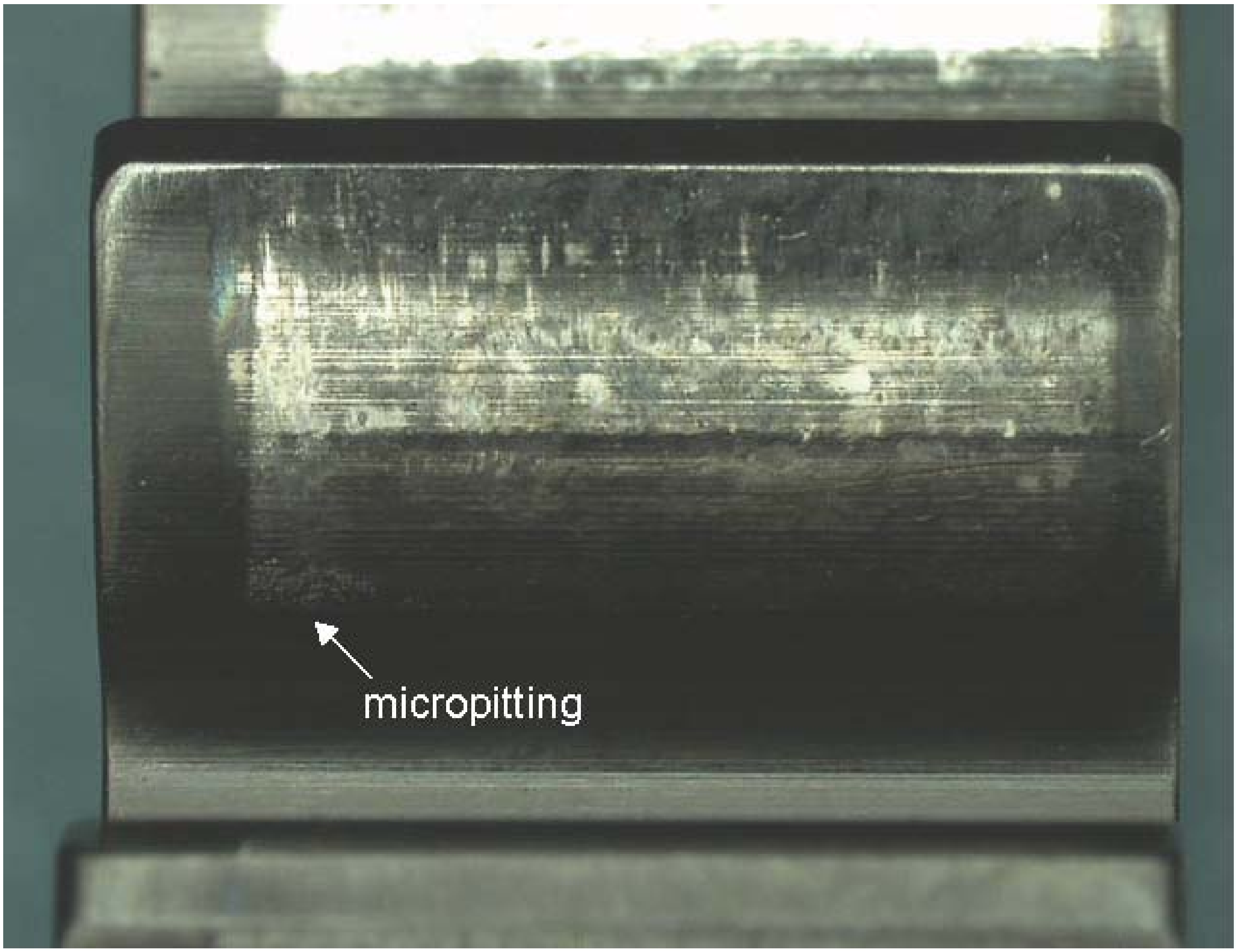
Figure 18

UP781957




Light Micropitting, Tooth Profile Is Not Affected

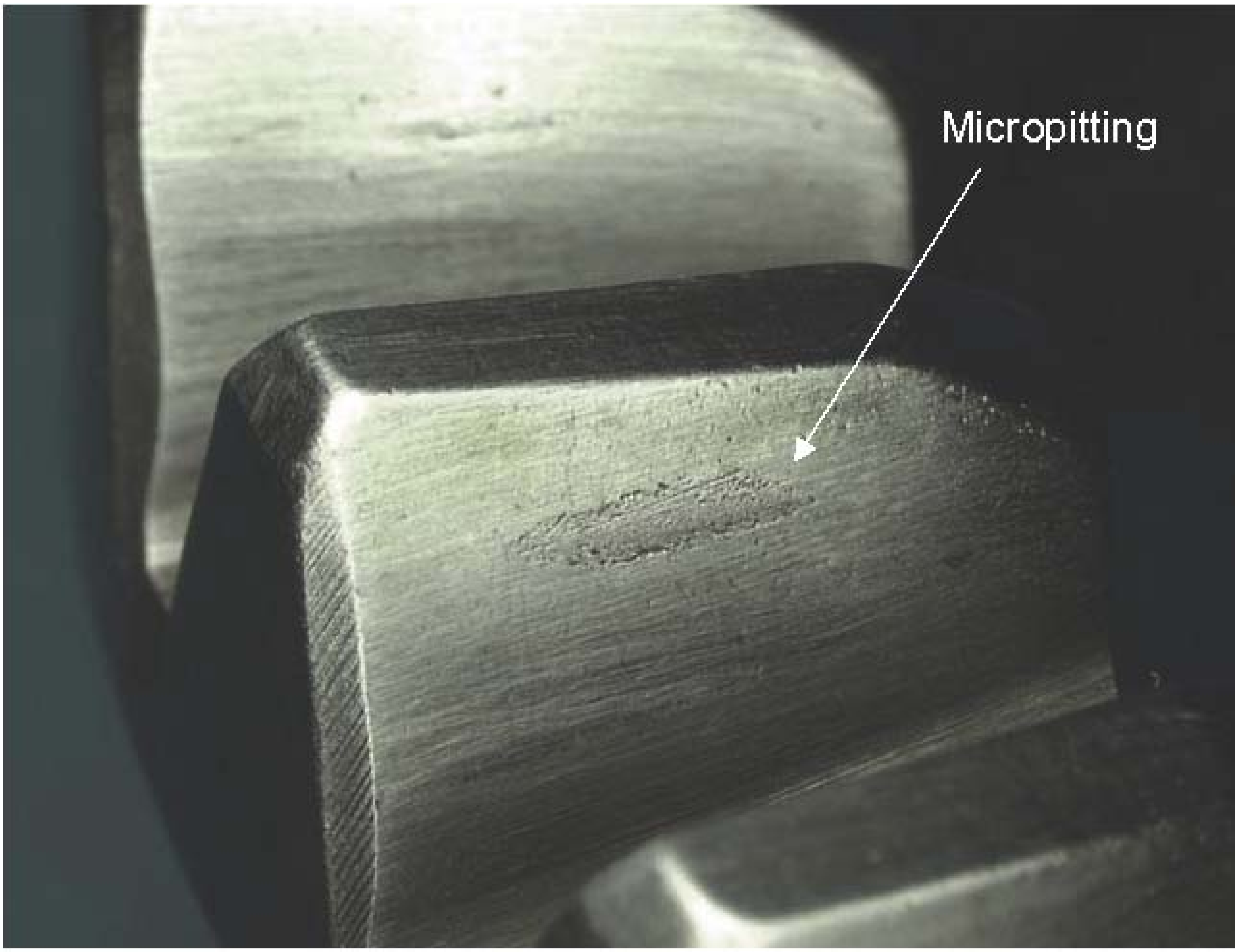
Figure 19




Initial Light Micropitting

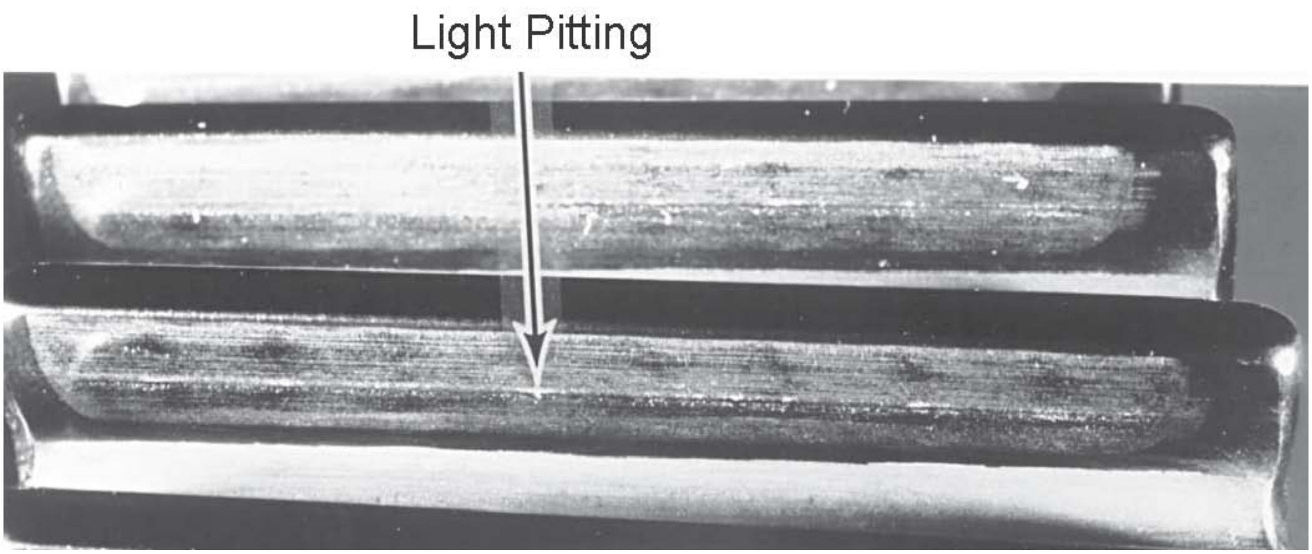
Figure 20 (Sheet 1 of 2)

UP781957




Initial Light Micropitting

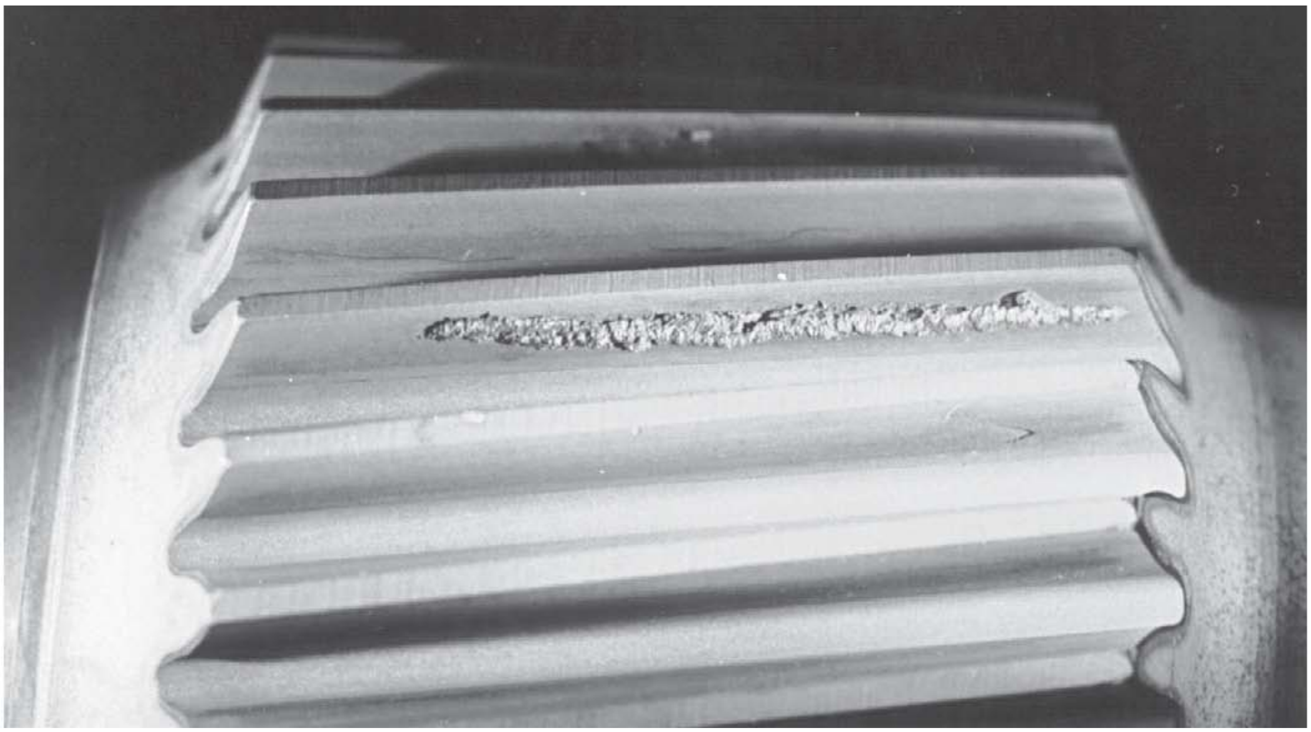
Figure 20 (Sheet 2 of 2)




Light Pitting

Figure 21

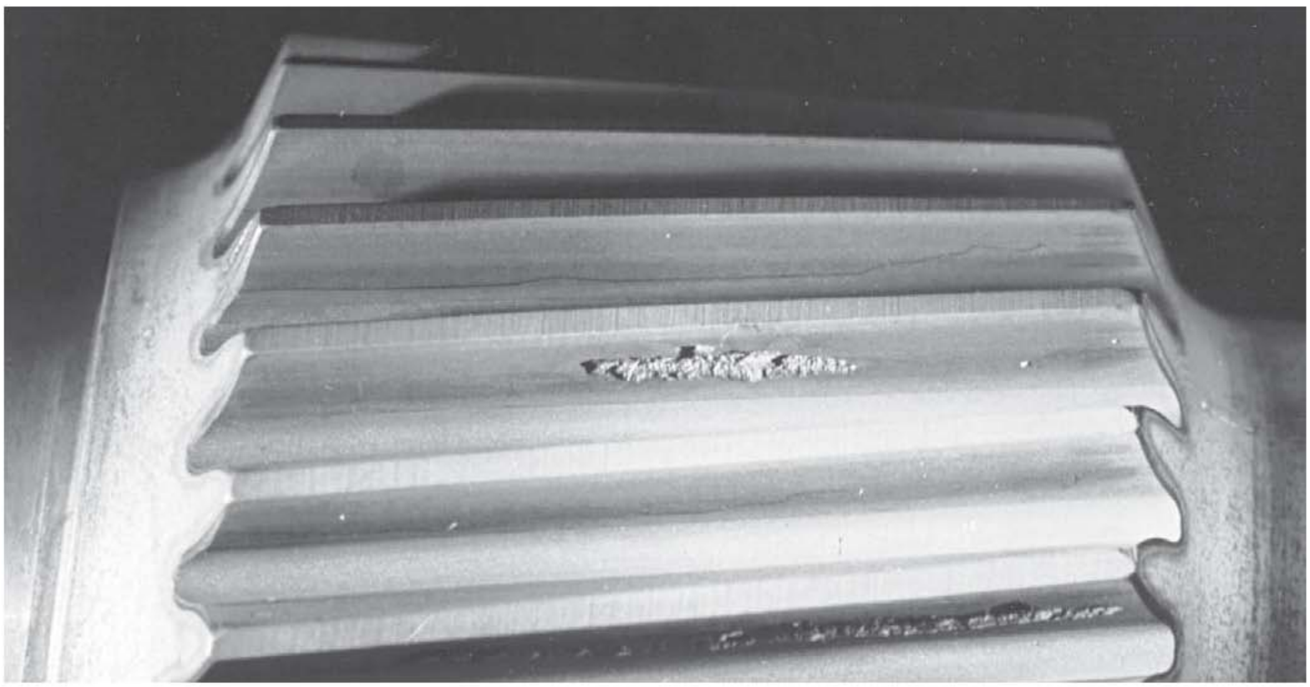
UP781957



Spalling Due to Temper

Figure 22 (Sheet 1 of 2)

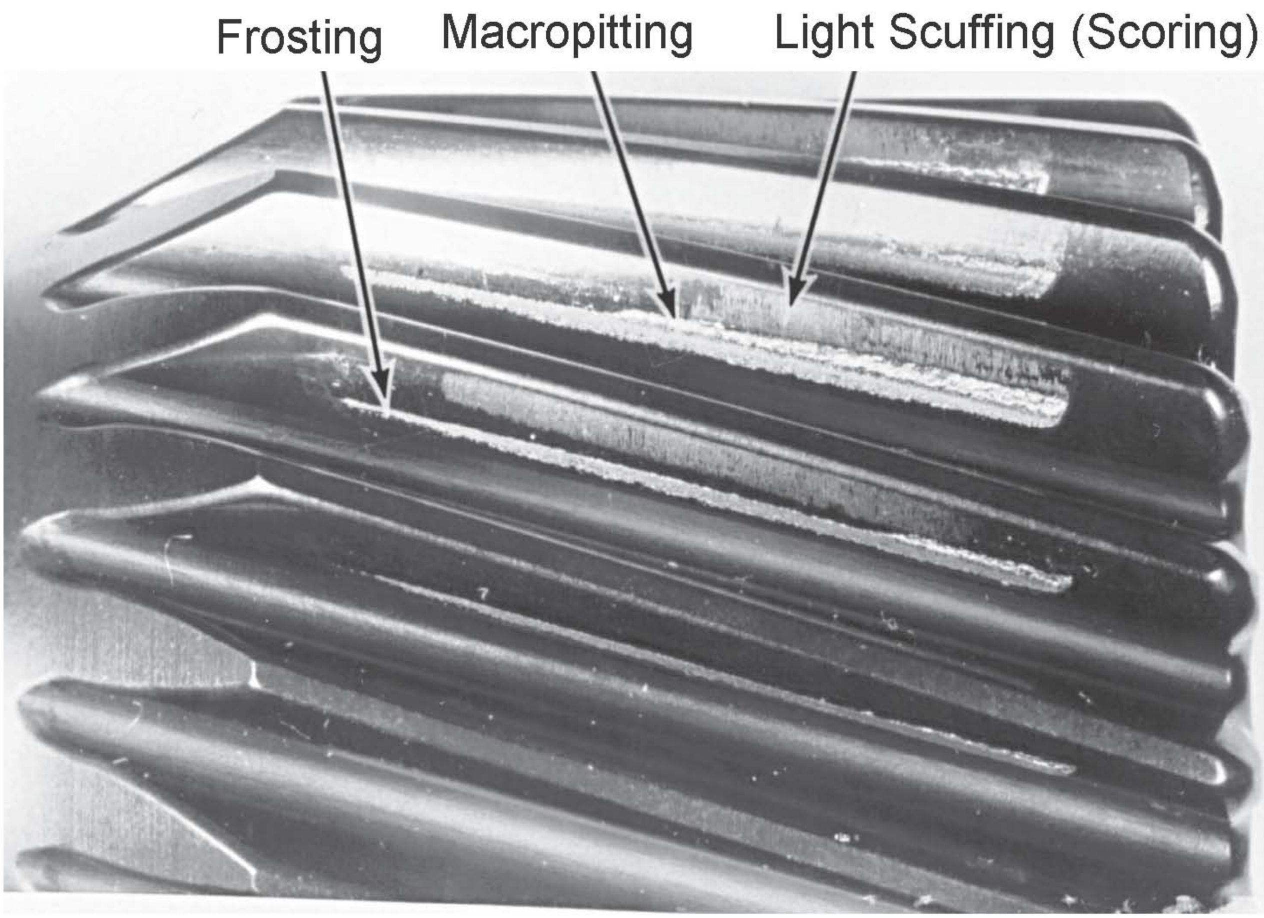
UP781957



Spalling Due to Temper

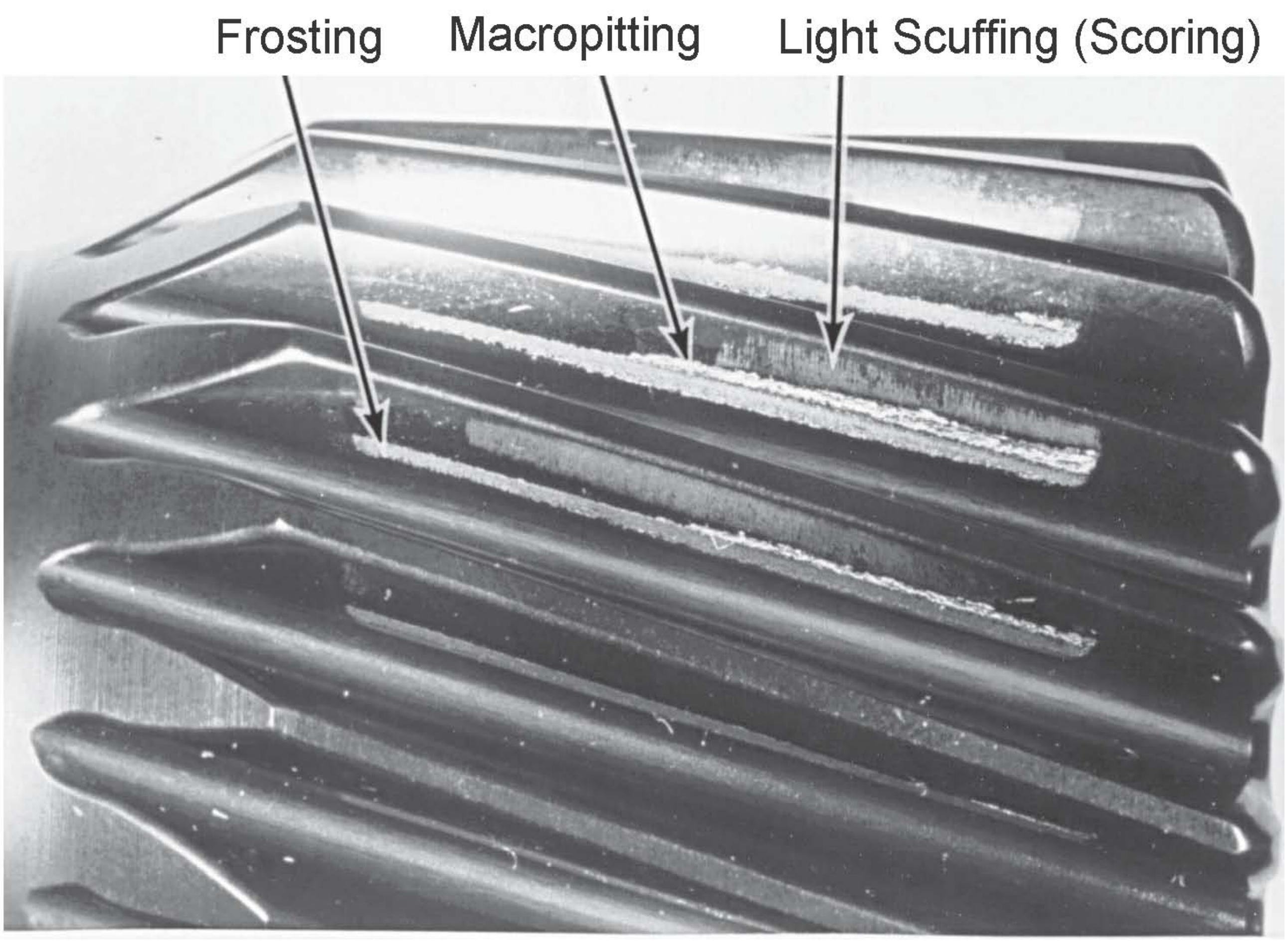
Figure 22 (Sheet 2 of 2)

UP781957




Combined Scuffing Frosting and Pitting

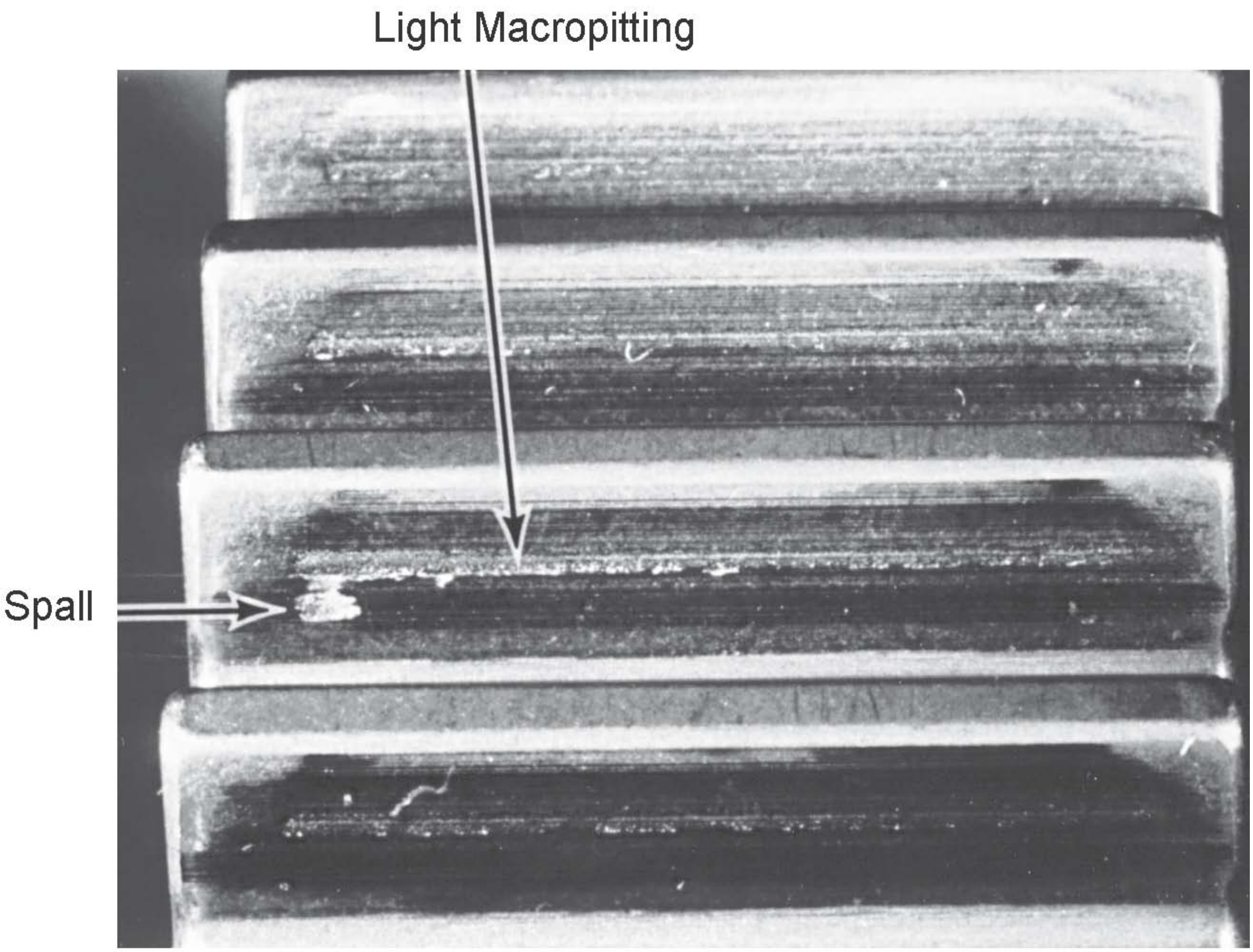
Figure 23 (Sheet 1 of 2)




Combined Scuffing Frosting and Pitting

Figure 23 (Sheet 2 of 2)

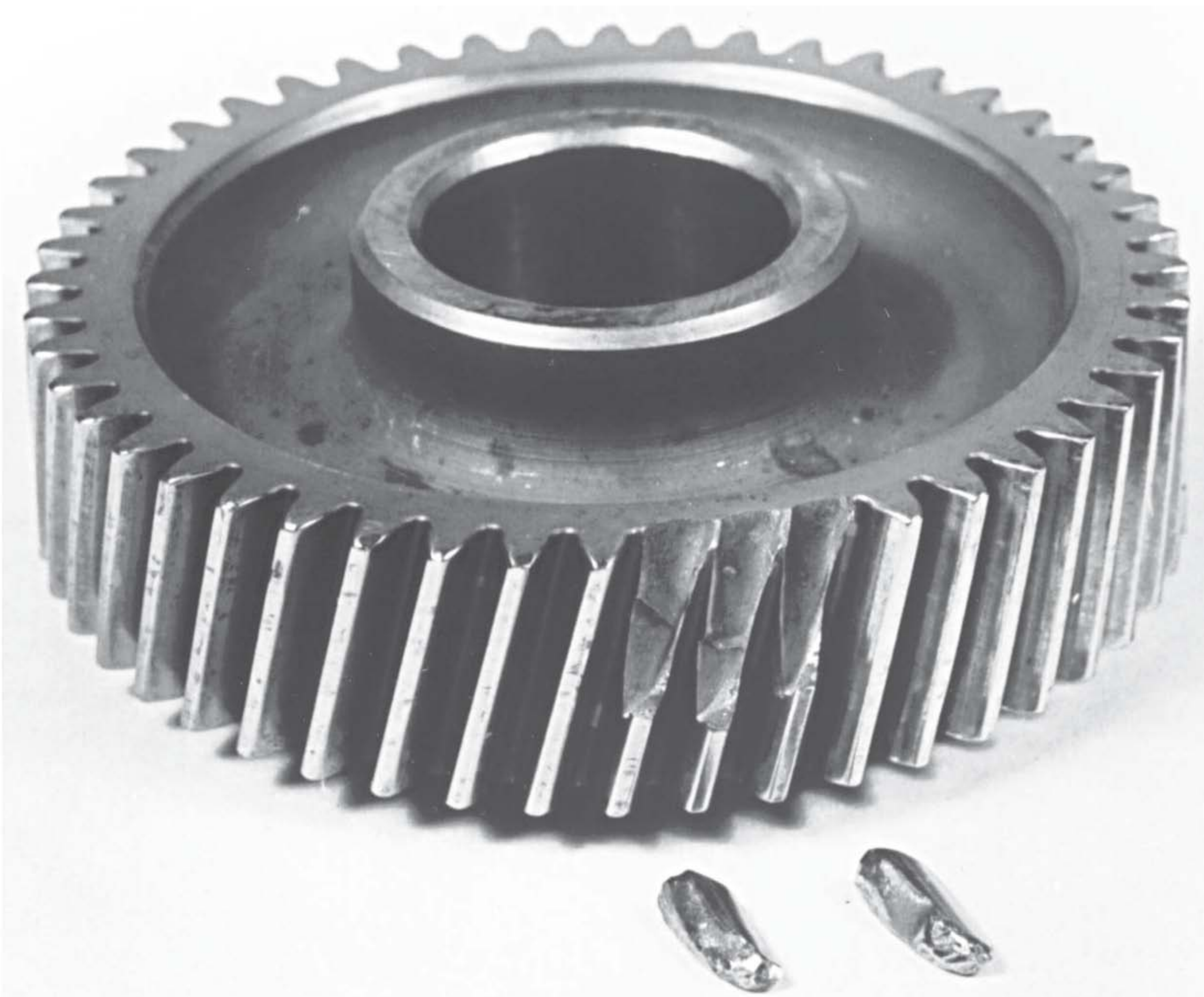
UP781957




Combined Light Pitting and One Spall

Figure 24

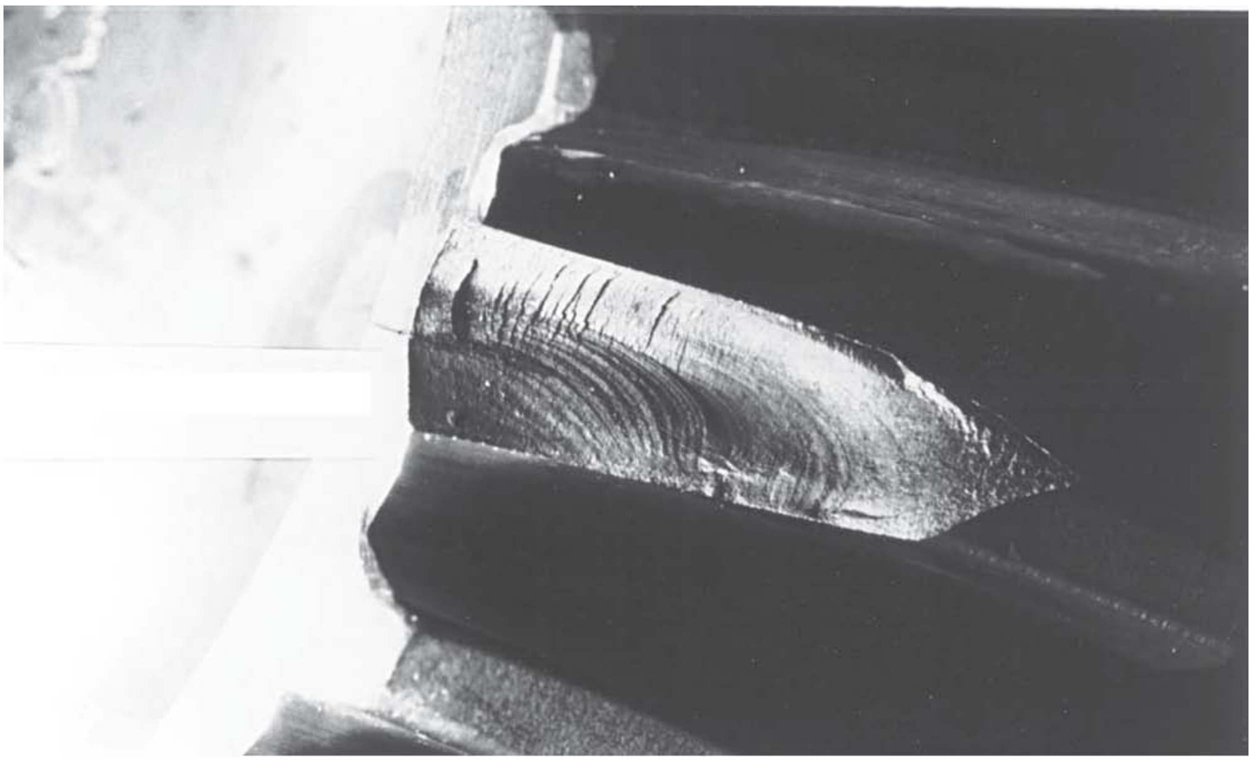
UP781957



Tooth Breakage

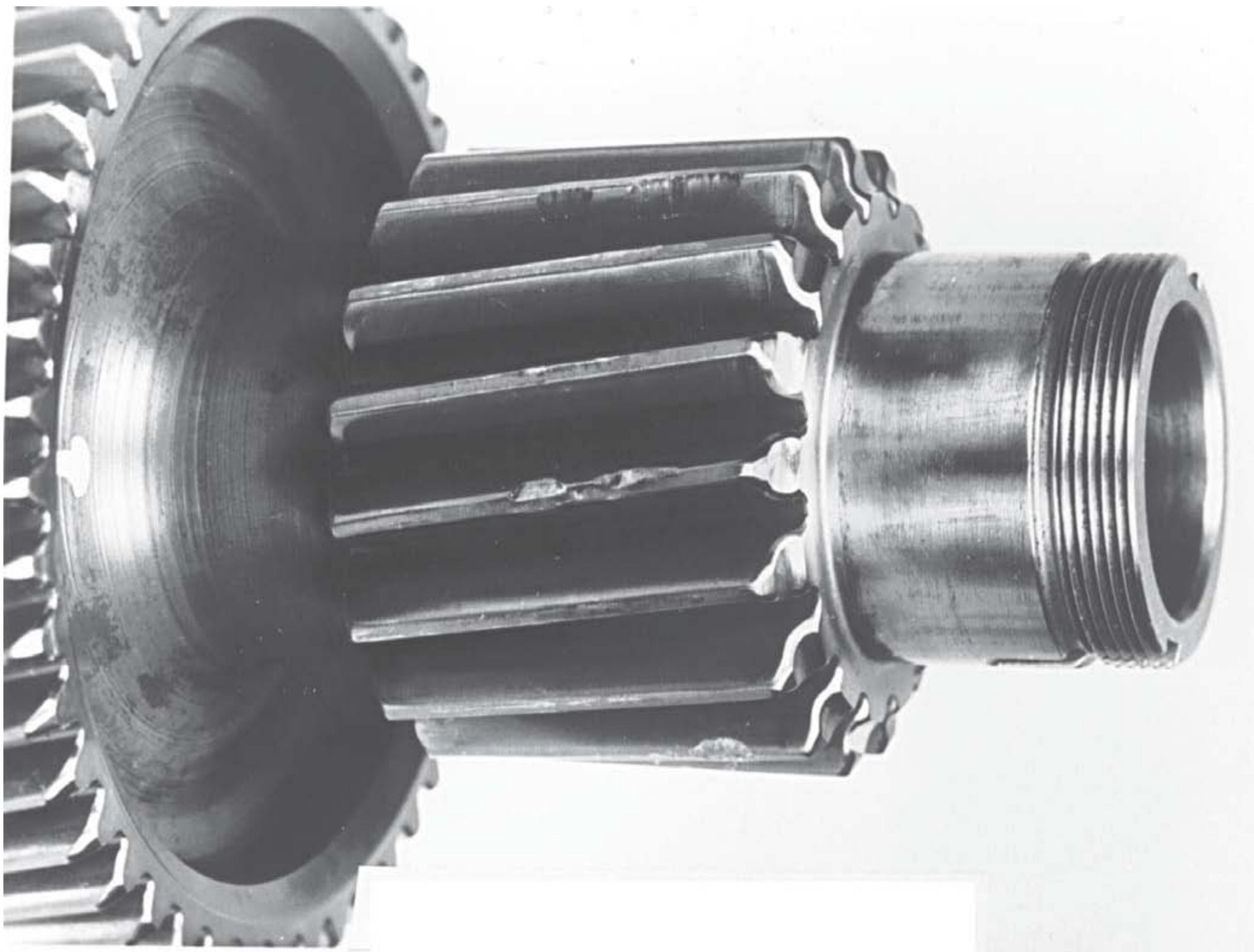
Figure 25

UP781957



Fatigue Clamshell and Cracked Rim

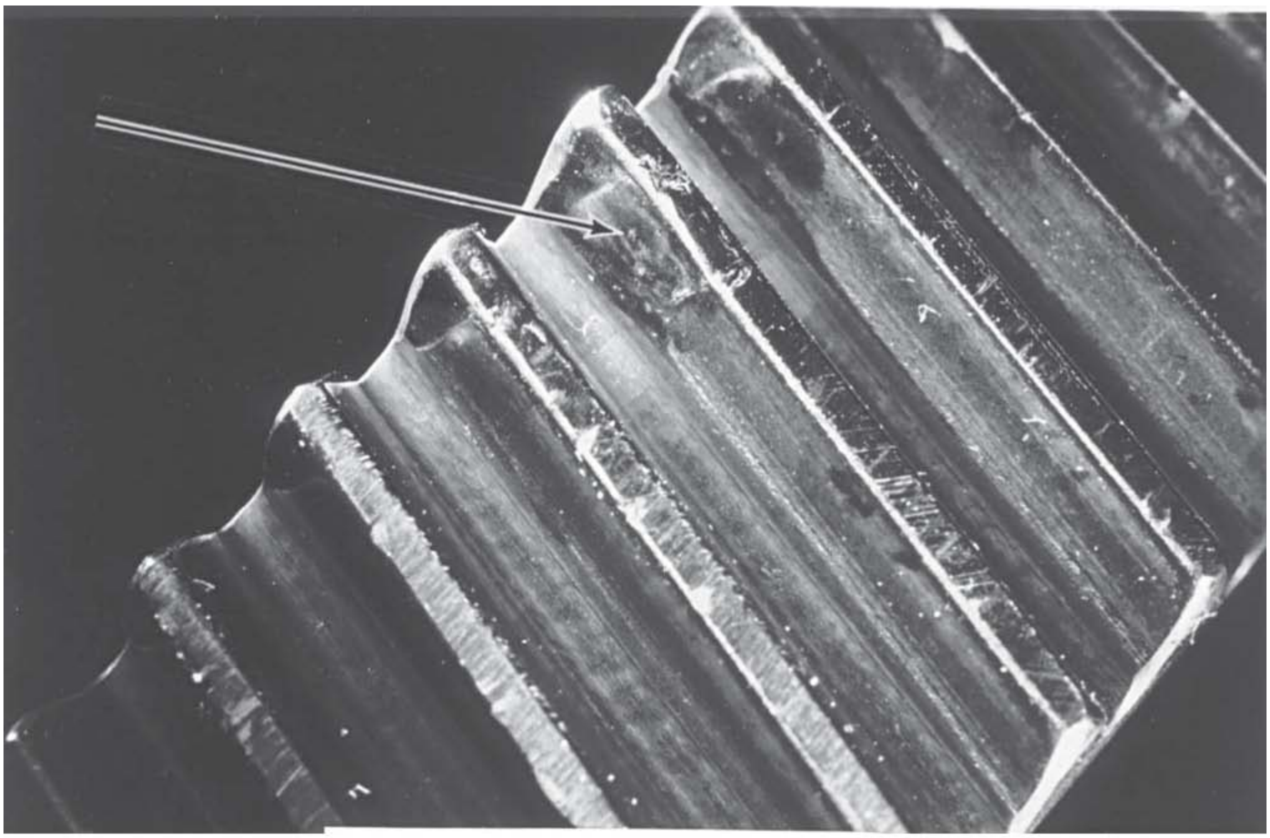
Figure 26



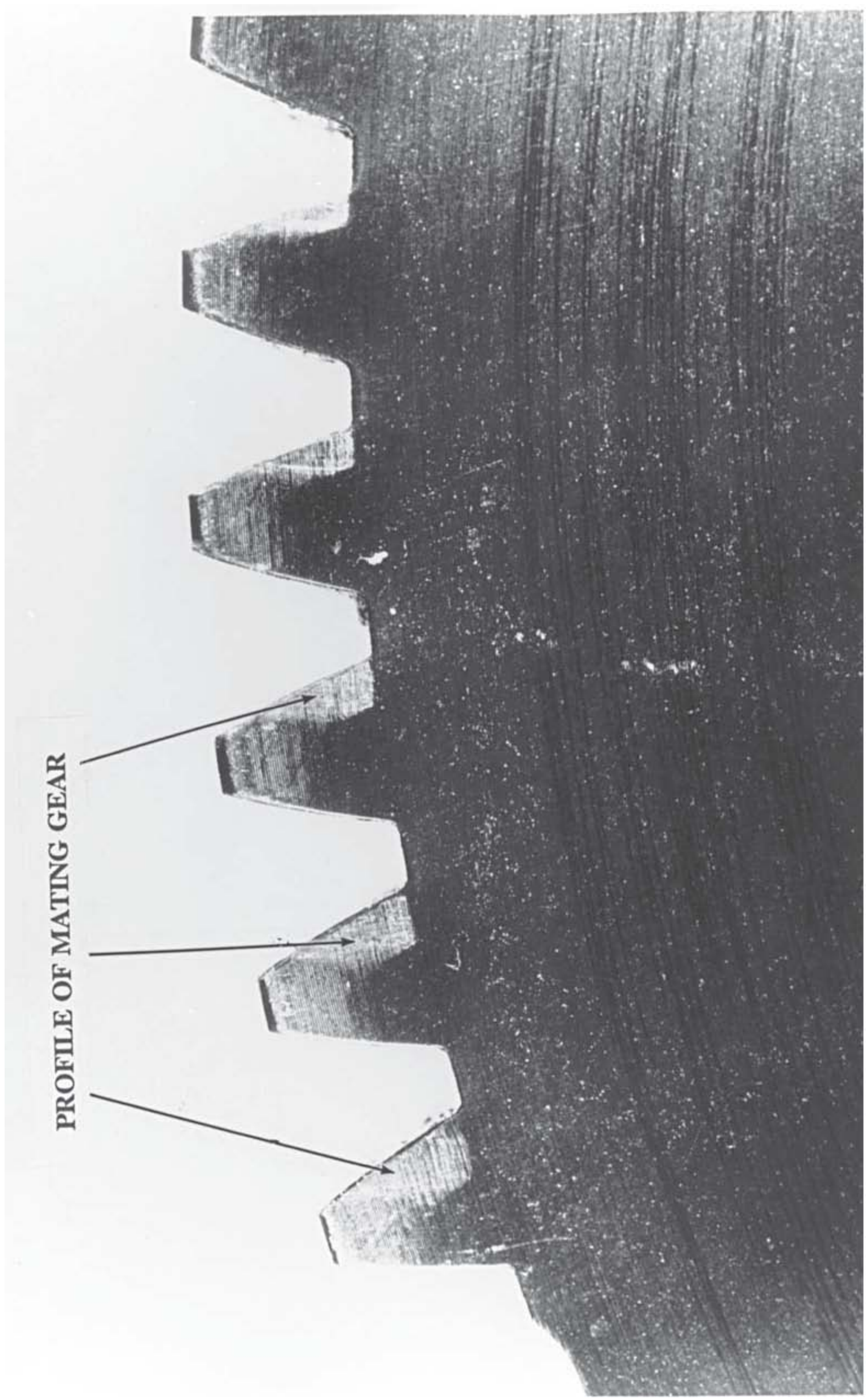
Foreign Object Damage

Figure 27 (Sheet 1 of 2)

UP781957

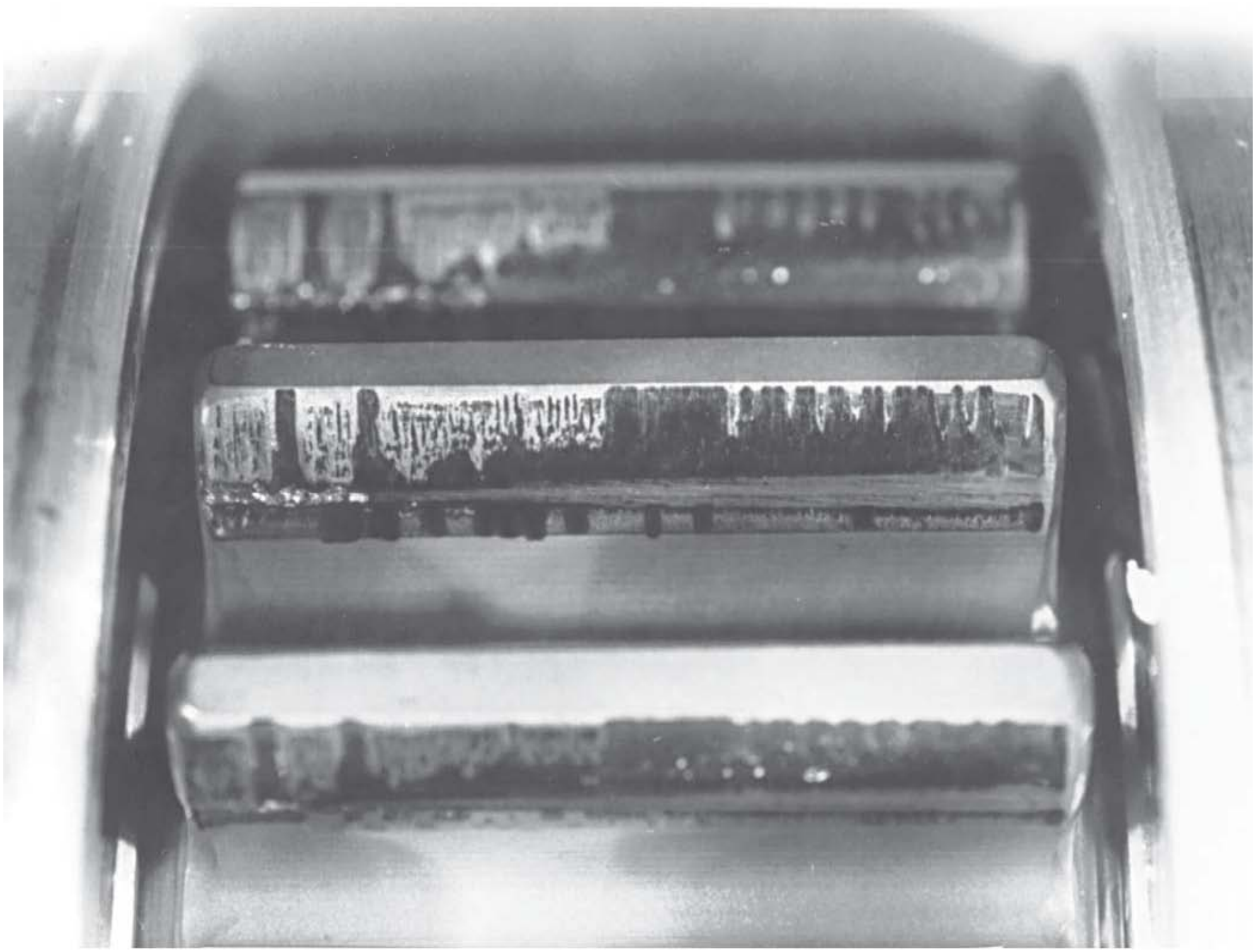


Foreign Object Damage
Figure 27 (Sheet 2 of 2)



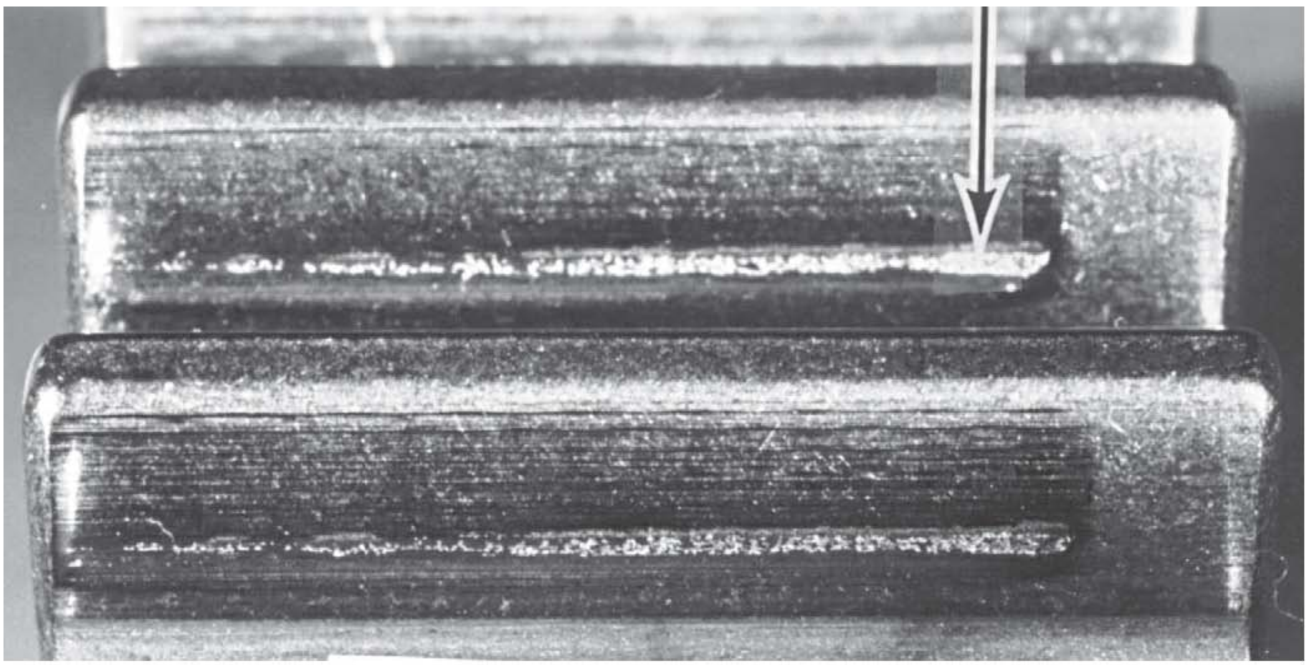

Assembly Damage

Figure 28



Scuffing (Scoring) Heavy

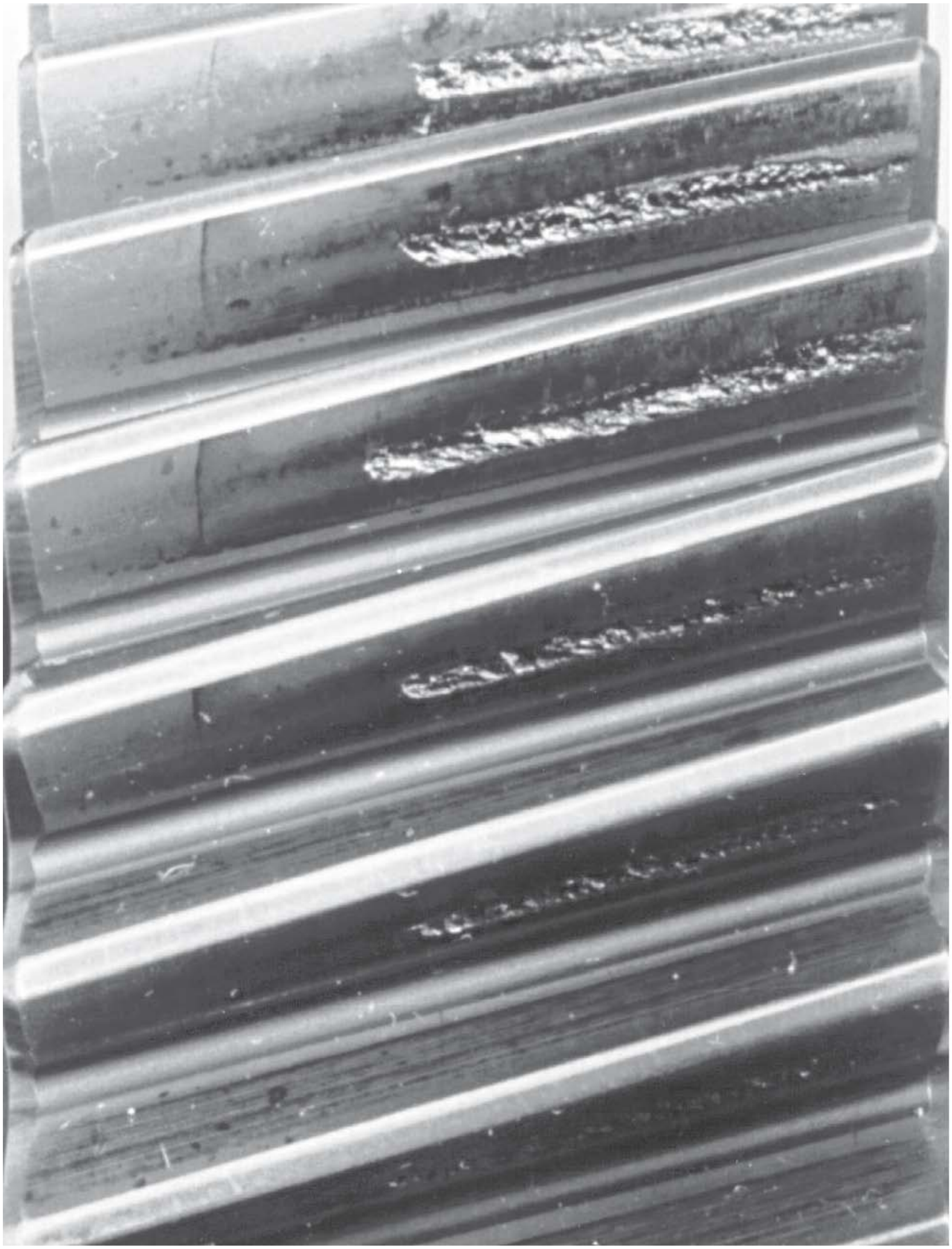
Figure 29



Pitting (Heavy)

Figure 30

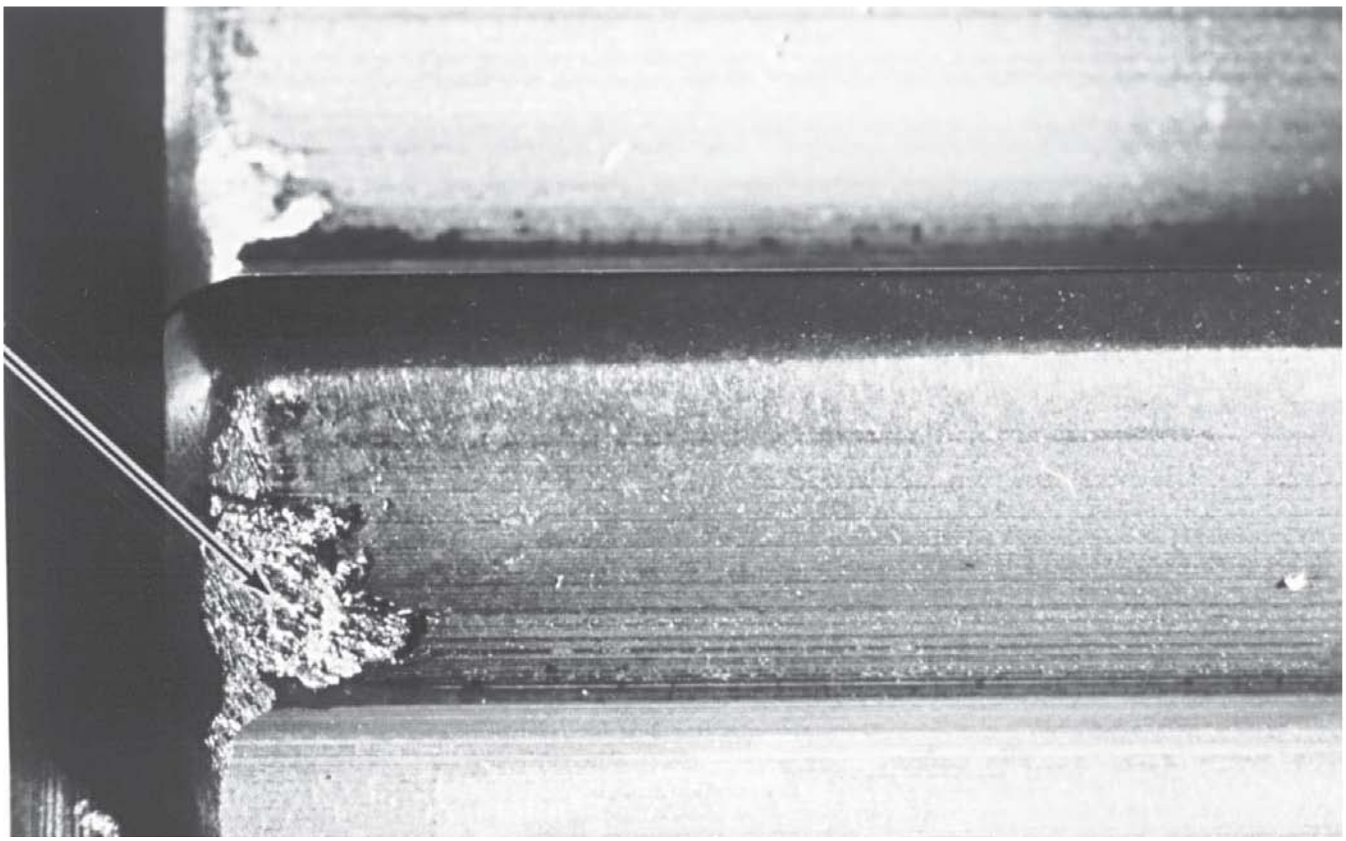
UP781957



Spalled Teeth

Figure 31

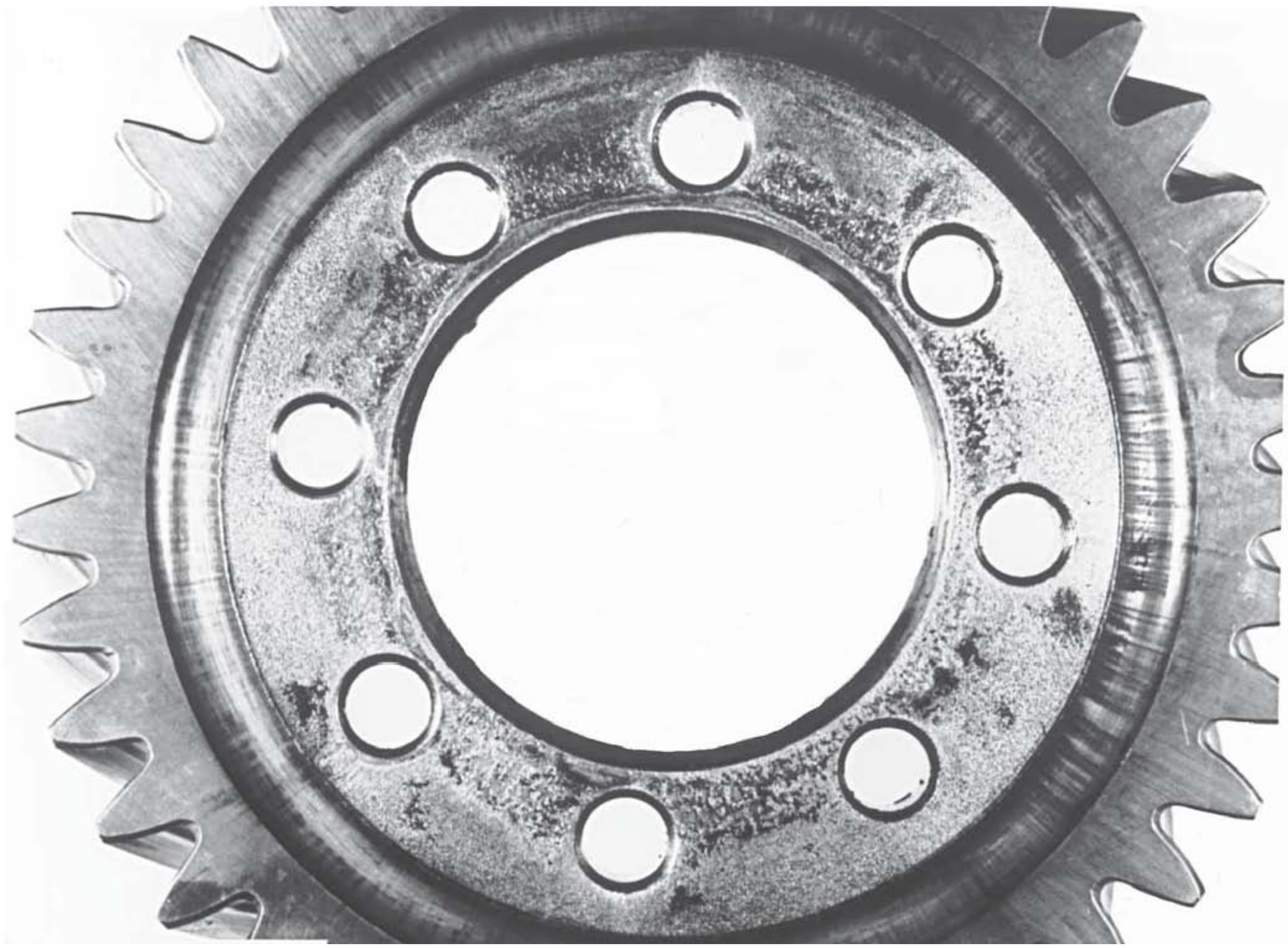
UP781957



End Load Spalling

Figure 32

UP781957



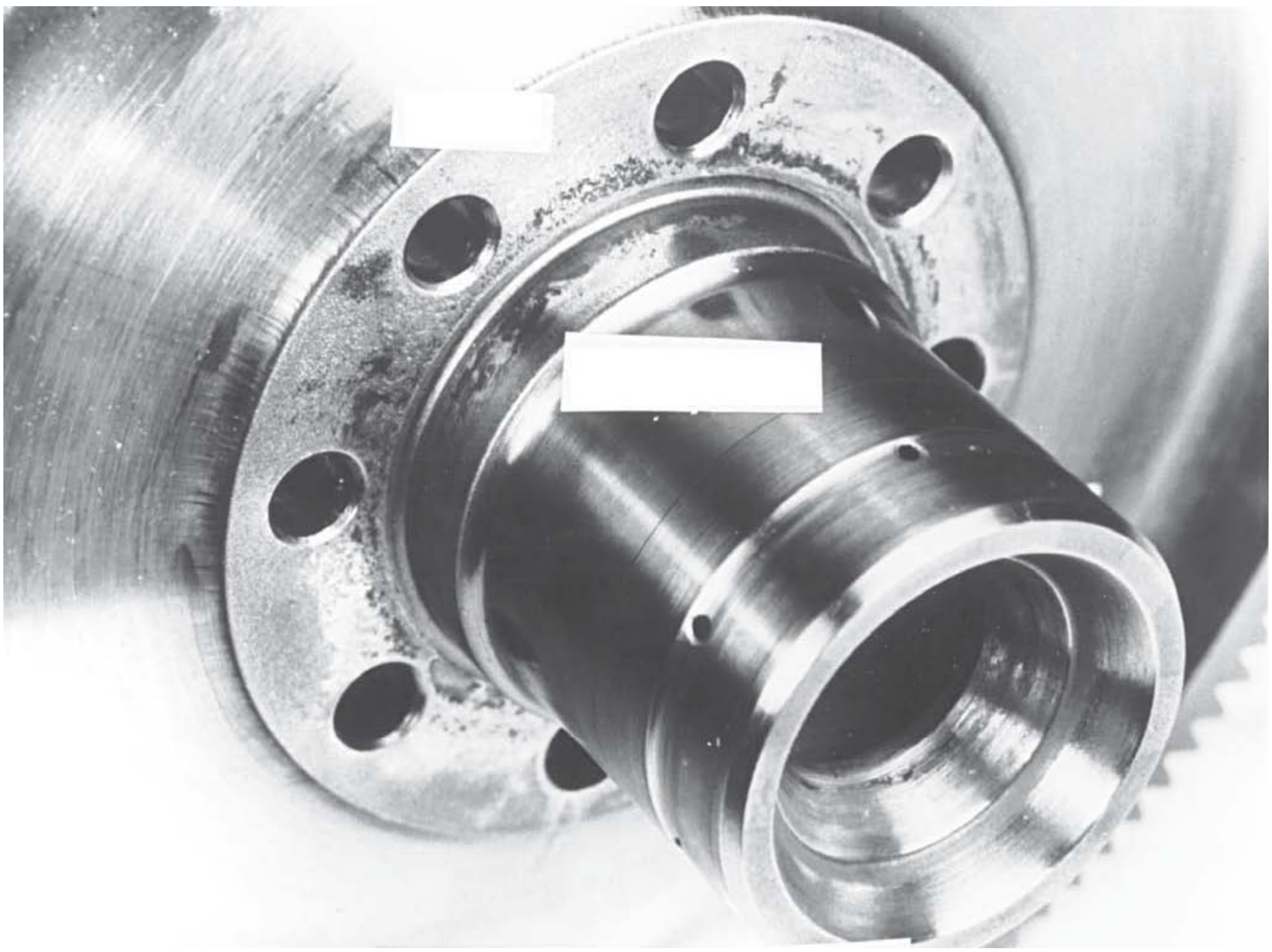
Fretting Corrosion

Figure 33 (Sheet 1 of 3)

UP781957

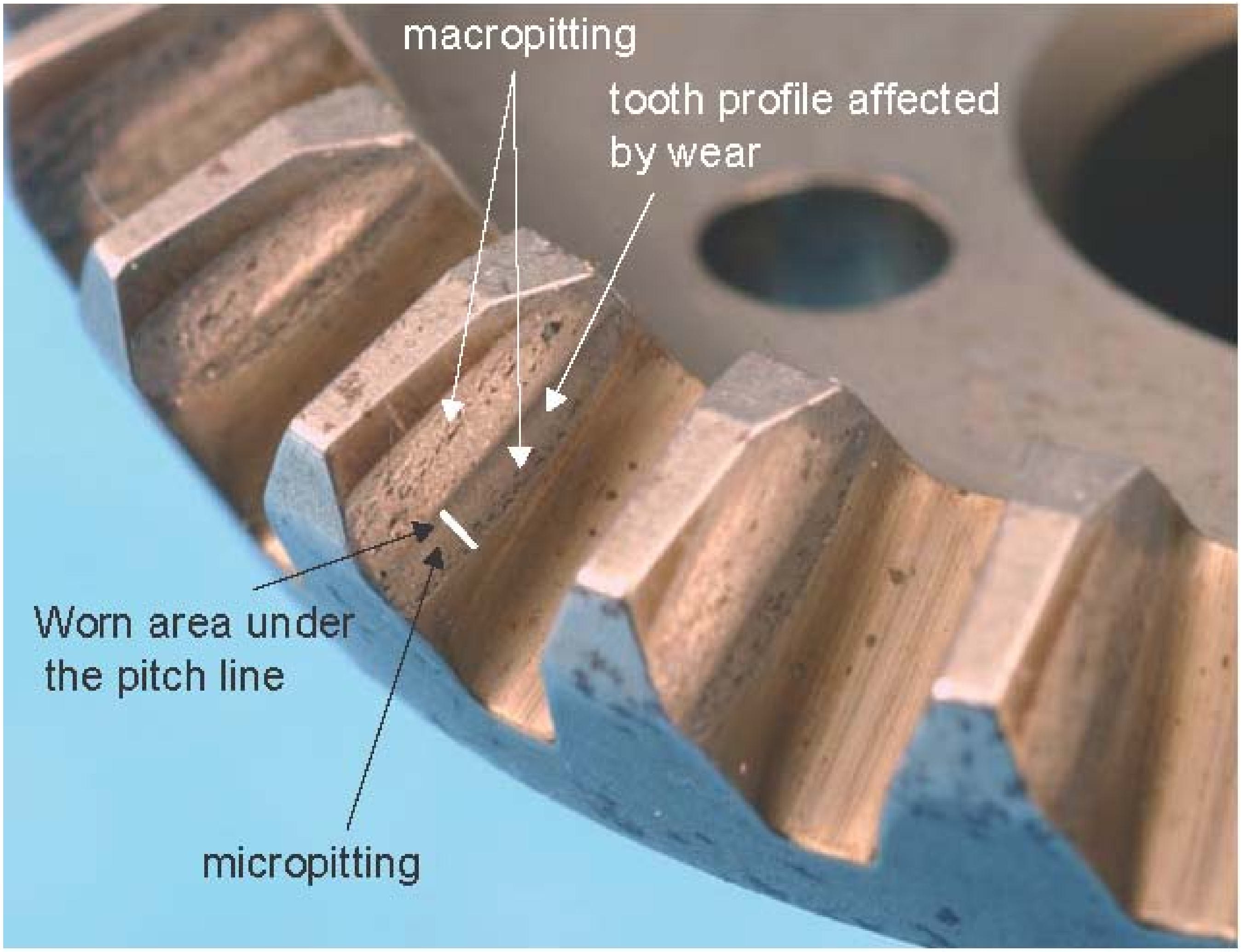
Fretting Corrosion

Figure 33 (Sheet 2 of 3)



Fretting Corrosion

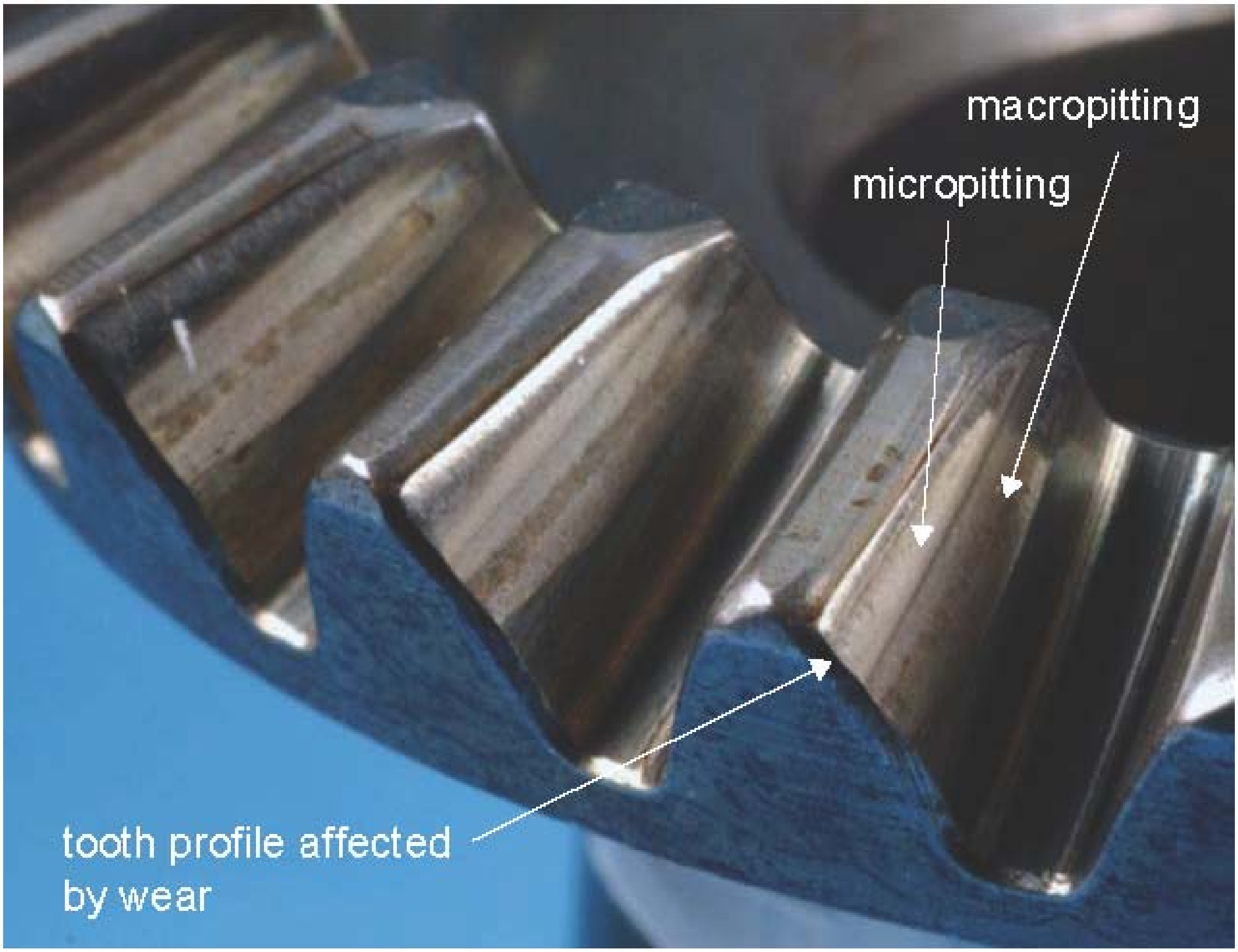
Figure 33 (Sheet 3 of 3)




Dark area below the pitch line indicates a recessed, worn material.

Worn Tooth Profile Below the Pitch Line, Heavy Micropitting and Initial Macropitting

Figure 34

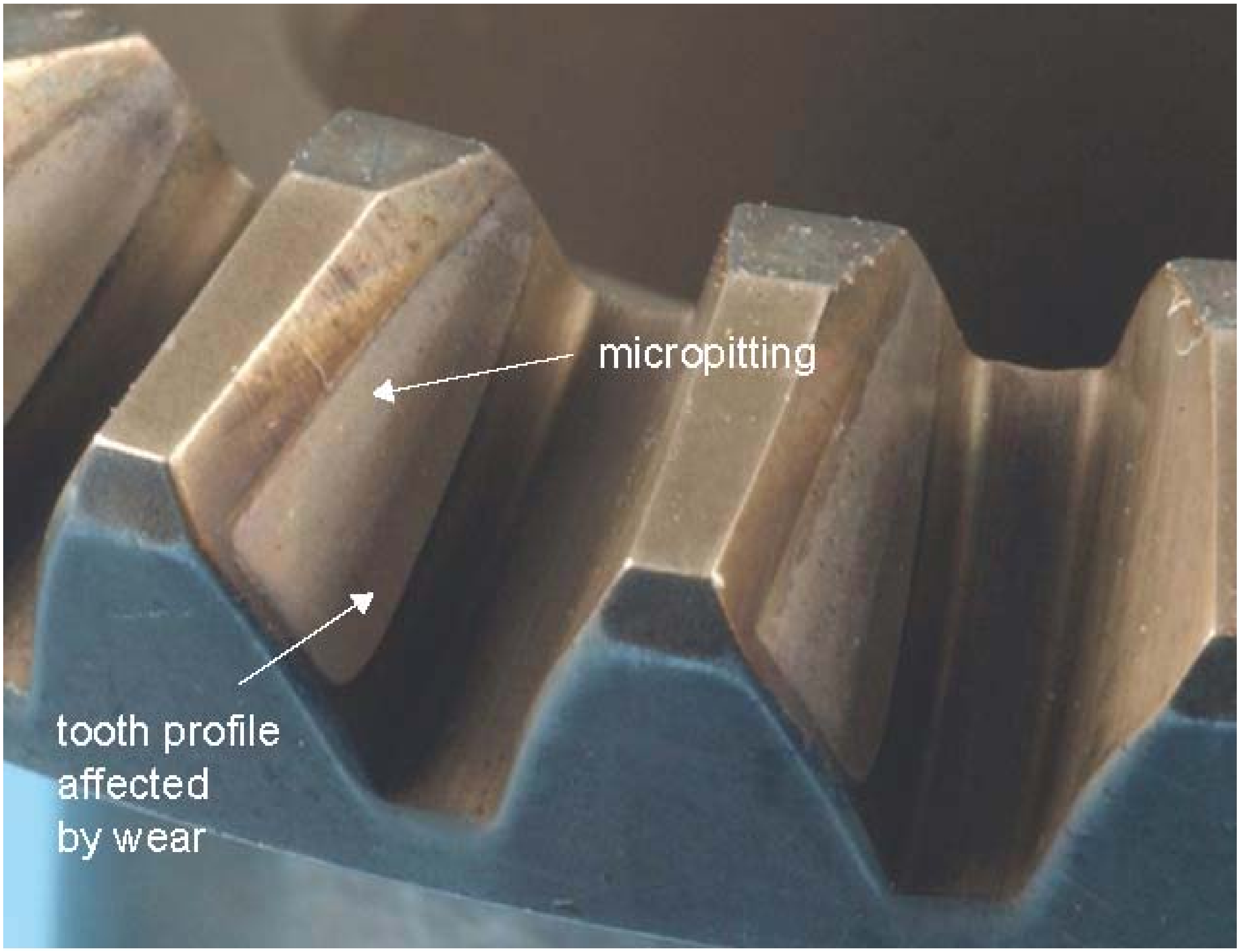



Tooth profile above the pitch line affected by wear.

Heavy Micropitting Wear and Macropitting

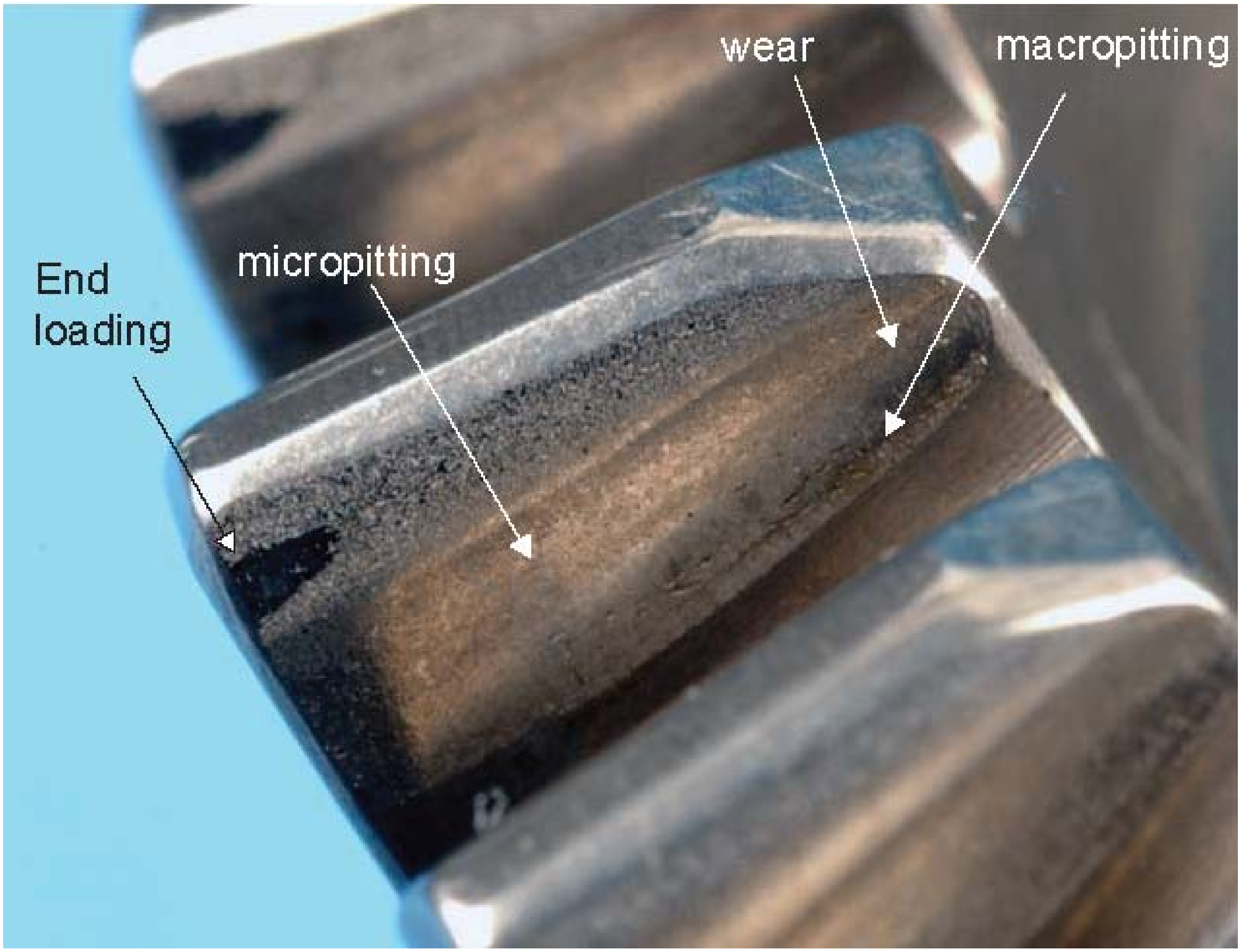
Figure 35

UP781957




Tooth profile modified below the pitch line by medium wear. Darker surface represents recessed, worn area.

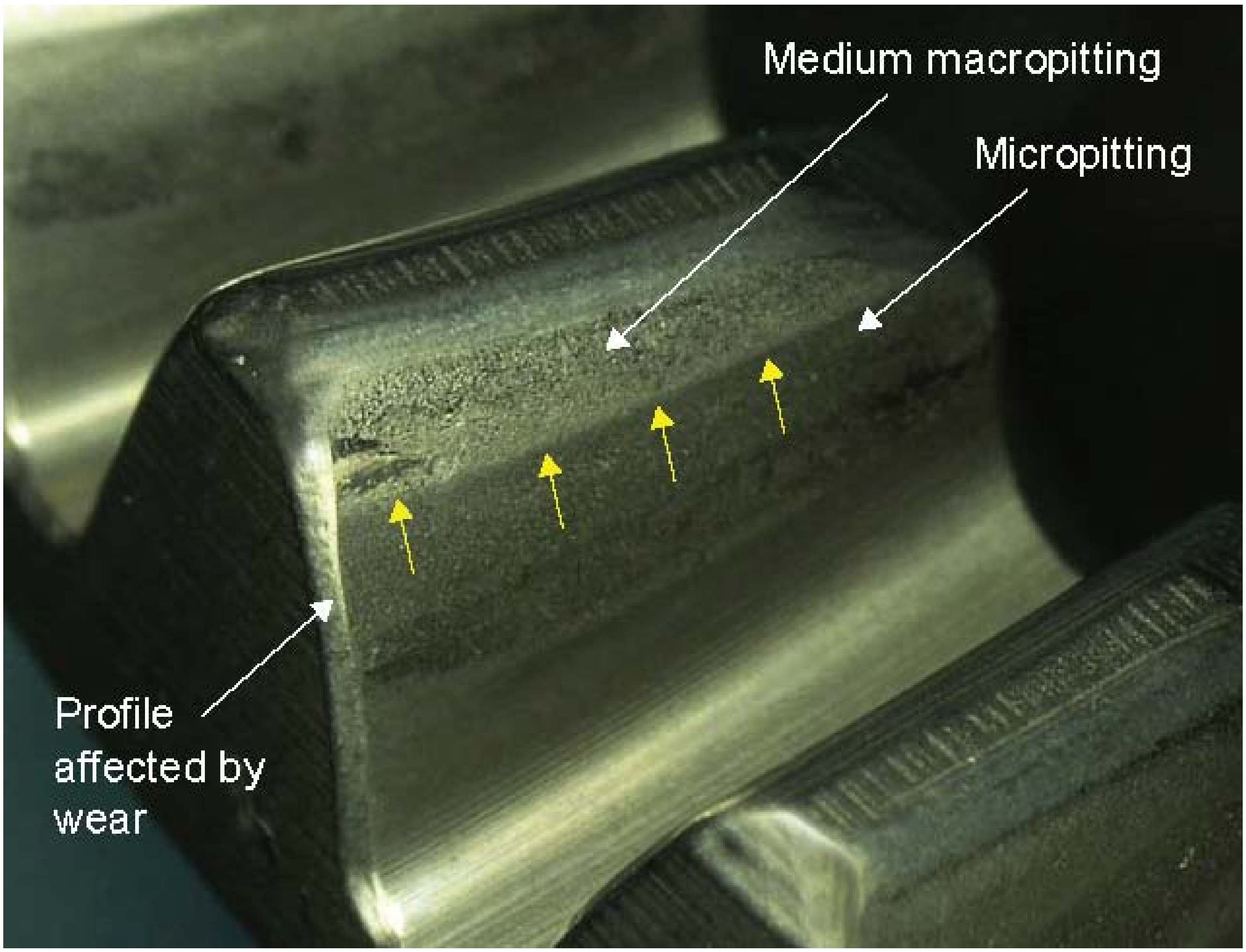
Heavy Micropitting
Figure 36




Visible end wear area due to unevenly distributed tooth loads.

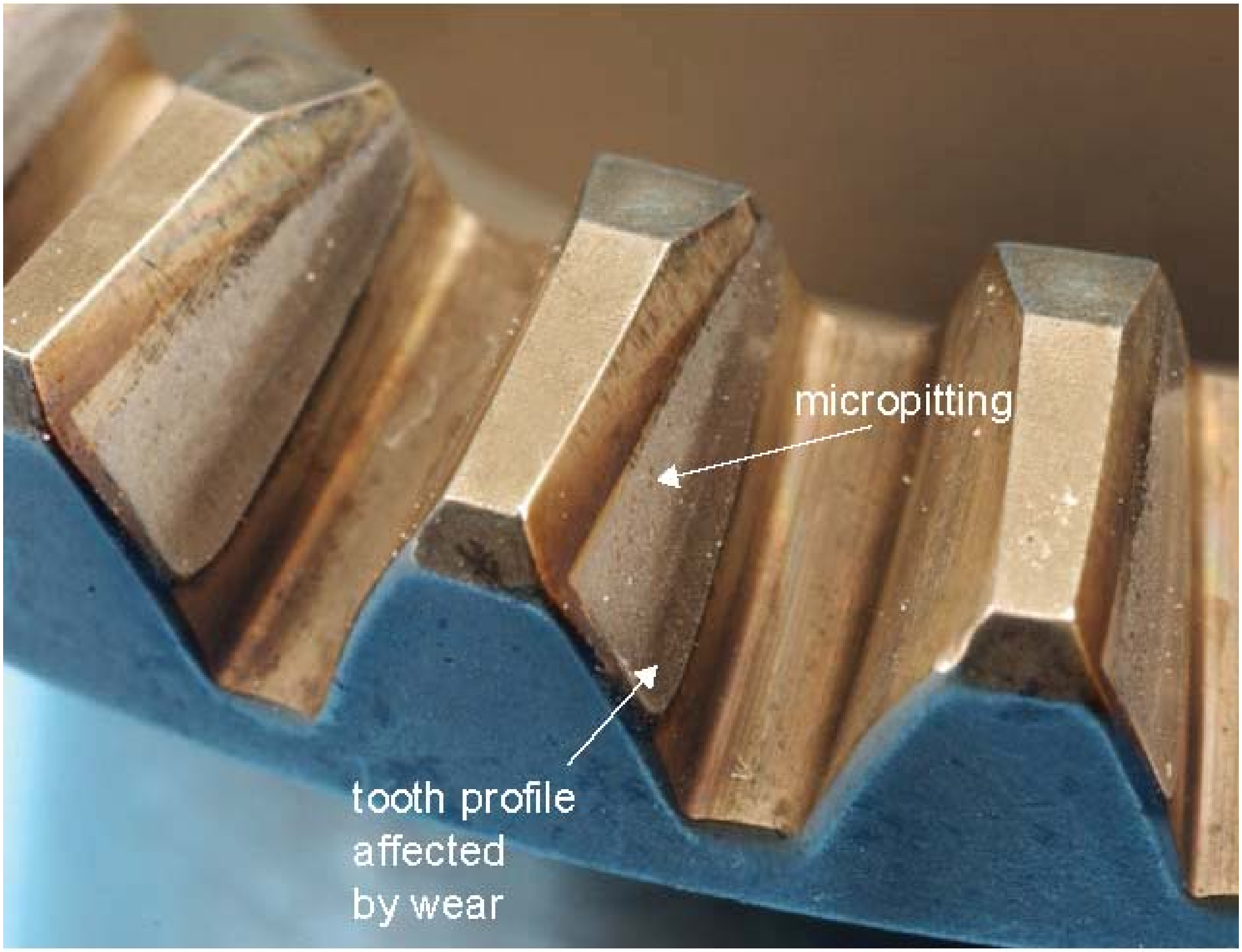
Heavy Micropitting with Medium Macropitting and Medium Wear
Figure 37

UP781957



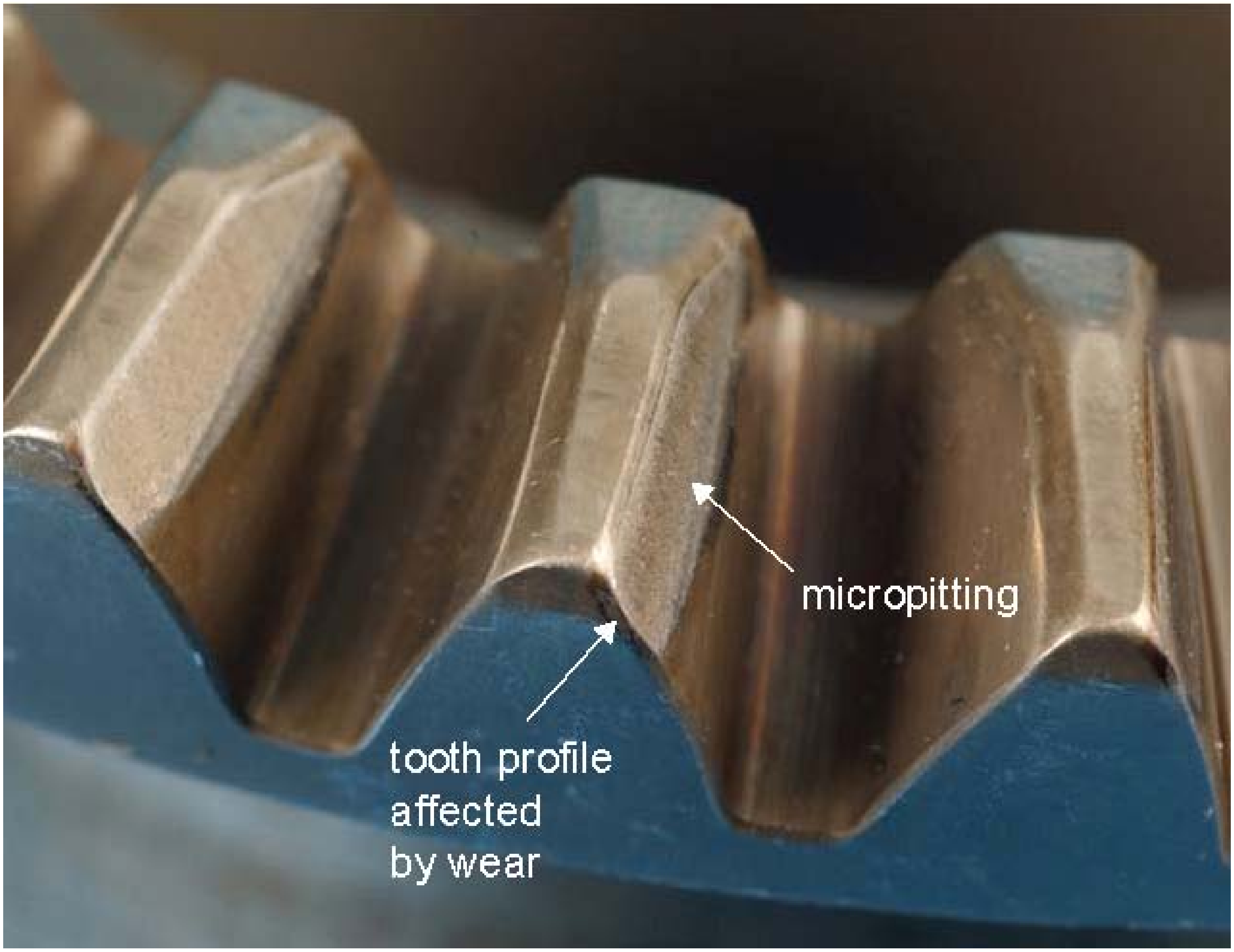

Tooth profile modified by wear. Yellow arrows indicate the step on the tooth surface.

Macropitting and Micropitting
Figure 38




Tooth profile modified below the pitch line by medium wear.

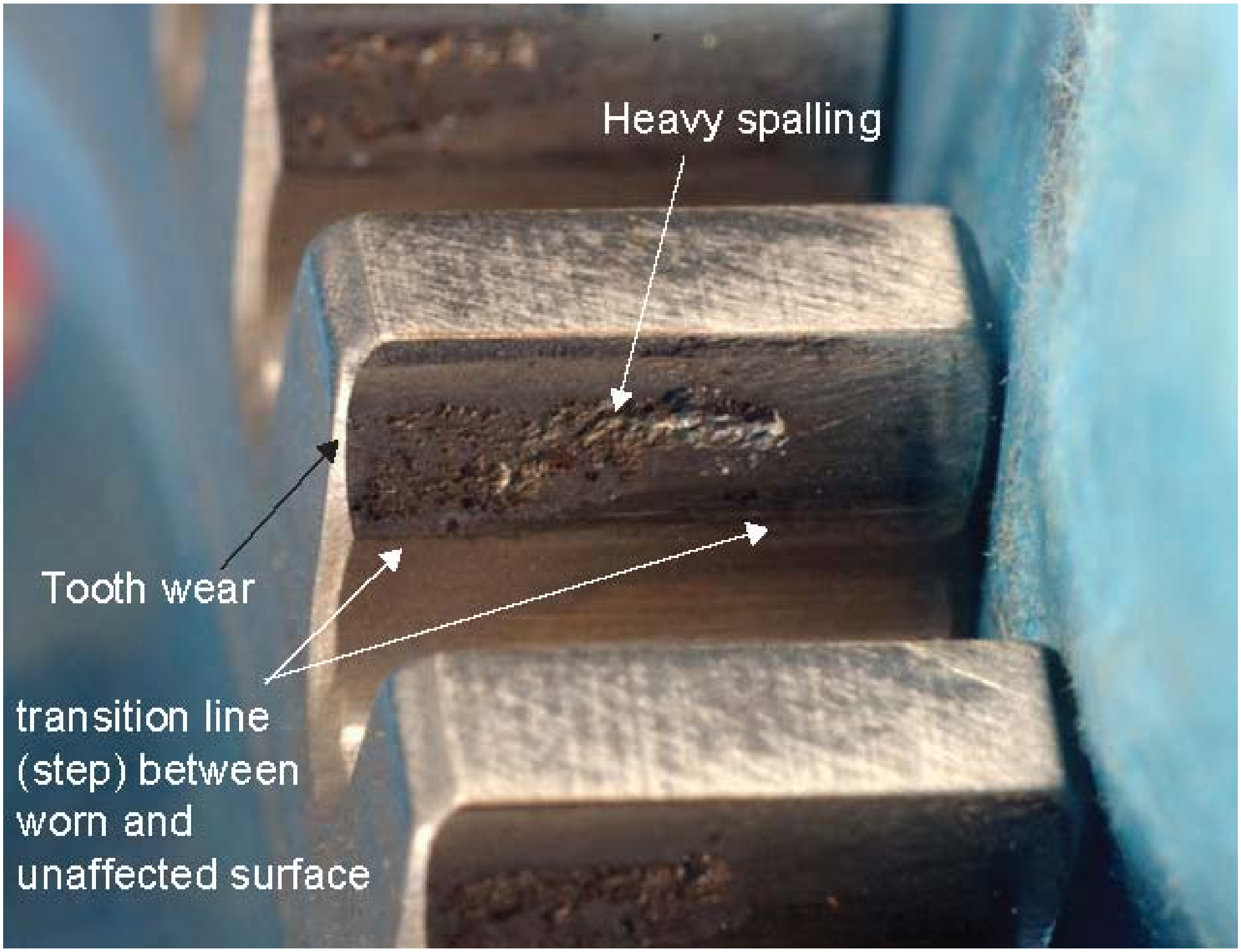
Heavy Micropitting
Figure 39




Tooth profile significantly affected by wear. The amount of wear can be estimated by looking at the edge of the tooth. Tooth profile curvature changes as the material is removed from the surface.

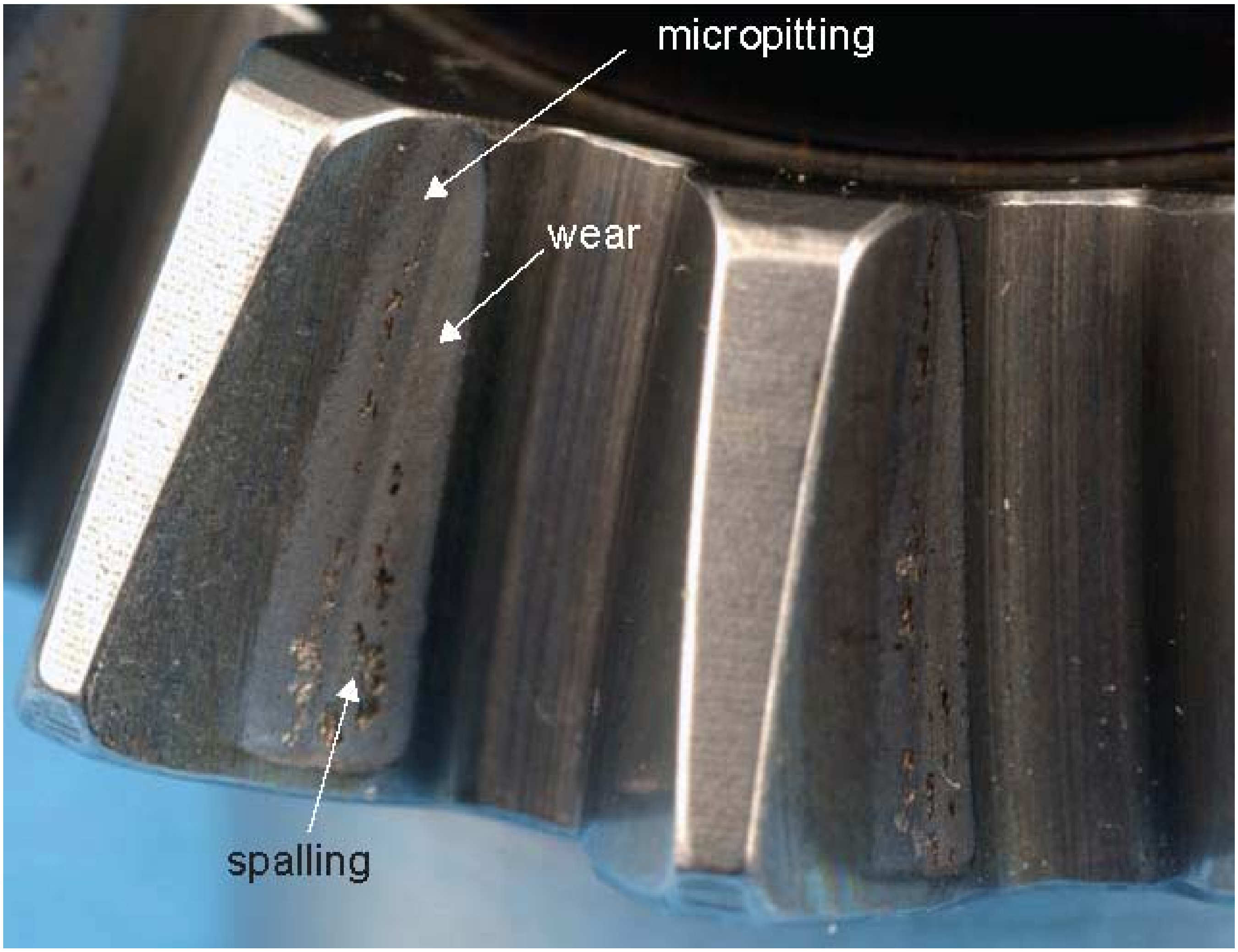
Micropitting Above the Pitch Line of the Tooth
Figure 40

UP781957



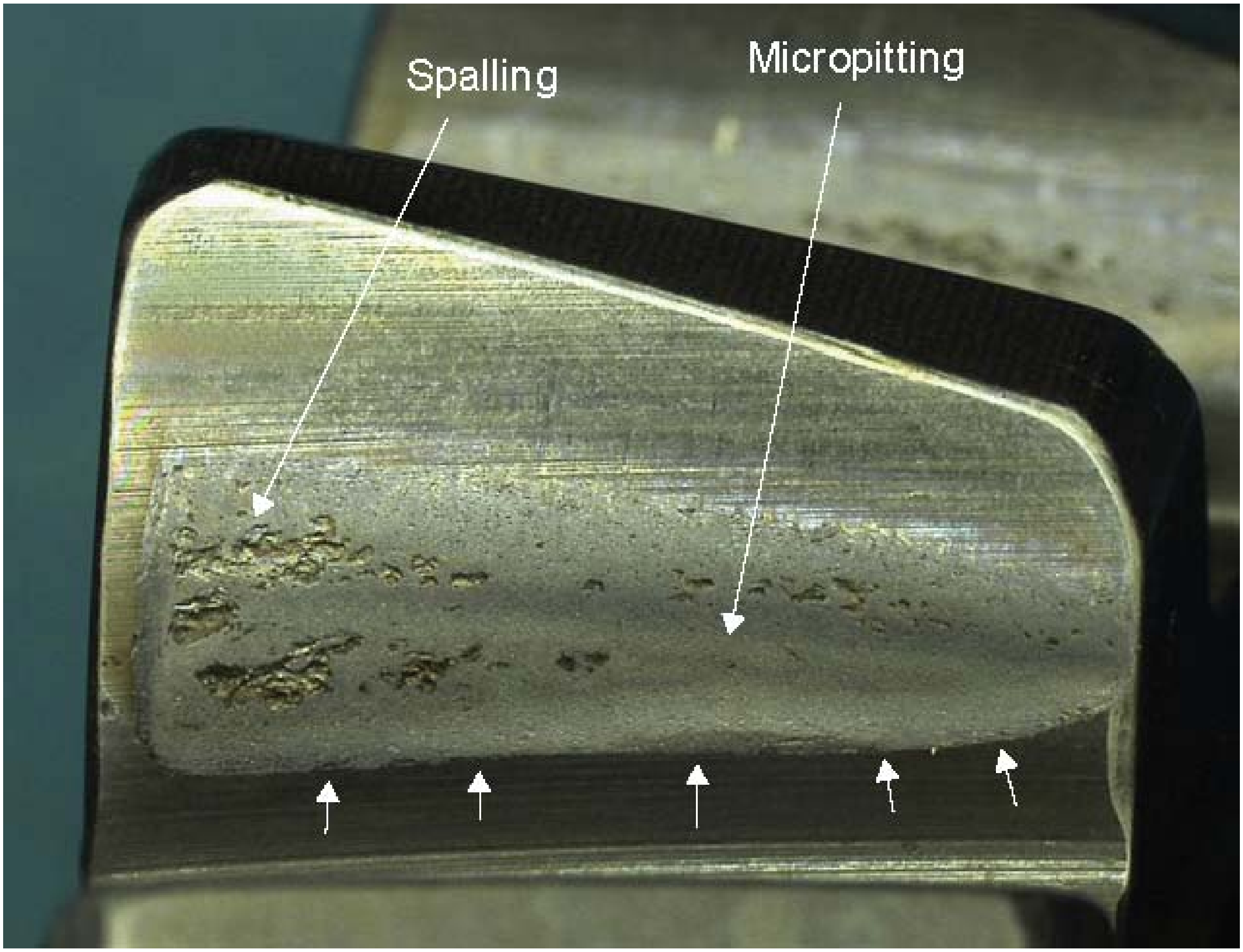

Tooth profile is significantly affected by wear.

Heavy Spalling and Heavy Wear
Figure 41



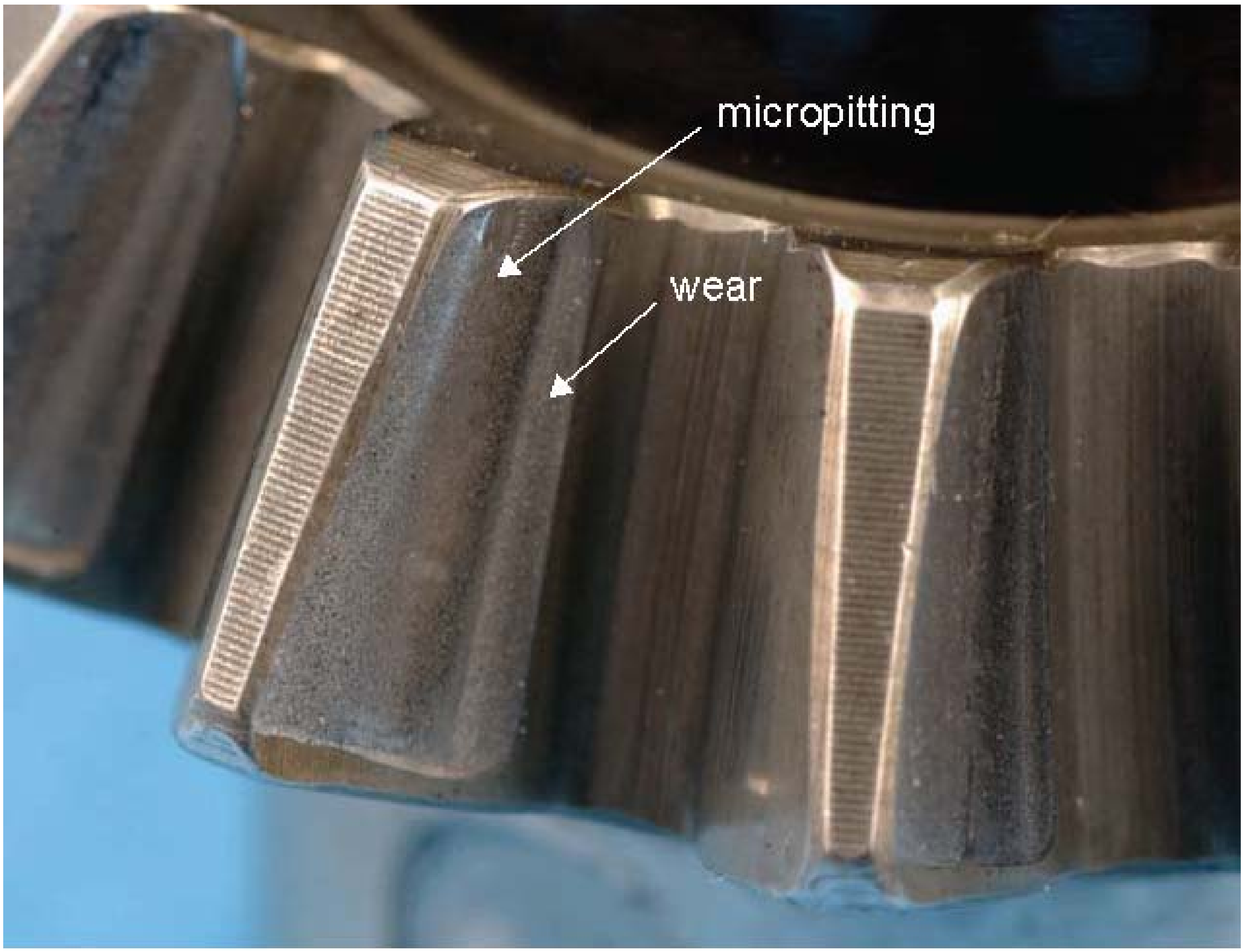

Wear below the pitch line of the tooth.

Medium Micropitting and Spalling
Figure 42 (Sheet 1 of 2)



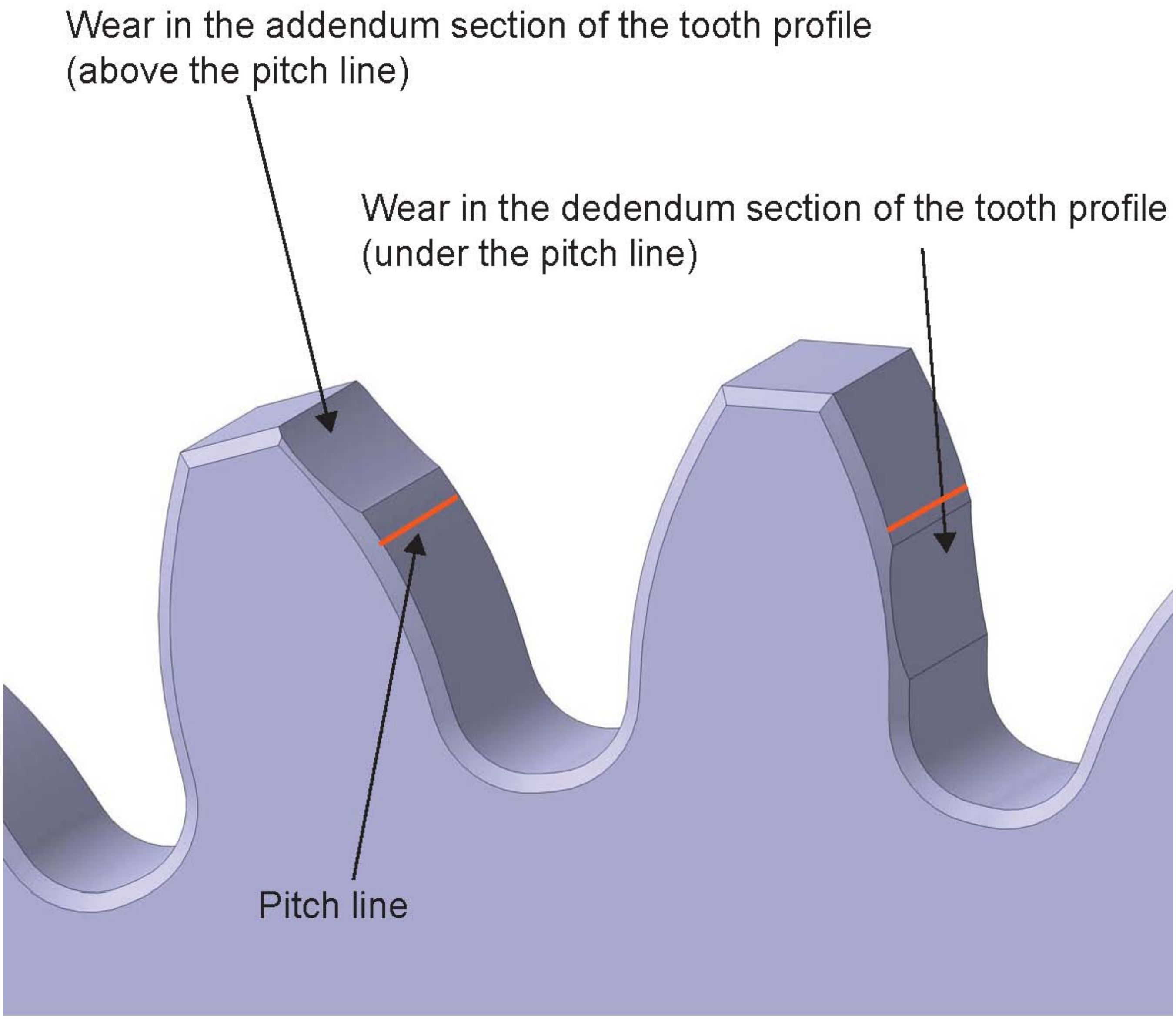

Tooth profile is affected by wear. White arrows indicate the edge (step) where the worn area starts.

Medium Micropitting and Spalling
Figure 42 (Sheet 2 of 2)

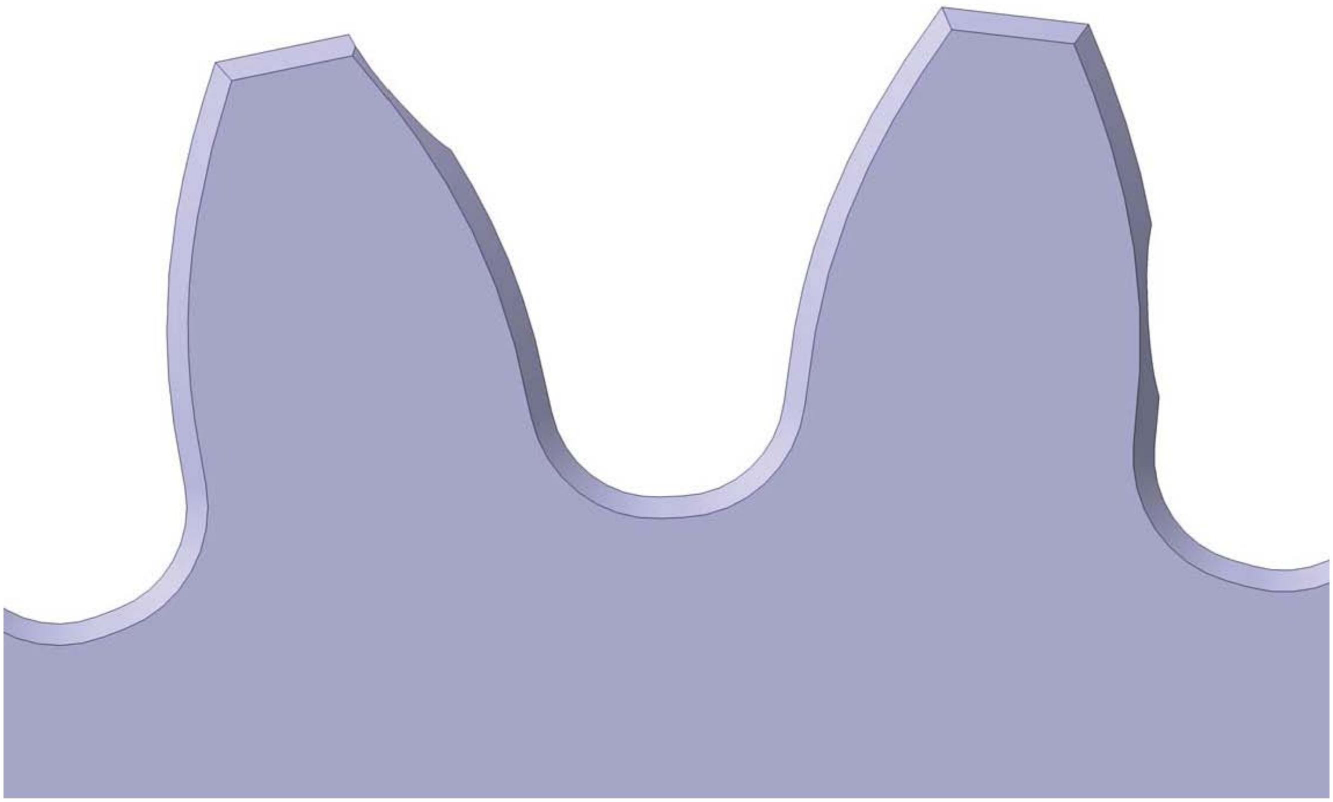



Wear Below the Pitch Line of the Tooth and Micropitting
Figure 43

UP781957




Wear in the Addendum and Dedendum Section of the Tooth Profile
Figure 44 (Sheet 1 of 2)



Clearly visible in this view is the involute tooth profile affected by the wear.

Wear in the Addendum and Dedendum Section of the Tooth Profile
Figure 44 (Sheet 2 of 2)

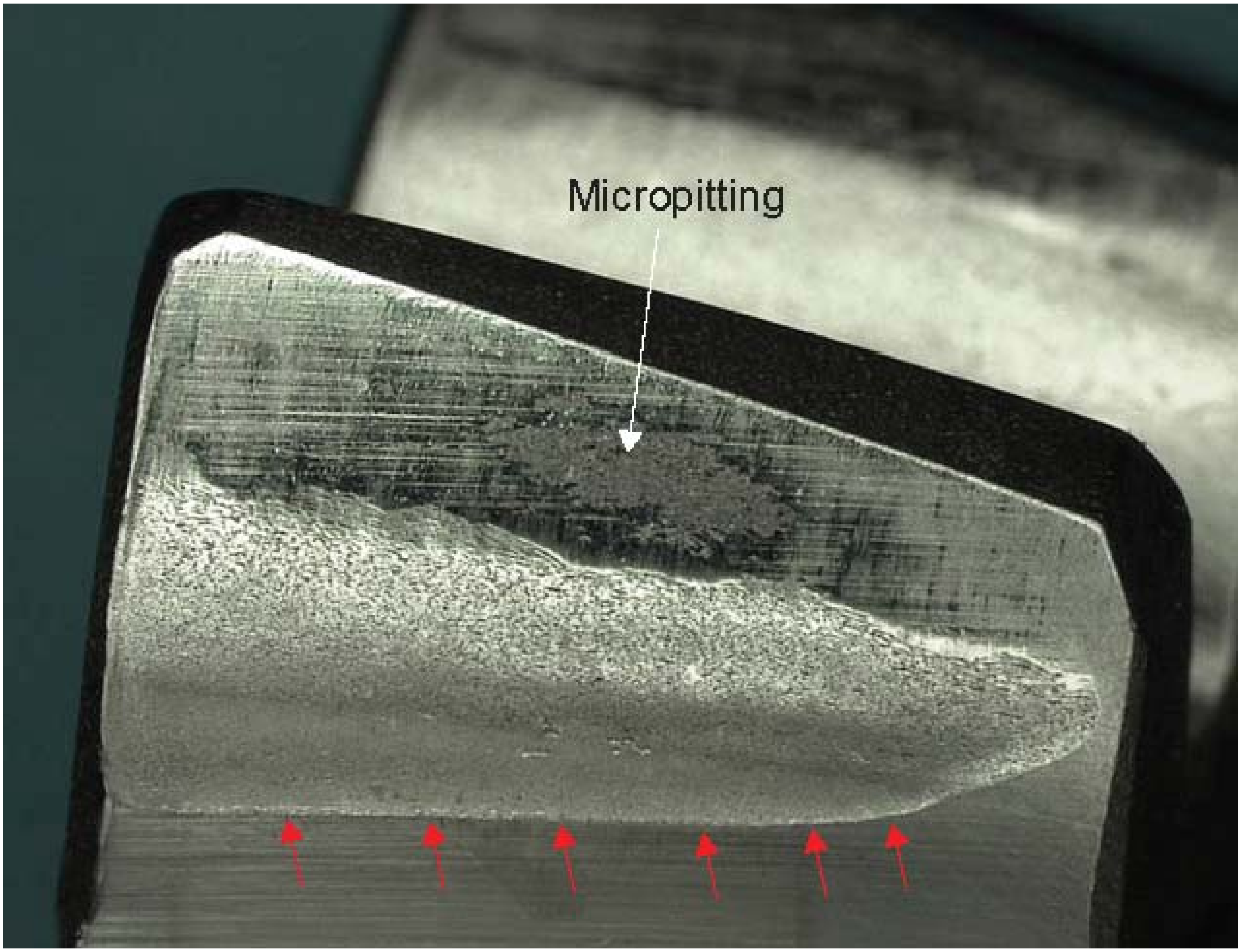
A significant amount of material is removed from the tooth surface.

Heavy Scuffing and Wear
Figure 45

UP781957

Grind lines are worn away.

Medium Scuffing and Wear
Figure 46



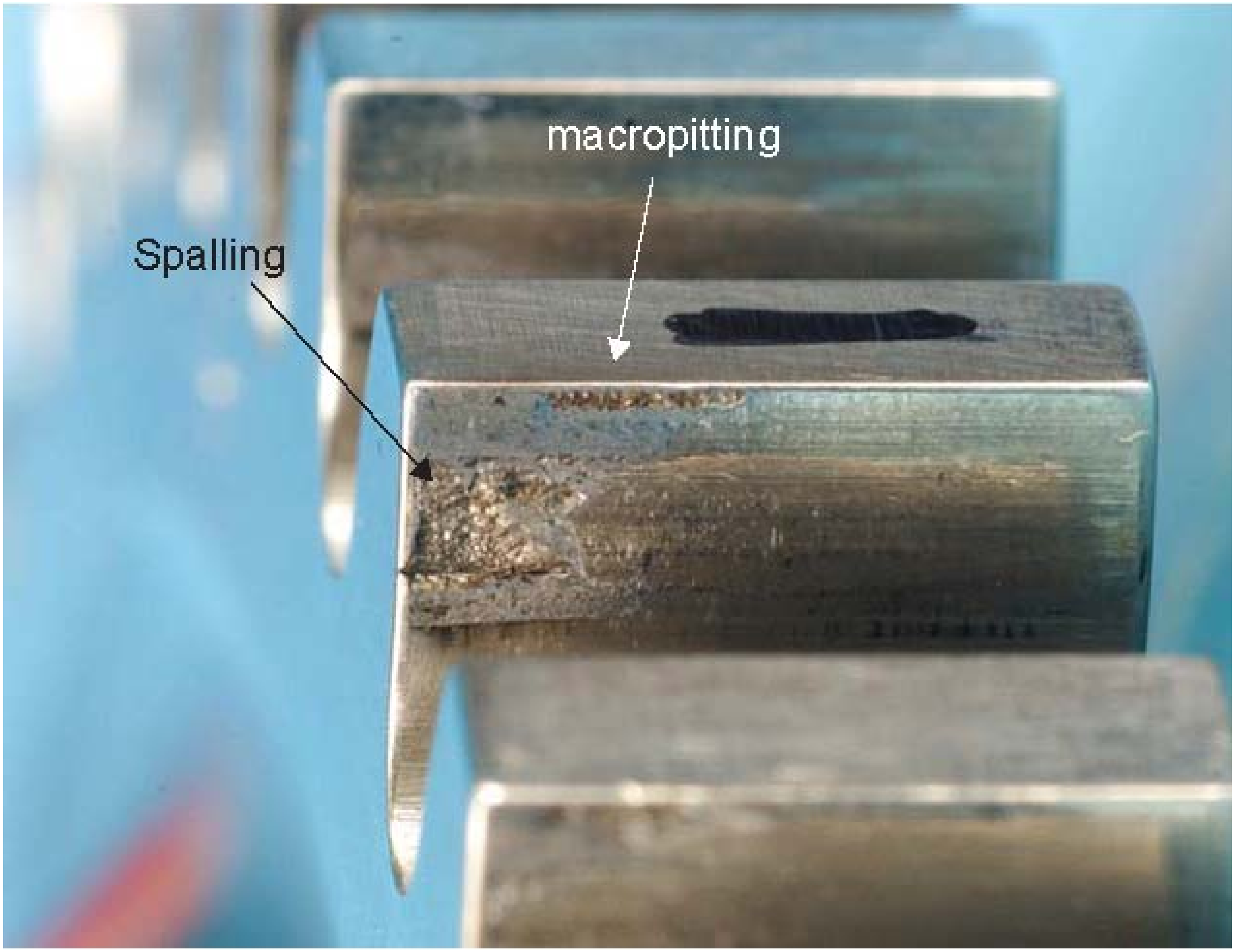

Tooth profile is significantly affected. Clearly visible is a step between the worn section of the tooth and the unaffected area (red arrows).

Light Micropitting and Heavy Pitting and Wear
Figure 47

UP781957

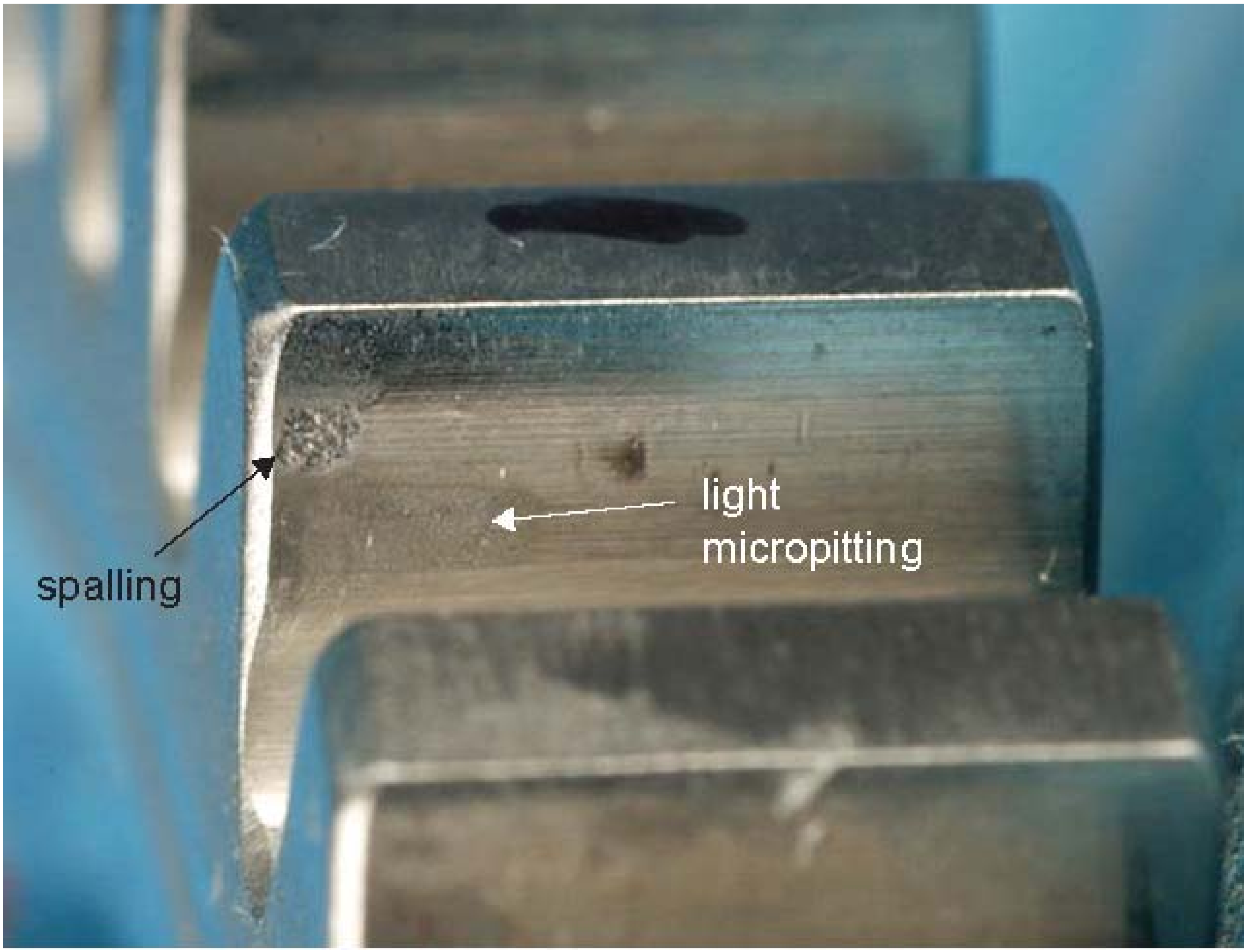
Tooth profile affected by wear.

Heavy Micropitting, Macropitting and Initial Spalling
Figure 48



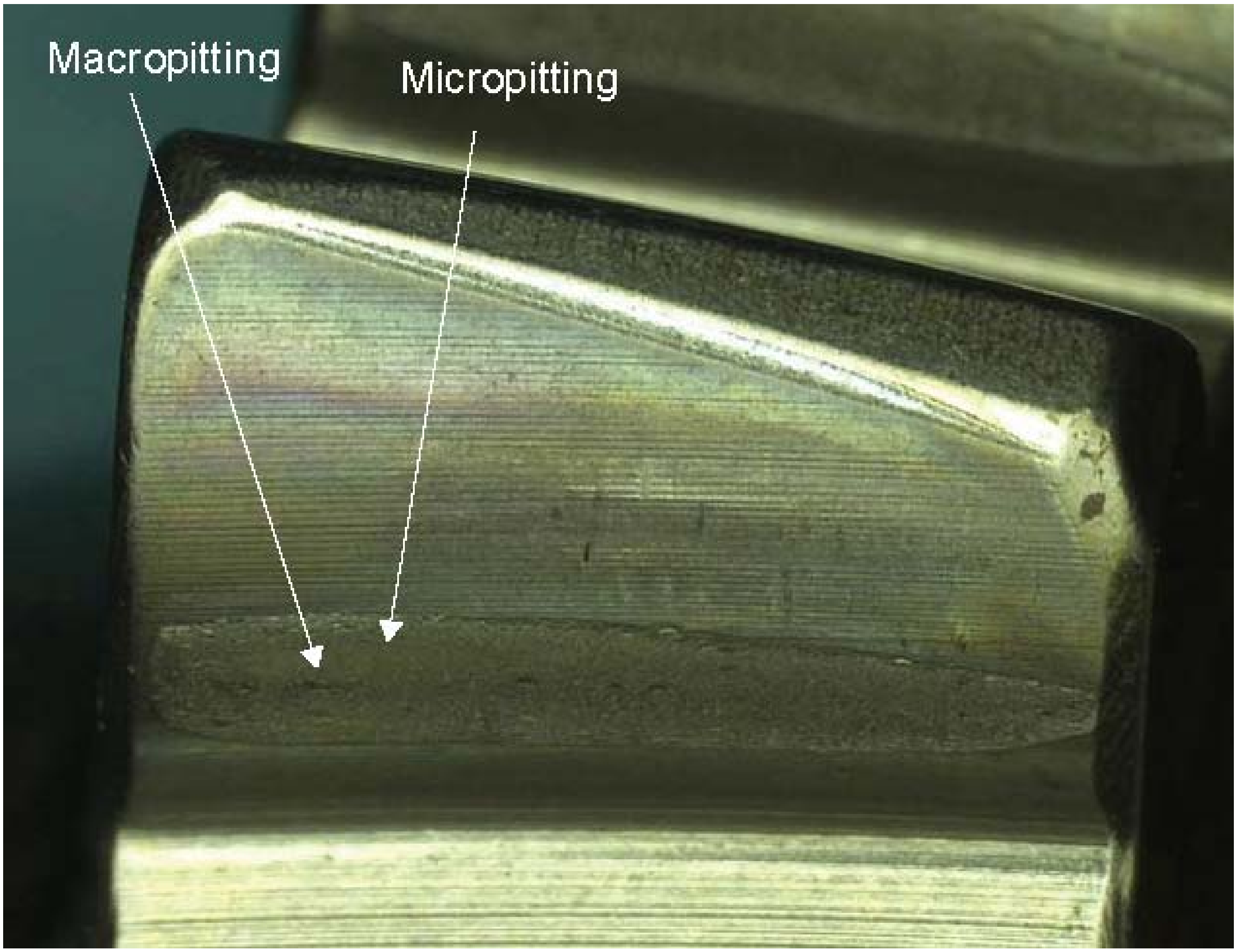

Spalling and Macropitting
Figure 49

UP781957



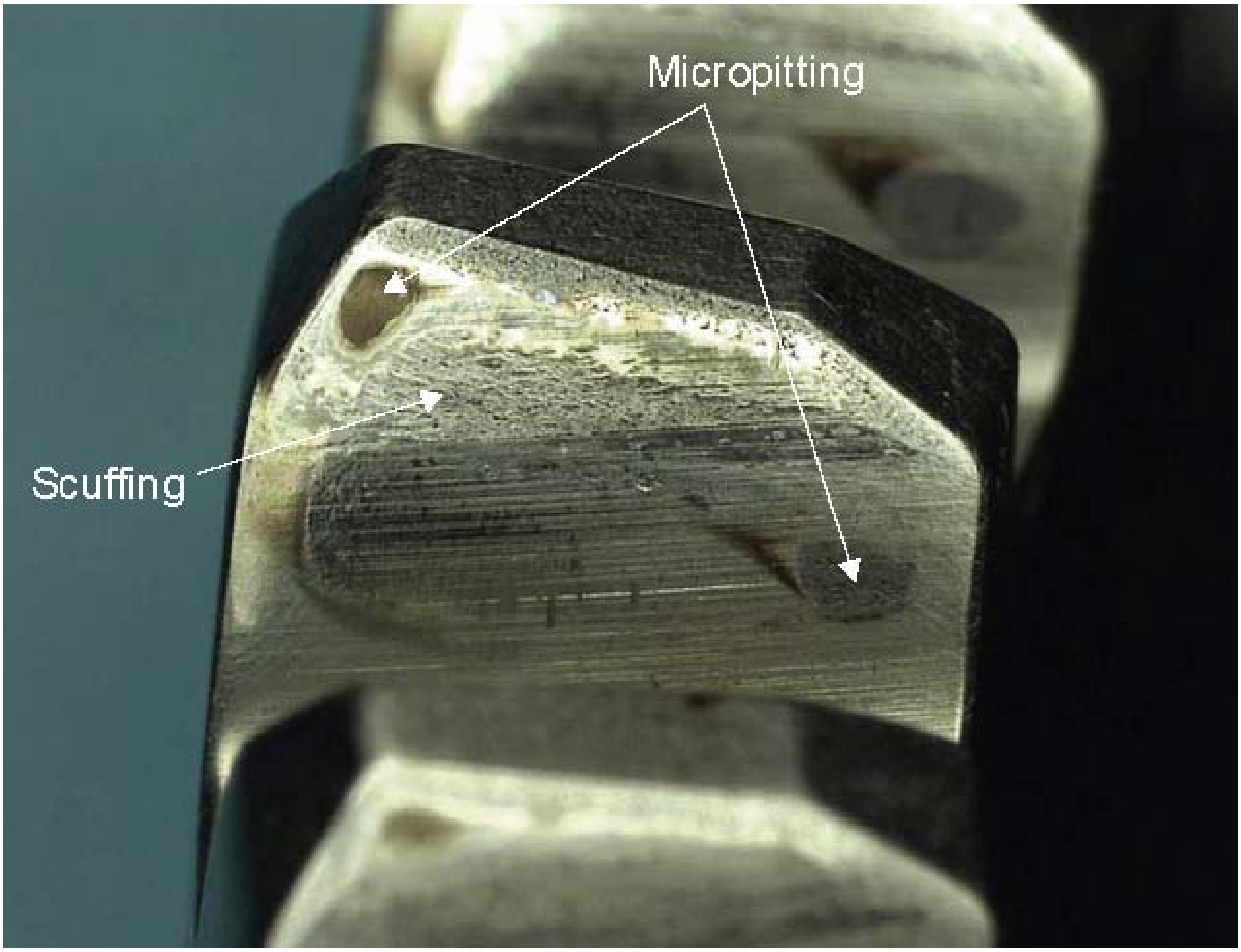

Initial Spalling and Light Micropitting
Figure 50

UP781957




Medium Micropitting and Initial Macropitting Below Pitch Line of the Tooth
Figure 51

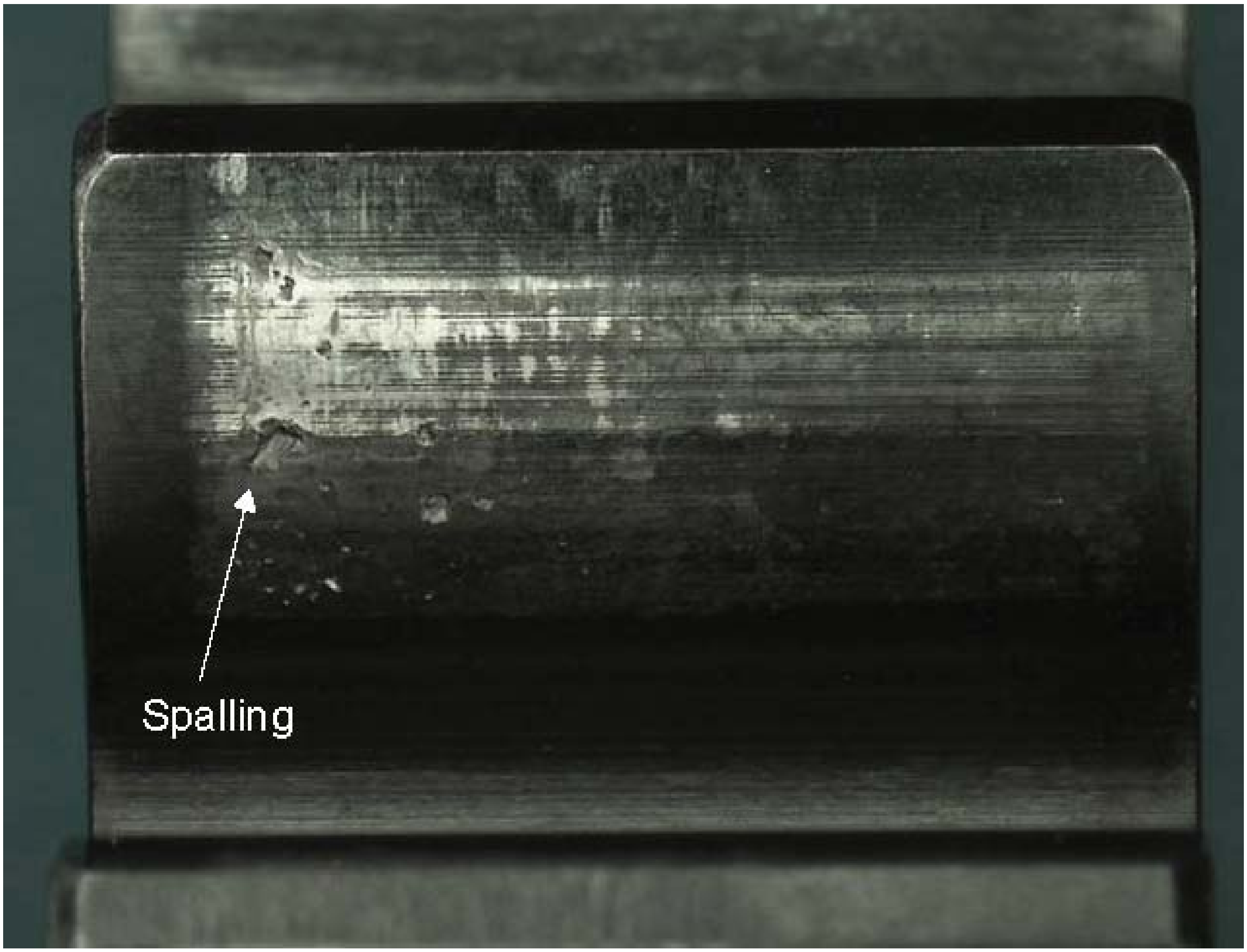
UP781957



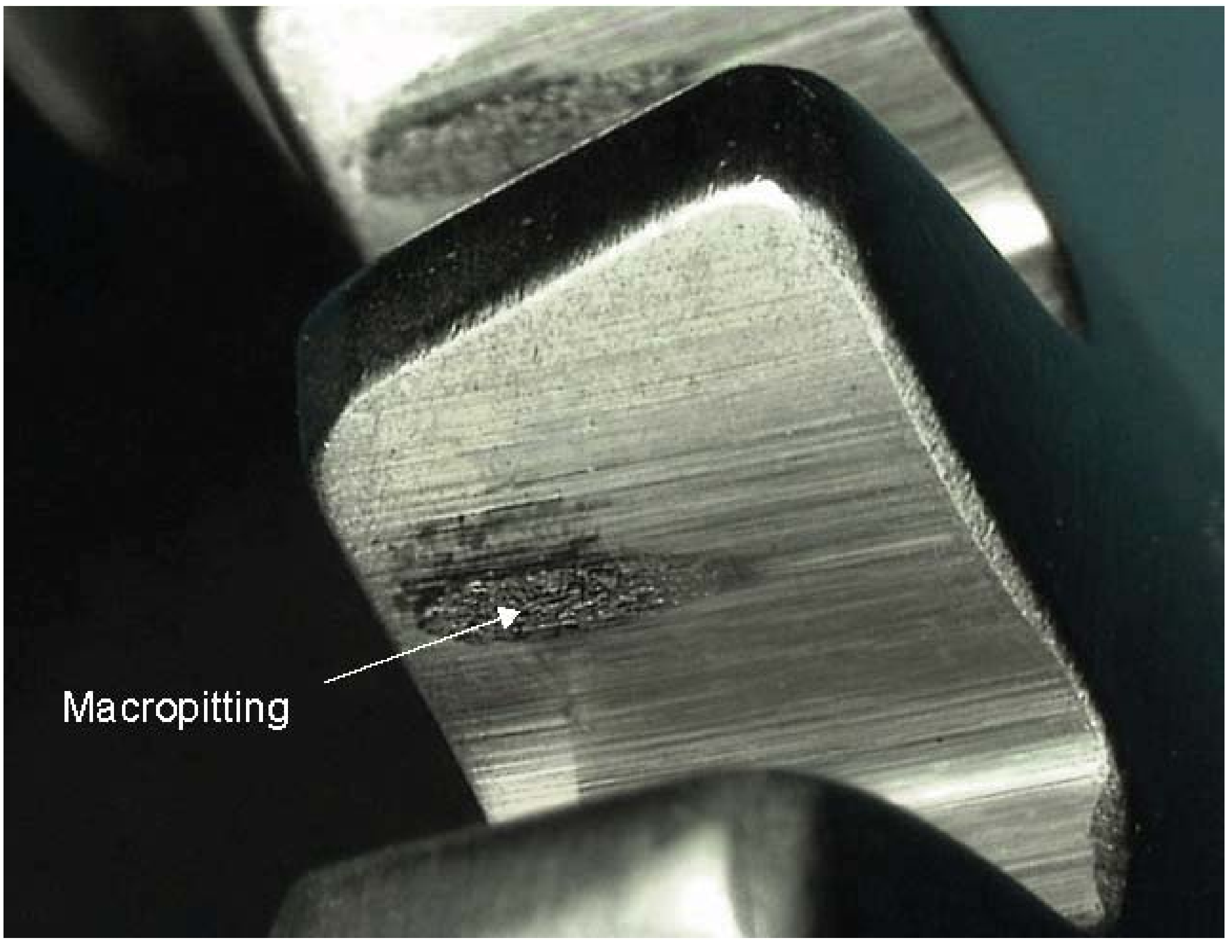

Scuffing visible in the addendum of the tooth.

Medium Micropitting, and Micropitting in High Contact Areas
Figure 52

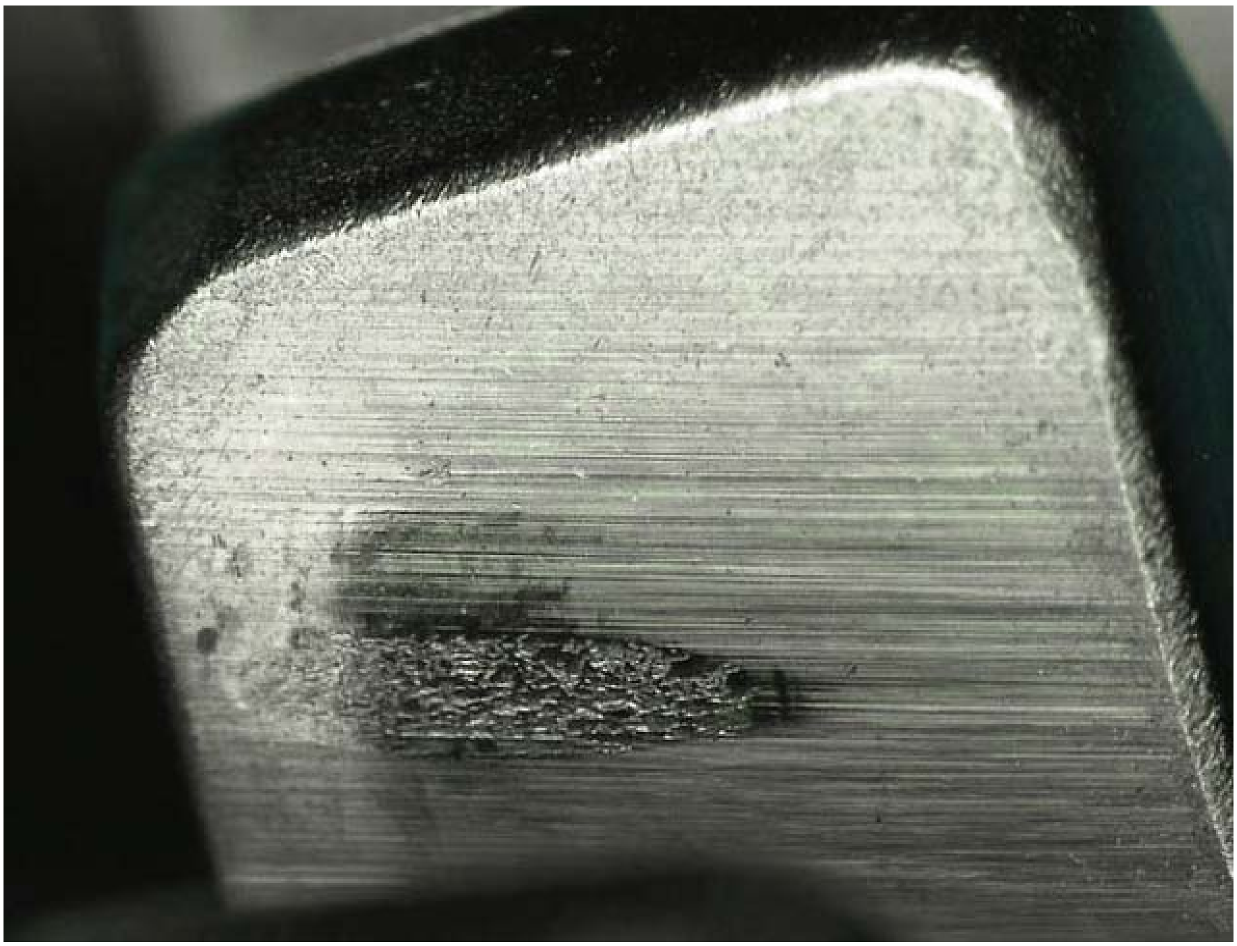
UP781957




Localized Spalling Due to Unevenly Distributed Tooth Loads
Figure 53




Medium Macropitting in the Tooth Contact Area
Figure 54 (Sheet 1 of 2)



Close up picture of medium macropitting in the tooth contact area.

Medium Macropitting in the Tooth Contact Area
Figure 54 (Sheet 2 of 2)


A Certain number of surface and edge imperfections (uneven chamfers for example) in non-working areas can be left "as is" without any treatment.

Examples of Repairable Small Dings, Nicks and Surface Blemishes on Gears
Figure 55 (Sheet 1 of 5)

UP781957


Dings and nicks of a similar nature and size as shown here should be repaired by blending. Surface damage extending into the tooth functional area has to be inspected for raised material which may create a high stress contact point during operation. Bulged material should be repaired by blending to make it flush with the base surface.

Examples of Repairable Small Dings, Nicks and Surface Blemishes on Gears
Figure 55 (Sheet 2 of 5)

UP781957


This surface imperfection extends from the tip chamfer into the tooth tip area. This section of the tooth is nonfunctional therefore no repair is necessary in this case.

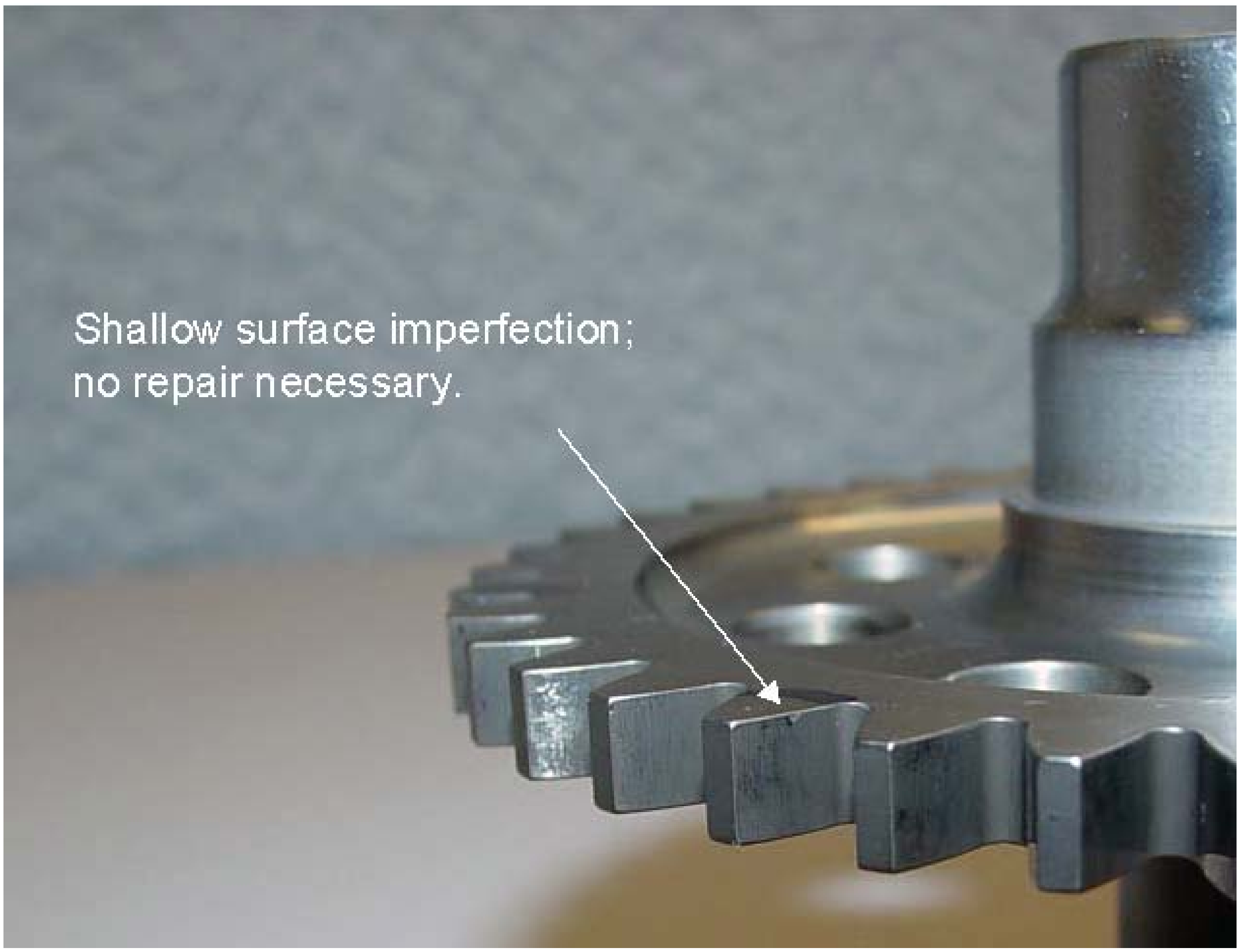
Examples of Repairable Small Dings, Nicks and Surface Blemishes on Gears
Figure 55 (Sheet 3 of 5)

UP781957


No sharp edges present. No repair necessary.

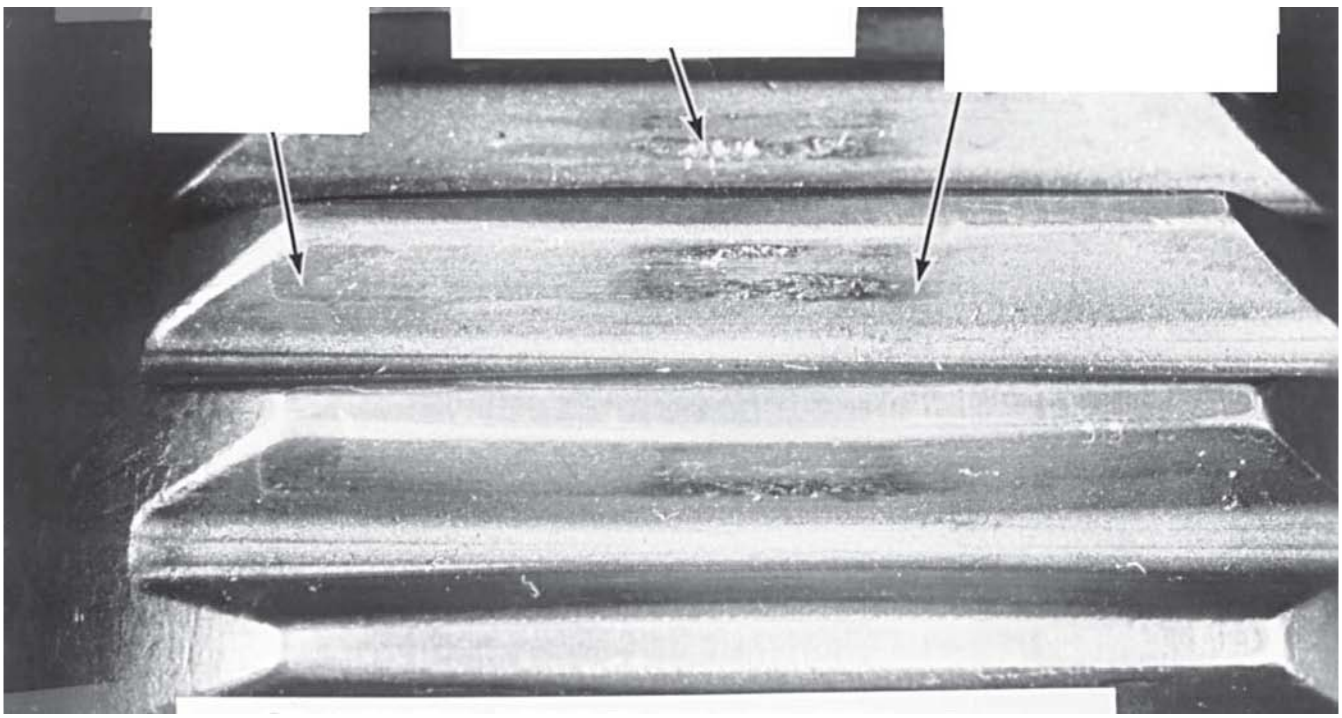
Examples of Repairable Small Dings, Nicks and Surface Blemishes on Gears
Figure 55 (Sheet 4 of 5)

UP781957

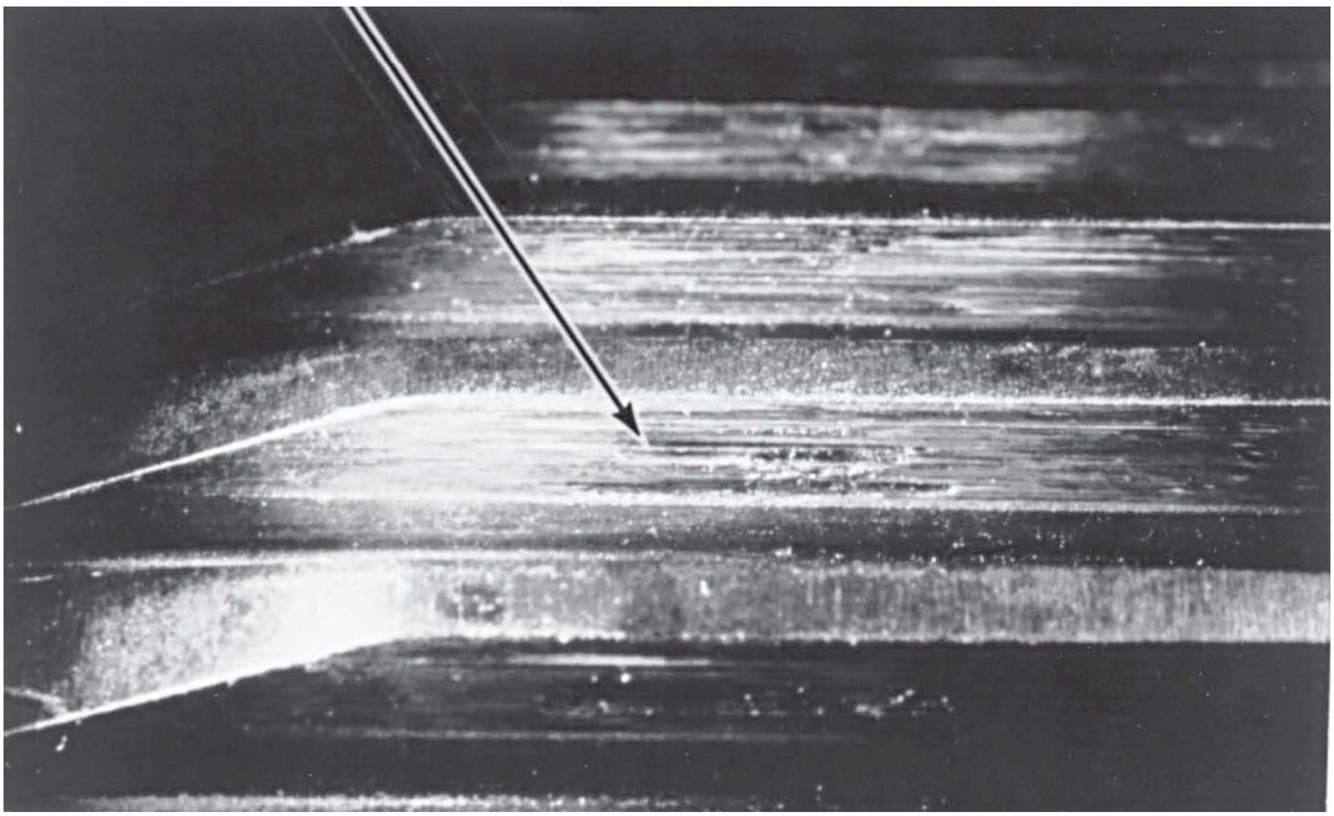



Examples of Repairable Small Dings, Nicks and Surface Blemishes on Gears
Figure 55 (Sheet 5 of 5)

UP781957

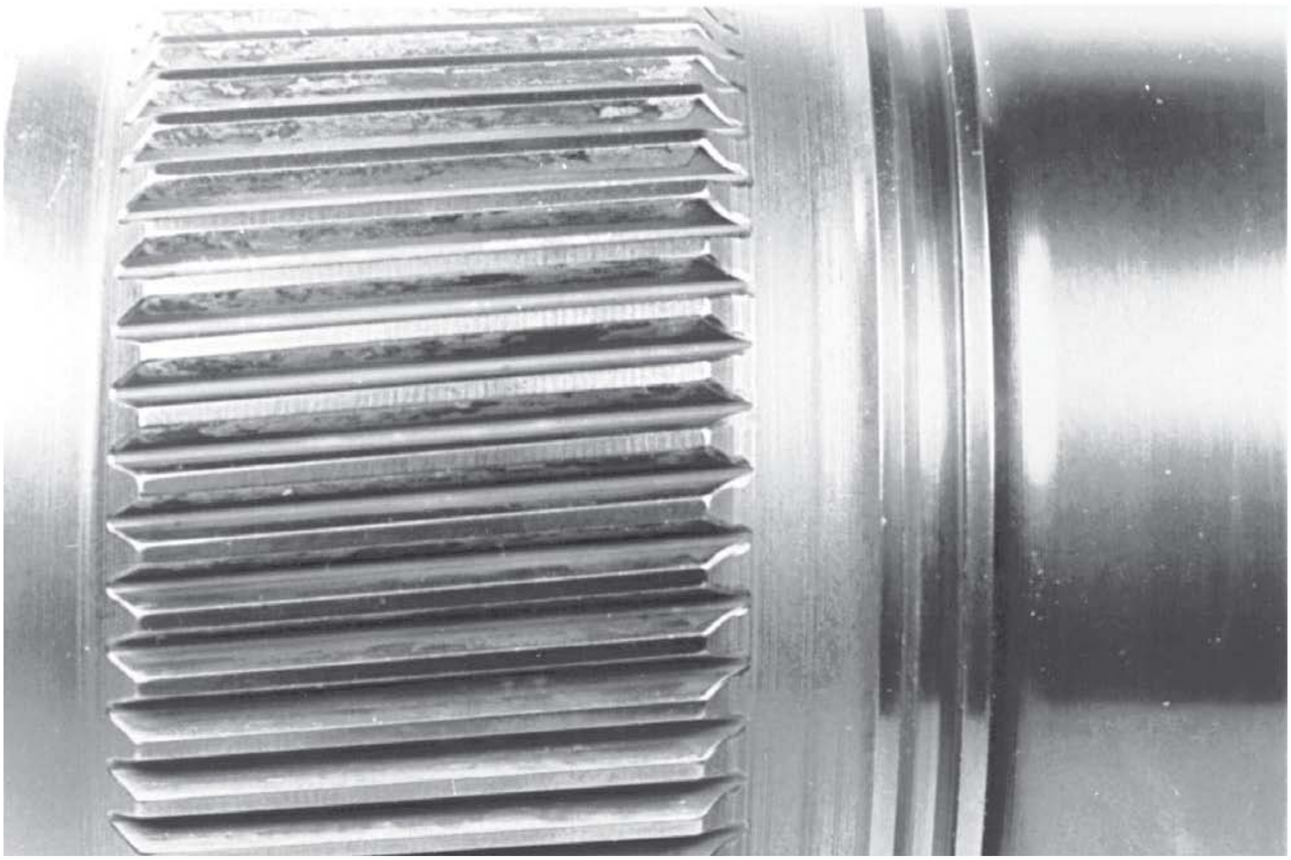


Crowned Spline Contact Pattern
Figure 56



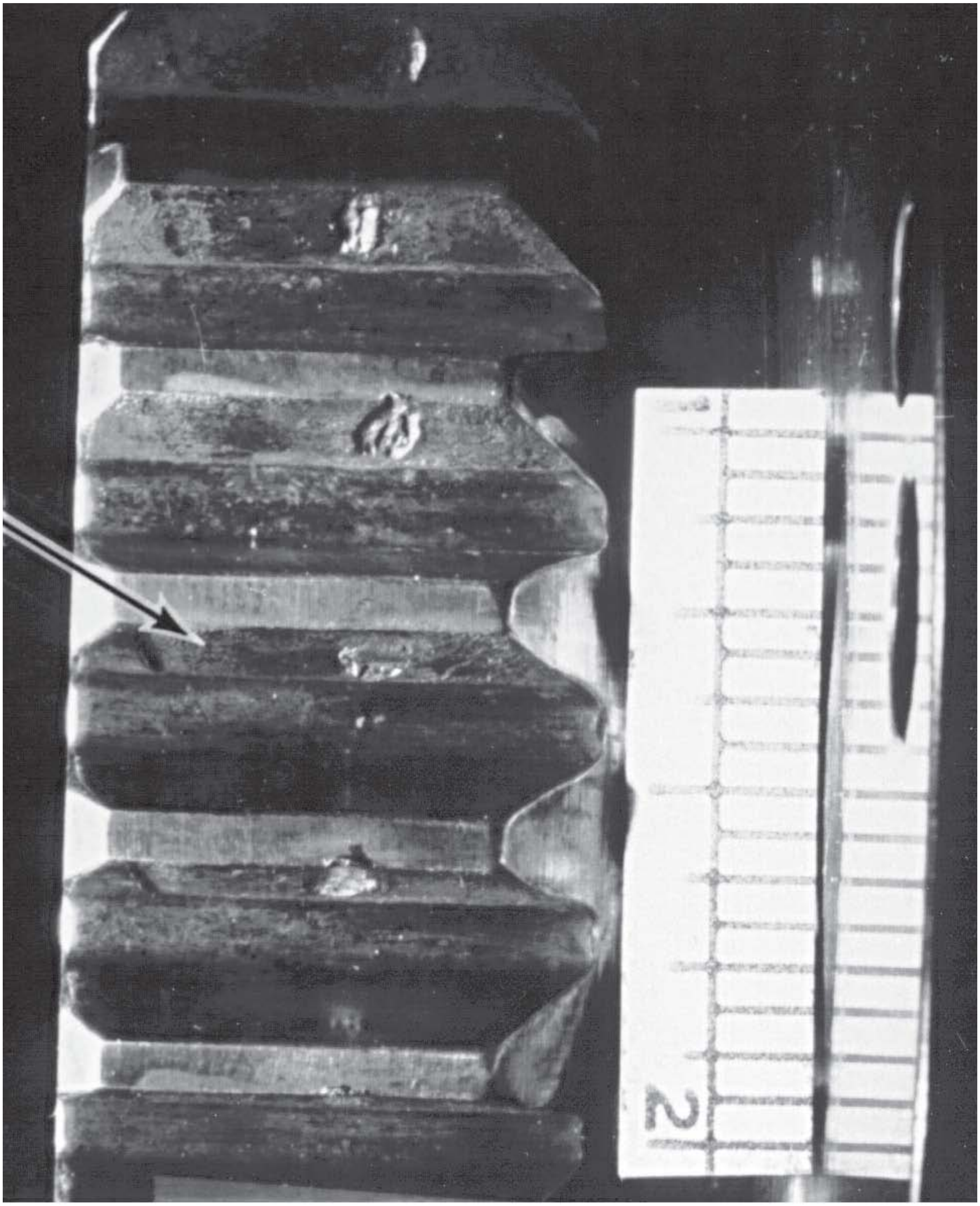
Spline Contact with Minimum Oil Flow
Figure 57

UP781957



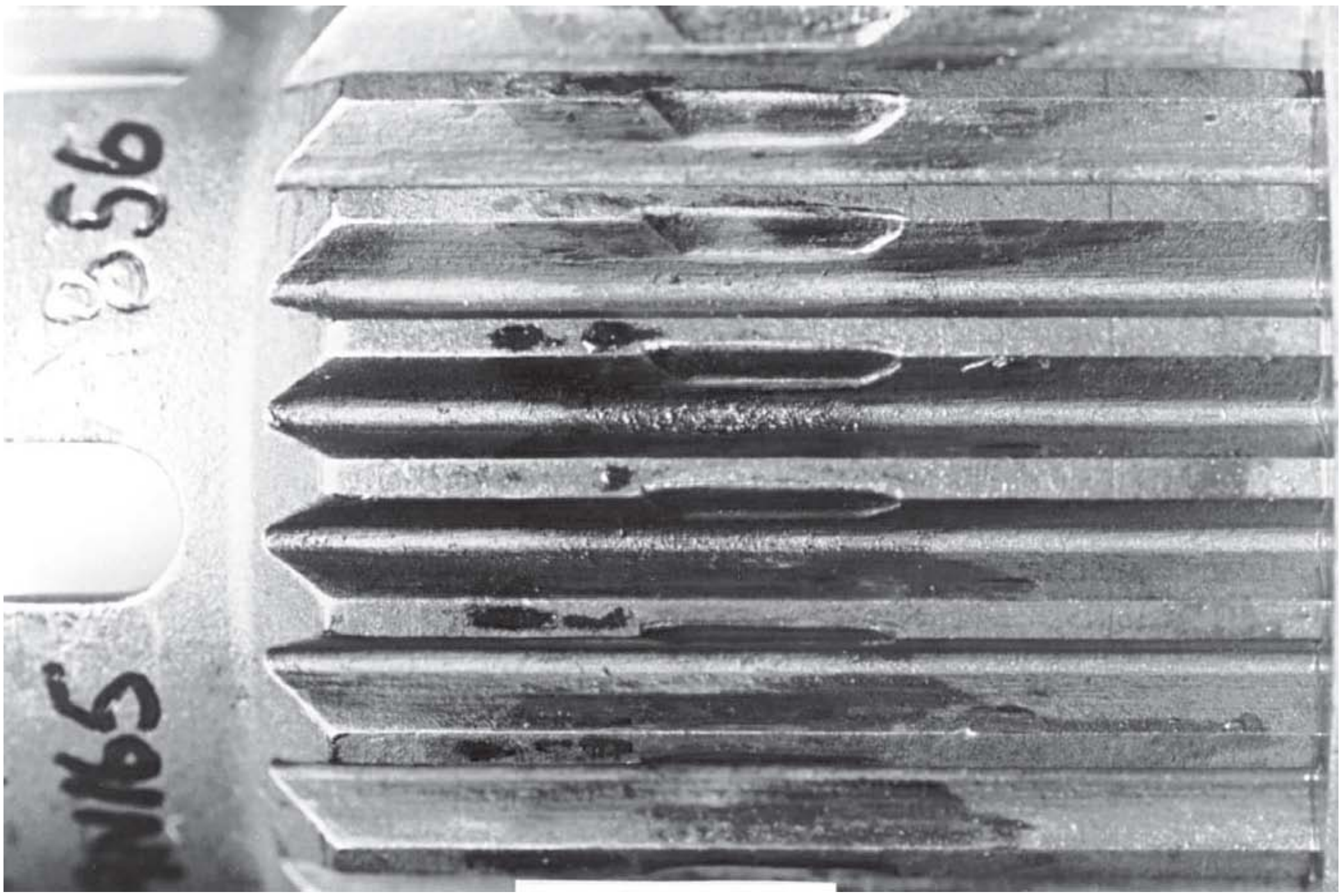
Fretting
Figure 58

UP781957

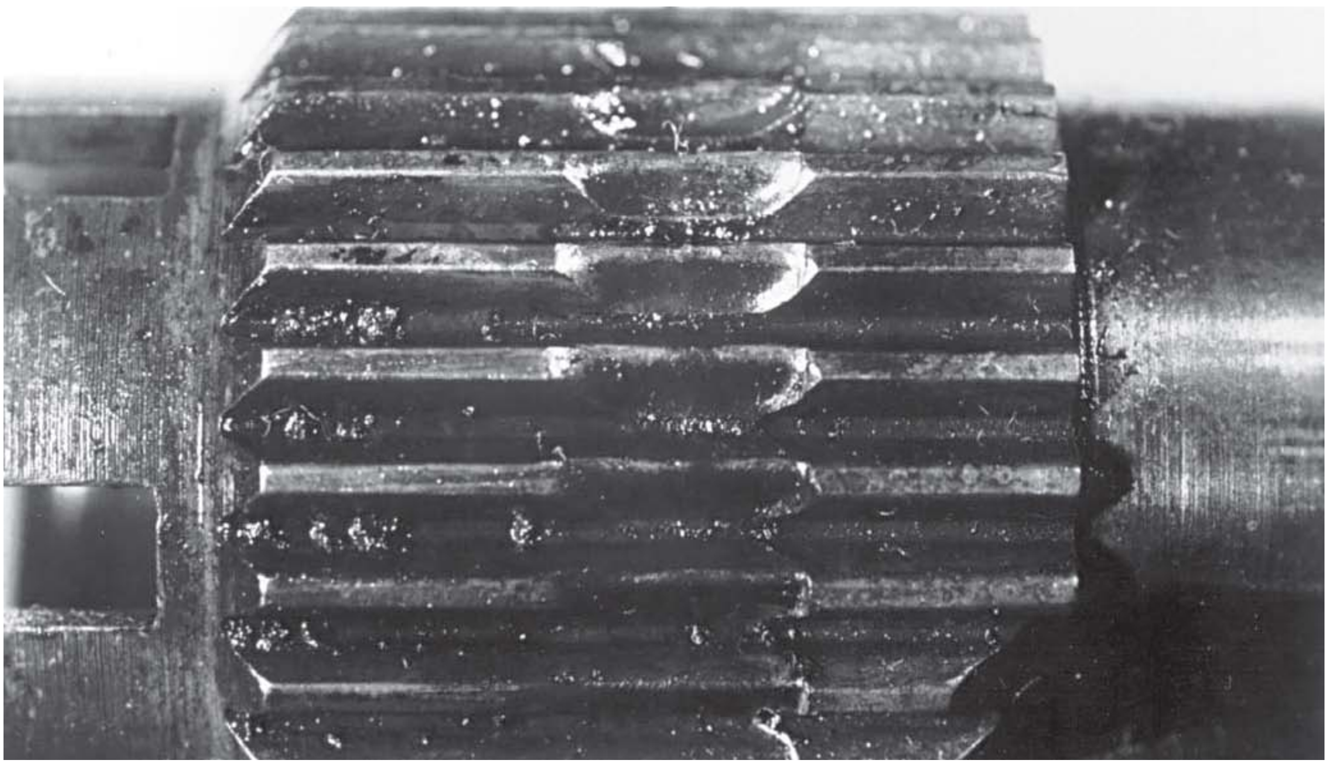



Spline Spalling Due to Misalignment
Figure 59

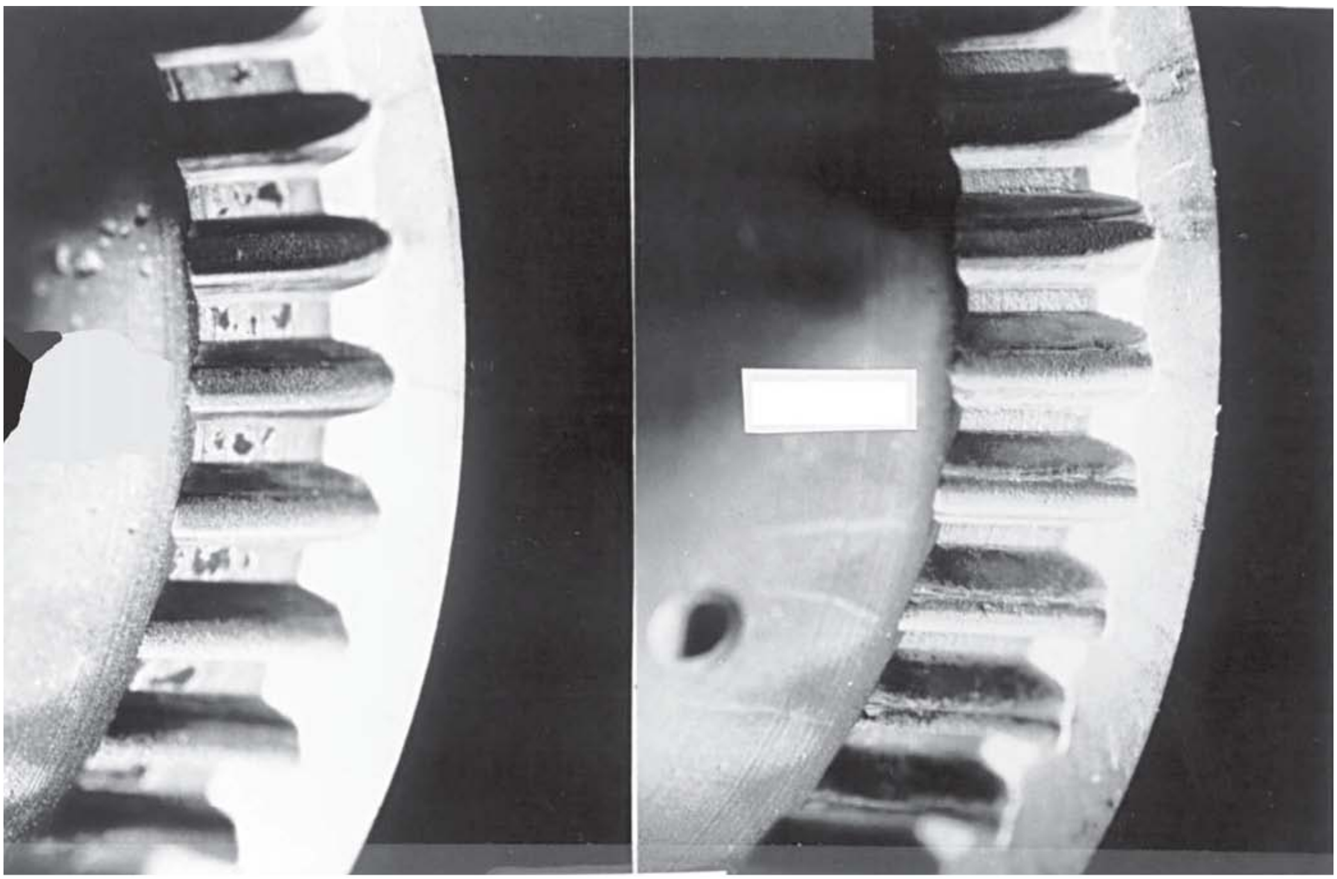
UP781957



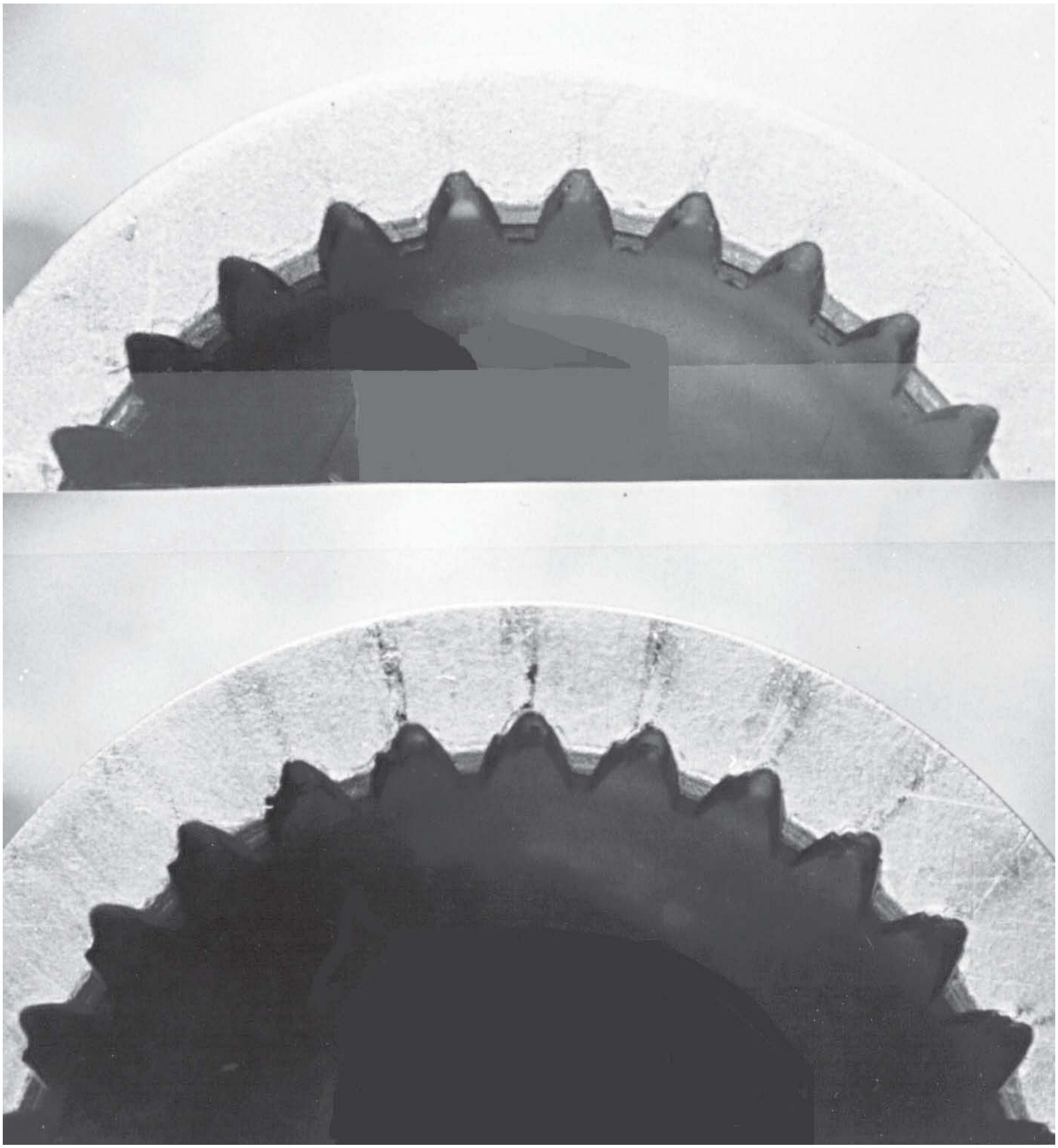

Spline Wear
Figure 60



Heavy Spline Wear
Figure 61



Internal Spline Wear Limits
Figure 62 (Sheet 1 of 2)

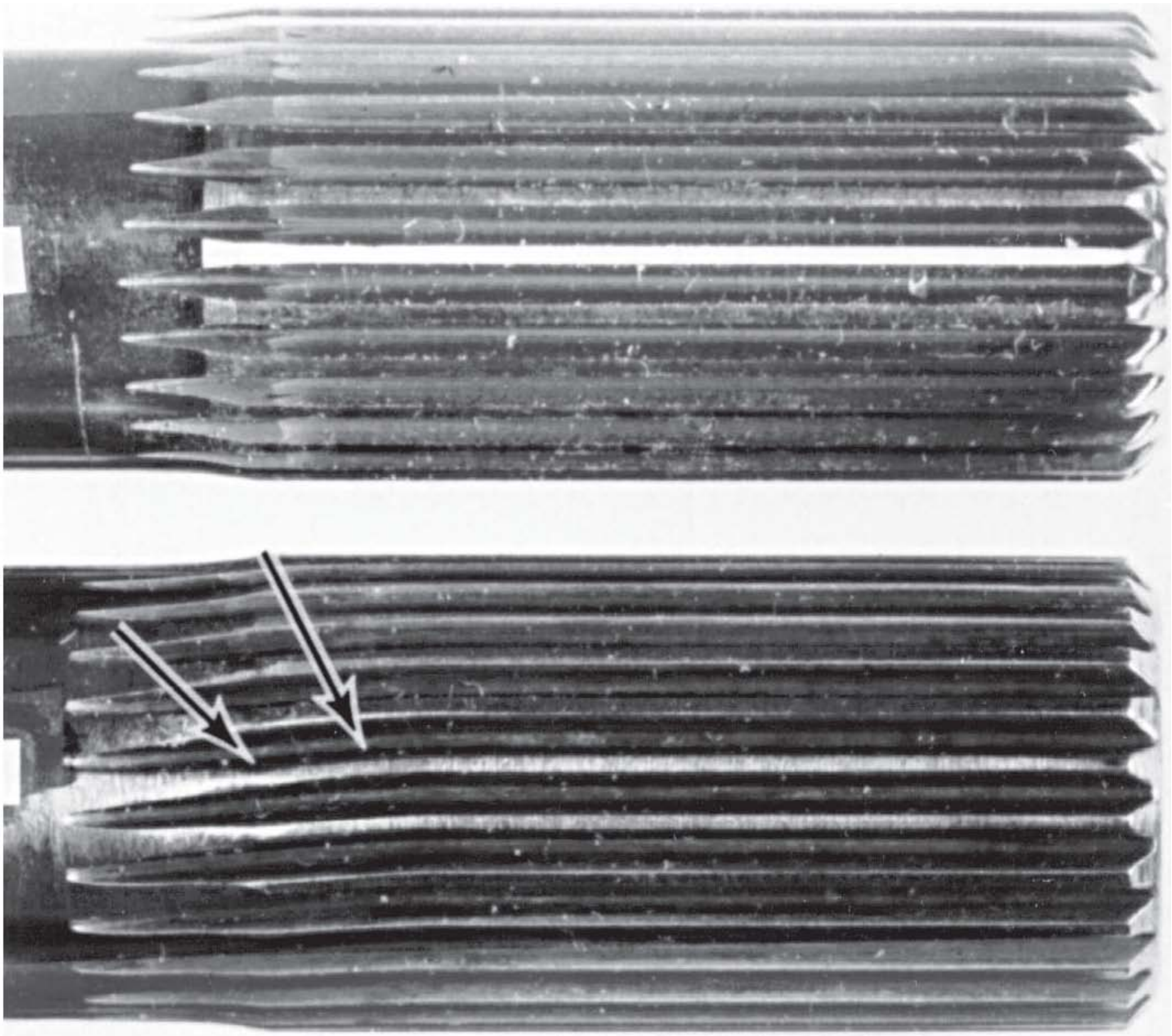


Internal Spline Wear Limits
Figure 62  (Sheet 2 of 2)

UP781957

Spline Tooth Damage
Figure 63

UP781957



Bent Teeth
Figure 64

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1. Ultrasonic Inspection (Contact and Immersion) - SP I309

A. This procedure contains the requirements for the ultrasonic inspection of materials and parts for the detection of discontinuities detrimental to serviceability of the part.

B. The ultrasonic test equipment shall consist of an electronic apparatus, transducers (search units), coupling medium, and suitable auxiliary equipment consistent with the following capabilities:

(1) The electronic equipment shall be capable of producing, receiving, and displaying high frequency electrical pulses at the required frequency and energy levels. The equipment shall have linear response characteristics over the range of material thickness and test frequencies involved. The cathode ray tube shall display pulses that enable measurement of indicated discontinuities relative to size and location.

(2) Transducers (search units) shall be capable of transmitting and receiving ultrasonic vibrations in the material being tested, at required frequency and energy levels. The piezoelectric elements of the transducers may be made of quartz, barium titanate, lithium sulphate, or other suitable material. Transducers may be of the focused type or have ancillary contact shoes shaped to suit the contour of the part to be tested. Transducers shall be suitably identified. Cracked or broken crystals and transducers that exhibit electrical arcing at the crystal face shall not be used.

(3) The coupling medium shall have good wetting properties and shall be capable of transmitting ultrasonic vibrations between the transducer and the part being tested. The following couplant materials are acceptable:

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

AREAS IN WHICH LUBRICATING OIL IS USED SHALL BE ADEQUATELY VENTILATED TO KEEP MIST AND FUMES TO A MINIMUM.

(a) Lubricating oil (02–22 or 02–23, 70–80–01).

(b) Water/glycerine mixture (10–33, 70–80–01).

(c) Kerosene (10–32, 70–80–01).

(d) Lubricating oil and glycerine mixture (02–22 or 02–23 and 10–33, 70–80–01).

(e) Water to which a suitable corrosion inhibitor and wetting agent have been added.

(f) Light grease (02–12, 70–80–01).

1. B. (4) Recording and/or defect level alarm apparatus may be used. It shall, however, be demonstrated that the equipment will comply with and maintain the sensitivity and resolution requirements to enable the detection and/or recording of defect indications as required by the applicable test specification.

(5) Manually operated water–column devices are not to be used for the determination of defect size. Defect size evaluation must be carried out by using either direct contact testing or precise immersed positioning methods.

(6) Transducer positioning devices must be capable of suitable transversing or indexing motion suitable to the part being inspected. For immersed testing, transducer positioners must be capable of accurate adjustment, within 1/2 of 1 degree. This accuracy shall be maintained. For contact testing, they shall maintain constant contact of the transducer to the part under test.

(7) Mechanical motion devices shall provide for uniform linear or rotary motion. The motion shall be controllable so that it shall not exceed one–half of the effective beam diameter of the transducer being used for each successive scan. The mechanical motion device shall be sufficiently precise to maintain accuracy of the incident or received ultrasonic beam in the material being tested.

(8) Reference Standard Blocks. A series of reference standard blocks or an actual master part prepared to serve as a reference block shall be of the same material and condition (heat treatment, surface finish, grain size, etc) as the part being inspected. Reference blocks used as standards shall contain flat–bottomed holes (FBH) of standard diameters at the same depths of the indicated discontinuities within ±1/16 inch (±1.6 millimeters) up to 1/4 inch (6 millimeters) depth, within ±1/8 inch (±3.2 millimeters) over 1/4 inch (6.4 millimeters) up to 1 inch (25.4 millimeters) depth, within ±1/4 inch (±6.4 millimeters) over 1 inch (25.4 millimeters) up to 3 inches (76.2 millimeters) depth, and within ±1/2 inch (±12.7 millimeters) over 3 inches (76.2 millimeters) depth.

C. General Requirements

(1) Frequency. Choice of frequency shall be based on the best compromise of sensitivity, resolution, and detection, with respect to class of inspection required by the material or part, thickness, and possible flaw orientation.

(2) Sensitivity settings shall be sufficiently high to assure detection of all discontinuities in excess of the acceptance level.

(3) Scanning.

(a) When scanning material or part, the search unit shall be indexed not more than 50 percent of the effective beam diameter for each scan.

(b) When mechanical scanning is employed, the rate of travel of the transducer shall be consistent with equipment repetition rate to assure full coverage and detection.

(c) When manual scanning is employed, the rate of travel shall not exceed 6 inches (152 millimeters) per second.

1. C. (4) Flaw Marking and Evaluation. All indications equal to that produced by smallest void in the applicable reference block or loss of 50 percent or more of a normal back reflection shall be marked as to location and depth as the test proceeds. The locations shall then be critically evaluated by angulation for maximum response.

(5) Surface condition of the part shall be of such quality that it shall be equivalent to 250 rms or better. The surface condition shall be uniform over the surface area to be tested.

D. Procedure

(1) Ultrasonic inspection shall meet the requirements of SAE AMS2630 or SAE AMS2632 as applicable, to the extent specified herein. Examine material or part for any surface irregularities (burns, gouges, etc) and remove with a sander capable of producing a surface finish equal to that required for a good response. Clean part of any loose scale, dirt, or adhering foreign material which will interfere with the transmission of the ultrasonic vibrations. Unless otherwise specified by the procuring activity, all critical components requiring the ultrasonic inspection shall be machined to a sonic shape (configuration drawing) to permit maximum ultrasonic inspectability. Machining shall be as follows:

(a) On all surfaces that can be inspected from both sides, stock allowance shall be 0.100 inch (2.54 millimeter) minimum.

(b) On all entry surfaces that can be inspected from one side only, stock allowance shall be 0.150 inch (3.81 millimeter) minimum.

(c) All surfaces are to be flat, cylindrical, or conical.

(2) Select the proper test frequency and search unit. (Refer to Step B.(2).) The transducer must be capable of efficient operation at the same rated frequency as that to be used in the test. In general, a higher frequency is used in the detection of internal defects of small magnitude; however, this gives minimum penetrating power. A low frequency will give the greatest penetrating power but is less sensitive to small defects.

1. D. (3) Calibration.

(a) Using a reference standard test block (Step B.(8)) the electronic apparatus shall be calibrated to produce a standard defect signal (i.e., pi height) when the search unit is placed over the simulated defect. If the size of this defect signal varies more than 10 percent in amplitude from the original calibration, the equipment should be recalibrated. This calibration should be performed in the same manner as the material or part to be inspected.

(b) The equipment shall be adjusted as necessary with reference to the standard test block to produce a clearly defined indication well separated from the front surface echo and the first back reflection. The initial pulse indication shall be adjusted so as to be as short and narrow as possible. The first back reflection shall be adjusted so as to give full scale base–to–peak amplitude. The defect indication should be adjusted to give at least 80 percent full scale base–to–peak amplitude. In immersion testing, the distance between the search unit and the material or part shall be adjusted to prevent interference between water multiples and the first back reflection and should be the same distance used in the calibration of the standard test block. The water depth distance between the transducer and the entry surface shall be within the limits recommended by the manufacturer in order to maintain the correct beam profile.

(c) The material or part shall be substituted for the standard test block. The method or technique used by the operator shall be such to ensure 100 percent inspection of the material or part.

1 Contact Method. When the contact method is used, the method of inspection may be by longitudinal, shear wave, surface wave, or a combination thereof.

a Angle Beam Testing. The sound beam angle and testing mode shall be established as part of the test procedure. The search unit qualification tests will establish the exit point and angle of exit. When contact shoe or search unit wear results in a change in sound beam entry angle of more than ±3 degrees (±0.052 radian) from the established angle, the search unit shall be replaced or repaired.

b Straight Beam Testing. Search unit qualification tests shall establish the sound beam character for the straight beam search unit. Visually inspect search unit to make sure that wear face surface is intact. Periodic visual inspections shall be made during tests to make sure that search unit facing has not degraded. Cracks, chipping, break up, or uneven wear conditions shall disqualify search unit and test.

c Surface Wave. Surface shall be clean before and during a surface wave test. Precautions shall be exercised to remove excess couplant, foreign material, and any matter that could influence the test.

1. D. (3) (c) 2 Immersion Method. When the immersion method is used, the method of inspection may be longitudinal (straight) beam, angle beam, shear wave, or a combination thereof.

a Longitudinal (Straight) Beam Testing. Beam entry angle shall be adjusted until the sound beam is perpendicular to test surface. Maximum signal amplitude from entry surface or multiple reflections may be used to determine this condition. During testing, established angle shall not vary more than ±2 degrees (±0.035 radian).

b Angle Beam Testing. Products may be inspected with both longitudinal and shear wave motions at various preselected angles. Once established, the surface entry angle shall not vary more than ±2 degrees (±0.035 radian).

c Water Path. Valid test may be performed in both the Fresnel (near) and Fraunhafer (far) field zones. A variety of sound beams, ranging from collimated to highly focused, may be used. Special interpretations of test results may be necessary to characterize discontinuity. A variety of test zones are possible; changing the test zone by varying water path during test may present serious complications. During test, the established water path shall not vary more than ±0.200 inch (±5.08 millimeter).

E. Material Acceptance Criteria. Ultrasonic quality levels are divided into Classes AA, A, B, and C. When more than one grade of inspection is required for a particular part or when certain areas of a part do not require ultrasonic inspection, it shall be so stated in the applicable repair procedure. When no class is specified in the repair procedure, the AA class shall be used.

(1) Class AA Areas.

(a) Discontinuity indications in excess of the response from a 3/64 inch (1.19 millimeter) diameter flat–bottom hole at the estimated discontinuity depth shall not be acceptable.

(b) Discontinuity indications greater than 10 percent of the response from a 3/64 inch (1.19 millimeter) diameter flat–bottom hole at the discontinuity depth shall not be closer than 1 inch (25 millimeters) or exhibit a length greater than 1/8 inch (3.18 millimeter).

(c) Harsh or sonic noise shall not exceed 10 percent of the response height received from a 3/64 inch (1.19 millimeter) diameter flat–bottom hole at the estimated discontinuity depth.

(d) With the instrument set so that the first back reflection from the correct test block is at 80 percent of the screen saturation adjusted for nonlinearity, the material shall be inspected for loss of back reflection. Any loss in back reflection in excess of 50 percent of full saturation of the screen shall be considered not acceptable.

1. E. (2) Class A Areas.

(a) Discontinuity indications in excess of the response from a 5/64 inch (1.98 millimeter) diameter flat–bottom hole at the estimated discontinuity depth shall not be accepted.

(b) Multiple indications in excess of the response from a 3/64 inch (1.19 millimeter) diameter flat–bottom hole shall not be closer than 1 inch (25.4 millimeter).

(c) Elongated (Stringer) type defects in excess of 1 inch (25.4 millimeter) in length shall not be acceptable if, at any point along the length, the discontinuity indication is equal to or greater than 50 percent of the response from a 3/64 inch (1.19 millimeter) diameter flat–bottom hole.

(d) Multiple discontinuities giving an indication less than the response from a 5/64 inch (1.98 millimeter) diameter flat–bottom hole are acceptable only if the back reflection pattern is 50 percent or more of the back reflection pattern of sound material of the same geometry. The sound beam must be normal to the front and back surfaces to make sure that loss of back reflection is not caused by surface roughness, surface waviness, or part geometry variation.

(3) Class B Areas.

(a) Discontinuity indications in excess of the response from an 1/8 inch (3.18 millimeter) diameter flat–bottom hole at the estimated discontinuity depth shall not be acceptable.

(b) Discontinuity indications in excess of the response from a 5/64 inch (1.98 millimeter) diameter flat–bottom hole at the estimated discontinuity depth shall not be closer than 1 inch (25.4 millimeter).

(c) Elongated (Stringer) type defects in excess of 1 inch (25 millimeter) in length shall not be acceptable if, at any point along the length, the discontinuity indication is equal to or greater than the response from a 5/64 inch (1.98 millimeter) diameter flat–bottom hole.

(d) Multiple discontinuities giving an indication less than the response from a 5/64 inch (1.98 millimeter) diameter flat–bottom hole are acceptable only if the back reflection pattern is 50 percent or more of the back reflection pattern of sound material of the same geometry. The sound beam must be normal to the front and back surfaces to make sure that the loss of back reflection is not caused by surface roughness, surface waviness, or part geometry variation.

(4) Class C Areas. Discontinuity indications in excess of the response from a 1/8 inch (3.18 millimeter) diameter flat–bottom hole at the estimated discontinuity depth shall not be acceptable.

(5) Material or parts failing to meet the above requirements shall be subject to rejection.

1. E. (6) Inspection of Machined Parts. Discontinuity indications in excess of the specified ultrasonic quality level shall be permitted if it is established that such discontinuities will be removed by subsequent machining operations. In such cases, a record of the ultrasonic test results shall be provided showing the location and size of indications by discontinuity class with respect to a benchmark on one corner of the surface from which the material is scanned.

(7) Standardization. Ultrasonic inspection system shall be standardized using appropriate reference standard as follows:

(a) Prior to start of each part configuration.

(b) After each 4 hours maximum of use.

(c) When changing ultrasonic inspection equipment operator.

(d) After shutdown or deviation of equipment which requires a standardization check.

(e) Where part is its own standard, equipment shall be standardized with each part.

(f) Certification. Ultrasonic inspectors shall be certified in accordance with the requirements of MIL–STD–410.

F. Rejection. Parts not conforming to requirements in the applicable specification or confirmation drawing shall be subject to rejection.

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1. Radiographic Inspection - SP I310

A. Radiographic inspection shall be performed in accordance with the requirements of MIL–STD–453. All areas of a part requiring radiographic inspection shall be examined using a sufficient number of radiographic views to satisfactorily establish the nature and extent of any discontinuities which may be present.

(1) Penetrameters shall be fabricated of material of the same composition or of radiographically similar material of approximately the same density as the object to be radiographed.

The dimensions of the penetrameter used for all metals and alloys shall be in accordance with Figure 1. However, when limited by part configuration, special penetrameters may be used.

(2) Use fine grain, high contrast, safety type industrial film.

(3) Radiographic exposure techniques shall be used as follows:

WARNING: TO GUARD OPERATING PERSONNEL FROM POSSIBLE DANGER OF X–RAY ABSORPTION, COVER REAR SIDE OF FILM HOLDER WITH A SHEET OF LEAD THICK ENOUGH TO FULLY ABSORB ANY SECONDARY REFLECTED RADIOGRAPHIC RAYS. AS A FURTHER PRECAUTION, ALL RADIOGRAPHIC OPERATING PERSONNEL SHALL WEAR A RADIATION DETECTOR TYPE BADGE OR CYLINDER.

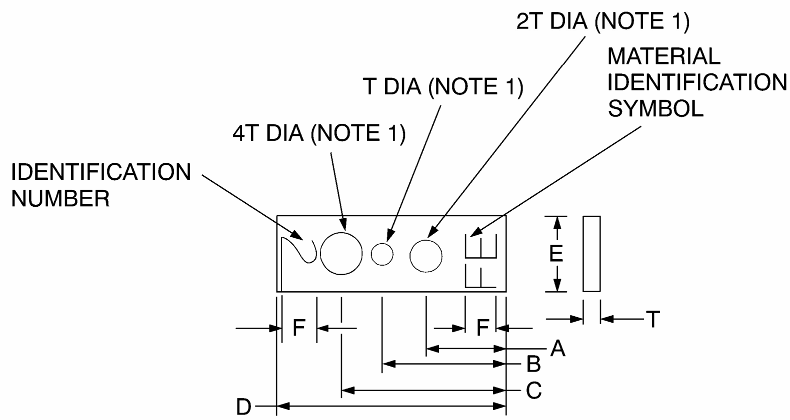
(a) The maximum image sharpness on the film shall be obtained by experimentally varying the film/focal distance.

(b) During exposure, the film shall be as close to the part surface as practicable.

(c) Screens, filters, and methods of blocking or section equalizing may be used when necessary.

(d) Radiographs shall be free from blemishes in the area of interest and shall be processed in accordance with the manufacturer’s instructions.

(e) Film density shall not be lower than 1.8 or higher than 3.5 in the area of interest. However, film density on radiographs of aluminum and magnesium castings may be as low as 1.4 provided at least 50 percent of the film area of interest is within 1.8 to 3.5. Film density shall be determined with an Ansco color densitometer or equivalent device.




| DIMENSION | SECTIONS UP TO AND INCLUDING 2.5 (63.5) THICK | SECTIONS OVER 2.5 (63.5) THICK |
|---|---|---|
| A | 0.625 (15.875) | 1.000 (25.400) |
| B | 1.063 (27.000) | 1.563 (39.700) |
| C | 1.438 (36.525) | 2.063 (52.400) |
| D | 1.875 (47.625) | 2.750 (69.850) |
| E | 0.500 (12.700) | 1.000 (25.400) |
| F | 0.250 (6.350) | 3.75 (9.53) APPROX |
| T | NOTE 2 | |

| SYMBOL | MATERIAL |
|---|---|
| SS | STAINLESS STEEL |
| AL | ALUMINUM |
| FE | STEEL |
| MG | MAGNESIUM |
| CU | COPPER |
| TI | TITANIUM |

NOTES:

1. MINIMUM T HOLE DIMENSIONS
   A. 1T HOLE – 0.010 (0.254) DIAMETER ± 10 PERCENT.
   B. 2T HOLE – 0.020 (0.508) DIAMETER ± 10 PERCENT.
   C. 4T HOLE – 0.040 (1.016) DIAMETER ± 10 PERCENT.

2. PENETRAMETER THICKNESS SHALL BE NO GREATER THAN 2 PERCENT BUT NOT LESS THAN 0.005 INCH (0.127 MM).

ALL DIMENSIONS ARE IN INCHES (MILLIMETERS)

LE55180

Penetrameter Dimensions

Figure 1

1. A. (3) (f) The part shall be reradiographed whenever there is doubt as to the interpretation or clarity of the film.

(g) After the optimum radiographic parameters have been established in accordance with Step (3), a permanent record of this data shall be made as outlined in Step (5). For any given part number, the radiographic operator shall use this method to maintain a standard inspection technique on all inspected parts or assemblies.

(4) The radiographic procedure shall be satisfactory when:

(a) The image details of the penetrameter, including the 2T hole (Figure 1) are sharply defined in the radiographs.

(b) The density level is as specified in preceding Step (3)(e).

(5) Reports of inspection. The radiographic laboratory shall furnish inspection reports giving the results of the radiographic inspection and signed by an authorized representative of the laboratory. The report shall list the purchase order number or equivalent identification, the number of parts, and the date of test. Each part shall be listed by the part number, serial number of the test, and rated condition of the part.

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1. Residual Magnetism Inspection - SP I311

A. Residual magnetism inspection is a means of measuring the presence of magnetism in modules, assemblies or parts.

B. Equipment other than that specified herein may be used provided it has been demonstrated that the device will produce equivalent results and has been approved by the Quality Engineering Department.

(1) The magnetic field meter is intended to be a comparative type of measurement tool. When calibrated in accordance with the requirements of this procedure, its accuracy is sufficient for most residual magnetism measurements. The following are suitable meters:

(a) Annis Model No. 25 (manufactured by R.B. Annis Co, 1101 Delaware St, Indianapolis, IN) or equivalent.

(b) Magnaflux Model No. 505056 (manufactured by Magnaflux Corp, 7300 W Lawrence Ave, Chicago, IL) or equivalent.

(2) Where absolute measurements, detection of residual magnetism of low levels or detection on small parts is required, especially in gears and bearings or parts with a maximum dimension of less than 6 inches (152 millimeters), a Hall Effect Probe or equivalent device will be necessary. The Hall Effect gaussmeter used in conjunction with the Hall Effect Probe shall be capable of detecting magnetic fields through a range of 1 to 10 gauss minimum. The probe shall be capable of withstanding magnetic fields up to 10,000 gauss. The following Hall Effect gaussmeter and probe have demonstrated the capability of meeting the requirements of this procedure:

Transverse probe (No. 951) and Gaussmeter (No. 7303) (manufactured by Magnetic Instrument Co, 8350 E 48th St, Indianapolis, IN), or Gaussmeter Model 4048 (manufactured by F.W. Bell, 6120 Hanging Moss Rd, Orlando, FL 32807), or equivalent.

NOTE: All field detection equipment must be periodically calibrated in accordance with manufacturers recommendations.

C. Demagnetizing apparatus shall be capable of demagnetizing all inspected parts (assemblies) to a satisfactory level. The demagnetized parts (assemblies) shall not produce magnetic field indications exceeding 3 gauss at the surface of the part unless otherwise specified.

1. D. Calibration equipment shall be capable of producing an accurate uniform magnetic field of known strength. The Helmholz coil or solenoid coil is recommended.

(1) Helmholz coil shall consist of 2 air coils of the same diameter, number of turns, and same gage wire. The coils shall be separated by a distance along their common axis equal to the radius of the coil. (See Figure 1.) Power shall be supplied in the same direction to both coils in a manner that will give the same amount of current in both coils.

NOTE: The area halfway between the coils is where the magnetic field is uniform. The coil diameter and the spacing between the coils must be large enough to accommodate the field meter to be calibrated.

(a) The magnetic field calculation for the Helmholz coil shall be as follows:

N = number of turns in 1 coil of wire.
I = current in amperes through the coil.
R = radius of 1 coil in centimeters.

$$\text{gauss} = \frac{0.899NI}{R}$$

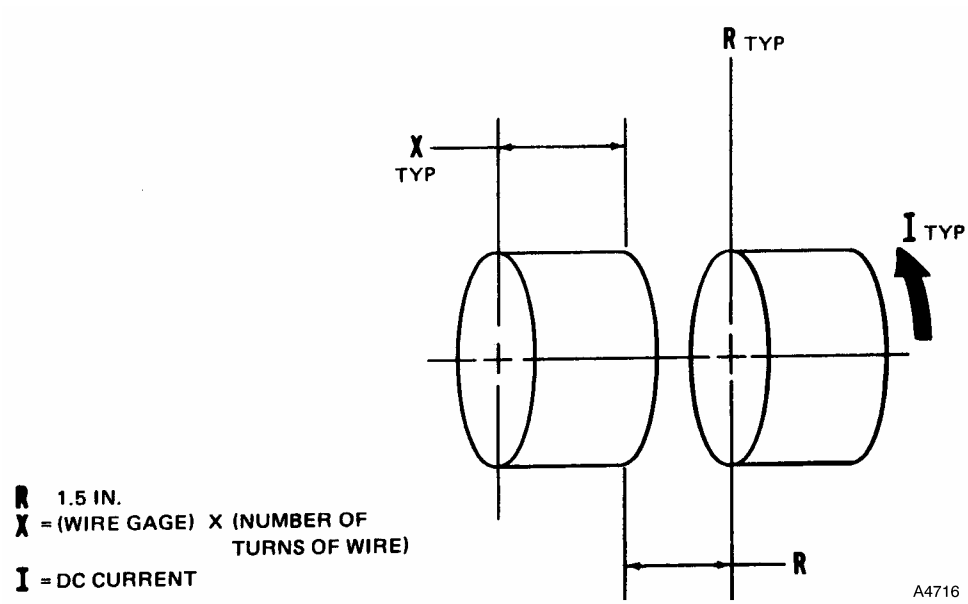
(2) Solenoid coil shall be a coil of wire with its length at least 10 times as long as its radius. (See Figure 2.)

NOTE: Magnetic field will be uniform inside the coil near its center. The coil diameter must be large enough to accommodate the field meter to be calibrated.

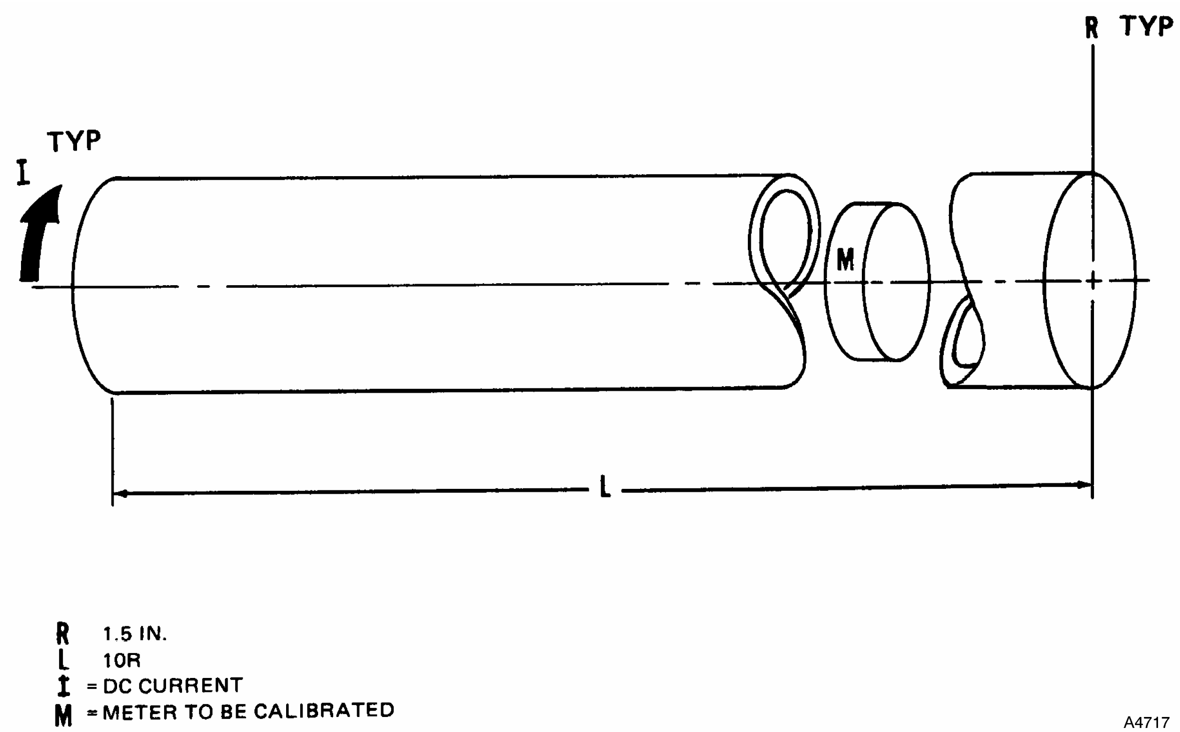
(a) The calculation for the solenoid coil shall be as follows:

N = number of turns of wire in solenoid coil.
I = solenoid current in amperes.
L = solenoid length in centimeters.

$$\text{gauss} = \frac{1.257NI}{L}$$




Typical Helmholz Coil
Figure 1




Typical Solenoid Coil
Figure 2

1. E. Inspection for residual magnetism shall be performed on all oil–wetted parts after the completion of all processes that could induce magnetism.

(1) Cleaning or back flushing operations shall always be preceded by a residual magnetism inspection (and demagnetizing operation as required). Particular attention must be paid to parts with internal cavities or passageways that could trap magnetized particles.

(2) Inspection for residual magnetism, and demagnetization (if required), shall be performed after any manufacturing operation known to induce residual magnetism (magnetic chucks, magnetic particle inspection, welding, etc).

(3) The inspection area shall be checked to make sure that no strong magnetic fields are present. If objects are found to be causing magnetic fields, they shall be removed before inspecting parts or assemblies. If the magnetic field is due to outside sources such as heavy machinery or the earth's field, allowance must be made for these factors during testing. If the field meter is aligned with this outside field, the outside field must be subtracted from, or added to, the reading.

F. The surfaces of all parts shall be cleaned (when required) to remove all traces of oil, grease, dirt, and other contaminants that might interfere with the detection of residual magnetic fields. Special care shall be exercised to make sure that all foreign material has been removed from all cavities and internal passageways where it might have adhered while the part was magnetized. The cleaner shall be a solvent capable of removing oil, grease, and other foreign materials from the part without adverse effects to the part.

G. A magnetic field inspection shall be performed in a manner that will make sure the detection of any residual magnetic field exceeding this specification and having axes in any direction.

H. When inspection requires the use of a field meter, perform the following:

(1) With test edge of meter facing part, move meter slowly towards part starting at a distance of 12 inches (305 millimeters) from the part surface. If meter deflects full scale at any time, the part shall be demagnetized.

(2) When test edge of meter touches part, move meter along surface of part covering as much of the part surface as possible. Special attention shall be given in corners and irregular surfaces.

(3) The gauss levels shall be as specified. (Refer to Paragraph K.)

(4) An inherent characteristic of field meters causes them to indicate less than actual gauss levels on parts with magnetic pole separation less than approximately 6 inches (152 millimeters). In this instance, a Hall Effect probe is an accurate means of obtaining true field strength.

1. I. If the field meter gives erratic readings or when the accuracy of the reading is suspect, the part shall be retested with a different field meter of known accuracy. The suspect field meter shall not be used until its accuracy has been verified.

J. When the residual magnetism exceeds the allowable limit for the part being tested, the part shall be thoroughly demagnetized in accordance with equipment manufacturer's recommendations or as follows:

(1) Position parts approximately 12 inches (305 millimeters) in front of coil.

(2) Apply direct current to coil.

(3) Move the component slowly and steadily through the coil (keeping part as close as possible to inner wall of coil) and go at least 3 feet beyond the end of the coil.

(4) Complex components requiring rotating the part on all axes as it is being demagnetized.

(5) Repeat Steps (3) and (4) above as necessary to make sure of adequate demagnetization of 3 gauss or less.

(6) Check magnetism (3 gauss maximum). If reading not within limits repeat demagnetization.

(7) If the component has oil passage(s) or flow paths, it must be back flushed after demagnetization to make sure particles and/or chips are removed.

K. Unless otherwise specified, all modules, assemblies, and parts requiring inspection shall show a level of residual magnetism at the surface of 3 gauss or less. The Hall Effect Probe shall be the referee method in determining actual gauss levels in instances of dispute.

1. Eddy Current Inspection - SP I312

A. Purpose

To provide instructions for performing eddy current inspection on electrically conductive parts and materials for detection of flaws and variations in physical properties.

B. Personnel Qualification

(1) Personnel performing eddy current inspection in accordance with this procedure shall be qualified and certified in accordance with NAS410.

(2) Personnel who evaluate indication for eddy current inspection in accordance with this procedure shall be qualified and certified to Eddy Current Level I, Level II, or Level III in accordance with NAS410.

(3) A list of certified personnel shall be maintained.

C. Written Procedure

Part specific instructions may be generated to supplement general requirements of this procedure. Specific procedure shall be reviewed and approved by personnel qualified and certified to Eddy Current Level III in accordance with NAS410 and shall comply with SP I312 and contain as minimum:

(1) Part number.

(2) Material type and condition and stage of fabrication at time of inspection.

(3) Manufacturer and identification of instrumentation to be used, including coil assemblies, fixtures, handling equipment, recorders, etc.

(4) Reference standard identification.

(5) Description of calibration and inspection procedure. Include instrumentation settings, scanning speeds, scanning increments, and fixtures or mechanisms used in examination.

(6) Acceptance criteria and procedure for interpretation of results.

(7) Date.

D. Equipment

(1) The eddy current instrument shall be capable of energizing coil assemblies with alternating current of suitable frequencies and shall be capable of sensing and indicating changes in the electrical impedance of the coil assemblies.

(2) Eddy current instruments used for flaw detection shall be capable of generating frequencies up to at least 2 MHz.

1. D. (3) The inspection apparatus shall include alarms, fixturing, manipulators, signal processors, and recording devices as required for the particular application.

(4) Coil assemblies may be of the absolute or differential type and shall be capable of inducing currents in the parts and sensing changes in the electromagnetic properties of the parts.

(5) The inspection area, equipment, reference standards, and parts shall be clean and free from foreign materials that might interfere with inspection.

(6) Temperature fluctuations that might interfere with inspection shall be avoided.

(7) The inspection area, equipment, reference standards, and parts shall be free from stray magnetic fields that might interfere with inspection.

NOTE: Ferromagnetic parts and reference standards shall be demagnetized to less than 0.5 gauss prior to inspection. Demagnetization adequacy shall be measured with an Annis Model 25 field indicator, or equivalent. The meters shall have a full scale range of, at most, –5 to +5 gauss (or oersteds).

E. Preparation

(1) Reference standards for flaw detection shall be of the same composition, condition, and geometry as the parts to be inspected and shall be free of interfering discontinuities. Calibration defects shall be based on the specified acceptance criteria.

(2) Reference standards for hardness or conductivity measurements shall be known hardness or conductivity.

(3) Reference standards for thickness measurements shall be of the same composition and condition and of similar geometry as the parts to be inspected. Coating thickness standards shall be either foils (shims) or actual coated substrates.

(a) Foils used for measurement of conductive coatings shall be of the same composition and condition as the coating. Nonconductive plastic foils may be used for measurement of nonconductive coatings.

(b) Coated substrate standards shall consist of coatings of known thickness permanently bonded to the substrate material.

F. Procedure

(1) Allow the instrument to warm up for a minimum period of time in accordance with the manufacturer's recommendations prior to performing any calibration and inspection.

(2) Calibrate instrument on the applicable standard(s) to obtain the appropriate response.

1. F. (3) When it is desired that measurements not be affected by thickness, the test frequency should be selected so that the depth of penetration is less than the thickness of the reference standard or part. The effective thickness may be increased by backing the reference standard or part with a sufficient thickness of the same material to exceed the depth of the penetration.

(4) When depth of penetration is equal to or greater than the reference standard or part thickness and the effective thickness cannot be increased, measurements shall not be made over metal or other electrically conductive surfaces.

(5) Sensitivity shall be set for maximum response without exceeding 90 percent of the available scope or scale range.

(6) For flaw detection, the signal–to–noise ratio between the response of the calibration flaw and that of the background noise shall be at least 3 to 1.

G. Process Control

(1) Since eddy current inspection procedures may be similar for many parts, general inspection instructions may be written to cover those details common to many parts. Inspection instructions for individual parts then only need reference the general procedure and include those items not covered or deviations from the general procedure.

(2) Instrument calibrations shall be performed prior to and after the inspection of each lot of parts and at least once every 4 hours of continuous operation or whenever improper functioning of the system is suspected. If the reference standard response is found to have changed more than ±10 percent since the prior calibration, all parts inspected in the interim shall be reexamined at the correct sensitivity.

(a) When specified, a strip–chart recording or photographic record shall be used for verification of calibration. Such records identify the part number, lot and/or part serial numbers, reference standard identification, and time and date of calibration.

(b) Records or evidence of testing (calibration decals) shall be maintained for all process control tests performed, indicating the intervals of testing and the results.

(3) Calibrations for physical characteristic measurements shall utilize at least two reference standards representing either the high or low limits of acceptability or an acceptable and unacceptable condition, as applicable. Best accuracy will be obtained by limiting the range of measurements and using additional standards to better define response within the range.

NOTE: Designs for physical characteristic standards shall include the value or range of values to be represented.

1. G. (4) Reference standard designs shall be documented by drawing or written description and shall include, but not be limited to the following:

(a) Unique identification.

(b) Overall size and shape.

(c) Material composition and condition (i.e., alloy and heat treat).

(d) Surface finish.

(5) Design for flaw standards shall include the following items in addition to Step (4):

(a) Type of calibration defect (e.g., EDM slot, fatigue crack).

(b) Size, number, and location of calibration defects.

(6) If commercially available reference standards are used, the manufacturer’s technical data or specification sheet will suffice.

(7) Each reference standard shall be serialized and certified as to physical characteristics (e.g., hardness, conductivity) and size of calibration defects, as applicable. Records of certification shall be maintained.

(8) Magnetic field indicators shall be calibrated every 6 months in a known magnetic field traceable to the National Institute of Standards and Technology (NIST).

(9) An audible or visible alarm shall be employed which automatically triggers when the established acceptance level is exceeded during eddy current inspection. If the inspection results are automatically recorded (e.g., strip chart), the use of an alarm is not required.

(10) Parts shall be examined using procedures and settings identical to those established during calibration.

H. Acceptance

(1) Parts shall not exhibit responses outside the established acceptance range or in excess of 100 percent of the calibration defect, whichever is applicable.

(2) For detection of flaws, parts whose scans exhibit background noise more than twice that of the reference standard shall be considered unacceptable until determined otherwise.

(3) Rejectable indications thought to be nonrelevant shall be regarded as unacceptable until either eliminated by surface conditioning or otherwise investigated and determined to be nonrelevant.

CHAPTER 70–25–00 - REPAIR

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1. Blend Repairing - SP R401

A. Blend repairing is a method for repairing parts affected by minor nicks, burrs, or scratches.

CAUTION: THE USE OF POWER TOOLS WHEN BLENDING IS NOT A PREFERRED METHOD. SUCH PRACTICE MAY GENERATE SUFFICIENT HEAT TO ADVERSELY AFFECT MATERIAL PROPERTIES. THE USE OF POWER TOOLS MUST BE SPECIFIED IN THE REPAIR PORTION OF THE MANUALS OR IN THE INDIVIDUAL MANUAL REWORK INSTRUCTIONS TO ALLOW THEIR USE.

(1) Blend repair such defects as follows:

(a) Repair using small diesinker type file and India or carborundum stone. Use crocus cloth (05–08, 70–80–01) or rubberized abrasive block (ST–20–ALO–88X, 06–14, 70–80–01) for final polishing.

(b) Blend all repairs and finish smoothly. Lines, scratches, or sharp edges that might cause concentration of stress are not permitted.

(c) No repairs are permitted on working surfaces of gears.

NOTE: Blend repairing of any coated part will require reapplication of coating, refer to applicable engine manual for specific coatings allowed.

(d) Blend repairing of coated turbine nozzle vanes and rotor blades shall consist of removing any projecting material only.

(2) Blend repair airfoil area with the following limits:

(a) Fan blade width must be at least eight times depth.

(b) Compressor blade width shall be at least two times depth and shall not exceed five times depth.

NOTE: The diameter of blend or distance along the leading edge/trailing edge for airfoil blend repair must meet the above limits, unless otherwise specified in the detailed repair procedure.

(c) Turbine nozzle width should be at least 10 times depth, but shall not exceed 0.625 inch (15.87 millimeter) maximum.

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1. Gas Carburizing - SP R407

A. All carburizing shall use gaseous carburizing compounds, carburizing furnace, heat treat furnace, etching solutions, and copper stripper.

(1) The carburizing furnace shall be capable of heating all parts in the load to within ±15°F (±8°C) of desired heat treating temperature after parts have been brought up to temperature, and shall produce a carburized case of uniform depths and carbon content on all parts of the load. The furnace shall have forced circulation of carburizing atmosphere.

(2) The heat treat furnace shall meet the requirements of SAE AMS–H–6875 and be equipped with suitable protective atmosphere to inhibit oxidation of copper plated parts.

(3) Carburizing and heat treat furnaces shall be equipped with automatic controlling and indicating pyrometers.

(4) Oil quenching tanks shall have provisions for adequate circulation and temperature control. The initial temperature of oil shall be maintained at 75 to 120°F (24 to 49°C) and the temperature rise of oil during quenching operation shall not exceed 30°F (17°C).

(5) The following solutions shall be used:

WARNING: NITRIC ACID AND CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(a) Nital–etch solution consisting of 95 percent methyl alcohol (07–25, 70–80–01) and 5 percent by volume of concentrated nitric acid (04–07, 70–80–01).

(b) Copper stripper solution consisting of 4 pounds (1814 grams) chromic acid (04–02, 70–80–01) and 5 ounces (148 milliliters) sulfuric acid (04–10, 70–80–01) per gallon (3.785 liters) of water at room temperature.

NOTE: When plating prior to machining is a practicable procedure, all part surfaces may be plated.

(6) Part to be carburized shall be placed in the furnace in such a way that carburizing medium will have free access to all areas to be carburized. Part surfaces that are not being carburized shall be masked by copper plate in accordance with the requirements of SAE AMS 2418. The range of copper plate thickness shall be 0.0008 to 0.0023 inch (0.020 to 0.058 millimeter).

1. A. (7) Test washers representing the carburized load and of the same material as the parts to be carburized shall be included in the carburizing furnace. These washers shall include fracture washers. When practicable, these washers shall not be plated prior to carburizing.

The fracture washers shall be removed periodically and water–quenched by furnace operator for purpose of determining the exact carburizing time required to produce the desired case depth. Case depth measurement of fracture washer shall be as specified on the engineering drawing and process machining allowance. Load washers shall be distributed throughout furnace load and shall receive same treatment as the parts being carburized. The load washers shall be evaluated for the purpose of qualifying the carburizing and heat treatment operations.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(8) Unless otherwise specified, the carburizing temperature shall be maintained between 1550 to 1700°F (843 to 927°C).

(9) The carburizing time shall be determined from the fracture washers and shall give the required case depth. In determining case depth required during carburizing operation, allowance shall be made for the amount of material to be removed from the carburized surfaces after carburizing.

(10) Carbon potential of carburizing medium shall be maintained at level to produce required case depth and microstructure. A discontinuous free carbide network (necklace), or a maximum amount of dispersed free carbides approaching necklace, shall be present below maximum grinding stock removal allowance.

(11) The case depth shall be equal to case depth as specified in detail procedure.

(12) After carburizing, the furnace load shall be cooled in reducing atmosphere to less than 1000°F (538°C), or other suitable operating procedure to prevent decarburization of parts.

(13) Carburized parts shall be stripped of copper plate and replated for hardening and tempering as follows:

(a) Copper stripping shall be performed by immersing the part in copper strip solution. (Refer to Step (5)(b).)

(b) Entire parts shall be replated in accordance with SAE AMS 2418.

1. A. (14) The parts shall be hardened as follows:

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(a) Heat parts to 1475 to 1500°F (802 to 815°C).

(b) Hold at heat for 30 minutes per inch (25.4 millimeters) of maximum cross section.

(c) Quench in oil.

WARNING: CONTACT OF SKIN WITH COOLED PART CAN CAUSE SEVERE FROSTBITE. HANDLE COOLED PART WITH TEMPERATURE RESIST GLOVES.

(15) Within 30 minutes after oil quenching, the parts shall be subzero–cooled in a freezer to -100°F (-73°C) minimum for 2 hours. After removal from the freezer, the parts shall be allowed to warm up to room temperature.

(16) When it is advantageous to manufacturing practice, and part function and quality are not deleteriously affected, the parts may be copper stripped before tempering and the subsequent bake cycle deleted.

(17) The parts shall be tempered as follows:

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(a) Heat parts to 275 to 300°F (135 to 149°C).

(b) Hold at heat for 2 hours.

(c) Air cool.

WARNING: STRIPPING SOLUTION MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. INDUSTRIAL GOGGLES/FACE SHIELD, AND NEOPRENE GLOVES SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES. RESPIRATOR SHALL BE WORN.

(18) Copper stripping shall be done by immersing part in stripping solution. (Refer to Step (5)(b).)

(19) Within 1 hour after copper stripping, all parts shall be baked at 255 to 275°F (124 to 135°C) for 2 hours.

(20) Parts carburized and heat–treated shall be finish ground to the dimensions specified on the engineering drawing.

1. A. (21) Measure effective case depth as follows:

NOTE: Effective case depth is defined as the distance from the carburized surface to the center of the transition zone between case and core, or the distance below the carburized surface where a hardness of Rockwell C50 is obtained.

(a) Fracture method. After removal of fracture washer from carburizing furnace, it should be water quenched directly from carburizing temperature. The washer should then be fractured at notch groove. The case depth by this method is then measured at the surface broken in tension. The perpendicular distance from carburized surface to junction of case and core as measured by Brinell glass, or equivalent, is case depth.

(b) Chemical etch method. Harden, oil quench, and freeze the load washer in same manner as the load it will represent. It is not necessary to temper load washer after hardening and oil quenching. Make cut perpendicular to carburized surface. Polish this cut with emery cloth (No. 000) (05–09, 70–80–01). (Care should be taken during cutting and polishing to avoid any tempering of the surface.) Etch polished surface for 1 minute in etching solution specified in preceding Step (5)(a).

The effective case depth is determined by measuring distance from carburized surface to center of inner dark band using Brinell glass or equivalent.

NOTE: In case of dispute, the microhardness test shall be used as a referee.

(c) Microhardness survey method. Prepare load washer with exception of etching as specified in Step (b) above. Metallographically polish specimen. Take series of hardness readings starting at point 0.003 inch (0.076 millimeter) from carburized surface in increments of 0.004 inch (0.102 millimeter) until total case has been traversed. The effective case depth is distance from carburized surface to where hardness of Rockwell C50 is obtained. The hardness survey shall be conducted using a microhardness tester, equipped with a 136 degree diamond indentor, and a 500 gram or 1 kilogram load.

(22) The criteria for acceptance or rejection of the case structure shall be determined accordingly.

(a) Acceptable: the case structure shall be martensite and discontinuous free carbides. The amount of carbides below the maximum grind stock removal allowance may vary from a fine dispersion to a maximum amount of dispersed free carbides approaching a necklace.

(b) Rejectable: the case structure shall not evidence any visual retained austenite when viewed at 500 power magnification or 10 percent retained austenite when analyzed by the X–ray diffraction method. Intergranular type oxidation shall not be permitted.

1. Thread Repair and Screw Thread Inserts - SP R409

NOTE: For sizes and methods of installation of screw thread inserts, refer to insert manufacturer's instructions. For information on Helicoil inserts and Kelox inserts, contact Helicoil Div, Shelter Rock Lane, Danbury, CT 06810. For information on Rosan inserts, contact Rosan/Aerospace Fastener Div, 3130 W Harvard St, Santa Ana, CA 92704. For information about Keensert inserts, contact Rexnord Specialty Fastener Div, 3000 W Lomita Blvd, Torrance, CA 90505.

Kelox or Keensert inserts can only replace slimserts. When replacing slimserts with Kelox inserts or Keensert inserts, care must be taken to assure that a 0.050 inch minimum wall thickness is maintained around the insert.

A. Inspect threaded inserts and all internal threads for damage or crossed threads.

B. If damage is noted, repair as follows:

(1) Using suitable chasing tool, tap, or die, chase damaged thread.

(2) If damage is too great, the threads may be repaired by using a suitable repair insert.

C. Whenever parent metal threads are damaged beyond normal limits for standard inserts, special plugs may be fabricated and installed, then finished to final requirements per applicable repair instructions.

(1) Coat magnesium threads with zinc chromate sealant (01–31, 70–80–01). If Kelox or Keensert inserts are to be installed, refer to Step (2) for instructions.

(2) Install Kelox or Keensert inserts as follows:

(a) Apply loctite retaining compound (01–10, 70–80–01) to magnesium threads and Kelox or Keensert insert.

(b) Install insert and allow loctite to dry for a minimum of 30 minutes.

WARNING: ETHYL ALCOHOL IS FLAMMABLE AND MAY AFFECT EYES, SKIN, AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(c) Remove excess loctite using cotton swab applicator (10–02, 70–80–01) and ethyl alcohol (07–23, 70–80–01).

1. C. (2) (d) Apply zinc chromate sealant (01–31, 70–80–01) to bottom of hole, Kelox or Keensert insert, and any uncoated areas, prior to installation of key ring.

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

CAUTION: WHEN REPAIRING HYDRAULIC PORTS, PACK END OF PART WITH PETROLATUM OR A SUITABLE SUBSTITUTE TO PREVENT MACHINING CHIPS FROM ENTERING ENGINE OIL SYSTEM.

NOTE: On hydraulic insert repairs, once packing has engaged parent metal, do not back out insert. If insert must be turned after partial engagement of packing, replace packing with a new packing.

Install key ring while zinc chromate sealant is still wet.

(3) On hydraulic insert repairs, lubricate required packing with lubricating oil (02–22 or 02–23, 70–80–01).

NOTE: All surfaces of the holes will be coated with zinc chromate sealant (01–31, 70–80–01) and insert shall be installed while sealant is still wet.

Zinc chromate sealant shall be evident around insert after installation.

D. Cadmium–plated or stainless steel inserts may be installed into magnesium parent metal holes that have been treated with zinc chromate sealant.

1. Replacement of Studs - SP R410

   A. Replace damaged studs as follows:

      (1) Replace studs that are stretched, broken, loose, or have damaged threads.

      (2) Whenever a stud requires replacement, replace with the next oversize. Sizes are stamped on the ends of oversize studs.

      (3) Where the threads of the stud hole have become damaged or stripped, it is possible to drill and retap the hole for a special stepped stud if there is sufficient material around the hole.

      (4) When installing an oversize stud in a bottomless stud hole, make sure that anchor end of stud does not project beyond bottom end of hole, causing interference with other parts. If necessary, file off anchor end enough to guard against interference and reidentify stud with proper oversize mark.

      (5) When installing a stud that incorporates a cotter pin or a lockwire hole, the projection length should be measured from the bottom of the stud hole.

      (6) For correct stud driving torque, refer to SP B109, 70–55–06. Torques given are based on engine oil as thread lubricant. If torque required to drive a stud to correct projection length should not come up to minimum or should exceed maximum, select another stud.

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1. Replacement of Bearing Liners and Bushings - SP R411

A. Damaged bearing liners and bushings may be replaced. Replace defective bearing liner or bushing as follows:

CAUTION: DO NOT SCORE BORE OF HOUSING.

(1) Carefully machine liner (bushing) until thin enough to buckle and peel away from housing.

(2) If liner (bushing) is pinned, grind lockpins flush with housing bore.

(3) Using Colorbrite marking pencil (09–05, 70–80–01), mark location of pins on face of housing.

(4) Place housing into temperature controlled oven at 127 to 138°F (53 to 59°C) for 30 minutes.

(5) Place new liner (bushing) into mixture of dry ice (10–14, 70–80–01) and ethyl alcohol (07–23, 70–80–01) for 30 minutes.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(6) Using heat resistant gloves, remove housing from furnace and clean bore with chromic acid (04–02, 70–80–01) and apply a thin coat of zinc chromate sealant (01–31, 70–80–01), or equivalent, to surface of bore that will mate with liner (bushing).

WARNING: CONTACT OF SKIN WITH COOLED PART CAN CAUSE SEVERE FROSTBITE. HANDLE COOLED PART WITH TEMPERATURE RESISTANT GLOVES.

CAUTION: TO PREVENT DAMAGE, MAKE SURE THAT HOUSING IS SUPPORTED BELOW BORE PRIOR TO PRESSING OPERATION.

(7) Using temperature resistant gloves, remove liner (bushing) from dry ice and place, with chamfered end down, into position over bore. Using suitable adapter and arbor press, press liner (bushing) into housing until it bottoms.

WARNING: DRILLING OPERATIONS CREATE METAL PARTICLES WHICH COULD ENTER THE EYE. SAFETY GOGGLES SHALL BE WORN.

1. A. (8) Using appropriate size drill and reamer (lockpin diameter) drill two holes, 180 degrees apart and 90 degrees from original holes, through the liner (bushing) and into housing.

(9) Drill holes to sufficient depth to install lockpins flush with liner (bushing) ID.

(10) Ream holes to size. Blow out chips with dry compressed air.

CAUTION: TO PREVENT DAMAGE TO LINER (BUSHING), USE CARE WHEN DRIVING PINS.

(11) Apply thin coat of zinc chromate sealant (01–31, 70–80–01), or equivalent, to lockpins and, using suitable drift and leather or plastic hammer, bottom drive pins into housing.

WARNING: GRINDING OPERATIONS CREATE METAL PARTICLES WHICH COULD ENTER THE EYE. SAFETY GOGGLES SHALL BE WORN.

(12) Finish grind liner (bushing) to proper dimension.

1. Repair of Seal Journals - SP R412

A. Minor repair of seal journals may be accomplished as follows:

(1) Place part on suitable lathe.

NOTE: Only those deposits that project above surfaces of journal need be removed. Carbon deposits imbedded below journal surface are acceptable.

(2) Remove circumferential tracking and residual deposits by lightly polishing journal in a circumferential direction with crocus cloth (05–08, 70–80–01).

(3) The surface finish of the shaft shall be such that it will provide the following:

(a) Continuous contact with the seal.

(b) Minute lubricant pockets under the lip.

(c) It shall not cause excessive lip wear.

(4) All shafts shall be plunge ground and all surfaces shall have a finish of 10 to 20 microinches AA or 11 to 22 rms. Observe the following:

(a) Lead grooves improperly dressed into grinding wheel can be transferred to shaft.

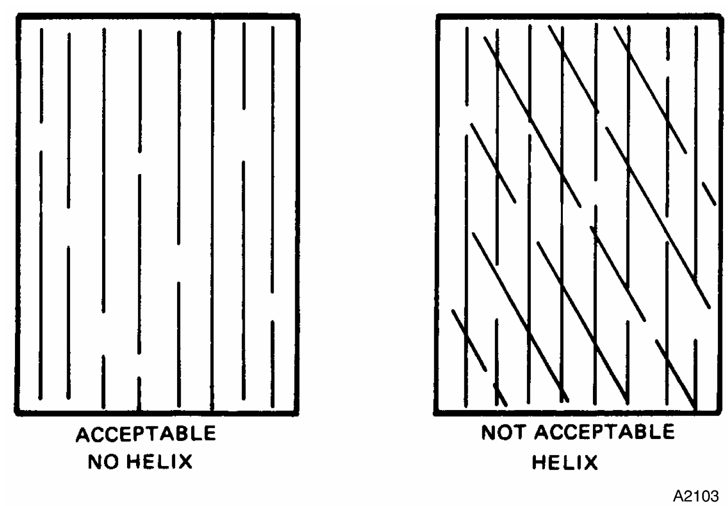
(b) Use a mixed number revolution per minute ratio (8–1/2 to 1, 9–1/4 to 1, etc) between the grinding wheel and the work piece.

(c) Use a cluster head dressing tool and dress at a rate of 3 inches (76.2 millimeters) per minute. Take a 0.0015 inch (0.038 millimeter) cut on first pass, then a 0.001 inch (0.025 millimeter) cut on return pass.

(d) Helical marks on journal surfaces are not acceptable. (See Figure 1.)

(e) Machine leads shall be avoided.

(5) Nicks, dents, or scratches shall not be allowed on machined shafts.




Helical Marks on Journal Surfaces
Figure 1

1. Repair of Bearing Journals - SP R413

A. Damaged or worn bearing journals can be returned to dimensional requirements by either nickel or chrome plating. The type of plating to be employed is dependent on the extent of dimensional impairment. Repair bearing journals according to the following instructions:

(1) Bearing journals having dimensional impairment of 0.002 inch (0.05 millimeter) or less should be repaired by nickel plating. (Refer to SP P513, 70–35–03.)

(2) Bearing journals having dimensional impairment of 0.002 inch (0.05 millimeter) or more should be repaired by chrome plating. (Refer to SP P509, 70–35–01.)

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1. Repair of Gears and Splined Parts - SP R414

A. Minor nicks, burrs, and scratches on other than working surfaces of gears or splined parts, may be repaired by blend repairing. (Refer to SP R401, 70–25–01.)

B. Noncarburized or nonnitrided bearing journals, shafts, or shaft gears worn to an undersize condition, or bores which have worn to oversize dimension, may be restored to dimensional requirements by chrome plating. (Refer to SP P509, 70–35–01.)

C. All plated parts having more than 20 percent of the original finish depleted may also be restored by chrome plating. (Refer to SP P509, 70–35–01.)

D. Dimensional inspection of parts reworked by chrome plating must be performed according to such instructions for the part as detailed in the applicable repair procedure.

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1. Hose Assembly Repair - SP R415

A. Minor fraying, chafing, and cuts shall be repaired as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Clean hose surfaces to be repaired with dry cleaning solvent (07–63, 07–64, or 07–65, 70–80–01) and dry thoroughly.

(2) Repair defective area with spiral teflon chafing sleeve. To determine proper length of chafing sleeve refer to Table 1.

(3) Perform functional test on repaired hose assembly as outlined in detail instructions.

B. Major chafing, fraying, and cuts may be repaired as follows:

(1) Remove fire shield retaining clamps and fire shield from hose assembly.

NOTE: Because of the 90 degree connector angles of some of the hoses it may not be feasible to replace fire shield material.

(2) Inspect underbraid. If underbraid is chafed or cut through, replace hose assembly. If underbraid is not chafed or cut through, install new fire shield material (08–33, 70–80–01) of the proper size. (See Figure 1.)

NOTE: Replacement fire shield must be next dash number size larger than original fire shield.

(3) Cut fire shield to desired length as shown in Figure 1 and carefully pull over hose end fitting.

(4) Clamp fire shield material with either Band–It Clamp No. JS242 or JS252 (Band–It Co, 4799 Dahlia St, Denver, CO 80219) or Aeroseal hose clamp (Transtechnology Corp, 100 Aeroseal Dr, Saltsburg, PA 15681). (See Figure 1.)

NOTE: The Band–It clamp is preferred. Its size causes less possible interference with adjacent hoses, connectors, and hardware.

(5) Refer to detailed instructions for functional test of specific hose assemblies.

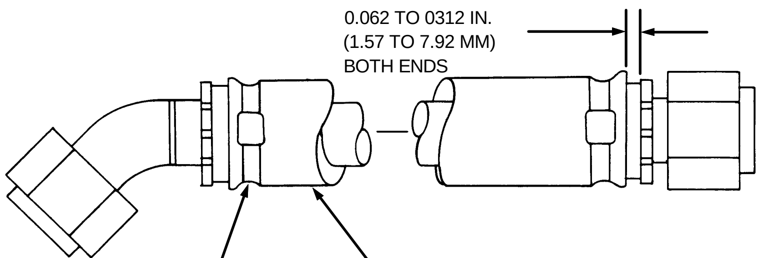
(6) Sealing the ends of the fire shield material sleeve with RTV (01-16, 70-80-01) to prevent fraying is acceptable.

Table 1. Chafing Sleeve Sizes

| Hose Size | Spiral Constant | Chafing Sleeve, Part No. |
|---|---|---|
| -3 | 1.2 | 2–300–519–01 (08–38, 70–80–01) |
| -4 | 1.5 | |
| -5 | 1.8 | |
| -6 | 2.1 | |
| -8 | 1.7 | 2–300–519–02 (08–38, 70–80–01) |
| -10 | 2.0 | |
| -12 | 2.4 | |
| -16 | 2.4 | 2–300–519–03 (08–38, 70–80–01) |
| -20 | 2.9 | |
| -24 | 3.6 | |

Example:

To determine the proper length of spiral sleeve required to cover a (6 inches) [152 millimeters] length of -5 hose, multiply the hose length (6 inches) [152 millimeters] by the spiral constant (1.8). The approximate sleeve length is the product of these two (6 inches x 1.8 = 10.8 inches [274 millimeters]). Use the 2–300–519–01 sleeve.




Hose Figure Shield Replacement
Figure 1

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1. Lock Cup Repair - SP R416

CAUTION: NO CRACKS OR BLEND REPAIRS ARE ALLOWED ON LOCK CUPS WHICH ARE USED TO SECURE TURBINE ROTORS.

A. Repair Lock Cup

NOTE: Do not remove all traces of locking dimples. Previous indication is needed to show lock cup has been reused.

(1) With lock cup outer edge suitably supported, cold straighten to remove locking impressions.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(2) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

(3) Fluorescent penetrant inspect for cracks. (Refer to SP I305, 70–20–05.)

NOTE: Any repair must be 30 degrees from any previous impression or repaired area.

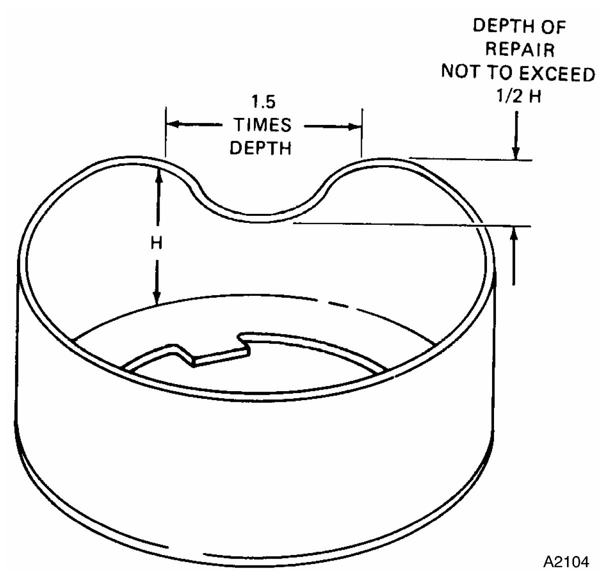
(4) Using a semicircular blend, completely remove cracks. No sharp edges are allowed in repaired area.

(a) Depth of repair shall not exceed 50 percent of wall height. (See Figure 1.)

(b) Blend area shall not exceed 1.5 times depth of repair. (See Figure 1.)

(5) Using fluorescent penetrant method, reinspect. (Refer to SP I305, 70–20–05.)

(6) Reuse of a lock cup shall be limited to three times.




Lock Cup Repair Dimensions
Figure 1

1. Repair of 37 Degree Flared Tube and Dynatube/Dual Seal Fittings - SP R418

   A. Leaking Joints

      (1) Disassemble and check for nicks, burrs, or foreign material on mating surfaces.

      (2) If necessary, realign and reassemble using new parts.

      (3) Flared tube gaskets and Dynaring seals shall be replaced if previously installed to prevent leakage.

      (4) If gasket or seal is not installed and leak persists, flared tube gasket (37 degree) or Dynaring seal may be installed. (Refer to Table 1, Table 2, and Table 3.)

      (5) If the Dynaring seal is not effective due to deep scratches or minor surface damage, etc, resurfacing kit R24837–53 (Resistoflex, Div of Unidynamics Corp, Woodland Rd., Roseland, NJ 07068) may be used to repair the fittings.

   B. For torque values, refer to SP B109, 70–55–06, Table 3 and Table 4.

Table 1. Flared Fitting Gaskets 37 Degree Purchased From Airdrome or Seco Seals Co

| Dash No. Reference | Aerospace Standard ID No. | Nominal Tube OD In. | Nominal Tube OD mm | Vendor ID No.* |
|---|---|---|---|---|
| –02 | AS3074–02 | 0.125 | 3.18 | AP50N–02 |
| –03 | AS3074–03 | 0.188 | 4.76 | AP50N–03 |
| –04 | AS3074–04 | 0.250 | 6.35 | AP50N–04 |
| –05 | AS3074–05 | 0.312 | 7.92 | AP50N–05 |
| –06 | AS3074–06 | 0.375 | 9.52 | AP50N–06 |
| –07 | AS3074–07 | 0.438 | 11.11 | AP50N–07 |
| –08 | AS3074–08 | 0.500 | 12.70 | AP50N–08 |
| –09 | AS3074–09 | 0.562 | 14.29 | AP50N–09 |
| –10 | AS3074–10 | 0.625 | 15.88 | AP50N–10 |
| –11 | AS3074–11 | 0.688 | 17.46 | AP50N–11 |
| –12 | AS3074–12 | 0.750 | 19.05 | AP50N–12 |
| –14 | AS3074–14 | 0.875 | 22.23 | AP50N–14 |
| –16 | AS3074–16 | 1.000 | 25.40 | AP50N–16 |
| –18 | AS3074–18 | 1.125 | 28.58 | AP50N–18 |
| –20 | AS3074–20 | 1.250 | 31.75 | AP50N–20 |
| –24 | AS3074–24 | 1.500 | 38.10 | AP50N–24 |
| –28 | AS3074–28 | 1.750 | 44.45 | AP50N–28 |
| –32 | AS3074–32 | 2.000 | 50.80 | AP50N–32 |

*Available from Airdrome Parts Co, 3251 Airport Way, Long Beach, CA 90806 Telephone (213) 426–9411
Seco Seals Co, 1374 Logan St, Building J, P.O. Box 1461, Costa Mesa, CA 92626 Telephone (714) 546–3478

Table 2. Flared Fitting Gaskets 37 Degree Purchased From Voi–Shan Co

| Dash No. Reference | Aerospace Standard ID No. | Nominal Tube OD In. | Nominal Tube OD mm | Vendor ID No.* |
|---|---|---|---|---|
| –02 | AS3075–02 | 0.125 | 3.18 | VSF1015N2B |
| –03 | AS3075–03 | 0.188 | 4.76 | VSF1015N3B |
| –04 | AS3075–04 | 0.250 | 6.35 | VSF1015N4B |
| –05 | AS3075–05 | 0.312 | 7.92 | VSF1015N5B |
| –06 | AS3075–06 | 0.375 | 9.52 | VSF1015N6B |
| –07 | AS3075–07 | 0.438 | 11.11 | VSF1015N7B |
| –08 | AS3075–08 | 0.500 | 12.70 | VSF1015N8B |
| –09 | AS3075–09 | 0.562 | 14.29 | VSF1015N9B |
| –10 | AS3075–10 | 0.625 | 15.88 | VSF1015N10B |
| –11 | AS3075–11 | 0.688 | 17.46 | VSF1015N11B |
| –12 | AS3075–12 | 0.750 | 19.05 | VSF1015N12B |
| –14 | AS3075–14 | 0.875 | 22.23 | VSF1015N14B |
| –16 | AS3075–16 | 1.000 | 25.40 | VSF1015N16B |
| –18 | AS3075–18 | 1.125 | 28.58 | VSF1015N18B |
| –20 | AS3075–20 | 1.250 | 31.75 | VSF1015N20B |
| –24 | AS3075–24 | 1.500 | 38.10 | VSF1015N24B |
| –28 | AS3075–28 | 1.750 | 44.45 | VSF1015N28B |
| –32 | AS3075–32 | 2.000 | 50.80 | VSF1015N32B |

*Available from Voi–Shan, 8462 Hiquera St, Culver City, CA 90230 Telephone (213) 870–5321

Table 3. Dynaring Seals

| Dash No. Reference | Nominal Tube OD In. | Nominal Tube OD mm | Vendor ID No.* |
|---|---|---|---|
| –3 | 0.188 | 4.76 | AP2641N03 |
| –4 | 0.250 | 6.35 | AP2641N04 |
| –5 | 0.312 | 7.92 | AP2641N05 |
| –6 | 0.375 | 9.52 | AP2641N06 |
| –8 | 0.500 | 12.70 | AP2641N08 |
| –10 | 0.625 | 15.88 | AP2641N10 |
| –12 | 0.750 | 19.05 | AP2641N12 |
| –14 | 0.875 | 22.23 | AP2641N14 |
| –16 | 1.000 | 25.40 | AP2641N16 |
| –20 | 1.250 | 31.75 | AP2641N20 |
| –24 | 1.500 | 38.10 | AP2641N24 |

*Available from Airdrome Parts Co, 3251 Airport Way, Long Beach, CA 90806

1. Repair of Riveted Parts - SP R419

A. Damaged Rivet Replacement General Guidelines

(1) Damaged rivet replacement should be performed in accordance with the following general guidelines:

(a) Rivets shall be formed by the cold continuous squeeze method. In this method, riveting machines, rivet sets, and rivet set adapters, specified in applicable manual, are used to form the rivet head from a continuous squeezing operation.

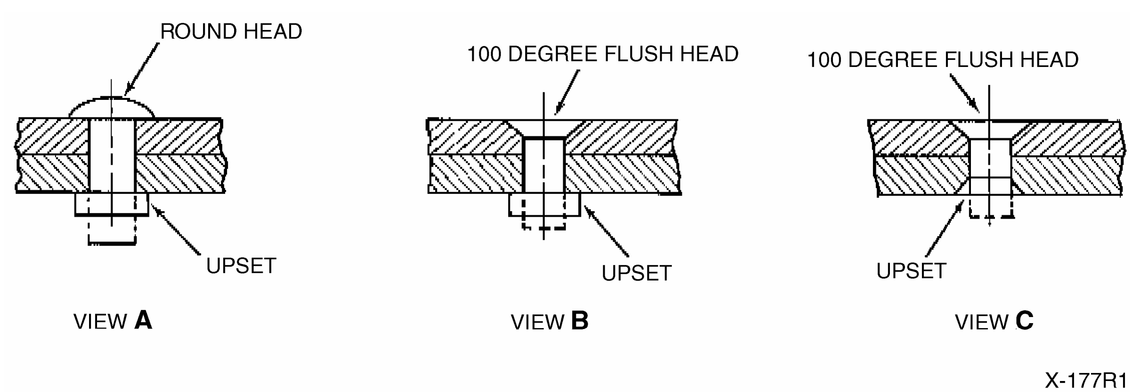
(b) The proper replacement rivet for an assembly is listed in the illustrated parts list of applicable manual.

(c) Rivets are manufactured in various shapes and sizes. Figure 1 shows two kinds of manufactured rivet heads, protuding (round) and 100–degree flush. It also shows two ways of upsetting rivets.

(d) Manufactured head is the head produced at the time the rivet is manufactured and before the rivet is installed in an assembly.

(e) “Protruding head” is a general term applied to any rivet where the head projects above the surface of the items being assembled.

(f) 100 degree flush head rivets are installed in countersunk holes and the heads of rivets are flush with outside surface of items being assembled.




Riveting (Typical)
Figure 1

1. B. Damaged Rivet Replacement.

(1) Replace damaged rivet as follows:

WARNING: USE CORRECT PERSONAL PROTECTION. PROCEDURES THAT NEED GRIND/MACHINE WORK WILL CAUSE LOOSE PARTICLES THAT CAN GET IN YOUR EYES.

CAUTION: EXERCISE CARE WHEN DRILLING OUT OLD RIVET NOT TO DAMAGE BASIC ITEMS.

(a) Drill or machine off head of installed rivet.

(b) Use a center–punch and hammer and punch out remainer of rivet.

(c) Clean rivet hole in accordance with 70–15–00–CLEANING and applicable manual.

NOTE: Equivalent substitutes may be used for external, non–structural applications such as nutplates and dataplates.

(d) Install new rivet in accordance with applicable manual, using tooling specified in applicable manual.

# CHAPTER 70–30–00 - PAINTING/SURFACE TREATMENT

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CHAPTER 70–30–00 - PAINTING/SURFACE TREATMENT

TABLE OF CONTENTS (CONT)

NOTE: For compressor rotor components and stator vanes that require recoating, the preferred Standard Practice is SP P528.

1. Aluminum Painting of Noncorrosion Resistant Surfaces - SP P501

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

A. Application of High Temperature Aluminum Paint: The procedures below are limited to parts that are severely corroded, rusted, or require complete paint removal, and finished parts that are scratched or reworked. (Refer to Steps (g) and (h) for painting magnesium with high temperature paint.)

(1) Surface Preparation for Aluminum Painting of Noncorrosion Resistant Surfaces.

(a) Chemical Cleaning Procedure No. 1.

For parts or assemblies operating at temperatures not exceeding 600°F (316°C), proceed as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

1 Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: RUST STRIPPER IS FLAMMABLE AND TOXIC TO EYES, SKIN, AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE. AFTER PROLONGED SKIN CONTACT, WASH CONTACTED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE IRRITATION, GO TO FRESH AIR. GET MEDICAL ATTENTION FOR OVEREXPOSURE OF SKIN OR EYES.

NOTE: Steps 2 and 3 shall apply only when parts are rusted.

2 Pickle parts in metal conditioner and rust remover (02–41, 70–80–01).

3 Dip parts in any standard alkali cleaner to neutralize residual acid. Rinse in water heated to 180°F (82°C) and air dry.

1. A. (1) (b) Cleaning Procedure No. 2.

For painted parts or assemblies that are subjected to temperatures between 600 to 1200°F (316 to 649°C) and that cannot be efficiently abrasive blasted, proceed as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

1 Emulsion degrease part. (Refer to SP C214, 70–15–04.)

WARNING: RUST STRIPPER IS FLAMMABLE AND TOXIC TO EYES, SKIN, AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE. AFTER PROLONGED SKIN CONTACT, WASH CONTACTED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE IRRITATION, GO TO FRESH AIR. GET MEDICAL ATTENTION FOR OVEREXPOSURE OF SKIN OR EYES.

NOTE: Steps 2 and 3 apply only when parts are rusted.

2 Pickle parts in metal conditioner and rust remover (02–41, 70–80–01).

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

3 Dip parts in any standard alkali cleaner in neutralized residual acid. Rinse in water heated to 180°F (82°C) and air dry.

4 Clean parts in hot alkali soak No. 1. (Refer to SP C206, 70–15–06.)

5 Clean parts using periodic reverse cleaning. (Refer to SP C209, 70–15–09.)

1. A. (1) (b) 6 If parts require a greater surface etch, perform the following.

WARNING: NITRIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

a Etch parts in 10 percent nitric acid (04–07, 70–80–01) for 1 to 3 minutes at room temperature and follow with a rinse in clean, cold running water.

b Desmut and clean parts in alkali cyanide periodic reverse cleaner (SP C209, 70–15–09) and follow with a thorough rinse in water heated to 180°F (82°C). Rinse with clean, cold running water.

WARNING: USE EXTREME CARE WHEN HANDLING ACIDS. CHEMICALS USED IN THE FOLLOWING TESTS ARE HAZARDOUS AND REQUIRE SPECIAL HANDLING.

7 To remove rust, pickle parts in hydrochloric acid (04–04, 70–80–01) [20° BE] at room temperature.

8 Thoroughly rinse part in clean, cold water.

9 Repeat Steps 7 and 8 as needed, if rust is not completely removed.

WARNING: CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

10 Dip in chromic acid solution: 24 ounces (680.376 grams) of chromic acid (04–02, 70–80–01) per gallon (3.785 liters) of water, heated to 180°F (82°C).

11 Thoroughly rinse and spray part in clean, cold water, then rinse in water heated to 210°F (99°C) for 1 minute. Allow parts to air dry.

12 If any rust remains, repeat preceding Steps 7 through 11 above.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

1. A. (1) (b) 13 Bake dry for 1 hour minimum at 275 to 300°F (135 to 150°C).

(c) Cleaning Procedure No. 3.

For parts, such as the second stage turbine disc, that operate at temperature from 600 to 1200°F (316 to 649°C), proceed as follows:

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

1 Clean parts by hot alkali soak method (SP C206, 70–15–06; SP C207, 70–15–07; or SP C208, 70–15–08). Use masking tape (10–24, 70–80–01) and mask as required.

2 Abrasive blast using zirconium oxide 103 grit (05–20, 70–80–01). Vapor blast close tolerance areas, such as ball root dovetails on turbine discs using aluminum oxide 325 grit (05–12, 70–80–01, and SP C205, 70–15–05.)

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KNM2). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

3 Using filtered, compressed air, blow off any abrasive adhering to part.

4 Using a cloth saturated with xylene (07–79, 70–80–01), wipe areas touched by hands after abrasive blasting.

5 Remove masking tape.

1. A. (1) (d) Phosphate Treatment Procedure. For steel parts operating at 600°F (316°C) requiring phosphate coating, proceed as follows:

1 Immerse cleaned parts in or spray with a balanced phosphate solution in accordance with SAE AMS 2480. Maintain solution at proper temperature and treat parts for a sufficient length of time to ensure there is a uniform coating on metal surfaces.

NOTE: Coating shall have a uniform, dull appearance, ranging from light to dark gray, with or without some silvery iridescence.

2 After parts have attained a uniform coating, rinse immediately in clean, cold running water.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

3 Bake dry for a minimum of 30 minutes at 260 to 280°F (125 to 135°C).

NOTE: Do not slush phosphate coated parts in oil prior to painting.

When SAE AMS 2481 antichafing requirements are specified on the repair procedure, SAE AMS 2480 phosphate treatment may also be used as an alternate for SAE AMS 2481.

(e) For parts requiring a coating thickness of 0.0008 to 0.0012 inch (0.020 to 0.031 millimeter) proceed as follows:

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1 Dip parts in a paint mixture composed of one part high temperature aluminum enamel (07–06, 70–80–01) reduced with xylene (07–79, 70–80–01) to 18 seconds viscosity (No. 2 Zahn Cup).

2 Air dry parts for 30 minutes.

3 Repeat Steps (e)1 and 2.

4 Use a Magne–gage to determine thickness.

1. A. (1) (e) 5 If cured film thickness of 0.0008 to 0.0012 inch (0.020 to 0.031 millimeter) has not been attained, repeat Steps (e)1 and 2, if required. Use Magne–gage to determine thickness.

6 Remove masking.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

7 Bake parts at 440 to 460°F (227 to 238°C) for 3 hours.

(f) Spray Paint Method.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1 Spray parts with a paint mixture composed of one part aluminum silicone paint (07–20, 70–80–01) reduced with toluene (07–77, 70–80–01) or reducer (07–71, 70–80–01) to 16 to 18 seconds viscosity (No. 2 Zahn Cup or No. 1 Demmler Cup).

2 Air dry parts for 30 minutes.

3 Repeat Steps (f)1 and 2.

4 Use Magne–gage to determine thickness.

5 Spray parts with additional coats to provide a cured paint film thickness of 0.0008 to 0.0012 inch (0.020 to 0.031 millimeter).

6 Remove masking.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

7 Bake parts at 440 to 460°F (227 to 238°C) for a minimum of 3 hours.

NOTE: Prior to applying high temperature aluminum paint to magnesium, refer to SP P524, 70–30–19, and perform Steps A.(1) through A.(6).

1. A. (1) (g) For coating thickness of 0.0008 to 0.0012 inch (0.020 to 0.031 millimeter) on magnesium surfaces:

1 Spray part surfaces with one coat of paint. (Refer to Step (f).)

2 Allow to air dry for 15 minutes minimum.

3 Repeat Steps (g)1 and 2.

4 Use Magne–gage to determine thickness. If thickness is not attained, apply additional coat. (Refer to Step (f) and repeat Steps (g)1 and 2.)

5 Remove masking.

NOTE: When material being coated is made of magnesium alloy (HZ 32A–T5), final cure coated surfaces at a 440 to 460°F (227 to 238°C) for 3 hours maximum.

6 Final cure coated surface at a temperature of 400 to 420°F (204 to 216°C) in a hot air oven for 3 hours minimum.

(h) For coating thickness over 0.0012 inch (0.031 millimeter) on magnesium surfaces:

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1 Spray part surfaces with one coat of paint. (Refer to Step (f).)

2 Allow to air dry for a minimum of 15 minutes.

3 Remove masking.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

4 Cure coated surfaces at a temperature of 290 to 310°F (143 to 154°C) for 30 minutes, then raise temperature to 400 to 420°F (204 to 216°C) for 1 hour and cool to room temperature.

1. A. (1) (h) 5 Reapply masking.

NOTE: When material being coated is made of magnesium alloy (HZ 32A–T5), final cure coated surfaces at 440 to 460°F (227 to 238°C) for 3 hours maximum.

6 Repeat Steps 1 through 4 as often as necessary to obtain desired coating thickness. Final cure time shall be 290 to 310°F (143 to 154°C) for 3 hours.

1. Spot Paint Procedure - SP P502

A. Touch up painting of aluminum painted parts whose surfaces have been scratched or exposed by rework.

(1) Surface preparation for parts requiring touch up painting.

WARNING: STRIPPER IS FLAMMABLE AND TOXIC TO EYES, SKIN, AND RESPIRATORY TRACT. USE WITH APPROVED FACE SHIELD, GLOVES, AND APRON. USE IN WELL–VENTILATED AREA. AVOID EXCESSIVE SKIN CONTACT WITH SKIN CONTACT OR INHALATION OF VAPORS.

(a) Using xylene (07–79, 70–80–01), remove oil and/or grease.

(b) Depending on surface condition, use wet or dry sand paper to lightly abrade areas to be spot painted. Final abrade with sand paper aluminum oxide cloth 320 grit (05–07, 70–80–01).

(2) Aluminum painting procedures for parts requiring touch up.

(a) Room temperature curing paint procedure.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1 Mix aluminum enamel (07–07, 70–80–01) and thinner (07–76, 70–80–01) to consistency specified on container.

2 Using brush, touch up gun, or cloth swab, apply paint as required.

(3) Air dry touched up parts. On a humid day use 200 watt infrared lamp to dry part.

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1. Black Oxide Coating - SP P503

A. Black Oxide Coating: In accordance with SAE AMS2485, increases antichafe and antifriction properties of carbon and low alloy steel parts, particularly on sliding or bearing surfaces by providing a finish coating that will retain an oil film.

(1) Apply black oxide coating to parts as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

CAUTION: TO PREVENT DAMAGE, DO NOT USE ON CARBURIZED PARTS.

NOTE: Black oxide coated parts that have loss of surface finish but exhibit no rust or pitting may be continued in service without rework provided the operational environment is oil wetted so as to prevent future corrosion.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.) Wipe parts with a clean, lint free cloth (10–10, 70–80–01).

WARNING: RUST STRIPPER IS FLAMMABLE AND TOXIC TO EYES, SKIN, AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE. AFTER PROLONGED SKIN CONTACT, WASH CONTACTED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE IRRITATION, GO TO FRESH AIR. GET MEDICAL ATTENTION FOR OVEREXPOSURE OF SKIN OR EYES.

NOTE: Instructions in following Step (b) pertains only to rusted parts. Instructions in following Step (c) pertains to parts that are not rusted.

(b) Pickle and dip parts in metal conditioner and rust remover (02–41, 70–80–01).

(c) Vapor blast nitrided gears (SP C205, 70–15–05) and rinse in cold water.

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

CAUTION: ASSEMBLIES CONTAINING PARTS MADE OF METALS OTHER THAN STEEL OR IRON SHALL NOT BE PROCESSED UNLESS SURFACES ARE SUITABLY MASKED, OR UNLESS THE BATHS CONTAIN AGENTS THAT PREVENT BATH DETERIORATION, AND IF ALLOWANCE IS MADE, WHEN NECESSARY, FOR REMOVAL OF ATTACHED AREAS. DO NOT USE ACID ON ANY NITRIDED SURFACES. DO NOT USE BLACK OXIDE ON CARBURIZED PARTS.

1. A. (1) (d) Alkaline soak part and rinse in water heated to 180°F (82°C), then rinse in cold water. Immerse cleaned parts, while wet, in one or more boiling aqueous alkali oxidizing baths for such times and at such temperatures necessary to produce acceptable coatings. Solution: 6 pounds/gallon (2.724 kilograms/3.785 liters) at 290°F (144°C) for approximately 30 minutes.

NOTE: Coating on polished surfaces shall be lustrous, continuous, and uniformly black. Coating on other surfaces shall be continuous black or dark gray and uniform on areas of equivalent surface roughness. Coating shall be substantially free from red oxide, indicated by red spots or an overall reddish brown color. Coating shall be smooth, dense, and adherent, and shall not chip, peel, crack, or rub off during normal handling or storage.

(e) Intensity of black is dependent on bath temperatures and duration of immersion. Immersion for 15 to 30 minutes in a 300°F (149°C) bath is a common practice for single solution treatment.

CAUTION: TO PREVENT DAMAGE TO FINISH, DO NOT ALLOW PARTS TO DRY DURING PROCEDURE.

(f) To remove all traces of processing solutions and deposited salts, wash treated parts thoroughly in cold running water followed with a rinse in water heated to 180°F (82°C).

(g) Dip parts in corrosion preventive oil (02–38, 70–80–01).

1. Touch Up Procedure for Black Oxide Coating - SP P504

A. Damaged black oxide coated surfaces may be restored to specified requirements by a touch up procedure.

(1) Touch up black oxide coating as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: OXIDIZING BATHS CONTAIN CAUSTIC SODA AND WILL CAUSE SEVERE BURNS.

(b) Immerse part in oxidizing bath prepared with Black Magic (06–71, 70–80–01) for such times and at such temperature as necessary to produce acceptable coatings. Solution: 6 pounds/gallon at 280°F (138°C) for approximately 30 minutes.

NOTE: Operating the bath at temperatures approaching 300°F (149°C) or over will cause the buildup of red iron oxide, which can cause a red smut or off color on the surface of the blackened parts.

(c) Wash part thoroughly in cold running water. Follow with water rinse heated to 180°F (82°C) and air dry.

(d) Dip part in corrosion preventive oil (02–38, 70–80–01).

1. B. Touch up surfaces of black oxide coated parts which cannot be completely immersed in black oxide tank.

(1) Touch up black oxide coating as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

CAUTION: TO AVOID SURFACE DAMAGE, DO NOT USE THIS PROCEDURE ON CASE HARDENED NITRIDED OR CARBURIZED SURFACES.

(a) Emulsion degrease part (SP C214, 70–15–14) or locally degrease using methyl alcohol (07–25, 70–80–01).

(b) Locally abrade surfaces to be touched up with abrasive paper (05–28, 70–80–01).

(c) Wash thoroughly in cold, running water and blow dry.

(d) Apply Hoppe’s Gun Blue (06–72, 70–80–01) with cotton swab applicator (10–02, 70–80–01) or cloth and keep wet with solution for 3 minutes.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 $KNM^2$). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(e) Rinse in clean, cold water and blow dry.

(f) Dip part in corrosion preventive oil (02–38, 70–80–01).

1. Engine Gray Enamel Touch Up of Aluminum and Aluminum Alloy Parts - SP P505

A. This application is primarily for parts previously painted with engine gray enamel color 513 (07–02, 70–80–01) that are not subjected to a temperature above 350°F (177°C).

(1) Apply enamel in accordance with the following steps:

WARNING: THINNER CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

(a) Clean surfaces with toluene (07–77, 70–80–01). Allow to air dry.

(b) Mask part as required with masking tape (10–24, 70–80–01).

(c) Exposed base metal on aluminum and aluminum alloy parts, shall be chemically treated. (Refer to SP P507, 70–30–07.)

(d) Spray one coat of zinc chromate sealant (01–31, 70–80–01). Air dry for 30 minutes.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

NOTE: Preliminary coats may be air dried in a dust free area. Final coat shall be baked for 30 minutes, until firm and hard, at a temperature not exceeding 300°F (149°C).

(e) Spray or brush two coats of engine gray enamel (07–02, 70–80–01) over exposed area. Each coat of enamel shall be thoroughly baked at a temperature not exceeding 300°F (149°C).

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1. Dry Film Lubricant Coating (Electrofilm) - SP P506

A. Thermosetting, Resin Bonded, and Dry Film Lubricant Coatings: Bonded to bearing surfaces. Such coatings allow surfaces to operate without lubrication or in conjunction with conventional lubricants to effect a reduction in wear and to prevent galling and seizing.

NOTE: Use Method I for parts that operate at temperatures below 600°F (316°C). Method II is to be performed on parts that operate at temperatures above 600°F (316°C).

(1) Method I - Apply dry film lubricant coating as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Clean parts by emulsion degreasing. (Refer to SP C214, 70–15–14.)

(b) Ferrous alloy materials shall be either wet or dry abrasive blasted.

1 Dry abrasive blast material shall be 220 grit aluminum oxide (05–12, 70–80–01) or zirconium oxide 200 grit (05–20, 70–80–01).

2 Wet abrasive blast material shall be silicon dioxide 200 grit (05–14, 70–80–01).

NOTE: When properly done, light abrasive blasting can remove resin bonded, solid film, and lubricant coatings with minimum damage or tolerance loss.

(c) Unless otherwise directed by specific repair instructions, the part surface shall be prepared as follows:

1 Steel - in accordance with SAE AMS 2481.

2 Aluminum or aluminum alloy - in accordance with SAE AMS 2468 or SAE AMS 2470 (as applicable).

3 Magnesium alloys - refer to SP P518, 70–30–13.

4 Titanium alloys - refer to SP P501, 70–30–01.

CAUTION: DO NOT PHOSPHATE COAT CARBURIZED AREAS. REPEATED REWORK OF PHOSPHATE COATING AFFECTS BASE METAL DIMENSIONAL TOLERANCES.

(d) If dimensions are within tolerances, apply phosphate coating to part. (Refer to SP P508, 70–30–08 or SAE AMS 2481 (steel parts only).)

1. A. (1) (e) Using masking tape (10–24, 70–80–01), mask clean, dry surfaces where necessary.

NOTE: Paint spray facilities shall include a type MBC DeVilbiss spray gun (DeVilbiss Co, P.O. Box 913, Toledo, OH 43692) with a No. 30 nozzle, or equivalent.

(f) Proper dry film lubricant shall be sprayed on designated surfaces using a spray gun with an air pressure of 20 to 25 psi (138 to 172 kPa) held 8 to 10 inches (203 to 254 millimeters) from part surface. As an alternate method, the dry film lubricant may be applied with a soft brush.

WARNING: THINNER CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

1 Dry film lubricant Lube–Lok 4396 (06–19, 70–80–01) and thinner (07–75, 70–80–01). Mixture of one part concentrate to three and one–quarter parts thinner by volume.

2 Dry film lubricant Everlube 620 (06–16, 70–80–01) and thinner. Mixture of one part concentrate and three parts thinner by volume. Thinner shall be equal parts by volume of toluene (07–77, 70–80–01) and ethyl alcohol (07–23, 70–80–01).

3 Air dry coating for 10 minutes before baking.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

CAUTION: TO PREVENT CASE TEMPERING, BAKE PARTS HAVING CARBURIZED AREAS AT 255 TO 275°F (124 TO 135°C) FOR 5 HOURS.

(g) Bake parts at 365 to 385°F (185 to 196°C) for 1 hour. Other times and temperatures may be used when specified on the repair criteria.

NOTE: For parts that operate at a temperature above 600°F (316°C), procedure shall continue with Steps (a) through (g).

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

1. A. (2) Method II - Apply dry film lubricant coating as follows:

(a) Clean parts by emulsion degreasing. (Refer to SP C214, 70–15–14.)

(b) Wet or dry abrasive blast as outlined in Step (b).

NOTE: When properly done, light abrasive blasting can remove resin bonded, solid film, and lubricant coatings with minimum damage or tolerance loss.

(c) Mask clean, dry surfaces, where necessary, with masking tape (10–24, 70–80–01).

(d) Proper dry film lubricant shall be sprayed on designated surfaces using a spray gun with an air pressure of 20 to 25 psi (138 to 172 kPa) held 8 to 10 inches (203 to 254 millimeters) from surface of part. As an alternate method, dry film lubricant may be applied with a soft brush, or dipped.

NOTE: Paint spray facilities shall include a type MBC DeVilbiss spray gun with a No. 30 nozzle, or equivalent.

(e) Use dry film lubricant Lube–Lok 2006 (06–18, 70–80–01) undiluted when applied with a brush or dipped.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

NOTE: When necessary, dry film lubricant may be diluted with toluene or xylene (07–77 or 07–79, 70–80–01) for spraying.

(f) Bake parts at 450 to 500°F (232 to 260°C) for 1 hour. Other times and temperatures may be used when specified in repair criteria.

(g) Rebuild films that were damaged during rework by spot painting and proper baking. (Refer to SP P502, 70–30–02.)

(h) Remove chipped or spalled films and recoat parts.

(i) The cured coating shall be visually examined to verify the dry film lubricant coated surfaces show complete coverage, a smooth even appearance, and show no evidence of blistering, peeling, loss of bond, or discoloration.

(j) Slightly damaged coatings may be rebuilt by touch up and proper baking cycle.

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1. Chemical Film Coating for Aluminum, Aluminum Alloys, Magnesium, and Magnesium Alloys - SP P507

A. The following alodine nonimmersible procedure provides a touch up process for chemical film coating of anodized surfaces of aluminum and aluminum alloy parts. It is also a substitute touch up procedure for magnesium and magnesium alloy parts in surface treatments using chrome pickle touch up.

B. Apply chemical film coating per SAE AMS 2473 and as follows:

WARNING: ALODINE/CHEMICAL FILM IS TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. CHEMICAL GOGGLES AND NEOPRENE GLOVES ARE REQUIRED. USE IN WELL–VENTILATED AREA.

(1) Alodine 1200 may be obtained as a liquid, Alodine 1201 (06–07, 70–80–01), to be prepared in accordance with manufacturers recommendations or a powder to be prepared as follows:

(a) Alodine (06–06, 70–80–01): 3 ounces (85 grams).

(b) Add water to make 1 gallon (3.785 liters) solution.

(c) Nitric acid (04–07, 70–80–01): 0.338 ounce (10 milliliters).

NOTE: Alodine 1132 Touch–N–Prep pen may be used as an alternate to Alodine 1200. Flollow manufactures recommendations for use.

(2) Using masking tape (10–24, 70–80–01), mask all surfaces not intended for alodine treatment.

(3) Using 320 to 600 grit sand paper (05–28, 70–80–01), sand all exposed surfaces to thoroughly remove all oxidation.

WARNING: ETHYL ALCOHOL IS FLAMMABLE AND MAY AFFECT EYES, SKIN, AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(4) Clean exposed surfaces with clean, lint free cloth (10–10, 70–80–01) dampened with ethyl alcohol (07–23, 70–80–01).

(5) Allow cleaned surfaces to air dry for minimum of 30 minutes.

(6) After surfaces have dried, apply coating with clean, lint free cloth (10–10, 70–80–01) wet with alodine solution. Allow solution to remain on surface until the metal surface attains an iridescent gold or dark brown shade, approximately 3 minutes. The bright gold shade is preferred.

1. B. (7) Clean treated surfaces with clean, lint free cloth (10–10, 70–80–01) saturated with distilled water (10–26, 70–80–01). Repeat washing three times.

(8) Air dry treated parts at room temperature until dry.

(9) Wipe treated surfaces with clean, dry lint free cloth (10–10, 70–80–01). If alodine treatment rubs off, procedure shall be repeated.

1. Phosphate Coating - SP P508

A. Phosphate Treatment: Recommended as a method to minimize chafing on certain steel parts and to maintain a surface that will retain an effective lubricant oil film.

(1) Phosphate treat parts in accordance with SAE AMS 2481 and as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: RUST STRIPPER IS FLAMMABLE AND TOXIC TO EYES, SKIN, AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION REQUIRED. AVOID REPEATED OR PROLONGED CONTACT. GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE. AFTER PROLONGED SKIN CONTACT, WASH CONTACTED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. IF VAPORS CAUSE IRRITATION, GO TO FRESH AIR. GET MEDICAL ATTENTION FOR OVEREXPOSURE OF SKIN OR EYES.

(b) Immerse parts in metal conditioner and rust remover (02–41, 70–80–01) until stripped. Rinse in cold water, then in water heated to 180°F (82°C). Air dry parts. A light grit blast or vapor blast (SP C205, 70–15–05) may be used to assist in cleaning and preparing surfaces for phosphating.

NOTE: Phosphate coating shall be finely crystalline, adherent, completely nonmetallic, and uniform in color, usually grayish black.

(c) Immerse cleaned parts in a balanced manganese acid phosphate solution containing suitable accelerating agent. Maintain solution at 190 to 210°F (88 to 99°C) until desired coating is obtained.

(d) Rinse parts immediately in cold running water.

WARNING: CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

1. A. (1) (e) After cold water rinse, dip parts in a diluted chromic acid solution: 7.5 ounces (213 grams) chromic acid (04–02, 70–80–01) per 100 gallons (378.51 liters) of water, with an approximate ph of 5 at 180 to 200°F (82 to 93°C) for 20 to 60 seconds, unless otherwise specified.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(f) Bake dry at 275°F (135°C) for at least 30 minutes.

1. Hard Anodize Treatment of Aluminum Alloys - SP P511

A. Hard Anodizing: Increases surface hardness and abrasion and corrosion resistance of aluminum and aluminum alloy parts by forming a dense aluminum oxide coating.

B. Apply hard anodize treatment to parts according to SAE AMS2468 and the following instructions:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease parts. (Refer to SP C214, 70–15–14.)

(2) Inspect parts for abrasion, erosion, and pitting. If such conditions exist, DO NOT HARD ANODIZE PARTS.

(3) Aluminum parts that contain dissimilar metals shall have the dissimilar material covered, plugged, or removed before treatment.

(4) Mask areas of nontreatment.

WARNING: USE EXTREME CARE WHEN HANDLING ACIDS. CHEMICALS USED IN THE FOLLOWING TESTS ARE HAZARDOUS AND REQUIRE SPECIAL HANDLING.

(5) Coat appropriate surfaces of part with film of aluminum oxide by making the part an anode (15 to 18 percent) in sulfuric acid (04–10, 70–80–01). When parts are to be selectively coated, make electrical contact on surface not requiring coating.

NOTE: Wire, hooks, racks, and clamps used to suspend parts in the electrolyte shall be made of aluminum, aluminum alloy, titanium, or titanium alloy.

(6) Coating may vary in color from amber to black, but shall be substantially uniform on parts of the same alloy processed to the same nominal coating thickness. Coated surfaces shall not have sooty, watered, clouded, or frosted appearance.

(7) Coatings shall be substantially uniform in thickness except in small holes, fillets, radii, and deep recesses. Scratches, chips, and burned areas are not permitted; however, small irregularities at the points of electrical contact are acceptable.

(8) After coating, remove masking materials, thoroughly rinse parts in clean, cold water. Allow parts to air dry.

1. B. (9) Immerse part in a sealer solution of sodium dichromate (04–24, 70–80–01) at 70°F (21°C) or a minimum of 20 minutes or at 201°F (94°C) for minimum of 10 minutes.

NOTE: Sealer solution shall be water, maintained at a minimum temperature of 180°F (82°C). A maximum ph of 6.8 shall be maintained in sealer bath by the addition of chromic acid (04–02, 70–80–01).

(10) After removal from sealer, slight chromic acid stains are permissible.

1. Chromic Acid Anodizing of Aluminum Base Alloys - SP P512

A. Anodic Treatment: By chromic acid process increases corrosion resistance and provides a surface that will make sure of satisfactory adherence of paint and other organic finishes.

B. Perform chromic acid anodizing in accordance with SAE AMS 2470 and following instructions:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease parts. (Refer to SP C214, 70–15–14.)

(2) Aluminum parts that contain dissimilar metals shall have the material covered, plugged, or removed before treatment.

(3) Racks, hooks, or wire used to suspend parts shall be made of aluminum or aluminum alloys.

WARNING: OAKITE 33 CLEANER IS TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. CHEMICAL GOGGLES AND NEOPRENE GLOVES ARE REQUIRED. USE IN WELL–VENTILATED AREA.

(4) Soak parts in aluminum cleaner (07–42, 70–80–01) for 5 to 10 minutes.

(5) Rinse parts in water heated to 120°F (49°C) for at least 2 minutes, then rinse in water heated to 180°F (82°C) for at least 1 minute.

(6) Using the parts to be treated as the anode, make electrical contact. Make contact secure enough to ensure current is not broken during anodizing process.

WARNING: CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(7) Mix required quantity of anodizing solution in tank in the proportion of 6.7 to 13.4 ounces (190 to 380 grams) chromic acid (04–02, 70–80–01) to enough water for 1 gallon (3.785 liters) of solution.

(8) Heat solution to a temperature of 90 to 99°F (32 to 37°C) and immerse parts in tank.

NOTE: A voltage increase of approximately 8 volts per minute is recommended, but is not mandatory.

1. B. (9) Slowly raise voltage to 40 volts, and maintain voltage for 30 minutes minimum, keeping solution at temperature within limits specified in preceding Step (8).

(10) Remove part from anodizing bath and remove any covering or plugs that were installed in preceding Step (2).

(11) Rinse thoroughly.

(12) Immerse in sealer bath for a minimum of 20 minutes.

NOTE: Sealer solution shall be water, maintained at a minimum temperature of 180°F (82°C). A maximum ph of 6.8 shall be maintained in the sealer bath by the addition of chromic acid (04–02, 70–80–01).

(13) After removal from sealer, slight chromic acid stains are permissible.

1. Graphite Varnish Coating - SP P516

A. Apply graphite varnish coating according to SAE AMS 3132 and the following procedure:

(1) To ensure there is graphite varnish adhesion, damaged existing coating shall be removed and surface prepared by the use of wet abrasive blasting with a grit not coarser than 200.

NOTE: Coating may be removed by light, dry abrasive grit blast using 220 or finer aluminum oxide grit delivered at 40 to 60 psi suction pressure. Keep grit blast nozzle moving continuously, do not dwell at any one location for more than 5 seconds. Existing part surface finish and dimensions must be affected.

(2) Rinse in water heated to 180°F (82°C).

(3) Dry with clean air blast.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KNM$^2$). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

CAUTION: DO NOT VAPOR DEGREASE TITANIUM PARTS. USE EMULSION DEGREASING METHOD.

NOTE: Parts shall not be slushed in oil or in other preservatives before coating with graphite varnish.

(4) Emulsion degrease parts. (Refer to SP C214, 70–15–14.).

(5) Prepare graphite varnish according to one of the following:

(a) Mix by volume one part corrosion preventive resin varnish (02–40, 70–80–01) with two parts of colloidal graphite (06–21, 70–80–01) in alcohol dispersion (Amyl or Butyl alcohol base). Solution shall consist of 18 to 22 percent graphite colloidal by weight.

(b) Mix by volume one part graphite varnish (06–79, 70–80–01) with no more than one part varnish thinner (07–98, 70–80–01). Thin only as required to acquire proper consistency for application. Solution shall consist of 18 to 22 percent graphite colloidal by weight.

1. A. (6) Apply coating mixture by one or more applications by dipping, brushing, or spraying to provide a dry layer of 0.0004 to 0.0007 inch (0.010 to 0.017 millimeter) thickness.

(7) Air dry for at least 15 minutes or until dry to the touch after each coating layer.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(8) Cure by heating in a hot air circulating oven to 325 to 345°F (163 to 174°C). Hold at temperature for 50 minutes or 290 to 310°F (143 to 154°C) and hold at temperature for 1 to 2 hours.

(9) Remove part from oven and air dry.

(10) Appearance of coating shall be as follows:

(a) A coating shall appear black when air dried and after curing.

(b) The coating shall be a homogeneous film, free from craters, particles of hardened material, and other defects causing discontinuity of the coating.

(11) Thickness shall be as follows:

(a) Thickness of coating may be determined by micrometer measurement of part, or by Dermitron nondestructive tester Model D2 or Elcometer Model 256FN Thickness Tester (Elcometer Inc, P.O. Box 1203, 877 S Adams, Birmingham, MI 48011) or Fischerscope Permascope E (Fischer Technology Inc, 750 Marshall Phelps Rd, Windsor, CT 06095), or equivalent. Measurement will include the surface coating 0.0020 to 0.0030 inch (0.051 to 0.056 millimeter), the paint being the difference between total coating thickness and the surface coating thickness.

(b) Maximum coating thickness shall not exceed 0.0007 inch (0.017 millimeter) unless otherwise directed by specific repair instructions.

(c) Cured coating shall not show tackiness when lightly rubbed with a cloth saturated with alcohol thinner.

(d) Inspection shall consist of visual examination of coating and conformance to thickness requirements.

1. A. (12) If the graphite varnish coating has been damaged, strip coating and recoat as follows:

NOTE: If, after 10 minutes, coating is not completely removed, a soft bristle brush may be used to facilitate removal.

(a) Prepare a cleaning solution by dissolving 8 ounces (227 grams) of the following mixture in 1 gallon (3.8 liters) of water.

WARNING: AVOID INHALATION OF SODIUM CARBONATE DUST. AVOID CONTACT WITH SKIN AND EYES.

1 Sodium carbonate, two parts (04–22, 70–80–01).

2 Sodium hydroxide, two parts (04–25, 70–80–01).

3 Sodium metasilicate, three parts (04–26, 70–80–01).

4 Sodium resinate, one part (04–28, 70–80–01).

5 Trisodium orthophosphate, one part (04–29, 70–80–01).

(13) Heat solution to 195 to 200°F (91 to 93°C).

(a) Submerge part to be stripped for approximately 10 minutes while maintaining solution at above temperature.

NOTE: Coating may be removed by wet vapor blast (SP C205, 70–15–05) or by light, dry abrasive grit blast using 220 or finer aluminum oxide grit delivered at 40 to 60 psi suction pressure. Keep grit blast nozzle moving continuously, do not dwell at any one location for more than 5 seconds. Existing part surface finish and dimensions must not be affected.

(b) Recoat part as outlined in preceding Steps (5) through (11).

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1. Engine Gray or Green Enamel Touch Up of Magnesium or Aluminum Parts - SP P517

A. This procedure applies to parts previously painted with engine gray enamel that require touch up.

B. Treatment of Worn or Scuffed Surface Finishes

(1) Abrasive blast to remove corrosion.

WARNING: ETHYL ALCOHOL IS FLAMMABLE AND MAY AFFECT SKIN, EYES, AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. AVOID REPEATED OR PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(2) Clean area with ethyl alcohol (07–23, 70–80–01). Allow 15 minutes for area to thoroughly dry.

WARNING: NITRIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(3) Swab the bare magnesium surfaces with either a chrome pickle solution or alodine solution and the bare aluminum alloy surfaces with an alodine solution.

NOTE: Chrome pickle solution shall be composed of: 24 ounces (680.4 grams) sodium dichromate (04–24, 70–80–01) and 24 fluid ounces (710 milliliters) nitric acid (04–07, 70–80–01) per gallon (3.785 liters) of water prepared at ambient temperature.

For aluminum alloys, alodine (SP P507, 70–30–07) formulated for brush application, shall be used. Alodine is an acceptable substitute for chrome pickle used on magnesium alloys.

(4) Keep the surface wet with the solution for 2 to 5 minutes.

(5) Wipe the solution off the part with a clean lint free cloth (10–10, 70–80–01) saturated with water.

(6) Wipe the surface dry with a clean lint free cloth (10–10, 70–80–01).

(7) Dry the area using 500 watt heat lamp for 10 to 15 minutes.

(8) Mask as required.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1. B. (9) Using a brush or spray equipment, apply a coat of clear air dry epoxy resin (07–12, 70–80–01) and catalyst (07–15, 70–80–01) or equivalent.

Clear, air dried epoxy resin shall consist of equal parts of base and catalyst thoroughly mixed. Mixture shall be allowed to stand for 30 minutes before restirring prior to use. When required, clear epoxy resin may be thinned with reducer (07–72, 70–80–01) to a consistency suitable to the equipment being used (brush or spray).

CAUTION: TO PREVENT DAMAGE TO PARTS, DRYING SHALL BE ACCOMPLISHED IN DUST FREE AREA. AVOID USE OF SOLVENTS ON TOUCH UP AREA FOR AT LEAST 1 WEEK.

(10) Air dry for 24 hours.

(11) Visually inspect using the following criteria.

(a) Cured, clear epoxy resin shall have a slightly lustrous appearance and shall not produce any notable change in the surface color.

(b) Cured, clear epoxy resin or engine gray finish shall be continuous and firmly adherent with no blisters, sags, or runs. In addition, when a strip of masking tape is firmly applied to coated surface and pulled off rapidly, the masking tape shall not remove any coating.

NOTE: This does not include any spots of coating adhering to masking tape that can be attributed to dust from spraying operation.

(12) Engine gray epoxy resin (07–10, 70–80–01) shall now be brushed or sprayed on area. Color shall meet the requirements of FED–STD–595, Table VIII, Gloss 16091.

NOTE: Engine gray epoxy resin shall be prepared in accordance with manufacturer’s instructions.

Engine gray epoxy resin may be thinned with reducer (07–72, 70–80–01).

1. B. (13) Masking shall be removed (if applicable).

(14) When necessary to achieve a uniform coating, Step (12) may be repeated, masking as needed.

(15) Room temperature cure the engine gray epoxy resin for 1 week minimum before attempting to clean or wipe the area with solvents.

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1. HAE Recoating of Abraded and Eroded HAE Surface Treatment - SP P518

A. Protection of abraded and eroded or improperly protected magnesium alloy parts may be accomplished by using the following equipment and solutions in accordance with one of three HAE recoating methods.

B. Classification of coating process requirements will be specified in the following manner:

(1) Single HAE process required for parts designed with an allowance of 0.001 to 0.0015 inch (0.025 to 0.037 millimeter) for HAE buildup.

(2) Double HAE process for parts without an allowance for HAE coating.

(3) Light HAE process for parts with machined areas held below a surface roughness of 63AA.

C. Parts shall be prepared for HAE coating by:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(2) Hot alkaline soak. (Refer to SP C206, 70–15–06.)

WARNING: CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(3) Immerse in chromic acid solution composed of 24 ounces (680.38 grams) chromic acid (04–02, 70–80–01) to 1 gallon (3.785 liters) of water heated to 200°F (93°C) for 1 to 15 minutes. Thoroughly rinse in clean, cold running water.

1. D. Parts having dissimilar metals or areas not requiring HAE coating shall be suitably masked. Coating racks shall also be masked as required, the following methods of masking shall apply:

(1) Tapped holes.

(a) Threaded teflon plugs with silicone rubber o–rings.

(b) Machine magnesium plugs with o–rings or washers cut from 0.125 inch (3.175 millimeters) thick silicone rubber sheet.

(2) Other areas and rack.

(a) Vinyl coating or tape.

(b) Plating stop–off.

(c) Waxes.

(d) Plugs and o–rings referenced in preceding Step (1)(b).

E. Recommended minimum clearance distance for parts in an electrolyte tank is listed below.

(1) 10 inches (25.4 centimeters) from tank sides.

(2) 12 inches (30.48 centimeters) from tank bottom.

(3) 3 inches (7.64 centimeters) below surface of solution.

(4) 10 inches (25.4 centimeters) between parts in tank, 5 inches (12.7 centimeters) minimum for smaller parts.

F. Application of single HAE coating.

(1) Parts prepared in accordance with Paragraphs C. and D. shall be divided into groups of approximate same surface area. Each group shall constitute an electrode.

(2) Arrangement of parts on a rack shall be such that a firm electrical contact is made with all parts held by clamps and bars. When the tapped holes of part are used for fixturing, threaded magnesium rod racks shall be used.

1. F. (3) Immersing.

(a) Parts shall be completely immersed in HAE solution with a recommended temperature range within 40 to 60°F (5 to 15°C) and in accordance with the tank clearances stated in Paragraph E.

(b) An electrical voltage shall be applied to produce a constant current density of 15 to 45 amperes per square–foot (0.093 square–meter). Terminating voltage is in the range of 80 to 90 volts.

NOTE: Treatment time and terminating voltage will vary with current density, temperature, part configuration, bath concentration, and number and distance between parts.

(4) Parts shall be rinsed in clean, cold running water, followed immediately by rinsing in clean, hot running water at a temperature of 180°F (82°C) minimum for 2 minutes.

WARNING: AVOID CONTACT OF SODIUM DICHROMATE WITH SKIN AND EYES. AVOID BREATHING DUST OR SOLUTION SPRAY. IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION FOR EYES. WASH CLOTHING BEFORE RE–USE.

(5) Parts shall be dipped in dichromate–bifluoride solution made up of 2 percent sodium dichromate (04–24, 70–80–01) and 10 percent ammonium bifluoride (04–12, 70–80–01) in water, for use at room temperature but not rinsed in water. Drying shall be performed with a filtered air blast.

(6) Treated parts shall be aged in either of the following:

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(a) Humidity oven for 4 hours at 170 to 180°F (77 to 82°C) and at humidity of 85 to 95 percent.

(b) Recirculating curing oven for 1 hour at 270 to 290°F (132 to 143°C).

G. Application of the double HAE process.

(1) Apply a single coat in accordance with Steps F.(1) through (4).

(2) Without removing the masking or rinsing, parts shall be stripped of the first HAE coating by immersion in hot chromic acid (04–02, 70–80–01) for use at a temperature not less than 200°F (93°C) and thoroughly rinsed in clean, cold running water.

(3) Stripped part shall then be recoated in accordance with all steps in Paragraph F.

1. H. Application of light HAE process.

This process will be in accordance with all steps in Paragraph F. with the exception of Step (3)(b). Current density shall be maintained by varying the voltage until approximate terminating value of 80 to 90 volts has been reached.

I. Coated areas that are not adequately coated and bare electrical contact areas shall be recycled through the light HAE coating procedure. When the light HAE coating procedure is not practicable, the following procedure shall be used:

(1) Area shall be cleaned thoroughly with ethyl alcohol (07–23, 70–80–01).

WARNING: CHROMIC PICKLE SOLUTION IS TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. CHEMICAL GOGGLES AND NEOPRENE GLOVES ARE REQUIRED. USE IN WELL–VENTILATED AREA.

(2) Chrome pickle solution shall be applied to area with a cotton swab. Solution shall consist of: 1.5 pounds (0.681 kilogram) of sodium dichromate (04–24, 70–80–01) and 1.5 pints (0.7095 liters) of nitric acid (04–07, 70–80–01) at specific gravity of 1.42 to 1 gallon (3.785 liters) of water solution, for use at room temperature.

NOTE: Alodine 1200 (SP P507, 70–30–07) may be used as an alternate touch up procedure to chrome pickle.

(3) Solution shall be allowed to remain on the surface for 2 to 5 minutes, rinsed well in clean, cold water, and air dried.

J. HAE bath shall periodically have an adequate sample removed and tested for conformance to the following control limits:

| HAE SOLUTION (CONTROL LIMITS) | | GRAMS/LITER |
|---|---|---|
| Potassium hydroxide<br>(Chloride content 0.01 maximum) | (04–20, 70–80–01) | 120 to 160 |
| Aluminum hydroxide | (04–11, 70–80–01) | 40 to 50 |
| Potassium fluoride | (04–19, 70–80–01) | 30 to 40 |
| Trisodium Orthophosphate | (04–29, 70–80–01) | 30 to 40 |
| Potassium manganate | (04–21, 70–80–01) | 12 to 20 |

K. Apply Synthetesine No. 200 sealant in accordance with SP P519, 70–30–14.

1. Synthetesine No. 200 Sealant - SP P519

A. This procedure provides for a cured resin finish coating to be used on HAE coated magnesium parts.

NOTE: This coating is not suitable for use on materials that are harmfully affected by the resin curing temperature of 340 to 360°F (171 to 182°C).

(1) Prepare synthetesine as follows:

(a) When used as a sealant:

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

Mix one part by volume, engine gray (epoxy phenolic resin) (07–03, 70–80–01), or blue (07–01, 70–80–01) with one part by volume thinner (07–76, 70–80–01) and adjust to give a 18 to 22 second viscosity at 81°F (27°C) using a No. 4 Zahn Cup. An acceptable alternate is engine gray epoxy (07–04, 70–80–01) and thinner (07–72, 70–80–01).

(b) When used as a machinable friction reducing coating:

NOTE: When coating is used for area buildup, higher viscosity formula may be used.

1 Add three and one–third parts by weight of graphite flakes (02–11, 70–80–01) to 200 parts by weight of formula given in Step (a).

NOTE: The color gray must be specified, this product is also available with clear resin base.

2 Alternate machinable, friction reducing coating, graphite filled epoxy paint (07–97, 70–80–01).

1. A. (1) (c) When used as a finish coating:

For exposed finished parts, mix one part by volume engine gray epoxy–phenolic pigmented enamel (07–03, 70–80–01) with one part by volume thinner (07–76, 70–80–01) to give 18 to 22 second viscosity at 81°F (27°C) using a No. 2 Zahn Cup. An acceptable alternate is engine gray epoxy–phenolic resin (07–04, 70–80–01) and thinner (07–72, 70–80–01).

NOTE: When the epoxy phenolic resin requires a retardant for proper application, e.g., during hot weather, modify by adding three parts thinner to one part butyl cellosolve (07–73, 70–80–01). This mixture is used the same way as unmodified thinner.

(2) Apply synthetesine using the following equipment:

(a) Spray Gun, Binks No. 29 (suction type) with 66 x 66 S.D. Nozzle.

(b) Brush (for touch up).

(3) Strontium chromate epoxy polyamide primer (07–18, 70–80–01) is used as an effective undercoat protection against corrosion where bare magnesium or HAE surfaces are visible.

(a) Prepare surfaces to be coated. (Refer to SP C517, 70–30–12.)

(b) Mask as required.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(c) Spray one cross coat of strontium chromate epoxy polyamide primer (07–18, 70–80–01).

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(d) Cure first coat at a temperature of 240 to 260°F (117 to 127°C) for 30 to 60 minutes.

(e) Verify adhesion by tape testing prior to application of second coat.

(f) If poor adhesion is found, repeat Step (d) prior to applying second coat.

1. A. (3) (g) Spray a second cross coat of strontium chromate epoxy polyamide primer. (Refer to preceding Step (c).)

(h) Allow primer to air dry for 4 hours minimum.

NOTE: Strontium chromate epoxy polyamide primer after second coat and final cure shall have a thickness of 0.0007 to 0.0012 inch (0.018 to 0.030 millimeter) thick.

(i) Apply finish coating. (Refer to Step (6).)

(4) Apply epoxy phenolic resin undercoating (sealant) (07–03, 70–80–01) as follows:

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(a) Prepare surfaces to be coated. (Refer to SP P517, 70–30–12.)

(b) Mask as required.

(c) Prepare epoxy phenolic resin (sealant) as outlined in preceding Step (1)(a).

(d) Apply one light coat of sealant, 0.0002 to 0.0003 inch (0.005 to 0.008 millimeter), over reworked area.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(e) Remove masking and cure in an oven at 340 to 360°F (171 to 182°C) for 1 hour.

NOTE: Sprayed coating shall have a semigloss appearance typical of an enamel finish and shall be firmly adherent to base metal. There shall be no general blistering in coating.

(5) Apply machinable friction reducing coating as follows:

(a) Prepare surfaces to be coated. (Refer to SP P517, 70–30–12.)

(b) Mask as required.

(c) Prepare epoxy phenolic resin (sealant) as outlined in preceding Step (1)(a).

(d) Apply one light coat of sealant, 0.0002 to 0.0003 inch (0.0051 to 0.0076 millimeter) after curing, over reworked area.

1. A. (5) (e) When removed, remask part as required.

(f) Prepare friction reducing formula as outlined in preceding Step (1)(b), and apply with a spray gun. (Refer to Step A.(2).)

NOTE: Using 30 to 40 psi (207 to 276 kPa) compressed air, gun shall be held approximately 12 inches (305 millimeters) from surface. Passes shall be made at a linear rate of 6 inches (152 millimeters) per second, to apply a uniform dry film coat of approximately 0.0005 inch (0.013 millimeter). It generally requires 4 passes.

(g) Air dry for 10 minutes.

(h) Apply sufficient coats to build coating thickness to 0.0016 inch (0.041 millimeter) or dimensional requirements, whichever are less.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(i) Remove masking and cure coating for a minimum of 30 minutes at 230 to 250°F (110 to 121°C), then increase temperature to 340 to 360°F (171 to 182°C) for 1 hour.

(j) Apply sufficient coats to build coating to dimensional requirements by repeating Steps (f) through (i). Do not exceed 0.015 inch (0.38 millimeter) maximum.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(k) Cure final coat for 3 hours at 340 to 360°F (171 to 182°C).

NOTE: Thickness of coating may be determined by micrometer measurement of part or by Dermitron Nondestructive Tester Model D2 or Elcometer Model 256FN Thickness Tester (Elcometer Inc, P.O. Box 1203, 877 S Adams, Birmingham, MI 48011) or Fischerscope Permascope E (Fischer Technology Inc, 750 Marshall Phelps Rd, Winsor, CT 06095), or equivalent. Measurement will include the HAE surface coating 0.0020 to 0.0030 inch (0.0508 to 0.0559 millimeter), the paint being the difference between total coating thickness and HAE thickness.

Sprayed coating shall be smooth and firmly adherent to base metal. There shall be no evidence of blistering of coating.

(l) Measure thickness of coating.

1. A. (6) Application of Finish Coating.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(a) Apply one light coat of epoxy phenolic resin (sealant) as outlined in preceding Step (4).

NOTE: If machinable friction reducing coating and finish coating are to be applied to the same part, machinable coating shall be precured for 2 hours at 340 to 360°F (171 to 182°C) before applying the finish coating.

(b) Remask as required.

(c) Prepare finish coating as outlined in preceding Step (1)(c).

(d) Apply finish coating of 0.001 inch (0.03 millimeter) thick over areas to be coated.

(e) Air dry for 10 minutes minimum.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(f) Thicker coating is required, remove masking and cure for 1 hour at 340 to 360°F (171 to 182°C) before applying additional coating.

NOTE: Coating shall not exceed 0.007 inch (0.18 millimeter) in thickness.

(g) Remask and apply sufficient additional coatings as outlined in Steps (2) through (7) until required coating thickness is obtained.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(h) Cure final coat for 3 hours at 340 to 360°F (171 to 182°C).

NOTE: Sprayed coating shall have a semigloss appearance typical of an enamel finish and shall be firmly adhered to the base metal. There shall be no general blistering of the coating.

(7) Touch up damaged coatings in accordance with instructions in SP P525, 70–30–20.

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1. Passivation of Stainless Steel Parts - SP P520

NOTE: All heat treatment, machining, and work procedures shall be completed prior to passivation.

Passivation shall not be performed on stainless steel parts that have been previously plasma sprayed. Presence of plasma sprayed surfaces will usually be revealed by a roughened edge, a darker hue during the cleaning process, or will be identified with S as prefix to serial number or federal manufacturer's code.

A. Classification of passivation shall be divided into two types:

(1) Type I - for all types of 300 series stainless steel.

(2) Type II - for all types of 400 series stainless steel and all heat treatable corrosion resistant steels (except AM350 and AM355).

B. Extent and method of cleaning shall be determined by the amount of scaling found on the part surfaces. Cleaning shall be performed in the following manner:

CAUTION: PARTS WITH CHROME PLATE CANNOT BE IMMERSED IN ACID CLEANING OR PICKLING SOLUTIONS.

(1) Cleaning scale free surfaces as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

(b) Rinse in clean, cold filtered water.

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

NOTE: Parts may remain wet if they are to be processed in alkaline cleaning solution. Otherwise rinse in clean, hot running water heated to a minimum of 180°F (82°C).

(c) Hot alkali soak (SP C207, 70–15–07) for a minimum of 5 minutes.

1. B. (1) (d) Rinse in clean running water heated to a minimum of 180°F (82°C), followed by rinsing in clean, cold running water.

(e) Inspect parts for the presence or water breaks. If water breaks are present, repeat Steps (a) through (c) until parts are free of water breaks.

(2) Cleaning lightly scaled surfaces as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(b) Clean in alkaline derust solution for use at 200 to 220°F (93 to 105°C), composed of alkaline derust compound (07–34, 70–80–01), 3 pounds (1.362 kilograms) per gallon (3.785 liters) water for 30 to 60 minutes.

(c) Rinse in clean, cold running water.

(3) Cleaning heavily scaled surfaces as follows:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

CAUTION: PARTS SHALL BE RECLEANED ONCE THROUGH THE FOLLOWING CLEANING PROCESS IF WATER BREAKS ARE PRESENT. CHROME PLATED PARTS SHALL OMIT STEP (d).

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: ABRASIVE BLASTING OPERATIONS INVOLVE HAZARDOUS AIRBORNE PARTICLES WHICH MAY BE HAZARDOUS TO BODY AND EYES. GOGGLES, FACE SHIELD, ABRASIVE–BLASTING RESPIRATOR (DURING EXTERNAL GUN OPERATIONS), AND LEATHER GLOVES WITH GAUNTLETS SHALL BE WORN.

1. B. (3) (b) Dry or wet abrasive blast with an air pressure of 60 to 90 psi (414 to 621 kPa).

1 Dry aluminum oxide (05–12, 70–80–01) - 220 to 325 grit.

2 Wet aluminum oxide (05–12, 70–80–01) - 325 grit: 0.5 to 0.75 pound (0.227 to 0.340 kilogram) to 1 gallon (3.785 liters) of water.

(c) Rinse in clean, cold running water.

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(d) Immerse in alkaline cleaning compound composed of (07–32, 70–80–01), 8 ounces (227 grams) per gallon (3.8 liters) of water, for 5 to 15 minutes.

NOTE: To assure cleanup, parts may be brushed with a stiff fiber or stainless steel bristle brush after any cleaning process.

(e) Rinse in running water heated to 180°F (82°C), and follow with a rinse in clean, cold running water.

(4) When additional surface preparation is required to properly prepare the surface for passivation, an acid pickle may be employed as follows:

WARNING: NITRIC AND HYDROFLUORIC ACIDS CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(a) Stainless steels - 300 series. Immerse part in an acid pickle solution composed of, by volume, one part hydrofluoric acid (04–06, 70–80–01) [technical grade, 70 percent], two parts nitric acid (04–07, 70–80–01) [40° Baume minimum], and three parts water heated to 140°F (60°C) maximum.

1. B. (4) (b) Stainless steels - 400 series. Immerse part in bath of hydrochloric acid (04–04, 70–80–01) [for use at room temperature] technical grade (20° Baume).

(c) Parts shall be immediately rinsed in clean, cold running water.

(d) Examine cleaned surfaces for presence of water breaks. If water breaks are present, repeat preceding Steps B.(3)(b)2, (3)(c), (d), and (e). If necessary, repeat acid pickle in preceding Steps (4)(a) and (c).

CAUTION: PARTS SHALL ONLY BE RECYCLED ONCE THROUGH THE ACID PICKLE.

C. Parts shall be immersed in the proper passivation solution for 30 to 60 minutes depending on type classification. (Refer to Paragraph A.) Types of solutions are as follows:

(1) Type I - for use at 111 to 131°F (44 to 55°C):

(a) Nitric acid: (04–07, 70–80–01) [$HNO_3$, commercial grade, 40°Baume] 17 to 23 percent by volume.

(b) Water: 77 to 83 percent by volume.

WARNING: AVOID CONTACT OF SODIUM DICHROMATE WITH SKIN AND EYES. AVOID BREATHING DUST OR SOLUTION SPRAY. IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION FOR EYES. WASH CLOTHING BEFORE RE–USE.

(c) Sodium dichromate: (04–24, 70–80–01) [technical grade] 3.5 to 4.5 ounces (99.23 to 127.58 grams) per gallon of solution.

(2) Type II - for use at room temperature. Equal parts by volume of water and nitric acid (04–07, 70–80–01) [HNO3, commercial grade, 40° Baume].

CAUTION: CARE SHALL BE EXERCISED TO MAKE SURE OF COMPLETE REMOVAL OF PASSIVATION SOLUTION FROM BLIND HOLES AND OTHER RECESSES.

(3) Within 30 seconds of completion of passivation treatments, parts or assemblies shall be rinsed in clean, cold running water followed immediately by rinsing in clean running water heated to 180°F (82°C).

(4) Immerse in sodium dichromate solution composed of 4 to 6 percent by weight of sodium dichromate (04–24, 70–80–01) [technical grade] in water for use at 140 to 160°F (60 to 71°C) for 30 to 45 minutes.

Within 30 seconds of completion of sodium dichromate treatment, rinse in clean, cold running water.

1. C. (5) Immerse part in acid rinse water solution with ph maintained at 3 to 5 using chromic acid (04–02, 70–80–01) [technical grade] or phosphoric acid (04–08, 70–80–01) [technical grade] for use at 149 to 170°F (65 to 77°C), and agitate until part is thoroughly wet.

While part is still wet, rinse in clean, cold running water, then rinse in clean running water heated to 180°F (82°C) running water.

(6) After completion of the passivation process and passivity testing (Step D.(7)), bake parts with a hardness of 40 Rc minimum for 3 hours ±20 minutes at a temperature of 365 to 385°F (185 to 196°C).

(7) Passivity testing shall be done by the following method.

D. Unless otherwise approved by the procuring activity, 400 series stainless steels with a chromium content less than 16 percent shall be tested for passivity by the high humidity test per Step (5). All other Type I and Type II materials shall be tested passivity per the following.

(1) Immerse part in passivity test solution composed of, by weight, four parts copper sulfate (04–15, 70–80–01) [technical grade], 10 parts sulfuric acid (04–10, 70–80–01), and 90 parts water for 6 to 7 minutes.

(2) Ferric iron in the test solution shall not exceed 15 grams per liter.

(3) Rinse in clean, cold running water.

(4) Allow part to air dry.

(5) Unless otherwise approved by the procuring activity, 400 series stainless steel with a chromium content less than 16 percent shall be tested by the high humidity test as follows:

(a) The part or test panel shall be thoroughly cleaned with acetone and completely dried. An inert atmosphere or desiccated container may be used to hold the sample prior to testing.

(b) Samples shall be exposed to 100 percent humidity, at 100°F (38°C), in a humidity cabinet for 24 hours as specified in ASTM Standard D1748.

(c) After completion of the test, the sample shall show no evidence of rust stains or corrosion products.

(6) Parts that are too large or are impractical to immerse, the following method may be used.

(a) Place 6 to 10 drops of passivity test solution on the part to be tested. Keep area wet for 6 to 7 minutes by adding additional drops as necessary.

(b) Rinse test area by wiping with a clean cloth, saturated with clean cold water.

1. D. (7) Test results. The presence of free copper (or copper plating) on a part indicates an active surface or incomplete passivation.

(8) After completion of inspection, parts immersed in passivity test solution shall be treated as follows:

(a) Immerse in passivation solution for 15 to 20 minutes in accordance with preceding Paragraph C.

(b) Rinse in accordance with preceding Step C.(3).

(9) Parts failing to meet passivity test shall be cleaned, passivated, and rinsed in accordance with the requirements of preceding Step C.(3) and tested in accordance with Paragraph D.

1. Complete Repaint of HAE Treated Magnesium Parts - SP P521

CAUTION: THIS METHOD DESCRIBES A TOTAL REPAINT OF PARTS THAT HAVE BEEN TREATED BY THE HAE PROCESS. AREAS WITH MISSING OR DAMAGED HAE COATING SHOULD BE TREATED PRIOR TO PAINTING. (REFER TO SP P518, 70–30–13.) PAINTING SHOULD BE DONE PRIOR TO THE APPLICATION OF ROOM TEMPERATURE TOUCH UP PAINTS. THE HIGH CURING TEMPERATURE OF THE EPOXY RESIN PAINTS COULD RESULT IN DAMAGE TO THE TOUCH UP PAINT.

A. Prepare part for painting.

(1) Strip paint. (Refer to SP C215, 70–15–15.)

(2) Touch up areas of damaged HAE coating as required. (Refer to SP P524, 70–30–19.)

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(3) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 $KNM^2$). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(4) Blow dry with shop air. Remove remaining moisture by placing parts in air circulating oven at 340 to 360°F (171 to 182°C) for 30 minutes.

(5) Mask as required for sealant operation. Do not coat bearing liners or other non–magnesium surfaces.

WARNING: PAINT REDUCER CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

(6) **(Optional)** Solvent wipe areas to be painted using epoxy paint thinner (07–72, 70–80–01).

1. B. Paint surfaces.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(1) Prepare clear epoxy sealant (07–14, 70–80–01) in accordance with manufacturer's instructions. Thin as required per manufacturer's recommendations. Recommended viscosity: 18 to 22 seconds using a No. 2 Zahn cup. If needed, butyl cellosolve thinner (07–73 or 07–74, 70–80–01) may be added as a retardant.

(2) Preheat parts to 130 to 160°F (54 to 71°C) prior to coating. Using spray equipment, coat internal and external surfaces with clear epoxy sealant (07–14, 70–80–01) 0.001 to 0.004 inch (0.0254 to 0.1016 millimeters) thick. Allow to air dry for 15 to 20 minutes.

(3) Place part in air circulating oven and bake for 60 to 90 minutes at 340 to 360°F (171 to 182°C).

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(4) Using heat resistant gloves, remove part from oven and inspect painted surface. Coating shall show no visible indication of defects such as blistering, entrapped air pockets, cracking, flaking, peeling, or scaling. The coating shall exhibit no sags, runs, or voids. When visually inspected without magnification, the finish shall be homogeneous, uniform, and smooth.

C. Mask all areas marked BZ.

(1) No primer allowed on internal surfaces.

WARNING: PAINT REDUCER CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

(2) Prepare strontium chromate primer (07–18, 70–80–01) in accordance with manufacturer's recommendations. Thin as required per manufacturer's recommendations. Recommended viscosity is 16 to 22 seconds using a No. 2 Zahn cup. If needed, butyl cellosolve thinner (07–73 or 07–74, 70–80–01) may be added as a retardant.

NOTE: The first coat of paint should have a translucent finish and should not be totally yellow (due to a thin consistency of mixture).

1. C. (3) Using spray equipment, apply a thin coat of strontium chromate paint (07–18, 70–80–01) to external surfaces and allow to air dry for 15 to 20 minutes.

(4) Place part in air circulating oven and bake for 30 minutes at 240 to 260°F (116 to 127°C).

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(5) Using heat resistant gloves, remove part from oven and replace masking if required. Apply a second coat of strontium chromate primer (07–18, 70–80–01). Total primer coating thickness shall be 0.0007 to 0.0013 inch (0.008 to 0.033 millimeter). Allow primer to air dry for 2 to 4 hours. Do not remove masking unless necessary. Coating should have a bright yellow appearance.

(6) Inspect painted surface. Coating shall show no visible indication of defects such as blistering, entrapped air pockets, cracking, flaking, peeling, or scaling. The coating shall exhibit no sags, runs, or voids. When visually inspected without magnification, the finish shall be homogeneous, uniform, and smooth.

D. Paint unmarked areas with gray epoxy topcoat.

(1) Mask areas marked MP and BZ.

(2) Prepare gray enamel top coat (07–04, 70–80–01) in accordance with manufacturer’s instructions. Thin as required per manufacturer’s recommendations. Recommended viscosity is 15 to 22 seconds through a No. 2 Zahn cup. If needed, butyl cellosolve thinner (07–73 or 07–74, 70–80–01) may be added as a retardant.

(3) Using spray equipment, apply gray enamel top coat (07–04, 70–80–01) to external surfaces 0.0005 to 0.002 inch (0.013 to 0.05 millimeter) thick. Allow to air dry for a minimum of 30 minutes. Remove masking.

(4) Place part in air circulating oven and bake for 30 minutes at 240 to 260°F (116 to 127°C) for 30 minutes. Then increase temperature to 340 to 360°F (171 to 182°C) for 1 hour.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(5) Using heat resistant gloves, remove part from oven and inspect painted surface. Coating shall show no visible indication of defects such as blistering, entrapped air pockets, cracking, flaking, peeling, or scaling. The coating shall exhibit no sags, runs, or voids. When visually inspected without magnification, the finish shall be homogeneous, uniform, and smooth.

1. E. Paint all areas marked MP with graphite filled epoxy top coat.

(1) Mask as required to paint areas marked MP.

(2) Prepare graphite filled epoxy top coat (07–16, 70–80–01) in accordance with manufacturer's instructions. Thin as required per manufacturer's recommendations.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(3) Using spray equipment, apply graphite filled epoxy top coat to external surfaces 0.001 to 0.0016 inch (0.03 to 0.406 millimeter) thick. Allow to air dry for a minimum of 10 minutes. Remove masking.

(4) Place part in air circulating oven and bake for 30 minutes at 230 to 250°F (110 to 121°C), then increase temperature to 340 to 360°F (171 to 182°C) for 1 hour. Cure final application for 3 hours at 340 to 360°F (171 to 182°C).

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(5) Using heat resistant gloves, remove part from oven and inspect painted surface. Coating shall show no visible indication of defects such as blistering, entrapped air pockets, cracking, flaking, peeling, or scaling. The coating shall exhibit no sags, runs, or voids. When visually inspected without magnification, the finish shall be homogeneous, uniform, and smooth.

(6) Remove all masking from part.

(7) Clean and lubricate areas that might rust, such as bearing liners, using 2380 turbine oil (Exxon) or equivalent.

1. Dichromate Treatment of Magnesium Base Alloys - SP P522

A. Damaged Surface Coatings

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

NOTE: Processing of parts shall be completed with minimal delay between steps.

(1) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(2) Strip parts using hot alkali soak No. 1. (Refer to SP C206, 70–15–06.)

(3) Rinse parts in hot water heated to 180°F (82°C), then rinse in cold water.

(4) Removal of corrosion may be accomplished by hand–sanding using silicon carbide sand paper (05–28, 70–80–01) or grit blasting using abrasive grit (05–13, 70–80–01) provided a cleanup depth of 0.010 inch (0.25 millimeter) from original surface is not exceeded.

(5) Rinse parts in cold water, then air dry.

(6) Using a suitable masking material, mask parts as required.

WARNING: HYDROFLUORIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(7) Immerse parts in a solution composed of 24 fluid ounces (710 milliliters) of hydrofluoric acid (04–06, 70–80–01) [60 percent HF] and a sufficient quantity of water to make 1 gallon (3.8 liters) of solution at ambient temperature. Soak parts for 5 minutes.

(8) Rinse parts in cold water.

WARNING: AVOID CONTACT OF SODIUM DICHROMATE WITH SKIN AND EYES. AVOID BREATHING DUST OR SOLUTION SPRAY. IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION FOR EYES. WASH CLOTHING BEFORE RE–USE.

1. A. (9) Immerse parts in a solution composed of 16 ounces (454 grams) of sodium dichromate (04–24, 70–80–01) and 0.33 ounces (9.5 grams) of calcium fluoride (04–14, 70–80–01) or magnesium fluoride (04–18, 70–80–01) and a sufficient quantity of water to make 1 gallon (3.8 liters) of solution at 200°F (93°C) minimum. PH shall be maintained at 4.2 to 5.5.

(10) Soak parts for 30 minutes.

(11) Rinse parts in cold, then water heated to 180°F (82°C). Dry with clean, dry compressed air.

NOTE: Parts shall have a continuous, uniform brown–to–black appearance.

(12) When applicable, apply engine gray enamel. (Refer to SP P523, 70–30–18.)

1. Touch Up of Dichromate Treated Magnesium Base Alloys - SP P523

A. This procedure is used to protect treated surfaces (either painted or unpainted) that have been nicked, scratched, reworked, or damaged.

(1) Painted surface.

(a) Wipe surface clean with a wiper soaked in toluene (07–77, 70–80–01) and allow surface to air dry before chrome pickling.

(b) Using cotton swab applicator (10–02, 70–80–01), apply chrome pickle solution consisting of:

WARNING: AVOID CONTACT OF SODIUM DICHROMATE WITH SKIN AND EYES. AVOID BREATHING DUST OR SOLUTION SPRAY. IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION FOR EYES. WASH CLOTHING BEFORE RE–USE.

1 Sodium dichromate (04–24, 70–80–01): 24 ounces (680 grams).

WARNING: NITRIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

2 Nitric acid (04–07, 70–80–01) (specific gravity 1.42): 1.5 pints (0.709 liters).

3 Water to make 1 gallon (3.8 liters) of solution.

NOTE: Alodine surface treatment (SP P507, 70–30–07) may be used as an alternate touch up procedure to chrome pickle.

(c) Allow solution to remain on part surface for 2 minutes minimum before thoroughly rinsing off with clean, cold running water. Wipe dry with a clean wiper.

(d) Apply zinc chromate sealant (01–31, 70–80–01) and allow to dry for a minimum of 30 minutes.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1. A. (1) (e) Brush or spray one part engine gray baking enamel (07–05, 70–80–01) and thinner or reducer recommended by paint manufacturer. Mixture shall be adjusted to give a flow time of 20 to 22 seconds with a No. 2 Zahn Cup.

NOTE: When required to maintain film properties, viscosity of engine gray enamel(s) may be varied by use of thinner or reducer recommended by paint manufacturer to a consistency suitable for equipment being used (brush or spray).

1 Allow enamel to air–dry for a minimum of 30 minutes.

2 Bake at 275 to 300°F (135 to 149°C) for a minimum of 30 minutes.

(2) Unpainted surfaces.

WARNING: THINNER CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

(a) Wipe surfaces clean with a wiper dampened with toluene (07–77, 70–80–01).

WARNING: CHROMIC PICKLE SOLUTION IS TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. CHEMICAL GOGGLES AND NEOPRENE GLOVES ARE REQUIRED. USE IN WELL–VENTILATED AREA.

(b) Using a cotton swab applicator (10–02, 70–80–01), apply chrome pickle solution (Step A.(1)(b)) to part surface.

NOTE: Alodine surface treatment (SP P507, 70–30–07) may be used as an alternate touch up procedure to chrome pickle.

(c) Allow solution to remain on part surface for 2 minutes minimum before thoroughly rinsing with clean, cold running water. Wipe dry with a clean wiper.

1. Touch Up Procedure for HAE Coated Surfaces - SP P524

A. This procedure applies to touch up of small areas of exposed metal or worn coating.

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

TO PREVENT INHALING FUMES, PERFORM CLEANING OPERATION IN A WELL–VENTILATED AREA. AVOID PROLONGED INHALATION OF FUMES.

(1) Clean areas that require touch up, using ethyl alcohol (07–23, 70–80–01).

(2) After cleaning, inspect area for corrosion. Corrosion is indicated by pitting or flaking on surface of metal.

(3) Removal of corrosion may be accomplished by hand sanding using silicon carbide sand paper (05–28, 70–80–01) or grit blasting using new or clean aluminum oxide 250 grit (05–12, 70–80–01).

(4) Rinse parts in cold water; then air dry.

WARNING: NITRIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

NOTE: Solution shall be composed of 24 ounces (680 grams) sodium dichromate (04–24, 70–80–01) and 24 fluid ounces (710 milliliters) nitric acid (04–07, 70–80–01) per gallon (3.8 liters) of water prepared at ambient temperature.

Alodine surface treatment (SP P507, 70–30–07) may be used as an acceptable touch up procedure to chrome pickle.

(5) Using a cotton swab applicator (10–02, 70–80–01), apply chrome pickle solution in accordance with to areas being treated.

(6) Allow chrome pickle solution to remain on surface for 2 to 5 minutes. Then rinse thoroughly with clean, cold water.

(7) Using 500 watt heat lamps, dry treated areas for 5 to 10 minutes.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

1. A. (8) Prepare a mixture of clear epoxy resin sealant.

NOTE: Mixture shall be composed of one part clear epoxy resin (07–14, 70–80–01) by volume and two parts epoxy reducer (07–72, 70–80–01). For each gallon of reduced resin, add 0.25 ounces (2.40 milliliters) antifloat agent (07–83, 70–80–01).

(9) Using a brush, apply one coat of the clear epoxy resin sealant to the exposed areas.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(10) After touch up, cure part in an oven at 300°F (149°C) for 1 hour.

(11) Where baking is not possible or inconvenient, use clear air dry epoxy resin (07–12, 70–80–01) and catalyst (07–15, 70–80–01).

WARNING: EPOXY PAINT CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

NOTE: Epoxy resin may be thinned with epoxy reducer (07–72, 70–80–01).

Formulation used for dipping shall be tested for nonvolatile content and viscosity upon receipt or blending, and maintained thereafter by additions of thinner to compensate for loss by evaporation. Formulations for dipping shall be controlled in use by testing the nonvolatile content prior to use. Testing shall be performed in accordance with ASTM–D1259 or similar approved procedure and maintained at the initial as received value by addition of the specified.

(12) After touch up, cure part at room temperature for 24 hours.

1. Resin Coating Touch Up for Synthetesine Painted Surfaces on Magnesium and Aluminum Alloys - Room Temperature Curing - SP P525

A. Coating is to be used only on external nonmating or mating surfaces, when specified. Suitable release film methods are to be used. Damage to the painted surfaces is defined as having voids in the coating through which the HAE undercoat or the bare magnesium surface can be seen.

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(1) Clean affected area with ethyl alcohol (07–23, 70–80–01). Allow 15 minutes for area to thoroughly dry.

(2) Areas where the HAE or anodize coating has been removed shall be touched up as follows:

WARNING: CHROMIC PICKLE SOLUTION IS TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. CHEMICAL GOGGLES AND NEOPRENE GLOVES ARE REQUIRED. USE IN WELL–VENTILATED AREA.

(a) Swab the bare magnesium surfaces with chrome pickle solution or alodine solution and the bare aluminum alloy surfaces with alodine solution.

NOTE: For magnesium alloys, solution shall be composed of 24 ounces (680 grams) sodium dichromate (04–24, 70–80–01) and 24 fluid ounces (710 milliliter) nitric acid (04–07, 70–80–01) per gallon (3.8 liters) of water prepared at ambient temperature.

For aluminum alloys, alodine solution (SP P507, 70–30–07, Step B.(1)) formulated for brush application shall be used. Alodine 1200 may be used as an acceptable alternate substitute for chrome pickle when used on magnesium alloys.

(b) Keep the surface wet with the solution for 2 to 5 minutes.

(c) Wipe the solution off the part with a clean cloth saturated with water.

(d) Wipe the surface dry with a clean, lint free dry cloth (10–10, 70–80–01).

(e) Dry the area using a suitable heat lamp for 10 to 15 minutes.

1. A. (3) Mask or shield surrounding areas not requiring epoxy touch up.

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(4) Apply a Class 2 coating of strontium chromate epoxy paint (07–18, 70–80–01) to a thickness of 0.0005 to 0.001 inch (0.012 to 0.025 millimeter). Allow to air dry for 2 to 4 hours.

(5) Engine gray epoxy coating (07–10, 70–80–01) shall be applied as follows:

WARNING: PAINTS, PRIMERS, LACQUERS, AND VARNISHES MUST BE HANDLED CAREFULLY AND USED ONLY IN WELL–VENTILATED APPROVED AREAS. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

NOTE: Paint shall be prepared in accordance with manufacturer's instructions.

(a) Apply epoxy paint by brushing or spraying.

(b) Smoothly blend the epoxy paint into original coating.

(c) Remove masking or shielding.

NOTE: A 250 watt reflector heat lamp placed 2 to 4 inches (51 to 102 millimeters) from surface will cure epoxy paint in approximately 3 hours providing the surface temperature reaches 120°F (49°C) by the end of the cure cycle.

Requirements of Steps (a), (b), and (c) will apply to brushed release film.

(d) Cure epoxy paint at room temperature, 70°F (21°C) minimum, for at least 24 hours.

CAUTION: DO NOT CLEAN WITH SOLVENTS FOR AT LEAST 1 WEEK.

1. A. (6) When touch up has been performed on a mating surface, apply release film in accordance with the following.

NOTE: As an alternate treatment for mating surfaces, apply nondrying sealant. (Refer to SP P526, 70–30–21.)

(a) Mask or shield nonmating areas as required.

(b) Spray one or two light coats of release film (06–22, 70–80–01) on mating surfaces. Allow to dry for about 5 minutes between coats.

NOTE: When using spray can, contents shall be well agitated before each use.

Apply release film by brushing when this is the more practical method of application.

(c) Air dry release film for 30 minutes minimum after final coat is applied.

(d) If parts are not joined immediately after curing of release film, take protective measures to protect film area from dirt or solvent contamination.

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1. Application of Nondrying Sealant - SP P526

A. Aluminum or magnesium parts that contact steel parts in areas not normally oil wetted shall be protected with nondrying sealants.

WARNING: ZINC CHROMATE SEALANT MAY AFFECT SKIN, EYES, AN RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(1) Approved non–drying sealants consist of zinc chromate sealant (01–30, 01–31, 01–32, 01–33, or 01–34) or Hylomar jointing compound (01–29, 70–80–01).

CAUTION: DO NOT APPLY SEALANT IN AREAS BATHED IN LUBRICATING OIL DURING ENGINE OPERATION.

(2) Apply sealant under heads and on threads of bolts and nuts, both sides of washers, under the heads of locking or locating pins, and exposed ends of pins after parts are assembled.

NOTE: Sealant must be used liberally to completely coat threads. Leave adequate sealant around bolt heads to assure a hermetic seal.

(3) Apply a ring of sealant on split–line surfaces bordering tapped holes. Do not apply sealant to entire split line surface or flanges.

WARNING: THINNER CONTAINS A HIGHLY VOLATILE SOLVENT. AVOID PROLONGED BREATHING OF VAPORS. PROVIDE ADEQUATE VENTILATION WHEN USING. KEEP AWAY FROM OPEN FLAME.

NOTE: Leave adequate sealant to assure a hermetic seal.

(4) When assembly is complete, excess sealant may be wiped off with a clean cloth dampened in toluene (07–77, 70–80–01).

NOTE: Excess sealant which extrudes into split–line surfaces during assembly should remain in order to seal the area from moisture.

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1. Application of Epoxy Adhesive for Bonding or Epoxy Buildup of Discrepant Parts - SP P527

A. Prepare surface to be epoxy–coated.

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(1) Thoroughly clean areas to be coated using ethyl alcohol (07–23, 70–80–01).

(2) Grit blast surfaces to be coated using aluminum oxide 220 grit (05–12, 70–80–01) or No. 103 zirconium abrasive grit (05–20, 70–80–01).

NOTE: In extreme cases where grit blasting is not possible, surface roughing may be accomplished by using 120 grit aluminum oxide cloth (05–07, 70–80–01).

(3) Remove all residual grit from surface using a clean, dry airblast.

NOTE: Epoxy coating shall be applied within 2 hours of surface preparation.

B. Epoxy adhesive (01–04, 70–80–01) is supplied as a two part system consisting of a epoxy resin (Part A) and a curing agent (Part B). Mixed as follows:

(1) Epoxy resin (Part A) shall be 100 parts by weight.

(2) Curing agent (Part B) shall be 17 parts by weight.

NOTE: The minimum pot life is 60 minutes at 75°F (24°C).

C. Apply epoxy adhesive for adhesive bonding.

(1) Mask areas adjacent to surfaces to be bonded to prevent adhesive buildup on non–bonded surfaces.

NOTE: Adhesive may be removed before cure cycle using ethyl alcohol (07–23, 70–80–01.)

(2) Apply a thin continuous film 0.0002 to 0.0006 inch (0.005 to 0.015 millimeter) of epoxy adhesive (Paragraph B.) to all surfaces to be bonded.

(3) Join surfaces to be bonded and clamp to keep adequate pressure on bonded joint during cure.

1. C. (4) Remove masking material.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(5) Cure epoxy adhesive at 190 to 210°F (90 to 100°C) for 1 hour minimum.

D. For dimensional buildup, apply epoxy adhesive.

(1) Mask areas adjacent to areas to be coated.

(2) Apply mixed epoxy adhesive (Paragraph B.) to surfaces to be built up to required thickness dimensions.

(3) Remove masking material.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(4) Cure epoxy adhesive at 190 to 210°F (88 to 99°C) for 1 hour minimum.

1. Application of Aluminum/Ceramic Coating - SP P528

A. The following procedure is applicable to parts or assemblies that are subjected to engine operating temperatures up to 1200°F (649°C).

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Surface preparation for application of aluminum/ceramic coating is as follows:

(a) Emulsion degreasing part. (Refer to SP C214, 70–15–14.)

(b) If necessary, mask or plug areas as needed prior to coating.

(c) Using aluminum oxide 90 to 150 grit (05–12, 70–80–01), dry abrasive blast surface at 60 to 70 psi (414 to 483 kPa) suction pressure to make sure a roughened surface exists.

(2) Apply coating as follows:

(a) Approved aluminum/ceramic coatings are:

1 SermeTel W (06–10, 70–80–01).

2 Alseal 518 (06–11, 70–80–01).

3 SermeTel 5380 DP Process (06–12, 70–80–01).

4 Alseal 5K (06-11, 70-80-01).

(b) Spraying, the preferred method of application, may be accomplished using a DeVilbiss EGA 502 spray gun, DeVilbiss Co, P.O. Box 913, Toledo, OH 43692 with an F or G tip, or equivalent, at 20 to 40 psi (138 to 276 kPa) air pressure.

NOTE: Coating may also be applied by brushing or swabbing.

(c) For best results, recommended relative humidity level should be 40 to 60 percent.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(d) Precure coating by heating the parts to 150 to 200°F (66 to 93°C) for 30 minutes minimum.

NOTE: Improper precure will cause the coating to blister during final cure. Precure shall not be required if part is gradually heated to cure temperature (with a conveyor oven).

(e) Cure coating by heating parts to 625 to 675°F (329 to 357°C) for 30 minutes minimum.

1. A. (3) Measure thickness. If desired thickness of coating is not met, apply additional coating. (Refer to Step (2).)

(4) The coating shall be burnished by glass bead peening (preferred method) at 15 to 20 psi pressure (103 to 138 kPa), or 20 to 40 psi (138 to 276 kPa) suction pressure, or a non–abrasive scouring pad (10–19, 70–80–01).

(5) Using a Simpson Multimeter Model 260, or equivalent, check electrical conductivity of the coating. A maximum resistance of 15 ohms at a 1 inch (25 millimeter) minimum probe separation is required. Measurements shall be made at a minimum of four locations, equally spaced, on each coated surfaces of the part. If required conductivity is not achieved, repeat Step (4) until desired resistance is achieved.

(6) Measure coating thickness to make sure thickness requirements are met. (Refer to Step (3).) If desired thickness is not met, apply additional coating per Step (2), and repeat Steps (4) and (5).

(7) Visually inspect coating surfaces for complete coverage, smooth even appearance, and no blistering, peeling, loss of bond, or discoloration. Coating shall appear silver to grey in color.

(8) Check coating bond by applying a strip of masking tape (10–24, 70–80–01) firmly to the coating surface and peel off rapidly. The masking tape shall not remove any coating. If any coating is removed by the tape, remove coating by dry abrasive blasting (Step (1)) and recoat (Step (2)), or locally rework discrepant areas per Step (9).

(9) Local rework of discrepant areas may be accomplished as follows:

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(a) Clean affected area using ethyl alcohol (07–23, 70–80–01).

(b) Locally abrade surfaces to be touched up with silicon carbide sand paper (05–28, 70–80–01).

(c) Apply aluminum/ceramic coating material using brush method. (Refer to Step (2).)

1. Application of Solid Dry Film Lubricant Coating - SP P529

A. The following procedure is applicable to parts requiring solid dry film lubricant coating.

NOTE: Handle parts with care to prevent nicks, dents, or other damage which might occur during handling. Wear lint free gloves (10–34, 70–80–01) and use clean equipment during all processes to protect surface finish.

(1) Prepare surface for the application of solid dry film lubricant coating as follows:

WARNING: ALKALINE CLEANING SOLUTION CAN CAUSE BURNS. CHEMICAL GOGGLES, RUBBER BOOTS, APRON, AND INDUSTRIAL RUBBER GLOVES SHALL BE WORN. USE IN A WELL–VENTILATED AREA. RESPIRATOR SHALL BE WORN UNLESS WAIVED BY THE BIOENVIRONMENTAL ENGINEERS.

(a) Alkali soak No. 1. (Refer to SP C205, 70–15–05.)

(b) Bake low alloy steel, hollow parts or other corrodible materials at 250°F (120°C) for a minimum of 1 hour.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(c) Using temperature resistant gloves, remove part from oven and using masking tape (10–24, 70–80–01), mask parts as required.

NOTE: Areas not to be dry lubricated, shall be masked by an approved method.

(d) Using aluminum oxide 90 to 150 grit (05–12, 70–80–01) dry abrasive blast surface create at 60 to 70 psi (414 to 483 kPa) suction pressure to create a roughened surface.

NOTE: If abrasive blasted surfaces are not coated immediately, the part shall be suitably bagged. If parts are not coated within 2 hours after blasting, parts shall be reblasted prior to coating.

1. A. (2) Apply solid dry film lubricant coating as follows:

(a) Solid dry film lubricant coating (06–77 or 06–78, 70–80–01) shall be applied by spraying, brushing or dipping.

(b) Spraying may be accomplished using a DeVilbiss EGA 502 spray gun (DeVilbiss Co, P.O. Box 913, Toledo, OH 43692) with an F or G tip, or equivalent, at 20 to 40 psi (138 to 276 kPa) air pressure. Unless otherwise specified, the dry film lubricant coating shall be applied at a rate that will produce a cured film thickness of 0.0002 to 0.0005 inch (0.005 to 0.013 millimeter).

NOTE: A premixed solution of one part ethyl alcohol (07–23, 70–80–01), one part MEK and two parts toluene (07–77, 70–80–01) may be used to thin the dry film lubricant to a usable consistency.

(c) Air dry solid dry film lubricant coating for 30 minutes minimum.

(d) Remove masking material.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(e) Cure parts by baking at a temperature of 390 to 410°F (200 to 210°C) for 60 minutes. As an alternate curing method, bake parts at a temperature of 290 to 310°F (144 to 154°C) for 2 to 3 hours.

(3) Inspect coated surfaces for adherence to base metal. Inspect for uniform continuous surface free from spalling, chipping, flaking, cracking, and other objectionable imperfections. Surfaces shall appear dark grey after curing and show complete coverage. If coating is not acceptable, repeat Steps (1)(b) through Step (3) as required.

(4) Cured film thickness of all parts shall be determined by micrometer measurement or a Dermitron type thickness tester. (Refer to Step (2)(b).)

1. Application of Aluminum/Silicon Coating - SP P530

A. The following procedure is applicable to parts or assemblies subjected to high temperatures, and shall be used only for touch–up and not for complete recoating.

(1) Prepare surface for application of aluminum/silicon coating as follows:

(a) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

NOTE: A thorough cleaning of surfaces to be coated is essential since incomplete removal of diffused metal sulfides will enable further attack on coating and base metal.

(b) Using masking tape (10–24, 70–80–01) mask areas of parts or assemblies not requiring coating.

WARNING: ABRASIVE BLASTING OPERATIONS INVOLVE HAZARDOUS AIRBORNE PARTICLES WHICH MAY BE HAZARDOUS TO BODY AND EYES. GOGGLES, FACE SHIELD, ABRASIVE–BLASTING RESPIRATOR (DURING EXTERNAL GUN OPERATIONS), AND LEATHER GLOVES WITH GAUNTLETS SHALL BE WORN.

CAUTION: HANDLE ABRASIVE BLASTED PARTS OR ASSEMBLIES IN SUCH A MANNER AS NOT TO CONTAMINATE ABRASIVE BLASTED SURFACES.

(c) Thoroughly abrasive blast area to be coated using aluminum oxide 220 grit (05–12, 70–80–01) and an air pressure of 60 psi (414 kPa).

(d) When reworking damaged coatings by this process, feather the edges of damaged coating to create a more suitable surface for coating adhesion.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KNM$^2$). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(e) Using clean compressed air, or a fiber brush, remove all loosened contaminants and grit, and remove masking.

NOTE: Make sure reworked areas are not handled because contamination can affect the heat tint color and confuse its identification.

1. A. (2) Heat tint check part or assembly to make sure of complete sulfidation removal as follows:

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(a) Heat assembly to 1075 to 1125°F (579 to 607°C) for 1 hour and cool to room temperature.

(b) Using color standards as noted, inspect part or assembly for complete sulfidation removal.

NOTE: Dark gray to black indicates presence of sulfidation. Part or assembly are not acceptable; repeat previous Steps (1)(b) through (e). A small hand grinder and rubber wheel may be used to remove residual sulfidation.

Light gray or gold indicates the presence of a nickel aluminide coating. Parts are acceptable. Aluminum/silicon coating is not required.

Dark blue indicates bare metal, nickel alloy. Parts are acceptable for recoating.

(3) Apply aluminum/silicon coating as follows:

(a) Roll Sermaloy J aluminum/silicon coating (06–15, 70–80–01) on ball mill rollers for 15 minutes or more until thoroughly mixed. After being rolled, pass the coating material progressively through 50, then 100, and 150 mesh sieves.

CAUTION: HANDLE PARTS OF ASSEMBLIES IN SUCH A MANNER WHICH WILL PREVENT RECONTAMINATION. AVOID TOUCHING OF THE AREA TO BE COATED.

MAKE SURE PARTS OR ASSEMBLIES ARE COMPLETELY DRY BEFORE APPLYING COATING.

NOTE: Aluminum/silicon coating is a proprietary product and is available only through manufacturer or one of its designees.

(b) Using masking tape (10–24, 70–80–01) mask areas of part or assembly not requiring coating.

1. A. (3) (c) Apply aluminum/silicon coating by spraying or brushing. The coating shall be applied by alternately applying a coating of 0.001 to 0.002 inch (0.03 to 0.05 millimeter), then curing. (Refer to following Steps (d), (e), and (g).) Repeat this process four times to obtain a 0.006 inch (0.15 millimeter) nominal thickness before diffusion treatment.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

CAUTION: COATING IS EASILY CRUMBLED AND MUST NOT BE TOUCHED.

NOTE: Restir aluminum/silicon coating material before applying to make sure that material is in even suspension.

(d) Allow coating to air dry for 15 minutes minimum, then oven dry at 150 to 200°F (66 to 93°C) for a minimum of 15 minutes.

(e) Remove masking.

(f) Oven cure coated parts at 600 to 650°F (316 to 343°C) for 60 minutes minimum.

(g) Inspect cured parts for crazing, cracking, and any other visible surface imperfections. If imperfections are evident, coatings shall be stripped and part recoated.

NOTE: Heat tint check is not required for parts processed for recoating.

(4) Diffusion heat treatment as follows:

(a) Unless otherwise specified, the diffusion heat treatment shall be 1575 to 1625°F (857 to 885°C) for 2 hours in a nitrogen, argon, or hydrogen atmosphere.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

NOTE: Heating rate shall be 1000 to 1200°F (538 to 649°C) per hour.

(b) Using temperature resistant gloves, parts may be removed when furnace temperature reaches 400°F (200°C) and air cooled.

(c) Using aluminum oxide 200 or finer grit (05–12, 70–80–01), lightly grit blast at 40 psi (276 kPa) pressure to remove powdery residue from coated surfaces. Alternate method is to use a light vapor blast. (Refer to SP C205, 70–15–05.)

NOTE: Do not reduce coating thickness.

(d) Visually inspect coating for complete coverage.

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CHAPTER 70–35–00 - PLATING

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1. Chrome Plating - SP P509

A. Chrome plating is a procedure that may be used to return some damaged or worn parts to required dimensions in accordance with detailed repair procedures.

CAUTION: BECAUSE OF DANGER OF HYDROGEN EMBRITTLEMENT, ELECTROPLATING, ELECTROETCHING, OR PICKLING OF CASE HARDENED SURFACES SHALL NOT BE ATTEMPTED. A PART SUSPECTED OF BEING CASE HARDENED SHALL BE HARDNESS TESTED. NONCARBURIZED AREAS WILL HAVE A ROCKWELL 15N RANGE OF 75 TO 82. CASE HARDENED PARTS WILL USUALLY BE ABOVE 90.

B. Chrome plating will be performed based on the material type being plated.

NOTE: Unless otherwise specified, parts harder than Rockwell C40 that have been ground after heat treatment shall be suitably stress relieved before chrome plating. Stress relieve for time and temperature shown for each part as directed in applicable paragraphs.

Chrome plating shall not be applied over chrome plated, carburized, or nitrided surfaces. Old chrome plate shall be removed by grinding or electrochemical means. If necessary, check test shall be performed to determine that the base metal has no chrome plate remaining. (Refer to Paragraph E.) Electrochemical removal of chrome from case hardened parts requires close control and careful masking of case hardened surfaces.

All parts will require a post plating deembrittlement bake. For proper time and temperature, refer to applicable manual section. Baking temperature shall not exceed 275°F (135°C) on carburized parts.

(1) Low alloy steels and 400 series stainless steels use Process 2. (Refer to Paragraph C.)

(2) Nickel base alloys and 300 series stainless steels use Process 2A. (Refer to Paragraph F.)

(3) For precipitation hardened steels use Process 2B. (Refer to Paragraph G.)

(4) For plating cast iron use Process 2C. (Refer to Paragraph H.)

1. B. (5) Mask areas not to be chrome plated as follows:

NOTE: When using wax masks, high temperature limit for carburized parts shall be 275°F (135°C) maximum.

(a) Heat cerita wax (10–27, 70–80–01) to approximately 200 to 220°F (93 to 104°C) or until the wax is liquefied.

(b) Dip part into wax and agitate. Periodically raise part from solution; make sure that thin film of wax is forming on part.

(c) Remove part from solution. Allow wax coating to solidify and partially cool.

(d) Redip part into wax solution and immediately remove; allow second layer to solidify. Continue until a coating of approximately 1/16 inch (1.587 millimeters) thick is accumulated.

(e) Inspect part to ensure the wax coating covers the entire working surface. If coating shows air bubbles or other imperfections, repeat masking operation.

CAUTION: WHEN REMOVING WAX, MAKE SURE UNDERLYING METAL IS NOT DAMAGED AND SURROUNDING WAX IS NOT PULLED AWAY FROM METAL. HANDLE PARTS CAREFULLY TO PREVENT CHIPPING AND EXPOSING PARENT METAL.

NOTE: To prevent wax from melting, wax coated parts shall not be subjected to temperatures in excess of 108°F (43°C).

(f) Using a brass tool, remove wax solids from areas to be plated. Remove remaining wax residue using dry abrasive pumice (05–15, 70–80–01). Remove dry pumice.

WARNING: CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(6) Immerse racked parts in chromic acid bath, 28 ounces (0.794 kg) chromic acid (04–02, 70–80–01) to 1 U.S. gallon (0.8 Imperial gallon) [3.8 liters] water. Anodically etch for 1 to 10 minutes until an even gray matte finish is obtained on all areas to be plated.

(7) Transfer parts from chromic acid bath to chrome plating bath without rinsing. Chrome plate parts cathodically at current density of 2 to 4 amperes per square inch (645 square millimeters) of area to be plated.

1. B. (8) Remove parts from chrome plate bath and rinse in cold water.

(9) Remove wax coating by dipping part into water heated to 200 to 212°F (93 to 100°C). Wax will melt and float to surface. Before removing parts from water, ensure that molten wax is removed from surface of the water.

C. Process 2. Used to chrome plate low alloy steels and 400 series stainless steels.

(1) Mask part as required. (Refer to Paragraph B.)

(2) Prior to use, adjust plating bath level to about 4 inches (102 millimeters) from top of tank and check that temperature is 130 to 135°F (54 to 57°C) and that specific gravity is an optimum 19° BE Baume (18 to 24° BE Baume is permissible).

(3) Demagnetize (use on all magnetized parts).

(4) Measure magnetism. (Refer to SP I311, 70–20–11.)

(5) Assemble anode as required.

CAUTION: REVERSE ETCH SHALL NOT BE USED ON 300 SERIES STAINLESS STEELS.

(6) Reverse etch.

(a) Place parts in reverse etch and reverse at proper current density and required time.

(b) When using internal anodes connect jumper cable from cathode rod to conforming anode prior to reverse etch.

(7) Place parts in plating tank and arrange anode and cathode bars in plating tank as required.

(8) For ID plating connect jumper cable from anode bar to conforming anode. For OD plating, hang anodes on each anode bar.

(9) Plate at 2–1/2 to 3–1/2 amperes per square–inch (645 square–millimeters) of area to be plated.

(10) Check amperage reading at least every 3 hours.

(11) Remove one part from solution at end of plating cycle.

(12) Allow excess plating solution to drain off.

(13) Rinse in cold running water.

(14) Check plating quality and final chrome plating dimension. (Refer to Paragraph D.)

1. C. (15) If part is acceptable remove all parts from tank and repeat Steps (12) through (14).

(16) Remove wax coating by dipping part into water heated to 200 to 212°F (93 to 100°C). Wax will melt and float to surface. Before removing parts from water, ensure molten wax is removed from surface of water.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(17) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

D. Inspect chrome plate using 4 power magnification to make sure chrome plate is smooth, continuous, firmly bonded to base metal, and free of frosty areas, blisters, and other defects.

(1) Cracks that do not penetrate to base metal are acceptable.

NOTE: If necessary, check test shall be performed to determine if base metal is penetrated. (Refer to Paragraph E.)

(2) Pits that do not penetrate to base metal are acceptable if within the following limits:

(a) Individual pits shall have rounded edges at top perimeter with a maximum dimension of 0.050 inch (1.27 millimeter) and an area greater than the bottom of the pit.

(b) Distance between pits shall be 0.25 inch (6.4 millimeter) or greater with no more than an average of one acceptable pit for each linear inch (25 millimeter) of plated surface area.

(3) Individual pin holes 0.003 inch (0.08 millimeter) or less, located in clusters having a maximum dimension no greater than 0.250 inch (6.35 millimeter), are acceptable provided there is no more than one acceptable cluster for each 6 linear inches (152 millimeters) of plated surface area. If limits are exceeded, remove chrome and redo.

1. E. Perform check test. (Test to be performed if visual inspection indicates presence of pits or cracks.)

(1) Emulsion degrease part for approximately 10 minutes. (Refer to SP C214, 70–15–14.)

(2) Mask all areas not being chrome plated.

WARNING: HYDROFLUORIC ACID AND SULFURIC ACID CAUSE SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(3) Prepare test solution using 4 grams of copper sulfate (04–15, 70–80–01) and 0.27 ounces (8 milliliters) sulfuric acid (04–10, 70–80–01) mixed in 2.98 ounces (88 milliliters) of distilled water. Using a clean cotton applicator (10–02, 70–80–01), apply test solution on plated area.

NOTE: Surface shall be kept wet for at least 6 minutes.

(4) Using a clean, lint free cloth (10–10, 70–80–01), wipe part dry.

(5) Using 4 power magnification, check for presence of copper in cracks or pits. If evident, reject part per detail instructions.

(6) Thoroughly flush acceptable parts in cold running water and air dry. Apply corrosion preventive oil (02–38, 70–80–01).

1. F. Process 2A. Used to chrome plate nickel base alloys and 300 series stainless steels. (Refer to Table 1.)

(1) Mask part as required. (Refer to Paragraph B.)

(2) Prior to use, adjust plating bath level to about 4 inches (10 centimeters) from top of tank and check that temperature is between 130 to 135°F (54 and 57°C) and that specific gravity is an optimum 19° BE Baume, permissible 18 to 24° BE.

(3) Vapor blast. (Refer to SP C205, 70–15–05.)

(4) Assemble anode as required. Use for ID plating.

(5) Chemical activate. Immerse in 35 percent hydrofluoric acid (04–06, 70–80–01) for 1 to 2 minutes; then rinse in cold water.

WARNING: HYDROFLUORIC ACID AND SULFURIC ACID CAUSE SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

NOTE: The following is an alternate activation method to facilitate chrome plate adhesion to high alloy or corrosion and heat resistant alloys.

(6) Anodically etch in 25 percent sulfuric acid (04–06, 70–80–01) and 5 percent hydrofluoric acid (04–06, 70–80–01) at 30 to 50 amperes per square–foot (0.093 square–meter) for 1 to 2 minutes.

(7) After immersion time has elapsed, remove parts from solution and rinse in cold water.

(8) Nickel plate parts as follows:

While still wet with pickle solution (refer to 70–35–03, Step 1.A.(1)(f)), immerse parts in Woods Nickel Plate (flash) bath: 32 ounces (907 grams) nickel chloride (04–17, 70–80–01) and 16 ounces (472 milliliters) hydrochloric acid (04–04, 70–80–01) [20° Baume] and sufficient water to make 1 gallon (3.785 liters) of solution.

(9) Allow parts to remain in nickel plate (flash) bath for 3 to 4 minutes using a current density of 10 to 50 amperes per square–foot (0.093 square–meter) of area to be plated.

(10) Remove parts from nickel plate (flash) bath and thoroughly rinse in cold water.

1. F. (11) Place parts in plating tank and arrange anode and cathode bars in plating tank as required.

(12) For ID plating connect jumper cable from anode bar to conforming anode. For OD plating hang anodes on each anode bar.

(13) Chromium plate at 2–1/2 to 3–1/2 amperes per square–inch (645 square–millimeters) of area to be plated.

(14) Check amperage reading at least every 3 hours.

(15) Perform Steps C.(11) through (17).

(16) Inspect chrome plating. (Refer to Paragraph D.)

NOTE: The alloys listed in Table 1 requiring chrome plating shall be processed per Paragraph F. The stress relief temperature will be 700°F (371°C) for 2 hours before chrome plating and 375°F (191°C) for 3 hours after chrome plating.

Table 1. Nickel Base Alloys and 300 Series Stainless Steels

| Alloy | Alloy |
|---|---|
| M3602 Inconel 713C | SAE AMS 5521 310 Stainless Steel |
| M3603 D979 | SAE AMS 5525 A–286 |
| M3604 Inconel 702 | SAE AMS 5532 N–155 |
| M3606 Inconel 718 | SAE AMS 5536 Hastelloy X |
| M3610 Inconel 713C | SAE AMS 5537 L–605 |
| M3611 Rene 41 | SAE AMS 5542 X–750 |
| M3612 (0021) | SAE AMS 5545 Rene 41 |
| M3613 U–700 | SAE AMS 5596 Inconel 718 |
| M3614 Nickel Base | SAE AMS 5597 Inconel 710 |
| M3615 D979 Modified | SAE AMS 5599 Inconel 625 |
| M3617 C–101 | SAE AMS 5648 316 Stainless Steel |
| M3620 Nickel Base | SAE AMS 5651 310 Stainless Steel |
| M3621 C–103 | SAE AMS 5662 Inconel 718 |
| SAE AMS 5362 316 Stainless Steel | SAE AMS 5663 Inconel 718 |
| SAE AMS 5363 347 Stainless Steel | SAE AMS 5680 347 Stainless Steel |
| SAE AMS 5365 310 Stainless Steel | SAE AMS 5706 Waspaloy |
| SAE AMS 5366 310 Stainless Steel | SAE AMS 5712 Rene 41 |
| SAE AMS 5376 N–155 | SAE AMS 5713 Rene 41 |
| SAE AMS 5383 Inconel 718C | SAE AMS 5734 A–286 |
| SAE AMS 5390 Inconel 718C | SAE AMS 5735 A–286 |
| SAE AMS 5510 321 Stainless Steel | SAE AMS 5736 A–286 |
| SAE AMS 5511 304L Stainless Steel | SAE AMS 5759 L–605 |
| SAE AMS 5512 347 Stainless Steel | SAE AMS 5768 N–155 |
| SAE AMS 5513 304 Stainless Steel | |
| SAE AMS 5515 302 Stainless Steel | |

1. G. Process 2B. Used to chrome–plate precipitation–hardened steels. (Refer to Table 2.)

(1) Mask part as required. (Refer to Paragraph B.)

(2) Prior to use, adjust plating bath level to about 4 inches (10 centimeters) from top of tank and check that temperature is 130 to 135°F (54 to 57°C) and that specific gravity is (19° BE Baume optimum; permissible 18 to 24° BE).

(3) Vapor blast. (Refer to SP C205, 70–15–05.)

(4) Assemble anode as required.

(5) Place parts in reverse etch and etch for 8 to 10 seconds at 6 volts. When using conforming anodes connect jumper cable from cathode rod to conforming anode prior to etch.

(6) Place parts in plating tank and arrange anode and cathode bars as required.

(7) For ID plating, connect jumper cable from anode bar to conforming anode. For OD plating, hang anodes on each anode bar.

(8) Chrome plate: plate at 2–1/2 to 3–1/2 amperes per square–inch (645 square–millimeters) of area to be plated.

(9) Check amperage readings at least every 3 hours.

(10) Perform Steps C.(11) through (17).

(11) Inspect chrome plating. (Refer to Paragraph D.)

Table 2. Precipitation Hardened Steels

| Alloy | | Alloy | |
|---|---|---|---|
| SAE AMS 5342 | 17–4 PH Stainless Steel | SAE AMS 5658 | 15–5 PH |
| SAE AMS 5343 | 17–4 PH Stainless Steel | SAE AMS 5659 | 15–5 PH |
| SAE AMS 5344 | 17–4 PH Stainless Steel | SAE AMS 5673 | 17–7 PH |
| SAE AMS 5368 | AM–355 Stainless Steel | SAE AMS 5743 | AM–355 Stainless Steel |
| SAE AMS 5547 | AM–355 Stainless Steel | SAE AMS 5745 | AM–350 Stainless Steel |
| SAE AMS 5548 | AM–350 Stainless Steel | SAE AMS 5763 | Custom 450 |
| SAE AMS 5549 | AM–355 Stainless Steel | SAE AMS 5863 | PH 15–7 Mo |
| SAE AMS 5649 | 316 FM | M 3703 | AM–355 Stainless Steel |
| SAE AMS 5644 | 17–7 PH | M 3710 | AM–355 Stainless Steel |
| SAE AMS 5645 | 30321 | M 3712 | Custom 450 |

1. H. Process 2C. (Used to chrome plate cast iron alloys SAE J434 and SAE AMS 5328.)

(1) Mask part as required. (Refer to Paragraph B.)

(2) Prior to use, adjust plating bath level to about 4 inches (10 centimeters) from top of tank and check that temperature is between 130 to 135°F (54 and 57°C) and that specific gravity is (19° BE Baume optimum; permissible 18 to 24° BE).

(3) Vapor blast. (Refer to SP C205, 70–15–05.)

(4) Assemble anode as required.

(5) Cathodic etch for 1 minute in 35 percent sulfuric acid (04–10, 70–80–01) and 5 percent hydrofluoric acid (04–06, 70–80–01).

(6) Place parts in plating tank and arrange anode and cathode bars as required.

(7) For ID plating connect jumper cable from anode bar to conforming anode. For OD plating, hang anodes on each anode bar.

(8) Chrome plate.

(a) Flash plate at 10 amperes per square–inch (645 square–millimeters) for 10 seconds.

(b) Drop current to normal. Plate at 2–1/2 to 3 amperes per square–inch (645 square–millimeters) of area to be plated.

(9) Check amperage readings at least every 3 hours.

(10) Perform Steps C.(11) through (17).

(11) Inspect chrome plating. (Refer to Paragraph D.)

1. Cadmium Plating - SP P510

A. Cadmium plating is a corrosion preventive surface coating.

B. Cadmium plate parts according to SAE AMS 2400 and the following instructions.

(1) Ensure all surfaces to be cadmium plated are chemically clean and free of abrasion, erosion, or pitting.

WARNING: AMMONIUM NITRATE IS A STRONG OXIDIZER. CONTACT WITH OTHER MATERIALS MAY CAUSE FIRE. HARMFUL IF INHALED OR SWALLOWED. IRRITATING TO EYES, NOSE, AND THROAT.

(2) Remove damaged cadmium plate in a 20 percent solution of ammonium nitrate (04–13, 70–80–01) maintained at room temperature. Rinse in cold water.

NOTE: A flash coating of nickel under cadmium plate is required when plating stainless steel parts. A flash coating is not required on any low alloy steels.

(3) Apply cadmium plate directly onto part by electrodeposition.

(4) After cadmium plate has been deposited, remove parts from plating solution and rinse in room temperature water.

WARNING: CHROMIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(5) Immerse cadmium plated part in a 3 to 5 percent solution of chromic acid (04–02, 70–80–01.) Agitate for several minutes.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(6) Rinse part in room temperature water, then dry, using moisture free compressed air.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

1. B. (7) Parts that require stress relieving shall be heated in a circulating hot air furnace at 365 to 385°F (185 to 196°C) for not less than 3 hours.

NOTE: Slight staining or discoloration shall not be cause for rejection.

(8) Check to ensure cadmium plate is smooth, continuous, firmly bonded to parent metal, uniform in appearance, not coarsely crystalline, and is free from pinholes, porosity, blisters, nodules, pits, and other defects.

1. Nickel Plating - SP P513

   A. Nickel plating may be employed to return damaged or worn low alloy steel, corrosion resistant steel, and nickel base alloy parts to required standards.

      (1) Nickel plate parts in accordance with SAE AMS 2403, SAE AMS 2424, and the following instructions.

         NOTE: Unless otherwise specified, parts harder than Rockwell C40 that have been ground after heat treatment shall be suitably stress relieved before cleaning. Stress relieve part as directed in applicable manual.

         (a) Demagnetize parts.

            WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

         (b) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

            CAUTION: FOR CARBURIZED PARTS, MASKING MATERIAL TEMPERATURE SHALL NOT EXCEED 275°F (135°C).

            DO NOT PLATE AREAS PREVIOUSLY PLATED, CARBURIZED, OR NITRIDED.

         (c) Using suitable masking material, mask surfaces not intended for nickel plating. (Refer to Step B.(5), SP P509, 70–35–01, for wax masking procedure.)

         (d) Place parts in a suitable rack.

1. A. (1) (e) Abrasive blast surfaces to be plated as follows:

WARNING: ABRASIVE BLASTING OPERATIONS INVOLVE HAZARDOUS AIRBORNE PARTICLES WHICH MAY BE HAZARDOUS TO BODY AND EYES. GOGGLES, FACE SHIELD, ABRASIVE–BLASTING RESPIRATOR (DURING EXTERNAL GUN OPERATIONS), AND LEATHER GLOVES WITH GAUNTLETS SHALL BE WORN.

1 On normal surfaces, using silicon dioxide No. 200 (05–14, 70–80–01) and an air pressure of 40 psi (276 kPa) minimum, wet abrasive blast surface to be plated.

NOTE: Aluminum oxide 150 grit (05–12, 70–80–01) may be used in place of silicon dioxide.

2 On hard to clean surfaces, using aluminum oxide 220 (05–12, 70–80–01) and an air pressure of 60 psi (414 kPa) minimum, dry abrasive blast surfaces to be plated followed by wet abrasive blast specified in preceding Step 1.

(f) Pickle parts as follows:

CAUTION: THE USE OF CURRENT IN ACID PICKLING IS FORBIDDEN DUE TO THE RISK OF HYDROGEN EMBRITTLEMENT.

1 On corrosion resistant steel and nickel base alloy parts.

WARNING: HYDROFLUORIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

a Immerse parts in a solution consisting of 1 part hydrofluoric acid (04–06, 70–80–01) [HF 70 percent commercial grade] to 2 parts water for 1 to 2 minutes.

WARNING: HYDROFLUORIC ACID AND SULFURIC ACID CAUSE SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

NOTE: The following solution may be used instead of hydrofluoric acid pickle.

1. A. (1) (f) 1 b Immerse parts in a solution consisting of 1 pound (454 grams) of dry acid cleaning powder (07–82, 70–80–01) per gallon (3.785 liters) of water, heated to 120°F (49°C) for 1 to 2 minutes, or other Honeywell written approved dry acid solutions.

NOTE: The following solution may be used instead of dry acid cleaning powder.

c Anodically etch in 25 percent sulfuric acid (04–10, 70–80–01) and 5 percent hydrofluoric acid (04–06, 70–80–01) at 30 to 50 amperes per square–foot (0.093 square–meter) for 10 to 20 seconds.

d After immersion time has elapsed, remove parts from solution and rinse in cold water.

e Inspect plated areas for water breaks.

2 On low alloy steel parts.

a Immerse parts in hydrochloric acid (04–04, 70–80–01) [commercial grade] for 1 to 2 minutes.

b After immersion time has elapsed, remove parts from the acid and rinse in cold water.

c Inspect plated area for water breaks.

1. A. (1) (g) Nickel plate parts as follows:

1 While still wet with pickle solution applied in preceding Step (f), immerse parts in Woods Nickel Plate (flash) bath: 32 ounces (907 grams) nickel chloride (04–17, 70–80–01) and 16 ounces (472 milliliters) hydrochloric acid (04–04, 70–80–01) [20° Baume] and sufficient water to make 1 gallon (3.785 liters) of solution.

2 Allow parts to remain in nickel plate (flash) bath for approximately 5 minutes, using a current density of 60 amperes per square–foot (0.093 square–meter) of area to be plated.

3 Remove parts from nickel plate (flash) bath and thoroughly rinse in cold water.

(h) Nickel plate parts for dimensional buildup as follows:

1 With current OFF, immerse parts in sulfamate nickel bath (Step 2). When parts are immersed, provide agitation or circulation of the bath; then raise current to 45 amperes per square–foot (0.093 square–meter) of part area and continue to apply current until desired plate thickness is obtained.

2 Prepare sulfamate nickel bath as follows:

Mix 0.05 ounce (1.42 grams) wetting agent (09–01, 70–80–01) per gallon (3.785 liters) of sulfamate nickel solution (04–33, 70–80–01) heated to 40 to 60°C (100 to 140°F).

NOTE: Acidity of sulfamate nickel bath shall be maintained between 3.5 and 5.0 ph by adding boric acid (04–01, 70–80–01) or sulfamic acid (04–09, 70–80–01).

3 Remove parts from solution and rinse in clean, cold running water followed by a rinse in clean running water heated to 180°F (82°C).

(i) Remove masking. (Refer to Step B.(9), SP P509, 70–35–01, for removal of wax masking.)

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

CAUTION: BAKING TEMPERATURE FOR CARBURIZED PART SHALL NOT EXCEED 275°F (135°C).

(j) Bake parts at the time and temperature given in applicable paragraph for each part. When time and temperature are not specified, bake parts at 255 to 275°F (124 to 135°C). Hold at temperature for 5 hours minimum, then cool to room temperature.

1. A. (1) (k) Inspect parts in accordance with SAE AMS2424. Plating shall not blister, peel, scale, crack, or show other detrimental effects after being subjected to temperatures specified for the bake cycle.

(l) If any plating defects specified in preceding Step (1) exist, strip nickel plating as follows:

1 On corrosion resistant steel or nickel base alloys, strip nickel plating as follows:

WARNING: NITRIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

a Immerse parts in stripping solution consisting of equal volumes of water and nitric acid (04–07, 70–80–01) [40° Baume] until nickel plate is removed.

NOTE: Agitation of solution is required to thoroughly remove nickel plate.

b Rinse parts in clean, cold running water and follow with a rinse in clean running water heated to 180°F (82°C).

2 Replate parts as specified in Steps (a) through (k).

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1. Nickel Plating for Preparation of CRES and Nickel Base Alloy Surface for Brazing - SP P514

A. Nickel plate shall be required on braze joint area of stainless or corrosion resistant steels and superalloy parts having the equal or larger percentage by weight of the following alloying elements:

(1) Titanium 0.70 percent

(2) Aluminum 0.14 percent

(3) Titanium plus Aluminum 0.70 percent

NOTE: Brush nickel plating shall be used as an alternate process to the following. Materials and instructions can be obtained from SIFCO Selective Plating, 5708 Schaaf Rd, Cleveland, OH 44131.

B. Nickel plate parts in accordance with SAE AMS2424 and following instructions.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: BECAUSE OF TOXICITY OF SOME DEPOSITED MATERIAL, KEEP BOTH PART AND BRUSH WET WITH WATER TO PREVENT AIRBORNE DUST.

(2) Using silicon dioxide grit 200 (05–14, 70–80–01), abrasive blast part surface as follows:

(a) On normal surfaces, wet abrasive blast surface to be plated using air pressure of 40 psi (276 kPa) minimum.

(b) On hard–to–clean surfaces, dry abrasive blast surface to be plated using air pressure of 60 psi (414 kPa) minimum, prior to wet abrasive blast in Step (a).

(3) Rinse part in clean, cold running water.

(4) Inspect rinsed surface for water breaks. If water breaks exist, repeat Step B.(1) through (4).

WARNING: HYDROFLUORIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

1. B. (5) Immerse parts in hydrofluoric acid solution consisting of 1 part hydrofluoric acid (04–06, 70–80–01) to 2 parts water for 30 to 60 seconds.

(6) Rinse in clean, cold running water.

(7) While still wet, immerse parts in Woods nickel plate solution; 30 to 34 ounces (851 to 964 grams) nickel chloride (04–17, 70–80–01), 15 to 18 ounces (444 to 532 milliliters) of 30 percent hydrochloric acid (04–04, 70–80–01) [20° BE], and enough water to make 1 gallon (3.785 liters) of solution.

(8) Electroplate for a minimum of 5 minutes using a current density of approximately 60 amperes per square foot (0.093 square meter).

(9) Rinse parts quickly in clean, cold running water.

C. Brazing

(1) With parts still wet and with current on, immerse parts in sulfamate nickel bath: sulfamate nickel solution (04–33, 70–80–01) and 0.05 ounce (1.42 grams) wetting agent (09–01, 70–80–01) per gallon (3.785 liters) of solution, heated to 100 to 140°F (40 to 60°C).

NOTE: Acidity of sulfamate nickel bath shall be maintained between 3.5 and 5.0 ph by adding boric acid (04–01, 70–80–01) or sulfamic acid (04–09, 70–80–01).

A thickness of 0.0004 to 0.0008 inch (0.010 to 0.020 millimeter) nickel plate shall be applied. Required plating thickness is obtained in approximately 15 minutes.

(2) Remove parts from bath and rinse in clean, cold running water followed by a rinse in clean, hot running water heated to 180°F (82°C) minimum.

1. C. (3) Heat parts as follows:

(a) Hollow or cored parts which have had their openings sealed in such a manner to prevent the entrance of any plating or rinse solutions shall be heated to 255 to 275°F (124 to 135°C). However, if the hollow or cored parts have had the plating or rinse solutions enter the hollow or cored passages, the part shall be heated to 890 to 910°F (477 to 488°C) to ensure the removal of all liquid from the interior of part.

(b) Heat parts 255 to 275°F (124 to 135°C); hold at heat for 2 hours minimum and cool to room temperature.

(c) Scour nickel plated areas with a nonabrasive scouring pad (10–19, 70–80–01) to remove all traces of oxidation.

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(4) Wipe nickel plated areas with a clean lint free cloth (10–10, 70–80–01) wet with ethyl alcohol (07–23, 70–80–01).

D. Inspection shall show no blistering, peeling, scaling, cracking, or other harmful effects after being subjected to the temperature specified in Step C.(3).

E. Stripping of Nickel Plated Parts

WARNING: NITRIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(1) Immerse parts in stripping solution composed of equal parts by volume of water and nitric acid (04–07, 70–80–01) [40° Baume].

NOTE: Agitation of the solution is required to thoroughly remove all nickel plate from parts.

(2) Rinse in clean, cold running water and follow with a rinse in clean running water heated to 180°F (82°C).

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1. Silver Plating - SP P515

NOTE: Copper and copper alloy parts may require a nickel strike. (Refer to SP P514, 70–35–04.)

A. Silver plate parts in accordance with SAE AMS 2410 and the following:

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(1) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: NITRIC ACID AND SULFURIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

(2) Strip old plate by immersing part in a solution of 1 part nitric acid (04–07, 70–80–01) and 19 parts sulfuric acid (04–10, 70–80–01).

NOTE: When stripping stainless steel parts, water shall not be added to stripping solution. Water will dilute stripping solution and make it ineffective.

(3) Rinse in water heated to 180°F (82°C) and blow dry.

(4) Visually inspect. If plate is not completely removed, repeat Steps (2) and (3).

(5) Mask, if required, using plater's wax (10–28, 70–80–01), stop off lacquer (03–14, 70–80–01), or masking tape (10–24, 70–80–01).

(6) Using dry abrasive pumice (05–15, 70–80–01), clean areas to be plated.

(7) Clean part in standard electrolytic cleaner or by standard periodic reverse method (SP C209, 70–15–09) for 1 1/2 to 2 minutes. Remove part from cleaner and rinse in water heated to 150°F (66°C), then rinse in cold water.

WARNING: MURIATIC ACID CAUSES SEVERE BURNS. DO NOT GET ACID IN EYES, ON SKIN, OR ON CLOTHING. WEAR APPROVED SAFETY EQUIPMENT, INCLUDING RUBBER APRON, RUBBER GLOVES, AND CHEMICAL GOGGLES WHEN HANDLING ACID. ALWAYS POUR ACIDS SLOWLY INTO WATER WHILE STIRRING. DO NOT ADD WATER TO ACID CONTAINER.

1. A. (8) Pickle part in concentrated muriatic acid (04–05, 70–80–01) for 1 1/2 to 2 minutes. Remove part from pickling solution and rinse in clean, cold water.

NOTE: Nickel strike on copper and copper alloys may be optional. (Refer to SP P514, 70–35–04 for all parts requiring nickel strike.)

(9) Electrically contact rack and immerse in silver strike bath consisting of the following:

(a) Potassium cyanide (04–35, 70–80–01): 18 ounces (510 grams).

(b) Soluble silver salts (04–36, 70–80–01): 0.82 ounce (23 grams).

(c) Potassium carbonate (04–34, 70–80–01): 4 ounces (113 grams).

(d) Quantity of water to make 1 gallon (3.785 liters) bath.

(10) Plate part for 1 minute using current density of 15 amperes per square–foot (0.093 square–meter) of area to be plated.

(11) Remove part from bath.

(12) Electrically contact rack and immerse part in silver plate bath consisting of:

(a) Potassium cyanide (04–35, 70–80–01): 14 ounces (397 grams).

(b) Soluble silver salts (04–36, 70–80–01): 9 ounces (255 grams).

(c) Potassium carbonate (04–34, 70–80–01): 3 ounces (85 grams).

(d) Silverex Brightener “A” 04–33, 70–80–01): 7.82 ounces (230 milliliters).

(e) Silverex Brightener “R” (04–33, 70–80–01): 1 ounce (0.0338 milliliter).

(f) Quantity of water to make 1 gallon (3.8 liters) bath.

CAUTION: TO PREVENT DAMAGE TO PART, DO NOT BREAK ELECTRICAL CONTACT AT ANY TIME DURING ACTUAL SILVER PLATING OPERATION.

1. A. (13) Plate part for period of time necessary to attain proper dimensions using a current density of 15 amperes per square–foot (0.093 square–meter) of area to be plated.

NOTE: Unless otherwise specified, plate thickness shall be 0.001 to 0.002 inch (0.03 to 0.05 millimeter).

(14) Remove part from bath and rinse thoroughly in room temperature still water, then rinse in running water.

WARNING: AIR PRESSURE USED FOR CLEANING OR DRYING OPERATIONS SHALL BE REGULATED BETWEEN 5 AND 25 PSIG (35 TO 172 KPA). USE APPROVED SAFETY EQUIPMENT (GOGGLES/FACE SHIELD) TO PREVENT INJURY TO THE EYES. DO NOT DIRECT JET OF COMPRESSED AIR AT SELF OR OTHER PERSONNEL.

(15) Remove masking, if applied; then rinse part in water heated to 150°F (66°C) and dry in compressed dry air.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(16) Copper and copper alloy parts shall be heated to 475 to 500°F (245 to 260°C) after plating, rinsing, and drying, and held at heat for not less than 20 minutes or more than 1 hour.

(17) After plating, rinsing, and drying, all parts as specified herein, except nuts, shall be heated to 935 to 965°F (502 to 518°C) and held at heat for not less than 20 minutes or more than 1 hour. Temperature of the parts shall not be over 400°F (205°C) for more than 7 hours. Above 400°F (205°C), heating and cooling medium shall be a neutral or reducing atmosphere (except that hydrogen shall not be used) or shall be a neutral or nonoxidizing molten salt bath. If such heating would lower hardness of parts below drawing limits or otherwise harm the parts, heating shall be at the highest practicable temperature that will maintain specified properties. Heating of nuts will not be required.

(18) Visually inspect parts for blisters and, if they are evident, strip plate and repeat all preceding steps.

WARNING: CORROSION PREVENTIVE COMPOUNDS ARE FLAMMABLE AND MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN WELL–VENTILATED AREA. CHEMICAL GOGGLES, NEOPRENE GLOVES, RUBBER APRON, AND COVERALLS SHALL BE WORN. KEEP AWAY FROM SPARKS AND FLAMES.

1. A. (19) Agitate in corrosion preventive braycote (02–37, 70–80–01).

(20) Wrap parts and place in suitable containers.

## CHAPTER 70–40–00 - BRAZING

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1. Silver Braze Repair - SP R404

A. Silver braze repair shall be in accordance with the technique used (torch, furnace, or induction) and the following instructions:

CAUTION: DO NOT USE SILVER BASE BRAZING ALLOYS (SAE AMS4765 THRU SAE AMS4774) UNLESS SPECIFICALLY AUTHORIZED IN THE APPLICABLE REPAIR PROCEDURE. USE OF THESE ALLOYS ON HOT END COMPONENTS MADE OF HIGH NICKEL ALLOYS CAN RESULT IN SEVERE STRESS CRACKING.

(1) Braze joints shall be classified as follows:

(a) Class I - Joints subjected to high stresses or fatigue loading.

(b) Class II - Joints subjected to intermediate stresses.

(c) Class III - Joints subjected to low stresses.

(2) All symbols shall be in accordance with AWS A2.4–86.

(3) Perform furnace silver brazing procedure using a furnace equipped with recording instruments and automatic temperature controls capable of providing uniform temperatures with variations no greater than ±25°F (±14°C) from control point to working zone. A means shall be provided for controlling and maintaining the furnace atmospheres, as required, to prevent decarburization or scaling of carbon or low alloy steels and carburization or nitriding of corrosion and heat resistant alloys. For furnace brazing, parts shall be assembled and aligned as required. Flux may be used to control the furnace's atmosphere. After preplacement of filler material, the assembly shall be placed in the furnace and held there until the filler material has melted and formed in the desired bonding. After brazing has been accomplished, the assembly shall be cooled in a protective atmosphere, as required, to prevent scaling.

NOTE: Controls shall be calibrated at regular intervals by measuring working thermocouple temperature against a potentiometer of known accuracy. Check temperatures by inserting a calibrated thermocouple adjacent to the working thermocouple with part being brazed and comparing reading obtained with that of recording and controlling pyrometers. Checks are to be made at least once every three months at normal working temperatures.

(4) For torch silver brazing, parts shall be preheated with a neutral or slightly reduced flame to bring the entire joint uniformly to the flow temperature of the filler material, but no higher than necessary to produce a satisfactory joint. Localized overheating and sealing shall be avoided. The filler material shall be introduced at one edge of the joint, or in a groove provided for the purpose in one of the mating surfaces, and shall flow by capillary action to fill the braze area. Parts to be joined may be secured in position by jigs, clamps, supports, or be self fixturing. Such fixtures, jigs, and supports shall be of noncontaminative materials and designed to involve only point or line contact. Design shall also accommodate expansion and contraction of the part during torch brazing.

1. A. (5) For induction silver brazing, use high frequency output source and mating surfaces coated with flux (03–13, 70–80–01). Place filler material in position and heat the joint area to the flow temperature. The joint may be supplementary face fed; however, melting of filler material shall be in evidence prior to any face feeding.

NOTE: Brazing fixtures shall be capable of maintaining proper braze clearance, have dimensional stability, and have compatible coefficients of expansion with parts being joined.

(6) Application of braze alloy and the braze cycle shall be repeated as required for assemblies requiring more than one braze cycle to complete the assembly operation.

(7) Post braze cleaning shall be performed to remove all residual flux from assembly. If rinsing in hot water at 180°F (82°C) minimum does not remove flux, a suitable approved cleaning procedure may be used.

(8) All surfaces to be brazed shall be prepared by one or more of the following methods:

NOTE: Any combination of the following cleaning methods that effectively removes all dirt, grease, paint, scale, or foreign matter from the part to be brazed may be used. Polishing is not applicable to plated or otherwise specially prepared surfaces.

(a) Mating surfaces shall be prepared for brazing by polishing with a silicon carbide impregnated cloth wheel or wire brush.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(b) When required to maintain cleanliness, parts and fixtures to be placed in brazing furnace shall be emulsion degreased. (Refer to SP C214, 70–15–14.)

1. A. (8) (c) All surfaces to be brazed shall be either dry or vapor blasted as follows:

WARNING: ABRASIVE BLASTING OPERATIONS INVOLVE HAZARDOUS AIRBORNE PARTICLES WHICH MAY BE HAZARDOUS TO BODY AND EYES. GOGGLES, FACE SHIELD, ABRASIVE BLASTING RESPIRATOR (DURING EXTERNAL GUN OPERATIONS), AND LEATHER GLOVES WITH GAUNTLETS SHALL BE WORN.

1 Dry abrasive blasting shall be accomplished using silicon carbide 325 grit (05–16, 70–80–01) air pressure at 40 psi minimum (276 kPa).

NOTE: After dry abrasive blasting, parts shall be handled in a manner that will prevent recontamination of the part surface.

2 Vapor blast parts. (Refer to SP C205, 70–15–05.)

3 Vapor blasted parts shall have the areas to be brazed wiped with a clean lint free wiper (10–10, 70–80–01) wet with ethyl alcohol (07–23, 70–80–01).

(9) Nickel plate shall be required on the braze joint area of stainless or corrosion resistant steels and superalloy parts having the equal or a larger percentage by weight of the following alloying elements:

(a) Titanium 0.70 percent

(b) Aluminum 0.40 percent

(c) Titanium plus Aluminum 0.70 percent

(10) Nickel plate 0.0004 to 0.0008 inch (0.010 to 0.020 millimeter) thick shall be applied. (Refer to SP P513, 70–35–03.)

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(11) The nickel plated braze joint surface(s) shall be thoroughly wiped with ethyl alcohol (07–23, 70–80–01).

(12) The detail parts shall be assembled in the position specified in the repair procedure.

1. A. (13) Optimum joint clearance between mating surfaces shall be 0.001 to 0.005 inch (0.025 to 0.127 millimeter) with the following exceptions:

(a) When one of the mating surfaces is knurled 0.003 to 0.005 inch (0.08 to 0.13 millimeter) deep, a minimum gap clearance is not required.

(b) Isolated areas of the braze gap may have clearances up to 0.010 inch (0.25 millimeter).

(14) Perform brazing procedure as follows:

(a) If required, use flux on surfaces to be brazed.

WARNING: BRAZING OPERATIONS ARE HAZARDOUS TO THE EYES. WELDING GOGGLES WITH PROPER SHADE LENSES ARE REQUIRED.

CAUTION: ALL CLAMPS OR FIXTURES IN THE IMMEDIATE VICINITY OF SURFACES TO BE BRAZED SHALL BE FREE OF OIL, GREASE, PAINT, SCALE, OR OTHER FOREIGN MATERIALS.

NOTE: Fluxes shall be used, as required, to promote fluidity of the filler metal. Fluxes shall be capable of dissolving any oxides and preventing additional oxidation of filler metal and base material during heating. Fluxes may be applied in the form of powder, paste, vapor gas, or coating on the filler material.

(b) Braze filler material will be identified in detailed repair procedures.

(c) When fabricating aluminum assemblies where sheet material clad with brazing metal is employed, the joints shall make contact since the cladding substance provides sufficient clearance.

(d) Necessary staking, pinning, or riveting, tack, or spot welding shall not be employed in areas subjected to high stress during service.

(e) On closed assemblies, appropriate vent holes shall be drilled.

(f) Lacquer stop off (03–14, 70–80–01) shall be used as required to restrict flow of filler metal.

(g) Whenever practicable, when one end of the fabricating joint is inaccessible for visual inspection, place filler metal at that (blind) end prior to assembly.

1. A. (14) (h) Parts to be joined shall be assembled so that the clearances between mating surfaces are within the tolerances specified in the detailed repair procedures. The assembly shall be supported so that proper alignment of parts is maintained.

NOTE: Unless otherwise specified, the optimum gap between mating surfaces shall be 0.001 to 0.005 inch (0.03 to 0.13 millimeter).

Heat treatment shall be as specified in detailed repair procedures.

(i) Residual flux shall be removed from all surfaces by rinsing parts in water heated to 180°F (82°C) after completion of brazing operations.

(15) Inspect silver braze repaired parts as follows:

(a) Visual and fluorescent penetrant inspect (SP I302, 70–20–02 and SP I305, 70–20–05) for the following conditions; limits are as specified in Table 1.

1 Cracks or voids in braze or adjacent base metal.

2 Surface porosity.

3 Completeness of ring or fillet of braze material at all joint edges on the side of braze application.

4 Completeness of braze band (excluding the fillet) around the circumference or along the length of all braze joints.

5 Freedom from excess braze material on surface of assembled details.

(16) Radiographic and ultrasonic inspect for internal defects. (Refer to SP I310, 70–20–10 and SP I309, 70–20–07.) Limits are as specified in Table 2.

(17) Inspection criteria as established by braze joint classification shall be as follows:

(a) Class I braze joints shall be 100 percent radiographic or ultrasonic inspected. (Refer to SP I310, 70–20–10 and SP I309, 70–20–07.)

(b) Class II braze joints shall be 100 percent radiographic or ultrasonic inspected (SP I310, 70–20–10 and SP I309, 70–20–07) until the quality level of the joint is established.

(c) Class III braze joints do not require radiographic or ultrasonic inspection. (Refer to SP I310, 70–20–10 and SP I309, 70–20–07.)

(18) When a pressure test is specified, leakage shall not exceed allowable limits.

(19) For specific inspection procedures, refer to the applicable repair procedure.

Table 1. Acceptance Limits for Visual and Fluorescent Penetrant Limits for Brazed Joints

| Type of Defect | Class I | Class II | Class III |
|---|---|---|---|
| Cracks or Linear Indications (Braze and Base Material) | Unacceptable | Unacceptable | Unacceptable |
| Voids | Unacceptable | Unacceptable | Unacceptable |
| Surface Porosity (Fillet Only, Non–Machined Surfaces) | Acceptable | Acceptable | Acceptable |
| Total Lack of Braze Exposed by Machined or Grinding in Non–Fillet Area | 5% of C | 10% of C | 20% of C |
| Lack of Braze – Ring of Fillet of Braze Material at All Joint Edges | Unacceptable | 10% of C | 20% of C |

NOTE: C = Circumference or Length of Braze Joint

Table 2. Acceptance Limits for Radiographic and Ultrasonic Inspection of Brazed Joints (Class I and II)

| Type of Defect | Percentage of Width (Transverse to Circumference or Length of Joint) | Maximum Total (Cumulative) Length Percentage of Joint (1) (2) | |
|---|---|---|---|
| | | Class I | Class II |
| Cracks (Braze and Base Material) | Unacceptable | Unacceptable | Unacceptable |
| Lack of Braze or Bond (3) | Greater than 50 | 2 | 3 |
| | 50 to 33 | 5 | 10 |
| | 32 to 25 | 10 | 20 |
| | 24 to 20 | 20 | 100 |
| | Less Than 20 | 100 | - |
| Voids (4) | | Unacceptable | Unacceptable |

NOTES: W = Width of brazed joint

(1) Maximum Total (Cumulative) Length of Joint Defects: If 3 percent of Class I braze joint indications fall into the 50 to 33 percent category the allowable percentage for defects in the 32 to 25 percent category shall be 7 percent maximum.

(2) Lack of bond greater than 50 percent shall be acceptable when the following requirements can be met:

(a) Individual indications greater than 50 percent in width shall not exceed 1 percent in length.

(b) For 0.5 inch (12.7 millimeters) on either side of the 50 percent indications (Step (a)), there shall be no indications larger than 25 percent.

(c) When two or more indications are closer to the 50 percent indication than two times the width of the smaller indication, the indications and the space between them may be evaluated as a single indication (Step (a)) and accepted or rejected accordingly.

(3) Lack of Bond - An area of the braze joint where the braze alloy has failed to adhere (bond) to the base metal and produces a signal response when inspected ultrasonically.

Surface Porosity - A roughening or spongy appearance or open pores on the surface of the brazed alloy. It shall be confined to the surface of the braze, and shall show no significant joint penetration as determined by radiographic inspection.

(4) Void - An interruption in the braze which is continuous through the joint cross section.

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1. Vacuum Furnace - Nickel Braze Repair - SP R405

A. The high temperature nickel braze repair instructions herein are intended to be used to make sure that nickel brazing operations meet prescribed requirements for brazing in a vacuum atmosphere.

(1) All symbols shall be in accordance with AWS A2.–86.

(2) Braze joints shall be classified as follows:

(a) Class I - Joints subjected to high stresses or fatigue loading.

(b) Class II - Joints subjected to intermediate stresses.

(c) Class III - Joints subjected to low stresses.

B. Required procedures and operations.

(1) All surfaces to be brazed shall be prepared in the following manner, except for surfaces that are to be nickel plated.

(2) Part surfaces shall be thoroughly cleaned using ethyl alcohol (07–23, 70–80–01).

NOTE: Polishing is not applicable to plated or otherwise specially prepared surfaces.

(3) Mating surfaces shall be prepared for brazing by polishing with a silicon carbide impregnated cloth wheel or wire brush.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(4) When required to maintain cleanliness, parts and fixtures to be placed in brazing furnace shall be emulsion degreased. (Refer to SP C214, 70–15–14.)

WARNING: ABRASIVE BLASTING OPERATIONS INVOLVE HAZARDOUS AIRBORNE PARTICLES THAT MAY BE HAZARDOUS TO BODY AND EYES. GOGGLES, FACE SHIELD, ABRASIVE BLASTING RESPIRATOR (DURING EXTERNAL GUN OPERATIONS), AND LEATHER GLOVES WITH GAUNTLETS SHALL BE WORN.

1. B. (5) All surfaces to be brazed shall be either dry abrasive or vapor blasted as follows:

(a) Dry abrasive blasting shall be accomplished using abrasive Nicrobraze blasting grit 60 (05–13, 70–80–01) and air pressure of 40 psi minimum (276 kPa).

NOTE: After dry abrasive blasting, parts shall be handled in a manner that will prevent recontamination of the surfaces.

(b) Vapor blast. (Refer to SP C205, 70–15–05.)

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(6) Vapor blasted parts shall have the areas to be brazed wiped with a clean lint free cloth (10–10, 70–80–01) wet with ethyl alcohol (07–23, 70–80–01).

(7) Nickel plate shall be required on the braze joint area of stainless or corrosion resistant steels and superalloy parts having the equal or larger percentage by weight of the following alloying elements:

| | | |
|---|---|---|
| (a) | Titanium | 0.70 percent |
| (b) | Aluminum | 0.14 percent |
| (c) | Titanium plus Aluminum | 0.70 percent |

1. B. (8) When required nickel plate 0.0004 to 0.0008 inch (0.010 to 0.020 millimeter) thick shall be applied. (Refer to SP P514, 70–35–04.)

(a) The nickel plated braze joint surface(s) shall be thoroughly wiped with ethyl alcohol (07–17, 70–80–01).

(b) The detail parts shall be fixtured in the position specified on the assembly drawing.

(c) The optimum joint clearance between mating surfaces shall be 0.002 to 0.005 inch (0.05 to 0.13 millimeter) with the following exceptions:

NOTE: When consistent with good manufacturing practices, prick punches shall be permitted in the area to be brazed to maintain the required gap between mating surfaces.

1 When one of the mating surfaces is knurled 0.003 to 0.005 inch (0.08 to 0.13 millimeter) deep, a minimum gap clearance is not required.

2 Isolated areas of the braze gap may have clearances up to 0.010 inch (0.25 millimeter).

3 Braze gaps at areas with sharp radii (e.g., leading and trailing edges of vane to shroud joints) may have clearances up to 0.025 inch (0.64 millimeter).

C. Braze alloy paste application shall be as follows:

(1) Braze alloy paste shall be applied to the braze joint areas designated on the repair procedure. The fillet shall be kept to a minimum to prevent excessive braze flow and erosion of base metal.

(2) When necessary, lacquer stop off (03–14, 70–80–01) shall be applied to restrict flow of braze alloy.

(3) Excess braze alloy paste shall be removed from the joints.

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(4) The braze alloy paste shall be dried at room temperature for 2 hours minimum or baked in an oven at 160 to 250°F (71 to 121°C) for 50 to 70 minutes.

1. D. The braze cycle shall be as follows:

(1) The assembly shall be placed in the furnace. Suitable high temperature shields shall be used on coated parts as required to protect the coating from damage caused by direct radiation.

(2) The cooling gas line shall be purged and the furnace vacuum pumped down to 10 microns or less prior to application of heat.

(3) The heating rate shall not exceed 100°F (56°C) per minute from room temperature to 800°F (427°C) and 50°F (28°C) per minute from 800°F (427°C) to the approved equalizing temperature.

(4) When the pressure exceeds 50 microns during the heat up and the temperature is below 1000°F (538°C), the heat shall be turned off to allow the furnace vacuum to recover to 10 microns or less.

(5) The equalizing temperature shall be maintained until the pressure recovers to 2 microns or less and then continued for a period of 1 hour minimum.

(6) The heat up rate from the equalizing temperature to the brazing temperature shall be at the specified control rate.

(7) Unless otherwise specified, the assembly shall be maintained at the brazing temperature specified in Table 1 for 10 to 30 minutes.

(8) The heat up rate, equalizing holding time, and brazing temperature and time shall be as approved by the procuring activity.

(9) Unless otherwise specified in the repair procedure, the assembly shall be cooled with either a vacuum or argon gas. If argon gas is used, not more than minus 2 inches (51 millimeters) gage pressure of gas shall be introduced until reaching a part temperature of 400°F (204°C).

WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(10) The furnace’s door may be opened below 400°F (204°C).

Table 1. Brazing Alloy and Reference Brazing Temperature

| Braze Alloy | Equalizing Temperature* | Brazing Temperature* |
|---|---|---|
| SAE AMS 4776** | 1740 to 1950°F (949 to 1066°C) | 2050 to 2150°F (1121 to 1176°C) |
| SAE AMS 4777 | 1740 to 1950°F (949 to 1066°C) | 1900 to 1975°F (1038 to 1076°C) |
| SAE AMS 4779 | 1740 to 1950°F (949 to 1066°C) | 2050 to 2175°F (1121 to 1190°C) |
| SAE AMS 4787 | 1960°F (1071°C) | 1790 to 1885°F (977 to 1029°C) |
| SAE AMS 4783 | 1740 to 1950°F (949 to 1066°C) | 2150 to 2250°F (1176 to 1231°C) |
| SAE AMS 4782 | 1740 to 1950°F (949 to 1066°C) | 2100 to 2200°F (1155 to 1204°C) |
| M3870 | 1740 to 1950°F (949 to 1066°C) | 2075 to 2150°F (1134 to 1176°C)*** |
| M3872 | 1740 to 1950°F (949 to 1066°C) | 2075 to 2150°F (1134 to 1176°C) |
| Nicrobraze | 1740°F (949°C) | 2075°F (1135°C) |

*The temperatures noted are actual part temperatures as established in furnace calibrations.

**Brazing cycle for components containing coated parts must be maintained within a temperature range of 2050 to 2075°F (1121 to 1134°C).

***For aluminide coated parts, the brazing temperature range shall be 2050 to 2100°F (1121 to 1155°C).

1. E. Inspect nickel braze repaired parts as follows:

(1) Visually (SP I302, 70–20–02) and fluorescent penetrant (SP I305, 70–20–05) inspect for the following conditions. Limits are as specified in Table 2.

(a) Cracks or voids in braze or adjacent base metal.

(b) Surface porosity.

(c) Completeness of ring or fillet of braze material at all joint edges on the side of braze application.

(d) Completeness of braze band (excluding the fillet) around the circumference or along the length of all braze joints.

(e) Freedom from excess braze material on surface of assembled details.

(2) Radiographic and ultrasonic inspect for internal defects. (Refer to SP I310, 70–20–10 and SP I309, 70–20–09.) Limits are as specified in Table 3.

(3) Frequency of inspection as established by braze joint classification shall be as follows:

NOTE: Joints brazed with preplaced brazing alloy foil preforms shall be ultrasonically inspected.

(a) Class I braze joints shall be 100 percent radiographic or ultrasonic inspected. (Refer to SP I310, 70–20–10 or SP I309, 70–20–09.)

(b) Class II brazed joints shall be 100 percent radiographic or ultrasonic inspected (SP I310, 70–20–10 or SP I309, 70–20–09) until the quality level of the joint is established. A sampling plan approved by the procuring activity's Quality Department may then be instituted. If the brazing process is modified or changed, the radiographic or ultrasonic inspection shall be reinstated until the quality level of the joint is reestablished.

(c) Class III brazed joints shall not require radiographic or ultrasonic inspection.

(4) When a pressure test is specified, leakage shall not exceed allowable limits.

(5) For specific inspection procedures, refer to the applicable repair procedure.

Table 2. Acceptance Limits for Visual and Fluorescent Penetrant Limits for Brazed Joints

| Type of Defect | Class I | Class II | Class III |
|---|---|---|---|
| Cracks or Linear Indications (Braze and Base Material) | Unacceptable | Unacceptable | Unacceptable |
| *Voids | Unacceptable | Unacceptable | Unacceptable |
| Surface Porosity (Fillet Only, Non–Machined Surfaces) | Acceptable | Acceptable | Acceptable |
| Total Lack of Braze Exposed by Machining or Grinding in Non–Fillet Area | 5% of C | 10% of C | 20% of C |
| Lack of Braze - Ring of Fillet of Braze Material at All Joint Edges | Unacceptable | 10% of C | 20% of C |

NOTES: C = Circumference or Length of Braze Joint

*Voids – An interruption in the braze which is continuous through the joint cross section.

Table 3. Acceptance Limits for Radiographic and Ultrasonic Inspection of Brazed Joints (Class I and II)

| Type of Defect | Percentage of Width (Transverse to Circumference or Length of Joint) | Maximum Total (Cumulative) Length Percentage of Joint (1) (2) Class I | Class II |
|---|---|---|---|
| Cracks (Braze and Base Material) | Unacceptable | Unacceptable | Unacceptable |
| Lack of Braze or Bond (3) | Greater than 50 | 2 | 3 |
| | 50 to 33 | 5 | 10 |
| | 32 to 25 | 10 | 20 |
| | 24 to 20 | 20 | 100 |
| | Less Than 20 | 100 | - |
| Voids (4) | | Unacceptable | Unacceptable |

NOTES: W = Width of brazed joint

(1) Maximum Total (Cumulative) Length of Joint Defects: If 3 percent of Class I braze joint indications fall into the 50 to 33 percent category the allowable percentage for defects in the 32 to 25 percent category shall be 7 percent maximum.

(2) Lack of bond greater than 50 percent shall be acceptable when the following requirements can be met:

(a) Individual indications greater than 50 percent in width shall not exceed 1 percent in length.

(b) For 0.5 inch (12.7 millimeters) on either side of the 50 percent indications (Step (a)), there shall be no indications larger than 25 percent.

(c) When two or more indications are closer to the 50 percent indication than two times the width of the smaller indication, the indications and the space between them may be evaluated as a single indication (Step (a)) and accepted or rejected accordingly.

(3) Lack of Bond - An area of the braze joint where the braze alloy has failed to adhere (bond) to the base metal and produces a signal response when inspected ultrasonically.

Surface Porosity - A roughening or spongy appearance or open pores on the surface of the brazed alloy. It shall be confined to the surface of the braze, and shall show no significant joint penetration as determined by radiographic inspection.

(4) Void - An interruption in the braze which is continuous through the joint cross section.

1. Stainless Steel Tubing Braze Repair - SP R417

A. Repair Damaged Stainless Steel Tubing

(1) Measure to determine if worn or abraded area is within repairable limits.

(2) Maximum depth of repairable damage will be one–half of the tubing walls thickness.

B. Prepare Damaged Stainless Steel Tubing

(1) Blend area to remove rough fretting and rough edges.

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

(2) Clean damaged area and stainless steel wire with ethyl alcohol (07–23, 70–80–01).

(3) Using stainless steel wire (SAE AMS 5685) 0.020 to 0.024 inch (0.51 to 0.61 millimeter) diameter, closely wrap adjacent area to 0.50 inch (12.7 millimeters) beyond damage. (See Figure 1.)

C. Torch Braze Stainless Steel Tubing

WARNING: ENSURE BRAZING AREA IS ADEQUATELY VENTILATED. SILVER BRAZE ALLOY CONTAINS CADMIUM. AT BRAZING TEMPERATURES, TOXIC CADMIUM OXIDE FUMES WILL BE RELEASED.

CAUTION: PROTECT FITTINGS CLOSE TO HEAT AFFECTED AREA TO PREVENT MELTING OF BRAZE AT FITTING JOINTS.

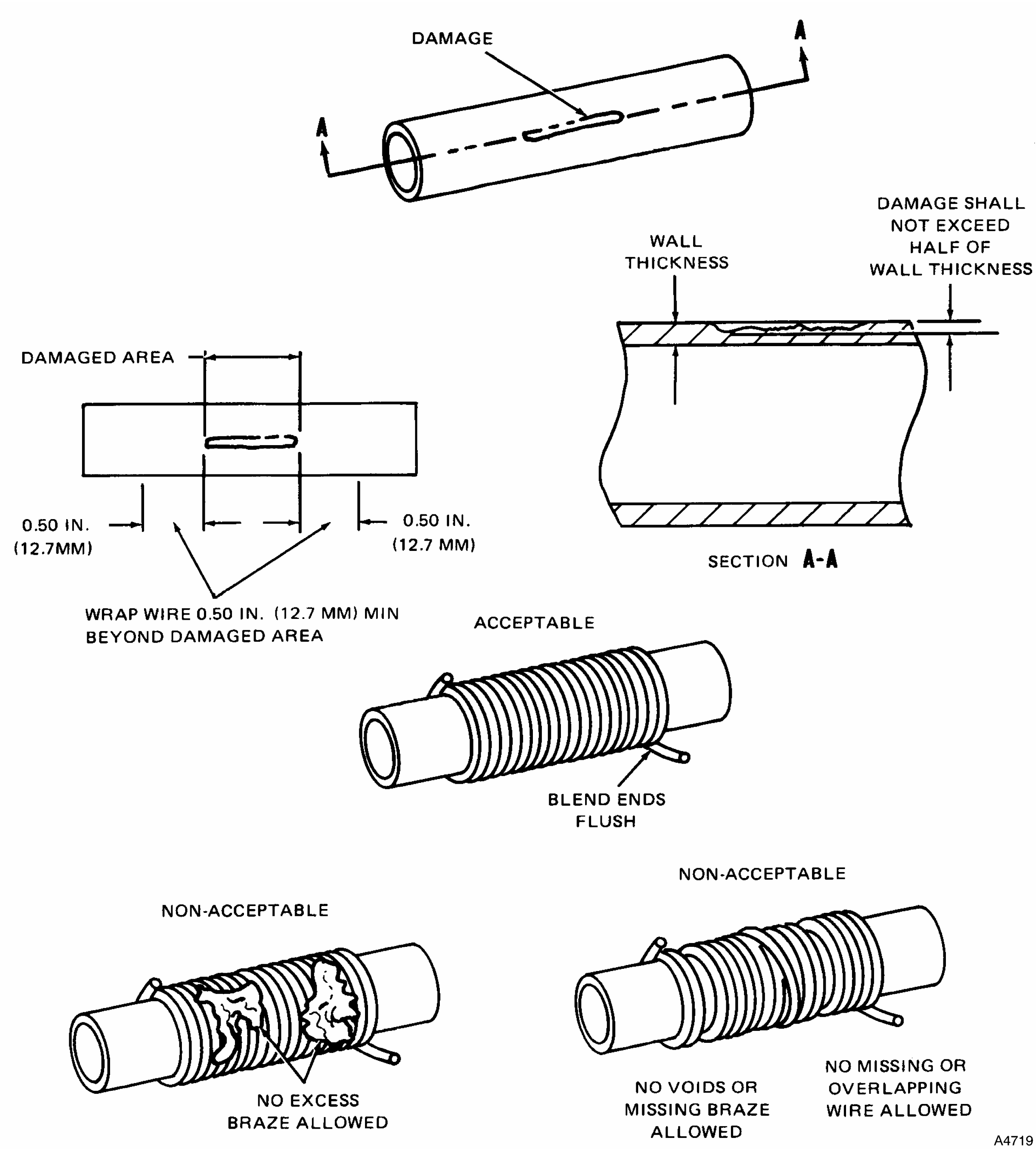
(1) Wrap fittings close to heat affected area with suitable heat resistant material. If remelt occurs, rebraze per Step (3).

CAUTION: DO NOT TACK WELD ENDS OF STAINLESS STEEL WIRE TO HOLD ENDS IN PLACE.

(2) While brazing, maintain a slight tension on end of wire to prevent spiral wrap from unwinding.

(3) Using brazing filler material (03–02 or 03–03, 70–80–01) and flux (03–13, 70–80–01), braze area using minimum heat. Ensure all wire coils are filled with continuous braze. (See Figure 1.)

(4) Remove residual flux by rinsing part in water heated to a minimum of 180°F (82°C). If flux is not removed, a suitable approved cleaning procedure may be used.




Stainless Steel Tubing Braze Repair
Figure 1

1. D. Visually Inspect Repaired Area

(1) Braze shall be completely free of voids. (See Figure 1.)

(2) Inspect all areas adjacent to repair for possible remelt condition.

(3) Blend wire ends flush to surface. Ensure all burrs and excess braze material is removed. (See Figure 1.)

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# CHAPTER 70–45–00 - WELDING

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1. Fusion Weld Repair - SP R402

A. Fusion weld repair shall be performed in accordance with the following instructions:

WARNING: WELDING OPERATIONS CAN PRODUCE HEAT, TOXIC FUMES, INJURIOUS RADIATION, METAL SLAG, AND AIRBORNE PARTICLES. PROTECTION EQUIPMENT CONSISTING OF WELDERS HELMET, APRON, AND GLOVES REQUIRED. GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE.

(1) Types of welding processes used shall be in accordance with Standard AWS A2.4–86 unless otherwise specified on the engineering drawing or as defined as follows:

(2) Weld joints shall be classified as follows:

(a) Class I - Joints subject to high stresses or fatigue loading.

(b) Class II - Joints subject to intermediate stresses or fatigue loading.

(c) Class III - Joints subject to intermediate stresses.

(d) Class IV - Joints subject to low stresses.

NOTE: Class II weld shall be used if no weld class is specified in the repair procedure.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(3) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

WARNING: GRINDING OPERATIONS CREATE METAL PARTICLES WHICH COULD ENTER THE EYE. SAFETY GOGGLES SHALL BE WORN.

NOTE: In situations where emulsion degreasing is impractical, parts shall be wiped with a clean lint free cloth (10–10, 70–80–01) wet with ethyl alcohol (07–23, 70–80–01). Allow part to dry completely.

(4) Using a carbide burr, thoroughly rout to completely remove each imperfection and expose clean, sound metal.

NOTE: Rout minimum amount necessary to completely remove imperfections.

(5) Reinspect part to ensure complete removal of imperfections. Reinspect using the same inspection method used to detect the original imperfection.

1. A. (6) Using an austenitic stainless steel wire brush, remove all surface treatment from area to be welded.

NOTE: If part requires substantial weld repairs, surface treatment shall be removed from entire part by solvent immersion, emulsion degreasing, or vapor blasting methods. (Refer to SP C202, 70–15–02; SP C214, 70–15–04; or SP C205, 70–15–05.)

(7) Thoroughly clean off chips, scale, dirt, oil, and other foreign material detrimental to proper welding from area to be welded.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(8) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

NOTE: Parts to be welded shall not be sandblasted or steel grit blasted.

(9) Back up area to be repaired with copper or inert gas and reweld using gas process and filler material specified in repair procedure.

(10) Classification of the weld joint and the welding process to be employed shall be as specified in the tail of the weld symbol of the applicable repair procedure. When a weld class and/or process is not specified, a class shall be assigned per 70–45–01, Step 1.A.(2). The respective requirements contained herein shall then apply. Weld symbols shall be in accordance with Standard AWS A2.4–86. The welding process shall include, but not be limited to, the following requirements:

(a) Joint mismatch.

1 Maximum gap not exceeding 25 percent of thinner member being joined.

2 Maximum mismatch of part not to exceed 10 percent of thickness of thinner member.

(b) Whenever joint design or tolerances require backing, backup plates shall be copper or other suitable material.

(c) When preheating is required prior to welding, part shall be preheated as specified in the repair procedure. When stress relief of a preheated part is required immediately after welding, part shall be maintained at preheat temperature until loaded into stress relief furnace.

(d) Prior to welding, tack welded joints shall be visually examined for cracks. Cracked tack welds shall be completely removed by grinding and replaced by a new tack weld.

NOTE: Visual examination of Class I tack welds shall be performed at 5 power magnification.

1. A. (10) (e) Peening of weld joints is prohibited.

(f) Unless otherwise specified in the repair procedure, flush or convex fusion welds shall have the following dimensional allowances. Table 1 contains specific tolerances for aluminum and magnesium alloys. Table 2 contains general limits for all materials.

(11) Fusion welds shall conform to the following inspection criteria:

(a) Weld beads shall be reasonably smooth and free of irregularities and shall blend into the parent metal in smooth gradual curves.

(b) The weld shall show complete fusion without an excess of overlapping.

(c) Edge weld penetration shall be at least equal to the thickness of the thinner material and shall slightly overlap the outer edges of adjacent material to make sure that the weld cross sectional area requirement.

(d) The size of a fillet weld and intermittent or a tack weld length shall not exceed 1.5 times the value specified on the engineering drawing.

(e) Surface imperfections of welds shall be in accordance with the limits of acceptability stated in Table 3 and Table 4.

(f) Arc scratches resulting from fusion welding shall not be evidenced on adjacent part areas.

(12) Dimensional Limits. Seam allowances for flush and convex welds shall be as follows:

(a) Dimensional allowance for butt welds on the crown and/or underbead is a maximum of one third the thickness of the thinner material.

(b) Cracks, incomplete penetration or fusion, porosity and voids, metallic and nonmetallic inclusions shall be in accordance with the limits stated in Table 5 and Table 6.

(13) All welded joints in nonmagnetic materials and/or materials welded with nonmagnetic filler material shall be inspected per the requirements of Inspection/Check for the applicable repair, typically using fluorescent penetrant inspection method. (Refer to SP I305, 70–20–05.)

Table 1. Specific Tolerances for Aluminum and Magnesium Alloys

| Material Thickness in Inches (Millimeters) | Flush Weld Allowance | Convex Weld Allowance |
|---|---|---|
| 0.000 to 0.030 (0.00 to 0.76) | 0 to +30% | +10% to +50% |
| 0.031 to 0.080 (0.79 to 2.03) | -10% to +30% | +20% to +60% |
| 0.081 to 0.156 (2.06 to 3.96) | -7% to +30% | +30% to +60% |
| 0.157 (3.96) and over | -5% to +0.06 inch (1.5 millimeters) maximum | +0.06 to +0.12 inch (1.5 to 3.1 millimeters) |

Table 2. General Limits for All Materials

| Nominal Stock Thickness in Inches (Millimeters) | Flush Weld Allowance | Convex Weld Allowance |
|---|---|---|
| 0.000 to 0.030 (0.00 to 0.76) | 0% to +20% | +10% to +60% |
| 0.031 to 0.080 (0.79 to 2.03) | 0% to +15% | +10% to +50% |
| 0.081 to 0.156 (2.06 to 3.96) | 0% to +10% | +10% to +40% |
| 0.157 (3.99) and over | 0% to +0.02 inch (0.5 millimeter) maximum | +10% to 0.12 inch (3.1 millimeters) maximum |

Table 3. Acceptance Limits for Visual, Magnetic Particle, and Penetrant Inspection of Fusion Welded Joints (Iron, Nickel, and Cobalt Base Alloys)

| Type of Defect | Class I | Class II | Class III | Class IV |
|---|---|---|---|---|
| Cracks and Crack Like Indications | U | U | U | U |
| Incomplete Penetration and Fusion | U | U | U | U |
| Surface Porosity | | | | |
| Maximum size D | U | T/4, up to 0.060 inch (1.52 millimeter) maximum | T/3, up to 0.080 inch (2.03 millimeter) maximum | T/3, up to 0.100 inch (2.54 millimeter) maximum |
| Maximum total (cumulative length per linear inch) (25 millimeters) | U | Two of maximum size or equivalent length | Three of maximum size | Five of maximum size or equivalent length |
| Minimum distance between indications | U | 4D | 3D | 2D |
| Undercutting | | | | |
| Maximum depth | U | T/20 | T/10 | T/5 |
| Maximum length | U | 10T in 50T | 10T in 20T | 10T in 20T |

NOTES: U - Unacceptable

T - Thickness of Thinnest Base Material

D - Diameter of Largest Dimension of Defect(s)

Table 4. Acceptance Limits for Visual and Penetrant Inspection of Fusion Welded Joints (Aluminum, Magnesium, Copper, and Titanium Base Alloys)

| Type of Defect | Class I | Class II | Class III | Class IV |
|---|---|---|---|---|
| Cracks and Crack Like Indications | U | U | U | U |
| Incomplete Penetration and Fusion | U | U | U | U |
| Surface Porosity | | | | |
| Maximum size D | U | T/3, up to 0.060 inch (1.52 millimeter) maximum | T/2, up to 0.080 inch (2.03 millimeter) maximum | T/2, up to 0.100 inch (2.54 millimeter) maximum |
| Maximum total length per linear inch) (25 millimeters) | U | Four of maximum size or equivalent length | Five of maximum size or equivalent length | Five of maximum size or equivalent length |
| Minimum distance between indications | U | 3D | 2D | 1D |
| Undercutting | | | | |
| Maximum depth | U | T/20 | T/10 | T/5 |
| Maximum length | U | 10T in 20T | 10T in 20T | 10T in 20T |

NOTES: U - Unacceptable

T - Thickness of Thinnest Base Material

D - Diameter of Largest Dimension of Defect(s)

Table 5. Radiographic and Ultrasonic Acceptance Limits for Fusion Welded Joints (Iron, Nickel, and Cobalt Base Alloys)

| Type of Defect | Class I | Class II | Class III |
|---|---|---|---|
| Cracks (Weld and Base Material), including cavities or inclusions with a tail | U | U | U |
| Incomplete Penetration and Fusion | U | Butt and corner welds: U<br>Fillet welds: maximum length - 4T in any 10T length of weld or 40% of joint length, whichever is less.<br>Plug: 20% along circumference | Butt and corner welds: U<br>Fillet welds: maximum length - 10T in any 20T length of weld or 50% of joint length, whichever is less.<br>Plug: 30% along circumference |
| Porosity and Voids | | | |
| Maximum size D | T/3, up to 0.060 inch (1.52 millimeter) maximum | T/2, up to 0.080 inch (2.03 millimeter) maximum | T/2, up to 0.100 inch (2.54 millimeter) maximum |
| Maximum total length per linear inch) (25 millimeter) | Two of maximum size or equivalent length | Three of maximum size or equivalent length | Six of maximum size or equivalent length |
| Minimum distance between indications | 5D | 4D | 3D |
| Metallic and Nonmetallic Inclusions | | | |
| Maximum size D | T/3, up to 0.060 inch (1.52 millimeter) maximum | T/2, up to 0.080 inch (2.03 millimeter) maximum | T/2, up to 0.100 inches (2.54 millimeter) maximum |
| Maximum total length per linear inch) (25 millimeter) | Two of maximum size or equivalent | Three of maximum size or equivalent length | Four of maximum size or equivalent length |
| Minimum distance between indications | 5D | 4D | 3D |

NOTES: U - Unacceptable

T - Thickness of Thinnest Base Material

D - Diameter of Largest Dimension of Defect(s)

Table 6. Radiographic and Ultrasonic Acceptance Limits for Fusion Welded Joints (Aluminum, Magnesium, Copper, and Titanium Base Alloys)

| Type of Defect | Class I | Class II | Class III |
|---|---|---|---|
| Cracks (Weld and Base Material), including cavities or inclusions with a tail | U | U | U |
| Incomplete Penetration or Fusion | U | Butt and corner welds: U<br>Fillet welds: maximum length - 4T in any 10T length of weld or 40% of joint length, whichever is less. | Butt and corner welds: U<br>Fillet welds: maximum length - 10T in any 20T length of weld or 50% of joint length, whichever is less. |
| Coarse Porosity and Voids | | | |
| Maximum size D | T/2, up to 0.060 inch (1.52 millimeter) maximum | T/2, up to 0.100 inch (2.54 millimeter) maximum | T/2, up to 0.100 inch (2.54 millimeter) maximum |
| Maximum total length per linear inch (25 millimeter) | Three of maximum size or equivalent length | Six of maximum size or equivalent length | Ten of maximum size or equivalent length |
| Minimum distance between indications | 4D | 2D | 1D |
| Fine Porosity | | | |
| Maximum size D | T/5, up to 0.015 inch (0.38 millimeter) maximum | T/5, up to 0.015 inch (0.38 millimeter) maximum | T/5, up to 0.025 inch (0.64 millimeter) maximum |
| Maximum total length per linear inch (25 millimeter) | 20 of maximum size or equivalent length | No limit | No limit |
| Minimum distance between indications | 2D | 1D | 1D |

Table 6. Radiographic and Ultrasonic Acceptance Limits for Fusion Welded Joints (Aluminum, Magnesium, Copper, and Titanium Base Alloys) (Cont)

| Type of Defect | Class I | Class II | Class III |
|---|---|---|---|
| Metallic and Nonmetallic Inclusions | | | |
| Maximum size D | T/3, up to 0.060 inch (1.52 millimeter) maximum | T/2, up to 0.080 inch (2.03 millimeter) maximum | T/2, up to 0.100 inch (2.54 millimeter) maximum |
| Maximum total length per linear inch (25 millimeter) | Two of maximum size or equivalent | Three of maximum size or equivalent length | Four of maximum size or equivalent length |
| Minimum distance between indications | 5D | 4D | 3D |

NOTES: U - Unacceptable

T - Thickness of Thinnest Base Material

D - Diameter of Largest Dimension of Defect(s)

NOTE: When part configuration or size makes magnetic particle inspection impractical, the weld joint may be inspected by fluorescent penetrant inspection provided it has been approved in writing by the procuring activity.

1. A. (14) All welded joints in magnetic materials and/or materials welded with magnetic filler material shall be inspected per the requirements of Inspection/Check for the applicable repair, typically using magnetic particle inspection method. (Refer to SP I303, 70–20–03.)

(15) All welded joints shall be subjected to NDT inspections as appropriate for the class of weld specified in the repair procedure and as noted in the applicable Inspection/Check section. The following applies to repairs when no NDT method is specified in the repair procedure.

(a) All Class I welded joints shall be radiographically or ultrasonically inspected, unless otherwise specified in the repair procedure.

(b) All Class II and III welded joints shall be inspected per applicable Inspection/Check requirements, unless otherwise specified in the repair procedure.

(c) Class IV welded joints shall be inspected per the applicable Inspection/Check section requirements and unless specified, do not require radiographic or ultrasonic inspection.

1. Spot and Seam Resistance Weld Repair - SP R403

WARNING: WELDING OPERATIONS CAN PRODUCE HEAT, TOXIC FUMES, INJURIOUS RADIATION, METAL SLAG, AND AIRBORNE PARTICLES. PROTECTION EQUIPMENT CONSISTING OF WELDERS HELMET, APRON, AND GLOVES REQUIRED. GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE.

A. Perform resistance weld repairs in accordance with MIL–W–6858 and the following instructions:

(1) All welding symbols shall be in accordance with AWS A2.4–86.

(2) Classification. The classification of weld joint categories shall be determined in accordance with the following applications:

(a) Class I - Joints subjected to high stress and fatigue loading.

(b) Class II - Joints subjected to intermediate stresses.

(c) Class III - Joints subjected to low stresses.

(3) Prior to welding, all surfaces shall be clean and free of film or other foreign material detrimental to the quality of the weld.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(4) Emulsion degrease part. (Refer to SP C214, 70–15–14.)

NOTE: In situations where emulsion degreasing is impractical, parts shall be wiped with a clean lint free cloth (10–10, 70–80–01) wet with ethyl alcohol (07–23, 70–80–01). Allow part to dry completely.

(5) When abrasive blasting is used for surface preparation, the following materials shall **NOT** be used:

(a) Sand as the abrasive for any surface.

(b) Steel grit as the abrasive for stainless steel surfaces.

1. A. (6) The mating surfaces of parts to be welded shall be aligned as follows:

(a) Fit up.

1 Mating surfaces shall be brought into contact by means of manual pressure.

2 During assembly of cylindrical or conical assemblies, the allowable fit up shall be evenly distributed at the mating surface circumferences. During welding, the extent of any gap gathering ahead of the electrodes shall not exceed one half the maximum diameter gap clearance of Table 1.

Table 1. Fit Tolerances for Spot and Seam Welding

| Stock Thickness in Inches (Millimeters) | Part Circular Diameter or Equivalent Circular Diameter in Inches (Millimeters) | Maximum Gap Clearance on Diameter in Thousandths of an Inch (Millimeter) |
|---|---|---|
| Up to and including 0.045 (1.14) | 3 (76) | 0.010 (0.25) |
| | 6 (152) | 0.015 (0.38) |
| | 10 (254) | 0.020 (0.51) |
| | 16 (406) | 0.025 (0.64) |
| | 20 (508) | 0.027 (0.79) |
| | 25 (635) | 0.028 (0.71) |
| | 30 (762) | 0.029 (0.74) |
| | 36 (914) | 0.030 (0.76) |
| | 48 (1219) | 0.031 (0.79) |
| Over 0.045 to 0.093 (1.14 to 2.36) | 3 (76) | 0.006 (0.15) |
| | 6 (152) | 0.011 (0.28) |
| | 10 (254) | 0.016 (0.41) |
| | 16 (406) | 0.021 (0.53) |
| | 20 (508) | 0.022 (0.56) |
| | 25 (635) | 0.023 (0.58) |
| | 30 (762) | 0.024 (0.61) |
| | 36 (914) | 0.025 (0.64) |
| | 48 (1219) | 0.0255 (0.65) |
| Over 0.093 (2.36) | 3 (76) | 0.004 (0.10) |
| | 6 (152) | 0.007 (0.18) |
| | 10 (254) | 0.010 (0.25) |
| | 16 (406) | 0.0135 (0.34) |
| | 20 (508) | 0.0145 (0.37) |
| | 25 (635) | 0.015 (0.38) |
| | 30 (762) | 0.016 (0.41) |
| | 36 (914) | 0.016 (0.41) |
| | 48 (1219) | 0.016 (0.41) |

NOTE: Where more than two stock thicknesses are involved, use the curve values for the thickest sheet metal.

1. A. (6) (b) The minimum overlap required to produce a sound weld shall be sufficient to prevent metal expulsion or part distortion due to welding. (Refer to Table 2 for overlap requirements.) The contacting overlap centerline shall also be the centerline for either intended spot or seam welds.

(c) Tack/spot welds located in the area of the intended spot or seam weld shall be permitted for assembly. The tack/spot weld shall be just strong enough to hold the parts together. Fusion tack welds shall not be used.

NOTE: In the event of a tack/weld fracture the fracture shall occur at the faying surface of the tack/spot weld and not through the parent metal.

(7) Spot welding shall be used for assembly of parts. The extent of deviation for spot welds shall be as follows:

(a) From the centerline: 0.060 inch (1.52 millimeter) and 0.060 inch (1.52 millimeter) out–of–line with the adjacent spot weld.

(b) The quality of the weld joint not impaired by the deviated spot weld.

NOTE: Specially shaped electrodes may be used to produce spot welds of unconventional shapes provided approval has been given for both the electrodes and designated overlap area.

(8) Seam welds shall be used for assembly of parts. Seam welds that transverse the part shall terminate within 0.120 inch (3.05 millimeter) of the ends of the parts being welded. The ends of the part shall be trimmed back to the welds if excessive indentation or deformation occurs on completion of the welding cycle.

(9) Inspection shall be performed as follows:

All welding symbols shall be in accordance with AWS A2.4–86.

Table 2. Overlap Requirements

| Stock Thickness, Thinner Sheet Inches (Millimeters) | Minimum Overlap Necessary |
|---|---|
| Less than 0.030 (0.76) | Multiply sheet thickness by 12 |
| 0.031 to 0.050 (0.79 to 1.27) | Multiply sheet thickness by 10 |
| 0.051 to 0.100 (1.30 to 2.54) | Multiply sheet thickness by 8 |
| 0.101 to 0.200 (2.56 to 3.08) | Multiply sheet thickness by 6 |

1. A. (10) Resistance welds shall conform to the following:

(a) The centerline of the material overlap shall be the centerline of the spot or seam weld.

(b) Spot, seam, and tack welds shall be aligned within 0.060 inch (1.52 millimeter) of the centerline.

(c) Seam welds shall terminate within 0.120 inch (3.05 millimeter) of the ends of the weld run.

(d) Surface imperfections of welds shall be in accordance with the limits stated in Table 3.

(e) There shall be no evidence of fusion welding methods (e.g., metallic, inert or carbon arc tack welds) employed in association with resistance welding.

(f) Cracks, porosity and voids, metal expulsion between sheets and surface flashes shall be in accordance with the limits stated in Table 4. Nugget size shall be specified on repair procedure.

(g) All welded joints shall be visually inspected to verify conformance to applicable requirements of the repair procedure. When nugget size is not specified, the minimum nugget size shall be in accordance with MIL–W–6858.

(h) All welded joints in nonmagnetic materials and/or materials welded with nonmagnetic filler material shall be fluorescent penetrant inspected. (Refer to SP I305, 70–20–05.)

(i) All welded joints in magnetic materials and/or materials welded with magnetic filler material shall be magnetic particle inspected. (Refer to SP I303, 70–20–03.) At completion of inspection parts and/or assemblies shall be demagnetized. (Refer to SP I311, 70–20–11.) The demagnetized part or assembly shall not produce magnetic indications exceeding 3 gauss or 3 oersteds (240 amperes per meter).

NOTE: When a part's configuration or size makes magnetic particle inspection impractical, the weld joint may be fluorescent penetrant inspected.

Table 3. Acceptance Limits for Visual, Magnetic Particle and Penetrant Inspection of Resistance Welds (All Alloys)

| | Class I | | Class II* | | Class III* | |
|---|---|---|---|---|---|---|
| Type of Defect | Spot | Seam | Spot | Seam | Spot | Seam |
| Cracks and Crack Like Indications | U | U | U | U | U | U |
| Surface Pits (or Clusters) | | | | | | |
| Maximum size D | 0.040 inch (1.02 millimeter) | 0.040 inch (1.02 millimeter) | 0.060 inch (1.52 millimeter) | 0.060 inch (1.52 millimeter) | 0.060 inch (1.52 millimeter) | 0.060 inch (1.52 millimeter) |
| Maximum number | 10% of N | Three per linear inch (25 millimeter) | 20% of N | Five per linear inch (25 millimeter) | 30% of N | Five per linear inch (25 millimeter) |
| Electrode pickup maximum acceptable | 2% of N | 2% of joint length and/or W per linear inch (25 millimeter) | 3% of N | 3% of joint length and/or W per linear inch (25 millimeter) | 5% of N | 5% of joint length and/or W per linear inch (25 millimeter) |
| Sheet separation maximum acceptable | 3% of N | 3% of joint length and 3W maximum length | 10% of N | 10% of joint length and 5W maximum length | 20% of N | 20% of joint length and 5W maximum length |
| Maximum acceptable separation | 0.005 inch (0.13 millimeter) or T/10, whichever is greater | 0.005 inch (0.13 millimeter) or T/10, whichever is greater | 0.005 inch (0.13 millimeter) or T/10, whichever is greater | 0.005 inch (0.13 millimeter) or T/10, whichever is greater | 0.005 inch (0.13 millimeter) or T/10, whichever is greater | 0.005 inch (0.13 millimeter) or T/10, whichever is greater |

Table 3. Acceptance Limits for Visual, Magnetic Particle and Penetrant Inspection of Resistance Welds (All Alloys) (Cont)

| | Class I | | Class II* | | Class III* | |
|---|---|---|---|---|---|---|
| Type of Defect | Spot | Seam | Spot | Seam | Spot | Seam |
| Excessive Indentation: | | | | | | |
| Maximum acceptable | 3% of N | 3% of joint length and/or W per linear inch (25 millimeter) | 10% of N | 10% of joint length and/or W per linear inch (25 millimeter) | 20% of N | 20% of joint length and/or W per linear inch (25 millimeter) |

*See Figure 1.

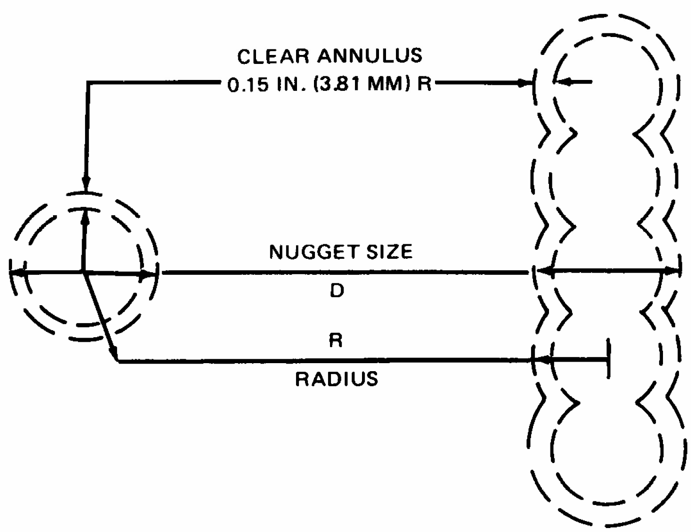
NOTES: U - Unacceptable

D - Diameter of Largest Dimension of Defect

W - Weld Nugget Diameter

N - Number of Spot welds in the Joint

T - Thickness of Thinnest Sheet




NOTE :

1. NO PART SHALL BE ACCEPTABLE WHEN THE NUMBER OF WELDS THAT HAVE CRACKS, PORES, OR INSTANCES OF INCOMPLETE FUSION WITH A LINEAR DIMENSION GREATER THAN (0.15 IN. (3.81 MM) D OR THAT EXTEND INTO THE 0.15 IN. (3.81 MM) R CLEAR ANNULUS AREA EXCEEDS 6 PERCENT OF THE TOTAL NUMBER OF WELDS IN THE PART.

A4720

Radiographic Criteria for Spot and Seam Welds
Figure 1

Table 4. Radiographic and Ultrasonic Acceptance Limits for Resistance Welds All Alloys, Except as Noted

| | Class I | | Class II* | | Class III* | |
|---|---|---|---|---|---|---|
| Type of Defect | Spot | Seam | Spot | Seam | Spot | Seam |
| Cracks | U | U | U | U | U | U |
| Fine Porosity: | | | | | | |
| Maximum size D | 0.010 inch (0.25 millimeter) | 0.010 inch (0.25 millimeter) | 0.015 inch (0.3 millimeter) | 0.015 inch (0.38 millimeter) | 0.025 inch (0.64 millimeter) | 0.025 inch (0.64 millimeter) |
| Maximum number of indications | Two indications per spot in 30% of N | Five per linear inch (25 millimeter) | Two per spot in 50% of N | 10 per linear inch (25 millimeter) | Two per spot in 50% of N | 15 per linear inch (25 millimeter) |
| Minimum distance between indications | 2D | 2D | 1D | 1D | 1D | 1D |
| Void and Large Porosity: | | | | | | |
| Maximum size | W/4 | W/4 | W/2 | W/2 | W/2 | W/2 |
| Maximum number of indications | 25% of N, two successive spots | Three of maximum size per linear inch (25 millimeter) | 35% of N, four successive spots | Three of maximum size per linear inch (25 millimeter) | 50% of N, six successive spots | Five of maximum size per linear inch (25 millimeter) |
| Limits of extension within the nugget | Within 15% of W of fusion line | Within 15% of W of fusion line | Within 10% of W of fusion line | Within 10% of W of fusion line | Within 5% of W of fusion line | Within 5% of W of fusion line |
| Minimum distance between indications | 1D | 1D | 1D | 1D | 1D | 1D |

Table 4. Radiographic and Ultrasonic Acceptance Limits for Resistance Welds All Alloys, Except as Noted (Cont)

| | Class I | | Class II* | | Class III* | |
|---|---|---|---|---|---|---|
| Type of Defect | Spot | Seam | Spot | Seam | Spot | Seam |
| Metal Expulsion Between Sheets (Spit) and Surface Flashes Maximum Acceptable | | | | | | |
| Nickel and Cobalt base alloys | 30% of N | Six per linear inch (25 millimeter) | 50% of N | 10 per linear inch (25 millimeter) | 60% of N | 15 per linear inch (25 millimeter) |
| All other alloys | 10% of N | Three per linear inch (25 millimeter) | 25% of N | Five per linear inch (25 millimeter) | 35% of N | 10 per linear inch (25 millimeter) |

*See Figure 1.

NOTES: U - Unacceptable

D - Diameter of Largest Dimension of Defect

W - Weld Nugget Diameter

N - Number of Spot welds in the Joint

T - Thickness of Thinnest Sheet

1. A. (11) Unless otherwise specified in the repair procedure, all welded joints shall be subject to radiographic (SP I310, 70–20–10) or ultrasonic (SP I309, 70–20–09) inspection to verify conformance. (See Figure 1.) The inspection criteria per class shall be as follows:

(a) All Class I welded joints shall be radiographically or ultrasonically inspected. (Refer to SP I310, 70–20–10 and SP I309, 70–20–09.)

(b) All Class II welded joints shall be radiographically or ultrasonically inspected (SP I310, 70–20–10 or SP I309, 70–20–09) until the quality level of the joint is established. A sampling plan may then be instituted.

(c) All Class III welded joints shall be radiographically or ultrasonically inspected (SP I310, 70–20–10 or SP I309, 70–20–09) until the quality level of the joint is established. The frequency of inspection may then be discontinued. However, weld joints shall still be subject to review by radiographic or ultrasonic inspection.

(12) All weld rework shall be inspected in accordance with applicable requirements of Steps A.(10)(g), (h), and (i).

1. Electron Beam Weld Repair - SP R406

A. Electron beam welding requires a vacuum weld chamber, a suitable power supply, and electron optical equipment, and shall be performed in accordance with the following instructions. (Weld symbols shall be in accordance with Standard AWS A2.4–86.)

(1) Power Supply. Variation in the electron beam welder's power supply output shall not exceed 1 percent for output voltage. Also:

(a) Electron gun shall have a variable electromagnetic focusing system.

(b) Focusing arrangement shall be capable of focusing on a minimum spot size of 0.020 inch (0.51 millimeter), at maximum power, with 95 percent of electron energy focused (5 percent maximum scatter) at focal distances necessary to weld components.

(2) The vacuum system shall be capable of achieving a vacuum of 1 x $10^{-4}$ millimeters of mercury (Hg) with components and fixtures in chamber. Also:

(a) Vacuum weld chamber shall be capable of maintaining a vacuum of 5 x $10^{-4}$ millimeters Hg while continuously welding maximum joint length and thickness of part under normal conditions.

(b) Leakage rate shall not effect pressure rise greater than 1 x $10^{-2}$ millimeters Hg per hour, starting from 1 x $10^{-3}$ millimeters Hg chamber pressure.

(3) The work handling mechanisms shall have velocity accuracy of plus or minus 1 percent above travel speed range required.

(a) Work table and rotary fixture shall be true within 0.0005 inch (0.013 millimeter).

(b) Mechanical or optical alignment system shall be capable of prealigning the joint with an electron beam within 0.001 inch (0.03 millimeter).

(4) Gages and Controls.

(a) The electron beam welding machine shall have an adequate number of accurate gages to ensure satisfactory control of the welding process.

(b) All gages and controls shall be calibrated at regular intervals against instruments of known accuracy. A record of all calibrations shall be maintained.

1. A. (5) Fixtures shall be made of non–gassing (vapor pressure less than 10–8 millimeters Hg) material and shall have dimensional stability to maintain proper fit.

(a) Any portion of the fixture subject to beam impingement (e.g., bottom of backup groove) shall be the same material as the component being welded.

(b) Disposable fixture inserts may be used for welding different materials.

(6) All components to be electron beam welded shall be free from oil, grease, dirt, oxides, or other foreign matter.

(7) Surfaces to be welded shall be free of burrs, laps, tears, etc, and shall be completely dry and free of cleaning agents. All chalk and ink marks shall be removed.

WARNING: ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

NOTE: Other approved cleaning solvents may be used provided the solvents leave a residue free surface.

(8) Prior to welding, the joint surface shall be wiped using a lint free cloth (10–10, 70–80–01) with dampened with ethyl alcohol (07–23, 70–80–01).

(9) All fixtures shall be free of moisture, oil, grease, and other foreign matter.

(10) Fit requirements prior to welding are as follows:

(a) Maximum gap between mating surfaces shall not exceed one percent of joint thickness or a maximum of 0.001 inch (0.03 millimeter), whichever is less, unless otherwise specified in the detailed repair procedure.

(b) Maximum allowable mismatch of assembled parts at joint shall not exceed 5 percent of material thickness of thinnest member.

(11) Inspect repaired parts as specified in the detailed inspection paragraphs and in accordance with Table 1 and Table 2.

(12) All parts, regardless of class or grade, shall be 100–percent visually inspected.

Table 1. Acceptable Limits for Visual, Magnetic Particle and Fluorescent Penetrant Inspection of Welded Joints

| Type of Defect | Class I | Class II | Class III |
|---|---|---|---|
| Cracks and Crack Like Indications | U | U | U |
| Incomplete Penetration and Fusion | U | U | U |
| Surface porosity | | | |
| Maximum size D | U | T/5, up to 0.060 inch (1.52 millimeter) maximum | T/3, up to 0.080 inch (2.03 millimeter) maximum |
| Maximum total (cumulative length per linear inch) | U | Two of maximum size or equivalent length | Three of maximum size or equivalent length |
| Minimum distance between indications | U | 2D | 1D |
| Undercutting | | | |
| Maximum depth | U | T/20 | T/10 |

NOTES: U - Unacceptable

T - Thickness of Thinnest Base Material (at the weld joint as measured parallel to the beam’s direction of entry)

D - Diameter Dimension of Indication. If two or more indications of acceptable size can be encompassed by a circle, with the calculated maximum acceptable dimension for the material thickness used, the resulting cluster of indications shall be rated as a single indication.

Table 2. Acceptable Limits for Radiographic and Ultrasonic Inspection of Welds

| Type of Defect | Class I | Class II and III |
|---|---|---|
| Cracks (Weld and Base Material), including cavities or inclusions with a tail | U | U |
| Incomplete Penetration or Fusion | U | U |
| Porosity and Voids | | |
| Maximum size D | T/5, up to 0.060 inch (1.52 millimeter) maximum | T/3, up to 0.080 inch (2.03 millimeter) maximum |
| Maximum total (cumulative) length per linear inch (25 millimeter) | Two of maximum size or equivalent length of smaller indications | Three of maximum size or equivalent length of smaller indications |
| Minimum distance between indications | 5D | 2D |

NOTES: U - Unacceptable

T - Thickness of Thinnest Base Material (at the weld joint as measured parallel to the beam's direction of entry

D - Diameter Dimension of Indication. If two or more indications of acceptable size can be encompassed by a circle, with the calculated maximum acceptable dimension for the material thickness used, the resulting cluster of indications shall be rated as a single indication.

1. A. (13) Radiographic and ultrasonic inspection. (Refer to SP I310, 70–20–10 and SP I309, 70–20–09.) Unless otherwise specified, all classes and grades of welds shall be radiographically or ultrasonically inspected. The frequency of inspection shall be as follows:

(a) Class I. Joints in highly stressed areas. Welds shall be 100 percent magnetic particle (SP I303, 70–20–03) or fluorescent penetrant (SP I305, 70–20–05) inspected and 100 percent radiographically or ultrasonically inspected. (Refer to SP I310, 70–20–10 and SP I309, 70–20–09.)

(b) Class II. Joints in moderate stress areas.

1 Grade A. Welds shall be 100–percent magnetic particle or fluorescent penetrant inspected and 100–percent radiographically or ultrasonically inspected.

2 Grade B. Welds shall be 100–percent magnetic particle or fluorescent penetrant inspected and 100–percent radiographically or ultrasonically inspected until a rejection rate of less than 5 percent is established.

(c) Class III. Joints in low stress areas.

1 Grade A. Welds shall be 100–percent magnetic particle or fluorescent penetrant inspected. Welds shall be 100–percent radiographically or ultrasonically inspected until a rejection rate of less than 5 percent is established.

2 Grade B. Welds shall be 100–percent magnetic particle or fluorescent penetrant inspected until a rejection rate of less than 5 percent is established. The weld joint shall be radiographically or ultrasonically inspected until the weld procedure is approved and then radiographic or ultrasonic inspection may be discontinued.

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# CHAPTER 70–50–00 - FLAME SPRAY

## TABLE OF CONTENTS

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1. Plasma and Thermal Flame Spray Repair - SP R408

A. The following procedures are the general processing requirements for the application of flame spray coating to metal surfaces for dimensional buildup and replacement of abradable coatings and replacement of thermal barrier coatings. This procedure shall be used for the buildup of undersized linear and outside diameters and for oversized inside diameters. Unless otherwise noted, the maximum material buildup allowed is a finish ground thickness of 0.015 inch (0.38 millimeter).

CAUTION: THERMAL SPRAY COATING DOES NOT CONTRIBUTE TO THE LOAD CARRYING ABILITY OF A STRUCTURE; THEREFORE, THE GRINDING OF SURFACES PRIOR TO THERMAL SPRAYING SHALL BE WITHIN LIMITS OF THE DETAIL REPAIR INSTRUCTIONS.

IF REQUIRED, HEAT TREATMENT AND PROCESSES SUCH AS ACID OR ALKALI CLEANING, BLACK OXIDE, ELECTROPLATING, PASSIVATION, OR ANODIZING SHALL PRECEDE THERMAL SPRAYING. IF ANY WELD OR BRAZE REPAIRS ARE TO BE MADE ON THE PART, THE REQUIRED REPAIRS AND INSPECTIONS SHALL BE ACCOMPLISHED BEFORE APPLICATION OF THE THERMAL SPRAYED COATING.

(1) Parts that are thermal sprayed shall be marked with a Ⓢ as a prefix to the serial number, 0.060 to 0.160 inch (1.52 to 4.06 millimeter) high by 0.001 to 0.006 inch (0.03 to 0.15 millimeter) deep, using a vibropeen etching tool. Parts not having a serial number will be identified in front of the Federal Manufacturer’s code number with a Ⓢ. These parts shall not be exposed to any subsequent processing that could attack the sprayed surface (e.g. passivation, anodization, heat treatment and acid or alkaline cleaning).

NOTE: If the repair procedure recommends using bond coating A6712 (06–01, 70–80–01), an alternate coating SR61 (06–50, 70–80–01) may be used; these plasma spray coatings are proprietary and shall be performed by the primary manufacturer or one of its designees.

In no case shall Ⓢ symbol be applied as a suffix to the serial number or manufacturer’s code.

(2) Components that are believed to have had a thermal spray applied shall not be chemically processed (for example passivation, alkaline cleaning, etc). Although there is no positive method of testing for the presence of thermal sprayed coatings, they will usually exhibit a roughened edge or darker hue when wet.

1. B. Requirements for establishment of a new process control sheet.

(1) The spray operator shall demonstrate suitable proficiency in the operation of thermal spray equipment and in the performance of other related operations.

(2) A ”Process Parameter Control Card” similar to that shown in Figure 1 will be established and maintained for each part number to be sprayed. Each process control card will be substantiated by the following:

(a) Two cup tests in accordance with Step (5) or two bend tests in accordance with Step (6).

(b) Three bond strength test in accordance with Step (7).

(c) One microstructural evaluation in accordance with Step (8).

(3) Process control sheets which are identical except for part number may be substantiated by similarity.

(4) Requirements for in–process control:

(a) All parts shall be coated in accordance with a current process control card.

(b) For each thermal spray lot, one bend test per Step (6) (or one cup test per Step (5)) and one microstructural evaluation shall per Step (8) shall be conducted.

(c) A lot shall be defined as all parts sprayed consecutively with the same material, using the same process parameters without any changes to the equipment setup.

NOTE: Microstructure samples and physical testing data for all qualified Process Parameter Sheets must be kept on file.

**PROCESS PARAMETER CONTROL SHEET**

SHEET ____ OF _____

FACILITY ____________________ PROCESS # ____________________
WORK ORDER NUMBER ____________________
PART NUMBER ____________ S/N ____________
AREA TO BE COATED ____________________
PART MATERIAL ____________________
GUN TYPE ____________ GUN MODEL ________ NOZZLE ____________

PART PREPARATION

METHOD OF CLEANING ____________________
MASKING INFORMATION ____________________
GRIT TYPE AND SIZE ____________________
GRIT BLAST PRESSURE (PSI) ____________ ± ________ SUCTION _______ PRESSURE ____________
NOZZLE TO WORK DISTANCE ____________________

GAS

GAS (1) PRIMARY ____________________
GAS (2) SECONDARY ____________________

| | | | |
|---|---|---|---|
| REGULATOR (1) | PSI ____________ ± | NOZZLE ____________ |
| REGULATOR (2) | PSI ____________ ± | METERING VALVE ____________ |
| GAS FLOW (1) | C.F.H. ____________ ± | AIR CAP ____________ |
| GAS FLOW (2) | C.F.H. ____________ ± | SIPHON PLUG ____________ |

POWER

VOLTAGE DC OPERATING ____________________ ±
AMPERES DC OPERATING ____________________ ±

COATING MATERIAL

MATERIAL SPECIFICATION ____________________
MATERIAL LOT # ____________________
SPRAY RATE ____________________

COATING DATA

ELAPSED TIME BETWEEN SURFACE PREP AND SPRAYING ____________________
POWDER FEED RATE (LB/HR) ____________________
CARRIER GAS ____________________ METER WHEEL ____________
GUN TO WORK DISTANCE ____________________ CARRIER GAS FLOW ____________
MINIMUM GUN TO WORK ANGLE ____________________
PART RPM _____ ± _____ SURFACE FEET/MIN ____________ ±
COATING THICKNESS AS SPRAYED ____________________
PREHEAT TEMP ____________ ± ____ METHOD OF PREHEAT ____________________
MAX PART TEMP DURING SPRAYING ____________________
NUMBER OF PASSES PER CYCLE ____________ ±
COOL TIME PER CYCLE ____________ ±
METHOD OF COOLING AIR ________ GAS ______ STATIC ____________
TOTAL NUMBER OF CYCLES (COOL & SPRAY) ____________ ±
CERTIFICATION # ____________________
APPROVAL ____________________

A4721

Process Parameter Control Sheet
Figure 1

1. B. (5) Cup Test.

(a) A test panel shall be cup tested to verify conformance to the applicable coating material specification requirement as follows:

1 Fabricate a minimum of two test panels, 3.00 inch (76.20 millimeter) long, 1.75 inch (44.45 millimeter) wide, and 0.050 inch (1.27 millimeter) thick, of material as specified in Table 2. Prepare each panel for coating by thoroughly vapor degreasing (SP C201, 70–15–01) or dry cleaning solvent (SP C203, 70–15–03) and grit blasting as described in Paragraph C., “Thermal Spray Repair Procedure.”

2 Using manufacturer’s recommended thermal spray parameter, apply coating 0.004 to 0.006 inch thick (0.10 to 0.15 millimeter) to one side of each test panel test samples. For Metco 81VF (06–50, 70–80–01), a coating thickness of 0.002 to 0.004 inch (0.05 to 0.10 millimeter) should be used. Record all information on Process Parameter Control Sheet. (See Figure 1.)

3 Place sprayed test sample on cup test machine (DTY–10 Service Diamond Tool Co, Ferndale, MI), or equivalent, having a 0.875 inch (22.23 millimeter) ball and a 1.375 inch (34.93 millimeter) die.

NOTE: Test sample shall be positioned such that as the cup is formed, the coated side of sample will be outside (convex side) of the cup.

4 Using slow and uniform deformation rate, draw the sample to depth specified. (Refer to Table 1.)

5 Examine the coated surface of the panel for indications of coating failure. Cracking shall be acceptable provided there is no evidence of flaking or spalling. Flaking or spalling of the coating shall be justification for failure.

Table 1. Plasma/Flame Spray Materials

| Powder Name | Group and Item No. | Bond Strength Minimum P.S.I. (kPa) | Cup Draw Inch (mm) |
|---|---|---|---|
| Nickel Aluminum Composite | 06–25, 70–80–01 | 3150 (21,719) | 0.125 (3.18) |
| Nickel Aluminide Plasma Powder | 06–28, 70–80–01 | 2350 (16,203) | 0.250 (6.35) |
| Nickel Aluminide Thermal Powder | 06–28, 70–80–01 | 1100 (7,585) | 0.300 (7.62) |
| Nickel Aluminide Wire | 06–28, 70–80–01 | 1500 (10,342) | 0.300 (7.62) |
| Molybdenum Powder | 06–29, 70–80–01 | 2500 (17,237) | 0.300 (7.62) |
| Tungsten Carbide Powder | 06–34, 70–80–01 | 3000 (20,684) | 0.090 (2.3) * |
| Polyester Aluminum Powder | 06–35, 70–80–01 | 1100 (7,585) | 0.060 (1.52) |

Table 1. Plasma/Flame Spray Materials (Cont)

| Powder Name | Group and Item No. | Bond Strength Minimum P.S.I. (kPa) | Cup Draw Inch (mm) |
|---|---|---|---|
| Nickel Chromium/Aluminum Powder | 06–37, 70–80–01 | 5300 (36,544) | 0.175 (4.45) |
| Nickel–Chromium, Aluminum, Yttrium Powder | 06–39, 70–80–01 | 4000 (27,580) | 0.300 (7.62) |
| Molybdenum, Nickel Aluminum | 06–41, 70–80–01 | 4000 (27,580) | 0.300 (7.62) |
| Silicon Aluminum Powder | 06–43, 70–80–01 | 2800 (19,305) | 0.200 (5.08) |
| Silicon Aluminum Wire | 06–81, 70–80–01 | 4000 (27,580) | 0.200 (5.08) |
| Cobalt Powder | 06–46, 70–80–01 | 4000 (27,580) | 0.200 (5.08) |
| Polyester Aluminum Bronze Powder | 06–49, 70–80–01 | 2000 (13,790) | 0.200 (5.08) |
| Chromium Carbide/Nickel Chromium Powder | 06–50, 70–80–01 | 4500 (31,026) | 0.200 (5.08)* |
| Zirconium Oxide Powder | 06–54, 70–80–01 | 800 (5,516) | N/A |
| Zirconium Oxide Powder | 06–69, 70–80–01 | 800 (5,516) | N/A |
| Nickel–Chromium Powder | 06–57, 70–80–01 | 3000 (20,684) | 0.200 (5.08) |
| Zirconium Oxide Powder | 06–58, 70–80–01 | 1300 (8,963) | N/A |
| Zirconium Oxide Powder | 06–59, 70–80–01 | 3000 (20,684) | N/A |
| Nickel–Chromium–Boron–Nitride Powder | 06–60, 70–80–01 | 4000 (27,580) | 0.200 (5.08) |
| Nickel, Chromium, Aluminum Powder | 06–61, 70–80–01 | 4000 (27,580) | 0.300 (7.62) |
| Aluminum Oxide Powder | 06–63, 70–80–01 | — | N/A |
| Nickel, Chromium, Aluminum, Powder | 06–64, 70–80–01 | 4000 (27,580) | 0.300 (7.62) |
| Tungsten Carbide | 06–65, 70–80–01 | 6000 (41,368) | N/A |
| Nickel–Chromium, Aluminum, Molybdenum Powder | 06–66, 70–80–01 | 4250 (29,302) | 0.300 (7.62) |
| Copper, Nickel Indium Powder | 06–67, 70–80–01 | 4000 (27,580) | 0.300 (7.62) |
| Zirconium Oxide Powder | 06–69, 70–80–01 | 800 (5,516) | N/A |

*Cup panel coating thickness 0.002 to 0.004 inch (0.05 to 0.10 millimeter)

Table 2. Test Specimen Materials

| Part Base Material | Bond Specimens | Cup and Microstructure Specimens |
|---|---|---|
| Magnesium | SAE AMS 4350 | SAE AMS 4377 |
| Steel, Nickel, Cobalt | SAE AMS 6382 | SAE AMS 6350 |
| Titanium | SAE AMS 4928 | SAE AMS 4901 |
| Aluminum | SAE AMS 4117 | SAE AMS 4026 |

1. B. (6) Bend Test.

(a) Bend test specimen shall be of the material specified in Table 2. Dimensions are as follows:

| | |
|---|---|
| Titanium Alloys: | 1.75 X 3.00 X 0.03 |
| All Others: | 1.75 X 3 00 X 0.05 |

(b) Specimens shall be marked on uncoated side for purpose of cross–reference.

(c) The use of specific equipment is not required for this test. Equipment of local manufacture is recommended. It may be hand operated or automated. It should include a cylindrical bar having an approximate 0.5 inch diameter and permit the test specimen to be positioned with accuracy an consistency. It must also permit the test specimen to bend 180 degrees over the cylindrical bar.

(d) Surface preparation of test specimens must be identical to that indicated for the part to be sprayed.

(e) Examine the coated surface of the panel for indications of coating failure. Cracking shall be acceptable provided there is no evidence of flaking or spalling. Flaking or spalling or the costing shall be rejectable.

1. B. (7) Bond Strength Test.

(a) Fabricate three test samples (Bond Bars) to dimensions (Figure 2) using material specified in Table 2.

(b) Prepare each bar for coating with a thorough degrease and grit blasting as described on the Process Parameter Sheet (as prepared for the Cup Test).

(c) Using the parameters of the Process Parameter Control Sheet, apply the thermal spray coating material a minimum of 0.015 inch (0.38 millimeter) thick to the end of long shank of sample.

(d) Fabricate three additional pieces of a suitable material to the dimensions given. (See Figure 2.)

(e) Identify these uncoated pieces by scribing a slot on the outside diameter.

(f) Prepare each uncoated bar for bonding by degreasing and grit blasting using the practice described in the Process Parameter Sheet (as prepared for the Cup Test).

WARNING: ADHESIVE IS TOXIC. TO PREVENT PERSONNEL INJURY, AVOID CONTACT WITH EYES AND PROLONGED OR REPEATED CONTACT WITH SKIN. EYE PROTECTION IS REQUIRED.

(g) Apply epoxy adhesive (01–04, 70–80–01) to the long shank ends of the coated and uncoated pieces.

(h) Accurately align and join the ends of the samples. A fixture incorporating a V–block design with a well to provide clearance for the adhesive is recommended.

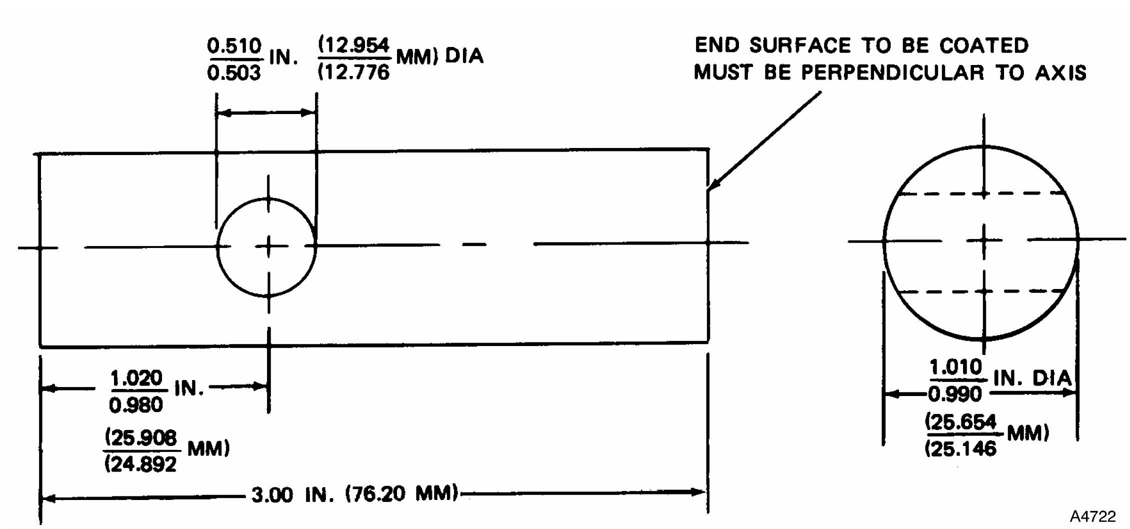
WARNING: HANDLING HOT ITEMS PRESENTS A SERIOUS BURN POTENTIAL. NON–ASBESTOS HEAT RESISTANT GLOVES ARE REQUIRED.

(i) Cure adhesive in a circulating air oven at 190 to 210°F (90 to 100°C) for 1 hour minimum.

NOTE: An abrasive disc or wheel may be used, but care shall be taken to move the disc or wheel parallel to the centerline of the test sample.

(j) Dress the edge of the coating flush with the outside diameter of the test sample.

(k) Test the bond samples with a standard laboratory tensile tester with universal joint grips for each end of the joined samples. Set the no load crosshead speed at approximately 0.050 inch (1.27 millimeter) per minute. Bond strength shall meet requirements provided in Table 1.




Bond Strength Test Specimen
Figure 2

1. B. (8) Microstructural Evaluation.

(a) Mount a portion of the Cup Test sample, polish a transverse section, and perform metallographic microscopic examination.

(b) The coating shall not reveal cracks, excessive or massive oxides, excessive porosity, and shall be essentially free of grit and contamination at the coating/base material interference.

C. Thermal Spray Repair

CAUTION: CHANGES IN PROCESSING METHODS SHALL REQUIRE REQUALIFICATION OF THE OPERATOR AND PARAMETER.

(1) Grind or machine surface oversize or undersize to allow for finish thickness of coating.

NOTE: Finish coating thickness shall not be less than 0.003 inch (0.08 millimeter).

(2) Part surfaces shall be clean of oil, grease, dirt, scale, paint, water, or any other foreign matter.

WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE PROTECTIVE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

ETHYL ALCOHOL CONTAINS METHYL ALCOHOL. CANNOT BE MADE NONPOISONOUS. USE ONLY IN WELL–VENTILATED AREA. KEEP AWAY FROM HEAT AND OPEN FLAME. AVOID CONTACT WITH EYES.

CAUTION: DO NOT DEGREASE TITANIUM OR TITANIUM ALLOY PARTS IN TRICHLOROETHANE CHLORIDE. TRICHLOROETHANE CHLORIDE CONTENT FOR ALL LIQUIDS USED FOR CLEANING OR RINSING TITANIUM OR TITANIUM ALLOY PARTS SHALL NOT EXCEED 200 PARTS PER MILLION.

(3) Emulsion degrease part (SP C214, 70–15–14) or wash thoroughly with ethyl alcohol (07–23, 70–80–01).

(4) Mask areas adjacent to surfaces to be thermal spray coated with tape (10–24, 70–80–01).

1. C. (5) Surfaces to be thermal spray coated shall be roughened by grit blasting with the coarsest silicon carbide grit, that will not distort the part's shape in any way.

(a) Typical grit blasting parameters when using suction blasters:

1 When grit blasting sheet metal use 60 to 80 grit silicon carbide (05–16, 70–80–01) at a pressure of 60 to 70 psig (444 to 483 kPa).

2 When grit blasting cast or wrought surfaces, use 20 to 60 grit silicon carbide (05–16, 70–80–01) at a pressure of 50 to 80 psi (345 to 552 kPa).

(b) When using pressure blasters, pressure shall be kept as low as possible in the 15 to 30 psi (103 to 207 kPa) range, so as to not distort parts.

(6) Remove residue silicon carbide grit with clean, dry, compressed air.

(7) Remove masking tape.

(8) Inspect grit blasted surfaces for shiny spots or indications of insufficient roughness. Repeat Step (5) as necessary.

CAUTION: SURFACES NOT THERMAL SPRAYED WITHIN 2 HOURS SHALL BE REPROCESSED.

(9) Surfaces shall be kept clean and thermal sprayed within 2 hours. If necessary to clean areas within the 2 hour limit, wipe with a clean, white, lint free cloth (10–10, 70–80–01) moistened with ethyl alcohol (07–23, 70–80–01) and allow 15 minutes to dry.

(10) Remask in accordance with detail repair procedures. Ensure only those areas to be thermal sprayed are exposed.

(11) Fixture part securely on a turntable in a metallizing spray cabinet equipped with exhaust system and dust collector.

(a) Adjust turntable RPM so the coated area is moving approximately 300 surface feet per minute with respect to the thermal spray gun.

(b) Set gun traverse rate to index coating deposit approximately 0.2 inches per revolution.

NOTE: It is mandatory that all rotating parts and critical nonrotating parts be thermal sprayed with a traverse mounted gun or other type of automated/mechanical spray system. It is recommended to thermal spray noncritical parts with a traverse mounted thermal spray gun.

(12) When setting up equipment use the Process Parameter Control Sheet (Figure 1) and follow the manufacturer's suggested safety precautions.

(13) Turn on turntable and blower motors.

1. C. (14) Set thermal spray gun parameters (Figure 1), activate the traverse, and preheat area to be sprayed to 140°F (66°C) using the thermal spray gun.

(15) Use a contact pyrometer to control temperature during the preheating and coating application to prevent discoloration, oxidation, distortion, or other conditions detrimental to the coating of parent metal.

NOTE: Measure temperature when establishing initial procedure. Monitoring of each part is not required after an acceptable procedure has been established, but periodic temperature checks are suggested to verify temperature has not changed.

(16) Apply thermal spray material in accordance with detail repair procedures. (Refer to Step B.(6), (7), and (8).

NOTE: Final coating material thickness should exceed 0.005 to 0.010 inch (0.13 to 0.25 millimeter) to produce a smooth finished surface after final machining of grinding.

(17) Parts must be identified after coating. (Refer to Step A.(1).)

WARNING: MACHINING OR GRINDING OPERATIONS CREATE METAL PARTICLES WHICH COULD ENTER THE EYE. SAFETY GOGGLES SHALL BE WORN.

(18) Machine or grind coating surfaces to dimension, as required by detail repair procedure in accordance with manufacturer's recommendations and instructions.

(a) Use sharp, single point carbide tools and take light cuts to prevent tearing or discoloration of surface layer.

(b) Machine or grind coated magnesium parts dry or with a light machine oil.

(19) Parts shall be stripped and recoated when they do not conform to this procedure or exhibit cracking, spalling, blistering, chipping, or defamations.

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## CHAPTER 70–55–00 - ASSEMBLY

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1. Bevel Gear Assembly - SP B102

A. During initial buildup of bevel gears, gear pattern and backlash are adjusted properly by use of shims. During disassembly, measure and record shim thickness to reduce calculations at reassembly. If it becomes necessary to adjust backlash and pattern (Figure 1, showing a typical bevel gear mounting), proceed as follows:

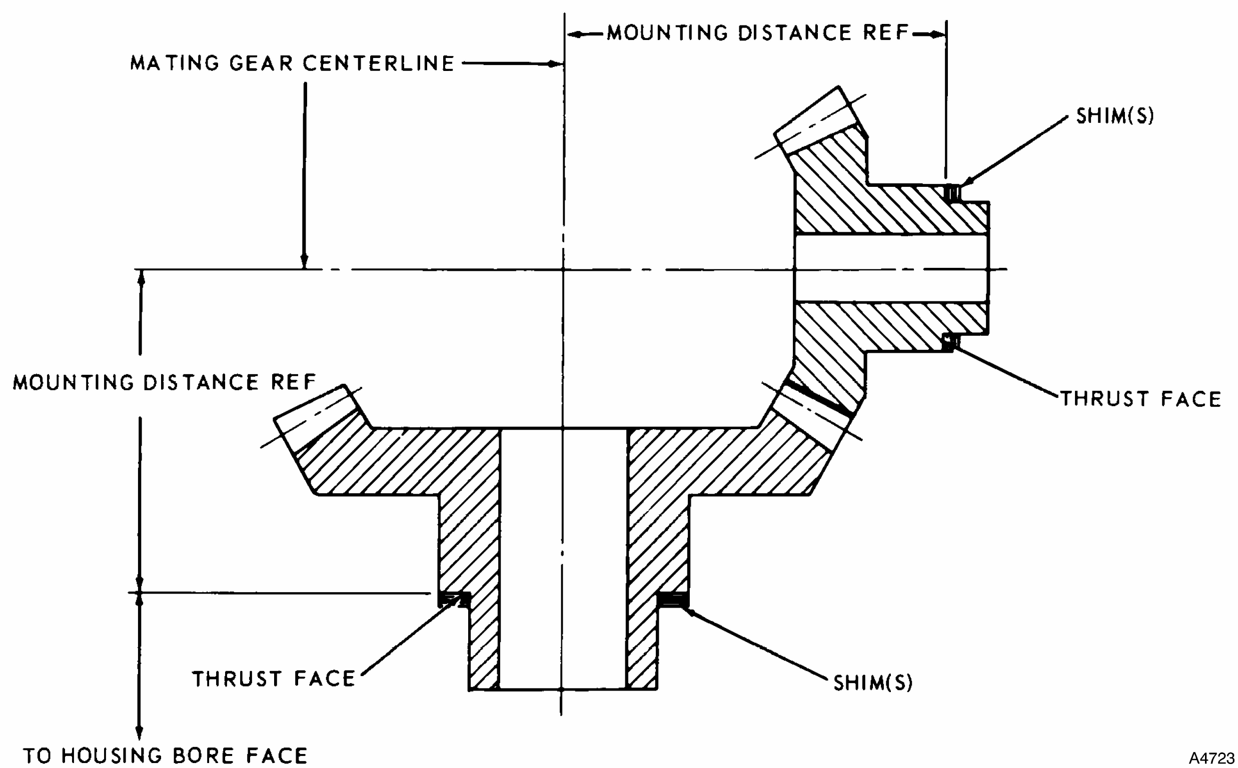
(1) If backlash is close to the acceptable range, a pattern check shall precede backlash check. If backlash is not close to acceptable range, backlash check shall be made first.

(2) Perform pattern check by applying yellow ocher (09–07, 70–80–01) or equivalent on one gear and the same color or nothing on the mating gear. Rotate the gears five revolutions in both directions. Figure 2 presents patterns and suggested adjustments. Recheck after adjustments.

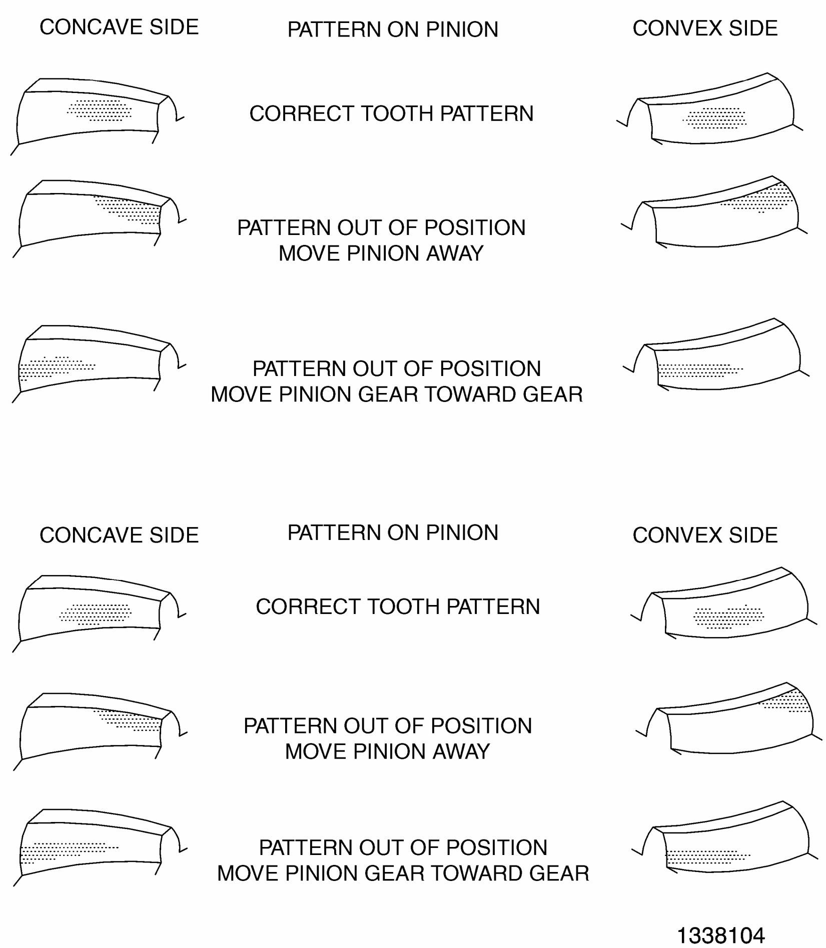
(3) Measure backlash using a dial indicator applied normally to tooth surface at heel of gear or by using applicable backlash gage. (See Figure 3 and Figure 4.)

(4) When backlash exceeds recommended amount, correct by moving gear member closer to pinion member. If backlash is less than recommended amount, correct by moving gear member away from pinion member. Recheck after adjustments.

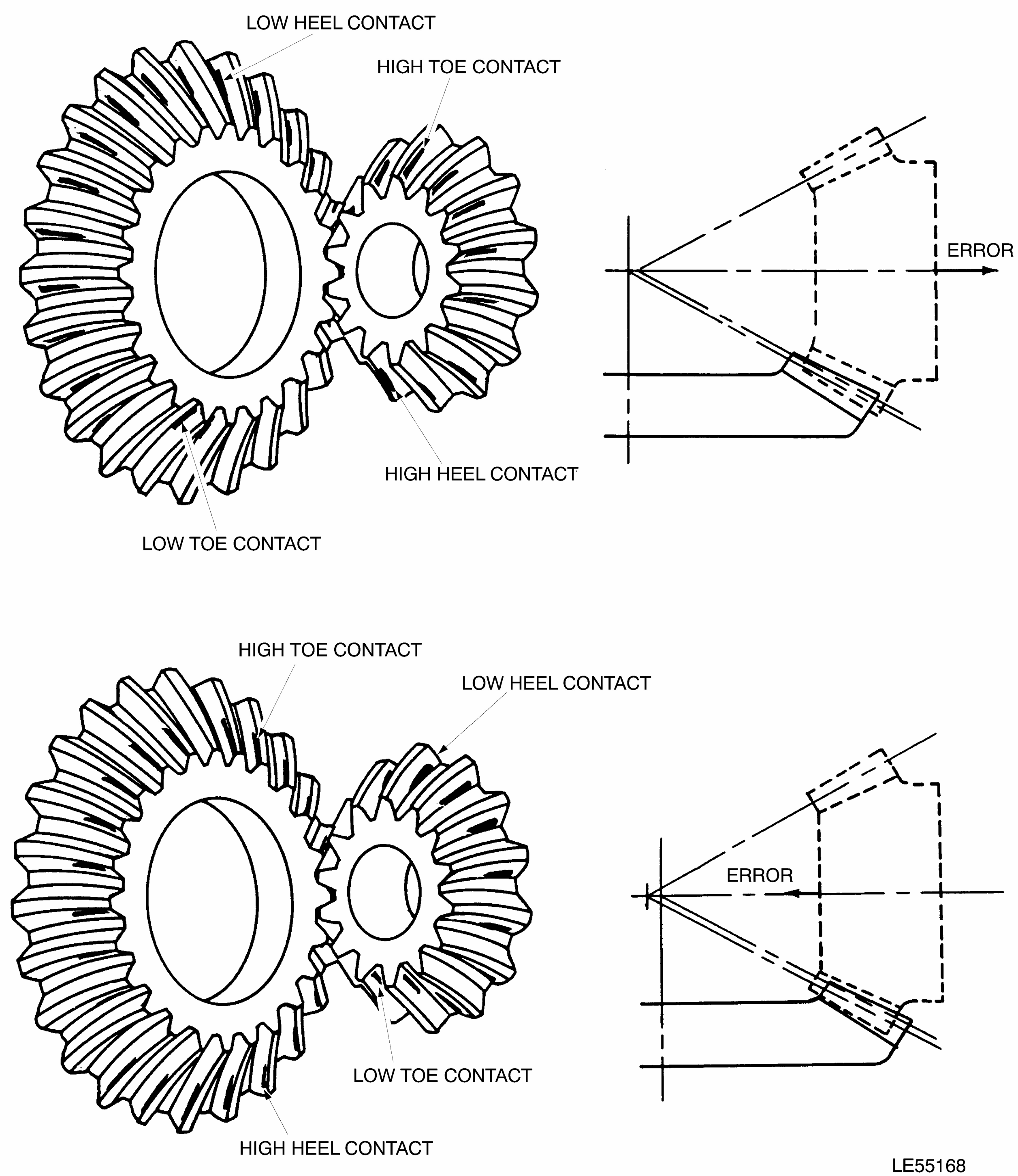
NOTE: Gear member is the larger of the two gears. If both gears are same size, either member or both may be used for adjustment.



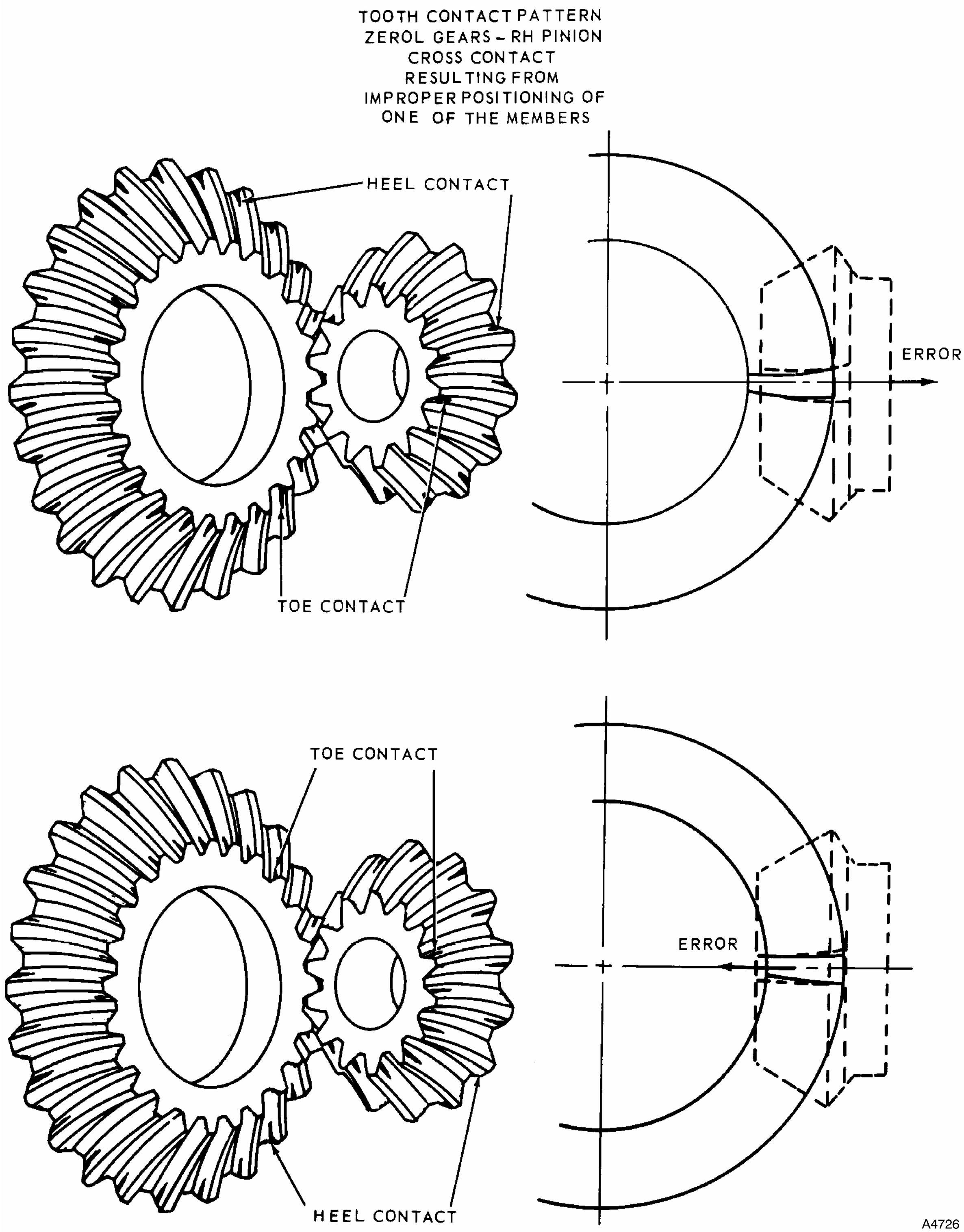

Typical Bevel Gear Mounting
Figure 1



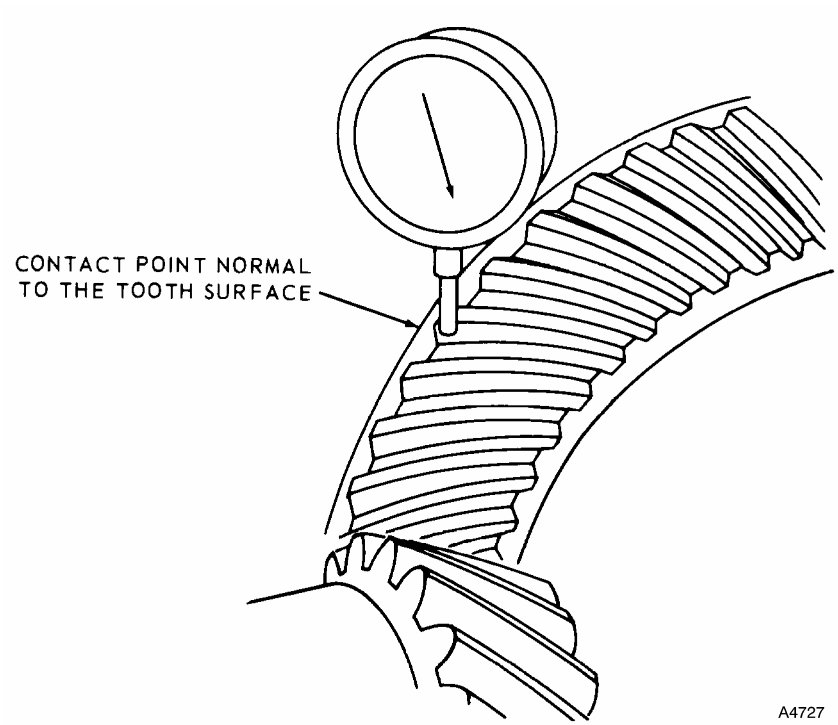

Typical Gear Patterns
Figure 2 (Sheet 1 of 3)



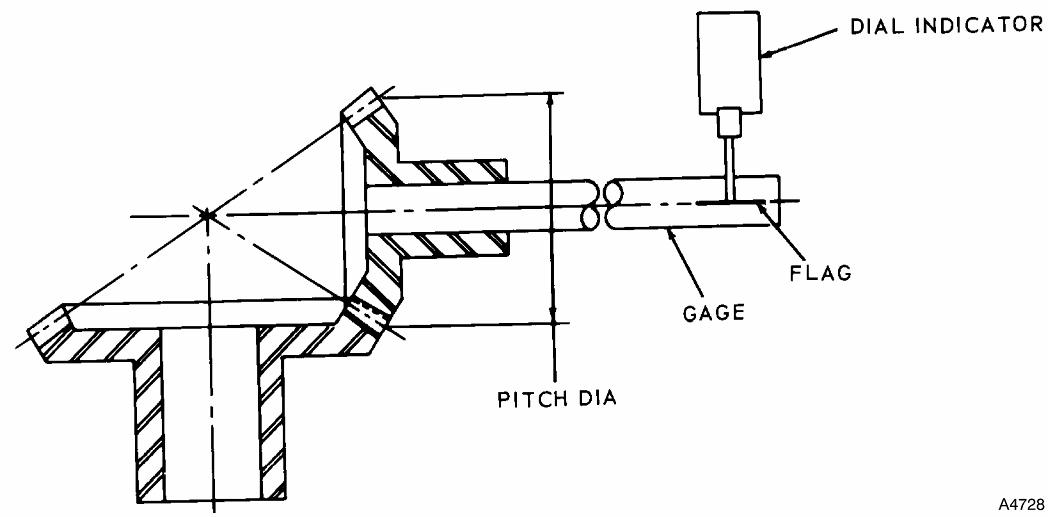

Typical Gear Patterns
Figure 2 (Sheet 2)




Typical Gear Patterns
Figure 2 (Sheet 3)




Direct Method for Backlash Measurement
Figure 3




Use of Shaft Rotation for Backlash Measurement
Figure 4

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1. Lubrication of Packings and O–Rings - SP B103

CAUTION: TO PREVENT DAMAGE TO LIP SEALS DURING DRY–RUNNING PERIOD OR INITIAL STARTS, DIP ALL LIP SEALS IN ENGINE LUBRICATING OIL BEFORE INSTALLATION.

A. All gaskets, preformed packings, noncarbon seals, and O–rings removed during disassembly shall be replaced with new, serviceable items.

B. Unless instructions recommend the use of special compounds for a particular installation, only the following shall be used during assembly:

(1) Petrolatum (02–34, 70–80–01) for lubricating fuel system preformed packings.

(2) Shortening compound (02–08, 70–80–01) or castor oil (02–16, 70–80–01) or assembly fluid (02–44, 70–80–01) for lubricating oil system preformed packings.

(3) Pneumatic system grease (02–12, 70–80–01) for lubricating pneumatic system preformed packings.

(4) Packing assembly aid, Ultrachem assembly fluid (02–09, 70–80–01) or shortening compound (02–08, 70–80–01) or assembly fluid (02–44, 70–80–01) for holding seals and packings in a groove during assembly.

CAUTION: DO NOT IMMERSE CARBON SEALS IN LUBRICATING OIL.

(5) Regardless of the location or configuration, prior to its installation the carbon seal face shall be wiped with clean, room temperature lubricating oil (02–23, 70–80–01). All other surfaces are to be left clean and dry.

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1. General Assembly Procedures - SP B105

A. General precautions shall be adhered to during reassembly to make sure that all parts have been properly installed as indexed at removal and necessary tolerance checks performed.

B. Make sure that all components are clean before and during assembly.

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

C. For ease of assembly, lubricating oil (02–22 or 02–23, 70–80–01) or shortening compound (02–08, 70–80–01) may be used as a general lubricant when reassembling mechanical components other than those found in the fuel system.

D. Place protective covers over all exposed openings.

E. Remove corrosion preventive compounds from parts which are bathed by the engine lubrication system.

F. If no torque value is called out in assembly procedure, use standard torque for item, based on material, part, and thread size. (Refer to SP B109, 70–55–06.)

G. Lubricate packings, lip seals, and O–rings with proper lubricant for system involved. (Refer to SP B103, 70–55–02.)

H. When seals, packings, cotter pins, and lockwashers are involved in reassembly, use new items. Previously used lock cups may be repaired and reused. (Refer to SP R416, 70–25–10.)

I. Apply antiseize thread compound to threaded hot end parts. (Refer to SP B108, 70–55–05.)

J. Special care must be exercised when installing bearings. (Refer to SP B110, 70–55–08.)

K. For those nonoil wetted aluminum or magnesium parts that are in contact with steel parts, use a nondrying zinc chromate sealant. (Refer to SP P526, 70–30–21.)

NOTE: When an assembly has been taken apart, the same solvent used to remove excess sealant during build–up may be used to remove old sealant. (Refer to SP P526, 70–30–21.)

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

AREAS IN WHICH LUBRICATING OIL IS USED SHALL BE ADEQUATELY VENTILATED TO KEEP MIST AND FUMES TO A MINIMUM.

1. L. Depreserve bearings (SP B110, 70–55–08) and lubricate with lubricating oil (02–22 or 02–23, 70–80–01) prior to installation. (Refer to SP C213, 70–15–13.)

M. Prior to installation of laminated shims, measure shim thickness in three locations, approximately 120 degrees apart. Thickness shall be within 0.002 inch (0.03 millimeter). Replace shim if not within limits.

N. Inspection for residual magnetism and demagnetization shall be performed after any manufacturing operation known to induce residual magnetism. (Refer to SP I311, 70–20–11.)

(1) Prior to assembly, all ferrous alloys including carbon steels, low alloy steels, 400 series stainless steels, and martensitic corrosion resistant steels, should be inspected for the presence of residual magnetism. (Refer to SP I311, 70–20–11.)

(2) An adequately demagnetized part shall produce a reading of 3 gauss or less.

CAUTION: DO NOT IMMERSE CARBON SEALS IN LUBRICATING OIL.

O. Regardless of the location or configuration, prior to its installation the carbon seal face shall be wiped with clean, room temperature lubricating oil (02–23, 70–80–01). All other surfaces are to be left clean and dry.

1. Mainshaft Seal Data - SP B107

A. Whenever handling dry carbon seals, wear white, lint–free gloves (10–34, 70–80–01).

(1) All new mainshaft carbon element seals shall be handled with extreme caution and stored in their original carton, or equivalent, until used.

(2) Mainshaft carbon element seals may be reused provided they are clean, repaired, and meet all inspection criteria.

WARNING: PROLONGED CONTACT WITH LUBRICATING OIL MAY CAUSE A SKIN RASH. THOSE AREAS OF SKIN AND CLOTHING THAT COME IN CONTACT WITH LUBRICATING OIL SHOULD BE THOROUGHLY WASHED IMMEDIATELY. REMOVE SATURATED CLOTHING IMMEDIATELY.

CAUTION: DO NOT IMMERSE CARBON SEALS IN LUBRICATING OIL.

(3) Regardless of the location or configuration, prior to its installation the carbon seal face shall be wiped with clean, room–temperature lubricating oil (02–23, 70–80–01).

(4) Steel faceplates can rust if not lubricated with clean engine oil.

(5) Seals shall be processed in accordance with Paragraphs B., C., and D.

B. Handling of Seal

(1) Upon removal from engine, identify and tag each seal with a nonmetallic fastener to prevent damage to carbon elements. Include the following information on each tag:

(a) Engine/Module serial number or identification.

(b) Total engine time since last overhaul.

(c) Seal part number and serial number.

(d) Position.

(2) Transport seals in plastic or wooden partitioned boxes. Pack seals to avoid metal–to–metal contact.

(3) Seals should be stored in sealed polyethylene bags (10–05, 70–80–01) in partitioned containers while awaiting processing.

NOTE: Seals shall be cleaned prior to inspection.

(4) Inspect and repair seals in a clean, well lighted area, free from dust and other contaminants.

C. Preinspect Carbon Seals (Refer to SP I301, 70–20–01)

1. D. Cleaning of assembled seals. Prior to assembly of seals into engine, they must be cleaned as follows:

(1) Use a two compartment vapor degreaser (Model LAC–100) (Branson Equipment Co) or equivalent with sonic degreaser, Model A–1200 (Branson Equipment Co), or equivalent.

(2) Fill vapor degreaser with trichloroethane.

NOTE: Compartment 1 contains a trichloroethane vapor atmosphere for initial cleaning of seals. Compartment 2 contains condensed trichloroethane for final cleaning, which is continually replenished by condensed vapor from Compartment 1. The fluid level of Compartment 2 is maintained or limited by an overflow back into Compartment 1. Compartment 2 also contains a sonic wave generator and is maintained at a temperature of approximately 150°F (66°C).

The boiling point of trichloroethane is 187.3°F (86.3°C). The solution in Compartment 1 shall be replaced when the boiling point exceeds 195°F (91°C). This increase in the boiling point is caused by impurities in the solution. The trichloroethane in Compartment 2 rarely needs replacing.

(3) Suspend seals in the vapor atmosphere of Compartment 1 for approximately 7 minutes to remove grease and residues, or until the seals are clean.

(4) Remove seals from Compartment 1, and immerse seals in the liquid trichloroethane in Compartment 2 for approximately 20 seconds.

CAUTION: DO NOT USE EXCESSIVE AIR PRESSURE NEAR SEAL'S INNER COMPONENTS.

(5) Remove seals from Compartment 2 and dry with clean, dry compressed air.

1. Use of Antiseize Compounds - SP B108

WARNING: DO NOT ALLOW ANTISEIZE TO COME IN CONTACT WITH SKIN. POSSIBLE REDNESS OR MILD TRANSIENT IRRITATION OF SKIN OR EYES MAY OCCUR AFTER PROLONGED OR REPEATED CONTACT, ESPECIALLY IN SENSITIVE INDIVIDUALS. IF ANTISEIZE COMES IN CONTACT WITH SKIN, WASH WITH SOAP AND WATER. IF IRRITATION OCCURS, CONSULT PHYSICIAN. IN EYES, FLUSH WITH TEPID WATER 15 MINUTES HOLDING EYELIDS APART. CONSULT PHYSICIAN IMMEDIATELY.

CAUTION: ANTISEIZE COMPOUND CONTAINING LEAD SHALL NOT BE USED IN OR ON THE ENGINE.

A. To facilitate subsequent disassembly, apply antiseize compound (02–01, 70–80–01) to all threaded parts attached to the hot section except fuel fittings and locations where another compound is specified.

B. When using antiseize compound on igniter plugs or igniter plug connectors, use compound sparingly and ensure that compound does not contact insulation material.

C. When an antiseize compound is required during the assembly of parts that are bathed by the lubrication system, all excess compound shall be wiped from threads and mating surfaces.

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1. Standard Torque Procedures and Values - SP B109

A. The following are standard torque tables, figures, and instructions for use of torque wrenches:

(1) General instructions for use of torque wrenches.

(2) Torque wrench calibration. Torque wrenches shall be calibrated frequently using weights and a measured lever arm. Inaccurate readings may occur because of abuse or constant use. Do not check one wrench against another.

(3) Table 1 lists recommended torque wrench sizes.

(4) Torque wrench extensions and adapters. Extensions or adapters may be used with any torque wrench. Since extensions or adapters change the length of the torque arm for which the scale is calibrated, torque applied at the end of extension or adapter is not correctly indicated on the scale and shall be calculated. When using extensions or adapters, apply the manual torque at the calculated arm length at the center of the handle. When substituting values in formulas, use inch (millimeter) units to obtain an answer in pound–inches (newton–meters) and foot (meter) units to obtain an answer in pound–feet (newton–meters). The centerline of the wrench and the wrench extension or adapter shall align as shown in Figure 1. To determine the indicated torque, using extensions or adapters, use the formula shown in Figure 1.

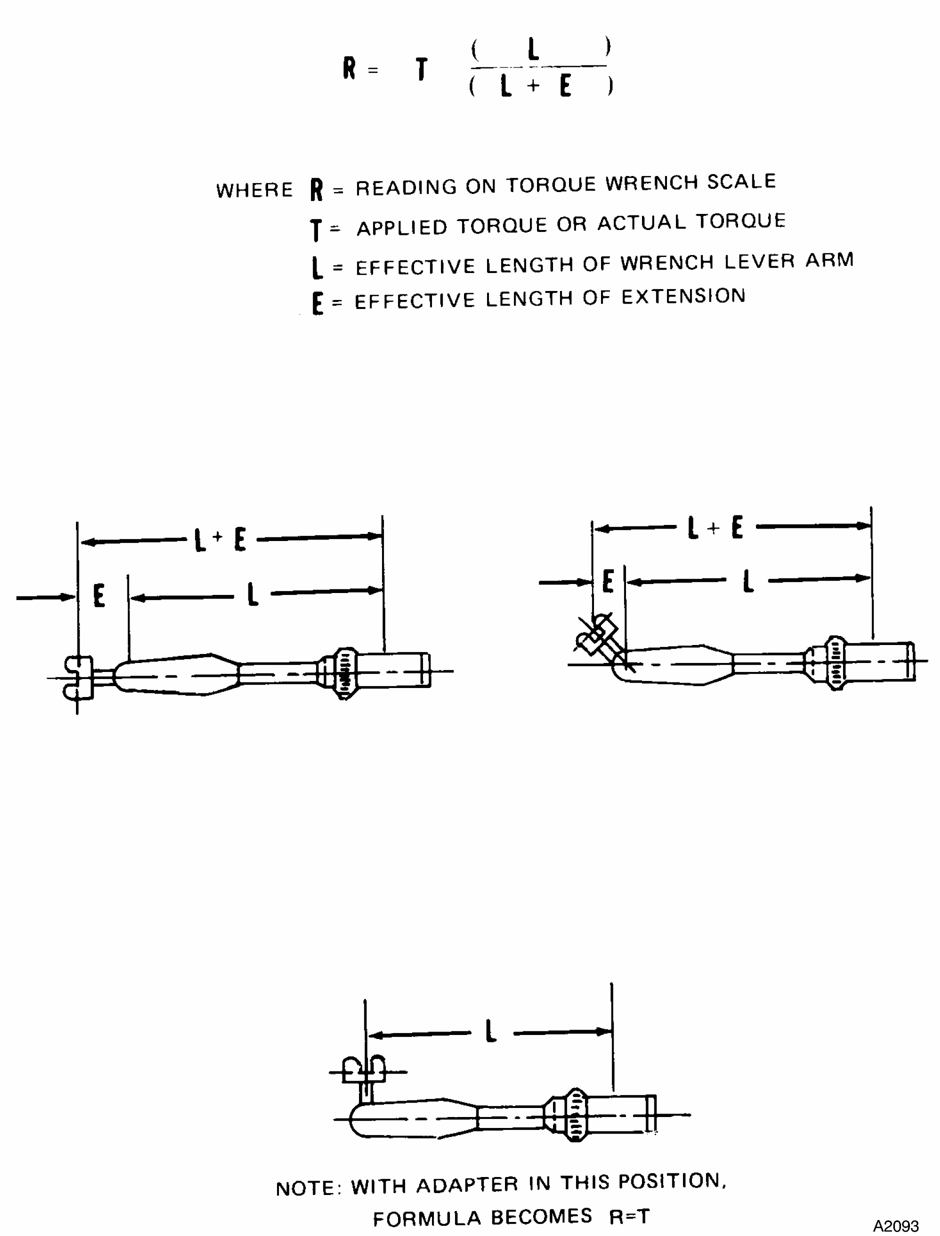
WARNING: AVOID PROLONGED INHALATION OF SOLVENT VAPORS. WEAR RUBBER GLOVES AND USE HAND CREAM TO PREVENT CONTACT WITH SKIN. DO NOT HEAT SOLUTION.

(5) Procedure for applying torque. Clean parts to be tightened in dry cleaning solvent. (Refer to SP C203, 70–15–03.) Unless otherwise instructed, do not lubricate parts. Torque should be applied slowly and evenly until the specified torque value is reached, then held at this value until the nut, bolt, or screw has stopped turning. When torquing fittings “B” nuts or connectors to unions that have dissimilar material, use torque value for lower strength material.

(a) Unless otherwise specified, when applying torque, proceed in steps of gradually increasing tension. Tighten the bolts, screws, or nuts in a staggered sequence until the part is firmly seated, then apply a gradual increase in torque on each fastener part until the specified torque value is reached. Do not retighten unless otherwise instructed.

Table 1. Recommended Torque Wrench Sizes

| Required Torque | | Torque Wrench Size (Maximum Rating) | |
|---|---|---|---|
| Pound–Inches | Newton–Meters | Pound–Inches | Newton–Meters |
| 0 to 25 | 0.0 to 2.8 | 30 | 3.4 |
| 25 to 140 | 2.8 to 15.8 | 150 | 16.9 |
| 140 to 550 | 15.8 to 62.1 | 600 | 67.8 |
| Pound–Feet | Newton–Meters | Pound–Feet | Newton–Meters |
| 30 to 140 | 40.6 to 189.8 | 150 | 203.4 |
| 140 to 240 | 189.8 to 325.4 | 250 | 338.9 |
| 240 to 1000 | 325.4 to 1355.8 | 1000 | 1355.8 |




Application of Torque Wrench Extension Formula
Figure 1

1. A. (5) (b) When lockwiring holes or cotter pin holes are to be aligned, the following torque procedure is recommended:

1 First tighten part to minimum torque value.

2 If holes do not align, continue to tighten the part until holes do align, but do not exceed maximum torque value specified for the operation.

3 If holes still do not align, select another part and repeat Steps 1 and 2.

(c) Fasteners containing self–locking inserts should not be reused if minimum prevailing torque is not obtained at installation.

(d) Do not attempt to correct any leakage or misalignment of fluid connections by over torquing.

(6) Standard torque values. Standard torque values for general application are listed in Table 2. Standard torque values for stepped and straight studs are shown in Table 3. Stepped and straight studs are shown in Figure 2.

NOTE: When no special torque values are given in an assembly and/or installation procedure, standard torque values shall apply. All torque values are in pound–inches. Threads shall be clean and undamaged.

(7) Special torque values. Special torque values are included in assembly and installation instructions for the particular part of assembly.

(8) Dynatube/Dual Seal Fittings installation torques are listed in Table 4.

(9) Repair leaking joints of 37 degree flared tube and Dynatube/Dual Seal Fitting. (Refer to SP R418, 70–25–11.)

Table 2. Standard Torque Values

| Torque Values For Fluid Fittings (37 Degrees) | | | | | | |
|---|---|---|---|---|---|---|
| | Nominal Tube OD | | Torque (A) | | Torque (B) | |
| Size | Inches | Millimeters | Pound–Inches | Newton–Meters | Pound–Inches | Newton–Meters |
| -2 | 0.125 | 3.18 | 22 to 30 | 2.48 to 3.39 | 35 to 50 | 3.95 to 5.65 |
| -3 | 0.188 | 4.78 | 30 to 45 | 3.39 to 5.08 | 75 to 100 | 8.47 to 11.3 |
| -4 | 0.250 | 6.35 | 40 to 60 | 4.52 to 6.78 | 115 to 150 | 12.99 to 16.95 |
| -5 | 0.312 | 7.92 | 55 to 75 | 6.21 to 8.47 | 150 to 200 | 16.95 to 22.60 |
| -6 | 0.375 | 9.52 | 75 to 115 | 8.47 to 12.99 | 250 to 300 | 28.25 to 33.90 |
| -7 | 0.438 | 11.30 | 95 to 140 | 10.73 to 15.82 | 300 to 350 | 33.90 to 39.54 |
| -8 | 0.500 | 12.70 | 150 to 225 | 16.95 to 25.42 | 450 to 500 | 50.84 to 56.49 |
| -9 | 0.562 | 14.27 | 175 to 270 | 19.77 to 30.51 | 550 to 600 | 62.14 to 67.79 |
| -10 | 0.625 | 15.88 | 200 to 315 | 22.60 to 35.59 | 650 to 700 | 73.44 to 79.09 |
| -11 | 0.688 | 17.48 | 260 to 405 | 29.38 to 45.76 | 800 to 900 | 90.39 to 101.7 |
| -12 | 0.750 | 19.05 | 300 to 450 | 33.90 to 50.84 | 900 to 1000 | 101.7 to 113.0 |
| -14 | 0.875 | 22.22 | 360 to 540 | 40.67 to 61.01 | 1050 to 1200 | 118.6 to 135.6 |
| -16 | 1.000 | 25.40 | 500 to 630 | 56.49 to 71.18 | 1200 to 1400 | 135.6 to 158.2 |
| -18 | 1.125 | 28.58 | 540 to 745 | 61.01 to 86.17 | 1400 to 1700 | 158.2 to 192.1 |
| -20 | 1.250 | 31.75 | 600 to 810 | 67.79 to 91.52 | 1500 to 1800 | 169.5 to 203.4 |
| -24 | 1.500 | 38.10 | 700 to 1000 | 79.09 to 113.0 | 1900 to 2200 | 214.7 to 248.6 |
| -28 | 1.750 | 44.45 | 800 to 1150 | 90.39 to 129.9 | 2200 to 2700 | 248.6 to 305.1 |
| -32 | 2.000 | 50.80 | 850 to 1300 | 96.04 to 146.9 | 2500 to 3000 | 282.5 to 338.9 |

(A) These values apply to aluminum fittings.

(B) These values apply to steel fittings.

NOTE: For Dynatube torque values including Dynaring seals, refer to Table 4.

Table 2. Standard Torque Values (Cont)

| Standard Steel Screws, Bolts, and Nuts | | |
|---|---|---|
| Slotted Head Screws | | |
| Thread Size | Pound–Inches | Newton–Meters |
| 2–56 | 2 to 3 | 0.2 to 0.3 |
| 3–48 | 3 to 4 | 0.3 to 0.4 |
| 4–40 | 5 to 6 | 0.4 to 0.6 |
| 5–40 | 6 to 7 | 0.6 to 0.7 |
| 6–32 | 7 to 9 | 0.7 to 1.0 |
| 8–32 | 10 to 12 | 1.1 to 1.4 |
| 10–32 | 18 to 20 | 2.03 to 2.3 |
| 7/32–24 | 22 to 25 | 2.5 to 2.8 |
| 1/4–28 | 30 to 35 | 3.4 to 4.0 |
| 5/16–24 | 40 to 45 | 4.5 to 5.1 |
| 3/8–24 | 55 to 60 | 6.2 to 6.8 |
| 7/16–20 | 80 to 90 | 9.0 to 10.2 |
| 1/2–13 or –20 | 100 to 110 | 11.3 to 12.4 |
| 9/16–18 | — | — |
| 5/8–18 | — | — |

Table 2. Standard Torque Values (Cont)

| Bolts and Nuts | | |
|---|---|---|
| Thread Size | Pound–Inches | Newton–Meters |
| 2–56 | — | — |
| 3–48 | — | — |
| 4–40 | — | — |
| 5–40 | — | — |
| 6–32 | — | — |
| 8–32 | — | — |
| 10–32 | 40 to 45 | 4.5 to 5.1 |
| 7/32–24 | 65 to 70 | 7.3 to 7.9 |
| 1/4–28 | 70 to 95 | 7.9 to 10.7 |
| 5/16–24 | 120 to 165 | 13.6 to 18.6 |
| 3/8–24 | 250 to 325 | 28.2 to 36.7 |
| 7/16–20 | 400 to 475 | 45.2 to 53.7 |
| 1/2–13 or –20 | 500 to 700 | 56.5 to 79.1 |
| 9/16–18 | 750 to 1000 | 84.7 to 113.0 |
| 5/8–18 | 1000 to 1400 | 113.0 to 158.2 |

Table 2. Standard Torque Values (Cont)

Taper Pipe Thread Fittings and Plugs

| Thread Size | In Steel Case Pound–Inches | In Steel Case Newton–Meters | In Magnesium or Aluminum Case Pound–Inches | In Magnesium or Aluminum Case Newton–Meters |
|---|---|---|---|---|
| 1/16–27 | 35 to 40 | 4.0 to 4.5 | 10 to 15 | 1.1 to 1.7 |
| 1/8–27 | 75 to 125 | 8.5 to 14.1 | 30 to 40 | 3.4 to 4.5 |
| 1/4–18 | 200 to 250 | 22.6 to 28.2 | 70 to 85 | 7.9 to 9.6 |
| 3/8–18 | 300 to 375 | 33.9 to 42.4 | 95 to 110 | 10.7 to 12.4 |
| 1/2–14 | 400 to 500 | 45.2 to 56.5 | 140 to 160 | 15.8 to 18.1 |
| 3/4–14 | 500 to 600 | 56.5 to 67.8 | 175 to 200 | 19.8 to 22.6 |
| 1–11–1/2 | 600 to 700 | 67.8 to 79.1 | 230 to 260 | 26.0 to 29.4 |

Self–Locking Inserts

| Thread Size | Maximum Prevailing Torque Pound–Inches | Maximum Prevailing Torque Newton–Meters | Minimum Prevailing Torque Pound–Inches | Minimum Prevailing Torque Newton–Meters |
|---|---|---|---|---|
| 4–40 | 5 | 0.6 | — | — |
| 6–32 | 10 | 1.1 | 1.0 | 0.1 |
| 8–32 | 15 | 1.7 | 1.5 | 0.1 |
| 10–32 | 18 | 2.0 | 2.0 | 0.2 |
| 1/4–28 | 30 | 3.4 | 3.5 | 0.4 |
| 5/16–24 | 60 | 6.8 | 6.5 | 0.7 |
| 3/8–24 | 80 | 9.0 | 9.5 | 1.1 |
| 7/16–20 | 100 | 11.3 | 14.0 | 1.6 |
| 1/2–20 | 150 | 16.9 | 18.0 | 2.0 |
| 9/16–18 | 200 | 22.6 | 24.0 | 2.7 |
| 5/8–18 | 300 | 33.9 | 32.0 | 3.6 |
| 3/4–16 | 400 | 45.2 | 50.0 | 5.6 |
| 7/8–14 | 600 | 67.8 | 70.0 | 7.9 |
| 1.000–14 | 800 | 90.4 | 80.0 | 9.0 |

*Some indication of torque.

Table 2. Standard Torque Values (Cont)

| Torque Values for Jam Nuts, Bolts, and Fittings Used With Packing | | | | |
|---|---|---|---|---|
| Nuts (MS9099, MS9100, MS9200, MS9201, MS9553), Plug (MS9015), Union (AN815), and Bolt - Universal Fitting (AN774, AN775) | | | | |
| | Nominal Tube OD | | Torque | |
| Size | Inches | Millimeters | Pound–Inches | Newton–Meters |
| -2 | 0.125 | 3.18 | 22 to 24 | 2.48 to 2.71 |
| -3 | 0.188 | 4.78 | 28 to 32 | 3.16 to 3.62 |
| -4 | 0.250 | 6.35 | 38 to 42 | 4.29 to 4.74 |
| -5 | 0.312 | 7.92 | 58 to 63 | 6.55 to 7.00 |
| -6 | 0.375 | 9.52 | 70 to 80 | 7.91 to 9.04 |
| -7 | 0.438 | 11.13 | 95 to 105 | 10.73 to 11.86 |
| -8 | 0.500 | 12.70 | 145 to 155 | 16.38 to 17.51 |
| -9 | 0.562 | 14.27 | 165 to 185 | 18.64 to 20.90 |
| -10 | 0.625 | 15.88 | 190 to 210 | 21.47 to 23.73 |
| -11 | 0.688 | 17.48 | 260 to 290 | 29.38 to 32.77 |
| -12 | 0.750 | 19.05 | 285 to 315 | 32.20 to 35.59 |
| -14 | 0.875 | 22.22 | 350 to 390 | 29.54 to 44.06 |
| -16 | 1.000 | 25.40 | 475 to 525 | 53.67 to 59.32 |
| -18 | 1.125 | 28.58 | 570 to 630 | 64.40 to 71.18 |
| -20 | 1.250 | 31.75 | 570 to 630 | 64.40 to 71.18 |
| -24 | 1.500 | 38.10 | 570 to 630 | 64.40 to 71.18 |
| -28 | 1.750 | 44.45 | 570 to 630 | 64.40 to 71.18 |
| -32 | 2.000 | 50.80 | 570 to 630 | 64.40 to 71.18 |

Table 2. Standard Torque Values (Cont)

| Torque Values for Jam Nuts for Bulkhead Fittings | | | | |
|---|---|---|---|---|
| | Nominal Tube OD | | Torque | |
| Size | Inches | Millimeters | Pound–Inches | Newton–Meters |
| -2 | 0.125 | 3.18 | 22 to 24 | 2.48 to 2.71 |
| -3 | 0.188 | 4.78 | 28 to 32 | 3.16 to 3.62 |
| -4 | 0.250 | 6.35 | 38 to 42 | 4.29 to 4.74 |
| -5 | 0.312 | 7.92 | 58 to 63 | 6.55 to 7.00 |
| -6 | 0.375 | 9.52 | 70 to 80 | 7.91 to 9.04 |
| -7 | 0.438 | 11.13 | 95 to 105 | 10.73 to 11.86 |
| -8 | 0.500 | 12.70 | 145 to 155 | 16.38 to 17.51 |
| -9 | 0.562 | 14.27 | 165 to 185 | 18.64 to 20.90 |
| -10 | 0.625 | 15.88 | 190 to 210 | 21.47 to 23.73 |
| -11 | 0.688 | 17.48 | 190 to 210 | 21.47 to 23.73 |
| -12 | 0.750 | 19.05 | 190 to 210 | 21.47 to 23.73 |
| -14 | 0.875 | 22.22 | 190 to 210 | 21.47 to 23.73 |
| -16 | 1.000 | 25.40 | 190 to 210 | 21.47 to 23.73 |
| -18 | 1.125 | 28.58 | 190 to 210 | 21.47 to 23.73 |
| -20 | 1.250 | 31.75 | 190 to 210 | 21.47 to 23.73 |
| -24 | 1.500 | 38.10 | 190 to 210 | 21.47 to 23.73 |
| -28 | 1.750 | 44.45 | 190 to 210 | 21.47 to 23.73 |
| -32 | 2.000 | 50.70 | 190 to 210 | 21.47 to 23.73 |

Table 3. Stepped and Straight Stud Torque Values

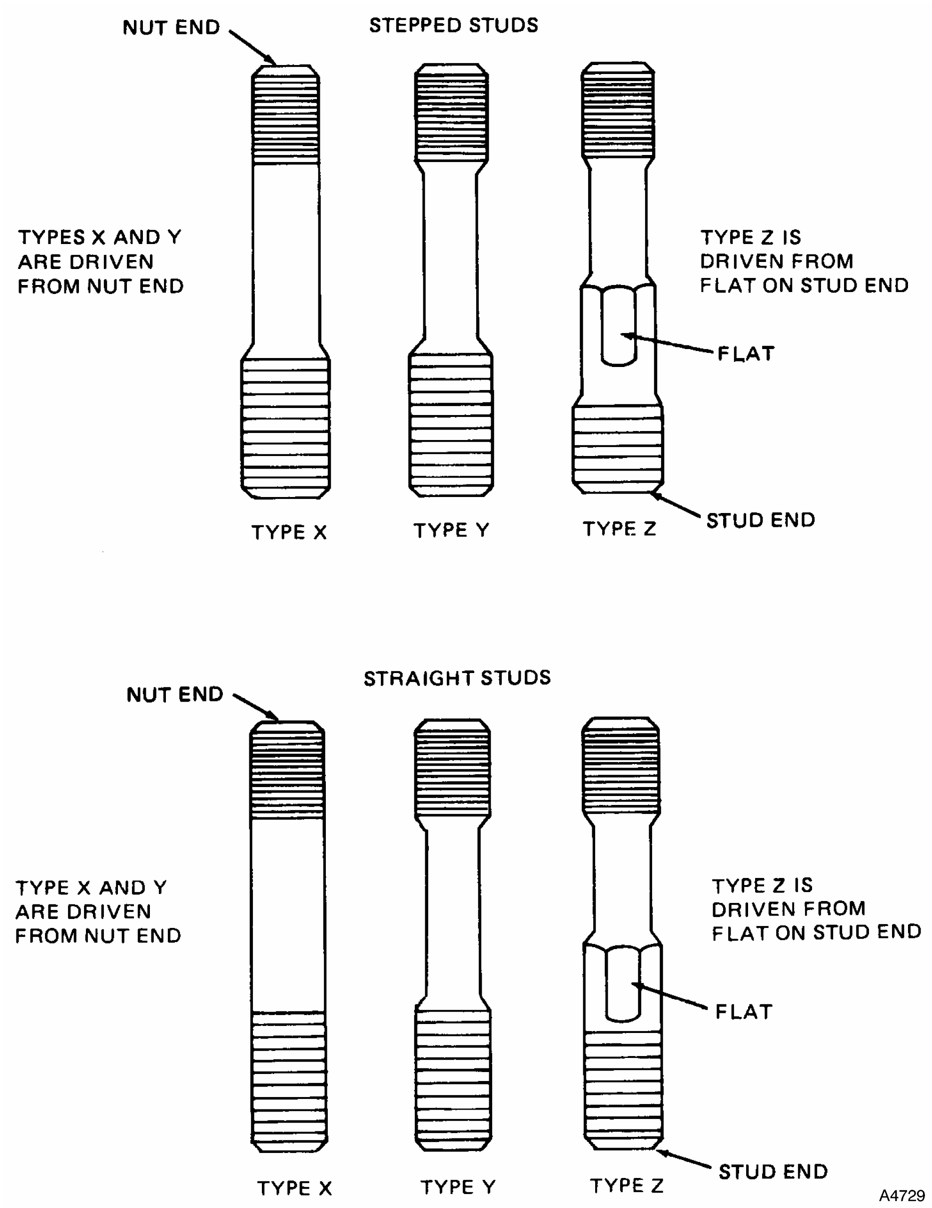
| Stepped Stud Torque Values | | | |
|---|---|---|---|
| Thread Size | | Type X | |
| Nut End | Stud End | Pound–Inches | Newton–Meters |
| 10–32 | 1/4–20 | 20 to 50 | 2.3 to 5.6 |
| 1/4–28 | 5/16–18 | 50 to 110 | 5.6 to 12.4 |
| 5/16–24 | 3/8–16 | 100 to 240 | 11.3 to 27.1 |
| 3/8–24 | 7/16–14 | 175 to 475 | 19.8 to 53.7 |
| 7/16–20 | 1/2–13 | 250 to 725 | 28.2 to 82.0 |
| 1/2–20 | 9/16–12 | 400 to 1150 | 45.2 to 130.0 |
| 9/16–18 | 5/8–11 | 600 to 1650 | 67.8 to 186.4 |
| 5/8–18 | 11/16–11 | 900 to 2400 | 101.7 to 271.2 |
| Thread Size | | Type Y | |
| Nut End | Stud End | Pound–Inches | Newton–Meters |
| 10–32 | 1/4–20 | — | — |
| 1/4–28 | 5/16–18 | 50 to 75 | 5.6 to 8.5 |
| 5/16–24 | 3/8–16 | 100 to 160 | 11.3 to 18.1 |
| 3/8–24 | 7/16–14 | 175 to 325 | 19.8 to 36.7 |
| 7/16–20 | 1/2–13 | 250 to 525 | 28.2 to 59.3 |
| 1/2–20 | 9/16–12 | 400 to 850 | 45.2 to 96.0 |
| 9/16–18 | 5/8–11 | 600 to 1150 | 67.8 to 130.0 |
| 5/8–18 | 11/16–11 | 900 to 1700 | 101.7 to 192.1 |
| Thread Size | | Type Z | |
| Nut End | Stud End | Pound–Inches | Newton–Meters |
| 10–32 | 1/4–20 | — | — |
| 1/4–28 | 5/16–18 | 50 to 165 | 5.6 to 18.6 |
| 5/16–24 | 3/8–16 | 100 to 350 | 11.3 to 39.5 |
| 3/8–24 | 7/16–14 | 175 to 600 | 19.8 to 67.8 |
| 7/16–20 | 1/2–13 | 250 to 1000 | 28.2 to 113.0 |
| 1/2–20 | 9/16–12 | 400 to 1500 | 45.2 to 169.5 |
| 9/16–18 | 5/8–11 | 600 to 2100 | 67.8 to 237.0 |
| 5/8–18 | 11/16–11 | 900 to 3100 | 101.7 to 350.2 |

Table 3. Stepped and Straight Stud Torque Values (Cont)

| Straight Stud Torque Values | | | |
|---|---|---|---|
| Thread Size | | Type X | |
| Nut End | Stud End | Pound–Inches | Newton–Meters |
| 4–48 | 4–40 | 3 to 7 | 0.3 to 0.8 |
| 6–40 | 6–32 | 8 to 14 | 0.9 to 1.6 |
| 8–36 | 8–32 | 18 to 25 | 2.0 to 2.8 |
| 10–32 | 10–24 | 25 to 35 | 2.8 to 4.0 |
| 1/4–28 | 1/4–20 | 50 to 95 | 5.6 to 10.7 |
| 5/16–24 | 5/16–18 | 100 to 225 | 11.3 to 25.4 |
| 3/8–24 | 3/8–16 | 175 to 375 | 19.8 to 42.4 |
| 7/16–20 | 7/16–14 | 250 to 650 | 28.2 to 73.4 |
| 1/2–20 | 1/2–13 | 400 to 1000 | 45.2 to 113.0 |
| 9/16–18 | 9/16–12 | 600 to 1450 | 67.8 to 163.8 |
| 5/8–18 | 5/8–11 | 900 to 2000 | 101.7 to 226.0 |
| Thread Size | | Type Y | |
| Nut End | Stud End | Pound–Inches | Newton–Meters |
| 4–48 | 4–40 | — | — |
| 6–40 | 6–32 | — | — |
| 8–36 | 8–32 | — | — |
| 10–32 | 10–24 | — | — |
| 1/4–28 | 1/4–20 | 50 to 95 | 5.6 to 10.7 |
| 5/16–24 | 5/16–18 | 100 to 225 | 11.3 to 25.4 |
| 3/8–24 | 3/8–16 | 175 to 375 | 19.8 to 42.4 |
| 7/16–20 | 7/16–14 | 250 to 400 | 28.2 to 45.2 |
| 1/2–20 | 1/2–13 | 400 to 700 | 45.2 to 79.1 |
| 9/16–18 | 9/16–12 | 500 to 1050 | 56.5 to 118.6 |
| 5/8–18 | 5/8–11 | 700 to 1400 | 79.1 to 158.2 |

Table 3. Stepped and Straight Stud Torque Values (Cont)

| Straight Stud Torque Values | | | |
|---|---|---|---|
| Thread Size | | Type Z | |
| Nut End | Stud End | Pound–Inches | Newton–Meters |
| 4–48 | 4–40 | — | — |
| 6–40 | 6–32 | — | — |
| 8–36 | 8–32 | — | — |
| 10–32 | 10–24 | — | — |
| 1/4–28 | 1/4–20 | 50 to 105 | 5.6 to 11.9 |
| 5/16–24 | 5/16–18 | 100 to 250 | 11.3 to 28.2 |
| 3/8–24 | 3/8–16 | 175 to 400 | 19.8 to 45.2 |
| 7/16–20 | 7/16–14 | 250 to 700 | 28.2 to 79.1 |
| 1/2–20 | 1/2–13 | 400 to 1100 | 45.2 to 124.3 |
| 9/16–18 | 9/16–12 | 600 to 1600 | 67.8 to 180.8 |
| 5/8–18 | 5/8–11 | 900 to 2200 | 101.7 to 248.6 |




Stepped and Straight Studs - Typical
Figure 2

Table 4. Dynatube/Dual Seal Fittings

| Installation Torque | | |
|---|---|---|
| Dash No. Ref. | Pound–Inches* | Newton–Meters* |
| –03 | 60 to 108 | 6.8 to 12.2 |
| –04 | 120 to 168 | 13.6 to 19.0 |
| –05 | 120 to 192 | 13.6 to 21.7 |
| –06 | 180 to 300 | 20.3 to 33.9 |
| –08 | 360 to 480 | 40.7 to 54.2 |
| –10 | 492 to 660 | 55.6 to 74.6 |
| –12 | 600 to 840 | 67.8 to 95.0 |
| –14 | 720 to 1020 | 81.3 to 115.2 |
| –16 | 840 to 1128 | 95.0 to 127.4 |
| –20 | 1080 to 1440 | 122.0 to 162.7 |
| –21 | 1296 to 1680 | 146.4 to 189.8 |
| –24 | 1320 to 1800 | 149.1 to 203.3 |
| –25 | 1500 to 1980 | 169.5 to 223.7 |

*These values also apply when Dynaring seals are installed.

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1. Lockwiring - SP A005

A. Lockwiring is used for securing two or more parts with wire that is installed in such a manner that any tendency for such parts to loosen will initiate counteractive tightening of the wire. For lockwiring procedures, refer to NASM 33540 and the following.

B. Stainless steel aircraft grade lockwire shall have a diameter of approximately three fourths the diameter of the hole(s) provided in the part(s) to be lockwired.

C. Maximum span between tension points shall be 6 inches (152 millimeters) unless otherwise specified.

D. The wire shall be kept taut while twisting. Caution shall be exercised to keep the wire tight without overstressing or affecting installation torque of affected part. The number of twists per inch shall be approximately eight. Nicks, kinks, and other mutilations are not acceptable. To avoid abrasions from pliers, grasp the wire end at a point that will not be twisted.

E. Be certain that parts remain tightened to correct torque. During lockwiring procedure, do not loosen or tighten parts to manipulate wire.

F. Figure 1 and Figure 2 show lockwiring procedures and applications.

G. Lockwire shall be tight after installation to prevent failure from rubbing or vibration.

H. Lockwire ends shall be cut off at least three complete twists from last tension point, then turned in to prevent snagging.

I. When parts have been tightened to the proper torque, positioned, and inspected, proceed as follows:

(1) Insert wire through hole in first bolt. (See Figure 1, Procedure 2.)

(2) Bend wire to the right around head of bolt and under other end of lockwire. Tighten wire around head of bolt. (See Figure 1, Procedure 3.)

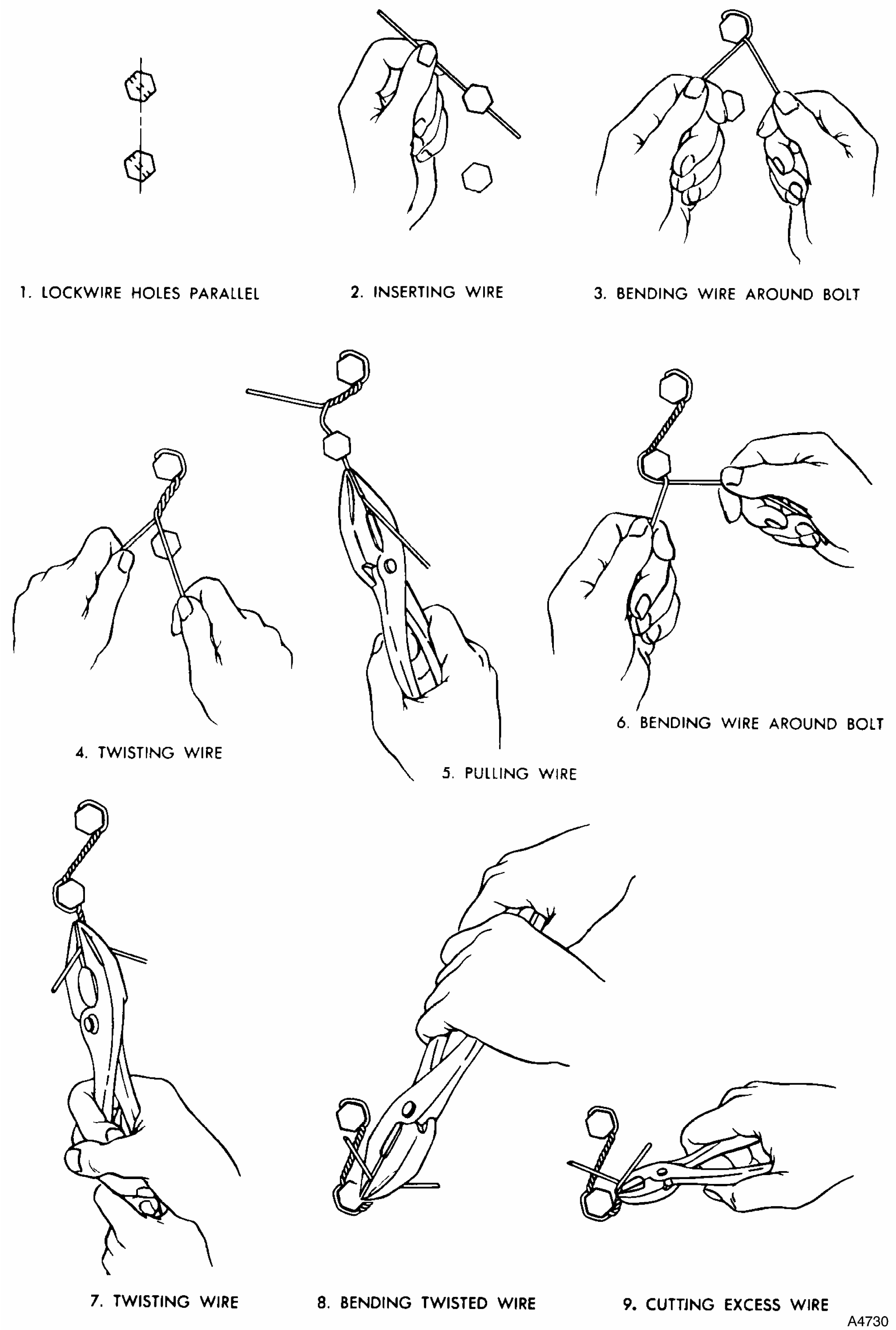
(3) Keeping wire tight around head of first bolt, twist wire strands clockwise around each other until length is just short of hole in second bolt. (See Figure 1, Procedure 4.)

(4) Insert one end of wire through hole in second bolt and pull with pliers until tight. (See Figure 1, Procedure 5.)

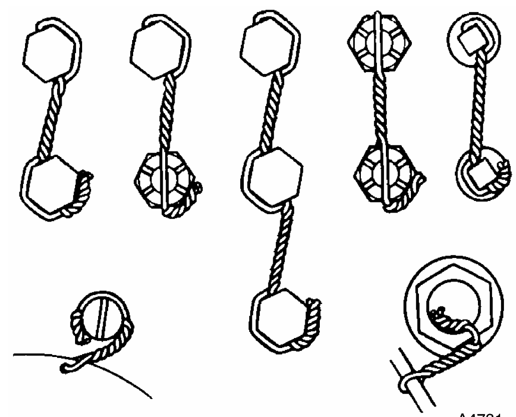
(5) Bring other end of wire around head of bolt and under lockwire protruding from bolt. (See Figure 1, Procedure 6.)

(6) Keeping wire tight, twist ends counterclockwise around each other. (See Figure 1, Procedure 7.)

(7) Cut off excess wire. Pigtail wire sharp ends in toward engine. (See Figure 1, Procedure 9.)




Lockwiring Procedure
Figure 1




Lockwiring Applications
Figure 2

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1. Bearing Installation and Handling - SP B110

A. Bearing installation areas. Establish bearing installation in locations that will provide adequate protection during bearing installation. Such areas shall be kept clean and protected against exposure to abrasive materials and corrosive fumes.

B. Check for magnetism. (Refer to SP I311, 70–20–01.) An adequately demagnetized bearing shall produce a reading of 3 gauss or less. If reading exceeds 3 gauss, demagnetize and recheck for magnetism.

C. Bearings preserved for a short period of time (SP B106, 70–10–03) or new bearings can be installed without depreservation. Bearings preserved for extended periods shall be depreserved in accordance with SP B106, 70–10–03.

D. Visually inspect bearings shipped as sets to make sure both bearings have the same serial number; bearings with mismatched serial numbers cannot be used.

CAUTION: BEARING SURFACES ARE SUSCEPTIBLE TO NICKING OR DENTING. HANDLE THEM CAREFULLY; AVOID DROPPING OR LETTING THEM COLLIDE WITH ONE ANOTHER OR OTHER OBJECTS. IF BEARINGS ARE SUSPECTED OF DAMAGE, TAG FOR INSPECTION AND USE NEW BEARINGS.

E. To facilitate installation of bearings, their bores and shafts on which they are to be installed may be heated or cooled as necessary. Do not exceed 180°F (82°C) when heating a bore in which a bearing is being installed. Dry ice (10–14, 70–80–01) or liquid nitrogen (10–17, 70–80–01) may be used to cool a shaft on which a bearing is being installed.

F. Unless otherwise directed, install all bearings with serial and part numbers facing out.

NOTE: In the event that the serial number is marked on the side opposite the part number, a vibropeening tool shall be used to transfer the serial number to the part number side.

G. Bearings that are installed on a shaft should be installed with the proper equipment, such as an arbor press.

CAUTION: A COCKED OR SKEWED BEARING CAN EASILY BE DAMAGED.

(1) When installing a bearing, use a suitable sleeve which engages the bearing race without contacting any other part of the bearing.

CAUTION: PRESS OR PUSH ON THE RACE HAVING THE INTERFERENCE FIT. IF PRESSURE IS APPLIED AGAINST THE WRONG RACE OR AGAINST THE ROLLING ELEMENTS OR RETAINER, DAMAGE IN THE FORM OF BRINELLING, BENDING, OR FRACTURING MAY RESULT.

(2) Install bearings exactly to right angles to the shaft.

(3) Pressure shall be applied evenly only on the inner race of the bearing to avoid damage to balls, rollers, or raceways.

1. H. Bearings that are installed in sleeves and housings should be installed with the proper equipment, such as an arbor press.

CAUTION: A COCKED OR SKEWED BEARING CAN EASILY BE DAMAGED.

(1) Install bearings exactly at right angles to the axis of the bore.

(2) Pressure shall be applied evenly only on the outer race of the bearing to avoid damage to balls, rollers, or raceways.

(3) Support housing/sleeve so as not to put undue pressure or strain on the structure.

I. After installation make sure that no binding exists. Bearing shall rotate freely and meet any end play requirements that may exist.

1. Lockwiring with Safety Cable Systems - SP A010

NOTE: This procedure is alternate to SP A005, 70–55–07 and may be used whenever SP A005, 70–55–07 is referenced.

A. Safety cable systems lockwiring is used for securing two or more parts with wire that is installed in such a manner that any tendency for such parts to loosen will initiate counteractive tightening of the wire. For safety cable systems lockwiring procedures, refer to NASM 33540 and the following.

B. Safety cable materials and installation procedures must meet all requirements of SAE AS4536, in addition to following requirements. In cases of discrepancies between this procedure and SAE AS4536, this procedure takes precedence.

CAUTION: USE THE CORRECT CABLE AND FERRULE MATERIAL FOR HIGH TEMPERATURE ZONES. FAILURE TO DO SO MAY RESULT IN PREMATURE BREAKAGE.

NOTE: If temperature in area to be lockwired can reasonably be expected to exceed 800°F (426°C), only SAE AMS5687 cable and ferrules shall be used.

C. Safety cable materials specified in SAE AS4536 (SAE AMS5697, SAE AMS5689, or SAE AMS5687) are acceptable for use. Cable diameter must be approximately 75 percent of hole diameters provided in parts to be secured.

D. Maximum span between cable end fitting and ferrule shall be 6 inches unless otherwise specified. (Refer to Table 1 for definition of terms.)

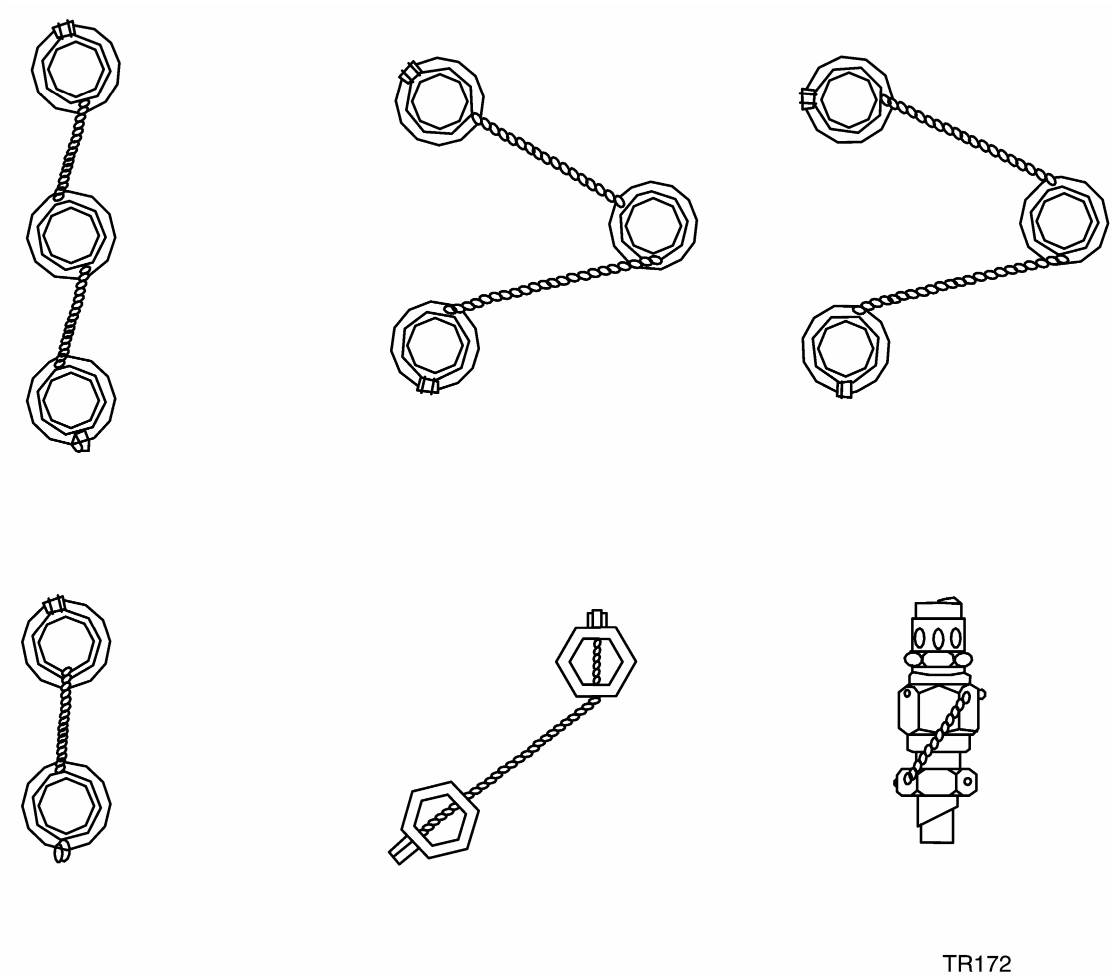
E. Safety cable shall be installed in accordance with manufacturer’s instructions. For examples of typical installations, see Figure 1 and Figure 2.

F. Ensure parts remain tightened to correct torque. Do not loosen or tighten parts to facilitate installation of cable.

G. Safety cable and ferrules must be new upon each application. Reuse is not acceptable.

Table 1. Definition of Terms

| Term | Definition |
|---|---|
| End Fitting | Metal fitting at end of cable supplied by manufacturer. |
| Ferrule | Metal fitting crimped during installation of safety cable. |
| Pull Off Load | Load required to pull cable out of ferrule or end fitting. |




Standard Hardware
Figure 1

CAUTION: FAILURE TO OBSERVE FLEX REQUIREMENTS CAN RESULT IN PREMATURE SAFETY CABLE BREAKAGE.

1. H. Safety cable must be stretched tightly between parts being secured. (Refer to SAE AS4536 for specific flex limits.)

I. If crimped ferrule is difficult to remove from the installation tool or if excessive crimping force is required or if ferrule appears overly deformed, adjust installation tool in accordance with manufacturer's instructions. After adjustment, check pull off load of ferrule. (Refer to Table 1 for definition of terms.)

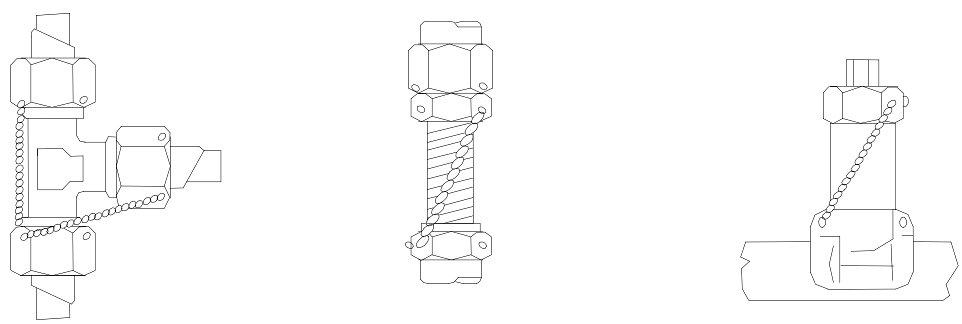
J. Pull off strength of crimped ferrules must be checked using calibrated device capable of exerting known force to safety cable. Device must restrain ferrule from motion without squeezing ferrule.

K. Safety cable installation tool must be checked weekly to ensure that crimped ferrules are capable of meeting minimum pull off load requirements in Table 2. If ferrule does not meet pull off requirements, proceed as follows:

(1) Set test equipment for 10 pounds less than requirement in Table 2. For 0.020 inch diameter cable, set equipment to 5 pounds less than requirement. Repeat pull off test. If ferrule passes test, do not perform Step (2), proceed to Step (3).

(2) Identify all parts secured since tool was last checked. Remove safety cable and reinstall after recalibrating installation tool.

(3) Recalibrate installation tool in accordance with manufacturer's instructions and test ferrule pull off load again.




Tube Couplings
Figure 2

Table 2. Minimum Pull Off Load Requirements

| Cable Diameter (Inches) | Minimum Pull Off Load (Pounds) |
|---|---|
| 0.020 | 35 |
| 0.032 | 80 |
| 0.040 | 120 |

1. Ring Seal Installation - SP A011

   A. Examine the seal ring for damage. The threads shall be clean, free of burrs, chips and damage. If scratches or dents are found on the 37 degree mating surface, discard damaged fitting and replace; do not attempt to repair.

   B. Thoroughly clean the fitting and groove with denatured alcohol (07-25, 70-80-01). Do not use steel tools to clean the grooves. Tools of soft brass, copper or wood are acceptable for use on steel fittings. Ensure contaminants do not remain in the groove.

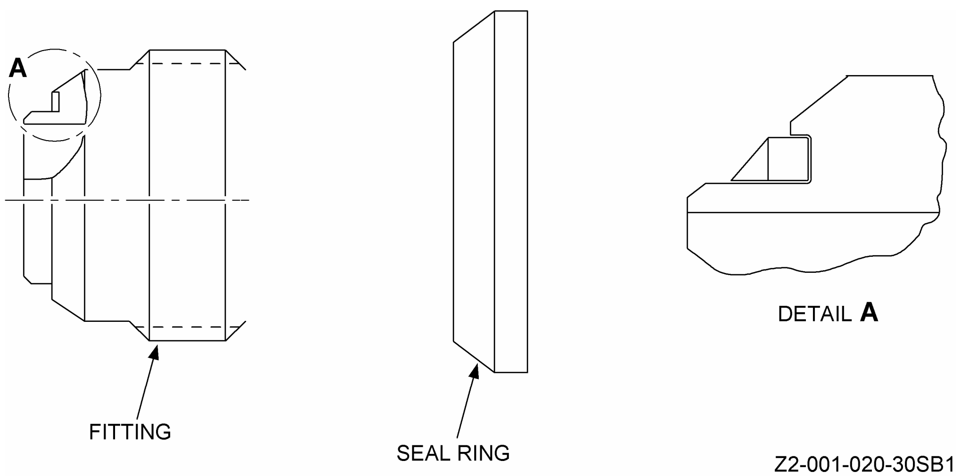
   C. Allow the fitting and groove to thoroughly air-dry.

   NOTE: Install seal rings on hose side of fitting.

   D. Using fingers only (no tools), install the ring (flat face toward the fitting, tapered face away from the fitting) into the groove and push it in place until the flat face “seats” at the bottom of the groove (Figure 1). The ring should protrude above the 37 degree taper surface of the fitting by a minimum of 0.002 inch (0.051 millimeter) to assure a seal after the mating parts are assembled. Lubricants are not needed when installing seal rings.

   E. Torque fittings in accordance with Table 2, 70-55-06.

   F. Ring seals are intended for one time use only. Do not re-use ring seals.




Installation of Ring Seals
Figure 1

1. Assembly and Balance of Engine Parts - SP A012

NOTE: This standard practice covers assembly and balancing of the following parts:

Centrifugal Compressor
Compressor Rotor
First Turbine Spacer
First Turbine Wheel (First Gas Producer)
Gas Producer Turbine (1st and 2nd Gas Producers)
Integral Third Turbine Disk -Shaft (1st Power Turbine)
Integral Third Turbine Wheel-Shaft (1st Power Turbine)
Fourth Turbine Wheel (2nd Power Turbine)
Power Turbine Assembly

NOTE: Parts applicable to specific engine configuration are classified into types as follows:

Type I: Parts with application to engines using the welded third turbine wheel configuration.
Type II: Parts with application to engines using the bolted third turbine wheel configuration.

A. Equipment Required

(1) Model Type S Gisholt Dynetric Balancing Machine or equivalent.

(2) Schenck HL2B or equivalent.

(3) Tools.

| Tip Shake Inspection | |
|---|---|
| Part Number | Gage/Tool Number |
| 0-101-200-ALL | G6526002 |
| 0-101-230-ALL | T6526023 |
| 0-101-240-ALL | T6526013 |
| 0-101-250-ALL | T6526013 |
| 0-101-260-ALL | T6526013 |
| 2-043-140-ALL | G6526057 |
| 2-043-240-ALL | G6526058 |
| 2-100-140-ALL | T6526023 |
| 2-100-150-ALL | T6526013 |
| 2-100-160-ALL | T6526013 |
| 2-100-170-ALL | T6526013 |
| 2-101-630-ALL | T6526024 |
| 2-101-770-ALL | G6526002 |
| 2-101-780-ALL | G6526009 |

1. B. Consumables

(1) Never-Seez lubricant (Pure Nickel Special) (02-02, 70-80-01).

(2) Never-Seez lubricant (General Purpose Grade) (02-01, 70-80-01).

(3) WD-40 (Penetrating Oil) (02-30, 70-80-01).

C. Marking of parts. All parts will be marked in accordance with AS478, Paragraphs 4.2 and 4.2.1.

D. Compressor Disk Required Procedures and Operations

(1) Use the following blade grouping procedures listed as follows or an equivalent computerized blade mapping procedure.

(2) Perform the following steps to ensure that blades of equal weight are installed 180° apart.

(a) Weighing. Weigh blades to the nearest 0.1 gram and mark in accordance with AS478, Paragraphs 4.2 and 4.2.1.

(b) Grouping. Arrange all 42 blades in a single row in order of descending blade weights. Weight of any blade shall not vary more than 0.1 gram from weight of blade immediately preceding or succeeding it. (Refer to Table 1 that shows two rows due to space.)

Table 1. Arrangement of Compressor Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | | | | | | | | |

(c) Rearrange blades in a row as follows in Table 2.

Table 2. Rearrangement of Compressor Blades

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 9 | 14 | 17 | 22 | 25 | 30 | 33 | 38 | 41 | 4 | 7 | 12 | 15 | 20 | 23 | 28 | 31 | 36 | 39 | 2 | 5 | 10 |
| 13 | 18 | 21 | 26 | 29 | 34 | 37 | 42 | 3 | 8 | 11 | 16 | 19 | 24 | 27 | 32 | 35 | 40 | | | | | | |

(d) Assembly. Assemble blades into the disk in the order established through grouping shown in Table 2. If blade is replaced, replace the blade 180˚ away with one of equal weight.

(e) Tip Shake Inspection. Where compressor tip shake is required per print or the overhaul manual, the shake requirement shall be defined as the blade total free motion in the rotor circumferential direction when inspected on the blade suction side at approximately mid chord using the appropriate gage or tool as specified in preceding Step 1.A.(3) or dial indicator method specified in appropriate overhaul manual.

1. E. Gas Producer First Turbine Procedures and Operations

(1) Weighing. Weigh blades to the nearest 0.1 gram and mark in accordance with AS478, Paragraphs 4.2 and 4.2.1.

(2) Grouping: When A and B blades are used:

(a) Select up to 40 A and 40 B blades then arrange into two separate rows according to descending blade weight. (Refer to Tables 3 and 4.) The weight of each blade shall not vary more than 0.1 gram from the preceding blade.

Table 3. Row 1 Type A Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | | | | | | | | | |

Table 4. Row 1 Type B Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | | | | | | | | | |

(b) Rearrange A and B rows as follows in Tables 5 and 6.

Table 5. Rearrangement of Type A Blades

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 9 | 14 | 17 | 22 | 25 | 30 | 33 | 38 | 41 | 4 | 7 | 12 | 15 | 20 | 23 | 28 | 31 | 36 | 39 | 2 | 5 | 10 |
| 13 | 18 | 21 | 26 | 29 | 34 | 37 | 42 | 3 | 8 | 11 | 16 | 19 | 24 | 27 | 32 | 35 | 40 | | | | | | |

Table 6. Rearrangement of Type B Blades

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 33 | 30 | 25 | 22 | 17 | 14 | 9 | 6 | 1 | 40 | 35 | 32 | 27 | 24 | 19 | 16 | 11 | 8 | 3 | 37 | 34 | 29 | 26 |
| 21 | 18 | 13 | 10 | 5 | 2 | 39 | 36 | 31 | 28 | 23 | 20 | 15 | 12 | 7 | 4 | | | | | | | | |

(c) Select A and B blades alternately and insert into disk according to the following sequence in Table 7.

Table 7. Rearrangement of A and B Blades

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 38B | 6A | 33B | 9A | 30B | 14A | 25B | 17A | 22B | 22A | 17B | 25A | 14B | 30A | 9B | 33A | 6B | 38A |
| 1B | 4A | 40B | 7A | 35B | 12A | 32B | 15A | 27B | 20A | 24B | 23A | 19B | 28A | 16B | 31A | 11B | 36A | 8B |
| 39A | 3B | 2A | 37B | 5A | 34B | 10A | 29B | 13A | 26B | 18A | 21B | 21A | 18B | 26A | 13B | 29A | 10B | 34A |
| 5B | 37 | 2B | 3A | 39B | 8A | 36B | 11A | 31B | 16A | 28B | 19A | 23B | 24A | 20B | 27A | 15B | 32A | 12B |
| 35A | 7B | 40A | 4B | | | | | | | | | | | | | | | |

1. E. (3) Grouping. When a single blade part number is used.

(a) Arrange 80 blades in a single row according to descending weight in the following order. (Refer to Table 8.) The weight of each blade shall not vary more than 0.1 gram from the preceding blade.

Table 8. Single Number Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 |
| 75 | 76 | 77 | 78 | 79 | 80 | | | | | | | | | | | | | | | | | | | |

(b) Rearrange grouping when a single number blade is used. (Refer to Table 9.)

Table 9. Rearrange Single Number Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 9 | 14 | 17 | 22 | 25 | 30 | 33 | 38 | 41 | 46 | 49 | 54 | 57 | 62 | 65 | 70 | 73 | 78 | 4 | 7 | 12 | 15 | 20 |
| 23 | 28 | 31 | 36 | 39 | 44 | 47 | 52 | 55 | 60 | 63 | 68 | 71 | 76 | 79 | 5 | 10 | 13 | 18 | 21 | 26 | 29 | 34 | 37 | 42 |
| 45 | 50 | 53 | 58 | 61 | 66 | 69 | 74 | 77 | 3 | 8 | 11 | 16 | 19 | 24 | 27 | 32 | 35 | 40 | 43 | 48 | 51 | 56 | 59 | 64 |
| 67 | 72 | 75 | 80 | | | | | | | | | | | | | | | | | | | | | |

(4) Assembly. Assemble blades as follows, using a lubricant WD-40 (02-30, 70-80-01) or equivalent, if necessary.

(a) Assemble retaining ring into the groove of the aft face of the wheel, with anti rotation knob facing forward. Compress ring with installation and removal tool LTCT13781 or equivalent.

(b) Assemble blades.

1 When using A and B blades, assemble blades in alternate positions as shown in Table 7.

2 When using single part number blades in alternate positions as shown in Table 9 and Figure 14.

(c) Position the forward sealing disk against the forward surfaces of the blade shanks. The blades shall extend over the face of the wheel one half the length of the blade shank.

(d) Apply a load to the forward sealing disk so that the full complement of blades moves axially rearward. As the sealing disk and blades move, ensure all internal grooves on the face of the blades hook over and loop the outside diameter of the sealing disk.

1. E. (4) (e) Move the sealing disk and the blades as a unit until the rear faces of the blades contact the retaining ring. Ensure that the through holes in the sealing disk align with the three holes in the turbine wheel.

(f) Remove the restraint from the retaining ring, allowing the retaining ring to expand into the internal grooves of the blades.

(g) Load the sealing disk against the turbine wheel until the disk contacts the wheel.

(5) Gas Producer Second Turbine. Perform the following steps to ensure that blades of equal weight are installed 180° apart.

(a) Weighing. Weigh blades to the nearest 0.1 gram and mark in accordance with AS478, Paragraphs 4.2 and 4.2.1.

(b) Grouping.

1 Select 36 A blades and 36 B blades. Arrange A and B blades in two separate rows according to descending blade weight. The weight of each blade may not vary more than 0.1 gram from the preceding blade. (Refer to Tables 10 and 11.)

Table 10. Row 1 Type A Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | | | | | | | | | |

Table 11. Row 1 Type B Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | | | | | | | | | |

2 Rearrange A and B rows as follows in Tables 12 and 13.

Table 12. Rearrangement of Type A Blades

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 9 | 14 | 17 | 22 | 25 | 30 | 33 | 4 | 7 | 12 | 15 | 20 | 23 | 28 | 31 | 36 | 2 | 5 | 10 | 13 | 18 | 21 |
| 26 | 29 | 34 | 3 | 8 | 11 | 16 | 19 | 24 | 27 | 32 | 35 | | | | | | | | | | | | |

Table 13. Rearrangement of Type B Blades

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | 30 | 25 | 22 | 17 | 14 | 9 | 6 | 1 | 35 | 32 | 27 | 24 | 19 | 16 | 11 | 8 | 3 | 34 | 29 | 26 | 21 | 18 | 13 |
| 10 | 5 | 2 | 36 | 31 | 28 | 23 | 20 | 15 | 12 | 7 | 4 | | | | | | | | | | | | |

1. E. (5) (b) 3 Select A and B blades alternately and insert into disk in the following sequence in Table 14.

Table 14. Rearrangement of A & B Blades

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 33B | 6A | 30B | 9A | 25B | 14A | 22B | 17A | 17B | 22A | 14B | 25A | 9B | 30A | 6B | 33A | 1B | 4A |
| 35B | 7A | 32B | 12A | 27B | 15A | 24B | 20A | 19B | 23A | 16B | 28A | 11B | 31A | 8B | 36A | 3B | 2A | 34B |
| 5A | 29B | 10A | 26B | 13A | 21B | 18A | 18B | 21A | 13B | 26A | 10B | 29A | 5B | 34A | 2B | 3A | 36B | 8A |
| 31B | 11A | 28B | 16A | 23B | 19A | 20B | 24A | 15B | 27A | 12B | 32A | 7B | 35A | 4B | | | | |

(c) Assembly. Assemble blades into the wheel from the aft side of the disk with A and B blades in alternate positions. In between adjacent blades, insert a sealing plate while assembling the blades into the wheel. Refer to appropriate overhaul manual for details of the sealing plate. After all blades are installed, insert and compress pins using pin driver fixture LTCT6907 or equivalent. Spread the plates as specified in appropriate overhaul manual using punch LTCT6210 or equivalent, and peening fixture LTCT6214 or equivalent.

F. Balancing. All dynamic balancing operations shall be performed using the balance machines specified in Paragraph 1.A., applicable bearings (LTCT2712, LTCT13032, or equivalent) and safety shield or shroud (LTCT1386, LTCT1388, or equivalent).

(1) Gas Producer Section

(a) Centrifugal Compressor

1 Mount the centrifugal compressor inducer-impeller assembly on adapter (LTCT1254, GTLA1052, or equivalent).

2 Measure runout of the surface indicated in Figure 2. Maximum radial runout shall not exceed 0.001 inch Total Indicator Reading (TIR).

3 Dynamically balance the assembly. Correct unbalance condition in the assembly by removing material from the inducer-impeller in the areas designated on the engineering drawing (in the appropriate overhaul manual). Remaining unbalance in both and rear balancing planes shall not exceed 1 gram-inch.

(2) Compressor Rotor

(a) Assemble the compressor rotor per applicable overhaul manual.

(b) Support the compressor rotor as shown in Figure 3, on the rotor lands and dynamically balance the rotor. Use cradle and shroud LTCT6188, KD6725, 6726, KD6725/7003, or equivalent. Correct unbalance condition by removing material from first compressor disk and the rear of impeller, in the areas shown in applicable overhaul manual. The remaining unbalance shall not exceed 2 gram-inches on the forward balancing plane, and 2 gram-inches on the rear balancing plane.

1. F. (2) (c) After balancing, touch up seal lands in accordance with Figure 2 and the appropriate overhaul manual. Where the protective finish is removed, clean the area with a suitable degreaser or solvent, and protect with a finish equivalent to the original.

(d) Except for areas that are seal rubbing surfaces, mark all parts with a straight line (ink or paint) in accordance with AS478, Paragraphs 4.2 and 4.2.1, running from the front to the rear of the assembly after balancing.

(3) First Turbine Spacer

(a) Mount the first turbine spacer, as shown in Figures 4a and b of Figure 4, on arbor LTCT13141, GTLA1228, ND 1001, or equivalent, and torque bolts to 100 lb-inches.

(b) Measure runout. The radial axial runout of the spacer shall not exceed 0.0006 inch TIR.

(c) Perform a single plane static (force) balancing in the balance machine. Correct unbalanced condition by removing material from the spacer in the applicable area shown in the applicable overhaul manual. The remaining unbalance shall not exceed 0.5 gram-inch.

(4) First Turbine Wheel

(a) Secure seal plate to disk with six MS16996-32 screws, or equivalent. Ensure screws weigh within 0.1 gram of each other, machining tips of screws if required. Lubricate screws sparingly on threads and under heads and torque to 150±10 lb-inches.

(b) Mount the first turbine wheel, as shown in Figure 5, on arbor LTCT1385, LTCT12021, GTLA1221, or equivalent, and torque arbor nut, if applicable, to 200 lb-inches.

(c) Measure runouts. The radial runout of the wheel shall not exceed 0.0005 inch TIR, and the face runout shall not exceed 0.003 inch TIR (see Figure 5 for runout locations). The radial runout of the sealing disk shall not exceed 0.002 inch TIR.

(d) Load all the blades by tapping uniformly forward on fixture KD7232 or equivalent.

(e) If the first stage sealing plate has a balancing ring added to it, two-plane (force-force) balance the first G.P. turbine assembly to within 1 gram-inch in each plane by removing material. Use the first stage G.P. seal balancing ring as Plane A, and the aft face of the first disk as Plane B.

(f) Make a static (force) and couple (moment) setup in the balance machine to read static (force) unbalance on the aft face of the wheel, and couple (moment) unbalance across the part.

(g) Check-balance the static (force) and couple (moment) unbalance on the planes specified in step (e). If the couple (moment) unbalance exceeds 10 gram-inches$^2$, check the face runouts of the sealing plate (refer to step (e)).

CAUTION: IF THE STATIC (FORCE) UNBALANCE EXCEEDS 30 GRAM-INCHES PRIOR TO MATERIAL REMOVAL FOR BALANCING, RETURN THE ASSEMBLY FOR RE-BLADING AND DETAILED INSPECTION OF THE DISK.

1. F. (4) (h) Balance the static (force) by removing the material until the unbalance does not exceed 0.5 gram-inch. Couple (moment) balance shall not exceed 10 gram-inches$^2$.

(i) Alternate balancing method. Dynamically balance the assembly using static-couple setup. Remove balancing material from the seal balancing ring and aft face of the disk. The residual static unbalance shall not exceed 10 gram-inches$^2$.

(5) Gas Producer Turbine

(a) Assembly.

1 With Gas Seal. Assemble the balanced G.P. spacer (See Paragraph 1.F.(3)) and the second turbine onto the arbor-mounted first turbine (see Figure 6), and check runouts in accordance with Step (b). Assemble gas seal onto first turbine and proceed with balancing in accordance with Steps (c) through (h).

2 Without Gas Seal. Assemble the balanced G.P. spacer (See Paragraph 1.F.(3)) and the second turbine onto the arbor-mounted first turbine (see Figure 6) and proceed with Steps (b) through (h).

(b) Measure face runout of the turbine wheels. Runout shall not exceed 0.003 inch TIR, and the radial runout of the second wheel shall not exceed 0.0025 inch TIR (see Figure 6). Radial runout of the spacer shall not exceed 0.0007 inch. If the runouts exceed specified limits, disassemble the turbine assembly, re-orient or replace as required, and repeat procedure.

(c) If the first stage G.P. turbine sealing plate has a balancing ring added to it, two-plane (force-force) balance the G.P. turbine assembly to within 2 gram-inches in each plane by removing material. Use the first stage G.P. seal balancing ring as Plane A and the second disk aft face as Plane B.

(d) Make a static (force) and couple (moment) balance setup for the assembly. The aft face of the turbine is used to balance the static (force) while the couple (moment) is check-balanced.

(e) If couple (moment) unbalance exceeds 15 gram-inches$^2$, re-index the second turbine and repeat step (b).

1. F. (5) (f) Balance the static (force) on the second disk by removing material from the area specified on the engineering (overhaul manual) drawing (see Figure 6). The remaining static (force) unbalance shall not exceed 2 gram-inches, and couple (moment) unbalance shall not exceed 15 gram-inches$^2$.

(g) Alternate balancing method. Dynamically balance the assembly using static-couple set-up. Remove balancing material from both the faces of disk for balancing. The residual static unbalance shall not exceed 2 gram-inches and the residual couple unbalance shall not exceed 10 gram-inches$^2$.

(h) Except for seal rubbing surfaces, mark in accordance with AS478, Paragraphs 4.2 and 4.2.1 all parts with a straight line (ink or paint) running from the front to the rear of the assembly after balancing.

(i) When disassembling, remove the second wheel, then remove the spacer from the first wheel using puller LTCT14765 or equivalent.

(6) Power Turbine

(a) Internal Third Turbine Disk-Shaft (Without Blades) - Type I.

1 Support the disk-shaft on the disk-shaft bearing journals using saddle bearings LTCT2712, JJ 1125 and JJ 1126, or equivalent.

2 Measure runouts and verify that radial and face runouts do not exceed the values specified in Figure 7.

3 Dynamically check-balance the disk-shaft using the balancing machine, and record the results. If the unbalance on the forward plane is less than 8 gram-inches, return the disk-shaft assembly for blading. If the unbalance on the forward end of the power shaft exceeds 8 gram-inches, return the shaft to Quality Control for concentricity inspection (outside to inside diameter) and wall thickness variations per Geometrical Multiplane Balancing Procedure or equivalent. The shaft shall be eccentrically ground to reduce distributed unbalance, without thinning the shaft wall below appropriate overhaul manual dimensions. The shaft disk shall be checked-balance following this operation to ensure that the unbalance in the forward end is less than 8 gram-inches.

4 After the requirements of step 3 are met, dynamically balance the disk-shaft assembly per the appropriate overhaul manual. The unbalance at forward end balance plane shall not exceed 0.5 gram-inches and unbalance at aft balance plane shall not exceed 1 gram-inch.

1. F. (7) Blading and Assembly of Power Turbine Disk. Perform the following steps to ensure that blades of equal weight are installed 180° apart or apply an equivalent computerized blade mapping sequence.

(a) Weighing. Weigh blades to the nearest 0.1 gram and mark in accordance with AS478, Paragraphs 4.2 and 4.2.1.

(b) Grouping Third Turbine Blades. Arrange all 64 blades in a single row in order of descending blade weights. Weight of any blade shall not vary more than 0.1 gram from weight of blade immediately preceding or succeeding it. (Refer to Table 15 that shows two rows due to space.)

Table 15. Third Turbine Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | | | | | | | | | | |

Table 16. Rearranged Third Turbine Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 9 | 14 | 17 | 22 | 25 | 30 | 33 | 38 | 41 | 46 | 49 | 54 | 57 | 62 | 4 | 7 | 12 | 15 | 20 | 23 | 28 | 31 | 36 |
| 39 | 44 | 47 | 52 | 55 | 60 | 63 | 2 | 5 | 10 | 13 | 18 | 21 | 26 | 29 | 34 | 37 | 42 | 45 | 50 | 53 | 58 | 61 | 3 | 8 |
| 11 | 16 | 19 | 24 | 27 | 32 | 35 | 40 | 43 | 48 | 51 | 56 | 59 | 64 | | | | | | | | | | | |

(c) Grouping Fourth Turbine Blades. Arrange all 60 blades in a single row in order of descending blade weights. Weight of any blade shall not vary more than 0.1 gram from weight of blade immediately preceding or succeeding it. (Refer to Table 17 that shows two rows due to space.)

Table 17. Fourth Turbine Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | | | | | | | | | | | | | | |

(d) Rearrange 60 fourth turbine blades in a row according to the order in Table 18.

Table 18. Rearranged Fourth Turbine Blades

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 9 | 14 | 17 | 22 | 25 | 30 | 33 | 38 | 41 | 46 | 49 | 54 | 57 | 4 | 7 | 12 | 15 | 20 | 23 | 28 | 31 | 36 | 39 |
| 39 | 44 | 47 | 52 | 55 | 60 | 2 | 5 | 10 | 13 | 18 | 21 | 26 | 29 | 34 | 37 | 42 | 45 | 50 | 53 | 58 | 61 | 3 | 8 | 11 |
| 16 | 19 | 24 | 27 | 32 | 35 | 40 | 43 | 48 | 51 | 56 | 59 | | | | | | | | | | | | | |

1. F. (8) Assembly. Assemble blades into the balanced integral third turbine disk-shaft and the fourth turbine disk as follows:

NOTE: If a blade is replaced, replace the blade 180° away with a blade whose difference in weight does not exceed 0.1 gram. The heavier of the two blades shall occupy the same position occupied by the heaviest of the original pair.

(a) Integral Third Turbine Wheel-Shaft Assembly.

1 With the blades arranged as specified in (7)(b) above or per equivalent computerized blade mapping sequence, assemble blades into disk, starting with blade 1, and proceed in a counterclockwise direction from aft side, ending with blade 64 in disk groove 64 (see Figure 9).

(b) After all blades have been installed with the rivet heads on the aft side of the disk, rivet blades in place using riveting fixture LTCT14163 or equivalent. Refer to appropriate overhaul manual for details of assembly.

(c) For A and B bladed disks, assemble blades around the wheel with A and B blades in alternate positions, and repeat the procedure specified in preceding Step (b).

(9) Fourth Turbine Disk Assembly

(a) With blades arranged as specified in (7)(c) or per equivalent computerized blade mapping sequence, assemble blades into disk, starting with blade 1 positioned in disk groove 1, and proceed in a counter-clockwise direction from aft side, ending with blade 60 in disk groove 60 (see Figure 9).

(b) After all blades have been installed with the rivet heads on the aft side of the disk, rivet blades in place using riveting fixture LTCT14165 or equivalent. Refer to appropriate overhaul manual for details of assembly.

(10) Balancing of Power Turbine Assemblies

(a) Integral Third Turbine Wheel Shaft-Bladed (Type I)

1 Supporting the assembly on the assembly bearing journals, measure runouts. Radial and face runouts shall not exceed the values specified in Figure 10.

2 Dynamically balance the assembly with the balancing machine. Correct unbalanced condition by removing material from the balancing plane on the third turbine wheel as shown on the engineering drawing (in the appropriate overhaul manual). The remaining unbalance shall not exceed 1 gram-inch on the forward balancing plane, and 1 gram-inch on the rear balancing plane.

1. F. (10) (b) Fourth Turbine Wheel (bladed)

1 Type I

a Mount the type I fourth turbine wheel assembly, shown in Figure 11, on arbor LTCT14677, JJ 1364, or equivalent.

NOTE: Handle arbor and wheel with care. Arbor is a press fit and there is no retaining nut.

b Measure runouts. The radial runout shall not exceed 0.0025 inch, and face runout shall not exceed 0.003 inch.

c Perform a two-plane balance on the wheel assembly using the balancing machine. Correct unbalanced condition by removing material from the disk in the areas designated on the engineering drawing (overhaul manual). Remaining unbalance shall not exceed 1 gram-inch unbalance shall not exceed 2 gram-inches and the residual couple unbalance shall not exceed 15 gram-inches$^2$ in each plane.

d Alternate Balancing Method. Dynamically balance the assembly using static-couple setup. Remove balancing material from both the faces of the disk for balancing. The residual static unbalance shall not exceed 2 gram-inches and residual couple unbalance shall not exceed 15 gram-inches$^2$.

2 Type II

a Mount the type II fourth turbine wheel, shown in Figure 12, on arbor LTCT6866 or equivalent, and torque bolts to 80 lb-inches.

b Measure runouts. The radial runout shall not exceed 0.0025 inch, and face runout shall not exceed 0.003 inch.

c Perform a two-plane balance on the wheel assembly using the balancing machine. Correct unbalanced condition by removing material from the disk in the areas designated in the appropriate overhaul manual. Remaining unbalance shall not exceed 0.5 gram-inch in each plane.

1. F. (11) Power Turbine Assembly (Type II)

(a) Assemble the power turbine shaft (power shaft), third turbine wheel, and the power turbine disk shaft (stub shaft). Install nine bolts and three locking plates, lubricating threads and underside of bolt heads.

1 Tighten nine bolts to the torque value as shown in the appropriate overhaul manual in increments in the following bolt sequence: 1-5-3-8-2-6-4-9-7. Verify that pilot runout does not exceed 0.001 TIR.

2 Add balancing adapter LTCT13509 or equivalent to the assembly, simulating a fourth wheel, and torque the six bolts on the balancing adapter to 30 lb-inches.

(b) Supporting the assembly on the assembly bearing journals, measure runouts. The radial and face runouts shall not exceed 0.003 inch TIR (see Figure 13 for runout locations).

(c) Dynamically balance the assembly using the balancing machine. Correct unbalanced condition by removing material from the balancing plane on the forward end of the power turbine shaft (power shaft) and the balancing plane designated on the third turbine wheel, as shown in the appropriate overhaul manual. Remaining unbalance shall not exceed 1 gram-inch on the forward balancing plane, and 1 gram-inch on the rear balancing plane. Note the angular location of the unbalance in the forward plane.

(d) Remove balancing adapter LTCT13509 or equivalent, and replace the arbor with a prebalanced fourth turbine wheel as follows:

1 Using hand force, ensure that the ring-clamp seats freely on the fourth turbine disk. With ring-clamp on the fourth disk, check for clearance between ring-clamp and disk, using 0.001 inch feeler stock. If clearance exists in other than the radius area, replace ring-clamp, wheel, or both.

2 Locate fourth wheel onto stub shaft using guide pins.

3 Install ring-clamp and temporarily secure with four slave bolts and two slave tab lock rings (2-141-131-02 or equivalent). Remove guide pins and install two remaining slave bolts. Lubricate slave bolt threads and underside of bolt head areas.

4 Tighten bolts to the torque value specified on the engineering drawing (in the appropriate overhaul manual) in the following sequence: 1-4-5-2-3-6. Torquing increments shall involve turning bolts down in sequence to 15 lb-inches, then torquing bolts in sequence, each in increments of 1.2 turns maximum until seated, to final torque.

5 Measure face runout at rear face of fourth wheel, directly below rivets. Runout shall not exceed 0.003 inch TIR.

1. F. (11) (d) 6 Release torque and remove slave bolts and tab lock rings. Recheck rear face runout. If runout exceeds tolerance, remove and inspect affected parts.

7 Refasten the fourth wheel using the same slave bolts, slave tab lock rings, and torquing procedure. Ensure that no binding occurs. Dynamically check-balance the assembly on the balancing machine. Residual unbalance shall not exceed 2 gram-inches in the forward balancing plane, and 4 gram-inches in the balancing plane of the fourth turbine wheel. The angular location of the unbalance in the forward plane shall not differ by more than 80 degrees from the angular location noted in Step (c).

8 Except for seal rubbing surfaces, mark in accordance with AS478, Paragraphs 4.2 and 4.2.1 all parts with a straight line (ink or paint), running from the front to the rear of the assembly, after balancing.

G. Engine Level Runout Inspection

(1) Gas Producer. At assembly of the gas producer into the engine, face runout on the first wheel shall be checked as shown in Figure 4. Face and radial runouts shall be checked on the second wheel as shown in Figure 6. Face runouts on both wheels shall not exceed 0.004 inch TIR, and radial runout on the second wheel shall not exceed 0.003 inch TIR. The combination of the second wheel face and radial runout shall not exceed 0.006 inch TIR.

H. Power Turbine. At assembly of the fourth turbine wheel assembly into the engine, face runout on the fourth wheel shall be checked at the rear rim face, inward of the broached slots. Face runout on the fourth wheel shall not exceed 0.003 inch TIR. The assembly of the fourth wheel assembly into the engine shall be as follows:

(1) Type I

(a) Lubricate threads of integral wheel shaft.

WARNING: USE PROTECTIVE GLOVES WHEN HANDLING THE HEATED WHEEL ASSEMBLY DURING INSTALLATION.

(b) Using control unit (LTCT6729, LTCT14547, or equivalent) in conjunction with heater (LTCT13873 or equivalent) installed on rear face of wheel assembly, heat the hub of wheel assembly, and install the wheel assembly on the shaft assembly, ensuring that splines are in alignment and fully engaged.

(c) Lubricate threads of retaining nut (2-141-222-01 or equivalent). Secure wheel assembly to shaft assembly with locking cup and retaining nut.

(d) Using adapter LTCT13857 or equivalent, and torque wrench LTCT9715 or equivalent, tighten retaining nut to torque value as shown in the appropriate overhaul manual. Bending of the locking cup shall not be permitted.

(e) Check fourth wheel assembly runout inboard of blade pins. Maximum runout shall not exceed 0.003 inch.

(f) Secure nut with locking cup.

1. H. (2) Type II

(a) Assemble the power turbine assembly as specified in Step (1) above ensuring that the balance marks are aligned when locating the fourth wheel onto the stub shaft. Ensure that the six bolts selected for final assembly will pass through the slave tab lock rings, ring-clamp, and thread freely into stub shaft without binding. If binding occurs, re-align the ring-clamp until bolts are centered. If binding persists, replace ring-clamp. After elimination of binding, replace assembly bolts with slave bolts, and complete the assembly procedure.

(b) Check for clearance between ring-clamp and disk using 0.001 inch feeler stock. Ring-clamp shall fit flush to disk. There shall be no clearance other than in the radius area. If clearance exists, replace ring-clamp, fourth wheel, or both.

(c) Lubricate threads and underside of fourth wheel retaining bolt head. Install fourth wheel retaining bolt. Before torquing, ensure that bolt pilot enters ring clamp without binding. If binding occurs, align ring-clamp until bolt is centered.

(d) Using adapter LTCT13719 or equivalent, and torque wrench, tighten fourth wheel retaining bolt to the torque value specified on the engineering drawing (in the appropriate overhaul manual). Release torque and re-apply the specified torque.

(e) Remove six slave bolts and two slave tab lock rings and position bolt locking ring on ring-clamp. Lubricate threads and undersides of the six bolt heads selected for final assembly.

NOTE: Rotate bolt locking ring until the tabs line up with the slots in the fourth wheel retaining bolt, and the holes line up with holes in the ring-clamp.

(f) Bend up tabs on tab lock-ring (one required).

(g) Secure fourth wheel, ring-clamp, and bolt locking ring to stub shaft with six assembly bolts and the tab lock ring. Tighten the bolts to the torque value specified on the engineering drawing (in the appropriate overhaul manual). Release torque and re-torque to the specified value. Torquing sequence and increments shall be as specified for the power turbine assembly (see Paragraph 1.F.(11)).

(h) Repeat step 1.H.(2)(b) above.

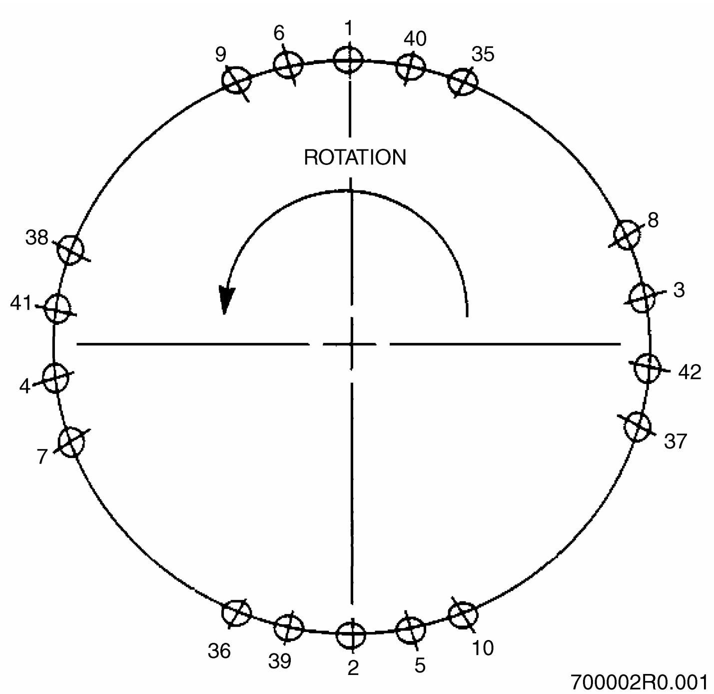
(i) Bend up tabs of tab lock-ring.

(j) Measure rear face runout of fourth turbine wheel directly below the rivets. Runout shall not exceed 0.003 inch TIR.

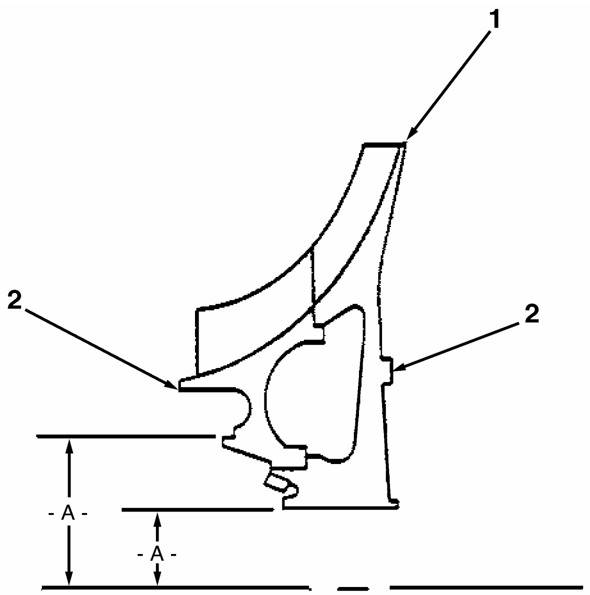
1. I. Quality Assurance.

(1) Monitor Equipment. All tools (e.g., arbors, adapters, and bearings) shall be examined for conformance to the applicable tool drawing every three months, unless the tool has not been used within three months from the last examination.

(2) Inspection. Inspection shall be sufficient to ensure that all parts and assemblies meet the assembly and balance requirements of this specification.




Compressor Disk - (Rear View)
Figure 1

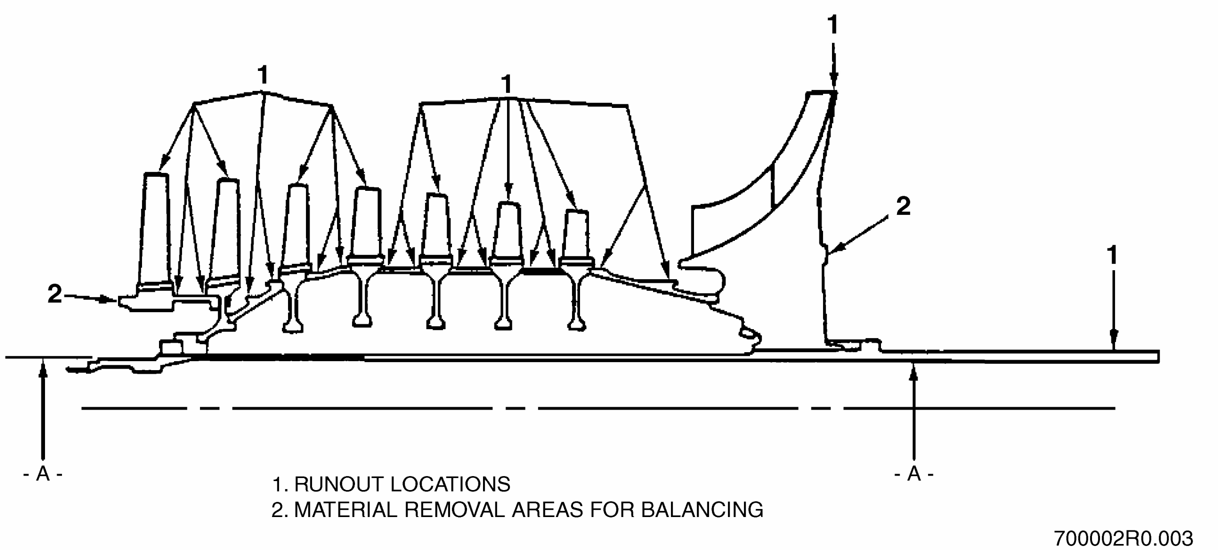



1. RUNOUT LOCATIONS
2. MATERIAL REMOVAL AREAS FOR BALANCING

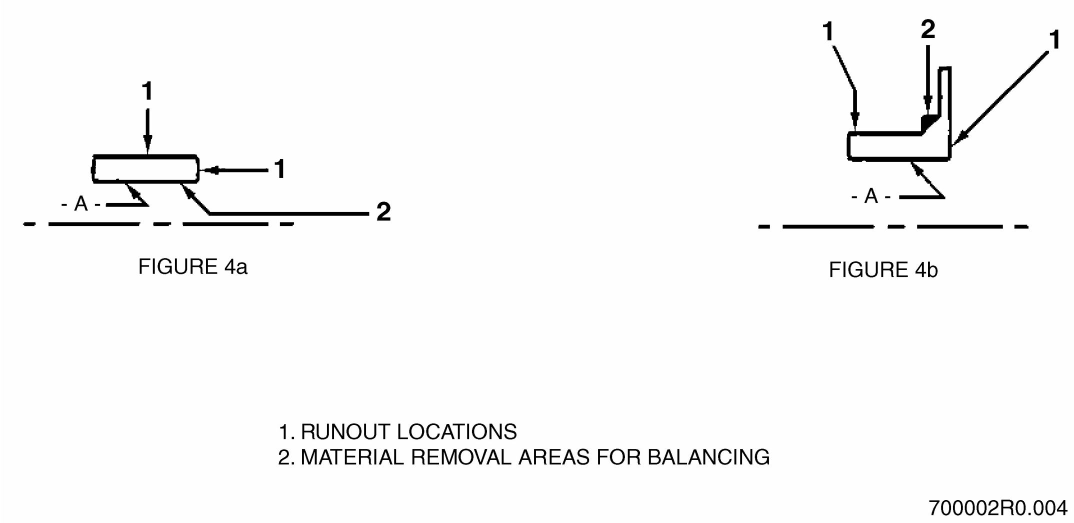
700002R0.002

Centrifugal Compressor

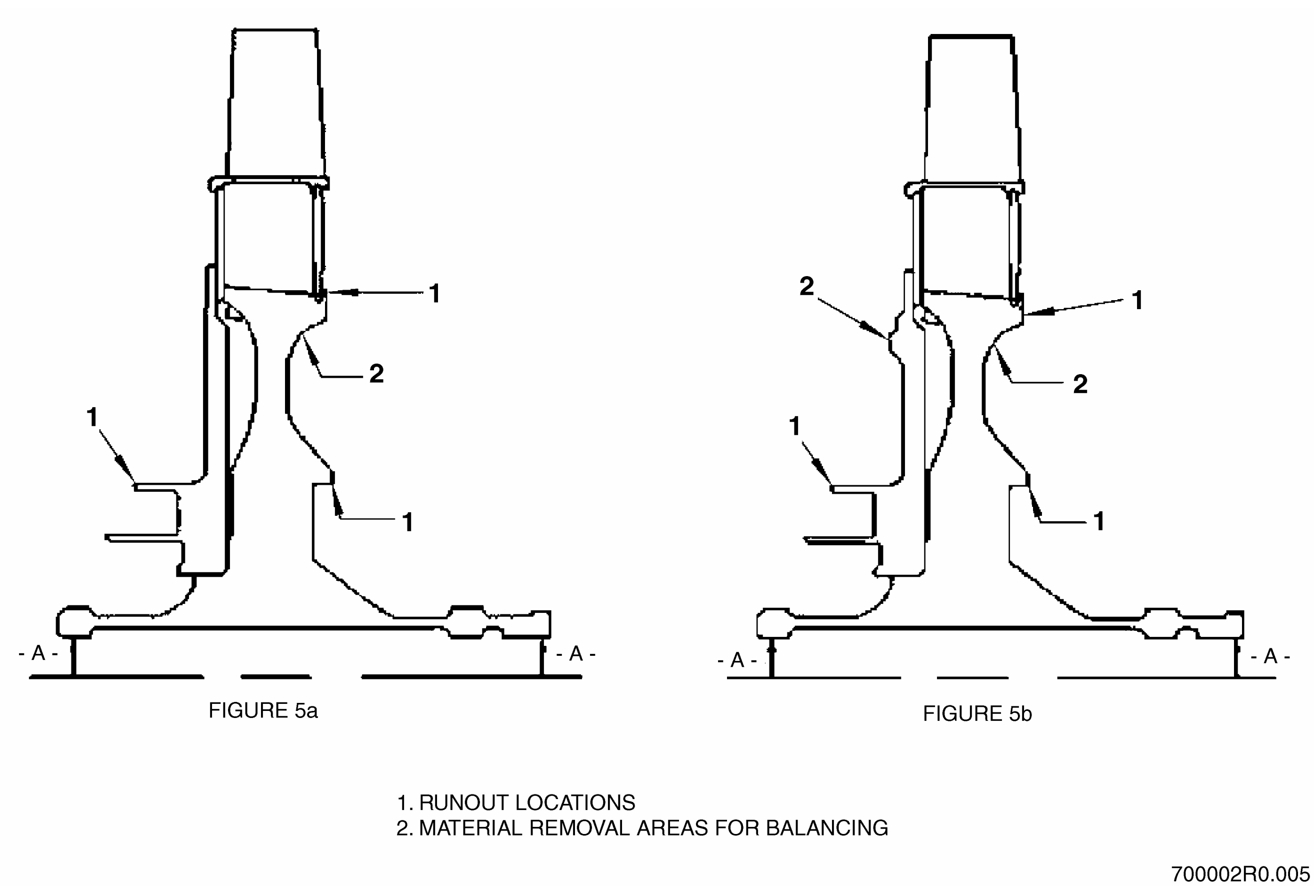
Figure 2



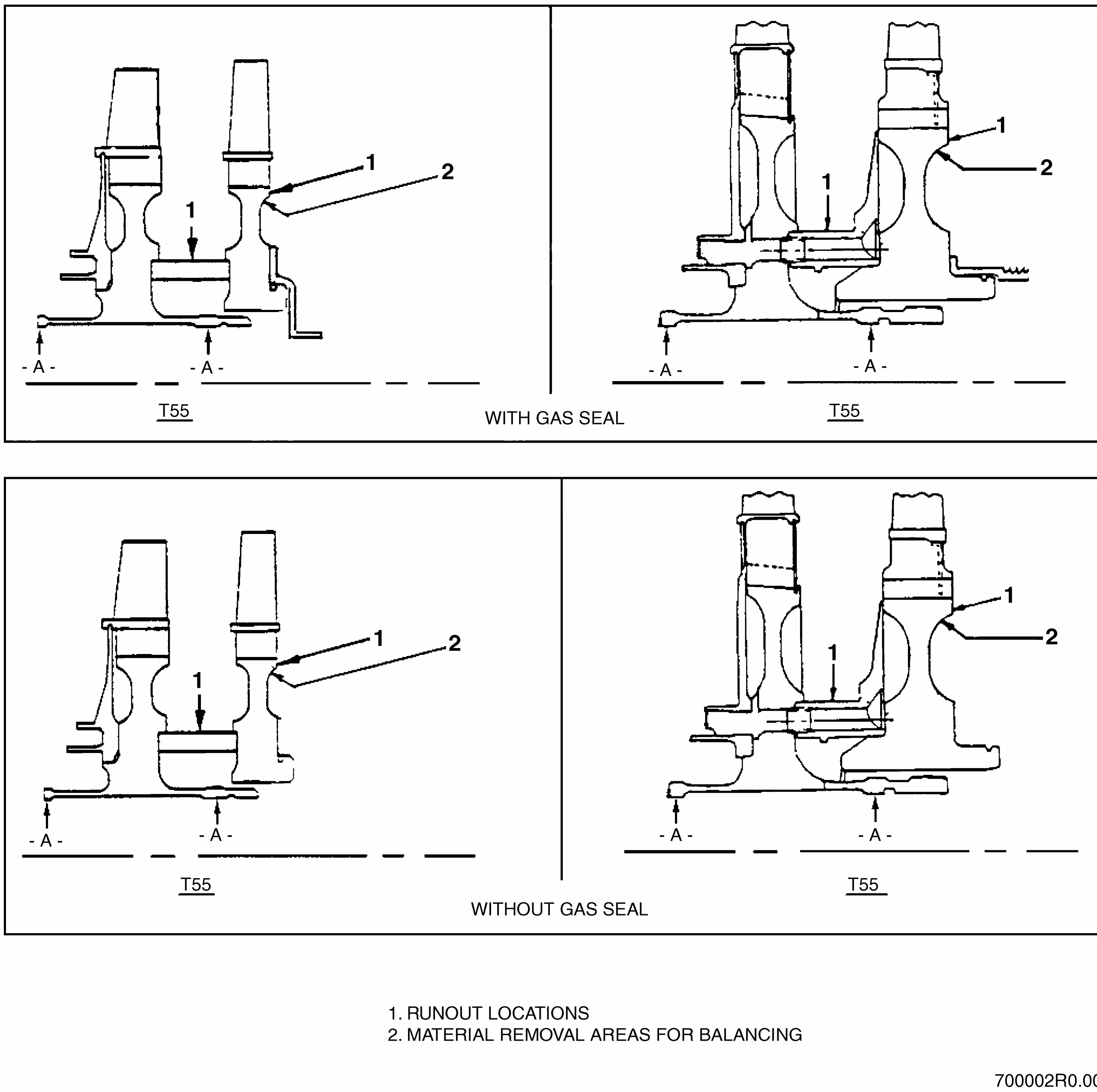

Compressor Rotor
Figure 3



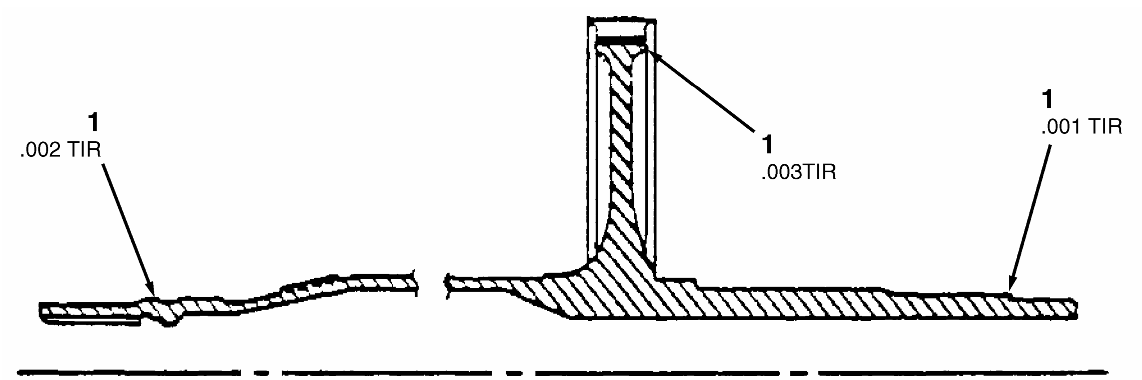

First Stage Turbine Spacer
Figure 4



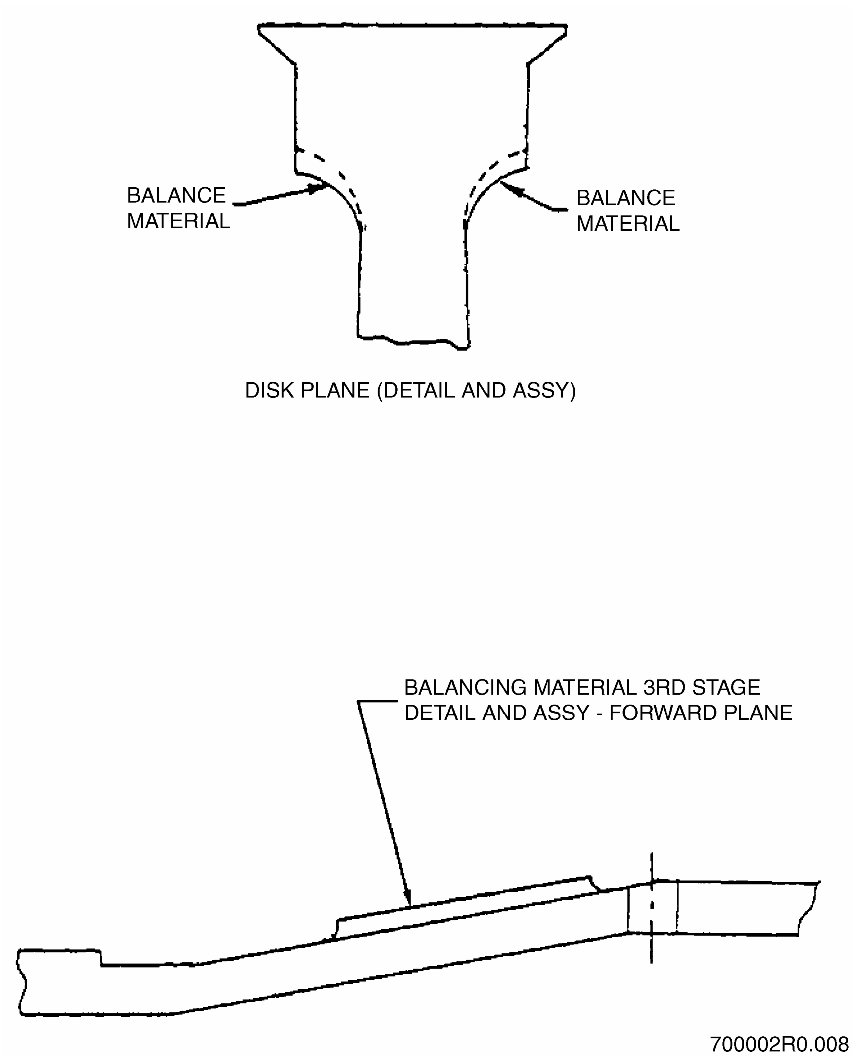

First Stage Turbine Wheel
Figure 5



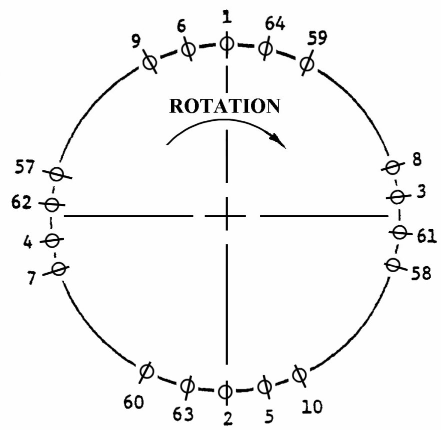

Gas Producer Turbine Assembly
Figure 6



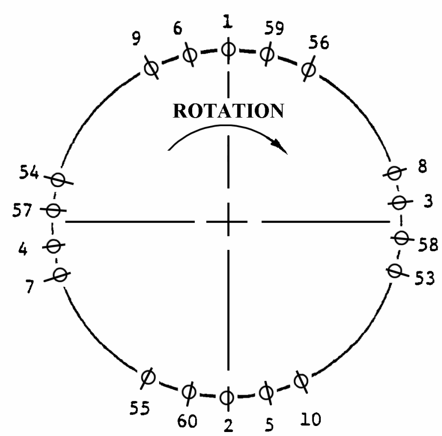

Integral Third Stage Turbine Wheel-Shaft - (Unbladed) Assembly (Type I)
Figure 7




Balance Material - Third Turbine Wheel-Shaft
Figure 8



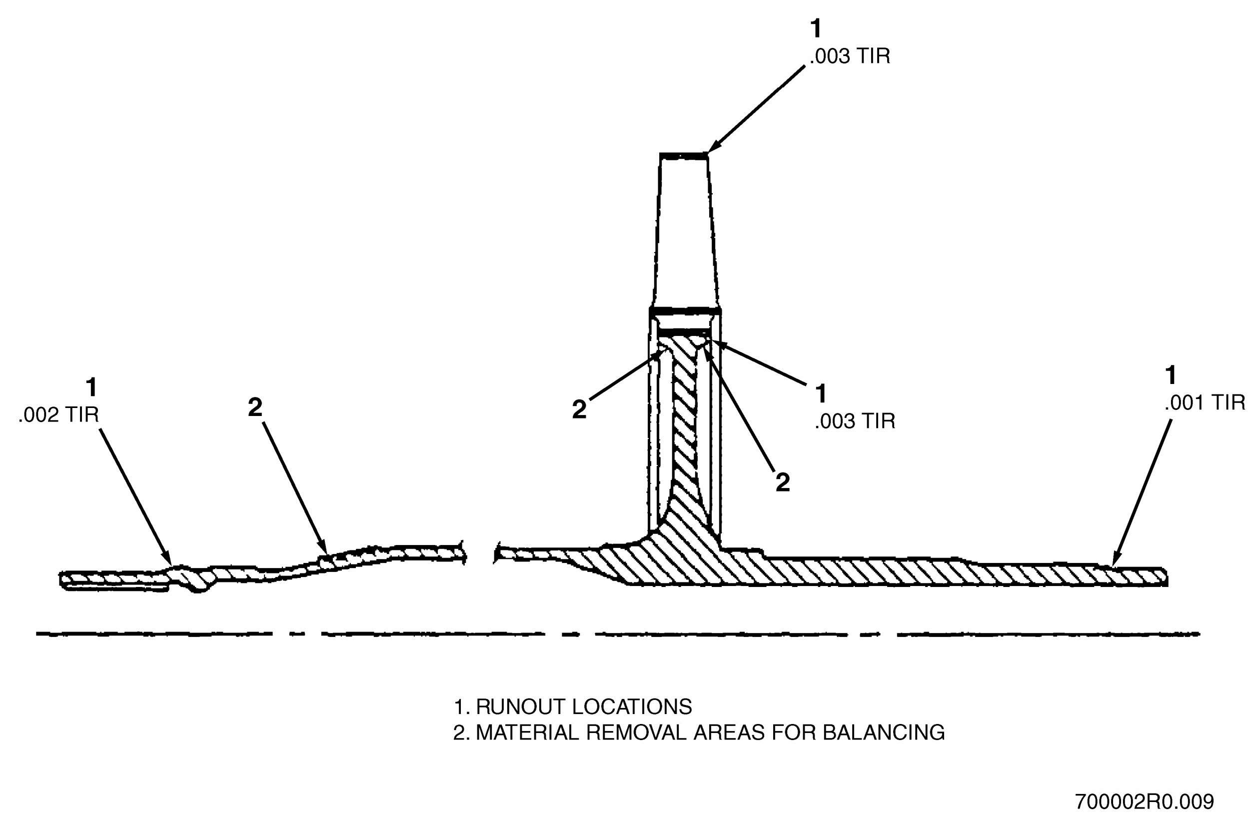
Third Stage



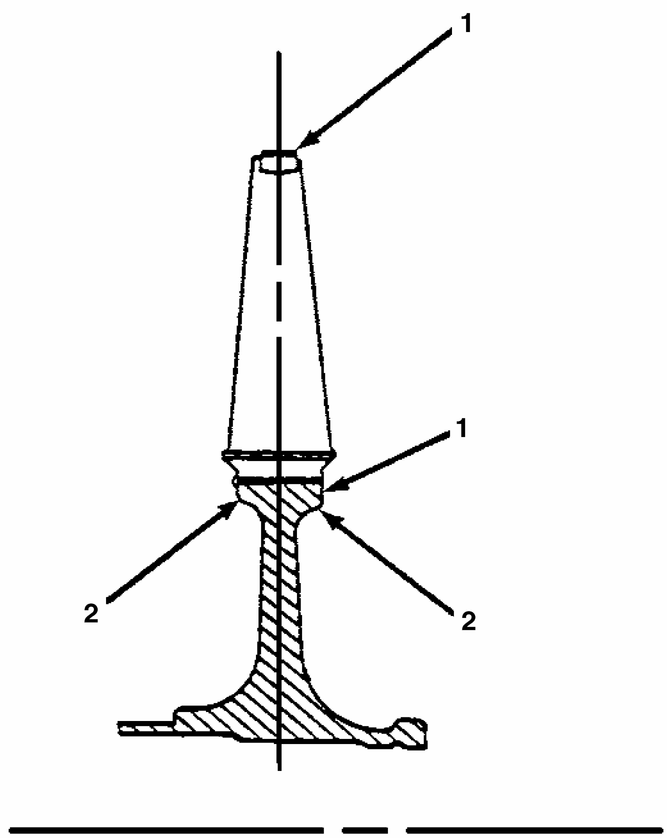
Fourth Stage

Turbine Disk - Rear View
Figure 9

UP781957



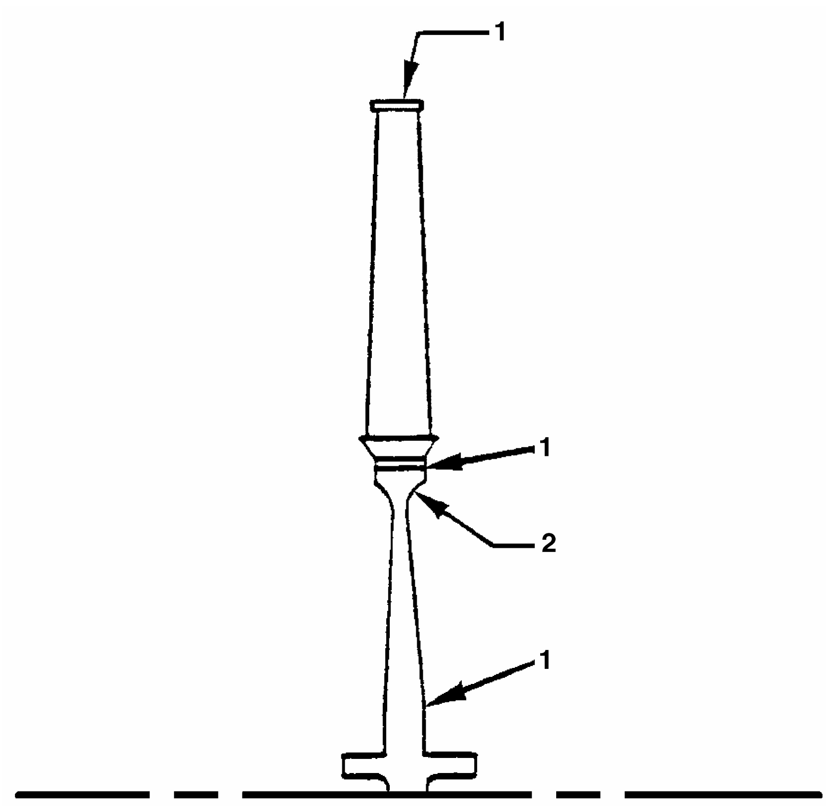

Integral Third Stage Turbine Wheel Shaft Assembly (Type I)
Figure 10



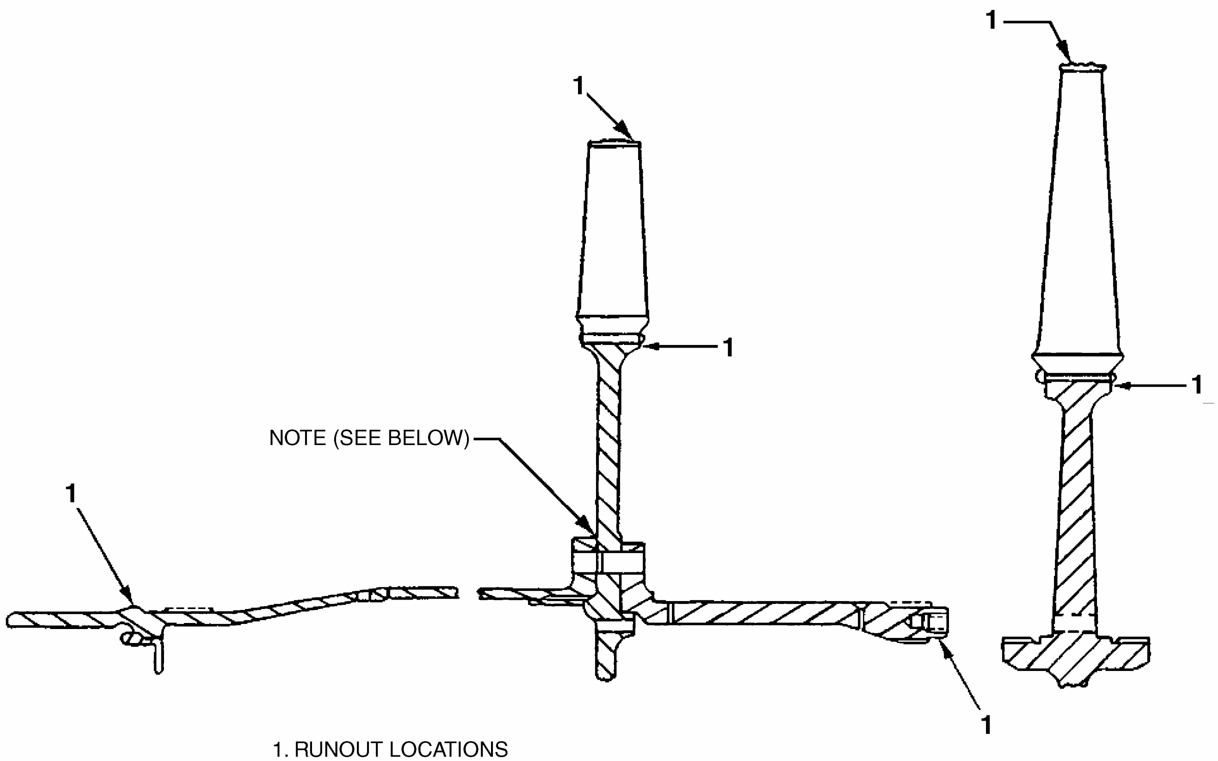

1. RUNOUT LOCATIONS
2. MATERIAL REMOVAL AREAS FOR BALANCING

700002R0.010

Fourth Stage Turbine Wheel (Type I)
Figure 11




Fourth Stage Turbine Wheel (Type II)
Figure 12

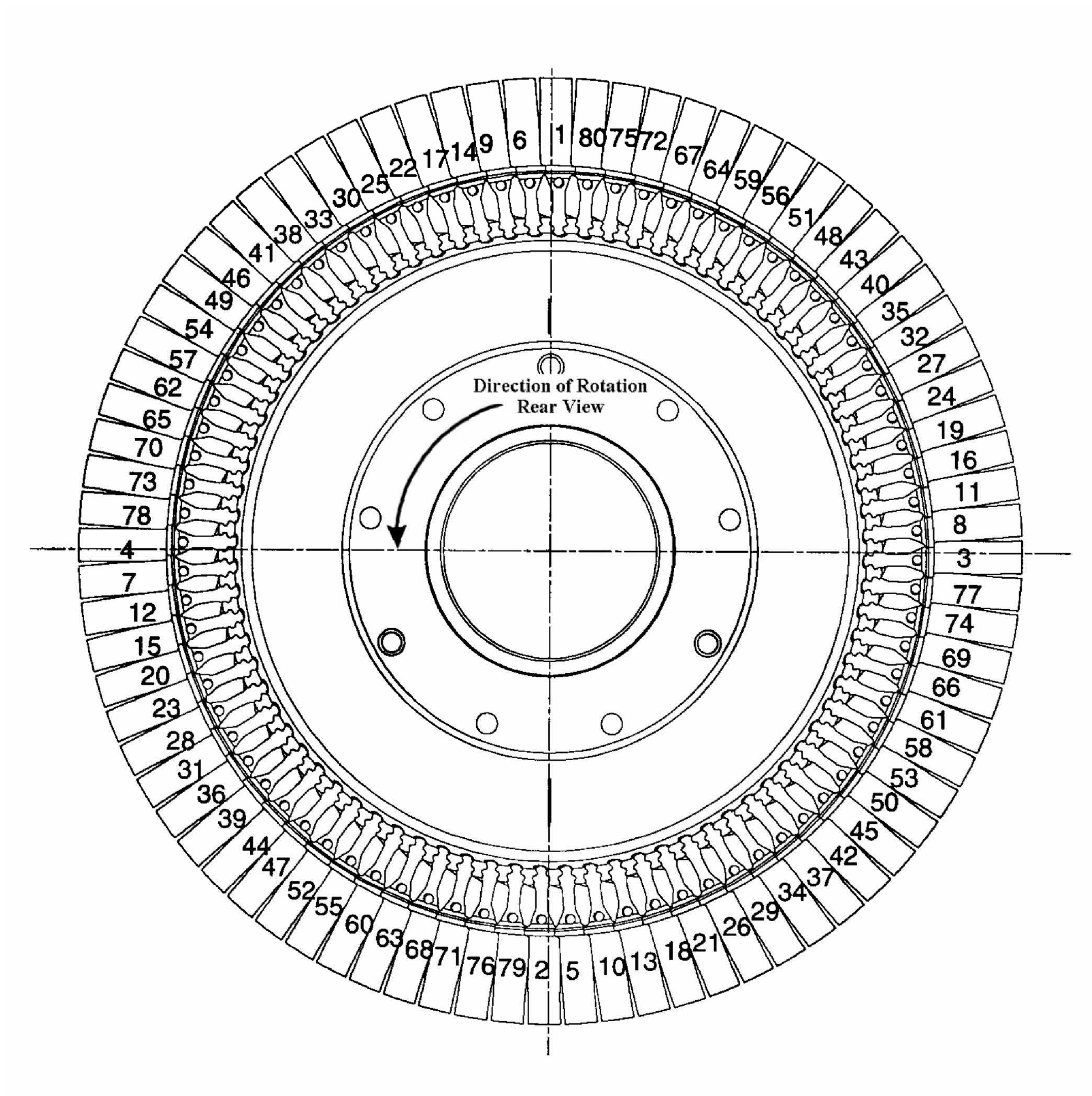



NOTE: THE INTERFACE BETWEEN THE THIRD TURBINE AND THE POWER SHAFT FLANGE MUST BE FLAT AND PARALLEL. NO GAP IS PERMITTED AFTER ASSEMBLY.

700002R0.012

Power Turbine Assembly (Type II)

Figure 13




Single Part Number Blade Installation Sequence First Stage Turbine Disk - Rear View
Figure 14

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## CHAPTER 70–60–00 - LASER

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1. Laser Cutting and Drilling - SP R419

A. Laser cutting and drilling shall be performed in accordance with the following instructions:

(1) Equipment. The laser cutting and drilling machine shall be equipped with suitable devices to control power output and mode, pulse rate and duration, cutting/indexing speed, beam focal position and orientation, beam spot size, and gas/assist flow rate.

(2) Processing parameters shall not be expressly defined in this specification, but are dependent upon the requirements of the product and equipment used.

(3) Heat treatment. When possible, laser cutting and drilling shall be performed on all parts prior to heat treatment.

(4) Surface to be brazed. Laser cutting of surfaces to be brazed shall be permitted provided the process for total recast layer removal is detailed in the process. The specific methods, or combination of methods, for recast layer removal shall consist of thermal treatment, chemical removal, abrasive blasting or machining.

(5) Visual inspection of parts. Unless otherwise specified in the technical documentation, the laser cut or drilled surface shall be free of imperfections caused by the laser processing (e.g. cracking, spatter, metal deposit, etc).

(6) Sampling. A representative sample or actual part shall require destructive evaluation every 30 days or every lot whichever is less.

(7) A representative sample shall be cut at right angles to the laser cut or drilled surface, polished, etched, and examined at 400 power magnification. The prepared surface shall not show evidence of imperfections in excess of those permitted in Table 1. The presence of these imperfections in a sample shall subject the parts it represents the rejection.

(8) Finished surfaces. Surfaces which are to be finish machined, chemically etched, or thermally treated after laser cutting or drilling may exceed the criteria specified in (4) provided the acceptance criteria can be met after final manufacturing operation.

(9) Records. Records shall include, but not be limited to, the following information:

(a) Manufacturer and type of laser, beam characteristics, power mode, pulse rate and durations, travel speed, and focal lens. (See Figure 1.)

(b) Part number, serial number (when applicable), number of parts, and rated condition of parts (i.e., accepted or rejected).

(c) Laboratory report of laser cut or drilled samples shall include reason for test, date, disposition, photomicrographs, and/or actual mounts and cutup remnants.

(10) Records shall be maintained on file for not less than 3 years.

1. A. (11) Definitions.

(a) Laser cutting. Any metal removal process using a laser beam focused to a high intensity spot to melt or vaporize material, cutting a slot through the full thickness of the workpiece while the workpiece is in motion relative to the beam. Trepanning of holes with a laser beam is included in this definition.

(b) Laser drilling (also called Percussion Drilling). Any metal removal process using a laser beam focused to a high intensity spot to melt or vaporize material without relative motion between the beam and workpiece, other than the indexing of the focal point along the axis of the hole.

(c) Lot. A shall be a continuous run of parts made without stopping or making any change in the laser drilling or cutting equipment or operating parameters.

Table 1. Laser Cutting and Drilling Acceptance Limits (1)

| Characteristics | Acceptance Limits | | | |
|---|---|---|---|---|
| Recast Layer Thickness (Depth) (5) Material | Average | | Globule | |
| | Inch | Millimeter | Inch | Millimeter |
| 300 Series SS | 0.003 | 0.08 | 0.004 | 0.10 |
| A286 | 0.003 | 0.08 | 0.004 | 0.10 |
| Hastelloy X | 0.003 | 0.08 | 0.004 | 0.10 |
| Hastelloy W | 0.003 | 0.08 | 0.004 | 0.10 |
| Haynes 230 | 0.003 | 0.08 | 0.004 | 0.10 |
| HS 188 | 0.004 | 0.10 | 0.008 | 0.20 |
| Inconel 903 | 0.003 | 0.08 | 0.004 | 0.10 |
| IN625 | 0.003 | 0.08 | 0.004 | 0.10 |
| N155 | 0.003 | 0.08 | 0.004 | 0.10 |
| Rene 41 | 0.004 | 0.10 | 0.008 | 0.20 |
| 713 | 0.003 | 0.08 | 0.004 | 0.10 |
| 718 | 0.003 | 0.08 | 0.004 | 0.10 |
| C101 | 0.003 | 0.08 | 0.004 | 0.10 |
| AM350 | 0.003 | 0.08 | 0.004 | 0.10 |
| AM355 | 0.003 | 0.08 | 0.004 | 0.10 |
| Titanium Alloys | 0.000 | 0.00 | 0.000 | 0.00 |

| | Recast Layer | | Base Metal | |
|---|---|---|---|---|
| Microcracks Length Material | Inch | Millimeter | Inch | Millimeter |
| 300 Series SS | 0.003 | 0.08 | 0.002 | 0.05 |
| A286 | 0.003 | 0.08 | 0.002 | 0.05 |
| Hastelloy X | 0.003 | 0.08 | 0.002 | 0.05 |
| Hastelloy W | 0.003 | 0.08 | 0.002 | 0.05 |
| Haynes 230 | 0.003 | 0.08 | 0.002 | 0.05 |
| HS 188 | 0.004 | 0.10 | 0.001 | 0.03 |
| Inconel 903 | 0.003 | 0.08 | 0.001 | 0.03 |
| IN625 | 0.003 | 0.08 | 0.002 | 0.05 |
| N155 | 0.003 | 0.08 | 0.002 | 0.05 |
| Rene 41 | 0.004 | 0.10 | 0.001 | 0.03 |
| 713 | 0.003 | 0.08 | 0.001 | 0.03 |
| 718 | 0.003 | 0.08 | 0.001 | 0.03 |

Table 1. Laser Cutting and Drilling Acceptance Limits (1) (Cont)

| Characteristics | Acceptance Limits | | | |
|---|---|---|---|---|
| | Recast Layer | | Base Metal | |
| Microcracks Length Material | Inch | Millimeter | Inch | Millimeter |
| C101 | 0.003 | 0.08 | 0.001 | 0.03 |
| AM350 | 0.003 | 0.08 | 0.001 | 0.03 |
| AM355 | 0.003 | 0.08 | 0.001 | 0.03 |
| Titanium Alloys | 0.000 | 0.00 | 0.000 | 0.00 |
| Cut Edge Taper | 0.003 inch (0.07 millimeter) or 5% of “T” or “D” whichever is less. This applies to lower 75% of material thickness (4). | | | |
| Burr | 0.005 inch (0.13 millimeter) maximum. | | | |

NOTES:

(1) Tolerances apply to material up to 0.080 inch thick. For over 0.080 inch thick, tolerances shall be as specified on the engineering drawing.

(2) T - Thickness of material.
D - Depth of hole or slot.

(3) Hole tape is 2X edge taper.

(4) The top 25% of edge taper may be slightly larger but is still acceptable.

(5) For multiwall cuts on an individual part (laser cuts through two or more walls simultaneously), the allowable recast on the succeeding wall’s edge shall be 1.5 times the maximum allowed for the single wall cut.

NOTE: This waiver shall not apply to parts which are laser machined by simultaneously cutting through a stack of single parts.

LASER CUTTING/DRILLING PROCEDURE

Process ________________________________________

Specification ________________________________________

Certification Number ________________________________

Part Name ________________________________________

Part Number ______________________________________ Operation Number ____________________

Detail Part Number __________________________

Material(s) __________________________________

Operation to be performed (Describe fully) __________________________________________________

Cleaning ___________________________________

Heat Treatment ______________________________

Laser Facility (Describe fully) ______________________________________________________

Machine Settings:

Power Output _______________________________

Power Mode ________________________________

Pulse Rate _________________________________

Frequency __________________________________

Cutting/Indexing Speed _______________________

Focal Length ________________________________

Angle to Surface _____________________________

Gas–Assist Flow Rate ________________________

Gas–Assist Type ____________________________

Special Requirements ______________________________________________________________

Prepared: _______________________________________ Date ____________________

Approved: _______________________________________ Date ____________________

(Honeywell Materials Laboratory)

Laser Cutting/Drilling Procedure
Figure 1

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# CHAPTER 70–65–00 - HEAT TREATMENT

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1. General Heat Treatment - SP R419

NOTE: This procedure shall not be used with rotating components or components used for primary containment.

A. The following symbols, added as a suffix to the applicable SP number, shall indicate required material heat treat condition and method of processing.

(1) L1 - Anneal.

(2) L2 - Normalize, homogenize.

(3) L3 - Harden.

(4) L4 - Temper.

(5) L5 - Stress relief (after machining or forming).

(6) L6 - Stabilization.

(7) L7S - Solution treatment.

(8) L7T - Aging.

(9) L8 - Special treatments.

B. Materials

(1) Materials contacting alloys during processing shall be selected such that deleterious interactions are avoided.

(2) Protective furnace environments shall be permitted for all heat treatments. The use of protective furnace atmosphere shall not result in abnormal surface effects (e.g., carburizing or decarburizing, nitriding, oxidizing, or removal of low vapor pressure elements).

(3) Atmosphere gasses and gas generators shall be controlled to provide consistent analysis to meet requirements.

(4) When specified for use, gasses shall meet the following requirements:

(a) Hydrogen: 99.95% Pure, Dew Point = 60°F or lower.

(b) Argon: 99.995% Pure, Dew Point = 60°F or lower.

1. C. Equipment

(1) Vacuum furnaces shall have instrumentation to sense and record the furnace vacuum.

(2) Heat treatment furnaces shall be capable of maintaining required temperatures in all areas of the work–load zone within the tolerance specified on the applicable SP as follows:

| Symbol | Work Load Zone Tolerances |
|---|---|
| I | ±25°F (14°C) |
| II | ±15°F (10°C) |
| III | ±10°F (6°C) |
| IV | Specified temperature range |

(3) Quenching tanks shall be capable of maintaining the following bath temperatures: Oil bath: 75 to 140°F (24 to 60°C): Water bath: 140°F (60°C) maximum.

(4) Handling equipment shall be capable of transferring alloy to be quenched from the furnace into the quenching medium such that the prior temperature tolerance is no more than doubled. That is, if a prior temperature of T ±25°F (14°C) is specified, the material shall enter the quench medium at T ±50°F (10°C) or higher.

(5) For parts requiring subzero cooling, a mechanically–cooled compartment capable of maintaining a temperature of -100°F (-73°C) or cooler in any area of the work load zone shall be used. A liquid media may be used to facilitate heat transfer. Subzero cooling equipment shall be equipped with time and temperature indicating and recording instruments.

(6) The heat treating supplier shall provide necessary controls as required to maintain specified processing data in the event of electrical power brownouts or total power failures during thermal treatments or automatic quenching operations.

D. Preparation

(1) Alloy surfaces shall be free of excessive carburization, decarburization, oils, grease, soilage, and marking materials that have potentials for deleterious interaction with alloys during heat treatment.

(2) Material shall be provided with suitable, compatible marking, stamping, or tagging to ensure specified traceability is maintained.

(3) Copper electroplating may be used as required to avoid carburization or decarburization.

1. E. Procedure

(1) Material shall be heat treated to the conditions specified and shall be in accordance with the codes and operations listed in the individual SP for the applicable alloy.

(2) Furnace temperature override controls shall be set at a maximum of 50°F (10°C) over the furnace control setting.

(3) Material shall be racked and fixtured to permit uniform heating and cooling so distortion, uneven residual stresses, and contact between pieces during heating and cooling is avoided.

(4) Time at temperature shall be recorded from the time the heaviest section reaches the temperature specified by the instruction sheet.

(5) When load thermocouples are used, time shall start when specified number of thermocouples are within the temperature tolerance for the operation; otherwise, time shall start when the control thermocouple recovers to the set temperature indicated before loading.

(a) Unless otherwise specified, a minimum of two load thermocouples shall be used for each heat treat batch.

(b) Placement of thermocouples should be specified to ensure part time at temperature is correct (i.e. placed directly in braze area, use of standard block sizes to insert thermocouple in a heat sink to simulate part thickness).

(6) Parts shall be held at temperature for the time specified in the applicable SP. Time at temperature tolerances shall not exceed the following.

| Time at Temperature | Tolerance |
|---|---|
| Up to 2 hours | -0, +5 minutes |
| 2 hours to 10 hours | -0, +10 minutes |
| Over 10 hours | -0, +30 minutes |

(7) When the cooling method specified in the SP is “air cool” and the furnace contains a protective atmosphere, the parts in the furnace shall be cooled at a rate equivalent to air cooling (e.g., parts heat treated in a vacuum may be cooled by the introduction of an approved inert gas and fan cooled in place).

(8) Tempering shall follow immediately after normalizing (where normalizing through–hardens the material) or hardening. Other heat treat operations which provide the most practical and economical manufacturing process may be incorporated into the manufacturing sequence with prior Honeywell approval.

1. E. (9) When cooling to room temperature in vacuum/inert atmospheres, parts may be removed and allowed to cool in air after cooling below 200°F (93°C).

(10) Unless otherwise stated, vacuum is specified as a minimum pressure of 1 X $10^{-3}$ Torr. Exceptions may be made for outgassing during braze cycles.

(11) Unless otherwise stated, partial pressure is 1 to 500 microns.

F. Process Control

(1) Furnaces, ancillary equipment, and pyrometry shall comply with SAE–AMS 2750, SAE–AMS 2759, SAE–AMS 2770, SAE–AMS 2801, SAE–AMS–M–6857, SAE–AMS–H–81200, or this specification, as applicable.

(2) Quenching media shall be sufficiently agitated to prevent visible evidence of vapor blanketing of material being quenched.

(3) Quenching media shall, by continuous circulation and filtering or periodic upgrading, be maintained sufficiently free of impurities and decomposition products to provide acceptable cooling characteristics.

(4) Temperature control charts shall be retained by the heat treat supplier and shall indicate furnace load number and date.

(5) Furnace load logbooks, or equivalent records approved by Honeywell, shall be retained by the heat treat supplier and shall include, as a minimum, the following information:

- Date and start time
- Part number(s)
- Quantity (each part)
- Furnace and load number
- Operator number
- Furnace time and temperature
- Lot number
- Part serial number (when specified)

(6) Parts failing to meet the requirements specified may be reheat treated once. Retempering shall not be considered a reheat treatment.

(7) Reheat treatment processes shall comply with initial heat treatment requirements.

(8) Records of reheat treatments shall be included with initial heat treatment records for the material represented.

G. Quality Assurance Provisions

(1) Honeywell reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure processing conforms to the requirements of this specification.

(2) Tests for compliance with hardness requirements are classified as “Acceptance Tests” and shall be performed in accordance with Paragraph H.

1. H. Sampling:

(1) Compliance testing shall be performed as specified by SAE–AMS 2750, SAE–AMS 2759, SAE–AMS 2770, SAE–AMS 2774, SAE–AMS 2801, SAE–AMS–M–6857, SAE–AMS–H–81200, or this specification, as applicable.

(2) Rejections. Material not processed in compliance with this specification shall be rejected.

I. Reports

(1) The processing records herein form a part of the traceable documentation and shall be maintained by the heat–treat supplier.

(2) Furnace charts and furnace load logbooks shall be made available for Honeywell audits by the heat treat supplier as specified in the documentation requirements for the component/material.

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1. INCO718 - SP R420

NOTE: This procedure shall not be used with rotating components or components used for primary containment.

A. Applicable Material Specifications: SAE–AMS 5383, SAE–AMS 5589, SAE–AMS 5596, SAE–AMS 5597, SAE–AMS 5662, SAE–AMS 5663, SAE–AMS 5664, M3606, and M3635

Table 1. Heat Treat Condition Codes

| Code | Operation | Temperature Tolerance |
|---|---|---|
| | Normalize: | I |
| L2 | 1. Heat parts to 2000°F (1093°C) in an inert atmosphere. | |
| | 2. Hold at heat for 1 to 2 hours. | |
| | 3. Cool in an inert atmosphere to below 90°F (32°C). | |
| L2A | Homogenize: | I |
| | 1. Heat parts to 2100°F (1149°C) in an inert atmosphere. | |
| | 2. Hold at heat for 10 hours. | |
| | 3. Cool in an inert atmosphere to room temperature. | |
| L7S | Solution Treatment: | I |
| | 1. Heat parts within range of 1750 to 1800°F (954 to 982°C) in an Inert atmosphere, holding at selected temperature within ±25°F (±14°C). | |
| | 2. Hold at heat for 1 hour. | |
| | 3. Cool in an inert atmosphere to room temperature (HRC 29 maximum, or equivalent). | |
| L7SZ | Solution Treatment: | I |
| | 1. Heat parts to 2075°F (1135°C) in an inert atmosphere. | |
| | 2. Hold at heat for 10 hours. | |
| | 3. Furnace cool to 1900°F (1038°C). | |
| | 4. Hold at heat for 2 hours. | |
| | 5. Cool to room temperature. | |
| L7T | Aging: | II |
| | 1. Heat parts to 1325°F (718°C). | |
| | 2. Hold at heat for 8 hours. | |
| | 3. Furnace cool at a rate of 100°F (38°C) per hour to 1150°F (621°C).* | |
| | *Alternate: The product may be cooled at a minimum rate of 75°F (24°C) per hour, provided the total precipitation time is not less than 18 hours. | |
| | 4. Hold at heat for sufficient time to provide a total of 18 hours at the aging temperatures. | |
| | 5. Air cool to room temperature (HRC 35 minimum, or equivalent). | |

Table 1. Heat Treat Condition Codes (Cont)

| Code | Operation | Temperature Tolerance |
|---|---|---|
| L7TA | Aging:<br>1. Heat parts to 1350°F (732°C).<br>2. Hold at heat for 10 hours.<br>3. Furnace cool at a rate of 100°F (38°C) per hour to 1150°F (621°C).<br>4. Hold at 1100°F (593°C) for 8 hours.<br>5. Air cool to room temperature (HRC 35.5 minimum, or equivalent). | II |
| L7ST | Solution Treatment Plus Aging:<br>L7S followed by L7T (HRC 35.5 minimum, or equivalent). | |
| L7TB | Aging:<br>1. Heat parts to 1500°F (816°C).<br>2. Hold at heat for 2 hours.<br>3. Air cool to room temperature.<br>4. Heat parts to 1325°F (718°C).<br>5. Hold at heat for 8 hours.<br>6. Furnace cool at a rate of 100°F (38°C) per hour to 1150°F (621°C).<br>7. Hold at 1150°F (621°C) heat for 8 hours.<br>8. Air cool to room temperature (HRC 35.5 minimum, or equivalent). | II |
| L7D | Delta Aging:<br>1. Heat parts to 1600°F (871°C) in an inert atmosphere.<br>2. Hold at heat for 10 hours.<br>3. Cool in an inert atmosphere to room temperature. | II |
| L7E | Short Aging:<br>1. Heat parts to 1400°F (760°C) in an inert atmosphere.<br>2. Hold at heat for 5 hours.<br>3. Furnace cool at 100 ±15°F (38°C) per hour to 1200°F (649°C).<br>4. Hold at heat until a total aging time (1. + 3.) of 8 hours has been reached.<br>5. Cool to room temperature. | I |

1. C–101 - SP R421

A. Applicable Material Specifications: M3617 (C–101 Nickel Base)

Table 1. Heat Treat Condition Codes

| Code | Operation | Temperature Tolerance |
|---|---|---|
| L8 | Special Heat Treatment: | I |
| | 1. Heat parts to 2050°F (1121°C) in an inert atmosphere or vacuum. | |
| | 2. Hold at heat for 2 hours. | |
| | 3. Cool to 1400°F (760°C) in an inert air atmosphere, at a rate of 130°F (54°C) per minute minimum, then air or inert gas fan cool to 400°F (204°C) or less. | |
| | 4. Heat parts to 1550°F (843°C) in an inert or air atmosphere. | |
| | 5. Hold at heat for 4 hours. | |
| | 6. Air or inert gas fan cool to 400°F (204°C) or less. | |
| | 7. Heat parts to 1400°F (760°C) in an inert or air atmosphere. | |
| | 8. Hold at heat for 16 hours. | |
| | 9. Air or inert gas fan cool to room temperature. | |
| L8A | Special Heat Treatment A: | I |
| | 1. Heat parts to 2050°F (1121°C) in an inert atmosphere or vacuum. | |
| | 2. Hold at heat for 2 hours. | |
| | 3. Cool in air or inert atmosphere at a rate equivalent to air cool. | |
| L8B | Special Heat Treatment B: | I |
| | 1. Heat parts to 1550°F (843°C) in an inert or air atmosphere. | |
| | 2. Hold at heat for 4 hours. | |
| | 3. Air or inert gas fan cool to 400°F (204°C) or less. | |
| | 4. Heat parts to 1400°F (760°C) in an inert or air atmosphere. | |
| | 5. Hold at heat for 16 hours. | |
| | 6. Cool in air. | |
| L8C | Post HIP Heat Treatment | I |
| | 1. Heat parts to 2200°F (1204°C) in an inert atmosphere. | |
| | 2. Hold at heat for 2 hours. | |
| | 3. Cool to 1800°F (982°C) in an inert atmosphere, at a rate of 100 to 200°F (38 to 93°C) per minute, then air or inert gas fan cool to room temperature. | |

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1. HASTELLOY X - SP R422

A. Applicable Material Specifications: SAE–AMS 5390, SAE–AMS 5336, SAE–AMS 5754, SAE–AMS 5798, M3614 (Hastelloy X)

Table 1. Heat Treat Condition Codes

| Code | Operation | Temperature Tolerance |
|---|---|---|
| L7S | *Solution Heat Treatment:<br>1. Parts up to 0.25 (6.35 mm) thick.<br>a. Heat parts to 2150°F (1177°C).<br>b. Hold at heat for 15 minutes.<br>c. Rapid air cool.<br>d. Hardness: HB 116–241, or equivalent.<br>2. Parts greater than 0.25 inch (6.35 mm) thick.<br>a. Heat parts to 2175°F (1191°C).<br>b. Hold at heat for 30 minutes.<br>c. Water quench.<br>d. Hardness: HB 116–241, or equivalent.<br>**For in–process solution treatment of M3614 only:<br>3. Parts up to 0.25 inch (6.35 mm) thick.<br>a. Heat parts to 1975°F (1079°C).<br>b. Hold at heat for 15 minutes.<br>c. Rapid air cool.<br>d. Hardness: HB 116–241, or equivalent.<br>4. Parts greater than 0.25 inch (6.35 mm) thick.<br>a. Heat parts to 1950 to 2050°F (1066 to 1121°C).<br>NOTE: Use the temperature within this range to meet the property requirements.<br>b. Hold at heat for 30 minutes.<br>c. Water quench.<br>d. Hardness: HB 116–241, or equivalent.<br>*For identification of proper solution heat treatment on internal documents (e.g., operation sheets, etc), identify as SP R422–L7S1, SP R422–L7S2, etc.<br>**Final solution treatment after all forming and welding operations are completed shall be at 2150°F (1177°C). | I |

Table 1. Heat Treat Condition Codes (Cont)

| Code | Operation | Temperature Tolerance |
|---|---|---|
| L7SR | Special (Rejuvenation) Heat Treatment R: | I |
| | 1. Heat parts to 1200°F (649°C). | |
| | 2. Introduce partial pressure hydrogen. | |
| | 3. Heat parts to 2050°F (1121°C). | |
| | 4. Hold at heat for 50 to 70 minutes. | |
| | 5. Control cool to 1700°F (927°C) at a rate of 20 to 50°F (10°C) per minute. | |
| | 6. Hold for 1 minute. | |
| | 7. Gas fan cool to 250°F (121°C) or less. | |

## CHAPTER 70–80–00 - CONSUMABLE MATERIALS

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# CHAPTER 70–80–00 - CONSUMABLE MATERIALS

1. Introduction

   A. General

      (1) This section contains a complete listing of the Consumable Materials used during maintenance of the engine.

      (2) The Consumable Materials list provides an item number for the consumable, its nomenclature, manufacturer's designation and/or specification, and the manufacturer. Similar or like products are grouped together by categories and alternate equivalent materials have a letter suffix attached to the basic item number. Use of all the materials listed is not mandatory if the contractor has qualified equivalent materials at their facility to accomplish all job functions in a competent and efficient manner. The consumable material categories are as follows:

| Group | Category |
|---|---|
| 01 | Adhesives, Fillers, and Sealants |
| 02 | Lubricants, Oils, and Corrosion Preventatives |
| 03 | Brazing and Welding Materials |
| 04 | Acids, Etchants, and Strippers |
| 05 | Abrasives |
| 06 | Coatings |
| 07 | Paints and Solvents |
| 08 | Stock Materials |
| 09 | Inspection Materials |
| 10 | General Materials |

1. B. Prior to use of any consumable material, observe all safety precautions in 70–00–04.

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIAL'S INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

C. Explanation of Columns

(1) Column 1 - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material.

(2) Column 2 - Description. Indicates the item name and, if required, a description to identify the item.

(3) Column 3 - Specification. Indicates the Federal or Aerospace Material Specification for the item listed in Column 2, as applicable.

(4) Column 4 - Manufacturer's Designation. Indicates the manufacturer's brand name and/or identification of the item listed in Column 2, as applicable. A * designation proprietary process that may only be performed by the manufacturer or their designees.

(5) Column 5 - Manufacturer. Indicates the manufacturer of an item and his location, as applicable.

GROUP 01
ADHESIVES, FILLERS, AND SEALANTS

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 01– | | | | |
| 01 | Adhesive | | 3M 1838 B/A | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 02 | Adhesive | | 3M 1300L | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 03 | Adhesive, Epoxy | | Epon 907 | Miller Stephenson Chemical Co, Inc, George Washington Hwy, Danbury, CT 06810 |
| 04 | Adhesive, Epoxy | | EA9394 | Dexter–Hysol, Deer Point, CA (925) 458–8000; available from Adhesive Packaging Specialties Inc, 103 Foster St, P.O. Box 31, Peabody, MA 01960 |
| 05 | Adhesive, Epoxy | | EA9394 | Dexter–Hysol, Deer Point, CA (925) 458–8000; available from Tracon Co, 55 N St, Medford, MA 02155 |
| 06 | Adhesive, Epoxy | | Devcon - Aluminum F | ITW Devcon, Brunel Close, Park Farm Industrial Estate, Wellinborough, Northants NN8 6Qx |
| 07 | Compound, Thread Locking | | Loctite 272 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 08 | Compound, Thread Locking | MIL–S–46163, Type I | Loctite 277 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 09 | Compound, Retaining | | Loctite 620 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 10 | Compound, Retaining | MIL–R–46082, Type II | Loctite 640 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |

GROUP 01
ADHESIVES, FILLERS, AND SEALANTS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 01– | | | | |
| 11 | Primer | ASTM D5363 Grade T | Locquic Primer T, No. 747 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 12 | Adhesive, Epoxy | | Epoxylite #203 | Epoxylite Corp, P.O. Box 19671, 9400 Toledo Way, Irvine, CA 92713–9671 |
| 13 | Adhesive, Epoxy | | Epon 934 | Aerospace–Structural Adhesives, 2850 Willow Pass Rd, P.O. Box 312, Bay Point, CA 94565–0031 |
| 14 | Adhesive, Epoxy | | Epoweld 8173 | Hardman Inc, 600 Cortlandt St, Bellville, NJ 07109–3328 |
| 15 | Adhesive, Silicone Rubber | | RTV 31 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 16 | Adhesive, Silicone Rubber | | RTV 106 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 17 | Adhesive, Silicone Rubber | | RTV 159 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 18 | Catalyst | | RTV 9950 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 19 | Filler, Silicone Rubber | | Semkit LTCT11527–04 | Adhesives Packaging Specialties Inc, 103 Foster St, P.O. Box 31, Peabody, MA 01960 |
| 20 | Filler, Silicone Rubber | | Semkit TE32380 | Adhesives Packaging Specialties Inc,103 Foster St, P.O. Box 31, Peabody, MA 01960 |

GROUP 01
ADHESIVES, FILLERS, AND SEALANTS (CONT)

| Group–<br>Item No. | Description | Specification | Manufacturer's<br>Designation | Manufacturer |
|---|---|---|---|---|
| 01– | | | | |
| 21 | Catalyst, Foam | | DABCO T | Air Products and Chemicals, Inc, 7201 Hamilton Blvd, Allentown, PA 18195–1501 |
| 22 | Prepolymer | | PAPI | Dow Chemical, LaPorte, TX<br>or<br>Dow Chemical, Midland, TX |
| 23 | Primer, Red | | V–06 | Upjohn Corp, Polyder Div, LaPorte, TX |
| 24 | Filler, Polyether | | Polyether Resin #2 | Dow Corning Corp, P.O. Box 995, 3901 S Saginaw Rd, Midland, MI 48640 |
| 25 | Filler, Silicone Rubber | | RTV 88 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 26 | Stabilizer, Silicone Glycol | | 193 Surficant | Dow Corning Corp, P.O. Box 995, 3901 S Saginaw Rd, Midland, MI 48640 |
| 27 | Compound, Jointing, Hylomar | | PL–32 Spray | Marston Bentley Inc, 1848 Starr–Batt Dr, Rochester, MI 48309 |
| 28 | Compound, Jointing, Hylomar | | PL–32/L | Marston Bentley Inc, 1848 Starr–Batt Dr, Rochester, MI 48309 |
| 29 | Compound, Jointing, Hylomar | | PL–32/M | Marston Bentley Inc, 1848 Starr–Batt Dr, Rochester, MI 48309<br>or<br>Marston Lubricants, 9 Naylor St, Liverpool, England L36DS |
| 30 | Compound, Sealant | | KEL–F–800 | Standard T Chemical Co, Staten Island, NY 10300 |
| 31 | Sealant, Zinc Chromate | TT–P–1757, SAE AMS 3110 | | |

GROUP 01
ADHESIVES, FILLERS, AND SEALANTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 01– | | | | |
| 32 | Sealant, Zinc Chromate, Nondrying | | JC5A (CA1000 is Alternate) | Courtaulds Aerospace, ASC–Phoenix, 3902 E Roeser Rd, Phoenix, AZ 85040–3972 |
| 33 | Non–Chromate Sealant, Nondrying | | (CA1000 Alternate to JC5A) | Courtaulds Aerospace, ASC–Phoenix, 3902 E Roeser Rd, Phoenix, AZ 85040–3972 |
| 34 | Non–Chromate Sealant, Nondrying | | | |
| 35 | Compound, Sealant Proseal | MIL–S–81733, Type II | PS87B2 | Courtaulds Aerospace, ASC–Phoenix, 3902 E Roeser Rd, Phoenix, AZ 85040–3972 |
| 36 | Filler, Glass Microballoons | | IG–101 | Emerson and Cuming Composite Materials Inc, 59 Walpole St, Canton, MA 02021 |
| 37 | Primer, Red | | SS 4155 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 38 | Filler, Silicone Rubber | | RTV 630 | GE Company, Silicone Products Div, 260 Hudson River Rd, Waterford, NY 12188 |
| 39 | Compound, Thread Locking | | Loctite 088 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 40 | Sealant, Pipe | | Loctite 592 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 41 | Filler, Silicone Rubber | | V–695 | Rhodia, VSI, 405 Jordan Rd, Troy, NY 12160 |

GROUP 01
ADHESIVES, FILLERS, AND SEALANTS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 01– | | | | |
| 42 | Primer | | DC1200 | Dow Corning Corp, P.O. Box 995, 3901 S Saginaw Rd, Midland, MI 48640 |
| 43 | Joining Compound, High Temperature | | Silkolene 762 | Dalton & Co, Ltd, Silkolene Oil Refinery, Belpher, Derbyshire England |
| 44 | RTV Primer | | SS4004 | GE Company, Silicon Products Div, 260 Hudson River Rd, Waterford, NY 12188 |

GROUP 02
LUBRICANTS, OILS, AND CORROSION PREVENTATIVES

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 02– | | | | |
| 01 | Compound Thread, Antiseize | MIL–PRF–907 | Never Seez, General Purpose Nickel Base | Bostik Consumer Div, Emhart Corp, 221 Oley St, P.O. Box 3716, Reading, PA 19605 |
| 02 | Compound Thread, Antiseize | | Never Seez, Pure Nickel Special NSN–165 (1 lb can) | Bostik Consumer Div, Emhart Corp, 221 Oley St, P.O. Box 3716, Reading, PA 19605 |
| 03 | Compound Thread, Antiseize | MIL–PRF–907 | Loctite 767 Copper Base | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 04 | Compound Thread, Antiseize | | High Purity Antiseize, PN 51572 | Henkel Loctite Corp, 1001 Trout Brook Crossing, Rocky Hill, CT 06067 |
| 05 | Fluid, Hydraulic | | | |
| 06 | Fluid, Calibrating | MIL–C–7024, Type I | | |
| 07 | Fluid, Calibrating | MIL–C–7024, Type II | | |
| 08 | Packing Assembly Aid | A–A–20100A | Primex 3 Shortening | PRC Desoto International, 3092 E Roeser Rd, Phoenix AZ 85040 |
| 09 | Packing Assembly Aid | | Ultrachem Assembly Fluid 1 | Ultrachem Inc, 900 Centerpoint Blvd, New Castle, DE 19720 |
| 10 | Graphite Powder | | 154 | Acheson Colloids Co Div, Acheson Industries Inc, P.O. Box 611747, 1600 Washington Ave, Port Huron, MI 48061–1747 |
| 11 | Graphite Flakes | | No. 635 | Dixon Ticonderoga Co, Ridgeway Blvd, P.O. Box 287, Lakehurst, NJ 08733 |
| 12 | Grease | SAE–AMS–G–4343 | | |

GROUP 02
LUBRICANTS, OILS, AND CORROSION PREVENTATIVES (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 02– | | | | |
| 13 | Powder, Molybdenum Disulfide | SAE–AMS–M–7866 | Moly–Powder | Dow Corning Corp, P.O. Box 995, 3901 S Saginaw Rd, Midland, MI 48640 |
| 14 | Grease, Molybdenum Disulfide | | Molykote Type G–N | Dow Corning Corp, P.O. Box 995, 3901 S Saginaw Rd, Midland, MI 48640 |
| 15 | Dry Graphite Film Lubricant | MIL–L–23398 | D.G.F. 123 | Miracle Power Products Corp, 1101 Belt Line St, Cleveland, OH 44109–2849 |
| 16 | Oil, Castor | ASTM D960 | | |
| 17 | Oil, Cutting | | Kut–45 | Quaker Chemical Corp, Elm and Lee St, Conshohocken, PA 19428 |
| 18 | Oil, Cutting | | Circo–X–Light | R.E. Carroll Co, P.O. Box 139, 1570 N Olden Ave, Trenton, NJ 08638–3204 |
| 19 | Oil, Immersion | | | |
| 20 | Oil, Lubricating | MIL–PRF–6081 | Grade 1010 | |
| 21 | Oil, Lubricating | MIL–PRF–6085 | | |
| 22 | Oil, Lubricating | MIL–PRF–7808 | | Refer to applicable ENGINE MANUAL - Description and Operation |
| 23 | Oil, Lubricating | MIL–PRF–23699 | | Refer to applicable ENGINE MANUAL - Description and Operation |
| 24 | Oil, Lubricating | MIL–PRF–32033 | Alox 2201EF | Alox Corp, 3943 Buffalo Ave, P.O. Box 517, Niagara Falls, NY 14302 |
| 25 | Oil, Lubricating, Machine | | 30 Weight | Local Purchase |
| 26 | Oil, Penetrating | MIL–C–81309 | | |

GROUP 02
LUBRICANTS, OILS, AND CORROSION PREVENTATIVES (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 02– | | | | |
| 27 | Oil, Penetrating | A–A–50493 | Exxon Penetrating Oil | Exxon Co USA, Government Sales, P.O. Box 2180, 800 Bell St, Houston, TX 77252–2180 |
| 28 | Oil, Penetrating | A–A–50493 | Mobil Penetrating Oil | Mobil Chemical Co, Chemical Coatings Div, Short Hills, NJ |
| 29 | Oil, Penetrating | A–A–50493 | Texaco Penetrating Oil | Texaco Inc, Corporate Headquarters, 2000 Westchester Ave, White Plains, NY 10604 |
| 30 | Oil, Penetrating | A–A–50493 | WD–40 Penetrating Oil | Local Purchase |
| 31 | Oil, Penetrating | | LPS–2 | LPS Laboratories Inc, 4647 Hugh Howell Rd, P.O. Box 5004, Tucker, GA 30084 |
| 32 | Oil, Spindle | MIL–L–46014, Type II | Velocite 6 | |
| 33 | Oil, Treatment | | STP | Local Purchase |
| 34 | Petrolatum | VV–P–236 | | |
| 35 | Plastilube | | Moly No. 3 | Sulflo, Inc, 1158 Erie Ave, P.O. Box 285, N Tonawanda, NY 14120–3507 |
| 36 | Corrosion Preventative | MIL–C–11796 | | |
| 37 | Corrosion Preventative Compound | MIL–C–6529, Type I | Braycote | |
| 38 | Corrosion Preventative Oil | MIL–C–8188 | | |

GROUP 02
LUBRICANTS, OILS, AND CORROSION PREVENTATIVES (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 02– | | | | |
| 39 | Corrosion Preventative | | 3475 | American Oil and Supply Co, 238 Wilson Ave, Newark, NJ 07105 |
| 40 | Corrosion Preventative Varnish | MIL–R–3043, SAE AMS 3132 | | |
| 41 | Metal Conditioner and Rust Remover Compound | MIL–C–10578 | | Chemetall Oakite Inc, 50 Valley Rd, Berkeley Heights, NJ 07922–2712 |
| 42 | Grease | MIL–G–81322 | PO Aircraft Grease 395 | American Oil and Supply Co, 238 Wilson Ave, Newark, NJ 07105 |
| 43 | Oil, Synthetic Turbine | | Brayco 599 | Castrol, Inc, Specialty Products Div, 16715 Von Karman Ave, Suite 230 Irvine, CA 92714–4952 |
| 44 | Assembly Fluid | | Royco HF–825 | Anderol Inc, Box 518, 215 Merry Lane, East Hanover, NJ 07936–0518 |

GROUP 03
BRAZING AND WELDING MATERIALS

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 03– | | | | |
| 01 | Brazing Filler Alloy | SAE AMS 4765, AWS A5.8 CL BAg–13A | | |
| 02 | Brazing Filler Alloy | SAE AMS 4769, AWS A5.8 CL BAg–1 | | |
| 03 | Brazing Filler Alloy | SAE AMS 4770, AWS A5.8 CL BAg–1A | | |
| 04 | Brazing Filler Alloy | SAE AMS 4771, AWS A5.8 CL BAg–3 | | |
| 05 | Brazing Filler Alloy | SAE AMS 4772, AWS A5.8 CL BAg–13 | | |
| 06 | Brazing Filler Alloy | SAE AMS 4775, AWS A5.8 CL BNi–1 | | |
| 07 | Brazing Filler Alloy | SAE AMS 4776, AWS A5.8 CL BNi–1A | | |
| 08 | Brazing Filler Alloy | SAE AMS 4777, AWS A5.8 CL BNi–2 | | |
| 09 | Brazing Filler Alloy | SAE AMS 4782, AWS A5.8 CL BNi–5 | | |
| 10 | Brazing Filler Alloy | SAE AMS 4787 | | |
| 11 | Brazing Filler Alloy | AWS A5.8 CL BNi–6 | | |
| 12 | Brazing Filler Alloy | AWS A5.8 CL BNi–10 | | |
| 13 | Flux, Silver Brazing | SAE AMS 3410, O–F–499 | | |

GROUP 03
BRAZING AND WELDING MATERIALS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 03– | | | | |
| 14 | Lacquer Stop Off | | Nicrobraze Green | Wall Colmonoy Corp, Stainless Processing Div, 19345 John R St, Detroit, MI 48203 |
| 15 | Lacquer Stop Off | | Nicrobraze 170 | Wall Colmonoy Corp, Stainless Processing Div, 19345 John R St, Detroit, MI 48203 |
| 16 | Solder | | 488S0146 | Local Purchase |
| 17 | Solder | ASTM B32, Grade AG 1.5 | | |
| 18 | Welding Wire | | CM64 | Metec Inc, Fairfield, NJ |
| 19 | Welding Wire | | Oxweld 65 | Union Carbide Corp, A Subsidiary of Dow Chemical Co, 39 Old Ridgebury Rd, Danbury, CT 06817–0001 |
| 20 | Welding Wire | SAE AMS 4181 | | |
| 21 | Welding Wire | SAE AMS 4190 | | |
| 22 | Welding Wire | SAE AMS 4395 | | |
| 23 | Welding Wire | SAE AMS 4396 | | |
| 24 | Welding Wire | SAE AMS 4418 | QE22A | |
| 25 | Welding Wire | SAE AMS 4954 | | |
| 26 | Welding Wire | SAE AMS 4956 | | |
| 27 | Welding Wire | SAE AMS 5670 | | |
| 28 | Welding Wire | SAE AMS 5680 | | |
| 29 | Welding Wire | SAE AMS 5694 | | |
| 30 | Welding Wire | SAE AMS 5774 | | |
| 31 | Welding Wire | SAE AMS 5776 | | |
| 32 | Welding Wire | SAE AMS 5784 | | |
| 33 | Welding Wire | SAE AMS 5786 | | |

GROUP 03
BRAZING AND WELDING MATERIALS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 03– | | | | |
| 34 | Welding Wire | SAE AMS 5789 | | |
| 35 | Welding Wire | SAE AMS 5794 | | |
| 36 | Welding Wire | SAE AMS 5796 | | |
| 37 | Welding Wire | SAE AMS 5797 | | |
| 38 | Welding Wire | SAE AMS 5798 | | |
| 39 | Welding Wire | SAE AMS 5804 | | |
| 40 | Welding Wire | SAE AMS 5832 | | |
| 41 | Welding Wire | SAE AMS 5837 | | |
| 42 | Welding Wire | SAE AMS 5838 | | |
| 43 | Welding Wire | SAE AMS 6382 | | |
| 44 | Welding Wire | SAE AMS 6457 | | |
| 45 | Brazing Filler Alloy | QQ–B–654 | | |
| 46 | Welding Wire | Haynes 230 | | |

GROUP 04
ACIDS, ETCHANTS, AND STRIPPERS

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 04– | | | | |
| 01 | Boric Acid | MS–36038 | | Mallinckrodt Baker Inc, 222 Red School Lane, Phillipsburg, NJ 08865–2219 |
| 02 | Chromic Acid | A–A–55827 | Commercial Grade | |
| 03 | Glacial Acetic Acid | A–A–55829 | Commercial Grade | |
| 04 | Hydrochloric Acid | ASTM E1146 | Commercial Grade | |
| 05 | Muriatic Acid | ASTM E1146 | | |
| 06 | Hydrofluoric Acid | MIL–A–24641 | Commercial Grade | |
| 07 | Nitric Acid | A–A–59105 | Commercial Grade | |
| 08 | Phosphoric Acid | A–A–55820 | Oakite 131 | Chemetall Oakite Inc, 50 Valley Rd, Berkeley Heights, NJ 07922–2712 |
| 09 | Sulfamic Acid | | | |
| 10 | Sulfuric Acid | A–A–55828 | | |
| 11 | Aluminum Hydroxide | | Dried Gel NF Grade | |
| 12 | Ammonium Bifluoride | | Commercial Grade | Axton Cross Co, P.O. Box 463, N Haven, CT 06473 |
| 13 | Ammonium Nitrate | A–A–59476/ MIL–A–50460 | | |
| 14 | Calcium Fluoride | | | |
| 15 | Cupric Sulphate | ANSI B602 | Reagent Grade | |

GROUP 04
ACIDS, ETCHANTS, AND STRIPPERS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 04– | | | | |
| 16 | Ferric Chloride | A–A–59456 | | |
| 17 | Nickel Chloride | DOD–N–51512 | | |
| 18 | Magnesium Fluoride | | | |
| 19 | Potassium Fluoride | | Commercial Grade | |
| 20 | Potassium Hydroxide | ASTM E1456 | CP OR USP Grade | |
| 21 | Potassium Manganate | | | |
| 22 | Sodium Carbonate | A–A–59563 | | |
| 23 | Sodium Cyanide | | | |
| 24 | Sodium Dichromate | A–A–59123 | | |
| 25 | Sodium Hydroxide | ASTM D456 | | |
| 26 | Sodium Metasilicate | ASTM D537 | | |
| 27 | Sodium Orthophospate | | Commercial Grade | |
| 28 | Sodium Resinate | | | |
| 29 | Trisodium Orthophosphate | O–S–642 | Commercial Grade | |
| 30 | Silver Stripper | | Enstrip A | Enthone Inc, 350 Frontage Rd, West Haven, CT 06516 |

GROUP 04
ACIDS, ETCHANTS, AND STRIPPERS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 04– | | | | |
| 31 | Brightener | | Brightener–A | OMI International Corp, 75 River Rd, Nutley, NJ 07110–3513 |
| 32 | Brightener | | Brightener–B | OMI International Corp, 75 River Rd, Nutley, NJ 07110–3513 |
| 33 | Nickel Sulfamate Solution | | | MacDermid Enthone Industrial Solutions 245 Freight Street Waterbury, CT 06702 |
| 34 | Potassium Carbonate | | | |
| 35 | Potassium Cyanide | | | Octagon Process Inc, 596 River Rd, Edgewater, NJ 07020–1105 |
| 36 | Silver Salts, Soluble | | | OMI International Corp, 75 River Rd, Nutley, NJ 07110–3513 |
| 37 | Sodium Bicarbonate | | Commercial Grade | Armex Maintenance Formula |

GROUP 05
ABRASIVES

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 05– | | | | |
| 01 | Bead, Glass | MIL–G–9954 | 0.0017 to 0.0035 inch | |
| 02 | Bead, Glass | MIL–G–9954 | Size 232 (0.0165 inch) | |
| 03 | Bead, Glass | MIL–G–9954 | 0.0059 to 0.003 inch | |
| 04 | Bead, Plastic | | 20 and 30 | Clemco Industries Corp, Div Clemco Zero Products and Aerolyte Systems, 1 Cable Car Dr, Washington, MO 63090 |
| 05 | Compound, Diamond Abrasive | | No. 3 | |
| 06 | Compound, Polishing Rouge | | Roberts Rouge No. 1 | |
| 07 | Cloth, Aluminum Oxide | | 120 to 400 Grit | Local Purchase |
| 08 | Cloth, Crocus | A–A–1206 | | |
| 09 | Cloth, Emery | ANSI B74.18 | 100 to 600 Grit | |
| 10 | Abrasive | | No. 88X – Super Fine to Extra Coarse Grit | Brightboy Abrasives, 7754 Arjons Dr, San Diego, CA 92126 |
| 11 | Disc, Diamond Wheel | | 220 Grit, Grade L or N | |
| 12 | Grit, Abrasive Blasting, Aluminum Oxide | | 12 to 400 Grit | Washington Mills, ElectroMinerals Corp, P.O. Box 423, 1801 Buffalo Ave, Niagara Falls, NY 14302–0423 |
| 13 | Grit, Abrasive Blasting | | Nicroblast 60 Grit | Wall Colmonoy Corp, Stainless Processing Div, 19345 John R St, Detroit, MI 48203 |

GROUP 05
ABRASIVES (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 05– | | | | |
| 14 | Grit, Vapor Blasting, Silicon Dioxide | SAE AMS3755 | Novaculite 200 to 325 Grit | Pressure Blast Manufacturing Inc, 41 Chapel St, Manchester, CT 06040–3034 |
| 15 | Grit, Abrasive Pumice Powder | | | |
| 16 | Grit, Abrasive Blasting, Silicon Carbide | A–A–59316 | 20 to 600 Grit | Waldron Co Inc, P.O. Box 335, 57 Broadway, N Haven, CT 06473–1603 |
| 17 | Grit, Abrasive Silicon Carbide | | 962 | Alloy Metals, Inc, 501 Executive Drive, Troy, MI |
| 18 | Grit, Abrasive Garnet | | 150 grit | |
| 19 | Grit, Abrasive Blasting, Steel Shot | SAE J1993/ SAE J827 | Size 110 and 170 | |
| 20 | Grit, Abrasive Blasting, Zirconium Oxide | | Size 103 and 200 | American Minerals Inc, Hickory Hills Plaza, Suite 328, 151 South Warner Rd, Wayne, PA 19087 |
| 21 | Pad, Polishing and Cleaning | | | |
| 22 | Plastic Abrasive Media | | Types 1, 2, & 3 | U.S. Technology Corp, 79 Connecticut Mills Ave, Danielson, CT 06239 |
| 23 | Plastic Abrasive Media | | Types 1, 2, & 3 | Clemco Industries Corp, Div Clemco Zero Products and Aerolyte Systems, 1 Cable Car Dr, Washington, MO 63090 |
| 24 | Plastic Abrasive Media | | Types 1, 2, & 3 | Aero–Blast Products Inc, 11019 Mostellor Rd, Cincinnati, OH 45241 |

GROUP 05
ABRASIVES (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 05– | | | | |
| 25 | Plastic Abrasive Media | | Type 4 | Clemco Industries Corp, Div Clemco Zero Products and Aerolyte Systems, 1 Cable Car Dr, Washington, MO 63090 |
| 26 | Plastic Abrasive Media | | Type 5 | U.S. Technology Corp, 79 Connecticut Mills Ave, Danielson, CT 06239 |
| 27 | Plastic Abrasive Media | | Type 5 | Aero–Blast Products Inc, 11019 Mostellor Rd, Cincinnati, OH 45241 |
| 28 | Sandpaper, Silicon Carbide | A–A–1047 | 60 to 600 Grit | Washington Mills, ElectroMinerals Corp, P.O. Box 423, 1801 Buffalo Ave, Niagara Falls, NY 14302–0423 |
| 29 | Stone, Carborundum | | | Local Purchase |

GROUP 06
COATINGS

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 01 | Bond Coating Material | | *A6712 | Englehard Surface Tech, 12 Thompson Rd, E Windsor, CT 06088–9696 |
| 02 | Bond Coating Material | | *SR61 | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 |
| 03 | Coating Process | | *LW–IN40 | Praxair Surface Technologies, Praxair Inc, 1555 Main St, Indianapolis, IN 46224–3283 |
| 04 | Coating Process | | GG–WC–102 | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 or Sermatech International Inc, TelAir Inc, High Holbum Rd, Cedar Gate Industrial Estate, Ripley Derbyshire DES#3NW |
| 05 | Coating Material | | SermeTel–BB–1 | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 |
| 06 | Coating Material, Alodine | | 1200 | Amchem Products Inc, 300 Brookside Ave, Ambler, PA 19002 |
| 07 | Coating Material, Alodine | | Alodine 1200 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 08 | Coating Material, Alodine 1132 Touch–N–Prep Pen | MIL–C–5541 | | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 09 | Coating Material, Kit | | M–1/M–7 | Alloy Surface Co Inc, 100 Locke Rd, Wilmington, DE 19809–3513 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 10 | Coating, Aluminum/ Ceramic | | SermeTel W | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 |
| 11 | Coating, Aluminum/ Ceramic | | Alseal 518<br>Alseal 5K | Coatings for Industry, 319 Township Line Rd, Souderton, PA 18964–1905 |
| 12 | Coating, Aluminum/ Ceramic | | SermeTel 735 with SermeTel 962 base coat | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 |
| 13 | Coating Material | | SermeTel 5380 DP | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 |
| 14 | Coating, Aluminum/ Nickel | | *Lycoming 701 Coating | Honeywell Defense & Space, Greer Repair and Overhaul, 85 Beeco Rd Greer, SC 29650–1004 |
| 15 | Coating, Aluminum/ Silicon | | *Sermaloy J | Sermatech International Inc, 155 S Limerick Rd, Royersford, PA 19468–8160 |
| 16 | Coating, Dry Film Lubricant | | Everlube 620 | E/M Corp, P.O. Box 2400, 2801 Kent Ave, W Lafayette, IN 47906 |
| 17 | Coating, Dry Film Lubricant | | Mollydag 254 | Acheson Colloids Co, Div of Acheson Industries Inc, P.O. Box 611747, 1600 Washington Ave, Port Huron, MI 48060 |
| 18 | Coating, Dry Film Lubricant | | Lube–Lok 2006 Electrofilm | E/M Corp, P.O. Box 2400, 2801 Kent Ave, W Lafayette, IN 47906 |
| 19 | Coating, Dry Film Lubricant | | Lube–Lok 4396 Electrofilm | E/M Corp, P.O. Box 2400, 2801 Kent Ave, W Lafayette, IN 47906 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 20 | Coating, Dry Film Lubricant | MIL–L–23398 and MIL–L–46147 | Perma–Slik G | E/M Corp, P.O. Box 2400, 2801 Kent Ave, W Lafayette, IN 47906 |
| 21 | Colloidal Graphite | | Electrofilm 154 | Acheson Colloids Co, Div of Acheson Industries Inc, P.O. Box 611747, 1600 Washington Ave, Port Huron, MI 48060 |
| 22 | Film, Release | | RAM GS–3 | Ram Chemicals, Div of Whittaker Corp, 210 E Alondra Blvd, Gardena, CA 90248–2008 |
| 23 | Powder, Plasma Spray | | Metco 56C–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 24 | Powder, Plasma Spray | | Metco 72F–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 25 | Powder, Plasma Spray | | Metco 450–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 26 | Powder, Plasma Spray | | Sulzer Amdry 956 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 27 | Wire, Plasma Spray | | BondArc 75B (Alternate to Metco 450–NS) | TAFA Inc, 46 Pembroke Rd, Concord, NH 03301 |
| 28 | Powder, Plasma Spray | | Metco 404–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 29 | Powder, Plasma Spray | | Metco 63–NS | Sulzer Metco (US), Inc, P.O. Box 1006,1101 Prospect Ave, Westbury, NY 11590–0201 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 30 | Powder, Plasma Spray | | Sulzer Amdry 313–X | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 31 | Powder, Plasma Spray | | Miller Thermal AI–1013 | Miller Thermal Inc, Alloys International Div, 1901 Ellis School Rd, Baytown, TX 77521 |
| 32 | Powder, Plasma Spray | | Sylvania SD–151 | GTE Sylvania, Metallurgical and Chemical Div, Hawes St, Towanda, PA 18848 |
| 33 | Powder, Plasma Spray | | Eutectic 18951 | Eutectic Corp, 9625 Southern Pine Blvd, Charlotte, NC 28273 |
| 34 | Powder, Plasma Spray | | Metco 439–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 35 | Powder, Plasma Spray | | Metco 601–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 36 | Powder, Plasma Spray | | Sulzer Amdry | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 37 | Powder, Plasma Spray | | Metco 443–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 38 | Powder, Plasma Spray | | Sulzer Amdry 960 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 39 | Powder, Plasma Spray | | Sulzer Amdry 962 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 40 | Powder, Plasma Spray | | Union Carbide NI–164–2 | Praxair Surface Technologies, Specialty Powders, 1555 Main St, Indianapolis, IN 46224–3283 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 41 | Powder, Plasma Spray | | Metco 447–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 42 | Powder, Plasma Spray | | Eutectic 21021 | Eutectic Corp, 9625 Southern Pine Blvd, Charlotte, NC 28273 |
| 43 | Powder, Plasma Spray | | Metco 52C–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 44 | Powder, Plasma Spray | | PAC 901 | Powder Alloy Corp, 5871 Creek Rd, Cincinnati, OH 45242 |
| 45 | Powder, Plasma Spray | | Miller Thermal AI–1035 | Alloys International, Div Miller Thermal Technologies Inc, 1901 Ellis School Rd, Baytown, TX 77521–1215 |
| 46 | Powder, Plasma Spray | | Metco 45VF–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 47 | Powder, Plasma Spray | | PAC 90–VF | Powder Alloy Corp, 5871 Creek Rd, Cincinnati, OH 45242 |
| 48 | Powder, Plasma Spray | | Miller Thermal AI–1016 | Alloys International, Div of Miller Thermal Technologies Inc, 1901 Ellis School Rd, Baytown, TX 77521–1215 |
| 49 | Powder, Plasma Spray | | Metco 605–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 50 | Powder, Plasma Spray | | Metco 81VF–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 51 | Powder, Plasma Spray | | Sulzer Amdry 305 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 52 | Powder, Plasma Spray | | Miller Thermal AI–1005 | Alloys International, Div of Miller Thermal Technologies Inc, 1901 Ellis School Rd, Baytown, TX 77521–1215 |
| 53 | Powder, Plasma Spray | | Union Carbide CRC–106 | Praxair Surface Technologies, Specialty Powders, 1555 Main St, Indianapolis, IN 46224–3283 |
| 54 | Powder, Plasma Spray | | Metco 202–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 55 | Powder, Plasma Spray | | Sylvania SX–165 | GTE Sylvania, Metallurgical and Chemical Div, Hawes St, Towanda, PA 18848 |
| 56 | Powder, Plasma Spray | | PAC 2020 | Powder Alloy Corp, 10881 5871 Creek Rd, Cincinnati, OH 45242 |
| 57 | Powder, Plasma Spray | | Metco 43F–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 58 | Powder, Plasma Spray | | Zirspra Premium M3968 | Zircoa Inc, 31501 Solon Rd, Solon, OH 44139 |
| 59 | Powder, Plasma Spray | | Zirspra M3969 | Zircoa Inc, 31501 Solon Rd, Solon, OH 44139 |
| 60 | Powder, Plasma Spray | | Metco 301–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 61 | Powder, Plasma Spray | | Sulzer Amdry M3972 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 62 | Powder, Plasma Spray | | Union Carbide Ni–292 | Praxair Surface Technologies, Specialty Powders, 1555 Main St, Indianapolis, IN 46224–3283 |
| 63 | Powder, Plasma Spray | | Metco 105–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 64 | Powder, Plasma Spray | | Sulzer Amdry M3974 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 65 | Powder, Plasma Spray | | Metco 73F–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 66 | Powder, Plasma Spray | | Metco 444–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 67 | Powder, Plasma Spray | | Metco 58–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 68 | Powder, Plasma Spray | | LCN–2 | Praxair Surface Technologies, Specialty Powders, 1555 Main St, Indianapolis, IN 46224–3283 |
| 69 | Powder, Plasma Spray | | Metco 204–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 70 | Powder, Plasma Spray | | Muscle Shoals ZY–7 | Muscle Shoals Minerals Co, Old Hwy 72 and Mulberry Lane, Tuscumbia, AL 35674 |
| 71 | Surface Treatment, Black Magic | | Activated Black Magic Plus | Mitchell–Bradford Chemical Co, Inc, P.O. Box 169, 160 Wampus Lane, Milford, CT 06460–4837 |

*Proprietary process

GROUP 06
COATINGS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 06– | | | | |
| 72 | Surface Treatment, Hoppe's Gun Blue | SAE AMS 2484 | Hoppe's 1702 | Penguin Industries Inc, Airport Industrial Mall, Coatesville, PA 19320 |
| 73 | Wire, Plasma Spray | | Metco 405–NS | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |
| 74 | Coating, Dry Film Lubricant | | Frekote–1 | The Dexter Corp, 1 Dexter Dr., Seabrook, NH 03874 |
| 75 | Coating, Dry Film Lubricant | | Everlube 1380C | E/M Corp, 1 John Downey Dr., New Britain, CT 06051 |
| 76 | Coating, Dry Film Lubricant | MIL–L–23398 | D.G.F. 123 | Miracle Power Products Corp, 1101 Beltline St, Cleveland, OH 44109–2849 |
| 77 | Coating, Dry Film Lubricant | | Molykote 3400A | Dow Corning Corp, P.O. Box 995, 3901 S Saginaw Rd, Midland, MI 48640 |
| 78 | Coating, Dry Film Lubricant | MIL–L–81329 | Everlube 811 | E/M Lubricants Inc, P.O. Box 2200, Hwy 52 NW, West Lafayette, IN 47906 |
| 79 | Coating, Graphite Varnish | | G8450 | Griggs Paint, 3635 S 16 St, Phoenix, AZ 602–243–3293 |
| 80 | Wire, Plasma Spray | | TAFA 01A | TAFA Inc, 146 Pembroke Rd, Concord, NH 03301 |
| 81 | Coating, Graphite Varnish | | Metco 446 | Sulzer Metco (US), Inc, P.O. Box 1006, 1101 Prospect Ave, Westbury, NY 11590–0201 |

*Proprietary process

GROUP 07
PAINTS AND SOLVENTS

| Group–<br>Item No. | Description | Specification | Manufacturer's<br>Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 01 | Paint, Enamel, Blue | | 78 X 021 | Valspar Inc, 2000 Westhall St, Pittsburgh, PA 15233 |
| 02 | Paint, Enamel, Engine Gray | | Color 513 | |
| 03 | Paint, Enamel, Engine Gray | | S–3612–810 | Valspar Inc, 2000 Westhall St, Pittsburgh, PA 15233 |
| 04 | Paint, Enamel, Gray | FED–STD–595 Table VIII Gloss 16091 | IP9156 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 05 | Paint, Enamel, Engine Gray Baking | SAE AMS 3125 | | Randolph Products Co, 701 Twelfth St, P.O. Box 830, Carlstadt, NJ 07072 |
| 06 | Paint, Enamel, Aluminum | | 7841–8 | Westinghouse Electric Corp, Corporate Standards, Research Center, 1310 Beulah Rd, Pittsburgh, PA 15235–5068 |
| 07 | Paint, Enamel, Aluminum | TT–P–28 | HTA 154 | International Paint Co Inc, P.O. Box 386, 2270 Morris Ave, Union, NJ 07083–5704 |
| 08 | Paint, Phenolic Enamel, Pigmented | TT–E–522 | | |
| 09 | Paint, Epoxy Catalyst | | EB–02359V | Courtaulds Aerospace ASC–Phoenix, 3902 E Roeser Rd, Phoenix, AZ 85040–3972 |
| 10 | Paint, Epoxy Resin, Grey | MIL–C–22750 | Kit 16081 | Randolph Products Co, 701 Twelfth St, P.O. Box 830, Carlstadt, NY 07072 |
| 11 | Paint, Epoxy Resin, Grey | MIL–C–22750 | Kit IP9158 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 12 | Paint, Epoxy Resin, Clear | | IP9041 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 13 | Paint, Epoxy Resin, Clear, 2 Part System | MIL–C–22750 | | Randolph Products Co, 701 Twelfth St, Carlstadt, NY 07072 |
| 14 | Paint, Epoxy Resin, Clear Baking | | IP9167 Araldite 985 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 15 | Paint, Epoxy Catalyst, 2 Part System | | IP9039 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 16 | Paint, Graphite Filled Epoxy, Top Coat, Black | | IP9159 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 17 | Paint, Epoxy Resin, Phenolic Buff | | S–3162–806 | Valspar Inc, 2000 Westhall St, Pittsburgh, PA 15233 |
| 18 | Paint, Epoxy Resin, Strontium Chromate (Yellow) (2 Part System) | MIL–P–23377, Type I | | Randolph Products Co, 701 Twelfth St, Carlstadt, NY 07072 |
| 19 | Paint, Epoxy Resin, Strontium Chromate (Yellow) | | IP9168 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 20 | Paint, Silicone Aluminum | | 86009 | Glyptal Inc, 305 Eern Ave, Chelsea, MA 02150–3344 |
| 21 | Alcohol, Amyl | | Commercial Grade | |
| 22 | Alcohol, Butyl (Butanol) | ASTM D304–05 | Commercial Grade | |
| 23 | Alcohol, Ethyl (Ethanol) | A–A–59282 | Commercial Grade | |
| 24 | Alcohol, Isopropyl | TT–I–735 | Commercial Grade | |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 25 | Alcohol, Methyl (Methanol) | O–M–232<br>SAE AMS 3004 | Commercial Grade | |
| 26 | Cleaner, Acetone | ASTM D329 | Commercial Grade | |
| 27 | Cleaner, Chemical Parts Dip | | 241 | McKay Mfg Co, 1920 Randolph St, Los Angeles, CA 90001–1438 |
| 28 | Filler, Silicone Rubber | | VI–SIL V–695<br>VI–SIL V–06R | VSI Aerospace N America, 405 Jordan Rd, Troy, NY 12180 |
| 29 | Cleaner, Fingerprint Remover/ Corrosion Preventive | MIL–C–15074 | Tectyl 275 | Ashland Petroleum Co, Valvoline Div, P.O. Box 14000, 3499 Dabney Rd, Lexington, KY 40512 |
| 30 | Cleaner, Liquid Soap | P–S–624 | | |
| 31 | Cleaning Compound, Alkaline | | Magnustrip 662 | Magnus Chemicals Limited,190 Industrial Blvd, Boucherville, PQ, Canada J4B 2–3 |
| 32 | Cleaning Compound, Alkaline | P–C–436 | | |
| 33 | Cleaning Compound | | Applied 4–204 | Applied Australia Pty, Ltd, 90–92 Fairbanks Rd, Clayton South, Australia 3169 |
| 34 | Cleaning Compound, Alkaline | ARP 1755 | Turco 4181 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 35 | Cleaning Compound, Alkaline Derust | | Cee–Bee J–84A | McGean Rohco Inc, CEE–BEE Chemicals Div, 9520 E Cee–Bee Dr, Downey, CA 90241–5501 |
| 36 | Cleaning Compound, Alkaline Derust | | Endox Q–576 Liquid | Enthone Inc, 350 Frontage Rd, West Haven, CT 06516 |
| 37 | Cleaning Compound, Alkaline Derust | | Ardrox–185L | Brent Europe Ltd, Ridgeway, Iver, Buckinghamshire UK SLO 9JJ |
| 38 | Cleaning Compound, Alkaline Derust | | Applied 5–770 | Applied Australia Pty, Ltd, 90–92 Fairbanks Rd, Clayton South, Australia 3169 |
| 39 | Cleaning Compound, Alkaline Derust | | Applied 5–840 | Applied Australia Pty, Ltd, 90–92 Fairbanks Rd, Clayton South, Australia 3169 |
| 40 | Cleaning Compound, Alkaline Permanganate | | Turco 4338 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 41 | Cleaning Compound, Alkaline Permanganate | | Cee–Bee J88 | McGean Rohco Inc, CEE–BEE Chemicals Div, 9520 E Cee–Bee Dr, Downey, CA 90241–5501 |
| 42 | Cleaning Compound, Aluminum | | Oakite 33 | Chemetall Oakite Inc, 50 Valley Rd, Berkeley Heights, NJ 07922–2712 |
| 43 | Cleaning Compound, Carbon Removing | P–C–111 | 107–J–239 | Chemetall Oakite Inc, 50 Valley Rd, Berkeley Heights, NJ 07922–2712 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 44 | Cleaning Compound, Carbon Removing | AMS–C–19853 | Transpo 6X | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 45 | Cleaning Compound, Carbon Removing | | Applied 8770 | Applied Australia Pty, Ltd, 90–92 Fairbanks Rd, Clayton South, Australia 3169 |
| 46 | Cleaning Compound, Carbon Removing | MIL–C–25107 | Turco 2976 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 47 | Cleaning Compound, Carbon Removing | | Turco 3310 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 48 | Cleaning Compound, Enbond | | Enbond NS–35 | Enthone Inc, 350 Frontage Rd, West Haven, CT 06516 |
| 49 | Cleaning Compound, Magnaflux | | SKC–NF/2C–7B | |
| 50 | Cleaning Compound | | Magnus 61C | Magnus Chemicals Ltd, 190 Industrial Blvd, Boucherville, PQ, Canada J4B 2–3 |
| 51 | Cleaning Compound | | Magnus 751 | Magnus Chemicals Ltd, 190 Industrial Blvd, Boucherville, PQ, Canada J4B 2–3 |
| 52 | Cleaning Solution | | GTE CC | Rochem Co, Geneva, Switzerland |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 53 | Cleaning Solution, Alkaline | TT–C–490 | Oakite Rustripper | Chemetall Oakite Inc, 50 Valley Rd, Berkeley Heights, NJ 07922–2712 |
| 54 | Cleaning Solution | | Turco 4181 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 55 | Cleaning Solution | | Ardrox 185 | Brant Europe Ltd, Ridgeway, Iver, Bucks, United Kingdom SLO 9JJ, Phone: 0753 630200 |
| 56 | Cleaning Solution | MIL–PRF–85704 | Turco 5884 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 57 | Cleaning Solution | Type I | B&B 3100 | B&B Tritech Inc, 875 W 20th St, Hialeah, FL 21361 |
| 58 | Cleaning Solution | | B&B TC100 | B&B Tritech Inc, 875 W 20th St, Hialeah, FL 21361 |
| 59 | Cleaning Solution | | Penetone 19 | Penetone Corp, Subsidiary of West Chemical Products Inc, 74 Hudson, Tenafly, NJ 07670–1017 |
| 60 | Cleaning Solution | | Ardrox 2204 | Androx Limited, P.O. Box 814, 19 Woodburn Ave, St Catherines, Ontario, Canada |
| 61 | Cleaning Solution | | Magnus 1214 | Magnus Chemicals Limited, 190 Industrial Blvd, PQ, Quebec, Canada J4B 2–3 |
| 62 | Cleaning Solution | | ZOK 27 | Airworthy Limited, Elsted Midhurst, Sussex England G0290JT or Zokman Products, 1220 E Gump Rd, Ft Wayne, IN 46845 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 63 | Dry Cleaning Solvent | MIL–PRF–680 | Mineral Spirits 135 | Shell Oil Co, P.O. Box 2463, 1 Shell Plaza, Room 1196, Houston, TX 77001 |
| 64 | Dry Cleaning Solvent | MIL–PRF–680 | Solvasol 5 | Valspar Inc, 2000 Westhall St, Pittsburgh, PA 15233 |
| 65 | Dry Cleaning Solvent | MIL–PRF–680 | Varsol, 1, 2, 3, & 5 | Exxon Co, Div of Exxon Corp, P.O. Box 2180, 800 Bell St, Houston, TX 77252–2180 |
| 66 | Safety–Kleen | MIL–PRF–680 TYPE II | | Safety–Kleen Systems Inc, 5400 Legacy Drive, Cluster II, Building 3, Plano, Texas 75024 |
| 67 | Dry Cleaning Solvent | | Penetone TPC | Penetone Corp, Subsidiary of West Chemical Products Inc, 74 Hudson, Tenafly, NJ 07670–1017 |
| 68 | Emulsion Degreasing Solvent | MIL–C–87937 | Emul–Klene 3878 | Henkel Surface Technologies, 32100 Stephenson Hwy, Madison Heights, MI USA 48071 |
| 69 | Emulsion Degreasing Solvent | SAE AMS 1530 | Blue Gold | Modern Chemicals, Unity Chemicals Corp PTE LTD, P.O. Box 0155, Farrer Rd, Singapore 9128 |
| 70 | Emulsion Degreasing Solvent | MIL–C–87937 | Mirachem 500 | Mirachem Corp, 1045 S Edward Dr, Tempe, AZ 85285–7608 |
| 71 | Reducer, Enamel/ Synthetic Paint | | 311 | The Sherwin–Williams Co, 101 Prospect Ave, Cleveland, OH 44115 |
| 72 | Reducer, Epoxy Paint | | IP665–550–025 | Indestructible Paint, 66 Erna Ave, Milford, CT 06460 |
| 73 | Thinner, Butyl Cellosolve | | Epoxy Curing Retardant | Lix Corp of Missouri, 2808 E 85th St, Kansas City, MO 64132–2536 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 74 | Thinner, Butyl Cellosolve | | Epoxy Curing Retardant | Goodyear Rubber Co, San Francisco, CA 94123 |
| 75 | Thinner, Dioxane | A–A–59282 | | |
| 76 | Thinner, Enamel Paint | A–A–3007 | T–336A | Valspar Inc, 2000 Westhall St, Pittsburgh, PA 15233 |
| 77 | Thinner, Toluene (Toluol) | A–A–59107<br>SAE AMS 3180 | | The Sherwin–Williams Co, 101 Prospect Ave, Cleveland, OH 44115 |
| 78 | Thinner, Polysolve | | Polysolve EE 286139 | Axton–Cross Co, P.O. Box 6529, Cross St, Holliston, MA 01746 |
| 79 | Thinner, Xylene (Xylol) | ASTM D846–84 | G710 | Glyptal Inc, 305 Eern Ave, Chelsea, MA 02150–3344 |
| 80 | Epoxy Resin, Heat Curing | | 901/B1 | Shell Oil Co, P.O. Box 2463, 1 Shell Plaza, Room 1196, Houston, TX 77252 |
| 81 | Paint, Epoxy Catalyst | MIL–C–22750, Type I | EB–04634V | Courtaulds Aerospace ASC–Phoenix, 3902 E Roeser Rd, Phoenix, AZ 85040–3972<br>or<br>Randolph Products Co, 701 Twelfth St, Carlstadt, NY 07072 |
| 82 | Solvent, Cleaning Powder | | Metex M629 | MacDermid Inc, 245 Freight St, Waterbury, CT 06702 |
| 83 | Solvent, Antifloat Agent | | Troysol AFL | Troy Chemical Co, 1 Ave L, Newark, NJ 07105 |
| 84 | Solvent, Antifloat Agent | | TroyKYD | Troy Chemical Co, 1 Ave L, Newark, NJ 07105 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 85 | Cleaning Compound, Alkaline Derust | | Cee–Bee J–84 | McGean–Rohco Inc, CEE–BEE Chemicals Div, 9520 E Cee–Bee Dr, Downey, CA 90241–5501 |
| 86 | Cleaning Compound, Alkaline Derust | | Applied 5–840 | Applied Australia Pty, Ltd, 90–92 Fairbanks Rd, Clayton South, Australia 3169 |
| 87 | Acedic Desealer | | Cee–Bee J–19 | McGean–Rohco Inc, CEE–BEE Chemicals Div, 9520 E Cee–Bee Dr, Downey, CA 90241–5501 |
| 88 | Conditioner, Acidic Descaler | | Applied 2–751 | Applied Australia Pty, Ltd, 90–92 Fairbanks Rd, Clayton South, Australia 3169 |
| 89 | Emulsion Degreasing Solvent | | Citrikleen | Penetone Corp, 74 Hudson Ave, Tenafly, NJ 07670–1017 |
| 90 | Cleaning Solution | | Turboclean 2 | Trafficair Inc, 200 Technology Dr, Alpharetta, GA 30202 |
| 91 | Cleaning Solution | | Turboclean 2 RTV | Trafficair Inc, 200 Technology Dr, Alpharetta, GA 30202 |
| 92 | Solvent, Concentrated | | Krankwash | Rochem/Markam, 27 E 33rd St Patterson, NJ 07514 |
| 93 | Solvent, Concentrated | | Mega Power | John B Moore Corp, Outer Main St, P.O. Box 65, South Amboy, NY 08878 |
| 94 | Solvent, Concentrated | | Penair MS704 | Penetone Corp, 74 Hudson Ave, Tenafly, NJ 07670 |
| 95 | Emulsion Degreasing Solvent | | Daraclean 282 | W.R. Grace and Co, 6000 W 51 St, Chicago, IL 60638 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 96 | Emulsion Degreasing Solvent | | Formula 815GD | The Brulin Corp, P.O. Box 270, 2920 Dr, A.J. Brown Ave, Indianapolis, IN 46206 |
| 97 | Paint, Graphite Filled Epoxy | | IP–9159 | Colonial Coatings, 66 Erna Ave, Milford, CT 06460 |
| 98 | Varnish Thinner | SAE AMS 3170 | QS4082 | Griggs Paint, 3635 S 16 St, Phoenix, AZ 602–243–3293 |
| 99 | Impact Resistant Primer | | 515X349 | PRC–Desoto International Inc, Div Asc – Los Angeles, 5430 San Fernando Rd, Glendale, CA 91203 |
| 100 | Impact Resistant Urethane Top Coat, Black | | 822K002 | PRC–Desoto International Inc, Div Asc – Los Angeles, 5430 San Fernando Rd, Glendale, CA 91203 |
| 101 | Impact Resistant Urethane Top Coat, Untinted White | | 831K055 | PRC–Desoto International Inc, Div Asc – Los Angeles, 5430 San Fernando Rd, Glendale, CA 91203 |
| 102 | Impact Resistant Urethane Top Coat, Tinted White | | 821X820 | PRC–Desoto International Inc, Div Asc – Los Angeles, 5430 San Fernando Rd, Glendale, CA 91203 |
| 103 | Paint, Rubber (Viton) | | Chemtac 20 | Advanced Polymer Coatings Inc, 6023 Ward Ln, Levittown, PA 19057 |
| 104 | Curing Agent | | Chemcure B | Advanced Polymer Coatings Inc, 6023 Ward Ln, Levittown, PA 19057 |
| 105 | Solvent, Emulsion Degreasing | MIL–C–87937 | Brulin 815GD<br>Brulin 1990 | The Brulin Corp, P.O. Box 270, 2920 Dr, A.J. Brown Ave, Indianapolis, IN 46206 |
| 106 | Solvent, Emulsion Degreasing | MIL–C–87937 | X–IT Plus | Fortune Chemical Co, 225 Deer Valley Rd, #4, Phoenix, AZ 85027 |

GROUP 07
PAINTS AND SOLVENTS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 07– | | | | |
| 107 | Solvent, Emulsion Degreasing | MIL–C–87937 | Ecomate FN | SOQ Environmental Tech, Box 28450, Tempe, AZ 85285 |
| 108 | Solvent, Emulsion Degreasing | | DE.SOLV.IT 5000 Orange–Sol High–D+ | Orange–Sol, Inc, P.O. Box 306, Chandler, AZ 85244–0306 |
| 109 | Cleaner, Aqueous Emulsion | MIL–C–87937 MIL–C–29602 | DE.SOLV.IT 3000 Orange–Sol/ADL | Orange–Sol, Inc, P.O. Box 306, Chandler, AZ 85244–0306 |
| 110 | Immersion Alkaline Cleaner | | Ardrox-6376 | Brent Europe Ltd, Ridgeway, Iver, Buckinghamshire UK SLO 9JJ |
| 111 | Scale and Carbon Remover Aid | | Ardrox-1435 | Brent Europe Ltd, Ridgeway, Iver, Buckinghamshire UK SLO 9JJ |
| 112 | Component Descaler | | Ardrox-1873A | Brent Europe Ltd, Ridgeway, Iver, Buckinghamshire UK SLO 9JJ |

GROUP 08
STOCK MATERIALS

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 01 | Alumel Alloy | MIL–W–5846 | | |
| 02 | Aluminum Alloy | SAE AMS 4025 | | |
| 03 | Aluminum Alloy | SAE AMS 4026 | | |
| 04 | Aluminum Alloy | SAE AMS 4027 | | |
| 05 | Aluminum Alloy | QQ–A–250/4, SAE AMS 4035 | | |
| 06 | Aluminum Alloy | SAE AMS 4082 | | |
| 07 | Aluminum Alloy | SAE AMS 4083 | | |
| 08 | Aluminum Alloy | SAE AMS 4115 | | |
| 09 | Aluminum Alloy | SAE AMS 4116 | | |
| 10 | Aluminum Alloy | SAE AMS 4117 | | |
| 11 | Aluminum Alloy | SAE AMS 4127 | | |
| 12 | Aluminum Alloy | SAE AMS 4150 | | |
| 13 | Aluminum Alloy | SAE AMS 7488 | | |
| 14 | Chromel Alloy | MIL–W–5846 | | |
| 15 | Copper Alloy | SAE AMS 4611 | | |
| 16 | Filler Alloy | | UNS–N6626 | Avista Stainless Inc, Fairfield, NJ |
| 17 | Filler Alloy<br>50%<br>50% | <br>AMS4777<br>AWS A5.8 BNi-10 | *M-Fill I<br>Amdry 770 and<br>Nicrobraz 170 | Commercially Available |
| 18 | Filler Alloy | | M3874 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |

*Proprietary item

GROUP 08
STOCK MATERIALS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 19 | Filler Alloy<br>45%<br>55% | <br>M3617<br>AWS A5.8 BNi-9 | *M-Fill III<br>**C101 and<br>Nicrobraz 150 | Honeywell International, Inc. Technical Operations Center, P.O. Box 29003, Phoenix, AZ 85038-9003<br>855-808-6500 (US/ Canada)<br>602-365-6500 (Int'l) |
| 20 | Honeycomb Material, Seal | SAE AMS 5536 | | |
| 21 | Magnesium Alloy | SAE AMS 4350 | | |
| 22 | Magnesium Alloy | AZ61A–F per ASTM–B–107 | | |
| 23 | Magnesium Alloy | ZK60A–T5 per SAE AMS 4352 | | |
| 24 | Magnesium Alloy | ZK60A–T5 per ASTM–B–107 | | |
| 25 | Magnesium Alloy | SAE AMS 4375 | | |
| 26 | Magnesium Alloy | SAE AMS 4376 | | |
| 27 | Magnesium Alloy | AZ31B–H24 per SAE AMS 4377 | | |
| 28 | Magnesium Alloy | AZ31B–H24 per ASTM–B–107 | | |
| 29 | Rubber | SAE AMS 3216 | | |
| 30 | Seal, Solder Shrink | | | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 31 | Sleeve, Butt Splice | | D–436–36 | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 32 | Sleeve, Butt Splice | | D–436–38 | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |

*Proprietary item
**Prepare C101 per M3874 except chemistry per M3617.

GROUP 08
STOCK MATERIALS (CONT)

| Group– Item No. | Description | Specification | Manufacturer’s Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 33 | Sleeve, Fire Shield | | Titeflex 93688 | Titeflex Corp, Subsidiary of Bundy Corp, P.O. Box 90054, 603 Hendee, Springfield, MA 01139 |
| 34 | Sleeve, Protective Nylon | | Yellow, Green | Protective Closure Inc, 2150 Elmwood Ave, Buffalo, NY 14207–1910 |
| 35 | Sleeve, Solder Shrink | | D105–00 | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 36 | Sleeve, Solder Shrink Shield Terminator | | D107–00 | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 37 | Sleeve, Anti–Chafing | | *2–141–359–01 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |
| 38 | Sleeve, Anti–Chafing, Spiral | | *2–300–519–01 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |
| 39 | Sleeve, Anti–Chafing, Spiral | | *2–300–519–02 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |
| 40 | Sleeve, Anti–Chafing, Spiral | | *2–300–519–03 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |

*Proprietary item

GROUP 08
STOCK MATERIALS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 41 | Steel | | *M4140 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |
| 42 | Steel | SAE AMS 5069 | | |
| 43 | Steel | SAE AMS 5132 | | |
| 44 | Steel | SAE AMS 5510 | | |
| 45 | Steel | SAE AMS 5518 | | |
| 46 | Steel | SAE AMS 5525 | | |
| 47 | Steel | SAE AMS 5532 | | |
| 48 | Steel | SAE AMS 5536 | | |
| 49 | Steel | SAE AMS 5537 | | |
| 50 | Steel | SAE AMS 5560 | | |
| 51 | Steel | SAE AMS 5580 | | |
| 52 | Steel | SAE AMS 5585 | | |
| 53 | Steel | SAE AMS 5596 | | |
| 54 | Steel | SAE AMS 5599 | | |
| 55 | Steel | SAE AMS 5613 | | |
| 56 | Steel | SAE AMS 5636 | | |
| 57 | Steel | SAE AMS 5640 | | |
| 58 | Steel | SAE AMS 5645 | | |
| 59 | Steel | SAE AMS 5646 | | |
| 60 | Steel | SAE AMS 5732 | | |
| 61 | Steel | SAE AMS 5735 | | |
| 62 | Steel | SAE AMS 5737 | | |
| 63 | Steel | SAE AMS 5743 | | |

*Proprietary item

GROUP 08
STOCK MATERIALS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 64 | Steel | SAE AMS 5754 | | |
| 65 | Steel | SAE AMS 5759 | | |
| 66 | Steel | SAE AMS 6260 | | |
| 67 | Steel | SAE AMS 6265 | | |
| 68 | Steel | SAE AMS 6302 | | |
| 69 | Steel | SAE AMS 6381 | | |
| 70 | Steel | SAE AMS 6382 | | |
| 71 | Steel | SAE AMS 7490 | | |
| 72 | Steel Braid | SAE AMS 5510 | 1150 | Brim Electronics Inc, 120 Home Place, Lodi, NJ 07644–1514 |
| 73 | Steel Wire | SAE AMS 5685 | 0.020 Inch Diameter | |
| 74 | Test Piece, Cylinder Material | | Lycoming M3617 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |
| 75 | Tubing, Heat Shrinkable, Conductive | | 70–21–0002–0004 | Chromerics Inc, Woburn, MA |
| 76 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/2 SAE AMS 3579 | Insul–Grip HS–105 | Insul–Tab Inc, 45 Industrial Parkway, Woburn, MA 01801 |
| 77 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/8 SAE AMS 3632 | Insul–Grip Kaynar HSK–600 | Insul–Tab Inc, 45 Industrial Parkway, Woburn, MA 01801 |
| 78 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/8 SAE AMS 3632 | Kaynar | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |

*Proprietary item

GROUP 08
STOCK MATERIALS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 79 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/12–310–C | PTFE | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 80 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/12–315–C | PTFE | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 81 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/12–315–0 | PTFE | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 82 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/13 | Insul–Grip HS–Viton | Insul–Tab Inc, 45 Industrial Parkway, Woburn, MA 01801 |
| 83 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/13 | Viton | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 84 | Tubing, Heat Shrinkable, Insulative | AMS–DTL–23053/14 | 37N328 | Newark Electronics, 340 Broad St, Windsor, CT 06095 |
| 85 | Tubing, Heat Shrinkable, Insulative, Teflon | SAE AMS 3653 | Teflon TFE | Insul–Tab Inc, 45 Industrial Parkway, Woburn, MA 01801 |
| 86 | Steel Wire | SAE AMS 5688 | | |
| 87 | Magnesium Alloy | SAE AMS 4375 | | |
| 88 | Magnesium Alloy | SAE AMS 4376 | | |
| 89 | Steel | SAE AMS 5663 | | |
| 90 | Sheet, Molded Steel | SAE AMS 5667 | | |
| 91 | Label, Temperature Recording | | Model 110–12–17 | Teletemp Corp, P.O. Box 92631, 351 S Raymond Ave, Fullerton, CA 92631 |

*Proprietary item

GROUP 08
STOCK MATERIALS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 08– | | | | |
| 92 | Label, Temperature Recording | | Model 110–19–18 | Teletemp Corp, P.O. Box 92631, 351 S Raymond Ave, Fullerton, CA 92631 |
| 93 | Label, Temperature Recording | | Model 110–34–44 | Teletemp Corp, P.O. Box 92631, 351 S Raymond Ave, Fullerton, CA 92631 |
| 94 | Sheet Clear Silicon | | 0.3 x 2.5 x 6 inches (0.76 x 64 x 152 millimeters) | Speciality Sales, Div of The Wickes Co, 515 N Washington, Saginaw, MI 48607–1370 |
| 95 | Firesleeving, Fiberglass (cloth with silicon rubber coating) | | 2.5 x 4 inches (64 x 102 millimeters) | Eaton Aeroquip Inc, Engineered Systems Div, 300 SE Ave, Jackson, MI 49203 |
| 96 | Firesleeving, Fiberglass (cloth with silicon rubber coating) | | 2.5 x 6 inches (64 x 152 millimeters) | Eaton Aeroquip Inc, Engineered Systems Div, 300 SE Ave, Jackson, MI 49203 |
| 97 | Steel | SAE AMS 5734 | | |
| 98 | Tubing, Heat Shrinkable, Insulation | AMS–DTL–23053 | RNF100 | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |
| 99 | Sleeve, Solder Shrink, Shield Terminator | SAE–AS83519 | | Raychem Corp, 300 Constitution Dr, Menlo Park, CA 94025–1111 |

*Proprietary item

GROUP 09
INSPECTION MATERIALS

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 09– | | | | |
| 01 | Agent, Wetting | | Kodak Photo–Flo | Eman Kodak Co, Eastern Regional Distribution Center, 1187 West Ridge Rd, Rochester, NY 14650–0001 |
| 02 | Compound, Gear Marking | | No. 89 | Organic Products Corp, P.O. Box 428, 1963 E Irving Blvd, Irving, TX 75060–4555 |
| 03 | Film, X–Ray | | Kodak M | Eman Kodak Co, Eastern Regional Distribution Center, 1187 West Ridge Rd, Rochester, NY 14650–0001 |
| 04 | Leak Detection Spray | | Galutec 160X–01 | American Gas and Chemical Co Ltd, 220 Pegasus Ave, Nvale, NJ 07647–1904 |
| 05 | Marker | | Dichem | |
| 06 | Marker, Felt Tip | | EverBond Marks–A–Lot | Avery Dennison Corp, www.averydennison.com |
| 07 | Marker, Ocher | | | |
| 08 | Marker, Opco | | | Organic Products Co, 1963 E Irving Blvd, Irving, TX 75060–4555 |
| 09 | Marker, Self–Laminating | | SLSH 10375 White | W. H. Brady Co, 6555 W Goodhope Rd, Milwaukee, WI 53203 |
| 10 | Crayon, High Temperature | | Tempil Stik 325 | Air Liquide America Corp, Tempil Div, 2901 Hamilton Blvd, South Plainfield, NJ 07080–2519 |
| 11 | Marking Crayon, High Temperature | | | Faber Castell Corp, P.O. Box 330, 551 Spring Pl Rd, Lewisburg, TN 37091–3447 |

GROUP 09
INSPECTION MATERIALS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 09– | | | | |
| 12 | Marking Ink | | Clear Print No. 9 | Phillips Process Co Inc, 20 Magnolia St, Rochester, NY 14608 |
| 13 | Marking Ink, Black | | Marco 1141 | Tape and Mark Inc, 31–46 14th St, Long Island, NY 11106 |
| 14 | Couplant, Ultrasonic | | Ultragel II | Echo Ultrasound, Inc, 1 Echo Dr, Reedsville, PA 17084–9772 |

GROUP 10
GENERAL MATERIALS

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 10– | | | | |
| 01 | Antifreeze/ Coolant (Ethylene Glycol) | A–A–52624, ASTM E1119 | | |
| 02 | Applicator, Cotton Swab | | | |
| 03 | Argon Gas | MIL–A–18455 | | |
| 04 | Argon Liquid | | | |
| 05 | Bag, Polyethylene | MIL–DTL–24466 | | |
| 06 | Barrier Material | MIL–PRF–121 | | |
| 07 | Barrier Material | MIL–PRF–131 | | |
| 08 | Blanket, Insulating | | Kaowool 6 pound 695585 | Thermal Ceramics, 2102 Old Savannah Rd, P.O. Box 923, Augusta, GA 30906 |
| 09 | Brush, Wire | HB–178 | | |
| 10 | Cloth, Cleaning, Lint Free | CCC–C–46 | | |
| 11 | Coolant, Water Soluble | | 975 | Van Straton Inc, Chicago, IL |
| 12 | Cushioning Material | | | |
| 13 | Desiccant, Bagged | MIL–D–3464, Type I, II, and III | | |
| 14 | Dry Ice (Carbon Dioxide Solid) | LGA CG–6.9 | | |
| 15 | Fuels | | | Refer to applicable ENGINE MANUAL – Description and Operation |

GROUP 10
GENERAL MATERIALS (CONT)

| Group– Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 10– | | | | |
| 16 | Maskant Spray | | Spray Guard 49006 | TAFA Inc, 146 Pembroke Rd, Concord, NH 03301 |
| 17 | Nitrogen Liquid | A–A–59503 | | |
| 18 | Pad, Nitrile Rubber | SAE AMS 3200 | 0.05 to 0.01 Inch Thick | |
| 19 | Pad, Non-Abrasive Scouring | | Scotchbrite | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 20 | Paper, Tissue | | | Local Purchase |
| 21 | Solution | | ML | Harco Laboratories Inc, 186 Cedar St, Branford, CT 06405 |
| 22 | Steel Strapping, Shipping | | 3/4 Inch Width | |
| 23 | Tape, Electrical Insulating | ASTM D2686 | X1099 | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 24 | Tape, Vinyl Masking | ASTM 5486 | | |
| 25 | Tape, Reflective | | 3M Type 7610 | Honeywell Defense & Space, Distribution Center, Sales Administration, P.O. Box 29003, Phoenix, AZ 85038–9003 |
| 26 | Water, Distilled | | Commercial, Grade | Local Purchase |
| 27 | Wax, Cerita | MIL–W–12598 | | |
| 28 | Wax, Plater's Masking | | | |

GROUP 10
GENERAL MATERIALS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 10– | | | | |
| 29 | Wire, Electrical, Insulated | SAE AS 22759 | 20 Gage | Alpha Wire Corp, 711 Lidgerwood Ave, Elizabeth, NJ 07207 |
| 30 | Wax, Balancing | | Boflex | IGI Boler Inc, 85 Old Eagle School Rd, P.O. Box 384, Wayne, PA 14087 |
| 31 | Hydrogen Peroxide | A–A–53707 | | |
| 32 | Kerosene | ASTM D3699 | | |
| 33 | Glycerine | ASTM D1258 | | |
| 34 | Gloves, Lint Free | | | Local Purchase |
| 35 | Petrolatum Distillate | | | |
| 36 | Tape, Fiberglass | | | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 37 | Nylon Bagging Film | | Wrighton 6400 High Temperature | Coastline International Distributors Ltd, 274 Bangor St, Lindenhurst, NY 11757 |
| 38 | Fiberglass, Teflon Coated | | Release Ease 234 TFP | Coastline International Distributors Ltd, 274 Bangor St, Lindenhurst, NY 11757 |
| 39 | Cloth Breather/Bleeder | | Air Weave N4 | Coastline International Distributors Ltd, 274 Bangor St, Lindenhurst, NY 11757 |
| 40 | Fiberglass, Fabric | | Type 112 | Coastline International Distributors Ltd, 274 Bangor St, Lindenhurst, NY 11757 |

GROUP 10
GENERAL MATERIALS (CONT)

| Group–Item No. | Description | Specification | Manufacturer's Designation | Manufacturer |
|---|---|---|---|---|
| 10– | | | | |
| 41 | Tape, Sealant | | GS–213–3 | Coastline International Distributors Ltd, 274 Bangor St, Lindenhurst, NY 11757 |
| 42 | Tape, Boron Epoxy | | 5505/4.0 | Textron Systems Corp, 201 Lowell St, Wilmington, MA 01887–4113 |
| 43 | Film, Structural Adhesive | | AF–191, .08 Wt | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 44 | Tape, High Temperature | | Flash Breaker 2 | Coastline International Distributors Inc, 274 Bangor St, Lindenhurst, NY 11757 |
| 45 | Tape, Abrasion Resistant | | Scotch 8671 | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 46 | Tape, Sound/ Vibration Dampening | | Y434 | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 47 | Tape, Sound/ Vibration Dampening | | Y435 | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 48 | Tape, Sound/ Vibration Dampening | | Y436 | 3M Center, Building 42–6E–37, St Paul, MN 55144–1000 |
| 49 | Tape, Aluminum | | | |
| 50 | Tape, Teflon | | | |