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MILITARY SPECIFICATION

LANDING GEAR, AIRCRAFT SHOCK ABSORBER (AIR-OIL TYPE)

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers the requirements for shock absorber landing gears of the air-oil type.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

| | |
|-----------|--|
| QQ-C-320 | Chromium Plating (Electrodeposited) |
| QQ-N-290 | Nickel Plating (Electrodeposited) |
| QQ-S-781 | Steel Strapping, Flat |
| PPP-B-576 | Box, Wood, Cleated, Veneer, Paper Overlaid |
| PPP-B-601 | Boxes, Wood, Cleated Plywood |
| PPP-B-636 | Box, Fiberboard |

Military

| | |
|------------|--|
| MIL-C-104 | Crates, Wood; Lumber and Plywood Sheathed, Nailed and Bolted |
| MIL-P-116 | Preservation, Methods of |
| MIL-B-121 | Barrier Material, Greaseproofed, Waterproofed, Flexible |
| MIL-P-130 | Paper, Wrapping, Laminated and Creped |
| MIL-S-5002 | Surface Treatments and Metallic Coatings for Metal Surfaces of Weapons Systems |
| MIL-P-5514 | Packings; Installation and Gland Design, Hydraulic, General Requirements for |
| MIL-P-5516 | Packings and Gaskets, Preformed, Petroleum Hydraulic Fluid Resistant |
| MIL-H-5606 | Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance |
| MIL-T-6053 | Tests, Impact, Shock Absorber, Landing Gear, Aircraft |

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| | |
|-------------|--|
| MIL-H-6083 | Hydraulic Fluid, Petroleum Base, Preservative |
| MIL-I-6866 | Inspection, Penetrant Method of |
| MIL-I-6868 | Inspection Process, Magnetic Particle |
| MIL-S-7742 | Screw Threads, Standard, Optimum Selected Series: General Specification for |
| MIL-G-8348 | Gage Assemblies, Air Pressure, Dial Indicating Chuck Type, Self Contained |
| MIL-A-8867 | Airplane Strength and Rigidity, Ground Tests |
| MIL-C-16173 | Corrosion Preventive Compound, Solvent Cutback, Cold-Application |
| MIL-P-25732 | Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 275° F |
| MIL-B-26195 | Boxes, Wood-Cleated, Skidded, Load-Bearing Base |
| MIL-D-70327 | Drawings, Engineering and Associated Lists |

STANDARDSMilitary

| | |
|-------------|--|
| MIL-STD-10 | Surface Roughness, Waviness, and Lay |
| MIL-STD-129 | Marking for Shipment and Storage |
| MIL-STD-130 | Identification Marking of US Military Property |
| MIL-STD-143 | Specifications and Standards, Order of Precedence for the Selection of |
| MIL-STD-453 | Inspection, Radiographic |
| MIL-STD-805 | Towing Fittings and Provisions for Fixed-Wing Aircraft |
| MIL-STD-809 | Adapter, Aircraft, Jacking Point, Design and Installation of |
| MIL-STD-831 | Test Reports, Preparation of |
| MS15000 | Fittings, Lubrication (Hydraulic) Acceptable Tip Designs |
| MS15001 | Fittings, Lubrication (Hydraulic) Surface Check, 1/4-28 Taper Threads, Steel, Type I |
| MS15002 | Fittings, Lubrication (Hydraulic) Surface Check, Straight Threads, Steel, Type II |
| MS15003 | Fittings, Lubrication (Hydraulic) Surface Check, 1/8 Pipe Threads, Steel, Type III |
| MS15004 | Fittings, Lubrication (Hydraulic) Surface Check, 1/4-28 Taper Threads, Nickel-Copper Alloy, Type IV |
| MS15005 | Fittings, Lubrication (Hydraulic) Throat or Surface Check 1/8 Pipe Threads, Nickel-Copper Alloy, Type V |
| MS15006 | Fittings, Lubrication (Hydraulic) Leakproof, 1/8 Pipe Threads, Steel, Type VI |
| MS21025 | Nut, Castellated, Bearing Retaining |
| MS28772 | Packing, D-Ring, Shock Strut |
| MS28774 | Retainer, Packing Backup, Single Turn, Tetrafluoroethylene |
| MS28775 | Packing, Preformed, Hydraulic Plus 275° F (O-Ring) |
| MS28776 | Scraper, Piston Rod |
| MS28782 | Retainer, Packing, Back-Up, Teflon |
| MS28889 | Valve, Air, High-Pressure Charging |
| MS33675 | Ring, Wiper, Installation and Gland Design |

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Air Force-Navy AeronauticalAN6227
AND10071Packing, O-Ring Hydraulic
Boss and Installations - Air Connection

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

2.2 Other publications.- The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue in effect on date of invitation for bids or request for proposal shall apply:

National Bureau of Standards

Handbook H28 Screw-Thread Standards for Federal Service

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.)

Uniform Classification Committee

Uniform Freight Classification Rules

(Application for copies of the above publication should be addressed to the Uniform Classification Committee, 202 Chicago Union Station, Chicago, Ill. 60606.)

3. REQUIREMENTS

3.1 Preproduction.- This specification provides for preproduction testing.

3.2 Materials.- Materials shall be as specified herein. When materials are used which are not specifically designated, they shall conform to applicable specifications, or be completely defined in detail specifications or drawings furnished by the contractor for the article.

3.2.1 Protective treatment.- When materials are used in the construction of landing gears that are subject to corrosion in salt air or other atmospheric conditions likely to occur during service usage, they shall be protected against such corrosion in a manner that will in no way prevent compliance with the performance requirements of this specification. Metallic coatings and surface treatments shall be in accordance with MIL-S-5002. Cadmium plated parts shall not be subjected to temperature in excess of 450° F.

3.2.2 Selection of specifications and standards.- Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.3 Nomenclature.- The nomenclature used in this specification shall be as outlined on figure 1.

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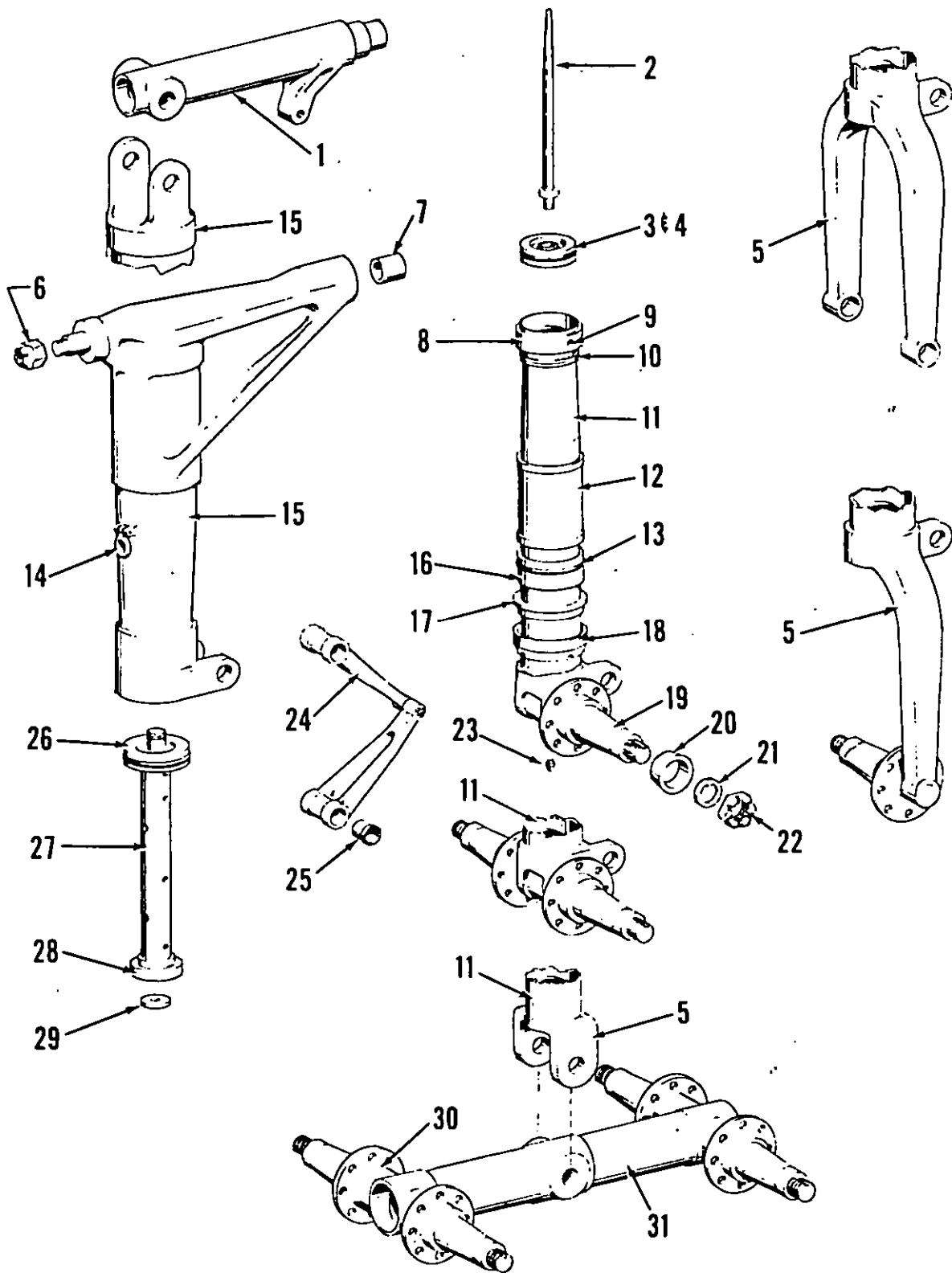


FIGURE 1. Nomenclature (sheet 1 of 2)

Item No.

- 1.....BEAM, TRUNNION
- 2.....PIN, METERING (TUBE, METERING) AS THE CASE MAY BE
- 3.....DIAPHRAGM, PISTON
- 4.....BASE, METERING ROD
- 5.....FORK, LANDING GEAR
- 6.....NUT, CASTELLATED, HEXAGON
- 7.....BEARING SLEEVE
- 8.....PISTON NUT
- 9.....SET SCREW
- 10.....VALVE, SNUBBER
- 11.....PISTON, LANDING GEAR
- 12.....STOP, PISTON EXTENSION
- 13.....PACKING, PREFORMED (O- OR D-RING ADDED TO TITLE AS SUPPLEMENTARY INFORMATION)
- 14.....ADAPTER, AIRCRAFT TOWING
- 15.....CYLINDER, LANDING GEAR
- 16.....BEARING SLEEVE
- 17.....RETAINER, PACKING
- 18.....PACKING NUT
- 19.....AXLE, LANDING GEAR
- 20.....SPACER, AXLE, LANDING GEAR
- 21.....WASHER, KEY
- 22.....NUT, SLOTTED, HEXAGON
- 23.....ADAPTER, AIRCRAFT JACKING POINT
- 24.....ARM ASSEMBLY, TORQUE, LANDING GEAR
- 25.....BEARING, SLEEVE OR BUSHING, SLEEVE (ACCORDING TO HIGHEST USAGE)
- 26.....BASE, RESTRICTOR SUPPORT TUBE
- 27.....TUBE, SUPPORT, ORIFICE
- 28.....ADAPTER, ORIFICE
- 29.....ORIFICE
- 30.....ADAPTER, AXLE
- 31.....AXLE, BEAM LANDING GEAR

FIGURE 1. (Sheet 2 of 2) Nomenclature

3.4 Drawings.- Drawings of the shock absorber as described in 3.4.1 and 3.4.2 shall be submitted by the contractor. All shock absorber landing gears shall conform to drawings provided by the contractor at time procurement is undertaken or of later approved changes.

3.4.1 Preliminary drawings.- Preliminary drawings of each new type and size of shock absorber landing gear or modification thereof shall be submitted prior to manufacture for the approval of the procuring activity. The drawings shall be in sufficient detail to clearly indicate the construction and operating features, materials, estimated weight, applicable design specification, aircraft identification, approximate compression ratios, and fluid level in the extended, static, and fully compressed positions. The identity of the surface treatment specification, and the tensile strengths of the major ferrous components shall also be furnished.

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3.4.1.1 A preliminary schematic drawing of the alighting gear with respect to the aircraft shall be submitted, indicating the following:

- (a) The position of main and auxiliary wheels in the static, compressed, and extended positions.
- (b) The angular relation of the shock absorber to the ground line in the three point and level landing attitudes for tail wheel aircraft.
- (c) The angular relation of the shock absorber to the ground line in the three point and maximum tail down attitudes for tricycle gear aircraft.
- (d) The angular relation of the shock absorber to the ground for normal landing attitude for other alighting configurations.
- (e) The most aft and forward center of gravity positions and corresponding gross weight.
- (f) The static wheel reactions for landing gross weight.

3.4.1.2 Tools.- Preliminary drawings of any special tools required for assembly or disassembly of the landing gear shall be submitted.

3.4.2 Final drawings.- Final production drawings in accordance with MIL-D-70327 showing dimensions and materials of all parts shall be submitted by the contractor to the procuring activity for approval with, or before, the delivery of the first production article.

3.4.2.1 The production drawings shall indicate the final weight, compression ratios, extended air pressure, and reference performance and strength report, in addition to the data listed in 3.4.1 and 3.4.1.1.

3.4.2.2 Tools.- Final production drawings shall be suitable for the manufacture of all special tools necessary to disassemble or service the shock absorber landing gear; photographs or sketches demonstrating the usage shall also be submitted.

3.4.3 Report.- A report containing the following design data shall be furnished with the above preliminary drawings if these data are not clearly shown on the drawings. These data shall be for landing gross weights, both basic and overload, for takeoff gross weights, and for ground handling gross weights and the corresponding design center of gravity positions.

- (a) The tire size and inflation pressure for proper deflection at each critical design condition and corresponding design gross weight.
- (b) Design vertical sinking speed of aircraft and corresponding test load, and nosewheel sinking speed for free flight engagement of carrier-based aircraft.
- (c) The total air volume and isothermal pressure in the extended and fully compressed positions and the static position and isothermal pressure for maximum takeoff gross weight, at the most adverse center of gravity of aircraft.
- (d) The preliminary loads imposed by the landing conditions and by all additional strength requirements.

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3.5 Design.- The shock absorber landing gear shall be of such design and construction that the passage of the oil specified herein, through an orifice, is used to absorb the energy of impact, and in which air is used as the elastic medium to restore the unsprung parts to their extended position.

3.5.1 Interchangeable parts.- Interchangeable individual and component parts of shock absorber landing gears shall be identified by the detail part number of the original design.

3.5.2 Efficiency.- The computed efficiency, as determined by the following formula from the data obtained during a drop test, shall be not less than 75 percent for a variable orifice. Where a constant orifice is used, the efficiency may be as low as 60 percent. Under special conditions where the shock attenuation may be programmed to allow proper coordination with the onset rates for drag load, the efficiency will be negotiated.

$$\text{Percent EFF} = 100 \times \frac{A}{L_m \times m}$$

Where: A = Energy absorbed by the shock absorber during its stroke. This energy is obtained by integration of the area under the curve of landing gear load versus landing gear stroke.

L_m = Maximum load in pounds obtained during stroke.

m = Maximum stroke obtained during the test.

3.5.3 Load factor.- Unless otherwise specified in the contract or purchase order, drop tests shall be made in accordance with MIL-T-6053 or MIL-A-8867 (requirement paragraph titled "Drop tests"), whichever is applicable. The maximum load factor produced shall be not greater than that specified for the particular aircraft for which the landing gears are intended.

3.5.4 Hydraulic fluid.- The fluids with which the landing gear shall be designed to operate are listed in table I. Note should be taken of the design temperature ranges and the fluid selected accordingly, including a compatible packing material.

TABLE I. Packing requirements for temperature ranges

| Temperature range | Packing standard | | Packing material | Fluid | Installation |
|------------------------------|------------------|---------|------------------|--------------------------------|--|
| | D-ring | O-ring | | | |
| Type I: -65° F to 160° F | | AN6227 | MIL-P-5516 | MIL-H-5606 or MIL-H-6083 | MIL-P-5514 |
| | MS28772 | | MIL-P-5516 | MIL-H-5606 or MIL-H-6083 | Inside running seals only See 3.6.4 |
| Type II: -65° F to 275° F | | MS28775 | MIL-P-25732 | MIL-H-5606 or MIL-H-6083 | MIL-P-5514 |

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3.5.5 Orifice.— When a metering pin is used, the entering edge of the orifice shall be well rounded in such a way that the passage for oil flow is smooth and without abrupt changes. When an orifice is used without a metering pin, a sharp-edged orifice may be used. Its edges shall be clean and smooth, without chamfer or radius. In either type, there shall be no obstructions sufficiently near the orifice to interfere with the free flow of fluid through it. The material of which the orifice is made shall have sufficient surface hardness to minimize wear which will affect the metering action.

3.5.6 Metering pin.— The metering pin shall be securely mounted and adequately safetied and sealed with its axis parallel to the cylinder axis and concentric with the orifice axis. It shall be guided or otherwise so designed that there shall be no detrimental contact between the pin and the orifice throughout the entire stroke for all design conditions. In metering pin orifice combinations where contact is intended, metering pin and orifice materials shall be selected with a view toward minimizing wear and toward obtaining uniform metering characteristics for the expected service life of the shock absorber landing gear.

3.5.6.1 When a threaded base type of metering pin is used, the base hex used for installation and removal of the pin shall be a multiple of 1/4 inch across the flats.

3.5.7 Sealing joints.— Any joint which requires service disassembly shall not be sealed by the use of fused or adhesive materials; except where static joints are subject to corrosion, the use of an adhesive sealant may be used with approval of the procuring activity.

3.5.8 Air connections.— The air connections installation shall conform to AND10071. The air valve shall be in accordance with MS28889. Elastomeric sealing element materials, if used, shall conform to table I.

3.5.9 Filling provisions.— The filler plug and air valve shall be so located as to be easily accessible for proper servicing. Adequate clearance shall be provided for the application of an air charging device similar to that shown in MIL-G-8348. It shall not be possible for the oil level to exceed a value which will cause the air volume in the compressed position to be reduced below that specified in 3.4.3(c) when filled in accordance with instructions given on the nameplate. Inner passages and spaces, such as those formed by the piston within the outer cylinder, shall be adequately vented to eliminate air traps while filling or during operation. The design shall permit filling of the shock absorber when installed on an airplane without resort to special tools or airplane jacking, the time required for filling shall be minimized.

3.5.10 Drainage provisions.— Means shall be provided, where the optimum design is not unduly jeopardized, to permit draining of most of the fluid prior to major disassembly or removal of the piston from the aircraft. A drain plug is preferable in order that the fluid may be drained with the landing gear in the extended position. If this is impracticable, draining may be accomplished with the landing gear in the retracted position.

3.5.11 Extended position oil level.— The quantity of oil above the orifice, with shock absorber fully extended, shall be sufficient to avoid unsatisfactory shock-absorption characteristics caused by foamed oil or leakage. This shall be demonstrated by conducting, within an elapsed time of 5 minutes, two successive drops

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conforming to the tests specified in 4.6.2.8. These drop tests shall then be repeated after having removed a volume of oil corresponding to 1/2 inch of oleo stroke. The foregoing demonstration may be omitted if the normal oil level above the orifice, in inches, is at least 125 percent of the piston diameter, or 5 inches, whichever is less.

3.5.12 End connections.— The end connection of the shock absorber landing gear shall be of such design and construction as to be suitable for the aircraft for which the landing gear is intended. Bushings and lubricator fittings conforming to MS15000, MS15001, MS15002, MS15003, MS15004, MS15005, and MS15006, shall be provided in all connections where relative motion between mating parts exist other than that resulting from deflections between mating parts, unless ball or permanently lubricated bearings are used.

3.6 Packing.—

3.6.1 Packing to prevent leakage of oil and to maintain the normal air pressure in the landing gear shall be placed for optimum design. Extension loads shall not be taken on the packing.

3.6.2 Unless otherwise specified, packing shall conform to the specifications specified in table I for operation in the appropriate fluids at the indicated design temperature ranges.

3.6.3 The packing nut locking devices shall provide for a packing nut adjustment by the increments of not over 45 degrees.

3.6.4 The packing cross-sectional shapes and sizes shall conform to the specifications in table I. Gland dimensions shall conform to the specifications in the "Installation" column of the same table. The packing gland dimensions for D-rings shall conform to MIL-P-5514. Unless otherwise specified by the procuring activity, backup rings shall be selected in accordance with MS28782 or MS28774. Means shall be provided for adequate lubrication of all running seals without disassembly of the landing gear.

3.6.5 All landing gears shall incorporate scraper rings in accordance with MS28776. The scraper rings shall be installed in accordance with MS33675.

3.7 Packing nuts.— Packing gland nuts shall contain slots for spanner wrenches in accordance with table II and figure 2 or 3, depending on the type of nut.

TABLE II. Slots for wrenches 1/

| Diameter D (inches) | Slot depth T (inch) | | Slot width W (inch) | | Slot length L type II (inch) |
|------------------------|---------------------|---------|---------------------|---------|---------------------------------|
| | Type I | Type II | Type I | Type II | |
| 2 - 4 | 5/16 | 1/8 | 5/16 | 5/16 | 7/8 |
| 4 - 5 | 5/16 | 5/32 | 3/8 | 3/8 | 1 |
| 5 - 7 | 3/8 | 3/16 | 7/16 | 7/16 | 1-1/8 |
| 7 - 13 | 7/16 | 7/32 | 1/2 | 1/2 | 1-1/4 |

1/ See figures 2 and 3.

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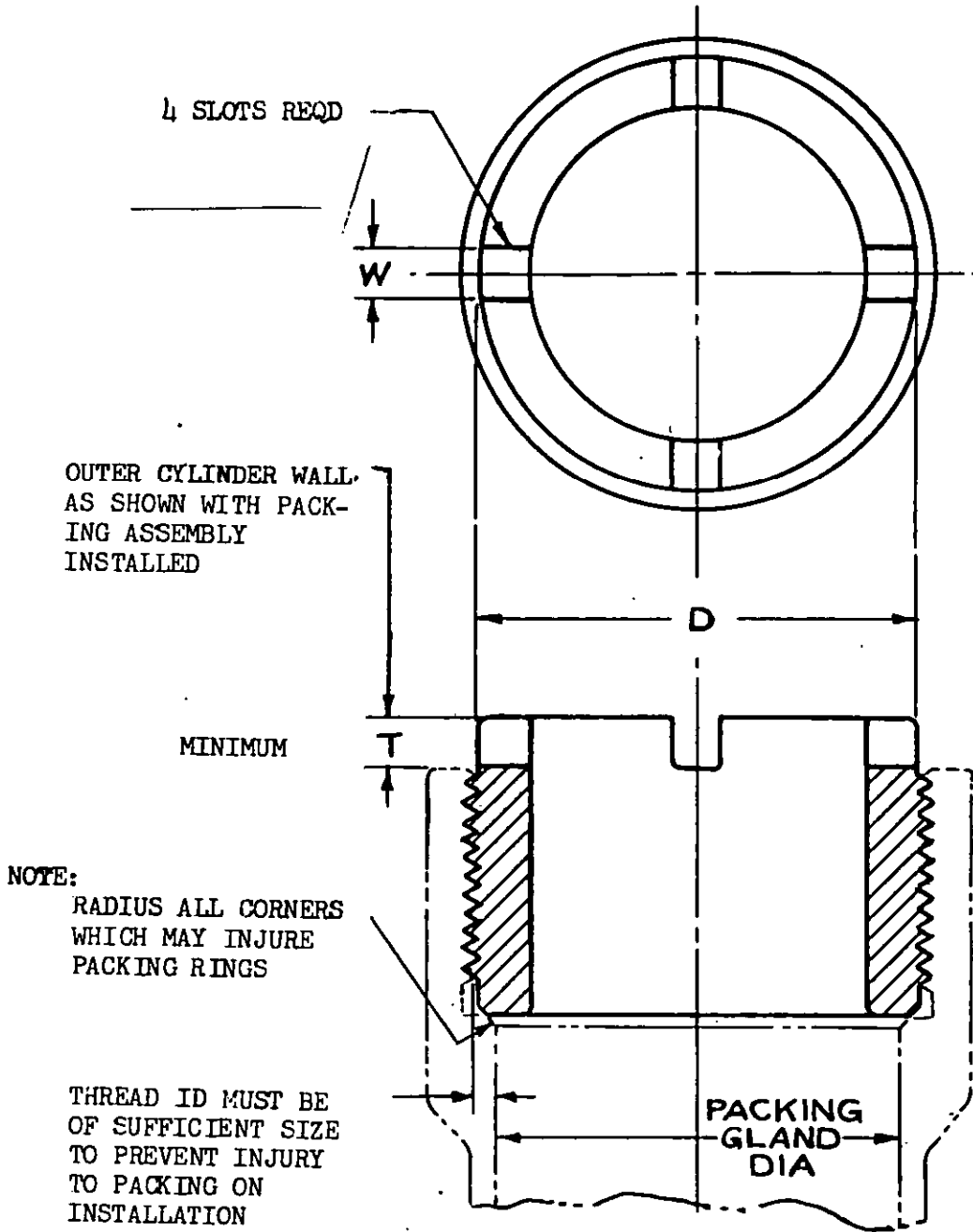


FIGURE 2. Externally threaded packing nut, type I

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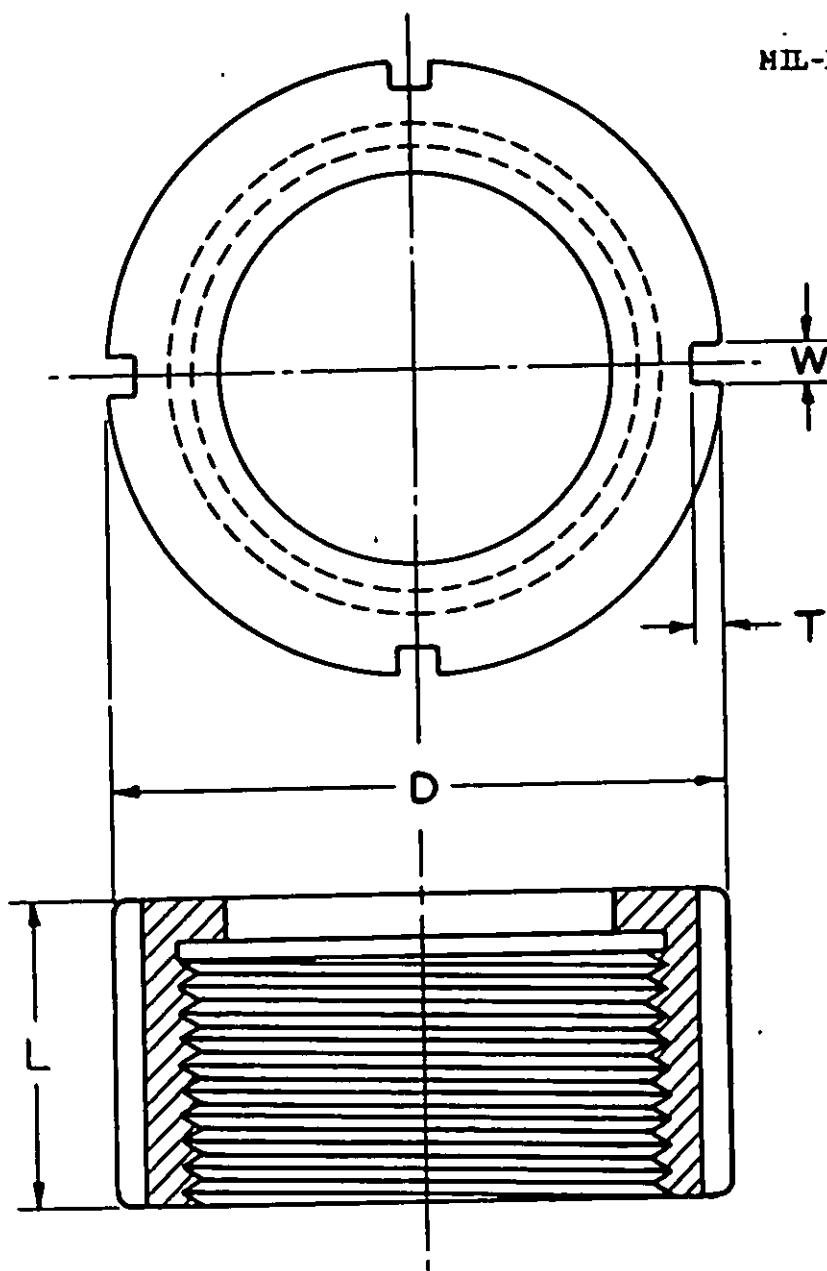


FIGURE 3. Internally threaded packing nut, type II

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3.8 Finish of piston.- The portion of the piston which slides through the running seal and the bearing shall be ground, hard chromium plated, and have a surface finish of 5 to 16 microinches in accordance with MIL-STD-10. The chromium plating shall be in accordance with QQ-C-320. The minimum thickness of chromium plating shall be 0.001 inch for land-based aircraft and 0.0035 for carrier-based aircraft. If the landing gear is to be used on amphibious aircraft, the finish shall consist of 0.001 \pm 0.0005 inch nickel plate conforming to QQ-N-290, followed by a minimum of 0.004 inch chromium plate. All plating shall be free from pits, blisters, or other injurious surface imperfections.

3.9 Tensile strength limit loads.- The attachment of the piston nut to the piston and all other connections in the landing gear which carry the loads when the landing gear is extended shall be so designed as to carry in tension a limit load of at least 20 times that of the unsprung weight, the sudden landing gear extension loads for carrier-based aircraft, or 3 times the load owing to air pressure with the landing gear extended, whichever is the greater.

3.10 Piston clearance.- The clearance between the piston and its bearing, as well as the outer cylinder bore and its bearing, shall be such that no adverse interference or clearance gap as limited by MIL-P-5514 occurs at any temperature between -65° F and 160° F.

3.11 Bearing loads and spacing.- Bearing spacing and bearing stresses shall be as selected by the designer, subject to approval by the procuring activity. An analysis shall be submitted substantiating the design with regard to spacing, bearing materials, bearing stresses and possible binding. Bearing materials shall not be used when swelling results from the fluids and temperatures specified in table I, or distortion (out of roundness) exceeding 0.0005 inch per inch of piston diameter.

3.11.1 Cantilever landing gears.- With the landing gear fully extended, the distance between the outer ends of the bearings shall be at least 2.75 times the piston diameter. The bearing spacing and location relative to the wheel or wheels shall be such that the combinations of vertical, side, and drag loads associated with ground turning, braking, and landing conditions shall not cause the shock absorber to be restrained by friction forces from re-extension after having experienced compression due to any of these loads.

3.11.1.1 The bearings stress based on limit load or design load and a uniform distribution shall not exceed 6,000 psi.

3.11.2 Pin-ended landing gears.- With the landing gears fully extended, the distance between the outer ends of the bearings shall be at least 1.25 times the piston diameter.

3.12 Piston nut attachment.- The means of locking the piston nut to the piston shall be subject to the approval of the procuring activity. If threaded, it shall be attached to the piston by threads of sufficient size and number depending on the size of shock absorber landing gear. The thread shall be in accordance with 3A or 3B of MIL-S-7742, for diameters up to 6 inches, and Handbook H28 for threads of all diameters over 6 inches. The thickness of the piston wall shall be sufficient to withstand the diametrical load owing to wedging action of the threads between piston when the critical tension load as determined in 3.9 is applied to the assembly. Thread size and threaded length of the connection shall be subject to the following limitations:

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- (a) For threaded lengths up to 4 inches, the number of threads per inch shall not exceed 16.
- (b) For threaded lengths from 4 to 6 inches, the number of threads per inch shall not exceed 12.
- (c) For threaded lengths from 6 to 15 inches, the number of threads per inch shall not exceed 8.

3.13 Axle.- All axles using a wheel bearing retaining nut shall have two through cotter pin holes at 90-degree spacing. Steel retaining nuts shall be provided in accordance with MS21025, unless a substitute design is approved by the procuring activity for an optimum design condition. Consideration shall be given to towing and jacking provisions in accordance with MIL-STD-805 or MIL-STD-809, respectively.

3.14 Packing removal.- If removal of the piston nut from the piston is necessary for removal of the packing, the piston nut face shall be provided with standard spanner notches, in accordance with table II; or in lieu thereof, projecting lugs which provide the same amount of bearing surface for the wrench.

3.15 Rebound element.- A rebound snubbing arrangement shall be provided, which will dissipate energy in the landing gear, as necessary from the compression of the air when fully compressed, and which will reduce impact forces upon full extension of the landing gear in takeoff or catapulting. Unless otherwise specified, the requirements of rebound as specified in MIL-T-6053 or MIL-A-8867 (requirement paragraph titled "Sudden extension of landing gear"), whichever is applicable, shall be accomplished.

3.16 Oil return.- When the gear is extended from the stowed position in the aircraft, the oil shall return to its normal position within a time consistent with the operational requirements of the aircraft.

3.17 Locking device.-

3.17.1 Nontorsional loaded undercarriage.- The device used to lock the piston nut to the piston shall have sufficient strength to resist 3 times the torque necessary to produce rotation when an axial tension load equal to 10 times the unsprung weight of the undercarriage is applied to the landing gear.

3.17.2 Torsional loaded undercarriage.- The devices used to lock the piston nut to the piston and the packing nut to the outer cylinder shall have sufficient strength to carry at least 5 percent of the design torque.

3.18 Landing gear bottoming.- The landing gear, when fully compressed, shall be capable of carrying in compression the maximum design impact load. If the piston nut is used for the stop in the fully compressed position, shearing or bending stress induced in the piston shall be adequately provided for by providing sufficient bearing area in the stop or shoulder.

3.19 Inflation.-

3.19.1 The air pressure in the fully compressed position shall be sufficient, in combination with other design features, to prevent bottoming during landing, taxiing, and catapulting. The air pressure in the fully extended position shall be sufficient to insure full extension of the oleo after takeoff and to maintain the design extension

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of the oleo when in the retracted position under all probable conditions of flight. The latter requirements may be waived if the contractor can demonstrate that movement of the oleo in the retracted position will not result in damage to the airplane or malfunction of the gear. The air pressure in the oleo shall be in accordance with the applicable operating instructions.

3.19.2 The static inflation pressure in the landing gear shall not exceed 2,500 psi, unless otherwise authorized by the procuring activity.

3.20 Performance.- The shock absorber landing gear assembly shall be capable of satisfactorily completing the drop tests specified in 4.6.2.8. The landing gear shall operate satisfactorily without leakage, binding, or interference between component parts, which impair the landing gear operation, at all temperatures between 160° F to -65° F, and under all applicable loading conditions throughout this temperature range.

3.20.1 Extreme temperatures.- Performance requirements which exceed the above temperature ranges shall be adjusted to suit the requirements of the individual weapon system, and subject to approval by the procuring activity.

3.21 Standard tools.- The design of the landing gear and parts shall be such as to accommodate to the greatest possible extent, disassembly, reassembly, and service maintenance by means of those tools and items of maintenance equipment which are normally available as commercially standard.

3.22 Identification of product.-

3.22.1 Name and instruction plate.- A sample or drawing of the name and instruction plate, conforming to figure 4 properly filled in with the instructions, shall be submitted to the procuring activity, and the approval received thereof, prior to placing the instructions on the nameplate. This plate shall be in accordance with MIL-STD-130, furnishing information as shown on figure 4 of this specification. A Vandyke, or equivalent, of the approved instructions shall be furnished the procuring activity.

3.23 Workmanship.- Workmanship shall be of the quality necessary to produce landing gears free from defects which affect proper functioning.

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Classification of inspections.- The examining and testing of landing gears shall be classified as:

- (a) Preproduction inspections (4.3)
- (b) Quality conformance inspections (4.4)

NAME AND TYPE OF LANDING GEAR

MFD. BY _____

FOR _____

SERIAL No. _____

SPEC. No. _____

ORDER No. _____

DESIGN No. _____

INSTRUCTIONS FOR SERVICING

WARNING

RELEASE AIR IN LANDING GEAR BEFORE DISASSEMBLING

INSERT COMPLETE INSTRUCTIONS FOR SERVICING AND MAINTAINING LANDING GEAR, WITH PHRASE "FILL WITH MIL-H-5606 OR MIL-H-6083 FLUID" INCLUDED IN THESE INSTRUCTIONS. GIVE DIMENSION IN INCHES BETWEEN CONVENIENT MEASURING POINTS WITH CORRECT INFLATION FOR APPLICABLE LOAD OF THE AIRCRAFT. LETTERS TO BE 1/16 INCH HIGH.

MATERIAL: METALLIC

FIGURE 4. Name and instruction plate

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4.3 Preproduction inspections.

4.3.1 Sampling instructions.- The preproduction samples shall consist of one shock absorber landing gear representative of the production equipment (see 6.2).

4.3.2 Test reports.- After the contractor completes the preproduction inspections, he shall prepare a preproduction test report in accordance with MIL-STD-831 and furnish three complete copies of the report to the procuring activity. Approval of the preproduction test report, except the drop test, by the procuring activity shall be required prior to shipment of more than one set of landing gears. Drop test reports shall incorporate the test methods and results as specified in 4.6.2.8 and shall be approved prior to the acceptance of the first production aircraft (see 6.2).

4.3.3 Tests.- The preproduction inspections shall consist of all the examinations and tests listed under 4.6, with the exception of 4.6.2.3 and 4.6.2.4.

4.4 Quality conformance inspections.- The quality conformance inspections shall consist of individual tests and periodic sampling tests.

4.4.1 Individual tests.- Each landing gear shall be subjected to:

- (a) Examination of product (4.6.1)
- (b) Inspection for internal defects (4.6.2.3)
- (c) Inspection for surface defects (4.6.2.4)
- (d) Extended leakage (4.6.2.5)
- (e) Leakage, vertical position, except duration to be 6 hours minimum (4.6.2.7)

4.4.2 Periodic sampling tests.- Components which are to be subjected to periodic sampling tests shall be selected at random from components which have passed the individual tests, and shall be proof tested as specified in 4.6.2.2, 4.6.2.6 and 4.6.2.7. The selection of samples shall be made as follows:

- (a) One from the first 10 production items.
- (b) One from the 70th to 80th production item.
- (c) One from each 100 thereafter until the 500th item.
- (d) One from each 100 or less after the 500th item.

4.4.3 Rejection.- When one item selected from a production run fails to meet the specification, no item still on hand or later produced shall be accepted until the extent and cause of failure are determined.

4.4.3.1 Individual tests may continue.- For operational reasons, individual tests may be continued pending the investigation of a sampling test failure. But final acceptance of items on hand or produced later shall not be made until it is determined that items meet all the requirements of the specification.

4.4.3.2 Defects in items already accepted.- The investigation of a test failure could indicate that defects may exist in items already accepted. If so, the contractor shall fully advise the procuring activity of all defects likely to be found and methods of correcting them.

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4.5 Test conditions.- Hydraulic fluid conforming to MIL-H-6083 shall be used during the tests specified herein. A run-in test not to exceed 20 cycles may be run at the option of the contractor, prior to testing as specified in 4.6.

4.6 Inspection methods.-

4.6.1 Examination of product.- Shock absorber landing gears shall be inspected for compliance with drawings, identification of product, interchangeability, strut travel, binding, and workmanship.

4.6.2 Performance tests.-

4.6.2.1 Temperature tests.- (See 6.3.)

4.6.2.2 Proof pressure test.- The high-pressure chamber of the landing gear shall be subjected to a hydraulic working pressure equal to the maximum design limit hydraulic working pressure for 15 minutes. The shock absorber landing gear shall not show signs of yield, leakage, or permanent deformation at the conclusion of this test. This test may be made with the orifice closed to protect the air chamber from the test pressure and may also be made with the landing gear end-loaded with the maximum operating load.

4.6.2.3 Inspection for internal defects.- Fusion welds of major components shall be inspected for the presence of internal defects by radiographic methods in accordance with MIL-STD-453, with acceptance standards as agreed upon between the contractor and procuring activity. Ultrasonic inspection methods may be used as an alternate, subject to agreement between the contractor and procuring activity. Areas subject to internal defects shall be defined on production drawings and referenced documents and shall be inspected by the methods and standards of acceptance specified in this paragraph.

4.6.2.4 Inspection for surface defects.- The surfaces of stressed parts shall be inspected by magnetic particle or penetrant inspection methods in accordance with MIL-I-6868 and MIL-I-6866, respectively, as appropriate. Heat-treated steel parts (260,000 psi ultimate tensile strength and above) that require a grinding operation after final heat treat, shall be inspected by nital etch on all surfaces subject to grinding. After inspection, the etch solution (6 percent nitric acid and 94 percent alcohol) shall be rinsed from the part with water. The part shall be subsequently baked for 3 hours at 375° F.

4.6.2.5 Extended leakage.- After the landing gear has been assembled, the piston shall be cycled six times over a distance not less than 30 percent of the full piston stroke. Attitude during test may be either horizontal or vertical. There shall be no evidence of leakage.

4.6.2.6 Leakage test, horizontal position.- The leakage test of the shock absorber landing gear in the horizontal position shall be made with the landing gear in the fully extended position and normal inflation pressure. There shall be no leakage of hydraulic fluid or loss of air pressure at the end of 8 hours.

4.6.2.7 Leakage test, vertical position.- The leakage test of the shock absorber landing gear in the vertical position shall be made with the normal end load and normal inflation pressure. The landing gear shall be at the pressure obtained when the aircraft is at rest on the ground. There shall be no leakage of hydraulic fluid or loss of air pressure at the end of 24 hours.

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4.6.2.8 Drop test.- Drop tests shall be accomplished in accordance with MIL-T-6053 or MIL-A-8867 (requirement paragraph titled "Drop tests"), whichever is applicable.

4.7 Packaging, packing, and marking.- Preparation for delivery shall be examined for conformance to section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation.-

5.1.1 Levels A, B, and C.- Each shock absorber landing gear shall be protected from corrosion in accordance with Method I of MIL-P-116.

5.1.2 Each shock absorber landing gear shall be filled with preservative hydraulic fluid conforming to MIL-H-6083.

5.1.3 Non-corrosion-resistant external parts and all exposed critical surfaces shall be coated with corrosion-preventive compound conforming to grade 2 of MIL-C-16173. When practicable, conforming wraps of barrier material, greaseproof, waterproof, flexible, in accordance with grade A or grade C of MIL-B-121 shall be applied.

5.2 Packaging.-

5.2.1 Levels A and B.- Each landing gear shall be preserved in accordance with 5.1 and packaged one each to a shipping container. Unless otherwise specified in the contract, each landing gear shall be secured to the base of the container utilizing wooden blocks and metal straps (see figures 5 and 6) (NOTE: Felt or other suitable cushioning material shall be used at all contact or mounting points, utilizing in all instances neutral barrier paper conforming to MIL-P-130 or grade A barrier paper conforming to MIL-B-121, next to the surface of the landing gear.) Metal holddown straps shall be 1-1/4 inches and 2 inches in width, as applicable, conforming to type I, class C of QQ-S-781.

5.2.2 The landing gear torque arm shall be disconnected at either end or at the apex and fastened flat to the landing gear, except where such action requires the use of special tools or skilled technicians, or where there will be no savings in cube. If practicable, the cylinder shall be closed and securely fastened to prevent opening in order to standardize the size of the container.

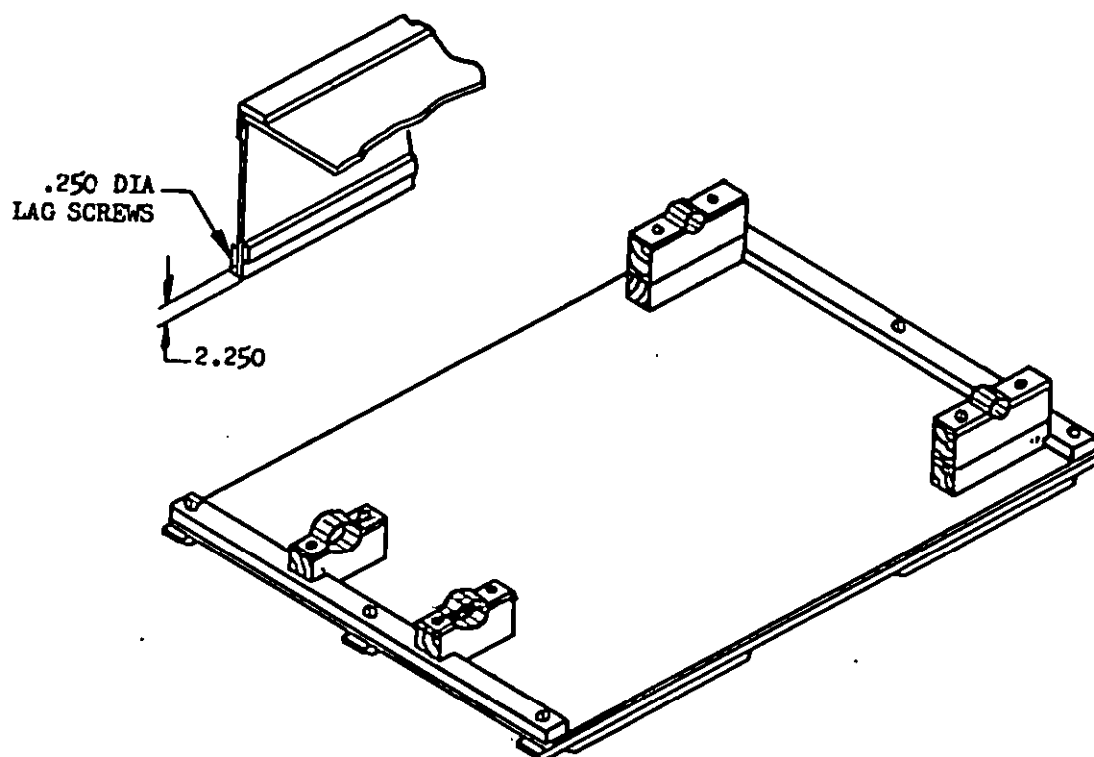
5.2.3 Disassembled accessory parts shall be packed in fiberboard cartons conforming to PPP-B-636 and secured within the exterior shipping containers.

5.2.4 Level C.- Shock absorber landing gears shall be packaged in accordance with the manufacturer's commercial practice.

5.3 Packing.-

5.3.1 Levels A and B.- Landing gears weighing 150 pounds or less shall be packed in a combination type exterior shipping container utilizing a cleated plywood base with a cleated veneer, paper-overlaid cover conforming to PPP-B-576 or PPP-B-601. Landing gears weighing 150 pounds to 1,000 pounds shall be packed in a combination type exterior shipping container utilizing a skidded plywood base with a cleated plywood or cleated veneer, paper-overlaid cover (see figures 5 and 6) conforming to type I or II (as specified in the contract or order), style A, class 1 of MIL-B-26195. Landing gears weighing in excess of 1,000 pounds shall be packed in containers conforming to type I, class 2, style b of MIL-C-104.

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THE CONTAINER SHALL BE CONSTRUCTED IN COMPLIANCE WITH MIL-B-26195.

FELT CUSHIONING LINED WITH CHEMICALLY NEUTRAL BARRIER PAPER (MIL-P-130) SHALL BE USED AT ALL POINTS OF CONTACT BETWEEN LANDING GEAR AND BLOCKING.

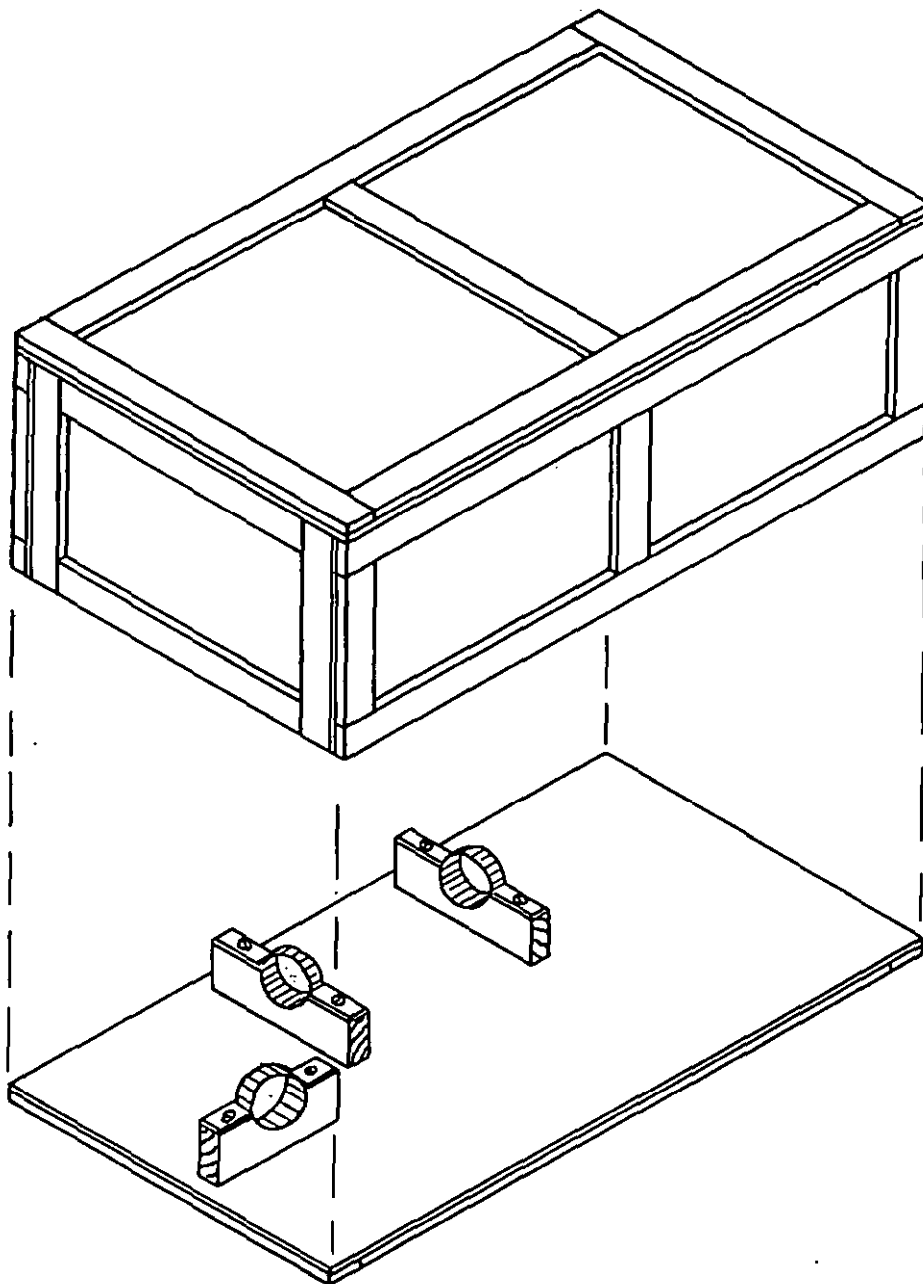
CONTAINER SIZE AND BLOCKING MAY BE ADJUSTED TO FIT VARIOUS LANDING GEARS.

MATERIALS MAY BE SELECTED ACCORDING TO SIZE, WEIGHT, AND MODE OF SHIPMENT AS APPLICABLE.

THE BOX COVER MAY BE REMOVED FOR AIR SHIPMENT, IF PRACTICABLE.

FIGURE 5. Guide for packing landing gears exceeding 150 pounds

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THE CONTAINER SHALL BE CONSTRUCTED IN COMPLIANCE WITH PPP-B-601 OR PPP-B-576.

FELT CUSHIONING LINED WITH CHEMICALLY NEUTRAL BARRIER PAPER (MIL-P-130) SHALL BE USED AT ALL POINTS OF CONTACT BETWEEN LANDING GEAR AND BLOCKING.

CONTAINER SIZE AND BLOCKING MAY BE ADJUSTED TO FIT VARIOUS LANDING GEARS.

MATERIALS MAY BE SELECTED ACCORDING TO SIZE, WEIGHT, AND MODE OF SHIPMENT AS APPLICABLE.

THE BOX COVER MAY BE REMOVED FOR AIR SHIPMENT, IF PRACTICABLE.

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5.3.2 Level C.- Landing gears shall be packed in accordance with the manufacturer's commercial practice. The packing shall conform to Uniform Freight Classification Rules and Interstate Commerce Commission regulations to assure safe delivery to destination by common carrier at the lowest applicable rate.

5.4 Marking of shipments.-

5.4.1 Packages.- Each shock absorber landing gear shall have a detachable tag with the following information noted thereon:

THIS UNIT CONTAINS PRESERVATIVE HYDRAULIC
FLUID (MIL-H-6083). DO NOT DRAIN - USE
HYDRAULIC OIL (MIL-H-5606).

5.4.1.1 Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129 and, in addition, shall contain the following:

Designer's part number
Date of manufacture

6. NOTES

6.1 Intended use.- Shock absorber landing gears conforming to this specification are intended for use on aircraft.

6.2 Ordering data.- Procurement documents should specify:

- (a) Title, number, and date of this specification.
- (b) Data requirements (see 3.4 and 3.22).
- (c) Where the preproduction test report should be sent when testing is performed by the contractor or where the preproduction samples are to be sent when testing is to be performed by the procuring activity (see 4.1 and 4.3).
- (d) Applicable levels of preservation, packaging, packing, and type of box required (see section 5).
 - (1) Level B preservation and packaging is intended to provide economical but limited protection, and should be specified only when it is determined the landing gears will be held in covered storage approximately 6 months from date of initial packaging.

6.3 Temperature tests.- Temperature tests may be performed at the option of the procuring activity, who will specify the procedure for testing.

Custodians:

Army - MO
Navy - WP
Air Force - (11)

Reviewer activities:

Army -
Navy - WP
Air Force - (11), (70)

User activities:

Army -
Navy -
Air Force -

Preparing activity:
Air Force - (11)

Project No. 1620-0040

SPECIFICATION ANALYSIS SHEET

Form Approved Budget
Bureau No. 119-ROO4INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

MIL-L-8552C Landing Gear, Aircraft Shock Absorber (Air-Oil Type)

ORGANIZATION

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

 Direct Government Contract Subcontract

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

A. GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

 YES NO

IF "YES" IN WHAT WAY?

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

SUBMITTED BY (Printed or typed name and activity)

DATE