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AEROSPACE STANDARD

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Superseding AS4775

Aircraft Maintenance Jacks - General Requirements

FOREWORD

This document is intended to establish minimum standards, and provide a recommendation for the design, manufacture and testing of aircraft jacks; which will permit safe operation and minimize potential aircraft damage and personnel safety hazards associated with aircraft jacking operations.

The jacks described in this document are intended to be used for scheduled and unscheduled aircraft maintenance, modification, repair, emergency repair, as well as functional test and general inspection of aircraft.

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1. SCOPE:

This document covers the general requirements for hydraulic aircraft jacks. It can be applied to tripod, unipod, and axle jacks that may be used on open ramp areas as well as in the aircraft hanger.

Throughout this Aerospace Standard, the minimum essential criteria are identified by the key word “shall”. Recommended criteria are identified by use of the key word “should”. Deviation from recommended criteria should only occur after careful consideration and thorough service evaluation have shown alternate methods to provide an equivalent level of safety.

The term “vertical load” throughout this Aerospace Standard is defined as the force imposed on the aircraft jack at the airframe jack point.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from: SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP490	Electro-hydraulic Flow-Control Servo valves
ARP598	The Determination of Particulate Contamination in Liquids by the Particle Count Method
ARP1247	General Requirements for Aerospace Ground Support Equipment, Motorized and Non-Motorized
AS33559	Adapter Aircraft, Jacking Point
J514	Hydraulic Tube Fittings
J517	Hydraulic Hose
J533	Flares for Tubing
AMS 2404	Plating, Electroless Nickel
AMS 5560	Standard Steel Hydraulic Tubing

2.1 (Continued):

AMS-QQ-C-320 Plating, Chromium (Electrodeposited)

AMS-QQ-P-416 Plating, Cadmium (Electrodeposited)

2.2 International Standards - ISO:

Available from: http://www.iso.org.

ISO 1464 Aerospace - Tripod jacks - Clearance Dimensions

2.3 Industrial Publications:

Available from: American Welding Society, 550 N.W. LeJune Rd., Miami, FL 33126 or http://www.aws.org.

AWS (American Welding Society)

D1.1 Structural Welding Code - Steel

2.4 U.S. Government Publications:

Available from: http://assist.daps.dla.mil/quicksearch.

MIL-PRF-5606H Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance

Available from: http://www.osha.gov.

OSHA Occupational Safety & Health Act) Title 29 Part 1910 Subpart D Ladders, Platforms, and Controls

3. JACK ASSEMBLY:

The jack assembly shall be a compact hydraulic operated unit that provides rapid and easy deployment. External connections, when specified, shall enable operation from a pneumatic pressure source, electric power, external hydraulic source, or when connected to a manifold, enable operation in conjunction with other jacks.

4. CLASSIFICATION:

All aircraft jacks shall be classified as to their design or use. These classifications shall be in accordance with Table 1.

TABLE 1 - Classification of Aircraft Jacks

Classification of Jacks	Characteristics of Jacks
Landing Gear (Axle)	Hand Carried Dolly Mounted Cantilever
Airframe (Unipod & Tripod)	Fixed Height Variable Height

5. GENERAL DESIGN CONSIDERATIONS:

5.1 The Aircraft Interface:

The aircraft manufacturers jacking points and allowable vertical loads and horizontal forces at those points shall be considered. The jack shall interface properly and securely with the aircraft jack points, and shall conform to the interface adapter per AS33559.

5.2 Floor Loading:

The jack base, beam, or foot pads shall be of such proportions as to limit floor loading to less than 2700 kPa (400 psi) for tripod jacks and less than 7000 kPa (1000 psi) for axle jacks at rated capacity whenever possible.

5.3 Human Factors, Controls:

All controls shall be grouped and spaced in a logical arrangement to provide ease of operation. They shall be spaced for easy access and prompt recognition as to function. Any turning, pumping, or pulling action shall be with a constant and reasonable force, and prompt in its response.

5.4 General Design Criteria:

The jack shall be designed to operate under and/or meet the following conditions:

a. A maximum settling rate of 0.051 cm/ram/h (0.020 in/ram/h) while supporting a vertical load equal to the rated capacity.

b. Vertically raise 150% of the rated capacity.

c. Withstand a horizontal force equal to 15% of the rated capacity while supporting a vertical load equal to the rated capacity with the ram and the screw extension (if any) fully extended.

d. An internal pressure equal to 150% of the pressure at rated capacity with 0.05 cm^3/h external leakage; the internal leakage of the pump shall not exceed a rate of 5.0 cm^3/h.

e. Operate at all temperatures ranging from -40 to +54 °C (-40 to +130 °F).

f. 200 cycles of raising and lowering the rated capacity.

g. The dust, rain, snow, ice, temperature, and other environmental conditions normally expected in service.

5.4.1 Materials and Components: The material and components used in the manufacture of the jack shall be commercially available whenever possible. They shall be appropriate for the application and the environment they will be subjected to. All components shall be arranged for maximum ease of operation and maintenance.

5.4.2 Metals: Metals shall be corrosion resistant or treated for the environment they will encounter in storage or normal use. Suitable steel complying with ASTM, AMS, or AISI standards shall be used.

5.4.3 Dissimilar Metals: Unless specifically protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other.

5.4.4 Workmanship: The jack assembly shall be fabricated, assembled, and finished to the highest current manufacturing standards. Particular attention shall be given to freedom from blemishes, burrs, and sharp edges, accuracy of fabricated parts, alignment of assemblies, and tightness of fasteners.

5.4.5 Welding: Where welding or brazing is used in the manufacture of the jack assembly, the process shall be in accordance with the highest commercial standards and D1.1 Structural Welding Code of the American Welding Society. All welded joints shall be free from cracks, oxide inclusion, and injurious porosity.

5.4.6 Dimensions and Tolerances: Dimensions and tolerances not specified shall be as close as is consistent with good commercial shop practices. Where they may affect the interchangeability, operation, or performance of the jack, they shall be held or limited accordingly.

5.4.7 Screw Assemblies: All assembly screws and bolts shall be tight, with a minimum of two threads showing beyond the nut. Certain screw assemblies are an exception such as the tripod cylinder head to leg fasteners.

5.4.8 Finishes and Markings: The assembly shall be finished with paint that is resistant to fire resistant hydraulic fluids commonly used in commercial aircraft.

All jacks shall be clearly and permanently marked with their rated capacity. All jacks with tow bars shall be clearly marked: "TOWING SPEED - 5 MPH," (or "8 km/h" as applicable).

5.4.9 Identification: All jacks shall be permanently identified with the manufacturers name, the model number and serial number.

5.5 Maintainability:

The jack shall be designed and constructed to provide the following:

a. A minimum number of parts consistent with performance and reliability.

b. A minimum necessary amount of training and time for assembly, disassembly, troubleshooting, maintenance, and servicing.

c. A minimum disturbance to other parts or components while performing adjustments, servicing, maintenance or replacement of components.

d. A minimum amount of general and special purpose tools and equipment to perform adjustments, servicing, maintenance or replacement of components.

6. HYDRAULIC SYSTEM AND COMPONENT DESIGN:

6.1 Hydraulic System:

6.1.1 Description: The hydraulic system consist of a hydraulic cylinder, pump (manual, air operated, and/or electric powered), manual release valve, safety relief valve, check valves, reservoir, and all necessary tubing, hoses, and fittings as shown in Figure 1. It shall be equipped as a minimum with a single self-contained, hand operated hydraulic pump or when applicable dual or two-speed hand operated pumps.

6.1.2 Hydraulic Fluid: The hydraulic system shall be designed to operate with MIL-PRF-5606 or equivalent commercially available hydraulic fluids.

6.1.3 System Pressure: For design purposes, the optimum hydraulic pressure shall be 20,700 kPa (3000 psi) for tripod and unipod jacks, and 41,400 to 55,000 kPa (6000 to 8000 psi) for axle jacks at rated capacity.

6.1.4 Overload Protection: The hydraulic system shall have overload protection.

6.1.5 Air Entrapment: The hydraulic system shall be provided with provisions to purge it of entrapped air.

6.1.6 Auxiliary Pumps: When specified the hydraulic system shall include provisions to enable operation either from a pneumatic pressure operated pump, electric power operated pump, external hydraulic pressure source, and/or when connected to a manifold, enable operation in conjunction with other jacks.

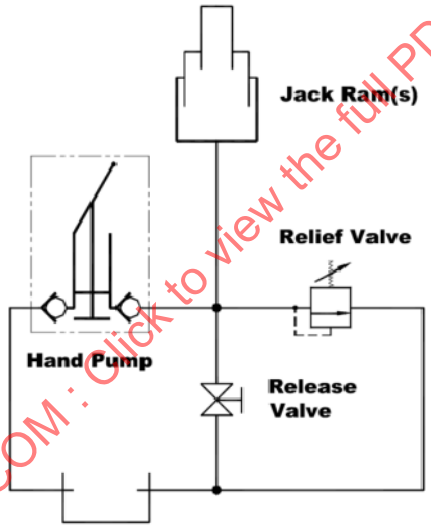

FIGURE 1 - Typical Hydraulic System, Hydraulic Aircraft Jack

6.2 Components:

6.2.1 Pump:

6.2.1.1 Description: The pump shall be a piston type and operated by hand. When specified, the jack shall include a pneumatic or electric driven pump that is independent from the hand operated pump. Pneumatic operated pumps shall include a provision to limit pressure to 105% to 110% of the pressure required to lift the rated capacity of the jack.

6.2.1.2 Handle: The ratio between the jack ram and pump piston shall be such that a force of not greater than 445 N (100 lbf) is required at the end of the pump handle to raise a load equivalent to the rated capacity of the jack. The pump handle shall be removable from the pump, and provisions should be made to stow it on the jack.

6.2.1.3 Filtration: The pump should be equipped with an inlet screen of approximately 50 mesh.

6.2.1.4 Surface Finish: The pump piston shall be polished to a 16 RMS finish.

6.2.1.5 Plating: The pump piston shall be hard chrome plated.

6.2.1.6 Seals: Pump piston seals shall be of the O-ring type with backup rings or lip seals.

6.2.2 Reservoir:

6.2.2.1 Capacity: The hydraulic fluid reservoir shall have a capacity equal to the amount of fluid required to fully extend the jack plus a 10% minimum reserve. For reservoirs exceeding 2 U.S. Gallons, a level indicator should be included.

6.2.2.2 Access: A filler plug shall be provided on the top of the reservoir. The reservoir should include a clean-out cover or method of disassembly for cleaning.

6.2.2.3 Markings: The reservoir shall be clearly marked with the type of fluid to be used.

6.2.2.4 Air Vent: The reservoir air valve or vent shall be located on or near the top of the fluid reservoir. It shall be sized to accommodate the maximum amount of air being displaced by fluid. When specified for jack transport with fluid, the reservoir shall include provisions for closing the air vent to prevent fluid loss from tipping. A permanent placard or automatic device shall be included to open the vent for jack operation.

6.2.3 Jack Rams and Cylinders:

6.2.3.1 Covers: Jacks with external threaded rams should be provided with a removable cover to prevent the entrance of rain and dust when in transport, storage, or not in use.

6.2.3.2 Surface Finish: The sealing and bearing surface of the ram and ram cylinder shall be polished to a 16 RMS finish.

6.2.3.3 Plating: The internal surfaces of the ram cylinders shall be hard chrome plated. Axle jack ram cylinders may be induction nitrided. Rams shall be hard chrome plated or induction nitrided, except for threaded rams, which shall be cadmium, electroless nickel, or zinc plated.

6.2.3.4 Bearings: The ram and cylinder bearings used in the jack shall be of sufficient size and contact area to provide maximum stability under all load conditions. The bearings shall be protected as much as possible from abrasive particles encountered during use.

6.2.3.5 Seals: Jack ram seals shall be of the O-ring type with back-up rings or lip type seals.

6.2.3.6 Ram Screw Extension: If the jack is equipped with a ram screw extension, it shall be cadmium, electroless nickel, or zinc plated and shall have a positive stop to prevent its overextension.

6.2.3.7 Release Valve: The hydraulic fluid release valve shall be located between the high-pressure side of the ram and the reservoir. Opening of this valve allows hydraulic fluid to return to the reservoir.

6.2.3.8 Safety Bypass Relief Valve: To prevent overloading of the jack a safety bypass valve shall be located between the pump check valve and the hydraulic ram. It shall be vented to the reservoir, and set at 105 to 110% of the jacks rated capacity.

6.2.3.9 Safety Device: Tripod and unipod jacks shall be provided with a mechanical device or locknut capable of supporting the rated capacity of the jack during lifting and lowering operations if a failure of the hydraulic system should occur. This device shall be in operation at all times the jack is in use.

7. STRUCTURAL DESIGN CONSIDERATIONS:

7.1 Jack Adapter:

A jack adapter shall be provided, which will interface with the mating jack point adapter mounted on the aircraft (reference AS33559). The jack adapter shall be either integral to the jack screw extension, or a separate component part.

7.2 Supporting Jack Structure:

For those jacks requiring a tripod structure, a rigid symmetrical tripod structure shall support the hydraulic cylinder assembly. The structure shall provide the complete jack with stability and safety under all combinations of rated capacity and horizontal force and extended height conditions. Dimensions shall be in accordance with Figure 2.

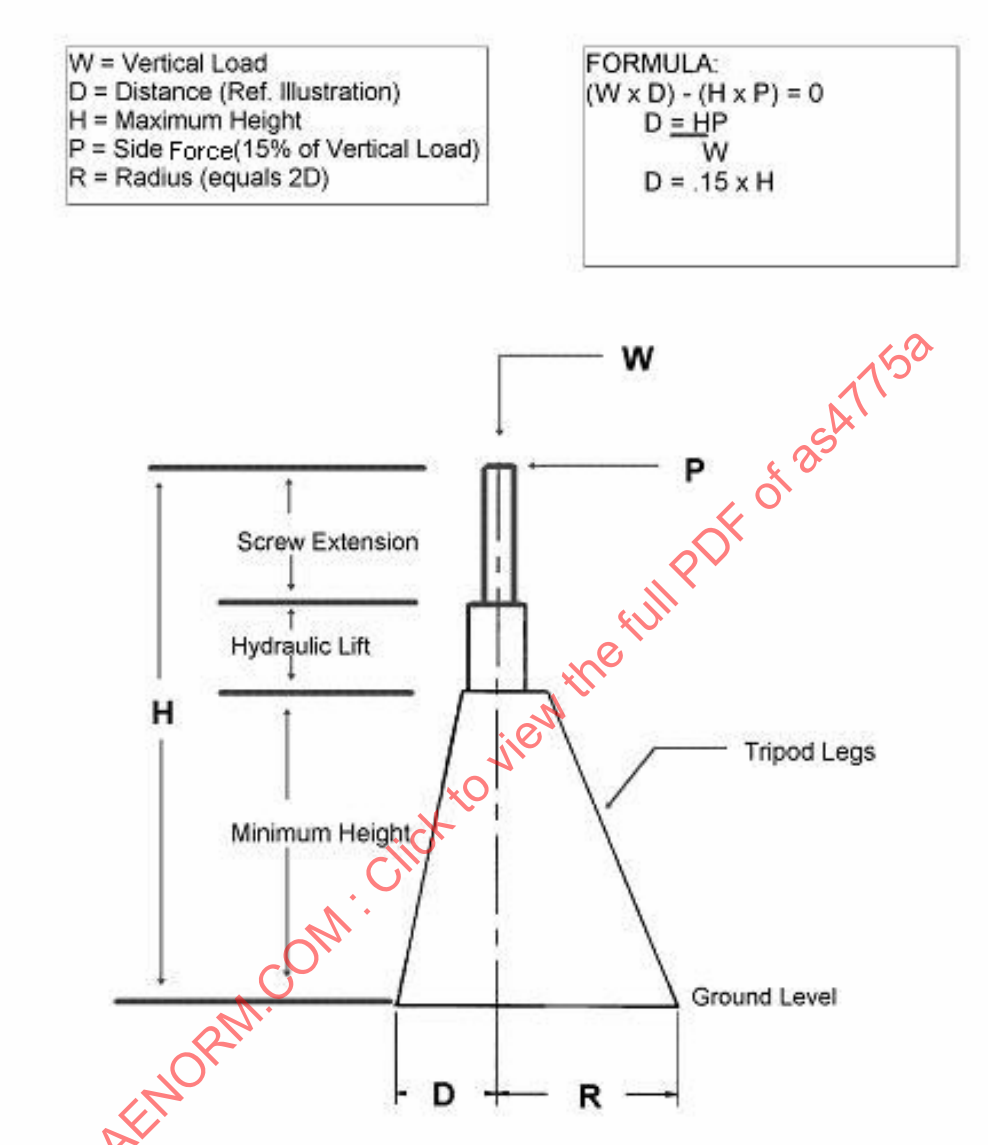

FIGURE 2 - Tripod Leg Design

7.3 Tripod Jack Legs:

The jack legs shall be designed as axial force carrying members and shall be of tubular construction. The upper end of each leg shall attach to the upper end of the hydraulic cylinder assembly so as to transfer the total vertical load on the cylinder assembly to the legs. The lower end of the legs shall be laterally stabilized by horizontal bracing between each leg and the lower end of the cylinder assembly. All hollow members shall be provided with drain holes.

7.4 Tripod Jack Bracing:

Braces may be used if necessary to interconnect adjacent pairs of legs and provide stability to the lower end of the hydraulic cylinder assembly. They shall not be used to support any vertical loads imposed on the cylinder assembly. Design and positioning of these braces shall be such as to minimize formation of bending moments in the legs

7.5 Tripod Jack Ladders and Platforms:

Tripod and unipod jacks exceeding a minimum height of 152 cm (60 in) may, if specified, include a ladder and platform attached to the jack assembly. The platform must be high enough to comfortably allow the operator to reach the screw extension for adjustment and operate/adjust the safety device (or locknut). The ladder steps shall be a non-slip steel surface 46 cm (18 in) wide minimum, and the platform shall be a non-slip steel surface 46 cm x 46 cm (18 in x 18 in) minimum with safety railing. Ladders and platforms shall be in compliance with OSHA Title 29 Part 1910 Subpart D Standards.

7.6 Fastening Devices:

Screws, pins, bolts, and similar parts shall be installed with adequate means for preventing loss of proper tightness and adjustment. Such parts shall be SAE Grade 5 or better and those parts not subject to removal or adjustment should be swaged, peened, staked, or otherwise permanently deformed.

7.7 Component Selection:

All components shall be new and have proper clearances and adjustments and meet the design life limits of the jack assembly. They shall function within the limits of their intended use.

7.8 Component Maintenance:

All components shall be selected on the basis of maximum life with a minimum of maintenance. Selection shall be made using the highest engineering standards and practices.

7.9 Reliability:

The jack shall have a mean-time-between-failure of not less than 108 cycles with a reliability of not less than 0.9908 for a 1-cycle mission at 0.9 confidence.

$$\text{FORMULA}: \ \text{MTBF} = \frac{\text{Total Test Time}}{2.3} \qquad \text{(Eq. 1)}$$