INCH-POUND

MIL-W-5013L
31 October 1991
SUPERSEDING
MIL-W-5013K(AS)
29 October 1982

MILITARY SPECIFICATION

WHEEL AND BRAKE ASSEMBLIES, AIRCRAFT GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers main and auxillary wheel and brake assemblies for all types of military aircraft.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications. Standards and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

FF-B-lW	-	Bearing, Roller, Tapered.
QQ-A-596	-	Aluminum Alloy, Permanent and Semi-Permanent Mold Castings.
QQ-A-601	-	Aluminum Alloy Sand Castings.
QQ-G-320	-	Chromium Plating (Electrodeposited).
QQ-P-416	-	Plating, Cadmium (Electrodeposited).
TT-P-28	-	Paint, Aluminum, Heat Resisting (1200°F).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Air Engineering Center, Systems Engineering and Standardization Department (Code 53), Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1630

SPECIFICATION'S (continued)

FEDERAL (continued)

PPP-B-636	Box, Shipping, Fiberboard.
PPP-C-843	Cushioning Material, Cellulosic
PPP-T-60	Tape, Packaging, Waterproof.
PPP-T-76	Tape, Packaging, Paper (for Carton Sealing).

MILITARY

MIL-P-116	Preservation, Methods of.
MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible.
MIL-F-3541	Fittings, Lubrication, General Specification for.
MIL-G-4343	Grease, Pneumatic System.
MIL-S-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems.
MIL-T-5041	Tires, Pneumatic, Aircraft.
MIL-H-5440	Hydraulic Systems, Aircraft Types I and II, Design Installation Requirements for.
MIL-G-5514	Gland Design: Packings, Hydraulic, General Requirements for.
MIL-C-5541	Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys.
MIL-T-5544	Thread Compound, Antiseize, Graphite-Petrolatum.
MIL-B-6812	Bolts, Aircraft.
MIL-I-6870	Inspection Requirements, Nondestructive; for Aircraft Material and Parts.
MIL-H-6875	Heat Treatment of Steel, Process for.
MIL-F-7179	Finishes, Coatings and Sealants for the Protection of Aerospace Weapons Systems.
MIL-F-7190	Forgings, Steel, for Aircraft/Aerospace Equipment and Special Ordnance Applications.
MIL-B-7838	Bolt, Internal Wrenching 160 KSI FTU.

SPECIFICATIONS (continued)

MILITARY (continued)

MIL-B-7894	Bolt, Machine, 1200F.
MIL-B-8075	Brake Control Systems, Antiskid, Aircraft Wheels, General Specification for.
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aerospace Vehicles.
MIL-B-8584	Brake Systems, Wheel, Aircraft, Design of.
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-H-8775	Hydraulic System Components, Aircraft and Missiles, General Specification for.
MIL-R-8791/l	Retainer, Packing, Hydraulic and Pneumatic, Poly-tetratfluoroethylene Resin (Single Turn).
MIL-S-8802	Sealing Compound, Temperature-Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High-Adhesion.
MIL-B-8831	Bolt, 180 WI Ftu and 180 KSI Fsu, 450F, Protruding and Flush Head, General Specification for.
MIL-C-8837	Coating, Cadmium (Vacuum Deposited).
MIL-A-8860	(Series, as applicable).
MIL-A-8863	Airplane Strength and Rigidity, Ground Loads for Navy Acquired Airplanes.
MIL-A-8868	Airplane Strength and Rigidity Data and Reports.
MIL-S-8879	Screw Threads, Controlled Radius, Root with Increased Minor Diameter, General Specification for.
MIL-T-9046	Titanium and Titanium Alloy, Sheet, Strip and Plate.
MIL-T-10727	Tin Plating, Electrodeposited or Hot Dipped for Ferrous and Hen-Ferrous Metals.
MIL-F-18264	Finishes: Organic Weapons Systems Application and control of.
MIL-T-18303	Test Procedures, Preproduction, Acceptance and Life for Aircraft Electronic Equipment, Format for.
MIL-V-19068	Valve, Shuttle, Hydraulic, Aircraft Type II Systems.

SPECIFICATIONS (continued)

MILITARY (continued)

MIL-A-21180	Aluminum Alloy Castings, High Strength.
MIL-A-22773	Aluminum Alloy Forgings, Heat Treated.
MIL-P-23377	Primer Coating: Epoxy, Chemical and Solvent Resistant.
MIL-C-25427	Coupling Assembly, Hydraulic, Self-Sealing, Quick Disconnect.
MIL-P-25732	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 275°F (132C).
MIL-G-8132Z	Grease, Aircraft, General Purpose Wide Temperature Range, NATO Code Number G-395.
MIL-L-81352	Lacquer, Acrylic (for Naval Weapon Systems).
MIL-C-81907	Coating System, Polyurethane, Aliphatic, Weather Resistant: Process for Application of.
MIL-P-81958	Pressure Relief Devices, Overpressurization Prevention, Wheel/Tire, Aircraft.
MIL-P-81985	Peening of Metals.
MIL-G-83016	Gauge, Aircraft Wheel, Integral, Tire Pressure Indicating.
MIL-F-83142	Forging, Titanium Alloys, Premium Quality.
MIL-C-83286	Coating, Urethane, Alphatic Isocyanate, for Aerospace Applications.
MIL-P-83461	Packing Preformed, Petroleum Hydraulic Fluid Resistant, Improved Performance at 275°F (135°C).

STANDARDS

FEDERAL

FED-STD-595	Color (Requirements for Individual color chips (3x5 Supplements) should be submitted to the Naval Publications and Forms Center, Philadelphia, citing FED-STD-595 together with appropriate chip number as shown therein.)

STANDARDS (continued)

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	Marking for Shipment and Storage.
MIL-STD-130	Identification Marking of Military Property.
MIL-STD-210	Climatic Information to Determine Design and Test Requirements for Military Systems and Equipment.
MIL-STD-470	Maintainability Program Requirements for Systems and Equipment.
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production.
MIL-STD-838	Lubrication of Military Equipment.
MIL-STD-882	System Safety Program Requirements.
MIL-STD-889	Dissimilar Metals.
MIL-STD-970	Standards and Specifications, Order of Preference for the Selection of.
MIL-STD-1472	Human Engineering Design Criteria for Military System, Equipments and Facilities.
MIL-STD-1949	Inspection Magnetic Particle.
MIL-STD-2073-1 -	DOD Material Procedures for Development.
MIL-STD-2154	Inspection, Ultrasonic, Wrought Metals, Processes for.
MIL-STD-2175	Castings, Classification and Inspection of.
MIL-STD--6866	Inspection, Penetrant, Method of.
MS14155	Washer, Recessed Countersunk Two Surfaces, for Use With Wheel Bolts and Nuts Up To and Including 180 KSI Ftu .
MS14156	Nut, Wheel, Self-Locking, Flanged, Steel, 180 KSI Ftu, 450°F (232°C) Spline Drive.
MS14157	Bolt, Wheel, Tension Flanged Steel, 180 KSI Ftu, 450°F (232°C) External Spline Drive.

STANDARDS (continued)

MILITARY (continued)

MS14163	-	Bolt, Wheel, Tension, Flanged, Steel, 220 KSI Ftu, 450°F (232°C) External Wrenching Spline Drive.
MS14177	-	Washer, Recessed, Countersunk Two Surfaces, for Use With Wheel Bolts and Nuts Up To and Including 220 KSI Ftu .
MS15795	-	Washers, Flat-Metal, Round, General Purpose.
MS20002		Washer, Countersunk and Plain, High Strength.
MS27436		Valve Special, Aircraft, Wheel.
MS27611		Valve, Hydraulic Bleeder, Aircraft Wheel Brake.
MS33649		Bosses, Fluid Connection-Internal Straight Thread.

AIR FORCE-NAVY AERONAUTICAL STANDARDS

AN960		Washer, Flat.
AND10067	-	Valve Installation - Hydraulic Bleeder (Standard Dimensions for).
AND10598	-	Chamfer or Radius - Valve Holes in Airplane Wheel Rims.

MILITARY HANDBOOK

MIL-HDBK-275	-	Guide for Selection of Lubricants, Fluids and Components, for Use In Flight Vehicles and Components.

MILITARY BULLETIN

MIL-BULL-544	-	List of Specifications and Standards (Book Form).

PUBLICATIONS

OPNAVINST 4790.2A	Maintainability.

{Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Naval Publications and Forms Center, Standardization Document Ordering Desk, Bldg 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the soliciation. Unless otherwise specified, the issues

of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B633 - Standard Specification for Electrodeposited Coatings of 'Zinc on Iron and Steel.

ASTM Dl141 - Standard Specification for Substitute Ocean Water.

(Application for copies should be addressed to American Society for Testing and Materials, 1916 Race Street, Suite 304, Philadelphia, PA 19103.)

THE TIRE AND RIM ASSOCIATION, INC.

Tire and Rim Standards

(Application for copies should be addressed to the Tire and Rim Association, Inc., 3200 West Market Street, Akron, OH 44313.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

AS 666 Cavity Design and O-Ring Selection for Static Seal Use in Aircraft Tubeless Tire Wheels

AS 707 Thermal Sensitive Pressure Release Devices for Tubeless Aircraft Wheels

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

AMERICAN NATIONAL STANDARDS INSTITUTE , INC. (ANSI)

B46.1 Surface 'Texture (Surface Roughness, Waviness and Lay)

(Application for copies should be addressed to the United States of America Standards Institute, 10 East 40th Street, New York, NY 10016.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be l vatlable in or through libraries or other informational services.)

2.3 Order or precedence. In the event of a conflict between the text of this document and the 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.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), the contractor shall furnish sample units for first article inspection and approval (see 4.2 and 6.3).

3.2 Selection of materials, parts and processes. The materials, parts and processes used shall be selected primarily to accomplish the designated performance requirements. Specifications and standards for all material parts and processes which are not specifically designated herein shall be selected in accordance with MIL-STD-143 and Military Bulletin 544 and shall require procuring activity approval prior to use. Variations from designated items and the use of newly developed advanced materials shall require procuring activity approval.

3.2.1 Materials. All parts of the assembly shall be made of corrosion resistant material or shall be suitably protected against corrosion internally and externally during normal service life. The use of dissimilar metals in contact with each other shall be avoided. When this is not practicable, they shall be suitably protected against galvanic corrosion. Dissimilar metals are defined in MIL-STD-889. Carbon composites shall be considered as graphite for dissimilar metal purposes.

3.2.1.1 Metals.

3.2.1.1.1 Aluminum.

3.2.1.1.1.1 Castings. Aluminum alloy sand castings shall be in accordance with 355 or 356 of QQ-A-601. Permanent mold castings shall be in accordance with B195, 355 or 356 of QQ-A-596. High strength aluminum alloy castings shall be in accordance with MIL-A-21180. The minimum ultimate tensile strength of the test specimens cut from castings, in addition to referenced specification requirements and unless otherwise specified, shall be not less than 50 percent of the values for separately cast test bars. The ultimate tensile strength of test bars cut from critical areas of wheel castings shall be not less than 75 percent of the values for separately cast test bars as specified by the casting specification (see 4.3.10).

3.2.1.1.1.2 Forgings. Aluminum alloy forgings shall be in accordance with MIL-A-22771.

3.2.1 .1.7.3 Shot peening. Where practical, all high strength aluminum parts shall be saturation shot peened in accordance with MIL-P-81985.

3.2.1.1.2 Beryllium. Shall not be used for Navy aircraft.

3.2.1.1.3 Magnesium. Magnesium and magnesium alloys shall not be used.

3.2.1.1.4 Steels.

3.2.1 .1.4.1 Selection. Aircraft quality steels shall be used as required.

a. Free machining carbon steel shall not be used.

b. Consumable electrode vacuum melted steel shall be used for parts made from heat treated alloy steel with ultimate tensile strengths of 220,000 psi and above. The variation in ultimate tensile strength for the parts shall not exceed -0 +20,000

psi. The use of steel heat treated in excess of 220,00 psi shall be subject to specific approval of the procuring activity.

c. Steel forgings shall be in accordance with MIL-F-7190.

d. Preference shall be given, in the selection of carbon and low alloy steels, to compositions having the least hardenability which will ensure through-hardening of the part concerned.

e. Steel parts shall be heat treated in accordance with MIL-H-6875.

f. Compositions shall be selected such that heat treatment to the required strength and service temperatures shall preclude temper-embrittlement.

g" Steels whose mechanical properties are developed by cold deformation shall be so selected that the recovery temperature will be at least 50°F above the expected operating temperature range.

h. Critical parts shall be designed and processed so as to result in no decarburization of highly stressed areas. Elsewhere. decarburization shall be avoided or eliminated,wherever practicable and where not practicable shall be compensated by appropriate reductions in design fatigue strength. Parts heat treated above 180,000 psi strength levels shall require procuring activity approval.

i. The mechanical drilling of holes in martensitic steels after hardening to strength levels of 180,000 psi and above shall be avoided whenever practicable. When drilling is performed on high strength alloy steel parts heat treated to 180,000 psi and above, the final hole sizing shall be performed in accordance with procedures approved by the procuring activity.

j. Any necessary straightening of parts after heat treatment to strength levels of 180,000 psi and above shall be accomplished at the tempering temperature, +0°, -50°F (10°C), or the parts shall receive a stress-relieving treatment at this temperature immediately after straightening. Parts shall be inspected for cracks after straightening.

k. All high strength steel fittings heat treated to 220,000 psi and above shall be saturation shot peened in accordance with MIL-P-81985.

3.2.1.1.4.2 Corrosion resistant steeels (CRES) limitations. The following limitations shall apply in the selection and application of corrosion resistant steels:

a. Unstabilized austenitic steels shall not be fusion welded.

b. Precipitation hardening semi-austenitic grades shall not be used in applications which require extended exposure to temperatures in the 750°F-900°F range.

c. Types 416, 431 or 19-9DL stainless steel shall not be used.

d. Precipitation hardening stainless steels shall be aged at temperatures not less than 1000°F (538°C) in all applications. Exception #s made for castings which may be aged at 935°F ± 15°F (502°C ± 8°C) and fasteners which may be used in the H950 Condition. Exception also may be made for springs of 17-7 PH Cres with a CH 900 temper using a 900°F (482°C) aging temperature.

3.2.1.1.5 Titanium.

3.2.1.1.5.1 Forgins. Titanium forgings shall be in accordance with MIL-T-63142

3.2.1.1.5.2 Sheet and plate. Titanium sheet and plate shall be in accordance with MIL-T-9046.

3.2.1.1.5.3 Alloys. Titanium and titanium base alloys may be used in applications where their use #s justified in terms of weight savings, improved performance, improved serviceability, and where adequacy of manfacturing methods can be demonstrated. All applications shall use the annealed rather than the solution treated or solution treated and aged material condition. All titanium machined parts shall be saturation shot peened in accordance with MIL-P-81985. This requirement may be waived for non-fatingue susceptible parts upon which no grinding operation is performed.

3.2.1.1.6 Castings. The use of castings for structural applications requires procuring activity approval. Castings shall be classified in accordance with MIL-STD-2175.

3.2.1.2 Composites.

3.2.1 .2.? Carbon composites. Structural carbon composistes may be used for brake heat sinks. When used, metals in contact with the graphite composites shall be considered dissimilar metals as required in MIL-STD-889. Metals prone to galvanic attack in contact with graphite composite shall not be used. The carbon heat sink material shalll be traceable by batch or lot number to the brake serial number level. The contractor shall develop material consistency tests for procuring activity approval which shall be conducted on representative material samples submitted as required for the Acceptance Tests. The contractors established material properties tests will be conducted on a batch sample of the test material in order to define the baseline properties for quality control of follow-on brake heat sinks. The contractor shall provide to or control his subcontractors in the procedures so that quality of the manufactured product is maintained (see 4.1.2 and 4.4.5.3).

3.2.1.3 Non-specification material. For materials which no federal, military or industry specification exists, the contractor shall be required to

develop specifications covering technical requirements and test methods thereof, and acceptance criteria for review and acceptance by the procuring activity.

3.2.2 Parts.

3.2.2.1 Standard parts. Standard parts (MS, AN or JAW shall be used whenever they are suitable for the purpose and shall be identified on the drawings by their part numbers.

3.2.2.2 Interchangeability. All parts having the same manufacturer's part number shall be fuctionally interchangeable as defined in MIL-1-8500.

3.2.2.3 Bearings. The wheel bearings shall be of the tapered roller type Conforming to FF-B-187.

3.2.2.4 Bolts. Bolts heat treated to a minimum of 125,000 psi for general structural applications shall be in accordance with MIL-B-6812. Bolts heat treated from 160,000 psi to 180,000 psi shall be in accordance with MIL-B-7838. Bolts heat treated from 180,000 to 200,000 psi shall be in accordance With MIL-B-8831. High strength bolts of greater than 200,000 psi ultimate tensile may be used subject to the procuring activity approval. Approved type high strength (160,000 psi minimum ultimate tensile strength) internal wrenching bolts shall be in accordance with MIL-B-7838. Corrosion resisting steel bolts in temperatures not exceedtng 1200°F (649°C), shall be in accordance with MIL-B-7874, as applicable. Steel bolts smaller than one-fourth inch in diameter shall not be used in any single bolted structural connection or any application where a failure would adversely affect safety of flight. Aluminum alloy bolts, nuts and screws may be used in nonstructural lightly stressed aluminum alloy parts. Structural bolts which are loaded in tension shall be prestressed to a value consistent with minimizing the effects of fatigue in the joint. The proper bolt torque values shall appear in the applicable maintenance document (see 3.3.15). Where it is necessary to use a single attachment bolt with the head down in an application where its loss would affect safety of flight, the head of the bolt shall be lockwired or retained in position independent of the attaching nut. Cadmium plated steel bolts or nuts used with aluminum alloy parts shall be insulated from the aluminum alloy by aluminum alloy washers beneath the bolt head and nut, except that cadmium plated steel washers may be used for bolts loaded in tension.

3.2.2.5 Bushings. Bushings shall be provided for all bolts or pins subject to angular or other motions which would tend to distort or enlarge the hole. Bushings shall be securely anchored (an Interference fit is acceptable) to the member to preclude slippage or movement. Bushings shall assure all wear or deformation at the joint and be readily replaceable. Peening or staking is prohibited. A bushing, however, with a very close sliding fit may be used as a sliding spacer to take up accumulated width tolerances so a fitting will not be deformed due to torque with attachment bolt, for example: When using a sliding bushing to clamp the inner race of a bearing without deforming the basic fitting. In the event the inside diameter of bushing is distorted out of round during the press fit operation, the bushing shall be reamed to size after Installation. Reestablishment of the finish after

reaming is required. Where the shoulders of two bushings are in sliding contact, the shoulder of one of the bushings shall be hard chrome plated or otherwise treated to form a suitable bearing surface.

3.2.2.6 Fittings.

3.2.2.6.1 General. Structural fittings shall be made from aluminum, steel, or titanium alloys within the Imitations imposed per this specification or other applicable specifications. Connections of solid end fittings to wheel and brake assembly using aluminum alloy rivets shall be suitable for possible replacement of rivits by the next larger size. Steel rivets or bolts may be subsitituted for aluminum alloy rivets subject to approval by the procuring activity. Abrupt changes in cross section shall be avoided. The minimum fillet radius for structural parts shall be 0.110 inch. Where justified by design, if not critical in fatigue, smaller radii may be used if verified by analysts and test, subject to the procuring activity approval. This requirement also applies to spot faces, counterbores, countersinks and recesses.

3..2.2.6.2 Threads. In case of structural fittings produced of steal, heat-treated in excess of 125,000 psi and incorporating a threaded portion loading primarily in tension, the threads shall be in accordance with MIL-S-4879. The threads shall be rolled in a simple pass after heat treatment. Where the state-of-the-art does not permit this, specific approval shall be required by the procuring activity.

3-2.2.6.3 Lubrication fittings (exceptions). Except as otherwise provided herein for amphibian applications and beaching-gear applications, wheels shall not be fitted with pressure-type lubrication fittings.

3.2.2.7 Packing "O" rings and baskets.

3.2.2.7.1 Wheels. Packings, "O" rings and gasketss for the wheels shall be in accordance with MIL-G-5514.

3.2.2.7.2 Brakes. The “(?” rings for the brakes shall be in accordance with MIL-G-5514 except:

a. High temperature seals, when used, must be installed in a standard groove.

b. Back-up rings, if used, shall conform to MS2774. Teflon compounds containing up to 15 percent graphite may be used for back-up rings.

3.2.2.6 Pins. The use of friction-retained pins without auxillary means of retention, such as nuts and cotter pins, is prohibited (e.g., groove pins, taper pins, etc.}. Peening, staking or safety wiring is not acceptable for pin retention. Roll parts are prohibited. Rotating pins or bolts shall be hard chrcme plated to accordance with procedures noted herein.

3.2.2.9 Washers. Washers used with internal wrenching or other similar high strength tensile type bolts shall be in accordance with MS20002, except

in those cases where special washers, chamfered on both sides, are required to prevent improper installation. Washers used with other structureal fasteners shall be in accordance with AN960 or MS15795. Lock washers and metallic crush washers shall not be used.

3.2.3 Processes.

3.2.3.1 Stress corrosion factors. To prevent premature failures caused by stress corrosion or hydrogen embrittlement; the design and method of manufacture of parts or steels heat treated to tensile strengths above 220,000 psi, or of bare high strength aluminum alloys or titanium alloys and the techniques by which they are assembled and installed shall be such that sustained or residual surface tensile stress and stress concentrations are minimized. Practices such as the use of press or shrink fits, taper pins. clevis joints in which tightening of the bolt #reposes a bending load on the lugs, and straightening and assembly operations, which result in sustained or residual surface tensile stresses shall be avoided wherever practicable. In cases where such practices cannot be avoided, corrective-practices such as ' stress relief heat treatments, optimum grain flow orientation, shot peening, or similar surface working shall be used to minimize the hazard of stress corrosion or hydrogen embrittlement damage.

3.2.3.2 Fatigue factors. To prevent premature failures caused by repeated loads, the design and method of manufacture, including consideration of the damaging effect of decarburization and certain metallic coatings of all critical parts and the techniques by which they are assembled and installed shall be such that sustained or residual tensile stresses and stress concentration are minimized. Practices such as cold straightening, cold forming. and the assembly of mismatched surfaces, which result in sustained or residual surface tensile stresses shall be avoided. Corrective practices such as stress relief heat treatment, optimum grain flow orientation, shimmering, shot peening or similar surface working shall be used to minimize premature fatigue failure, subject to approval by the procuring activity. Surface roughness of all surfaces which are subject to repeated stresses shall not be in excess of 125 rms as defined in ANSI B46.1. Particular attention shall be given to optimum heat treatment procedures, corrosion protection and finish to minimize corrosion damage which may be the site of premature fatigue failure.

3.2.4 Protective treatment.

3.2.4.1 Painting. Finishes and coatings shall be Type I in accordance with MIL-F-7179.

3.2.4.1.1 Heat properties. To protect wheels, brakes and tires from the detrimental effect of heat generated in or transferred to the components, surface treatments authorized herein shall be utilized in such a manner as to make maximum use of their heat-retarding, absorbing and dissipating properties, if applicable, regardless of color.

3.2.4.1.2 Oil. Paint need not be applied to parts which are constantly immersed #n or covered with oil nor need it be applied to surfaces where it would impair proper functioning.

3.2.4.1.3 Flanges. For demountable flange-type wheels, the portion of the hub on which the remountable flange rests and the inner surfaces of the demountable flange shall be primed but shall not be painted.

3.2.4.1.4 Primer and color. Unplated non-wearing metallic brake discs or brake drums surfaces shall be thoroughly cleaned and protected by one coat of primer in accordance with MIL-P-23377, or other surface treatments subject to the approval of the procuring activity. The topcoat color for Navy wheels shall be white, color number 17875, in accordance with FED-STD-595.

3.2.4.1.5 Aluminum. The exterior surface of anodized aluminum and aluminum alloy parts shall be protected with one coat of primer in accordance with MIL-P-23377, followed by two coats of polyurethane conforming to MIL-G-81773 and applied in accordance with MIL-C-81907. Alternate treatment such as heat-resisting aluminum paints, conforming to TT-P-28, phosphate ester resistant epoxy paints, and others may be used when authorized by the procuring activity. Touchup shall be dine in accordance with MIL-C-5541, Type I, Grade B, Class 2.

3.2.4.2 Anodized aluminum. All aluminum and aluminum alloy parts shall be anodized in accordance with MIL-A-8625, Type II. Pistons shall be hard anodized in accordance with MIL-A-8625, Type III, to reduce galling #f the seal is contained in the cylinder wall.

3.2.4.3 Steel plating. Unless other surface treatments are approved by the procuring activity, all steel parts shall be plated. The parts which reach temperatures detrimental to plating need not be plated.

3.2.4.3.1 Chromium. Chromium plating shall be in accordance with QQ-C-320. Plating shall be applied directly on steel and at a rate not to exceed 0.0005 inches per hour (see 4.3.10.3).

3.2.4.3.1.1 Heat treatment. Parts heat treated to 240,000 psi and over, bake at 375°F ± 25°F (193°C ± 14°C) within 3 hours after plating for a minimum of 23 hours. After grinding of chrome plate 220,000 psi and over, all parts shall be baked at 375°F ± 25°F (193°C ± 14°C) for 3 hours.

3.2.4.3.1.2 Embrittlement relief. Parts sheat treated to 220,000-240,000 psi range shall have at least an 8 hour bake for embrittlement relief in accordance with QQ-C-320.

3.2.4.3.1.3 Thickness. The minimum thickness shall be 0.002 inches for all chrome plated parts except the piston, which shall be 0.0035 inches.

3.2.4.3.1.4 Shot peening. Prior to plating, critical parts such as pins, pistons and cylinders shall be shot peened in accordance with MIL-P-81985.

3.2.4.3.2 Zinc. Zinc plating shall be in accordance with ASTM 6633. Zinc plating shall not be used on parts the temperature of which may exceed 600°F (315°C) in service.

3.2.4.3.3 Cadmium. Cadmium plating shall be electrodeposited in accordance with QQ-P-416, Type II, Class 2, except steel parts heat treated to 220,000-240,000 psi range, which shall be vacuum deposited in accordance with MIL-C-8837. Any other process shall be subject to the the proocuring activity approval. Cadmium plating shall not be used on parts the tempperture of which exceeds 450°F (232°C) in service.

3.2.4.3.4 Tin. Tin plating, in accordance with MIL-T-10727, Type I, shall be used in lieu of cadmium plating where flaking may tend to contaminate equipment in contact with hydraulic fluid or may be used where applicable.

3.2.4.3.5 Exceptions. Brake discs or brake drum shall not be cadmium or zinc-plated.

3.2.4.3.6 Springs. Springs and other parts on which plating is not practicable need not be plated.

3.2.4.3.7 Corrosion-resistant steel. Corrosion-resistant steel parts need not be plated unless required for dissimilar metal interface or functional reasons. They should be passivatd in accordance with MIL-S-5002.

3.2.4.4 Titanium. Surface treatment of titanium and titanium alloys shall be as approved by the procuring activity prior to use.

3.2.4.5 Name plates. The backs of mechically attached name plates, instruction plates, and designation plates shall be primed in accordance with MIL-P-23377 epoxy polyamide primer prior to installation. Upon Installation, the rear of these plates shall be sealed in accordance with MIL-S-8802, Class B sealant. The faces of all plates shall be covered with a coating of clear acrylic lacquer comforting to MIL-L-81352 and applied in accordance with MIL-F-18264.

3.2.4.6 General conditions. Paint shall not be applied to brake lining, brake discs or bearing race surfaces. The bearing and braking surfaces shall be protected during the application of finish to the wheels and brakes. Surface treatments other than those noted shall be subject to the procuring activity approval prior to use.

3.3 Design. The main wheel and brake assembly and auxillary wheels shall be designed to accomplish the performance requirements specified herein and shall confirm the capability by satisfactorily completing the performance tests specified in Section 4.

3.3.1 General. Wheels and brakes shall conform to the detail requirements of the applicable specifications specified herein and to the applicable drawings and shall accommodate the tires in accordance with MIL-T-5041.

3.3.2 Fairing. Wheels and brakes shall be suitably formed to provide external contours as smooth and free from projections as practicable. Wheels shall be furnished without fairings or provisions for fairings. Brakes may also be furnished without dust covers, except in cases where the brake design is such that covers or fairings are necessary to prevent entrance of foreign material that may adversely affect brake operation or service life. Where

fairings are used, the means of attachment shall be such as to permit rapid removal and shall involve to loose parts. An access hole with cover shall be provided at the valve stem where more than six fasteners are employed in attaching an outer wheel fairing. Fairings shall preferably be recessed into the wheel contour to provide minimum overall whdth for wheel and fairnig assembly.

3.3.3 Installation. The wheel and brake assemblies shall be capable of installation on the left and right hand sides of the aircraft, both as a wheel and brake assembly and as separate wheel assemblies and brake assembles. They shall be designed so that they cannot be improperly assembled or improperly installed on the aircraft.

3.3.4 Anti-skid. The wheel and brake assembly shall be designed to operate satisfactorily with an antt-skid control system provided in accordance with MIL-B-8075 (see 4.3.34).

3.3.5 Moisture entrapmnt. The wheel and brake assembly shall be designed to prevent the extrapment of moisture in any position from fully extended to fully retracted. This way be accomplished by effectively sealing enclosed areas against the entrance of water or by providing adequate drainage. Cork seals, dams and metal end plugs machined to fit shall not be used.

3.3.6 Wheel design. The wheels shall be designed to meet the operating conditions specified in Table I and first article tests in 4.3.

3.3.6.1 Wheel capacity. The rated load capacity of each landing wheel or auxillary wheel on an aircraft shall be equal to or greater than the maximum load that the wheel will be subjected to at maximum towing or taxiing static design gross weight of the aircraft. In cases where auxillary wheels do not normally support static loads (as in wingtip protectionsn wheels), the wheel capacity will be based on appropriate dynamic loading calculations. A complete itatic and dynamic, analysis of the main and auxillar wheel loads shall be made. From this analysis, a loading spectrum shall be prepared. The spectrum shall identify the loads to be tested in Section 4 (see 4.3.13, 4.3.14).

3.3.6.2 Wheel assembly. The design of all new wheels shall be of the demountable flange type or of the divided type to facilitate changing the tire. Demountable flanges or divided wheels shall bont employ inserts in conjunction with their joining bolts. For demountable flange-type wheels, the remountable flange may be on either the outboard or inboard side of the wheel. All remountable flanges shall be locked to the wheel in a manner that will prevent the removable flange and its retaining device from leaving the wheel in case a flat tire occurs while the wheel is rolling.

3.3.6.3 Bearing seats. The design of all new wheels shall be such that steel bearing seats may be Incorporated if found necessary.

3.3.6.4 Heat shield. A heat shield, if required, shall be provided to minimize direct radiation between the brake heat sink and the wheel. In addition, the heat shield shall minimize conducted and convected heat flow.

The not effect shall be to restrain the wheel tubewell temperature so as to achieve more controllable tire toe temperatures attributed-to brake heat. The heat shield shall be designed to minimize possible damage due to normal wheel, tire and brake maintenance and handling.

3.3.6.5 Temperature. The wheel bead ledge temperature shall not be permitted to exceed 350°F (177°C) except after a rejected takeoff. Maximun speed of cooling air for the 5-stop condition shall be 5 mph. If deviation from the above temperature is required, a rational analysis of maximum allowable wheel bead ledge temperature and time at temperature shall be made in the first article test report. There shall be no tire degradation indicated by the the results of the analysis.

3.3.7 Brake design. The kinetic energy absorption capacity of the brakes on an aircraft shall be adequate to accomplish the number of dynameter stops shown in Table I and the requirements of Table II, under the various aircraft conditions indicated, without replacement of brake lining or other parts except as noted. The capacity of an individual brake shall be determined from the landing-gear configuration, based on the number of braked wheels and the dynamic loading of each wheel.

3.3.7.1 Braking capacity caluclations. The brakes, in conjunction with authorized auxiliary braking devices, shall be capable of stopping the aircraft under the conditions shown in Table I. To determine the design energy capacity required for the braking system, one of the following methods shall be used. In addition, if the aircraft mission requirements, such as require turnaround, dictate other brake system operations which impose more severe brake usage, suitable brake dynamometer test conditions shall be established for the appropriate aircraft mission.

3.3.7.1.1 Method I. The following formula may be used.

Kinetic energy - CWV^2 ft lb in which:

C = 0.0423 for nose or bicycle gear aircraft and all helicopters

C = 0.0344 for tailwheel aircraft

W = Height of the aircraft in pounds under the loading condition being considered

V = Power-off stall speed of the aircraft in knots[1/] at the weight W under consideration. Unless otherwise specified by the procuring activity, a speed of 35 knots shall be used for helicopters.

1/ If speed is given in mph, convert to knots by multiplying mph by 0.87.

TABLE I. Wheel brake capacity requirements.

Type of Aircraft	No. of Dynamometer Stops	Average Rate of Deceleration 1/ (ft/sec/sec)	Aircraft Weight	Energy Credit 2/ Reversed Propellers or Engine Thrust	Energy Credit 2/ Drag Parachute	Brakes on Speed
Land and carrier based:						
Bomber	45 3/	10	LPLGW	Yes 4/	Yes 4/	$.9V_A$
Fighter or interceptor						
Attack	5 3/	10	MLGW	No	Yes 4/	$.9V_A$
Reconnaissance						
Tankers (refueling)	2 5/	10	MLGW(RTO)	No	No	$.9V_A$
	2 6/		MTOGW(RTO)	No	Yes 4/	1.0MWLO
	1 7/	10	LPLGW(LANDING)	No	No	$.9V_A$
	* 7/	4–6	LPLGW(TAXI IN)	No	No	
	* 7/	4–6	MTOGW(TAXI OUT)	No	No	
	1 7/	10	MTOGW(RTO)	No	No	.9MWLO
Land based:						
Patrol or antisubmarine						
Minelayer	100	10	LPLGW	Yes 4/	Yes 4/	$.9V_A$
Cargo or transport						
Ground support	2 2/ 6/	10	MTOGW(RTO)	No	No	1.0MWLO
Trainer						
Liaison						
Helicopter	20	6	Basic design gross	Not applicable	Not applicable	35 Knots
Research and other types not listed	As specified by the procuring activity					

Notes:

1/ To be used in connection with Method I. If Method II is used, aircraft deceleration and dynancmeter deceleration shall be consistent with computations submitted and be minimum of those listed.

2/ The amount of energy credit shall be approved by the procuring activity in each instance (see 3.3.7.1.2.1).

3/ The 45-5 dynamic torque sequence shall be conducted with five sequences of nine landplane landing design gross weight stops followed by one maximum landing gross weight stop.

4/ If used in standard landing procedure.

5/ Test to whichever condition is the more critical.

6/ The friction materials used for the 45 and 5 stop, or the 100 stop conditions (whichever is applicable) shall be used for worn brake RTO stop. New friction materials and other arts damaged beyond use by the worn brake RTO may be replaced before the new brake RTO stop. If the worn brake RTO meets the requirements of Table I, a new brake RTO is not required. The worn brake RTO stop is for information only unless it meets RTO requirements. However, the remarks shall be included as art of the test report. See 4.3.22 for additional carbon wet brake test.

7/ Rapid turnaround (if required, see 4.3.23).

$'_A$ = Standard day approach speed for related weight

LPLGH = Landplane landing gross weight
MLGW = Max landing gross weight
MWLO = Rational main wheel lift off speed
MTOGW = Max take off gross weight
* = Brake energy a function of amount of braking required to oppose the idle thrust and the number of anticipated stops during the taxi phase.

TABLE II. Wheel brake field service life spectrum analysis format.

Brake Stop Description	Typical Field Service Landing	Short Field Landing	Overweight Landing	Aborted Mission
Kinetic energy (ft-lb)				
Deceleration (ft/sec/sec)				
Tire load (lb)				
Brake on velocity (kts)				
Flywheel inertia equivalent (lb)				
Taxi distance @ 30 knots (ft)	7500 before & after stop	3000 before & after stop	7500 before after stop	3000 before stop
Number of 30 knot stops during taxi (one of which is to be at max effort)	2 before & after stop	2 before & after stop	2 before & after stop	2 before stop
Number of stops and sequence of stops at each condition (read left to right & top to bottom)	5 5 20 60 5 5	- 1 1 - - -	1 - - 3 1 -	- - - - - 1
Totals	100	2	5	1

GENERAL NOTES:

1. Appilcable to all land and carrier based and land based aircraft listed in Table I. All conditions are to represent average expected operational aircraft in service. The design goal of the wheel brake will be the number of landings specified by the procuring activity. For Table II, the analysis is to be based on realistic average conditions expected to be experienced in service usage of the aircraft.

b. The brake drag and energy absorbed during taxi shall be consistent with the operational environment defined for the specific aircraft. Cooling air of 30 knots may be used during all taxis. Taxi snubs during rolling may be specified if applicable to-the aircraft system.

c. Success criteria:

No brake drag	No failed parts
No component distortion	No binding
Torque/pressure relationship	No malfunctioning
Thermal limits If applicable	Stop distance

3.3.7.1.2 Method II. Braking capacity required may be calculated by means of mathematical and graphical analysis based on commonly l ccapted principles of kinetics and aerodynamics. The exact presentation may vary with different aircraft, but the following factors should generally be considered with curves or tables to indicate their effects at various aircraft weights:

a. Actual energy of the mass aircraft at instant of touchdown.

b. An integration of the kinetic energy added to the aircraft by thrust of the aircraft's propulsion system during the stop.

C. An integration of kinetic energy absorbed by aerodynamic drag of the aircraft during the stop.

d. An Integration of the kinetic energy absorbed by auxiliary braking effort, such as propeller reverse thrust, deceleration parachutes, or jet reverse thrust, during the applicable portion of the stop in accordance with Table I.

e. An integration of the kinetic energy to be absorbed by wheel brakes during the stop.

f. Effect of wing lift in reducing the wheel load during the stop, thereby decreasing the torque which can be developed-without skidding the tires.

g. Distribution of load and brake capacity among the various wheels.

h. Total stopping distance.

i. Static force available for holding aircraft stationary while running up engines.

j. Appropriate ground winds, airport altitudes and ambient atmospheric conditions.

k. Landing speed and weight for aircraft shall be not less than aircraft design conditions defined in paragraph 6.4.9.

l. Brake retarding forces versus time curves and brake retarding forces versus speed curves for each design condition.

3.3.7.1.2.1 Approval. When Method II is used, the contractor shall prepare an appropriate analysts acceptable to the procuring activity to obtain approval of the proposed system.

3.3.7.2 Dynamic braking torque. In the design of brakes, consideration should be given to the maximum torque which can be applied to the brakes at each Instant of the stopping period without danger of skidding the tires. This torque is a function of aircraft speed and wing lift at the pertinent instant, together with the coefficient of friction which can be developed by the tire against the runway surface. Special design consideration shall be

given to consistent torque gains, elimination of torque sag or gabbiness during all dynamic or static conditions.

3.3.7.3 Peak torque. The peak brake torque during any aircraft braking condition, within the speed and pressure range of the aircraft, shall not produce a peak drag deflection of the strut and axle exceeding that due to a drag load of 0.8 times the maximum wheel static 1g vertical load, at maximum design gross weight, applied at the corresponding rolling radius. To verify the above, an envelope of peak torque versus pressure shall be established for various energy inputs, hot and cold brakes and new and worn brakes. The data shall be recorded in the first article test report (see 4.3.7 and 4.3.27).

3.3.7.4 Operating systems. Brakes shall be designed for use with hydraulic, pnematic or mechanical operating systems in accordance with MIL-B-8584, whichever is compatible with the aircraft system. Hydraulic systems shall be designed for no measurable leakage (less than one drop) when subjected to the static leakage test, 4.3.31.1, and shall not exceed one drop of fluid per each 3 inches of peripheral moving seal length under the dynamic leakage test, 4.3.31.2.

3.3.7.5 Brake backup structure. The brake backup structure shall be designed to promote even brake disc pressure and wear radially across the brake disc.

3.3.7.6 Contaminate protection. Consideration shall be given during design to prevent entry of excessive amounts of mud, dust and dirt into vulnerable areas of the brake assembly.

3.3.8 Construction.

3.3.8.1 Wheel assembly construction.

3.3.8.1.1 Rim contours. The wheel rim contour shall conform to the AMD rim contour standard for the particular tire listed in MIL-T-5041. In cases where AND standards do not exist, the rim contour shall conform to the specification control drawing or to the one recommended by Tire and Rim Association. The procuring activity shall specify whether or not the wheel is a tubeless, tube type, or convertible wheel. If the wheel is for use with a conventional tire and tube and a tubeless tire, the valve hole location and dimension shall conform to the requirements of the applicable AND rim contour standard or the specification control drawing, or as recommended by the Tire and Rim Association standard. Valve hole chamber or radius shall conform to AND10598. If the wheel is for use with only a tubeless tire, the valve installation shall form a part of the wheel assembly. It shall use a standard core and cap and shall be conveniently usable with standard Inflating and gaging chucks. The location of the inlet into the tire shall be as shown on the applicable AND rim contour standard or the specification control drawing, or as recommended by the Tire and Rim Association standard. If the wheel is a convertible wheel (for use with both a tire and tube and a tubeless tire), the wheel manufacturer shall make available a wheel seal and valve assembly suitable for use with a tubeless tire. The procuring activity shall specify whether or not this valve and seal is to be furnished with each wheel.

3.3.8.1.2 Wheel bolts. The wheel tie bolts, nuts and washers combination shall be as follows:

a. Tie bolt- MS14157 or MS14163.

b. Nut - MS14156 or MS14164.

c. Washer - MS14155 or MS14177.

3.3.8.1.3 Tie bolt bosses. Bosses shall be raised, where practicable.

3.3.8.1.4 Static balance. Wheel assemblies shall be statically balanced within the limits specified on Figure 1 to the nearest whole ounce-inch. The method of balancing shall be such that the limits of the assembly unbalance will not be exceeded by changing major portions of the rotation assembly, such as brake drums or demountable flanges. Split wheels shall be balanced in a manner to prevent unbalancing beyond the specified limits, by assembling the 2 wheel halves in alternate positions or by assembling halves of different wheels. Balance weights shall be securelyattached in such a manner that wheel performance will not be impaired. Balance for wheels mounting tubeless tires shall be checked with the valve installed. For wheels of 10-inch bead seat diameter or less, actual static balance operations may be omitted, provided the manufacturer shows by drawing and salvage tolerances that 2-ounce-inch unbalance is never exceeded.

3.3.8.1.5 Knurlimg. Knurling is not required unless specified on the applicable specification control drawing.

3.3.8.1.6 Lubricant and lubricant retainers. Suitable retainer shall be provided to prevent lubricant from reaching the braking surface and to prevent foreign matter from entering the bearings. The retainers shall be removable to allow for cleaning and lubrication of the bearings. Where practicable, wheel bearings shall be sealed on the stationary surface. A structural dam shall be provided on the nonsealed side to assist in grease retention. Application requirements of MIL-G-813275 shall be observed. Grease confroming to MIL-G-81322 shall be used to lubricate wheel bearings. Provisions shall be made for lubrication of static and dynamic seals in pneumatic applications with grease conforming to MIL-G-4343, unless the type of seal demands otherwise from the standpoint of compatibility,

3.3.8.1.7 Tubeless tire wheel air seals. Mating tubeless wheel parts and valves shall be sealed to prevent leakage of air pressure (see 4.3.18).

3.3.8.1.7.1 Wheel mating seals and grooves. Seals and grooves shall be in accordance with AS 666. Standard USAF approved "Shore 70" seal compounds shall normally be used. Approved compounds are in accordance with MIL-P-25732 or MIL-P-83461. If necessary to meet specified high temperature requirements, other compounds may be used.

3.3.8.1.7.2 Valve boss seals. The boss o-ring seal shall be comatible dimensionally with the size of boss to be used and in accordance with MS33649.

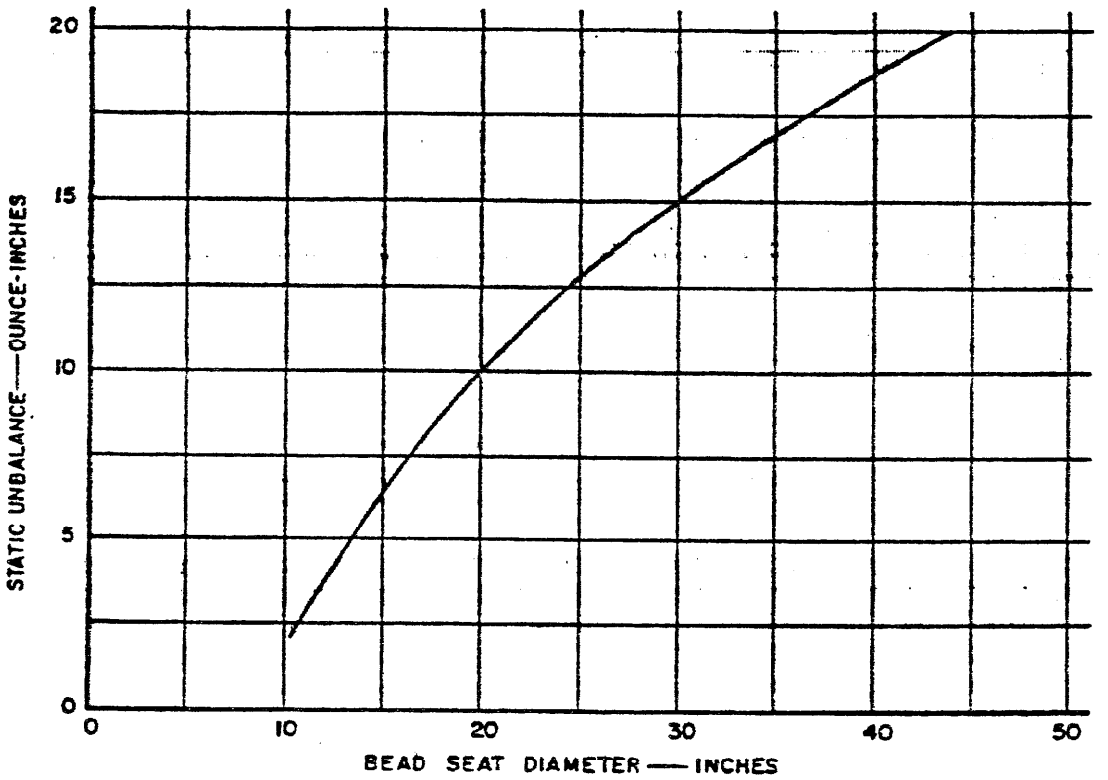

FIGURE 1. Allowable static unbalance.

3.3.8.1.8 Tire air filler valves.

3.3.8.1.8.1 Tubeless tire wheel valves. Valves on strictly tubeless tire wheels shall confrom to MS274436. Where the state-of-the-art does not permit this, specific approval shall be required by the procuring activity.

3.3.8.1.8.2 Convertible wheel valves. Valve assemblies, including sea;s. shall be built to Tire and Rim Association standards and, if possible. shall be selected from those already in use by the military services.

3.3.8.1.8.3 Valve DOS'S The loss for accomodation of the air valve shall be in accordance with MS33649.

3.3.8.1.6.4 Auxilliary featurees. The inclusion of any auxilliary feature in the wheel or brake design, such as a tire pressure control system or a safety overpressurization prevention relief valve, shall require a formal demonstration and the procedure and results shall be approved in writing by the procuring activity. The intrface shall be defined in the specification control drawing.

3.3.8.1.8.5 Gages. If pressure gages are used, they shall conform to MIL-G-83016.

3.3.8.1.8.6 Tire inflation safety valve. The inflation valve, if used to prevent Inadvertent overpressurization of the tires during servicing, shall be the overpressurization relief type conforming to MIL-P-81958, Type IV.

3.3.8.1.9 Wheel thermal-sensitive pressure release devices. Thermal-sensitive pressure release devices (fuse plugs) conforming to AS 707, except as noted, shall be provided in all tubeless-brake-type wheels (except on liason or helicopter applications as required). The device shall be so located that its replacement will require the removal of the tire. However, external capability to detect or correct minor leaks is desirable. The fuse plug temperature setting shall be subject to approval of the procuring activity. High reliability designs will be preferred.

3.3.8.2 Brake construction.

3.3.8.2.1 Bolt holes. Brakes shall be so designed that the brake holes may be reworked with replaceable bushings to correct for wear or corrosion of the base material. Cylinder-bore-gland design shall be in accordance with MIL-G-5514 (where feasible).

3.3.8.2.2 Lining wear indicators and automatic adjusters. Brake lining wear Indicators shall be provided. Automatic adjusters shall be provided to compensate for brake lining wear. Brake assemblies shall be designed for the most practicable protection of the brake adjusters.

3.3.8.2.3 Piston liners. Brake piston liners shall be furnished and shall be designed to be replaceable. Exceptions to the liner requirement shall be justified on a cost or mission effectiveness basis acceptable to the procuring activity.

3.3.8.2.4 Inlet and bleeder fittings. Bleed fittings are not required for pneumatic brakes. Brake inlet fittings;, threads and bosses shall be in accordance with MIL-H-5440. A bleeder fitting will be provided as near to the top of the brake as clearance and service area near the main landing gear will allow. The bleeder fitting, in addition to permitting system bleeding, will allow ground installation and removal of bleeder hose standard brake pressure gages without introducing contamination or requiring system rebleeding. Brake bleeder valves shall conform dimensionally to MS27611, installed in a boss, inlet fitting, or attaching bolt machined in accordance with AND10067. Whenever possible, a threaded steel insert shall be provided for inlet bosses in aluminum brakes. If practicable, all fittings shall be made safe.

3.3.8.2.5 Couplings. Self-sealing couplings conforming to MIL-C-25427 shall be used with all brakes which require removal prior to wheel removal.

3.3.8.2.6 Brake release. Unless shown to be unnecessary, a brake mechanism shall be provided and designed to fully release to the designed travel, at a pressure not less than 110 percent of the maximum steady-state back pressure at the brake inlet on the aircraft (see 4.3.36).

3.3.8.2.7 Shuttle valve. A shuttle valve, when incorporated in a hydraulic system, shall conform to the requirements of MIL-V-19068.

3.3.8.2.8 Fluid displacement. The maximum fluid displacement of the brake shall be as limited as practicable. The displacement after brake contact shall be minimized to optimize pressure control, at the brake, with minimum flow.

3.3.8.2.9 Composite heat sink. When the brake employs a structural carbon heat sink, the rotor lugs must use clips or metallic structure to protect against damage during wheel installation. Chamfered entry shall be used on wheel keys and/or clips to facilitate alignment during wheel installation. Ex[psed surfaces of the carbon heat sink shall be adequately protected from oxication.

3.3.8.2.9.1 Brake stack clips. Brake stack clips shall last the wearout life of the carbon stack on the aircraft.

3.3.8.2.9.2 Brake stack refubishment. The contractor shall investigate possible methods and procedures to refurbish carbon heat stacks. The proposed plan shall be submitted with the proposal for evaluation.

3.3.8.2.10 Running clearance. The built-in running clearance shall be sufficient to comply with 3.3.8.2.6 for new and used brakes and for any hot and cold brake conditions or pressurization histories through aircraft maximum design gross weight condition in Table I (see 4.3.3.2).

3.3.8.2.11 Piston stops. Piston stops shall be provided when structural carbon composites are used for brake heat sinks which limit travel to prevent venting of hydraulic fluid upon stark failure or operation beyond the normal removal condition. The piston stops shall allow sufficient piston travel to permit a maximum designed gross weight, rejected take-off (MDGW RTO) at the worn out brake condition. The stops shall be designed for 1-1/2 maximum operating pressure without the disks installed (see 4.3.33).

3.3.8.2.12 Fluid temperature. The hydraulic fluid temperature in the a brake piston cavities shall not exceed 300°F (149°C) after any brake stops in Table I except an RTO (see 4.3.30).

3.3.9 Design for amplibious aircraft and beaching gear application.

3.3.9.1 Watertight sealing. Provisions shall be made to seal the wheels to prevent entrance of water to the wheel bearings or other portions of the wheel or brake where the presence of water might be detrimental. Unsealed wheel and brake assemblies will be permitted if all exposed materials therein are corrosion-resistant and the design its such that brake action and service life will not be impaired by the presence of salt water or fresh water.

3.3.9.2 Lubricant and lubricant retainers. Suitable retainers shall be provided to prevent the lubricant from reaching the braking surface. Excess lubricant will be permitted to enter the hub cavity between the bearings, or the cavity may be completely filled with water-resistant grease in accordance with MIL-G-81322 in order to exclude water.

3.3.9.3 Removal and storage of beaching gear. Provisions shall be made for the removal and storage of the wheel and the brake assembles as an integral unit. Self-sealing couplings conforming to MIL-C-25427 shall be used for hydraulic brake line connections.

3.3.9.4 Lubricant - fittings. Pressure-type lubrication fittings conforming to MIL-F-3541 may be used only for greasing beach-gear wheel bearings, filling the cavity between the bearings, or filling a seal to prevent water from entering the brake.

3.3.10 Clearance.

3.3.10.1 Wheel brake clearance. The contractor shall submit a report to the procuring activity for approval showing adequate radial clearance for all load conditions in this specification. Special attention shall be given to assure that the brake running clearance shall not be changed due to “g” forces in any landing gear position.

3.3.11 Total weight. The total weight of the wheel and brake assembly shall be a minimum consistent with good design. The contractor shall conduct a weight control program.

3.3.12 Piston "O" ringss. The maximum operating temperatures for continuous use of “O” rings shall be 300°F (149°C) for any brake stops in Table I except an RTO. Exposure to temperature of the RTOS in Table I shall not result in leakage at maximum operating pressure for one minute after the s top. The "O" rings shall lasst the life of the carbon heat sink without leakage in service.

3.3.13 Environmental. The equipnmnt shall not suffer damage, deterioration or degradation of performance, beyond the limits of this specification, when subjected to any environment or any natural combination of environments specified herein and in MIL-STD-210. The environmental requirements are

design conditions and may be verified by military and analysis in the test procedures document (see 4.3.6); no specific additional tests should be required except as noted herein.

3.3.13.1 Temperature. The equipment shall be capable of meeting the requirements of this specification during and after exposure to the following ambient air temperatures:

a. Storage: -80°F to +185°F {-62°C to +85°C).

b. Operating: -40°F to +160°F (-40°C to +71°C) from sea level to 15,000 feet

3.3.13.2 Altitude. The equipment shall be capable of meeting the requirements of this specification during and after exposure to pressurees encountered from sea level to the maximum operational altitude.

3.3.13.3 Humidity. The equipment, under both operating and non-operating conditions, shall be capable of meeting the requirements of this specification during and after exposure to relative humidities up to 100 percent. This inluced sonditions wherrein condensation takes place in and on the equipment.

3.3.13.4 Salt atmosphere. The equipment under both operating and non-operating conditions, shall be capable of meeting the requirements of this specification during and after exposure to salt-sea atmosphere as encountered in carrier service.

3.3.13.5 Fungus. The equipment, under both operating and non-operating conditions, shall be capable of meeting the requirements of this specification during and after indefinite exposure to fungus growth as encountered in tropical climates.

3.3.13.6 Sand and dust. The equipment, under both operating and non-operating conditions, shall be capable of meeting the requirements of this specification during and after exposure to sand and dust particles as encountered in desert areas.

3.3.14 Reliability. The minimum acceptable reliability of a wheel or wheel-brake assembly for one takeoff and landing (one operation) shall be at least 95 percent at a 90 percent confidence level. Satisfactory completion of all applicable tests in Section 4 shall constitute demonstration of compliance with MIL-STD-785. The design goal reliability expressed quantitatively in MTBF shall be included on the design proposal drawings (see 3.3.24.1, 4.3.29 and 4.3.40).

3.3.14.1 Operational service life. The brake stack and wheel operational service life shall be controlled by the design requirements of Section 3 and the actual service environment. There shall be no damage to the equipment and the equipment shall perform in accordance with the requirements of this specificatin during or after the equiment has been exposed to any environmental conditions or any combination of the conditions specili herein. The baste brake frame (basic brake housing, torque tube, basic)

pressure, backup plates and carbon heat sink portions when applicable) service life shall be the total land-based and carrier landings as specified by the procuring activity (see 4.3.37).

3.3.15 Maintainability. The equipment shall be designed in accordance with the qualitative and quantitative maintainability requirements utilizing MIL-STD-470 as a design guide. The equipment shall be capable of being maintained at organizational, intermediate and depot levels of maintenance as defined in Volume II, Chapter 2, OPNAVINST 4790.2A (see 4.3.39).

3.3.15.1 Detail maintainability requirements. The following detail maintainability requirements shall be demonstrated in accordance with the applicable test of 4.3.39.

3.3.15.1.1 Preventive maintenance. Preventive maintenance shall be kept to a minimum and shall be limited to visual inspection. All preventive maintenance requirements shall be justified, documented and submitted to the procuring activity for approval.

3.3.15.1.2 Corrective maintenance.

3.3.15.1.2.1 Qrganizational level. Organizational level maintenance generaly shall consist of visual inspect on, and removal and replacement of faulty wheel and brake assembly.

3.3. 15.1.2.2 Intermediate level. It is required that all intermediate level repairs of the wheel and brake assembly generally consisting of repair, bench testing, adjustment, removal and replacement of components, etc., be accomplished within the minimum time practicable. The mean time to disassemble and reassemble the wheel assembly and brake assembly at the intermediate maintenance level shall be recorded separately with the total time not to exceed the established intermediate repair time by more than 30 minutes.

3.3.15.1.2.3 Depot level. Depot level maintenance requirements shall be kept to an absolute minimum.

3.3.15.2 General maintainability requirements.

3.3. 15.2.1 Task criteria. The maintenance actions required by 3.3.15.1 are to be accomplished with a maximum of 2 maintenance personnel of no higher than intermediate skill (E-4) for at least 95 percent of the maintenance tasks.

3.3.15.2.2 Adjustments. Installation adjustments shall not be required.

3.3.15.2.3 Support equipment. Requirements for support equipment shall be held to an absolute minimum. In particular, requirements for Peculiar Ground Support Equipment (PGSE) shall be justified, documented and submitted to the procuring activity for approval prior to first article test.

3.3.16 configuration management. Articles furnished in accordance with this specification shall be configured and produced under a system of configuration management.

3.3.16.1 Configuration approval. Configuration review meetins shall be held periodically before configuration approval as recorded on the design proposal drawings is obtained from the procuring activity.

3.3.17 Stress analysis. The contractor shall prepare a stress analysis for all critical fatigue and static loads on both wheel halves (or basic wheel and remountable flange when applicable) and, when applicable, any brake structure supporting the wheel loads. These analyses may be accomplished by either analytical or test strain methods and shall be verified by test strain data where possible. The analyses shall be governed by the requirements defined in the paragraph entitled “Stress Analysis Reports” of MIL-A-8868.

3.3.18 Thermal analysis. A complete thermal analysts shall be done on all major wheel, brake and axle components to verify the temperature constraints of this specification are satisfied. For items procured as replacement hardware, the stress analysis should be submitted concurrent with and as a part of the test report.

3.3.19 Vibration and shock.

3.3.19.1 Transient loading. Special attention shall be given to assure that the brake running clearance will not be changed due to “g” forces in any landing gear position. The wheel and brake assembly shall be capable of simultaneously withstanding the maximum acceleration in the radial direction (landing) and in the rotational direction occurring during aircraft operations without Impairing the function of the wheel and brake assembly. The brake shall perform satisfactorily in the normal aircraft environment during service.

3.3.20 Safety. The wheel and brake assembly shall be designed to preclude the Incorporation of features which result in critical or catastrophic hazards as classified in MIL-STD-882.

3.3.21 Human engineering. The design of the wheel and brake assembly shall conform to the Design for Maintainability requirements of MIL-STD-1472 (see 4.3.37).

3.3.22 Special tools. The design shall be such that special or unusual tools shall not be required for installation, removal or normal maintenance and inspection of the wheels and brakes. The design shall provide to the greatest possible extent for disassembly, reassembly and service maintenance by means of those tools and Items of maintenance equipment which are normally available as commercial standard. Designs requiring special maintenance tools and equipment shall be kept to a minimum.

3.3.23 Identification of product.

3.3.23.1 Wheel marking. Wheels shall carry the following information to accordance with MIL-STD-130. Integral lettering shall be required: nameplate or metal stamping shall be used only when specifically approved.

a. Size.

b. Serial number on both wheel halves, on demountable flange and wheel body, or in the case of other designs on similar major wheel parts.

c. Manufacturer's name and drawing number.

d. Date of manufacture (month and year, which may be combined with the serial number).

e. Divided-type wheels shall carry a caution note to require deflation of the tire before loosening of the tie bolts.

f. Divided-type wheels shall carry a suitable note to clearly describe the method and torque values used in tightening the tie bolts. The note should read: Lubtork to pound-feet (pound-inches). Lubtork shall mean that the threads and the bearing surfaces of the nut, bolthead and washers shall be lubricated with antiseize compound conforming tO MIL-T-5544 with relubrication for each subsequent torque application.

3.3.23.2 Brake marking. Brakes shall carry the following information in accordance with MIL-STD-130. Stamping or interrgral lettering is preferred. If nameplates are required, details shall be submitted with the design proposed drawings.

a. Manufacturer's name and drawing number.

b. Date of manufacture (month and year, which may be combined with the serial number).

c. Serial number.

d. Brakes which cannot be used interchangeably shall be marked left hand, right hand, inboard hand, right hand, inboard, or outboard, as applicable.

e. Operating medium.

f. Torque values when necessary.

3.3.23.3 Location of marking. At least the manfacturer's part numbers shall appear on wheels and brakes to be read directly, except for designs Incorporating an internal brake where no part of the brake is exposed, in which case the deviation in marking of both wheel and brake shall be submitted to the procuring activity for approval. When practicable, the drawing number shall be so located as to be readable after assembly of the part in the complete unit.

3.3.23.4 Part and subassembly marking. Each part and subassembly except the following shall be marked with the appropriate part or subassembly drawing numbers:

a. Those which are permanently assembled by welding, brazing, soldering, or riveting. These shall carry the subassembly drawing number.

b. Those which do not have suitable or sufficient surface for the drawing number.

c. Those upon which marking would impair the function or structural Integrity.

3.3.23.5 Typing Marking. Markings shall be such that they will not be obliterated or effaced as a result of service.

3.3.23.6 Other marking. Other markings required for identification or instruction shall be subject to procuring activity approval.

3.3.23.7 Age control, packings and gaskets. The wheel and brake assembly shall be supplied with suitable markings showing the date of assembly or reassembly of the equipment in quarter-of-year and year; e.g., 3Q69 representing the third quarter of 1969. Acceptable methods of marking shall be by decal or indelible ink stamping. The age of the oldest packing and/or gasket, at the date of assembly or reassembly of the unit shall not exceed 12 quarters (36 months).

3.3.24 Drawings.

3.3.24.1 Design proposal drawings. Design proposal drawings prepared by the contractor shall Indicate the applicable specification drawing number, Including revision, and shall contain or be accompanied by the following Information as applicable:

a. Wheel weight (“actual” or "calculated") including lubricants and finishes.

b. Brake weight (“actual” or "calculated") including lubricants, fluids and finishes.

c. A curve of brake pressure versus displacement showing the following:

1. Initial pressure to start brake movement.

2. Initial pressure to cause contact between braking surfaces.

3. Brake release pressure.

4. Displacement versus pressure for new brake and for worn brake at approximately 70°F (21°C).

5. Displacement versus pressure for new brake and for worn brake, after heating, by means of a landplane landing design gross weight energy design gross (as defined in Table I) brake appilcation.

6. Normal operating pressure (see 6.4.6), normal parking pressure (see 6.4.7), and maximum operating pressure (see 6.4.8).

3.3.24.2 Interface component drawings. Drawings shall be prepared for each interface component of the approved assembly. These documents shall be suitable for preparation of a wheel, brake, or wheel-brake assembly interface design drawing and specification.

3.3.25 Performance. The components of the wheel and brake assembly shall meet the requirements specified herein at the guaranteed weight. Proof of compliance with this requirement consists of final procuring activity approval of the design stress analyses and successful completion of the tests of Section 4.

3.3.26 Workmanship. Workmanship shall be in accordance with high grade aircraft practice and of quality to assure safety, proper operation, and service life. Workmanship shall be subject to the inspection and approval of the cognizant inspection activity (see 4.3.9).

3.3.26.1 Rim surfaces. The surface of the rim between bead seats shall be free from defects or casing protrusions which would be Injurious to the inner tube. Acceptable depressions in rim or bead seatswhich might injury the tube or casing shall be filled with a hard-surface filler before the primer coat is applied. No holes which extend entirely through the rim shall be filled in this manner but shall be drilled out and filled with a flush plug, subject to the approval of the Inspector.

3.3.26.2 Rivets. When rivets are used they shall be well headed over. Rivets coming in contact with the casing or tube shall be flush with the rim surface.

3.3.26.3 Smoothness of surfaces. After surface treatment and prior to application of surface coatings, machined surfaces shall not exceed the following surface finish as defined in Standard ANSI 646.1.

Part of Wheel	Surface of Roughness (Microinch rhr max)
Bead seat radii, remountable flange lock ring grooves and simllar stress radii	32
Radii between flange faces and outside diameter of flanges; also recesses for bearing cups	125
Bead seat	32
Rim surface between bead seats	250

In lieu of the surface finish specified, alternate processing methods may be used In the areas noted, subject to the approval of the procuring activity. Except as specified above, surfaces of nonmachined sections of the wheel, such as spokes, ribs and rims between bead seats, shall be of reasonably fine-grained appearance and be free from coarse or rough spots. Burrs and fins shall be removed by filling or grinding.

3.3.27 Precedence of documents. When the requirements of the contract. this specification or applicable subsidiary specifications are in confilct. the followlng shall apply:

a. contract. The contract shall have precedence over any other document .

b. Aircraft specification. The general specification for design and construction of aircraft weapon systems shall take precedence over this specification.

c. This specification. This specification shall have precedence over all applicable subsidiary specification.

d. Referenced documents. Any document referenced in this specification shall have precedence over all documents referenced therein.

3.3.28 Performance objectives. Minimum size and weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objectives which shall be considered in the production of this equipment. Where it appears a substantial reduction in size and weight or improvement in simplicity of design, performance, ease of maintenance or reliability will result from the use of materials, parts and processes other than those specified herein can be realized, a request for approval shall be submitted to the procuring activity for consideration. Each request shall be accompanied by complete supporting information.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall meet all requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall Inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Carbon material consistecny control. When a structural carbon heat sink is employed, the contractor shall submit with the proposal a Control Program Plan (3.2.1.2.1) established to maintain the same material consistency of carbon material that is used in the test of paragraph 4.3.

4.2 Classification of inspections. Items covered by this specification shall be subjected to the following performance tests:

First article inspection	(See 4.3)
Quality conformance inspection	(See 4.4)

4.3 First article inspection. First article inspections detailed in the subparagraphs shall be made on equipment completely representative of the equipments to be supplied under contract.

4.3.1 Scope of first article inspections. First article inspections shall include all inspections specified in all 4.3 subparagraphs and shall be performed in accordance with requirements of this specification test values and parameters shall be as designated in the design requirements paragraphs of this specification. If during the course of running first article inspections, corrective action is required, the contractor shall re-evaluate the previously approved tests, test plans and reports to assure their continual validity. The corrective action, extent of required retest and test plan revisions shall be subject to approval of the procuring activity.

4.3.2 First article test samples. The first article inspection samples shall be representative of the production assembly and of the quantity required to complete all tests herein. Samples shall be tested in the manner designated in the contract, purchase order, invitation for bids, or as authorized by the procuring activity (see 6.2.1g).

4.3.3 First article in the inspections attendance. The option of witnessing all or part of the testing shall be extended to the procuring activity engineering personnel. Two weeks advance notice will be furnished to the responsible activity on the start of testing.

4.3.3.1 Test fittings. Test wheel and brake assemblies shall be equipped with necessary inlet fittings and adapters, and with chromel-alumel thermocouple leads for measuring temperatures of critical portions of the wheel and brake.

4.3.3.2 Wheel-brake interference. For wheel assemblies used in conjunction with brakes, the yield load test of 4.3.13.1, 4.3.13.3 and 4.3.14.1 must be run with the brake Installed and It shall be determined that no interference exists.

4.3.4 Safety of flight tests. The following level of successsful testsing shall be completed before the wheel or brake equipment or the wheel-brake assembly is considered safe to release for flight test:

a. Wheels:

1. All static load tests (see 4.3.13 and 4.3.14).

2. Burst test (see 4.3.15).

3. 30 percent of required roll test (see 4.3.16).

b. Brakes:

1. 90 percent of structural torque (see 4.3.16).

2. 60 percent of 45-5 stop dynamic torque sequence or 100 stop dynamic torque sequence, whichever applies followed by RTO or 1 stop test condition (see 4.3.19).

3. 60 percent of endurance test (see 4.3.29}.

4.3.5 First article status. The first article status will be determined only by the responsible government procuring activity.

4.3.6 Test procedurees document. The contractor shall prepare a test procedures document. The test procedures document shall be in accordance with the applicable portions of MIL-T-18303 and shall include the following:

a. A complete and detailed listing of all test procedures and the sequence in which each test will occur.

b. A complete description of the data to be recorded, a description of the recording equipment, and a sample of similar test data previously recorded on a similar test.

c. A description of the equipment to be used in the test and how this equipment will be assembled for testing.

d. A Quality Program Plan (see 4.1.1).

The test procedures document should be submitted to the procuring activity for approval. The procedure shall be in accordance with the approved specification and the intended data recording shall be acceptable to the procuring activity. No variations may be permitted without written approval of the procuring activity.

4.3.7 First article test report. In the event first article tests are authorized to be conducted by the contractor or by a commercial laboratory having suitable equipment, complete test reports shall be prepared for approval by the activity responsible for granting approval or of the aircraft manufacturer, as applicable. The first article inspection report should be submitted to the procuring activity for approval. When the wheel and brake assembles are designed for use on Navy aircraft, one copy of the report should also be forwarded to the Commander, Naval Air Systems Command (AIR-53032), Washington, DC 20361-5300. An interim progress report should be published if first article tests time is extensive. The report should contain results of all pretesting to date, a description of the difficulties and failures encountered with the test item and the expected completion schedule. Distribution should be made the same as for the final first article test

schedule report. The first article inspection report should be amended to include the extended roll test data of 4.3.16.5 after receipt of approval of the original test report. The inspection report shall include the following:

a. A statement of requirements and a statement of the results for each test required by the procurement specification. Prominently identified and highlighted in the forward sectin shall be the deviations, exceptions, special approvals and related item.

b. Actual recorded oscillograph data (4.3.19.6) for runs of the dynamic torque brake test with suitable calibration data to permit evaluation as follows:

2 samples of the 45 stops {start, end)
1 sample of the 5 stops
All of the RTO
Sample of the 100 stop (start, middle, end)
All of the RTO

c. A copy of operator instructions and commets.

d. Certification of the accuracy of the recording instruments.

4.3.8 First article inspection report approval Regardless of any Inherent virtue exhibited by the test results themselves, the first article test requirements have not been satisfied until the procuring activity has approved the contractor's First Article Inspection Report. Any production of equipment prior to such approval is undertaken at the contractor's own risk.

4.3.9 Examination of product. Each wheel and brake component shall be carefully examined to determine conformance to this specification with respect to material, workmanship, finish, dimensions, construction, surface conditions, and marking. Non-destructive testing shall be accomplished in accordance with MIL-I-6870.

4.3.10 Material and process test.

4.3.10.1 X-ray control. Castings shall be classified and inspected radiographically in accorcdance with MIL-STD-2175.

4,3.10.2 Penetrant inspection. Unless otherwise authorized by the procuring activity, penetrant inspection shall be in accordance with MIL-STD-6866. Fully machined aluminum castings shall have 100 percent penetrant inspection.

4.3.10.3 Magnetic inspection. All magnetizable highly stressed parts of wheels and brake assembles shall be subjected to magnetic inspection in accordance with MIL-STD-1949. All ground chrome plated parts shall be fluorescent magnetic particle inspected.

4.3.10.4 Ultrasonic inspection. Inspection shall be in accordance with the applicable material specification approved on the design proposal drawings. If ultrasonic inspection is performed either on the original forging billet or at an intermediate forming state, the final machined forgings need not be. Ultrasonic inspection requirements for titanium and steel products shall be in accordance with MIL-I-8950, Class AAA.

4.3.11 Wheel pressure retention. All wheel intended for use with tubeless tires shall show adequacy to retain rated operating tubeless tire pressure.

4.3.12 Radial and lateral runout. The radial runout of bead seats and the lateral runout of the rim flanges shall not exceed the following values:

a. Bead seat runout (radial) 0.005 inch +0.0005 Inch-per-Inch of bead seat diameter.

b. Lateral runout of the rim flanges 0.002 inch +0.001 Inch-per-inch of bead seat diameter.

Indicator readings shall be taken as close to the bead seat radius as possible. Readings shall be taken with bearing cuprs installed and with cones of the same part number as shown on the original approved drawing or on the applicable specification control drawing. A defective wheel is a wheel having any one runout reading in excess of the above specified limits.

4.3.13 R<u>adial loa</u>d <u>test</u>. The maximum limit load shall be determined in accordance with MIL-A-8863 and shall be equal to the operational condition of maximum radial load reaction with the side load equal to zero. If the critical combined bad condition, as defined under the combined bad test, has a limit radial component in excess of the determined limit radial load, this test shall be omitted unless the aircraft is designed for carrier service or use with ground arresting gear (see 6.3.13.3). This test shall be performed by applying the radial load to the wheel through l tire inflated to an initial pressure equal to the rated inflation pressure (or as specified in the procuring document for shipboard operations). Either air or water inflation may be used. If the tire is filled with water, the water shall be bled off during loading to approximate the same tire deflection that would result if air inflation were used, and the inflation pressure shall not exceed the pressure at maximum tire deflaction. The load shall be applied to the wheel and perpendicular to the axle centerline by means of an axle passing through the hub. The tire shall be loaded directly aggainst a flat, nondflecting surface. Deflection and permanent set readings shall be taken at suitabled points on the wheel to indicate deflections of the wheel rim at the bead seat, hubs, and other critical areas. Wheels intended for tubeless tire mounting shall be so tested with said mountings unless otherwise specified. The required radial load tests are specified below. Strain gages and special coatings to determine region of highest stress within the wheel structure may be used.

4.3.13.1 Yield radial load test. The wheel shall support the yield radial load applied consecutively at 0°, 90°, 180° and 270”, followed by two more load applications at the 0° position. The 0° position shall be the most

critical load contact Point which shall normally include the valve hole. The 90" Increments may be altered when structural conditions indicate. The successive loadings at the 0° position shall not cause radial permanent set Increments of increasing magnitude. The permanent set increment caused by the last loading (at the 0° position) shall not exceed 5 percent of the tots? deflection caused by the last loading. There shall be no yielding of the wheel such as would result in loose bearing cups, air leakage, or Interference in any critical clearance areas such as brake interface part (if brake-type wheel). The bearing cups and cones and rollers shall be used for this test. The test shall be performed with the brake assembly installed and bolts torqued within the normal torque range.

4.3.13.2 Ultimate radial load test. The ultimate load shall be applied at the 0° position of the same wheel on which the yield radial loads were applied. The wheel shall support the ultimate load for 10 seconds after which there shall be no cracks in any areas. The bearing cones may be replaced with cortical bushings, but the cups-shall be used. If desired, a tubeless tire may be replaced with tire and tube. The brake assembly is to be rammed. Upon successful completion of this test, the radial load shall be reapplied to failure. The load at which failure occurs shall be recorded in the first article test report (see 4.3.7).

4.3.13.3 Design landing radial load test. The maximum design landing load shall be determined in accordance with MIL-A-8863. The load shall be aPplied in the same manner as described in 4.3.13. However. the maximum load is a design load, as defined in the paragraphs entitled "Design Loads" in MIL-A-8863, and the same limitations apply. The load shall be supported for not less than 10 seconds, and the resulting permanent set shall not produce loose bearing cups, air leakage, interference in critical running areas, or make the wheel unsuitable for further service. The tire inflation pressure shall be the maximum design operating pressure for the condition being simulated. For Navy aircraft intended for shipboard use, the wheel shall be loaded for this test condition through 1-1/2-inch diameter cable or steel bar that simulates statically the wheel desiqn landing load plus the load imposed by rolling over or landing on a 1-1/2-inch diameter cable. If a cable is used, the specimen shall be at least 3 feet long with ends secured to prevent looseness. The wheel shall be loaded perpendicular to the axle centerline. At the completion of the above, the same wheel and brake assembly shall be rolled a minimum of 5000 feet at the rated static load. It is permissible to compensate tire inflation pressure for flywheel curvature. Distance for each roll cycle shall be 300 feet minimum.

4.3.14 load test. The combined load test shall be Combined radial-side performed by applying the load to the wheel through a tire inflated to an initial pressure or the carrier design operating pressure. Air or water inflation pressure may be used. If the tire is filled with water, the water shall be bled off during loading to approximate the same tire deflection that would result if air inflation were used, and inflatton shall not exceed the pressure at maximum tire deflection. Yield loads shall be applied in both inboard and outboard directions on the same wheel and at the ground angle and magnitude determined in accordance with applicable specifications. The maximum limit combined load horizontal and vertical loads shall be furnished to the procuring activity. The wheel and tire assembly shall be mounted on an

axle passing through the hub. The tests shall be conducted with bearing cups, cones and rollers installed. Strain gages and special coatings to determine region of highest stress within the wheel may be used. The tire shall be loaded directly against a flat, nondeflecting surface so that the combined load is as ascertained above. The loads shall be applied simultaneously, either continuously or in increments of approximately 10 percent of the specified values. Readings shall be taken at suitable points on the wheel to Indicate deflections and permanent sets. The required combined load tests are specified below. For the combined load tests, it is permissible to limit the tire deflection to that deflection achieved under limit load conditions of vertical and lateral loads by use of load transfer blocks (saddle type) which bear directly on wheel rim structure. Another alternative, where justifiable, is the use of tire inflation exceeding the aforementioned values.

4.3.14.1 Yield combined radial-side load test. The wheel shall support the components of the yield combined load applied consecutively at 0°, 90°, 180° and 270°, followed by two more load applications at the 0° position. Each load application shall be sustained for a minimum of 10 seconds. The 0° position shall be the most critical load contact point which shall normally include the valve hole. The 900 increments may be altered when structural conditions dictate. The successive loadings at the 0° position shall not cause permanent set increments of increasing magnitude. There shall be no yielding of the wheel such as would result in loose bearing cups, air leakage through the wheel or past the wheel seal, or interference in any critical clearance areas. Brake-type wheels shall be tested with the brake installed, and it shall be determined that no interference exists. The bearing cups and cones and rollers shall be used for this test. A tire and tube may be used when testing a tubeless wheel only when it has been demonstrated that pressure will be lost due to the inability of the tire bead to remain properly positioned when under load.

4.3.14.2 Ultimate combined radial-side load test. The ultimate combined load shall be applied at the 0° position of the same wheel on which the respective yield combined load tests were performed. The ultimate load shall be sustained for a minimum of 10 seconds after which there shall be no cracks in any area. The wheel shall be loaded in the must critical direction. The bearing cones may be replaced with conical bushings, but the cups shall be used. The brake assembly is to be removed. Tubeless tire mountings may be replaced with a tire and tube. With the side load component held constant or allowed to proportionally Increase with the vertical load, the vertical load shall be Increased until failure occurs.

4.3.15 Burst test. The burst test load shall be applied to the wheel by means of hydrostatic pressure in the tire. A tire and tube may be used when testing a tubeless tire wheel by adding the necessary valve hole to the test article. Wheels of land-based aircraft shall be tested to a burst pressure of 3.5 times the rated tire pressure, at the rated static load of the wheel or the burst strength of the tire, whichever is least. Wheels of carrier-based aircraft shall be tested to 4.5 times the rated tire pressure or to the burst strength of the tire, whichever is least. Helicopter wheels shall be tested to a burst pressure producing not less than 3.0 times the axial load which results from the tire pressure required for the static wheel load at the taxi gross weight.

4.3.16 Roll test. The roll test shall consist of a series of landings or a continuous roll of the wheel assembly against a rotating flywheel to complete the roll test spectrum of Table III for a total of 3000 miles.

4.3.16.1 Roll test criteria. Roll tests shall be performed with tires having the same size and ply rating as will be installed for aircraft usage. Tubeless tires shall be used when testing tubeless wheels. Dynamometer roll test tire inflation pressure shall be the flat-surface inflation applicable to the loading condition imposed and corrected for flywheel curvature in accordance with Figure 2. For each loading condition, the roll test tire inflation pressure shall be constant based on tire diameter. All tire test pressures, flywheel sizes and mileage shall be reported in the first article test report. Roll tests shall be performed in accordance with the procedures and conditions specified herein and shall not result in cracks or other evidence of failure.

4.3.16.2 Thermal conditioning. Prior to roll testing, all wheel and brake assemblies and wheels utilizing shot peening, roll burnishing, or other cold-working processes shall have been subjected to thermal conditioning equivalent to the cumulative temperature-time history resulting from brake heat dissipation experienced during the dynamic torque tests of 4.3.19 except for the rejected takeoff condition. Thermal conditioning may be accomplished by performing dynamic torque testing, by simulation of the thermal distribution in the wheel utilizing a simulated brake heat sink to produce the same temperatures encountered during the dynamic torque testing, or by a suitable oven heat soak.

4.3.16.3 Stress measurement. Prior to or during the roll testing, the stresses to the bead seat or other areas affected by the tire shall be measured on the roll test wheel or a separate wheel for each loading condition and for each test inflation pressure which is utilized. The stress measurements shall be reported in the first article test report.

4.3.16.4 Minimum roll distance. The minimum appiled loading conditons and roll distances shall be as specified in the roll test spectrum above.

a. Helicopter wheels are not subject to the loading conditions in the roll test spectrum above unless specified in the aircraft detail specification. Instead, helicopter wheels shall be rolled 250 miles minimum with an applied radial load not less than the static wheel reaction based on helicopter maximum taxi gross weight.

b. Beaching-gear wheels need not be roll tested.

4.3.16.5 Extended roll test. With approval of the procuring activity, the roll to failure portion of this test may be concluded prior to failure provided two times the required roll test distance has been obtained on the test wheel. The first article test report shall be amended to include these data.

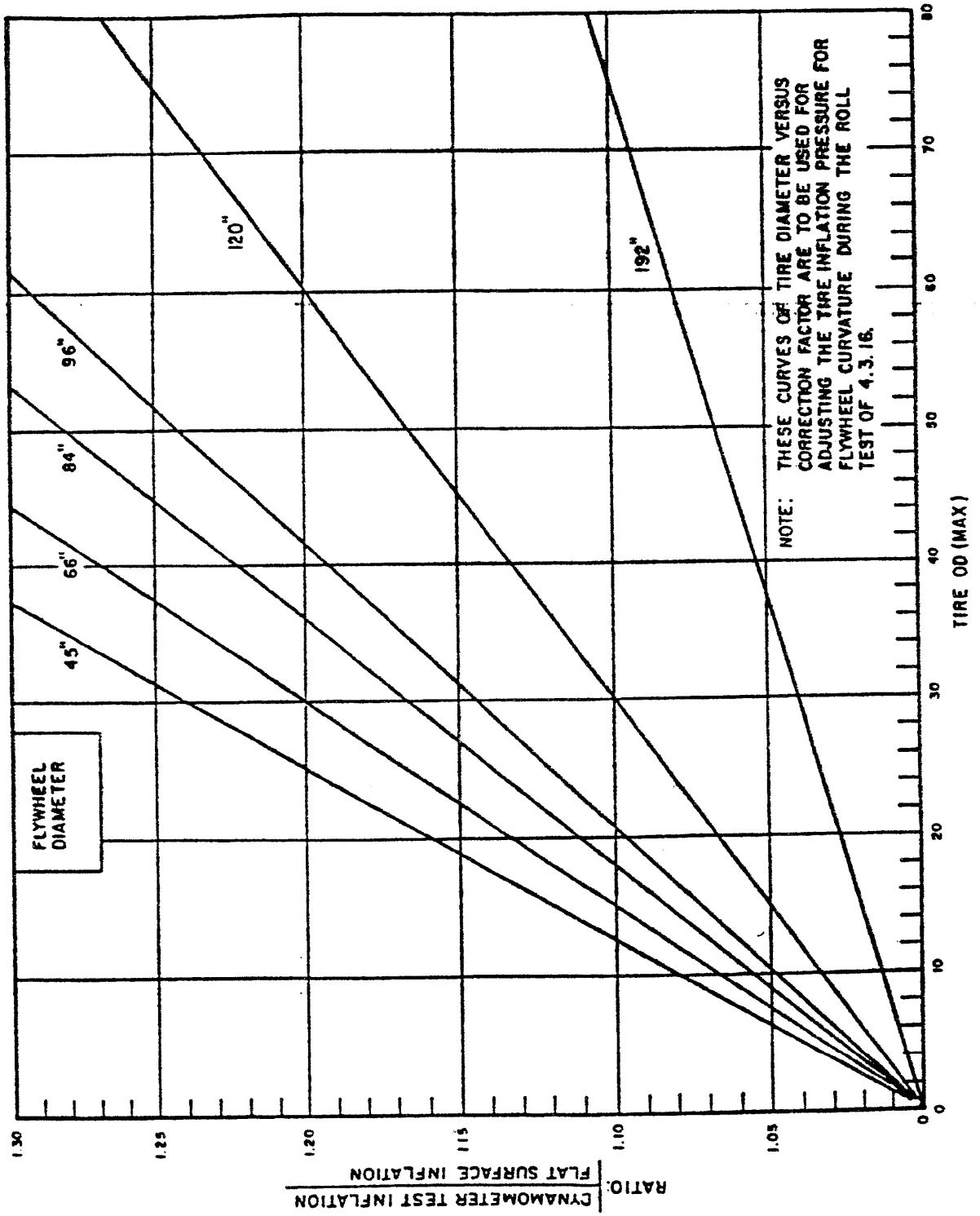

FIGURE 2. Inflation correction factor for flywheel curvature.

TABLE III. Roll test spectrum.

Condition	Load	Distance	Tire Inflation Pressure
Straight Roll	Rated Static Load	900 miles	High 1/
Straight Roll	Rated Static Load	1770 miles	Rated 2/
Inboard Yaw	Maximum Design Gross Weight 3/	150 miles	Rated
Outboard Yaw	Maximum Design Gross Weight 3/	150 miles	Rated
Catapult 6/	Catapult Condition 4/	30 miles 5/	High
		3000 miles 7/	

1/ High pressure shall be that required for carrier operation. This straight roll high pressure shall revert to rated pressure for planes not designed for carrier operations.

2/ 25 miles may be done at reduced tie bolt torque at 90 percent of the minimum recommended on the design drawing.

3/ The radial and side load corresponding to a 0.25g turn at maximum design gross weight shall be applied.

4/ Catapult load condition shall be established by the airframe manufacturer.

5/ May be more than one continuous roll provided the total is 30 miles. The wheel speed and duration shall be as required for maximum tire life. Roll cycle distance shall be 300 feet minimum. The distance shall revert and be added to straight roll (rated pressure) for planes not designed for carrier operations.

6/ Required for carrier-based airplane design only.

7/ The wheel must be inspected at the conclusion of the 3000 miles by Zyglo and Eddy Current and found to be free of cracks or other evidence of failure. Tie bolt or bearing failure after the first 3000 mile portion of the test has been completed will not be construed as wheel failure.

4.3.17 Static test. When the static test loads specified in the spectfication or applicable drawings are not consistent with imposed loads on the aircraft, alternate loads and test procedures may be worked out to the satisfaction of the procuring activity.

4.3.18 Tubeless wheel pressure test.

4.3.18.1 Static test. The tubeless tire and wheel assembly shall be inflated to a pressure of 1.5 times the rated inflation pressure and immersed in water. The rate of leakage, as evidenced by bubbles, shall not exceed four bubbles per second from the wheel.

4.3.18.2 Diffusion test. The tubeless tire and wheel assembly shall hold the normal inflation pressure for 24 hours with no greater pressure drop than 5 pounds per square inch (psi). This test shall be performed after the tire growth has been stabitize in accordance with MIL-T-5041.

4.3.18.3 Dynamic pressure test: The tuneless tire and wheel assembly shall be rolled under the load specified by the roll test (4.3.16) for 25 miles with no pressure drop greater than 5 percent of 8 psi. whichever is less. Mileage accumulatd during this test may be used in computing the total mileage in the roll test.

4.3.18.4 Wheel first article approval limitation, Wheel designed and first article approved for tubeless tire use, when used with conventional fire and tube, shall require no further test except the customary mounting test.

4.3.19 Dynamic torque test. The number of stops and rates of deceleration shall be computed as specified in Section 3. The wheel and brake shall successfully complete the test sequence defined in Table I, noting that the 45-5 test shall be conducted with a sequence of nine normal energy stops (landplane landing design gross weight), followed by one overload stop (maximum landing gross weight), and the sequence repeated five times. During this test, the brake assembly may not be disassembled and the parts may not be changed or removed. The fuse plugs shall not release until a minimum of one minute following the RTO or turnaround test. The maximum speed of cooling air for the 5 stop condition shall be 5 mph. The brake may only have the lining dust removed by the use of an airhose or equivalent. When the wheel assembly is reinstalled, the brake rotating discs must be placed in the same position and in the relationship with the other discs that they were when the wheel was removed. This is necessary to insure continued disc lining wear patterns. After completion of the tests, all parts shall be cleaned and Inspected for defects using aided inspection methods, such as magnetic particle or dye penetrant. No parts shall have cracked during this test to the extent of compromising the structural integrity during the 20, 45-5, or 100 stop conditions. If cracks or defects are present, an analysis shall be performed to determine the origin and cause of the defect and the potential effect of continued service in the first article test report. Tires used for this test shall be only production size tires. Tubeless tires shall be used when testing tubeless-wheels. The dynamic torque test shall be in accordance with the following procedure:

4.3.19.1 Kinetic energy. Proper kinetic energy values shall be determined from appropriate calculations in accordance with paragraph 3.3.7.1.

4.3.19.2 Flywheel weight. A flywheel weight that will give an inertia equivalent approximately equal to, but not less than, the weight of aircraft per brake shall be selected. If the Method II brake energy analysis is used. the flywheel inertia equivalent weight shall be as defined by Method II analysis (see 3.3.7.1.2). (The inertial equivalent weight at the periphery of any flywheel #s assumed equal to the weight of the flywheel multiplied by the square of its radius of gyration and divided by the square of the flywheel radius.)

4.3.19.3 Flywheel speed. The flywheel speed at application of the brake shall be determined as that peripheral speed which, under the chosen flywheel weight, will give the required kinetic energy.

4.3.19.4 Procedure. The following shall be accomplished bring the flywheel to the proper velocity, land the test wheel apply the prescribed load, apply brake pressure, and bring the test unit to a complete stop. The design specification will identify the required stop distance. The average distance for any five consecutive landplans landing weight stops shall be equal to the correct distance for the test condition. All stops which fall to meet the minimum required performance must be compensated by a comparable. increase in deceleration within the next five steps.

4.3.19.5 Data. During the dynamic torque test, the following data shall be recorded in the first article test report:

a. Height and description of wheel, brake, tire and tube used.

b. Flywheel diameter, inertia equivalent, speeds and kinetic energies.

c. The test facility shall obtain time temperature relationships of the following components for the conditions noted and present the data in the formal first article test report:

1. Hydraulic fluid.

2. Flywheel adjacent to the fuse plug (if incorporated).

3. Bead ledge above each brake.

4. Other critical components.

Temperature recordings should continue until the hottest portion has cooled to 300°F. Temperature limits of the bead ledge shall be in accordance with 3.3.6.5 unless otherwise defined in the applicable specification document. A minimum of three design landing stops . two maximum landing weight stops and the critical one stop test, shall be conducted without accelerated cooling after conclusion of the stop. Accelerated air cooling on other stops may be employed after the

above-noted components have attained their peak temperature. Three additional landidng stops shall be monitored withaccelerated cooling if used. Accelerated cooling procedures used shall be described. When rolling fans are used, the time of colling, temperature of the cooling air, and velocity at the test brake shall be noted in the test report.

d. Wheel load.

e. Brake operating pressure (or force) for each stop.

f. Average dynamic torque for each stop.

g. Stopping time and distance for each stop.

h. Static torque information.

i. Fluid displacement for new brake and brake worn to maximum allowable clearance at room temperature for each wear condition.

j. Tangential-force at cirvumference of tire required to rotate wheel, with brake pressure released to back pressure after completion of every fifth stop.

k. Time required for wheel, brake and tire assembly, landed against flywheel, to stop flywheel from an initial landing speed of 30 mph. This observation should be made after every fifth stop, except that it may be omitted when no noticeable brake drag is present.

l. Brake operating clearance prior to test and at least four times during the test.

m. The thickness of the lining of each of the lined discs and the thickness of each unlined disc at the beginning and at the end of the normal energy stops (including 5 stop or overload condictions where applicable}.

n. The number of stops to wearout shall be estimated by calculating the average wear per stop per lined disc per side during the normal energy stops (4.3.19.5m) and prorating this wear rate to zero lining on the lined disc with the least of friction material remaining at the time of the measurement (before RTO) test). This shall be an estimate of lining wearout. If another performance parameter is more critical from an assembly wearout point of view, this shall be used to predict assembly wearout. In either event, these data shall be used for reliability calculations only.

o. The after stop to fuse plug release and energy level of stop.

p. Ability of tubeless tire wheels to retain air satisfactorily under braking conditions.

q. Any other information that will be assistance to ultimate users of the wheel and brake assembly.

4.3.19.6 Oscillograph. Oscillograph traces shall be made during the dynamic torque test, recording the following for each run for submission in part, with the test report (4.3.7):

a. Flywheel velocity.

b. Test wheel velocity.

c. Brake torque.

d, Brake pressure at the brake port.

4.3.20 Spectrum dynamic torque test. An additional dynamic torque test shall be conducted on a different brake assembly than used for the tests of 4.3.19. This test shall dublicate service type of energy input as specified in Table II. The entire test shall be conducted with the same inertia equivalent as used for the landplane landing design gross weight condition of Table I. The data and reporting requirements of 4.3.19 shall apply. The test sequence and the number of stops shall be subject to the approval of the procuring activity.

4.3.20.1 Carbon brakes. Intersperesed in the dynamic torque test spectrum the carbon heat sink, where installed, shall have sea water wetted surfaces tests conducted.

4.3.21 Normal energy dynamic torque test. The normal energy dynamic torque test shall consist of the braked stops performed in accordance with Table I herein (45-5 or 100 stops as applicable). Static torque pulls shall be conducted prior and subsequent to each of the stops noted by Table I to demonstrate compliance with 4.3.25 requirement. The tire bead seat temperature shall not exceed 350°F as a result of brake heat developed during any stop performed during the normal energy dynamic test. If a deviation is taken to the temperature limits in 3.3.6.5, then a test must be conducted to verify there is no tire degradation. The tire must be subjected to the 45-5 or 100 stops as applicable and after completion shall be inspected to determine no degradation has occurred. The tire then shall be burst to confirm it meets its specification requirements.

4.3.21.1 Carbon heat sink. When carbon heat sinks are installed, five landing design gross weight condition and one maximum landing gross weight condition stops for 45-5 stops or 10 landing design gross weight condition stops for 100 stops shall be conducted after spraying 2 liters of sea water or equivalent over the heat sink with the wheel removed.

4.3.22 Carbon wet brake test. Following the RTOs performed in Note 6 of Table I, the following RTO shall be performed on a carbon brake. A new brake or brake reconditoned after completion of the RTOS in Note 6 of Table I (worn to the equivalent or greater than the 45 and 5 stop or 100 stop condition of Table I) shall be wetted with 2 liters of sea water and the brake subjected to an RTO of Table I for information only. The sea water shall be substitute ocean water in accordance with ASTM 01141-52.

4.3.23 Turnaround dynamic torque test. In the event a mission turn-around requirement is placed upon the total aircraft system, a special brake dynamic torque test sequence shall be conducted demonstrating the required capability. The test sequence shall be subject to the approval of the government procuring activity.

4.3.24 Brake fusing level and thermal release dynamic torque tests.

4.3.24.1 Brake fusing level stop. Following a normal landing at maximum field landing weight, the brakes shall be capable of decelerating the aircraft down to taxi speed and then decelerating to zero. After applying brake pressure for one minute, the brakes shall not fuse or lock with wheels free to roll for continued taxiing. Standard day conditions, no wind, and 0.3 tire coefficient shall apply.

4.3.24.2 Thermal release dynamic torque test. The thermal release dynamic torque test shall consist of a series of braked stops performed using the test setup for the overload landing condition of Table II. By adjusting brake application speed, The amount of kinetic energy absorbed by the wheel and brake unit shall be varied from stop to stop in a manner so as to establish the minimum value of kinetic energy absorption which will result in the wheel thermal plugs relieving the tire inflation pressure. The test sequence shall be outlined in the test plan. These tests shall be performed when the brake stack is near the maximum wear limit. The temperature recorded during these stops shall establish the relationship between brake kinetic energy absorption and the temperature of the tire bead seat, the axle and anti-skid wheel speed sensor. Five mph auxiliary cooling air may be used for this test. This test shall be for information only.

4.3.25 Static torque test. During the dynamic torque test, the brake pressures required to develop static torque corresponding with the maximum wheel load at 0.55 ground coefficient shall be determined under the following conditions:

a. With brake at room temperature, approximately 70°F (21°C).

b. With brake heated by a landplane landing design gross weight energy stop and with static torque test applied as soon as possible after completion of that stop.

c. At least 10 percent, at 50 percent approximately, and again after 90 percent of the number of stops required by Table I. If the brake is carbon, there shall be one additional wet static torque test for each condition. (This test may be conducted by applying a tangential force at the rolling radius of the tire.) This test shall be done as part of dynamic torque tests, 4.3.19. Data submitted shall be as listed in 4.3.19.5.

4.3.26 Taxi and parking test. Within one minute after completing a normal condition braked stop performed in accordance with Table I herein, the wheel brake assembly shall be taxied at taxi speed for 10,000 feet minimum. Throughout the taxi, pressure not less than 110 percent of the maximum steady

state back pressure of the hydraulic operating system, when Installed, shall be maintained at the brake inlet port. When the taxi is completed, maximum parking hydraulic pressure shall be applied at the brake inlet port and maintained for at least one hour. After at least one hour has elapsed, pressure at the brake inlet port shall be reduced to 110 percent of the maximum steady state back pressure. The brake shall be functionally operational after conclusion of test and shall be capable of maximum braking hydraulic pressure.

4.3.27 Structural torque test. The brake shall be actuated at twice the normal operating pressure, or force in the case of a mechanical brake, or the maximum safe operating pressure, whichever is higher. Tangential load shall then be applied at the static load radius of the tire until the applied tangential load equals 1.2 times (1.0 for helicopters) the maximum rated static load of the wheel. The friction surfaces of the brake may be bolted or clamped together or otherwise restrained to withstand the required tangential load of 1.2 times (1.0 for helicopters) the maximum rated static load of the wheel . The wheel and brake shall withstand the structural torque test without failure. Co-rotating nose-wheels shall also be tested to verify the structural integrity of the co-rotating feature. The shall be subjected to a tangential load of 1.2 times maximum rated load of the wheel applied at the rolling radius of the tire. There shall be no evidence of failure as a result of this test.

4.3.28 Pressue-torque response test. The pressure-torque response test shall be the bode and-step/ramp tests defined in 4.3.28.1 and 4.3.28.2. The The testing shall be accomplished on the dynamometer and shall be accomplished early enough to be available for skid control system tuning. Brake pressure shall be measured at the brake.

4.3.28.1 Bode plots Tests shall be conducted to construct bode diagrams (amplitude ratios and phase angles versus frequency) for the brake pressure/torque frequency response for the conditions defined below. Amplitude ratio is defined as peak-to-peak output torque divided by the peak-to-peak input brake pressure. The skid control valve shall be used for pressure cycling with the hydraulic line lengths simulating the actual aircraft. Testing shall be accomplished on a brake which has a miimum of 10 break-in stops per 4.3.19 (or equivalent). The tests shall be conducted about a mean pressure with the dynamic pressure cycling equal to 150 ± 50 Psi peak-peak at the test frequency. Wet brake tests shall be conducted for carbon brakes only. Time between wetting and wet brake tests shall be recorded. Wet test points may be combined to minimize test time so long as rubbing surfaces remain wet. Test frequencies, test velocities, and mean pressures shall be selected so as to adequately define the brake frequency response character tics. Dynamometer inertia equivalent and heat sink loading rate (HP/in) shall be approximately equal to the normal landing conditions of 4.3.19.

4.3.28.2 Step/ramp testing. Tests shall be conducted to define the pressure versus torque response characteristics of the equipment to step and ramp inputs as defined below. The test conditions of 4.3.28.1 shall apply except as modified herein. Data shall be recorded in pressure/torque time histories. Input pressure steps/ramps and tesst velocities shall be selected

to adequately define the brake response to steps and ramps. Testing shall include tests at three brake temperatures ranging from ambient to normal landing condition brake temperatures.

4.3.29 Endurance. The hydraulic brake shall be subjected to 100,000 cycles (50,000 for helicopters) of application and release of pressure equal to normal operating pressure and 5000 cycles (2500 for helicopters) at a pressure equivalent to the maximum operating pressure. This test shall be conducted using a minimum clearance equivalent to the maximum clearance allowable between adjustments. The first portion of the test may be divided into four parts so that 25,000 cycles (12,500 for helicopters) may be applied at each of four positions of brake piston travel conforming to 25 percent, 50 percent, 75 percent and 100 percent travel, respectively. The rate of cycling shall be not greater than 30 cycles per minute. During and at conclusion of the test, the leakage rate shall be limited as specified in 4.3.31.2 and there shall be no evidence of other malfunction. Alternate endurance tests may be used upon written authorization of the procuring activity.

4.3.29.1 Impulse cycling. The brake assembly shall be subject to 200,000 impulse cycles from 250 psi to 1.5 times the normal system's pressure (or braking pressure) to 250 psi. Cycling may be conducted at the maximum rate consistent with achieving the required pressure levels and ensuring the pistons return to their rest position after each pressure cycle. The cycles shall be divided into four parts so that an equal number of cycles may be applied at each of the four positions of brake piston travel conforming to 25%, 50%, 75% and 100%, respectively. There shall be no deformation or structural failure of the brake assembly.

4.3.30 Extreme temperature test.

4.3.30.1 Aging and heat test. The brake, filled with operating fluid, shall be subjected to a temperature of 160°F (71°C) for AN seals, 225°F (107°C) for MS seals or better, or higher temperature as required by the particular application other than energy overload conditions for 7 days. With the brake and operating fluid being maintained at this temperature, the brake shall be cycled 1000 times at normal operating pressure followed Immediately by 25 cycles at maximum operating pressure. Leakage rate shall be limited as specified in 4.3.31.2. Where warranted, deviation from the aging temperature and the time specified above may be granted upon presentation of substantiating data to the activity responsible for approval.

4.3.30.2 Cold test. Upon completion of the aging and heat test (4.3.31.1), the brake, filled with operating fluid under atmospheric pressure, shall be subjected to a temperature of -65°F (-54°C) for a period of 72 hours. There shall be no leakage during this period. With the brake and operating fluid being maintained at this temperature, the brake shall be cycled 25 times at normal operating pressure followed immediately by five cycles at maximum operating pressure. The brake clearance shall be checked between each cycle at maximum operating pressure to insure that the brake releases completely. The time required for the brake to release completely shall be noted. Leakage rate shall be limited as specified in 4.3.31.2. Upon completion of the cold test, the brake shall satisfactorily pass the leakage test (see 4.3.31).

4.3.31 Functional and leakage test. Functional and leakage test shall be in accordance with 4.3.31.1 and 4.3.31.2. Each complete brake submitted for acceptance under contract shall be tested with fluid compatible with that specified for use on the aircraft. Alternate actuation media and processes may be used upon written authorization of the procuring activity. Each completed brake submitted for acceptance under contract shall be subjected to a functional test for which written approval of the procedure has been received from the procuring activity. First article tests (4.3.31.1 and 4.3.31.2) shall be done after performing the tests in 4.3.30.2. The brake shall be tested with hydraulic fluid for which the brake was designed.

4.3.31.1 Static leakage test. The brake shall be parked for a period of 5 minutes with an applied operating pressure equal to 1-1/2 times (1.0 for helicopters) the maximum oparating pressure. The brake shall then be parked for a period of 5 minutes with an applied pressure of 5 psi. There shall be no measurable leakage (less than one drop) or permanent set during these tests. Deflection and permanent set measurements are not required for acceptance tests (see 4.4.6).

4.3.31.2 Dynamic leakage test. The brake shall be subjected to 25 cycles of the application and release of maximum operating pressure. Leakage at static seals shall not exceed a trace. Leakage at moving seals shall not exceed one drop of fluid per each 3 inches of peripheral seal length.

4.3.32 Static pressure test. The brake shall be parked for a period of 5 minutes with an applied operating pressure equal to twice the maximum operating pressure. The test shall be conducted with linings having a thickness comparable to the maximum permissible wear. There shall be no leakage or failure during this test. Pressure shall then be increased until failure occurs and the ultimate pressure shall be recorded.

4.3.33 Piston stops, and proof pressure-test. The piston stops and brake housing for carbon heat sinks shall demonstrate their ability to withstand one and one-half times the maximum operating pressure for 5 minutes without the brake discs installed. No deformation or performance degradation shall result.

4.3.34 Anti-skid compatibility testing. Dynamometer testing shall be conducted to determine the compatibility of the anti-sktd system when installed and the brake designed to this specification. As a minimum, dynamometer stops shall be run simulating wet and dry brake stack condition, wet and dry runway condition at both landing speed and one-half landing speed. Simulate aircraft hydraulic system. Run tests at high psi/sec application rate. The tests shall demonstrate full brake torque control for maximum runway friction under all conditions. A test plan must be coordinated with and be approved by the procuring activity before start of testing.

4.3.35 Anti-spin braking test. A wheel, brake and tire assembly shall be spun up to design landing speed, then unlanded and immediately apply the brake to stop the wheel. The onset pressure rise rate shall be the maximum designed for the system. The pressure shall be the maximum that can occur during the sequence of landing and takeoff. There shall be no permanent deformation or evidence of structural failure.

4.3.36 Brake return pressure. Tests shall be conducted before and after the endurance test (4.3.29) to determine the minimum hydraulic pressure, or force in the case of mechanical brakes, to bring the'braking surfaces into contact. Tests shall likewise be conducted to deteg-mine the minimum pressure or force at which the braking surfaces disengage on release of pressure. The tests shall be conducted with the brake mounted on the torque flange of a horizontal axle with the wheel assembled. The braking surfaces shall dis-engage on release of pressure at all pressures below that specified on the applicable design drawing.

4.3.37 Service test. The right is reserved to require suitable service tests of wheels, brakes or wheel-brake assemblies prior to granting of first article approval. This test will consist of a series of flight tests or taxi tests with the equipment Installed on the aircraft for which it was designed.

4.3.38 Maintainability demonstration. The contractor shall conduct a maintainability demonstration in accordance with this specification. The demonstration shall consist of a minimum of three disassemblies and reassemblies of the wheel assembly and brake assembly with the average time serving to determine compliance with the requirements of paragraph 3.3.15.1.2.

4.3.39 Reliability demonstration test. The 3000 mile roll test of paragraph 4.3.16 shall satisfy this requirement.

4.3.40 Disposition of test sample(s). The equipment tested shall be kept intact by the contractor until first article approval has been granted by the procuring activity. Disposition of the test samples shall be provided with first article test report approval.

4.3.41 Extreme temperature clearance analysis. The first article test procedure shall include a dimensional analysis proving that adequate clearance is available for all parts having relative motion at both temperature extremes under the most adverse dimensional combinations. This analysis shall be prepared so as to satisfy the adverse tolerance conditions and test fluid selection of MIL-H-8775.

4.4 Acceptance tests. Acceptance tests shall consist of (a) tests of materials arid parts, (b) tests of wheel assembles, and (c) tests of brake assemblies.

4.4.1 Responsibility. Acceptance tests shall be the responsibility of the contractor. Prior to delivery of all equipment, the contractor shall subject the equipment submitted for acceptance under this contract to the inspections and tests performed in accordance with contractor prepared test procedures as approved by procuring activity. A test shall be Included to test each individual self adjuster to contractor's established quality control push/pull-through-force limits to insure trouble-free operational service usage.

4.4.2 Acceptance test procedures. Acceptance tests shall be performed to verify that equipment supplied under the contract meet the requirements specified in Section 3, and are equivalent to the first article test equipment in all respects, including design, construction, workmanship, test, performance, and

quality. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of its acceptance in the finished product. All equipments shall have satisfactorily passed the applicable acceptance tests prior to delivery. No deliverable equipment shall have accrued more than 6 percent of its operating life (including all test and checkout time) when received by the procuring activity. If, during testing, 6 percent of the useful life of a limited life item is exceeded {based on the previously established replacement schedule) those items must be replaced prior to shipment to the procuring activity and a final functional performance check per paragraph 4.4 must be satisfactorily completed. Evidence-of non-compliance with the above shall constitute cause for rejection. For non-complying equipment already accepted, It shall be the obligation of the contractor to designate the necessary corrections and incorporate them after approval by the procuring activity.

4.4.3 Tests of materials and parts. Materials and parts used in the manufacture of wheels and brakes shall be subjected to the following tests.

4.4.3.1 Examination af product. Conduct examination of product as detailed in 4.3.9.

4.4.3.2 Materials test. Conduct tests detailed in 4.3.10."

4.4.4 Tests of wheel assemblies. Tests of wheel assemblies shall consist of Individual and sampling tests.

4.4.4.1 Individual tests. Each completed wheel assembly shall be subjected to the examination of product (see 4.3.9).

4.4.4.2 Sampling tests. Wheels shall be selected at random and inspected for runout as specified in the radial and lateral runout test (see 4.3.12) and for wheel pressure retention, where applicable, as specified in 4.3.11.

4.4.5 Tests of brake assemblies. Each completed brake shall be subjected to the following individual tests:

4.4.5.1 Examination of components. Each wheel and brake component shall be carefully examined to determine conformance to this specification with respect to material, workmanship, finish, dimensions, construction, surface conditions and marking. Non-destructive testing shall be accomplished in accordance with MIL-I-6870.

4.4.5.2 Functional and leakage test. Each complete brake submitted for acceptance shall be tested with fluid compatible with that specified for use on the aircraft. Alternate actuation media and processes may be used upon written authorization of the procuring activity. Each completed brake submitted for acceptance shall be subjected to a functional test for which written approval of the procedure has been received from the procuring activity. The brake shall be tested with hydraulic fluid for which the brake was designed.

4.4.5.2.1 Static leakage test. The brake shall be parked for a period of 5 minutes with an applied operating pressure equal to 1-1/2 times (1.0 for helicopters) the maximum operating pressure. The brake shall then be parked for a period of 5 minutes with an applied pressure of 5 psi. There shall be no measurable leakage (less than one drop) or permanent set during these tests. Deflection and permanent set measurements are not required.

4.4.5.2.2 Dynamic leakage test. The brake shall be subjected to 25 cycles of the application and release of maximum operating pressure. Leakage at static seals shall not exceed a trace. Leakage at moving seals shall not exceed one drop of fluid per each 3 inches of peripheral seal length.

4.4.5.3 Carbon heat sink test criteria. When carbon heat sink is used, the tests shall include the primary configuration carbon heat sink material consistency tests to assure uniformity in friction, wear, oxidation, density, strength, flexibility, etc., compared to the material initially qualified. Representa- tive samples from each manufacturing material lot or batch shall be submitted to tests similar to tests performed on the qualification material samples.

4.4.6 Fluids. Acceptance tests shall be conducted with fluids compatible with the seals, seal lubricants and design operating media. Upon completion of the tests, the excess fluid shall be drained, but a corrosion-preventive film of compatible oil or fluid shall be allowed to remain in the cylinders. (WARNING: In pneumatic components, do not use a material conducive to a "diesel explosion" hazard.) The cylinder shall then be suitably capped to prevent leakage of the preservative media.

4.5 Equipment failure. Should a failure occur during any of the acceptance or special tests specified herein, the following action shall be taken:

a. Immediately notify the procuring activity is representative.

b. Prepare a malfunction report noting suspected cause and submit to procuring activity.

c. Determine the cause of failure.

d. Determine If the failure is a recurring manufacturing problem or design deficiency.

e. Submit analysis to the procuring activity.

f. Submit to the procuring activity for approval the proposed corrective action intended to reduce the possibility of the same failure(s) recurring.

4.5.1 Corrective validation. When a failure occurs during the Acceptance Tests, the proposed-corrective action shall include a test to check all equipment for the noted non-conformance unti it has been determined that the defect has been satisfactorily corrected.

4.6 Similarity. Wherever adequate factual data exists demonstrating similarity of design and requirements, this data shall be utilized to minimize the test program (see 3.3.13).

4.7 Rejection and retest. Equipment which has been rejected may be reworked or have parts replaced to correct the defects and be resubmitted for acce[tamce/ Before resubmittal, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished to the procuring activity for approval. After corrections have been made, all tests deamed necessary by the procuring activiity shall be repeated.

4.7.1 Defects in items already accepted. When investigation of a test failure indicates that like defects exist or could exist or could exist in items already accepted, the contractor shall so advise the procuring activity, designate the necessary corrective action(s), and incorporate them after approval by the procuring activity.

4.8 Conformace to test samples. It is to be understood that wheel or brake assemblies supplied under contract shall be identical to or completely interchangeable with samples tested and found satisfactory, except that:

a. Minor changes in drawings, parts or materials may be made without prior approval of the procuring activity, provided they do not adversely affect the strength, performance, interchangeability, weight, or material physical properties of the part or assembly. Notice of such changes should be submitted to the government inspector for information. The right is reserved to disapprove any such changes which are considered to adversely affect the above-mentioned characteristics.

b. Other changes for first article samples should not be made without prior approval of the procuring activity.

5. PACKAGING

5.1 Preservation and packaging. Preservation and packaging of wheel and brake assembles shall be level A and C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Wheel assembly pakcaging. Each wheel assembly shall be cleaned, preserved and packaged in accordance with MIL-P-116, Method I, utilizing preservation compounds P-2 or P-6 on all exposed metal surfaces susceptible to corrosive deterioration.

5.1.1.1.1 Bearing preparation and lubrication. All antifriction bearing parts and retainer parts which are not pressed into operating position prior to assembly shall be thoroughly cleansed, then packed with grease specified in 3.3.8.1.6 to protect the item against corrosion in storage. The installed components shall be ready for operation without additional cleaning or greasing. The cones assembled in place shall be secured therein by hub caps

or grease retainers. The retaining components shall be free of all contamination and moisture. Each assembled bearing shall be covered on both sides by moisture impervious closures or seals. Whenever applicable, chemically neutral, greaseproof barrier material conforming to MIL-B-121, Grade A, shall be used in direct contact with the bearing. Where both bearing hubs are joined in lieu of other interior closures or seals, the entire hub cavity may be fitted with cellulosic wadding conforming to PPP-C-543, Type II, Class A or B, wrapped or bagged within chemically neutral greaseproof paper. The greaseproof side of the paper shall always be exposed to the grease.

5.1.1.1.2 Packing of Wheel assembly. The cleaning, preservation, greasing, assembly and sealing of the bearings of the wheels shall be done in succession with a minimum of delay. The possibility of contamination of the wheel components shall be concluded during these operations. Where excessive motion of the cone might break the bearing seal, plywood or fiberboard shall be used to supplement blocking of the bearing seal. The blocking and hub caps shall be securely attached to the wheel by any suitable mechanical means. Each preserved wheel shall be packed within a fiberboard container conforming to PPP-B-636, Type CF, Class domestic. The container shall be sealed in accordance with the instructions in the appendix thereto. Wheels in excess of 90 pounds, preserved and wrapped as specified, shall be packed directly into shipping containers.

5.2.1.2 Brake assembly.

5.2.1.2.1 Piston-actuatoed type. Each brake assembly shall be cleaned, preserved and packaged in accordance with MIL-P-116, Method I, utilizing P-2 and P-6 preservative compounds on all external metal surfaces which are susceptible to corrosive deterioration. Preventive measures shall be instituted to preclude the preservative compounds from coming in contact with the braking surfaces. Each brake assembly shall be wrapped in chemically neutral, greaseproof barrier material conforming to MIL-B-121 (or barrier material of equivalent protective value) and secured with pressure sensitive tape conforming to PPP-T-60 or PPP-T-76. The greaseproof side of the barrier material shall be exposed to the greased surfaces of the item. Each brake assembly shall then be unit packaged with a fiberboard container conforming to PPP-B-636, Type CF, Class domestic. The container shall be sealed in accordance with the instructions in the appendix thereof. Piston-actuated brake assembles in excess of 90 pounds, preserved and wrapped as specified, shall be packed directly into shipping containers.

5.2.1.2.2 Expander tube actuated type. Each brake assembly shall be cleaned and packaged in accordance with MIL-P-116, Method III. The nozzle inlet shall be suitably plugged or capped to prevent the entry of foreign matter. The brake assembly shall be wrapped with a chemically neutral barrier material conforming to MIL-B-121 (or barrier material of equivalent protective value) and secured with pressure sensitive tape conforming to PPP-T-60 or PPP-T-76. Each brake assembly shall be unit packaged within a fiberboard container conforming to PPP-B-636, Type CF, Class domestic. The container shall be sealed in accordance with the instructions in the appendix thereof. Expander tube brake assembles in excess of 90 pounds, preserved and wrapped as specified, shall be packed directly Into shipping containers.

5.2.2 Level C. Preservation and packaging shall be such as to afford protection and prevent deterioration or damage, to a degree which is adequate, but not in excess, during shipment under normal environmental conditions and commercial modes of transportation.

5.3 Packing. Packing shall be Level A, B or C in accordance with MIL-STD-2073 (see 6.2).

5.4 Marking. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. Marking of unit and shipping containers shall include the date of manufacture.

6. NOTES

(This section contains Information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification is intended for use by wheel and brake manufacturers in the design, fabrication and testing of wheels and brakes for military aircraft (GFE). This specification is also intended as a guide for airframe manufacturers to prepare procurement documents for contractor-furnished wheel and brake equipment (CFE).

6.2 Ordering data

6.2.1 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).

c. When applicable, the part numbers, size and materials of wheels and brakes to be furnished.

d. Whether the assembles are for amphibious or beaching gear.

e. Whether or not the wheel is a tubeless, tube type, or convertible wheel; whether wheel seal and valve assembly are to be furnished (see 3.3.8.1.1).

f. Operational service life (see 3.3.14.1).

g. Design proposal drawings should be submitted for engineering approval prior to contract awards and Interface component drawings 60 days after approval of design proposal drawings (see 3.3.24).

h. The number and specific assembly(ies) comprising the first article test samples and where they should be sent, the activity responsible for testing, and instructions concerning the submittal of the test reports (see 4.3.2, 4.3.6 and 4.3.7). The schedule shall be:

Item	Submittal Time
Test procedures document	45 days prior to first article test. Government will respond in 30 days. Tests to start in 45 days or on receipt of approval. whichever is earlier.
First article test report	60 days after completion of tests. Government will respond in 30 days.
Stress and thermal analysis	90 days after approval of first article test report.
Interim progress report	If the first article tests extend beyond 45 calendar days from the start, an interim progress report should be published and every 30 days that the test effort Continues.
Extended roll test data report	180 days after receipt of approval of the original test report (or as approved by the procuring activity).

1. Submission of data (see 6.2.2).

j. Special tire pressure for shipboard operations (see 4.3.13).

k. Special radial load angle (see 4.3.13.3).

l. Number of landings for service life spectrum (Table II, Note A).

m. Level of preservation, packaging and packing (see 5.1).

n. Carbon heat stock refurbishment plan (see 3.3.8.2.9.2).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9(n)(2) are invoked and the DD Form 1423 Is not used, the data specified below shall be delivered by the contractor in accordance. with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs:

Reference Number	DID Number	DID Title	Suggested Tailoring
3.2.1.1.4.11	DI-MISC-80711	Scientific and Technical Report	
3.2.1.2.1 (when applicable)	DI-NDTI-80566	Test Plan	
3.2.1.3	DI-E-3131	Material Specification	
3.3.6.1	DI-MISC-80711	Scientific and Technical Report	
3.3.7.1.2.1	DI-MISC-80711	Scientific and Technical Report	
3.3.10.1	DI-GDRQ-81029	Deck Strength Limitation Data Report	
3.3.15.1.1	DI-MNTY-80822	Maintainability Program	
3.3.15.1.2.2	DI-MNTY-80822	Maintainability Program	
3.3.15.1.2.3	DI-MNTY-80822	Maintainability Program	
3.3.15.2.3	DI-ILSS-80118	Support Equipment Recommendation Data (SERD)	
3.3.17	DI-MISC-80711	Scientific and Technical Reports	
3.3.18	DI-MISC-80711	Scientific and Technical Reports	
3.3.24.1	DI-DRPR-81000	Product Drawing and Associated Lists	
3.3.24.2	DI-DRPR-81000	Product Drawing and Associated Lists	
3.3.26.3	DI-MISC-80711	Scientific and Technical Reports	
4.3.1	DI-NDTI-80566	Test Plan	
4.3.6	DI-NDTI-80566	Test Plan	

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.3.23	DI-NDTI-80566	Test Plan	
4.4.1	DI-NDTI-80566	Test Plan	
4.3.7	DI-MISC-80711	Scientific and Technical Report	
4.3.14	DI-MISC-80711	Scientific and Technical Report	
4.3.34	DI-NDTI-80566	Test Plan	
4.3.19	DI-R-5299	Failure Analysis and Corrective Report	
4.5	"	"	
4.7	"	"	
4.7.1	"	"	
3.2 3.2.1.1.4.1.b 3.2.1.1.4.1.h 3.2.1.1.6 3.2.2.4 3.2.2.6.1 3.2.2.6.2 3.2.3.2 3.2.4.1.4 3.2.4.1.5 3.2.4.3 3.2.4.3.3 3.2.4.4 3.2.4.6 3.3.8.1.8.1 3.3.8.1.8.4	DI-CMAN-80641 " "	Request for Waiver " "	

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.3.8.1.9	DI-CMAN-80461	Request for Waiver	
3.3.8.2.3			
3.3.23.1			
3.3.23.3			
3.3.23.6			
4.3.10.2			
4.3.16.5			
4.3.17	"	"	
4.3.20			
4.3.29			
4.3.30.1			
4.3.31			
4.4.2			
4.8b			

(Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 First article When a first article is required for inspection and approval (see 3.1, 4.2 and 6.2).

6.4 Definitions.

6.4.1 Design drawings. The terms specification control drawing" or "applicable design drawing" referred to in this specification will be interpreted as meaning the design drawing prepared by and available from the contractor.

6.4.2 Failure. A failure is the inability of the equipment to perform its required function within the specified conditions for a specified duration.

6.4.3 RTO. Rejected take-off.

6.4.4 Miles. Statute miles.

6.4.5 Clarification of termigolgy. The following terms shall be read as if followed by the phrase "in accordance with all requirements of this specification:

a. Operate.

b. Operating.

c. Operation.

6.4.6 Normal operating pressure. Normal operating pressure will be Interpreted as meaning that pressure, or mechanical force in the case of mechanical brakes, required to produce an aircraft deceleration in accordance with the procurement document, as determined by an average of pressure measurements in landplane landing design gross weight tests specified in 4.3.19.

6.4.7 Normal parking pressure. Normal parking pressure will be interpreted as meaning that pressure, or mechanical force in the case of mechanical brakes, required to lock the wheel at a load equal to the rated static load specified for the wheel on the applicable design drawing, assuming a coefficient of friction of 0.31 between the tire and the ground.

6.4.8 Minimum operating pressure. Maximum operating pressure will be Interpreted as meaning that pressure, or mechanical force in the case of mechanical brakes, required to lock the wheel at a load equal to the rated static load specified on the applicable design drawing, assuming a coefficient of friction of 0.55 between the tire and the ground or the maximum pressure required to conduct the specified dynamic torque test, whichever is greater. For helicopters, the maximum operating pressure is the pressure required to hold the helicopter on a 20° slope, or as otherwise specified, or the maximum pressure required to conduct the specified dynamic torque tests, whichever is the greater.

6.4.9 Weights and speeds. The weight conditions specified in Table I and related speeds are defined in the MIL-A-8860 series.

6.4.10 Loads. For the purpose of load testing, the following definitions will apply:

a. Limit load: The maximum load anticipated in all normal conditions of operation as determined by the procuring activity. It shall be not less than the load determined by utilizing MIL-A-8860 series specifications.

6. Yield load: 1.15 times the limit load.

c. Design ultimate load: 1.5 times the limit load.

d. Design landing loads will be as determined by the procuring activity in accordance with the load conditions of MIL-A-8863.

6.5 International agreement. Certain provisions, identified by 3.3.8.1.1 and 3.3.8.1.8 of this specification, are the subject of international standardization agreements ASCC 17/6, ASCC 17/14, and STANAG 3209. When amendment, revision or cancellation of this specification is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.6 Subject term (kyword) listing.

Decks, flight
Gear, landing
Interface, platform
Systems, landing
T i r e s

6.7 Changes from previous issue The margins of this specification are

tions, corrections, deletions) from the previous issue were made. This was done as a convenience only and the government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the content Irrespective of the marginal notations and relationships to the last previous issue.

Custodian:
Navy - AS
Army - AV
Air Force - 99

Review activities:

Preparing Activity:
Navy - AS
Project No. 1630-0340

INDEX

INDEX (continued)

INDEX (continued)

INDEX (continued)

INDEX (continued)

INDEX (continued)

INDEX (continued)

INDEX (continued)