

INCH-POUND

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## PERFORMANCE SPECIFICATION

### COUPLINGS, REGULATED, AERIAL PRESSURE REFUELING TYPE MA-2, TYPE MA-3 AND TYPE MA-4

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

#### 1. SCOPE

1.1 Scope. This specification covers regulated, refueling couplings for use by tanker aircraft for refueling other aircraft using the probe and drogue method of aerial refueling.

1.2 Classification. The couplings are of the following types (see 6.2).

1.2.1 Types. The types of couplings are as follows:

Type MA-2: These couplings have no pressure regulation or surge suppression capability.

Type MA-3: These couplings incorporate a single fuel pressure regulation mechanism.

Type MA-4: These couplings incorporate dual, redundant fuel pressure regulation mechanisms.

#### 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division, Code 41K000B120-3, Highway 547, Lakehurst, NJ 08733-5100 or emailed to [michael.sikora@navy.mil](mailto:michael.sikora@navy.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

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been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

## 2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

### FEDERAL STANDARDS

FED-STD-595 - Colors Used in Government Procurement  
Color Number: 17875

### DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys

MIL-DTL-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-PRF-7024 - Calibrating Fluids, Aircraft Fuel System Component

MIL-S-7742 - Screw Threads, Standard Optimum Selected Series, General Specification for (Inactive for New Design)

MIL-I-8500 - Interchangeability and Replaceability of Component Parts for Aerospace Vehicles

MIL-A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys

MIL-PRF-23377 - Primer Coatings: Epoxy, High-Solids

MIL-N-25161 - Nozzle, Aerial Pressure Refueling, Type MA-2

MIL-DTL-27426 - Rings, Retaining, Spiral (Uniform Cross Section)

MIL-DTL-31000 - Technical Data Packages

MIL-PRF-81352 - Coatings, Aircraft Touch-up

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- MIL-DTL-83133 - Turbine Fuels, Aviation, Kerosene Type, NATO F-34 (JP-8), NATO F-35, and JP-8+100
- MIL-PRF-85285 - Coating: Polyurethane, Aircraft and Support Equipment

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-129 - Military Marking for Shipment and Storage
- MIL-STD-130 - Identification Marking of U.S. Military Property
- MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests
- MIL-STD-889 - Dissimilar Metals
- MS24354 - Drogue Cone, Nozzle and Reception Coupling - Type MA-2, Flight Pressure Refueling System, Assembly of. (Inactive for New Design)
- MS24355 - Coupling, Reception-Type MA-2, Flight-Pressure-Refueling, Assembly of (ASG). (Inactive for New Design)
- MS24356 - Nozzle-Type MA-2, Flight Pressure Refueling (ASG). (Inactive for New Design)
- MS24358 - Fitting, Hose End-Type MA-2, Flight Pressure Refueling, Reception Coupling, Outline Dimensions for. (Inactive for New Design)
- MS24361 - Ring, Split-Type MA-2, Flight Pressure Refueling, Reception Coupling. (Inactive for New Design)
- MS24362 - Sleeve-Type MA-2, Flight Pressure Refueling, Reception Coupling. (Inactive for New Design)

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch> or <http://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg 4D, Philadelphia, PA 19111-5094.)

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2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

- NASM 20995 - Wire, Safety or Lock
- NASM 25027 - Nut, Self-locking, 250 Degrees Fahrenheit, 450 Degrees Fahrenheit, and 800 degrees Fahrenheit
- NASM 33540 - Safety Wiring and Cotter Pinning
- NASM 33588 - Nut, Self Locking, Aircraft, Reliability And Maintainability Usage Requirements for

(Copies of these documents are available online at <http://www.aia-aerospace.org> or from the Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)  
INTERNATIONAL

- ASTM-D471 - Rubber Property - Effects of Liquids
- ASTM-D910 - Gasolines, Aviation
- ASTM-D1655 - Aviation Turbine Fuels

(Copies of these documents are available online at <http://www.astm.org> or from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME-B46.1 - Surface Texture (Surface Roughness, Waviness and Lay)
- ASME-Y14.100 - Engineering Drawing and Related Documentation Practices

(Copies of these documents are available online at <http://www.asme.org> or from the American Society of Mechanical Engineers, P.O. Box 2300, Fairfield, NJ 07707-2300.)

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GOSUDARSTVENNYE STANDARTY STATE STANDARD (GOST-Russian)

GOST 10227 (TS-1) - Fuels for Jet Engine Specifications

(Copies of this document are available from GOST Interstandard, 117049 Moscow, B-49 Russia, Attn: Mr. Nickolay Usov, [nusov@gost.ru](mailto:nusov@gost.ru) or in English from [ihs.com](http://ihs.com).)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) INTERNATIONAL

- SAE-AS568 - O-Rings, Aerospace Size Standard for, - Method
- SAE-ARP868 - Fuel System Components, Pressure Drop Tests for, - Method
- SAE-AMS1424 - Fluid, Deicing/Anti-Icing, Aircraft, SAE Type 1
- SAE-AMS1428 - Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian, (Pseudoplastic), SAE Types II, III, and IV
- SAE-AMS2175 - Casting, Classification and Inspection of
- SAE-AMS2447 - Coating, Thermal Spray, High Velocity, Oxygen/Fuel Process
- SAE-AS5202 - Port or Fitting End, Internal Straight Thread
- SAE-AMS7259 - Rings, Sealing, Fluorocarbon (FKM) Rubber High-Temperature-Fluid Resistant Low Compression Set 85-95
- SAE-AS8879 - Screw Threads-UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter
- SAE-AMS-R-25988 - Rubber, Fluorosilicone Elastomer, Oil and Fuel Resistant, Sheets, Strips, Molded Parts, and Extruded Shapes
- SAE-AS29513 - Packing, Preformed, Hydrocarbon Fuel Resistant, O-Ring
- SAE-AMS-R-83485 - Rubber, Fluorocarbon Elastomer, Improved Performance at Low Temperatures

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(Copies of these documents are available online at <http://www.sae.org> or from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15090.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, (except for related specification sheets), 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 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. The couplings furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.4 and 6.3).

3.3 Components. The coupling shall consist of an assembled unit conforming to the envelope shown on figure 1 for MA-3 and MA-4 couplings and conforming to MS24355 for MA-2 couplings. Attachment parts (MS24358, MS24361, MS24362, SAE-AS29513, and a spiral retaining ring conforming to MIL-DTL-27426) are not considered a portion of the coupling. Installation features of these attachments are shown on MS24354.

#### 3.4 Materials.

3.4.1 Fluid resistance. All materials used in the construction of the coupling shall be resistant to the following fluids:

- a. Jet fuels conforming to MIL-DTL-5624, MIL-DTL-83133 and GOST 10227 (TS-1).
- b. Jet-A, Jet-A1, Jet-B, and other commercially available turbine fuels conforming to ASTM-D1655.
- c. NATO fuels F-34, F-35, F-37, F-40, and F-44.
- d. Test fluids conforming to MIL-DTL-5624, ASTM-D471, Types I and III, and MIL-PRF-7024 Type II.
- e. Deicing fluid conforming to SAE-AMS1424 and SAE-AMS1428.

3.4.2 Corrosion-resistant materials. All materials shall be corrosion-resistant or treated to resist corrosion from fuels, salt spray, and atmospheric conditions to be encountered in storage or

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normal service.

3.4.2.1 Protective coatings. Protective coatings shall not chip or flake and shall prevent deterioration of the base material under all conditions of service, especially those conditions where high concentrations of salt may be encountered. Aluminum alloy parts shall be anodized in accordance with MIL-A-8625 or chemical conversion coated per MIL-DTL-5541. Flame coating may be used in accordance with SAE-AMS2447. Painted surfaces shall not be allowed as a protective coating unless specified in 3.6.10. Cadmium and chromium coatings shall not be used.

3.4.3 Prohibited materials. Magnesium, chromium, zinc, cadmium, and copper or their alloys shall not be used. Teflon shall not be used in any location where impact loads may be encountered. Except for identification markings on couplings as specified in 3.6.10, paint shall not be used.

3.4.3.1 Age-sensitive materials. Age-sensitive materials shall not be used, except those specified in 3.6.1.

3.4.4 Castings. Castings shall be clean, sound, and free from holes, porosity, cracks, and other defects. Castings shall be classified in accordance with SAE-AMS2175, Class 1, Grade C, but all critical (load bearing) castings shall be Class 1, Grade B.

3.4.5 Dissimilar metals. Dissimilar metals, as specified in MIL-STD-889, shall not be used in contact with each other unless protected against electrolytic corrosion.

3.5 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected by standard commercial practices or as specified in the contract.

3.6 Flight/ground test. The contract shall specify the requirements for laboratory and flight tests for final U.S. approval of the coupling.

3.7 Construction. The coupling shall be designed to prevent incorrect assembly. It shall be constructed so that no parts will work loose during shipment, storage, or operational use. The unit shall be constructed to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and use.

3.7.1 O-rings, packing, and seals. O-rings, packing, and seals shall conform to SAE-AS568, SAE-AMS-R-25988, SAE-AMS-R-83485, or SAE-AMS7259. Their design and construction shall be such as to ensure maximum protection against leakage and damage due to friction.

3.7.2 Threaded parts. Screw threads shall conform to MIL-S-7742 or SAE-AS8879. Pipe

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threads shall not be used.

3.7.2.1 Locking of threaded parts. All threaded parts shall be positively locked by safety wiring, self-locking nuts, or other approved methods. Safety wiring shall conform to NASM20995 and shall be installed in accordance with NASM33540. Self-locking nuts shall conform to NASM25027 and shall be used in accordance with NASM33588. The use of lock washers, set screws, cotter pins, or staking shall not be permitted unless specifically approved by the qualifying activity.

3.7.3 Weight. Maximum weight of the couplings without the fairing shall be as follows:

- a. MA-2 couplings shall not weigh more than 18 pounds.
- b. MA-3 couplings shall not weigh more than 18 pounds.
- c. MA-4 couplings shall not weigh more than 22 pounds.

3.7.4 Finishes. The coupling finish shall be smooth and free from sharp edges. Surface roughness, indicated on figure 1, sheet 1 of 3, shall be as specified in accordance with ASME-B46.1.

3.7.5 Reliability. The coupling shall be designed and constructed in a manner that will ensure the highest degree of operational reliability under all service conditions when operating with any qualified nozzle.

3.7.6 Maintainability. The coupling shall have the minimum number of parts consistent with reliability. It shall permit easy assembly, disassembly, and location of trouble sources. It shall be maintained with tools and equipment normally available commercially by service maintenance personnel with a minimum of training.

3.7.7 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable in accordance with MIL-I-8500. The item identification and part number requirements of ASME-14.100 shall govern the manufacturer's part numbers and changes thereto.

3.7.8 Dimensions. MA-2 coupling dimensions shall be in accordance with MS24355. Coupling dimensions for MA-3 and MA-4 couplings shall be in accordance with figure 1.

3.7.9 Lubrication. The coupling shall operate satisfactorily without requiring lubrication, other than the fluid being transferred.

3.7.10 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130. The identification shall be permanent and shall



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not peel off, crack, or loosen with age, environmental conditions, or damage resulting from aerial refueling operations. The location selected for markings shall not affect the performance of the coupling. The external surface of the coupling housing shall be identified with one coat of epoxy primer conforming to MIL-PRF-23377, and two coats of either acrylic lacquer in accordance with MIL-PRF-81352 or polyurethane in accordance with MIL-PRF-85285; color as specified in FED-STD-595, color number 17875 (gloss white). A contrasting paint color to the white background shall be used for the lettering product identification. On the casting the following identification information should be found: part number, serial number, latch force settings, and pressure regulator settings.

3.7.11 Workmanship. The coupling shall be uniform in quality, clean, and free from defects. Attention shall be given to neatness and thoroughness of assembly, alignment of parts, tightness of assembly, and removal of burrs.

3.8 Design. The coupling shall conform to figure 1 and be compatible with aerial refueling nozzles conforming to MIL-N-25161 to accomplish fuel transfer in flight at inlet pressures up to 120 psig. MA-3 and MA-4 couplings shall provide surge pressure protection for the receiver aircraft along with steady state pressure control to prevent excessive pressures from entering the receiver during refueling. This shall be accomplished by means of pressure regulating mechanisms integral to the coupling; a single mechanism in the case of MA-3 couplings, while the MA-4 couplings shall incorporate dual, redundant mechanisms. The failure of either mechanism in MA-4 couplings shall not prevent the coupling from providing pressure regulation and surge control as specified.

3.8.1 Regulator operation. MA-3 and MA-4 couplings shall be compatible with current ground support equipment, unless agreed upon by the purchasing agency. Current ground support equipment allows for ambient pressure sensing ports, three or four with circumference spacing 120° for 3 ports and 90° for 4 ports, for each pressure regulation device. Each set of vent ports shall be equipped with a boss in accordance with SAE-AS5202 to allow a fuel line connection and plugs to be attached so that fuel pressure can be applied to one of the ambient sensing ports, thereby causing the regulation device to remain open and inactive. The couplings shall also be equipped with a fuel pressure sensing port downstream from the internal regulation mechanisms. This port may be used as the fuel pressure source in lieu of the nozzle outlet pressure during ground testing of the regulator(s). The regulation devices shall be designed so that, in the event of a failure, they shall remain open and shall permit fuel transfer.

3.8.1.1 Regulation capability (MA-3 and MA-4 couplings). The coupling outlet pressure shall be regulated within the limits shown below over the flow range of 10 cubic centimeters per minute (cc/min) to 600 gallons per minute (gpm). An SAE-AS5202 port shall be provided to measure toggle cavity regulated pressure. MA-4 couplings shall meet this requirement with either regulator inactive (the regulated pressure may be different for each regulator).

- a. For flow rates of 1 gpm to 600 gpm, if the inlet pressure is greater than the pressure drop

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+55 psig, the regulated outlet pressure shall be  $50 \pm 5$  psig.

b. With inlet pressures up to 120 psig at a flow rate of 10 cc/min to 600 gpm, the regulated outlet pressure shall be not greater than 60 psig at flow rates between 10 cc/min and 1 gpm, or 55 psi at flow rates greater than 1 gpm, unless stated otherwise in the contract.

c. With a flow rate of 600 gpm and cycled inlet pressure rates from 60 to 100 psig, the outlet pressure shall be not greater than 60 psig with no external leakage and shall pass the functional test.

d. With an inlet pressure of 60, 80, and 100 psig and a flow rate below 10 cc/min, the regulated outlet pressure shall not increase greater than 10 percent of the inlet pressure.

3.8.1.1.1 Relief valves (MA-3 and MA-4 couplings). Regulator designs, which allow trapping of high pressures within the coupling that could hamper engagement, shall be provided with an internal pressure relief system to dissipate the trapped pressure within 10 seconds.

3.8.1.1.2 Pressure sensing ports (MA-3 and MA-4 couplings). Internal cavities, which join the ambient pressure sensing ports, shall drain when the coupling is in the stowed horizontal position so that any accumulated water condensate shall not, when frozen, render the regulator inoperative.

3.8.1.2 Surge suppression (MA-3 and MA-4 couplings). The coupling shall be capable of suppressing surges without sustaining damage. Surge pressure peaks recorded downstream of the coupling within 30 inches of the MA2 nozzle interface to the probe shall be not greater than 120 psig. Outlet pressures shall equalize within 10 seconds. MA-4 couplings shall meet these requirements with either regulator inactive.

3.8.2 Alignment. The coupling shall incorporate a ball joint having a range of movement within a 45-degree or greater included angle cone, the centerline of which shall coincide with the centerline of the coupling. The ball joint action shall facilitate alignment with an MA-2 nozzle and shall permit 360 degrees of rotation of the coupling body when engaged with an MA-2 nozzle. Body rotation shall not be restricted by the nozzle design. The force required to move the coupling ball (without fuel pressure) throughout the complete range of movement shall be not greater than 20 pounds as applied to the coupling outlet flange. The force required to rotate the body about the ball joint shall be not greater than 50 ft-lbs with a 100-pound radial load applied to the outlet flange.

### 3.8.3 Latching mechanisms.

3.8.3.1 Engagement. The force required to engage couplings of all classes with an MA-2 nozzle having a 50-pound sleeve force shall be not greater than 155 pounds with a 0 to 10 psig static fuel pressure in the coupling.

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3.8.3.2 Disengagement. The latching mechanisms (3 minimum) shall be such that the force required to disengage the nozzle from the MA-3 and MA-4 couplings is adjustable between 300 and 550 pounds (300 and 800 lbs for MA-2 couplings) with zero psig fuel pressure in the coupling, and without change or addition of components. The force required to disengage the nozzle shall increase at the rate of  $4 \pm 0.5$  pounds for each 1.0 psi increase in regulated pressure at any fixed adjustment. The coupling shall not disengage when subjected to a surge pressure of 120 psig (receiver side of coupling). Unless otherwise specified by the qualifying activity, the setting of the latching mechanism shall be  $320 \pm 20$  pounds with zero psig fuel pressure. Under these conditions, the disengagement force at 50 psi shall be  $520 \pm 45$  pounds. The force to separate the nozzle from the coupling (with 10 psig or 50 psig of fuel pressure) with a toggle setting of both  $320 \pm 20$  lb. and  $520 \pm 45$  lb. shall be not greater than 830 lb. when the disconnect angle of the ball joint is at the  $22.5^\circ$  position.

3.8.4 Operating and proof pressure. The coupling shall be able to withstand a minimum hydrostatic operating pressure of 120 psig with no external leakage, deformation, or structural failure. The coupling shall also withstand a minimum internal hydrostatic proof pressure of 230 psig with no external leakage, deformation, or structural failure. Once this test is complete the coupling shall pass the leakage tests of 4.8.5 and the functional tests of 4.8.14.

During flowing disconnects, very short duration surge pressure spikes at the inlet of the coupling will greatly exceed the proof pressure limits specified above. The coupling shall be capable of withstanding these short duration, elevated surge pressure spikes.

3.8.5 Leakage and spillage. The leakage and spillage shall be allowed as follows:

a. When the engaged MA-3 and MA-4 couplings and nozzle are subjected to fluid flow rates up to 600 gpm (1200 gpm for MA-2 couplings) and a constant inlet pressure of  $120 \pm 2$  psig ( $60 \pm 2$  psig for MA-2 couplings), there shall be no evidence of external leakage.

b. When the engaged coupling and nozzle are subjected to an inlet fluid pressure of  $120 \pm 2$  psig and a fluid flow of 100 to 600 gpm, the spillage shall be not greater than 100 cc (25 cc for MA-2) per disengagement.

c. When the coupling is engaged and disengaged on a nozzle with an inlet fluid pressure of 10 psig, spillage shall be not greater than 25 cc per engagement or disengagement.

3.8.6 Pressure drop. The pressure drop through the couplings shall be as follows:

a. MA-2 couplings: The total pressure drop through the engaged nozzle and coupling shall be not greater than 3 psig at 600 gpm or 12 psig at 1,200 gpm.

b. MA-3 and MA-4 couplings: The total pressure drop through the engaged nozzle and

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coupling shall be not greater than 21 psig at 600 gpm for MA-3 couplings and 34 psig at 600 gpm for MA-4 couplings.

3.8.7 Fuel resistance and extreme temperature. The coupling shall function after exposure to extreme temperatures specified in table I. After exposure to  $158 \pm 2$  °F the coupling shall function properly. It shall pass the functional tests of 4.8.14 and leakage tests of 4.8.5.

3.8.8 Contaminated fuel. The coupling shall function after exposure to contaminants specified in table II. After exposure to the contaminants, the coupling shall pass the regulation tests of 4.8.1 (MA-3 and MA-4 couplings only), the leakage tests of 4.8.5, and the functional tests of 4.8.1.4.

3.8.9 Normal operating loads. The coupling shall be subjected to the following loads and have no deformation and pass the leakage tests of 4.8.5 and functional tests of 4.8.14.

- a. A 1,500-pound tension load in combination with a 3,000-pound radial load (1,000 lb radial load for MA-2 couplings).
- b. A 2,500-pound compression load with a 3,000-pound radial load.
- c. A 2,000-pound tension load (MA-3 and MA-4 couplings).
- d. A 2,500-pound compression load.
- e. A 3,000-pound radial load.

3.8.10 Ultimate (burst) pressure. The coupling shall withstand a hydrostatic pressure of 180 psig with no deformation, no structural failure, or no leakage sufficient to cause a pressure drop. The coupling shall also withstand an internal hydrostatic burst pressure of 360 psig with no permanent deformation, no structural failure, or no leakage sufficient to cause a pressure drop. Once this test is complete the coupling shall pass the functional tests of 4.8.14 and the leakage tests of 4.8.5.

3.8.11 Nozzle-coupling compatibility. The coupling shall be compatible with all nozzles on the current Qualified Products List, QPL-81975. The coupling shall engage the nozzle with no hang-ups or excess torque.

3.8.12 Altitude (MA-3 and MA-4 couplings). When the ambient coupling pressure is reduced to 8.5 inches of mercury absolute (HgA), the coupling's regulated outlet pressure shall not decrease greater than 15 psi, and there shall be no measurable leakage of fuel from the ports.

3.8.13 Environmental requirements. The coupling shall pass environmental testing to verify that the coupling functions in the working environment it will be exposed to.

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TABLE I. Fuel resistance and extreme temperature tests.

Test Period and Duration <u>1/</u>	Test Fluid and Temperature	Operation During Period	Operation and Tests Immediately After Period
Phase I - Soak <u>2/</u> (Coupling disengaged during first 72 hours, engaged with nozzle last 24 hours)  96 hours	ASTM-D471, Type III 158 $\pm$ 2 °F	Engage nozzle with coupling every 6 hours. At no time during the test shall the force to engage nozzle be greater than 155 pounds.	Perform functional tests of 4.8.14 using ASTM-D471, Type III.
Phase I - Dry (Coupling only, drained and blown dry)  24 hours	Circulating air at 158 $\pm$ 2 °F	None	Perform functional tests of 4.8.14 using ASTM-D471, Type I.
Phase II - Soak <u>2/</u> (Coupling and nozzle disengaged)  18 hours	ASTM-D471, Type III 158 $\pm$ 2 °F	Engage nozzle with coupling every 6 hours. At no time during the test shall the force to engage nozzle be greater than 155 pounds.	Perform functional tests of 4.8.14 using ASTM-D471, Type III.
Phase II - Dry (Coupling only, drained and blown dry)  30 hours	Circulating air at 158 $\pm$ 2 °F	None	Perform functional tests of 4.8.14 using ASTM-D471, Type I.
Phase III - Soak <u>2/</u> low temperature (Coupling and nozzle disengaged)  18 hours	ASTM-D471, Type I -67 $\pm$ 2 °F		Maintaining the ambient air and fluid temperature at -67 $\pm$ 2 °F, the nozzle shall be engaged with the coupling and examined for external leakage while maintaining the pressure conditions of 4.8.14c for 15 minutes. There shall be no leakage. With the ambient temperature and test fluid at -40 $\pm$ 5 °F, the nozzle shall be engaged

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TABLE I. Fuel resistance and extreme temperature tests - Continued.

Test Period and Duration <u>1/</u>	Test Fluid and Temperature	Operation During Period	Operation and Tests Immediately After Period
Phase III - Soak (Continued)			and disengaged from the coupling 50 times. During this test, a fluid pressure of 10 psig shall be maintained in the coupling and nozzle. Upon completion, there shall be no leakage after 15 minutes at 2 and 60-psig pressure in the engaged and disengaged condition. The total leakage shall be recorded.

1/ Each period shall follow immediately after the preceding one in the order noted.

2/ During periods of soaking in the test fluid, the coupling shall be filled with the test fluid in such a manner as to ensure complete contact of all parts with the fluid as would be expected under service conditions.

3.8.13.1 Salt water immersion. After immersion and heating cycles, the coupling shall pass the functional tests of 4.8.14 and the leakage tests of 4.8.5. Corrosion, which could cause malfunction of the coupling or contamination of the aircraft fuel system, shall be cause for rejection.

3.8.13.2 Salt fog. After exposure to salt fog, the coupling shall pass the functional tests of 4.8.14 and the leakage tests of 4.8.5. Corrosion, which could cause malfunction of the nozzle or contamination of the aircraft fuel system, shall be cause for rejection.

3.8.13.3 Sand and dust. The coupling shall function after exposure to both sand and dust and pass the functional tests of 4.8.14 and the leakage tests of 4.8.5.

3.8.13.4 Vibration. The coupling shall pass the functional tests of 4.8.14 and the leakage tests of 4.8.5 after being exposed to the test curve on figure 3.

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TABLE II. Contaminant mixture.

Contaminant	Particle Size (Microns)	Quantity (grams per 1000 liters)
Iron oxide	0 - 5	19.00
	5 - 10	1.00
Sharp silica sand	150 - 300	0.70
	300 - 420	0.70
Prepared dirt conforming to AC Spark Plug Co. Part No. 1543637, coarse Arizona road dust or equivalent	Mixture as follows: 0-5 (12 percent) 5-10 (12 percent) 10-20 (14 percent) 20-40 (23 percent) 40-80 (30 percent) 80-200 (9 percent)	5.30
Cotton linters	Staple below 7 U.S. Dept of Agriculture Grading Standards	0.07
Iron chips	150 - 500	10.00
Aluminum chips	150 - 500	10.00
Crude naphthenic acid		0.03 percent by volume
Salt water solution (5 ±1 percent by weight NaCl)		0.01 percent entrained

3.8.13.5 Impact and endurance. When being dropped as specified in table III, leakage shall be not greater than 25 cc per in-line engagements or disengagements. During angular disengagements, the leakage shall be not greater than 100 milliliters (ml). After being dropped as specified in table III, the coupling shall pass the functional tests of 4.8.14 and the leakage tests of 4.8.5.

3.8.13.6 Disassembly and inspection. After all testing is completed, the coupling shall be disassembled and all parts shall be inspected. Parts shall not show any distortion, weakness, or abnormal wear.

3.8.14 Functional. The coupling shall allow the passage of fuel when fully engaged with an aerial refueling nozzle conforming to MIL-N-25161 and in the case of MA-3 and MA-4 couplings, shall provide downstream pressure regulation and surge suppression resulting from valve closure in the receiver aircraft. Upon engagement with the nozzle, the coupling master seal shall make contact with the nozzle's sleeve lip seal surface prior to the nozzle's sleeve starting to open. Upon disengagement, fuel flow shall be automatically shut off in both the coupling and the nozzle prior to separation between the coupling master seal and the nozzle sleeve's sealing lip at disconnect angles up to 22.5 degrees off center. This operation shall be accomplished without the

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use of any external source of power other than the forces generated by the receiver aircraft to separate the nozzle and coupling. The nozzle shall not bind within the coupling, and the coupling shall not be damaged when off-center disconnects are made at angles up to 22.5 degrees. The engagement of the nozzle, its sealing in the coupling, and the complete disengagement of the nozzle from the coupling shall constitute one complete cycle of operation.

TABLE III. Impact and endurance test.

Condition <u>1/</u>	Displacement of coupling centerline from nozzle centerline (inches)	Drop distance of nozzle nose to coupling poppet	Angle of disconnect (degrees)	Coupling latch setting (lb + 20)	Cycles <u>2/</u>
Impact <u>3/</u>	0	18	0	500	<u>4/</u> 100
	2	18	0	500	400
	4	20	0	500	500
Endurance <u>5/</u>	0	9	15	500	<u>4/</u> 1000
	0	9	15	500	<u>6/</u> 250
	0	9	0	500	<u>4/</u> , <u>7/</u> 2750

## NOTES:

1/ Thirty percent of the cycles at each condition shall be performed at  $-67 \pm 2$  °F.

2/ A cycle is defined as one engagement and one disengagement.

3/ During the impact test, engagement shall be complete. If impact does not cause engagement, manual force shall be applied as required to complete engagement.

4/ Fifty cycles shall be accomplished with zero fuel pressure and a dry nozzle.

5/ Drop test shall not be required. Mechanical engagement shall be permissible, provided engaging velocity is not less than 5 feet/sec (fps) prior to seating the sleeve upon the master coupling seal.

6/ Disengagement shall be accomplished with  $50 \pm 2$  psig fuel pressure applied to the reception coupling.

7/ The 1,000 cycles specified in the contaminated fuel test (see 4.8.8) may be considered a part of this test, provided the engaging velocity during the test is not less than 5 fps.



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3.9 Marking of shipments. Interior and exterior containers shall be marked in accordance with MIL-STD-129.

3.9.1 Instructions. The following instructions shall be marked on the unit and intermediate packages and shipping container:

IF IN STORAGE AFTER (DATE)\*, THE COUPLING SHALL BE TESTED AND INSPECTED BEFORE USE.

\*Insert date 18 months after curing date of oldest synthetic rubber part used in the coupling.

#### 4. VERIFICATION

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

- a. Qualification inspection (see 4.4).
- b. Conformance inspection (see 4.6).

4.2 Inspection conditions. Unless otherwise specified, tests shall be performed at atmospheric pressure. Ambient air temperature shall be between 60 °F and 90 °F. Unless otherwise specified, the test fluid shall conform to MIL-DTL-5624, Grade JP-5 or MIL-DTL-7024.

4.3 Test nozzles. Nozzles used in the following tests and evaluations shall conform to MIL-N-25161.

4.4 Qualification inspection. Qualification inspections shall consist of tests on two couplings by the supplier and verification tests on two couplings by the Government. The qualification tests shall consist of the complete series of tests and inspections specified below, performed in the order listed. The verification tests shall consist of any of the tests below that the Government desires to perform. Successful completion of this inspection is required for qualification.

- a. Test Sample No. 1

<u>Test</u>	<u>Paragraph</u>
Inspection	4.7.1
Functional	4.8.14

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<u>Test</u>	<u>Paragraph</u>
Limit (Proof) Pressure	4.8.4
Leakage and Spillage	4.8.5
Pressure Drop	4.8.6
Fuel Resistance and Extreme Temperature	4.8.7
Contaminated Fuel	4.8.8
Regulator Operation	4.8.1
Latching Mechanism	4.8.3
Normal Operating Loads	4.8.9
Ultimate (Burst) Pressure	4.8.10
Disassembly and Inspection	4.8.13.6

## b. Test Sample No. 2

<u>Test</u>	<u>Paragraph</u>
Inspection	4.7.1
Functional	4.8.14
Nozzle-Coupling Compatibility	4.8.11
Altitude	4.8.12
Salt Water Immersion	4.8.13.1
Salt Fog	4.8.13.2
Sand and Dust	4.8.13.3
Vibration	4.8.13.4
Leakage and Spillage	4.8.5
Ultimate (Burst) Pressure	4.8.10
Disassembly and Inspection	4.8.13.6

4.4.1 Rejection and retest of qualification samples. If, during the qualification tests, a major part fails, the test shall be terminated and the qualifying activity shall be notified. Upon authorization by the qualifying activity, the replacement unit assembly shall have a redesigned part or one of different material, except that if the failure was caused by faulty material or workmanship, the qualifying activity may require the installation of a part of the original design with the defect overcome. Minor parts may be replaced and penalty runs performed at the option of the qualifying activity.

4.4.2 Test samples. Test samples submitted for Government or procuring agency verification shall consist of two couplings identified with the manufacturer's own part number. Samples shall be submitted to the qualifying activities as specified in the contract.

4.5 Flight/service tests. At the option of the qualifying activity, one or more of the test couplings that were submitted to the Government (see 4.4.2) shall be subjected to flight/service tests. Testing shall be in accordance with the requirements of the qualifying agency.

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4.6 Conformance inspection. Conformance inspections shall be performed under the surveillance of the Government inspector on lots submitted for acceptance under contract. The conformance tests shall consist of individual tests and sampling tests.

4.6.1 Individual tests. Each coupling shall be subjected to the following inspections:

- |                           |        |
|---------------------------|--------|
| a. Inspection             | 4.7.1  |
| b. Functional             | 4.8.14 |
| c. Limit (Proof) Pressure | 4.8.4  |
| d. Regulation Capability  | 4.8.1  |
| (MA-3 and MA-4 couplings) |        |

4.6.2 Sampling tests. One coupling selected by the inspector from each lot of 100 or fraction thereof that has passed the individual tests shall be subjected to the following tests as specified in 4.8:

- |                               |          |
|-------------------------------|----------|
| a. Leakage and spillage       | 4.8.5    |
| b. Regulation capability      | 4.8.1    |
| (MA-3 and MA-4 couplings)     |          |
| c. Normal operating loads     | 4.8.9    |
| d. Ultimate (Burst) pressure  | 4.8.10   |
| e. Disassembly and inspection | 4.8.13.6 |

4.6.3 Lots. A lot shall consist of couplings of the same part number manufactured under essentially the same conditions and submitted for inspection at the same time.

4.6.4 Rejection and retest. When one or more couplings from a lot fail to meet the requirements of this specification, acceptance of all couplings in the lot shall be withheld until the extent and cause of the failure are determined. Before resubmitting, full particulars concerning the failures and necessary corrective actions shall be furnished to the qualifying activity. After corrective actions have been taken, all conformance inspections shall be repeated. Couplings rejected after retest shall not be submitted for further testing without specific approval of the qualifying activity.

4.7 Construction inspection methods.

4.7.1 Inspection. Each coupling shall be carefully examined to determine compliance with the dimensional requirements of the applicable drawings and figure 1. The coupling shall be examined to determine conformance to the requirements of this specification with respect to weight, dimensions, materials, design, interchangeability, construction, finish, identification, and workmanship in accordance with 3.7.

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4.8 Design testing.

4.8.1 Regulator operation (MA-3 and MA-4 couplings). The following tests shall be conducted with the coupling and nozzle engaged using an apparatus similar to that shown on figure 2.

4.8.1.1 Regulation capability. The test shall be performed as follows:

a. Using the pressure drop test results of 4.8.6 with flow rates of 1, 100, 200, 300, 400, 500, and 600 gpm, and an inlet pressure of 50 psig+ the pressure drop corresponding to the flow rate measured in 4.8.6b, the delivery pressure shall be not less than 45 psig and be not greater than 55 psig.

b. With coupling inlet fluid pressures of 60, 80, 100, and 120 psig, the coupling outlet pressure shall be monitored as the flow rate is varied from 10 cc/min to 600 gpm and back to 10 cc/min. The regulated outlet pressure shall be within the pressure regulation envelope of 3.8.1.1b.

c. While maintaining a flow rate of 600 gpm, the inlet pressure shall be cycled from 60 to 100 psig and back to 60 for a total of 2,000 cycles, at a rate of 6 cycles per minute. If equipped with ambient sensing ports, the attitude of the coupling shall be most conducive for the drainage of leakage, which may be retained internally by the coupling. The outlet pressure shall meet the requirements of 3.8.1.1c. Following this test, the coupling shall be subjected to and pass the functional tests of 4.8.14.

d. With a coupling inlet fluid pressure of 60 psig, the coupling outlet pressure shall be monitored as the flow rate is decreased from 10 cc/min to 10 drops per minute. The regulated outlet pressure shall meet the requirements of 3.8.1.1d. The test shall be repeated at inlet pressures of 100 and 120 psig.

4.8.1.2 Surge suppression. With a nozzle inlet fluid pressure of  $55 \pm 5$  psig and flow rates as shown, surge pressures shall be generated by closure of the CRC valve (a 3-inch Truline ball valve with a closure rate of 0.2 seconds and P/N CN 755 or equivalent). Surge pressures shall be recorded upstream and downstream of the coupling. Surge pressure peaks recorded downstream of the coupling shall be not greater than the requirements specified in 3.8.1.2. The test shall be repeated five times for each refueling hose configuration shown on figure 2. For MA-4 couplings, this test shall be performed three ways:

a. With both regulators working, record surges upstream and downstream of coupling.

b. With regulator one inactive (held in wide open position), record surges upstream and downstream of coupling.

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c. With regulator two inactive (held in wide open position), record surges upstream and downstream of coupling.

4.8.2 Alignment. The following tests shall be conducted with the coupling and nozzle engaged using a facility similar to that shown on figure 2. The test coupling shall be engaged with a nozzle. The coupling body shall be rotated around the ball joint to meet the requirements of 3.8.2. Next apply a radial load of 100 pounds to the coupling outlet flange. The force to rotate the coupling body around the ball joint shall meet the requirements of 3.8.2.

4.8.3 Latching mechanism.

4.8.3.1 Engagement. Using a test stand similar to that shown on figure 2, the test coupling shall be filled with fuel and pressurized to 10 psig. Weights shall be added to the coupling until engagement with the nozzle is made. The engaging force (weight of fuel, coupling, and weights) shall be not greater than 155 pounds as specified in 3.8.3.1. Tapping of the mast to effect engagement shall not be allowed. The nozzle and coupling centerlines shall not be displaced for this test.

4.8.3.2 Disengagement. The test coupling shall be engaged with a nozzle and the latching mechanism adjusted to produce a disengagement force of  $550 \pm 30$  pounds ( $320 \pm 20$  for MA-2 couplings). With the nozzle pressure increased to 50 psig (no flow), the disengaging force shall increase no greater than as specified in 3.8.3.2. The test shall be repeated with a latching mechanism setting of  $320 \pm 30$  pounds (no adjustment needed for MA-2 couplings) and the values recorded. Then with a coupling outlet pressure of 50 psig and a flow rate of  $600 \pm 25$  gpm, the disengaging force shall be rechecked. The force shall change no greater than 25 pounds from that obtained in the no flow test and shall meet the requirements of 3.8.3.2. The test shall be repeated with the nozzle at a 22.5 degree angle from centerline of the coupling. The force to disengage the nozzle shall be as specified in 3.8.3.2.

4.8.4 Operating and proof pressure. With the coupling engaged with a nozzle and the nozzle outlet blanked off, the coupling shall be subjected to a hydrostatic operating pressure of 120 psig for a minimum of one minute. There shall be no external leakage, deformation, or structural failure as specified in 3.8.4. The coupling alone shall then be subjected to an internal hydrostatic proof pressure of 240 psig for a minimum of five minutes. There shall be no external leakage, deformation, nor structural failure as specified in 3.8.4.

4.8.5 Leakage and spillage. This test shall be performed as follows:

a. The engaged coupling and nozzle shall be subjected to fluid flow rates up to 600 gpm (1200 gpm for MA-2) in 100 gpm increments at a constant inlet pressure of  $120 \pm 2$  psig (60 psig for MA-2 couplings). There shall be no evidence of external leakage as specified in 3.8.5a.

b. The engaged coupling and nozzle shall be subjected to an inlet fluid pressure of  $120 \pm 2$

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psig and a fluid flow of 100 to 600 gpm in increments of 100 gpm. The nozzle shall be disengaged at every increment. The spillage shall be not greater than 100 cc (25 cc for MA-2) per disengagement as specified in 3.8.5b.

c. The coupling shall be subjected to an inlet fluid pressure of 10 psig while fitted with a 2,000 cc reservoir containing a minimum of 1,100 cc of test fluid and providing unrestricted fuel flow. A nozzle shall be engaged and disengaged a minimum of five times. Spillage shall be not greater than 25 cc per engagement or disengagement as specified in 3.8.5c.

4.8.6 Pressure drop. The pressure drop test shall be conducted in accordance with SAE-ARP868 and the following:

a. MA-2 couplings: The nozzle and coupling shall be subjected to flow rates ranging from 0 to 1200 gpm in 100 gpm increments at  $50 \pm 2$  psig inlet pressure. Sufficient data shall be acquired to plot a pressure versus flow curve. The total pressure drop through the engaged nozzle and coupling shall be as specified in 3.8.6a.

b. MA-3 and MA-4 couplings: The test shall be conducted with a coupling inlet fuel pressure of  $40 \pm 2$  psig at flow rates ranging from 1 to 600 gpm. The pressure shall be measured at 50 gpm increments and the results used in the regulation capability tests defined in 4.8.1.1. At 600 gpm the pressure drop shall be not greater than the value in section 3.8.6. With all regulators inactive, the max pressure drop through the engaged nozzle and coupling shall be as specified in 3.8.6b.

4.8.7 Fuel resistance and extreme temperature. The coupling shall be subjected to tests in accordance with table I. At the conclusion of the final test period, the coupling shall be returned to room temperature and meet the requirements of 3.8.7.

4.8.8 Contaminated fuel.

4.8.8.1 Contaminant. The test fluid shall contain the types and concentration of contaminants specified in table II.

4.8.8.2 Test method. The engaged nozzle and coupling shall be subjected to a flow rate of at least 50 gallons per minute and operated for 1,000 cycles (a cycle shall consist of engaging for 30 seconds and disengaging). The flow-generating device shall ensure that the contaminants remain in uniform suspension in the fluid. Solid contaminant shall not be re-circulated through the nozzle. Upon completion, the coupling shall be flushed and drained. The coupling shall then meet the requirements of 3.8.8.

4.8.9 Normal operating loads. The coupling shall be subjected to the loads of 3.8.9. The tension loads shall be applied between the toggle latches and the hose attachment point by inserting a nozzle and locking the toggles in place. The radial loads shall be applied on the

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coupling body 4.25 inches from the drogue cone attachment flange (see figure 5). No malfunction or deformation shall be evident upon completion of this test. The coupling shall then be subjected to the leakage tests of 4.8.5 and the functional tests of 4.8.14. The coupling shall then meet the requirements of 3.8.9.

4.8.10 Ultimate (burst) pressure. With the coupling engaged with a nozzle and the nozzle outlet blanked off, the coupling shall be subjected to a hydrostatic pressure of 180 psig for a minimum of one minute. It shall meet the requirements of 3.8.10. With the nozzle still engaged, the outlet blanked off, and the regulators held open, the coupling inlet shall then be subjected to an internal hydrostatic burst pressure of 360 psig for a minimum of one minute. It shall meet the requirements of 3.8.10. The pressure shall then be lowered to 60 psig. There shall be no evidence of external leakage. The nozzle shall then be subjected to the leakage tests of 4.8.5 and the functional tests of 4.8.14. The coupling shall then meet the requirements of 3.8.10.

4.8.11 Nozzle-coupling compatibility. The coupling shall be engaged with a nozzle so that the nozzle's sleeve latches are aligned with the coupling's locking roller windows in a manner which will produce the highest likelihood of binding or hang-up during disconnect. The nozzle shall then be disconnected. No binding nor hang-up shall occur. The coupling and the nozzle shall then be re-engaged. With the nozzle held fixed, the coupling shall be rotated about its longitudinal axis through 360 degrees in both directions with the loads of 3.8.10 applied. No hang-ups nor excess torque shall occur as specified in 3.8.11. This test shall be repeated using each nozzle on the Qualified Products List, QPL-81975.

4.8.12 Altitude (MA-3 and MA-4 couplings). The coupling, when equipped with pressure sensing ports and engaged with a nozzle, shall be subjected to a fluid flow of 400 gpm at an inlet pressure of 80 psig. While maintaining this condition, the ambient coupling pressure shall be reduced gradually to 8.5 inches of mercury absolute (HgA). Sufficient data points shall be taken to plot a curve of regulated output versus ambient pressure. The sensing ports shall then be closed and the test repeated. The regulated outlet pressure shall be as specified in 3.8.12.

4.8.13 Environmental requirements.

4.8.13.1 Salt water immersion. The coupling shall be immersed in a solution consisting of 5 percent by weight of sodium chloride in distilled water and drained. If equipped with ambient sensing ports, inspection shall be made to verify the draining requirements of 3.8.1.1.2. The coupling shall then be placed in an oven and heated at  $130 \pm 5$  °F for a period of not less than one hour. The immersion and heating cycles shall be repeated 50 times. Immediately after completion of the 50 cycles, the coupling shall be flushed with warm water to remove all salt accumulation. The coupling shall then be dried, wetted with test fluid, and shall meet the requirements 3.8.13.1.

4.8.13.2 Salt fog. The coupling shall be installed in a test chamber in such a way that the sleeve shall remain closed and the inlet end shall be sealed against moisture. A salt solution of

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5 ± 1 percent sodium chloride in distilled water shall be atomized within the test chamber. At least 0.28 liter of salt solution shall be atomized per cubic foot of test chamber volume for 24 hours. Fallout rate of the salt fog shall be measured at least once every 24 hours and shall be between 0.5 and 3.0 ml/hour per 80 sq cm of collection area. Test chamber temperature and salt solution temperature prior to atomization shall be maintained at 95 ± 5 °F. The coupling shall be exposed to salt fog for 48 hours, after which it shall be dried in ambient air as specified in 4.1 for 48 hours. The coupling shall then be flushed with warm water, dried, wetted with test fluid, and shall meet the requirements of 3.8.13.2.

4.8.13.3 Sand and dust. The coupling shall be subjected to blown sand and dust in the manner specified herein. At the conclusion of the test, the loose sand and dust, which remains in or on the coupling, shall be blown away and the coupling shall meet the requirements of 3.8.13.3.

4.8.13.3.1 Test conditions.

4.8.13.3.1.1 Sand composition. The sand particles used shall be of sub-angular structure with a mean roundness factor of 0.2 and a hardness factor of 7 (Mohs' scale). The sand shall consist of silica sand composed of at least 95 percent by weight silicon oxide with the following sized distribution:

- 1.0 ± 0.5 percent shall be retained by a 20-mesh screen
- 1.7 ± 0.5 percent shall be retained by a 30-mesh screen
- 14.8 ± 1.0 percent shall be retained by a 40-mesh screen
- 37.0 ± 1.0 percent shall be retained by a 50-mesh screen
- 28.6 ± 1.0 percent shall be retained by a 70-mesh screen
- 12.7 ± 1.0 percent shall be retained by a 100-mesh screen

The remainder shall pass through a 100-mesh screen.

4.8.13.3.1.2 Dust composition. The dust used shall consist of silica flour or red China clay with the following size distribution:

- 100 percent shall pass through a 100-mesh screen
- 98 ± 2 percent shall pass through a 140-mesh screen
- 90 ± 2 percent shall pass through a 200-mesh screen
- 75 ± 2 percent shall pass through a 325-mesh screen

4.8.13.3.1.3 Air velocity. For the sand test, the air velocity shall be maintained between 3,450 and 5,700 feet per minute (fpm). For the dust test, the air velocity shall be maintained between 300 and 500 fpm.

4.8.13.3.1.4 Sand and dust concentrations. Sand concentration shall be maintained at



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$2.2 \pm 0.5$  grams per cubic centimeter ( $\text{gm}/\text{cm}^3$ ). Dust concentration shall be maintained at  $10.6 \text{ gm}/\text{cm}^3$ .

4.8.13.3.2 Test procedure. The coupling's inlet shall be sealed and the coupling shall be mounted in such a way as to allow sand and dust to be blown upon the coupling from different directions. Each test shall be run two times: once with the coupling's outlet pointed directly into the flow, and once with the coupling's axis aligned perpendicular to the flow. The coupling shall be subjected to blowing sand for 90 minutes from each direction. The coupling shall then be subjected to blowing dust for six hours at room temperature and six hours at an ambient air temperature of  $350 \pm 10$  °F. The coupling's temperature shall be allowed to stabilize at the ambient air temperature prior to each test run.

4.8.13.4 Vibration. The vibration test shall be performed in accordance with figure 3. This test shall be performed with the coupling in a dry condition. For the purpose of this test, a tension load of  $500 \pm 25$  pounds shall be applied to the hose attachment end of the coupling to simulate the forces applied during stowage in flight. Upon completion of this test, the coupling shall meet the requirements of 3.8.13.4.

4.8.13.5 Impact and endurance. The coupling shall be installed upon the fixture shown on figure 4 and subjected to testing under the conditions described in table III. Unless otherwise specified, an internal fluid pressure of  $10 \pm 2$  psig shall be maintained in the coupling throughout this test. The coupling shall meet the requirements of 3.8.13.5.

4.8.13.6 Disassembly and inspection. The coupling shall be disassembled, and all parts shall be inspected. Parts that are distorted, weakened, or are abnormally worn, constitute failure as specified in 3.8.13.6.

4.8.14 Functional. The coupling shall be checked at static pressures of 2 and 60 psig for one minute at each pressure. There shall be no evidence of external leakage. After relieving the 60 psig pressure, the ball joint shall be moved  $\pm 22.5$  degrees from the coupling centerline. The force required to move the coupling about the ball shall be not greater than 20 pounds. The coupling latching mechanism shall be adjusted to produce a nominal disengaging force of 320 pounds at zero psig fuel pressure, unless otherwise specified by the procuring activity. A testing and production tolerance of  $\pm 20$  pounds will be allowed for the disengaging force. The following tests shall then be conducted:

a. A fuel pressure of 50 psig shall be applied to the coupling inlet and the latching mechanism shall be checked. The disengagement force shall increase  $200 \pm 45$  pounds from the nominal setting at zero fuel pressure as specified in 3.8.3.2.

b. Using a test stand similar to that shown on figure 2, the test coupling shall be filled with fuel and pressurized to 10 psig. Weights shall be added to the coupling until engagement with the nozzle is made. The engaging force (weight of fuel, coupling, and weights) shall be not greater

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than 155 pounds as specified in 3.8.3.1. Tapping of the mast to effect engagement is not allowed. The nozzle and coupling centerlines shall not be displaced for this test.

c. The coupling, with a nozzle engaged, shall be pressurized to 2 and 60 psig for one-minute periods each. No external leakage shall occur. For MA-3 and MA-4 couplings, if the coupling incorporates a pressure relief valve, a pressure of 160 psig shall be applied to the nozzle while maintaining 60 psig at the coupling inlet. Coupling inlet pressure variations shall be monitored and a record of its variation with time shall be recorded. Pressures shall equalize within 10 seconds as specified in 3.8.1.2.

d. While maintaining a 10 psig fuel pressure in the coupling and no fluid pressure in the nozzle, the nozzle shall be disengaged and engaged at least five times. No evidence of binding, chattering, or excessive forces shall occur as specified in 3.8.14.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

6.1 Intended use. The aerial refueling couplings covered by this specification are intended for use by tanker aircraft for refueling receiver aircraft by means of the probe-drogue method of aerial refueling. The coupling, which is extended from the tanker, engages the nozzle on the receiver aircraft, thereby allowing the transfer of fuel. The coupling may also be used for defueling the tanker aircraft on the ground with the use of a special item of test equipment. The coupling provides a regulated fuel supply.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. The disengaging force required, if other than 320 pounds (see 3.8.3.2).

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c. Locations of markings (see 3.9).

d. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List, QPL-81975 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Air Systems Command, 48110 Shaw Road, Bldg 2187, Code 4.3.5.3, Patuxent River, MD 20670.

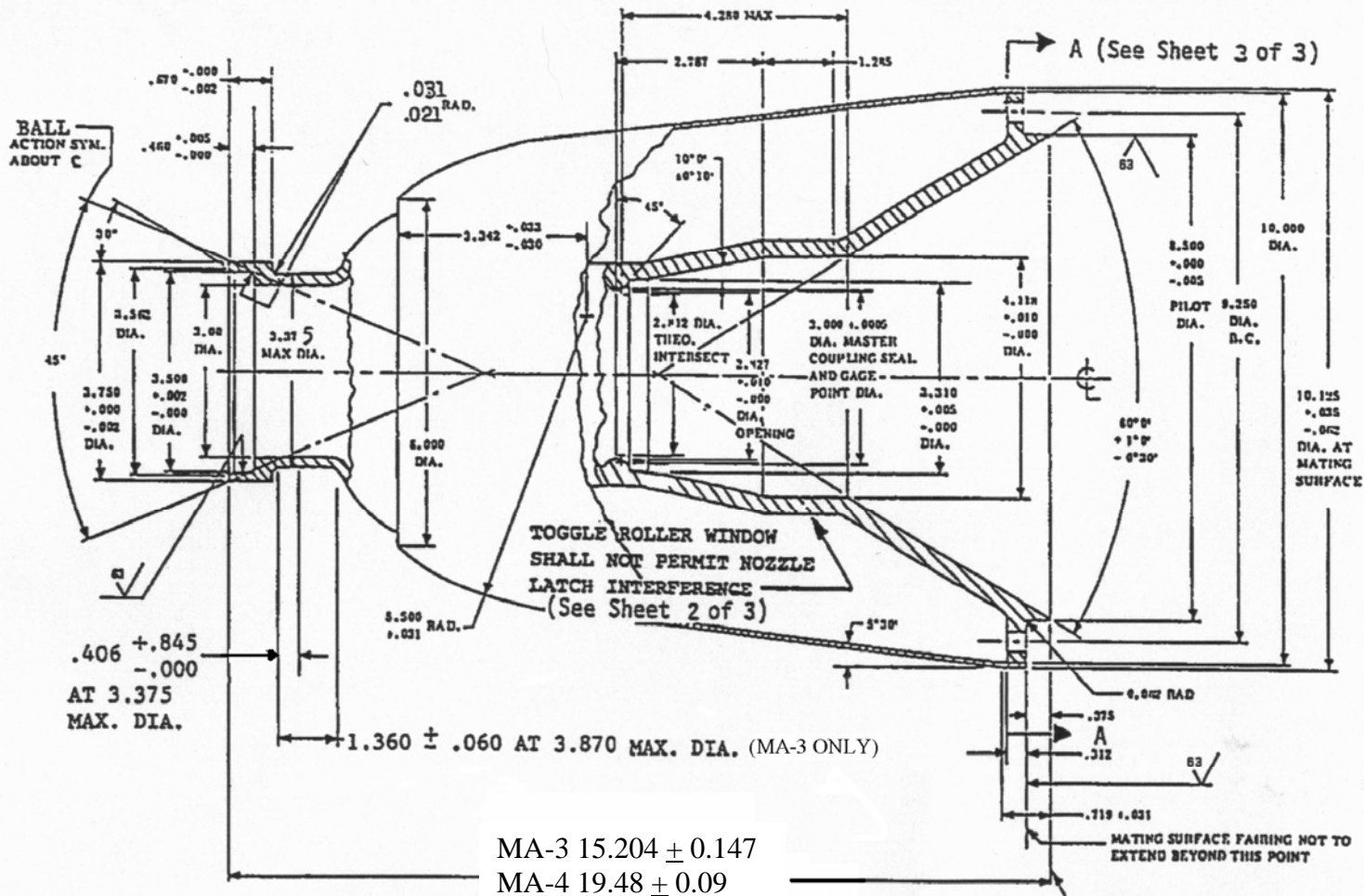
6.4 Subject term (key word) listing.

Air-to-air  
Buddy store  
Drogue  
Fuel  
Hose reel  
Probe

6.5 International standardization agreement implementation. This specification implements AIR STD 25/13, In Flight (Aerial) Refueling Equipment, Dimensions and Functional Characteristics and STANAG 3447, Aerial (In Flight) Refueling Equipment, Dimensional and Functional Characteristics. When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at <http://assist.daps.dla.mil>.

6.6 Changes from the previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

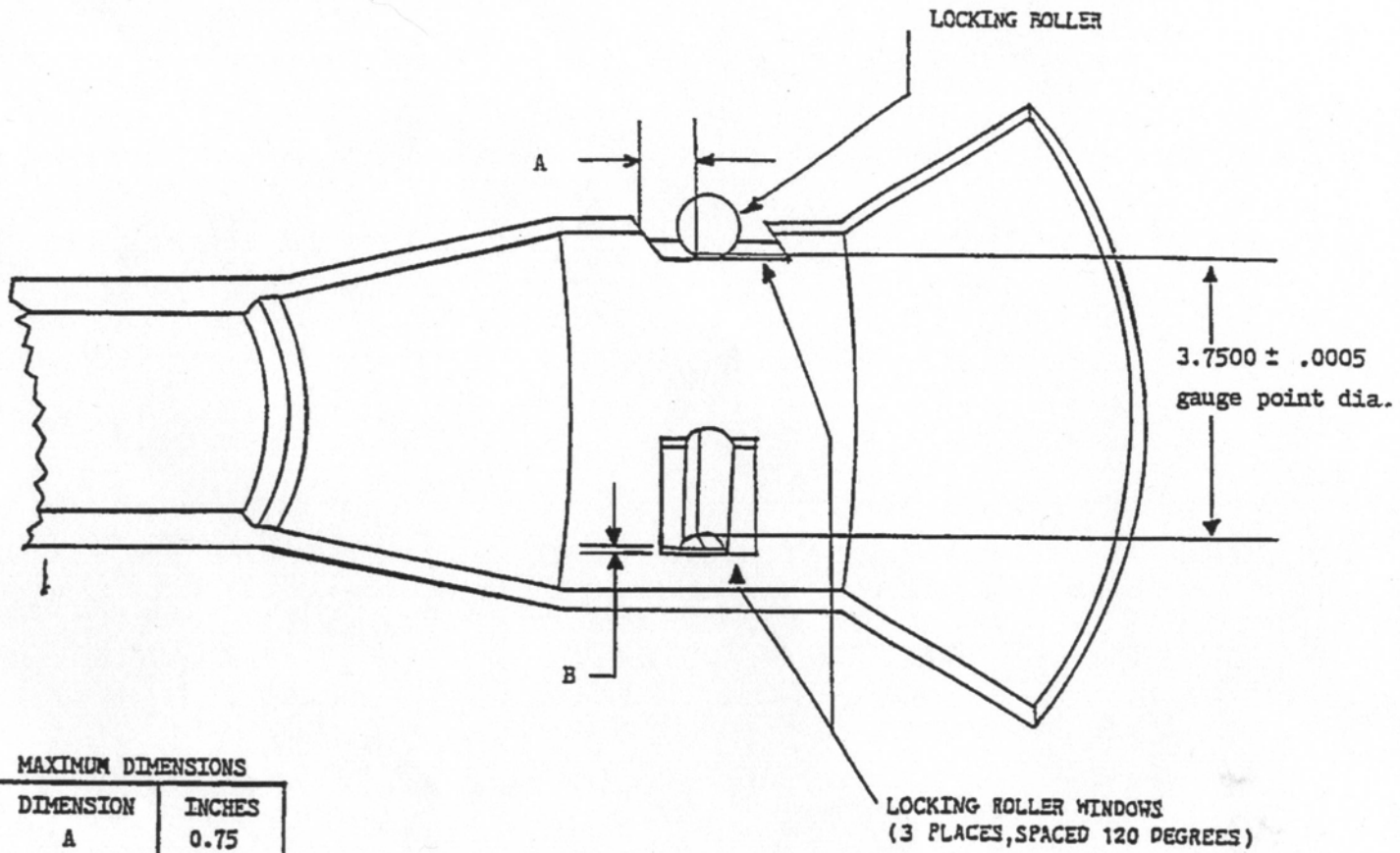
FIGURE 1. Coupling dimensions (Sheet 1 of 3).



MA-3 15.204 ± 0.147

MA-4 19.48 ± 0.09

Dimensions in inches. Unless otherwise specified, tolerances: Decimals . xx = 0.03  
 .xxx = 0.010  
 Angles ± 1°



## MAXIMUM DIMENSIONS

DIMENSION	INCHES
A	0.75
B	0.25

NOTE: Dimensions A and B represent maximum allowable clearances between the locking roller and the locking roller window edges.

FIGURE 1. Coupling dimensions (sheet 2 of 3) - Continued



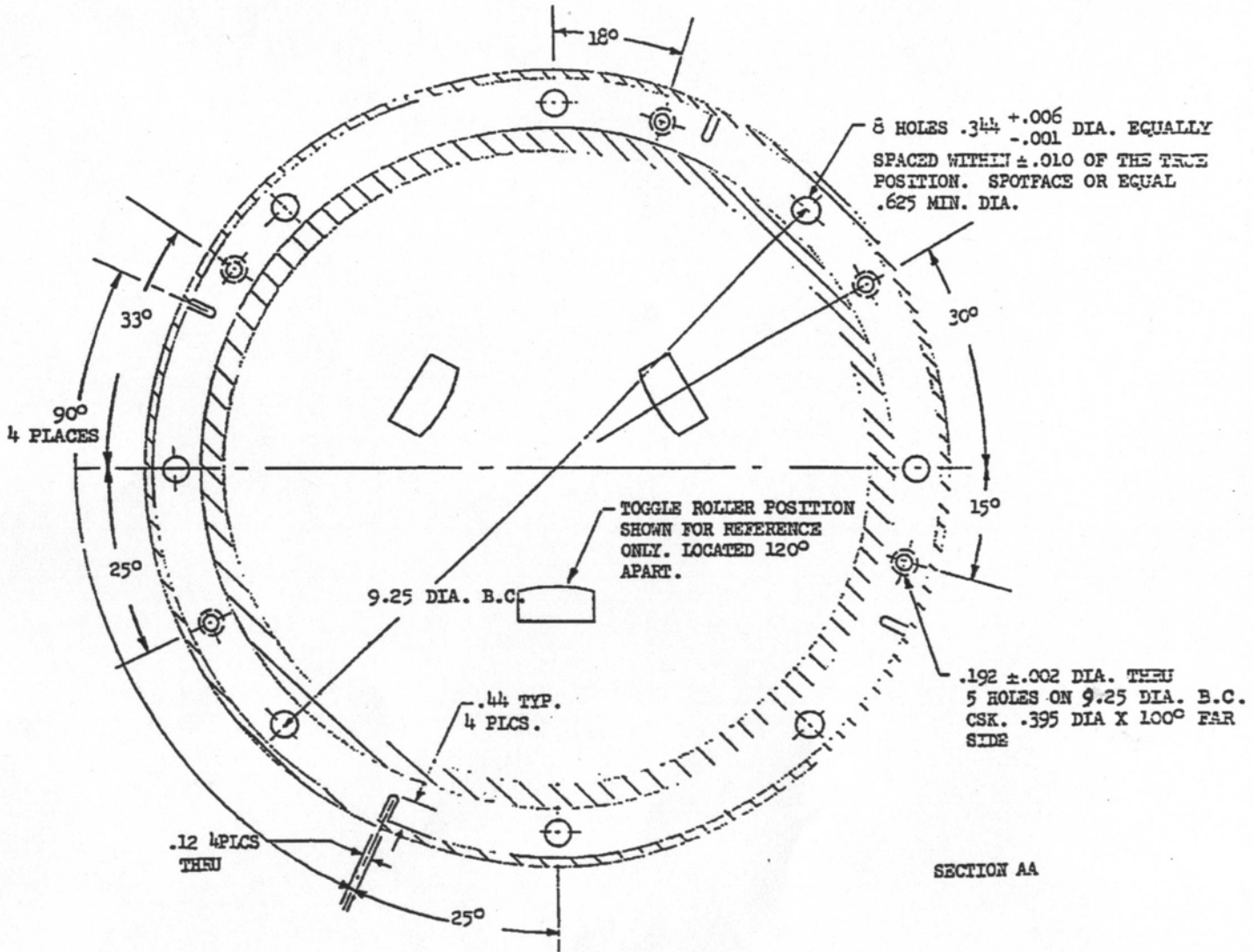
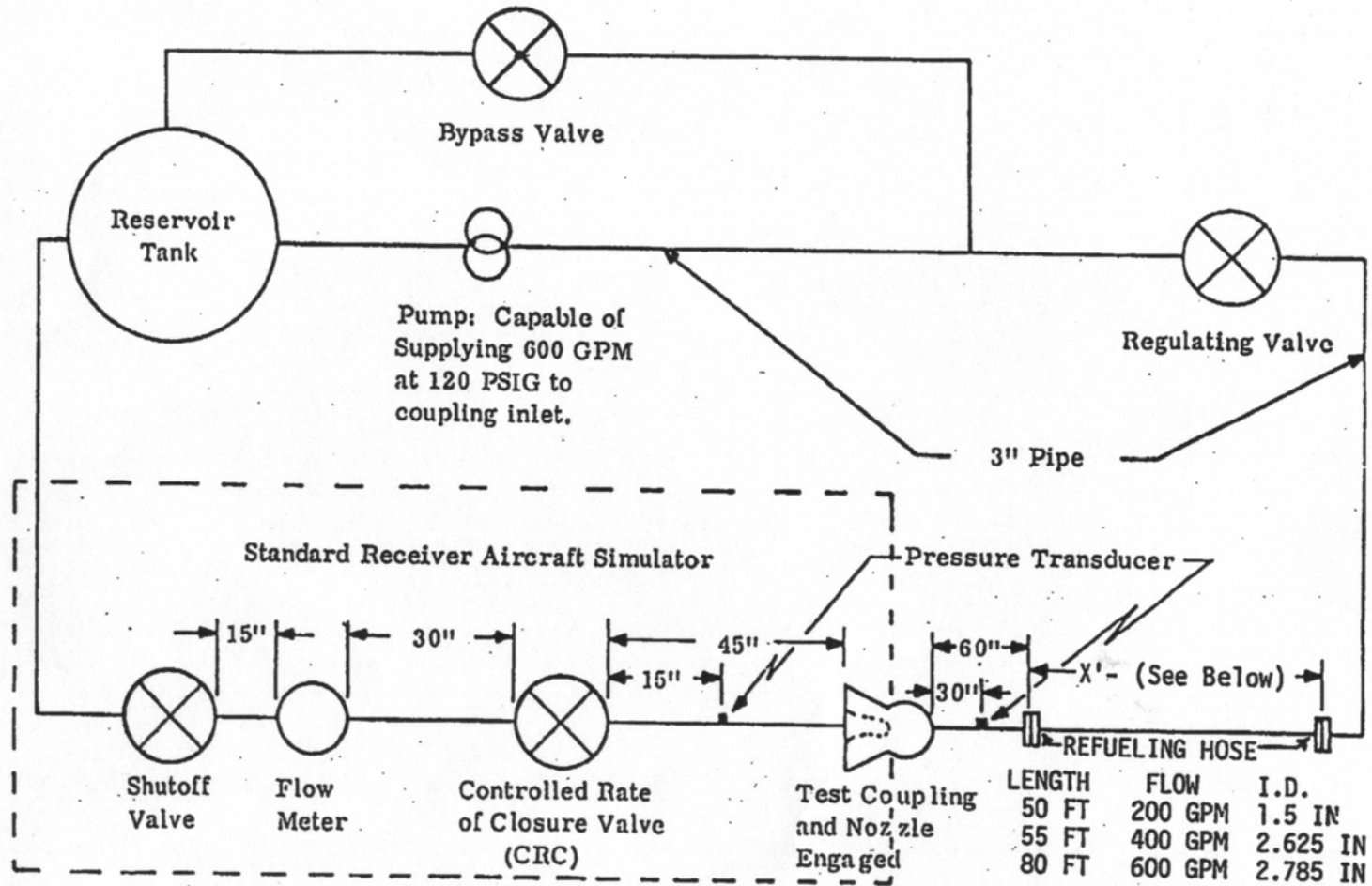


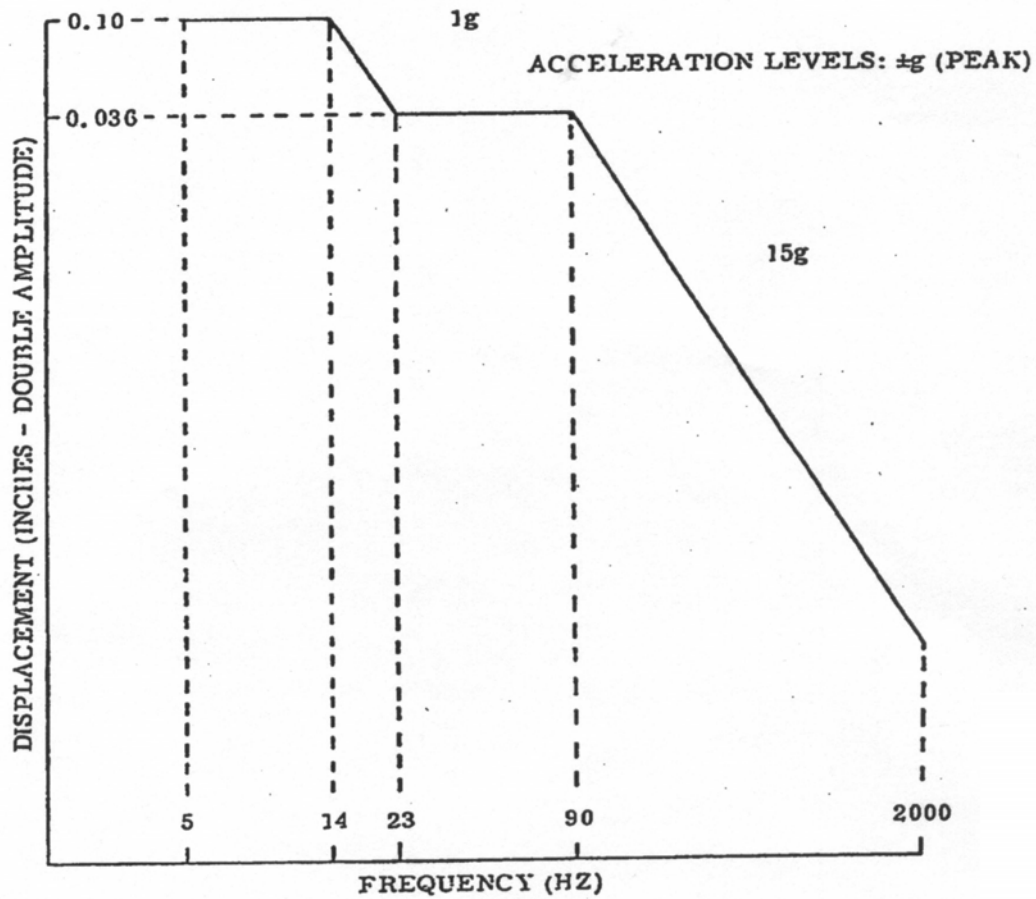
FIGURE 1. Coupling dimensions (sheet 3 of 3) - Continued

FIGURE 2. Surge suppression and pressure regulation test set-up.



Note: The hose is to be secured at the both ends and lies straight along the ground as long as the test fixture is only 1-3 feet off the ground.

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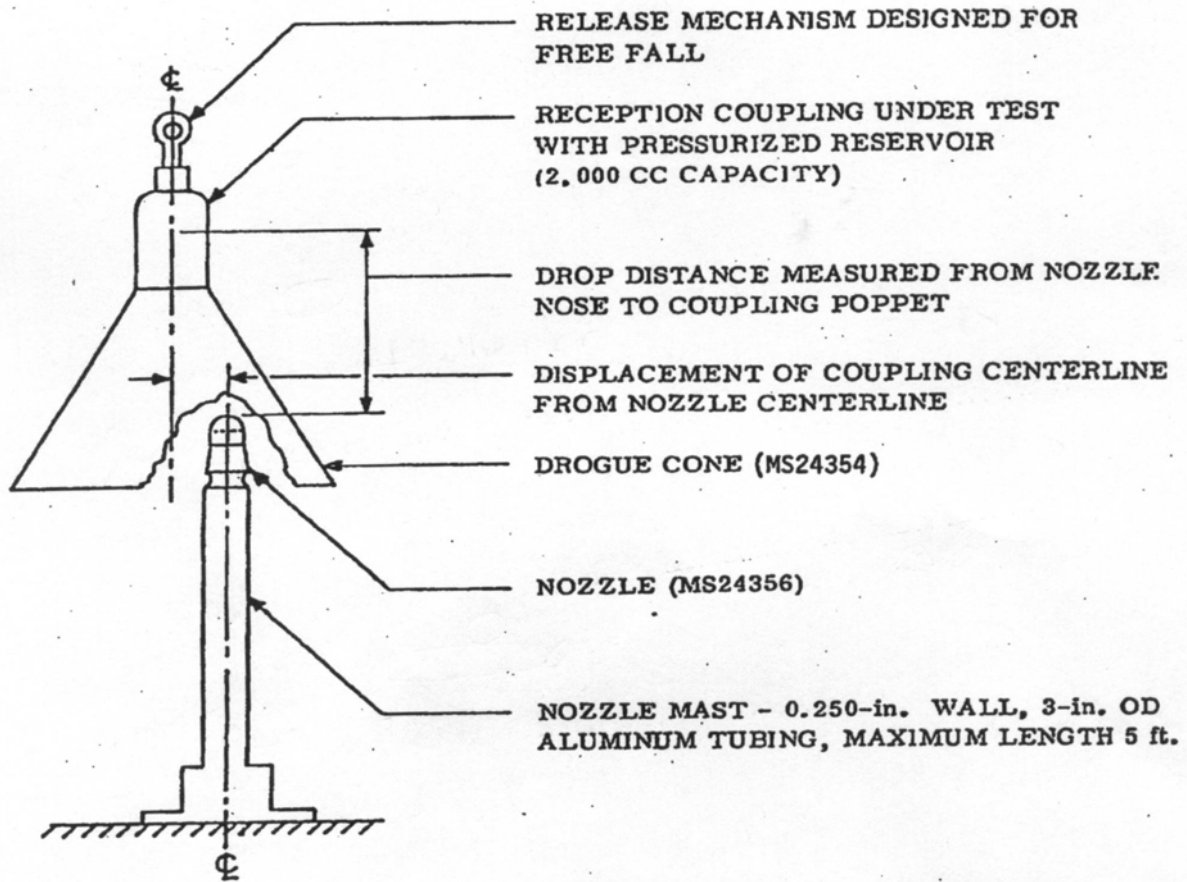


Note: Instructions for test are contained in MIL-STD-810, Test Method 514.5.

FIGURE 3. Vibration test curve.



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FOR THE PURPOSE OF THE IMPACT TEST, THE COMBINED WEIGHT OF DROGUE AND RECEPTION COUPLING SHALL BE  $40^{+1}_{-0}$  LB.

Note: It is recommended that bungee cords be used to drop the coupling during the testing to simulate a more accurate representation of flight.

FIGURE 4. Impact and endurance test set up.

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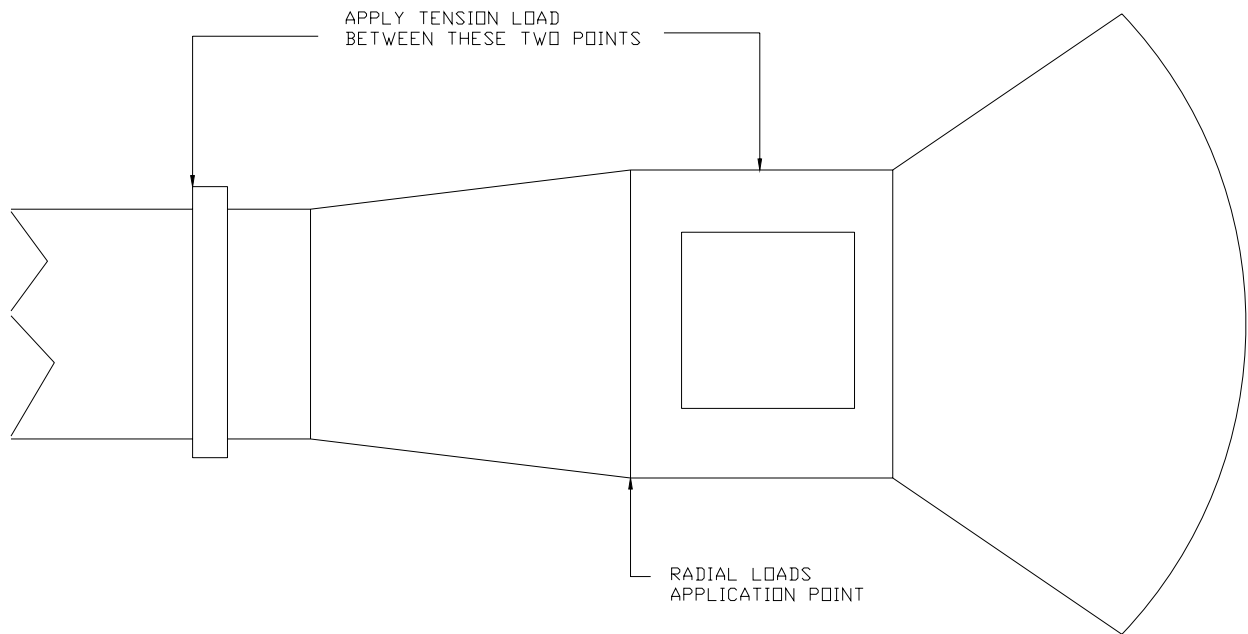


FIGURE 5. Load application points.

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CONCLUDING MATERIAL

Custodians:

Navy - AS  
Air Force - 99

Preparing activity:

Navy - AS

(Project 1680-2007-001)

Review activity:

Air Force - 11

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.