MIL-A-19736A (Wep)
5 August 1960
SUPERSEDING
MIL-A-19736 (Aer)
5 November 1956

MILITARY SPECIFICATION

AIR REFUELING SYSTEMS, GENERAL SPECIFICATION FOR

This specification has been approved by the
Bureau of Naval Weapons, Department of the Navy

1. SCOPE

1.1 Scope: This specification covers the general requirements for design, installation and test of probe and drogue air refueling systems for fixed wing aircraft. Detail requirements necessary to completely define specific equipment will be set forth in a detail specification or drawing provided by the procuring activity or contractor.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, drawings, and publications, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS:

Federal

QQ-C-320	Chromium Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (Electrodeposited)

Military

MIL-P-116	Preservation, Methods of
MIL-S-4040	Solenoid, Electrical, General Specification for
MIL-H-4495	Hose, Rubber, Inflight Refueling
MIL-C-5015	Connectors; Electrical, "AN" Type
MIL-B-5087	Bonding; Electrical (For Aircraft)
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment
MIL-P-5315	Packing "o" Rings, Hydrocarbon Fuel Resistant
MIL-H-5440	Hydraulic Systems; Design, Installation and Tests of Aircraft
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal
MIL-P-5518	Pneumatic System ; Design, Installation and Test in Aircraft
MIL-J-5624	Jet Fuel, Grades JP-3, JP-4, and JP-5
MIL-C-6021	Castings; Classification and Inspection of
MIL-R-6106	Relays; Electric, Aircraft, General Specification
MIL-T-6396	Tanks, Fuel, Oil, Water-Alcohol, Coolant Fluid, Aircraft, Non-Self-Sealing, Removable

FSC 1680

MIL-L-006730	Lighting Equipment; Exterior, Installation of Aircraft (General Specification)
MIL-S-6744	Switch Assemblies and Actuators; Push Button and Limit
MIL-R-6855	Rubber; Synthetic, Sheet, Molded, and Extruded for aircraft application
MIL-P-6906	Plates, Information and Identification
MIL-E-7080	Electrical Equipment, Piloted Aircraft, Installation and Selection of, General Specification for
MIL-F-7179	Finishes and Coatings: General Specification for Protection of Aircraft and Aircraft Parts
MIL-S-7742	Screw Threads; Standard, Aircraft
MIL-M-7911	Marking, Identification of Aeronautical Equipment, Assemblies, and Parts
MIL-T-7928	Terminals Lugs and Splice; Crimp Style, Copper
MIL-P-7936	Parts and Equipment, Aeronautical Preparation for Delivery
MIL-P-7962	Primer Coating, Cellulose - Nitrate Modified Alkyd Type, Corrosion - Inhibiting, Fast Drying
MIL-S-8512	Support Equipment, Aeronautical, Special, General Specification for the design of
MIL-D-8513	Drawings and Data Lists, Preparation of, For Special Support Equipment (for Aeronautical and Associated Equipment)
MIL-A-8591	Airborne Stores and Associated suspension Equipment; General Design Criteria for
MIL-F-8615	Fuel System Components; General Specification for
MIL-A-8625	Anodic - Coatings, for Aluminum and Aluminum Alloys
MIL-D-8706	Data, Design: Contract Requirements for Aircraft
MIL-H-8775	Hydraulic System Components, Aircraft, General Specifications for
MIL-A-8865	Airplane Strength and Rigidity; Miscellaneous loads
MIL-F-17874	Fuel System; Aircraft, Installation and Test of
MIL-C-18012	Control Configuration and Markings
MII-I-18802	Installation of Fuel and Oil Lines and connections in Naval Aircraft
MIL-L-19537	Laoquer; Acrylic - Nitrocellulose, Gloss for (Aircraft use)
MIL-D-22625	Design and Evaluation of Cartridges for Cartridge Actuated Devices
MIL-N-25027	Nut, Self-Locking
MIL-N-25161	Nozzle, Flight Pressure Refueling, Type MA-2
MIL-C-25162	Coupling, Reception, Flight Pressure Refueling, Type MA-2
MIL-C-26482	Connectors, Electric, Circular, Miniature, Quick Disconnect

STANDARDS:

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
AND-10375	Colors, Fluid Line Identification

DRAWINGS:

Military

MS-20995	Wire, lock
MS-25040	Switch - Sensitive Sealed 28V D. C., 15 Amp., 115 V A. C., 10 Amp., Roller Lever Actuated
MS-29513	Packing Fluid Rings, Hydrocarbon Fuel Resistant
MS-33540	Safety Wiring, General Practices for
MS-33547	Pins, Spring, Functional Limitations of
MS-33586	Metals, Definition of Dissimilar
MS-33588	Nuts and Plate Nuts, Self-Iocking, Functional Limitations
MS-33633	Inserts, Self-Locking, Screw Thread Tapped Hole

PUBLICATIONS:

Air Force - Navy Aeronautical Bulletin

No. 143	Specifications and Standards; Use of
No. 410	Age-controls Fuel System, Synthetic Rubber Part

(Copies of this specification and applicable specfications, standards, drawings and publications may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania Attention: Code CDS)

3. REQUIREMENTS

3.1 Materials and standard parts.

3.1.1 Quality: Air refueling equipment shall be built in accordance with nigh grade aircraft practice and of quality to afford safety, satisfactory operation and long service life. All materials used in the manufacture of air refueling equipment shall be of high quality, suitable for the purpose and in accordance with applicable specifications.

3.1.2 Weight: Materials of the lightest weight consistent with the design and the intended use of the equipment shall be employed. Equipment shall be lightweight and of small size.

3.1.3 Metals.

3.1.3.1 Non-sparking: Non-sparking metals shall be used for parts located where fuel vapor maybe present.

3.1.3.2 Magnesium: Magnesium and its alloys shall not be used in contact with fuel.

3.1.3.3 Corrosion resistance: All metals used shall resist corrosion in or shall be protected to withstand aircraft fuels, salt spray, prolonged high humidity and atmospheric conditions for the life of the equipment when in storage and in normal service use.

3.1.3.4 Dissimilar metals: Dissimilar metals are defined in Standard Ms 33586. Dissimilar metals in immediate contact shall be avoided. Where use of dissimilar metals in immediate contact is unavoidable they shall be insulated.

3.1.3.5 Finishes and coatings: Finish shall be in accordance with Specification MIL-F-7179. Aluminum parts shall be anodized in accordance with Specification MIL-A-8625. Steel parts, except working surfaces and parts made of corrosion - resisting steel, shall be cadmium plated in accordance with Specification QQ-P-416. Sliding surfaces of steel parts shall be chromium plated in accordiance with Specification QQ-C-320 or other finish approved by the procuring agency. Finish of hydraulic system components shall be in accordance with Specification MIL-H-8775.

3.1.3.6. Castings: Castings shall be clean, sound and free from blowholes, porosity, cracks and other defects and shall conform to Specification MIL-C-6021, Class 1B.

3.1.4 Non-metallic materials.

3.1.4.1 Fuel resistance: Non-metallic material which is in contact with fuel shall withstand jet fuels conforming to Spectification MIL-J-5624 and preservative compounds.

3.1.4.2 O-rings: O-rings subjected to fuel shall conform dimensionally to Standard MS 29513 and physically to Specification MIL-P-5315.

3.1.4.3 Synthetic rubber: Unless otherwise specified, synthetic rubber shall conform to Specification MIL-R-6855. Age controls for fuel system synthetic rubber parts shall be in accordance with ANA Bulletin No. 410.

3.1.5 Selection of materials and parts: Specifications and standards for all materials, parts, processes and equipment which are not specifically designated herein shall be selected in accordance with the order of precedence set forth in ANA Bulletin No. 143. AN or MIL standard parts shall be used wherever they are suitable for the purpose.

3.1.6 Conservation of material: Non-critical materials shall be used wherever practicable when performance, interchangeability or reliability will not be adversely affected or production significantly altered.

3.1.7 Threads: Pipe threads shall not be used except for permanently installed pipe-threaded plugs and shall not be used in high strength aluminum, steel and corrosion-resisting steel. Straight screw threads shall be in accordance with Specification MIL-S-7742. Thread inserts may be used subject to the limitations of Standard MS 33633.

3.1.8 Locking of parts: All threaded parts shall be securely locked by safety wiring, self-locking nuts, cotter pins or other approved methods. Safety wire shall conform to Standard MS 20995 and shall be used in accordance with Standard MS 33540. Self-locking nuts shall conform to Specification MIL-H-25027 and shall be used in accordance with Standard MS 33588. Staking and use of lock washers is not permitted.

3.1.9 Snap rings: Snap rings shall not be used where improper installation or dislocation of the ring would cause failure of any component or assembly. Snap rings shall not be used where the accumulation of tolerances could allow destructive end play or looseness. Snap rings shall not be used internally in equipment. Snap rings may be used to lock bearing pins, non-pressurized end caps, etc. in place. Snap rings shall be capable of being installed and removed with standard pin-type pliers or other standard tools.

3.1.10 Spring pins: Spring pins may be used in accordance with Standards 33547. Spring pins are not acceptable in hydraulic systems.

3.1.11 Marking of fluid lines: Fluid lines shall be identified in accordance with Standard AND 10375.

3.1.12 Cleaning: All parts, components and equipment shall be clean and free from dirt, sand, metal chips, and other foreign matter during and after assembly.

3.2 Air refueling systems.

3.2.1 Probe and drogue: The air refueling system shall utilize probe and drogue type equipment.

3.2.2 Compatibility: It is a design objective to make each tanker suitable for refueling models

of receiver aircraft and to make each receiver suitable for refueling from all drogue tankers including those of the U. S. Air Force.

3.2.3 Formation: The formation shall place the nose of the receiver aircraft aft of the tail of the tanker when engaged in refueling position at least 15 feet forward of full trail. It is a design objective to provide not less than fifteen feet of vertical separation between tanker and receiver aircraft.

3.2.4 Reliability: Reliability of the air refueling operation shall be the paramount consideration in design of air refueling systems and equipment. Simplicity is required. Features which are not required for reliable and safe accomplishment of the air refueling operation shall not be incorporated, It is not intended to achieve reliability by duplication of equipment or functions except as specifically required herein. Designs which have proven satisfactory in service shall be utilized for functional components and mechanisms.

3.2.5 Effect on aircraft performance: Receiver air refueling equipment and tanker permanent provisions shall. be designed to minimize the penalty to aerial performance and capability of the basic aircraft.

3.2.6 Communications: The air refueling system shall be suitable for accomplishing the air refueling operation during radio silence.

3.2.7 Refueling airspeed: Air refueling systems and equipment shall operate satisfactorily calibrated airspeeds from 200 knots up to and including 300 knots at Mach number not greater than 0.90.

3.2.8 Engagement: Air refueling systems and equipment shall operate satisfactorily when the receiver aircraft engages the tanker aircraft at relative speeds not greater than 10 feet per second.

3.2.9 Design conferences: Representatives of the contractor shall confer with the air refueling engineers of the Bureau of Naval Weapons during the development of air refueling systems. The purpose is to exchange information and to review proposed designs in advance of formal submittal of data. The contractor shall initiate the first conference as soon as the preliminary schematic diagram of the air refueling system has been prepared. Later conferences shall be arranged as significant developments occur throughout the program.

3.3 General equipment requirements.

3.3.1 Environment: Air refueling equipment shall function satisfactorily in ground and flight environmental conditions. Detail requirements will be included in equipment specifications prepared by the procuring activity or contractor based upon procedures of Specification MIL-E-5272 and the following conditions:

3.3.1.1 Temperature: Ambient temperatures of minus 65 degrees Fahrenheit to plus 160 degrees Fahrenheit. It is not intended that temperature shock tests be required.

3.3.1.2 Altitude: Operating altitudes from sea level up to 40,000 feet.

3.3.1.3 Corrosion resistance: In addition to salt spray resistance, equipment shall withstand accelerated corrosion conditions in accordance with Specification MIL-F-8615.

3.3.1.4 Vibration: Vibrational conditions encountered in flight. Equipment and tanks shall withstand tests in accordance with Specification MIL-E-5272 and Specification MIL-T-6396 as applicable.

3.3.1.5 Explosion: If appropriate, the explosion-producing characteristics of equipment shall be determines.

3.3.1.6 Temperature - altitude - humidity: If appropriate, equipment shall be required to demonstrate satisfactory operation under combined temperature - altitude - humidity conditions.

3.3.1.7 Shock: Inappropriate, the ability of equipment to withstand mechanical-shock shall be determined.

3.3.1.8 Fuel: Equipment subjected to fuel shall conform to the fuel resistance-requirements of Specification~LF-8615.

3.3.2 Hydraulics: Hydraulic systems associated with or part of air refueling equipment shall be in accordance with Specification MIL-H-5440. Hydraulic components shall conform to Specification MIL-H-8775.

3.3.3 Pneumatics: Pneumatic systems associated with or part of air refueling equipment shall be in accordance with Specification MIL-P-5518.

3.3.4 Maintainability.

3.3.4.1 Access: Functional equipment shall be arranged so that access is provided for preflight servicing adustment and routine maintenance without removing the tanker package from the aircraft. Hose reels shall be accessible for preflight servicing, adjustment and routine maintenance without removal from the tanker package.

3.3.4.2 Ground check: Provisions and procedures for ground operation checkout shall be adequate, simple and brief.

3.3.4.3 Ground handling: Tanker packages shall be of size and weight compatible with shipboard elevators and handling equipment. Equipment shall have provisions for hoisting, loading and transporting as required.

3.3.4.4 Ground support: The design objective is that air refueling equipment should not require special tools for assembly, disassembly, installation or adjustment. Support equipment for installation, ground operation checkout and maintenance shall be in accordance with Specification MIL-D-8512. Lists and drawings for such equipment shall conform to Specification MIL-D-8513.

3.4 Electrical systems.

3.4.1 Equipment: Selection and installation of electric equipment in air refueling systems shall be in accordance with Specification MIL-E-7080. Solenoids shall be in accordance with Specification MIL-S-4040. Limit switches shall be hermetically sealed and shall be in accordance with Specification MIL-S-6744. Relays shall be hermetically sealed and shall be in accordance with Specification MIL-R 63.06.

3.4.2 Connections: All external electrical connections shall be terminal connections in accordianoe with Specification MIL-T-7928 or environmental class connectors in accordance with Specification MIL-C-5015 and/or Specification MIL-C-26482. It shall not be possible to connect the eletrical leads to the wrong termdnals.

3.4.3 Circuit protection: The circuit protective devices shall be accessible to the pilot or crew

3.4.4 Bonding: All fuel transfer equipment shall be bonded in accordance with specification MIL-B-5087 to prevent buildup of static electrical charge by flowing fuel. The equipment shall be bonded to the airframe structure.

3.5 Fuel System: Air refueling systems shall be in accordance with applicable requirements of Specification MIL-F-17874 for installation and test of aircraft fuel systems.

3.5.1 Fuels: The system shall be suitable for transferring fuels conforming to Specification MIL-J-5624, Grades JP-4, and JP-5.

3.5.2 Pressure.

3.5.2.1 Operating pressure: Systems which require operating pressures in excess of 60 pounds per square inch gage (psig) shall withstand operating proof and burst pressure of 120, 240 and 360 psig respectively.

3.5.2.2 Pressure at coupling: Fuel pressure at the reception coupling throughout th range of flow rates shall. be regulated at 50 psig. The pressure shall be not greater than 55 psig for all flow rates including the no-flow condition. The reception coupling shall not be subjected to pump pressure during engagement and disengagement of receiver aircraft.

3.5.2.3 Surge: The surge pressure throughout the air refueling equipment for all conditions of flow and shutoff shall be not greater than the proof pressure of the system. Devices for relief of surge pressure shall not require spillage or dumping of fuel outside or the fuel system.

3.5.3 Transfer rate.

3.5.3.1 Tanker system.

3.5.3.1.1 Delivery: Tanker aircraft shall transfer fuel to receiver aircraft over the following range of flow rates:

Light attack tanker aircraft	0 to 200 gallons per minute or higher
Other tankeraircraft	O to 300 gallons per minute or higher

3.5.3.1.2 Replenishment: Tanker aircraft shall replenish the tanker package fuel at rates compatible with the delivery rates of 3.5.3.1.1. The design objective is to maintain the maximum flow rate for 5 minutes. The replenishment system shall permit continuous transfer to the receiver of all fuel available for air refueling.

3.5.3.2 Receiver system: Receiver aircraft shall accept fuel at flow rates determined by the fueling requienments of Specification MIL-F-17874. The following flow rates are desired when the pressure at the probe nozzle is 35 psig:

Fighter and light attack receiver aircraft	200 gpm or higher
Other receiver aircraft	300 gpm or higher

3.5.4 Meter: The tanker system shall include a meter to indicate in pounds the quantity of fuel transferred to the receiver. The indicator shall be calibrated in pounds of JP-5 fuel if a volumetric meter is used. The indicator shall easily be reset to zero. If specified, a preset feature to schedule the quantity of fuel to be transferred shall be provided.

3.5.5 Filling: Tanker packages containing fuel stowage shall have provisions for filling and defueling by the tanker aircraft pressure fueling system. Unless otherwise specified, gravity filler units shall not be included.

3.5.6 Jettisoning: Means shall be provided to jettison all fuel carried in the tanker packaged. Jettisoned fuel shall not impinge on the aircraft or tanker package. No fire or explosion hazards shall result from fuel jettisoning under any normal flight condition.

3.6 Tinker system operation: The design objective is fail-safe transfer of fuel to the receiver aircraft. The system shall be suitable functionally for emergency engagement and fuel transfer in event of failure of the hose response action. It shall be possible to transfer fuel to the receiver aircraft by gravity if necessary, in event the fuel pump does not function. The system shall be suitable for practice engagements by receiver aircraft without transfer of fuel.

3.6.1 Pump: The fuel pump and any other pressurizing means shall be provided with an automatic control so that, with the reel in TRAIL but not EMERGENCY TRAIL, pressure is removed from the system when less than 25 feet of hose is extended and when the hose is within 5 feet of the fully trailed position. The pump shall shut down in the emergency event that the hose or drogue is lost and the reel rewinds. The operator shall have control to turn the pump and any other pressurizing means on and off at any phase of the air refueling operation. When the hose reel is in EMERGENCY TRAIL, control power to the fuel pump shall be supplied from the emergency power bus.

3.6.2 Valve: A normally open fuel valve shall be provided upstream of the hose reel. If a preset feature to schedule the quantity of fuel to be transferred is specified the valve shall close automatically when the indicator reads zero. Otherwise the valve shall be closed only when the operator selects the closed Position for dry hookups, fuel jettisoning guillotining or other reason. The operator shall have control to close and to open the valve during any phase of air refueling. Hose reel operation in EMERGENCY TRAIL shall not preclude control of the fuel valve if normal power to it is available.

3.6.3 Hose reel: The hose reel operation is specified in 3.8.10 through 3.8.16. Emergency trail shall operate on emergency power.

3.6.3.1 Guillotine: The hose guillotine requirements are specified in 3.8.17. If the guillotine is installed in a tanker package that cannot be jettisoned from the aircraft, the guillotine shall operate on emergency power from a separate circuit with circuit breaker.

3.6.3.3.1 Operation: At the time the nose is guillotined the fuel valve shall be closed, the fuel pump shall be stopped, the hose reel shall be stopped and all electric power except that to the guillotine shall be off. This feature maybe accomplished automatically upon operation of the guillotine control switoh or may require propositioning of other control switches.

3.6.4 Fuel jettison: Fuel jettisoning is specified in 3.5.6. While fuel is being jettisoned directly from the tanker package all electric power to the tanker package except that to the fuel jettison system shall be off. This feature may be accomplished automatically upon operation of the fuel jettisoning control switch or may require propositioning of other control switches. Subsequent to guillio-tining the hose it shall shall be possible to jettison tanker package fuel.

3.6.5 Internal: The system shall provide fuel transfer in both directions between the tanker aircraft fuel system and the tanker package. The system for tanker aircraft carrying more than one type of fuel shall segregate the fuels so it is impossible to intermix the fuels-or-to transfer the wrong fuel to the tanker engines and to the receiver aircraft.

3.6.6 Failure analysis: A failure analysis of the tanker air refueling system shall be made and submitted. Failure analysis of the hose reel shall be included.

3.7 Tanker aircraft installation.

3.7.1 Convertibility: Air refueling equipment shall be assembled in a package so as to be readily installed and removed. Loose equipment items should be kept to a minimum. The elapsed time to install and check out the taker package shall be not greater than one hour for tanker external stores and three hours for fixed external pods and bomb-bay installations.

3.7.2 Arrangement: Tanker aircraft with a single air refueling station shall carry the tanker package on the longitudinal centerline of the aircraft. Internal tanker packages shall be located so that the hose emerges near the center of gravity of the aircraft.

3.7.3 Hose reel installation.

3.7.3.1 Performance: The hose reel with hose and drogue shall perform in accordance with all the requirements of 3.8 as installed in the tanker aircraft.

3.7.3.2 Drogue ejection: Spring force shall be provided to launch the drogue into the airstream. The coupling and drogue stowage arrangement shall not employ latches or other locking mechanisms which fasten the drogue in the stowed position.

3.7.4 Structural criteria.

3.7.4.1 Bomb-bay package and fixed external pod: Limit strength with design yield end design ultimate factors of 1.15 and 1.50 respectively shall be provided for the local inertial accelerations and for aerodynamic loads existent at the bomb-bay or pod location.

3.7.4.2 Tanker external stores: Strength shall be provided for the following conditions:

a. Loads in accordance with Specification MIL-A-8591. For arrested landings the store shall be considered 25 percent full of fuel. For landings ashore, the store shall be considered full of fuel.

b. Maximum equivalent airspeed of 600 knots at Mach number not greater than 1.0 with the drogue retracted.

3.7.4.3 Hose load: Strength shall be provided for the hose load in accordance with Specification MIL-A-8865.

3.7.5 Lighting.

3.7.5.1 Signal lights: The following signal lights shall be mounted adjacent to each other on the tanker aircraft in a position that is clearly visible to the pilot of the receiver aircraft during all phases of the air refueling operation:

a. A yellow light which is automatically turned on only when the hose is within 5 feet of the trailed position and the tanker is ready for engagement.

b. A red light which is automatically turned on when the hydraulic pressure at the hose reel is too low for proper response action.

c. A green light which is automatically turned on when the fuel is being transferred to the receiver. The light shall be controlled by a primary element which senses actual fuel flow.

The yellow and red lights shall. function for both dry and wet engagements. Provisions for dinting the lights shall be included.

3.7.5.2 Hose light: A floodlight shall be provided to illuminate the air refueling hose at the area where it trails from the tanker. The color of the light shall be Aviation Red. The light shall be installed or shielded in such a manner as to prevent the light from being a source of direct or reflected glare to the tanker and receiver pilot or crew.

3.7.6 Tanks: Tanker packages that include fuel tanks shall be in accordance with applicable requirements of Specification MIL-T-6396 for removable tanks and Specification MIL-T-18847 for external tanks.

3.7.8 Tanker external stores: Requirements for the tanker external stores are incorporated in the detail specifications for the Aircraft Weapons Systems that carry such stores It is intended that an existing qualified tanker external store be used.

3.8 Hose reels: Hose and reel equipment shall be used to transfer fuel in-flight. The reel shall be hydraulic driven, automatically controlled and electrically operated from a remote control panel. If feasible an existing qualified hose reel or a modification thereof shall be used.

3.8.1 Operating life: The design objective is 500 hours of operation without lubrication, adjustment or replacement of parts. The hose reel shall endure 1000 cycles of operation without lubrication, adjustment or replacement of parts except the fuel hose.

3.8.2 Lubrication: The hose reel shall require no lubrication,

3.8.3 Drive: A hydraulic motor shall power the hose reel drum and serving gear which shall be provided The The mecanical power transmission system may use gearing, shafting, or chain. It is not required that the hose reel be powered in the trail direction, The hydraulic drive system shall control the trail function so that friction brakes will not be employed.

3.8.4 Construction: The hose reel shall withstand the loads, vibration and shook encountered in, shipping, installation and service. Hoisting lugs or pads shall be provided. Reel construction shall afford ease qf adjustment and repair.

3.8.5 Hose installations Particular attention shall be given to the hose installation on the reel in order to increase the service life of the hose. The hose reel drum shall be grooved to support the hose wrapped on it. All areas where the hose rubs when moving shall be designed to reduce friction and wear. The hose shall not be subjected to sharp local bending at any point including the serving gear. The hose reel drum diameter shall be not less than seven times as large as the nominal hose size (inside diameter of the hose).

3.8.6 Loads: The hose reel shall withstand 115 percent of both the basic aircraft design limit loads and design disconnect loads, which shall be called out in the procurement specification, without incurring malfunction or permanent set that will adversely affect operation of the unit. In addition, the hose reel assembly shall withstand 150 percent of these loads without structural failure. Loads apply with the hose on the reel and full of fuel. The limit disconnect load shall be calculated as follows :

D . Aerodynamic drag of fully-trailed hose and drogue at speed and altitude for maximum dynamic pressure.
W = Weight of hose full of fuel plus coupling and drogue.
L = Aerodynamic lift of fully-trailed hose.

The limit disconnect load is applied along both the centerline and the extremities of a 40 degree cone centered about the normal lay of the hose when extended during flight.

3.8.7 Fuel system: The hose reel shall withstand operating, proof and burst pressures of 120, 240 and 360 pounds per square inch gage (psig) respectively. There shall be no leakage, damage or permanent sat when the hose reel is subjected to 240 psig fuel pressure for five minutes. There shall be no leakage or rupture when the hose reel is subjected to 360 psig fuel pressure for one minute.

3.8.8 Electrical system: The hose reel shall utilize D.C. power having characteristics in accordance with MIL-STD-704 for Category C.

3.8.9 Hydraulic system: An accumulator may be used to augment the hydraulic supply available to the reel.

3.8.9.1 Filter: Hose reels powered by an aircraft hydraulic system shall be provided with a filter at the inlet the reel hydraulic system.

3.8.9.2 Low pressure An electrical circuit shall be provided for remote indication when hydraulic pressure at the reel is less than that required for its normal operation.

3.8.10 Control system: The reel shall have provisions for remote electrical control of its operation, The selected operating condition shall function automatically.

3.8.11 Trail: When TRAIL is selected the hose and drogue shall extend at an average speed not less than 5 feet per second (fps) and not greater than 10 fps. The speed shall be snubbed as the trailed position is reached. Reels carrying more than 60 feet of hose shall have previsions for setting the trail length to the desired amount. The trail length is required to be set on the ground only.

3.8.12 Response: Upon engagement by a receiver aircraft the hose reel shall accelerate the boss to rewind at a speed of 10 fps within 1 second. The response action shall prevent hose whip, looping, oscillation and excessive slack at an engagement speed of 10 fps throughout the airspeed envelope. The response action shall not interfere with complete engagement of the nozzle and reception coupling at an engagement speed as slow as 2 fps. The response action shall prevent excessive slack and inadvertent disconnect throughout the air refueling operation.

3.8.13 Fueling: An electrical circuit shall be provided to control automatically a fuel pump in the tanker fuel system. The pump shall be off when less than 25 feet of hose is extended and when the hose is within 5 feet of the trailed position. The pump shall shut down in the emergency event of loss of the hose or drogue while trailed.

3.8.14 Rewind: When REWIND is selected the hose and drogue shall retract at an average speed not less than 5 fps. The speed shall be snubbed as the drogue nears the stowed Position. Power shall be sufficient completely to rewind the hose and drogue throughout the airspeed envelope. The rewind control system shall not depend upon actuation of switches by the coupling drogue assembly as it reaches the stowed position to stop the reel,

3.8.15 Reel lock: Means shall be provided to prevent the reel from unwinding the hose when the drogue is stowed and the reel control switch is in REWIND or OFF. If a mechanical lock is used an electrical circuit shall be provided to indicate when the look is engaged. The indication shall be given only when the lock is fully engaged and shall not require adjustment or rigging. With the reel control switch in TRAIL the reel lock shall be unlatched by hydraulic actuation.

3.6.16 Emergency trail: In the event of loss of hydraulic pressure to the reel lock with the drogue stowed the lock shall be unlatched by electrical actuation when EMERGENCY TRAIL is selected. The hose and drogue shall extend to the trail position at a controlled rate of speed that will not damage the equipment. In the event of loss of hydraulic power and/or electrical power supplied to the hose reel after the reel lock has been unlatched by either TRAIL or EMERGENCY TRAIL actuation the hose and drogue snall extend to the trail position at a controlled rate of speed that will not. damage the equipment.

3.8.17 Hose jettison: A guillotine shall be incorporated in the hose reel seining gear fair-lead.

3.8.17.1 Actuation: The guillotine shall be actuated by a Navy approved standard cartridge. Design and evaluation of the guillotine and cartridge shall be in accordance with Specification MIL-D-21625.. The guillotine shall be explosion proof in that actuation of the unit shall not ignite a surrounding explosive fuel mixture.

3.8.17.2 Functional: The guillotine shall cut the hose cleanly, shall freely separate the downstream portion and shall seal both ends of the hose. The sealed end of the hose remaining on the hose reel shall withstand a fuel pressure of 55 pounds per square inch gage without leakage. The guillotine shall function as specified throughout the airspeed envelope with the hose and drogue extended to any trail position.

3.8.18 Painting: Hose reels shall be finished with two coats of primer in accordance with Specification MIl-P-7962 and two coats of gray laoquer in accordance with Specification MIL-L-19537.

3.9 Air refuling hose: Unless otherwise specified the hose shall conform to Specification MIL-H-4495, Type I. Hose fittings shall be readily replaceable by use of simple hand tools, Fittings shall not cut or damage the hose in service. An external spring shall be provided at the trailing end of the hose to prevent local bending or kinking. The hose assembly shall withstand 500 cycles of hose reel operation without requiring replacement.

3.12 Reception Coupling: The reception coupling snall conform to Specification MIL-C-25162. The tanker shall be suitable for use of any qualified brand of reception coupling. No modification shall be required to any part of the reception coupling to accommodate it to the installation.

3.13 Drogue: The drogue shall be approved by the Bureau of Naval Weapons.

3.14 Control panels: Panels shall be in accordance with Specification MIL-C- 18012. Controls and indicators shall be provided as necessary for all functions and shall include the following:

Reel trail and rewind control

Fuel valve control

Fuel pump control

Emergency trail control

Guillotine switch with guard

Light dimming switch

Fuel meter indicator

Signal lights:

Drogue stowed with reel locked: White

Drogue at full trail ready for engagement: Yellow

Low hydraulic pressure: Red

Fuel flowing: Green

Controls for emergency functions shall be grouped together in an area of the panel separate from the other switchest.

3.15 Receiver aircraft probes.

3.15.1 Location: The design objective is to locate the probe so that its tip or nozzle is comfortably within the receiver pilot's direct vision as he views the tanker aircraft and the extended drogue during closure to engagement. The nozzle shall be visible to the receiver pilot through the windshielci The nozzle shall be located as high and far forward as practicable and near the longitudinal centerline of the aircraft. kind tunnel investigation shall be made to determine a probe location such that stability of the drogue is not adversely affected by the air flow field around the receiver aircraft during closure to engagement. The probe installation shall not adversely affect airflow distribution of the engine air induction system or other air scoop inlets.

3.15.2 Installation: Probes may be fixed or retractable. Fixed probes shall not interfere with the pilot's vision of carrier landing systems. Fixed probe installations shall be compatible with handling of the aircraft on elevators and decks of aircraft carrier. The shape of all probes shall be suitable for engaging the reception coupling with all sizes of collapsible drogues which have an outside diameter not greater than 34 inches, target diameter not less than 22 inches and length not greater than 20 inches. There shall. be no physical interferered between the probe and the drogue nor the drogue and the receiver aircraft. Probe fairings, doors and actuating mechanisms shall be made so that the drogue cannot hang up thereon.

3.15.3 Strength: Probe strength shall be in accordance with Specification MIL-A-8865. Retractable probes shall be capable of extension and retraction at calibrated airspeeds up to 400 knots.

3.15.4 Mechanisms: Actuating mechanisms for retractable probes shall be simple and shall not require complicated rigging or close adjustment of linkages. The probe shall be positively locked in the extended position. Telescoping probes shall. not allow fuel between the inner and outer tubes.

3.15.5 Fuel line: The probe nozzle shall conform to Specification MIL-N-25161. A check valve shall be installed between the probe and the aircraft fuel system. Installation of the fuel line shall be in accordance with Specification MIL-I-18802. Unless specifically approved the fuel line shall not pass through gun or rocket compartments. If such an arrangement is approved the line shall be protected from links, brass and rocket debris encountered during firing.

3.15.6 Light: A probe light in accordance with Specification MIL-L-006730 as a design objective shall be provided. The probe light shall be controlled ON and OFF by a switch in the cockpit for that purpose. The light shall be installed or shielded in such a manner as to prevent the light from being a source of direct or reflected glare to the pilot or crew.

3.16 Marking: All marking shall be durable and not subject to effacing or obliteration in service. The part number shall be located so as to be easily seen. Stamping shall be avoided. Identification plates shall conform to Specification MIL-P-6906.

3.16.1 Equipment: An identification plate shall be securely fastened to each piece of air refueling equipment and shall contain the following information:

Name of equipment

Manufacturers name or trademark, model

number, part number and serial number

Weight

3.17 Engineering data: Requirements of Specification MIL-D-8706 for design data are applicable.

3.17.1 Aerodynamic: Aerodynmic investigations and models needed to meet the aerodynamic requirements as specified in 3.15.1 shall be provided for and data and reports shall be submitted as part of and in accordance with Specification MIL-D-8706 concerning aerodynamic investigations, supplemented if necessary by additional reports.

4. Quality Assurance Provisions.

4.1 Unless otherwise specified herein the supplier is responsible for the performance of all inspection requirements prior to submission for Government inspection and acceptance. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. Inspection records of the examinations and tests shall be kept complete and available to the Government as specified in the contract or order.

4.2 Preliminary flight tests: If feasible, tanker and receiver aircraft shall be flight tested prior to production of air refueling equipment to determine that the system affords a satisfactory formation for ease of engagement and refueling. Dummy probes may be used to evaluate proposed locations. Test-rig hose and drogue installations may be used. Fuel transfer is not necessary.

4.3 Tanker aircraft: The test program shall consist of two phases; ground and flight.

4.3.1 Ground tests: Ground tests shall include the following tests of the tanker package integrated with the basic airplane fuel system.

4.3.1.1 Convertibility: Interchangeability and replaceability of the aircraft configuration from the basic aircraft to a tanker version shall be made to determine that conversion time and time required to functionally check the tanker equipment comply with 3.7.1.

4.3.1.2 Fuel calibration: The total and usable capacities of tanker package fuel tanks shall be determined.

4.3.1.3 Fueling: Pressure refueling and defueling rates of the tanker configured aircraft shall be measured to determine compliance with requirements of Specification MIL-F-17874.

4.3.1.4 Taxi: Ground taxi or towing tests of the fully serviced tanker aircraft shall be conducted to determine compliance with requirements of Specification MIL-F-17874.

4.3.1.5 Functional: A functional checkout with the tanker package installed shall be performed to demonstrate that the hose reels, pumps and associated systems are operable and properly adjusted. The complete fuel system installed as part of the tanker package including the lines, hose reel, hose and reception coupling shall be proof-pressure tested. Fuel transfer tests shall be conducted and the fuel pressure at the inlet to the reception coupling shall be determined over the range of flow rates. Surge pressures in the tanker fuel system shall be determined for conditions of pump start-up and for fuel shut-off both by simulated receiver aircraft automatic fuel level control and by inadvertent disengagement by the receiver aircraft with fuel flowing at maximum rate.

4.3.1.6 Structural: Tanker external store and pod installations shall be structurally tested to design ultimate load, most critical condition to failure, for critical conditions of the installation.

4.3.2 Flight tests: Flight tests of the tanker aircraft shall be conducted to determined the performance envelope of minimum and maximum air refueling speeds from 500 feet to maximum altitude.

4.3.2.1 Trail and rewind: Drogue extension and retraction with fuel in the hose shall be performed at 15,000 feet altitude and at 40,000 feet altitude (or maximum attainable altitude if lower than 40,000 feet). Extension and retraction shall be performed at both the minimum and maximum speeds of the air refueling envelope at each altitude. The minimum airspeed at which the drogue will remain fully extended shall be determined. Compliance with 3.8.11. and 3.8.14 shall be demonstrated. Multi-point tankers shall have all stations evaluated both singly and concurrently.

4.3.2.2 Refueling: Engagement by receiver aicraft, fuel transfer and disengagement shall be accomplished at the speeds and altitudes of 4.3.2.1 to determine compliance with 3.6.3.8.12 and 3.8.13. Multi-point tankers shall have all stations evaluated both singly and concurrently. Also, one refueling operation shall be conducted at 500 feet altitude at maximum refueling speed in light turbulence. One refueling operation at high altitude shall include transfer of the maximum available quantity of fuel from the tanker.

4,3.2.3 Emergency; All emergency provisions shall be demonstrated to determine compliance with 3.5.6, 3.6, 3.8.16 and 3.8.17.2 One emergency drogue extension, engagement and fuel transfer shall be performed. Tanker package fuel jettisoning shall be demonstrated at maximum air refueling speed at 5,000 feet altitude. Jettisoning of droppable tanker packages shall be demonstrated with dummy packages at 500 feet altitude at takeoff speed full of fuel with the drogue retracted and at maximum air refueling speed empty of fuel with the drogue extended. Hose jettisoning shall be demonstrated at maximum air refueling speed at 5,000 feet altitude.

4.3.2.4 Lighting: One air refueling operation shall be performed at night under conditions of darkness without moonlight. Multi-point tankers shall have all stations evaluated concurrently.

4.3.2.5 Other demonstrations: Structural, aerodynamic, and carrier suitability demonstrations shall be performed as applicable and as required.

4.4 Receiver aircraft.

4.4.1 Ground tests.

4.4.1.1 Functional: The installed probe shall be proof-pressure tested and functionally tested. Fuel transfer rates shall be determined for pressure up to 55 psig at the probe nozzle. Surge pressures in the receiver system shall be measured to determine compliance with requirements of Specification MIL-F-17874.

4.4.1.2 Mechanical: Retractable probes shall be operated to demonstrate extension and retraction.

4.4.1.3 Structural: The probe installation shall be structurally tested to determine compliance with 3.15.3.

4.4.2 Flight tests.

4.4.2.2 Engagement; Engagements shall be made to determine compliance with 3.15.1.

4.4.2.2 Refueling: Engagement, fuel transfer and disengagement shall be accomplished to determine the

optimum engagement procedure and conformance to 3.5.3.2.

4.4.2.3 Performance: The receiver air refueling performance envelops of minimum and maximum speeds for satisfactory refueling operations from 500 feet to maximum altitude shall be determined, Engagement and fuel transfer at light weight simulating the emergency refueling condition shall be demonstrated. Engagement and fuel transfer to the full fuel loading shall be demonstrated with the receiver aircraft in configuration representative of a long-range mission.

4.4.2.4 Lighting: Air refueling shall be demonstrated at night under conditions of darkness without moonlight.

4.5 Safety: All tanker and receiver installations shall be tested as necessary to demonstrate safety with respect to fire and explosive hazards associated with the air refueling operation such as but not limited to fuel system leakage, operation of electronic and electrical equipment, explosive devices and firing of armament subsequent to refueling.

4.6 Equipment: The detail specification or drawing prepared by the procuring activity or contractor for air refueling equipment shall contain all inspection and test requirements necessary to demonstrate conformance to this specification.

5. Preparation for delivery.

5.1 Preservation and packaging: All tanker packages and air refuling equipment that have contained fuel shall be completely drained of fuel and shall be purged prior to delivery. This requirement also applies to empty tanker packages delivered in or on the aircraft.

5.1.1 Level A: Air refueling equipment shall be preserved and packaged in accordance with Method I, Ia, or II of Specification MIL-P-116, as applicable. Openings shall be protected against the entrance of dirt or other foreign matter by closures in accordance with Specification MIL-C-5501.

5.1.2 Level C: Air refueling equipment shall be preserved and packaged in accordance with standard commercial practice.

5.2 Packing.

5.2.1 Level A: Air refueling equipment shall be packed as specified in Specification MIL-P-7936 for overseas shipment. Tanker external stores shall be packed in reusable pressurized shipping containers.

5.2.2 Level B: Air refueling equipment shall be packed as specified in Specification MIL-P-7936 for domestic shipment and storage. Tanker external stores shall be packed in reusable pressurized shipping containers,

5.2.3 Level C: Air refueling equipment shall be packed in substantial commercial exterior shipping containers so as to insure safe arrival, at the lowest cost, to the point of delivery. The containers shall conform with the Consolidated Freight Classification Rules in effect at time of shipment.

5.3 Marking: All interior and exterior containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Ordering data: Ordering data for air refueling equipment shall specify the desired level of packaging and packing.

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

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

SPECIFICATION

ORGANIZATION *(Of submitter)* | CITY AND STATE

CONTRACT NO. | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT $

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

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

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

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

SUBMITTED BY *(Printed or typed name and activity)* | DATE

DD, FORM 1426 APR 63 NAVSHIPS FORM 4863, WHICH IS OBSOLETE

C-8279