

MIL-I-18802A(WEP)

13 March 1962

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## MILITARY SPECIFICATION

### FUEL AND OIL LINES, AIRCRAFT, INSTALLATION OF

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

#### 1. SCOPE

1.1 Scope. This specification covers the requirements for installation of fuel and oil lines in aircraft, except those lines furnished as part of the engine.

#### 2. APPLICABLE DOCUMENTS

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

#### SPECIFICATIONS

##### Federal

- WW-T-787 Tubing, Aluminum-Alloy, Round, Square, Rectangular and other Shapes, Seamless Drawn, 5052
- WW-T-789 Tubing, Aluminum-Alloy, Round, Square, Rectangular and other Shapes, Seamless Drawn, 6061 and 6062

##### Military

- MIL-B-5087 Bonding, Electrical (for aircraft)
- MIL-T-5578 Tank, Fuel, Aircraft, Self-Sealing
- MIL-T-5579 Tank, Self-Sealing Oil, Aircraft
- MIL-T-6396 Tank, Fuel, Oil, Water-Alcohol, Aircraft, Non-Self-Sealing, Removable, Internal
- MIL-S-7742 Screw Threads, Standard, Optimum Selected Series: General Specification for
- MIL-T-8606 Tubing, Steel, Corrosion-Resistant (18-8 Stabilized)
- MIL-H-8794 Hose, Rubber, Hydraulic, Pneumatic, Fuel and Oil Resistant

FSC-2915

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MIL-H-8795	Hose Assemblies, Hydraulic, Pneumatic, Fuel and Oil Resistant
MIL-F-18280	Fittings, Flareless, Fluid Connection
MIL-F-18287	Fittings, Hose End, Detachable (for Self-Sealing Fuel Hose)
MIL-T-18847	Tank, Fuel, Aircraft, Auxiliary External, Design and Installation of
MIL-C-22263	Coupling, Fuel Line, Flexible, 125 PSI
MIL-H-25579	Hose Assembly, Tetrafluoroethylene, High Temperature, Power Plant, Aircraft
JAN-A-669	Anti-Seize-Compound, White-Lead-Base, General Purpose (for Threaded Fittings)

## STANDARDS

Military

MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MS 21919	Clamp, Cushioned, Tube Support, Loop-Type, Aircraft
MS 28740	Fitting End, Hydraulic, Pneumatic, Fuel and Oil Hose
MS 28741	Hose Assembly, Detachable End Fittings, Medium Pressure
MS 33514	Fitting End, Standard Dimensions for Flareless Tube Connections and Gasket Seal
MS 33515 <sup>f</sup>	Fitting End, Standard Dimensions for Bulkhead Flareless Tube Connections
MS 33583	Tubing End, Standard Dimensions for Double Flare
MS 33584	Tubing End, Standard Dimensions for Flared
MS 33586	Metals, Definitions of Dissimilar
MS 33611	Tube Bend Radii
MS 33656	Fitting End, Standard Dimensions for Flared
MS 33657	Fitting End, Standard Dimensions for Bulkhead Flared Tube Connections
MS 33786	Fitting Installations, Flared Tube and Hose, Swivel
MS 33790	Bend Data, Hose, Hydraulic, Pneumatic, Fuel and Oil, Minimum

Air Force-Navy Aeronautical

AND 10064	Fittings, Installation of Flared Tube Straight Threaded Connectors
AND 10104	Tubing, Steel, Corrosion-Resistant, Round, Standard Dimensions for
AND 10375	Colors, Fluid Line Identification
AN 735	Clamp, Loop-Type Bonding

(When requesting specifications, standards, publications and drawings refer to both title and number. Copies of this specification and applicable specifications may be obtained upon application to the Commanding Officer, Naval Aviation Supply Depot, Code CDS, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania.)

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### 3. REQUIREMENTS

3.1 Components. The approval and installation of components under this specification apply to static components as distinguished from such other components as pumps, valves, strainers, filters, filler units, filler caps, fuel c.g. control units, fuel transfer pressure regulators, fuel tank pressure control units. Static components will generally include lines, fittings and tanks.

3.2 Selection of specifications and standards: Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143 except as provided in 3.2.1 and 3.2.2.

3.2.1 Commercial parts. Commercial parts having suitable properties may be used where, on date of invitation for bids, there are no suitable standard parts. Commercial utility parts, such as screws, bolts, nuts, cotter pins, having suitable properties may be used provided:

- a. They can be replaced by standard parts (MS or AN) without alteration.
- b. The corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings.

3.2.2 Standard parts. With the exception of 3.2.1, MS and AN standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.3 Materials. Materials shall be suitable for the intended purpose and shall conform to applicable Government specifications.

3.3.1 Metals. Magnesium shall not be used in fuel and oil line installations.

3.3.2 Dissimilar Metals. Dissimilar metals, as outlined in Standard MS 33586, shall not be used in intimate contact with each other, unless suitably protected against electrolytic corrosion.

3.3.3 Screw Threads. Screw threads shall conform to Specification MIL-S-7742. Pipe threads shall not be used in fuel and oil line installations.

3.3.4 Plastics. Plastic lines shall not be used unless specifically approved by the Bureau of Naval Weapons.

3.4 Protection against fire. Within power plants compartments and other locations where fires are likely to occur as a result of flammable fluid leakage, all fluid carrying lines and other fluid containers shall be capable of enduring a 2000 F flame for a period of five (5) minutes without leakage, with fluid flow through the lines. The lines shall be approved flexible assemblies. Such approval shall be by the Bureau of Naval Weapons and will be based on the Contractor's requirements of the particular airplane installation involved.

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### 3.5 Design and Location.

3.5.1 Design of Line Installation. Fuel and oil lines shall be readily replaceable in service, and shall follow the simplest and most direct route possible, consistent with the airplane design. Piping connections shall be so located that they are readily accessible for inspection and maintenance. Fuel lines shall not be installed in cockpit or cabin areas. When fuel and oil lines pass through spaces containing possible ignition sources, they shall be located as low as practicable within the space. Fuel and oil shall not be led over exhaust or other high temperature piping and shall not parallel this piping within six (6) inches. Lines may cross within this distance if suitably protected with a shield or insulation.

3.5.2 Piping Selection. Pressure fuel lines may be of aluminum alloy tubing conforming to specifications WW-T-787 or WW-T-789, or of corrosion resistant steel tubing conforming to specification MIL-T-8606. Where flexible lines are required they shall conform to specification MIL-H-8795 and MIL-H-25579.

3.5.3 Fitting and Line Location. Where similar size lines are adjacent, fittings shall terminate at locations sufficiently separated to prevent cross connections of the lines.

3.5.4 Traps. Piping and fittings shall be installed with a minimum restriction to flow. Traps in which water, air or vapor can collect shall be avoided. Drains shall be provided for all trapped lines.

3.5.5 Vulnerability. Fuel and oil lines shall be routed to obtain maximum protection by the aircraft structure when subjected to gunfire. Such consideration shall be classed as secondary to requirements related to protection against fire. Fuel lines may be routed through fuel tanks.

3.5.6 Anti-Seize Compound. All male threads and metallic gaskets on fittings shall be coated with an anti-seize compound conforming to Specification JAN-A-669. Caution shall be taken to prevent any of the compound from entering the system.

3.5.7 Accessory Units. All accessory units such as filters, valves, etc., the weight or operation of which impose adverse stresses or vibration on the tubing, shall be supported by means other than the tubing. If rigid connections are used between accessories, then all accessories so connected shall be rigidly mounted on the same base.

3.5.8 Identification. Fuel and oil lines shall be identified by color markings in accordance with Standard AND 10375. Only stamping or etching shall be used for identification on any lines passing through fuel or oil tanks.

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3.5.9 Use of special fittings other than JAN, MS or AN standard fittings, will not be approved unless conclusive evidence of the need thereof is presented.

3.5.10 Approved special fittings, when authorized, shall conform to the applicable MS and AN standards as regards the means of making connections to mating parts, i.e., flares, threads, bosses and pads.

3.5.10.1 Bosses and pads to which fittings are attached, shall conform to the applicable MS, AN and AN standards.

3.5.10.2 Gaskets, O-rings and similar non-metallic parts shall conform to the applicable MS and AN standards, and shall be made of materials suitable for its design function in the fuel or oil system and for the particular fuel and/or oil designated in the aircraft detail specification.

3.5.11 Bonding. Fuel and oil lines shall be bonded in accordance with Specification MIL-B-5087 and Standard AN 735.

### 3.6 Metal Tubing Fuel and Oil Lines and Connections.

3.6.1 Selection. Fuel and oil system lines and connections shall be in accordance with the applicable MS and AN standards listed in paragraph 2 herein.

3.6.2 Material. Metal tubing shall be fabricated of aluminum alloy conforming to Specifications WW-T-787 and WW-T-789, or of corrosion resistant steel conforming to Specification MIL-T-8606.

3.6.3 Dimensions. Tubing shall be restricted to the sizes and wall thicknesses specified in Table I.

TABLE I TUBE SIZE AND WALL THICKNESS

Tube OD (inches)	Minimum Wall Thickness (inches)		
	Aluminum (Other than drain and vent lines)	CRES Steel	Drain and Vent Lines
1/4	.028	.016	
3/8	.028	.022	.022
1/2	.035	.028	.022
5/8	.042	.028	.028
3/4	.042	.028	.028
1	.049	.035	.035
1 1/4	.049	.035	.035
1 1/2	.049	.035	.035
2	.049	.035	.035
2 1/2	.055	.049	.035
3 and over	To be determined		

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NOTE. Aluminum fuel lines up to 2 inches OD located inside the tanks, may have wall thickness of .035 inch.

3.6.4 Tubing support. Tubing shall be adequately supported at approximately 24 inch intervals by the use of looped type cushioned clamp supports conforming to Standard MS 21919 except where such support will interfere with the proper performance of flexible connections. Cushioned clamp supports need not be provided inside fuel or oil tanks. Special care shall be taken to avoid the existence of unsupported sections of fuel and oil lines whose natural frequency will be such that dangerous amplitudes of vibration may occur in operation, thereby leading to tubing failure.

3.6.5 Tubing Bends. Bends shall be uniform without kinks or waves, with minimum bend radii conforming to Standard MS 33611.

## 3.6.6. Tubing Connections.

3.6.6.1 Flared Tube Connections. Solid connections for 1/4 and 3/8 inch aluminum alloy tubing shall use double flared tubing conforming to Standard MS 33584, and shall use MS or AN flared tube fittings. Connections for bulkheads and firewalls shall employ MS or AN flared tube fittings and fitting ends conforming to Standard MS 33657.

3.6.6.2 Flareless Connections. Flareless fittings shall conform to Specification MIL-F-18280,

3.6.7 Wrench Torque. To assemble flared tube joints, the wrench torque values shall conform to Standard AND 10064.

## 3.7 Flexible Hose Fuel and Oil Lines and Connections.

3.7.1 Flexible Couplings. Minimum of 1 inch OD flexible tube couplings may be used provided:

- a. They receive specific approval of the Bureau of Naval Weapons.
- b. They shall conform to Specification MIL-C-25014.
- c. They shall be kept to an absolute minimum.
- d. They are all of the same type.
- e. They shall meet the requirements of the installation as regards temperature, surge pressures, vibration, etc.

3.7.1.1 Alignment. Where a coupled joint is close to rigid structural attachments, the alignment and gap shall not exceed the prescribed requirements of the coupling manufacturer.

3.7.2 Flexible Bellows and Convoluted Tubing. Installations of this type may be used provided:

- a. They receive specific approval of the Bureau of Naval Weapons.
- b. The use is limited to fuel lines.

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3.7.3 Flexible Hose Assemblies. Hose assemblies shall conform to Specification MIL-H-8795 for flexible hose lines, and to Specification MIL-H-18288 for self-sealing hose lines.

3.7.3.1 Hose assemblies shall be so installed that, under either static of operating conditions, the complete hose assemblies shall not be subject to tension, compression, or torsional forces.

3.7.3.2 Dimensions. Hoses shall be restricted to the diameters listed in Specifications MIL-H-8794 or MIL-H-18288, as applicable.

3.7.3.3. Hose Support. Hoses shall be adequately supported by the use of looped type cushioned clamp supports conforming to Standard MS 21919.

3.7.3.4 Hose Bends. Bends shall be uniform with minimum bend radii conforming to Specification MIL-H-8795.

3.7.3.5 Hose Braiding. Flexible lines installed in fuel cells shall have no extruded material visible through the hose braid.

3.7.3.6 Tetrafluoroethylene Flexible Assemblies. Tetrafluoroethylene lines in conformance with Specification MIL-H-25579, may be used where required in the fuel system. Where moisture may collect under sleeved tetrafluoroethylene lines, the socket and nipple shall be of corrosion resistant material.

3.7.4 Flexible Connections. Flexible connections shall be used at points in the systems where vibrational and other stresses are such as to produce relative movements between the ends of parts of lines, which would render their connections with rigid fittings or metal tubing inadvisable. The use of connections which depend on a torqued bolt or bolts to provide clamping for attachment connections to fluid lines, shall be avoided. This type of connection may be approved by the Bureau of Naval Weapons for use on a particular installation provided evidence of need thereof is presented.

3.8 Vent and Drain Lines. All vent and drain lines shall terminate at a point outside the aircraft, and shall be so located or formed that drainage cannot be returned to any part of the aircraft structure or enter the exhaust wash from either upstream or downstream. Drains shall not be grouped.

3.8.1 Identification. In addition to the requirements of 3.5.10, vent and drain line outlets shall be identified by positive markings on the outside skin of the aircraft.

4. QUALITY ASSURANCE PROVISIONS. (Not applicable).

5. PREPARATION FOR DELIVERY. (Not applicable).

6. NOTES. (Not applicable).

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**NOTICE:** When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 119-R004
<b>INSTRUCTIONS</b>		
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		
<input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> 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?		
<input type="checkbox"/> YES <input type="checkbox"/> 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

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