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MILITARY SPECIFICATION

TANKS, FUEL, AIRCRAFT, AUXILIARY EXTERNAL, DESIGN AND INSTALLATION OF

This specification is approved for use within the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers requirements for the design, test, and installation of auxiliary external aircraft fuel tanks.

1.2 Classification. Auxillary external aircraft fuel tanks covered by this specification shall be of the following types:

Type I - Non-survivable fuel tank

Type II - Survivable fuel tank

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

TT-S-735	Standard Test Fluids, Hydrocarbon
MMM-A-132	Adhesives, Heat Resistant, Airframe Structural, Metal to Metal
PPP-B-636	Boxes, Shipping, Fiberboard

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Air Engineering Center, Systems Engineering and Standardization Department (Code 93), Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1560

MILITARY

MIL-P-116	Preservation, Methods of
DOD-D-1000	Drawings, Engineering and Associated List
MIL-B-5087	Bonding, Electrical, and Lightning Protection, for Aerospace Systems
MIL-C-5501	Cap and Plug, Protective, Dust and Moisture Seal
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-T-6396	Tanks, Aircraft, Propulsion Fluid System, Removable, Non-self-sealing
MIL-C-6529	Corrosion Preventative, Aircraft Engine
MIL-W-6858	Welding Resistance, Spot and Seam
MIL-F-7179	Finishes, Coatings, and Sealants for the Protection of Aerospace Weapon Systems
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-D-8512	Support Equipment, Aeronautical, Special, General Specification for the Design of
MIL-A-8591	Airborne Stores, Suspension Equipment, and Aircraft Store Interface (Carriage Phase), General Design Criteria for
MIL-W-8604	Welding, Fusion, Aluminum Alloys, Process and Performance of
MIL-F-8615	Fuel System Components, General Specification for
MIL-D-8708	Demonstration Requirements for Airplanes
MIL-F-8785	Flying Qualities of Piloted Airplanes
MIL-A-8868	Airplane Strength and Rigidity Data and Reports
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-C-9084	Cloth, Glass, Finished, for Resin Laminates
MIL-R-9299	Resin, Phenolic, Laminating
MIL-F-17874	Fuel Systems, Aircraft, Installation and Test of
MIL-I-18802	Installation of Fuel and Oil Lines, Aircraft
MIL-R-21931	Resin, Epoxy
MIL-C-38373	Cap, Fluid Tank Filler
MIL-P-38477	Plastic Material, Pressure Sensitive Adhesive for Aerospace Identification and Marking
MIL-C-52950	Crates, Wood, Open and Covered
MIL-R-60346	Roving, Glass, Fibrous (for Prepreg Tape and Roving, Filament Winding, and Pultrusion Applications)
MIL-V-81356	Valve, Fuel System Pressurization and Vent
MIL-C-81986	Core Material, Plastic Honeycomb, Nylon Paper Base, For Aircraft Structural Applications

STANDARDS

FEDERAL

FED-STD-141	Paint, Varnish, Lacquer, and Related Materials: Methods for Sampling and Testing

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-453	Inspection, Radiographic
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-889	Dissimilar Metals
MIL-STD-1515	Fastener Systems for Aerospace Applications
MI L-STD-1523	Age Controls of Age Sensitive Elastomeric Materiel (for Aerospace Applications)
MIL-STD-1595	Qualification of Aircraft, Missile and Aerospace Fusion Welders
MIL-STD-6866	Inspection, Liquid Penetrant
MS29571	Valve, Fuel Drain, Self-Locking, Flush Type
MS33540	Safety Wiring and Cotter Pinning, General Practice for

2.1.2 Other Government documents, drawings, and publications. The following other Government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

NAVAL AIR SYSTEMS COMMAND

SD-24 Vol. I and Vol. II	General Specification for Design and Construction of Aircraft Weapons Systems
MIL-BULL-147	Specifications and Standards of Non-government Organizations Released for Flight Vehicle Construction
MIL-BULL-544	List of Federal/Military/Industry Specifications and Standards and NAVAIR Series Documents Approved by the Naval Air Systems Command

(Copies of specifications, standards, handbooks, drawings, publications and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the Issues of documents not listed in the DODISS shall be the Issue of the nongovernment documents which Is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-F22	Hydrophobic Surface Films by the Water-Break Test, Test Method for
*ASTM-D1002	Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal), Test Method for
*ASTM-D2583	Indentation Hardness of Rigid Plastics by Means of a Barcol Impresser, Test Method for
*ASTM-D3951	Commercial Packaging, Practice for

*DOD Adopted

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

ASD-M10357	ICU Polyisocyanurate Foam (Avco Systems Division)

(Application for copies should be addressed to the AVCO Systems Division, 201 Lowell Street, Wilmington, MA 01887.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 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, MIL-BULL-147, and MIL-BULL-544.

3.2 Type I and Type II tanks. Unless otherwise specified, the following paragraphs pertain to both Type I (non-survivable) and Type II (survivable) external fuel tanks.

3.3 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3.1 and 6.3).

3.4 Materials. Materials shall conform to applicable specifications and shall be as specified herein. Materials which are not covered by applicable specifications, or which are not specifically described herein, shall be of the best quality, of the lightest practical weight, and suitable for the purpose intended.

3.4.1 Metals. Metals used in this tanker its components shall be of the corrosion-resisting type or suitably treated to resist corrosion in fuels, salt spray, or atmospheric conditions during the service life of the tank when in storage or in normal service use.

3.4.1.1 Dissimilar metals. Dissimilar metals as defined in MIL-STD-889 shall not be used in intimate contact with each other unless suitably protected against electrolytic corrosion.

3.5 General characteristics.

3.5.1 Design. External auxiliary fuel tanks shall be designed to carry fuel satisfactorily, without any leakage, under the conditions of Installation, vibration, temperature, pressure, and loadings (including accelerations of flight maneuvers, catapult take-off, and arrested landings) peculiar to the appicable aircraft. The fuel and air systems shall be designed to function satisfactorily under the foregoing conditions. All tanks shall be so designed that they shall be readily removable or jettisonable from the aircraft. Suspension provisions shall comply with the requirements of MIL-A-8591.

3.5.1.1 Design analysis. The contractor shall provide a design stress analysis report of the tank in accordance with MIL-A-8868, sixty days prior to initiation of the first article tests. One copy of the report shall be forwarded to the Commander, Naval Air Systems Command (AIR-53031, Washington, DC 20361-5300, for approval, and one copy to the Commander, Naval Air Development Center (Code 6013), Warminster, PA 18974-5000, for information.

3.5.1.2 Drawings. Drawings and associated lists shall be prepared in accordance with DOD-D-1000 Level III. Drawing submittal shall be in accordance with the data requirements of the contract.

3.5.1.3 Capacity. The usable capacity of the tank shall be not less than specified nor more than 110 percent of that specified. Sufficient gross capacity shall be provided to allow for expansion of fuel, but the gross capacity shall be not more than 115 percent of the specified capacity.

3.5.1 .3.1 Usable fuel. The usable fuel shall be in accordance with the tank gallon size specified in the contract.

3.5.1 .3.2 Unusable fuel. The tank shall have a maximum of 1 percent unusable fuel of the total usable fuel.

3.5.1 .3.3 Undrainable fuel. The tank shall have a maximum of one pint of undrainable fuel.

3.5.1. 3.4 Expansion space. The tank shall have an expansion space equivalent to 5 percent of the total usable fuel.

3.5.1.4 Weight. The completely assembled empty tank weight shall be designed to create the lightest weight tank.

3.5.1 .4.1 Tank center of gravity. The center of gravity location and travel with varying quantities of fuel within the tank shall be such that there shall be no adverse effects on the aircraft structure or aerodynamic characteristics that depend on center of gravity location at all attitudes of the aircraft that are otherwise allowable.

3.5.1.5 Fuel tank design loads.

3.5.1 .5.1 Rotary wing crashworthiness application. The tank must be able to withstand survivable or marginally survivable crash areas (see Figure 1) without leakage. The tank shall be in any fuel condition from empty to full.

3.5.1 .5.2 Strength. Strength shall be provided in the tank and suspension for the loads in accordance with MIL-A-8591 at the following weights:

a. Flight conditions: tank 3/4 full and tank empty

b. Catapulting conditions: tank full

c. Landing conditions: tank 1/4 full

The critical combination to be used for design shall be selected by the contractor and approved by the Naval Air Systems Command.

3.5.1. 5.3 Tank ejection load. The tank shall be capable of withstanding the ejection loads without rupture In accordance with MIL-A-8591.

3.5.1. 5.4 Cradling and handling areas. As a minimum, all tanks shall have cradling and handling areas capable of withstanding loads equal to three times the weight of the tank without permanent deformation.

3.5.1.6 Suspension. Tanks shall be provided with means of suspending the tank from the applicable aircraft. The location of the suspension system shall be in accordance with MIL-A-8591. The suspension lugs shall be removable.

3.5.1 .6.1 Sway brace area. The bomb rack sway brace pad areas shall be provided in accordance with MIL-A-8591.

3.5.1.7 Ejection area. The ejection area shall conform to the requirements of MIL-A-8591.

3.5.1.8 Pressures. The tank shall withstand the following pressures.

3.5.1 .8.1 Internal pressure. The internal pressure loads are as follows:

Operating:	15 psig
Proof:	75 psig
Burst:	112 psig

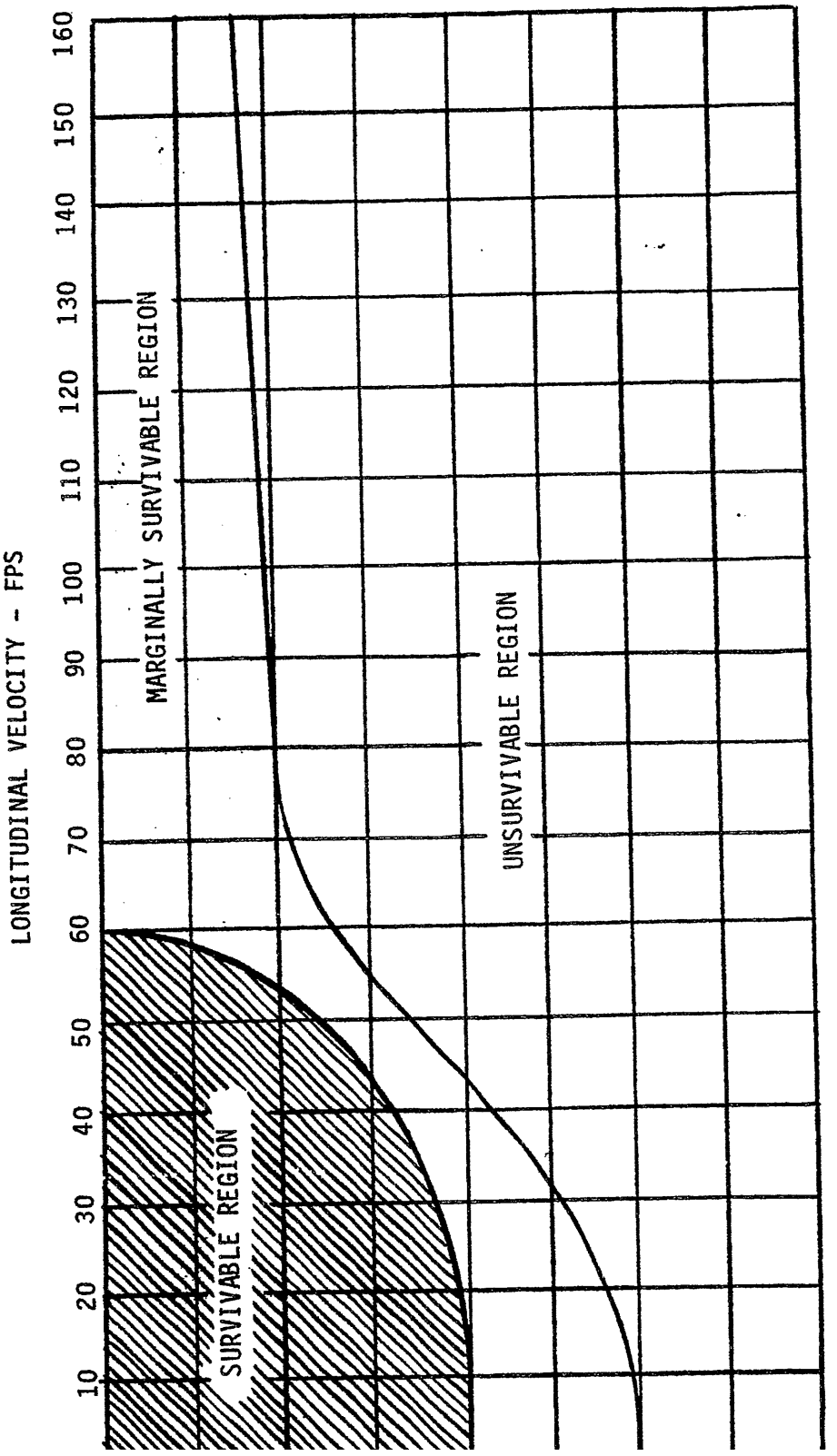

FIGURE 1. Initial impact velocities (Based on accident case histories of military and civilian aircraft).

3.5.1 .8.2 External (vacuum) pressure. The external vacuum pressure loads are as follows:

Operating:	0 psig
Proof:	10 psig negative
Burst:	12 psig negative

3.5.1.9 Fuel transfer system. The fuel transfer system shall be designed in accordance with MIL-F-17874 and allow for both ground and in-flight fueling and defueling of the fuel tank. The fuel tank fuel lines and connections and installation shall be in accordance with MIL-F-8615. Provisions shall be incorporated to prevent fuel spillage from the fuel and air connectors during jettison or disengagement from the aircraft.

3.5.1 .9.1 Pressure relief/vent valve. Unless otherwise specified, the tank shall be equipped with a pressure relief/vent valve that conforms to MIL-V-81356. If it is not practical to utilze a valve conforming to MIL-V-81356, the tank shall be equipped with a pressure relief valve. The valve shall be designed to remain closed when the pressure differential between the tank and ambient atmospheric pressure is less than 2 ± 0.5 psi above normal, and to open and relieve the excess fuel pressure when the differential is greater than 2 0.5 psi above normal. The pressure relief valve shall incorporate a means to prevent leakage of fuel during catapult and arrested landing.

3.5.1.9.1.1 External leakage. The pressure relief valve shall be capable of containing any pressure less than the relief setting without external leakage.

3.5.1.9.2 Vent fitting locations. When applicable, ram type vents shall be located at the forward part of the tank with a minimum vent diameter of 1/2 inch for tanks of 100 gallons capacity but less than 350 gallons, and 1-1/4 inch for tanks with a capacity equal to or greater than 350 gallons. The vent system shall be designed so that proper venting is obtained during flight maneuvers likely to be performed by the particular aircraft to which the tank is applied. Intercostals and annular frames attached to the top inner profile of the tank shall be vented sufficiently to allow entrapped air to pass freely to the external vent fitting. The design shall be such that siphoning or spillage shall be prevented in flight or during catapulting or arrested landings. The vents shall be designed to minimize entry of dirt, oil, or other foreign matter into the tank.

3.5. 1.9.3 Drain valves. The tank shall contain sufficient drain valves in accordance with MS29571-1. The drain valve shall be replaceable without entering the tank.

3.5.1.9.3.1 Drain location. A drain opening shall be provided at the low point resulting at the ground attitude of the aircraft for which the tank is designed. Where the tank is intended to be used on more than one model of aircraft, drain openings shall be provided at each low point resulting at the ground attitude of each applicable aircraft.

3.5.1 .9.3.1.1 Additional drain locations. In addition to the requirements of paragraph 3.5.1.9.301, drain locations shall be provided to accommodate future aircrafts. The drain openings for these additional locations shall be at the low points resulting from the following tank ground attitudes:

a. 1° nose down

b. level

c. 5° tail down

3.5.1.9.3.1.2 Separation of drain locations. Openings shall not be provided on centers less than 10 inches apart. In those cases where compliance with paragraphs 3.5.1.9.3.1 and 3.5.1.9.3.1.1 would result in drain openings located less than 10 inches apart, a single opening shall be provided at the point resulting in most complete drainage of each applicable installation.

3.5.1.10 Fuel quantity gaging. The fuel quantity gaging system shall be specified in the contract or purchase order (see 6.2).

3.5.1.11 Access openings. A minimum of one access opening shall be provided for access to plumbing and mounting connections. Access openings shall be large enough to ensure insertion or removal of all detachable internal hardware such as valves, tubing, switches, probes, etc.

3.5.1.12 Strainer. A non-corrosive fuel strainer of approximately 10 mesh wire (0.03 to 0.06 inch diameter) cloth shall be provided at the lower end of the fuel outlet line. The strainer shall be removable to permit cleaning when the tank is installed on the aircraft without entering the tank.

3.5.2 Tools for assembly. The tanks shall be constructed and assembled with manually operated tools. If special tools are required, both special tools and commercial standard tools shall be in accordance with MIL-D-8512.

3.5.3 Service connections. Quick disconnects shall be provided for fuel lines, pressure lines, and electrical wires between the tank and the aircraft, as approved by the Naval Air Systems Command.

3.5.3.1 Connection locations. Unless otherwise specified, the service connections shall be located on the tank upper surface in line with the suspension lugs. The connections shall be positioned and sized as follows: The fuel connection shall not exceed a 2-1/2 inch line size and its centerline shall be 5-1/4 inches aft of the centerline of the aft 30 inch suspension lug. The air connection shall not exceed a 1-1/2 inch line size and its centerline shall be 8-3/4 inches aft of the centerline of the aft 30 inch suspension lug. The electrical connector(s) shall be positioned in an area extending between 10-1/2 inches and 17-1/4 inches aft of the centerline of the aft 30 inch suspension lug.

3.5.3.2 Fuel line connection and installation. The tank fuel lines connections and installation shall be in accordance with MIL-I-18802 and MIL-F-17874.

3.5.4 Tank construction. For Type I and Type II application, the tank shall be manufactured from materials approved by the Naval Air Systems Command. The tank shell shall conform to the design requirements of 3.5.1.

3.5.4.1 Internal structure. The internal structure, such as frames, beams, and bulkheads, shall be capable of efficiently carrying all the fuel tank design loads of 3.5.1.5.

3.5.4.1.1 Internal stiffeners, baffles, and check-valves. Internal stiffeners, baffles, and check valves used shall be located as necessary to restrict the aft and forward shift of the center of gravity as specified in 3.5.1.4.1.

3.5.4.2 Line contour. The outside diameter of the tank shall be in accordance with the appropriate drawing.

3.5.4.3 Tank liner. The metallic tank liners or non-metallic tank liners shall be capable of carrying that portion of the composite design loads allocated to the liner.

3.5.4.3.1 Metallic liner. The metallic liners shall be constructed of aluminum or other material as approved by the Naval Air Systems Command and shall be welded and inspected in accordance with 3.5.4.4 through 3.5.4.7.

3.5.4.3.2 Non-metallic liner. The non-metallic liners shall be constructed of non-metallic materials that shall take into account-all factors which affect required strength, rigidity, and structural reliability. The material shall be fuel compatible and shall be permeability tested in accordance with MIL-T-6396. The material shall have a high strength-to-weight ratio with sufficient elastic modulus in the liner to achieve good dimensional and buckling stability. The fabrication of the liner shall involve state-of-the-art processes as approved by the Naval Air Systems Command.

3.5.4.4 Welding. Fusion welding on aluminum liners shall be in accordance with MIL-W-1604. Resistance, spot, and seam welding shall be In accordance with MIL-W-6858.

3.5.4.5 Welding certification. Welding shall be performed by personnel certified in accordance with MIL-STD-1595.

3.5.4.6 Welding X-ray inspection. X-ray inspection of welds shall be performed in accordance with MIL-STD-453 and acceptance criteria shall be in accordance with paragraph 4.6.2.1.

3.5.4.7 Dye penetrant inspection. The external welds shall be inspected in accordance with paragraph 4.6.2.2.

3.5.5 Fins. Provisions. shall be made for the attachment of stabilizing fins to the tail cone of the tank. These provisions shall be included to permit future use of the tank on other aircrafts. The provisions shall permit the fins to be mounted in either the horizontal or vertical positions, of 45° from the vertical position. The fin configuration shall be subject to approval by the Naval Air Systems Command (see 6.2).

3.5.6 Thread connections. Screw threads shall be in accordance with MIL-S-7742 or MIL-S-8879. The conditions governing the selection of the applicable threads are described in SD-24. All threaded parts shall be securely locked by safety wiring, metal type self-locking nuts, cotter pins, or other means approved by the Naval Air Systems Command.

3.5.6.1 Pipe threads. Pipe threads shall only be used for permanently installed pipe-threaded plugs.

3.5.6.2 Threaded safety. All threaded parts shall be positively locked or safetied in accordance with MS33540 or other accepted practice. Wherever loosening of a self-locking nut could possibly result in the nut or other parts entering the fuel system plumbing, approval of the installation shall be obtained from the procuring activity. The use of cotter pins on studs, or the use of lockwashers or staking is prohibited.

3.5.7 Fasteners. Fasteners shall be selected and used in accordance with MIL-STD-1515.

3.5.8 Maintainability. The tank shall be designed for ease of repair, Including complete overhaul. It shall be repairable by replacing defective components with serviceable ones. No test or additional adjustments shall be required other than a functional test. Special skills, techniques, non-standard tools, or excessive task time shall not be required. Ease of maintenance, accessibility, etc., will be major determinants in the design selection for procurement. The contractor shall provide a repair procedure.

3.5.9 Structural flight performance. The tanks, at the weight specified in 3.5.1.5.2. shall be designed to withstand the limit load factors of MIL-A-8591 while pressurized to 25 psig without any deformation that might adversely affect the aerodynamic characteristics as specified in 3.5.10 and 3.5.11.

3.5.10 Aerodynamic flight performance. The addition of external tanks to an aircraft, at the weights specified in 3.5.1.5.2, shall not adversely affect the characteristics of the aircraft on which they are installed to such an extent as to result in an Inability to comply with the aerodynamic flight performance requirements of MIL-D-8708 and MIL-F-8785.

3.5.11 Maximum permissible speeds. The change in maximum permissible speed of an aircraft as defined in MIL-F-8785 shall be kept to a minimum due to the addition of external fuel tanks.

3.5.12 Aircraft installation requirements. Ground clearance shall be in accordance with SD-24 - Vol I and Vol II for armament as applicable. The weight of permanent installation provisions shall be kept to a minimum. All installation provisions shall be kept to a minimum and shall be kept within the contours of the aircraft wherever practicable in order to minimize drag after the release of the tanks. The fuel tank installation shall be such as to prevent looseness during flight which would induce wing flutter, buffeting, or yawing of the aircraft. In addition, the following requirements shall apply:

a.Ground clearance shall be in accordance with SD-24 - Vol I and Vol II for armament. In addition, sufficient clearance and access shall be provided for installing, filling, draining, and removing the tank.

b. The catapult bridle, when taut, shall be not less than 4 inches away from the nearest part of the tank for fuselage installations and shall be not less than 6 inches from wing installations. The tank installation shall be designed so that when the catapult bridle is released, it shall not strike or hang up on any part of the tank installation.

c. On carrier type aircraft, the tank installation shall clear the catapult bridle and the catapult bridle shall not strike the tank at the end of the launching run.

d. The tank shall not obstruct a satisfactory barrier engagement of the aircraft.

3.6 Fueling.

3.6.1 Filling previsions. Provisions for gravity or pressure filling shall be incorporated as required by the applicable drawings, specifications, or purchase order (see 6.2).

3.6.2 Pressure fueling. The pressure fueling and transfer system-shall be designed and constructed to withstand and operate properly with internal fueling pressure of 60 psig.

3.6.3 Proof pressure. The pressure fueling and transfer system, exclusive of the tank shell, shall be capable of withstanding internal proof pressures of 120 psig. The external leakage shall be not greater than 31 cc per minute through the pilot valve and leakage shall be not greater than 0.5 cc per minute through the shut-off valve.

3.6.4 Burst pressure. The pressure fueling and transfer system, exclusive of the tank shell, shall be capable of withstanding an internal fuel burst pressure test of 180 psig. There shall be no evidence of rupture or breakage.

3.6.5 Design fueling rate. The tank pressure fueling system shall be capable of receiving fuel at flow rates of 50 gallons per minute at 20 psig measured at the fuel line quick disconnect nipple.

3.6.6 Maximum fueling rate. The pressure fueling equipment shall be capable of receiving fuel at a rate corresponding to 60 psig total pressure at the fuel line quick disconnect.

3.6.7 Fuel outlet line. Fuel outlet line(s) shall be provided and so located that connection to the fuel system of the aircraft on which the tank will be mounted shall be readily made, Such connection shall be leakproof but shall not prevent ready jettisoning of an empty or fuel tank. The fuel line shall be so arranged that all of the rated capacity of the tank may be utilized with the aircraft in a line flight attitude. In addition, the outlet location and the bottom of the tank shall be so designed that the maximum mount of fuel may be utilized with the aircraft in flight attitudes between normal angles of climb and glide. The suction line shall be so installed that it shall be free of restrictions and sharp bends.

3.6.7.1 Fuel outlet line support. The fuel outlet line shall be supported in the tank so that it will satisfactorily withstand any load, vibration, or acceleration conditions encountered in service. A means of definitely locating and securing the lower end of the suction line at the specified distance from the bottom of the tank shall be provided.

3.6.7.2 Gravity filler unit. Unless otherwise specified, where gravity filling provisions are required, a flush type filler cap in accordance with MIL-C-38373 shall be used. The adapter shall be as specified by the aircraft contractor and approved by the Naval Air Systems Command.

3.7 Environmental.

3.7.1 Temperature. The tank shall be capable of satisfying temperatures of -65° ± 5°F to +160° ± 5°F, with no evidence of any leakage when tested in accordance with 4.6.15.1.

3.7.2 Ultraviolet Light. The exposed tank components or the external surface of the tank shall not be affected by normal ultraviolet light exposure with the exception of external coating discoloration.

3.7.3 Fungus. The tank shall not be damaged by fungus when tested in accordance with 4.6.15.2.

3.7.4 Humidity. There shall be no visual sign of corrosion on the tank when tested in accordance with 4.6.15.3.

3.7.5 Salt fog. There shall be no visual sign of corrosion on the base metal when tested in accordance with 4.6.15.4.

3.7.6 Sand and dust. There shall be no damaging effects from the dry dust laden atmosphere when tested in accordance with 4.6.15.5.

3.7.7 Electromagnetic compatibility. There shall be no extraordinary precautions required against electromagnetic radiation when tested in accordance with 4.6.15.6.

3.7.8 Lightning strike. There shall be no catastrophic damage due to a stmulated lightning strike when tested in accordance with 4.6.23.

3.7.9 Electrostatic discharge. The tank shell shall neither retain an unsafe electrostatic discharge nor exceed the maximum decay rate when tested in accordance with 4.6.22.

3.8 Finish.

3.8.1 Internal finish. The Internal surface of the tank shall be treated in accordance with MIL-F-7179 Type I.

3.8.2 External finish. Neither the external coating nor the composite surface to which it is applied shall crack, chip, or scale during the normal service life of the tank or due to extremes of normal atmospheric conditions.

3.8.2.1 External coating. Unless otherwise specified, external coatings shall be in accordance with MIL-F-7179.

3.8.3 Erosion protection. To prevent rain erosion for Type II, the painted tank shall be protected at the nose section with a metal cap or an applied coating as approved by the Naval Air Systems Command. The erosion protection coating shall be applied up to a tangent line making an angle of 15° with the center line of the tank.

3.8.4 Aerodynamic smoothness. The external surface of the tank shall be aerodynamically smooth and free from projections. Variation from the nominal contour smoothness of the tank as shown on the applicable drawings shall not exceed the dimensions shown therein when measured with a spline over the distance of 6 inches in any direction.

3.8.4.1 Surface roughness. Every effort shall be made to keep the external surface of the tank as smooth as possible. When measured by a visual comparison to a surface finish comparator, the outside surface shall be not greater than 500 micro-inches for 50 percent of the surface area. The remaining surface area shall be not greater than 1,000 micro-inches.

3.9 Marking identification. Each part or assembly shall be identified in accordance with MIL-STD-130.

3.9.1 Seals identification. The part numbers and the manufacturer's name and address for all replaceable elastomeric seals used in the tank shall be noted on the tanks manufacturer's assembly drawings. The age of the seals shall be identified on each unit in accordance with MIL-STD-1523.

3.9.2 Exterior decalcomania. Unless otherwise specified, a decal shall be furnished that conforms to MIL-P-38477. The decalcomania shall be located on the tank exterior near the aft filler unit and shall be legibly filled in with the following information:

TANK, FUEL AIRCRAFT, AUXILIARY EXTERNAL

Type designation (furnished by Naval Air Systems Command)
Tank Material
Capacity (in U.S. Gallons)
Weight Empty
Manufacturer's Part Number
Manufacturer's Serial Number
Contract or Order Number
Manufacturer's Name and Trademark
U.S. Property

3.9.3 Internal nameplate. A metal internal nameplate shall be securely affixed to an Internal structural component. The information to be included on the nameplate shall be identical to that specified in 3.9.2. The nameplate shall be visible and accessible through one of the access doors.

3.9.4 Identification of fuel and vent system components. An identification decalcomania conforming to MIL-STD-130 shall be securely attached to each separate piece of the fuel and vent system components except tubing, and shall contain the following information:

Name of Part
Part Number (in-accordance with applicable drawing)
Manufacturer's Serial Number (if applicable)
Manufacturer's Name and/or Trademark

3.10 Cure dates. The age of synthetic rubber parts shall be identified on each unit in accordance with MIL-STD-1523.

3.11 Interchangeability. All parts having the same manufacturer's part number shall be directly Interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the number requirements of DOD-D-1000.

3.12 Workmanship. Workmanship shall be of the quality necessary to produce tanks free from all defects which may affect proper functioning in service.

3.13 Cleaning. Each component shall be thoroughly cleaned of dirt, sand, metal chips, or other foreign matter while being assembled and after final assembly.

3.14 Non-metallic reinforcements. In addition to the requirements of paragraph 3.1 through 3.13, shells constructed of non-metalic materials shall also meet the following requirements.

3.14.1 Fibers. Reinforcing fibers shall be high strength, heat resistant, and suitability insulated to withstand the fuel fire requirements of paragraph 3.15.4. Fiber sizing used to Increase composite bond strength shall be compatible with the composite resin system used.

3.14.1.1 Filament winding fibers. Filament winding roving fibers shall be in accordance with MIL-R-60346. Other fibers considered for use shall have a minimum tensile strength of 150,000 psi and must be approved by the Naval Air Systems Command.

3.14.1.2 Insulative fibers. Insulative fibers applied to the outside face of the composite shall be capable of withstanding a temperature of 2,000°F for 20 minutes without disintegration or loss of more than 90 percent of its original breaking strength.

3.14.2 Fabrics. Fabrics shall be chosen for the use intended and shall be of the highest quality consistent with high strength-low weight construction. Fabric sizing used to increase composite fabric to resin bond strength shall be compatible with the composite resin system used.

3.14.2.1 Structural fabrics. Structural fabrics shall be in accordance with MIL-C-9084. Other fabrics considered for use in structural composites shall have a minimum laminate tensile strength of 20,000 psi and must be approved by the Naval Air Systems Command.

3.14.2.2. Insulative fabrics. Insulative fabric applied to the tank shall be secured to the tank structural composite shell with sufficient continuous insulative fibers to ensure that the fabric will remain in place when subjected to the fuel fire requirements (see 3.15.4). Insulative fabrics shall be capable of withstanding a temperature of 2,000°F for 20 minutes without disintegration or loss of more than 90 percent of its original laminate breaking strength.

3.14.3 Resins. Structural and adhesive resins of the best quality, consistent with the specification requirements, shall be used,

3.14.3.1 Resins shelf life. Accurate records of resin shelf life shall be maintained. Resin or other similar products having shelf life requirements shall be disposed of when unused beyond the “use before” or shelf life date.

3.14.3.2 Structural composite resins. Structural composite resin systems shall be phenolic resin in accordance with MIL-R-9299 or epoxy resin in accordance with MIL-R-21931. Designs which incorporate other resin systems must be approved by the Naval Air Systems Command. Fire retardant additives considered for use with an approved resin system shall not cause catalysis or degrade the physical properties of the approved system more than 10 percent.

3.14.3.3 Adhesive resins. Adhesive resins for structural bonding of similar or dissimilar items shall be in accordance with MMM-A-132 and listed on its qualified products list. Design which incorporated other resin systems must be approved by the Naval Air Systems Command.

3.14.4 Sandwich core. Core materials shall be of the best quality consistent with high strength-low weight construction. The core materials shall not be readily combustible nor should the structural portion of the core decompose to a point that it no longer thermally protects the inside structural windings when subjected to the fuel fire requirements (see 3.15.4).

3.14.4.1 Structural core. Structural core materials shall be honeycomb in accordance with MIL-C-81986 and shall have a minimum compressive strength of 250 psi. Other structural core materials considered for use must be approved by the Naval Air Systems Command.

3.14.4.2 Insulative core. Insulative core materials shall be in accordance with ASD-M10357 or verified to be equivalent by certified test and approved by the Naval Air Systems Command.

3.14.5 Filler materials. Filler materials used for structural, cosmetic, or sealing purposes shall not crack, chip, or peel during the normal service life of the tank.

3.14.6 Liner proof pressure. The aluminum liner shall be capable of withstanding an internal proof pressure of 5 psig prior to adding the composite filament wound outer structure, without deformation or leakage.

3.14.7 Liner preparation. The aluminum liner shall be satisfactorily treated for corrosion. The liner shall also be treated to ensure an adhesive bond between the liner and the filament wound outer structure of 600 psi minimum lap shear strength (see 4.6.8.4.3).

3.14.8 Structural composite shell.

3.14.8.1 Filament winding. The filament winding operation shall be performed on equipment capable of repeatable helical and circumferential winding operations. The repeatable accuracy of the equipment between successive passes of circumferential windings shall be ± 0.010 inches and between successive passes of helical winding of ± 0.020 inches. Actual winding accuracy shall be in accordance with 3.14.8.1.2. The winding pattern shall be approved by the Naval Air Systems Command prior to construction. Winding shall not be interrupted during a pass except for breakage (see 3.14.8.1.5).

3.14.8.1.1 Roving degradation. The guiding system for rovings shall be such that it will not damage the rovings, such as fraying, etc, during the winding process.

3.14.8.1.2 Roving gap. Any space between wound in place rovings, whether in the same band or between bands, shall be not more than 0.250 inches wide. In the regions of tooling pins the gap shall be not greater than 0.60 inches.

3.14.8.1.3 Roving bridging. There shall be no bridging of the roving over the surface of the tank due to inverted curvature of the surface or thickness differences between sandwich reinforcements and the primary core material or thickness differences between adjoining sections of primary core material in any areas of the tank that exceeds 0.500 inches in width. Length of bridge shall not exceed 12 continuous inches and all bridging must be filled with an appropriate filler material. In the regions of tooling pins, bridging shall not exceed 0.600 inches.

3.14.8.1.4 Roving slippage. The roving slippage from the machine causes an applied position sideways which achieves a more natural winding path on the surface of the tank but shall be not greater than 0.250 inches.

3.14.8.1.5 Roving knots. There shall be no knots in the rovings. If a roving is broken during the winding operation it shall be repaired by overlapping the ends of the roving on the part by 2 inches minimum. A knot may be tied to pull the roving through a resin bath to the part, however, the knot must be cut out when the end is placed on the part.

3.14.8.1.6 Roving resin control. All roving, whether pre-impregnated or wet wound, must be thoroughly impregnated.

3.14.8.1.7 Uniform composite construction. Uniform structural composite construction shall be maintained from the beginning to end of each winding operation (circumferential and helical).

3.14.8.2 Composite sandwich core. The structural composite sandwich core shall be of the best quality materials consistent with the general and special characteristic requirements of this specification and in accordance with paragraph 3.14.4.

3.14.8.2.1 Materials voids or build-ups. Foam voids or build-ups that exist over 0.2 square inch shall be repaired to ensure uniform sandwich core integrity and construction (see 3.14.8.4). Foam voids or build-ups are limited to 0.5 square inch in one square foot.

3.14.8.2.2 Splice gaps. Splice gaps between sections of core material shall be not greater than 0.250 inches.

3.14.8.2.3 Crushed core. Crushed structural core material shall not be used in any part of the tank wall structure. Crushed core is defined as honeycomb core material with bent, crushed, or fractured faces of the honeycomb cell involving more than 3 percent of a 16 square inch area, or structural foam depressed below its nominal thickness by 0.030 inch over -5 percent of a 16 square inch area.

3.14.8.3 Penetrations. Care should be taken in the design of the tank to minimize unnecessary penetrations through the tank wall in order to conserve a light weight condition and increase strength. All penetrations should be reinforced and sealed to prevent moisture, fuel, or chemical environmental damage and withstand the load requirements of 3.5.1.5 and 3.15.2.

3.14.8.4 Repair procedure. For Type H tank, the contractor shall provide a procedure for the repair of a filament wound tank having damage including complete penetration of the filament windings and liner.

3.15 Survivability. Type II tanks shall meet the following survivability requirements.

3.15.1 Forced ejection. The tank shall be capable of absorbing without rupture or leakage the impact loads generated when the tank is force ejected onto a concrete surface 48 ± 2 inches below the tank centerline when tested in accordance with 4.6.17.

3.15.2 Gunfire. The tank shall withstand the loads generated from the hydraulic ram and Internal ignition pressure loads from an impact by a projectile when tested in accordance with 4.6.19.

3.15.3. Internal fuel vapor ignition. The tank shall contain the explosive pressures generated from fuel vapor ignition without rupture when tested in accordance with 4.6.18.

3.15.4 Fuel fire. The tank, suspended in an open pit for 15 minutes, shall withstand the fuel fire test of 4.6.20.

3.15.5 Crash impact. A full tank shall be subjected to a ground impact test without leakage when tested in accordance with 4.6.21.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance, All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become apart of the contractor's overall Inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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

a. First article inspection (see 4.3.1)

b. Quality conformance inspection (see 4.4)

4.3 First article test. First article tests are those tests accomplished on samples to determine their suitability for a specific installation specified by the procuring activity.

4.3.1 First article inspection. For Type I, one tank shall be selected and for Type II, four tanks shall be randomly selected by a designated government Inspector as first article sample units from the first ten production units using production fabrication methods on production tooling. The selection tanks shall be designated "A" for Type I and "A", "B", "C" and "D" for Type II respectively, and shall be subject to the following tests in the order listed in Table I.

TABLE I. Testing for Type I and type II tanks.

Test or Inspection	Reference Paragraph	Type I	Type II			
		A	A	B	C	D
Individual inspection	4.4.1	X	X	X	X	X
Examination of product	4.6.1	X	X	X	X	X
Tank contour	4.6.7	X	X	X	X	X
Assembled tank weight	4.6.9	X	X	X	X	X
Functional test	4.6.11	X	X	X	X	X
Pressure test	4.6.12	X	X	X	X	X
Tank capacity	4.6.13	X	X	X	X	X
Center of gravity	4.6.10	X	X	X	-	-
Slosh/vibration	4.6.14	X	X	-	-	X
Environmental	4.6.15	X	X	-	-	-
Load tests	4.6.16	X	X	-	-	-
Forced ejection test	4.6.17	X	X	-	-	-
Vapor ignition test	4.6.18	-	-	X	-	-
Ballistic	4.6.19	-	-	-	X	X
Fuel fire test	4.6.20	-	-	X	-	-
Electrostatic test	4.6.22	-	-	-	X	-
Lightning strike	4.6.23	X	X	-	-	-

- Indicates test not applicable

4.3.2 First article test procedure. A test procedure which contains a detailed description of the first article test including the test equipment shall be prepared prior to conducting first article tests. The manufacturer shall furnish three copies of the test procedure to the local Government Inspector; one copy shall be submitted to the Naval Air Systems Command Headquarters (Code AIR-5303), Washington, DC 20361-5300 for approval, and one copy to the Naval Air Development Center (Code 6013), Warminster, PA 18974-5000 for information. Approval of the first article test procedure shall be obtained prior to conducting first article tests.

4.3.3 Place of test. First article tests shall be conducted at the contractor's plant under the supervision of the Government Inspector. Contractors not having adequate testing facilities shall engage the services of a commercial laboratory satisfactory to the Naval Air Development Center (Code 6013), Warminster, PA 18974-5000. The Naval Air Development Center shall be notified of the testing facilities prior to testing.

4.4 Quality conformance inspection sampling. The acceptance inspection shall consist of the Individual and Sampling Inspections (see 4.4.1 and 4.4.3) and shall be conducted under the supervision of the Government Inspector.

4.4.1 Individual Inspection. The Type I tank shall be subjected to the following inspections:

Dye penetrant inspection	(4.6.2.2)
Internal surface condition	(4.6.3)

Each Type II tank shall be subjected to the following tests and inspections:

Dye penetrant Inspection	(4.6.2.2)
Internal surface condition	(4.6.3)
Liner proof pressure	(4.6.4)
Tank liner diameter	(4.6.5)
Liner preparation	(4.6.6)

In addition, each Type II tank shall be tested in accordance with paragraph 4.6.8.

4.4.2 Acceptance. Each Type I and Type II tank submitted for acceptance under the contract shall be subject to the following tests and inspections:

Examination of product	(4.6.1)
Assembled tank weight	(4.6.9)
Functional test of components	(4.6.11)
Pressure test of individual tanks	(4.6.12.2)

4.4.3 Sampling inspection. The contractor shall furnish samples from each lot for the following tests. These tests are described under the "Test Methods" (see 4.6) and are to be conducted in the order indicated:

Examination of product	(4.6.1)
Functional test of components	(4.6.11)
Pressure test	(4.6.12)
Slosh/vibration	(4.6.14)
Functional test of components	(4.6.11)

The tanks will be selected by the Government Inspector without preliminary Inspection or repair and tanks shall be subjected to the above inspections. For the purposes of this paragraph, the lot size shall be set by the contractor, consistent with his production and test capabilities, which will meet the contract delivery schedule and be in accordance with MIL-STD-105 inspection level S-1, acceptance No. zero. Sample tanks shall be in addition to the contract quantity. The contractor is required to build all tanks in each lot prior to the selection of the sample tanks to be tested, and the tanks shall not be shipped until satisfactory completion of the tests. Failure of a tank under the sampling tests shall be cause for rejection of all tanks in that lot. The contractor shall take necessary corrective action to

eliminate any deficiencies in the rejected tanks. A tank incorporating the corrective action shall be resubmitted for retest. Upon satisfactory retest, the rejected tanks may be submitted for acceptance under the contract upon concurrence of the Government Inspector, based on evidence submitted, that any necessary corrective action has been incorporated into the tanks.

4.5 Satisfactory performance. The failure of a tank to meet the specified requirements of any of the following tests and inspections shall constitute failure of the tank. Rejected tanks shall not be resubmitted for inspection without furnishing to the Government Inspector full particulars concerning previous rejection and the measures taken to overcome the defects. Upon resubmission of the tank for inspection after a failure, the inspection shall start at the beginning of the test during which failure occurred.

4.6 Test methods.

4.6.1 Examination of product. The tank shall be examined for conformance with the requirements of this specification with respect to materials, workmanship, design, interchangeability, exterior surface, construction, external finish, markings, smoothness, and applicable drawings.

4.6.1.1 Finish. The finish of both type tanks shall be examined for uniformity of the protective cover, proper degree of hardness, and for proper match with the specified color and finish adhesion.

4.6.1 .1.1 Uniformity of cover. The entire outer surface shall be visibly examined for uniformity of the external finish. There shall be no bare spots, blowholes, thin flows, or thick flows.

4,6.1 .1.2 Finish hardness. The hardness of the outer finish on all tanks or a representative cured specimen of the same coating mix shall be tested in accordance with FED-STD-141, Method 6212. If the finish hardness test is tested on the tank, the finish shall not be marred by the test.

4.6.1 .1.3 Finish color. A color of an outer finish on all tanks shall be inspected by a government representative and shall be judged for satisfactory color.

4.6.1 .1.4 Finish adhesion. The first article and each lot sample shall be tested in accordance with FED-STD-141, Method 6301. Any evidence of peeling shall be cause for rejection of the lot.

4.6.2 Weld quality inspection. Tank designs that incorporated a welded metal liner or any other structural welded joints shall be inspected and conform to the following acceptance criteria.

4.6.2.1 X-ray inspection. X-ray inspection shall be performed on a 5 percent sample basis. The sample shall be based upon the number of tanks to be furnished on each lot and shall be representative of the entire production lot. Failure of the sample to comply with the weld acceptance criteria shall

result in rejection of all welds until the contractor has demonstrated to the local government authority that the failure condition has been corrected. In the event the contractor cannot propose a procedure satisfactory to the local government authority to correct the failure conditioning, the local government authority shall invoke 100 percent x-ray inspection. Negatives of the welds shall be forwarded with the first article test report.

4.6.2$_0$2 Dye penetrant inspection. Dye penetrant inspection of all external welds shall be in accordance with MIL-STD-6866, Type I, Method A, sensitivity Level 1.

4.6.2.3 Defects. Cracks, lack effusion, and Incomplete weld penetration 10 any form are unacceptable. Unless otherwise specified, dimension "T" (see 4.6.2.3.2 through 4.6.2.3.5) is defined as the nominal parent metal thickness of the thinnest joint member.

4.6.2.3.1 External defects. Cracks shall not be acceptable in the weld metal or adjacent base metal. Cracks occurring in the weld bead reinforcement area hot and face) may be removed. Unless otherwise noted, oxide folds and suckbacks shall not be acceptable if the thickness in the area is less than the minimum sheet or plate thickness allowed in the material specification or the drawing tolerance for machined or formed sheets or parts, whichever is applicable. Discontinuities exposed to the surface shall not be acceptable if the linear dimension and total area values exceed the corresponding radiographic limits specified for all internal discontinuities.

4.6.2.3.2 Internal defects. Cracks shall not be acceptable in the weld metal or adjacent base metal. Porosity, voids, and oxide inclusion defects shall be limited as follows: maximum pore size of unconnected voids shall be not greater than a linear dimension greater than 50 percent of the weld bead thickness or shall be not greater than a diameter of 0.050(1/20) inches, whichever is smaller. The summation of all unconnected voids in any linear inch of weld shall be not greater than 7 percent of an area equal to (1 inch x T) square inch. Aligned porosity shall be not greater than 3.5 percent of an area equal to (1 inch x T) square inch. Porosity pores smaller than 0.00008 square inches in an area are considered nondetrimental and need not be evaluated. Weld metal radiographic images which appear to have pores that overlap can be differentiated from each other by Radiographic 'Triangulation and shall be evaluated as separate pores, and considered for rejection.

4.6.2.3.3 Porosity and inclusions. For the purposes of this specification, the diameter of any porosity cavity shall be defined as its largest dimension. Interconnected porosity shall be considered a single cavity. Inclusions, either tungsten or non-metallic, shall be subject to the same dimensional limitations as porosity. When both inclusions and porosity are present, the sum of their areas shall fall within the limitations defined in porosity (either total or scattered, as applicable).

4.6.2.3.4 Stringer discontinuity. A stringer discontinuity is defined, for the purpose of x-ray interpretation, as a void, an oxide stringer, or a series of voids and/or stringers in a linear distribution when the ratio of the major dimension to the minor dimension of an individual discontinuity is 5:1 or greater. The stringer discontinuity shall be considered a single stringer where the adjacent discontinuities are not separated by a length equal to or greater than 15 percent of "T". A stringer discontinuity is permissible if the summation of all connected, elongated, or aligned voids or inclusions do not exceed a total area of 0.060 square inches in any 6.0 inch length of weld and occurs in the weld bead reinforcement area (root and face).

4.6.2.3.5 Undercutting. Undercutting shall be cause for rejection if it is in excess of 1/10 "T" in depth. Undercutting of any depth less than 1/10 "T" shall be not greater than one inch of weld length.

4.6.3 Internal surface conditioning. The cleanness of all tanks (see 3.13) shall be judged by a visual examination and wiping all accessible suspect areas with a clean, white, lint free cloth. This examination shall be made before liner proof pressure test.

4.6.4 Liner proof pressure test. All metal liners shall be proof pressure tested for five minutes to the requirements of 3.14.6. There shall be no leakage.

4.6.5 Tank liner diameter. While pressurized in accordance with 4.6.4, the tank liner diameter shall be measured in four locations to verify compliance to the applicable drawings. These measured dimensions shall be recorded.

4.6.6 Liner preparation. All metallic liner materials abraided, cleaned, etched, or primed for bonding or overwrap shall demonstrate that the surface is clean by a water-break-free test using de-ionized water in accordance with ASTM-F22.

4.6.7 Tank contour. The outside diameter of the tank liner shall be measured for conformance with the appropriate drawing.

4.6.8 Composite construction.

4.6.8.1 Tank Iiner bond. Test specimens simulating tank materials, construction, and surface preparation, and completed at the time of tank winding and Identified with the tank and serial number, shall be tested to the requirements of 3.14.7.

4.6.8.2 Filament winding inspection. The filament winding machinery and process shall comply to the requirements of 3.14.8.1 and receive continuous Inspection during the winding operation either by controlled operator instructions or an attending qualified inspector. Cleanliness of the atmosphere, machinery, and operator will be maintained. Any item previously cleaned and prepared for bonding shall be handled with white throw away gloves or clean rubber gloves. Any item being improperly handled or otherwise contaminated shall be recleaned by the approved process cleaning requirement (see 3.13).

4.6.8.3 Impregnated roving placement. Continuous in-process inspection and final inspection shall ensure that the impregnated filament wound roving placement does comply with the requirements of 3.14.8.1.2 through 3.14.8.1.6.

4.6.8.4 Composite construction testing. Materials testing shall be conducted on samples of the filament wound composite in accordance with the requirements of 3.14.8.1.7. These tests shall include resin content, Barcol hardness, and lap shear testing. The lap shear test (see 4.6.8.4.3) shall be run on the test specimens made in accordance with 4.6.8.1 and to the following criteria.

4.6.8.4.1 Resin content, An unused section of the tank, such as a door opening, shall be used to determine the resin content of the cured filament winding by burning out the resin and weighing the filament that remains. The resin content shall not vary by more than ± 5 percent from the original design.

4.6.8.4.2 Barcol hardness testing. Barcol hardness testing shall be performed on four areas of each tank. Two tests will be made; one each within 5 Inch radius of each attach lug, and one each within a 10 inch radius of the access door or fill cap opening of both nose and tail compartments. This test shall be in accordance with ASTM-D2583 to a minimum Barcol hardness of 40. To minimize the possibility of skin penetration, the contractor shall conduct this test to the structural core reinforced areas of the tank.

4.6.8.4.3 Lap shear testing. To ensure a bond between the filament wound fibers and the tank surface has been achieved, bonding samples of the same material and thickness, and cleaned by the same process as the tank, shall be bonded to two groups of impregnated fiberglass fabric. These specimens shall be used for lap shear testing in accordance with ASTM-D1002 to the requirements of 3.14.7. There shall be no evidence of failure below the test value. Sections of the composite shell that are removed for the door cutouts may be used as alternate test samples for determining the Integrity of the liner bond.

4.6.8.5 Composite sandwich core. The composite sandwich core tanks shall be inspected before and during application for compliance with the requirements of paragraph 3.14.8.2.

4.6.8.6 Structural composite curing. Continuous composite curing on all tanks shall be monitored by observation of processes and controls, and by process curing control devices with accompanying recorders. Curing control records shall be maintained as part of the quality control.

4.6.9 Assembled tank weight. The gross weight of the complete fuel tank dry shall be checked for conformance with the requirements of 3.5.1.4.

4.6.10 Center of gravity. The center of gravity location shall be checked for conformance with the requirements of 3.5.1.4.1.

4.6.11 Functional test of components. The completely assembled tank shall be checked to determine satisfactory functioning of the fuel system, air pressure and vacuum relief valves, and fuel quantity gaging components furnished as part of the tank. The fluid used for this test shall be in accordance with MIL-T-5624.

4.6.12 Pressure test. The air pressure line and other openings, except the one for applying pressure, shall be sealed and the tank shall be subjected to the pressure test of 4.6.12.1 or 4.6.12.2 as applicable. During the test, leakage of the tank shall be detected by the application of a soap solution at all seams and fittings while the tank is under air pressure or by filling the tank with a fluorescent dye and examining the exterior surface with the ultra-violet lamp.

4.6.12.1 Pressure test for first article and sampling tests. Tanks designed for pressure fueling shall be subjected to the following tests a., b., and c. without leakage or failure. Tank designed for gravity fueling only shall be subjected to tests b. and c. and shall not be subjected to the pressure test at 86 psig. These tests shall be conducted both before and after the load tests of paragraph 4.6.16.

a. An internal positive pressure of 86 psig (115 percent of design limit pressure) for 3 minutes.

b. An internal negative pressure of -10 psig for 3 minutes.

c. An internal positive pressure of 50 psig (200 percent of design operating pressure) for 15 minutes.

4.6.12.2 Pressure test of individual tanks. Each production assembly shall be pressure tested to the following tests a., b., and c. without failure, leakage, or permament set:

a. An internal negative pressure of -10 psig for 3 minutes.

b. An internal positive pressure of 75 psig for 3 minutes.

c. A positive pressure of 15 psig for 15 minutes.

4.6.13 Tank capacitv. The usable capacitv of the tank shall be checked for conformance with the requirements of 3.5.1.3 herein.

4.6.14 Slosh/vibration. Each compartment of the tank shall be filled to two-thirds of its capacity with water containing a fluorescent dye to aid in examining the leakage with an ultra-violet lamp. The tank shall not be pressurized for the test. The tank center line shall be at least 20 inches above the slosh axis. The duration of the test shall be 12.5 hours in the pitching condition and 12.5 hours in the roll condition. Upon completion, the tank shall be completely filled with water and vibrated for 10 minutes. The displacement of the tank during the slosh/vibration test shall be not less than 0.032 inches double amplitude measured at the suspension lugs of the

tank. The frequency of the-vibration shall be between 1940 and 2000 cycles per minute. While undergoing the specified vibration, the assembly shall be rocked at between 16 and 20 cycles per minute through a total angle of 30°, approximately 15° each side of the level position. Upon completion of the test, there shall be no evidence of any leakage or excessive wear of the tank. Any inadvertent release as a result of vibration shall be deemed a failure. Following the slosh/vibration test the tank shall be subjected to the following tests a., b., and c. without failure by any leakage or evidence of debonding:

a. An internal pressure of 112 psig for 3 minutes.

b. A negative pressure of -12 psig for 3 minutes.

c. A positive pressure of 50 psig for 15 minutes.

4.6.14.1 Method of vibration displacement measurement. An electronic vibration measuring device whose pickups are permanently mounted on the tank shall be used to measure the vibration displacement. The average peak value, at the point being measured during a 30 second interval, shall be taken as the recorded value.

4.6.15 Environmental tests. The tank shall be subjected to the following environmental tests.

4.6.15.1 High and low temperature exposure. The tank shall be dried for one day at a temperature of 160° ±5°F. The tank shall then be filled with fluid in accordance with TT-S-735, Type II, containing a satisfactory staining agent, and shall be cooled at -65° ±5°F for a period of three days. The tank shall then be drained and examined for any unsatisfactory condition or Indication of fluid leakage. If found satisfactory, the tank shall then be filled with fluid in accordance with TT-S-735, Type II, containing a satisfactory staining agent and subjected to a temperature of 160° ±5°F for a period of three days. The tank shall then be drained and examined for any unsatisfactory condition or Indication of fluid leakage. During the temperature drop, warmup, and leak check phases of this test, the tank shall be pressurized to 15 psig. Any leakage shall be considered as tank failure. All joints, seams, and fittings shall be covered with brown paper to aid in determining leakage.

4.6.15.1.1 Alternate high and low temperature exposure. In lieu of the method using a staining agent and brown paper, the leakage test may be conducted by using test fluid in accordance with TT-S-735, Type II, with a flourescent dye such as eosin added, and examining the exterior surface of the tank with an ultra--vlolet lamp.

4.6.15.2 Fungus test. All components containing any material that can be a nutrient or be damaged by fungi shall be tested in accordance with MIL-STD-81O, Method 508.3.

4.6.15.3 Humidity exposure. The tank shall be tested in accordance with MIL-STD-810, Method 507.2, Procedure I.

4.6.15.4 Salt fog test. The tank shall be tested in accordance with MIL-STD-810, Method 509.2.

4.6.15.5 Sand and dust test. The tank shall be tested in accordance with MIL-STD-810, Method 510.2.

4.6.15.6 Electromagnetic compatibility test. The tank assembly shall be tested in accordance with MIL-STD-462 to demonstrate that extraordinary precautions are not required against Hazards of Electromagnetic Radiation (HERO).

4.6.16 Load tests. Load tests shall be performed to demonstrate that the tanks, at the weights specified in 3.5.1.5.2, shall withstand 1.15 times the load factors without permanent deformation in accordance with MIL-A-8591.

4.6.16.1 Ultimate loads. The tank shall be subjected to the ultimate load factor and aerodynamic loads without failure (see 3.5.1.5). The tank shall then be tested to failure under the most critical condition as identified in the stress analysis.

4.6.17 Forced ejection test. To investigate ejector mechanism penetration to Type I, the tank shall be filled with water to the usable fuel capacity and shall be subjected to a forced ejection onto a soft surface. The ejector mechanism shall not penetrate the tank. For Type H, the tank shall be filled with water to the usable fuel capacity and shall withstand one release from the forced ejection mechanism onto a concrete surface 48 ±2 inches below the tank centerline. The ejector mechanism shall not penetrate the tank. The tanks shall not rupture or leak.

4.6.18 Internal fuel vapor ignition test. A tank suspended from a bomb rack shall withstand the explosive pressures caused by rapid ignition of an N-pentane air mixture (see 3.15.3). The explosion shall produce a pressure peak rise of at least 6.5 atmospheres within 60 milliseconds; no structural damage is permitted. If an Incendiary projectile is specified as an ignition source, only projectile penetration damage is permissible.

4.6.19 Ballistic. The tank shall withstand the loads generated from internal Ignition pressure when impacted by a 14.5 mm Armor Piercing Incendiary (API) service velocity projectile (see 3.15.2). The projectile impact shall not yield an entrance or exit orifice wound larger than the projectile contact frontal area. Structural damage is permitted but leakage shall occur only from the entrance or exit.

4.6.20 Fuel fire test. The tank shall contain the JP-5 while suspended in an open pit fuel fire of MIL-T-5624 grade JP-4 for 15 minutes without rupture (see 3.15.4). The centerline of the tank shall be 36 ±2 inches above the fuel ground line.

4.6.21 Crash impact test. A full tank shall not leak when subjected to a ground lmpact test (see 3.15.5). Vertical and longitudinal velocity components as shown in Figure 1 shall be specified by the contracting officer. The tank attitude upon ground impact shall be 0° ±10°. The ground surface shall be cement or equivalent.

4.6.22 Electrostatic discharge test. The electrostatic discharge and maximum decay rate tests shall meet the requirements of 3.7.9 and shall be specified in the contract or purchase order (see 6.2).

4.6.23 Lightning strike test. The tank assembly shall satisfactorily pass the lightning test requirements of MIL-B-5087.

4.6.24 Flight tests. Flight testing will be required if the configuration has not been previously certified for the airframe for which it is being procured (see 6.2).

5. PACKAGING

5.1 Preservation. The level of preservation shall be level A or Commercial.

5.1.1 Level A.

5.1 .1.1 Cleaning. The tank(s) shall be cleaned in accordance with procedure C-1 of MIL-P-116.

5.1.1.2 Preservative. After the cleaning in 5.1.1.1, the interior of the tank shall be preserved with MIL-C-6529 Type III, corrosion preventive oil-type compound. Particular care shall-be exercised to ensure complete coverage of all internal surfaces and complete drainage.

5.1.1.2.1 Application. Remove the access door to expose the intercostals, annular frames, and the skin of the tank. Either pour a sufficient quantity of the preservative oil into the tank to cover by slushing all internal surfaces when the tank Is rotated or, if available, use a spraying apparatus with a flexlble outlet hose to spray the preservative oil into the Intercostal, annular frames, and the skin of the tank.

5.1.1.2.2 Drainage. Drain off the excess preservative oil by rotating the tank if necessary.

5.1.1.3 Closures. After the application of the preservative in 5.1.1.2, the tank interior shall be protected against foreign material by sealing the exterior openings with caps and plugs conforming to MIL-C-5501. During shipment and storage the tank shall be vented through the fuel line to compensate for thermal changes.

5.1.1.4 Fittings (fuel fittings, spare plugs, and screws).

5.1.1.4.1 Cleaning. Fittings shall be cleaned in accordance with C-1 of MIL-P-116.

5.1.1.4.2 Preservative. The fittings shall be preserved in accordance with Method III of MIL-P-116.

5.1 .1.4.3 Fittings unit pack. The cleaned fittings shall be placed in a shipping container of appropriate size, conforming to PPP-B-636, Type CF (corrugated fiberboard), class waterproof and water vapor resistant (WWVR). The closure shall be In accordance with the appendix in PPP-B-636.

5.1.2 Commercial. Preservation shall be in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level A or Commercial.

5.2.1 Level A. The tank shall be packed in a crate conforming to MIL-C-52950, type meeting level A protection. The tank and any spare parts (tail, tail fin, or tail cone) shall be securely mounted in the crate. The tank shall be secured as far as possible by Its aircraft suspension points. Saddles or other blocking shall be used only to prevent excessive motion of the tank in the crate. Blocking, bracing, and cushioning shall be designed to withstand the tests specified herein when the crate is fully loaded and fully assembled for surface shipment. The fittings unit pack shall be secured to the interior face of the crate.

5.2.2 Commercial. The tank shall be packed in accordance with ASTM D 3951.

5.3 Marking. The shipping containers and the fittings unit pack shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The external fuel tanks covered by this specification are Intended for use on aircraft which require carrying external fuel on missions subject to fuel fire and gunfire. The use of Type I (non-survivable) and Type H (survivable) facilitates the procurement of any external fuel tank.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Type of tank (see 1.2 and 3.2)

c. Type of fuel quantity gaging system (see 3.5.1.10)

d. Type of tail fins (see 3.5.5)

e. Type of filling (see 3.6.1)

f. Electrostatic discharge test (see 4.6.22)

g. Flight testing (see 4.6.24)

h. Preservation, packaging, and packing (see section 5)

6.3 First article. When a first article inspection is required, a sample selected from the first ten production items will be tested. The first article sample should consist of one Type I tank or four Type II tanks. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles.

6.4 Subsequent production contracts. On subsequent contracts or purchase orders for a previously designed tank, the production tank shall be manufactured In accordance with applicable drawings furnished or specified by the procuring activity. Unless otherwise specified in the contract or purchase order, the design as depicted in the applicable drawings shall be considered to be In accordance with this specification. For subsequent contracts or purchase orders, the applicable design requirements of this specification should be verified only where the drawings are incomplete or ambiguous with respect to a particular design feature. The tests of Section 4 are applicable to these contracts or purchase orders.

6.5 Subject term (keyword) listing.

Fuel tank, external, aircraft

Fuel tank, non-survivable, aircraft

Fuel tank, survivable, aircraft

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

Preparing activity:
Navy - AS

(Project No. 1560-N135)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-T-18847C(AS)	TANKS, FUEL, AIRCRAFT, AUXILLIARY EXTERNAL, DESIGN AND INSTALLATION OF

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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