NOT MEASUREMENT SENSITIVE

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SUPERSEDING
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PERFORMANCE SPECIFICATION

TRUCK, AIRCRAFT FUELING-DEFUELING, 6,000 GALLON, A/S32R-11

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

1. SCOPE

1.1 Scope. This specification covers the requirements for one type of aircraft refueling cargo tank truck capable of refueling and defueling military and commercial aircraft on Government installations worldwide. The aircraft refueling truck is compliant with all applicable Department of Transportation (DOT) regulations for transportation and is air transportable in C-130, C-17, and C-5 aircraft.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to: WR-ALC/GRVEB, Robins AFB GA 31098-1813. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil

AMSC N/A FSC 2320

2.2 Government documents.

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

FEDERAL STANDARDS

FED-STD-297	Rustproofing of Commercial (Nontactical) Vehicles
FED-STD-595/14052	Green, Gloss
FED-STD-595/24052	Green, Semi-gloss
FED-STD-595/31136	Red, Flat or Lusterless
FED-STD-595/33446	Tan
FED-STD-595/37038	Black, Flat or Lusterless
FED-STD-595/37875	White, Flat or Lusterless
FED-STD-807	Trucks: Heavy Commercial, 6X4 and 6X6, 19,500 to 30,000 KG (43,000 to 66,000 pounds) Gross Vehicle Weight Rating (GVWR)

COMMERCIAL ITEM DESCRIPTIONS

A-A-393	Extinguisher, Fire, Dry Chemical (Hand Portable)
A-A-50696	Reels, Static Discharge, Grounding, 50 and 75 Foot Cable Lengths
A-A-52557	Fuel Oil, Diesel; for Posts, Camps, and Stations
A-A-52624	Antifreeze, Multi Engine Type
A-A-59326	Coupling Halves, Quick Disconnect, Cam locking Type

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-B-18013/1	Battery, Storage, Support Equipment
MIL-DTL-25524	Turbine Fuel, Aviation, Thermally Stable
MIL-A-25896	Adapter, Pressure Fuel Servicing, Nominal 2.5 Inch Diameter
MIL-DTL-25959	Tie Down, Tensioners, Cargo, Aircraft
MIL-PRF-27260	Tie Down, Cargo, Aircraft, CGU-1/B
MIL-PRF-52308	Filter-Coalescer Element, Fluid Pressure
MIL-DTL-53030	Primer Coating, Epoxy, Water Based, Lead and Chromate Free
MIL-DTL-53039	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resist
MIL-DTL-83133	Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)

MIL-DTL-83413/10	Connectors and Assemblies, Electrical, Aircraft Grounding: Jumper Cable Assembly, Aircraft to Fuel Nozzle, Discharger, Electrostatic

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-882	Standard Practice for System Safety
MIL-STD-889	Dissimilar Metals
MIL-STD-1366	Transportability Criteria
MIL-STD-1472	Human Engineering

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-470	Designing and Developing Maintainable Products and Systems
MIL-HDBK-781	Reliability test methods, plans, and environments for engineering development, qualification, and production
MIL-HDBK-1223	Nontactical Wheeled Vehicles Treatment, Painting, Identification Marking and Data Plate Standards
MIL-HDBK-1791	Designing for Internal Aerial Delivery in Fixed Wing Aircraft
MIL-HDBK-1791 C-17 Appendix	Designing for Internal Aerial Delivery in Fixed Wing Aircraft C-17 Appendix

(Copies of these documents, except for MIL-HDBK-1791 C-17 Appendix, are available online at https://assist.daps.dla.mil/quicksearch or https://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. A copy of MIL-HDBK-1791 C-17 Appendix can be obtained from the Procuring Contracting Officer (PCO) or requested by contacting Air Transportability Test Loading Agency (ATTLA) at 937-255-6296.)

FOREIGN SPECIFICATIONS

EURO-ASIAN COUNCIL FOR STANDARDIZATION, METROLOGY AND CERTIFICATION

GOST 10227	Fuels for Jet Engines, Specifications

(Copies of these documents are available online at http://www.gost.ru/wps/portal/pages.en.Main, from the Leninsky prospect, 9, Moscow, V-49, GSP-1, 119991, Russian Federation or English translations are available from various specification and standards publication technical services)
UNITED KINGDOM MINISTRY OF DEFENSE

Standard 91-87	Turbine Fuel, Aviation, Kerosine Type: Containing Fuel System Icing Inhibitor NATO Code: F-34 Joint Service Designation: AVTUR/ FSII
Standard 91-91	Specification and Qualification Procedures for Aviation Jet Turbine Fuel, Aviation Kerosine Type, Jet A-1 NATO Code: F-35 Joint Service Designation: AVTUR

(Copies of these documents are available online at http://www.dstan.mod.uk or from the UK Defence Standardization Room 1138, Kentigern House, 65 Brown Street, Glasgow G2 8EX)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DRAWINGS

MS24484	Adapter, Pressure Fuel Servicing, Nominal 2.5 Inch Diameter

LAWS AND REGULATIONS

Code of Federal Regulations (CFR)

49CFR172.302	General Marking Requirements for Bulk Packaging
49CFR393	Federal Motor Carrier Safety Regulations
49CFR178	Specifications for Packagings
49CFR178.346	Material and Thickness of Material
29CFR1910	Labor, Section XVII Occupational Safety and Health Administration (OSHA) Parts 1900-1999

Federal Acquisition Regulation (FAR)

FAR 23.404	Agency Affirmative Procurement Programs

National Institute of Standards and Technology (NIST)

HDBK44 Section 3.31/S.1.1.4-5	Advancement of Indicating and Recording Elements

(Copies of The Code of Federal Regulations (CFR) may be obtained at http://www.gpoaccess.gov/cfr/index.html or available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402.)

(Copies of FAR and DFARS may be obtained from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. Electronic copies of the FAR may be obtained from https://www.acquisition.gov/far/ . Electronic copies of the DFARS may be obtained from http://www.acq.osd.mil/dpap/dars/dfars/index.htm .)

(Copies of Government documents required by the contractor in connection with this acquisition functions should be obtained from or as directed by the contracting activity.)

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

AMERICAN PETROLEUM INSTITUTE

API 579-1/ASME FFS-1	Fitness for Service
API RP 2003	Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents

(Copies of API specifications are available from the American Petroleum Institute, 1220 L Street, NW Washington, DC 20005-4070 1220 or at http://www.api.org).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1655	Aviation Turbine Fuels
ASTM D975	Oil, Diesel Fuel
ASTM B241/B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM A312/A312M	Pipes, Stainless Steel, Seamless, Welded and Heavily Cold Worked Austenitic, Standard Specification for High Temperature and General Corrosive Service
ASTM D910	Gasolines, Aviation
ASTM D4306	Aviation Fuel Sample Containers for Tests Affected by Trace Contamination

ASTM D 4057	Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D 4177	Practice for Automatic Sampling of Petroleum and Petroleum Products.
ASTM D5001	Aviation Turbine Fuels by the Ball-on-Cylinder Lubricity Evaluator (BOCLE), Measurement of Lubricity of,
ASTM D5006	Standard Test Method for Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels, Measurement of
ASTM D3241	Oxidation, Thermal, Stability of Aviation Turbine Fuels (JFTOT Procedure)
ASTM D6615	Standard Specification for Jet B Wide-Cut Aviation Turbine Fuel
ASTM D7467	Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)
ASTM D7566	Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons

(Copies of ASTM standards may be obtained from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. Electronic copies of ASTM standards may be obtained from http://www.astm.org)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Boiler and Pressure Vessel Code

Section VIII	Rules for Construction of Pressure Vessels

(Copies are available from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017 - Electronic copies may be obtained from http://www.asme.org)

AMERICAN WELDING SOCIETY (AWS)

D1.1/D1.1M	Structural Welding Code–Steel
D1.2/D1.2M	Structural Welding Code–Aluminum

(Application for copies should be addressed to American Welding Society, 550 N.W. LeJeune Road, Miami FL 33126. Electronic copies may be obtained from http://www.aws.org)

ENERGY INSTITUTE

EI 1529	Aviation Fueling Hose
EI 1581	Specification and Qualification Procedures for Aviation Jet Fuel Filter Separators
EI 1584	Four-Inch Hydrant System Components and Arrangements

(Copies are available from the Energy Institute, 61 New Cavendish Street, London W1G 7AR, UK or at http://www.energyinst.org).

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 385	Tank Vehicles for Flammable and Combustible Liquids
NFPA 407	Aircraft Fuel Servicing

(Application for copies should be addressed to American Welding Society, 550 N.W. LeJeune Road, Miami FL 33126. Electronic copies may be obtained from http://www.aws.org)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J534	Lubrication Fittings
SAE AMS 336	Silicone Rubber, Extreme Low Temperature Resistant 55 – 65 Duro For Sheeting & Extrusion
SAE J682	Rear Wheel Splash and Stone Throw Protection
SAE J695	Turning Ability and Off Tracking
SAE J821	Electrical System for Construction and Industrial Machinery
SAE J994	Alarm-Backup-Electric-Laboratory Performance Testing
SAE J1099	Technical Report on Low Cycle Fatigue Properties Ferrous and Non-Ferrous of Materials
SAE ARP 1247	General Requirements for Aerospace Ground Support Equipment, Motorized and Non-Motorized
SAE AMS 2175	Castings, Classification and Inspection of

(Application for copies should be addressed to SAE, Inc., 400 Commonwealth Drive, Warrendale PA 15096.) Electronic copies may be obtained from http://www.sae.org/servlets/index

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First production. When specified (see 6.2), one aircraft refueling truck shall be subjected to first production inspection in accordance with 4.2.

3.2 Aircraft refueling truck description. The aircraft refueling truck shall receive, transport, store, and pump turbine and jet fuels in accordance with ASTM D910, ASTM D1655,

MIL-DTL-5624, MIL-DTL-25524, MIL-DTL-83133, GOST 10-227, Def Stan 91-91, Def Stan 91-87, ASTM D6615, and ASTM D7566. The truck has a capacity of 6000 gallons and is capable of: (1) continuously issuing fuel to aircraft at volumetric flow rates (flow rates) up to 600 gallons per minute (gpm), (2) continuously bottom loading fuel into the cargo tank at flow rates up to 750 gpm, (3) continuously defueling aircraft at flow rates up to 300 gpm, and (4) receiving fuel from a Type III hydrant system in order to independently issue fuel to the aircraft at flow rates up to 600 gpm or issue fuel to the aircraft refueling cargo tank at rates up to and including a maximum of 700 gpm (self-contained design; see 3.13).

3.3 Design and construction. The aircraft refueling truck shall be designed and constructed so that no parts will work loose in service. It shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service. It shall be weatherproof and designed to prevent the intrusion of water and sand into critical operating components. The aircraft refueling truck shall be designed to optimize energy efficiency while minimizing engine fuel consumption. Unless otherwise specified, SAE ARP 1247 requirements for aerospace ground support equipment, as applicable to a refueling truck, shall apply.

3.3.1 Materials, protective coatings, and finish. All components which come into contact with fuel shall be compatible with all fuels in accordance with ASTM D910, ASTM D1655, MIL-DTL-5624, MIL-DTL-25524, MIL-DTL-83133, GOST 10-227, Def Stan 91-91, Def Stan 91-87, ASTM D6615, and ASTM D7566. Magnesium alloys, wood products, polyvinyl chloride (PVC), polyester, room temperature vulcanizing rubber (yielding acetic acid), or asbestos shall not be used in any component or assembly of this truck. Zinc coated metals, brass, bronze, or other copper bearing alloys shall not come in direct contact with fuel.

3.3.1.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3.1.2 Green Procurement Program (GPP). GPP is a mandatory federal acquisition program that focuses on the purchase and use of environmentally preferable products and services. GPP requirements apply to all acquisitions using appropriated funds, including services and new requirements. FAR 23.404(b) applies and states the GPP requires 100 percent of Environmental Protection Agency designated product purchase that are included in the Comprehensive Procurement Guidelines list that contains recovered materials (see 6.3.1), unless the item cannot be acquired:

a. Competitively within a reasonable timeframe,

b. Meet appropriate performance standards, or

c. At a reasonable price.

The prime contractor is responsible for ensuring that all subcontractors comply with this requirement.

3.3.1.3 Metals. All materials in contact with the fuel and not specified elsewhere in this document shall be corrosion resistant and shall not be adversely affected by or affect the fuel. All components and piping downstream of the filtration system shall be of aluminum or stainless steel. All aluminum components in direct contact with fuel, except the tank, shall be anodized or chemically conversion coated. Brass components shall be minimized but accepted in hose couplings/hose reducers and drain valves. Copper components will be minimized but accepted in drain lines that render the product as sump fuel. All other material in contact with the fuel shall be free of cadmium, copper, lead, or zinc. Non-metallic materials shall not affect or be adversely affected by the fuel under any operating conditions specified for the equipment.

3.3.1.4 Impregnation of castings. Aluminum castings may be impregnated to prevent weeping.

3.3.1.5 Elastomers. Elastomeric materials shall be certified compatible with all fuels specified herein.

3.3.1.6 Protective coatings. Cleaning, chemical treatments, painting, plating, and films shall be in accordance with best commercial practice. Materials that deteriorate when exposed to sunlight, weather, or operational conditions normally encountered during the service life of the item shall not be used or shall have means of protection against such deterioration that does not prevent compliance with the performance requirements specified herein. Protective coatings that chip, crack, or scale with age or extremes of climatic conditions or when exposed to heat shall not be used. Fasteners, handles, and fittings used in the assembly of the item shall also be primed and painted. Surface preparation and pretreatment shall be in accordance with the respective primer and topcoat specifications.

3.3.1.7 Dissimilar metals. Dissimilar metals, as defined in MIL-STD-889, shall not be in contact with each other. Metal plating or metal spraying of dissimilar base metals to provide electromotively compatible abutting surfaces is acceptable. The use of dissimilar metals only when separated by suitable insulating material is permitted, except in systems where bridging of insulation materials by an electrically conductive fluid can occur. Sealants or gel type gasket materials shall be used between faying surfaces and butt joints.

3.3.1.8 Finish. The exterior finish color of the aircraft refueling truck shall be as specified in 3.3.1.8.1 using the manufacturer's standard commercial paint system. The tank boarding ladder (see 3.12.6) shall not be painted. Driveline and cab components, which are not visible during normal operations with the cab door closed, may be their original color. The finish top coat shall extend into the door jambs and hood jambs to the extent that the OEM finish color cannot be seen through the gaps between the body panels when the doors and hood are closed.

3.3.1.8.1 Gloss green. Unless otherwise specified (see 6.2c), all exterior surfaces, except for the tank boarding ladder, all trim, and compartment interior surfaces shall be painted gloss green, color number 14052 of FED-STD-595. The chassis and running gear may be green or black.

3.3.1.8.2 Semi-gloss green. When specified (see 6.2c), all exterior surfaces, except for the tank boarding ladder, all trim, and compartment interior surfaces shall be painted semi-gloss green, color number 24052 of FED-STD-595. The chassis and running gear may be green or black. Driveline and cab components, which are not visible during normal operations with the cab door closed, may be their original color.

3.3.1.8.3 Desert sand. When specified (see 6.2c), all exterior surfaces, including driveline components (see 6.3.8), except for the tank boarding ladder, all trim, and compartment interior surfaces shall be painted tan 686A, color 33446 of MIL-DTL-53039.

3.3.1.9 Fluid traps and faying surfaces. There shall be no fluid traps on the aircraft refueling truck. Faying surfaces of all structural joints, except welded joints, shall be sealed to preclude fluid intrusion.

3.3.1.9.1 Ventilation. Ventilation shall be sufficient to prevent moisture retention and buildup.

3.3.1.9.2 Drainage. Drain holes shall be provided to prevent collection or entrapment of water or other unwanted fluid in areas where exclusion is impractical. All designs shall include considerations for the prevention of water or fluid entrapment and ensure that drain holes are located to effect maximum drainage of accumulated fluids. The number and location of drain holes shall be sufficient to permit drainage of all fluids when the unit is in a 10 degree incline in any plane. The minimum size of the drain holes shall be 0.25 inch.

3.3.1.10 Rustproofing. The vehicle chassis and cab shall be rustproofed to a tropical level in accordance with FED-STD-297. Rustproofing shall not be applied to the first production unit until after approval of the test report.

3.3.2 Markings. The aircraft refueling truck shall be marked for the appropriate service using MIL-HDBK-1223 for guidance. Four DOT hazardous material labels, number 1863, shall be mounted on the vehicle, one on each side of the forward 1/3 of the cargo tank, one on the upper right hand corner of the rear of the tank, and one on the front bumper of the truck. The aircraft refueling truck shall also be marked in accordance with 49 CFR 172.302 and National Fire Protection Association (NFPA) 407. All external devices which require an operational or maintenance interface shall be marked in accordance with MIL-STD-130. Markings shall be vinyl decals and shall be 1-inch high block letters unless prohibited by the available space. In such cases, the markings shall be the largest size possible, but shall not be less than ½-inch high. Markings, Information/Caution shall be Lusterless Black, Color Number 37038 of FED-STD-595, and Markings, Warning/Danger shall be Lusterless Red, Color Number 31136 of FED-STD-595. Other markings shall be painted red, color number 31136 of FED-STD-595 for trucks painted gloss green; painted black, color number 37038 of FED-STD-595 for trucks painted semi-gloss green; and painted white, color number 37875 of FED-STD-595 for trucks painted desert sand. The center of gravity of the empty aircraft refueling truck shall be stenciled on the unit within 1.0 inch of the calculated center of gravity.

3.3.2.1 Flammable. "FLAMMABLE" 4 or 6-inch letters shall be located on each side and the rear of the aircraft refueling truck.

3.3.2.2 No smoking within 50 feet. "NO SMOKING WITHIN 50 FEET" 4 or 6-inch letters shall be located on each side and the rear of the aircraft refueling truck.

3.3.2.3 Cargo fire avoid water. "CARGO FIRE-AVOID WATER" 2-inch letters shall be located on each side and the rear of the aircraft refueling truck.

3.3.2.4 Jet fuel product. "JET FUEL PRODUCT" 4 or 6-inch letters shall be located on each side and the rear of the aircraft refueling truck.

3.3.2.5 Emergency tank shutoff. "EMERGENCY TANK SHUTOFF" shall be marked in 2-inch letters near each emergency tank shutoff (see 3.10.2.1).

3.3.3 Identification and information plates.

3.3.3.1 Identification plate. An identification plate in accordance with MIL-STD-130 shall be securely attached to the aircraft refueling truck in a readily accessible location. The identification plate shall contain the following information:

a. Serial Number

b. Vehicle Registration Number

c. Date of Delivery

d. Make and Model

e. National Stock Number

f. Commercial and Government Entity (CAGE) Code

g. Contract Number

h. Date of Warranty Expiration

i. Cargo Tank Capacity (Gallons)

j. Vehicle Weight, Unloaded (Pounds)

k. Gross Vehicle Weight (Pounds)

l. Fuel Type

m. Engine oil viscosities for ambient temperatures ranging from -40° F to +125° F

3.3.3.2 Transportation data plate. A transportation data plate shall be securely attached to the aircraft refueling truck in a readily accessible location. The data plate shall include as a minimum the following information:

a. Side and rear silhouette views of the aircraft refueling truck.

b. Horizontal and vertical location of the center of gravity of the aircraft refueling truck in air transportable configuration, marked on the silhouette views.

c. Shipping weight.

d. Loading cubage.

e. Overall height, width, and length.

f. Front and rear axle loads.

g. Tie down information.

3.3.4 Safety.

3.3.4.1 System safety. The design of the aircraft refueling truck shall not contain any system safety mishap risk categories greater than medium as defined in Table A-IV of MIL-STD-882.

3.3.4.2 Component protection. All space in which work is performed during operation, service, and maintenance shall be free of hazardous protrusions, sharp edges, or other features which may cause injury to personnel. All moving parts and all parts subject to high operational temperatures or subject to being electrically energized, that are of such nature or so located as to be hazardous to personnel, shall be guarded or insulated to eliminate the hazard.

3.3.4.3 Foreign object damage (FOD). All loose metal parts, such as pins or connector covers, shall be securely attached to the aircraft refueling truck with wire ropes or chains. "Dog tag" style beaded chains shall not be provided. Removable panels, if provided, shall be attached with captive fasteners. Tire valve stem caps shall be made of plastic.

3.3.4.4 Sound levels. The maximum A-weighted sound levels produced during pumping operations shall not exceed 84 dBA at the operator's location, in front of the operator control panel.

3.3.4.5 Electromagnetic interference (EMI). The aircraft refueling truck shall be in accordance with the following radiated emission and susceptibility requirements of MIL-STD-461: RE102 (to the limits of the FIGURE RE102-4, Navy Fixed & Air Force curve) and RS103 (to the levels of TABLE VII) for the following ranges:

30MHz – 1GHz at 10 Volt per metre (V/m)

1GHz – 18GHz at 50V/m

3.3.4.6 Electrostatic discharge. The design of the aircraft refueling truck shall preclude equipment damage due to electrostatic discharge (ESD), protect personnel from electrical shock due to static charging, and prevent ignition of explosive atmospheres due to sparking.

3.3.4.6.1 Bonding. All metal components shall be bonded in accordance with API RP 2003. A bonding braid, with less than 10 ohms resistance, shall be attached to all sump drain locations.

3.3.4.6.2 Prevention of static electricity. Fuel shall not spray or free fall into or out of the cargo tank during operation or servicing. Nonmetallic components shall be certified to a resistance of 10E+8 ohms/in^2 or less.

3.3.4.7 Design and hydrostatic pressure ratings. All pumping and bottom loading system components shall have a minimum design operating pressure rating as required to meet all requirements as specified in 3.8.2 or 150 psig, whichever is greater, and shall withstand a hydrostatic pressure of 1.5 times the minimum design operating pressure.

3.3.5 Human engineering. The aircraft refueling truck shall be designed in accordance with MIL-STD-1472 for ease of operation, inspection, and maintenance, including the use of arctic mittens and Mission-Oriented Protective Posture (MOPP) Level 4 Chemical Warfare Gear. The range of control positions of any device shall not obstruct the range of control positions of another device.

3.3.6 Fastening devices. All screws, bolts, nuts, pins, and other fastening devices shall be properly designed, manufactured, and installed with adequate means of preventing loss of torque or adjustment. Cotter pins, lock washers, or nylon patches shall not be used for this purpose, except for the attachment of trim items or as provided in commercial components. All components connecting to the chassis frame rails shall be installed in accordance with standard commercial practice. Tapped threads shall have a minimum thread engagement in accordance with Table I.

TABLE I. Minimum Thread Engagement

Material	**Minimum Thread Engagement**
Steel	1.0 times the nominal fastener diameter
Cast iron, brass, or bronze	1.5 times the nominal fastener diameter
Aluminum, zinc, or plastic	2.0 times the nominal fastener diameter

3.3.7 Welders and welding. All welders shall be certified to weld in accordance with AWS D1.1 and AWS D1.2 for structural components and ASME Boiler and Pressure Vessel Code Section IX for the cargo tank and filter vessel. The contractor shall make available to the Government certifications for all welders being utilized on the aircraft refueling truck. Welding procedures and all welding on the aircraft refueling truck shall be in accordance with AWS D1.1 and AWS D1.2 and ASME Boiler and Pressure Vessel Code Section IX, as applicable. The surface parts to be welded shall be free from rust, scale, paint, grease, and other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the welded parts. Welds shall transmit stress without cracking or permanent distortion when the parts connected by the welds are subjected to test, proof, and service loadings.

3.3.8 Lubrication. Lubrication fittings shall be in accordance with SAE J534. Grease seals shall include pressure relief devices to prevent damage. Extended lubrication fittings may be used to enhance accessibility.

3.3.9 Foolproofness. Where improper installation of an item causes a malfunction, an asymmetric mounting system shall be provided, where practical, to ensure proper mounting of the item.

3.3.10 Service life. The aircraft refueling truck chassis and the refueling system components shall be selected for a design service life of not less than 15 years, and verified by Finite Element Analysis (FEA) and strain gauge testing based on the strain-life fatigue analysis technique/approach. Design stress levels shall be attained by utilizing a design load that is based on dynamic loading with a safety factor of two. The dynamic load shall be the combination of load forces that the structure must support or resist in a static state with adjustments for shock loads and accelerations in all directions encountered during air or full-capacity ground transport and operations. At a minimum, the dynamic load shall be 1.6 times the full static load, including all refueling system components and full-capacity cargo tank. All data, assumptions, calculations and IGS files shall be provided to the Government upon analysis completion.

3.4 Environmental conditions.

3.4.1 Operation and storage temperature range. The aircraft refueling truck shall be capable of operation and storage in ambient temperatures ranging from -40° F to +125° F.

3.4.2 Humidity. The aircraft refueling truck shall be capable of storage and operation at relative humidity from 0 to 100 percent.

3.4.3 Fungus. All materials used in the aircraft refueling truck shall be fungus resistant or shall be suitably treated to resist fungus. Materials treated for fungus resistance shall retain their original electronic and physical properties, shall not present toxic hazards, and treatment shall last for the entire service life of the part. The aircraft refueling truck shall be suitable for operation and storage in conditions encountered in a tropical environment.

3.4.4 Salt fog. The aircraft refueling truck shall be capable of storage and operation in high temperature, high humidity, salt laden, and sea coast environments without damage or deterioration of performance.

3.4.5 Sand and dust. The aircraft refueling truck shall be capable of storage and operation during exposure to wind-blown sand or dust without damage or deterioration of performance.

3.5 Weight and dimensions. Overall weight and dimensions in air transport configuration shall not exceed:

a. Weight 30,000 pounds.

b. Length 456 inches.

c. Width 106 inches.

d. Height 102 inches.

The aircraft refueling truck air transport configuration is with the cargo tank and pumping system empty.

3.6 Transportability.

3.6.1 Surface transportability. The aircraft refueling truck shall be transportable via all modes of surface shipment (highway (see 6.3.3), rail, and water) in accordance with MIL-STD-1366, and shall be capable of withstanding the mechanical shock and vibration characteristics of highway, rail, and water transport, except that design for rail impact testing (see 5.2.5 of MIL-STD-1366) is not required.

3.6.2 Air transportability. The aircraft refueling truck, without a Hydrant Service (HS) Module (HSM) (see 3.13), shall be air transportable on C-130, C-17, and C-5 aircraft. Design criteria can be found in MIL-HDBK-1791. In all air transport configurations, the aircraft refueling truck shall be capable of being restrained and withstanding, without loss of serviceability, 2.0 G up and 4.5 G down accelerations, and shall be capable of being restrained and withstanding, without loss of structural integrity, 3.0 G forward, 1.5 G aft, and 1.5 G lateral accelerations. The aircraft refueling truck shall be equipped with pressure relief devices or configured for air transport to prevent any part from becoming a projectile in the event of catastrophic loss of aircraft cabin pressure. The aircraft refueling truck shall drive on and off the aircraft, negotiating the required maximum ramp angles without shoring.

3.6.2.1 Shoring. The aircraft refueling truck shall be air transportable without shoring.

3.6.2.2 Axle weight. Axle weight shall not exceed 13,000 pounds.

3.6.2.3 Tire pressure. Tire pressure shall not exceed 100 psig and shall not be reduced for air transport.

3.6.2.4 Tie downs. The aircraft refueling truck shall be symmetrically restrained during air and ground transport. Tie down points shall be rated at a minimum of 25,000 pounds, marked for capacity, with a clear opening compatible with MIL-DTL-25959 and MIL-PRF-27260 tie down devices. Each end of each tie down device shall terminate at a tie down point and not pass through any other tie down point. There shall be no interference between tie down devices and the aircraft refueling truck. The axles may be used as tie down points; however, no more than 50 percent of the restraint in any direction may be provided by the axles.

3.6.2.5 Equipment removal and reconfiguration. Preparation for air transport shall take no more than 15 minutes and restoration to operating configuration shall take no more than 15 minutes for two persons using common hand tools (see 6.3.6). All equipment removed shall be stored on the aircraft refueling truck; caps and plugs shall permit moving and storage in transport configuration.

3.7 Reliability and maintainability.

3.7.1 Reliability. The aircraft refueling truck shall have a mean time between failure (MTBF) of at least 100 hours measured at 90 percent one-sided confidence limit. Definitions of reliability terms shall be in accordance with A.3.

3.7.2 Maintainability. The aircraft refueling truck shall be designed for maintainability in accordance with 5.9 through 5.9.18 of MIL-STD-1472; forces shall not exceed those specified for both males and females.

3.7.2.1 Preventive maintenance. The recommended routine preventive maintenance interval (PMI) shall be at least 400 operating hours. Preventive maintenance tasks, other than tasks required daily or before operation, shall not require more than 24 man-hours. This shall be calculated by:

$$PMMH_T = \sum_{i=1}^{N} \frac{PMMH_i}{i}$$

where:

$PMMH_T$	is the total preventive maintenance man-hours,
i	is a multiple of the routine PMI (that is, i=1 for the routine PMI, i=2 for every other routine PMI, etc.), and
$PMMH_i$	is the preventive maintenance man-hours at the ith PMI.

3.7.2.2 Corrective maintenance. The aircraft refueling truck shall have a mean time to repair (MTTR) of no greater than 2.0 hours measured at a 90 percent confidence level (10 percent consumer's risk). MTTR shall be calculated in accordance with A.4.5.3.

3.7.2.3 Inspection and servicing provisions.

a. Four people shall be able to perform all daily inspection and service tasks within 15 minutes without the use of tools. Daily inspection and service tasks include, but are not limited to: inspecting for leaks; checking brakes, steering, horn, lights, engine, transmission, power take-off (PTO), and drive belts; adjusting lubricants, coolant, windshield washer fluid levels, and tire pressure; draining sump and air reservoir; activation and deactivation of the deadman device; and completely unwinding hose and connecting to the bottom loader.

b. Common hand tools (see 6.3.6) shall be used to the maximum extent possible. Any peculiar hand tool (see 6.3.7), if required to service or repair any part of the fueling system or a sub-system, shall be provided with each truck.

c. Drain plugs and filters shall be directly accessible and oriented to have unimpeded drainage to a catch pan.

d. The aircraft refueling truck shall be designed with maximum usage of sealed lifetime lubrication bearings.

e. The aircraft refueling truck shall be designed so the correct oil and coolant levels can be checked while the unit is not running.

f. The aircraft refueling truck shall be designed so that there is no need to disconnect or remove components to gain access to other components.

g. All pneumatic lines and electrical harnesses shall be equipped with quick disconnect fittings.

The aircraft refueling truck shall have a one task time limit of four hours for removing and replacing any item in the fueling system, such as: filter elements, the PTO, the pump, a hose reel, or a fueling hose replacement.

3.7.2.4 Relative accessibility. Critical items that require rapid maintenance shall be most accessible. When relative criticality is not a factor, items that require the most frequent access shall be most accessible. High failure rate items shall be accessible for replacement without moving non-failed items.

3.7.2.5 Error-proof design. The design of the aircraft refueling truck shall incorporate error-proofing in equipment mounting, installing, interchanging, connecting, and operating.

a. Equipment shall include physical features (for example, supports, guides, size, or shape differences, fastener locations, and alignment pins) that prevent improper mounting. In the absence of physical features, equipment shall be labeled or coded to identify proper mounting and alignment.

b. Equipment that has the same form and function shall be interchangeable throughout a system and related systems. If equipment is not interchangeable functionally, it shall not be interchangeable physically.

c. Connectors serving the same or similar functions shall be designed to preclude mismating or misalignment.

d. Design, location, procedural guidance, and suitable warning labels shall be provided to prevent damage to equipment while it is being handled, installed, operated, or maintained.

3.7.2.6 Special Tools. The design of the aircraft refueling truck shall minimize the requirement for peculiar hand tools (see 6.3.7).

3.7.2.7 Diagnostic Software. A copy of any commercially available diagnostic software recommended for maintaining the aircraft refueling truck shall be provided with each aircraft refueling truck on CD-ROM or DVD-ROM.

3.8 Performance.

3.8.1 Mobility.

3.8.1.1 Turning diameter. The aircraft refueling truck wall-to-wall turning diameter, as defined by SAE J695, shall not exceed 99 feet in either direction.

3.8.1.2 Gradeability. The fully loaded aircraft refueling truck shall be in accordance with the gradeability requirements of FED-STD-807.

3.8.1.3 Suspension articulation. The fully loaded aircraft refueling truck shall negotiate an eight inch high radius top berm, with 15 percent approach and departure angles (secondary containment barrier around a fill stand), in a straight pass as well as a minimum radius turn mid-way in either direction. There shall be no structural failure of any component, including permanent deformation, or evidence of impending failure. There shall be no interference between the aircraft refueling truck components or between the aircraft refueling truck, the ground, and all required obstacles, with the exception of normal contact by the tires.

3.8.1.4 Speed. The fully loaded aircraft refueling truck shall be capable of achieving speeds of 55 mph on level, paved highway, 40 mph over an unimproved road (see 6.3.4), and 15 mph over cobblestone road (see 6.3.5).

3.8.1.5 Roadability. The fully loaded aircraft refueling truck, including filter system and piping, shall be capable of being driven continuously over a combination of paved roads at a minimum average speed of 45 mph, graded gravel or unimproved roads at a minimum average speed of 25 mph, and cobblestone roads at a minimum average speed of 10 mph.

3.8.2 Pumping system. The pumping system shall be capable of performing the following functions and at no time shall fuel flow be allowed to backflow through the meter and filtration system. For all flow modes of operation, pressure and flow shall be stable at any operating condition specified herein.

a. In High Flow mode, issue a minimum of 5700 gallons of fuel to an aircraft from the cargo tank, through the filtration system, the meter, and the single-point hose and nozzle at flow rates of 600 gpm +0/– 25 gpm with nozzle back pressures over the range of 0 psig to the operator selected maximum nozzle backpressure ± 5 psig. In High Flow mode, the pumping system shall be designed such that flow rate is continuously monitored through an automated control system that will maintain the flow rate by varying the engine RPM. The automated control system will also adjust the flow rate to prevent the single-point nozzle pressure from exceeding the operator selected maximum nozzle pressure setting while minimizing engine fuel consumption. The pumping system shall be equipped with an operator selected dual nozzle pressure control system (PCS) and shall include: (1) a primary PCS with operator selectable settings of either 50 psig or 35 psig maximum single-point nozzle pressure, and (2) a secondary PCS with 55 psig maximum pressure.

b. In Low Flow mode, issue a minimum of 5700 gallons of fuel to an aircraft from the cargo tank, through the filtration system, the meter, and either the single-point nozzle or the overwing nozzle (see 3.10.13.2) at flow rates of 100 gpm +10/– 0 gpm with nozzle back pressures over the range of 0 psig to 50 ± 5 psig. In Low Flow mode, the pumping system shall be designed such that flow rate is continuously monitored through an automated control system that will maintain the flow rate by varying the engine RPM. The automated control system will also adjust the flow rate to prevent the single-point or overwing nozzle pressure from exceeding 50 ± 5 psig while minimizing engine fuel consumption.

c. In Defuel mode, with the fuel level height no greater than ten feet above the ground; defuel fuel a minimum of 5700 gallons from an aircraft through the single-point nozzle and hose, through the filtration system, the meter, and into the cargo tank at a minimum flow rate of 175 gpm without the assistance of aircraft boost pumps and 300 ± 10 gpm with the assistance of aircraft boost pumps. The minimum obtainable flow rate shall be at least 15 gpm. An auxiliary throttle shall be used for controlling flow. The deadman control system (DCS) operations shall terminate, upon fuel contact with the primary tank-level sensor, thus terminating flow (see 3.12.7.4).

d. In Defuel mode, with the fuel level at least three feet below ground level, defuel through a 15 foot long, 1.5 inch pigtail hose connected to the single-point nozzle, through the filtration system, the meter, and into the cargo tank at flow rates of 50 gpm. The minimum obtainable flow rate shall be at least 10 gpm. An auxiliary throttle shall be used for controlling flow. The deadman control system (DCS) operations shall terminate, upon fuel contact with the primary tank-level sensor, thus terminating flow (see 3.12.7.4).

e. In HS mode, receive fuel through the HSM (see 3.13), from a Type III hydrant system, in order to independently: (1) issue fuel to the aircraft or, (2) fill the aircraft refueler cargo tank. When issuing fuel to the aircraft, the truck engine shall be operating and in the High Flow mode, High Pressure setting. All fuel shall pass through the filtration system, the meter, and the single-point hose and nozzle, at maximum flow rate of 600 gpm with single-point nozzle back pressures over the range of 0 psig to 50 ± 5 psig. When filling the cargo tank, the truck engine shall be operating and at no time shall fuel pass through the pump, filtration system, or the meter. The HMS system shall control flow rates from 0 to a maximum of 700 gallons per minute (GPM) with a maximum hydrant inlet pressure of 130 psig when filling the cargo tank.

3.8.2.1 Closed pump discharge. The pump shall operate at the maximum rated pump speed, with the pump discharge side closed, for a minimum of 30 minutes without evidence of damage or overheating.

3.8.2.2 Dry pump operation. The pump shall operate dry at maximum pump speed for 10 minutes without evidence of damage or overheating.

3.9 Chassis and cab.

3.9.1 Chassis. The truck chassis shall be a standard commercial chassis in accordance with FED-STD-807 for a six by four chassis with a two door cab, Type 1, Class F, as modified to comply with the specific requirements herein. A rear air suspension system shall be provided. The fully loaded aircraft refueling truck shall be towable from the front with or without the front tires off the ground. The driver side and passenger side mirrors shall be electronically adjustable from the driver position within the cab. Both driver and passenger side mirrors shall be large enough to provide a clear and distinct perspective of the entire length of the truck and rear bumper. The truck shall include backup lights and a backup alarm. The backup alarm shall meet the Type D (87 dBA) requirements of SAE J994. Unless provided as standard equipment on the commercial chassis, all lighting shall be LED.

3.9.2 Frame analysis. An analysis shall be provided to verify that the truck frame shall withstand factored imposed loads of operation under all of the conditions described herein. The frame, less crossmembers and reinforcements, shall have a resisting bending moment (RBM) of each rail of not less than

$$RBM\,(in-lbs) \geq 0.167 \times WB \times GVW$$

where:

WB is the wheelbase in inches, and
GVW is the gross vehicle weight in pounds-force

at the area of maximum frame rail depth. Bending is assumed to occur about the flexural members strong-axis.

3.9.3 Axle analysis. An analysis shall be required to verify that the commercial load rating of each axle shall exceed the gross imposed load, measured at the ground.

3.9.4 Wheel loading. Wheel loading variation on any axle shall not exceed 2.5 percent of the total axle load, for either curb or gross load conditions. Gross load conditions shall include the fully optioned aircraft refueling truck weight, plus the tank, pump and piping systems full of JP-8 fuel, and a crew of two 250 pound operators.

3.9.5 Engine, fuels, and exhaust system. The truck engine shall provide the necessary power to meet the minimum performance requirements specified herein while utilizing the most efficient technological resources of minimizing fuel consumption. The truck engine shall be capable of operating on 1-D S15, 1-D S500, 1-D S5000, 2-D S15, 2-D S500, and 2-D S5000 diesel fuels in accordance with A-A-52557 and ASTM D 975, JP-5, JP-8, Bio Diesel blends up to 20% in accordance with ASTM D7467, TS-1 with US military additive package in accordance with GOST 10-227, Jet A-1 in accordance with Def Stan 91-91, Jet A-1 with US military additive package in accordance with Def Stan 91-87, Jet A and Jet A-1 in accordance with ASTM D1655, and aviation turbine fuel blends (i.e. FT, HRJ, etc) in accordance with ASTM D7566. An engine emergency shutoff valve, with reset capabilities, shall be provided in the engine air intake system, controlled by the emergency engine shutoff switch located on the operator control panel (see 3.10.8.1).

3.9.5.1 Engine starting system.

3.9.5.1.1 Starter. The engine shall be equipped with a 12-volt DC electric starter.

3.9.5.1.2 Engine starting aids. The engine shall start within 15 seconds cranking in any ambient temperature within the required operating range of the aircraft refueling truck. Installed glow plugs, fluid starting aids, and heat from the winterization system (see 3.9.11.3), as shown in Table II, may be used prior to and during the start period to facilitate engine starting under the following conditions:

TABLE II. Engine starting aids

Temperature Range	**Starting Aids Permitted**
40° F through 125 °F	None
1° F through 39° F	Glow plugs and fluid starting aids
-40 °F through 0° F	Glow plugs, fluid starting aids, and heat from the winterization system

3.9.5.2 Exhaust system. The truck muffler shall be mounted under and behind the front bumper, with a right side outlet pointing down and forward. No portion of the exhaust system shall extend behind the truck cab.

3.9.5.3 Engine and related equipment. The aircraft refueling truck shall be equipped with a diesel engine. The engine shall be certified to comply with the strictest Environmental Protection Agency (EPA) non-road diesel engine emission requirements consistent with the requirement to operate on fuels containing over 15 parts per million (ppm) sulfur and those fuels as specified in 3.9.5, at the time of engine manufacture.

3.9.5.4 Engine air intake system. The engine air intake system shall be in accordance with 3.13.1.4.3 of SAE ARP1247. The inlet shall not draw air from directly beneath the aircraft refueling truck and shall not be located near the cooling system air outlet nor the engine exhaust outlet. Joints shall be minimized between the air filter outlet and the actual engine air inlet and shall be designed to ensure no leakage of unfiltered air into the engine. A differential pressure air filter service indicator shall be provided.

3.9.5.5 Engine cooling system. The engine cooling system shall be in accordance with 3.13.1.4.2 of SAE ARP1247. Silicone radiator and heater hoses, a coolant filter, and a coolant recovery system shall be provided. Engine coolant shall be in accordance with A-A-52624, Type I, and of adequate strength to provide protection to -40° F. The engine out (top of radiator) coolant temperature shall not exceed the engine manufacturer's recommendations at 125° F.

3.9.5.6 Engine oil operating temperature. The engine oil sump temperature shall not exceed the engine manufacturer's recommendations at 125° F.

3.9.5.7 Engine oil filter. The engine oil filter shall be in accordance with 3.13.1.4.4 of SAE ARP1247.

3.9.5.8 Fuel tank. The fuel tank shall be in accordance with 3.13.1.5.5 through 3.13.1.5.9 of SAE ARP1247. The tank shall be provided with corrosion protection and baffles. A 0.25 to 0.375-inch nominal drain plug shall be provided for emptying fuel and sediment into a container underneath the aircraft refueling truck without removal of the tank or any other major component. The fuel tank shall have a fuel fill opening of not less than three inch inside diameter and shall be designed to drain fuel spillage overboard for collection outside the aircraft refueling truck. The fuel cap shall be equipped with a retention device to prevent loss and FOD. The fuel fill opening, fuel cap, and fuel cap retention device shall be manufactured from non-sparking material.

3.9.5.9 Engine diagnostic system. If the engine is equipped with an electronic control module, a diagnostic system shall be provided with a means to indicate engine faults; it shall be equipped with a CAN buss connector. If the aircraft refueling truck is equipped with a diagnostic or built-in-test system, the engine diagnostic system shall be integrated with it; if not, it shall be a standalone system.

3.9.6 Transmission. The truck shall be equipped with an automatic transmission.

3.9.7 Power take-off (PTO). The fuel delivery system pump shall be driven via a transmission driven PTO or split shaft gearbox design. The system shall be designed to either move the truck or drive the pump; never both concurrently. PTO engagement, from road to pump mode or from pump to road mode, shall occur without gear clash or system shock loading. The auxiliary throttle shall not operate while the PTO is in road mode and the truck accelerator pedal shall not operate while the PTO is in pump mode. PTO engagement shall be controlled from the driver's seated position and shall not occur unless and until selector is in neutral, engine is at idle, and truck parking brake is engaged.

3.9.8 Propeller shafts. The cargo tank and the pumping system shall be protected from any part of a failed propeller shaft. A failed propeller shaft shall not drop to the ground and shall not generate a spark from contact with any restraining device.

3.9.9 Wheels and tires.

3.9.9.1 Tires. All tires and wheels shall be identical and shall be in accordance with the Tire and Rim Association requirements for this application.

3.9.9.2 Spare wheel. A spare wheel shall be provided with each truck. A mount point on the truck is not required. The wheel shall be secured properly in the cab passenger side without damaging any interior components or material.

3.9.10 Brakes. The truck shall be equipped with an air brake system. The air system shall be rechargeable from auxiliary air lines, using 0.25 inch male style quick-disconnect fittings, one located at the front and one at the rear of the truck. A sealed emergency brake interlock override valve shall be mounted inside the cab. Each air reservoir shall have a manually operated drain valve.

3.9.11 Electrical system. The aircraft refueling truck shall have a 12-volt, negative ground electrical system in accordance with 3.13.1.2 of SAE ARP1247 except as otherwise specified herein.

3.9.11.1 Batteries and battery compartment.

3.9.11.1.1 Batteries. Batteries shall be of the commercial maintenance-free sealed lead acid, starved electrolyte, gas recombination, spiral wrapped, absorbent gas mat, top post type in accordance with MIL-B-18013/1.

3.9.11.1.2 Battery compartment. The batteries shall be enclosed in a weatherproof box or compartment and be readily accessible. The battery box shall be frame mounted and located forward of the back of the cab. If the battery box cannot be located forward of the back of the cab, it shall be located on the right side of the truck with the power cables routed within conduit a minimum of six inches forward of the rear of the cab. The battery cover shall be easily detachable and reattachable and shall not interfere with any electrical wiring harnesses in the battery compartment. The cover shall be made of a non-deforming material.

3.9.11.1.3 Battery cables. The battery cables shall be sized to handle the system voltage and current levels, be clearly identified with "+" and "-" or red and black markings, and shall not be spliced.

3.9.11.2 Wiring. Wiring shall be in accordance with SAE standards for low-tension insulated cable and shall be identified by color or number, or both, in accordance with SAE J821. All electrical circuits shall be protected by circuit breakers located inside the cab. The circuit breakers shall be accessible to the operator. All wiring shall be neatly run and installed in a manner so that it is protected from physical and environmental damage.

3.9.11.3 Winterization system. A winterization system shall be provided for starting in temperatures to -40° F. The winterization system shall include heat sources for engine coolant, engine oil, and fuel tank as well as battery warmers. The winterization system shall be designed to operate externally on 110 or 220 VAC, 50 or 60 Hertz. A labeled light on the instrument panel shall indicate when the AC power is connected. The winterization system shall incorporate high-temperature shutoff switches to prevent overheating of any fluid or component. When specified (see 6.2d), for extreme climatic temperatures, an additional moisture removing device for the truck air system shall be included.

3.9.11.4 Lighting system. In addition to the truck lights and reflectors required by Federal Motor Carrier Safety Regulations (49CFR393), the following lights shall be provided.

3.9.11.4.1 Pumping compartment lights. The pumping compartment and the operator control panel shall be illuminated to a minimum level of 50 foot-candles. All controls, instruments, and the flow meter shall be illuminated for nighttime operations. Lamps shall be vapor proof in accordance with NFPA 407 and designed to minimize glare and provide the necessary illumination. The pumping compartment shall be provided with light switches which shall be controlled from the operator control panel.

3.9.11.4.2 Night servicing lights. Two adjustable, vapor proof, service lights shall be located approximately eight feet above the ground, one at the left front and one at the left rear of the cargo tank. Lights and internal components shall be adequately sealed to prevent the intrusion of moisture. Each light shall switch and adjust from a control handle within reach of a person standing on the ground. Combined light levels shall illuminate the entire side of the truck. The lights shall operate only while the truck clearance lights are “ON”.

3.9.11.5 Alternator. A single or dual alternator charging system in accordance with 3.13.1.4.9 of SAE ARP1247 shall be provided. The alternator shall be capable of restoring the energy expended during an engine start in less than 15 minutes of engine idle at - 40° F.

3.9.12 Cab. In addition to the cab requirements of FED-STD-807, the cab shall be equipped with: an air filter service indicator; low coolant level indicator; coolant temperature gauge; transmission temperature gauge; fuel level gauge; oil pressure gauge; oil temperature gauge; hourmeter; tachometer; and two switched reading lights for use while seated or while standing at either door during night operations. An air conditioning system in accordance with 3.4.24 of FED-STD-807 shall be provided. A separate 15-amp circuit, with breaker, shall be provided in the cab for a purchaser provided radio.

3.9.13 Rear bumper. The truck shall have a rear bumper, with a rolled end design, in accordance with 49CFR178. Stop, tail, and back-up lights shall be recessed into the bumper.

3.9.14 Rear fenders. The truck shall have metal fenders over the rear wheels. The fenders shall support a 250 pound person at any point that can be stepped on, without permanent deformation. Mud flaps shall be installed at the rear of each fender, in accordance with SAE J682.

3.9.15 Wheel chock storage container. A container for one wheel chock shall be provided on the left side of the truck in an easily accessible location. The container shall not be less than 10 inches wide by eight inches high by 24 inches deep, with a drainable, smooth interior.

3.10 Pumping system. The fuel pumping system shall include the piping, tank suction header, pump, filtration system, meter, and operator control panel. Pumping fuel in the High Flow mode, High Pressure setting, with a single-point nozzle pressure up to and including 50 psig for 100 continuous hours while maintaining 600 gpm, shall not degrade the system.

3.10.1 Piping. Pipe mounting shall prevent failure due to chaffing, vibration, or movement, due to operational or mobility induced forces. Piping shall be protected when passing through sheet metal and shall not be used as a step. Coupling grooves shall be cut or rolled in accordance with coupling manufacturer’s requirements and recommendations. Pipe and fittings shall be either flange or groove connected, or a combination. Piping shall be not less than schedule 40 seamed or seamless aluminum in accordance with ASTM B241/B241 or schedule 10 stainless steel and shall disassemble in sections. A check valve shall be the first component in each line connected to the cargo tank, and, except for the pump suction line, shall be oriented to prevent flow from the tank. Fuel pressure build-up in the piping and hose(s) shall relieve into a fuel recovery tank. Provisions shall be provided in the piping downstream of the filtration system and prior to the meter that will allow for four one quarter turn ball valves, as specified in 3.10.6.1, with quick disconnects, drybreaks, and dust plugs, equally spaced within a twelve inch section of pipe.

3.10.1.1 Fuel recovery tank. A fuel recovery tank of sufficient size (24 hours of operational use) to allow for thermal expansion of fuel and fuel from the fuel filtration system air eliminator shall be provided. The recovery tank shall be equipped with relief valves and vents as necessary for safe operation. The recovery tank shall be equipped with a manual drain valve to allow for complete draining of the tank. An automatic emptying system, to empty the recovery tank during refueling and defueling operations, shall be provided and shall incorporate a full recovery tank shutdown system. The automatic emptying system shall not utilize an electrically driven pump and shall not allow the backflow of fuel into the recovery tank when not in use. The automatic emptying system shall return the fuel up-stream of the fuel filtration system. The system shall also incorporate an override momentary-on push button located on the operator control panel to allow the manual operation of the automatic emptying system. The system shall drain the contents of the tank within ten minutes and shall not allow the dumping of fuel on the ground. A gauge shall be provided on the tank to monitor the level of fuel and shall be readable by the operator standing on the ground. A recovery tank warning light, illuminating Red, shall be provided and shall be located on the operator control panel. The recovery tank warning light shall illuminate whenever the fuel level in the recovery tank exceeds the predetermined level where the automatic return system is scheduled to activate. The recovery tank warning light shall remain illuminated until product level drops below the return system activation point.

3.10.2 Tank suction header. The tank suction header shall include the following: a check valve, an in-line strainer, a suction maintenance shutoff valve, and a dedrumming stub. The suction line shall not originate at the tank sump. The in-line strainer shall be a Y-type, with a serviceable eight mesh screen, rated for flows of 600 gpm. The tank suction header shall be equipped with a suction maintenance shutoff valve to isolate the cargo tank from the pumping system. It shall be mounted prior to and in close proximity to the in-line strainer. The suction maintenance shutoff valve shall be a manual, quarter turn design, operable while standing or kneeling on the left or right side of the truck. The dedrumming stub shall include a dedicated shutoff valve, and a two inch cam lock coupler, with dust plug, in accordance with A-A-59326.

3.10.2.1 Emergency tank shutoff control. Two emergency tank shutoff controls shall be installed on the aircraft refueling truck and shall be located on each side of the tank in close proximity to the emergency tank valve. The emergency tank shutoff control shall immediately terminate the fuel flow in any mode regardless of whether the deadman device is activated or deactivated. The emergency tank shutoff control shall not be recessed and shall be manually operated. The emergency tank shutoff switch shall be of the toggle activated or push-pull type. If a push-pull type of air operated valve is used, the valve shall be a two-position detent valve which is easily operated and arranged so that it is pushed to activate. The operating handle or operating circuit of all internal valves shall be equipped with a fusible link or plug that closes the valves in the event of a fire.

3.10.3 Pump. The pump shall be a self-priming, centrifugal (see 6.3.2), aircraft fuel-dispensing unit, direct driven by a PTO or split shaft gearbox. A drain plug shall be installed at the pump housing low point. Maximum engine speed shall not exceed maximum rated pump speed.

3.10.4 Pump discharge shutoff valve. A pump discharge shutoff valve shall be located downstream of the pump prior to any device or branch connection. The valve shall be a manual, quarter turn design, and operable while standing or kneeling on the left or right side of the truck.

3.10.5 Filtration system. The filtration system shall be rated for the maximum pump flow and pressure. The filter vessel and elements shall be qualified in accordance with the requirements of EI 1581, Specification and Qualification Procedures for Aviation Jet Fuel Filter Separators, Category M100, Type S, Two Stage System configuration.

3.10.5.1 Filter vessel. The filter vessel shall be designed and constructed in accordance with the most recent edition and revision of ASME Boiler and Pressure Vessel Code Section VIII. The vessel shall be inspected and stamped by a qualified ASME inspector. The filter vessel shall be constructed of aluminum and shall include a ball valve vent to aid in draining of the filter vessel. The ball valve vent shall include a check valve for allowing air in only. The filter vessel shall remain full, regardless of the level of fuel in the cargo tank, during pumping or while taking a sample from the drain. The filter vessel drain shall have a self-closing valve, accessible to a person standing or kneeling on the ground. The filter vessel shall be stenciled with 1 inch black lettering identifying:

a. The next change date (month and year). Three years from installation date.

b. Filter coalescer element part number from element end cap.

c. Maximum allowable differential pressure (15 psig).

3.10.5.2 Water-slug shutoff device. A water-slug shutoff device shall be provided to stop fuel flow within 10 seconds when a predetermined water level is reached in the vessel and then resume fuel flow within 30 seconds when the water level is lowered to a predetermined level.

3.10.5.3 Float-actuated valve provisions. The float actuated valve used in conjunction with the flow shut-off system shall include provisions which permit manual movement of the float through an external testing mechanism that is accessible by a person standing on the ground.

3.10.5.4 Water drain. The water sump of the filter vessel shall be equipped with a one inch manually operable ball-type valve with a spring return handle that renders the valve normally closed. The drain valve shall be directed toward the ground, guarded from damage, accessible without crawling under the truck and designed to prevent fuel contact with the operator.

3.10.5.5 Element sealing. Element connections shall be sealed in accordance with EI 1581.

3.10.6 Sampling provisions.

3.10.6.1 Sampling device. A fuel sampling device shall be provided downstream of the filtration system, prior to the meter, and easily accessible while standing in front of the operator control panel. Adequate space shall be provided to connect in-line samplers approved by the Air Force for solids and water samples. The sampling device shall consist of the necessary corrosion resistant piping, a one quarter turn ball valve, and a quick disconnect with a dry break coupler and dust plug for connection to the sampling kit.

3.10.6.2 Sampling high-level override control. A sampling high-level override control shall be provided to allow for system recirculation of a fully loaded aircraft refueling truck, in Defuel mode, for sampling purposes. The sampling high-level override shall be an on-off toggle switch with a tamper proof cover that can be securable in the off position with a padlock and shall be located on the operator control panel (see 3.10.8.1). The sampling high-level override control shall not open with the padlock installed. A padlock shall be provided by the Government.

3.10.7 Volumetric flow meter (meter). All fuel flow through the filtration system, in or out of the cargo tank, shall be metered. The meter shall be certified accurate for High Flow to ± 0.2 percent between 50 and 650 gpm in accordance with NIST Handbook 44 Section 3.31 Table 1. The meter shall be capable of registering low flow down to 2.5 gpm. The meter shall be electronic, positive displacement, with LED digital display, capable of displaying totalized flow and a rate of flow indicator in gallons per minute. The meter shall have a resettable counter and a non-resettable totalizer. Advancement of counter and primary indication elements shall be in accordance with NIST Handbook 44 Section 3.31 S.1.1.4-5. The meter shall be readable from a distance of 15 feet, during daytime or nighttime operations. The meter shall be compatible with current fuels Automatic Data Collection (ADC) equipment. A digital output meter shall be used and shall be equipped with a pulse output. Each refueling unit will include Syn-Tech P/N 032A0124A consisting of mounting brackets, temperature probe, pulsar assembly, barrier cable, antenna and wiring to allow mating to a government furnished Syn-Tech Fuel Master 2525 Automatic Point of Sale Device (APOSD) P/N 032A0100 at delivery destination. Additionally the set-up will include pneumatic lines from the (DCS) ran into the vehicle cab to allow the Government supplied Fuel Master Truck Interface Module to be placed in line via a 1/4" brass male (P/N BH3C) fitting and a 1/4" female quick disconnect coupler (P/N B23) fittings to control the pneumatic DCS when attached. When the Fuel Master 2525 Automatic Point of Sale Device is not attached, the pumping system will fully operate in a manual mode.

3.10.8 Pumping system controls. Pumping system controls shall be grouped together by function and shall include but not be limited to: fueling modes, pressure mode settings and readouts, primary vent controls, fuel flow control, hose reel controls, indicators and warning lights, override controls, pretest controls, and visibility lights for the pumping compartment and operator control panel. After mode selection, manipulation of controls, except for the auxiliary throttle and the deadman device, shall not be required. Pressure shall be internally managed, without atmospheric pressure relief. The primary vent activation control on the operator control panel shall have provisions for a padlock. The pumping system shall not operate with the primary vent(s) closed and locked. A padlock shall be provided by the Government.

3.10.8.1 Operator control panel. A person standing on the ground shall accomplish all operations on the operator control panel. Primary vent activation controls and hose reel isolation valves shall be of the slide and latch type. The operator control panel shall be easily accessible for maintenance from the rear and may swing out, if necessary. Instructions and diagram plates shall be mounted on or adjacent to the operator control panel. The operator panel controls shall include but not be limited to:

a. Fueling modes
    1. High Flow (see 3.8.2a)
        a. High Pressure setting
        b. Low Pressure setting
    2. Low Flow (see 3.8.2b)
    3. Defuel (See 3.8.2c)
    4. Hydrant Servicing (see 3.13.2.7)
        a. Aircraft fill setting
        b. Cargo tank fill setting

b. Pressure mode settings and readouts
    1. High Pressure setting @ 50 psig (see 3.8.2a)
    2. Low Pressure setting @ 35 psig (see 3.8.2a)
    3. Tachometer (see 3.10.8.1.2)
    4. Pressure gauges (see 3.10.8.1.3)
    5. Differential pressure gauge (see 3.10.8.1.4)

c. Cargo tank vent controls (see 3.12.4)
    1. Primary vent activation mode for refueling, defueling, and hydrant servicing

d. Hose reel controls
    1. Single-point hose reel isolation valve (see 3.10.13.1)
    2. Single-point hose reel rewind button (see 3.10.13.1)
    3. Overwing hose reel isolation valve (see 3.10.13.2)
    4. Deadman hose reel rewind button (see 3.10.14)

e. Indicator, warning, and visibility lights
    1. Recovery tank warning light (see 3.10.1.1)
    2. Pumping compartment and operator control panel light switches (see 3.9.11.4.1)
    3. Dry and Wet indicator lights (see 3.12.7.4)

f. Override controls
    1. Recovery tank override button (see 3.10.1.1)
    2. Emergency engine shutoff switch (see 3.10.8.1.5)
    3. Sampling high-level override switch (see 3.12.7.4.1)

g. Pretest controls
    1. Defuel high-level pretest button (see 3.10.9)
    2. HSM high-level pretest button (see 3.13.2.6)

3.10.8.1.1 Pump controls. Pump controls shall be fully independent. Multiple mode selections shall not be possible. A failure in one mode shall not cause either an activation or failure of another mode.

3.10.8.1.2 Tachometer. An electronic, LED digital display, tachometer shall be provided and shall have provisions for indicating the maximum engine speed in rpm for pumping. The tachometer shall incorporate both a bargraph indication and numerical value readout and shall be readable from a distance of 15 feet, during daytime or nighttime operations.

3.10.8.1.3 Pressure gauges. Pressure gauges shall be identified by function and shall be of the LED digital display type, with the pressure readouts taken from pressure transducers that are incorporated in the flow and pressure control system. The pressure gauge displays shall provide both a bargraph indication and a numerical value and shall be certified accurate to within one percent of the scale range. Pressure gauge scales shall be at least 10 percent greater than any recordable pressure and shall include provision for indicating maximum safe operating pressure. The single-point nozzle pressure gauge shall indicate actual pressure at the single-point nozzle, or shall use a system reference point that gives a full range reading within one psig of actual pressure. All pressure gauges shall be readable from a distance of 15 feet, during daytime or nighttime operations.

3.10.8.1.4 Differential pressure gauge. A non-calibrating differential pressure gauge shall continuously monitor the pressure drop across the filter coalescer stage during operation and register and hold the highest-pressure drop achieved during operation.

3.10.8.1.5 Emergency engine shutoff. An emergency engine shutoff switch shall shut down the truck engine without the use of any other control. The switch shall be an on-off toggle switch marked by a red circle, color number 31136 of FED-STD-595, at least one inch in diameter.

3.10.9 Defuel high-level pretest control. The defuel system shall include a defuel high-level pretest momentary-on push button located on the operator control panel for the purpose of testing the high-level shutoff system prior to defueling operations. Activation of the defuel high-level pretest control in Defuel mode shall terminate the flow of fuel.

3.10.10 Adjustable valves. All adjustable valves in the pumping system shall be operable, while standing on the ground, in full view of the operator control panel gauges during adjustments. Provisions shall be included to prevent tampering or adjustments of all factory preset components.

3.10.11 Flow and pressure control system. The FCS and PCS shall include the necessary components for regulating and monitoring pressure, flow, and surge. The necessary safety devices shall be incorporated into the flow and PCS in order to maintain safe operations.

3.10.11.1 Flow control system (FCS). The FCS shall limit the maximum flow rates based on the flow requirements for each pump mode setting.

3.10.11.2 Pressure control system (PCS). The PCS shall consist of an independent primary and secondary system. The primary PCS shall be set to control and limit the single-point nozzle pressure to the maximum pressure setting selected when in High Flow mode. The secondary PCS shall be set to control and limit the single-point nozzle pressure if the primary PCS fails, to a maximum of 55 psig. The PCS shall also limit the single-point nozzle pressure to a maximum peak surge pressure of 120 psig during a complete aircraft fueling valve(s) closure occurring in a maximum timeframe of two seconds. Any surge pressure developed shall not exceed the pressure rating of any single component in the aircraft refueling truck pumping system. The PCS shall include a pump bypass system (see 3.10.11.3). The PCS shall have the single-point nozzle pressure sensed through a pressure sensing type component that consistently and repeatedly simulates the fuel pressure at the single-point nozzle. Locked-in pressure shall not exceed 55 psig at the single-point nozzle 15 seconds after flow stops. The system shall automatically resume from an induced no-flow condition to full flow within 15 seconds.

3.10.11.3 Bypass system. A bypass system shall be provided to relieve excess pump pressure under flow conditions. The bypass shall be upstream of the filtration system and in the event of a maximum peak pressure surge due to a complete aircraft fueling valve (s) closure made in a maximum time of two seconds, excess single-point nozzle pressure and surge pressure relief shall not be returned to the cargo tank and the single-point nozzle pressure shall be limited to a maximum peak surge of 120 psig.

3.10.12 Safety provisions. Each pumping system valve or control shall be protected from the improper setting of any other valve or control in the system, or from exceeding 55 psig at the single-point nozzle. A sequence of system valve and control adjustments shall be established to restore normal operational settings from any combination of improper adjustments.

3.10.13 Hose reels.

3.10.13.1 Single-point hose reel. A single-point hose reel for the single-point hose shall be provided and accommodate 70 working feet (from the hose roller guide to the end of the single-point nozzle) of 2.5 inch non collapsible hose with 2.5 inch National Pipe Thread Tapered Thread (NPT) male threads on each end. The single-point hose reel shall be installed in the pumping compartment and shall include a clutch released drag brake that is adjustable from zero to 50 pounds force to deploy the hose. An isolation valve shall be provided for the single-point hose reel. The isolation valve shall be located and controlled from the operator control panel. The single-point hose reel shall also have a manual rewind, with a removable crank handle that stores in the pumping compartment. The single-point hose reel shall be air powered or electric powered and capable of retracting the fully deployed, fuel filled, single-point hose over a paved surface in not more than 45 seconds, against a 15 pound force drag brake setting. A momentary-on push button for rewinding the single-point hose reel shall be provided and shall be conveniently located on the operator control panel such that the operator can guide the single-point hose with one hand while operating the rewind control button with the other hand. Stainless steel guide rollers utilizing permanently lubricated metal bearings shall be provided to prevent damage to the single-point hose while winding or unwinding. The single-point hose assembly, including couplings, shall consist of 60 feet of EI 1529, Grade 2, Type C hose, and a dry break coupling compatible with the single-point nozzle. When specified (see 6.2e), the single-point hose assembly, including couplings, shall consist of 60 feet of EI 1529, Grade 2, Type CT hose, and a dry break coupling compatible with the single-point nozzle. The single-point hose shall deploy off the top of the single-point hose reel, with the last half turn restricted from unwinding. The single-point nozzle shall include a 40 mesh stainless steel strainer and an automatic vacuum breaker. A D-3 Universal Nozzle and coupling with dry break adapter shall be provided and attached to the single-point hose. The single-point nozzle assembly shall have provisions for an interlock system that shall prevent the truck parking brake from being released unless the single-point nozzle is properly stowed. When specified (see 6.2f), a strainer Ball Valve shall be provided in lieu of the drybreak adapter and coupling and attached to the single-point hose.

3.10.13.2 Overwing hose assembly. When specified (see 6.2g), an air powered or electric powered fuel dispensing overwing hose assembly shall be provided. The overwing hose assembly shall consist of the overwing hose reel, 60 feet of EI 1529, Grade 2, Type C hose, and an OPW model 295AF nozzle, or equivalent. The overwing nozzle grounding wires shall be jacketed. The overwing nozzle shall have provisions for an interlock system that shall prevent the parking brake from being released unless the overwing nozzle is properly stowed. The overwing hose assembly shall be installed in a separate compartment on the left side of the cargo tank. The overwing hose assembly shall operate independently of, or simultaneously with, the single-point hose and nozzle, up to the maximum flow limits for Low Flow mode. When an overwing hose assembly is provided, the overwing hose reel isolation valve shall be controlled from the operator control panel. The overwing hose assembly compartment door shall swing down to open to allow unobstructed access for the operator. The latch handle shall be the full width of the door, operable while wearing arctic mittens and MOPP Level 4 Chemical Warfare Gear and releasable from any point. The overwing hose reel shall: (1) accommodate 70 working feet (from the hose roller guide to the end of the nozzle) of 1.5 inch non-collapsible hose, (2) include an adjustable released drag brake that allows for a slow and controlled deployment of the overwing hose, and (3) have features to prevent over-travel during deployment and rewind. A momentary-on push button for rewinding the overwing hose reel shall be provided and shall be conveniently located such that the operator can guide the overwing hose with one hand while operating the rewind control button with the other hand. Stainless steel guide rollers utilizing permanently lubricated metal bearings shall be provided to prevent damage to the overwing hose while winding or unwinding.

3.10.14 Deadman control system (DCS). Either an electric or air operated DCS shall be provided in accordance with NFPA 407. A deadman device shall be provided as part of the DCS and shall be used to initiate or terminate the flow of fuel in all fueling modes at the single-point and overwing hose reels, hydrant pit outlet, and at the emergency tank valve, by activating or deactivating the deadman device. Deactivating the deadman device shall reduce engine speed to idle. After reactivation of the deadman device, the flow shall resume within 15 seconds. The deadman device shall be operable while wearing arctic mittens and MOPP Level 4 Chemical Warfare Gear and shall allow the operator to range from the operator control panel to the full length of the servicing hose(s). If an electric DCS is provided, it shall be certified intrinsically safe and incorporate a continuous operator input feature; loop wiring is acceptable. A momentary-on push button for rewinding the deadman hose reel shall be provided and shall be conveniently located on the operator control panel such that the operator can guide the deadman hose with one hand while operating the rewind control button with the other hand. It shall be capable of retracting the fully deployed deadman hose and device within one minute. The deadman hose shall have a minimum length of 80 feet. A fairlead shall guide the hose during deployment or rewind.

3.11 Pumping compartment. The aircraft refueling truck shall have an enclosed pumping compartment between the cab and the cargo tank. The entire pumping system and associated piping, filtration system, meter, and the single-point hose reel and nozzle shall be housed within the compartment. The pump shall not be housed within the pumping compartment. All system controls, meter, and servicing hoses shall be accessible to a person standing on the ground.

3.11.1 Construction. The compartment shall be an assembly of the following: a structural frame, a floor, single panel walls, and structural roof panels, forming a weather resistant enclosure. The roof panel shall have a continuous longitudinal center hinge and shall support a factored load of 300 pounds per square foot) without permanent deformation. The roof panels shall be latched to the structure and shall include lifting points to aid in removal.

3.11.2 Ventilation. The compartment shall provide for natural air circulation and shall not allow the accumulation of fuel vapors. The cab facing wall panel shall not be ventilated. The three remaining side panels shall have full-length louvers near the top, and if necessary, near the bottom, with a combined total free area of not less than six square feet. The compartment floor shall have louvers on each side, with a combined free area of not less than four square feet. Floor louvers shall be guarded from water and debris thrown up by the front tires. Self-storing winterization covers shall be provided for each louver. Drains shall be provided beneath the nozzle(s) storage point(s).

3.11.3 Doors. A roll-up door shall be provided on each side of the compartment. Vertical door openings shall be the maximum possible within the personnel working range. Doors shall latch in the open position. If the open door exceeds six feet above the ground, an assist strap shall be included. Latch handles shall be the full width of the door, operable while wearing arctic mittens and MOPP Level 4 Chemical Warfare Gear, and releasable from any point. The left side compartment door shall be sufficiently wide to access the pumping system controls, the meter, and the single-point hose. The right side compartment door shall be sufficiently wide for inspection and service access to the components and controls within.

3.12 Cargo tank. A dimensional analysis of the cargo tank and cargo tank sump capacities shall be provided. The truck shall have a single-compartment cargo tank in accordance with all requirements of NFPA 385, NFPA 407, and 49CFR178.346 (DOT 406), with a minimum capacity of 6,000 gallons, plus a minimum three percent expansion space. All welders performing welding operations on the cargo tank shall be certified in accordance with ASME Boiler and Pressure Vessel Code Section IX. A fixed indicator, in gallons, shall be visible through the manhole cover. In the top of each section, except for the section containing the manhole shall be a capped, minimum three inch diameter, cleaning stub. The cargo tank bottom shall have an unobstructed path sloped towards a minimum 12 gallon sump. There shall be no metal-to-metal contact between the tank mounting brackets and the truck chassis mounting brackets. The cargo tank shall be constructed of aluminum. A Strapping Chart to indicate tank fuel quantity per inch shall be provided in the technical order for each truck produced.

3.12.1 Baffles. Tank baffles shall be approximately equally spaced and shall allow personnel internal access to the entire tank. To prevent static electricity generation caused by free falling fuel, baffles shall be designed to allow uniform filling of the tank through the bottom loader at maximum flow rates up to 750 gpm or through the HSM at maximum flow rates up to 700 gpm.

3.12.2 Sump drain. The sump shall have a minimum 1.5-inch self-closing drain valve. The drain valve shall be directed toward the ground, guarded from damage, accessible without crawling under the truck and designed to prevent fuel contact with the operator.

3.12.3 Manhole. The cargo tank shall have a minimum 20 inch diameter manhole. The manhole shall prevent standing water from entering the cargo tank.

3.12.4 Cargo tank vent system. The cargo tank vent system shall include a (1) primary vent system and a (2) secondary pressure and vacuum relief system, in accordance with 49CFR178 (DOT 406). The primary vent system shall be used for refueling, defueling, bottom loading, and hydrant servicing operations. The secondary pressure and vacuum relief system shall be used for non-fueling operational environments to provide protection against thermal expansion and contraction. A primary vent activation control shall be located on the operator control panel and shall serve to activate the primary vent system prior to performing refueling, defueling, and hydrant servicing operations. For bottom loading operations, a primary vent activation control shall be located on the bottom loading control panel. The primary vent activation control on the operator control panel shall have provisions for a padlock. The primary vent system shall be capable of completely opening at a minimum of 90 psig and shall be sized for a cargo tank fill rate of 750 gpm and a single-point nozzle discharge rate of 600 gpm. The primary vent(s) shall be interlocked for refueling, defueling, bottom loading, and hydrant servicing operations. The primary vent actuating cylinder(s) shall be fail-safe, such that the fuel operation cannot commence flow unless the vent(s) is fully open. All vents shall have covers, separate from the lid, which shall prevent particles larger than 0.01 inches from entering the tank. Vent covers shall deflect any relief down onto the top of the tank.

3.12.5 Catwalk. A catwalk shall span the full length of the top of the cargo tank and the manhole, and include a landing platform for the rear-tank boarding ladder. The catwalk shall be at least 30 inches wide, support a factored load of 300 pounds per square foot without permanent deformation, and shall have a drainable surface. The catwalk shall have scuff guards on both sides and shall be equipped with fall protection, in accordance with 29CFR1910.

3.12.6 Tank boarding ladder. A tank boarding ladder shall provide access to the catwalk from the rear center of the cargo tank. The ladder shall not project behind the rear bumper, and each rung shall support a factored load of 300 pounds per square foot without permanent deformation. A fixed step below the rear bumper shall facilitate access to the ladder. The ladder shall be permanently marked “Max Weight 250 lbs” in accordance with MIL-HDBK-1223.

3.12.7 Bottom loader system. The aircraft refueling truck shall be equipped with an automatic bottom loader system that shall be capable of: (1) with the truck engine off, filling the cargo tank from a truck fill stand rack system, and if required, (2) filling the cargo tank from a Type III hydrant system via the HSM (see 3.13). Prior to performing bottom loading operations at the fill stand rack system, electrical power to the high level shutoff system shall be supplied by the activation of an on-off toggle switch located on the cab dash of the truck and readily accessible by the driver. The bottom loader system shall use truck air for power. The control lines shall be routed external to the cargo tank, with the exception of the pilot valve air control line, which may be routed internally, provided that the line can be removed from the bottom loader internal valve after the internal valve is removed from the cargo tank. All control lines shall be neatly placed and installed in a manner so that they are protected from physical and environmental damage. The bottom loader system components shall include: a control panel, inlet manifold, inlet receptacle for connection to the single-point hose and nozzle, internal valve(s), shutoff valve, high-level shutoff controls, cab dash on-off toggle switch, and, if required, vapor recovery system (see 3.12.8). The bottom loader, loading connections, and bottom loading control panel and controls shall be located on the left side of the cargo tank. The bottom loader control panel and controls shall be protected from the elements. The primary vent system shall automatically activate and open when a connection to the bottom loader inlet receptacle is established. The primary vent system shall be interlocked to activate only after the truck parking brakes are set. Fuel shall not flow in or out of the cargo tank until the primary vent system is fully open and shall stop flowing within 15 seconds if the primary vent system closes. Instructions for bottom loading and diagram plates shall be mounted on or adjacent to the bottom loader control panel. The bottom loader system shall accept fuel flow up to 750 gpm with bottom loader inlet pressures not exceeding 150 psig. The bottom loader system shall operate with a minimum fill stand pressure of 15 psig and a maximum fill stand pressure of 150 psig.

3.12.7.1 Inlet manifold. The bottom loader inlet manifold shall connect the bottom loader inlet receptacle to the cargo tank.

3.12.7.2 Inlet receptacle. The bottom loader inlet receptacle shall include housing in accordance with MIL-A-25896 and a single-point nozzle adapter and dust cover in accordance with MS24484-2.

3.12.7.3 Shutoff valve. A bottom loader shutoff valve, with not less than eight segmented and latched positions from closed to fully open for opening and closing the bottom loader, shall be installed in the bottom loading inlet manifold.

3.12.7.4 High-level shutoff system. A dual, independent, automatic, electronically controlled, high-level shutoff system shall stop fuel flow when the cargo tank is full when performing bottom loading, defueling, and hydrant servicing operations. The high-level shutoff system shall include: (1) independent primary and secondary tank-level sensors, (2) a bottom loader high-level pretest momentary-on push button located on the bottom loader control panel, (3) a defuel high-level pretest momentary-on push button located on the operator control panel, and if required (see 3.13), (4) a HSM high-level pretest momentary-on push button located on the operator control panel. The primary tank-level sensor, upon contact with fuel shall: (1) signal the fill stand rack system to shut down when performing bottom loading operations, (2) terminate deadman device operations, thus terminating flow, when performing defueling operations, and (3) shut down the hydrant pit valve, terminating flow, when performing hydrant servicing operations. The secondary tank-level sensor, upon contact with fuel shall: (1) signal the bottom loader internal valve to close within two to four seconds at maximum fill rates up to 750 gpm during bottom loading operations (2) shut down the defuel control system, terminating flow when performing defueling operations, and (3) terminate the flow of fuel into the cargo tank when performing hydrant servicing operations. The primary tank-level sensor shall be installed approximately 0.75 inches lower than the secondary tank-level sensor. The primary and secondary tank-level sensor shall be adjustable up to six inches below the 6000 gallon level mark. The signals through the sensors shall be continually monitored, and any faults in the electronic circuits shall result in shut down of the defueling, bottom loading, and hydrant servicing operations. Upon activation of any of the three high-level pretest button, the flow of fuel shall terminate simulating a fully-loaded aircraft truck. The high-level shutoff system shall be compatible with commercial "Scultrol" ST-15 Single Point and ST-35 Multiple Compartment loading rack monitors, Scully Intellitrol, or to an equivalent commercial system by using a dual-socket adapter and shall include pretest momentary-on push button located on the bottom loader control panel for test verification of the secondary tank-level sensor. The socket adapter shall be equipped with ground verification and a truck identification capability that can be programmed into the loading rack monitor to prevent product commingling. If the high-level shutoff system is not functional, the truck shall not perform defueling, bottom loading, and hydrant servicing operations. High-level shutoff indicator lights shall be provided and located on the operator control panel. The high-level shutoff indicator lights shall be illuminated during normal refueling, defueling, bottom loading, and hydrant servicing operations and shall include a (1) Dry indicator light, illuminating Green, indicating the tank-level sensors are not in contact with fuel and therefore the cargo tank is not full to capacity, and a (2) Wet indicator light, illuminating Red, indicating the tank-level sensors are contacting fuel and the cargo tank is full to capacity.

3.12.7.4.1 High-level shutoff override. The high-level shutoff system shall include two overrides: (1) bottom loader high-level override located on the bottom loader control panel to allow gravity discharge of 5500 gallons of fuel in not more than 55 minutes, and (2) sampling high-level override located on the operator control panel to allow internal fuel recirculation in the Defuel mode for sampling purposes. The bottom loader high-level override shall be a momentary-on push button protected with a tamper proof cover and can be secured with a padlock. Release of the bottom loader high-level override button shall close the bottom loader internal valve within 15 seconds. The sampling high-level override shall be an on-off toggle switch with a tamper proof cover and can be secured with a padlock. The Government shall provide all padlocks.

3.12.7.5 Bottom loader control panel. All operations on the bottom loader control panel shall be accomplished by a person standing on the ground. The primary vent activation control shall be located on the bottom loader control panel and shall be the slide and latch type. The bottom loader control panel shall be easily accessible for maintenance. Instructions for bottom loading and diagram plates shall be mounted on or adjacent to the bottom loader control panel. The bottom loader control panel controls shall include but not be limited to:

a. Bottom loader high-level pretest (see 3.12.7.4)

b. Bottom loader high-level override (see 3.12.7.4.1)

3.12.8 Vapor recovery system. When specified, (see 6.2h) a vapor recovery system shall be provided and shall override the cargo tank vent actuation system and shall remove fuel vapors from the cargo tank during bottom loading. The vapor recovery system shall terminate near the bottom loading connection with a dry break adapter and a dust cap. The system and adapter shall be in accordance with API RP 1004.

3.13 Hydrant service module (HSM). When specified (see 6.2i), a HSM shall be provided and located on the left side of the vehicle; the module shall be capable of: (1) receiving fuel from a Type III hydrant system in order to independently issue fuel to the aircraft or (2) filling the truck cargo tank from a Type III hydrant system. When issuing fuel to the aircraft, the refueling operation shall be performed with the truck engine operating and all fuel shall pass through the filtration system, the meter, and the single-point nozzle, at a maximum flow rate of 600 gpm and maximum single-point nozzle pressures not exceeding 50 ± 5 psig. In the event of a maximum peak pressure surge due to a complete aircraft fueling valve (s) closure made in a maximum time of 2 seconds, excess single-point nozzle pressure and surge pressure relief shall not be returned to the cargo tank and the maximum pressure at the single-point nozzle shall be limited to 120 psig. When filling the cargo tank through the HSM, (1) the truck engine shall be operating, (2) the fuel shall not pass through the pump, filtration system, or the meter, at (3) a flow rate up to and including a maximum of 700 gpm with a maximum hydrant inlet pressure of 130 psig. The HSM shall include the necessary hardware for performing the required operations specified herein. In order to perform both operations independently, the HSM shall include, but not be limited to, plumbing, valves, hydrant hose reel, and hydrant hose and coupler.

3.13.1 Flow and pressure control system. The HSM shall utilize the existing FCS and PCS of the aircraft refueling truck. The FCS and PCS shall include the necessary components for regulating and monitoring pressure and flow. The necessary safety devices shall be incorporated into the flow and pressure control system in order to maintain safe operations when independently issuing fuel to the aircraft or filling the cargo tank from the Type III Hydrant System.

3.13.2 HSM components.

3.13.2.1 Hydrant hose assembly and coupler. The HSM shall be equipped with a hydrant hose assembly that shall include couplings and a 3 inch maximum diameter hydrant hose that is a minimum of 25 feet in length and no greater than 30 feet in length. The hydrant hose for the HSM shall be an EI Standard 1529, Grade 2, Type C hose. The hydrant hose and coupler shall be easily accessible to personnel and shall be properly stowed and secured during transportation. The hydrant hose shall be equipped with a 4-inch API style coupler in accordance with EI 1584. When specified (see 6.2j), a 351GF-14S coupling shall be provided for hydrant pit connection. The aircraft refueling truck shall have provisions for a safety interlock system that shall prevent the truck parking brake from being released unless the hydrant coupler is properly stowed.

3.13.2.2 Hydrant hose reel. Hard piping shall be used to provide a path for fuel to flow from the hydrant hose reel to the truck piping system for aircraft and cargo tank filling applications. The hydrant hose reel shall include a powered rewind and shall have a locking mechanism to ensure the hose does not come loose during transportation. The hydrant coupler shall be no higher than 3 feet above the ground when in the stowed position. The hydrant hose reel shall be designed for refueling with any portion of the hose unwound. The hydrant hose reel shall rewind the entire flooded hose at a minimum rate of 1.5 feet per second. The hydrant hose reel shall be of the top pull type and shall have a drum size in accordance with EI 1529. The hydrant hose reel shall have features to prevent over-travel during deployment and rewind. The rewind assembly shall incorporate a clutch and brake assembly. The fluid flow path shall be aluminum or stainless steel. The hydrant hose reel shall be furnished with a manual crank for emergency rewinding if utilizing a power rewind motor; provisions shall be made for storing the crank on the vehicle. The hydrant hose reel shall be designed to prevent the last half turn of hose from unwinding from the reel. Stainless steel guide rollers utilizing permanently lubricated metal bearings shall be provided to prevent damage to the hydrant hose while winding or unwinding. A momentary-on push button for rewinding the hydrant hose reel shall be provided and shall be conveniently located such that the operator can guide the hydrant hose with one hand while operating the rewind control button with the other hand.

3.13.2.3 Piping. All piping shall be securely mounted to the vehicle to prevent chaffing and vibration during all modes of vehicle operation. All valves and components shall be coupled to the piping using groove type couplings or flanged connections. The piping shall be seamless schedule 40 aluminum in accordance with ASTM B241/B241M or seamless schedule 10 TP 304L stainless steel in accordance with ASTM A312/A312M. The piping shall not extend past the rear bumper and aluminum piping shall utilize cut or rolled grooves for the groove type couplings. All piping shall be positioned so it is protected by the chassis rails or mounted equipment. The piping system shall incorporate a one inch minimum drain valve at the lowest point. All piping swivel joints shall be sealed and not require lubrication.

3.13.2.4 Sensing lines. Sensing lines for connection to the Type III hydrant system shall be provided and located on a reel(s) next to the hydrant hose reel. Two lines shall be required for connection to the pit; one line shall be dedicated for air pressure and the other line for fuel pressure. The reel(s) shall be the spring rewind type. The sensing lines shall not exceed the length of the hydrant hose. The reel shall be equipped with arresting features for making random stops at any position. Provisions shall be made to prevent the last half turn of hose from unwinding and a ball stop shall be provided to prevent over wind. Dummy sensing line connections shall be installed adjacent to the reel to secure connections when not in use.

3.13.2.5 Deadman control system (DCS). The HSM shall utilize the existing DCS of the aircraft refueling truck. The activation and deactivation of the deadman device shall control the flow of fuel by opening and closing the hydrant pit valve without impeding the current use for aircraft refueling.

3.13.2.6 High-level shutoff system. The HSM shall utilize the existing high-level shutoff system. The primary tank-level sensor shall close the hydrant pit valve and the secondary tank-level sensor shall terminate the flow of fuel into the cargo tank. The HSM shall be equipped with a high-level pretest momentary-on push button located on the operator control panel. The high level pretest shall test the verification of the truck’s secondary tank-level sensor by terminating the flow of fuel, simulating a fully loaded aircraft refueling truck. If any part or component of the high-level shutoff system is inoperable, the HSM shall not operate.

3.13.2.7 Hydrant service module (HSM) controls. The HSM fueling mode control shall be located on the operator control panel and shall include: (1) an aircraft tank fill setting utilized when issuing fuel to the aircraft from a Type III hydrant system, and (2) a cargo tank fill setting utilized when filling the cargo tank from a Type III hydrant system.

3.13.3 Removal and reinstallation. The HSM shall be removable for air transport. The HSM, when removed, shall leave the aircraft refueling truck in its original configuration. The removal and reinstallation of the HSM shall be accomplished by two mechanics within eight hours.

3.14 Auxiliary equipment.

3.14.1 Fire extinguishers. Two Type I, Class 1, Size 20 fire extinguishers, in accordance with A-A-393, shall be installed, one on each side of the truck. The fire extinguishers shall be accessible to personnel standing on the ground and shall be protected from tire splash.

3.14.2 Clean-up materials compartment. A six cubic foot weather resistant compartment, for storage of 200 pounds of environmental clean-up materials, shall be mounted to the right side truck frame rail, below the cargo tank. The compartment shall have a hinged hatch type cover with hold open features.

3.14.3 Static discharge bonding and grounding reels. Two Type I, spring rewind, grounding reels, in accordance with A-A-50696, shall be installed side-by-side at the rear of the pumping compartment on the left side of the truck. One reel shall have a welder style grip clamp and the other shall have a grounding plug. There shall be no more than 10 ohms resistance between the reels and the cargo tank. The cable reel shall be fitted with a cable guide that allows deployment and rewinding of the cable in a tangle-free manner. The reel shall be electrically bonded to the tanker chassis frame. The static cables shall be equipped with a cable stop to prevent the bonding clip or plug from striking the reel guide.

3.15 Quality assurance at contractor fixed fuel facilities. The contractor shall establish minimum quality procedures required to deliver clean, dry fuel to equipment being tested on a continuing basis. The contractor is required to maintain written quality control procedures covering :

a. source of fuel supply,

b. receiving,

c. storing,

d. servicing,

e. sampling,

f. testing,

g. calibration of measuring and test equipment,

h. safety,

i. maintenance,

j. reports, and

k. corrective actions.

3.15.1 Fuel quality control. Fuel stored and used for testing R-11 aircraft refuelers shall be maintained to appropriate fuel quality standards and quality control procedures that prevent the contamination of the fuel (e.g. chemical, biological and material). Quality control procedures shall include as a minimum: working tank inspection and cleaning, draining of working tank sump, draining of filtration equipment sump and monitoring of differential pressures across working tank filtration equipment. All fuel entering the R-11 cargo tank for any purpose shall be filtered through a certified EI 1581 filtration system.

3.15.1.1 Working tank cleaning and inspection. The working tank shall be cleaned and inspected. Working tank floor must be visually inspected at least every 12 months. Check for build-up of sediment, evidence of microbial growth or significant coating failure. If inspection reveals microbial growth or build up of sediment exceeding 1/10 of the area of the tank bottom surface, cleaning must be accomplished. Jet fuel storage tanks shall be cleaned with water only. High pressure application is recommended. Assure removal of all free water, and allow tank to dry thoroughly. Inspect internal epoxy coating for evidence of chipping, flaking, or other deterioration and repair as required. The working tank inspection and cleaning dates (if applicable) shall be recorded (month and year) on the working tank manhole cover and shall remain legible at all times. The contractor facility shall maintain a record log of the inspection results and these records shall be made available upon request to the Government Quality Assurance Representative (QAR).

3.15.1.2 Draining of working tank sump. The working tank sump shall be drained and inspected daily or prior to issuing to the R-11 aircraft refueler. The inspection shall check for the accumulation of water or any type of gelatinous substances. Provisions shall be made for the collection and testing of the fuel in the working tank. The contractor facility shall maintain a record log of the inspections and these records shall be made available upon request to the Government QAR.

3.15.1.3 Draining of filtration equipment sump. The working tank filtration sump shall be drained under pressure daily when used. The product drained from the sump shall be inspected for the presence of water or any type of gelatinous substance. The contractor facility shall maintain a record log of the inspections and these records shall be made available upon request to the Government QAR.

3.15.1.4 Monitoring differential pressure. The differential pressure shall be monitored across the working tank filtration equipment. The differential pressure readings shall be taken and recorded during issuance of product to the R-11 aircraft refueler. For accuracy, these checks should be undertaken when the flow rate is steady, and as close as possible to maximum operating flow rate. The filter elements must be replaced when a sudden drop in differential pressure occurs under similar flow conditions, the filter vessel differential pressure exceeds 20 psig, the filter elements have been used for a period of 36 months, or poor fuel quality. The use of Monitor elements shall be prohibited. Contractor shall verify proper operation of filter differential gauge(s) in accordance with gauge manufacturers' procedures. Accuracy shall be within +/- 2 psig. The recorded results shall include but not be limited to the filter element changes and differential pressure readings and shall be made available upon request to the Government QAR.

3.15.1.5 Working tank filtration. The working tank filters shall meet the performance requirements of EI 1581 or MIL-PRF-52308. The working tank filtration equipment system shall be designed such that filtration bypass is not possible.

3.15.2 Sampling requirements.

3.15.2.1 Sample submission. The contractor is required to obtain, package and ship samples of each grade of aviation fuel to a testing laboratory designated in the contract. The sample size shall be two gallons of the aviation fuel used for testing. The sample frequency of submission shall be at the beginning of the contract period and once every six months thereafter. Contractor may submit the sample(s) to: HQ AFPET/PTPLA, Aerospace Fuels Laboratory, 2430 C Street, Area B, Bldg 70, Wright-Patterson AFB, OH 45433-7632. Test results shall be submitted to the Government QAR acceptance at the contractor facility. In the event the fuel sample does not meet specification requirements, the fuel shall not be used for testing until the fuel is within compliance. The contractor facility shall maintain a record log of the inspections and sampling results and these records shall be made available upon request to the Government QAR.

3.15.2.2 Sample container. Container selection should be IAW ASTM D 4306, Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination. Sample containers should be flushed 3 times with the container 10 to 20 percent filled with the same product being sampled. Before filled, each sample container shall be visually inspected for cleanliness and suitability. Fuel sample should be submitted in an epoxy lined, one-gallon, 24-gauge steel drum equipped with a 3⁄4-inch bung and seal (2" bung is also authorized provided container meets the same specifications). The container must meet UN/A1A specification and be approved for air shipment without an over-pack in accordance with 49 CFR, Paragraph 173.202(c) and International Air Transportation Association (IATA), Paragraph 5.0.2.12.2 and Table 5.0B when shipped under packing group III. Fuel shall be sampled for verification of product quality IAW ASTM D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products or ASTM D 4177 Practice for Automatic Sampling of Petroleum and Petroleum Products.

3.15.2.3 Sample location. The sample to be submitted for testing shall be taken during while the aircraft refueling vehicle is in recirculation mode and downstream of the filter separator.

3.15.2.4 Sample analysis. The fuel sample analysis shall consist of flash point, freeze point, thermal stability, Ball-On Cylinder Lubricity Evaluator (BOCLE) in accordance with ASTM D5001and Fuel System Icing Inhibitor (FSII) in accordance with ASTM D5006 if contract requires FSII to be in the fuel. The thermal stability property shall be performed in accordance with ASTM D3241 and have a heater tube temperature of 260°C.

3.15.3 Bonding during cargo tank fuel transfer. Bonding shall be established, prior to making any connections, between the fixed fuel system and the aircraft refueling truck, thus providing a conductive path to equalize static charge potential between the aircraft refueling truck and the facility. The bond shall be maintained until fueling connections have been removed.

3.16 Workmanship. The aircraft refueling truck, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Workmanship objectives shall include freedom from blemishes, defects, burrs and sharp corners and edges; accuracy of dimensions, surface finish, and radii of fillets; thoroughness of welding, painting, and riveting; marking of parts and assemblies; and proper alignment of parts and tightness of assembly fasteners. The aircraft refueling truck, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Workmanship objectives shall include freedom from blemishes, defects, burrs and sharp corners and edges; accuracy of dimensions, surface finish, and radii of fillets; thoroughness of welding, painting, and riveting; marking of parts and assemblies; and proper alignment of parts and tightness of assembly fasteners.

3.16.1 Bolted connections. Bolt holes shall be accurately punched or drilled and shall be deburred. Threaded fasteners shall be tight and shall not work loose during testing or service usage.

3.16.2 Riveted connections. Rivet holes shall be accurately punched or drilled and shall be deburred. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads shall be full, neatly made, concentric with the rivet holes and in full contact with the surface of the component.

3.16.3 Gear and lever assemblies. Gear and lever assemblies shall be properly aligned and meshed and shall be operable without interference, tight spots, loose spots, or other irregularities. Where required for accurate adjustment, gear assemblies shall be free of excessive backlash.

3.16.4 Cleaning. The aircraft refueling truck shall be thoroughly cleaned. Loose, spattered, or excess solder; welding slag; stray bolts, nuts, and washers; rust; metal particles; pipe compound; and other foreign matter shall be removed during and after final assembly.

4. VERIFICATION

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

a. First production inspection (see 4.2).

b. Operational inspection (see 4.3).

c. Production inspection (see 4.4).

4.1.2 Requirement verification matrix (RVM). The RVM of this specification shall be defined as shown in Table III.

TABLE III. Requirement verification matrix.

Section 3 Requirement	Verification Method	Section 4 Verification
3.1 First production.	N/A	N/A
3.2 Aircraft refueling truck description.	N/A	N/A
3.3 Design and construction.	Certification	4.6.1 Certification of product.
3.3.1 Materials, protective coatings, and finish.	Certification	4.6.1 Certification of product.
3.3.1.1 Recycled, recovered, or environmentally preferable materials.	Certification	4.6.1 Certification of product.
3.3.1.2 Green Procurement Program (GPP).	Certification	4.6.1 Certification of product.
3.3.1.3 Metals.	Certification	4.6.1 Certification of product.
3.3.1.4 Impregnation of castings.	Certification	4.6.1 Certification of product.
3.3.1.5 Elastomers.	Certification	4.6.1 Certification of product.
3.3.1.6 Protective coatings.	Certification	4.6.1 Certification of product.
3.3.1.7 Dissimilar metals.	Certification	4.6.1 Certification of product.
	Examination	4.6.1 Examination of product.
3.3.1.8 Finish.	Examination	4.6.1 Examination of product.
3.3.1.8.1 Gloss green.	Examination	4.6.1 Examination of product.
3.3.1.8.2 Semi-gloss green.	Examination	4.6.1 Examination of product.
3.3.1.8.3 Desert sand.	Examination	4.6.1 Examination of product.
3.3.1.9 Fluid traps and faying surfaces.	Examination	4.6.1 Examination of product.
3.3.1.9.1 Ventilation.	Examination	4.6.1 Examination of product.
3.3.1.9.2 Drainage.	Examination	4.6.1 Examination of product.
3.3.1.10 Rustproofing.	Certification	4.6.1 Certification of product.
3.3.2 Markings.	Examination	4.6.1 Examination of product.
3.3.2.1 Flammable.	Examination	4.6.1 Examination of product.
3.3.2.2 No smoking within 50 feet.	Examination	4.6.1 Examination of product.
3.3.2.3 Cargo fire avoid water.	Examination	4.6.1 Examination of product.
3.3.2.4 Jet fuel product.	Examination	4.6.1 Examination of product.
3.3.2.5 Emergency tank shutoff.	Examination	4.6.1 Examination of product.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	Verification Method	Section 4 Verification
3.3.3 Identification and information plates.	N/A	N/A
3.3.3.1 Identification plate.	Examination	4.6.1 Examination of product.
3.3.3.2 Transportation data plate.	Examination	4.6.1 Examination of product.
3.3.4 Safety.	N/A	N/A
3.3.4.1 System safety.	Analysis	4.6.2.1 System safety hazard analysis.
3.3.4.2 Component protection.	Examination	4.6.1 Examination of product.
3.3.4.3 Foreign object damage (FOD).	Examination	4.6.1 Examination of product.
3.3.4.4 Sound levels.	Test	4.6.2.2 Sound level test.
3.3.4.5 Electromagnetic interference (EMI).	Test	4.6.2.3 Electromagnetic interference test.
3.3.4.6 Electrostatic discharge.	Analysis	4.6.2.4 Electrostatic discharge analysis.
3.3.4.6.1 Bonding.	Examination	4.6.1 Examination of product.
	Certification	4.6.1 Certification of product.
3.3.4.6.2 Prevention of static electricity.	Demonstration	4.6.2.4.1 Prevention of static electricity demonstration.
3.3.4.7 Design and hydrostatic pressure ratings.	Test	4.6.3 Pumping and bottom loading system hydrostatic test.
3.3.5 Human engineering.	Demonstration	4.6.4 Human engineering demonstration.
3.3.6 Fastening devices.	Certification	4.6.1 Certification of product.
3.3.7 Welders and welding.	Certification	4.6.1 Certification of product.
3.3.8 Lubrication.	Certification	4.6.1 Certification of product.
3.3.9 Foolproofness.	Certification	4.6.1 Certification of product.
3.3.10 Service life.	Analysis	4.6.5 Service life analysis.
3.4 Environmental conditions.	N/A	N/A
3.4.1 Operation and storage temperature range.	Test	4.6.6.1 High temperature storage and operation test.
		4.6.6.2 Low temperature storage and operation test.
3.4.2 Humidity.	Test	4.6.6.3 Humidity test.
3.4.3 Fungus.	Certification	4.6.6.4 Fungus test.
3.4.4 Salt fog.	Test	4.6.6.5 Salt fog test.
3.4.5 Sand and dust.	Test	4.6.6.6 Sand and dust test.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	**Verification Method**	**Section 4 Verification**
3.5 Weight and dimensions.	Demonstration	4.6.7.1 Weight demonstration. 4.6.7.2 Dimension demonstration.
3.6.1 Surface transportability.	Analysis	4.6.8.1 Surface transportability analysis.
3.6.2 Air transportability.	Analysis	4.6.8.2 Air transportability analysis.
3.6.2.1 Shoring.	Certification	4.6.1 Certification of product.
3.6.2.2 Axle weight.	Demonstration	4.6.7.1 Weight demonstration.
3.6.2.3 Tire pressure.	Examination	4.6.1 Examination of product.
3.6.2.4 Tie downs.	Analysis	4.6.8.2 Air transportability analysis.
3.6.2.5 Equipment removal and reconfiguration.	Test	4.6.8.3 Equipment removal and reconfiguration test.
3.7 Reliability and maintainability.	N/A	N/A
3.7.1 Reliability.	Analysis	4.6.9.1 Reliability model and prediction.
	Test	4.6.9.2 Reliability tests. 4.6.9.2.1 RQT.
3.7.2 Maintainability.	Demonstration	4.6.9.3.1 Preventative maintenance demonstration. 4.6.9.3.3 Corrective maintenance demonstration.
3.7.2.1 Preventive maintenance.	Demonstration	4.6.9.3.1 Preventative maintenance demonstration.
3.7.2.2 Corrective maintenance.	Analysis	4.6.9.3.2 Corrective maintenance prediction.
	Demonstration	4.6.9.3.3 Corrective maintenance demonstration.
3.7.2.3 Inspection and servicing provisions.	Demonstration	4.6.9.3.3 Corrective maintenance demonstration.
3.7.2.4 Relative accessibility.	Examination	4.6.1 Examination of product.
3.7.2.5 Error-proof design.	Examination	4.6.1 Examination of product.
3.7.2.6 Special tools.	Certification	4.6.1 Certification of product.
3.7.2.7 Diagnostic software.	Certification	4.6.1 Certification of product.
3.8 Performance.	N/A	N/A
3.8.1 Mobility.	N/A	N/A
3.8.1.1 Turning diameter.	Test	4.6.10.1.1 Turning diameter test.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	Verification Method	Section 4 Verification
3.8.1.2 Gradeability.	Test	4.6.10.1.2 Gradeability test.
3.8.1.3 Suspension articulation.	Test	4.6.10.1.3 Suspension articulation test.
3.8.1.4 Speed.	Test	4.6.10.1.4 Speed test.
3.8.1.5 Roadability.	Test	4.6.10.1.5 Roadability test.
3.8.2 Pumping system.	Test	4.6.11 Pumping system performance test.
3.8.2.1 Closed pump discharge.	Test	4.6.11.1 Closed pump discharge test.
3.8.2.2 Dry pump operation.	Test	4.6.11.2 Dry pump operation test.
3.9 Chassis and cab.	N/A	N/A
3.9.1 Chassis.	Certification	4.6.1 Certification of product.
3.9.2 Frame analysis.	Analysis	4.6.1 Frame analysis.
3.9.3 Axle analysis.	Analysis	4.6.1 Axle analysis.
3.9.4 Wheel loading.	Analysis	4.6.1 Wheel loading analysis.
3.9.5 Engine, fuels, and exhaust system.	Certification	4.6.1 Certification of product.
3.9.5.1 Engine starting system.	N/A	N/A
3.9.5.1.1 Starter.	Examination	4.6.1 Examination of product.
3.9.5.1.2 Engine starting aids.	Demonstration	4.6.12.1 Engine starting aids demonstration.
3.9.5.2 Exhaust system.	Examination	4.6.1 Examination of product.
3.9.5.3 Engine and related equipment.	Certification	4.6.1 Certification of product.
3.9.5.4 Engine air intake system.	Examination	4.6.1 Examination of product.
	Certification	4.6.1 Certification of product.
3.9.5.5 Engine cooling system.	Certification	4.6.1 Certification of product.
	Test	4.6.6.1 High temperature storage and operation test.
3.9.5.6 Engine oil operating temperature.	Certification	4.6.1 Certification of product.
3.9.5.7 Engine oil filter.	Certification	4.6.1 Certification of product.
3.9.5.8 Fuel tank.	Certification	4.6.1 Certification of product.
3.9.5.9 Engine diagnostic system.	Certification	4.6.1 Certification of product.
3.9.6 Transmission.	Examination	4.6.1 Examination of product.
3.9.7 Power take-off (PTO).	Test	4.6.12.2 Power take-off (PTO) test.
3.9.8 Propeller shafts.	Examination	4.6.1 Examination of product.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	**Verification Method**	**Section 4 Verification**
3.9.9 Wheels and tires.	N/A	N/A
3.9.9.1 Tires.	Certification	4.6.1 Certification of product.
3.9.9.2 Spare wheel.	Examination	4.6.1 Examination of product.
3.9.10 Brakes.	Examination	4.6.1 Examination of product.
3.9.11 Electrical system.	Certification	4.6.1 Certification of product.
3.9.11.1 Batteries and battery compartment.	N/A	N/A
3.9.11.1.1 Batteries.	Certification	4.6.1 Certification of product.
3.9.11.1.2 Battery compartment.	Examination	4.6.1 Examination of product.
3.9.11.1.3 Battery cables.	Examination	4.6.1 Examination of product.
3.9.11.2 Wiring.	Certification	4.6.1 Certification of product.
3.9.11.3 Winterization system.	Demonstration	4.6.13 Winterization system demonstration.
3.9.11.4 Lighting system.	Examination	4.6.1 Examination of product.
3.9.11.4.1 Pumping compartment lights.	Test	4.6.13.1 Pumping compartment lights test.
3.9.11.4.2 Night servicing lights.	Test	4.6.13.2 Night servicing lights test.
3.9.11.5 Alternator.	Certification	4.6.1 Certification of product.
	Test	4.6.6.2 Low temperature storage and operation test.
3.9.12 Cab.	Examination	4.6.1 Examination of product.
3.9.13 Rear bumper.	Examination	4.6.1 Examination of product.
3.9.14 Rear fenders.	Test	4.6.14 Rear fender test.
3.9.15 Wheel chock storage container.	Examination	4.6.1 Examination of product.
3.10 Pumping system.	Test	4.6.15 Pumping system durability test.
3.10.1 Piping.	Certification	4.6.1 Certification of product.
3.10.1.1 Fuel recovery tank.	Test	4.6.15.1 Fuel recovery tank test.
3.10.2 Tank suction header.	Examination	4.6.1 Examination of product.
3.10.2.1 Emergency tank shutoff control.	Test	4.6.15.2 Emergency tank shutoff control test.
3.10.3 Pump.	Examination Certification	4.6.1 Examination and certification of product.
3.10.4 Pump discharge shutoff valve.	Demonstration	4.6.15.3 Pump discharge shutoff valve demonstration.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	**Verification Method**	**Section 4 Verification**
3.10.5 Filtration system.	Test	4.6.16 Filtration system test.
3.10.5.1 Filter vessel.	Certification	4.6.1 Certification of product.
3.10.5.2 Water-slug shutoff device.	Test	4.6.16.1 Water-slug shutoff device test.
3.10.5.3 Float-actuated valve provisions.	Test	4.6.16.2 Float-actuated valve test.
3.10.5.4 Water drain.	Examination	4.6.1 Examination of product.
3.10.5.5 Element sealing.	Certification	4.6.1 Certification of product.
3.10.6 Sampling provisions.	N/A	N/A
3.10.6.1 Sampling device.	Demonstration	4.6.17.1 Sampling device demonstration.
3.10.6.2 Sampling high-level override control.	Test	4.6.17.2 Sampling high-level override control test.
3.10.7 Flow meter.	Demonstration	4.6.18 Flow meter demonstration.
3.10.8 Pumping system controls.	Demonstration	4.6.19 Pumping system controls and adjustable valves demonstration.
3.10.8.1 Operator control panel.	Examination	4.6.1 Examination of product.
3.10.8.1.1 Pump controls.	Demonstration	4.6.19.1 Pump controls demonstration.
3.10.8.1.2 Tachometer.	Examination	4.6.1 Examination of product.
3.10.8.1.3 Pressure gauges.	Certification Test	4.6.19.2 Pressure gauge test.
3.10.8.1.4 Differential pressure gauge.	Demonstration	4.6.19.3 Differential pressure gauge demonstration.
3.10.8.1.5 Emergency engine shutoff.	Test	4.6.19.4 Emergency engine shutoff test.
3.10.9 Defuel high-level pretest control.	Test	4.6.20 Defuel high-level pretest control test.
3.10.10 Adjustable valves.	Demonstration	4.6.19 Pumping system controls and adjustable valves demonstration.
3.10.11 Flow and pressure control system.	Certification	4.6.1 Certification of product.
3.10.11.1 Flow control system.	Demonstration	4.6.21 Flow control system demonstration.
3.10.11.2 Pressure control system.	Test	4.6.22 Pressure control system test.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	Verification Method	Section 4 Verification
3.10.11.3 Bypass system.	Demonstration	4.6.23 Bypass system demonstration.
3.10.12 Safety provisions.	Demonstration	4.6.24 Safety provision demonstration.
3.10.13 Hose reels.	N/A	N/A
3.10.13.1 Single point hose reel.	Test	4.6.25.1 Single point hose reel test.
3.10.13.2 Overwing hose assembly.	Demonstration	4.6.25.2 Overwing hose assembly demonstration.
	Examination	4.6.1 Examination of product.
3.10.14 Deadman control system.	Test	4.6.26 Deadman control system test.
3.11 Pumping compartment.	Examination	4.6.1 Examination of product.
3.11.1 Construction.	Test	4.6.27 Pumping compartment construction test.
	Demonstration	
3.11.2 Ventilation.	Examination	4.6.1 Examination of product.
3.11.3 Doors.	Examination	4.6.1 Examination of product.
3.12 Cargo tank.	Analysis	4.6.28 Cargo tank analysis.
	Examination	
	Certification	
3.12.1 Baffles.	Examination	4.6.1 Examination of product.
3.12.2 Sump drain.	Examination	4.6.1 Examination of product.
3.12.3 Manhole.	Examination	4.6.1 Examination of product.
3.12.4 Cargo tank vent system.	Test	4.6.28.1 Cargo tank vent system test.
3.12.5 Catwalk.	Demonstration	4.6.28.2 Catwalk demonstration.
3.12.6 Tank boarding ladder.	Demonstration	4.6.28.3 Tank boarding ladder demonstration.
3.12.7 Bottom loader system.	Test	4.6.28.4 Bottom loader system test.
3.12.7.1 Inlet manifold.	Examination	4.6.1 Examination of product.
3.12.7.2 Inlet receptacle.	Certification	4.6.1 Certification of product.
3.12.7.3 Shutoff valve.	Test	4.6.28.4.1 Shutoff valve test.
3.12.7.4 High-level shutoff system.	Test	4.6.29 High-level shutoff test.
3.12.7.4.1 High-level shutoff override.	Test	4.6.29.1 High-level shutoff override test.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	Verification Method	Section 4 Verification
3.12.7.5 Bottom loader control panel.	Examination	4.6.1 Examination of product.
3.12.8 Vapor recovery system.	Test	4.6.30 Vapor recovery system test.
3.13 Hydrant service module.	Test	4.6.31 HSM test.
3.13.1 Flow and pressure control system.	Certification	4.6.1 Certification of product.
3.13.2 HSM components.	N/A	N/A
3.13.2.1 Hydrant hose assembly and coupler.	Demonstration	4.6.32.1 Hydrant hose assembly and coupler demonstration.
3.13.2.2 Hydrant hose reel.	Test	4.6.32.2 Hydrant hose reel test.
3.13.2.3 Piping.	Examination	4.6.1 Examination of product.
	Certification	4.6.1 Certification of product.
3.13.2.4 Sensing lines.	Examination	4.6.1 Examination of product.
3.13.2.5 Deadman control system.	Test	4.6.32.3 Deadman control system test.
3.13.2.6 High-level shutoff system.	Test	4.6.32.4 High-level shutoff test.
3.13.2.7 Hydrant service module controls.	Examination	4.6.1 Examination of product.
3.13.3 Removal and reinstallation.	Demonstration	4.6.33 Removal and reinstallation demonstration.
3.14 Auxiliary equipment.	N/A	N/A
3.14.1 Fire extinguishers.	Examination	4.6.1 Examination of product.
3.14.2 Clean-up materials compartment.	Examination	4.6.1 Examination of product.
3.14.3 Static discharge bonding and grounding reels.	Examination	4.6.1 Examination of product.
3.15 Quality assurance at contractor fixed fuel facilities.	Certification	4.6.1 Certification of product.
3.15.1 Fuel quality control.	Certification	4.6.1 Certification of product.
3.15.1.1 Working tank cleaning and inspection.	Certification	4.6.1 Certification of product.
3.15.1.2 Draining of working tank sump.	Certification	4.6.1 Certification of product.

TABLE III. Requirement verification matrix – Continued.

Section 3 Requirement	Verification Method	Section 4 Verification
3.15.1.3 Draining of filtration equipment sump.	Certification	4.6.1 Certification of product.
3.15.1.4 Monitoring differential pressure.	Certification	4.6.1 Certification of product.
3.15.1.5 Working tank filtration.	Certification	4.6.1 Certification of product.
3.15.2 Sampling requirements.	N/A	N/A
3.15.2.1 Sample submission.	Certification	4.6.1 Certification of product.
3.15.2.2 Sample container.	Certification	4.6.1 Certification of product.
3.15.2.3 Sample location.	Certification	4.6.1 Certification of product.
3.15.2.4 Sample analysis.	Certification	4.6.1 Certification of product.
3.15.3 Bonding during cargo tank fuel transfer.	Examination	4.6.1 Examination of product.
3.16 Workmanship.	Examination	4.6.1 Examination of product.
3.16.1 Bolted connections.	Examination	4.6.1 Examination of product.
3.16.2 Riveted connections.	Examination	4.6.1 Examination of product.
3.16.3 Gear and lever assemblies.	Demonstration	4.6.34 Gear and lever assemblies demonstration.
3.16.4 Cleaning.	Examination	4.6.1 Examination of product.

4.2 First production inspection. The first production aircraft refueling truck shall be subjected to the examinations, tests, demonstrations, and analyses as described in 4.6. The contractor shall provide or arrange for all test equipment and facilities.

4.3 User operational test. The first production aircraft refueling truck shall be delivered to a Government designated site for a test period of 90 days for user operational testing. The test period shall start after the truck has been inspected and prepared for service and the contractor has reviewed the operation and maintenance manuals with Government personnel. The truck shall be used seven days a week on a first out last in basis to maximize the utilization of the truck. Any day requiring more than 2 hours maintenance or repair shall not constitute a test day. Government personnel shall perform a daily checkpoint inspection of the aircraft refueling truck prior to first use of each day and report any discrepancies to the contractor for corrective action. Contractor personnel, using the technical data supplied with the truck, shall perform all inspections (other than daily checkpoint inspections) and maintenance on the truck during the entire test period. All parts and repairs shall be provided and accomplished by the contractor. The Government shall reserve the right to witness any required repair actions performed by the contractor. During each operational test day, the truck shall perform the following operations to the maximum extent possible with flow rates as specified herein: 1) bottom loading, 2) aircraft refueling, 3) aircraft defueling, 4) underground defueling, 5) aircraft overwing refueling, and 6) aircraft hydrant servicing. Hydrant servicing shall include the following independent operations: 1) filling the truck cargo tank from a Type III hydrant system, and 2) filling the aircraft from a Type III hydrant system.

4.4 Production testing. Unless otherwise specified, each production aircraft refueling truck shall be subjected to the applicable tests and demonstrations as described in the testing requirements of 4.6 for production models. A contractor-prepared, Government-approved test procedure for production acceptance testing shall be used. The contractor shall maintain a production acceptance test report at the contractor's facility for each production aircraft refueling truck.

4.5 Inspection requirements.

4.5.1 General inspection requirements. Apparatus used in conjunction with the inspections specified herein shall be laboratory precision type, calibrated at proper intervals to ensure laboratory accuracy. Certifications shall be made available for review by Government personnel.

4.5.2 Data. During all testing specified herein, at least the following data, unless not applicable, shall be recorded at intervals not to exceed 30 minutes. Additional data and/or shorter intervals shall be provided as appropriate for any specific test.

a. Date.

b. Time started.

c. Time finished.

d. Ambient temperature.

4.5.3 Test rejection criteria. Throughout all tests specified herein, the aircraft refueling truck shall be closely observed for the following conditions, which shall be cause for rejection:

a. Failure to conform to design or performance requirements specified herein or in the contractor's technical proposal.

b. Any spillage or leakage of any liquid, including lubricant or hydraulic fluid, under any condition, except as allowed herein.

c. Structural failure of any component, including permanent deformation, or evidence of impending failure.

d. Evidence of excessive wear.

e. Interference between the aircraft refueling truck components or between the aircraft refueling truck, the ground, and all required obstacles, with the exception of normal contact by the tires.

f. Misalignment of components.

g. Evidence of undesirable roadability characteristics, including instability in handling during cornering, braking, and while traversing all required terrain.

h. Conditions that present a safety hazard to personnel during operation, servicing, or maintenance.

i. Evidence of corrosion or deterioration.

j. Excess pressure or vacuum occurring in any baffled section of the cargo tank.

k. Overheating of any truck chassis or pumping system component.

l. Instability in pumping system pressure or flow.

4.5.4 Test conditions.

4.5.4.1 Test fuel. The first production test fuel requirement shall be Grade JP-8, turbine fuel, as specified in MIL-DTL-83133. An exception may be taken for truck engine fuel during cold chamber tests.

4.5.4.2 Test filters. All filter elements shall be certified for use with JP-8 + 100.

4.6 Test methods.

4.6.1 Examination of product. Each production aircraft refueling truck shall be inspected to verify compliance with the examination requirements as specified in Table III. A contractor-generated, Government-approved checklist shall be used to identify each requirement not verified by an analysis, certification, demonstration, or test, and shall be used to document the examination results. Particular attention shall be given to materials, workmanship, dimensions, surface finishes, protective coatings and sealants and their application, welding, fastening, and markings. Proper operation of each aircraft refueling truck function shall be verified. Certifications and analyses shall be provided in accordance with Table IV. Each production aircraft refueling truck shall be inspected to a Government-approved checklist.

TABLE IV. Certifications and analyses.

Paragraph	**Required Certifications and Analyses**
3.3 Design and construction.	Contractor certification that the aircraft refueler truck is designed and constructed in accordance with 3.3.
3.3.1 Materials, protective coatings, and finish.	Contractor certification that the aircraft refueler truck's materials, protective coatings, and finishes are in accordance with 3.3.1.
3.3.1.1 Recycled, recovered, or environmentally preferable materials.	Contractor certification that all recycled, recovered, or environmentally preferable materials are in accordance with 3.3.1.1.
3.3.1.2 Green Procurement Program (GPP).	Contractor certification that the requirements of the GPP are in accordance with 3.3.1.2.
3.3.1.3 Metals.	Contractor certifications that all metals used in the design of the aircraft refueling truck are in accordance with 3.3.1.3.
3.3.1.4 Impregnation of castings.	Contractor certification that the impregnation of casting requirements are in accordance with 3.3.3.1.
3.3.1.5 Elastomers.	Contractor certifications that all elastomeric materials used in the design of the aircraft refueling truck are in accordance with 3.3.1.5.
3.3.1.6 Protective coatings.	Contractor certifications that the protective coatings used on materials in the design of the aircraft refueling truck are in accordance with 3.3.1.6.
3.3.1.7 Dissimilar metals.	Contractor certification that the use of dissimilar metals are in accordance with 3.3.1.7.
3.3.1.10 Rustproofing.	Contractor certification that the vehicle chassis and cab are rustproofed in accordance with 3.3.1.10.
3.3.4.1 System safety.	Contractor system safety hazard analysis (see 4.6.2.1).
3.3.4.6 Electrostatic discharge.	Contractor electrostatic discharge analysis. (see 4.6.2.4).
3.3.4.6.1 Bonding.	Contractor certification that all metal components shall be bonded in accordance with 3.3.4.6.1.
3.3.6 Fastening devices.	Contractor certification that all fastening devices shall be in accordance with 3.3.6.

TABLE IV. Certifications and analyses – Continued.

Paragraph	Required Certifications and Analyses
3.3.7 Welders and welding.	Contractor certification that all welding requirements are in accordance with 3.3.7.
3.3.8 Lubrication.	Contractor certification that the lubrication requirements are in accordance with 3.3.8.
3.3.9 Foolproofness.	Contractor certification that foolproofness is in accordance with 3.3.9.
3.3.10 Service life.	Contractor analysis of the service life requirement (see 4.6.5).
3.4.3 Fungus.	Contractor certification that the fungus protection is in accordance with (see 4.6.6.4)
3.6.1 Surface transportability.	Contractor surface transportability analysis (see 4.6.8.1).
	Contractor certification that the aircraft refueling truck is transportable in accordance with 3.6.1.
3.6.2 Air transportability.	Contractor air transportability analysis (see 4.6.8.2).
3.6.2.1 Shoring.	Contractor certification that shoring is not required in accordance with 3.6.2.1.
3.6.2.4 Tie downs.	Contractor air transportability analysis (see 4.6.8.2).
3.7.1 Reliability.	Contractor reliability model and prediction analysis (see 4.6.9.1).
3.7.2.2 Corrective maintenance.	Contractor corrective maintenance prediction analysis (see 4.6.9.3.2).
3.7.2.6 Special tools.	Contractor certification that special tools are in accordance with 3.7.2.6.
3.7.2.7 Diagnostic software.	Contractor certification that diagnostic software is in accordance with 3.7.2.7.
3.9.1 Chassis.	Contractor certification that the chassis is in accordance with 3.9.1.
3.9.2 Frame analysis.	Contractor frame analysis (see 3.9.2).
3.9.3 Axle analysis.	Contractor axle analysis (see 3.9.3).
3.9.4 Wheel loading.	Contractor wheel loading analysis (see 3.9.4).
3.9.5 Engine, fuels, and exhaust system.	Contractor certification that the engine is in accordance with 3.9.5.
3.9.5.3 Engine and related equipment.	Contractor certification that the engine and related equipment are in accordance with 3.9.5.3.

TABLE IV. Certifications and analyses – Continued.

Paragraph	**Required Certifications and Analyses**
3.9.5.4 Engine air intake system.	Contractor certification that the engine air intake system shall be in accordance with 3.13.1.4.3 of SAE ARP1247.
3.9.5.5 Engine cooling system.	Contractor certification that the engine cooling system is in accordance with 3.9.5.5.
3.9.5.6 Engine oil operating temperature.	Contractor certification that the engine oil operating system is in accordance with 3.9.5.6
3.9.5.7 Engine oil filter.	Contractor certification that the engine oil filter is in accordance with 3.9.5.7.
3.9.5.8 Fuel tank.	Contractor certification that the fuel tank is in accordance with 3.9.5.8.
3.9.5.9 Engine diagnostic system.	Contractor certification that the engine diagnostic system is in accordance with 3.9.5.9.
3.9.9.1 Tires.	Contractor certification that the tires are in accordance with 3.9.9.1.
3.9.11 Electrical system.	Contractor certification that the electrical system is in accordance with 3.9.11.
3.9.11.1.1 Batteries.	Contractor certification that the batteries are in accordance with 3.9.11.1.1.
3.9.11.2 Wiring.	Contractor certification that the wiring is in accordance with 3.9.11.2.
3.9.11.5 Alternator.	Contractor certification that the alternator is in accordance with 3.9.11.5.
3.10.1 Piping.	Contractor certification that the piping is in accordance with 3.10.1.
3.10.3 Pump.	Contractor certification that the pump is in accordance with 3.10.3.
3.10.5.1 Filter vessel.	Contractor certification that the filter vessel is in accordance with 3.10.5.1.
3.10.5.5 Element sealing.	Contractor certification that element sealing is in accordance with 3.10.5.5.
3.10.8.1.3 Pressure gauges.	Contractor certification that the pressure gauge requirements are in accordance with 3.10.8.1.3.
3.10.11 Flow and pressure control system.	Contractor certification that the flow and pressure control system shall include all devices necessary devices to regulate pressure and flow as specified in 3.10.11.

TABLE IV. Certifications and analyses – Continued.

Paragraph	**Required Certifications and Analyses**
3.10.13.2 Overwing hose reel.	Contractor certification that the overwing nozzle provided is OPW model 295AF or equivalent as specified in 3.10.13.2.
3.12 Cargo tank.	Contractor analysis of the cargo tank (see 3.12).
	Contractor certification that the cargo tank is in accordance with 3.12.
3.12.7.2 Inlet receptacle.	Contractor certification that the inlet receptacle is in accordance with 3.12.7.2.
3.13.1 Flow and pressure control system.	Contractor certification that the HSM flow and pressure control system meets the requirements as specified in 3.13.1.
3.13.2.3 Piping.	Contractor certification that the piping is in accordance with 3.13.2.3.
3.15 Quality assurance at contractor fixed-fuel facilities.	Contractor certification that the quality assurance program at the contractor fixed-fuel facilities is in accordance with 3.15.
3.15.1 Fuel quality control.	Contractor certification that the fuel quality control requirements are in accordance with 3.15.1.
3.15.1.1 Working tank cleaning and inspection.	Contractor certification that the working tank cleaning and inspection requirements are in accordance with 3.15.1.1.
3.15.1.2 Draining of working tank sump.	Contractor certification that the draining requirements of the working tank sump are in accordance with 3.15.1.2.
3.15.1.3 Draining of filtration equipment sump.	Contractor certification that the draining requirements of the filtration equipment sump are in accordance with 3.15.1.3.
3.15.1.4 Monitoring differential pressure.	Contractor certification that monitoring differential pressure requirements are in accordance with 3.15.1.4.
3.15.1.5 Working tank filtration.	Contractor certification that the working tank filtration requirements are in accordance with 3.15.1.5.
3.15.2.1 Sample submission.	Contractor certification that the sample submission requirements are in accordance with 3.15.2.1.
3.15.2.2 Sample container.	Contractor certification that sample container requirements are in accordance with 3.15.2.2.

TABLE IV. Certifications and analyses – Continued.

Paragraph	**Required Certifications and Analyses**
3.15.2.3 Sample location.	Contractor certification that the sample location requirements are in accordance with 3.15.2.3.
3.15.2.4 Sample analysis.	Contractor certification that the sample analysis requirements are in accordance with 3.15.2.4.

4.6.2 Safety verification.

4.6.2.1 System safety hazard analysis. A system safety hazard analysis of the aircraft refueling truck shall be conducted in accordance with 4.2 through 4.8 of MIL-STD-882 to demonstrate compliance with the mishap risk requirements of 3.3.4.1.

4.6.2.2 Sound level test. A sound level test shall be performed on the pumping system operations in accordance with the requirements as specified in 3.3.4.4. The sound levels produced by the truck during High Flow mode shall be measured. Radiator shutters and/or fan clutches may be disengaged during the test. Ambient background sound levels prior to testing shall be at least 10 dBA weighted below the sound level limit allowed for the truck. Microphone placement shall be two feet in front of the pump operator control panel and five feet above ground. During the sound level test, the microphone shall be directed toward the maximum sound source. The test shall be performed on the first production model only.

4.6.2.3 Electromagnetic interference test. An EMI test shall be performed on the aircraft refueling truck to verify compliance with the requirements as specified in accordance with the requirements in 3.3.4.5. Winterization shall not be included in EMI testing of the aircraft refueling truck. The test shall be performed on the first production model only.

4.6.2.4 Electrostatic discharge analysis. An engineering analysis shall be performed to demonstrate compliance with the electrostatic discharge requirements of 3.3.4.6.

4.6.2.4.1 Prevention of static electricity demonstration. A demonstration shall be performed to verify that fuel shall not spray or free fall into or out of the cargo tank during operation or servicing as specified in 3.3.4.6.2. The demonstration shall be performed on the first production model only.

4.6.3 Pumping and bottom loading system hydrostatic test. The bottom loader inlet manifold assembly shall be pressure tested to 1.5 times the design pressure for 30 minutes to demonstrate compliance with 3.3.4.7. Certification of pressure ratings of the fuel dispensing system, in accordance with NFPA 407, shall be provided. Component with certifications to pressures greater than required by NFPA 407 shall also be provided. The test shall be performed on the first production model only.

4.6.4 Human engineering demonstration. A demonstration shall be performed to verify compliance with the requirements of 3.3.5. It shall be shown that the use of arctic mittens and Mission-Oriented Protective Posture (MOPP) Level 4 Chemical Warfare Gear allows for the ease of operation, inspection and maintenance of the aircraft refueling truck and does not obstruct the range of control positions of another device. The demonstration shall be performed on the first production model only.

4.6.5 Service life analysis. An engineering analysis shall be performed to demonstrate compliance with the service life requirements of 3.3.10. The engineering analysis shall include, but not be limited to, analysis of life of the aircraft refueling system components. It shall be shown that the cargo tank and pumping compartment assemblies, including the truck frame mounts, wheel bearings, main wheel axles, and the pumping system, shall maintain their structural integrity over the 15 year life of the vehicle. The information and data utilized for the 15 year life verification shall include use of a non-linear FEA engineering software package [for example, MSC NASTRAN (http://www.mscsoftware.com/Products/CAE-Tools/MSC-Nastran.aspx), ADINA (http://www.adina.com/index.shtml), etc] as well as experimental results from FEA analysis, working papers, comprehensive stress, strain and displacement plots, cycle counts, mode analysis and brittle lacquer, strain gage testing and all assumptions (i.e., FEA element shape/type, mechanical properties of material, loading conditions, etc) and supporting assumption rationale, and any recommendations. The analysis shall include all operational loadings thus accounting for all imposed combined stresses (i.e., thermal, shear, bending, axial, compression, torsion, etc) from dynamic loading and variable amplitude transmissions for fatigue analysis using the strain-life approach technique, vibrational distortions and shock loads. Estimated analysis values may be used for structural calculation. However, these values shall be verified either before or after the structural calculations by strain gage readings. Strain gage locations employed in the strain gage testing shall be determined by either brittle lacquer or FEA results or a combination of both. Strain gage recordings shall be converted to stress as specified in SAE J1099. The maximum stress values within the truck shall conform with good design practice such as limiting the maximum stress to two thirds of the material's yield strength. The mean and amplitude stresses associated with cyclic stress variations that occur during the anticipated service of the truck shall also be consistent with good mechanical design which shall consider the endurance limit of the material being evaluated including surface finish, stress concentration and size. Where welds are encountered, the fatigue design rules found in API 579-1/ASME FFS-1, June 5, 2007 shall be employed. In case of out-year localized welding failures, the contractor shall provide a comprehensive welding repair method/plan for all welding accomplished [including removal, welding type, process, electrode, current, instructions, testing (if necessary), etc]. Additionally, the contractor shall provide the Government with information as to the number of times a weld repair may occur without jeopardizing safety.

4.6.6 Environmental test.

4.6.6.1 High temperature storage and operation test. A first production aircraft refueling truck shall be tested for high temperature storage and operation in accordance with MIL-STD-810, Method 501.5, Procedures I and II, to demonstrate compliance with the high temperature storage and operating requirements of 3.4.1. The cargo tank shall be filled with a minimum of 5,500 gallons of fuel. The test cell temperature shall be elevated to 125° F and maintained until cargo fuel temperature has stabilized. After the fuel temperature in the cargo tank has stabilized to 125° F, the truck engine shall be started. All testing shall be carried out while maintaining 125°F. All hoses shall be deployed from the reels and rewound by both power and the manual methods once at 125°F. The single-point hose and nozzle shall be deployed and connected to the bottom loader inlet receptacle. With the pump engaged, the pump system shall be placed in High Flow mode, High Pressure setting. The bottom loader shutoff valve shall be adjusted to produce a minimum flow rate of 600 gpm against a maximum nozzle pressure of 50 psig and shall be maintained for 30 minutes. The bottom loader shutoff valve shall be incrementally closed in 100 gpm increments until flow has been reduced to a zero gpm flow condition; then incrementally opened in 100 gpm increments to increase flow back up to 600 gpm. Flow rates shall be maintained for three minutes each at each incremental flow rate. The single-point nozzle pressure shall remain stable as the flow rates are manipulated. During the zero gpm flow condition of the test, the totalized meter reading shall not exceed two gallons of dispensed fuel. A high-level shutoff sequence shall be demonstrated by activation of the high-level shutoff controls. The controls and components of the pumping system and the bottom loader system shall be cycled to demonstrate functional capability in high temperature operation. The engine coolant and the lubricant temperatures for the engine, transmission, and PTO shall not exceed the manufacturer's safe operating limit, as established prior to testing. The test shall be performed on the first production model only.

4.6.6.2 Low temperature storage and operation test. A first production aircraft refueling truck shall be tested for low temperature storage and operation in accordance with MIL-STD-810, Method 502.5, Procedures I and II, to demonstrate compliance with the low temperature storage and operating requirements of 3.4.1. The cargo tank shall be filled with a minimum of 5,500 gallons of fuel. The test cell temperature shall be reduced to 0°F and maintained until the cargo fuel temperature stabilizes. After the fuel temperature in the cargo tank has stabilized to 0°F, the engine shall be started without the assistance of the winterization system. The single-point hose used for this test shall be an EI 1529, Grade 2, Type CT hose. All hoses shall be deployed from the reels and rewound by both power and manual methods once at 0°F. The test cell temperature shall then be reduced to - 40°F and maintained until the cargo fuel temperature has stabilized. The chassis winterization system(s) may be operated throughout this cold soak period. Testing shall be carried out while maintaining -40°F. After the fuel temperature in the cargo tank has stabilized at -40°F, the truck engine shall be started with the assistance of the winterization system. With the pump engaged, the pumping system shall be placed in High Flow mode, High Pressure setting. The single-point hose and nozzle shall be deployed and connected to the bottom loader inlet receptacle. The bottom loader shutoff valve shall be adjusted to produce a minimum flow rate of 600 gpm against a maximum nozzle pressure of 50 psig and shall be maintained for 30 minutes. The bottom loader shutoff valve shall be incrementally closed in 100 gpm increments to reduce flow down to a zero gpm flow condition; then incrementally opened in 100 gpm increments to increase flow back up to 600 gpm. Flow rates shall be maintained for three continuous minutes each at each incremental flow rate. Single-point nozzle pressure shall remain stable as the flow rates are manipulated. During the zero gpm flow condition of the test, the totalized meter reading shall not exceed two gallons of dispensed fuel. A high-level shutoff sequence shall be demonstrated by activation of the high-level shutoff controls. The controls and components of the pumping system and the bottom loading system shall be cycled to demonstrate functional capability in low temperature operation. If battery warmers are provided, the electrolyte temperature shall be recorded at -40°F. The test shall be performed on the first production model only.

4.6.6.3 Humidity test. A humidity test shall be performed on the aircraft refueling truck in accordance with MIL-STD-810 Method 507.5, Procedure I. The test shall be performed on the first production model only.

4.6.6.4 Fungus test. In lieu of fungus testing, the contractor shall certify that the materials used in construction of the aircraft refueling truck are fungus resistant or suitably treated to resist fungus in accordance with the requirements of 3.4.3.

4.6.6.5 Salt fog test. A salt fog test shall be performed on the aircraft refueling truck in accordance with MIL-STD-810, Method 509.5. The test shall be performed on the first production model only.

4.6.6.6 Sand and dust test. A sand and dust test shall be performed on the aircraft refueling truck in accordance with MIL-STD-810, Method 510.5, Procedures I (12 hours) and II (90 minutes per side). The test shall be performed on the first production model only.

4.6.7 Weight and dimensional demonstration.

4.6.7.1 Weight demonstration. A demonstration shall be performed to verify the weight requirements in 3.5 and the axle weight requirements in 3.6.2.2. The center of gravity shall be measured in accordance with 4.4 of TOP 2-2-800. The demonstration shall be performed one time on the first production model and one time on the production models.

4.6.7.2 Dimensional demonstration. A demonstration shall be performed to verify the dimensional requirements in 3.5. The demonstration shall be performed one time on the first production model and one time on the production models.

4.6.8 Transportability verification.

4.6.8.1 Surface transportability analysis. A surface transportability engineering analysis shall be performed to demonstrate compliance with 3.6.1. The analysis shall utilize the data for rail, ship, and road transportation modes referenced in MIL-STD-810, Method 514.6 Procedure I.

4.6.8.2 Air transportability analysis. An air transportability engineering analysis shall be performed to demonstrate compliance with the air transportability requirements of 3.6.2 through 3.6.2.4. The analysis shall include the tie downs and all major components and their ability to withstand the accelerations specified in 3.6.2. In lieu of testing with an actual aircraft ramp, the aircraft refueling truck may approach, negotiate, and leave a sloped ramp between horizontal surfaces, in both forward and reverse directions. The ramp length and slope, including sharp angles with horizontal surfaces at the top and the bottom, shall be equivalent to the C-130 aircraft.

4.6.8.3 Equipment removal and reconfiguration test. A first production aircraft refueling truck shall be configured for transport on C-130, C-17, and C-5 aircraft and then reconfigured for operation to demonstrate compliance with 3.6.2.5. It shall be demonstrated that the forces required do not exceed those allowed in MIL-STD-1472. The test shall be performed on the first production model only.

4.6.9 Reliability tests and maintainability demonstration.

4.6.9.1 Reliability model and prediction. The contractor shall develop and maintain a basic reliability model for the system in accordance with A.4.1. The contractor shall prepare and maintain a basic reliability prediction for the system in accordance with A.4.2; it shall be based upon the associated basic reliability model.

4.6.9.2 Reliability tests. The first production aircraft refueling truck shall be subjected to a reliability qualification test (RQT), under normal environmental conditions, in accordance with 4.6.9.2.1. The testing requirements for the RQT shall be as specified in A.5.1. All requirements of Appendix A shall apply to the reliability tests.

4.6.9.2.1 RQT. A 430 hour fixed-duration RQT shall be performed to demonstrate compliance with 3.7.1. The contractor's failure reporting, analysis, and corrective action system (FRACAS) shall be in accordance with A.5.5. The RQT shall not stop except when the aircraft refueling truck is taken offline for a PMI or repair of a failure to restore the aircraft refueling truck to its operational configuration. Nominal consumer's and producer's risks shall be 19.7 and 17.5 percent respectively; the discrimination ratio shall be 3.0 and no more than 2 failures shall be allowed as specified in Test Plan XVII-D of MIL-HDBK-781. Configuration changes shall not be made during the RQT without approval of the procuring activity. The RQT test configuration shall be performed as follows:

a. The aircraft refueling truck cargo tank shall be filled with a minimum of 5000 gallons of Grade JP-8, turbine fuel, as specified in MIL-DTL-83133, and the single-point hose and nozzle connected to the bottom loader inlet receptacle;

b. The pumping system shall be operated continuously throughout the entire test period in High Flow mode, High Pressure setting while maintaining a flow rate in the range of 560-600 gpm and a single-point nozzle pressure in the range of 35-50 psig; and,

c. Without adjusting any controls, flow shall be shut-off at the bottom loader by closing the bottom loader shutoff valve once every 60 minutes. During this time, the engine shall be returned to idle, the PTO disengaged, then reengaged back into pump mode, re-establishing flow and single-point nozzle pressure to the ranges as specified in the RQT.

4.6.9.3. Maintainability demonstration.

4.6.9.3.1 Preventative maintenance demonstration. All recommended preventive maintenance tasks shall be performed and the task times shall be recorded. It shall be demonstrated that the forces required do not exceed those allowed in MIL-STD-1472. All preventive maintenance tasks recommended to be performed daily and at the routine PMI shall also be performed by personnel wearing arctic mittens and MOPP Level 4 Chemical Warfare Gear.

4.6.9.3.2 Corrective maintenance prediction. The contractor shall prepare and maintain a corrective maintenance prediction in accordance with A.4.5 to demonstrate compliance with the MTTR requirement (see 3.7.2.2). The model and failure rate data shall be consistent with that of the basic reliability model and prediction (see 4.6.9.1).

4.6.9.3.3 Corrective maintenance demonstration. The corrective maintenance demonstration shall be planned and performed using Test Method 9 of MIL-HDBK-470 as guidance. The contractor shall prepare a list of the corrective maintenance tasks for all expected failures over the life of the aircraft refueling truck. The Government shall select 30 of these tasks, which shall be performed, and the task times shall be recorded. It shall be demonstrated that the forces required do not exceed those allowed in MIL-STD-1472. The corrective maintenance tasks shall be performed by personnel wearing arctic mittens and MOPP Level 4 Chemical Warfare Gear.

4.6.10 Performance tests.

4.6.10.1 Mobility tests.

4.6.10.1.1 Turning diameter test. A turning diameter test shall be performed on the aircraft refueling truck to verify the wall-to-wall turning diameter in both directions in accordance with the requirements in 3.8.1.1. The test shall be performed three times on the first production model only.

4.6.10.1.2 Gradeability test. A gradeability test shall be performed to verify that the fully loaded aircraft refueling truck is in accordance with the gradeability requirements in 3.8.1.2. The test shall be performed one time on the first production model only.

4.6.10.1.3 Suspension articulation test. A suspension articulation test shall be performed to verify compliance with the requirements in 3.8.1.3. The fully loaded aircraft refueling truck shall be driven over eight inch high blocks square to the straight line path of the truck and at least the full width of the truck. The blocks shall be spaced between one half and three quarters of the wheelbase length of the truck and shall have not less than 15 percent approach and departure angles. The truck shall alternately pass straight over a block and then pass over a block at the mid-point of tight turn, where the rear tandem approximately crosses the block with diagonally opposite rear tires. Turns shall be alternated to the right and to the left. The truck shall pass over 1,500 blocks total. Test speed shall be at least five miles per hour. If a redesign is required due to part failures, interference, bottoming out of a mounting system, or permanent distortion of the truck, the cargo tank, or the pumping system, the test shall fail and be fully repeated. The test shall be performed on the first production model only.

4.6.10.1.4 Speed test. A speed test shall be performed to verify compliance with the requirements in 3.8.1.4. Testing shall be performed to show that the fully loaded aircraft refueling truck including the filtration system and piping, can (1) achieve a speed of 55 mph on level, paved highway (see 6.3.3), (2) achieve a speed of 40 mph over an unimproved road (see 6.3.4), and (3) achieve a speed of 15 mph over cobblestone road (see 6.3.5). The paved highway and unimproved road tests shall be performed three times on the first production model. The paved highway and unimproved road tests shall be performed one time on production models. The cobblestone road test shall be performed on first production models only.

4.6.10.1.5 Roadability test. A road driving test shall be performed to verify compliance with the requirements in 3.8.1.5. The fully loaded aircraft refueling truck, including the filtration system and piping, shall be driven a minimum of 450 miles over paved roads at a minimum average speed of 45 mph, a minimum of 100 miles over graded gravel or unimproved roads at a minimum average speed of 25 mph, and a minimum of 50 miles over cobblestone road at a minimum average speed of 10 mph. During each test, the truck shall complete a sequence of 10 short radius right and short radius left turns, and five sudden stops. All truck instruments shall remain in the normal zones and the transmission shall complete all shift sequences. At the end of each test, the pumping system shall be operated for 60 minutes at 600 gpm with a single-point nozzle pressure up to and including 50 psig. After all tests are completed, the truck shall show no evidence of loose parts, deformation, misalignment, leaks, oil consumption, or abnormal tire wear. If a structural failure occurs during testing, repairs may be made at the time of occurrence and the testing extended by the number of accumulated hours at the time of failure. If a leak or malfunction occurs in the tank, piping, or the pumping system during the test, corrective action shall be taken and the entire test repeated. The roadability test shall be performed one time on the first production model and one time on the production models. For production models, the fully loaded aircraft refueling truck shall be driven a minimum of 40 continuous miles at a minimum average speed of 45 mph on paved roads and a minimum of 10 continuous miles at a minimum average speed of 25 mph on unimproved roads. The cobblestone road test shall be performed first production models only.

4.6.11 Pumping system performance test. The following tests shall be performed on the pumping system to verify compliance to the requirements specified in 3.8.2. Pressure and flow shall be stable at any operating conditions during testing.

a. High Flow test.

    1. With the cargo tank full as set by the High-Level Shutoff System (3.12.7.4) the single-point hose and nozzle shall be connected to an external storage tank and a minimum of 5,700 gallons of fuel issued from the cargo tank of the R-11 aircraft refueler into an external storage tank in each of the “High Flow” pressure settings.

    2. With the operator selected maximum nozzle pressure set to 50 psig the system shall automatically issue fuel at rates of 600 gpm +0/– 25 gpm over a range of single-point nozzle pressures from 0 to 50 ± 5 psig.

3. With the operator selected maximum nozzle pressure set to 35 psig the system shall automatically issue fuel at rates of 600 gpm +0/– 25 gpm over a range of single-point nozzle pressures from 0 to 35 ± 5 psig.

4. The high flow test shall be performed three times for each pressure setting on the first production model and one time for each pressure setting on the production models.

b. Low flow test.

1. With the cargo tank full as set by the High-Level shutoff system (3.12.7.4) fuel shall be issued from the cargo tank of the R-11 aircraft refueler into an external storage tank in each of the "Low Flow" operating modes.

2. The system shall automatically issue fuel at rates of 100 gpm + 10/-0. Single-point nozzle pressure shall not exceed 50 ± 5 psig. The test shall be maintained for three minutes on the first production model and one minute on production models.

3. When equipped with the overwing hose assembly (see 3.10.13.2), the overwing hose and nozzle shall be tested to maintain flows at any increment between 0 gpm and 100 gpm by manipulation of the nozzle handle only. Overwing nozzle pressure shall not exceed 50 ± 5 psig.

4. The low flow test shall be performed for three minutes on the first production model and one minute on the production models.

c. Defuel test.

1. The single-point hose and nozzle shall be connected to an external storage tank with the fuel height no greater than ten feet above the ground. It shall be demonstrated that any failure in the high-level shutoff system shall prevent defuel activation.

2. With the mode selector set to Defuel, a minimum flow rate of 175 GPM shall be maintained utilizing the auxiliary throttle for at least five minutes without the assistance of a simulated aircraft boost pump. This test shall be repeated with a simulated aircraft boost pump and a flow rate of 300 ± 5 gpm shall be maintained for at least five minutes.

3. Next, a minimum flow rate of at least 15 gpm shall be established utilizing the auxiliary throttle and maintained for at least five minutes. Flow rate shall then be reestablished until the high level shutoff terminates flow. A minimum of 3,000 gallons of fuel shall be defueled during the test.

4. With the cargo tank full, the high level override shall be demonstrated.

5. The defuel test shall be performed three times on the first production model and one time on the production models.

d. Underground defuel test.

1. A 1.5 inch diameter pigtail hose, 15 feet long, shall be connected to the single-point nozzle. The hose shall be lowered into an external storage tank with the fuel level at least three feet below grade level.

2. With the mode selector set to Defuel, a flow rate of 50 gpm shall be established utilizing the auxiliary throttle. The minimum obtainable flow rate shall be at least 10 gpm. Flow shall be maintained for five minutes.

3. The underground defuel test shall be performed three times on the first production model and one time on the production models.

e. HSM demonstration. The HSM demonstration shall be as specified in 4.6.31.

4.6.11.1 Closed pump discharge test. A test shall be performed to operate the pump in a flooded condition at maximum speed for 30 minutes with the discharge side of the pump closed, without damage or measurable wear to the pump assembly. To verify compliance with the requirements in 3.8.2.1, the PTO/Pump assembly shall be disassembled and inspected for damage or overheating. The PTO/Pump, once re-assembled, shall contain all new parts. The test shall be performed on the first production model only.

4.6.11.2 Dry pump operation test. A test shall be performed to operate the pump in a dry condition at maximum speed for 10 minutes without damage or measurable wear to the pump assembly. To verify compliance with the requirements in 3.8.2.2, the PTO/Pump assembly shall be disassembled and inspected for damage or overheating. The PTO/Pump, once re-assembled, shall contain all new parts. The test shall be performed on the first production model only.

4.6.12 Engine starting system demonstration.

4.6.12.1 Engine starting aids demonstration. A demonstration shall be performed to verify that the engine starting aids operate in accordance with the requirements in 3.9.5.1.2. The demonstration shall be performed on the first production model only.

4.6.12.2 Power take-off (PTO) test. A test shall be performed to demonstrate the PTO is designed and operates in accordance with the requirements in 3.9.7. Testing shall show that the PTO system is designed to either move the truck or drive the pump, never both concurrently. Pump engagement, without gear clash or shock loading, shall be demonstrated by engaging the PTO from pump mode to road mode. Testing shall show that the auxiliary throttle does not operate while the PTO is in road mode and the truck accelerator pedal does not operate while the PTO is in pump mode. It shall be demonstrated that PTO engagement is controlled from the driver's seated position and shall not occur unless and until selector is in neutral, engine is at idle, and truck parking brake is engaged. The test shall be performed three times on the first production model and one time on the production models.

4.6.13 Winterization system demonstration. A demonstration shall be performed to verify the winterization system is designed and operates in accordance with the requirements in 3.9.11.3. The demonstration shall be performed one time on the first production model only.

4.6.13.1 Pumping compartment lights test. A test shall be performed to verify that the minimum lighting level inside the pumping compartment and at the operator control panel, is in accordance with the requirements in 3.9.11.4.1. It shall be shown that all controls, instruments, and the flow meter are illuminated for nighttime operations. The test shall be performed one time on the first production model and one time on the production models.

4.6.13.2 Night servicing lights test. A test shall be performed to verify that the night servicing lights are in accordance with the requirements of 3.9.11.4.2. It shall be shown that the combined light levels illuminate the entire side of the truck and that the lights operate only while the truck clearance lights are "ON". The test shall be performed one time on the first production model and one time on the production models.

4.6.14 Rear fender test. A test shall be performed in accordance with the requirements in 3.9.14 to verify that each rear fender can withstand a factored static load of 300 pounds per square foot at any position without permanent deformation. The test shall be performed one time on the first production model only.

4.6.15 Pumping system durability test. A test shall be performed to verify the pumping system operates in accordance with the requirements in 3.10. The cargo tank shall be filled with a minimum of 4500 gallons of fuel. The single-point hose and nozzle shall be connected to the bottom loader inlet receptacle. The pumping system, as specified in 3.10, shall be operated in High Flow mode, High Pressure setting, while maintaining a minimum of 600 gpm flow rate against a maximum single-point nozzle pressure of 50 psig. Without adjusting any controls, flow shall be shut off at the bottom loader and re-established incrementally four times each hour. At the end of each hour, the engine shall be returned to idle, the PTO disengaged, reengaged back into pump mode, and flow re-established. The test shall be performed for 100 hours on the first production model and one hour on the production models.

4.6.15.1 Fuel recovery tank test. A test shall be performed to verify that the fuel recovery tank operates in accordance with the requirements in 3.10.1.1. The test shall be performed three times on the first production model and one time on the production models.

4.6.15.2 Emergency tank shutoff control test. A test shall be performed to verify that the emergency tank shutoff controls immediately terminates the fuel flow in any mode regardless of whether the deadman device is activated or deactivated, in accordance with 3.10.2.1. The test shall be performed three times on the first production model and one time on the production models.

4.6.15.3 Pump discharge shutoff valve demonstration. A demonstration shall be performed to verify that the pump discharge shutoff valve is operable while standing or kneeling on the left or right side of the truck. The demonstration shall include indicating the location of the shutoff valve as specified in 3.10.4. The demonstration shall be performed three times on the first production model and one time on the production models.

4.6.16 Fuel filtration system test. Test reports shall be provided by the filter manufacturer verifying that the filtration system meets the qualification requirements in accordance with the requirements in 3.10.5.

4.6.16.1 Water slug shutoff device test. A test shall be performed to verify the water slug shutoff device operates in accordance with the requirements in 3.10.5.2. Testing shall show that fuel flow shall stop within 10 seconds upon manual activation of the water slug shutoff device. Fuel flow shall resume within 30 seconds when the shutoff is deactivated. The test shall be performed three times on the first production model and one time on the production models.

4.6.16.2 Float-actuated valve test. A test shall be performed to verify that the float-actuated valve operates in accordance with the requirements in 3.10.5.3. The test shall show that fuel flow stops when the external testing mechanism is activated. The test shall be performed three times on the first production model and one time on the production models.

4.6.17 Sampling provision demonstrations.

4.6.17.1 Sampling device demonstration. A demonstration shall be performed to verify the sampling device is in accordance with the requirements in 3.10.6.1. It shall be shown that adequate space is provided to connect in-line samplers approved by the Air Force for solids and water samples. The demonstration shall be performed one time on the first production model and one time on the production models.

4.6.17.2 Sampling high-level override control test. A test shall be performed to verify that the sampling high-level override control operates in accordance with the requirements in 3.10.6.2. The test shall show that the fully loaded aircraft refueling truck is capable of recirculation in the Defuel mode by activating the sampling high-level override control. The test shall be performed three times on the first production model and one time on the production models.

4.6.18 Flow meter demonstration. A demonstration shall be performed on the flow meter to verify the compliance with the requirements in 3.10.7. It shall be shown that the meter can register flow rates as low as 2.5 gpm and is readable from a distance of 15 feet during day or night. The demonstration shall be performed three times on the first production model and one time on the production models.

4.6.19 Pumping system controls and adjustable valves demonstration. A demonstration shall be performed to verify the pumping system controls are in accordance with the requirements in 3.10.8. Erroneous combination of settings shall be performed and the technical manual instructions for re-setting the valves and controls of the pumping system shall be demonstrated. After pump mode selection, manipulations of controls, except for the auxiliary throttle and the deadman device, shall not be required. The single-point hose and nozzle shall be deployed and the nozzle shall be connected to the bottom loader inlet receptacle. With the single-point nozzle closed, each system control, including the mode selectors shall be set to every possible erroneous combination. For each setting it shall be demonstrated that the flow or pressure, if generated, does not damage or fail the system or a component. The demonstration shall be repeated with each system control line, to or from the mode selector, disconnected or clamped off to demonstrate that no other mode is affected and that the flow and single-point nozzle pressure are still being controlled. The demonstration shall be performed one time on the first production model and one time on the production models. In addition, a demonstration shall be performed to verify that all adjustable valves shall be in accordance with 3.10.10. The demonstration shall show that all adjustable valves in the pumping system shall be operable, while standing on the ground, in full view of the operator control panel gauges during adjustments. The demonstration shall show that the provisions are provided to prevent tampering or adjustments of all factory preset components. The demonstration shall be performed one time on the first production model only.

4.6.19.1 Pump controls demonstration. A demonstration shall be performed on the pump controls to verify the pump controls are fully independent and that multiple mode selections are not possible as required in 3.10.8.1.1. The demonstration shall be performed one time on the first production model only.

4.6.19.2 Pressure gauge test. A test shall be performed to establish the difference between the actual pressure reading at the single-point nozzle and the indicated pressure reading for the single-point nozzle on the operator control panel. Starting with a fully loaded aircraft refueler truck, the single-point hose and nozzle shall be connected to the bottom loader inlet receptacle. A calibrated pressure gauge shall be connected to the single-point nozzle indicating actual pressure as measured at the aircraft. Flow shall be increased until 600 gpm is achieved and an actual single-point nozzle pressure of 50 psig maximum is recorded. The flow shall then be incrementally decreased in 100 gpm increments to zero flow, and then increased in 100 gpm increments to the maximum flow of 600 gpm. The flow and pressure differences between the actual single-point nozzle pressure reading at the bottom loader and the indicated single-point nozzle pressure reading at the operator control panel shall be recorded for each increment and shall be within the specified tolerances in accordance with the requirements in 3.10.8.1.3. The test shall be performed one time on the first production model and one time on the production models.

4.6.19.3 Differential pressure gauge demonstration. A demonstration shall be performed on the differential pressure gauge to verify compliance with the requirements in 3.10.8.1.4. The demonstration shall be performed one time on the first production model and one time on the production models.

4.6.19.4 Emergency engine shutoff test. A test shall be performed to verify that the emergency engine shutoff shall shut down the engine without the use of any other control as required in 3.10.8.1.5. The test shall be performed three times on the first production model and one time on the production models.

4.6.20 Defuel high-level pretest control test. A test shall be performed to verify that the activation of the defuel high-level pretest control shall terminate the flow of fuel in the Defuel mode as required in 3.10.9. The test shall be performed three times on the first production model and one time on the production models.

4.6.21 Flow control system demonstration. A demonstration shall be performed to verify that the FCS shall be capable of limiting the maximum flow rates for each pump mode setting in accordance with the requirements in 3.10.11.1. The demonstration shall be performed three times on the first production model and one time on the production models.

4.6.22 Pressure control system (PCS) test. A PCS test shall be performed to verify the requirements in 3.10.11.2. The single-point hose and nozzle shall be deployed and connected to the bottom loader inlet receptacle. A quick closing valve shall be added between the single-point nozzle and the bottom loader inlet receptacle. With the pump engaged, the pumping system shall be set to High Flow mode, High Pressure setting. With the deadman device activated, the bottom loader shutoff valve shall be adjusted to produce a maximum flow rate of 600 gpm against a maximum single-point nozzle pressure of 50 psig. While flowing at 600 gpm, the quick closing valve shall be shut within two seconds. Pressure at the single-point nozzle shall not exceed 120 psig. Locked-in pressures shall automatically reduce to not more than 55 psig within 15 seconds after closure. The quick closing valve shall be re-opened and fuel flow shall be restored within 15 seconds. The test shall be performed three times on the first production model and one time on the production models.

4.6.23 Bypass system demonstration. To verify compliance with the requirements in 3.10.11.3, a demonstration shall be performed verifying that the aircraft refueling truck's bypass system at no time relieves excess pump pressure into the cargo tank. The demonstration shall be performed one time on the first production model and one time on the production models.

4.6.24 Safety provision demonstration. A demonstration shall be performed to verify that all valves and controls associated with the pumping system shall meet the requirements in 3.10.12. The demonstration shall be performed one time on the first production model and one time on the production models.

4.6.25 Hose reel tests.

4.6.25.1 Single-point hose reel test. The single-point hose reel shall be tested to verify the requirements in 3.10.13.1. The ability to adjust the drag brake to regulate the unwind force on the hose between zero and 50 pounds shall be demonstrated. Powered rewind rate shall be measured by retracting a fuel filled fully deployed single-point hose on a hard surface against a drag brake setting of 15 pounds-force. The relationship of the rewind control with the operator's ability to assist the single-point hose onto the reel shall be demonstrated. The single-point hose shall not overfill the single-point hose reel or interfere with the pumping compartment or other components. It shall be demonstrated that the truck parking brake cannot be released unless the single-point nozzle is properly stowed. Powered rewinds shall be performed five times and manual rewind performed one time on the first production model. Powered and manual rewinds shall be performed one time on the production models only.

4.6.25.2 Overwing hose assembly demonstration. A demonstration shall be performed to verify the overwing hose assembly meets the requirements in 3.10.13.2. An examination shall be performed to verify the overwing hose assembly contains all the required components necessary for proper operation and use. The demonstration shall be performed one time on the first production model and one time on the production models only.

4.6.26 Deadman control system test. A DCS test shall be performed to verify the requirements in 3.10.14 for all pump modes. The single-point hose and nozzle shall be deployed and connected to the bottom loader inlet receptacle and the deadman device activated to initiate flow in High Flow and Low Flow modes. In the Defuel mode, the single-point shall be connected to an external storage tank. In the HS mode, the hydrant service hose shall be connected to a simulated Type III hydrant system and the single-point hose connected to an external storage tank. In the HS mode, the test shall be performed in both the aircraft fill and cargo tank fill settings. The High Pressure setting shall be used in the High Flow and HS mode only. Once the truck is operating at the maximum flow rate in each pump mode, the deadman device shall be deactivated, terminating flow, and shall resume flow within 15 seconds after reactivating the deadman device. The test shall be performed three times for each pump mode on the first production model and one time for each pump mode on production models. It shall be shown that a fully deployed deadman hose and deadman device can be retracted within one minute by activating the deadman hose reel rewind button on the operator control panel. The test shall be performed one time on the first production model and one time on the production models.

4.6.27 Pumping compartment construction test. A test of the pumping compartment construction shall be performed to verify the requirements in 3.11.1. The pumping compartment shall be tested to verify that the pumping compartment roof can support a factored load of 300 pounds per square foot at any point without permanent deformation. Testing shall verify that the pumping compartment roof can be removed using the lifting points provided. The test shall be performed one time on the first production model only.

4.6.28 Cargo tank analysis. A dimensional analysis of the tank and sump capacities shall be provided to verify the requirements in 3.12. Test reports and certifications of the tank, as specified in NFPA 407 and DOT 406, shall be provided for every truck produced.

4.6.28.1 Cargo tank vent system test. A test shall be performed on the primary vents for all pump modes to verify the requirements in 3.12.4. The single-point hose and nozzle shall be deployed and connected to the bottom loader inlet receptacle in both High Flow and Low Flow modes. In the Defuel mode, the single-point shall be connected to an external storage tank with the bottom of the tank at least 6 feet above the ground. For bottom loading, an external fuel supply source capable of producing a minimum of 750 gpm with bottom loader inlet pressures not exceeding 150 psig shall be established. In the HS mode, aircraft fill setting, and the truck engine operating, the hydrant service hose shall be connected to a simulated Type III hydrant system and the single-point hose connected to an external storage tank. In the HS mode, cargo tank fill setting, and the truck engine operating, the hydrant service hose shall be connected to a simulated Type III hydrant system. The High Pressure setting shall be used in the High Flow and HS mode only. During the primary vent test, it shall be shown that the aircraft refueling truck shall not perform refueling, defueling, bottom loading, and hydrant servicing operations unless the primary vent is completely open at a minimum of 90 psig. The maximum flow rates shall be: (1) 600 gpm through the single-point nozzle in High Flow mode, (2) 750 gpm when bottom loading, (3) 700 gpm in HS mode when filling the cargo tank, and (4) 600 gpm in the HS mode when issuing to an external storage tank. The system actuation fail-safe features shall be demonstrated. The test shall be performed one time on the first production model and one time on the production models.

4.6.28.2 Catwalk demonstration. A demonstration shall be performed to verify the catwalk requirements in 3.12.5. It shall be shown that the catwalk is capable of supporting a factored load of 300 pounds per square foot at any designated point without permanent deformation. The demonstration shall be performed one time on the first production model only.

4.6.28.3 Tank boarding ladder demonstration. A demonstration shall be performed to verify the tank boarding ladder requirements in 3.12.6. It shall be demonstrated that each rung of the boarding ladder can support 250 pounds without permanent deformation. The demonstration shall be performed one time on the first production model only.

4.6.28.4 Bottom loader system test. A test shall be performed on the bottom loader system to verify the requirements in 3.12.7. The truck shall be positioned for bottom loading and the engine shut down. An external fuel supply source capable of producing a minimum of 750 gpm with bottom loader inlet pressures not exceeding 150 psig shall be established. The bottom loader system shall accept the established rate of flow until the primary tank-level sensor activates, upon which the bottom loader internal valve reduces flow to 250 gpm and the fill stand rack system shuts down, terminating flow. The cargo tank shall then be drained to 3000 gallons and the test repeated at flow rates of 100, 300 and 500 gpm. Each flow rate shall be tested three times for the first production model and one time for the production models.

In addition, testing shall verify: (1) the bottom loader internal valve opens at no more than 15 psig inlet pressure, and (2) the bottom loader internal valve shall be capable of closing within 15 seconds if the primary vent closes. Testing shall verify that the primary vents shall be interlocked to activate only after the truck parking brakes are set and shall close if the brakes are released during the bottom loading operation. The test shall be performed three times on the first production model and one time on production models.

4.6.28.4.1 Shutoff valve test. A test shall be performed on the bottom loader shutoff valve to verify compliance with the requirements in 3.12.7.3. The test shall be performed three times on the first production model and one time on the production models.

4.6.29 High-level shutoff test. The high-level shutoff system shall be tested to verify the requirements in 3.12.7.4. Adjustment of the primary and secondary tank-level sensors up to six inches below the 6,000 gallon level shall be demonstrated. During the following tests, it shall be demonstrated that if the high-level shutoff system is not functional, the truck shall not perform bottom loading, defueling, or hydrant servicing operations. The following tests shall be performed:

a. Primary tank-level sensor and high-level pretest test:

1. Bottom loading: The truck shall be positioned for bottom loading and the engine shut down. The test shall begin with a 2,000 gallon outage each time for the 750 gpm rate. An external fuel supply source capable of producing a minimum of 750 gpm with bottom loader inlet pressures not exceeding 150 psig shall be established. The cargo tank shall be filled to capacity from an external source at a flow rate of 750 gpm. Once flow is established, activation of the bottom loader high-level pretest control shall terminate the flow of fuel simulating a fully-loaded aircraft truck. Flow shall be re-established and upon fuel contact with the primary tank-level sensor, the bottom loader internal valve shall reduce flow to a maximum of 250 gpm and the fill stand rack system shall shut down. The test shall be performed three times on the first production model and one time each on the production models.

2. Defueling: The truck shall be set up for defuel operations. The test shall begin with a 1,000 gallon outage each time for the test. The single-point shall be deployed and connected to an external storage tank with the bottom of the tank at least 6 feet above the ground. The pump system shall be placed in Defuel mode. Once flow is established, activation of the defuel high level pretest control shall terminate the flow of fuel simulating a fully-loaded aircraft truck. Defueling shall continue at a maximum flow rate of 175 gpm until the primary tank-level sensor is contacted with fuel, upon which the deadman device operations shall terminate, thus terminating flow. The test shall be performed three times on the first production model and one time on the production models.

3. Hydrant servicing: The truck shall be set up for hydrant service operations. The test shall begin with a 2,000 gallon outage each time. With truck engine operating, the pump system in HS mode, High Pressure setting, and cargo tank fill, the hydrant hose shall be deployed and connected to a simulated type III hydrant system. Once flow is established, activation of the HSM high-level pretest control shall terminate the flow of fuel simulating a fully-loaded aircraft truck. Flow shall continue at a maximum flow rate of 700 gpm until the primary tank-level sensor is contacted with fuel, upon which the hydrant pit valve shall shut down, terminating flow. The test shall be performed three times on the first production model and one time on the production models.

b. Secondary tank-level sensor test:

1. Bottom loading: The truck shall be positioned for bottom loading and the engine shut down. The test shall begin with a 2,000 gallon outage each time for the 750 gpm rate. An external fuel supply source capable of producing a minimum of 750 gpm with bottom loader inlet pressures not exceeding 150 psig shall be established. The cargo tank shall be filled to capacity from an external source at a flow rate of 750 gpm. Upon fuel contact with the secondary tank-level sensor, the bottom loader internal valve shall close within two to four seconds. The test shall be performed three times on the first production model and one time each on the production models.

2. Defueling: The truck shall be set up for defuel operations. The test shall begin with a 1,000 gallon outage each time for the test. The single-point shall be deployed and connected to an external storage tank with the bottom of the tank at least 6 feet above the ground. The pump system shall be placed in Defuel mode. Defueling shall commence at a maximum flow rate of 175 gpm until the secondary tank-level sensor is contacted with fuel, upon which the defuel control system shall shut down, terminating flow. The test shall be performed three times on the first production model and one time on the production models.

3. Hydrant servicing: The truck shall be set up of hydrant service operations. The test shall begin with a 2,000 gallon outage each time. With the truck engine operating, the pump system in HS mode and cargo tank fill setting, the hydrant hose shall be deployed and connected to a simulated type III hydrant system. Flow shall commence at a maximum flow rate of 700 gpm until the secondary tank-level sensor is contacted with fuel, terminating the flow of fuel into the cargo tank. The test shall be performed three times on the first production model and one time on the production models.

4.6.29.1 High-level shutoff override test. The high-level shutoff system overrides shall be tested to verify the requirements in 3.12.7.4.1.

a. Bottom loader high-level override test: A fully loaded aircraft refueling truck of 5,500 gallons of fuel shall be emptied from the cargo tank, by gravity discharge, through a three inch hose attached to the bottom loader inlet receptacle. Upon activation of the bottom loader high-level override button, the flow of fuel shall commence from the tank, exiting through the bottom loader, at an average flow rate of 100 gpm in not more than 55 minutes. It shall be demonstrated that release of the bottom loader high-level override button located on the bottom loader control panel shall close the bottom loader internal valve within 15 seconds. The test shall be performed three times on the first production model only.

b. Sampling high-level override test: With a fully loaded aircraft refueling truck, it shall be demonstrated that an internal recirculation flow rate of 400 gpm in the Defuel mode can be established by activating the sampling high-level override switch located on the operator control panel. Deactivating the sampling high-level override switch shall terminate the flow of fuel. The test shall be performed three times on the first production model and one time on the production models.

4.6.30 Vapor recovery system test. To verify compliance with the requirements of 3.12.8, the vapor recovery system shall be tested as specified in API RP 1004. The test shall be performed on the first production model only.

4.6.31 HSM test. A test shall be performed to verify that the HSM is designed and operates in accordance with the requirements in 3.13.

a. Aircraft fill test. With the engine operating, the pump shall be placed in HS mode, High Pressure setting, and aircraft fill. Testing shall verify that fuel can be issued from a simulated Type III hydrant system to an external storage tank, by flowing through the HSM, filtration system, the meter, and the single-point hose and nozzle, at a maximum flow rate of 600 gpm with nozzle back pressures over the range of 0 psig to 50 ± 5 psig. Testing shall verify that excess single-point nozzle and surge pressure relief shall not be returned to the cargo tank due to a maximum peak pressure surge resulting from a two second quick shutdown at the single-point nozzle connection to the external storage tank. The aircraft fill test shall be performed three times on the first production model and one time on the production models.

b. Cargo tank fill test. With the engine operating, the pump shall be placed in HS mode, High Pressure setting, and cargo tank fill. Testing shall verify that fuel can be issued from a simulated Type III hydrant system, through the HSM, into the cargo tank without passing through the pump, filtration system, or meter, at flow rates up to and including a maximum of 700 gpm at the maximum simulated hydrant inlet pressure of 130 psig. The cargo tank fill test shall be performed three times on the first production model and one time on the production models.

4.6.32 HSM components test and demonstration.

4.6.32.1 Hydrant hose assembly and coupler demonstration. An inspection and demonstration shall be performed to verify the hydrant hose assembly and coupler for the HSM meets the requirements in 3.13.2.1. The demonstration shall show that the interlock system prevents the parking brake from being released unless the coupler is properly stowed. The demonstration shall be performed three times on the first production model and one time on the production models.

4.6.32.2 Hydrant hose reel test. A test and inspection shall be performed to verify the hydrant hose reel for the HSM meets the requirements in 3.13.2.2. The test shall verify that the hydrant hose reel shall rewind the entire flooded hose at a minimum rate of 1.5 feet per second. The test shall be performed three times on the first production model and one time on the production models.

4.6.32.3 Deadman control system test. A test shall be performed to verify the requirements of the DCS in 3.13.2.5 when used with the HSM. The hydrant hose and coupler shall be connected to a simulated Type III hydrant system and flow established into the cargo tank at a minimum rate of 300 gpm by activation of the deadman device. Testing shall show that the flow of fuel into the cargo tank shall be controlled by activation and deactivation of the deadman device by opening and closing the simulated hydrant pit valve. The test shall be performed three times on the first production model and one time on the production models.

4.6.32.4 High-level shutoff test. A test shall be performed to verify the high-level shutoff system meets the requirements in 3.13.2.6. The pump system shall be placed in HS mode and the cargo tank filled to capacity through the HSM from a simulated Type III hydrant system at a flow rate up to and including a maximum of 700 gpm. Upon contact with fuel, the primary tank-level sensor shall close the simulated hydrant pit valve and the secondary tank-level sensor shall terminate the flow of fuel into the cargo tank. It shall be shown that activating the HSM high-level pretest button terminates the flow of fuel entering the cargo tank within two to four seconds, simulating a fully loaded aircraft refueling truck. The tests shall be performed three times on the first production model and one time on the production models.

4.6.33 Removal and reinstallation demonstration. A demonstration shall be performed to verify that the removal and reinstallation requirements of the HSM meet the requirements in 3.13.3. It shall be demonstrated that the HSM can be removed and reinstalled for air transportability within the required timeframe with the required number of mechanics as specified in 3.13.3. The demonstration shall be performed one time on the first production model only.

4.6.34 Gear and lever assemblies demonstration. A demonstration shall be performed to verify the gear and lever assemblies shall be properly aligned and meshed such that operations can be performed in accordance with 3.16.3. It shall also be shown that the gear assemblies shall be free of excessive backlash. The demonstration shall be performed one time on the first production model only.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. This truck is intended for use in fuel servicing of all types of aircraft under worldwide conditions.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. If first production inspection is required (see 3.1).

c. Finish color required, if not gloss green (see 3.3.1.8.1).

d. Moisture removing device, if required. (see 3.9.11.3)

e. CT hose, if required. (See 3.10.13.1)

f. Strainer ball valve, if required. (See 3.10.13.1)

g. Overwing hose assembly, if required. (See 3.10.13.2)

h. Vapor recovery, if required. (See 3.12.8)

i. Hydrant service module, if required. (See 3.13)

j. 351GF-14S coupling, if required. (See 3.13.2.1)

k. Packaging requirements (see 5.1).

6.3 Definitions.

6.3.1 Recovered materials. Materials collected and recovered from solid waste and reprocessed to become a source of raw materials, as compared to virgin raw materials.

6.3.2 Self-priming, centrifugal pump. A pump, when starting from a flooded suction, that is capable of initiating and sustaining flow, while also being able to free itself of entrapped air without losing prime.

6.3.3 Highway. A paved hard surface public road or equivalent.

6.3.4 Unimproved road. A level-to-rolling graded gravel surface.

6.3.5 Cobblestone road. A road consisting of a rounded stone with a minimum diameter of 5 inches.

6.3.6 Common hand tool. A non-powered tool that is likely to be found in a typical mechanic's toolbox. Common hand tools include open end, boxed end, combination, socket (both 6- and 12-point in both standard and deep-well), and hex key wrenches, in SAE sizes up to and including 1-inch and metric sizes up to and including 25-mm; ratchet handles, extensions, and swivels; slotted and Phillips-head screwdrivers; regular and snap-ring pliers; and a ball-peen hammer.

6.3.7 Peculiar hand tool. A non-powered tool that is not likely to be found in a typical mechanic's toolbox but yet required to perform the maintenance tasks.

6.3.8 Driveline components. Components that include drive shafts, axles, differential, and suspension components.

6.4 Key Words.

Air transportable
Cargo tank
Commercial aircraft
Military aircraft

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

RELIABILITY AND MAINTAINABILITY

A.1 SCOPE

A.1.1 Scope. This appendix provides definitions of reliability and maintainability terms and details a failure reporting, analysis, and corrective action system (FRACAS) for use during the first production and operational tests. It provides procedures for performing reliability models and predictions, a Failure Modes, Effects, and Criticality Analysis (FMECA), a Reliability-Centered Maintenance (RCM) analysis, and maintainability predictions. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS.

A.2.1 Government documents.

A.2.1.1 Specifications, standards, and handbooks. The following standard and handbooks of the exact revision listed below form a part of this specification to the extent specified herein.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-338	Electronic Reliability Design Handbook
MIL-HDBK-470	Designing and Developing Maintainable Products and Systems
MIL-HDBK-781	Handbook for Reliability Test Methods, Plans, and Environments for Engineering, Development, Qualification, and Production

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

A.2.2 Non-Government publications. The following documents of the exact revision listed below form a part of this document to the extent specified herein.

Reliability Information Analysis Center (RIAC)

NPRD-11	Nonelectronic Parts Reliability Data 2011
NPRD-95	Nonelectronic Parts Reliability Data 1995
FMD-97	Failure Mode/Mechanism Distributions 1997

(Application for copies should be addressed to Reliability Information Analysis Center, 201 Mill Street, Rome NY 13440.)

A.2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

A.3 DEFINITIONS

A.3.1 Discrimination ratio (d). The discrimination ratio (d) is one of the standard reliability qualification test (RQT) plan parameters; it is the ratio of the upper test MTBF (θ_0) to the lower test MTBF (θ_1) that is, $d = \frac{\Theta_0}{\Theta_1}$. (Reference MIL-HDBK-781)

A.3.2 Failure. The event, or inoperable state, in which any item, or part of an item, does not, or would not, perform as previously specified. (Reference MIL-HDBK-470)

A.3.3 Failure, chargeable. A failure that is not non-chargeable. Replacement of a consumable item (such as a filter or a fan belt) at the preventive maintenance interval (PMI) is not a chargeable failure.

A.3.4 Failure, non-chargeable. A failure that is a non-relevant (see A.3.6); that is induced by Government furnished equipment (GFE) operating, maintenance, or repair procedures; or of a part having a specified life expectancy and operated beyond the specified replacement time of the part. A nonrecurring fluid or recurring fluid leak that does or does not result in formation of a droplet shall be non-chargeable unless the leak causes the system to be unsafe. A recurring fluid leak where a droplet forms and falls and any recurring fluid leak where the frequency of droplets makes a measurable stream shall be chargeable. Light bulb failures shall be non-chargeable.

A.3.5 Failure, intermittent. Failure for a limited period of time, followed by the item's recovery of its ability to perform within specified limits without any remedial action. (Reference MIL-HDBK-470)

A.3.6 Failure, non-relevant. A failure caused by installation damage; accident or mishandling; failure of the test facility or test-peculiar instrumentation; an externally applied overstress condition, in excess of the approved test requirements; normal operating adjustments specified in the approved operating instructions; or human error. A secondary failure within the test sample, which is directly caused by a non-relevant or relevant primary failure, is also a non-relevant failure. The secondary failure has to be proved to be dependent on the primary failure.

A.3.7 Failure, relevant. An intermittent failure; an unverified failure (a failure which cannot be duplicated, which is still under investigation or for which no cause could be determined); a verified failure not otherwise excluded as a non-relevant failure; or a pattern failure.

A.3.8 Functionally Significant Item (FSI). A Functionally Significant Item (FSI) is an item whose failure meets one of the following criteria.

a. Could affect safety.

b. Could result in severe damage or equipment loss.

c. Could degrade or negate mission accomplishment (including survivability provisions).

d. Could have a significant economic impact.

e. Could have one or more of the above effects in combination with another item failure (hidden function).

f. Could have secondary consequences leading to one or more of the above effects.

g. Could have one or more of the above effects due to environmental deterioration or accidental damage.

A.3.9 Mean time between failure (MTBF). Mean time between failure (MTBF) is a basic measure of reliability for repairable items. The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

A.3.10 MTBF, lower test (θ_1). Lower test MTBF (θ_1) is that value which is the minimum acceptable. The standard RQT plans will reject, with high probability, equipment with a true MTBF that approaches (θ_1). The lower test MTBF is the required MTBF. (Reference MIL-HDBK-781)

A.3.11 MTBF, upper test (θ_0). Upper test MTBF (θ_0) is an acceptable value of MTBF equal to the discrimination ratio (d) times the lower test MTBF (θ_1). The standard RQT plans will accept, with high probability, equipment with a true MTBF that approaches (θ_0). This value (θ_0) should be realistically attainable, based on experience and information. The upper test MTBF is also known as the “design to” MTBF. (Reference MIL-HDBK-781)

A.3.12 MTBF, predicted (θ_p). Predicted MTBF (θ_p) is that value of MTBF determined by reliability prediction methods; it is a function of the equipment design and the use environment. Predicted MTBF (θ_p) should be equal to or greater than the upper test MTBF (θ_0) in value, to ensure, with high probability, that the equipment will be accepted during the RQT. (Reference MIL-HDBK-781)

A.3.13 Mean time to repair (MTTR). Mean time to repair (MTTR) is the sum of corrective maintenance times at any specific level of repair, divided by the total number of failures within an item repaired at that level during a particular interval under stated conditions. (Reference MIL-HDBK-470A)

A.3.14 Replaceable item (RI). A replaceable item (RI) is any of those physical entities normally removed and replaced to effect repair at the maintenance level for which the prediction is being made. (Reference MIL-HDBK-470A)

A.3.15 Risk, consumer's (β). Consumer's risk (β) is the probability of accepting equipment with a true MTBF equal to the lower test MTBF (θ_1). The probability of accepting equipment with a true MTBF less than the lower test MTBF (θ_1) will be less than the consumer's risk (β). (Reference MIL-HDBK-781)

A.3.16 Risk, producer's (α). Producer's risk (α) is the probability of rejecting equipment which has a true MTBF equal to the upper test MTBF (θ_0). The probability of rejecting equipment with a true MTBF greater than the upper test MTBF (θ_0) will be less than the producer's risk (α). (Reference MIL-HDBK-781)

A.4 REQUIREMENTS

A.4.1 Basic reliability model. The contractor shall develop and maintain a basic reliability model for the entire aircraft refueling truck. All equipment and associated quantities comprising these parts shall be included in the model to at least Level 3 of the Bill of Materials (BOM). All equipment, including those intended solely for item redundancy and alternate modes of operation, shall be modeled in series. A basic reliability block diagram shall be developed and maintained for the items with associated allocations and predictions in each reliability block. The basic reliability block diagram shall be keyed and traceable to functional block diagrams, drawings, and schematics, and shall provide the basis for accurate mathematical representation of basic reliability. Nomenclature of elements of the item used in the basic reliability block diagrams shall be consistent with that used in functional block diagrams, drawings, schematics, weight statements, power budgets, and specifications.

A.4.2 Basic reliability prediction. The contractor shall prepare and maintain a basic reliability prediction for the relevant subsystems of the aircraft refueling truck as described in 3.7; it shall be based upon the associated basic reliability model (see A.4.1). All equipment and associated quantities comprising these parts shall be included in the model except for documented exclusions approved by the procuring activity. Failure rate data (or equivalent reliability parameters) shall be consistent with the level of detail of the basic reliability model. The prediction shall be based upon the worst-case service use profile. All data sources for failure rates, failure distribution, and failure rate adjustment factors (for example, stress factors, duty cycle, etc.) shall be identified for each reliability block. Data sources shall be MIL-HDBK-217, NPRD-11, NPRD-95, or as otherwise approved by the procuring activity.

A.4.3 Failure Modes, Effects, and Criticality Analysis (FMECA). The contractor shall perform a FMECA on all FSIs utilizing the basic reliability model (see A.4.1). The body of the FMECA shall be a table with following information provided for each failure mode. In the discussion below, the term "item" refers to the part, subsystem, system, or end item, as appropriate.

A.4.3.1 Identification number. The contractor shall assign an identification number to each failure mode of each item for traceability purposes; it shall identify both the block in the reliability model and the specific failure mode related to that block.

A.4.3.2 Nomenclature. The nomenclature for the item shall be listed; the nomenclature shall be consistent with that used in the basic reliability model.

A.4.3.3 Functions. A concise statement of the functions performed by the hardware item shall be listed. These functions shall include the inherent function(s) of the item, secondary function(s), and relationship(s) to interfacing items.

A.4.3.4 Failure modes and causes. All predictable failure modes for each indenture level analyzed shall be identified and described. Potential failure modes shall be determined by examination of item outputs and functional outputs identified in applicable block diagrams and schematics. Failure modes of the individual item function shall be postulated on the basis of the stated requirements in the system definition narrative and the failure definitions included in the ground rules. The most probable causes associated with the postulated failure mode shall be identified and described. Since a failure mode may have more than one cause, all probable independent causes for each failure mode shall be identified and described. The failure causes within the adjacent indenture levels shall be considered. For example, failure causes at the third indenture level shall be considered when conducting a second indenture level analysis. Where functions shown on a block diagram are performed by a replaceable module in the system, a separate FMECA shall be performed on the internal functions of the module, viewing the module as a system. The effects of possible failure modes in the module inputs and outputs describe the failure modes of the module when it is viewed as an item within the system. To assist in assuring that a complete analysis is performed, each failure mode and output function shall, as a minimum, be examined in relation to the following typical failure conditions:

a. Premature operation.

b. Failure to operate at a prescribed time.

c. Intermittent operation.

d. Failure to cease operation at a prescribed time.

e. Loss of output or failure during operation.

f. Degraded output or operational capability.

g. Other unique failure conditions, as applicable, based upon system characteristics and operational requirements or constraints.

FMD-97 shall be used as a data source for failure modes and distributions.

A.4.3.5 Mission phase and operational mode. A concise statement of the mission phase and operational mode in which the failure occurs shall be provided. Where subphase, event, or time can be defined from the system definition and mission profiles, the most definitive timing information should also be entered for the assumed time of failure occurrence.

A.4.3.6 Failure effects. The consequences of each assumed failure mode on item operation, function, or status shall be identified, evaluated, and recorded. Failure effects shall focus on the specific block diagram element which is affected by the failure under consideration. The failure under consideration may impact several indenture levels in addition to the indenture level under analysis; therefore, “local,” “next higher level,” and “end item” effects shall be evaluated. Failure effects shall also consider the mission objectives, maintenance requirements, and personnel and system safety.

A.4.3.6.1 Local effects. Local effects concentrate specifically on the impact an assumed failure mode has on the operation and function of the item in the indenture level under consideration. The consequences of each postulated failure affecting the item shall be described along with any second-order effects which result. The purpose of defining local effects is to provide a basis for evaluating compensating provisions and for recommending corrective actions. It is possible for the “local” effect to be the failure mode itself.

A.4.3.6.2 Next higher assembly effects. Next higher level effects concentrate on the impact an assumed failure has on the operation and function of the items in the next higher indenture level above the indenture level under consideration. The consequences of each postulated failure affecting the next higher indenture level shall be described.

A.4.3.6.3 End item effects. End item effects evaluate and define the total effect an assumed failure has on the operation, function, or status of the uppermost system. The end item effect described may be the result of a double failure. For example, failure of a safety device may result in a catastrophic end effect only in the event that both the prime function goes beyond limit for which the safety device is set and the safety device fails. Those end effects resulting from a double failure shall be indicated on the worksheets.

A.4.3.7 Failure detection method. A description of the methods by which occurrence of the failure mode is detected by the operator shall be recorded. The failure detection means, such as visual or audible warning devices, automatic sensing devices, sensing instrumentation, other unique indications, or none shall be identified.

A.4.3.7.1 Other indications. Descriptions of indications which are evident to an operator that a system has malfunctioned or failed, other than the identified warning devices, shall be recorded. Proper correlation of a system malfunction or failure may require identification of normal indications as well as abnormal indications. If no indication exists, identify if the undetected failure could jeopardize the mission objectives or personnel safety. If the undetected failure allows the system to remain in a safe state, a second failure situation shall be explored to determine whether or not an indication would be evident to an operator. Indications to the operator shall be described as follows:

a. Normal. An indication that is evident to an operator when the system or equipment is operating normally.

b. Abnormal. An indication that is evident to an operator when the system has malfunctioned or failed.

c. Incorrect. An erroneous indication to an operator due to the malfunction or failure of an indicator (that is, instruments, sensing devices, visual or audible warning devices, etc.).

A.4.3.7.2 Isolation. Describe the most direct procedure that allows an operator to isolate the malfunction or failure. An operator will know only the initial symptoms until further specific action is taken such as performing a more detailed built-in-test (BIT). The failure being considered in the analysis may be of lesser importance or likelihood than another failure that could produce the same symptoms and this shall be considered. Fault isolation procedures require a specific action or series of actions by an operator, followed by a check or cross reference either to instruments, control devices, circuit breakers, or combinations thereof. This procedure shall be followed until a satisfactory course of action is determined.

A.4.3.8 Compensating provisions. The compensating provisions, either design provisions or operator actions, which circumvent or mitigate the effect of the failure shall be identified and evaluated. This step is required to record the true behavior of the item in the presence of an internal malfunction or failure.

A.4.3.8.1 Design provisions. Compensating provisions which are features of the design at any indenture level that nullify the effects of a malfunction or failure, control, or deactivate system items to halt generation or propagation of failure effects, or activate backup or standby items or systems shall be described. Design compensating provisions include:

a. Redundant items that allow continued and safe operation.

b. Safety or relief devices such as monitoring or alarm provisions which permit effective operation or limits damage.

c. Alternative modes of operation such as backup or standby items or systems.

A.4.3.8.2 Operator actions. Compensating provisions which require operator action to circumvent or mitigate the effect of the postulated failure shall be described. The compensating provision that best satisfies the indication(s) observed by an operator when the failure occurs shall be determined. This may require the investigation of an interface system to determine the most correct operator action(s). The consequences of any probable incorrect action(s) by the operator in response to an abnormal indication should be considered and the effects recorded.

A.4.3.9 Risk Priority Number (RPN). The contractor shall perform a Criticality Analysis (CA) by calculating a Risk Priority Number (RPN) for each potential failure mode. The RPN shall be calculated by:

$$RPN = S \times O \times D$$

where:

S = Severity (see A.4.3.9.1),
O = Occurrence (see A.4.3.9.2), and
D = Detection (see A.4.3.9.3).

A.4.3.9.1 Severity (S). Severity (S) is an assessment of the effect of the potential failure mode. It shall be estimated on a scale of "1" to "10" using Table 7.8-3 of MIL-HDBK-338B. Severity applies only to the effect of the failure.

A.4.3.9.2 Occurrence (O). Occurrence (O) is the likelihood that a specific failure mode will occur. The likelihood of occurrence ranking number is an index number, rather than a probability, although it is based upon a probability. Removing or controlling one of more of the causes or mechanisms of the failure mode, through a design change, is the only way a reduction in occurrence ranking can be obtained. The likelihood of occurrence ranking number shall be estimated on a scale of "1" to "10" using Table 7.8-4 of MIL-HDBK-338B.

A.4.3.9.3 Detection (D). Detection (D) is an assessment of the ability of the design control to detect a potential cause or mechanism or to detect the failure mode. In order to achieve a lower detection ranking, the planned design control has to be improved. The detection ranking number shall be estimated on a scale of "1" to "10" using Table 7.8-5 of MIL-HDBK-338B.

A.4.4 Reliability-Centered Maintenance (RCM).

A.4.4.1 Purpose. The purpose of RCM is to identify both field and depot level preventive maintenance requirements.

A.4.4.2 Analysis method. The decision logic described below shall be applied to each significant item (system, subsystem, module, component, accessory, unit, part, etc.) using the technical data available. Principally, the evaluations are based on the item's functional failures and failure causes. The method is to:

a. Identify the Functionally Significant Items (FSIs). Select the FSIs beginning at the system level descending as necessary through the part level. All items whose known or anticipated failure could adversely affect safety and mission success or have significant economic effects shall be included in the list of FSIs.

b. Identify "Other Items". During the identification process for FSIs, some items may be recognized as not meeting the criteria for an FSI, but past experience with like or similar items and recommendations for unique items may indicate a maintenance task is desirable. These nonsignificant items are categorized as “other items” and are dispositioned separately in the decision logic.

c. Accomplish a FMECA on each FSI in accordance with A.4.3. All predictable and potential failure modes and causes shall be fully considered in the FMECA, including those for environmental deterioration and accidental damage.

d. Utilizing the RCM decision logic, identify the tasks to be accomplished. If no applicable and effective task can be identified, redesign of equipment is required in the safety effects categories, redesign may be required in the mission effects categories, and redesign may be desirable in the nonmission economic effects categories.

    (1) Failures with direct adverse mission affects that cannot be prevented through preventive maintenance compromise the ability of the equipment to accomplish its intended functions. Since equipment may have multiple capabilities and a failure may not affect all of them or affect them all to the same degree, redesign shall be considered within the total set of equipment capabilities and mission scenarios. Redesign is required to allow full mission capability. If the equipment after the failure has partial mission capabilities, redesign shall be weighed against the degree and criticality of the mission impact to determine if the use of program resources for redesign is warranted.

    (2) Failures with nonmission economic effects that are not preventable through preventive maintenance will not compromise safety or mission; however, the economic penalties to allow items to fail may be so severe that it would be more advantageous to redesign.

e. Identify the intervals for task development.

f. Identify the recommended level of maintenance for accomplishing the tasks.

A.4.4.2.1 Task analysis. Prior to applying the RCM decision logic to an item, the FSI, its function, functional failure, failure mode, failure effect, and any additional data pertinent to the item, such as the manufacturer's part number, a brief description of the item, expected failure rate, hidden functions, redundancies, etc., shall be documented. Each functional failure and failure mode shall be processed through the logic so that a judgment can be made as to the necessity of a task. The resultant tasks and intervals shall be included in the preventive maintenance program.

A.4.4.2.2 Decision logic. The decision logic shall be used for analysis of systems and equipment items. The decision logic has three levels.

a. The first level (questions 1 and 2) categorize the FSIs and “other items.” The logic for “other items” leads to appropriate tasks and intervals based on past experience or manufacturers' recommendations. No further analysis is required for "other items." The logic for FSIs leads to the second and third level questions.

b. The second level (questions 3, 4, 5, 6, and 7) requires evaluation of each functional failure for determination of the ultimate effect category, that is, evident safety, mission, or nonmission economic effects, or hidden safety, mission, or nonmission economic effects.

c. The third level (questions A through F or A through E, as applicable) then takes the failure modes for each functional failure into account for selecting the specific type of tasks for each FSI.

In level 3 (the task selection section) paralleling and default logic has been introduced. Regardless of the answer to the first question (regarding lubrication or servicing), the next task selection question shall be asked in all cases. When following the hidden or evident safety effects paths or mission effects paths, all subsequent questions shall be asked. In the remaining nonmission economic effects paths, a "YES" answer subsequent to the first question allows exiting the logic.

A.4.4.2.2.1 Default logic. In the absence of adequate information to answer "YES" or "NO" to questions in the third level, default logic dictates a "NO" answer be given and the subsequent question be asked. As "NO" answers are generated, the only choice available is the next question, which in most cases provides a more conservative, stringent, or costly route.

A.4.4.3 Procedures. Step by step instructions to guide the analyst through the RCM decision logic are provided below.

A.4.4.3.1 First level (categorization of items).

a. FSIs versus "Other Items."

Question 1: Is this item being evaluated as an FSI?

For a "YES" answer, the analyst shall proceed to question 3 (A.4.4.3.2.a). For a "NO" answer, the analyst shall categorize it as "Other Item" and proceed to question 2 (A.4.4.3.1.b).

b. Requirements for nonsignificant items. Question 2 shall be asked of each "Other Item".

Question 2: Is this item similar to existing items?

For a "YES" answer, task selection shall be based on past experience with like or similar equipment. For a "NO" answer, task selection shall be based on manufacturer's recommendations.

Tasks resulting from question 2 should be kept to a minimum, but may include items necessary to meet minimum requirements for the comfort and morale of the operators, maintainers, etc. Further analysis of these items is not required.

A.4.4.3.2 Second level (consequence of failure).

a. Evident versus hidden functional failure.

Question 3: Is the occurrence of a functional failure evident to the operator during the performance of normal duties?

Question 3 shall be asked for each functional failure of the item being analyzed. The intent is to segregate the evident and the hidden functional failures.
A "YES" answer indicates the functional failure is evident; proceed to question 4 (A.4.4.3.2.b). A "NO" answer indicates the functional failure is hidden; proceed to question 6 (A.4.4.3.2.d).

b. Direct adverse effect on safety.

Question 4: Does the functional failure or secondary damage resulting from the functional failure have a direct adverse effect on operating safety?

For a "YES" answer the functional failure or secondary damage resulting from functional failure has to have a direct adverse effect on operating safety.

Direct: To be direct, the functional failure has to achieve its effect by itself, not in combination with other functional failures (no redundancy exists and it is a minimum essential equipment item).

Adverse effect on safety: This implies that the consequences are extremely serious or possibly catastrophic and might cause injury to personnel or extensive damage to equipment.

Operating: This is defined as the time interval from the moment of equipment start for the purpose of maintenance or mission to equipment shutdown.

For a "YES" answer, tasks shall be developed in accordance with A.4.4.3.3.1. For a "NO" answer, the analyst shall proceed to question 5 (A.4.4.3.2.c).

c. Direct adverse effect on mission.

Question 5: Does the functional failure have a direct adverse effect on mission capability?

For a "YES" answer, task selection shall be handled in accordance with A.4.4.3.3.2. For a "NO" answer, task selection shall be handled in accordance with A.4.4.3.3.3.

d. Hidden functional failure safety effect.

Question 6: Does the combination of a hidden functional failure and one additional failure of a system or back-up function have an adverse effect on safety?

For a "YES" answer, task development shall be handled in accordance with A.4.4.3.3.4. For a "NO" answer, proceed to question 7 (A.4.4.3.2.e).

e. Hidden functional failure mission effect.

Question 7: Does the combination of a hidden functional failure and one additional failure of a system or backup function have an adverse effect on mission capability? For a "YES" answer, task selection shall be handled in accordance with A.4.4.3.3.5. For a "NO" answer, task selection shall be handled in accordance with A.4.4.3.3.6.

A.4.4.3.3 Third level (effect categories). Once the applicable second level questions are answered, the analyst is directed to one of the six effects categories:

a. Evident safety effects.

b. Evident mission effects.

c. Evident nonmission economic effects.

d. Hidden safety effects

e. Hidden mission effects.

f. Hidden nonmission economic effects.

A.4.4.3.3.1 Evident safety effects. The evident safety effects category is to be approached with the understanding that tasks are required to assure safe operation. All questions in this category shall be asked. If no effective tasks result from this category analysis, redesign is mandatory.

A.4.4.3.3.2 Evident mission effects. The evident mission effects category is to be approached with the understanding that tasks are required to assure mission success. All questions in this category shall be asked. If' no effective tasks result from this category analysis, a redesign may be required depending on the extent of impact a failure would have on mission success (see A.4.4.2.d.(l)).

A.4.4.3.3.3 Evident nonmission economic effects. The evident nonmission economic effects category indicates tasks are desirable if the cost is less than the cost of repair. Analysis of the failure modes through the logic requires the first question (lubrication or servicing) to be answered. Either a "YES" or "NO" answer to question "A" requires movement to the next level; from this point on a "YES" answer completes the analysis and the resultant tasks satisfy the requirements. If all answers are "NO", no task has been generated. If economic penalties are severe, a redesign may be desirable (see A.4.4.2.d.(2)).

A.4.4.3.3.4 Hidden function safety effects. The hidden function safety effect requires tasks to assure the availability necessary to avoid the safety effects of multiple failures. All questions shall be asked. If there are no tasks found effective, then redesign is mandatory.

A.4.4.3.3.5 Hidden function mission effects. The hidden function mission effect category requires tasks to assure the availability necessary to avoid the mission effects of multiple failures. All questions shall be asked. If no effective tasks result from this category analysis, the extent of impact a failure may have on mission success could make redesign mandatory (see A.4.4.2.d.(l)).

A.4.4.3.3.6 Hidden function nonmission economic effects. The hidden function nonmission economic effect category indicates that tasks are desirable to assure the availability necessary to avoid the economic effects of multiple failures. Movement of the failure modes through the logic requires the first question (lubrication or servicing) to be answered. Either a "YES" or "NO" answer requires movement to the next level; from this point on, a "YES" answer completes the analysis and the resultant tasks satisfy the requirements. If all answers are "NO", no tasks have been generated. If economic penalties are severe, a redesign may be desirable (see A.4.4.2.d (2)).

A.4.4.3.3.7 Third level (task development). Task development is handled in a similar manner for each of the effect categories. For task determination, it is necessary to apply the failure modes for the functional failure to the third level of the logic diagram. There are seven possible task resultant questions in the effect categories.

a. Lubrication or servicing (all categories).

   Question A: Is a lubrication or servicing task applicable and effective?

   Applicability criterion: The replenishment of the consumable has to reduce the rate of functional deterioration.
   Effectiveness criterion – safety: The task reduces the risk of failure.
   Effectiveness criterion – mission: The task reduces the risk of failure.
   Effectiveness criterion – nonmission-economic: The task is cost-effective.

b. Operator monitoring (evident functional failure categories only).

   Question B: Is the ability to detect degradation of the function by normal operator monitoring applicable and effective?

   Applicability criteria: Reduced resistance to failure is detectable and rate of reduction in failure resistance is predictable. Indicators that annunciate failures at the time of occurrence are not applicable.

Effectiveness criteria – safety: The monitoring is part or the normal duties of the operator and reduces the risk of failure to assure safe operation.
Effectiveness criteria – mission: The monitoring is part of the normal duties of the operator and reduces the risk of failure to assure mission success.
Effectiveness criterion – nonmission economic: The monitoring is part of the normal duties of the operator.

c. Operational check (hidden functional failure categories only).

Question B: Is a check to verify operation applicable and effective?

Applicability criterion: Verification of operation is possible.
Effectiveness criterion – safety: The task ensures adequate availability of the hidden function to reduce the risk of multiple failures.
Effectiveness criterion – mission: The task ensures adequate availability of the hidden function to reduce risk of multiple failures.
Effectiveness criteria – nonmission economic: The task ensures adequate availability of the hidden function in order to avoid economic effects of multiple failures and has to be cost-effective.

d. Inspection or functional check (all categories).

Question C: Is the ability to detect degradation of the function by on-equipment or off-equipment task(s) applicable and effective?

Applicability criteria: Reduced resistance to failure is detectable and rate of reduction in failure resistance is predictable.
Effectiveness criterion – safety: The task reduces the risk of failure to assure safe operation.
Effectiveness criterion – mission: The task reduces the risk of failure to assure mission success.
Effectiveness criterion – nonmission economic: The task is cost effective, that is, the cost of the task is less than the cost of the failure.

e. Restoration (all categories).

Question D: Is a restoration task to reduce failure rate applicable and effective?

This task includes work (on or off equipment) necessary to return the item to a specific standard.

Applicability criteria: The item shows functional degradation characteristics at an identifiable age and a large proportion of units survive to that age. It has to be possible to restore the item to a specific standard of failure resistance.
Effectiveness criterion – safety: The task reduces the risk of failure to assure safe operation.

Effectiveness criterion – mission: The task reduces the risk of failure to assure mission success.
Effectiveness criterion – nonmission economic: The task is cost effective, that is, the cost of the task is less than the cost of the failures prevented.

f. Condemn (all categories).

Question E: Is a condemn task to avoid failures or to reduce the failure rate applicable and effective?

This task includes the removal from service of an item at a specified life limit. Condemn tasks are normally applied to parts such as cartridges, canisters, engine disks, durability structural members, etc.

Applicability criteria: The item shows functional degradation characteristics at an identifiable age and a large proportion of units survive to that age.
Effectiveness criterion – safety: A safe-life limit reduces the risk of failure to assure safe operation.
Effectiveness criterion – mission: A safe-life limit reduces the risk of failure to assure mission success.
Effectiveness criterion – nonmission economic: An economic-life limit is cost-effective, that is, the cost of the task is less than the cost of the failures prevented.

g. Combination (safety categories only).

Question F: Is there a task or combination of tasks which is applicable and effective?

Since this is a safety category question and a task is required, all possible avenues shall be analyzed. The most effective task or combination of tasks shall be selected.

h. Combination (mission categories only).

Question F: Is there a task or combination of tasks which is applicable and effective?

For the mission category, a review of all applicable tasks is necessary to assure mission success. From this review, the most effective task or combination of tasks shall be selected.

A.4.4.4 Setting preventive maintenance task frequencies or intervals. Determine whether real and applicable data is available which suggest an effective interval for task accomplishment. If there is no prior knowledge from similar systems or if there is insufficient similarity between the previous and current systems, the task interval or frequency can only be established initially by experienced personnel using good judgment and operating experience in concert with accurate data (reliability, redundancy, dispatch, etc.).

A.4.5 Corrective maintenance prediction.

A.4.5.1 Corrective maintenance prediction assumptions. The following assumptions shall be used for corrective maintenance predictions:

a. Failure rates experienced are all in the same proportion to those predicted,

b. Only one failure at a time is considered,

c. Maintenance is performed in accordance with established maintenance procedures,

d. Maintenance is performed by maintainers possessing the appropriate skills and training, and

e. Only active maintenance time is addressed; administrative and logistic delays and cleanup are excluded.

A.4.5.2 Corrective maintenance elements. Corrective maintenance actions consist of the following tasks: Preparation, Fault Detection and Isolation (FD&I), and Fault Correction. Fault Correction is further broken down into Disassembly, Interchange, Reassembly, Alignment, and Checkout. The time to perform each of these tasks is an element of MTTR; the associated task times are MTTR elements. The definitions and abbreviations for the MTTR elements used in prediction models are shown in Table A-1.

Table A-1. MTTR elements.

MTTR Element (abbreviation)[1]	**Definition**
Preparation Time (PT_n)	Time associated with those tasks required to be performed before fault isolation can be executed.
Fault Isolation Time (FIT_n)	Time associated with those tasks required to isolate the fault to the level at which fault correction begins.
Disassembly Time (DT_n)	Time associated with gaining access to the replaceable item or items identified during the fault detection process.
Interchange Time (IT_n)	Time associated with the removal and replacement of a faulty replaceable item or suspected faulty item.
Reassembly Time (RT_n)	Time associated with closing up the equipment after interchange is performed.
Alignment Time (AT_n)	Time associated with aligning the system or replaceable item after a fault has been corrected.
Checkout Time (CT_n)	Time associated with the verification that a fault has been corrected and the system is operational.
Start-Up Time (ST_n)	Time associated with bringing a system up to the operation state it was in prior to failure, once a fault has been corrected and the operation status of the system verified.

[1] The abbreviations have been changed from those of MIL-HDBK-470A so as to eliminate subscripts of subscripts, which can be confusing and difficult to read, and to delete the index for multiple FD&I indications.

The n subscript indicates that the nth replaceable item (RI) is the object of the maintenance action.

A.4.5.3 Corrective mathematical model. MTTR shall be calculated by the following equation, derived from Equation D-1 in Appendix D of MIL-HDBK-470A:

$$MTTR = \frac{\sum_{n=1}^{N} \lambda_n R_n}{\sum_{n=1}^{N} \lambda_n}$$

where:

N is number of replaceable items (RI),
λ_n is the failure rate of the nth RI, and
R_n is the mean repair time of the nth RI.

(Reference MIL-HDBK-470A)

This essentially says that the MTTR is the weighted average repair time for each possible repair, weighted by the failure rate corresponding to that repair.

A.4.5.4 MTTR prediction procedure. For each repairable item, estimate the failure rate and a time for each of the MTTR elements (see Table A-1), ensuring that the model and failure rate data are consistent with that of the basic reliability prediction (see A.4.2). The mean repair time for any repairable item is the sum of the times for its MTTR elements; the weighted mean repair time for the repairable item is the product of its failure rate and its mean repair time. Remember that identical repairable items used in different locations may have different mean repair times, as its accessibility may affect the disassembly, interchange, reassembly, and alignment times. Using the equation in A.4.6.3, sum the weighted repairable item mean repair times and divide by the sum of the repairable item failure rates to calculate the MTTR.

A.4.5.5 Maintenance action time standards. Task times shall be developed from the following sources in the order given:

a. Actual times experienced on the subject equipment,

b. Standard times from Tables D-IV and D-V of MIL-HDBK-470A,

c. Actual times experienced on similar equipment,

d. Other recognized time sources, or

e. Engineering judgment.

A.5 TESTING PROVISIONS

A.5.1 Reliability test requirements. The reliability tests shall be conducted in accordance with the reliability test procedures which have been approved by the procuring activity. Testing shall be continued until a reject decision has been reached or the total required test time has been completed, whichever comes first.

A.5.2 Reliability test records. Reliability test records shall be maintained as specified in the approved test procedure.

A.5.3 Performance parameter measurements. The test sample performance parameters to be measured and the frequency of measurement shall be as specified herein. When the value of any required performance parameter is not within specified limits, a failure shall be recorded. If the exact time of failure cannot be determined, the failure shall be presumed to have occurred at the time of the last recorded observation or successful measurement of that same parameter. Observations and measurements shall be made at the specified interval and recorded during the test cycle. At least one set of measurements shall be recorded when a test sample is first energized after any specified shutdown period.

A.5.4 Reliability compliance. Reliability compliance shall be reviewed by the procuring activity after each test sample failure is categorized or at any other appropriate time. Compliance shall be based on the total accumulated test time and the total number of chargeable failures at the time of the review.

A.5.5 Failure reporting, analysis, and corrective action system (FRACAS). A closed loop system shall be used to collect data, analyze, and record timely corrective action for all potential failures that occur during the first production and operational tests. The contractor's existing FRACAS shall be utilized with the minimum changes necessary to conform to this specification. The system shall cover all test samples, interfaces between test samples, test instrumentation, test facilities, test procedures, test personnel, and the handling and operating instructions. The contractor shall establish and maintain a FRACAS database; all information shall be entered into the database. Authorized procuring activity personnel shall have read-only access to the FRACAS database.

A.5.5.1 Problem and failure action. At the occurrence of a problem or potential failure that affects satisfactory operation of a test sample, entries shall be made in the appropriate data logs and the failed test sample shall be removed from test, with minimum interruption to the other test samples continuing on test.

A.5.5.1.1 Problem and failure reporting. A failure report shall be initiated at the occurrence of each problem or potential failure of the contractor hardware or software or GFE. The report shall contain the information required to permit determination of the origin and correction of the failure. The contractor’s existing failure report form may be used with minimum changes necessary to conform to the requirements of this specification. The failure report form shall include the information specified in a through c:

a. Descriptions of failure symptoms, conditions surrounding the failure, failed hardware identification, and operating time (or cycles) at the time of failure.

b. Information on each independent and dependent failure and the extent of confirmation of the failure symptoms, the identification of failure modes, and a description of all repair actions taken to return the test sample to operational readiness.

c. Information describing the results of the investigation, the analysis of all part failures, an analysis of the system design, and the corrective action taken to prevent failure recurrence. If no corrective action is taken, the rationale for this decision shall be recorded.

A.5.5.1.2 Identification and control of failed items. A failure tag shall be affixed to the failed part immediately upon the detection of any failure or suspected failure. The failure tag shall provide space for the failure report serial number and for other pertinent entries from the test sample failure record. All failed parts shall be marked conspicuously or tagged and controlled to ensure disposal in accordance with contract requirements. Failed parts shall not be handled in any manner which may obliterate facts which might be pertinent to the analysis. Failed parts shall be stored pending disposition by the authorized approval agency of the failure analysis.

A.5.5.1.3 Problem and failure investigations. An investigation and analysis of each reported failure shall be performed. Investigation and analysis shall be conducted to the level of hardware or software necessary to identify causes, mechanisms, and potential effects of the failure. Any applicable method (for example, test, microscopic analysis, applications study, dissection, X-ray analysis, spectrographic analysis) of investigation and analysis which may be needed to determine failure cause shall be used. When the removed part is not defective or the cause of failure is external to the part, the analysis shall be extended to include the circuit, higher hardware assembly, test procedures, and subsystem if necessary. Investigation and analysis of GFE failures shall be limited to verifying that the GFE failure was not the result of the contractor's hardware, software, or procedures. This determination shall be documented for notification of the procuring activity.

A.5.5.1.4 Failure verification. Reported failures shall be verified as actual failures or an acceptable explanation provided to the procuring activity for lack of failure verification. Failure verification is determined either by repeating the failure mode of the reported part or by physical or electrical evidence of failure (for example, leakage residue or damaged hardware). Lack of failure verification, by itself, is not sufficient rationale to conclude the absence of a failure.

A.5.5.1.5 Corrective action. When the cause of failure has been determined, a corrective action shall be developed to eliminate or reduce the recurrence of the failure. Repairs shall be made in accordance with normal field operating procedures and manuals. The procuring activity shall review the corrective actions at the scheduled test status review prior to implementation. In all cases the failure analysis and the resulting corrective actions shall be documented.

A.5.5.1.6 Problem and failure tracking and closeout. The closed loop failure reporting system shall include provisions for tracking problems, failures, analyses, and corrective actions. Status of corrective actions for all problems and failures shall be reviewed at scheduled test status reviews. Problem and failure closeout shall be reviewed to assure their adequacy.

A.5.6 Classification of failures. All failures shall be classified as relevant or non-relevant. Relevant failures shall be further classified as chargeable or non-chargeable. The procuring activity will make the final determination of failure classifications.

A.5.7 Corrective maintenance demonstration.

A.5.7.1 Corrective maintenance demonstration task selection and performance. At least 30 corrective maintenance tasks shall be performed. Task selection shall be as follows.

a. Step 1. Column 1 – Identify the major units which comprise the equipment.

b. Step 2. Column 2 – Subdivide each unit to the functional level at which maintenance for the demonstration is to be performed in accordance with the approved maintenance plan. This level may be an assembly, module, printed circuit card, or piece part.

c. Step 3. Columns 3 & 4 – For each functional level of maintenance identified in Column 2, identify in Column 3 the type of maintenance task or tasks to be performed and in Column 4 the estimated mean maintenance time for the task. The maintenance tasks and estimated maintenance time would be derived from a maintenance engineering analysis, a maintainability prediction effort, or from historical data. The same maintenance task, such as "remove and replace" of a module may result from different faults within the module. Column 3 would identify the maintenance task and not the fault or failure which results in the occurrence of the task.

d. Step 4. Column 5 – Determine the failure rate [failures per million hours] for each module, printed circuit card, etc., for which the maintenance task was identified in Column 3. The failure rates used should be the latest available from an associated reliability program.

e. Step 5. Column 6 – Determine the quantity of items in each major unit associated with each task in Column 3.

f. Step 6. Column 7 – Determine the duty cycle for each item associated with each task in Column 3 (such as operating time of a receiver to the operating time of the radar; engine operating hours to aircraft flight hours).

g. Step 7. Column 8 – Group together the maintenance tasks identified in Column 3 which have both:

    (1) Similar maintenance actions. NOTE: A maintenance action is an element of a maintenance task. Although the estimated maintenance time for

different maintenance tasks may be similar, the actions may be different, that is, one task may involve significant diagnostics and another involve minimum diagnostics but significant access time.

(2) Similar estimated maintenance times. The maintenance times in each group should be within a range that shall not exceed the smallest value in the group by more than 50 percent.

Task grouping should be limited to within major units identified in Column 1.

h. Step 8. Column 9 – Determine the total failure rate for each task grouping identified in Column 8. The total failure rate is equal to the sum of the products of Columns 5, 6, and 7 for all tasks within the group.

i. Step 9. Column 10 – Determine the relative frequency of occurrence for each task grouping by dividing the sum of the total failure rate (sum of Column 9) into the individual total failure rate for each group.

j. Step 10. Column 11 – Fixed Sample – A sample of maintenance tasks equal to four times the sample size specified for the selected test method (see … B.4.0 of [MIL-HDBK-470A]) or as specified or agreed upon with the procuring activity should be allocated among the task groups in accordance with the relative frequency of occurrence of the task group. ….

k. Step 11. Column 12 – The maintenance tasks to be demonstrated … are allocated among the task groups in accordance with the relative frequency of occurrence of maintenance for the group. The maintenance task to be demonstrated is then randomly selected from the maintenance tasks allocated to the group or modules, assemblies, etc., within the group (Column 11). The maintenance task to be demonstrated is not returned to the sample pool and is therefore demonstrated only once.

l. Step 12. Column 1 – Identify the maintenance task of interest.

m. Step 13. Column 2 – Determine the failure modes which will result in the maintenance task of interest.

n. Step 14. Column 3 – Determine the effect of each failure mode identified in column 2.

o. Step 15. Column 4 – Determine the relative frequency of occurrence of each failure mode.

A.5.7.2 Corrective maintenance demonstration accept and reject criterion. The accept and reject criterion shall be calculated by:

Accept if the specified maximum $MTTR \geq \overline{X}_C + \frac{\phi \hat{d}_C}{\sqrt{n_C}}$

where:

$\overline{X}_C$ is the average corrective maintenance time for the demonstration,

φ is the value of the normal distribution function for the specified level of consumer's risk, β (see Table A-2, below), and

$\hat{d}_C$ is the standard deviation of sample of the corrective maintenance tasks.

Reject if the specified maximum $MTTR < \overline{X}_C + \frac{\phi \hat{d}_C}{\sqrt{n_C}}$.

Table A-2. φ vs. **β**.

ϕ	β
0.84	20 percent
1.04	15 percent
1.28	10 percent
1.65	5 percent

Custodian:

Air Force - 84

Preparing activity:

Air Force - 84

Agent
Air Force - 99

(Project 2320-2011-001)

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