



AEROSPACE RECOMMENDED PRACTICE

ARP5818™

REV. A

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Superseding ARP5818

(R) Aircraft Refueling Vehicle
Design and Performance Requirements

RATIONALE

This SAE Aerospace Recommended Practice (ARP) has been updated to include changes in the industry that have occurred since the original document was released and to also provide reference, information, and minimum design and operating criteria for all aircraft refueling vehicles, including tankers, hydrant service vehicles, towable hydrant service carts, refueling cabinets, and any other type of aircraft refueling vehicles and equipment used at airports for aircraft refueling operations.

1. SCOPE

1.1 This document is a guideline for the design and operation of Aviation Aircraft Refueling Vehicles and for the materials, components, and systems used thereon. The criteria set forth herein are the minimum recommendations for all types of aircraft refueling vehicles, including tanker vehicles, hydrant service vehicles, towable hydrant carts, fixed refueling cabinets, and any other type of aircraft refueling vehicles used at airports for aircraft refueling operations with nominal operating fuel pressures and flow rates as specified within this document.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and 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.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP1247 Aircraft Ground Support Equipment - General Requirements
ARP1328 Aircraft Ground Support Equipment - Wind Stability Determination
ARP1330 Welding of Structures for Ground Support Equipment

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Documents

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AIR1375	Minimum Safety Requirements for Special Purpose Airline Ground Support Equipment
AIR4782	Hydrant Valve and Coupler Historical Background
AIR4783	Glossary of Terms - Aircraft Ground Refueling
AS5877	Detailed Specification for Aircraft Pressure Refueling Nozzle
ARP5918	Standardized Test Criteria for Aircraft Refuelers

SAE Handbook

2.1.2 EI Publications

Available from Energy Institute, 61 New Cavendish Street, London W1G 7AR, UK, Tel: +44 (0) 20 7467 7100, www.energyinst.org.

EI Bulletin 1529	Aviation Fuelling Hose and Hose Assemblies
EI Bulletin 1542	Identification Markings for Dedicated Aviation Fuel Manufacturing and Distribution Facilities, Airport Storage and Mobile Fuelling Equipment
EI Bulletin 1581	Specifications and Qualifications Procedures for Aviation Jet Fuel Filter/Separators
EI Bulletin 1582	Specification for Similarity for EI 1581 Aviation Jet Fuel Filter/Separators
EI Bulletin 1583	Specifications and Qualifications Procedures for Aviation Jet Fuel Filter Monitors With Absorbent Type Elements
EI Bulletin 1584	Standard for Four-Inch Hydrant System Components and Arrangements

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D910	Standard Specification for Aviation Gasolines
ASTM D1655	Standard Specification for Aviation Turbine Fuels
ASTM D4865	Standard Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems
ASTM D6615	Standard Specification for Jet B Wide-Cut Aviation Turbine Fuels

2.1.4 A4A Publications

Available from Airlines for America (A4A), 1301 Pennsylvania Avenue, NW, Suite 1100, Washington, DC 20004, Tel: 202-626-4000, www.airlines.org.

ATA Specification 103 Standards for Jet Fuel Quality Control at Airports

2.1.5 European Union – Measuring Instrument Directive (MID)/ Measuring Systems Global OIML R-117

Available from Bureau International de Métrologie Légale, 11, rue Turgot - 75009 Paris – France, Tel: 33 (0)1 48 78 12 82, www.oiml.org.

2.1.6 Joint Inspection Group Publications

To be supplied with Purchase Specifications if compliance with this Publication is required.

JIG 1 Guidelines for Aviation Fuel Quality and Operating Procedures for Joint into Plane Fueling Services

2.1.7 NFPA Publications

Available from NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471, Tel: 617-770-3000, www.nfpa.org.

NFPA 10 Standard for Portable Fire Extinguishers

NFPA 70 National Electrical Code

NFPA 385 Tank Vehicles for Flammable and Combustible Liquids

NFPA 407 Standards for Aircraft Fuel Servicing

2.1.8 TTMA Recommended Practices/Requirements

Available from Truck Trailer Manufacturers Association, 1020 Princess Street, Alexandria, VA 22314.

TTMA Recommended Practice RP #59-99 Tank Trailer Ladders and Walkways

TTMA Recommended Practice RP #98-99 Cargo Tank To Truck Chassis Attachment

2.1.9 U.S. Government Publications - Code of Federal Regulations (CFR)

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

Transportation (DOT) 49 CFR 173, 177, 178, 180, 383, 390, 393, 571

Labor (OSHA) 29 CFR 1910

2.1.10 United States - National Institute of Standards and Technology (NIST)/National Conference on Weights and Measures, Inc.

Available from the United States Government Printing Office, Washington, DC 20402.

US NIST Handbook 44

2.1.11 Local Requirements

Available from the local State, Municipality, Governmental Unit, Local Agency, or Airport Owner or Operator's office as required by the Aircraft Refueling Vehicle Purchase Specifications.

2.2 Definitions

Definitions for terms used in this document are defined in AIR4783. Other terms as used in this document shall be defined as follows.

- 2.2.1 AIRCRAFT REFUELING VEHICLE: For the purpose of this document the term aircraft refueling vehicle includes tanker vehicle, hydrant service vehicle, towable hydrant cart, or refueling cabinet.
- 2.2.2 AIRCRAFT REFUELING VEHICLE OEM: The original equipment manufacturer of the aircraft refueling vehicle (e.g., tanker vehicle, hydrant service vehicle, towable hydrant cart, or refueling cabinet) and identified as the final-stage manufacturer.
- 2.2.3 CAB-CHASSIS OEM: The original equipment manufacturer of the cab-chassis.
- 2.2.4 VEHICLE PURCHASE SPECIFICATIONS: The vehicle specifications as stipulated by the purchaser outlining the minimum equipment, capabilities, and operating requirements for the aircraft refueling vehicle.

3. AIRCRAFT REFUELING VEHICLE SYSTEM COMPONENTS AND SYSTEMS SELECTION AND UTILIZATION

- 3.1 The Aircraft Refueling Vehicle OEM shall be responsible for the selection of the available types of components and design the complete system so that all components are utilized in accordance with each of the component manufacturer's recommendations and ratings, and provide the performance requirements as called for herein. The Aircraft Refueling Vehicle OEM designer must be aware of the interactions between the various types of components that will affect total system performance as well as the capabilities and limitations of each.

4. DESIGN CRITERIA

4.1 General

- 4.1.1 Every effort is to be taken by the Aircraft Refueling Vehicle OEM to assure that the principles of engineering and ergonomics are designed into the functional controls of the vehicle.
- 4.1.2 The Aircraft Refueling Vehicle shall be designed and manufactured so that it operates with no undue stresses or abnormal wear on any components or structure of the Aircraft Refueling Vehicle.
- 4.1.3 The Aircraft Refueling Vehicle OEM shall be responsible to provide all components, equipment, and items required to place the Aircraft Refueling Vehicles in service and to perform the aircraft refueling function.
- 4.1.4 The Aircraft Refueling Vehicle OEM shall be responsible to design, manufacture, and certify that the Aircraft Refueling Vehicle is in compliance with 49CFR, NFPA 407, EI, ATA, EN, (except part 565 of 49 CFR (Vehicle Identification Number Requirements) for off-highway utility-type Trailers) and all other requirements that apply to construction, operation, and maintenance of aircraft refueling vehicles, as well as additional requirements of the Aircraft Refueling Vehicle Purchase Specifications.
- 4.1.5 All components, functions, and systems on the vehicle shall provide for safe, reliable operation, and operate in a fail-safe manner.

4.2 Aircraft Refueling Vehicle Driveability and Maneuverability

- 4.2.1 The Aircraft Refueling Vehicle shall be designed so that it is easily towed, moved, or maneuvered. The unit shall be able to traverse all roadways and areas at the airport necessary to service aircraft in a normal manner, without disruption of other vehicular or aircraft operational traffic, as specified by the Aircraft Refueling Vehicle Purchase Specifications.
- 4.2.2 Towable hydrant service carts shall be easily secured to the tow vehicle. The unit shall be towable at normal airport operating speeds and conditions as required by the Vehicle Purchase Specification.

4.2.3 Self-propelled hydrant service carts shall be easily driven and towable. The unit shall be easily secured to the tow vehicle and towable at normal airport operating speeds and conditions as required by the Vehicle Purchase Specification.

4.3 Aircraft Refueling Vehicle Operational Capabilities

4.3.1 Capability requirements shall be as specified by the Aircraft Refueling Vehicle Purchase Specifications, and consistent with all requirements as listed in this document.

4.4 Welding

4.4.1 All welding of pressure containing components of the Aircraft Refueling Vehicle, except those listed in the next paragraph, shall be performed using procedures, processes and welders (operators) certified in accordance with the ASME Boiler and Pressure Vessel Code, Section IX or other comparable national code for the country of origin. All materials shall meet the requirements of Section II, Part A (for ferrous materials), Part B (for non-ferrous), and Part C (for welding materials) or other comparable national code for the country of origin.

4.4.2 Any filter vessels, accumulators, surge tanks, fuel recovery vessels, or fuel containers that operate above 15 PSIG shall be manufactured per the ASME Section VIII - Division 1, Rules for Construction of Pressure Vessels, or other comparable national code for the country of origin.

4.4.3 All welding of piping systems shall be in accordance with ANSI B31 code, or other comparable national code for the country of origin.

4.4.4 All structural welding on the Aircraft Refueling Vehicle not addressed by ANSI B31 code for piping assembly shall be performed in accordance with applicable AISC, ANSI, and AWS codes, or other comparable national codes for the country of origin.

4.5 Materials of Construction

4.5.1 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. Brass components shall be minimized but accepted in hose couplings/hose reducers and drain valves. Copper components should be minimized, and acceptable 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.

4.6 Design/Operating Pressure and Flow Rating

4.6.1 The Aircraft Refueling Vehicle shall have a minimum design operating pressure of 150 PSIG.

NOTE: Operating pressures higher than 150 PSIG will require additional design consideration beyond the scope of this document, although many of the paragraphs can be used as a guideline.

4.6.2 The maximum operating pressure and flow capacity shall be certified by the Aircraft Refueling Vehicle OEM.

4.7 Hydrant System and Aircraft Refueling Vehicle Interface

4.7.1 Hydrant Pit Valve and hydrant coupler shall comply with EI Bulletin 1584.

4.8 Delivery Flow Rate and Pressures

4.8.1 The Aircraft Refueling Vehicle shall perform by delivering fuel at the maximum flow rate and pressure(s) required by the Aircraft Refueling Vehicle Purchase Specification and not exceed the design/operating pressure and flow rating.

4.9 Design Features

- 4.9.1 The construction of the complete Aircraft Refueling Vehicle shall be of new current production materials and components.
- 4.9.2 All systems shall be designed to allow an efficient operation of the Aircraft Refueling Vehicle. Pneumatic, electrical, hydraulic, and other systems shall be fully operational within an ambient temperature range between -20 °F and 150 °F, unless a wider range is specified by the Aircraft Refueling Vehicle Purchase Specifications.
- 4.9.3 All refueling system piping, components, and hoses shall be designed to assure that the maximum fuel flow velocity does not exceed the following limits.
 - 4.9.3.1 The maximum fuel flow velocity calculations or measurements through components shall be based on the component's nominal size.
 - 4.9.3.2 When the Aircraft Refueling Vehicle dispenses Jet Fuel Without SDA (Static Dissipating Additive), the piping and components shall be selected and designed to assure the maximum fuel flow velocity does not exceed 23 feet per second.
 - 4.9.3.3 When the Aircraft Refueling Vehicle dispenses Jet Fuel With SDA (Static Dissipating Additive), the piping and components shall be selected and designed to assure the maximum fuel flow velocity does not exceed 31 feet per second.
 - 4.9.3.4 All refueling dispensing hoses shall be sized to assure the maximum fuel flow velocity does not exceed 31 feet per second.
 - 4.9.3.5 All fuel hydrant connection hoses shall be sized to assure the maximum fuel flow velocity does not exceed 39 feet per second.
- 4.9.4 The system shall be designed to provide a minimum of 3 seconds relaxation time from the outlet of the last filter vessel to any dispensing nozzles, when SDA is not used.
- 4.9.5 All parts of the Aircraft Refueling Vehicle and auxiliary equipment shall be easily accessible for inspection, operation, and maintenance.
- 4.9.6 Any components which require maintenance or repair shall be readily removable and replaceable without requiring cutting or welding.
- 4.9.7 Aircraft Refueling Vehicles

The refueling system shall be designed with a provision that prevents any air from being drawn into the refueling system between the product tank's internal valve(s) and/or any other point upstream of the refueling hose(s). This provision shall specifically address any of the following operations:

- a. During refueling operations when dispensing fuel to a point where the complete product tank is emptied and the refueling system continues to operate.
- b. During defueling operations when air is either drawn into the system or pumped into the system (via the aircraft pumps) through the defueling hose(s), unless a provision is in place to follow the Vehicle OEM procedures that will purge all air from the refueling system before using the vehicle for aircraft refueling operations.
- c. Any other possible operation that may introduce air into the refueling system.

4.10 Factor of Safety

- 4.10.1 All structural members including attachment of major components shall be designed in accordance with safety factor of four unless otherwise specified.

5. ACCEPTANCE CRITERIA

5.1 Product Tank Hydrostatic Test

- 5.1.1 The product tank shall be hydrostatically tested in accordance with 49 CFR 178.345 and 178.346 or other comparable national code for the country of origin.
- 5.1.2 All other product tanks shall be hydrostatically tested in accordance with Aircraft Refueling Vehicle OEM requirements that assure the structural integrity of the tank during any operation.

5.2 Refueling System Hydrostatic Test

- 5.2.1 The complete refueling system including all piping, components, welded assemblies, etc. handling the product shall be hydrostatically tested. The test shall be performed at a hydrostatic pressure of 1-1/2 times the maximum design working pressure experienced by any portion of the system. Pressure loss during a 15 minute period shall not exceed 5 PSIG, and no additional pressure loss shall be permitted in constant pressure, temperature, and volume conditions. No visible leakage shall be permitted.
- 5.2.2 When equipment is designed to permit "In Place Hose Testing," the hose isolation valve and all components downstream must be rated to withstand the design working pressure of the hose.

5.3 Aircraft Refueling Vehicle Inspection, Acceptance, and Quality Control

5.3.1 Conformance to Specification

- 5.3.1.1 The Aircraft Refueling Vehicle OEM shall be responsible to demonstrate that the Aircraft Refueling Vehicle is designed and manufactured in accordance with all applicable requirements and the Aircraft Refueling Vehicle Purchase Specification.

5.3.2 Workmanship Standards

- 5.3.2.1 The workmanship shall be in accordance with ARP1247.

5.3.3 Quality Control

- 5.3.3.1 The Aircraft Refueling Vehicle OEM shall be responsible for assuring Quality Control of his suppliers and shall arrange for the required tests, certifications, and for the test location and all equipment required for testing.
- 5.3.3.2 The Aircraft Refueling Vehicle OEM shall be responsible to demonstrate compliance with these requirements, all others referenced by these requirements, and all requirements specified by the Purchase Aircraft Refueling Vehicle Specification.
- 5.3.3.3 The Aircraft Refueling Vehicle OEM shall have a test plan covering all tests required by these requirements, all others referenced by these requirements, and all requirements specified by the Purchase Aircraft Refueling Vehicle Specification. All such tests shall be performed and documented in an Aircraft Refueling Vehicle Test and Certificates Booklet.
- 5.3.3.4 The Aircraft Refueling Vehicle shall be fully tested to check its operation and performance, and include the following tests:
 - 5.3.3.4.1 Meet all operational and performance criteria as listed in ARP5918.
 - 5.3.3.4.2 Aircraft Refueling Vehicle laden and unladen total weight and weight distribution checked on a certified scale to assure vehicle does not exceed each axle's Gross Axle Weight Rating (GAWR) and the vehicle's Gross Vehicle Weight Rating (GVWR).
 - 5.3.3.4.3 Aircraft Refueling Vehicle driveability and maneuverability to include service braking, parking brakes, top speed, and turning diameter.

- 5.3.3.4.4 Power Take-Off and product pumping system operation.
- 5.3.3.4.5 Aircraft refueling and defueling system operation and performance.
- 5.3.3.4.6 Bottom-loading system operation.
- 5.3.3.4.7 Interlock system operation.
- 5.3.3.4.8 Other tests as required by these specifications, tests required by the referenced documents, and all tests as specified by the Aircraft Refueling Vehicle Purchase Specification.

5.3.4 Sample Inspection Report

- 5.3.4.1 See ARP5918 for a sample of a typical New Aircraft Refueling Vehicle Inspection Report.

5.3.5 Performance Testing

- 5.3.5.1 The Aircraft Refueling Vehicle OEM must have a test facility capable of conducting the required testing as required by ARP5918 to demonstrate the proper performance, safe operation of the equipment and to allow adjustment of all controls prior to delivery. As a minimum, the following capabilities must be on-hand at the Aircraft Refueling Vehicle OEM's production facility:
 - 5.3.5.1.1 Dynamic flow test equipment capable of flows and pressures at least 125% of the Aircraft Refueling Vehicle Purchase Specification with appropriate nozzle connections, pressure, flow controls, and instrumentation, dispensing from nozzles simulating aircraft refueling operations at various back pressures and simulating surge pressures.
 - 5.3.5.1.2 The fuel used for all tests shall be ASTM certified Jet A, kerosene or other petroleum fuel as required by Aircraft Refueling Vehicle Purchase Specifications. If requested by the Vehicle Purchase Specifications, an analysis of the fuel shall be performed by a laboratory to certify that the fuel conforms to ASTM D1655 minimum requirements.
 - 5.3.5.1.3 The test facility shall be equipped with fuel filtration and water removal system as part of the test loop to prevent contamination of the Aircraft Refueling Vehicle's equipment.
 - 5.3.5.1.4 Test gauges and flow meters shall be calibrated in accordance with NIST and U.S. Weights and Measures requirements or other comparable national code for the country of origin.
 - 5.3.5.1.5 Timers, electronic transducers and readouts/recorders calibrated as above for measuring surge pressures during quick valve closures.
 - 5.3.5.1.6 Quick closing valve system capable of being controlled to a valve closure in a maximum of 2 seconds measured at any rate of flow and up to the maximum flow rate specified for the equipment to prove the specified surge control compliance. Aircraft Refueling Vehicle must demonstrate compliance to the Aircraft Refueling Vehicle Purchase Specification and meet the testing criteria as specified in ARP5918. All final test results shall be documented accordingly. (See ARP5918 for a sample test report.)

5.3.6 Minimum Performance Test Criteria

- 5.3.6.1 Aircraft Refueling Vehicle performance with fixed or lift platform in accordance with ARP1247.
- 5.3.6.2 Weight distribution per Aircraft Refueling Vehicle OEM design requirements and limitations.
- 5.3.6.3 Under-body clearance in accordance with NFPA 407.
- 5.3.6.4 Aircraft performance shall meet the requirements of ARP5918

5.3.6.5 Verify operation of all dial type gauges to operate within $\pm 2\%$ of scale unless otherwise indicated.

5.3.6.6 Verify meter operations and calibration in accordance with 7.17.

5.3.7 Equipment Reliability

5.3.7.1 The Aircraft Refueling Vehicle shall meet the reliability requirement in accordance with the latest edition of ARP1247.

5.3.8 Standard Components

5.3.8.1 Wherever possible, commercially available standard parts complying with commercial standards shall be used.

5.3.9 Interchangeability

5.3.9.1 All components, assemblies, and sub-assemblies used in the construction of the Aircraft Refueling Vehicle shall be designed and manufactured to dimensional tolerances which permit interchangeability and will facilitate replacement of parts.

5.3.10 Availability of Spare Parts

5.3.10.1 The Aircraft Refueling Vehicle OEM shall manufacture the Aircraft Refueling Vehicle with components for which spare parts required to support the Aircraft Refueling Vehicle are readily available for a minimum period of ten years from the date of manufacture.

5.3.11 Accessibility

5.3.11.1 Components and/or systems requiring routine or frequent inspections or maintenance shall be readily accessible.

5.3.11.2 The Aircraft Refueling Vehicle shall be of open construction, and no excessive non-structural paneling shall be used.

5.3.11.3 Major assemblies shall be easily disconnected and removed from the Aircraft Refueling Vehicle without the necessity for extensive disassembly of other components. Flange and/or grooved type pipe connections shall be permitted.

5.3.12 Warranty

5.3.12.1 The Aircraft Refueling Vehicle OEM shall guarantee the complete Aircraft Refueling Vehicle against any defect in design, workmanship, material, and against any failure to operate satisfactorily for a minimum period of one year, and shall provide the same guarantee for the product tank for a minimum period of five years. The guarantees shall begin on the date the Aircraft Refueling Vehicle is placed in service. Should the service date be more than 90 days from the delivery date and the delay is of no fault of the Aircraft Refueling Vehicle OEM, the operator will be required to request, in writing, an extension. The warranty period extension will be granted at the Aircraft Refueling Vehicle OEM's option.

6. AIRCRAFT REFUELING VEHICLE DESIGN

6.1 Vehicle Design

6.1.1 The Aircraft Refueling Vehicle shall have GVWR and the GAWR for each axle as rated for the application at the maximum governed speed.

6.1.2 The Aircraft Refueling Vehicle's laden weight shall not exceed the GVWR, GCWR, or any of the vehicle's axle GAWR's.

6.1.3 The cab-chassis or trailer shall be selected with the proper wheelbase and chassis rated components as established by the Vehicle Purchase Specification. The rating of all components or systems shall be taken as the rating certified by the Cab-Chassis or Trailer OEM.

6.1.4 The vehicle shall have the laden or unladen weight distribution as follows:

6.1.4.1 Straight Type Vehicles

The vehicle's weight shall be distributed 25 to 50% on the front axle(s) and 75 to 50% on the rear drive axle(s).

6.1.4.2 Tractor/Semi-Trailer and Combination Type Vehicles

The vehicle's combination weight shall be distributed 50 to 70% on the tractor and 50 to 30% on the trailer, and the tractor's weight shall be distributed 25 to 40% on the front axle(s) and 75 to 60% on the rear drive axle(s).

6.1.5 The location of the center of gravity (CG) of the vehicle shall be a minimum of 24 inches forward from the centerline of the vehicle's rear drive axle(s) under all conditions of loadings.

6.1.6 Combination vehicles that operate as a tank truck pulling a full trailer shall be designed so that the gross vehicle weight (GVW) of the laden trailer does not exceed 50% of the gross combination weight (GCW) in any operating condition.

6.2 Cab-Chassis

6.2.1 The vehicle shall have either a commercially available standard production cab-chassis, or a cab-chassis specifically designed for low-speed, high volume, aircraft refueling operation. Specialty vehicles must be manufactured by a reputable Cab-Chassis OEM, having both sufficient engineering qualifications and production capabilities. The former shall meet all latest applicable federal regulations, including the applicable Federal Motor Vehicle Safety Standards (FMVSS) and all Motor Carrier Safety Regulations (MC-DOT); the latter also shall meet the above criteria, except those not applicable to vehicles with GVWR ratings far higher than those that may be legally operated on public highways even with special permits or vehicles that are specifically designed to only operate on airport property.

6.2.2 The cab-chassis shall have the appropriate axle configuration for its design and all other components required for the vehicle to comply with all applicable federal and local regulations. The cab-chassis shall have the minimum capacity that satisfies the vehicle's laden operating requirements. The vehicle's operating requirements shall be established by the Vehicle Purchase Specifications, that shall specify the minimum equipment capabilities, and operating requirements for the Aircraft Refueling Vehicle as required for the operation. The refueling capability specified shall be based on the Vehicle Purchase Specifications and type of aircraft that are to be refueled, and shall be within the scope of this document. The cab-chassis shall be selected so that all operating parameters shall be considered to provide optimum vehicle operation and maximum vehicle reliability.

6.2.3 Frame

6.2.3.1 The vehicle shall be equipped with a chassis frame of suitable strength and rigidity to allow the vehicle to operate properly at the rated GVWR.

6.2.3.2 The frame shall be properly selected to have the proper Yield Strength (YS), Section Modulus (SM), and Resistance Bending Moment (RBM) for the Aircraft Refueling Vehicle application. The frame shall be selected through an engineered process developing a shear and bending moment diagram and using a minimum safety factor of four, calculated in static conditions and based on frame yield strength and at maximum loading conditions.

- 6.2.3.3 The frame shall be a continuous formed steel channel, or a continuous miscellaneous (Ship and Car) type channel with minimum physical properties of ASTM A36. Where frame extensions are required, they shall be connected to the frame at a minimum distance of 12 inches behind the rear spring hanger bracket and have an overlapping inner frame reinforcement of the proper length, engineered to support all loading conditions with the required safety factor. The required section modulus shall not be obtained by the use of fish plating; however, the use of inverted "L", inner, or outer channels to obtain the required section modulus shall be permitted.
- 6.2.3.4 The product tank on Aircraft Refueling Vehicles and the refueling equipment on Hydrant Service Vehicles shall be equipped with a subframe. The framework assembly shall be installed directly to the chassis' and secured with assembly brackets engineered for the application by the Aircraft Refueling Vehicle OEM. The product tank shall have a wood, rubber, other high density plastic sill installed between the tank and chassis. The sill shall be secured to the tank with proper retaining and securing devices designed for the installation. When the refueling equipment framework is an integral part of the tank, it shall be equipped with all brackets, reinforcements, and gussets to provide a structurally sound design and be in compliance with DOT 406 requirements. All bolts, nuts, and washers where used to assemble all components to the chassis frame or tank shall be a minimum of SAE grade 5.
- 6.2.3.5 All hydrant service vehicle refueling equipment shall be installed on a separate "C" frame with external width dimensions identical to the frame. The refueling equipment frame assembly shall be installed directly to the chassis secured with assembly brackets engineered for the hydrant service vehicle application by the Hydrant Service OEM. All bolts, nuts, and washers used to assemble all components to the chassis frame shall be a minimum of SAE grade 5.
- 6.2.3.6 The wheelbase of the cab-chassis shall only be altered if permitted by the cab-chassis OEM and performed as per the cab-chassis OEM requirements. If the wheelbase of the cab-chassis is altered, the alteration shall include all cab-chassis OEM components. The cab-chassis' frame shall not be altered between the front and rear axles. Any alterations performed to any part of the cab-chassis shall be made in accordance with the cab-chassis OEM with the recommended cross members and grade of fasteners.

6.3 Trailer Type Vehicles

- 6.3.1 Trailer type vehicles shall have a full-trailer design configuration with parking brakes and shall comply with the minimum requirements as stipulated within this ARP, and shall also be designed, manufactured, and tested to operate in accordance with ARP1247 latest revisions.
- 6.3.2 The trailer shall have a minimum gross weight rating (GWR) as required for the weight of the laden aircraft refueling system, and be designed with a satisfactory weight distribution.
- 6.3.3 The trailer shall be customized for the proper installation of the refueling system. The trailer shall be in full compliance with all applicable FMVSS. The trailer designed for towing shall be equipped with the following minimum components:
- 6.3.3.1 Mechanical operated parking brakes that may be applied or released utilizing the tow bar or by other means that assures that the parking brakes are applied when the cart is disconnected from the tow vehicle.
 - 6.3.3.2 Electrical connector for the tow vehicle
 - 6.3.3.3 Break-away switch if equipped with service brakes
 - 6.3.3.4 12 V dry-cell battery in a weather-proof box if equipped with service brakes
 - 6.3.3.5 Towbar with 3 inch lunette eye
 - 6.3.3.6 Safety chains

6.3.4 Trailer Frame

- 6.3.4.1 The Aircraft Refueling Vehicle shall be equipped with a trailer frame of suitable strength, rigidity, and structural support to allow the Aircraft Refueling Vehicle to operate properly at the rated GVWR, and to withstand both vertical and side loads in all operating conditions.
- 6.3.4.2 The frame shall be properly selected to have the proper Yield Strength (YS), Section Modulus (SM), and Resistance Bending Moment (RBM) for the Aircraft Refueling Vehicle application. The frame shall be selected through an engineered process developing a shear and bending moment diagram and using a minimum safety factor of four, calculated in static conditions and based on frame yield strength and at maximum loading conditions.
- 6.3.4.3 The frame shall be a formed steel channel with minimum physical properties required for the design of the application.
- 6.3.4.4 All bolts, nuts, and washers used to assemble all components to the frame shall be a minimum of SAE grade 5.

6.3.5 Trailer Axle(s) and Suspension

- 6.3.5.1 The trailer shall be equipped with axle(s) and suspension system properly rated to provide a satisfactory GAWR. The GAWR shall be determined and set by the lowest rated capacity of the tires, brakes, wheels, suspension, and axle. All trailer axle and suspension systems shall have a rating as established by the axle and suspension manufacturer(s), and installed as per manufacturer's recommendations. The trailer axle(s) GAWR shall be established by the axle and suspension manufacturer. The trailer axle's GAWR shall not be less than the axle weight with laden Aircraft Refueling Vehicle. Each trailer axle shall be properly located so that the Aircraft Refueling Vehicle will have a satisfactory weight distribution in all conditions of loading.
- 6.3.5.2 The trailer shall be provided with the proper capacity wheel and tire assemblies. Split side 2-piece ring type wheels are not permitted.
- 6.3.5.3 The Aircraft Refueling Vehicle shall be provided with the proper capacity wheel and tire assemblies. The Aircraft Refueling Vehicle tires shall have the tread design required for the application. The tires shall provide positive traction in driving and turning while operating in the most severe conditions.

6.4 Front Steering Axle(s) and Suspension

- 6.4.1 The Aircraft Refueling Vehicle shall be equipped with front axle and suspension system properly rated to provide a satisfactory Aircraft Refueling Vehicle Front GAWR. The unit shall be equipped with a suspension system as deemed necessary for the operation and design of the vehicle. The GAWR shall be determined and set by the lowest rated capacity of the tires, brakes, wheels, suspension, and axle. The vehicle's Front GAWR shall not be less than the Aircraft Refueling Vehicle's front laden weight.
- 6.4.2 The vehicle shall be provided with the proper capacity wheel and tire assemblies. Split side 2-piece ring type wheels are not permitted. The vehicle's front tires shall be of highway tread design tires. The tires shall provide positive traction in driving and turning while operating in the most severe conditions, as established by the Vehicle Purchase Specifications.
- 6.4.3 Full Trailer towable Aircraft Refueling Vehicle shall be equipped with all required steering devices designed to tow the unit behind a vehicle without undo stress or fatigue on any components of the unit.
- 6.4.4 Self-propelled Aircraft Refueling Vehicle shall be equipped with an integral hydraulic power assisted or hydrostatic steering system. The Aircraft Refueling Vehicle that shall be equipped with a system that stops or reverts to manual mode in the event of the power assist failure.
- 6.4.5 The power assist steering system shall be easily operated by being capable of easily turning the wheels lock-to-lock with the Aircraft Refueling Vehicle stopped on hard surface pavement, and engine idling with laden Aircraft Refueling Vehicle.

6.5 Rear Axle(s)

- 6.5.1 The Aircraft Refueling Vehicle shall be equipped with rear axle(s) properly rated to provide a satisfactory vehicle Rear GAWR. The unit shall be equipped with a suspension system as deemed necessary for the operation and design of the Aircraft Refueling Vehicle. The GAWR shall be determined and set by the lowest rated capacity of the tires, brakes, wheels, suspension, and axle. The Aircraft Refueling Vehicle's Rear GAWR shall not be less than the Aircraft Refueling Vehicle's rear laden weight.
- 6.5.2 The vehicle's rear axle ratio and tires size shall be properly selected to provide the vehicle's top speed. When the vehicle top speed cannot be limited by selection of the proper rear axle ratio and tire size, the engine governor and/or throttle system shall be properly modified to limit the top speed as specified in Vehicle Purchase Specifications.
- 6.5.3 The vehicle shall be provided with the proper capacity wheel and tire assemblies. Split side 2-piece ring type wheels are not permitted. The vehicle's rear tires shall be of highway or snow/mud tread design tires. The tires shall provide positive traction in driving and turning while operating in the most severe conditions, as established by the Vehicle Purchase Specifications.

6.6 Engine

- 6.6.1 The vehicle engine shall be of the 4-cycle internal combustion gasoline or diesel type engine, or powered by other type of alternatively fueled engine that meets the latest EPA Regulations for the production model year and NFPA requirements for aircraft refueling vehicle application. The engine shall be properly sized with the transmission, providing a properly rated power train system with all other necessary components. The vehicle's power train and components shall be selected so that the vehicle is capable of maintaining a minimum speed of 10 MPH on a 10% grade at the laden GVWR and GCWR. The Aircraft Refueling Vehicle OEM shall certify that the power train is rated to meet all the performance requirements of the vehicle.
- 6.6.2 The vehicle top speed shall be limited to a maximum speed of 20 MPH unless a higher top speed is specified by the Vehicle Purchase Specifications. When the vehicle top speed cannot be limited by selection of the proper rear axle ratio and tire size, the engine governor and/or throttle system shall be properly modified to limit the vehicle's top speed. The modification shall not limit or restrict the operation of the vehicle in any manner other than to limit the vehicle's top speed.
- 6.6.3 The vehicle engine shall be installed in an engine compartment that meets all NFPA 407 requirements and provides considerable protection from weather and possible product spills. Any part of the engine that is exposed to possible product spills shall be covered with a removable aluminum or stainless steel cover. The cover shall be designed and configured so that the engine will have proper ventilation and to divert any product fuel that leaks or spills away from the engine, transmission, and any of its components.
- 6.6.4 The engine governor, throttle, ignition, and starting system shall be equipped with all Cab-Chassis OEM required components. Any modifications to the system shall be engineered, performed, and certified by the Aircraft Refueling Vehicle OEM. All modifications shall not adversely alter or affect the operation of the vehicle.
- 6.6.5 The engine shall be equipped with all components, shields, accessories, and systems required to provide reliable Aircraft Refueling Vehicle operation in severe conditions as established by the Aircraft Refueling Vehicle Purchase Specifications. All engine system controls, monitors, and indicators shall be installed on the control panel and be accessible for operation or observation by the operator.
- 6.6.6 The engine shall be equipped with the following minimum features:
 - 6.6.6.1 Engine manufacturer's recommended lubrication and cooling system.
 - 6.6.6.2 Engine oil filters: full flow, spin on type.
 - 6.6.6.3 The engine shall be serviced with a 50/50 mix of permanent type (ethylene glycol) antifreeze and water.

6.6.6.4 EPDM or Silicone coolant hoses (for radiator and heater). A coolant spin-on filter is recommended for extended service.

6.6.6.5 Fuel filter system:

- Spin-On type
- Diesel Engine shall be equipped with a filter/water separator with drain valve. A heated unit is recommended for cold temperature climates.

6.6.6.6 The engine shall be equipped with a heavy duty electric starter as required by the engine OEM.

6.6.6.7 The engine shall be equipped with the Engine OEM standard production recommended cold starting aid(s) for the Aircraft Refueling Vehicle to properly operate in ambient temperature and weather conditions as specified by the Aircraft Refueling Vehicle Purchase Specifications.

6.6.6.8 Controls, Monitors, and Indicators

The engine shall be equipped with the following minimum controls, monitors, and indicators:

- On/Off/Start switch
- Engine temperature gauge or indicator light
- Engine oil pressure gauge or indicator light
- Engine hour-meter
- Engine tachometer
- Air filter restriction indicator for engines larger than 165 HP
- Engine speed governor
- Diesel engines or when required by the Aircraft Refueling Vehicle Purchase Specifications, engine shutdown system with override, and visual and audible alarm for low oil pressure and high coolant temperature. The engine shutdown system with an automatic override is recommended.
- Controls, monitors, and indicators shall be installed for ease of operation, and they shall be properly labeled and ready observation by the operator.

6.7 Engine Exhaust

6.7.1 The engine exhaust system shall be configured so that it is not exposed to leaks of grease, oil, Aircraft Refueling Vehicle fuel, or product. The engine exhaust system shall be equipped with a muffler and a spark arrestor or a spark arresting type muffler.

6.7.2 The complete exhaust system shall be properly sized for the engine as required by the engine manufacturer. The exhaust shall discharge down and opposite and away from the operator, any areas of potential fuel spills from above, and areas where potential product spills can occur from servicing the unit.

6.7.3 Vehicles equipped with exhaust after treatment devices shall strictly comply with all NFPA 407 requirements for the design and operational requirements.