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AEROSPACE RECOMMENDED PRACTICE

ARP 1247A

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GENERAL REQUIREMENTS FOR AEROSPACE POWERED MOBILE GROUND SUPPORT EQUIPMENT

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1. SCOPE

This Recommended Practice outlines the basic general design requirements for powered mobile ground support equipment used in the civil air transport industry. It is intended to assist the airlines in standardizing requirements for various configurations of equipment.

2. APPLICABLE DOCUMENTS

The following documents, or portions thereof, of the issue in effect on the date of the purchaser's controlling specifications form a part of this Recommended Practice to the extent specified herein. In the event of conflicts between this Recommended Practice and the listed documents, this Recommended Practice shall apply unless otherwise stated herein.

2.1 SAE Publications:

J10 - Automotive Air Brake Reservoir Performance and Identification Requirements
J377 - Performance of Vehicle Traffic Horns
J512 - Automotive Tube Fittings
J514 - Hydraulic Tube Fittings
J517 - Hydraulic Hose
J533 - Flares for Tubing
J537 - Storage Batteries
J557 - High Tension Ignition Cable
J558 - Low Tension Cable
J561 - Electrical Terminals - Eyelet and Spade Type
J813 - Automotive Air Brake Reservoir Volume
J844 - Air Brake Tubing and Pipe
J858 - Electrical Terminals - Blade Type
J878 - Low Tension Cable Thermosetting Insulation
J919 - Sound Level Measurements at Operator Station
J928 - Electrical Terminals - Pin and Receptacle Type
J952 - Maximum Sound Levels for Engine Powered Equipment
J1401 - Hydraulic Brake Hose - Automotive
J1402 - Air Brake Hose - Automotive
J1403 - Vacuum Brake Hose
J1703 - Motor Vehicle Brake Fluid
ARP 836 - Design and Safety Criteria for Passenger Boarding Stairways
ARP 1052 - Selection Criteria for Reciprocating Primer Movers
ARP 1328 - Aircraft Support Equipment Stability Analysis
ARP 1330 - Weldings of Structurers for Ground Support Equipment

2.2 American National Standards Institute Publications:

ANSI B56.1-1969 - Safety Standard for Powered Industrial Trucks

2.3 Government Publications:

MIL-STD-461 - Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-1472 - Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
MIL-S-3950 - Switch, Toggle, General Specification for
O-A-548 - Antifreeze, Ethylene Glycol, Inhibited
FMVSS, Title 23 - Federal Motor Vehicle Safety Standards
CFR, Title 49 - Code of Federal Regulations
OSHA - Walsh Healey Provisions of the Occupational Safety and Health Act
Various Standards - United States Public Health Service Standards

2.4 Other Publications:

Section VIII - ASME Unfired Pressure Vessel Code
ATA Spec. 101 - Specification for Ground Equipment Technical Data
NFPA No. 70 - National Fire Prevention Association Standard No. 70, "National Fire Code"
NFPA No. 505 - Standard for the Use, Maintenance and Operation of Industrial Trucks
Various Standards - Caster & Floor Truck Manufacturer's Association Standards

3. REQUIREMENTS

3.1 Performance: The equipment, properly maintained, shall be designed to perform its intended function for its "Total Life" period (See par. 3.5).

3.2 Operability:

3.2.1 The equipment shall be designed for continuous operation at rated load for the period indicated in a functional specification provided by the purchaser as a controlling document herein referred to as a "controlling specification."

3.2.2 The equipment shall operate satisfactorily at any angle up to 10 deg. (0.175 rad) fore and aft and 5 deg. (0.0873 rad) sideways. In the event that this requirement imposes significant design constraints, the manufacturer shall define and propose a design suitable for the intended application.

3.3 Reliability: The eqipment and its accessories shall be designed and constructed with reliability of operation a primary consideration. The minimum reliability design requirement is that the equipment be designed to operate between periodic preventive maintenance periods of 200 operating hr. or eight weeks, whichever occurs first. The above interval does not apply to components in those cases where the component manufacturer recommends more frequent maintenance intervals. (For the purpose of this specification, normal servicing of fuel, oil, tire pressure, battery and water are not considered preventive maintenance.)

3.4 Maintenance Requirement:

3.4.1 Maintainability: Not applicable.

3.4.2 Maintenance Repair Cycle: Not applicable.

3.4.3 Service and Access:

3.4.3.1 Equipment components and systems requiring routine and frequent inspection and maintenance shall be readily accessible. Suitable access doors or removable enclosures shall be provided for this purpose.

3.4.3.2 Access doors, covers, and protective guards shall be designed for quick removal or opening.
ø Access holes in protective guards for lubrication are acceptable but shall be held to a minium number and size.

3.4.3.3 Access panels and doors normally used during aircraft servicing shall be designed to structurally
ø withstand wind blasts up to 90 mph (145 km/hr) in both open and closed position.

3.4.3.4 Access panels shall be hinged, pinned, etc., to prevent loss from the unit. Large panels of over 4 ft (1.219 m) in both height and width which are normally removed only for heavy maintenance; i.e.,
ø major component overhaul or removal, may be designed to be removed from the equipment when hinging or pinning is not practical.

3.4.3.5 Hinges shall be located on the forward edge of all vertically hung doors and on the lower edge of all horizontally hung doors. Where possible, at least 8 in. (203 mm) of clearance above the ground shall exist when any door is open. All hinge doors shall be provided with devices to secure them in either the open or closed position such that they will not be blown by jet blast or ambient winds. Stops or bumpers shall be installed so that the doors, when open, do not mark or scratch the paint work.

3.4.3.6 Major assemblies and components shall be capable of being disconnected and removed from the equipment without the necessity for extensive disassembly of other components. Standard automotive practice is acceptable. A design goal shall be that any major component should be able to be removed and reinstalled in a period not to exceed eight man-hours.

3.4.3.7 Parts requiring removal for replacement, service, or maintenance shall be fastened with removable
Ø fasteners or latching devices.

3.4.3.8 Weight of removable enclosures, or replaceable units, designed for one-man handling must be less than 33 lb (15 kg) and should preferably not exceed 30 lb (14 kg). Units exceeding 33 lb (15 kg) to a maximum of 80 lb (36 kg) must be designed for two-man handling.

3.4.3.9 All components that exceed 80 lb (36 kg), or that exceed 33 lb (15 kg) if only one man has access to the unit for handling, shall have provisions for attaching lifting or handling devices such as slings, hoists, or forklift tines. The minimum design safety factor of such devices based on the ultimate strength of the material shall be 5 to 1.

3.4.3.10 Any vital, unattached parts such as tractor hitch pins and lock pins which might otherwise be easily lost shall be secured to the equipment with cable or chain of durable size and material.

3.4.3.11 Pressure lubrication fittings shall be provided at all points where heavy loads, close tolerance,
Ø relative rotary or linear motion of parts occurs. This will normally include pivots, guides, bearings, and journals except sealed ball and roller bearings. Where access to the fittings is difficult, they shall be brought to a common lubrication panel.

3.4.3.12 Fastener heads and nuts shall be provided with adequate clearance for wrenches or drivers.
Ø Supplier shall advise whether metric or U.S. Standard (inches) hardware will be provided.

3.4.3.13 A means of positively securing lift devices at a convenient height for service and access be provided
Ø with each unit.

3.4.3.14 On lift bed types of equipment, the manufacturer shall provide alternate means of raising the hoist
Ø in event of failure of the primary power source if any components that could cause failure are not accessible while the hoist is in the down position.

3.4.3.15 On lift bed types of equipment a means shall be provided for a mechanic to raise and lower the
Ø hoist while working at ground level.

3.4.3.16 Chain and belt drives shall have provision for adjusting the tension to the manufacturer's specified
Ø value. This shall be in the form of take-up screws when needed to produce and hold adequate tension. A positive means to hold the adjustment shall be provided.

3.5 Total Life: "Total Life" is defined to be the hours of use from time of delivery of the equipment to the using activity until its identity is destroyed by classifying it as salvage and/or subject to cannibalization. The "Total Life" for which the equipment is designed, assuming it is used and maintained in accordance with the manufacturer's recommendation, shall be specified.

3.6 Environmental:

3.6.1 The entire unit shall be designed and equipped to start easily and operate satisfactorily under temperature conditions ranging from -25° to +125°F (31.7°C to 51.7°C) (after soaking at either of the stated temperatures for 24 hr).

3.6.2 The equipment shall be designed to operate satisfactorily after exposure to the following sequence of conditions:

a. 4 hours soak at +20°F (-6.7°C).

b. Thorough wetting with fine spray of +40°F (4.4°C) water

c. 4 hours soak at +20°F (-6.7°C).

3.6.3 The equipment and all its components shall be designed to operate satisfactorily after 6-hr exposure to heavy rainfall (0.30 in./hr) (0.76 cm/hr) driven by a 25 mph (40.2 km/hr) wind.

3.6.4 Components shall be protected from mechanical, electrical, and corrosion damage and impairment of operation due to rain, snow, ice, sand, grit, and deicing fluids.

3.6.5 Operator's compartments shall be designed to preclude excessive temperature from heat sources such as engine and exhaust system. Insulation and ventilation shall be provided if, or as, necessary to limit compartment temperatures, in any operational mode, to 100°F (37.8°C) on a calm, 85°F (29.4°C), full sunlight day.

3.7 Transportability:

3.7.1 The unit shall be designed for over-the-road unrestricted transportation insofar as possible. The manufacturer shall identify any constraints applicable to transportation or shipment of the unit or any subassemblies.

3.7.2 Units required, as outlined in the controlling specification, to operate on public highways or to be capable of being licensed for use on public highways shall meet the requirements of Chapter V - National Highway Safety Bureau, Department of Transportation, Title 49 of the Code Federal Regulations in effect on the date of manufacture. In addition, the unit shall be manufactured in a manner and equipped to be capable of operation in accordance with Part 393, sub-parts A, B, C, D, E, and G of Chapter III - Federal Highway Administration, Department of Transportation.

3.7.3 Units which may be licensed to operate on public highways shall have the minimum capability to accelerate on a level surface, from 0 to 40 mph (0 to 64.4 km/hr) within 60 seconds with full payload.

3.8 Safety:

3.8.1 It shall be the responsibility of the manufacturer to ensure that the equipment contains all the safety features required to protect the equipment, the operator(s), the load, and the aircraft serviced, in accordance with all generally accepted good design practices.

3.8.2 Powered Industrial Trucks (as defined by Part 1910.178 of OSHA) shall meet the design and construction requirements established in ANSI B56.1, Part II. In the event of conflict between this document and B56.1, Part II, B56.1 shall apply.

3.9 Personnel Safety:

3.9.1 Unless excluded for special purpose vehicles, a windshield shall be provided on all motorized vehicles designed for operation at speeds above 5 mph (8.1 km/hr). Powered windshield wipers shall be provided on all motorized vehicles which are equipped with a windshield. A powered wiper shall also be provided on any rear view window of each motorized vehicle required to approach aircraft in a reverse direction. Wiper motors and mechanical linkage must be protected against damage with wipers in a stalled condition. Window wiping and washing systems shall conform to FMVSS Title 23, Chapter 2, Standard No. 104. "Windshield Wiping and Washing Systems - Passenger Cars." Unless otherwise stated in the controlling specification, washing systems need not be provided on vehicles not equipped for highway travel.

3.9.2 On units where rear vision is restricted, outside mirrors shall be provided on each side of the cab as specified by the controlling specification. The mirrors shall be adequately braced to preclude accidental loss of adjustment or visual distortion due to vibration of vehicle. If specified, the mirror(s) shall have down vision capability.

3.9.3 ø An electric horn which meets the requirements of SAE Standard J377 shall be provided. The horns shall be supplied with control button located in the center of the steering wheel.

3.9.4 ø Control pedals shall be designed and located to permit safe operation if heavy overshoes are worn by the operator. Spacing between the brake pedal and accelerator shall follow standard automotive industry practice. In no case shall they be located so that the accelerator can be depressed accidently while applying the brakes with a booted foot. The use of pedal surface material which inhibits "slippage" of shoes when wet, is required.

3.9.5 A crash barrier which, when rigidly supported in a horizontal position, is capable of withstanding the impact of a 100 lb (45.4 kg) solid hardwood cube (or equivalent) dropped at random from a distance of 5 feet (1.5 m) 10 times, without fracture or permanent deflection exceeding 0.75 in. (1.9 cm) shall be installed on each vehicle designed to carry loose cargo to prevent injuring the operator with such cargo in the event of a collision.

3.9.6 Where required, heat shields or guards shall be installed to protect personnel operating the equipment or performing routine periodic maintenance on it against accidental contact with exposed parts which are subject to high operating temperatures. This does not apply to exhaust systems in commercial vehicle engine compartments.

3.9.7 Suitable guards shall be provided for all sprockets, gears, chains, fans, belts, and other moving parts located where operating or maintenance personnel may make accidental contact with them. In general, standard automotive practice is acceptable.

3.9.8 Vehicles designed for use off the airport shall have the operator and adjacent front seat positions equipped with seat belts conforming to FMVSS Title 23, Chapter 2, Standard No. 207 "Anchorage of Seats - Passenger Cars", No. 208 "Seat Belt Installation - Passenger Cars", and No. 209 "Seat Belt Assemblies - Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses."

3.9.9 Exposure of operating and maintenance personnel to electric shock hazards shall be minimized by the provision of suitable interlocks, grounding means or protective devices.

3.9.10 Guards or enclosures shall be provided for all exposed portions of electrical equipment.

3.9.11 Elevating devices shall be protected against uncontrolled movement or actuation in the event of a power source failure of any type (i.e., hydraulic, electrical, pneumatic, or engine).

3.9.11.1 Hydraulic lift cylinders shall have pilot operated check or counterbalance valves connected directly to their base fittings to prevent accidental lowering in the event of failure of any line in the system.

3.9.11.2 Electrical or pneumatic lifts shall be equipped with brakes to lock the system in the event of power failure or malfunction.

3.9.11.3 An emergency lowering system operable from the ground shall be provided on all lift units.

3.9.11.4 The location of emergency lowering controls must consider employee personnel injury exposure during the operation.

3.9.12 All pinch and shear points, sharp edges and protruding objects must be eliminated wherever possible and practical. If elimination is not possible, adequate guarding must be achieved to prevent injury and/or damage exposure.

3.9.13 Push/pull forces required to move other than control handles and access doors shall be limited to 60 lb (27.2 kg), when the operator is standing upright.

3.9.14 Where practical and possible, access to work areas shall be provided by means of stairs. Ladders shall be used only where use of stairs is not practical and possible. All stairs and ladders shall conform to current applicable OSHA regulations.

3.9.15 Steps and ladder rungs shall be of serrated grating panel material.

3.9.16 Stair risers, treads and stair and ladder angles shall conform to Occupational Safety and Health Act promulgated standards and documents for Industrial Operations. Critical angles shall be avoided where practical and possible.

3.9.17 Stairs used by the general public for access to and from the aircraft shall conform to SAE ARP 836.

3.9.18 Handrails shall be installed on all stairs and ladders.

3.9.19 Non-slip surfaces shall be provided in all areas where personnel will be required to walk or work during normal operations.

3.9.19.1 Serrated grating panels may be used where personnel will not be required to kneel or sit, and smoother surfaces are not required for rolling of casters. Protection shall be provided to prevent objects from falling on personnel and moving parts below such platforms.

3.9.19.2 Smoother non-slip materials shall be installed on personnel work areas as required by the operation. Abrasive impregnated aluminum or steel plate, adhesive applied abrasive sheet or painted on abrasive coatings shall be used only as approved by the purchaser.

3.10 Equipment Safety:

3.10.1 If required, the type, location, and color of reflecting devices will be specified by the controlling specification.

3.10.2 Consideration should be given for protection of lamps and reflectors against damage if dictated by normal design practice; i.e., likelihood of damage.

3.10.3 Non-marking cushion devices shall be installed on all equipment intended to be used in direct contact with or close proximity to aircraft to prevent damage to the aircraft. Such cushion devices shall be tubular or "D" section rubber bumpers of suitable length with an outside diameter and wall thickness as specified by the controlling specification.

3.10.4 All components and systems shall be fail-safe wherever practical.

3.10.5 Powered mobile equipment shall be designed with operator visibility a primary consideration.

3.10.6 All lift device mobility and/or positioning controls shall be of the "deadman" type.

3.10.7 Relief valves shall be provided in all hydraulic and pneumatic systems to prevent sustained pressures in excess of rated working pressure.

3.10.8 If required, the type, size, and location of fire extinguisher(s) will be stipulated in the controlling specification.

Ø

Ø 3.10.9 If stabilizers, outriggers, or spring lockouts are used, the following shall be provided:

3.10.9.1 An interlock shall be provided so that the stabilizing device used cannot be retracted or disconnected with the unit in a raised position.

Ø

Ø 3.10.9.2 An interlock shall be provided so that the unit cannot be raised without the stabilizing device down.

3.10.9.3 Any stabilizing device used that extends beyond the unit profile or that could create an employee injury hazard shall be painted high visibility yellow or alert orange (purchaser to specify) and have the corners rounded.

Ø

3.10.9.4 A stabilizer device warning light shall be provided in clear view of the operator to show that the stabilizer device is not fully retracted.

Ø

Ø 3.10.9.5 A means to retract the stabilizer when the engine is not operating shall be provided.

3.10.9.6 Stabilizer ground contact pads, at maximum design loading, shall not produce a ground contact pressure in excess of 150 psi (1.034 MPa).

Ø

3.11 Noise and Vibration:

3.11.1 The maximum average sound level generated by the equipment, when operated at rated capacity or load, shall not exceed 85 dbA (A-weighing network) when measured at the operator's position and at a distance of 15 ft (4.57 m) from the equipment at a minimum of 8 positions at 45 deg (.785 rad) radials. If it is not feasible or reasonable to achieve the above requirement because of economic and/or engineering technology, the manufacturer shall document the design limitations giving all the economic and/or engineering considerations and shall provide noise level readings as above at distances of 2, 5, 10, and 15 ft (.61, 1.52, 3.05, and 4.57 m) from the equipment.

3.11.2 Sound level measurements and techniques shall be in accordance with SAE J919 for the operator's position and in accordance with SAE J952 for the radial measurements except that the following paragraphs of J952 are not applicable: 4.1.3, 4.3.3, 4.3.4, 5.2, 5.6 and Table 1.

Ø

3.11.3 The unit shall be designed and constructed to prevent parts from working loose in service. It shall be built to withstand the stresses, jars, vibrations, and other conditions incident to shipping, storage, installation, and service. When necessary, provisions will be made to protect operators, instruments, components, hydraulics, and structure with suitable vibration isolators.

3.12 Equipment Definition: To be specified in the controlling specification.

3.12.1 Interface Requirements: Interface requirements will be specified in the controlling specification.

3.12.2 Customer Furnished Property List: Not applicable.

3.12.3 Manuals/Publications: The requirements for manuals and other documents will be provided in a controlling specification. All manuals must be available in accordance with ATA Specification 101 or in a format approved by the purchasing activity.

3.12.4 Tools and Test Equipment: Insofar as possible only standard tools shall be required for normal maintenance of any parts of the equipment. Any special tools or test equipment required for overhaul or performance checking shall be identified and drawings or source of manufacture documented.

3.12.5 Training: Not applicable.

3.13 Design and Construction:

3.13.1 General Design Features: It shall be the manufacturer's responsibility to recognize and comply with all codes and standards applicable to the design and construction of this type of equipment which are generally accepted and used as good practice in the industry.

3.13.1.1 Mechanical Design:

3.13.1.1.1 ø The stress levels for design shall be based on the total of structural weight plus maximum carried load. Consideration will be made for anticipated dynamic loads. In the case of units with scissor lifts or similar load carrying structures, the design shall be based on the highest stress occurring over the full range of motion.

3.13.1.1.2 ø Structural members manufactured of ductile material shall be designed with a minimum factor of safety of 3 based on yield strength.

3.13.1.1.3 Non-ductile materials shall be designed with maximum allowable working stress of one-fourth of the ultimate strength or the material manufacturer's published recommended allowable working stress, whichever is lower.

3.13.1.1.4 ø In determining the design factor of safety, weld efficiencies as designated by the American Welding Society or applicable design codes shall be used.

3.13.1.1.5 ø Joint efficiencies shall be included in determination of the factor of safety for bolted connections.

3.13.1.1.6 ø Wire rope installations shall be designed with a minimum factor of safety of 5 based on rated breaking strength for lifts not required to carry personnel and minimum factor of safety of 10 for lifts carrying personnel.

3.13.1.1.7 ø All lifting devices except wire rope shall be designed with a minimum factor of safety of 5 based on ultimate strength.

3.13.1.1.8 ø The unit shall be designed with sufficient structural rigidity that deflections due to load, wind, and motions of working parts to not create interferences, cause malfunctioning of the equipment, or present safety hazards to personnel, aircraft, or the unit itself.

3.13.1.1.9 In the case of standard chassis or component assemblies used by the end product manufacturer, certification of the application by the component manufacturer will constitute structural acceptability of such components.

3.13.1.1.10 ø Sholder bolts, bearings, or bushings shall be used when attaching parts having relative rotary or linear motion.

3.13.1.1.11 Equipment having an effect on public health, such as food or drinking water or lavatory service equipment, shall comply with and be certified by the United States Department of Health, Education and Welfare.

3.13.1.1.12 Stairs, ladders, scaffolds, platforms, etc., shall comply with the applicable OSHA requirements.
Ø Removable railings shall be avoided where practical and possible. Removable railings shall be positively retained on the unit.

3.13.1.1.13 Caster and wheel types and applications shall conform to the standards of the Caster and Floor Truck Manufacturer's Association.

3.13.1.1.14 The Wheels used on all mobile equipment shall be of a type and size which will not damage or cause undue wear to the surface over which they will normally operate.

3.13.1.1.15 Chain and belt drives shall have suitable provisions for adjusting drive tension. A positive lock shall be provided for the adjustment.

3.13.1.2 Electrical Design and Equipment:

3.13.1.2.1 Unless otherwise specified, electrical systems incorporating a storage battery shall have a nominal rating of 12 volts DC. Storage batteries used for cranking gasoline engines up to 300 cubic inch
Ø displacement shall have a minimum capacity of 70 ampere hours at a 20 hr rate per SAE Standard J537. Batteries used for cranking diesel engines, or gasoline engines exceeding 300 cubic inch displacement, shall be of proportionately larger capacity, following conservative design practice. Electrical system design shall be documented by the manufacturer.

3.13.1.2.2 The negative pole of any storage battery shall be securely grounded to the vehicle engine and to the vehicle frame.

3.13.1.2.3 Toggle switches shall be of MIL-S-3950 quality or equal, and rated for the loads which they control.
Ø Exposed toggle switches shall be environmentally sealed.

3.13.1.2.4 All circuits except starting motors shall have suitable overload protection. Fuses and circuit
Ø breakers shall be grouped in convenient locations and suitably marked for size and function. Logical grouping of circuits is anticipated. Headlight circuits shall be independently protected. Protection devices shall be sized to protect wiring and motors from damage due to overload.

3.13.1.2.5 All wiring shall be in conduit or loomed and shall be routed away from heat sources and fuel lines.
Ø Wiring shall be adequately supported to protect it from damage from snow and ice buildup, bumping, kinking, and flexing.

3.13.1.2.6 Common wire splices shall not be used. Connections shall be made using terminal strips and staked lugs or by patent connectors. Terminals shall meet the applicable requirements of SAE documents J561, J858, and J928.

3.13.1.2.7 Wiring shall meet the applicable requirements of SAE documents J557, J558, and J878.

3.13.1.2.8 Each conductor shall be sized to have current carrying capacity as allowed by the National
Ø Electrical Code equal to or greater than the capacity of the fuse or circuit breaker provided in its circuit. Optional and add-on components shall be considered in sizing and in the number of conductors provided.

3.13.1.2.9 Grommets and suitable anti-chafe material shall be used where wires are required to pass through a firewall or other similar relief or opening which exposes the wire to possible chafing.

3.13.1.2.10 Each wiring conductor shall be identified by color or number in accordance with a wiring diagram accessibly displayed in the equipment and/or in an accompanying document.

3.13.1.2.11 Any concealed wiring running within van walls or other inaccessible areas shall be contained in conduit for the length of the run and shall be terminated on a terminal strip at each end of the conduit or otherwise installed in a manner approved by the purchasing activity.

3.13.1.2.12 Wiring terminals shall be protected by insulating boots or heat shrinkable tubing.

Ø 3.13.1.2.13 Quick disconnect fittings where required shall be MS standard receptacles and plugs.

3.13.1.2.14 All electrical connections, including terminal strips and battery terminals not protected by an Ø engine compartment hood, shall be provided with covers to prevent accidental contact and short circuiting.

Ø 3.13.1.2.15 Electrical interlocks shall be fail-safe design.

3.13.1.2.16 Electrical devices including lights, switches, relays, wiring, and terminals, when located in an area exposed to weather, shall be of weatherproof design or protected by weatherproof enclosures.

3.13.1.2.17 Spark producing electrical components shall be located at least 18 in. (457 mm) above ground level wherever possible. All such components located below this level shall comply with the National Electrical Code requirements for Class 1, Division 2, Group D equipment.

3.13.1.2.18 A minimum of five footcandles (54 $1m/m^2$) of illumination shall be provided:

Ø a. On all controls and placards in a glare free manner.

b. At all operator positions and work areas by means of flood, spot, or dome lights.

3.13.1.2.19 Lights, electrical apparatus and wiring on units required to operate in hazardous locations Ø shall comply with Article 500 of the National Electrical Code.

3.13.1.2.20 All lamps shall be heavy-duty type.

3.13.1.2.21 The following lighting equipment shall be provided on each vehicle intended for use and frequent travel on airport ramps and roadways and shall comply with the appropriate provisions of the Uniform Vehicle Code and FMVSS Title 23, Chapter 2, Standard No. 108. (Lighting equipment for vehicles of lower speeds will be specified on the detail specification for each type equipment.)

a. Two sealed-beam head lamps with high and low beams and a beam indicator.

b. Two red combination tail and stop lamps, visible from the rear of the vehicle.

c. Directional turn signals.

d. On vehicles equipped for highway use, lighting conforming to FMVSS Title 23, Chapter 2, Standard No. 108 "Lamps, Reflective Devices, and Associated Equipment, etc." shall be provided.

e. Dual backup lights controlled by the transmission shift lever.

3.13.1.3 Hydraulic, Pneumatic Design: The following requirements shall apply to hydraulic systems other than the chassis brake system.

3.13.1.3.1 The hydraulic system shall be designed to operate over an ambient temperature range of -20°F to +125°F (-29° to +51.7°C).

3.13.1.3.1.1 The hydraulic fluid desired will be specified by the controlling specification. A nameplate stating the type of hydraulic fluid used and the total tank capacity shall be installed adjacent to the reservoir filler neck.

3.13.1.3.2 Ø The preferred maximum system pressure required by an operation is 1500 psi (10.34 MPa) or less.

3.13.1.3.3 Ø Maximum allowable flow velocity through any hose, tube or pipe shall be determined from the following table:

Service	V (FPS)	V (M/S)
Suction	4	1.2
Pressure--continuous duty	15	4.6
Pressure--intermittent (up to 50% duty)	25	7.6
Pressure--infrequent (up to 20% duty)	40	12.2

In cases where pressure drop due to tube and hose length becomes excessive with the flow specified above, such tubes and hoses shall be made of a larger diameter to reduce the pressure drop.

3.13.1.3.4 Ø Hydraulic components shall be protected from flows in excess of manufacturer's published ratings.

3.13.1.3.5 The hydraulic fluid reservoir shall have a minimum reserve of 25% of displaced hydraulic fluid, making the capacity equal to 1.25 times the total maximum displaced volume of the hydraulic components including that contained in the hydraulic lines, accumulators, and cylinders. The reservoir design is to include the following:

3.13.1.3.5.1 Ø Weatherproof breather with 10 micron filtering, having air flow capacity adequate to maintain essentially atmospheric pressure in the reservoir under maximum flow conditions.

3.13.1.3.5.2 A magnetic drain plug is to be incorporated in a sump located at the return end of the tank. The tank should be arranged such that the sump and drain are at the lowest point.

3.13.1.3.5.3 Full range fluid level indicator with adequate protection from breakage and located in an easily observable area.

3.13.1.3.5.4 A strainer type filler neck with attached cap.

3.13.1.3.5.5 The tank outlet to the pump and the major return port are to be located at opposite ends of the tank and one inch (25.4 mm) above the tank bottom. Any pump case, seal leakage, or other gravity drains are to be returned to the top of the tank with the actual discharge below that level at which oil should be added to the tank to prevent aeration.

3.13.1.3.5.6 Ø An access opening to allow full access to interior for cleaning. Access cover is to be gasketed and fastened leak-tight.

3.13.1.3.5.7 Ø Reservoir to be thoroughly cleaned and protected from contamination during assembly of the unit. Material and construction to conform to commercial quality and adequately protected against corrosion. Coated tanks are unacceptable unless approved by the buyer.

Note: Items such as strainers, check valves, relief valves, filters, or any other item requiring periodic inspection or repair shall not be located inside the tank, but outside where they can be serviced easily.

3.13.1.3.6 A filter cannister or a "y" type suction strainer of at least 60 mesh monel or stainless steel screen located between the tank and pump system for easy accessibility to the clean out port shall be provided.

3.13.1.3.7 Pumps are to be chosen so that their capacity will meet peak demands within manufacturers' capacity ratings of flow, pressure, and RPM. Where system reliability and/or pump manufacturers' specifications require it, a boost pump and low pressure filter with a differential pressure indication will be provided.

3.13.1.3.8 The system pump(s) and components are to be protected by a relief valve(s) which have a capacity equal to or greater than pump capacity. Relief valve(s) shall dump directly to tank.

3.13.1.3.9 The hydraulic fluid temperature of the system during peak demands shall not exceed 185°F (85°C). In no case shall the fluid temperature exceed the maximum operating temperature recommended by the pump manufacturer.

3.13.1.3.10 Dynamic pressure surges, spikes, and fluctuations shall be minimized with use of accumulators if necessary. Precharge information tags shall be attached adjacent to charge fitting.

3.13.1.3.11 Ø The material for all hydraulic lines shall be specified. Flexible lines shall be made of hydraulic fluid resistant material. The lines shall be protected and supported from chafing and binding. Hydraulic lines shall be routed so that, where possible, structural members will provide protection. Lines shall be supported so that fittings, tubing and hoses are separated from engine exhaust systems, and are not subject to damage from heat, external loads, and vibration. If necessary, heat barriers or shields shall be installed. Lines shall be protected from kinking and abrasion.

3.13.1.3.12 All hydraulic fittings will be in accordance with SAE J514. If flared, the 37° (0.646 rad) flare with "B" nut and sleeve is to be used. Flared copper seats are not to be applied to fittings for sealing purposes.

3.13.1.3.13 All pipe threads are to be joined with a suitable pipe sealant.

3.13.1.3.14 Hydraulic systems are to incorporate such devices as hydraulic fuses, pilot check valves, holding valves, accumulators where necessary, and interlock systems to eliminate uncontrolled action of mechanisms (i.e., the fall of booms, platforms, etc.) in the event of energy failure. Manual actuation of systems shall be provided to return systems to a safe condition should energy failure occur.

3.13.1.3.15 Hydraulic systems shall include such devices as necessary to prevent damage to pumps and/or motors during towing of vehicle.

3.13.1.3.16 Ø Hydraulic rams shall be installed so that bending loads are not imposed on the piston. They shall not normally be used directly as jacks or ground locks to stabilize mobile equipment unless approved by the purchaser.

3.13.1.3.17 Ø Test port locations shall be provided at points in the hydraulic system requiring access for pressure adjustments and troubleshooting. Each port shall be plugged with a 1/4 in. NPT plug or closest standard metric equivalent if applicable.

3.13.1.3.18 Ø The hydraulic tank filler and breather and lines shall be located away from engine and exhaust system components to prevent oil from splashing onto hot surfaces in the event of overflow, leak, or component failure.

3.13.1.3.19 Ø Hydraulic hoses shall conform to the quality of the SAE 100R1 thru 100R7, per SAE Standard J517, as applicable.

3.13.1.3.20 Ø All components which are capped when received from suppliers shall have the protective caps left in place until connection is made to each port.

3.13.1.3.21 Ø When charging the hydraulic system with oil, the manufacturer shall take steps to ensure that the oil is free from contamination. The supply container shall be protected from water and dirt contamination during storage. All transfer containers and fittings shall be thoroughly cleaned and dried prior to use to prevent contamination from dirt, water, and other fluids.

3.13.1.3.22 Ø The manufacturer shall operate all segments of the hydraulic system for a period of one hour to thoroughly circulate the hydraulic fluid, remove the hydraulic filter element, examine for contaminants, and replace with a new element. This shall be repeated until the used filter shows no evidence of contaminants. In the case of dead end lines to actuators, provisions for bleeding shall be made and measures shall be taken to ensure that fluid not normally being recirculated shall be made to do so during the cleansing period to ensure that all fluid, lines, and components are clean.

3.13.1.3.23 Pressure vessels such as air receivers shall comply with all applicable requirements of the ASME Unfired Pressure Vessel Code, Section VIII. Such equipment shall bear an ASME "U" Code Label and certification.

3.13.1.3.24 Relief valves to prevent sustained pressures in excess of working pressure and adequate self-draining filters shall be provided in all pneumatic systems.

3.13.1.3.25 Manufacturers shall furnish sufficient details of their proposed hydraulic and pneumatic systems to allow an engineering evaluation.

3.14.1.4 Engines and Related Equipment:

3.13.1.4.1 All engines shall be selected, rated, and certified for continuous duty in accordance with the criteria of SAE ARP 1052. Any deviation from this requirement must be expressly specified by the controlling specification.

3.13.1.4.2 Liquid coolant systems shall be rated for maximum engine loads under the above conditions, or at the conditions of maximum intermittent output approved by the engine manufacturer, whichever criterion results in the largest heat transfer capacity.

3.13.1.4.3 Ø A dry cartridge intake air filter shall be securely mounted in position and shall prevent the emission of flames under backfire conditions. If the engine is to be operated under load in a stationary condition, consideration shall be given to drawing intake air from outside the engine compartment enclosure. Pressure drop across the air filter at rated speed and load shall meet the engine manufacturer's recommendations.

3.13.1.4.4 A full flow oil filter shall be installed for the engine oil system.

3.13.1.4.5 All liquid fillers, drains, dipsticks and filters shall be readily accessible for convenient servicing.

3.13.1.4.6 Where practical, all driven equipment shall be installed so that the engine is unloaded during cranking (starting). Exceptions shall be noted and explained.

3.13.1.4.7 The support documents listed in paragraph 9 of ARP 1052 shall be provided for each engine application.

3.13.1.4.8 Spark plugs and other ignition system components shall be readily accessible for maintenance. Molded weatherproof boots on the ignition wiring for installation over the spark plugs shall be provided.

3.13.1.4.9 An engine driven alternator shall be installed for charging storage batteries. The alternator capacity shall not be less than 40 amperes, and shall supply at least 80% of the maximum possible vehicle electrical steady load at engine idle, and least 150% at 1000 engine RPM. Alternators supplied by engine manufacturer (and meeting the requirements above) are acceptable. Otherwise, they shall be as specified by the controlling specification.

3.13.1.4.10 Ø The engine shall be equipped with emission and noise control devices required by Federal Law as of the date of manufacture of the engine.

3.13.1.4.11 Ø Gasoline powered engines shall meet performance requirements without requiring leaded or premium grades of fuel. Diesel powered engines shall be certified for aviation turbine fuel. LPG engines shall be certified for (Natural Gas Producers Association) HD-5 motor fuel.

3.13.1.4.12 Ø Engine coolant antifreeze shall be ethylene glycol base. The mixture shall be of adequate strength to give protection down to -30°F (-34°C). The manufacturer must obtain written approval to use other than Federal Specification O-A-548a, Type II, antifreeze.

3.13.1.4.13 Ø Each engine shall be equipped with an hourmeter, hourmeter vibration dampener and oil pressure switch.

3.13.1.4.14 Ø Engine kill switches shall be provided on any lift type unit and installed per Appendix drawing number one. This switch is not required in the cab when the ignition switch is located in the cab. If so specified in the controlling specification, a mushroom type switch shall be provided in lieu of the guarded toggle shown in Appendix one.

3.13.1.5 Fuel System Design:

3.13.1.5.1 Gravity feed fuel systems shall not be used.

3.13.1.5.2 Fuel lines shall be of seamless annealed copper or steel tubing. Copper tubing shall have a wall thickness not less than 0.035 in. (0.89 mm). Steel tubing shall have a wall thickness not less than 0.028 in. (0.71 mm) and shall have a corrosion resistant exterior coating.

3.13.1.5.3 Fuel lines shall be well supported with adequate clearance from exhause lines and electrical system parts.

3.13.1.5.4 Flexible tubing shall be used to absorb vibration and prevent fatigue due to vibration. This is expecially applicable for fuel line connections between the frame and flexible mounted engine. Such connections shall be designed so as to prevent siphoning in the event of failure of a flexible section.

Ø 3.13.1.5.6 The fuel tank shall have a minimum capacity for a normal 8-hr shift.

3.13.1.5.6 ø Fuel tanks shall be located and installed so that any overflow during filling, or any leakage from the tank, lines, or fittings, will not impinge on the engine, exhaust system or electrical equipment, or enter the operator's compartment. Fuel tanks and line shall be located so as to be protected from damage in the event of collision or during parking or docking.

3.13.1.5.7 All custom made fuel tanks shall be equipped with a drain plug on the bottom of at least 0.250 in. (6.35 mm) diameter.

3.13.1.5.8 Fuel tank fillers shall comply with Federal Standards for automotive equipment and shall be accessible from ground level at the outside of the equipment. A permanent placard shall be installed adjacent to the filler indicating the type fuel to be used.

3.13.1.5.9 ø All fuel tank fill openings shall be equipped with a self-closing fill and attached vent cap. The filler and tank shall be designed to provide a minimum fill rate of 10 GPM (.63 l/s) through the fill cap and filler neck without splash-back for tanks of up to 25 gallon capacity. Larger tanks shall have a minimum fill rate of 20 GPM (1.26 l/s).

3.13.1.5.10 A non-fluctuating type fuel quantity indicator shall be provided in a location readily visible to the operator. When fuel for more than one system is supplied from a single tank, the tank outlets shall be designed so that the propulsion engine is the last system affected as the tank approaches empty.

3.13.1.5.11 ø The installation of the fuel system shall conform with applicable requirements of Sections 393.65 and 393.66, Title 49 Code of Federal Regulations in effect at the time of manufacture.

3.13.1.6 Exhaust System Design:

3.13.1.6.1 Engine back pressures introduced by the complete exhaust system shall not exceed the engine manufacturer's recommendations.

3.13.1.6.2 If specified in the controlling specification, engine exhaust systems shall be equipped with flame and spark arresting mufflers.

3.13.1.6.3 The exhaust system shall be routed clear of all fluid lines and fuel and electrical system components. If routed through areas where leakage of oil, grease, or fuel could occur, the exhaust system shall be shielded from direct contact by such leakage.

3.13.1.6.4 Exhaust system arrangement and routing shall be planned so as to optimize the acoustical requirements outlined in 3.14.1.

3.13.1.6.5 Flexible exhaust tubing is prohibited.

3.13.1.6.6 Piping and components shall be installed so that susceptible items such as tires, hoses, etc., are not exposed to undesirable heat.

3.13.1.6.7 The exhaust system discharge shall be located so that gases will not enter the operator's position or compartment whether the equipment is stationary or in motion. The discharge shall not be directed toward the pavement or the aircraft.

3.13.1.6.8 The exhaust pipe shall terminate a minimum of 18 in. (457 mm) above the ground when possible.

3.13.1.7 Self-Propelled Vehicles: Where possible and practical, the following requirements apply to units with conventional automotive truck chassis and to those with specialized non-automotive chassis:

3.13.1.7.1 Structure and Running Gear:

3.13.1.7.1.1 Where practical, the minimum ground clearance shall be 8 in. (203 mm) when the vehicle is loaded to its normal operating weight.

3.13.1.7.1.2 Where practical, the chassis frame rails shall be lower than any part of the engine, transmission or driveline except the differential housing to protect the components against high crowning damage.

3.13.1.7.1.3 Attachment to frame members shall be made following the chassis manufacturer's recommended processes.

3.13.1.7.1.4 Components attached to the chassis shall be located such that ground and approach clearances are Ø not reduced.

3.13.1.7.1.5 The frame rails shall be loaded so that a minimum factor of safety of 3 based on specified Ø yield strength is maintained under the most severe load condition.

3.13.1.7.1.6 Extensions of truck chassis frame lengths are permissible only when such alterations are behind the rear hanger of the rear spring and shall not be for the purpose of extending the wheelbase.

3.13.1.7.1.7 Holes in top or bottom flanges of truck chassis frame side rails are not permitted except as provided in the original chassis frame.

3.13.1.7.1.8 Where practical, under full rated load, the minimum approach angle shall be 16 deg (0.279 rad), Ø the ramp breakover angle 10 deg (0.175 rad), and the departure angle 10 deg (0.175 rad).

3.13.1.7.1.9 Where practical, no portion of the vehicle shall contact the ground with any combination of flat tires. Suitable jack points shall be provided.

3.13.1.7.1.10 The spring suspension system shall be adequate to prevent chassis bottoming under normal operating conditions with a full rated load.

3.13.1.7.1.11 The power train gear ratio (transmission, differential and driving axle) shall be selected to provide optimum conditions for the engine in respect to engine speed, loads and fuel economy in accordance with the engine manufacturer's recommendations. Unless otherwise stated, the vehicle design speed for this requirement shall be considered to be 30 mph (48.3 km/hr).

3.13.1.7.1.12 Drive shafts and other rotating mechanisms shall be guarded wherever their failure could result in a fuel tank rupture or cause injury to the operator or persons riding on the vehicle.

3.13.1.7.1.13 Driving axles shall be designed to prevent release of the wheel in the event of axle failure.

3.13.1.7.1.14 Driving wheels shall have sufficient clearance (2.5 in. (63.5 mm) minimum) under normal load to permit the installation of tire chains.

3.13.1.7.1.15 A power steering system shall be provided on all vehicles having a steering axle load of 9,000 lb (4082 kg) or more.

3.13.1.7.1.16 All wheels shall be equipped with fenders or other suitable devices to protect personnel and cargo from mud and spray.

3.13.1.7.1.17 Tires shall not be loaded in excess of the tire manufacturer's load rating for a speed of 30 mph (48.3 km/hr).

3.13.1.7.1.18 The design of seats, windshields, and structure shall afford the maximum vision practical for the driver.

3.13.1.7.1.19 Each vehicle intended for normal operation in the sitting position shall be equipped with a full seat within the standard height range, including backrest, for the operator. Each passenger station shall be similarly equipped. Each seat or supporting structure shall be designed to prevent the transmission of excessive vibration or road shock to the occupant. On non-cab equipped vehicles, a hip guard shall be installed on the outside edge of the seat.

3.13.1.7.1.20 Each vehicle operator or passenger station shall have an adequate support, brace, or floor for a footrest.

3.13.1.7.2 Braking Systems:

3.13.1.7.2.1 Ø All motorized units shall be equipped with brake systems meeting the requirements of Title 49 Code of Federal Regulations applicable to the class of vehicle and shall meet the requirements of Par. 393.41 "Warning Devices and Gauges," with no exceptions.

3.13.1.7.2.2 Ø Power brakes shall be supplied as needed to meet the minimum performance requirements of Section 393.52, Title 49 CFR, with less than 100 lb (45.4 kg) of effort required on the brake pedal.

3.13.1.7.2.3 Ø The parking brake system shall meet the requirements of CFR #393.41 unless otherwise specified in the controlling specification.

3.13.1.7.2.4 The secondary brakes shall be applied by an over-center operating lever actuated by a pulling motion from the operator's normal position or by a ratchet type foot operated device. Lever mechanism adjustments shall not be available from the operator's station for major brake adjustment; however, minute adjustments to the brake system can be made.

3.13.1.7.2.5 The secondary brakes shall remain applied after initial actuation without further energy input.

3.13.1.7.2.6 Hydraulic four-wheel brake systems shall incorporate a tandem master cylinder to split the hydraulic brakes into two separate systems.

3.13.1.7.2.7 All vacuum brake hose shall conform to SAE Standard J1403.

Ø 3.13.1.7.2.8 Airbrake systems shall conform to SAE Standards J813, J844, J1402, and J10.

3.13.1.7.2.9 All hydraulic brake hoses shall conform to SAE Standard J1401.

3.13.1.7.2.10 Hydraulic brake fluids shall conform to SAE Standard J1703.

3.13.1.7.2.11 Ø Hydraulic brake line material shall meet or exceed the requirements of SAE Standard J524. Tubing shall be routed, where possible, so that structural members will provide protection from damage. Tubing shall be firmly anchored to prevent vibration.

3.13.1.7.2.12 Ø Brake line tubing shall be formed, bent and flared using hand or powered tools specifically designed for this application. Hand bending without the use of forming tools is not acceptable.

3.13.1.7.2.13 Ø Brake line connections shall incorporate 45 deg (0.785 rad) double flared tubing (SAE J533) mating with inverted flare type automotive tube fittings (SAE J512).

3.13.1.7.2.14 Brake lines shall be routed away from high temperature areas such as engine block and exhaust system. Ø

3.13.1.7.2.15 Sleeving used to protect the brake lines from abrasion shall be of non-moisture absorbent material. Ø

3.13.1.7.3 Vehicle Cabs:

3.13.1.7.3.1 Self-propelled equipment on vendor built chassis shall, where practical, include provisions for equipping the vehicle with an operator's cab. The following specifications apply to cab designs, when the cab is not an integral part of the vehicle as furnished by the automotive chassis manufacturer.

3.13.1.7.3.2 Insofar as possible, the cab should be an aesthetically pleasing adjunct to the vehicle, contributing to, not detracting from, the styling.

3.13.1.7.3.3 The installed height shall be kept to a minimum. A minimum of 3 in. (76.2 mm) of headroom shall be maintained when an operator of normal height and build (approximately 5 ft 9 in.) (1.75 m) is seated erect.

3.13.1.7.3.4 The cab shall be of rigid metal or resin impregnated fiberglass, strong enough to provide some measure of protection should the vehicle overturn.

3.13.1.7.3.5 Rear window area shall be as large as practicable.

3.13.1.7.3.6 The interior finish shall be smooth and impervious to water.

3.13.1.7.3.7 If turn signals are specified, the rear signal lamps may be specified as mounted high on the rear of the cab. Therefore, suitable wiring should be provided and stubbed off. This also would be true of provisions for clearance lights.

3.13.1.7.3.8 The cab shall be provided with rugged, rigid doors removable for summer operation.

3.13.1.7.3.9 Door handles, latches, and hinges shall be rugged, positive and easily maintainable on all equipment, and shall conform to the requirements of FMVSS, Title 23, Chapter 2, Standard No. 206 "Door Latches and Door Hinge Systems - Passenger Cars" on units equipped for highway travel.

3.13.1.7.3.10 At least 50% of the door glazing shall be capable of being opened. This may be done with vertically split windows, sliding on horizontal tracks, or dropping down into the door controlled by more conventional crank and regulator mechanisms.

3.13.1.7.3.11 All glazing shall conform to the requirements of FMVSS Title 23, Chapter 2, Standard No. 205 "Glazing Materials - Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Busses." Expensive plane or compound curved glazing is to be avoided.

3.13.1.7.3.12 A cab heater and a defroster for the entire windshield, of the heated air/blower type is to be provided on all units with cab. Installation and sizing should conform to FMVSS No. 103. Ø

3.13.1.7.3.13 Standard automotive interior mirrors shall be provided on all cab units on which vision through the rear window is not blocked by body or van. Ø

3.13.1.8 Instruments and Controls:

3.13.1.8.1 Controls and controlling circuits shall be designed such that any failure within a control or its circuitry will not introduce an unsafe operating condition.

3.13.1.8.2 Controls shall be grouped and located so as to be convenient to the operator when at his normal operating station but shall be located so as not to permit clothing to catch accidentally on them. Controls for operating the vehicle from the driver's seat shall be located and identified as specified in FMVSS Title 23, Chapter 2, Standard No. 101 "Control Location and Identification - Passenger Cars."

3.13.1.8.3 Controls shall be designed in accordance with the requirements of MIL-STD-1472.

3.13.1.8.4 Controls shall be designed for satisfactory operation when the operator is wearing heavy arctic type gloves and overshoes.

3.13.1.8.5 Controls shall be identified with permanently affixed and non-fading placards.

3.13.1.8.6 Ø Controls shall be placarded in sharp color contrast in large enough letters to be easily read from the operator's position indicating the function and direction of motion of the control.

3.13.1.8.7 Control panels shall provide easy accessibility of controls and instruments and shall contain all items necessary for the safe operation and control of the equipment. The panel controls and instruments shall be suitably identified and distinctly divided between prime mover and any ancillary equipment.

3.13.1.8.8 All instruments and control panels shall be lighted to a level of 5 foot candles (54 $1m/m^2$) of illumination, and shall not produce a glare to the operator.

3.13.1.8.9 Instruments and controls exposed to the weather shall be of a ruggedized, weatherproof type and shall be protected from ice and snow accumulations.

3.13.1.8.10 Ø No more than 33 lb (15 kg) of force shall be required to actuate any hand control. No more than 100 lb (45.4 kg) of force shall be required to actuate any pedal control.

3.13.1.8.11 Ø Controls, except transmission selector levers, shall move and operate in the direction of travel of the controlled function.

Ø 3.13.1.8.12 ON-OFF switches shall be ON when in the up position.

3.13.1.8.13 Ø Transmission selector levers shall conform with requirements of FMVSS Standard No. 102 as applicable, or shall move from Reverse to Neutral to Drive when moved toward the driver. Park position shall not be provided if the airline so requests.

3.13.1.8.14 Ø Motion controls, except the transmission selector lever, shall be of the deadman type, returning to Neutral position when released.

3.13.1.9 Equipment Stability:

3.13.1.9.1 Ø The unit shall meet the following wind load requirements. Unit force values are based on: $F = C_D \cdot .00252\ V^2$ where C_D is the drag coefficient, assumed to be 1.20, $.00252\ V^2$ is the stagnation pressure of dry air at 68^oF (20^oC) and standard atmosphere pressure with velocity of V miles per hours, and F is the unit force in pounds per square foot.

Deflections shall be limited to allow safe operation under worst condition with a side unit force of 19.4 PSF (928.9 Pa) (80 mph) (128.7 km/hr) and the unit shall withstand a side unit force of 24.4 PSF (1168.3 Pa) (90 mph) (144.8 km/hr) without tipping over.

3.13.1.9.2 The manufacturer shall maintain calculations and/or test data per ARP 1328 which indicates the stability of the unit. All stability calculations shall be based on the equipment being at minimum and maximum operational weight and at:

(a) Maximum extension (elevation)

(b) Minimum extension (elevation)

3.13.1.9.3 If stabilizers, outriggers and/or spring lockouts are used or combinations of same or similar devices to gain stability, calculations or test data shall be developed both with and without the devices.

3.13.1.10 Options: Manufacturers shall design the following options as a minimum group. Inclusion of the options on specific equipment will be specified in the controlling specification.

3.13.1.10.1 The fuel tank(s) shall have standpipes of different heights and a manual reserve cut-in valve so that the vehicle has approximately a five-gallon fuel reserve capacity. The minimum distance between the low standpipe and the bottom of the fuel tank is to be 0.50 in (12.70 mm) to provide a sump area for contaminates.

3.13.1.10.2 Engines which operate at governed speed to drive equipment other than the vehicle propulsion system shall be equipped with a tachometer which is green lined within the correct operating RPM range and red lined above this range. The tachometer shall be riveted to the engine instrument panel.

3.13.1.10.3 The engine(s) shall be equipped with an adjustable speed limiting governor. The type used shall be designated in the controlling specification.

3.13.1.10.4 Low engine oil pressure and low coolant level devices equipped to do either or both of the following as defined in the controlling specification.

a. Shut down the engine.

b. Indicate on an annunciator the nature of the malfunction.

3.13.1.10.5 The hydraulic system shall have a high pressure filter of 20 micron absolute rating or less according to pump or component manufacturer's specification on maximum particle size. The filter shall be provided with a differential pressure indication actuated or "red lined" at maximum allowable pressure differential.

3.13.1.10.6 A hot water heat-exchanger cab heater capable of producing approximately 5,000 BTU (5.3 MJ) per hour.

3.13.1.10.7 Tropical treatment for moisture and fungus resistance.

3.13.1.10.8 Ø Engine speed controls for operating lifts, belts, etc., shall be on a demand throttle basis, to a predetermined operating speed.

Ø 3.13.1.10.9 Provision for towing fore and aft.

Ø 3.13.1.10.10 Cab sky lights of maximum practical size.

3.13.1.10.11 Ø A starter motor circuit cutout to prevent damage to the starter or ring gear once the engine is running.

Ø 3.13.1.10.12 Magnetic drain plugs shall be installed in the engine crankcase, transmisstion and differential.

Ø 3.13.1.10.13 Flame and spark arresting muffler.

Ø 3.13.1.10.14 On lift equipment, an emergency lowering system operable from the aerial device.

Ø 3.13.1.10.15 All hydraulic conductors shall be number coded at each coupling point such as manifolds, valves, motors, etc. The line code shall be noted on the hydraulic schematic supplied in the maintenance manual.

Ø 3.13.1.10.16 A shut-off valve shall be incorporated in the supply line between the reservoir and the pump or filter as applicable.

3.13.2 Materials, Parts, and Processes:

3.13.2.1 All parts and materials needed to fabricate, assemble, and finish the equipment shall be furnished by the manufacturer unless otherwise specified.

3.13.2.2 All materials and components assembled or fabricated into the equipment shall be new and unused, of high grade quality, of current production, and free from all defects or imperfections which might affect the serviceability or appearance of the finished product.

3.13.2.3 Fire resistant and non-moisture absorbing materials shall be used wherever possible.

3.13.2.4 All bolted, screwed, and threaded fastenings shall incorporate adequate locking devices.

Ø 3.13.2.5 Weldments requiring alignment with assemblies, interchangeability, fit and flatness shall be fabricated with the use of fixtures capable of maintaining dimensions in the finished part within design tolerance.

Ø 3.13.2.6 Specified sections and weld design and application shall be such that heat distortion of plates and members is minimized in the final weldment.

Ø 3.13.2.7 Components must be installed per the manufacturer's recommendations. Modification of the component which could affect its performance must be approved in writing from the manufacturer of the component and the purchaser so advised. Any modified component should be identified as such to the purchaser for purposes of interchangeability.

Ø 3.13.2.8 All components shall be chosen to be within their manufacturer's published ratings under most severe conditions of operation. This shall include but not be limited to the following:

a. Hydraulic Components: Pressure, temperature, flow ratings for hydraulic components and fluid.

b. Chassis Components: Load rating of tires, axles, springs, transmission, driveline, engine and power take-off.

c. Mechanical Components: Speed, torque, force, environment, lubrication means, and expected service life of chains, belts, sheaves, sprockets, shafts, bearings, gears, etc.

d. Electrical Components: Voltage, current, load characteristics, and duty cycle of electrical components.

e. Others: For components proprietary to the manufacturer design shall conform to established industry practices.

Ø 3.13.2.9 Fastener heads shall not be located on rub or wear surfaces.

3.13.3 Standard and Commercial Parts:

3.13.3.1 Insofar as practicable, commercially available standard parts complying with commercial and/or military standards shall be used throughout.

3.13.3.2 Commercial grade fasteners shall be used throughout.

3.13.4 Moisture and Fungus Resistance:

3.13.4.1 Equipment and controls that are exposed to the weather shall be weatherproof type.

3.13.4.2 Fire resistant and non-moisture absorbing materials shall be used whenever possible in the Ø fabrication.

3.13.5 Corrosion of Metal Parts:

3.13.5.1 Suitable and adequate corrosion protection shall be applied throughout the equipment. All metal parts except stainless steel, bright plated metal, or aluminum shall be primed before assembly.

3.13.5.2 When specified in the controlling specification, vehicle fender wells, underbody frame and sills, etc. shall be protected with heavy-bodied asphaltic undercoating applied in accordance with the manufacturer's instructions. Otherwise, all unexposed surfaces shall be painted with one coat of primer.

Ø 3.13.5.3 Fasteners shall be of corrosion resistant material or plated to prevent corrosion.

3.13.6 Interchangeability and Replaceability:

3.13.6.1 All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance.

3.13.6.2 All components and assemblies incorporated in the equipment shall be designed and manufactured to Ø dimensional tolerances which will permit future interchangeability and facilitate replacement of parts.

3.13.6.3 The individual parts and components of each unit shall be of the same original manufacture and Ø part number unless otherwise approved by the purchaser.

3.13.7 Workmanship:

3.13.7.1 High standards of workmanship and methods of fabrication shall be basic requirements.

3.13.7.2 Sheared or sharp metal edges shall be burred and broken. All exposed metal corners shall be removed and adequately radiused.

3.13.7.3 Welding shall conform to the recommendations of ARP 1330. Welds shall exhibit complete Ø penetration to the root and complete fusion to the base metal.

Ø 3.13.7.4 The finished weld shall be free of undercutting, slag inclusions, and cracks.

Ø 3.13.7.5 Slag and spatter shall be removed from the weld and surrounding area before painting.