

CHARLOTTESVILLE- ALBEMARLE AIRPORT

CHARLOTTESVILLE, VIRGINIA

**Multi-Tasking Snow Removal Unit to include Carrier Vehicle with 22' Snow Plow,
20' Rotary Broom and High Velocity Air blast system**

SPECIFICATIONS

June, 2015

CHARLOTTESVILLE-ALBEMARLE AIRPORT AUTHORITY

INVITATION TO BID (ITB)

Multi-Tasking Equipment (MTE) for Airfield Snow Removal High Speed, Multi-Tasking Snow Removal Unit to include Cab Forward Carrier Vehicle, 22' Snow Plow, 20' Rotary Broom and High Velocity Air blast system.

The Charlottesville-Albemarle Airport Authority, acting by and through the Executive Director, invites bids for the purchase of a Multi-Tasking Equipment (MTE) for Airfield Snow Removal High Speed, Multi-Tasking Snow Removal Unit to include Carrier Vehicle, 22' Snow Plow, 20' Rotary Broom and High Velocity Air blast system

Copies of the Bid Documents and Specifications are available upon request to W. D. Pahuta, Deputy Director, Charlottesville-Albemarle Airport Authority, 100 Bowen Loop, Suite 200, Charlottesville, Virginia, 22911, (434) 973-8342.

Bids will be received until 2:00pm, local prevailing time, June 25, 2015, by the Deputy Director, Charlottesville-Albemarle Airport Authority, 100 Bowen loop, Suite 200, Charlottesville, Virginia, 22911. Each bid must be contained in an envelope which shall be sealed, conspicuously endorsed with the bidder's name, date, and time Bid is to be received and may be either mailed or hand delivered. Bids will be opened and read aloud in the Authority offices at 2:00 pm, local prevailing time, June 25, 2015. Bids received after 2:00 pm local prevailing time will be returned unopened.

The Bid must be submitted on the blank form furnished by the Authority and must give all information required. This is Attachment A included in the ITB.

The Authority reserves the right to accept or reject any or all bids and to waive any informalities in Bids received, if it is in the best interest of the Authority to do so.

W. D. Pahuta
Deputy Director
Charlottesville-Albemarle Airport Authority

**CHARLOTTESVILLE-ALBEMARLE AIRPORT
AUTHORITY INVITATION TO BID**

GENERAL CONDITIONS

1. Bids must be submitted in a sealed envelope with the outside of the envelope marked in the lower left hand corner as follows:

Multi-Tasking Equipment (MTE) for Airfield Snow Removal High Speed, Multi-Tasking Snow Removal Unit to include Cab Forward Carrier Vehicle, 22' Snow Plow, 20' Rotary Broom and High Velocity Air blast system

June 25, 2015

2:00 PM

2. Bids will be time stamped upon receipt and retained unopened in a secure location until bid opening. **FACSIMILE AND TELEGRAPHIC BIDS SHALL NOT BE ACCEPTED AS RESPONSES FOR COMPETITIVE SEALED BIDDING.**
3. No consideration will be given to date of postmark.
4. The Airport Authority reserves the right to accept or reject any or all bids in whole or in part and to waive any informality in the bid. Informality shall be defined as a minor defect or variation from the exact requirements which does not affect the price, quality, quantity or delivery schedule. The Authority reserves the right to terminate the procurement process at any time if the Authority deems it is in its best interest to do so.
5. The specification herein is intended to indicate the character, quality and/or performance of the goods or services desired. Unless qualified by the provision "No Substitute" the name of a brand, manufacturer or catalog designation does not restrict the bidder to that brand or manufacturer. Alternates to the specified goods or service will be considered to the extent that such action is deemed in the best interest of the Airport Authority. Pursuant to Section 11-49 of the Code of Virginia, 1950, as amended, the Authority, in its sole discretion, shall determine if an article is an equal of that specified, considering quality, workmanship, economy of operation, and suitability for the purpose intended.
6. The Airport Authority will assume no responsibility for oral instruction, suggestion or

interpretation. . Any question regarding the bid documents and/or specifications should be directed to W. D. Pahuta, Deputy Director, and any material change will be submitted to all bidders through issuance of an addendum.

7. Modification of or corrections to bids are not acceptable after bids have been opened. Erroneous bids may be reclaimed or superseded any time prior to bid opening time. Any new bid must be marked with the additional notation "Supersedes all previous submissions".
8. Identity of bidders, except in the case of construction contracts, will not be disclosed prior to bid opening.
9. As part of this bid a notarized Certificate of No Collusion must be submitted with the bid. Certificate is attached.
10. Unless otherwise noted below no bid may be withdrawn from consideration for 120 days from

bid opening except as provided in Section 11-54 of the Code of Virginia, 1950, as amended. A bidder may withdraw a bid from consideration if the price bid was substantially lower than the other bids due solely to a mistake therein, provided the bid was submitted in good faith, and the mistake was a clerical mistake as opposed to a judgment mistake, and was actually due to an unintentional arithmetic error or an unintentional omission of a quantity of work, labor or material made directly in the compilation of a bid, which unintentional arithmetic error or unintentional omission can be clearly shown by objective evidence drawn from inspection of original work papers, documents and materials used in the preparation of the bid sought to be withdrawn. The bidder shall submit the original work papers, documents and materials used in the preparation of the bid at or prior to the time fixed for the opening of bids. Thereafter, the bidder shall have two days after the opening of bids within which to claim in writing any mistake as defined herein and withdraw his bid. Such mistake shall be proved only from the original work papers, documents and materials delivered as required herein. The work papers, documents and materials may be considered as trade secrets or proprietary information subject to Section D of 11-52 of the Code of Virginia. No bid may be withdrawn when the result would be the awarding of the contract on another bid of the same bidder or of another bidder in which the ownership of the withdrawing bidder is more than five percent. No bidder who is permitted to withdraw a bid shall, for compensation, supply any material or labor to or perform any subcontract or other work agreement for the person or firm to whom the contract is awarded or otherwise benefit, directly or indirectly, from the performance of the project for which the withdrawn bid was submitted. If a bid is withdrawn under the authority of this section, the lowest remaining bid shall be deemed to be the low bid.

11. Do not include taxes, including excise taxes in your quotation. A tax- exempt certificate will be provided upon request.
12. Tabulations of bids are a matter of public record and are available upon request.
13. Awards shall be based on determination of the lowest responsive and responsible bidder.

14. All prices submitted must be FOB Destination-Freight Prepaid and Allowed, unless otherwise specified.
15. In the case of error in the extension of prices the unit price shall govern.
16. Unless otherwise noted any equipment shall be new, unused, of current production and standard to the manufacturer. Where any part or nominal appurtenances of equipment are not described it shall be understood that all equipment and appurtenances standard to or recommended by the manufacturer for complete and safe use shall be included as part of this bid.
17. A Material Safety Data Sheet is required for all chemicals proposed to be furnished as a result of this bid. The MSDS must list all ingredients which constitute more than 1% of the product (.1% for known or suspected carcinogens); identify the product by common and chemical name; provide physical and chemical characteristics of any hazardous components; list any known acute or chronic health effects; specify exposure limits, precautionary measures, and emergency and first aid procedures.
18. The undersigned hereby certifies that the provisions of the federal Buy American provisions shall be met.
19. A requirement in the invitation to bid that fixes the time within which bids must be received is

not a minor defect or an informality that may be waived but, rather, a material and formal requirement that, under the circumstances present in the instant case, must be fulfilled to the letter of the law.
20. Bids shall be valid and binding for a period not less than ninety (90) days from the date set for receipt of bids

Conditions herein have been carefully read and this bid is submitted subject to all requirements stated herein. The undersigned hereby acknowledges and agrees if this bid is accepted to furnish all goods and/or services for which prices are quoted in strict accordance with the specifications.

SPECIAL CONTRACT TERMS AND CONDITIONS

1. The General Terms and Conditions applicable to the Authority's procurement transactions are attached as Attachment B and FAA provisions for Airport Improvement Program as Attachment C of this ITB, and are incorporated by reference as if set forth herein verbatim. The provisions of Attachment B and C should be construed together with the provisions of this ITB, so as to give effect to the terms and conditions set forth within each whenever possible. However, in the event of any conflict between the provisions of Attachment B or C and those set forth within this ITB, the provisions of this ITB shall govern as the requirement applicable to the contractor.

SPECIFICATIONS

One Multi-Tasking Snow Removal Unit to include Cab Forward Carrier Vehicle with 22 foot Snow Plow, 20 foot Rotary Broom and High Velocity Air blast system

INTRODUCTION, COMMON ITEMS, OPTIONS

INTENT:

It is the intent of these Specifications to provide the basis for the procurement one 4x4 all-wheel drive, cab forward carrier vehicle with a 22 foot runway plow and 20 foot broom/air blast unit. The vehicle and mounted equipment shall conform to these specifications and shall be of all wheel drive design and must be designed for the specific purpose of heavy, high-speed snow removal. The carrier vehicle shall be line built by the original manufacturer and the attachments shall also be built by the chassis manufacturer. All-wheel drive design, transmission and engine shall be approved by the original equipment manufacturer for use in their carrier vehicle and be fully warranted. Aftermarket conversions not approved and warranted by the original equipment manufacturer are not acceptable.

It is also the intent of these Specifications to stipulate the minimum acceptable requirements of good engineering design and performance and to establish the Bidder's responsibility in designing, manufacturing and furnishing all materials, parts, engineering and labor, and to supply the equipment being advertised for in complete conformance with the operational requirements outlined. Any item omitted which is clearly necessary for the satisfactory performance of the proposed equipment shall be considered a part of the Contract, even though not directly specified. All items furnished shall be new and unused, free of all defects and imperfections that could affect the serviceability of the finished product, and shall meet the minimum requirements contained herein.

GENERAL:

The Specifications do not include any proprietary items, circuits, or devices, which would preclude any equipment manufacturer from producing equipment to meet these Specifications. All technical tolerances, ratings, and technically specified criteria contained within these Specifications are considered to be written within the current state-of-the-art and are currently being met by commercially available equipment. The fact that a manufacturer chooses not to produce equipment to meet these Specifications, providing the above criteria are met, will not be considered sufficient cause to adjudge these Specifications as restrictive.

In cases where an item is identified by manufacturer's name, trade name, catalog number or reference it is understood that the Bidder proposes to furnish the item so identified and does not propose to furnish an "equal" unless the proposed "equal" is definitely indicated therein by the

Bidder. Bids on "equal" items will be considered provided each Bidder clearly states on the face of his Proposal exactly what he proposes to furnish as a proposed "equal", or forward with his bid, a cut, illustration or other descriptive matter which will clearly indicate the character of the article covered by his bid. The Airport Authority hereby reserves the right to approve as an equal, or to reject as not being an equal, any article the Bidder proposes to furnish which contains major or minor variations from Specification requirements, but which may comply substantially therewith.

It is the intent of these Specifications to establish that the Bidders will bid only the top of their line/deluxe/best and latest model unit including accessories and attachments and will offer the most life-cycle cost effective unit and accessories and attachments available. Used and or surplus equipment or prototypes will not be allowed.

While it is understood that the various components incorporated into the unit assembly are warranted by the specific component manufacturers, it shall be understood that the successful Bidder will be responsible for assistance in and resolution of any and all warranty related problems. The successful Bidder is regarded as the prime Contractor for the completed vehicle. As such, the Bidder will be held responsible for the proper selection, application and performance of the completed vehicle. All components of the drive train shall have torque capacities equal to the maximum output of each component plus an adequate factor of safety to prevent damage caused by excess torque loading. Along with his bid, the Bidder shall provide a signed certification that the components constituting the whole of the equipment being supplied comply with the applicable performance, design, and construction requirements of this specification, and are suitable for use in this type of vehicle.

RESPONSIBILITY OF BIDDERS AND CONTRACTORS:

In all cases, it is the Bidder's responsibility to supply all information requested by these Specifications exactly as specified. In cases where information is not provided, is incomplete, or is in a form not as requested, the purchaser may, at its discretion, rule a Bidder in non-conformance to Specification with regard to the item for which information is requested.

STANDARD EQUIPMENT:

Experimental or prototype units and accessories will not be acceptable. A Prototype vehicle is one that has been developed by the manufacturer with neither a record of certifiable test results nor supporting manuals. Materials or equipment which are not produced by regular production methods and/or which have not been offered for sale to the public through accepted sales channels for at least one (1) year prior to the offering of this bid will be considered experimental. At the time bids are submitted, the Bidder shall furnish evidence that the proposed equipment has been commercially available through him to the trade for a period of not less than one (1) year (equipment with a similar design of components), fully field tested, that the components are currently listed with SAE or ASTM, that the components are approved by the manufacturers for

their intended use, and that all welding on the unit meets current applicable AWS standards

TECHNICAL REQUIREMENTS:

General Description: The unit shall be self-propelled and consist of the necessary chassis configuration to provide the required maneuverability. There are three industry standard configurations of MTE which are Modular, Integral Non-Articulating and Integral Articulating.

- **Modular:** Typically consisting of a front mounted plow equipped power unit, employing a hitch, either fifth-wheel or pintle type, utilized to pull a trailer mounted tow-behind broom and airblast. Most modular configurations utilize separate drive engines, one dedicated to the traction unit, one dedicated to the tow behind broom/airblast.
- **Integral Non-Articulating:** Typically consisting of a front mounted plow equipped power unit utilizing a rigid, non-articulating common chassis and two main load bearing drive axles, one front and one rear, each with steering capabilities so as to enhance maneuverability. The rotary broom is mounted amidships with the airblast discharge nozzles located at, near, or behind the trailing discharge ends of the rotary broom. An Integral Non-Articulating unit may be equipped with either one or two engines to provide the required power for traction drive and the power driven components.
- **Integral Articulating:** Typically consisting of a front mounted plow equipped power unit utilizing an articulating chassis with multiple load bearing axles, drive axles may be located at the front or rear of the unit. The rotary broom mounted amidships and the airblast system located at, near, or behind the trailing discharge ends of the rotary broom. Integral Articulating units are typically equipped with two engines, one required for the traction drive and the second for the power driven components.

Any single operator configuration with a proven history of effective and efficient operation which positions the snowplow first, followed by the rotary broom and in turn followed by the high-velocity airblast system is acceptable providing said unit can adhere to the operational requirements, maintenance and storage capabilities of the airport.

This carrier vehicle shall be all wheel drive and must be **designed** and **manufactured** in the United States, for the specific purpose of snow removal.

This vehicle shall comply with all applicable FMCSR and FMVSS quality/safety standards, SAE ARP 5548 and requirements of the FAA Advisory Circular 150/5220-20.

These specifications require the doing of all things necessary or proper for, or incidental to the furnishing of said unit. All items of design and equipment not listed in these specifications, but involved in carrying out their intent, are required to be furnished by the bidder, the same as if these items were specifically mentioned and described in these specifications.

MINIMUM PERFORMANCE REQUIREMENTS:

The equipment shall have the ability to remove snow, ice, slush, sand, and other debris at rated speeds of 35 mph or faster, depending on conditions. Test procedures and airport/contractor obligations are listed in bold letters at the end of this section.

The design of this unit shall ensure positive tire-to-ground tractive effort while operating and performing full wall-to-wall turning diameter of 86 feet or less with plow and broom attachments unless otherwise specified. The vehicle shall be equipped with no fewer than two driving axles or one drive axle with differential lock.

The performance requirements are based on snow with a density of 15 to 40 pounds per cubic foot for the test to be considered valid with a designed speed of 35 mph. A quick generalized reference of snow density is as follows:

Snow Condition	Density
New fallen snow	2 to 6 lb. per cu. ft.
Snow plowed or swept 1 or 2 times	5 to 10 lb. per cu. ft.
Snow plowed or swept 3 or more times	10 to 15 lb. per cu. ft.
Firm packed snow	25 lb. per cu. ft.
Slush	40 lb. per cu. ft.

The drive system shall be capable of continuous operation with the necessary refueling during an entire snow event without maintenance. A snow event shall be considered to be at least 72 hours in duration. The vehicle shall require only one operator to perform all functions and shall provide comfortable operating environment with adequate conditioned air, visibility, and ease of control to operate for a minimum period of at least 8 hours with the necessary breaks.

Written installation and/or application approval from the manufacturers of ancillary components shall be provided upon request of the airport operator. This shall include various components such as the engine, drive train, hydraulic systems, electrical, electronic and data processing devices.

Hydraulic pressure, flow and temperature parameters shall be within the limits prescribed by the component manufacturer for this installation while the vehicle or subsystem is operated at its normal duty cycle in the maximum or minimum ambient temperature conditions normally expected. These approvals shall be delivered with the vehicle upon request of the airport operator.

Approvals for engine and transmission installation shall be based upon successful completion of installation tests conducted according to the component manufacturer's guidelines. Approvals shall indicate the cooling system and general installation allows the vehicle or subsystem to be operated continuously at full rated capacity in the maximum or minimum ambient temperature conditions normally expected without exceeding any of the maximum or minimum allowable temperature criteria established for installation approval. Any deviations allowed from standard criteria must be specifically waived in the written approval by the

component manufacturer. These approvals shall be delivered with the unit upon request of the airport operator.

Axles, transmissions, transfer cases and other gear reduction or multiplication devices shall be designed for continuous operation at maximum rated capacity in the maximum or minimum ambient temperature conditions normally expected without exceeding the maximum recommended operating temperatures as specified by the component manufacturer.

An MTE shall be designed to produce consistently clear pavement within the operating width without residue caused by bouncing or skipping of either the plow or rotary broom or other adverse effects such as oscillations of the plow or broom caster wheels while operating at a forward speed of at least 35 MPH.

To conform to a High Speed requirement the manufacturer shall provide testing results certified or conducted and certified by a PE or an officer of the company. The purchaser shall reserve the right, at his/her sole discretion and expense, to conduct a performance test to ensure performance and quality compliance within the stipulated requirements prior to acceptance.

Tests and Contractor Obligations:

The airport operator requires the following operational and performance testing. Certification of test compliance required with bid response. The subject testing may involve multiple runs on a runway or taxiway of sufficient length in snow densities of 15-40 pounds per cubic foot (PCF) and depths of snow (one inch, two inches, etc.), at speeds as high as 35 miles per hour to verify machine performance. Operations may be conducted with and/or without the high velocity air blast.

Tests for maneuverability may involve meeting the wall-to-wall turning diameter requested or proposed with considerations given to exceptions agreed upon in writing prior to issuance of the contractual agreement.

Additional operational testing may include but not be limited to acceleration, braking ability measured by G-force or stopping distance, operation of all systems and accessories electrical, pneumatic or hydraulic, vibration, leaks, unusual noises, water tightness of the cab and any NEMA rated enclosures.

The airport may weigh the unit to ensure the vehicle weight is within acceptable axle weight ratings.

Cold weather operations. A fully-equipped carrier vehicle (all types) with all attached snow removal and ice control equipment should be able to perform normal operations at an ambient temperature:

- (1) of 10°F (-12°C) below the lowest temperature in which the vehicle is expected to operate, or
- (2) at -40°F (-40°C) at airports located in extremely cold climates.

b. Hot weather operations. The vehicle should be capable of operating at an ambient temperature of 70°F (21°C) at the maximum speed recommended by the manufacturer without any of the vehicle components exceeding their normal operating temperature.

c. Power. Carrier vehicles must have sufficient power to perform all operational and attachment functions simultaneously.

d. Performance. The following tests must be conducted on a carrier vehicle loaded to its Gross Vehicle Weight and must include the following systems: hydraulic, power train, brake, lighting, controls, and instruments.

(1) 10 mile test. Drive the carrier vehicle over hard surfaced roads at normal airport speeds for a distance of 10 miles (16 km) with no problems experienced. Focus special attention on vibration, steering, vehicle drift, rattles, leaks, and interior controls.

(2) One hour test. Perform this time test at a speed of 5 mph (8 km/h) over all types of terrain that would normally be encountered at the airport.

(3) Service brake test. Conduct this test at speeds of 20 mph and 40 mph (32 km/h and 64 km/h). Using the service brakes only, the fully loaded carrier vehicle must be brought to a complete stop within a distance of 35 and 131 feet (11 and 40 m) respectively measured from the point of brake application. The test must be conducted for two complete cycles in either direction on a hard pavement surface that is dry, reasonably level and free of loose material. Make no steering corrections for vehicle drift during the stop.

(4) Emergency brake test. Conduct this test at a speed of 40 mph (64 km/h). Using the emergency brake only, the fully loaded carrier vehicle must be brought to a complete stop on the most critical airfield pavement grade within a distance of 288 feet (88 m) measured from the point of brake application. Conduct this test on a hard surface that is dry and free of loose material. Once stopped, the brake must continue to hold the carrier vehicle without movement for five minutes. Make no steering corrections for carrier vehicle drift during the stop.

Approvals:

The following approvals are required and shall be submitted with the quotation package. If the proposed vehicle configuration does not include the specified component, the offeror shall be obligated to indicate it in the proposal:

- Motive engine installation approval by engine manufacturer. The engine shall be a four stroke EPA compliant diesel type, six cylinders, minimum 13 liter nominal displacement, developing a minimum of 475 horsepower at 2100 RPM.
- Auxiliary/Aggregate engine installation approval by engine manufacturer. The engine shall be a four stroke Tier III, six-cylinder diesel engine rated a minimum 475 HP, 12.5 liter displacement minimum.
- Motive transmission approval by transmission manufacturer
- Chassis transfer case if applicable
- Axles (drive axles and non- drive axles)
- Hydraulic pumps
- Hydraulic motors
- Air blast unit
- Gear drives and gear boxes, all applicable power take-off devices (e.g. pump drives)
- Drive shafts shall have an application approval by the joint/shaft manufacturer.

Carrier Vehicle Description:

The term carrier vehicle represents the various self-propelled prime movers that provide the power necessary to move snow and ice control equipment during winter operations. These specifications contemplate the furnishing and delivery of a NEW, TWO ENGINE DESIGN MULTI-TASKING SNOW REMOVAL VEHICLE and indicate in general the type, size, and quality desired. Although these units may not be designed as over-the-road highway vehicles, unless otherwise specified by the purchaser, the following Federal Motor Vehicle Safety Standards shall apply as though they were an on-highway vehicle:

FMVSS 101 Controls & Displays

FMVSS 102 Transmission Shift Lever Sequence, Starter Interlock & Transmission Braking Effect

FMVSS 103 Windshield Defrosting & Defogging Systems

FMVSS 104 Windshield Wiping & Washing Systems

FMVSS 105 Hydraulic & Electric Brake Systems

FMVSS 106 Brake Hoses

FMVSS 108 Lamps, Reflective Devices, & Associated Equipment

FMVSS 111 Rearview Mirrors

FMVSS 113 Hood Latch Systems

FMVSS 116 Motor Vehicle Brake Fluids

FMVSS 119 New Pneumatic Tires

FMVSS 120 Tire Selection & Rims for Vehicles Other Than Passenger cars
FMVSS 121 Air Brake Systems
FMVSS 124 Accelerator Control Systems
FMVSS 201 Occupant Protection in Interior Impacts
FMVSS 205 Glazing Materials
FMVSS 206 Door Locks & Door Retention Components
FMVSS 207 Seating Systems
FMVSS 208 Occupant Crash Protection
FMVSS 209 Seat Belt Assemblies
FMVSS 210 Seat Belt Assembly Anchorages
FMVSS 302 Flammability of Interior Materials

Materials: Materials used on a carrier vehicle shall conform to the specifications listed in this document and the appropriate sections of Title 49, Chapter III, Subchapter B - Federal Motor Carrier Safety Regulations (Title 49). When not specifically listed, materials shall be of the best quality available for their intended commercial use. Component parts shall be new and free of all defects and imperfections that could affect the serviceability of the finished product. All parts and components of this unit shall be engineered and classified as HEAVY DUTY, and shall be of the size, material, and strength to sustain the maximum load limits and severe operating conditions encountered in snow removal, while resulting in minimum wear and fatigue.

Design: Equipment shall be developed in accordance with the best engineering practices available. This includes the incorporation of ergonomic designs specifically directed at the vehicle cab environment. Vehicle design shall include current state-of-the-art procedures that consider improved cab visibility, communications systems, interior lighting and the mitigation of noise and vibration. Design and installation of equipment shall permit easy accessibility for maintenance and service. All vehicle stress points shall be designed to distribute and dissipate shock forces. These specifications require the doing of all things necessary or proper for, or incidental to the furnishings of said unit. All items of design and equipment not listed in these specifications, but involved in carrying out their intent, are required to be furnished by the bidder, the same as if these items were specifically mentioned and described in these specifications.

Construction: Vehicle construction shall provide maximum protection against structural member failures. Equipment shall withstand the cold, moisture, strains, jars, vibration, and other conditions that are likely to be encountered during operation. All components and assemblies shall be free of hazardous protrusions, sharp edges, cracks, or other elements that might cause injury to personnel or damage to equipment. Location of all air, oil, and hydraulic lines as well as electrical wiring shall be in protected positions properly attached to the frame or body structure. Wherever these lines pass through structural members they shall be protected with looms or grommets except where a through-frame connector is necessary.

The chassis shall be designed to provide the optimum tractive effort encountered in the subject operating environment. Such design shall not exceed load bearing component ratings in plow/broom up or plow down positions. The unit shall be useable with or without the plow mounted.

Chassis:

Structural Members: The frame shall be constructed of alloyed steel, heat treated, with appropriate strength commensurate with the span of the frame and the loads imposed to ensure its structural integrity remains intact throughout its projected useful lifetime. The frame shall be assembled with Grade-8 flanged self-locking frame bolts, alternative fasteners such as Huck-Bolts may be considered as an acceptable alternative. FRAME LINERS, WRAPPERS, FISHPLATING, AND BOLT-ON EXTENSIONS SHALL NOT BE ACCEPTABLE unless specified by the airport operator. The chassis shall have an adequate number of cross members to resist frame distortion generated from lateral or torsional stress expected in this application.

Steps, stairways, ladders walkways handholds, and handrails used to access the cab, maintenance and operational areas or other parts of the equipment shall conform to the most recent edition of SAE J185 – Access Systems for Off-Road Machines, using the ‘preferred’ dimensions offered in this standard.

Two (2) tow hooks (each) shall be installed at the front and rear of the unit, or each unit, if design allows decoupling. Capacity and location of the hooks shall account for the rolling weight of the vehicle and the intended purpose of the tow hooks.

Dimensions and Clearances:

- a) The minimum ground clearance of the vehicle chassis, not including ancillary snow removal devices shall be approximately 10 inches measured at the bottom of the transfer case or differential housings.
- b) The maximum overall height of the vehicle including lights and exhaust stacks (with rain cap up if so equipped) shall be 132 inches. A placard shall be installed in the vehicle cab stating the maximum overall height. If practical, the placard should be located at the top of the windshield as nearly over the steering wheel as possible to be immediately visible to the operator when looking upwards.
- c) The maximum overall width of the vehicle’s widest device shall be 22 feet, specified by the customer, taking into consideration gates and doors to equipment shops at the airports.
- d) The maximum overall length of the chassis and broom combination (not to include the plow attachment) shall be 42 feet specified by the customer taking into consideration shop area and maneuverability expected of the vehicle during operation.
- e) Proposals shall include dimensional drawings of the unit as proposed. Drawings shall be included to describe the fully assembled configuration and the disconnected configuration if design provisions have been made to accommodate storage in restricted areas.

Weight Distribution: The gross vehicle weight of the vehicle shall be distributed over its axles in accordance with best engineering practices. The center of gravity shall be kept as low as possible under maximum load conditions. A copy of the calculated weight distribution shall be provided to the customer prior to construction. The actual weight distribution on the produced vehicle shall not deviate from the calculated weight distribution by more than 5% on any axle, or for the gross

weight as determined by weighing the unit at a public certified scale.

Accessibility and Component Location: Engine and chassis components shall be positioned to allow easy access for inspection and maintenance purposes. Components that historically present maintenance problems or those that have the potential to cause operational problems should particularly be located in unobstructed areas. Fluid capacities that must be checked during a pre-trip inspection, such as engine oil, engine coolant hydraulic oil level(s), windshield washer fluid level, and diesel fuel level shall be visually observable or otherwise capable of being checked without the need for tools, and without requiring work stands, portable ladders, or other equipment to check the service levels. To the extent practical lighting in these areas shall be adequate to perform the checks without the need for flashlights or other portable lighting. Cover plates shall be equipped with either quick-disconnect fastenings or hinges.

Engines:

The unit shall be manufactured and equipped with the latest production design diesel engines which meet the performance requirements for the MTE to function as designed. The engines provided shall be equipped with CAN Bus, SAE J-1939 communications protocol microprocessors, sensors and controls. The engines shall be of the latest emissions ratings permitted for the applications as required by the Local Prevailing Air Quality Authorities.

Engine and vehicle manufacturers shall provide an application approval, with the proposal to verify the proposed engine or engines are suitable for the application as configured and the installation is approved by the engine manufacturer. The vehicle shall utilize diesel engines which shall be designed and tuned for operation using ultra-low sulfur diesel fuel or the current fuel standard as specified by the engine manufacturer. All required engine fluids oils shall be as per current SAE, API, or ASTM specifications as required by the engine manufacturer. Dual engine vehicles shall be required to operate on common service fluids including fuel, oil, coolant, and any engine accessory hydraulic oil(s).

The engine shall develop sufficient torque and horsepower to meet its normal operational requirements. Typical horsepower (HP) for carrier traction drive engines range from 400 to 475 HP, with a power density not to exceed 44 HP per liter of displacement. Typical horsepower ranges for broom and airblast drive auxiliary engine shall range from 300 to 475 HP depending upon broom size and performance requirements, power density shall not exceed 44 HP per liter of displacement.

The engines shall be mounted on approved vibration isolating mounts so as to minimize the transmission of vibration and harmonics into the chassis and operator's cab.

As part of the CAN Bus engine control system, the engine shall be programmed for automatic protection with visual and audible warnings for engine faults such as low oil pressure/high coolant temperature/low coolant level. The carrier engine shall be programmed to provide an "engine derate" or "limp-in" mode in the event of one of the aforementioned engine faults. This is a

mandatory requirement so as to reduce the possibility of having a disabled or immovable MTE on an active runway or taxiway. The contractor or manufacturer of the MTE shall be required to provide a demonstration of this capability upon acceptance of the machine. The auxiliary engine, (not used for traction drive) shall be fitted with a shutdown system for the aforementioned engine faults.

Cooling Systems: Internal temperatures of liquid cooled engines shall utilize thermostatic regulation of coolant flow. The cooling system shall utilize a thermostatically controlled radiator fan. The radiator provided shall be constructed of a material that is resistant to the corrosive effects of acetate type pavement deicing chemicals commonly used in the aviation industry. Typically aluminum is preferred over copper and brass for this application. Radiator fan guards shall be provided as needed for safety purposes. The engine cooling system shall be filled with permanent type antifreeze protecting the system to -40 degrees F. Silicone radiator and heater hoses with compatible spring loaded or heat shrink hose clamps shall be provided. Drain cocks shall be installed at the lowest point of the cooling system and at other points necessary to completely drain the system. A sight glass or other device is required in all liquid cooling systems to allow the operator to determine that there is sufficient fluid for normal and safe operation without the need to open the system.

Fuel System: The fuel system shall comply with Title 49 and include all components necessary for a complete operational system.

Fuel Tank(s) and Lines: Useable fuel capacity should be no less than an 8-hour supply unless the airport operator requires a longer period. Engine literature shall be provided in the bid package that includes certified fuel usage rates. If dual tanks are used, the supply system shall be designed to ensure an uninterrupted flow of fuel to the engine(s) without input by the operator, and to allow shutoff of each tank should the crossover lines (or either tank) be damaged. Dual tanks shall also have adequately sized crossover lines and vents to allow refilling both tanks from one location. Fuel lines shall be securely fastened in place, installed to prevent chafing or strain and protected by grommets where lines project through metal apertures. Fuel tanks shall be equipped with an accessible bronze or brass drain plug or a quick drain.

Fuel Filler Pipe: The fuel filler pipe(s) shall be easily accessible. A light chain shall be attached near its opening and to the filler cap to prevent loss of the cap. The filler neck shall include a screen to prevent the entry of foreign objects into the tank. The fuel filler cap shall be painted a color appropriate for the type of fuel, and a permanent label shall be affixed as close as practical to the fill neck(s), in an area visible to the person refueling the vehicle, stating the appropriate fuel and capacity of the tank(s). If fuel fillers are not installed on both sides of the vehicle, a label shall be installed in the cab near the fuel gauge indicating which side of the vehicle must be positioned towards the fuel dispenser.

Fuel Pickup Tubes: On twin engine Integral configuration units in which two engines share common fuel supply tanks it is recommended that the broom engine pickup tube be approximately

1" shorter than the carrier engine. This can eliminate the possibility of a carrier out of fuel on an active runway or taxiway.

Fuel Filtration: The engines shall be fitted with the manufacturer's recommended fuel filtration devices.

Air Filtration: The engines shall be fitted with air filtration devices that have been approved and/or recommended by the engine manufacturer. Typically a two-stage system is utilized in this application. The first stage incorporates a centrifugal pre-cleaner at the air inlet to separate coarse airborne matter; the second stage shall consist of a dry type replaceable paper filter element. A restriction indicator is required for each engine air intake system. The connection between the air cleaner outlet(s) and the engine intake(s) shall be waterproof and dust tight. The air cleaner intake shall be positioned in a manner to discourage the ingestion of snow and other contaminants, e.g. within the hood cavity. Chassis engine air intake filter assemblies shall be positioned in a way such as not to interfere with operator visibility.

Engine Starter: The engine(s) shall be provided with an electrical starter of the correct voltage as specified by the MTE manufacturer. The starter shall be designed with overload protection. Starting circuitry shall be designed so as not to induce excessive voltage drop that may cause malfunction of the on-board microprocessors.

Exhaust System: The engine shall be equipped with an efficient and safe exhaust system to minimize noise, and exhaust gases from entering the vehicle cab under all operating conditions. Further noise reduction by noise suppression materials, such as muffler insulation, is encouraged. The engine muffler(s) combined with acoustically insulated cabs shall provide for a noise level not to exceed 85 db as measured 6 inches from the operator's ear at any operating condition. Horizontal portions of exhaust systems shall be protected, whenever possible, from corrosive agents and fuel spills. Mufflers and exhaust components positioned in or near normal operator work areas shall include appropriate guards to minimize the burn risk to airport personnel. Exhaust systems shall be positioned on the vehicle in a manner to minimize contact with slush and snow. Muffler(s) are to be made of aluminum, aluminized steel, stainless steel, or materials coated with ceramics. Devices shall be installed to prevent snow and slush from entering vertical exhaust stacks.

Lubrication: An engine's lubricating system shall be equipped with standard production fittings and accessories. Engine oil filter(s) shall be engine manufacturers- approved design and able to accept commercial replacement elements. All engine(s) shall receive lubrication prior to delivery with lubricants designated for use under ambient temperature conditions at the point of delivery. The unit(s) shall be labeled to identify the proper lubricants and their temperature ranges.

Engine Enclosure(s): The engine packages, as well as all attached hydraulic, electrical, and mechanical components, shall be protected wherever practical from snow, rain, chemicals, and other winter elements. Enclosures may be fabricated from aluminum, fiberglass, steel and/or other durable material commonly used for this application. Manufacturers shall be encouraged to utilize

corrosion resistant fasteners and hardware wherever feasible. Engine enclosures should be designed with maintenance access in mind. System components such as junction boxes, and other auxiliary items should not be directly mounted to the enclosure or its substructure. Self-tapping bolts are unacceptable in the construction of these enclosures. The enclosure shall be designed with openings which allow adequate cooling air flow to prevent overheating of the engine and other components. Adequate switched lighting shall be included. Drain lines shall be provided for engine oil, radiator coolant and hydraulic oil as required.

Engine Enclosure Doors: Door openings of adequate size to facilitate equipment servicing shall be provided. Doors shall be equipped with a positive closing mechanism. Hinged compartment doors shall be held in the open position by support arms, gas charged struts, or hydraulically actuated cylinders with pumps.

Drive Train:

The drive train shall consist of all components required to transmit rotational force from the engine package to the drive wheels. Components typically include a torque converter (fluid coupling) driven automatic/powershift type transmission or automated clutch/automated shift mechanical transmissions, transfer case, drop boxes, differential type axles with locking or limited slip clutches, power dividers, drive shafts, and various types of manual/automatic or electronic traction control systems. MTE may require all or part of the aforementioned items predicated by specific design.

Transmission: The transmission provided shall be an automatic shift type it may be an automatic/powershift type or specified as an automated mechanical type transmission. The transmission gear ratios shall be such to provide the correct gearing to maintain the optimum engine horsepower and torque ranges for the desired working ground speeds. CAN Bus / SAE J-1939 protocol electronic micro-processor transmission controls shall be considered as the industry standard for this application.

Transmission Controls: Shifting shall be accomplished via an operator's transmission shift control interface located within easy reach of the operator at the Operator's Control Station (OCS). The transmission shift control shall be lighted with an LED or LCD interface display and shall utilize either a key pad or joystick for actuation. A low transmission oil level sensor shall be incorporated into the operator interface. The following safety related interlocks shall be provided:

- a) The transmission controller shall be programmed to limit initial forward or reverse engagement based on low idle engine speed.
- b) Safety interlocks shall be installed that prevent starting the engine unless the transmission is in neutral, clutch disengaged, and parking brake set.
- c) In addition, a visual and audible warning or lockout shall be installed to prevent placing the vehicle in drive or reverse without first releasing the parking brake.

Transmission Cooler: A transmission cooler shall be provided with sufficient capacity to maintain transmission and oil in a temperature range acceptable to the transmission manufacturer.

Transfer Case: (if required) Transfer case assemblies shall be installed provide positive drive to the traction drive axle(s) and may be of single or multi-speed design if required. Typical transfer case types are as follows:

- a) Frame mounted with manual axle disconnect
- b) Frame mounted with center differential utilizing a manual or automatic lockout
- c) Frame mounted full time with overriding clutch type differential
- d) Frame mounted with full time automated torque proportioning clutch
- e) Transfer case integral to either the front or rear drive axle, which can incorporate an automatic torque proportioning transfer case differential or a manual or automatic lockout
- f) Transfer case integral to the automatic transmission which can incorporate an automatic torque proportioning transfer case differential or a manual or automatic differential lockout
- g) Manual transfer case actuation shall be accomplished by in cab operator controls. Controls can be cable mechanical, pneumatic, hydraulic or an electrically operated variant with linear actuators.
- h) Various transfer case arrangements may also utilize a micro-processor and CAN Bus control system with sensors and servos to engage or disengage as required to provide efficient means of traction control. The manufacturers standard transfer case is acceptable if required.

Drive Shafts: Drive trains shall be in conformance with SAE requirements and shall be designed to minimize the number of joints. Drive shafts shall be designed and selected to provide long life at maximum torque and speed operating conditions. Drive shafts shall not exceed joint and shaft manufacturer's recommendations with respect to angles, critical speeds, maximum operating speed, and other factors. All such analysis shall include at the worst case scenario for chassis and axle deflections. The shafts shall be properly balanced and installed to minimize vibration and wear. Drive shaft splines and joints shall include the best available weather protection and shall include lubrication fittings to permit greasing unless the manufacturer does not recommend field lubrication.

Axles: The axle manufacturer's published rating shall at the least be equal to the load imposed at ground level when the vehicle and/or each component is in its maximum load configuration (i.e., plow up and plow down; and/or a material body, if any, loaded to its cubic rated volume). The torque capacity of each axle and differential shall be at least 10% in excess of the maximum torque that the axle may experience under any GVW operating condition.

Axle reduction gear types may be as follows:

- a) Single reduction hypoid/amboid
- b) Double reduction, hypoid/amboid primary with planetary final drive hubs
- c) Double reduction, hypoid/helical

Inter-Axle Clutches: To enhance tractive effort, Automatic inter-axle connect/disconnect devices may also be offered. Acceptable automatic inter-axle devices may be referred to as "Torque

Proportioning”, “Limited Slip”, or “Microprocessor controlled with sensors and servos”. Manually operated controls shall utilize in cab indicators and switches easy reach of the operator. A manufacturer may (at their discretion) require a preprogrammed ground speed limiter to control maximum speed for inter-axle engagement mode so as to protect against driveline wind-up when encountering dry pavement.

Brake System:

Vehicle service and parking brake systems shall meet the latest (most current) Title 49 and FMVSS 121 Brake Systems requirements for vehicles of similar design. These systems, whether air, hydraulic, or of another design, shall be complete with all necessary equipment to safely control, stop and hold a fully equipped vehicle under all normal operating conditions. Systems shall be readily accessible for inspection and external adjustment. Anti-lock brakes shall be provided on all main load bearing axles for improved safety on the airport operational areas.

Steering:

Standard front axle steering shall be integral hydraulic power assist. The steering actuation shall be rated for heavy-duty service equal to the maximum load imposed in the worst condition, (plow up). The power transmitting shaft (if used) on each steering axle shall incorporate steering joints that do not produce objectionable steering characteristics while the vehicle is operating on uneven surfaces. A steering augmentation system is required to maximize maneuverability of the unit for taxiways, turnouts, high-speed exits and other tight turn areas.

Proven enhancements or alternatives are:

- a. Manufacturers standard designed All-Wheel Steering (AWS) **REQUIRED**
- b. Articulated Steering (as designated by design on some MTE)

All-Wheel Steering (AWS): applies to steering control of the traction drive wheels, whether the vehicle is a 4x4 or 6x6 drive axle configuration. AWS typical applications may be utilized on all configurations of MTE. MTE vehicles equipped with AWS system shall possess some or all of the functional modes as listed below:

- a) Conventional front steer only (refer to item 5.6)
- b) Coordinated front/rear steer, operated through steering wheel
- c) Crab front/rear steer, operated through steering wheel
- d) Independent rear steer, front wheels centered, operated by single axis joystick or momentary/self-centering rocker switch

The front axle steering shall be accomplished by conventional steering components including integral hydraulic power assist. The rear steering shall incorporate hydraulic steering servo(s), various linkage, and mechanical lock(s). The system shall also include position sensors on all axles fore and aft, ground speed sensors, a microprocessor control system and hydraulic directional control valve(s). AWS systems shall be designed to incorporate safeties that will revert back to the conventional steering mode any time a system fault is detected, this shall include but not be limited to vehicle speeds beyond the design parameters programmed into the control

system. The AWS system shall be operable in all transfer case operating modes.

A steering mode selection switch/joystick, in cab control console with indicator lights shall be provided. The system shall be designed to permit the operator to change the steering modes on the fly, providing that speed and wheel positions are within the operating parameters of the system. The system shall include safety provisions for gradually decreasing the AWS effects at speeds above 15 to 20 mph and shall automatically lock out the rear steering axle at 30 mph. The system shall restore to full operation as the vehicle slows down.

Managers Switch: If specified by the purchaser, a security switch shall be provided which will allow supervisory personnel to “lockout” or “enable” operation of the AWS. This switch is included to ensure that only those operators who are qualified to operate the vehicle all wheel steering system are permitted to do so.

Coordinated Mode: When operating in the coordinated mode, the system shall permit sufficient front wheel pivot or (dead band) before actuation of rear steering axle(s) to ensure a smooth response.

Crab Mode: the system shall permit sufficient front wheel pivot or (dead band) before actuation of the rear steering axle(s) to ensure smooth steering response. The dead band effect shall increase as vehicle speed increases up to the rear axle lock out point. The rear axle(s) shall be equipped with redundant center locking mechanism(s). The locking mechanism shall hydrostatically lock the axle(s) steering at center position with the directional control valve/slave cylinder and shall utilize a spring loaded mechanical lock pin or similar redundant safety device. The mechanical lock shall engage with spring force and disengage with either air or hydraulic pressure. Crab mode steering is typically limited to speeds under 15 MPH monitored and controlled by the micro-processor

Rear axle steering: The rear steer mode shall require the front steering axle be at the center position prior to enabling the rear steer. Rear steer is typically utilized for special handling and maneuvering.

Articulated steering: This steering type is inherent to the design of the Articulating Integral type of MTE. The frame configuration utilized in this type of MTE requires frame articulation for operational maneuverability in lieu of all steering action within the axles. Such systems are designed to enable high-speed operation and maximize intuitive use of the system. The system shall include all safety provisions for dampening of articulated steering effects at higher speeds, but it shall also allow full operation while the vehicle is moving at lower speeds.

If the unit offered can function both with and without articulation, the operator shall have the ability to select the desired mode of operation with provisions made for safe transition from one mode to the other. The electronic over hydraulically controlled articulation system shall operate in conjunction with the mechanically controlled front wheel steering system.

Managers Switch: If such unit can function with and without articulation and if specified by the

purchaser, a security switch shall be provided which will allow supervisory personnel to “lockout” or “enable” operation of the vehicle articulation system. This switch is included to insure that only those operators who are qualified to operate the vehicle articulation system are permitted to do so.

Suspension:

The suspension shall be so designed and engineered as to provide reserve carrying support with plow raised in the transport mode. The suspension shall utilize any combination of load supporting springs typically leaf, coil or air bags. All suspension components shall be rated to either meet or exceed the rated load per axle. Any hangers, pins and supports shall be heavy duty to give long life. Any pins shall be of the grease type with substantial bronze bushings.

Tires and Wheels:

Wheels: rim and tire ratings shall conform to the current recommendations as published by The Tire and Rim Association. The preferred rim type for this application is Steel or Aluminum Disk with a minimum of ten (10) bolt holes, hub piloted design with flanged or captured washer type lug nuts.

Tires: The tires shall be Bridgestone L315 open shoulder traction tread 445/65R22.5 or equal

Each tire shall have a rated carrying capacity at least equal to the loads imposed on them in the maximum load configuration (i.e., plow up and plow down, broom up and broom down in all configurations) and at the maximum rated speed for the vehicle. Tires on each individual axle shall be of the same size. Tires between axles may vary due to loads, configurations, and engineered gearing sets. In such cases, care must be taken and all components must be viewed as a system that provides an acceptable speed match between driven axles. Tires shall have an aggressive tire tread, a tread pattern specifically engineered for snow traction is preferred. Tires (and tubes when applicable) shall meet the first line commercial grade requirements for the speed and type of service required. The front and rear tread widths shall not vary by more than 4%. Manufacturers are encouraged to provide tires of a size and type that are common to the commercial transportation market and readily available at competitive costs.

Spare Rim/Tire. Spare rim and tire are required. If one size and configuration of tire and wheel cannot be immediately interchanged to all positions on the vehicle one spare rim and tire for each distinct configuration.

Mud flaps shall be provided behind each traction drive or steer tire, each axle set, and in front of rear axle or axle set to avoid snow and debris on truck.

Hydraulic System:

The hydraulic system(s) shall consist of rams, pumps, motors, piping, fittings, valves, controls, microprocessors, transducers, fluid reservoirs, filters, necessary and all other parts essential to

efficient operation. The system(s) shall be capable of positioning the hydraulic actuated equipment in any chosen position within the design limits of travel, and will be of such capacity that all controls can be operated simultaneously without noticeable reduction in response. Hydraulic system(s) shall be constructed to withstand all loads imposed in snow removal operations without the use of mechanical locks. The entire hydraulic system shall conform to SAE J514, 516, 517, 524. All hydraulic controls shall be located in the vehicle cab. The equipment manufacturer shall not be permitted to install any high-pressure hydraulic lines or other hydraulic transmission devices in the operators cab. Control of all snow removal attachments shall be by means of remote control CAN BUS, electric over hydraulic controls whenever possible. Adequate cooling shall be included to maintain acceptable hydraulic oil temperatures throughout expected vehicle operational ranges.

Pump(s) and Power Takeoff (PTO): The pump(s) shall be ruggedly constructed and powered by the engine through a PTO. The PTO may be in the form of a crankshaft driven device, multiple drive gear box driven directly off of the engine or transmission and may include a disconnect or declutch mechanism. The PTO shall have sufficient capacity to operate the hydraulic equipment specified herein under all operating conditions and speeds. Typical hydraulic pumps utilized for the snow removal attachments are piston type, pressure and flow compensating pumps. Belt driven pumps for snow removal attachments or devices shall not be acceptable.

Lines and Fittings: Only commercial quality hydraulic lines, hoses, and fittings that are capable of withstanding system working pressures under load are acceptable. Hydraulic hoses shall have a bursting pressure of three times their rated working pressure. The use of fittings, joints, and connections shall be kept to a minimum. Test gauge connection fittings or pressure transducers shall be provided at suitable points throughout system for maintenance and trouble-shooting. All hydraulic system components are to be shielded from engine exhaust heat, and heat shields shall be installed on the engine exhaust system to divert any possible leakage from the hydraulic system. Hoses shall be installed inside steel tubing wherever necessary to deflect the flow of fluid from exhaust and electrical system components in the event of hose rupture or leakage. Any quick disconnect fittings utilized in the system should be of the latest ISO spec low/no drip design.

Fluid Reservoir: The hydraulic fluid reservoir or tank shall have a filler neck consisting of a strainer, drain plug, shutoff valve, air vent and baffles. A sight glass or other device shall be provided to allow the operator to verify that fluid level is sufficient for safe operation without the necessity of opening the system. An oil level warning device shall be provided at the Operator Control Station for all hydraulic systems. A label shall be installed as close as practical to the filler neck indicating the proper fluid for servicing the hydraulic system, and the capacity of the tank. Separate hydraulic reservoirs may be utilized for different attachment systems so as to minimize cross contamination and potential progressive wear.

Cold Weather Operation: Hydraulic systems shall be designed and operated in accordance with the requirements specified in ARP1247. The hydraulic system shall meet the same low temperature requirements as the engine coolant system.

Filtration: The equipment manufacturer shall be required to provide all of the necessary filtration

devices to adequately maintain cleanliness level at or above the recommendations of the component manufacturers. This shall include but not be limited to suction strainers, return filters, high pressure filtration, high efficiency tank vent filters with desiccant. Filtration of the hydraulic system shall conform to SAE J931. Hydrostatic drive systems shall be fitted with 6-micron absolute rated filtration in the charge pressure lines. Clogged/restricted filter indicators shall be thermally protected to compensate for low cold weather flow nuisance alarms. Where appropriate, properly sized isolation valves shall be installed on each side of all filters to facilitate filter changing with minimal fluid loss. If filters are installed in compartments or other areas where fluid collection is possible, drain holes will be installed to allow fluid drainage during servicing.

Chassis Lubrication and Fluids:

The manufacturer shall be required to do all things necessary to ensure all wear and friction points are provided the recommended and required lubrication. The manufacturer shall provide lubrication charts as necessary to illustrate all lubrication points which shall include locations, lubrication/fluid type and nominal fill capacities.

The manufacturer shall provide charts and diagrams to illustrate the locations, quantities of lubricant or fluid types for all engines, transmissions, gear boxes or other fluid containing reservoirs.

Lube Charts: Provide laminated, weather resistant lube charts to be affixed to the MTE to be used as a reference for daily maintenance. The subject lube chart shall identify the proper lubricants, locations, products appropriate for their temperature ranges, nominal fill capacities for fluid changes with and without the filter.

Electrical System:

The electrical system shall be negatively grounded and installed in accordance with current state-of-the-art practices and appropriate Federal requirements. All parts of the electrical system shall be water resistant, easily accessible, securely mounted, and protected against extreme temperatures, physical damage, snow, oil, and corrosion. All electrical circuit wiring shall be made of stranded conductors with a capacity exceeding the anticipated maximum circuit loading. Insulation of electrical wiring shall be equal to the recommended standards established for insulation materials by the Society of Automotive Engineers (SAE). Manufacturers may employ at their discretion, multiplex technology/input/output microprocessor type controls for efficiency and maximization of control parameters for applicable electrical systems and/or devices. Acceptable electrical configurations are as follows:

- a. 12 volt electrical and starting
- b. 24 volt electrical and starting, with 12 volt lighting

Batteries: Batteries shall be securely mounted and adequately protected against physical injury, water, chemicals and exhaust heat. Battery mounting hardware shall be constructed from

corrosion resistant material. It is recommended that batteries be located as close as feasibly possible to its respective engine starter so as to minimize voltage drop and to provide ready access for change out and maintenance. Enclosed battery compartments shall have adequate ventilation.

Battery size and quantity shall be calculated based on the specific diesel engine cold cranking specifications (with the recommended oil viscosity) and reserve capacity as per SAE J 537.

Main Battery Disconnect(s): Master electrical on/off switches shall be provided. Disconnect switches shall be located either at the operator control station, or at the battery box in a location. All disconnect switches shall be labeled and labelling shall include the on/off positions.

Charging System: The MTE shall be equipped with self- regulating electric alternator(s) fitted to each drive engine (Carrier and Broom) unless it is an integral configuration where one alternator is acceptable. The alternator shall be capable of providing an output capacity that exceeds the anticipated electrical load. The minimum idle output of the alternator shall be 20% greater than that required by the vehicle with the engine operating at idle, heater and defroster set at low fan setting, parking and/or marker lights on, communication radio(s) on, windshield wipers operating, and either hazard flashers or Vehicle Safety Identification Lights on. The minimum output of the alternator when operating at governed engine speed shall be 20% greater than that required by the vehicle in its operating mode with the heater and defroster set to maximum settings, headlights and marker/tail lights on, communication radio(s) on, windshield wipers at maximum setting, and the Vehicle Safety Identification Lights operating. An electrical load analysis worksheet shall be provided to the customer prior to construction showing the electrical loads during as described herein.

All electrical components and systems shall operate without being affected by interference damage or disruption including detrimental effects or interference to on-board computer modules from either vehicle generated noise, or stray Electro Magnetic Fields (EMF) or other radio or radar induced fields encountered from airport operations. High-frequency noise emissions that may be generated by the vehicle, especially if such noise is detrimental to aircraft, Air Traffic Control, or air navigation equipment, shall be shielded.

Exterior Lighting: Unless otherwise specified, lighting and conspicuity shall conform to the requirements of FMVSS 108 plus the following as a minimum:

- a. Two (2) headlights per FMVSS 108
- b. Stop, Turn, Tail, lighting
- c. High mounted Stop lights
- d. Clearance and side marker lights to include:
 - three light cluster amber front, red rear
 - plow, broom and airblast end marker lights, amber front, red rear
 - side marker lights spaced approximately every four feet
 - illuminated license plate mounting bracket
- e. Two (2) backup lights minimum

All lights shall be protected and/or positioned to prevent snow buildup. In addition to FMVSS 108

headlights, the MTE is required to be equipped with Auxiliary or Specialty Lighting Typically this includes four light assemblies mounted and adjusted so as to illuminate the plowing path. The subject lights shall be controlled by an interlocking circuit that will automatically switch off the FMVSS 108 headlights in coordination with the operation of the auxiliary lighting.

Units are to be equipped with identification lighting for vehicles routinely operating in the AOA Movement Area as per the direction of the airport operator. Provide amber Whelen 800 safety strobe to be mounted on the uppermost part of the vehicle structure in accordance with the most recent edition of FAA Advisory Circular AC 150/5210 Painting, Marking, and Lighting of Vehicles used on an Airport.

The two (2) headlights with high/low beam and turn signals shall be mounted in a position near the leading edge of the cab at a level allowing light projection above the front mounted plow in any position. A system allowing flexibility in light placement and directional projection is encouraged to allow the purchaser to adjust the lighting to local conditions and preferences.

Two (2) High Intensity Discharge (HID) lights are required mounted on the light bar utilizing dedicated switching and circuits.

White lighting shall be provided at all step areas, engine compartments, and other areas that may be serviced by the operator. Ground lighting shall operate whenever the truck parking or headlights are operating. Compartment or service area lighting shall be switched, either by door actuation or local switches.

Audible Alarms: The carrier shall be equipped with a backup alarm installed at the rear of the vehicle. The backup alarm shall be activated whenever the transmission is placed in reverse. The backup alarm shall be an SAE J994, Type B vehicle backup alarm.

The vehicle shall be equipped with an electric or air horn to allow the operator to provide an audible warning in an emergency. Exposed air horns shall be fitted with snow shields.

Auxiliary Electrical Connections and Cables: Auxiliary electrical connections are typically required for the tow-behind broom and it's related accessories such as marker lights, camera or other purposes as required. Such connections and cables shall be installed in a manner where they will be supported and routed free from snags or obstructions. Connectors and cables shall be transportation grade and resistant to moisture contamination. These items shall be located in an easily accessible area at the rear of the chassis.

Cold Starting Aids:

The installation of the following components are required:

Engine Coolant Heater: Thermostatically controlled engine coolant heaters should be provided for each engine on the MTE and shall be 1500 watts 120v A/C.

A high idle control shall be provided for efficient engine warm up and to minimize “wet stacking” during stand-by operations. High idle switches or throttle controls shall be designed to operate only when the transmission is in neutral and the parking brake is set.

Ether Start: A cold weather ether start system. Such devices shall be approved by the engine manufacturer for the application and control of the device shall interface with the engine management system.

Battery Charger: On-board marine grade automatic charger. The charger shall provide a regulated tapering charge rated at not less than 10 amps per battery group.

All A/C powered cold starting aid devices shall be wired in accordance with the National Electric Code and in accordance with the device manufacturer’s recommended practices. All terminations shall be made in weather tight NEMA approved enclosures. The MTE shall be fitted with the appropriate number of external power ports so as to accommodate the required number of cold starting aids.

Power ports shall utilize receptacles with spring loaded covers and pilot lights.

Pneumatic System:

The unit shall be fitted with a pneumatic system to provide the necessary compressed air supply for the vehicle brakes and all other components requiring a source of compressed air. The system shall be a standard, transportation grade design as used in Class-8 highway applications. The system shall include a direct (engine) driven air compressor, air tanks, valves, air dryer, actuators and any other components required to make a reliable operating system. At a minimum, compressed air shall be required for the carrier vehicle brakes and tow behind broom brakes (if applicable) as per the latest published FMVSS 121 regulations.

Operator’s Cab:

The unit shall have a fully enclosed two person cab thermally and acoustically insulated (less than 85 db as measured 6” from the drivers ear at full engine load). Cabs shall be attached to the chassis with vibration isolating mounts. Any or all of the following cab configurations are acceptable :

- a. Cab Forward of engine
- b. Cab Over engine

The cab shall include the following provisions:

Visibility: the operator shall be positioned to impart ample visibility to both sides of the vehicle for the large implements deployed on the unit.

Telescoping, tilting adjustable steering column shall be provided.

Cab Glass:

- a. Windshield and side windows shall be arranged to provide a panoramic view of the work area. At a minimum, the windshield glass shall be electrically heated in common snow build-up areas. Adhesive backed heating elements are not acceptable.
- b. Roll down side windows shall be powered type to facilitate operation on both sides by the operator.
- c. Rear windows of cab may be stationary or sliding for additional ventilation.
- d. Window glass shall be DOT approved AS-1 for the windshield, AS-2 or AS-3 for the side windows. Windshield glass should be shaded.

Wiper and Washer system: Windshield washing and wiping shall be in accordance with FMVSS

Windshield Wiping and Washing Systems.

Heated windshield wipers.

Heat, Defrost and Conditioned Air: The cab shall be fitted with an integral high-output, fresh air type heater/defroster/air conditioner with multi-speed fan motors. A refrigerant charged air conditioner system shall be incorporated as a device to cool the cab for warm weather pavement maintenance and to control in-cab humidity and to control misting of the interior glass. Side glass defrosters ducts shall be required. Cab heater with defroster shall be capable of maintaining a 65 degree F inside temperature at sea level when the ambient temperature is -20 degrees F. Under all conditions of heating and ventilation, the temperatures measured in the operator's immediate environment should be uniform within 9 degrees F (5 degrees C) (see SAE J 1503, Performance Test for Air-conditioned, Heated and Ventilated Off-Road Self Propelled Work Machines). Warm weather air conditioning performance shall be capable of maintaining a 68-degree F at sea level with an ambient temperature of 100 degrees F. A screened, louvered vent with replaceable filter element is required for fresh air intake into the required heating and air conditioning unit. After-market/non-integrated roof-mounted air conditioning units are unacceptable. Vent controls or auxiliary fans shall be furnished as needed to provide maximum defrosting effect.

Doors and Hardware: Cab door(s) hinge(s) shall be bolted or welded to the door(s) and cab frame and provided with proper restraints against high winds. Doors and door locks shall comply with FMVSS 206 Door Locks & Door Retention Components. Door handle shall be positioned for use without bending or stooping.

Rear View Mirrors: The carrier shall be fitted with dual, heated, motorized (remote controlled) mirrors mounted to the exterior of the cab. It is recommended that the mirrors be directly mounted to the cab A-pillar with a stabilizer bar connecting the mirror frame to the outer door frame in lieu of mounting mirrors to the door itself. Each mirror assembly shall incorporate a separately controlled motorized convex mirror either integrated into the main mirror frame or add-on 6" diameter units. Mirror controls shall be operated from the operator position in the cab. Each primary mirror head shall have a surface area of not less than 100 in² (650 cm²).

Sun Visors: Multiple interior sun visors, opaque and/or tinted sun-visors for the front and side windows shall be provided.

Coat hooks (two)

The floor of the cab shall be insulated with thermal-acoustical sound barrier floor mat.

Power to be provided in cab for two (2) radios.

Windshield Deluge System: Provide a windshield deluge system to maintain operator visibility during snow removal operations. As a minimum, the system shall consist of a 5 GPM pump, a 15 gallon washer fluid reservoir, nozzles above the front windshield (2), nozzle above each side window (1), nozzle above left and right rear view mirrors, and the associated plumbing to make a functional system. Fill point shall be conveniently located at a height for easy refill. Discharge shall be controlled by a dash-mounted momentary switch in conjunction with wiper controls. This system shall not be considered as part of the regular wet wiper discharge for function.

Fire Extinguisher(s): The vehicle cab shall be fitted with at least one 2A-10BC interior mounted fire extinguisher that is readily accessible to the operator. Vehicles equipped with fuel tank(s), hydraulic oil tank(s), or any flammable liquid tank(s) that have a total combined volume of 200 gallons or more of flammable liquid shall be equipped with one 20 B:C: Purple K type fire extinguisher installed on the vehicle or equipment at a place readily accessible from the ground.

Emergency Egress: For safety purposes, the cab shall include at least two methods of egress for the operator. Primary egress shall be through a door. Secondary egress shall be provided in a plane other than the primary egress door. Alternate egress may be through another door, or an appropriately labeled roof hatch or emergency exit window.

Operator Control Station (OCS):

The OCS shall be ergonomically designed and fitted with all of the controls and operator interfaces to permit the optimum environment to operate the vehicle, various systems and attachments in a safe and conducive manner.

Seating: The operator seat shall be premium quality 6-way adjustable air ride. It shall be fully adjustable in the horizontal (fore and aft), and vertical positions with high or medium rise back,

foldable arm rests, adjustable lumbar support, cloth covered, and load adjustable. All vehicle seats shall be furnished with three-point safety belts, certified by the vehicle manufacturer to have been tested and in conformance with FMVSS requirements. Adjustments shall provide for ease of operation for individuals between the 5th and 95th percentile individuals.

Electrical Accessory Controls: Electrical accessory controls for items such as lights, signals, HVAC, Ignition, etc, switches for such items should be located in areas directly related to their frequency of use. As an example, High frequency use items such as AWS control, transmission control, wiper/washer, horn, signal indicator controls should be located in traditional locations within less than arms reach for the average operator. Low frequency use items such as head lights, auxiliary lights, ignition/starter, would be best located on a remote panel off to the side or overhead so as not to cause distraction to the operator. All of the aforementioned control switches shall be identified/labeled and lighted preferably in a bold font for easy identification. For safety purposes, snow removal attachment and transmission controls should be located to the right hand side of the operator, this is recommended so the operator can perform the typical snow removal operations while maintaining the left hand on the steering wheel at all times.

Instrumentation, Gauges, (Operator Interface): Instrumentation shall be centered in front of the primary operator, and positioned to minimize interruption of operator visibility. In general and to provide clear information, chassis engine and system information shall be grouped together with broom and air blast engine information noticeably and meaningfully grouped and displayed to the front of the operator.

Consideration should be given in regard to the advances in CAN BUS, SAE J-1939 protocol electronic control and display technology. In lieu of traditional gauge clusters, many manufacturers are opting for color LCD Graphic User Interface (GUI) panels. GUI panels are typically menu driven displays that provide all or more of the information displayed by traditional gauge clusters. Some GUI's offer custom display capabilities, providing basic or advanced operating data depending on the desires of the operator or the maintenance staff.

Available/Selectable information for both chassis and broom systems shall include but not be limited to the following:

- Speedometer/Odometer
- Tachometer(s)
- Engine Hour meter(s)
- Operating Voltage
- Air pressure gauge (dual system, physical/mechanical gauge required)
- Clock, (may be incorporated into the AM/FM radio)
- Fuel level with low level indicated by color and flashing visual alarm
- Engine(s) oil pressure
- Engine(s) coolant temperature
- Diesel Exhaust Fluid (DEF) level if applicable
- Diesel Particulate Filter (DPF) service/regen indicator, if applicable

- Transmission temperature
- Hydraulic oil temperature or warning light
- Hydraulic Broom drive oil pressure
- Broom speed (RPM)
- Broom control operating modes
- Rear wheel position indicator, if applicable
- Traction Drive modes, for transfer case and/or axle interlock

Warning Icons required for:

- Low Air Pressure
- ABS Fail (when applicable)
- ABS Communication Lost (when applicable)
- Engine Stop
- Engine fault warning
- Low voltage
- Engine overheat
- Engine low oil pressure
- Engine air intake restriction
- Transmission overheat
- Transmission fault
- Engine communication lost
- Control system node communication lost
- Transmission Communication lost
- Parking brake applied
- Windshield washer/deluge system fluid low level indicator
- Message center for fault messages affecting operation
- Warning device to indicate, door open, transmission in gear

All interior controls and displays shall incorporate variable intensity lighting control.

Auxiliary 12 volt power outlets (two)

Cup Holders within easy reach of the operator

Attachment Controls:

The operator controls in the cab shall have all necessary functions to operate the plow, broom and air blast either individually or in a coordinated mode. A dual-axis control joystick shall be provided for directional control of the plow, broom, and airblast systems. Directional positions shall be lift/lower and swing left/right.

Control Modes: The two modes of operation shall be referred to as “manual” and “automatic”. The mode shall be preselected by the operator with a control switch.

Manual Mode: In the manual control mode, the operator shall utilize separate/dedicated joysticks, push buttons or momentary switches or a combination thereof, to position each attachment individually in a separate manner. In manual mode, the operator will have the capability to plow only, broom only, airblast only, or any and combination of functions in any combination or increment of directions.

Automatic Mode: In the automatic or coordinated mode, the controls for all attachments will be combined into a single, dual-axis joystick. This shall permit the operator to perform all directional functions simultaneously by the movement of the dual-axis joystick. Some automatic controls may provide for a one touch control that will cycle all attachments left or right, other systems may incorporate the automatic broom airblast into momentary push buttons on a thumb panel on the dual-axis joystick, the later can offer more precise positioning of the plow without affecting the position of the broom.

High Speed, Power Reversible, Snow Plow and Hitch:

General Description: High-speed power reversible snowplows are manufactured expressly for airport runway high-speed plowing. High speed plowing typically refers to 25 mph or faster. They should be designed for continuous work under extreme conditions of airport snow removal.

Moldboard Assembly: Polyethylene Moldboard with Flared Ends. The plow width shall be 20 feet wide. The moldboard height shall be a minimum of 50 inches in the center of moldboard tapering at an upward angle of approximately 15 degrees to the discharge ends. The moldboard sheet shall provide a low coefficient of friction and resistance to corrosion and impact. The moldboard sheet shall be formed from 3/8" thick high molecular weight polyethylene sheet. When tested in conformance with ASTM D638, it shall evidence a minimum of 250% elongation at the break. Polyethylene material shall have an abrasion resistance rating of 44 or less as rated by standard ASTM sand slurry testing. The polyethylene sheet shall be formed from new resin (recycled material is not acceptable, and shall be ultra violet stabilized. The sheet shall evidence no break following izod impact test conducted in accordance with ASTM D256A. Alternate moldboard sheet materials may be specified by the user. The moldboard shall include a reinforcing frame with a top and bottom full length reinforcing angle or other structure. Airport operator shall specify the overhang after consultation with other airports facing similar snow removal situations and plow manufacturers. When requested, the plow manufacturer shall provide certification for the moldboard material.

Cutting Edge Reinforcement: Shall consist of structural steel angle or other suitable structure with equally spaced reinforcement welded to the top of the angle for added strength.

Moldboard Attack Angle Adjustment: Fixed moldboard type plows may require an adjustable attack angle incorporated so to provide 65°, 75° and 85° settings (from ground plane to back of cutting edge for use with either steel, carbide, rubber or urethane cutting edges) for the purpose of

enhancing the plowing operation to meet specific requirements (e.g. in-pavement lighting, scraping action, wearability).

Cutting Edge: High Carbon Steel

Plow Hitch: The truck hitch shall be mounted on the front of the vehicle chassis frame and as close to the front axle as possible. The hitch should be designed not to obstruct operator visibility. Adequate reinforcement and bracing with the use of a minimum of 1/2" thick truck frame side plate and shall meet the design requirements of the carrier vehicle manufacturer while not overloading gross vehicle weight rating. The side plates shall extend back as far as necessary to provide adequate support for the intended equipment specified. Lifting devices shall be attached and adequately braced to the push frame or the carrier vehicle's chassis frame. The lifting device is to be provided with a single acting or double acting lift cylinder with a minimum bore of 4 inch I.D. and stroke designed to provide the necessary lift and transport requirements.

Quick Hitches: The plow and hitch shall be furnished with a quick hitch that can be easily attached or detached by one person in less than 2 minutes.

Reversing Mechanism: Reversing shall be achieved by hydraulic cylinders that are either double or single acting, single or telescoping type. Hydraulic cylinders and the corresponding drive pump shall be of the correct size and type to provide adequate force for acceptable side to side plow reversing under load. A relief system shall be provided and plumbed in series to minimize damage in the event of contact with immovable obstructions. Reversing mechanisms shall remain attached to the vehicle and enable disconnect of the plow drive frame and moldboard without hydraulic disconnect of the reversing mechanism

Caster Wheel Assemblies: The caster assemblies shall be single or dual wheel type. Caster wheels shall be rated by the manufacturer for the weight loading and operating speed of the plow or broom. There are two (2) specifically different caster assembly designs to be considered.

Hydraulic System and Controls: Refer to section titled "Hydraulic System" and "Attachment Controls"

The hydraulic pump for the plow controls shall be driven by the traction drive or the auxiliary drive engine. Additional control features may be required as follows:

- Plow Float control
- Plow hitch/weight transfer system
- Lock-out switch for hitch removal or installation (if applicable)
- Hitch lock controls for remote controlled Quick-Hitch applications. Shall include confirmation light or mechanical flag type indicators to confirm the hitch mechanism is locked.

Support Stands: The power reversible plow shall be equipped with support stands to assist in

holding the plow upright and steady when decoupled from the carrier vehicle and to assist in positioning the plow for easy when re-hitching before use. Such stands shall be of sufficient strength to hold the plow's weight in the appropriate position and attitude during hitch and unhitch. They shall be equipped with a means for stowage out of the way during plow operation by means of positive locking pins. The design of the stands and locking device shall also allow positive locking in the deployed position.

Warning Labels: Permanent labels are required at all pinch points on hitch and plow, torque at side plates, and any other appropriate instructions.

Snow plow test:

Certification of compliance required with bid response

Snowplows and Hitches, to demonstrate the ability to:

- a) Sustain a speed of 25 mph (40 km/h) on level pavement with a snow plow cutting edge angle set at 37 degrees while negotiating a 3 to 6 inch (7.6 to 15.2 cm) snow accumulation having a density of approximately 25 lbs/ft³ (400 kg/m³) throughout a test section of at least 500 feet (150 m).
- b) Discharge snow to either side of the carrier vehicle while moving (if the unit is power reversible).
- c) Minimize snow spillover to 5 percent of total snow displaced.
- d) Produce a clear swath that is even, regular and non-skipping.
- e) Have the cutting edge (blade) free of vibration during operation.
- f) Carrier vehicles must be all-wheel drive.

Rotary Broom and Air Blast Specifications:

General: The following specifications consider the rotary broom and air blast attachment of the MTE and indicate in general the type, size and quality desired. These specifications require the doing of all things necessary or proper for, or incidental to the furnishing of the unit. All items of design and equipment not listed in these specifications, but involved in carrying out their intent, are required to be furnished the same as if these items were specifically mentioned and described in these specifications.

Mount Configurations: There are two basic broom mount configurations:

a. Stowable Broom Head: The stowable broom head provides an extended chassis, suitable frame structure, hardware and controls to lift the complete rotary broom assembly (including the caster wheels) clear from the pavement and pivot the assembly into a stowed position inside of the MTE dimensional footprint. Typical stowable rotary brooms utilize a mechanical locking device to support the weight of the assembly thus providing better weight distribution on the frame structure, thus eliminating the possibility of hydraulic leak down.

b. Non-Stowable Broom Head: The non-stowable broom utilizes a shorter carrier chassis frame structure. The broom remains within its operable sweeping range with the caster wheels in contact with the pavement at all times.

Swept path: 14.7 Feet at 35 degrees.

Brush diameter: 46 inches.

Bristle materials: Poly: Polypropylene, 0.075" x 0.105" oval shaped.

Bristle configurations: Wafer configured bristles.

Broom shaft torque: Minimum 4800 ft lbs

Brush shaft speed (RPM): Minimum 500 RPM

The broom head shall be 46 inches in diameter.

The broom head shall be capable of producing a minimum 4800 Ft-Lbs of torque per unit length of swept path at 500 RPM at a maximum hydraulic pressure of 5075 psi for component safety.

The values together shall equal or exceed the available power (engine horsepower) by the equation:

$$HP = \frac{\text{torque} \times \text{rpm}}{5252}$$

* The horsepower rating needs to provide adequate reserve to power an airblast system if specified.

This unit shall provide an air blast system capable of producing a minimum of 23,000 CFM at 400 MPH.

Snow control: The broom shall have the capability to control the direction and trajectory of snow and ice once it is airborne. The snow should be put where and only where the operator desires while maintaining visibility for other machine operators on the airfield and to minimize snow and ice build-up on the carrier vehicle.

Chassis handling and axle loading: For all runway broom configurations the chassis that the broom is mounted on must be positively and most efficiently controlled. Traction, steering, braking, and cornering cannot be sacrificed and must be maximized. Designs to distribute weight, lower the center of gravity, and add traction are required. Axle ratings and actual loading must be taken into account and the loading dispersed among the axles in accordance with best engineering practices. The center of gravity shall be kept as low as possible under maximum load conditions.

Broom Chassis Assembly: The broom frame shall be fabricated from heavy gauge tubular, channel or wide flange sections reinforced as required to minimize loading distortion. It shall have gussets front to rear at each welded joint. It shall be designed to eliminate flexing and ultimately bounce.

The axle required for a tow behind broom shall utilize a rigid suspension and shall use a standard truck axle and brakes for ease of service and parts availability. The axle, wheels and tires manufacturer's published rating shall at the least be equal to the load imposed at ground level when the broom and each component is in its maximum load configuration. It is critical that the equipment does not overload the GVWR of the axles, wheels, tires, springs or steering (GAWR) of the vehicle. It is not uncommon for the purchaser to request ABS brakes, FMVSS 121 compliant for trailers.

Materials used shall conform to the specifications listed in the appropriate sections of Title 49, Chapter III, Federal Motor Carrier Safety Regulations. When not specifically listed, materials shall be of the best quality available for their intended commercial use. Component parts shall be new, unused, of current production. They shall be used within their rated values. They shall be free of all defects and imperfections that could affect the serviceability of the finished product. Components should be readily accessible for repair and replacement, with minimal removal or disturbance to adjacent parts or components. Parts which are exposed to wear shall be capable of being replaced. Regular maintenance and servicing should be readily accomplished under normal working conditions.

All broom components shall be designed to provide continuous service under difficult working conditions in -40 degrees F to +100 degrees F cold or hot weather conditions without degradation of performance. The broom shall be designed to allow brushes to be easily replaced once worn or damaged.

The broom head and air blast shall be hydrostatic drive with infinitely variable speed hydraulic pumps and fixed displacement motors. The broom shall have the ability to remove snow, ice, slush, sand and other debris at the rated speed, capacity, and conditions. To confirm this, the following must be supplied by the manufacturer. Failure to provide this information for whatever reason will result in disqualification.

Auxiliary Engine Assembly (or Power Supply): Refer to section titled "Engines"

Electrical System: Refer to section titled "Electrical System"

Sheet Metal Components and Accessibility: Refer to section titled “Accessibility and Component Location”

Broom Hitch: The broom hitch shall be capable of sustaining all loads imposed during operation. It shall provide low friction, free flotation, for the broom head for bounce and skip free operation. It shall allow the broom head to be independent so the broom or carrier chassis does not induce bounce into the broom. The broom hitch shall have the necessary degrees of freedom to follow normal contours in the pavement and to accommodate surface irregularities while sweeping at the rated speed, without binding or sustaining damage. The broom oscillation shall provide true flotation left to right for the broom head. It shall have at least 8 degrees (+4, -4 degrees) of free floating oscillation from left to right.

Broom Angle: The broom angling mechanism shall be hydraulically actuated and controlled by the operator using an electro-hydraulic device. The broom shall be capable of swinging at least 30 degrees left and 30 degrees right from the bulldoze position. Angling from full right to full left shall not change the broom pattern. In between full left and full right, the pattern shall not change more than 1/2” or 12.5%.

Broom Elevation and Broom Pattern Adjustment: The broom elevation mechanism shall be hydraulically actuated and controlled by the operator using an electro-hydraulic device which shall raise the broom off the surface and lower it for sweeping. The elevation mechanism shall have adequate stroke to achieve 4 inches of ground clearance with a new broom. The lift cylinders shall be equipped with a counterbalance valve or similar device, to prevent the broom head from creeping down during operation or storage.

An easily adjustable and accessible height adjustment that sets the broom pattern shall be provided. The adjustment, when preset, shall act as a stop for the elevation mechanism allowing repeatable pattern adjustment. A toggle switch near the adjustment for remote broom elevation control and pattern confirmation shall also be provided.

Broom Head: The broom head frame shall be designed to sustain the loads imposed by the snow removal capacity of the unit. The broom drive shall be hydrostatic. Power shall be supplied from variable displacement hydrostatic pump(s) mounted on the broom engine’s gearbox. The gearbox shall be a parallel shaft pump drive with precision gears, AGMA 10 rating and a dipstick for oil level measurement. Hydrostatic motor(s) shall be tightly coupled to the broom core shaft with no looseness in any connection. The connection must be capable of handling the loads imposed by the hydrostatics. The entire broom head shall be vibration analyzed as a final inspection with report on vibration spectra (FFT plot). A sample FFT plot shall be provided upon request.

The broom head design shall allow an easy access for core and/or bristle replacement allowing repeatable location of broom centerline alignment during broom core remove and replace operations.

Broom Hood: The broom hood shall be fabricated from heavy gauge sheet steel or other durable material and securely fastened to the broom frame. It shall shield the top half of the broom completely and shall be non-clog design to prevent snow and ice buildup underneath the hood. It shall provide the necessary quick access to the broom for replacement of bristles and for inspection.

Stripper device: There shall be an adjustable and replaceable stripper bar or device on the front of the hood to strip the snow from the broom, preventing snow carryover from the front of the broom to the back of the broom. It shall be the full length of the broom. The stripper device adjustment shall be accomplished manually at the broom hood or automatically in accordance with brush wear. Adjustment is required to maintain a specific and predetermined amount of clearance between the stripper bar and the bristle tips.

Snow Deflector: Provide a hydraulically adjustable snow deflector mounted at the front of the hood. It shall give the machine operator ability to influence the angle or trajectory of the snow as it leaves the broom for snow cast control purposes and to minimize accumulation of swept snow on the carrier vehicle. The deflector shall be adjusted by the operator at the operator control station.

Broom Caster assemblies: The weight of the broom head shall be supported by swivel caster tire assemblies. They shall be mounted along the rear of the broom frame. The quantity of tires shall be commensurate with the loading from the broom head. The mounting position must be spaced for uniform weight distribution and shall track within the swept path of the broom. The caster tire assembly shall be capable of pivoting a full 360 degrees (unless not required) and shall not bind or come into contact with the broom or any other surface of the broom throughout their full arc of travel. Broom caster designs that do not employ a 360 degree pivot capability shall be equipped with an auto lift system which raises the broom and casters from the pavement whenever the carrier vehicle transmission is placed in reverse. Loading and operating speed of the broom shall not overload the rating of the entire caster assembly including the tires and wheels. To keep the caster assembly from shimmying, a shimmy damper device is required for each assembly. The mounting of the tire, wheel, hub, shaft and bearings must be quick change type for easy change while on the airfield.

Broom Cores: The core shall be bearing supported. Power drives may be located on either end of the core, center of the core or both ends of the core. Each core shall be individually dynamically balanced to acceptable values at rated RPM. The bristles on the cores shall be full width to the rated length and replaceable. The drive couplings if required shall be replaceable. The diameter of the core shall be industry standard for compatibility of various bristle manufacturers.

(Wafers): The cores shall be made of tubular steel construction with four hardened steel drive bars, equally spaced to center each wafer bristle. The diameter, a minimum of four drive bars create, must be such that the wafer bristle is easily installed and removed but not to allow excessive movement of the wafer bristle on the core.

Broom Bristles: The bristles for the broom shall be designed for runway operation and shall

withstand the normal operation of the broom. They shall be made with adequate retention to keep the bristle from falling out, fatigue strength to keep them from breaking, and wear resistance for acceptable life. The bristles shall withstand storage temperatures ranging from -60°F to + 160°F and operating temperatures ranging from -40°F to +125°F, without functional degradation due to the environment.

Wafers: The bristles shall be fastened in a radial wafer fashion and shall consist of a steel support ring filled with 50% steel wire bristles or 50% polypropylene (poly) bristles. The wafers may be separated by a steel spacer.

Outside diameter: 46 inch, Inside diameter = 19.50 +0.13 -0.00 inches

The support ring for the wafer shall be made of coil steel, minimum thickness 0.048 inch with edge protection to protect bristle from premature wear and breakage. All joints shall be welded to insure structural integrity. Each ring shall have steel drive pins to engage the sweeper core. These pins shall have a minimum diameter of 0.250 inch and 0.63 inches long with 0.50 inches of protrusion from the inside of support ring. One of the drive pins shall be installed at the center of overlap of support ring. The 46 inch wafer shall have not less than 4 drive pins spaced at 90 degrees around the inside circumference. Each wafer shall be marked on the ring to indicate the point of maximum static unbalance. The maximum static unbalance for any wafer shall be 50 oz-in.

Poly bristles shall be crimped and made from virgin polypropylene extruded and pulled strands. The bristles shall have an oval cross section not less than .060 x .090 inch with minimum tensile strength of 4,800 pounds per square inch (psi). Total weight of the poly wafer shall be 8 pounds minimum. Wire bristles shall be crimped and made of zinc galvanized drawn steel wire. The bristles shall be a minimum diameter of 0.0165 to 0.0180 inch nominal with minimal tensile strength of 325,000 pounds per square inch. The bristles crimp shall not be less than three crimps per inch at amplitude of 1/16 inch minimum. Total weight of the wire wafer shall be 10 pounds minimum.

Spacer Rings: The spacer ring which separates the wafer shall be made of coil steel with a minimum thickness of 0.048 inch. Forming the spacer shall create a flat bottom cross section with a welded overlap end seam to create adequate stiffness and strength to withstand the load imposed.

Forced Air Blast: The MTE shall be equipped with a forced airblast system. The system may feature either a single or double inlet or outlet centrifugal blower. The centrifugal impeller(s) shall be hydrostatically driven including a variable displacement pump and motor(s). The airblast system shall be capable of varying its speed allowing infinite control of blower speed from 0 to 100% from the operator station.

Air duct(s) shall be installed at the outlet of the impeller(s). Discharge nozzles(s) shall be attached to these air duct(s). Deflectors at the nozzle ends shall direct the flow to one side or the other.

When the broom is angled, the airblast direction shall be capable of automatically following, directing air perpendicular to the direction of travel and toward the direction of broom discharge. The deflector's control shall be hydraulic and interlocked with the broom head angle to blow in the direction of broom casting thus controlled by the operator's joystick. The deflectors change direction as the broom swings. A separate control shall allow the nozzle deflector's direction to oppose the broom angle. The controls shall permit air blast operation without broom operation. All controls for the air blast shall be operated from the operator station.

The air ducts shall rise within the width of the tires of the chassis for transport and storage. There shall be a minimum of 12 inches of ground clearance when raised.

The impeller/shaft assembly(s) shall be dynamically balanced at the rated RPM. The velocity and CFM at each nozzle shall be certified by an independent test facility and supplied with the bid.

Airblast performance: 23,000 CFM @ 400MPH

Broom Hydraulic System: Refer to section titled "Hydraulic System".

Operator Control Station: All controls shall be located at the Operator Control Station (OCS) in the vehicle cab as described in section 5.17. All hydraulic functions of the broom shall utilize electric over hydraulic valving. Connectors to the control solenoids shall be interlocking type to provide a secure connection, and able to withstand normal pressure washing procedures. All hydraulic positioning functions (broom head lift, broom head swing, deflector, and air nozzle lift) shall be equipped with a hydraulic position locking system.

Electrical System: Please refer to Section titled "Electrical System" for all electrical requirements.

Controls and Instrumentation: Refer to section titled "Instrumentation, Gauges, (Operator Interface)" for all controls and instrumentation requirements.

Diagnostic Capabilities: Broom and Airblast operator interfaces located at the Operator's Control Station (OCS) and/or in the engine compartment service panel shall have diagnostic capabilities for the broom and air blast. It shall incorporate automatic diagnostics which displays system faults. All systems for the broom and broom engine shall be part of the diagnostics.

Runway brooms with airblast required tests:

Certification of compliance required with bid response

Field test in accordance with SAE ARP 5564, Airport Runway Brooms, and the following testing

requirements:

A field test must be conducted to simulate operations on a runway or taxiway having a length of at least 1,000 feet (305 m). Snow depth may vary, but the broom should be capable of removing snow at the following depths and densities:

- a) Large Swath Brooms - over 12 feet. Three inches (7.6 cm) of light snow having a density of 8 to 15 lbs/ft³ (128 to 240 kg/m³) or one inch (2.5cm) of slush at a density of 40 lbs/ft³ (641 kg/m³).
- b) Speed must be as high as practical but not less than 8 mph (13 km/h) for small swath brooms and 25 mph (40 km/h) for large swath brooms.

The resulting cleared swath must demonstrate the following:

- a) The resulting swath width is reasonably clean without snow deposits resulting from bouncing or skipping of the brush.
- b) The unit with airblast must be capable of varying its brush rotational speed, angle of attack, and the degree of brush pressure applied to a surface area.
- c) The unit with airblast must be capable of broadcasting snow to either side of the carrier vehicle.
- d) The broom should show no performance degradation when sweeping thin deposits of sand, ash, water, or other light debris.
- e) The unit with airblast must be designed to allow all performance and monitoring functions to be controlled or observed by a single operator from the carrier vehicle cab.

Finish and Paint:

The complete unit shall be painted per the latest version AC 150/5210-5 for purchase under FAA Federal programs.

All surfaces requiring paint shall be properly prepared prior to primer and finish paint. It is recommended that all steel components be prepared by shot blasting to remove all rust and mill scale. This should include an anti-corrosion chemical treatment followed by painting with high solid content/low VOC commercial type automotive primer and two coats of a polyurethane enamel, acrylic enamel, acrylic urethane, or similar high durability, long life paint as required by the customer. Finish processes such as industrial powder coating shall be acceptable. The finished paint shall be free of "fisheye," "orange peel," chips, runs, or other imperfections that detract from the equipment's corrosion resistance and appearance.

The complete vehicle shall be painted with one (1) coat of metal primer and two (2) coats of FAA approved International Fleet Yellow acrylic urethane.

Rust Proofing and Corrosion Protection: The vehicle (underside of fenders, underside of battery box, underside of fuel tanks, inside fender supports) shall be treated with low VOC rust-proofing protection. Rust-proofing material shall be tan color and be applied to a thickness of 4-5 mils when dry.

Technical Publications: The manufacturer shall furnish two complete sets of manuals; one in hardcopy form and one in electronic format. The set of manuals shall consist of:

- Operation, Maintenance, and Troubleshooting manual
- Supplied equipment manual
- Parts manual identifying every part on the unit both in parts list form and exploded view or schematic form in the case of electrical and hydraulic

Delivery, Start-up and Training:

The unit shall be fully assembled and tested prior to delivery. The vendor (seller) is responsible for the safe and timely delivery of the MTE, required accessories, spare parts, and tools as agreed upon in the contractual purchasing agreement.

Pre-Inspection: Inspection of vehicle shall be made by two Airport Representatives at the manufacturer's factory upon completion of the complete unit, prior to delivery to the Charlottesville-Albemarle Airport. The cost of inspection trip is part of these specifications and shall be coordinated with the Airport so that ample time may be given in order to make proper arrangements. The inspections at the manufacturer's factory shall not be construed as a final inspection or acceptance of vehicle. All costs for inspections shall be made by the manufacturer.

Training: A qualified factory trained representative must fully install, start-up, and test the unit as well as provide training to the operators and maintenance people. Training shall be performed by factory trained and authorized technician. The training shall be performed at the customer's site and shall be 8 hours for operators training and an additional 8 hours for mechanics training (mechanics shall attend the operating training first). The purpose of this training is to review safe

and effective procedures for use and maintenance of the machine, review and test all systems, assure the full function of the machine. Training will be in small groups – both classroom and hands on training is required. Printed and bound operators manuals shall be provided for each attendee with illustrations. A copy sample of this manual must be provided with a proposal.

Material within the manual shall include at a minimum;

1. Vehicle operation and maintenance safety precautions
2. Instrument and control operation
3. Active matrix display summary and operation
4. Seat and seatbelt operation
5. Brake system operation
6. Daily operators' checks and services
7. Drive engine starting and shutdown
8. Auxiliary engine starting and shutdown (if applicable)
9. Driving recommendations
10. Special off-road driving procedures
11. All steer system operation (if applicable)
12. Electrical system
13. Maintenance and inspection intervals

Manufacturers Warranty:

The bidder shall warrant his equipment as to the specified capacities and performance, and to be free from all defects in design, material and workmanship. All labor, transportation cost and defective parts shall be replaced free of cost. THIS GUARANTEE SHALL CONTINUE FOR ONE (1) YEAR AFTER COMMENCEMENT OF ACTUAL OPERATION OF THE EQUIPMENT. No exceptions to the guarantee requirement will be accepted. Additionally, the engines shall be warranted for a minimum of two (2) years and the automatic transmission shall be covered for a minimum period of three (3) years after commencement of actual operation of the equipment.

Manufacturers shall be required to submit their complete warranty statement with the quotation package. This shall entail warranty for all components and subsystems covered, the duration periods, pro-rated items and clearly identifying all items considered to be non-warranted wear items.

Reports and Documentation:

The following reports shall be provided upon delivery of each item/unit.

Engine performance: The unit is to be delivered with a performance report for each engine. The performance report shall be used for verification of engine operating parameters and specification compliance. The report shall be a print out entailing full operational load and low speed light load as recorded from the J1939 data bus. A sample of test report shall be provided with the quotation package.

Alignment: The vehicle shall be delivered with a wheel and frame alignment report verifying proper alignment and set up of the frame rails and main load bearing axles. The report shall show camber, caster and toe-in before and after adjustment against acceptable product limits. A sample report shall be provided in the quotation package.

Main component list: The manufacturer shall provide a dedicated (by VIN) component list for each unit delivered. The component list shall be itemized and list each main system component. The list shall include but not be limited to items such as engine(s), transmission, main hydraulic system components, drive gear boxes, axles, brakes, alternators, batteries, belts, and filters, etc. The list shall provide the description, manufacturer, part number, and quantity required. The serial number of the engine, transmission, drive gear boxes and axles installed on the subject machine shall be provided.

Prototypes and Experience

The airport sponsor requires this specified piece of equipment in order to maintain the airfield during large and small snow events. It will be a central and critical element in the fleet and in the effort to accomplish the airport's published snow plan. Experience building machines of this nature is mandatory as is a track record of recent manufacture and in-service record for machines comparable and similar to that specified. Therefore, location and contact lists are required in the bid package to enable the airport sponsor to contact at least 10 airports that have taken delivery of similar equipment from the bidder within the last two years. Bids received without including such location and contact list will be considered non responsive and will not be considered.

Insurance

To protect the purchaser from potential involvement in litigation, the chassis manufacturer for this contract shall be adequately covered with liability insurance. The manufacturer shall carry commercial general liability insurance including coverage for the products-completed operations exposure, with limits of not less than \$1,000,000 Each occurrence (Bodily Injury and Property Damage), \$1,000,000 Products/Completed Operations Aggregate, \$5,000,000 General Aggregate, and \$1,000,000 Personal and Advertising Injury. The insurance shall be issued by an insurance company with a current A.M. Best rating of A- or higher. A Certificate of Insurance showing that this minimum amount of coverage is currently in force shall be included in the bid package for the bid to be considered.

Manufacturer / Supplier Stability:

In the interest of continued and reliable service, parts, and technical support, equipment suppliers shall have exhibited a consecutive history of financial stability and manufacture of similar equipment over a minimum of the past ten years. Documentation shall be provided in the bid

package to verify such continuous business activity, such as location and contact lists (minimum 10 users), financial statements, and annual reports. In the interest of process and quality control, the chassis manufacturer shall be ISO9001 certified. Because of the critical nature of the product and its application, the burden of proof for this requirement lays with the bidder and/or suppliers.

Chassis Manufacturer Certification

Chassis manufacturer shall be ISO 9001 certified for the production of heavy trucks. Claims of self-certification programs are self-serving and are not acceptable for this procurement activity. Third party verification is required given the import and scope of the equipment and the purchaser's equipment procurement program. Certification documentation of chassis manufacturer compliance with 9001 FROM AN ACCREDITED THIRD PARTY is required in the bid package. Bids not including this documentation will be deemed not acceptable.

Component Sourcing

Because of the critical nature of this machinery, it is essential that the complete unit and all components be newly manufactured and unused. To this end, the purchaser reserves the right to compare serial numbers of engines, transmissions, transfer cases and axles with the current production records of the component manufacturers. Any component found to be used, or not of current production will be rejected. The contractor (bidder) will replace the component in question with an appropriate and acceptable new replacement component at his own expense.

Preparation for Shipment:

- a. Shipment. The vehicle and its accessories, spare parts, and tools shall be packed in such a manner as to prevent pilferage and insure safe delivery to the Charlottesville-Albemarle Airport, Charlottesville, Virginia.
- b. Delivery. The vehicle shall be delivered F.O.B. to the Charlottesville-Albemarle Airport, Charlottesville, Virginia. A qualified delivery engineer in the employ of the manufacturer shall deliver the vehicle and instruct personnel in the operation, care, and maintenance of the vehicle. Such delivery shall be done at no additional cost or expense to the Airport.

The vehicle must not be driven from the factory, but conveyed by other means to the Charlottesville-Albemarle Airport.

ATTACHMENT A

Bid Sheet

One, Multi-Tasking Equipment (MTE) for Airfield Snow Removal High Speed, Multi-Tasking Snow Removal Unit to include Cab Forward Carrier Vehicle, 22' Snow Plow, 20' Rotary Broom and High Velocity Air blast system.

Company Name _____

Model/Truck _____

Total Bid Price \$ _____

Delivery Date _____ (Not to exceed 210 days from date of award)

Authorized Signature _____

