SAE Aerospace
An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

SAE ARP6059

Issued 2013-07

Solid De-Icing/Anti-Icing Material Spreader for Airport Application

RATIONALE

This SAE Aerospace Recommended Practice (ARP) is a continuation of the G-15 committee's primary mission of developing standards for airport snow and ice control equipment.

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http://www.sae.org/technical/standards/ARP6059

1. SCOPE

This equipment recommended practice defines the requirements for a permanent vehicle-mounted or slip-in accessory device designed to transport and distribute aggregate de-icing, anti-icing, or friction modifying solid materials or wetted solid materials onto runways, taxiways, ramp, and terminal areas and other paved surfaces on an airport. It is not intended for liquid material spreaders which are addressed in ARP5559. The material spreader may be permanently mounted on a carrier vehicle, trailer, or semi-trailer, or temporarily installed on a carrier vehicle trailer, or semi-trailer for seasonal use only. The carrier vehicle may be dedicated to material spreading applications only, or provide additional functions such as a plow vehicle, flat bed or dump body. Carrier vehicles are self-propelled prime movers, generally a commercial or purpose-built truck that provides the mobility to move the material spreader on these paved surfaces. Carrier vehicle recommended practices may be found in ARP5943 plows and ARP5539, rotary plow with carrier vehicle. This recommended practice does not include requirements for the carrier vehicle, snow plow or other applications for the carrier vehicle.

The airport sponsor requires this equipment in order to maintain the airfield prior to, during and after snow and ice events. In combination with other supporting Snow Removal Equipment (SRE), the material spreader will enable the airport to modify the friction on surfaces used by aircraft prior to the accumulation of snow or ice, during or after a snow or ice event; or, after the removal of snow or ice by other snow removal equipment. Material spreader vehicles are often equipped with a displacement plow to provide both plowing and material spreading functionality. Some units may be used for other service such as parking lot or roadway snow and ice control, applying material for spills, for use as a conventional dump truck, or other applications.

It is the intent of this document to describe a hopper type material spreader, or hopper type material spreader combined with a liquid reservoir for pre-wetting the chemical, complete with rear end spreading device and necessary operational controls, suitable for skid mounting or chassis mounting on a carrier vehicle for airport application. The spreader material deposition is controlled by a single operator, normally the driver of the carrier vehicle, employing a control panel conveniently placed near the operator control station close to the driver's position. Material spreaders are primarily defined by the carrying capacity of the hopper (typically expressed in cubic yards) and by the width of the path for reliable and accurate material spreading (typically expressed in feet). Presently, typical hopper capacities vary from about 8 cubic yards to about 16 cubic yards; and, spreading widths vary from about 12 feet to about 80 feet. The material spreading pattern should produce a uniform distribution pattern, an even path from as little as 2 feet wide to the maximum specified spreading width throughout the spreading speed range. The unit should be designed to allow loading with bucket loaders, fixed equipment and manual loading. It should provide for protecting the dry materials in the hopper from direct exposure to the elements, particularly moisture before, during and after a snow event, and the safe and consistent spreading of the material on airport surfaces. In addition, the unit must provide methods of efficiently removing material from the hopper when no longer needed (end of storm/season) or for unit maintenance.

Material spreaders should be designed for operation using any of the typical airport snow and ice control chemicals, specifically including airport sand, sodium acetate, calcium chloride, Sodium Formate Urea and Urea liquid solution and liquid Potassium Acetate. Airport sponsors may specify other chemicals appropriate to their operational needs.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

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

SAE J931 Hydraulic Fluid Power Circuit Filtration - Application & Methods

SAE J1503 Performance Test for Air-Conditioned, Heated, and Ventilated Off-Road, Self-Propelled Work Machines

SAE J1292 Automobile and Motor Coach Wiring

SAE J994 Alarm - Backup - Electric Laboratory Performance Testing

ARP1247 Aircraft Ground Support Equipment - General Requirements

2.1.2 ASTM Publications

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

ASTM D638

ASTM D256A

2.1.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

AC 150/5210-5B Painting, Marking, and Lighting of Vehicles on an Airport

2.1.4 FMCSR Publications from FMCSA

Available from Federal Motor Carrier Safety Administration, 1200 New Jersey Avenue, SE, Washington, DC, 20590, Tel: 1-800-832-5660, www.fmcsa.dot.gov.

Title 49, Chapter III, Subchapter B-Federal Motor Carrier Safety Regulations

2.1.5 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA document DO-186 Minimum Performance Standards for Airborne Radio Communications Equipment Operating Within the Radio Frequency Range 117.975 - 137.000 MHz

2.2 Definitions

AIRPORT SPONSOR: The entity responsible for snow and ice control in aeronautical operational areas, (e.g., ramp areas, taxiways, runways). The airport sponsor, either acting directly or through an agent or third party, and whether or not the actual purchaser of the equipment, acquires the dry material spreader for use in aeronautical operational areas.

APPLICATION RATE (SPREAD RATE): The application or spread rates of dry and liquid materials controlled and expressed in mass per area terminology (e.g., pounds per 1000 square feet). Pre-wet rates controlled and expressed in percentages of mass of liquid added to mass of solid (e.g., 30% pre-wet rate would mean 30 pounds of liquid per 70 pounds of dry chemical).

AXLE CAPACITY: The allowable load on an axle based on supportive engineering data and the best judgment of the manufacturer of the axle. Usually based on all the components in an axle system, tire-wheel-bearings-spindle, etc.

AXLE RATIO: The numerical ratio of the drive shaft speed to the speed of the axle. The numerical ratio equals the torque multiplication factor of the axle.

AXLE, DEAD: A means of support for the wheels at each end that is non-driven.

AXLE, LIVE: A means of support for the wheels at each end that is driven.

CAB: An enclosed area on a vehicle designed and intended to hold and carry an operator.

CARRIER VEHICLE: The prime mover to which a material spreader is permanently or temporarily attached; and, when so attached enables the material spreader to dispense materials on airport surfaces.

CERTIFICATION: Documentation validating the results of testing, engineering analysis, or application approval or other technical approval.

CG (CENTER OF GRAVITY): The imaginary point where the total weight of an object may be considered to act.

CONVEYOR: A mechanism in the material spreader that moves stored material from the hopper to the spreader's dispersing mechanism, or which conveys material by an independent means like a metering feed roller which is sometimes referred to as an "unloaded conveyor."

DIFFERENTIAL: The gear assembly on the drive axle that permits one wheel to turn slower or faster than the other when negotiating a turn. The gear assembly in a transfer case that allows the front prop-shaft to turn slower or faster than the other when negotiating a turn.

DIFFERENTIAL, AUTOMATIC LOCKING: The gear assembly in the transfer case that allows the front prop-shaft to turn slower or faster than the rear prop-shaft when negotiating a turn while providing maximum driving torque to both the front and rear axles. The gear assembly on the drive axle that permits one wheel to turn slower or faster than the other when negotiating a turn while providing maximum driving torque to both wheels. Automatic locking differentials provide positive drive to both driven members.

DIFFERENTIAL, MANUAL LOCKING (BEVEL GEAR): The gear assembly on the drive axle that permits one wheel to turn slower or faster than the other when negotiating a turn but with provisions for the operator to fully lock and unlock the differential action from the cab. Bevel gears provide positive drive to both driven members.

DIMENSIONS:

AE	Centerline of rear axle/tandem to the end of frame.
BA	Bumper to centerline of front axle
BBC	Bumper to back of cab
CA	Back of cab to centerline of rear axle
CE	Back of cab to end of the frame (AE + CA = CE)
FH	Frame height from the ground to the top of frame
OAL	Overall Length
WB	Wheelbase

DISPERSING MECHANISM: The mechanism of the material spreader that receives the material and disperses it in a controlled and measured manner onto the airport surfaces.

DROP BOX: A gear box (or chain box) that transmits the power output by an auxiliary engine to its driven implement. A drop box usually lowers the physical height of the power to assist in packaging machinery and equipment. A drop box can have one single ratio or multiple ratios.

EQUIPMENT, AUXILIARY: Any equipment, in addition to the basic chassis that is required for a piece of equipment/vehicle to perform its functions. For example, a winch would be auxiliary equipment for a tow truck. All Auxiliary Equipment necessary to enable the equipment to perform its functions must be included and installed as part of the equipment on delivery.

FMVSS: An abbreviation for the Federal Motor Vehicle Safety Standards.

FRONT/REAR AXLE DISCONNECT: A mechanism within a transfer case designed to engage and disengage drive to the axle.

FUEL CAPACITY, MAXIMUM: The maximum actual volume of fluid able to fit into on-board tanks.

FUEL CAPACITY, USEABLE: The maximum amount of fluid able to be drawn from an on-board tank with the vehicle and tank stationary and in the fixed, operating position.

GAWR: Abbreviation for Gross Axle Weight Rating. The rating of the lowest rated member as defined by the component manufacturer from the following components: tires, suspension, hubs/wheels, rims, bearings, beam, and brakes.

GEAR RATIO: The ratio of the speed of the input to a gearbox to the speed of the output from the gearbox. For a single pair of gears, the ratio is found by dividing the number of teeth on the driven gear by the number of teeth on the driving gear.

GEARED SPEED: The theoretical vehicle speed based on engine RPM, transmission gear ratio(s), driving axle ratio, and tire size.

GEARS, SINGLE AND MULTIPLE REDUCTION: Single reduction gearing refers to one speed reduction through the gearing component. Multiple reduction refers to more than one step of speed reduction through the gearing component.

GRADE-ABILITY: The percent grade that a vehicle will negotiate.

GRATES: Devices installed on the top of the hopper to prevent oversized materials from entering the hopper during hopper filling operations.

GVWR: Abbreviation for Gross Vehicle Weight Rating. The sum of the Gross Axle Weight Ratings (GAWR).

HEAPED LOAD: The capacity of the hopper when loaded to the point at which the hopper is filled above level to a point that the material is stacked or heaped to its natural angle of repose. The maximum volume of dry material that the hopper can carry without spillage.

HOPPER: The portion of the material spreader designed to store the materials.

HORSEPOWER, GROSS BRAKE (or actual delivered horsepower): A measure of the rate at which engine power is produced. The time rate of doing work, as measured by a Pony brake or electric dynamometer can also be described as the amount of work done by a certain torque being exerted over a definite space of time. Brake horsepower is expressed as the torque in pound feet times the number of revolutions per minute divided by the constant 5252.

$$\text{Brake HP} = \frac{\text{torque x engine rpm}}{5252}$$

HORSEPOWER, GROSS: The brake HP determined under conditions defined by dynamometer test of the stripped engine, that is, the brake horsepower of the engine with only those accessories and attachments necessary to the functioning of the engine during test.

HORSEPOWER, NET: The brake horsepower delivered to the clutch, or its equivalent, with all accessories and attachments function (including exhaust pipe, muffler and tail pipe) which are standard or regular equipment on the engine as installed in the particular chassis.

LOADING HEIGHT: The height, with the vehicle empty, from the ground to the highest point of the material spreader (including grates when so equipped). The height necessary to permit loading material into the material spreader.

MATERIAL SPREADING CONTROL SYSTEM (MSCS): The system that controls the various components in the material spreader and carrier vehicle to allow the selection of desired application rates and to assure that material is dispersed in accordance with the selected rate regardless of ground speed, and/or that the operator is suitably alarmed should the selected rate not be achieved.

MAXIMUM TIRE LOAD RATING: The load rating at the maximum permissible inflation pressure for that tire.

MAXIMUM LOADED VEHICLE WEIGHT: The sum of curb weight, passengers, and cargo; equal to the Gross Vehicle Weight (GVW).

MAXIMUM PERMISSIBLE INFLATION PRESSURE: The maximum cold inflation pressure to which a tire may be inflated.

MAXIMUM SPEED: The speed attainable by accelerating at maximum rate from a standing start for one mile.

MAXIMUM STARTING GRADE: The percent grade on which a vehicle is able to start from a complete stop.

MAXIMUM SUSTAINED VEHICLE SPEED: Highest speed a vehicle can maintain under full load conditions on level ground.

NHTSA: An abbreviation for the National Highway Traffic Safety Administration.

NEW AND CURRENT PRODUCTION COMPONENTS: New, unused, and free of all defects and imperfections that could affect the serviceability of the finished product. Component with a manufacture date no older than 1 year prior to bid proposal.

NEW AND OF CURRENT PRODUCTION UNIT, AS IN TOTAL UNIT (CHASSIS AND ATTACHMENTS): Unit whose manufacture (assembly of) started no earlier than the award date of the contract.

PAYLOAD: The actual weight of the useful cargo carried by a vehicle.

PERCENT OF GRADE: The figure used in computing the power requirements of a truck. Usually taken at the steepest grade a truck will be required to climb on its route. Percent of grade is determined by dividing the height of a hill by its length.

PLY RATING: A unit of measurement used in tire construction to denote strength of tires.

POWER DIVIDER: Usually a small auxiliary gear box or chain driven device to allow distribution of drive shaft power to several different mechanical devices mounted on the same truck.

PRE-WETTING SYSTEM: A system, including tanks, plumbing, pump, and dispersal devices, to apply a metered amount of liquid to the material before it is dispensed onto the airport surface.

POWER TAKE-OFF (PTO): A mechanical device used to transmit engine power to auxiliary equipment. Power take-offs can be mounted on either a main or auxiliary transmission. Front-mounted and flywheel-mounted power take-offs are also used in various applications.

POWER TRAIN: All the components that handle the engine power from the truck engine to the driving wheels. This includes transmissions, drive shafts, as well as differentials and driving axles.

PUSHER AXLE: A non-driven (dead) axle installed forward of the driven axle(s) to increase the permissible gross weight, and consequently, the payload.

REFLECTORS: Glass or plastic prism lenses which reflect light.

RESISTING BENDING MOMENT (RBM): A calculation used to compare frames of different section modulus and of different material. It is the product of the section modulus times the yield strength of the frame material. The formula expression is:

RBM = Section Modulus x Yield Strength

It is readily apparent from the above formula that the yield strength of a frame is as important as the section modulus. The RBM should, therefore, be taken into account whenever frames of unlike material and section modulus are being compared.

ROAD ROLLING RESISTANCE: Sum of the forces at area of contact between a vehicle’s tires and road surface acting against the direction of movement.

ROADSIDE: The left side of the vehicle when viewed from the rear. Opposite side from curbside.

ROLLING RADIUS: Height measured from the center of the axle to the ground.

SERIAL NUMBER: A number issued to a vehicle or to a component of a vehicle for identification purposes. See Vehicle Identification Number (VIN).

SET-BACK FRONT AXLE: The front steering axle is normally as close to the front of the vehicle as the design and wheel and tire size permit. When the front axle is purposely located farther toward the rear it is referred to as being "set back." Center line of front axle to front of front bumper is normally from 28 to 37 inches on regular models and 48 inches or more on set-back front axle models.

SHIPPING WEIGHT: The dry weight of a complete truck with all standard equipment including grease and oil but without any fuel or coolant.

SPRING CAPACITY: The allowable load that can be supported by the spring(s).

STEERING, POWER: Steering system that uses hydraulic or air pressure to control a steering axle without a direct mechanical (controlling) link between the operator’s controls and the steering axle.

STEERING, POWER ASSISTED: Steering gear or mechanism with a direct mechanical (controlling) connection to a steering axle that has provisions for part of the force required for operation to be provided by air, hydraulic, or other means, not including mechanical leverage (longer handles).

STOPPING DISTANCE: The distance traveled by a vehicle from the point of application of force to the brake control to the point at which the vehicle reaches a full stop.

STRUCTURAL MEMBER: A part of a vehicle designed primarily to support the load of a vehicle in operation.

SUCTION LINE: A tubular connection between a reservoir or tank and the inlet of a pump.

SYNCHRONIZED TRANSMISSION: A type of manual truck transmission with built in devices to automatically match the rotating speeds of the transmission gears.

TAG AXLE: A non-driven (dead) axle installed behind the drive axle(s) to increase the permissible gross weight, and consequently, the payload. Also termed "trailing axle."

TANDEM AXLE: Two axles mounted as a group. In a dual-drive tandem, both axles have drive mechanisms and are connected to the engine power unit.

TARE WEIGHT: The total weight of an empty vehicle in a condition ready to receive payload.

THIRD PARTY: A disinterested party (not the manufacturer) professionally qualified to observe, understand, and/or record test data who is acceptable to the purchaser.

TILT CAB: A cab that pivots forward to gain access to the engine or other major component.

TIRE CLEARANCE: Space between tires and the nearest part of the body or under-construction.

TIRE LOADED RADIUS: The distance from the center of the wheel to the road with tire loaded to rated capacity. Static radius applies when vehicle is at rest. Rolling radius applies for a vehicle in motion. Rolling radius is usually slightly greater than the static radius.

TORQUE CONVERTER: A hydraulic drive which transmits power with the ability to change torque.

TRACTIVE EFFORT: The maximum force developed by a vehicle power train at contact between the driven wheels and road surface with 100% traction.

TRANSFER CASE: Split power gear box transmitting drive to the front and rear axles.

TRANSMISSION: Selective gearbox providing various combinations of gear ratios.

TRANSMISSION, AUTOMATIC: A type of transmission designed to self-select and change gear ratios based on vehicle and engine speed.

TRANSMISSION, HYDROSTATIC: A type of transmission that provides gear reduction between the engine and drive wheels that uses fluid under pressure to transmit power and torque rather than mechanical components.

TRANSMISSION, MANUAL: A type of transmission that can function only with periodic input from an operator to select the gear reduction or drive ratio in use in the transmission.

TRANSMISSION, POWERSHIFT: A type of transmission that can function only with periodic input from an operator to select the gear reduction or drive ratio in use in the transmission. Powershift transmissions include a device that allows the change of drive ratios or gears by means of an internal device that does not require operator action to interrupt power from the engine while changing the gear or drive ratio.

TREAD; WHEEL TRACK: (a) The distance between the centers of tires on the same axle at the points where they contact the road surface. Duals are measured from the center of dual wheels. (b) That portion of a tire that comes into contact with the road.

TRUNNION: (a) The axis, pivot point, or center point between axles. (b) The axis or pivot point of power transmission in a steerable drive axle where the turning member joins the non-turning member of the axle.

TURNING RADIUS: One half the diameter of a circle described by the center line of the outside front tire while a vehicle maneuvers through a 360 degree turn.

TWO-SPEED AXLE: A driving axle arrangement whereby the driver can select one of two ratios.

VEHICLE IDENTIFICATION NUMBER (VIN): A number issued to a vehicle for identification purposes. Format and code of a VIN is prescribed by law to identify manufacturer, configuration, and date of production.

WATER LEVEL LOAD: The volume of the hopper when completely filled to the top with the material level at the top edge.

3. TECHNICAL REQUIREMENTS

3.1 General Description

As used in this standard, material spreader shall mean a device used to transport and disperse in a measured and controlled fashion materials used to improve the friction characteristics of runway, taxiway, ramp, roadway, or other surfaces at an airport generally prior to, during, or after a snow or ice event generally by preventing winter contaminates from bonding to pavements, or by lowering the freezing point of winter contaminants. The material spreader consists of a structurally sound hopper body designed to safely contain and transport the various snow and ice control chemicals; a conveyor or other mechanism to move the material to the dispensing mechanism; a dispensing mechanism to produce the desired spreading pattern on the airport surface; and a material spreading control system to allow the selection of the application rate material dispensed onto the airport surfaces. Various additional components or systems (such as a pre-wetting system, grates, tie-down devices) may be specified by the airport sponsor, or are essential components necessary to provide a functional material spreader as detailed in the Airport Specific Equipment Section (see 3.16).

3.2 Minimum Performance Requirements

The nominal hopper capacity as stated by the manufacturer shall be within a range of -2% to + 1% of the actual hopper capacity when filled to a water level load.

The hopper shall be constructed of material selected to provide structural strength and long life when exposed to the specified chemicals used in snow and ice control. The hopper shall have a 10 year guarantee from the manufacturer against structural failure and corrosion that significantly reduces structural integrity or the hopper's ability to contain a full load of material without leakage. The airport sponsor may specify acceptable materials for the hopper. The hopper shall be provided with four lifting hooks, one at each corner of the body for installing and removing the spreader.

The material spreader shall be capable of dispensing materials in a controlled manner at various speeds from a minimum of 5-mph through 40-mph or more. Material flow shall be continuous in both forward and reverse motion, but shall automatically stop when the vehicle is not moving. The operator shall also have the ability to override the automatic rate when stationary for testing, off loading, demonstration purposes, or to temporarily increase the rate of material deposition to address specific pavement needs through the use of a switch or button that overrides the metering function and applies extra material.

The unit shall have a maximum material spreading width of not less than 40 feet, or as specified by the airport sponsor.

The spreader manufacturer shall provide the airport sponsor with the hydraulic power requirements, including pressure, volume, and fluid cooling needs that must be supplied by the carrier vehicle for proper operation of hydraulic spreaders. Similar information to allow the airport sponsor to determine other power sources shall be provided in cases where the spreader is driven by a system other than carrier vehicle hydraulics. The calculations must be comprehendible, complete, logical, and in a mathematical order per SAE and the Fluid Power Society standard formulas and practices.

Written installation and/or application approval from the manufacturers of hydraulic components must be provided. This shall include hydraulic pumps, motors and valves. Hydraulic pressure, flow and temperature parameters must be within the limits prescribed by the component manufacturer for this installation while the vehicle or subsystem is operated normal duty cycle in the maximum or minimum ambient temperature conditions specified. These approvals shall be delivered with the material spreader.

The airport sponsor may accept data resulting from a manufacturer's performance test or may request an independent performance test or may elect to conduct a performance test to ensure compliance with the requirements prior to acceptance.

3.3 Carrier Vehicle

The airport operator is responsible for providing a carrier vehicle of adequate size, type, and configuration to provide support and transport capability of the material spreader; using the information provided by the material spreader manufacturer as detailed later in this section. If the unit is to perform additional functions (such as plowing, dump body operations, trailer towing, etc.), these functional needs are to be defined by the airport sponsor to assure that the manufacturer(s) of the carrier vehicle and other attachments, components, or systems fully and completely understand the intended operational functionality of the unit.

Typically, the carrier vehicle for a material spreader is a commercial truck chassis, or truck chassis with vocational body, of the type, size, and quality desired. The carrier vehicle shall be classified as an on-highway vehicle, unless the airport operator and the carrier vehicle manufacturer concur that the unit should be classified as off-highway for conformance with regulatory requirements. Horsepower, number, and capacity of axles, GVWR and GAWRs, the number of driven wheels, cab type and configuration overall length, width, and height and other carrier vehicle specifications must be matched to the material spreader and other functionality requirements.

NOTE: Typically material spreaders of up to about 5 cubic yards can be mounted on a two axle truck carrier vehicle, while larger capacities will require a three axle chassis carrier vehicle. Skid-mounted hoppers are easily transferable from one truck to another, and may be removed to allow other uses of the vehicle during other seasons; however, they require a higher capacity truck, result in a higher center of gravity, and require a higher loading height than chassis mounted units.

If the carrier vehicle is designated as an off-highway vehicle, unless otherwise specified by the airport operator, the following Federal Motor Vehicle Safety Standards shall apply as though it was 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

3.3.1 Information to be Provided for Carrier Vehicle Selection

The material spreader manufacturer shall provide complete information on weights and centers of gravity to facilitate selection of an appropriate carrier vehicle. This shall specifically include:

- Empty weight of the complete material spreader including all accessories, fluids, tie-downs, and everything except the material.
- Shipping weight of the material spreader and the center of gravity location of the unit as delivered to facilitate material handling requirements.
- Gross weight, longitudinal center of gravity location, and vertical center of gravity location of the unit when filled to rated capacity (water level load unless otherwise specified) with each of the chemicals specified in this standard, and those specified by the airport sponsor.
- Gross weight, longitudinal center of gravity location, and vertical center of gravity location of the unit when filled to maximum heaped capacity with each of the chemicals specified in this standard, and those specified by the airport sponsor.
- Height from the base of the spreader to the highest point of the spreader, including top grates or other accessories to allow determination of loading height of the unit when mounted.

For new carrier vehicle applications, at the request of the airport sponsor, the spreader manufacturer shall work with the carrier vehicle manufacturer to assure the completed material spreader/carrier vehicle combination will not exceed any GAWR, the vehicle GVWR and that the weight distribution meets industry standards and recommendations. CG heights will also be verified for the completed material spreader/carrier vehicle to assure CG heights are within the carrier vehicle manufacturer and industry standards. This data is to be presented to the airport sponsor in the form of a diagram depicting key dimensions and weights. In addition, certification of the intended application will be provided by both the material spreader manufacturer and the carrier vehicle manufacturer detailing their approval of the configuration for the intended functions. When required by the airport sponsor, the completed unit shall be weighed at a certified scale in both the nominally empty configuration, and the fully laden (rated) capacity using the highest density liquid and dry materials specified by the airport sponsor. The material type, and specific gravities or density of the materials, and certified weight tickets showing gross and axle loadings shall be provided to the airport sponsor. Should the unit exceed any axle GAWR or the GVW it shall be cause for rejection of the unit.

3.4 Electrical System

All material spreader components and systems shall operate without being affected by interference damage or disruption including detrimental effects of interference to on-board computer modules from either material spreader generated noise, or stray EMF or RMF fields encountered from any airport operations. EMF and RMF noise sources that may be generated by the material spreader, especially if such noise is detrimental to aircraft, air traffic control, or air navigation equipment, shall be shielded.

All electrical system components shall be resistant to common aircraft and airfield liquid deicers including but not limited to: potassium acetate, propylene glycol, and ethylene glycol. The electrical system shall be negatively grounded and installed in accordance with current state-of-the-art practices and appropriate industry standards. All parts of the electrical system shall be water and moisture resistant, easily accessible, securely mounted, and protected against extreme temperatures, physical damage, snow, oil, and corrosion. All electrical circuit wiring shall be fuse or circuit breaker protected, made of stranded conductors with a capacity exceeding the anticipated maximum circuit loading, and limiting the voltage drop to the device to the nominal system voltage. Insulation of electrical wiring shall be equal to the recommended standards established for insulation materials by SAE.

The spreader manufacturer shall provide a complete wiring schematic of the entire spreader electric and electro-hydraulic system to the airport sponsor.

Digitally controlled electrical circuits shall be protected by solid state circuitry and logic to prevent damage due to over currant, system spikes, or accidental reversed polarity. Power supplies to control modules shall be protected by manual reset circuit breakers. Manual reset circuit breakers controlling all analog circuits shall be commonly located and easily accessible.

Chassis mounted material spreaders shall have their electrical systems permanently mounted to the carrier vehicle through the use of water and moisture resistant junction boxes.

Removable material spreaders shall use SAE standard connectors to allow installation or removal of the material spreader to the carrier vehicle without the use of tools. If more than one connector is used, they shall be of different sizes and configurations to make it impossible to make an incorrect connection, unless the connections are physically separated so that incorrect connections are not physically possible (example, one connection at the front and one at the back).

The airport sponsor shall specify the type(s) of material spreader electrical systems to be used on the carrier vehicle:

- 12 volt electrical and starting.
- 12 volt electrical/24 volt starting.
- 24 volt electrical and starting.

Unless otherwise specified by the airport sponsor, lighting, reflectors, and conspicuity shall conform to FMVSS 108. All lighting shall be 12 or 24 volt, and shall include, but not be limited to the following whether permanently mounted or slip-in: tail, stop, turn signals, clearance, identification license and backup lights:

For U.S. applications, amber beacon near or on cab roof with switch located at the operator control station (see FAA AC 150/5210-5B Painting, Marking, and Lighting of Vehicles on an Airport).

An audible and visual warning device to indicate that either carrier vehicle door is open with the transmission in gear.

A master on/off switch for the spreader shall be provided at the operator control station.

All spreader gauges and switches shall be the illuminated for ease of operation and identification at night. All critical in-cab spreader controls must be illuminated and easily identifiable by the operator in nighttime operations. Operators control panel shall be designed for ease of maintenance including removal of the entire control panel from the vehicle.

The operator’s controls in the chassis cab shall have all the necessary functions to operate the spreader.

Work lights with switches are to be provided at all locations where service or adjustments must be made.

3.5 Conveyor

The conveyor system shall be designed to transport material from the hopper to the distribution assembly. The conveyor/hopper design must be designed to remove not less than 90% of the nominal capacity of the hopper to the distribution assembly. The conveyor assembly must be designed to provide long life and easy adjustment and repairs. The conveyor assembly shall be equipped with overload protection to prevent damage from foreign objects, jams, or other instances. Protection may be through hydraulic by-pass, electrical over-current or overheat protection, shear pins or bolts, or other methods. As an alternative, an unloaded conveyor system may be utilized wherein material is metered to a conveyor not located with the hopper.

3.6 Discharge Gate

An adjustable discharge gate shall be located at the rear of the hopper to allow adjusting the flow of material to the distributer assembly. Alternate methods of controlling and adjusting material discharge may be utilized.

3.7 Disbursing Mechanism

The disbursing mechanism typically consists of one or more spinning disks that disburse the material in the desired pattern, although other mechanisms are permissible. When spreading disc(s) are used, they shall be made of suitable corrosion resistant material (typically polyethylene, Corten or stainless steel) of a diameter and construction to produce the necessary material dispersal pattern. They shall have an appropriate number of equally spaced removable vanes bolted to the distributor disc(s) for easy replacement. The distributer mechanism shall be designed to obtain a controlled spread from 2 to 40 feet.

3.8 Dispensed Material Size Control

Some chemicals used in snow and ice control can transform into large clumps or solid objects. To address this problem, airport material spreader must provide dispersed material size control adequate to preclude clumps of solid objects or stray material from being dispersed onto aeronautical surfaces thereby creating a FOD hazard. The material size must be positively controlled to limit the size of dispensed material to not more than 1/2 inch diameter. Larger clumps or objects must be physically separated from the spread material and collected for later removal; or, crushed, ground pulverized or broken up into appropriately sized particles for spreading. The mechanism designed to reduce large objects or clumps from being dispersed, should also be designed so as to not reduce the chemicals to a powder or flake consistency. If the material is reduced to a powder consistency it will be adversely affected by wind and may not be cast appropriately. Ideal particle size should be in the range of 1/8 inch diameter.

3.9 Distribution Control System

The unit must be equipped with a distribution control system to regulate the discharge of material onto the airport surfaces in a uniform and controlled fashion, allowing the operator to select the degree of material disbursement, and providing automatic disbursement at the selected regulated amount at any speed from stopped to maximum vehicle speed. The control system shall allow the operator to select distribution rates from as little as 1 pound of material per 1000 square feet to as much as 40 pounds per 1000 square feet. An intermittent over-ride control to enable an operator to apply added material to selected spots or areas shall be provided. The distribution control system shall be of the type specified by the airport operator:

Type 1 - Ground speed controlled distribution system in which the system uses information from the carrier vehicle's tires, axle, transmission or other data source to adjust material dispersal rate based on the speed of the carrier vehicle.

Type 2 - Terrain based control distribution system in which the system uses GPS or other systems to adjust the dispersal rate relative to the movement of the carrier vehicle over the terrain.

3.10 Hopper Screens

Screens shall be provided over the top of the hopper to prevent the entry of foreign objects into the spreader body, and to pre-screen chemicals to a size that can be de-aggregated by the material spreader's dispensing system. Hopper screens are classified into three types to meet the needs of the specific airport:

Type 1 - Light-duty screens made of wire, structural elements, or light grating designed to provide minor protection from foreign objects, and suitable material screening.

Type 2 - Heavy-duty screens made of substantial grating materials or structural elements suitable to support workers walking on top of the spreader and capable of sustaining impact loads from large foreign objects or impact loads from the bucket of a loader.

Type 3 - Heavy-duty power opening screens similar in material and construction to the Type 2, but providing the additional feature of being able to be opened through a powered system, to open and close allowing the operator to remove accumulated debris from the screens. Type 3 screens shall include warning lights and an audible signal at each side to warn nearby staff that the screens are being operated and debris may be falling from the screens.

Alternatively a one piece fixed Type 1 or Type 2 screen may be provided with two service access doors, both hinged for easy access. Each type shall be safety installed for easy opening and closing. Maximum length per section for Type 1 and 2 screens shall be 4 feet but not to exceed a maximum required lift force of 40 pounds. Type 3 screens may be of any length suitable for the lifting mechanism. Type 1 and 2 screens shall be equipped with handles or handholds to permit the operator to open or close the grates while wearing heavy winter gloves. They shall be attached to the upper side of the hopper with hinges that can be separated without the use of tools, and suitable latches or connectors to hold the screens in the closed position, unless the design is such that gravity precludes their opening during travel. The screens must be completely removable for hopper interior maintenance without the use of tools. A support strut, arm or chain shall be installed to prevent the screens from opening more than 10 degrees beyond vertical. The screen must be designed to allow no material collection on top of screen or hopper.

3.11 Pre-Wetting System

Unless specifically deleted by the airport sponsor, material spreaders shall include a pre-wetting system to allow the operator to improve the material spreading operation through pre-wetting of the material at or near the point of discharge. Pre-wetting systems shall be designed to provide pre-wetting application rates of at least 30% (liquid to solid) application rates. The pre-wetting system shall include mounted liquid tanks capable of wetting not less than a full load of dry material at the maximum recommended rate of 30% liquid pre-wetting to 70% solid. The airport sponsor may specify greater amounts of liquid (e.g., enough for two full loads of dry material at the specified or recommended rates of pre-wetting). The pre-wetting system shall include a pump and metering/control system liquid conductors, and nozzle(s) capable of dispensing the liquid material at the desired rates of application, and driver controls to allow turning the pre-wetting system on and off, and to allow adjustments of the pre-wetting rate. Pre-wetting systems shall be equipped with a method of draining tank(s) without spillage, and fill point(s) that allow filling the tank(s) from ground level without the need for ladders or stands. All components used in the pre-wetting systems exposed to the pre-wetting liquid shall be approved for use with those chemicals. Pre-wet system shall include indicator light(s) in cab to indicate when the pre-wet system is operating, anti-backflow check valve near the tank discharge, manual tank drain valve(s), manual discharge line shut off valve, in-line screen 40 mesh strainer, spray orifice(s), and low pre-wet tank level warning light. Tank fill caps shall be attached with chains or cables to prevent loss. Pre-wetting fill ports shall be prominently labeled indicating the approved materials to be used in the pre-wetting system. Pre-wet system shall be controlled by electronic control to adjust flow rate to match material spreading rate and vehicle ground speed. Unless otherwise specified by the airport sponsor, pre-wetting must provide for a range of from 2 gallons per ton of dispensed material to at least 30 gallons per ton of dispensed material. When requested by the airport sponsor, the pre-wetting system may be used for liquid material dispensing independent of the dry material.

3.12 Mounting

The material spreader manufacturer shall provide complete instructions for the proper mounting of the material spreader device. These instructions shall also include specific details as to power requirements necessary to drive the material spreader, and recommended electrical, pneumatic, hydraulic, or other schematic diagrams to assist the airport sponsor or the airport sponsor's contractor in properly installing the unit on the vehicle. The material spreader manufacturer, or duly authorized representative, shall be available to assist in the installation, and to make recommendations on proper installation methods and techniques. When requested by the airport sponsor, the material spreader shall be tested for proper weight distribution and functional operation with certification of proper installation attested to by the manufacturer or representative. Proper installation shall include appropriate strength of tie down connections between the vehicle and the material spreader, as well as verification that the unit meets weight distribution guidelines with the unit in any condition of loading from empty to maximum recommended fill condition.

3.12.1 For Slip in Spreaders

All mounting hardware, and printed instructions as to the proper method of installing the spreader in or on a truck with vocational dump or flatbed body, and to install controls in the cab or operator's area. Required electrical and hydraulic hookups shall use common industry standard bulkhead type electrical and hydraulic connectors such as the SAE standard trailer connectors, with the spreader end pre-wired. All necessary mating plug(s)/connector(s) must be provided with the spreader.

3.12.2 For Permanently Mounted Spreaders

A detailed listing of all mounting hardware, and printed instructions as to the proper method of installing the spreader on a truck chassis, including recommended electrical hookup to the truck chassis must be provided.

3.13 Painting and Finishing

3.13.1 Painting, Marking, and Lighting of Vehicles

For U.S. applications, the vehicle shall be painted in accordance with FAA AC 150/5210-5B unless otherwise specified by the airport sponsor. The material spreader and all equipment shall be cleaned first, then treated with a corrosion inhibitor, primed, puttied, sanded, and finally painted. The paint shall consist of not less than two coats of airport sponsored polyurethane enamel, acrylic enamel, acrylic urethane, or similar high durability, long-life paint, applied to produce full hiding. 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. Powder coating finishes are acceptable. Hoppers or other components constructed of stainless steel or other non-corrosive materials may be unpainted if so directed by the airport sponsor. Decals, Logos, Striping, and other markings will be installed by the material spreader manufacturer prior to delivery.

3.14 Labels and Instruction Placards

The material spreader shall be equipped with labels and placards to provide information to the operator and maintenance staff. At a minimum this shall include:

- A chart affixed near the front on the driver's side detailing the hopper capacity in cubic yards and listing the gross weight when filled to the struck capacity with each specified chemical as well as any other chemicals specified by the airport sponsor.
- A line on both sides and the words "Maximum Fill Level" (or similar) indicating the maximum filled height on the hopper.
- Caution or warning labels at all pinch points, discharge areas or other areas that could present a hazard to service or operating personnel.

3.15 Model Certification

One unit of each model offered by a manufacturer shall be tested and certified for capacity and performance. The certification shall be signed by an officer of the corporation, or a licensed professional engineer. Copies of the certification shall be provided with all Requests for Quotations, and with each delivered unit of that model. The certification shall include:

- Calculated or actual test data confirming the volumetric capacity of the hopper. Hopper capacity testing shall consist of hopper being filled to a water level load level with test material and the quantity of the material used to fill the hopper shall be measured and recorded. The capacity of the hopper to be within 5% of the nominal capacity.
- Actual certified weights of the material spreader empty, and then using the identified test material, water level loaded, and heap loaded; and, CG locations for each condition longitudinally, laterally, and height.
- Discharge Test - The hopper is to be filled to a water level load level with dry and liquid test materials and the unit operated to discharge until the solid material is exhausted. The solid material remaining in the hopper shall be not more than 5% of the nominal hopper capacity.
- Calculated or actual test data confirming the empty weight and CG of the material spreader.
- Calculated or actual test data of the weight and CG of the unit with water level material load, full pre-wetting tank(s) and all operational fluids and components.