

Snowplows and Hitches

RATIONALE

ARP5943 has been reaffirmed to comply with the SAE five-year review policy.

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1. SCOPE

This SAE Aerospace Recommended Practice (ARP) covers various requirements for airport runway plows, ramp plows, wings, and hitches to be used with various carrier vehicles primarily used to cast snow away from airport airside operational areas, such as runways, ramps, and taxiways. It does not apply to plows and hitches for non-airport snow removal equipment such as highway plows or construction/farm machinery.

1.1 Intent

The intent of this Recommended Practice is to provide a basis from which the airport operator can develop specifications for snow removal equipment required in wintertime for pavement clearing operations. This document contains sections, which, alone or in combination, are intended to describe many types of such equipment. It describes what is considered to be the minimum technical requirement to successfully specify such equipment. Because local conditions vary significantly describing the local requirements will build significantly upon these minimums.

The purchaser is considered to be the most knowledgeable authority regarding local conditions, requirements, and capabilities. All sponsors are encouraged to consult intensely with equipment manufacturers and other airports facing similar situations and conditions before and throughout the procurement process. It is the local airport's sole responsibility to maintain and operate the equipment purchased. Therefore, it behooves the sponsor to carefully consider maintainability, commonality, and product support while developing specifications and procuring equipment.

When writing specifications for snowplows, hitches, underbody scrapers and wings, it should always be a concern that the equipment does not overload the Gross Vehicle Weight Rating (GVWR) and/or the axles, wheels, tires, springs or steering Gross Axle Weight Rating (GAWR) of the vehicle to which it is to be installed.

When a combination of different types of snow removal equipment along with a dump body and/or material spreader, hydraulic system, etc., are required, the total weight of all the equipment along with the material to be used in the dump body or spreader and if required, the liquid used in a wetting system, cannot overload the GVWR of the vehicle.

In some cases, the airport operator will feel satisfied utilizing these guidance specifications precisely as they are provided herein with little more than the addition of terms and conditions required by local procurement procedures. In others, the operator may believe that significantly more detail is required. This may include specific systems, designs (such as in-pavement lighting and other runway surface materials that will determine what type plow cutting edges they will require), and/or components to accomplish the task at hand in a safe and expeditious manner.

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 a 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 J560 Primary and Auxiliary Seven Conductors Electrical Connector for Truck-Trailer Jumper Cable

SAE J572 Requirements for Sealed Lighting Unit for Construction and Industrial Machines

SAE J931 Hydraulic Power Circuit Filtration

SAE J1292 Automobile, Truck, Truck-Trailer, Trailer, and Motor Coach Wiring

SAE J2042 Clearance, Sidemarker and Identification Lamps for Use on Motor Vehicles 2032 mm or More in Overall Width

2.1.2 ASTM Publications

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

ASTM G 75-01 Standard Test Method for Determination of Slurry Abrasivity (Miller Number) and Slurry Abrasion Response of Materials (SAR Number)

ASTM D 256-05 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

ASTM D 638-03 Standard Test Method for Tensile Properties of Plastics

2.1.3 FAR and FAA Publications from FAA

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

AC150/5200-30A Airport Winter Safety and Operations

AC150/5200-18 Building for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials

AC150/5210-5B Painting, Marking, and Lighting of Vehicles on an Airport

2.2 Definitions

2.2.1 AXLE CAPACITY

The allowable load on an axle based on supportive engineering data and the best judgment of the manufacturer of the axle.

2.2.2 CARRIER VEHICLE

The prime mover to which a rotary snowplow, runway broom, or displacement plow is attached or any vehicle designed and purchased for the purpose of transporting any working snow head.

2.2.3 CASTER ASSEMBLIES

Wheels, generally of small size, with the ability to swivel and their attachment mechanism(s) to the plow. The wheels ride along the pavement and may support some of the weight of the plow and/or may provide a method of adjusting the clearance between the bottom of the cutting edge and the pavement. Each caster assembly can be of the single or dual wheel type, and the wheels may be of solid rubber, foam filled rubber, steel, or other materials.

2.2.4 COEFFICIENT OF FRICTION

Coefficient of friction is a unitless number that represents the resistance of sliding of two surfaces in contact with each other. These values should be between 0 and 1. Higher values indicate more resistance to sliding.

2.2.5 CUTTING EDGES

The portion of the plow that scrapes the surface, traditionally available in steel, rubber, polyethylene, with or without tungsten carbide inserts.

2.2.6 CUTTING EDGE REINFORCEMENT

Supports the cutting edge and prevents damage to moldboard upon impact at cutting edge.

2.2.7 "DE-CEL" TYPE CYLINDER

A type of cylinder designed to automatically control the speed of function as the cylinder reaches a certain point in its stroke.

2.2.8 DEE

Component which attaches the front of a side wing plow to the carrier vehicle's front post or mast. Typical designs are fixed (non-tripping) or full trip.

2.2.9 DRIVE FRAME

Portion of plow that attaches to the moldboard.

2.2.10 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.

2.2.11 GVWR

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

2.2.12 HITCH

Attaches to the truck chassis frame or front-end loader, then attaches to the plow drive frame - normally has a lifting device and lift ram to raise the plow off the pavement.

2.2.13 MAXIMUM LOADED VEHICLE WEIGHT

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

2.2.14 MAXIMUM TIRE LOAD RATING

The load rating at the maximum permissible inflation pressure for the specified tire.

2.2.15 MOLDBOARD

Portion of the plow that moves the snow, available in many shapes and sizes, depending on the local conditions and the combination of casting or rolling of the snow that might be required. Traditionally, moldboard surfaces have been made from polyurethane, steel, or stainless steel.

2.2.16 MOLDBOARD OVERHANG

The longitudinal distance between the cutting edge and the top of the moldboard. The top edge of the moldboard is forward of the cutting edge.

2.2.17 MOLDBOARD PITCH

The angle of the cutting edge in relation to the pavement.

2.2.18 REVERSING

The capability of angling or rotating the plow moldboard to allow the discharge of plowed snow to the left or right of the carrier vehicle when moving in a forward direction. Power Reversing is reversing from the operator's position in the cab by use of a system such as hydraulic rams, hydraulic or electric motors, or other devices or mechanisms to change the plow moldboard angle.

2.2.19 RIM PULL

Actual amount of effort in pounds available at point of contact of tire and road surface.

2.2.20 SHOCK/IMPACT ABSORBERS

Devices that absorb impact to prevent damage to plow, pavement surface, carrier vehicle and/or operator.

2.2.21 SAFETY CUSHION DEVICE

A component designed to absorb impact to minimize damage to the plow, pavement surface, and/or operator.

2.2.22 SNOW DEFLECTOR

Devices designed to minimize blowing snow from coming over the top of the moldboard.

2.2.23 TRIP MECHANISM

A method of allowing the plow cutting edge to pass over surface objects and automatically returns to the original plowing position. Examples include Trip Edge design where only the cutting edge trips while keeping the moldboard in a fixed position; and Trip Moldboard design where the complete moldboard is allowed to rotate; and, Moldboard Cushioning design where the cutting edge and moldboard, as one, deflect rearward and/or upward.

2.2.24 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.

3. TECHNICAL REQUIREMENTS

3.1 General Description

Displacement plows consist of a cutting edge to shear snow from the pavement and a moldboard to lift and cast the dislodged snow to the side of the cleared path. These units are primarily used for airside operational areas. The cutting edge may ride in contact with the pavement or be held a small distance above it by means of caster wheels, moldboard shoes or other devices. A complete displacement plow unit consists of a plow, carrier vehicle, and accessories. The design provides variable blade positions to either the right, left or straight ahead (plow perpendicular to the carrier vehicle) position. This allows high volumes of snow to be displaced in a direction dictated by wind conditions or other constraints. The ability to change the plow angle improves operational efficiency and may reduce the number of plow units required. Based on knowledge of local conditions and snow removal requirements, the purchaser may specify a specific type of snowplow. Examples are:

1. The straight uniformed height moldboard design. This type of plow controls the discharge in a somewhat precise area.
2. The flared end moldboard design broadcasts the snow higher and further than the standard straight moldboard design. Typically depending on the overall length of the plow, the flared ends should be a minimum of 12 inches higher at the discharge ends on the 14-foot to 18-foot widths, and a minimum of 16 inches on the 20-foot and larger widths.

3. The tapered snowplow that has a funnel shape moldboard with a high discharge height, which allows snow to be cast in a high arc.

4. HIGH SPEED, POWER REVERSE SNOWPLOWS

4.1 General

High-speed power reversible snowplows are manufactured expressly for airport runway high-speed plowing and ramp plowing. High speed plowing typically refers to 20 mph or faster. They should be designed for continuous work under extreme conditions of airport snow removal.

4.1.1 Moldboard Assembly

The plow width and moldboard design shall be specified by the user. (Note: Plow widths range from 14 feet to over 30 feet. Plow width selection is determined by factors such as the airport clearing time requirements pointed out in FAA AC150/5200-30A, storage/maintenance door width concerns which are alluded to in FAA AC 150/5220-18, security access points, confined operating areas, carrier vehicle horsepower and GVWR, and anticipated snow removal conditions. See Figures 1 and 2 for guidelines to clearing width and horsepower requirements.

- a. Steel Moldboard with Uniform Height. Typically moldboard height shall be 50 inches. The moldboard shall be constructed with a minimum of 10-gauge high abrasion resistant steel sheet with a combination of a full-length angle at the top and the bottom with a minimum of 3/8 inch thick vertical ribs, bracing, backup plates to manufacture a structurally sound moldboard. The minimum moldboard overhang shall be 12 inches.
- b. Steel Moldboard with Flared End. Typically moldboard height shall be 50 inches in the center of moldboard tapering at an upward angle of approximately 15 degrees to the discharge ends. The moldboard shall be constructed with a minimum of 10-gauge high abrasion resistant steel sheet with a combination of a full-length angle at the top and the bottom with a minimum of 3/8 inch thick vertical ribs, bracing, backup plates to manufacture a structurally sound moldboard. The moldboard shall overhang the cutting edge by not less than 12 inches.
- c. Polyethylene Moldboard with Uniform Height. Typically moldboard height shall be 50 inches. 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 inch thick high molecular weight polyethylene sheet. When tested in conformance with ASTM D 638-03, it shall evidence a minimum of 250% elongation at the break. Polyethylene material shall have an abrasion resistance rating of no higher than 44 for VHMW and 15 for UHMW type polyethylene materials as rated by ASTM G 75-01 sand slurry testing. (The lower the rated number, the more resistant to abrasion.) 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 D 256-05. 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 sponsor 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.
- d. Polyethylene Moldboard with Flared Ends. 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 inch thick high molecular weight polyethylene sheet. When tested in conformance with ASTM D 638, it shall evidence a minimum of 250% elongation at the break. Polyethylene material shall have an abrasion resistance rating of no higher than 44 for VHMW and 15 for UHMW type polyethylene materials as rated by ASTM G 75-01 sand slurry testing. (The lower the rated number, the more resistant to abrasion.) 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 D 256A. 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 sponsor 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.

4.1.2 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.

4.1.3 Moldboard Attack Angle Adjustment

Moldboard attack angle adjustment shall be 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).

4.1.4 Cutting Edge Types

The cutting edge type, size, and mounting requirements shall be specified by the user. Selection will be based on in-pavement lighting, snow conditions, and other environmental conditions. Six commonly used types are:

- a. Tungsten Carbide
- b. Rubber
- c. Polyurethane
- d. High Carbon Steel
- e. Rubber Section Blades with Carbide Inserts
- f. Reverse angle style cutting edges (cupped type)

4.1.5 Spray Guard

A spray guard shall be affixed to the top moldboard flange or reinforcement. It shall be of sufficient size and strength to direct snow to the proper discharge area and minimize snow coming over the top of the plow. It shall be a minimum of 3/8 inch thick by 12 inch wide rubber belt or polyethylene with metal retaining strap and necessary mounting hardware.

4.1.6 Drive Frame

The drive frame shall be of either oscillating or floating design, readily detachable (not permanently affixed) from the push frame of the carrier vehicle. A drive frame equipped with oscillating bars allows the plow to follow surface contours without putting excessive strain on the carrier vehicle chassis. Floating drive frames must be capable of supporting the weight of the displacement plow, eliminating the transfer of the plow weight to the carrier vehicle's lift device.

The drive frame shall connect to the moldboard at a minimum of four attachment points and to the chassis via a push plate with standard 31 inch centers or by means of an acceptable quick hitch.

4.1.7 Shock/Impact Absorbers

An automatic cushioning device shall be installed between moldboard and drive frame to minimize damage to the moldboard, cutting edge, and carrier vehicle, and to enhance driver safety.

4.1.8 Reversing Mechanism

Reversing may be achieved by hydraulic cylinders that are either double or single acting, single or telescoping type. Larger diameter and double acting cylinders provide more force for plow movement, but requires more hydraulic flow to achieve cycle times more easily achieved by single acting and telescoping style cylinders. A relief system shall be provided and plumbed in series to minimize damage in the event of contact with immovable obstructions.

- 4.1.8.1 Reversing mechanisms can be specified that either remain attached to the vehicle and enable disconnect of the plow drive frame and moldboard without hydraulic disconnect of the reversing mechanism, or that remain attached to plow providing a cleaner face to the carrier vehicle for use other capacities.

4.1.9 Caster Wheel Assemblies

The caster assemblies shall be single or dual wheel type as specified by the user. Caster wheels shall be rated by the manufacturer for the weight loading and operating speed of the plow. Casters shall be capable of 360-degree rotation and equipped with spring loaded adjustable brake dampeners to minimize wobbling. Vertical adjustment shall be accomplished through a caster barrel arrangement provided for each caster assembly. Infinite adjustment within the range of adjustment shall be accomplished by means of a stainless steel screw adjustment rod of sufficient diameter to provide the strength required to support the weight intended. Typically the screw adjustment rod shall be minimum 1-3/8 inch diameter stainless steel threaded rod.

4.1.10 Hydraulic Controls

Operation of the plow functions is accomplished through the use of hydraulic control valves activated by cable, pneumatic, or electric systems, as specified by the airport purchaser. Pump and control valves must be adequately sized to operate all plow and carrier vehicle accessories (spreader, liquid system, dump box) functions. Controls must be conveniently located in vehicle cab within easy reach of operator and must be clearly and permanently marked.

4.1.11 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 a positive locking pin. The design of the stands and locking device shall also allow positive locking in the deployed position.

4.1.12 Warning Labels

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

4.1.13 Paint

Paint shall be in accordance with FAA AC150/5210-5B Painting, Marking, and Lighting of Vehicles on an Airport unless otherwise specified by user.

4.2 Power Reversible Snowplow with Folding Wings

4.2.1 General

The power reversible snowplow with folding wings consists of a main center section and two folding wing sections, one located at each side of the center section. It shall be of heavy-duty (defined as below) construction and include sufficient reinforcement so as to withstand severe and prolonged load forces exerted to moldboard, frame, pivotal and load points.

The snowplow width shall be specified by the user. (Note: Plow widths range from 24 feet up to 32 feet. Plow width selection is determined by factors including the airport clearing time requirements, storage and maintenance door widths, confined operating areas, carrier vehicle horsepower and GVWR, and anticipated snow removal conditions.) The overall width of the plow assembly in the folded position (wings retracted) with required casters shall be no greater than 20 feet unless otherwise specified by the user.