U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: CHANGE 1 TO AIRPORT SNOW AND ICE CONTROL EQUIPMENT

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Change: 1

1. PURPOSE. This change provides guidance to airport operators involved in the procurement of snowsweepers to control ice and snow at airports during inclement weather.

2. CANCELLATION. This change cancels Advisory Circular (AC) 150/5220-12, Airport Snowsweeper, dated June 12, 1978.

3. PRINCIPAL CHANGES. This change adds an eighth chapter and Appendix 6 containing guidance on specifications for airport snowsweepers.

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CHAPTER 8. AIRPORT SNOWSWEEPER

53. **DESCRIPTION.** Snowsweepers (sweepers) are primarily used in the high-speed sweeping and cleaning of snow and debris from airport operational areas. They incorporate high speed brooms that consist of a number of brush sections which may be front mounted to a carrier vehicle (integral or attached), underbody mounted or mounted on a trailer arrangement towed by a carrier vehicle. All are capable of sweeping wet slushy snow as well as fine dry snow from pavement surfaces. The sweeper framework shall be designed to provide continuous service under difficult working conditions in cold climates. A sweeper may be complimented by an airblast system which is located behind the brush assembly. The sweeper airblast system is used to; sweep the pavement area clean of snow, slush, sand and other debris, help dry the pavement surface, and clear snow from around runway lights.

54. **SWEEPER TYPES.** Four different types of sweepers are being used worldwide on airports i.e. pushed, towed, underbody, and band type sweepers. The pushed type sweeper precedes the carrier vehicle and allows the operator to directly observe the area being swept. The towed type sweeper is fixed to a trailer and is towed by a conventional carrier vehicle. The operator observes the area being swept by use of mirrors and must maneuver the carrier vehicle and trailer together by carefully observing their outer dimensions. The underbody airport sweeper is a large multi-purpose unit of trailer or semi-trailer design that is pulled by a carrier vehicle and is capable of plowing and sweeping snow and debris simultaneously. The band sweeper precedes the carrier vehicle much like the broom on a pushed sweeper. However, instead of using a broom, it uses a continuously turning horizontal band that is made of reinforced rubber. The band has a number of protruding vertical ribs that are capable of moving snow to the right and left of the travel path.

55. **CLASSIFICATION.** The following two general classes constitute the family of airport sweepers. Typical sweeper types from each class are shown in Figure 8-1.

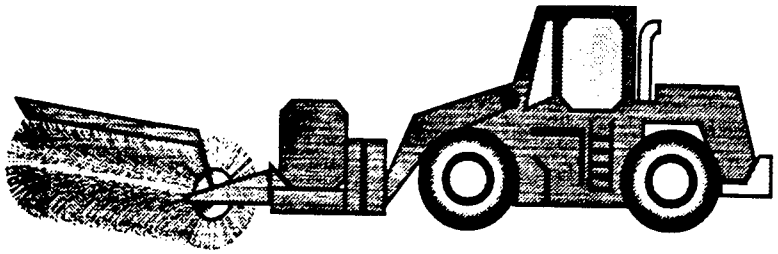
a. **Small Swath Sweeper.** This sweeper class may be of any physical design having a demonstrated or manufacturer's certified snow or slush removal and broadcasting ability sufficient to produce clear pavement within the swath width at the rated speed. The sweeper shall have a minimum broom diameter of 36 inches (91 cm) and a swath width of not more than 12 feet (3.7m).

b. **Large Swath Sweeper.** This sweeper class may be of any physical design having a demonstrated or manufacturer's certified snow or slush removal and broadcasting ability sufficient to produce clear pavement within the swath width at the rated speed. The sweeper shall have a minimum broom diameter of 36 inches (91 cm) and a swath width greater than 12 feet (3.7m).

All swath widths shall be measured when the broom is angled 30 degrees from the transverse position.

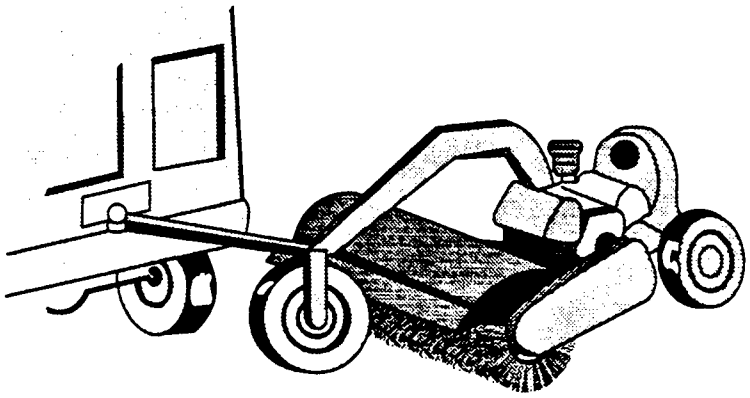
56. **COMPONENT PARTS.** Materials used on the sweeper and its carrier vehicle shall conform, where appropriate, to the specifications contained in this advisory circular. Accessories and attachments shall be the manufacturer's standard commercial product. Components should be readily accessible for repair and replacement, with minimal removal or disturbance to adjacent parts or components. Parts, such as grommets and bushings, which are exposed to wear shall be capable of being replaced. Regular maintenance and servicing should be readily accomplished under normal working conditions.

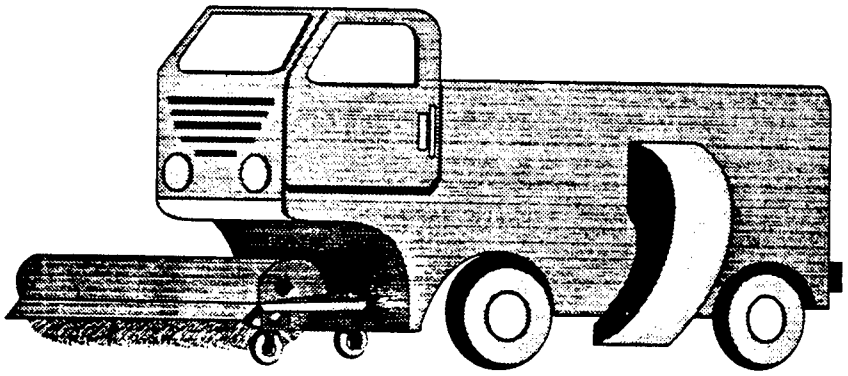
57. **PUSHED TYPE SWEEPERS.** This type of sweeper is commonly mounted on the front of a carrier vehicle. Tractor or wheel loader units are typically pushed type sweepers and generally fall into the small swath sweeper class. Most special purpose carrier vehicles are equipped with hydrostatically driven large diameter high speed high capacity brooms that are capable of clearing much of a runway well before displacement or rotary plows are committed. Truck type vehicles with sweepers clear snow in the same manner except the broom may be mechanically driven. Because either type clears snow before passing wheels or displacement plow blades have a chance to compact it, they provide a cleared path having maximum braking traction. The sweeper may have single or dual engines and incorporate an independent airblast system.



Pushed Type Sweeper
Tractor or Wheel Loader Vehicle
Powered by Auxiliary Engine
Small to Large Swath

Towed Type Sweeper
36-46 inch Brush
Small to Large Swath





Pushed Type Sweeper
Special Purpose Vehicle
Integral Engine/Rear Blower
Cab-Over Design
Large Swath

Pushed Type Sweeper
Special Purpose or Truck Type Vehicle
Heavy Duty/Large Swath
Front Blower/2 Engines

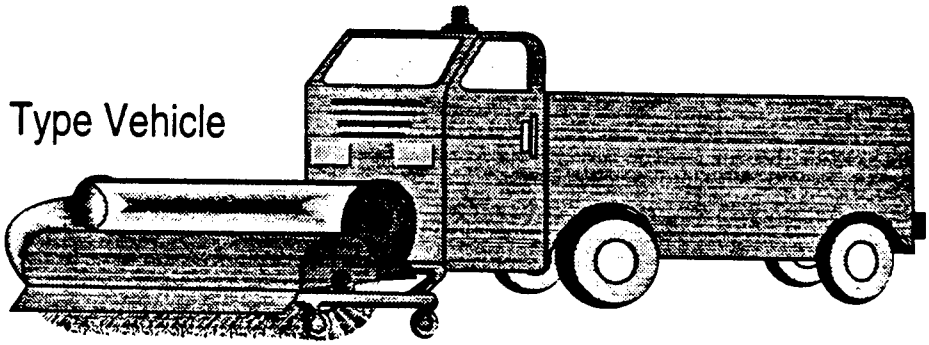


Figure 8-1. Typical Airport Sweeper Types

a. **Airblast System Location.** An airblast system is an optional feature that normally is incorporated into the design of the sweeper unit. On a carrier vehicle, for example, the system may be mounted on the front of the vehicle behind the brush frame or in the middle or rear of the vehicle. Upon conclusion of the winter season, the brush assembly and airblast equipment can be removed and the carrier vehicle used for other purposes. On special purpose units designed explicitly for snow sweeping, the system is normally a permanent feature located behind the cab between the vehicle and auxiliary engines or at the rear of the vehicle behind the auxiliary engine.

b. **Engine Location.** There are essentially two engine location options available with a pushed type runway sweeper. The sweeper may be powered by the carrier vehicle propulsion system or by a separate engine situated on the vehicle chassis behind the cab. Small swath sweepers and tractor/loader units, which are quite effective in confined areas, may have the engine fixed directly to the brush assembly.

58. **TOWED TYPE SWEEPER.** A towed type sweeper may be of any suitable commercial design which is pulled by a conventional carrier vehicle (see figures 8-1 and 8-2). These sweepers are available in straight mechanical, variable speed mechanical, and variable speed hydrostatic drive with some hydrostatic units capable of driving the larger high speed high capacity large diameter brooms similar to those found in the self-propelled units. The full system consists of a trailer frame which controls and helps to support the brush assembly. The brush assembly may be supported by casters, as primary or secondary pavement clearance devices, while the trailer is supported by pneumatic tires. Several trailer hitching options are available depending on manufacturer.

a. **Airblast System Location.** The airblast system, when specified for a towed type sweeper, is located behind the engine and placed in a manner to ensure good towing characteristics while maintaining rated blower performance.

b. **Engine Location.** The engine is located behind the brush assembly generally above the load carrying wheels of the trailer chassis. It should be located so as to provide a low center of gravity for optimum towing characteristics.

59. **BRUSHES.** The focal point of any sweeper is the brush (see figure 8-3). It must not only sweep snow and slush from pavement surfaces at speed, but it must also lift and broadcast these materials off the surface and away from the path of travel. Brushes come in different shapes and sizes and when worn or broken, generally can be easily replaced without causing undue downtime delays to the sweeper unit. Brushes may be mounted on a single tubular core or several abutting cores that receive power directly from the carrier vehicle engine or an independent engine. Choices in brush design and bristle composition provide users with a wide selection from which to chose to best meet their particular needs. Generally, brushes that display a mixed polypropylene/wire bristle composition will provide best overall sweeping results. Brushes are most effective when their contact with the pavement surface produces a "flicking action" that dislodges snow and slush and leaves a clean dry surface behind.

a. **Brush Geometry.** Three different types of brushes are available for use on airport sweepers, i.e., wafers, tufted wire sections, and cassettes (see Figure 8-3).

1) **Wafers.** Wafers are by far the most popular type of brush used on airports. They come in either straight or convoluted sections and are fastened to the brush core by pins or other devices. Spacers are inserted between straight wafers to ensure continued separation resulting in an effective full width sweeping pattern. Convoluted wafers, available only in 36 inch (91cm) brushes, do not require spacers because of their unique design which results in a side-to-side reciprocating action that eliminates streaking.

2) **Tufted Wire Sections.** Tufted wire sections are similar in design to the wafer but instead of a continuing circular shape, the brush consists of a number of individual tufted sections that are fixed to a circular inner ring. No locking devices are required with this type of brush.

3) **Cassettes.** Cassettes consist of wire tufts that lock into steel strips which in turn slide on to a brush core. Although expensive when compared to the wafer, they can be quite effective under certain conditions. One advantage of this type of system is that the strips can easily be changed out when broken by simply sliding in a new strip without having to demount adjacent cassettes.

b. **Bristles.** Brush bristles are made of polypropylene plastic (poly), wire, or a combination of one-half poly and one-half wire.

1) **Polypropylene.** The "poly" brush is a cleaning brush that is superior at lifting and moving non-frozen materials such as dry or loosely compacted wet snow from a pavement surface.

2) **Wire.** The wire brush is capable of penetrating and loosening hard compacted snow and ice, but does not perform well in throwing the material from the path of travel.

3) **Poly/Wire.** Over 90 percent of the brushes used on U.S. airports are made of one-half poly and one-half wire materials. This bristle structure combines the best qualities of the pure poly and wire brush in their ability to dislodge and move snow and ice.

60. **SELECTING A SWEEPER.** This paragraph provides guidance to airport operators and others involved in the selection of snow sweepers for a typical airport. Before choosing a unit or units using information presented herein, some consideration should also be given to the following features:

a. **Variable Speed Brooms.** By utilizing a multi-speed transmission or infinitely variable speed hydrostatic drive, a sweeper can be operated in a manner that optimizes its effectiveness in favorable wind conditions and minimizes deterioration of effectiveness in unfavorable conditions. Variable speed also optimizes brush life.

b. **Larger Diameter Brushes.** Relative to their smaller diameter equivalents, larger diameter brushes provide a more effective bristle attack angle, create lower particle projection, develop higher sweeping speeds (see Table 8-1), and sustain longer brush life.

c. **Convoluted Wafers.** These wafers have several advantages over straight wafers, e.g., they provide better flicking action, they tend to have a longer useful life, and they produce a centrifugal fan effect that helps dislodge fines which can more readily be swept or blown away by the sweeper.

EXAMPLE

The hypothetical situation presented involves a commercial service airport having 35,000 annual operations. Its single runway is 10,000 feet (3,000 m) long and 150 feet (46 m) wide. Additional non-runway surface areas, involving several taxiways and an apron, total 300,000 ft^2 (27,870m^2). Paragraph 17 of AC 150/5200-30A, indicates that this type of airport must have these critical surfaces cleared in one hour.

The airport operator decides to acquire a front mounted sweeper operating a 46 inch (117 cm) broom to clear the runway area and a towed sweeper operating a 36 inch (91 cm) broom for the non-runway surfaces. What are the broom lengths needed to meet the requirements of AC 150/5200-30A?

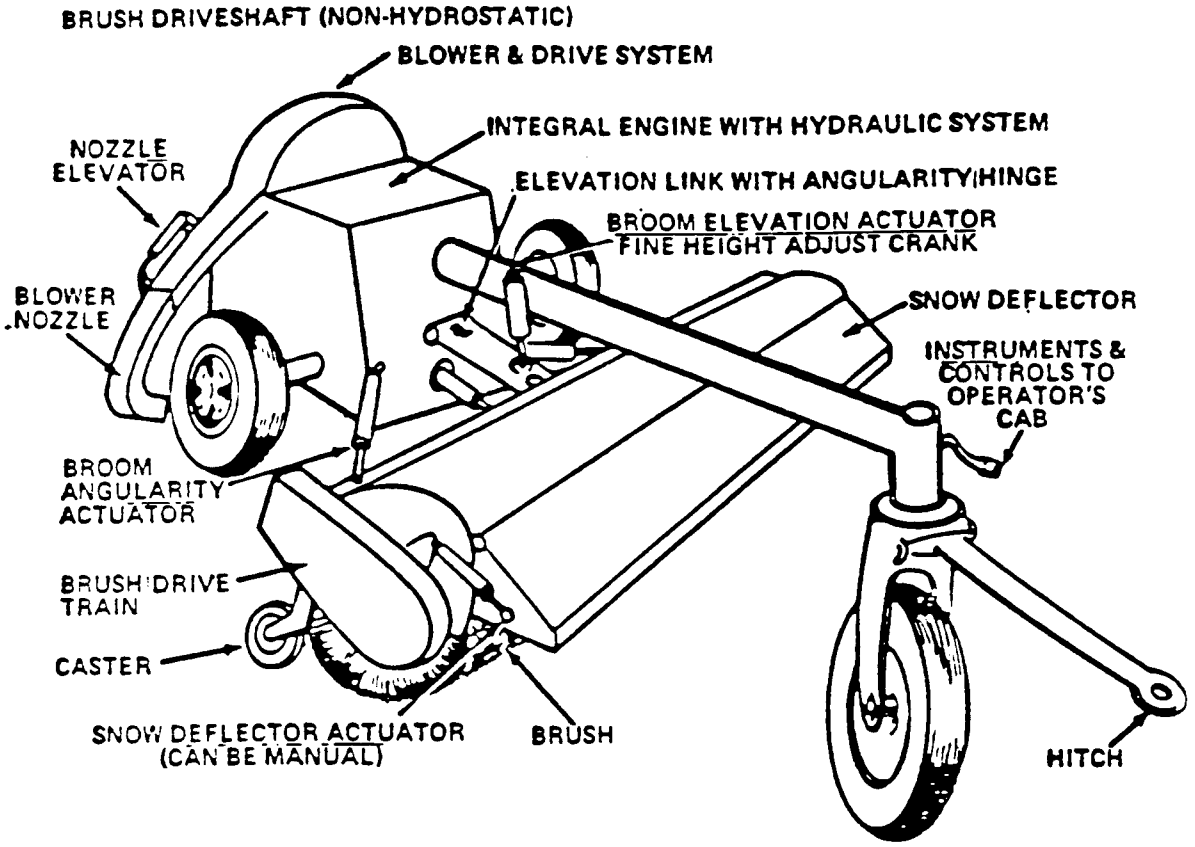
a. **Runway.** Using Table 8-1, it becomes apparent that there are several possible sweeper combinations available for consideration. The operator decides to examine a 22 foot broom, and must now determine the time it would take this unit to clear the runway.

$$\frac{10{,}000\text{ft} \times 150\text{ft}}{1{,}529{,}000\ \text{ft}^2/\text{hr/unit}} = 0.98 \text{ hours}$$

b. **Non-runway surfaces.** Non-runway primary surfaces are much more difficult to negotiate because they require more maneuvering on the part of the sweeper operator and a greater appreciation for the safety of the entire airside operation. The airport operator believes that a smaller sweeper or sweepers would allow better handling under such conditions and decides on an 18 foot broom length as determined from Table 8-2.

$$\frac{300{,}000\text{ sq ft}}{328{,}000\ \text{ft}^2/\text{hr/unit}} = 0.91 \text{ hours}$$

Under this scenario, the airport operator finds that the units selected would just meet the time requirements of the AC with very little cushion available for emergencies. Other sweeper combinations should also be explored. Larger sweepers or several smaller ones, providing a slightly greater safety factor, might be acceptable for AIP programming provided they can be properly justified. Each airport operator and specification writer must thoroughly explore the cost/benefit and safety requirements of their facility before programming any new or replacement equipment.



Note: General layout showing common sweeper components and construction features for most sweeper types, pushed as well as towed.

Figure 8-2 Towed Type Sweeper

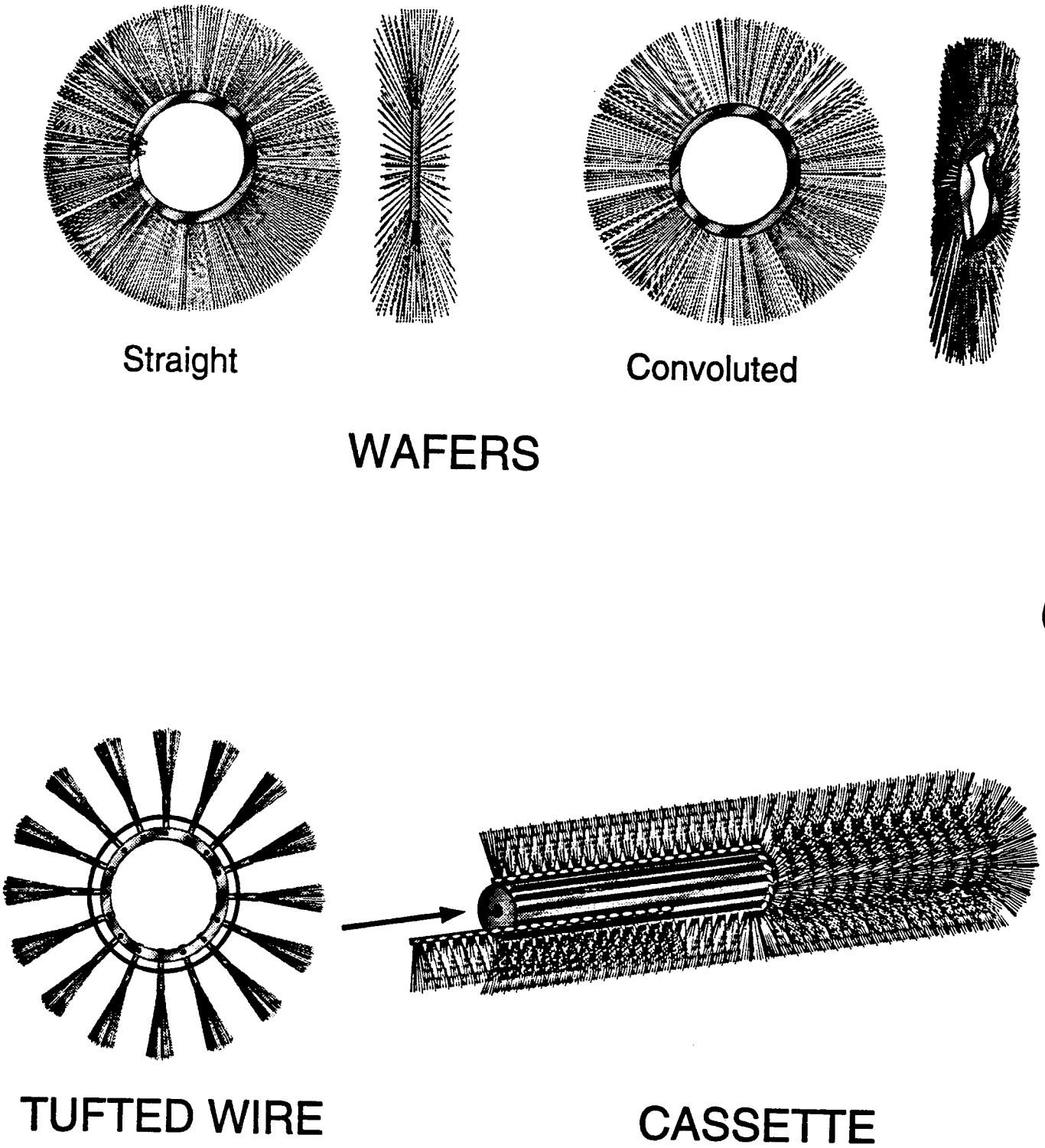


Figure 8-3 Brushes Used On Airports

TABLE 8-1. SWEEPER CAPACITIES

DRIVE/TYPE	NOMINAL WIDTH	WIDTH @ 30°	BRUSH DIA	NOMINAL SPEED	MEDIAN PERFORMANCE
FIXED SPEED MECHANICAL	12	10.4	36	0-16	351.2
FIXED SPEED MECHANICAL	14	12.1	36	0-16	409.7
VAR'BLE SPD MEC OR HYD	12	10.4	36	5-16	460.9
VAR'BLE SPD MEC OR HYD	14	12.1	36	5-16	537.7
VAR'BLE SPD MEC OR HYD	16	13.9	36	5-16	614.5
VAR'BLE SPD MEC OR HYD	18	15.6	36	5-16	691.4
VAR'BLE SPD MEC OR HYD	20	17.3	36	5-16	768.2
VAR'BLE SPD MEC OR HYD	22	19.1	36	5-16	845.0
VAR'BLE SPD MEC OR HYD	24	20.8	36	5-16	921.8
VAR'BLE SPD MEC OR HYD	12	10.4	46	8-30	834.0
VAR'BLE SPD MEC OR HYD	14	12.1	46	8-30	973.0
VAR'BLE SPD MEC OR HYD	16	13.9	46	8-30	1,112.0
VAR'BLE SPD MEC OR HYD	18	15.6	46	8-30	1,251.0
VAR'BLE SPD MEC OR HYD	20	17.3	46	8-30	1,390.0
VAR'BLE SPD MEC OR HYD	22	19.1	46	8-30	1,529.0
VAR'BLE SPD MEC OR HYD	24	20.8	46	8-30	1668.0

Table 8-1 Notes

* Width dimensions are in feet, brush diameters are in inches, nominal speed is in MPH, and median performance is in 1,000 square feet.
* Median performance was determined at an 80% efficiency to allow for overlap and turnaround.
* In many cases, fixed speed units cannot be operated in strong cross/headwinds. Under these conditions, snow will blow back across swept areas negating effects of the sweeping operation. This problem is not factored into the information presented in Table 8-1.

Table 8-2. SWEEPER PERFORMANCE ON NON-RUNWAY SURFACES.

Primary Area Swept at an Average Speed of 5 MPH (Performance in 1,000 square feet)								
Nominal Width	8	10	12	14	16	18	20	22
Swath Width	6.9	8.7	10.4	12.1	13.9	15.6	17.3	19.1
Performance (per hour)	145.1	182.9	218.7	254.4	292.2	328.0	363.7	401.6

Table 8-2 Notes

* Width dimensions are given in feet.
* Performance was determined at an 80% efficiency level to allow for overlap and turnaround.

61. **PERFORMANCE AND TESTING.** In accordance with paragraph 44, the manufacturer shall certify that its equipment meets the advertized operational and performance specifications. At the purchasers option, tests to verify the manufacturers claims may be required upon delivery. The information contained in this section will assist the purchaser in conducting verification tests.

a. **Pre-Testing.** Each test vehicle shall be examined to ensure that it is a standard production model and not a specially constructed unit made specifically for the test. Prior to testing, all controls, adjusting mechanisms, hydraulic systems and other assemblies shall be operated to ensure against leaks, restrictions and malfunctions. Once assured that the unit is fit, actual testing may begin.

b. **Carrier Vehicle.** The carrier vehicle, fully equipped and loaded to its gross vehicle weight with brush and blower in transport position, shall meet the physical requirements of Appendix 1, paragraph 4a and the testing requirements of paragraph 46.

c. **Sweeper.** Testing should be conducted on a runway or taxiway having a length of at least 1000 feet (305m). Snow depth can vary, but the sweeper should be capable of removing snow at the following depths and densities:

1) **Small Swath Sweeper.** Two inches (5 cm) of light snow having density of 8 to 15 lb/ft^3 (128 to 240 kg/m^3) or one-half inch (1.3 cm) of slush at density of 40 lb/ft^3 (641 kg/m^3).

2) **Large Swath Sweeper.** Three inches (7.6cm) of light snow having density of 8 to 15 lb/ft^3 (128 to 240 kg/m^3) or one inch (2.5cm) of slush at density of 40 lb/ft^3 (641 kg/m^3). Testing speed should be as high as practical but no less than 8 MPH (13 KPH) for small swath sweepers and 25 MPH (40 KPH) for large swath sweepers. The resulting swath width should be reasonably clean without snow deposits resulting from bouncing or skipping of the brush.

Sweepers shall be capable of varying their brush rotational speed, angle of attack, and the degree of brush pressure applied to a surface area. The unit shall be able to start and perform normal operations at an ambient temperature of 10°F (-12°C) below the lowest temperature in which the sweeper is expected to operate or -40°F (-40°C) at airports located in extremely cold temperatures. The unit must be capable of broadcasting snow to either side of the vehicle. The sweeper shall be designed to allow all performance and monitoring functions to be controlled or observed by a single operator from the carrier vehicle cab. The brush should show no performance degradation when sweeping thin deposits of sand, ash, water or other light debris.

d. **Airblast.** The airblast system shall be operated under the same conditions outlined for the sweeper, and shall meet the requirements specified in Appendix 6, paragraph 4e.

62-64 **RESERVED.**

APPENDIX 6. SPECIFICATIONS FOR SNOWSWEEPERS

PART A - AIRPORT OPERATOR CHECKLIST

FORWARD: When preparing a solicitation to purchase a sweeper system, an airport operator or specification writer should use PART A to identify user requirements and PART B to define the specification to meet these requirements. Part A is important because it tailors the sweeper to the unique preferences of the purchaser, i.e. special lighting, pushed versus pulled equipment, airblast system, unique safety equipment etc. Both parts, when combined, become the technical basis for a users request for proposal.

1. Anticipated uses and/or features of sweeper. (Be Specific).....

   .....

   .....

2. Primary surface area to be swept. .....Sq. Ft.

3. Critical time required to sweep primary surface areas.....Minutes

4. Sweeper speed needed to meet critical time.....MPH

5. Type of sweeper desired (Pushed / Pulled).....

6. Airblast system.....

   .....

7. Size of broom .....length.....diameter

8. Type of brush.....wire.....polypropylene.....poly/wire

9. Brush Geometry.....wafer.....tufted wire.....cassette

10. Optional equipment.....

    .....

    .....

11. Other.....

    .....

    .....

PART B - SPECIFICATIONS FOR SNOWSWEEPER

1. **MATERIALS.** Materials used on the snowsweeper shall conform to the specifications listed in this advisory circular. 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.

2. **PUSHED TYPE SWEEPERS.**

a. **Brush Frame.** The brush frame, which supports the brush assembly (see section 4a), shall be connected to a push mount, located in front of the carrier vehicle.

b. **Caster Location.** Sweepers shall be equipped with either two or four equally spaced heavy duty swivel type casters mounted on the rear of the brush frame.

c. **Engine Skid Assembly.** When the engine is located on a carrier vehicle chassis, it may be mounted directly to the frame or on a metal skid which fits on the bed area of the chassis. The skid assembly shall be designed for easy installation by overhead crane or forklift. It shall be equipped with two channel members, one on each side of the skid, to enhance safe movement and adjustment. A fuel tank, sufficient for 8 hours of continuous engine operation, shall be included with the skid assembly.

3. **TOWED TYPE SWEEPER.**

a. **Trailer Frame.** The trailer frame shall be properly balanced and fabricated of heavy gauge structural tubing, channel, or wide flange members reinforced as required to prevent distortion under load. Provisions shall be made for attaching engines, vehicle hitches, drives, casters, controls, brush mounts and other hardware needed for operation.

b. **Towbar and Vehicle Hitch.** The trailer frame may be coupled to the carrier vehicle by an overhead member that hitches directly to the vehicle or more commonly by a towbar that is attached to the front fork of the frame at the steering wheel. The swivel hinged tubular type towbar shall be connected to the trailer frame by a heavy duty kingpin and shall elevate as necessary for easy connection to any towing hitch. A safety chain and hook assembly shall be provided.

c. **Caster Location.** The brush frame, which is an integral but independent part of the trailer, shall be mounted on swivel caster wheels. These wheels are fixed along the rear of the frame and if more than two are used, they should be evenly spaced for uniform weight distribution.

d. **Wheels and Steering.** The noncastering wheels shall be the heavy duty automotive type with pressed steel rims and hubs. The trailer shall be guided by its front wheels located at a connection where the towbar meets the front steering fork. The front steering fork shall be fitted with tires and wheels identical to the noncastered wheels.

4. **COMMON EQUIPMENT.** The following items are common to pushed as well as towed type sweepers:

a. **Brush Assembly.** The brush assembly shall consist of a vehicular attachment mechanism, cylindrically shaped core, brush frame, hood and deflector, angling system, drive system, and casters.

1) **Vehicular Attachment.** The brush assembly shall be designed for quick attachment to and removal from its carrier vehicle or trailer. Once attached, it shall be capable of sustaining all loads, including side loads. The assembly shall not transmit bounce or oscillatory motion to the carrier vehicle and shall permit normal operational turning without binding or damage.

2) **Core.** The brush core is the rotating horizontal cylinder that secures the bristle sections of the brush in place for sweeping operations. The core shall be bearing supported and may be driven from either end, center, or from both ends. It shall be designed to allow bristle sections to be easily removed in the field and replaced.

3) **Brush Frame.** The brush frame shall be fabricated from heavy gauge tubular, channel or wide flange sections reinforced as required to prevent loading distortion. It should be designed to allow brushes to be easily replaced once worn or damaged. The frame shall be self-leveling, both perpendicular and parallel to the line of travel, to assure a clean sweep and longer brush life. When mounted on a carrier vehicle, no components of the brush frame shall interfere with the servicing and maintenance of the vehicle.

4) **Hood.** The brush hood shall be fabricated from heavy gauge sheet alloy steel or other durable material and be securely bolted to the brush frame. It shall shield the top half of the brush completely and shall include provisions for mounting a snow deflector on the front of the hood. The hood shall be of nonclog design to prevent ice buildup during freezing slush removal operations. It shall provide for necessary quick access to the brush for inspections and replacement of worn brush sections.

5) **Snow Deflector System.** A snow deflector shall be mounted on the front of the brush hood. The deflector shall have the ability to influence the angle that snow leaves the broom. The deflector shall be readily adjustable at the sweeper or remotely adjustable from the operators cab in the carrier vehicle.

6) **Angularity System.** The broom shall be self-leveling to assure a clean sweep and longer brush wear and life. Its angling mechanism shall be hydraulically actuated and controlled from the operators seat. The broom shall be able to swing at least 30 degrees left and 30 degrees right from the transverse position and have the necessary degree of freedom to follow the pavement while sweeping at the rated speed.

7) **Drive.** The brush core may be driven by a drive system of geared, hydrostatic or chain and sprocket design. When a chain type drive is used, adjustable idlers shall be installed to compensate for wear slack. Provisions shall be made for the operator to vary broom speed by remote control from the operators cab. Broom rotational speed shall be variable throughout a minimum range of 0 to 500 RPM. Drive shafts, universal joints, and mechanical units shall not depart from driveline rotational planes at excessive angles (greater than 15 degrees) during normal lifting or tilting operations of the broom.

8) **Casters.** Casters shall be capable of revolving a full 360 degrees and be equipped with hydraulic or friction shimmy dampeners. All tires shall have a minimum 10-ply rating and may be filled with a foam type product to dissipate heat and prevent flats. Casters will be mounted on the rear of the brush frame and shall track within the path swept by the brush. When adjusted according to manufacturers instructions, the casters shall be able to operate on bare pavement without damage to the tire. In addition, they shall not bind or come into contact with the brush assembly or rub against any other surface on the sweeper throughout their full rotational arc.

b. **Elevation Mechanism.** The broom shall be equipped with a remotely actuated hydraulic elevation mechanism that is capable of raising and lowering it for transport.

c. **Wear and Leveling.** An automatic or easily accessible height adjustment that "fine tunes" the degree of brush pattern should be provided. The adjustment, when preset, shall act as a stop for the remote elevation mechanism.

d. **Controls.** The carrier vehicle shall be equipped with secure and conveniently mounted in-cab controls that are user friendly and easily accessed by operators wearing heavy winter clothing. The controls shall allow the operator to start and stop the broom and airblast systems, turn on system lights, reposition snow deflector (if applicable), regulate broom speed, angle and lift, engine speed, and airblast speed and direction. Gauges showing fluid pressure, temperature, and warning readings shall also be furnished. The control display area shall be lighted for night operations in accordance with Appendix 1, paragraph 22j.

e. **Airblast System.** The system shall feature either a single or double outlet centrifugal blower having a minimum capacity of 6,000 CFM (2800 L/sec) and producing an air velocity of at least 270 MPH (435 KPH) at each outlet. The blower shall be driven by a variable displacement closed loop hydrostatic pump through a hydrostatic motor mounted directly to the fan blade shaft. It shall be capable of varying its speed throughout a range of 0 to 2200 RPM. When the broom is angled, the airblast shall automatically change, directing air perpendicular to the direction of travel and toward the direction of broom discharge. The air chutes shall be capable of moving in a vertical direction, raising and lowering as needed for travel or to clean runway lights. If required, each nozzle shall be capable of being completely turned off. Nozzles and broom shall be designed for independent use.

f. **Hydraulic System.** The hydraulic system shall meet the requirements of Appendix 1, paragraph 19 unless superseded by information contained under this section. The system shall supply fluid under pressure to the broom and blower drive circuits and to all hydraulically actuated components of the sweeper. All high pressure hydraulic hoses shall meet the requirements of 19(c) or have a safe operating pressure rating of not less than 5000 psi (350 kg/cm^2). Low pressure hoses shall have a pressure rating of not less than 500 psi (35 kg/cm^2). High and low pressure hoses shall be sized to ensure a proper flow of oil to working parts. In quick hitch applications, hoses should be equipped with male and female quick couplers to facilitate rapid removal and attachment. A hydraulic oil cooling system, which is capable of cooling the oil under all temperature conditions and is equipped with oil sight and temperature gauges, shall be supplied.

g. **Cowling.** The total power plant, including hydraulic and electrical components, and assessories shall be housed in a sturdy enclosure constructed of sheet metal, fiberglass or other durable material and equipped with louvered access doors to prevent overheating and to facilitate equipment servicing.

h. **Engine(s).** Based on the sweeper configuration (pushed or towed), the engine(s) must be capable of producing sufficient power to meet the maximum continuous operational requirements of the carrier vehicle, broom, and blower either working separately or in combination. Engines and their supporting systems including cooling, fuel, exhaust, hydraulic, electric, and lighting must meet appropriate requirements of Appendix 1.

i. **Lighting.** In addition to the lighting described in Appendix 1, paragraph 21, clearance lights should be mounted on each edge of the brush assembly for safety and to assist the operator in controlling the brush line of travel. These lights shall not come in contact with the vehicle frame nor interfere with the operation of the assembly. Towed type sweepers shall also be equipped with a lighting system similar to the one discussed in paragraph 21, including a revolving yellow beacon. These lights shall be controlled from within the carrier vehicle cab and be clearly visible when approaching the rear of the trailer.

j. **Electrical.** The carrier vehicles and towed trailers shall conform as appropriate with requirements of Appendix 1, paragraph 20. Towed type vehicles shall also be equipped with a sounding device that is activated when backing up and operates in conjunction with the carrier vehicle device.

k. **Communications Equipment.** Transceivers shall be installed in carrier vehicles in accordance with Appendix 1, paragraph 22b, and when appropriate, Appendix 2, paragraph 2j.

5. BRUSHES.

Brush Size. Airport sweeper brush lengths generally start at 10 feet (3m) and increase in 2.0 foot (0.6m) increments to 24 feet (7.3m). Although brushes are manufactured in varying diameters, the brush sizes used on airports are either 36 inches (91cm) or 46 inches (117cm) in diameter. The 46 inch (117cm) brush is more commonly used on push type sweepers while the 36 inch (91cm) brush is mostly used on pull type units. All brushes shall meet the requirements of military specification number MIL-F-83828.

6. **OPTIONAL EQUIPMENT.** Sweepers are designed to operate under normal winter conditions. To improve equipment effectiveness, however, certain options are available to the purchaser that can enhance performance. Typical options are the following:

a. **Airblast System.** See section 4e.

b. **Quick Disconnects.** Quick disconnects may be provided for all controls, hydraulic hoses/lines, electrical cables, drivelines, and instrumentation.

c. **Foam Filled Tires.** Foam filled tires provide increased tire resistance to side loads during tight turns and other stressful tire loadings.

d. **Dual Front Fork Wheels.** Dual wheels are available as additional steering safety on towed sweepers.

e. **Fenders.** Noncorrosive fenders and mudflaps help control snow, slush and water by helping to keep them off of the sweeper.

f. **Hydrostatic and Hydraulic Test Equipment.** This equipment allows trouble shooting of hydrostatic and hydraulic systems.

g. **Hydraulic Jack.**

h. **Maintenance Free Batteries.**

i. **Air Brakes for Towed Sweepers.**

j. **Automatic Low Oil Pressure/High Water Temperature Shut Down devices.**

k. **Fire Extinguisher.**

l. **Engine temperature and hydrostatic pressure loss warning devices.**

m. **Mudflaps for caster wheels.**

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