



AEROSPACE RECOMMENDED PRACTICE

ARP1971™

REV. D

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Revised 2019-02

Superseding ARP1971C

(R) Aircraft Deicing Vehicle - Self-Propelled

RATIONALE

The major rationale behind this update has been to include technical requirements for enclosed cabins (ARP5058) to this document. At the same time, other relevant technical and editorial issues recorded in the interim period since last update have been addressed, and the revision integrates equipment requirements related to “in-truck manufacturing” of Type I fluid.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) covers requirements for a self-propelled, boom-type aerial device, equipped with an aircraft deicing/anti-icing fluid spraying system. The unit shall be highly maneuverable for deicing all exterior surfaces of commercial aircraft, of sizes agreed upon between purchaser and manufacturer, in accordance with AS6285. The vehicle shall be suitable for day and night operations.

2. 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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS1424	Fluids, Aircraft Deicing/Anti-Icing, SAE Type I
AMS1428	Fluids, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV
ARP1247	Aircraft Ground Support Equipment - General Requirements
ARP1328	Aircraft Ground Support Equipment - Wind Stability Determination
ARP1558	Interface Protection - Ground Equipment to Aircraft

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Documents
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ARP1838	Pictograms for Ground Support Equipment
AS4828	Technical Manual Requirements for Ground Support Equipment
AS6285	Aircraft Ground Deicing/Anti-Icing Processes

2.2 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI A92.2	For Vehicle-Mounted Elevating and Rotating Aerial Device
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2.3 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 11075	Aerospace Aircraft Deicing/Anti-Icing Newtonian Fluids, ISO Type I
ISO 11076	Aerospace Aircraft Deicing/Anti-Icing Methods with Fluids
ISO 11077	Aerospace Self-Propelled Deicing/Anti-Icing Vehicle - Functional Requirements
ISO 11078	Aerospace Aircraft Deicing/Anti-Icing Non-Newtonian Fluids, ISO Type II (III, IV will be added)

2.4 OSHA Publications

Available from U.S. Department of Labor/OSHA, 200 Constitution Avenue, Washington, DC 20210, Tel: 800-321-6742, www.osha.gov/pls/publications/pubindex.list.

Safety and Health Standards 29 CFR 1910

2.5 Other Publications

CSA C-225	Vehicle-Mounted Aerial Devices
EN 280	Mobile Elevating Work Platforms - Design Calculations - Stability Criteria - Construction - Safety - Examinations and Tests
EN 1915-1	Aircraft Ground Support Equipment General Requirements, Part 1: Basic Safety Requirements
EN 1915-2	Aircraft Ground Support Equipment General Requirements, Part 2: Stability and Strength Requirements, Calculations and Test Methods
EN 1915-3	Aircraft Ground Support Equipment General Requirements, Part 3: Vibration
EN 1915-4	Aircraft Ground Support Equipment General Requirements, Part 4: Sound
EN 12312-6	Aircraft Ground Support Equipment Specific Requirements, Part 6: Deicers and Deicing/Anti-Icing Equipment
IATA AHM 975	Functional Specifications for an Aircraft Deicing/Anti-Icing Vehicle
NFPA 70	National Fire Protection Association Electrical Code

3. TECHNICAL REQUIREMENTS

3.1 General Description

The unit shall consist of a suitable self-propelled chassis, an aerial device with personnel basket/cabin constructed and mounted in accordance with national safety standards, fluid supply tanks, a fluid pumping system, and an enclosed flame combustion heater(s). The primary function of the vehicle shall be to apply heated deicing fluid and heated or unheated anti-icing fluid mixtures from a variable height boom to the surfaces of stationary aircraft while traversing their perimeter. An auxiliary engine will power the spraying system, the aerial device and the heater(s), or these systems shall be driven by the propulsion engine directly or through one or more power takeoff (PTO) devices which provide power from the chassis propulsion engine. All major items shall be enclosed in a compartmentalized body meeting recognized appearance and functional standards of the truck body industry.

3.2 Basic Performance Features

- 3.2.1 The primary function of the vehicle shall be to apply heated deicing fluid and heated or unheated anti-icing fluid mixtures from a variable height boom to the surfaces of stationary aircraft while traversing their perimeter. A hose shall also be fitted for ground use. The vehicle shall be acceptable for use around terminal gate areas, airport service roads, and aircraft service ramps.
- 3.2.2 The unit design must provide a safe and stable configuration for maneuvering about the aircraft with the boom in any possible position at speeds up to 6 km/h (4 mph) with fluid and fuel tanks at minimum, one-half, and maximum operating levels. A 40 km/h (25 mph) speed shall be safe and achievable with fluid tanks at maximum levels. A speed of at least 80 km/h (50 mph) (or 72 km/h (45 mph) for a diesel chassis) with fluid tank(s) at minimum levels may be specified as an option (see 3.9.29).
- 3.2.3 The aerial device, when extended, shall provide a basket/cabin floor-to-ground height as agreed upon between purchaser and manufacturer, and shall be extendable out to either side of the deicer. If the basket/cabin is designed for two persons, the basket/cabin capacity shall be at least 204 kg (450 pounds) (Europe - 205 kg) and with a 122 x 61 cm (48 x 24 inches) (Europe - 120 x 60 cm) floor area to accommodate two standing persons. Alternatively, an enclosed operator's cabin may be provided.

NOTE: The regulations of some countries may require a basket/cabin capacity in excess of 204.1 kg (450 pounds).

A small unit may be equipped with a personnel basket/cabin for one person only. The basket/cabin capacity shall in this case be at least 136 kg (300 pounds), and with a 61 x 61 cm (24 x 24 inches) (Europe - 60 x 60 cm) floor area to accommodate one standing person. Alternatively, an enclosed operator's cabin may be provided.

NOTE: The regulations of some countries may require a basket/cabin capacity in excess of 136 kg (300 pounds).

- 3.2.4 The deicing fluid system shall provide a delivery rate at the personnel basket/cabin spray nozzle of at least 151 L (40 gallons) per minute at minimum pre-nozzle discharging pressure of 690 kPa (100 psi), with the boom fully elevated.
- 3.2.5 The deicing fluid supply tank(s) shall be constructed of non-corroding material which is able to withstand the maximum fluid temperature that the fluid heating system will impose. The total tank capacity shall be agreed upon between purchaser and manufacturer. The option of a Type II, III, and IV anti-icing system may be required (see 3.9.1). The option of a split of the tank(s) allowing for a Type I or Type II, III, and IV/water variable proportioning system in addition to the Type II, III, and IV system may also be required (see 3.9.2 and 3.9.3).
- 3.2.6 The deicing fluid system shall be designed to withstand fluid temperatures of -40 to 96 °C (-40 to 205 °F).

- 3.2.7 An enclosed flame internal combustion type heater(s) with an automatic safety control system(s) shall be capable of raising the temperature of the maximum deicing fluid tank capacity of pure water (for test and demonstration purposes) from 2 to 82 °C (35 to 180 °F) within 1 hour or less. Alternatively, if the heating system is a fast heating design, it should heat pure water from the deicing tank at a minimum rate of 151 L (40 gallons) per minute from 2 °C (35 °F) tank temperature to 82 °C (180 °F) nozzle temperature within 5 minutes or less from the time of starting the heater. This type of system should be able to supply a sufficient amount of fully heated fluid to complete normal deicing operations.
- 3.2.8 Power distribution shall be so arranged that vehicle propulsion, fluid spraying, boom positioning, and fluid heating may be accomplished simultaneously with no detrimental effect upon any operation.
- 3.2.9 A separate engine shall be provided to drive the fluid, blower, and hydraulic pumps on all vehicles using a standard truck chassis. Alternatively, all hydraulic, fluid, heater, and electrical systems should be driven by a PTO(s) or hydraulics on the propulsion engine. In this type of system, the vehicle drive system should be devised so that appropriate engine speeds can be maintained during deicing without regard to vehicle speed (e.g., hydraulic vehicle drive).
- 3.2.10 Sufficient fuel tank capacity is required for all engines and heater(s) for continuous deicing operation for a minimum of 4 hours without refueling, including at least two complete duty cycles of filling, heating fluid as per 3.2.7, deicing, and returning to the fill station. The design shall provide 7.5 to 19 L (2 to 5 gallons) of usable fuel for the auxiliary engine after the supply is depleted for heater(s). The design shall provide for the shutdown of the heater(s) first. The propulsion engine should have a separate fuel tank (or stand pipe in a common fuel tank) of sufficient size to allow for 4 hours of continuous deicing operations. An option for a larger tank allowing 8 hours of continuous deicing operations may be required. The vendor shall supply calculations on the specific fuel consumption at rated output for each engine and the fluid heater(s) on request.
- 3.2.11 Operation of the spray fluid system shall not be contingent upon operation of the heater(s). Operation of the elevating boom and vehicle propulsion shall not be contingent upon operation of the fluid spray system. Operation of the boom elevation, fluid spray, and heater systems shall not be contingent on operation of the vehicle propulsion engine, unless the vehicle engine is the only power source.
- 3.2.12 In addition to the name-plate, the following shall be marked on deicers:
- Laden and unladen mass on each axle;
 - Permissible wind velocity;
 - Cabin/basket load capacity, including number of persons;
 - Operating instruction summary at the operator's place; and
 - Operating instruction summary for emergency lowering near the relevant controls.

3.3 Chassis Description

- 3.3.1 The chassis shall be a standard, current truck model offered by a leading automotive manufacturer or a custom chassis designed for the requirements of a deicing vehicle.
- 3.3.2 The vehicle driver shall be located at the left side of the chassis and shall have the maximum unobstructed view of the operator and basket/cabin under all operating conditions. The left side (looking forward) shall normally be considered as the working side for location nearest to the aircraft being serviced and contain external instruments and controls.

NOTE: The above may be reversed for countries that drive on the left-hand side of the road.

- 3.3.3 The chassis shall include an enclosed, heated cab for the vehicle driver and a passenger.
- 3.3.4 The vehicle shall be of minimum overall length, width, and height, consistent with stability requirements. Maximum length, width, and height, as permitted by local regulations, shall be agreed upon between purchaser and manufacturer.
- 3.3.5 In addition to standard truck cab equipment (heater/defroster, lights, electric wipers and washer, rear view mirrors, etc.), the roof of the cab shall be fitted with a 91 x 46 cm (36 x 18 inches) or larger observation window and electric wiper. This shall be located for overhead viewing from the driver's position.
- 3.3.6 The vehicle drivetrain shall be equipped with an automatic transmission or a hydraulic drive.
- 3.3.7 Power steering and power assisted dual braking system shall be provided.
- 3.3.8 The parking brake shall be applied by an over center operated lever, a foot operated ratchet, or spring set mechanism released by hydraulic or air pressure.
- 3.3.9 The standard chassis shall be rated to sustain loads imposed by the vehicle at speeds up to 40 km/h (25 mph) with the fluid tanks at minimum and maximum levels. If speed capability is specified (see 3.9.29), the chassis shall be rated to sustain the loads imposed by the higher speed capability.
- 3.3.10 Tow hooks shall be installed on the chassis structure, or on suitable members attached directly to the chassis; two at front (one on each side of the chassis centerline), and one at rear.
- 3.3.11 Snow/mud tread tires shall be provided on drive wheels.
- 3.3.12 Storage batteries shall be of the heavy-duty type. Vehicle electrical system shall be based on 12 V DC or 24 V DC. Fluid heater circuits shall be 120 VAC or 240 VAC, 12 VDC or 24 VDC.
- 3.3.13 Alternators shall be installed that supply 100% of the maximum vehicle steady electrical load capable of being imposed at engine idle rpm, plus a 1 A minimum additional charge capacity.

3.4 Aerial Device Description

- 3.4.1 The aerial device and its installation on the vehicle must conform to all national safety and stability regulations in all respects other than electrical insulation requirements. Boom elevating, telescoping, and basket/cabin leveling hydraulic cylinders shall be equipped with pilot operated check (or holding) valves mounted directly to the base of the cylinders to prevent inadvertent boom lowering from a hydraulic system pressure loss. All pivot points shall have easily accessible grease fittings or have self-lubricating type bushings. The personnel basket/cabin shall have a self-adjusting mechanism to maintain a vertical attitude for all boom positions. Outriggers or other ground contact devices shall not be required to obtain the specified stability.
- 3.4.2 The vehicle and boom shall remain stable, on level ground, with the fluid tanks empty, fuel tanks empty, hydraulic and engine oil at minimum safe levels, the boom at any attitude, basket/cabin loaded at maximum rated capacity, and a 75 km/h (46 mph) wind from any direction. Spring lock out devices or torsion bar systems may be utilized to maintain stability when boom is elevated, if required. The deicer must also remain stable in the same condition, zero wind and any one tire flat (unless non-pneumatic or foam filled tires are used). Also refer to ARP1247 and ARP1328.
- 3.4.3 Boom rotation shall be achieved by a turret, mounted on the chassis, which swings through a 180-degree arc in either direction. The turret shall be mounted on a circulating ball turntable bearing, with accessible grease points. Alternatively, a fixed boom may be employed with a highly maneuverable vehicle which provides similar operational flexibility.

- 3.4.4 The aerial basket/cabin shall be designed to position an operator to effectively apply fluid to the upper areas of aircraft control surfaces, wings, empennage, and fuselage.
- 3.4.5 Stability and safety shall be paramount in the boom and basket/cabin design. Operation of the boom and its controls shall be smooth and positive.
- 3.4.6 Aerial Device Safety Factor Design Requirements

Manufacturers may use Method A and/or Method B.

3.4.6.1 Aerial Device Safety Factor Design Requirements - Method A

Design requirements for the aerial device shall be in accordance with ANSI A92.2. The design requirement shall include a minimum dynamic safety factor of 2:1 (based on yield strength for ductile materials). The following dynamic loading conditions shall apply:

- Vehicle driving over a test fixture (defined below) at a speed of 6 km/h (4 mph) with any axle in forward and reverse directions.
- Vehicle driving at a speed of 6 km/h (4 mph) in forward and reverse directions and suddenly applying brakes to simulate emergency (panic) stops.

The dynamic loading conditions shall incorporate boom orientation and fluid tank level which generates maximum stress on the structural boom components. The basket/cabin shall be loaded at maximum rated capacity.

3.4.6.2 Definition of Test Fixture

The test fixture is defined as a device used to simulate obstacles that may be encountered on an airport ramp (e.g., wheel chocks, storm drains, fuel pit lids, snow and ice ruts, etc.). The test fixture shall be made out of wood measuring 10.2 cm (4 inches) high x 15.2 cm (6 inches) wide x 60.96 cm (24 inches) long. The top corners shall be symmetrically cut at 45-degree angles along the longitudinal length of the member providing a top flat surface measuring 5.1 cm (2 inches) in width. The test fixture shall be secured in such a manner that prevents sliding or overturning as the vehicle is driven over it during dynamic load testing.

3.4.6.3 Aerial Device Safety Factor Design Requirements - Method B

The dynamic safety factor of 2:1 in Method A can be substituted with the minimum stress factor S as specified in Table 1.

Design requirements for the aerial device shall be in accordance with EN 1915-2. Design calculations for the aerial device shall as a minimum include the following loads:

- a. Deadweight: Weight of individual parts of the structure.
- b. Payload: Weight of persons and equipment in the basket/cabin or enclosed cabin.
- c. Local loads: Where specified.
- d. Snow load: Weight of snow or ice on the structural parts depending on geographical area in question.
- e. Dynamic forces:
 1. Secondary dynamic forces: Forces caused by persons in the basket/cabin or enclosed cabin.
 2. Horizontal dynamic forces: Centripetal forces caused by driving the chassis.
 3. Vertical dynamic forces: Forces caused by the movement of the aerial device and by persons in the basket/cabin or enclosed cabin.
 4. Wind load: A windspeed of 20.58 m/s (40 knots) shall be taken into account.