



AEROSPACE STANDARD

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Superseding AS6286C

Aircraft Ground Deicing/Anti-Icing Training and Qualification Program

RATIONALE

This document provides the industry standards and guidance for the training and qualifying of staff, plus the expected contents of this training for effective deicing and anti-icing of aircraft on the ground.

AS6286 forms one part of three related SAE Aerospace Standards (AS) and should be read in conjunction with AS6285 and AS6332. Collectively, AS6285, AS6286, and AS6332 are known to the International Community as the Global Aircraft Deicing Standards. The lead document is AS6285, which all the other documents support and should therefore be in agreement with.

Exposure to weather conditions conducive to ice formation can cause the accumulation of frost, snow, slush, and ice on aircraft surfaces and components. These contaminants can adversely affect aircraft performance and controllability. In addition, they can adversely affect the operation of mechanical devices such as control surfaces, sensors, flaps, and landing gear. If frozen deposits are present other than those accounted for in the aircraft certification process, then the performance and safety of the aircraft will be compromised.

Regulations governing aircraft operations in ground icing conditions shall be followed. The International Civil Aviation Organization ICAO "Annex 6, Part I" mandates specific rules for the safe operation of aircraft during ground icing conditions, and all member states subsequently are required to have regulations in place to ensure conformance with these. Paraphrased, these rules specify that no one may dispatch or take off an aircraft with frozen deposits on components of the aircraft that are critical to safe flight. A critical surface or component is one which could adversely affect the mechanical or aerodynamic function of an aircraft. The intent of these rules is to ensure that no one attempts to dispatch or operate an aircraft with frozen deposits adhering to any aircraft component critical to safe flight. This is known as the "clean aircraft" concept.

This document specifies the standards for training and qualifying staff, plus the expected contents of their training. It provides guidance for the setting up of a proper training and qualification program for the deicing and anti-icing of aircraft on the ground. Although references are made to the other two global standards, some background information to support a training program is provided to make the material a better tool for the preparation and execution of the training and qualification process. Standard teaching plans and a practical assessment method are included. This material was compiled using various international documents, with support from SAE standards and individually contributed editorial comments. Its purpose is to serve as a "global deicing training manual." In addition, each organization involved in aircraft ground deicing and anti-icing is responsible for complying with local regulations and requirements imposed by manufacturers of aircraft, equipment, and fluids, in addition to regulatory and environmental authorities.

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Changes made are:

1. Final qualification - see 6.1.
2. Qualification and QC program - see 6.1.
3. Record keeping and test types - see 6.6.2.
4. Active Frost - see A.5.2.
5. Cold dry snow and ice crystals - see A.9.2
6. Precipitation intensity - see A.13.5.1.
7. Post deicing report - see A.14.1.4

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1. SCOPE

1.1 Field of Application

This document establishes the minimum training and qualification requirements for ground-based aircraft deicing/anti-icing methods and procedures. All guidelines referred to herein are applicable only in conjunction with the applicable documents. Due to aerodynamic and other concerns, the application of deicing/anti-icing fluids shall be carried out in compliance with engine and aircraft manufacturers' recommendations. The scope of training should be adjusted according to local demands. There are a wide variety of winter seasons and differences of the involvement between deicing operators, and therefore, the level and length of training should be adjusted accordingly. However, the minimum level of training shall be covered in all cases. As a rule of thumb, the amount of time spent in practical training should equal or exceed the amount of time spent in classroom training.

1.2 Agreements and Contracts

This information is recommended as a basis for operations and service support agreements.

1.3 Hazardous Materials

While the materials, methods, applications, and processes referenced to or described in this specification may involve the use of hazardous materials, this standard does not address the hazards which may be involved in their use. It is the sole responsibility of the user to ensure their familiarity with the safe and proper use of any hazardous materials and processes and to take all necessary precautionary measures to ensure the health and safety of all personnel involved.

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 shall take 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 +1 724-776-4970 (outside USA), www.sae.org.

AMS1424	Fluid, Aircraft Deicing/Anti-Icing, SAE Type I
AMS1424/1	Deicing/Anti-Icing Fluid, Aircraft SAE Type I Glycol (Conventional and Non-Conventional) Based
AMS1424/2	Deicing/Anti-Icing Fluid, Aircraft SAE Type I Non-Glycol Based
AMS1428	Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV
AMS1428/1	Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV Glycol (Conventional and Non-Conventional) Based
AMS1428/2	Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV Non-Glycol Based
ARP1971	Aircraft Deicing Vehicle - Self-Propelled
ARP5660	Deicing Facility Operational Procedures

AS5900	Standard Test Method for Aerodynamic Acceptance of AMS1424 and AMS1428 Aircraft Deicing/Anti-Icing Fluids
AS6285	Aircraft Ground Deicing/Anti-Icing Processes
AS6286B	Aircraft Ground Deicing/Anti-Icing Training and Qualification Program
AS6332	Aircraft Ground Deicing/Anti-Icing Quality Management
AS9100	Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations

2.1.2 FAA Publications

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

FAA Holdover Time Guidelines (current issue - annual publication)

FAA, Notice N 8900.ZZZ, "FAA-Approved Deicing Program for Winter 20xx-20yy" (current issue - annual publication)

FAA, Ground Deicing Program - Summary of Changes to FAA Holdover Time Guidelines and Associated Documents for Winter 20xx-20yy (current issue - annual publication).

FAA, Ground Deicing Program - General Information (current issue - annual publication)

2.1.3 ICAO Publications

Available from International Civil Aviation Organization, 999 University Street, Montreal, Quebec H3C 5H7, Canada, Tel: +1 514-954-8219, <https://www.icao.int/>.

ICAO Doc 9640 AN/940 Manual of Ground Deicing/Anti-icing Operations

ICAO Doc 9835 AN/453 Manual on the implementation of ICAO Language Proficiency Requirements

ICAO Annex 6, Operation of Aircraft, Part 1 - International Commercial Air Transport - Aeroplanes

ICAO Doc 4444 ATM/501 - Procedures for Air Navigation Services - Air Traffic Management

2.1.4 ISO Publications

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

ISO 9001 Quality management systems - Requirements

2.1.5 Transport Canada Publications

Available from Transport Canada, Tower C, Place de Ville, 330 Sparks Street Ottawa, Ontario K1A 0N5, Tel: 1-800-305-2059, www.tc.gc.ca.

Transport Canada, Holdover Time (HOT) Guidelines Regression Information (current issue - annual publication)

Transport Canada Holdover Time Guidelines: Winter 20xx-20yy (current issue - annual publication)

Transport Canada, TP 14052E, "Guidelines for Aircraft Ground Icing Operations" (current issue - annual publication)

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

Aircraft Manufacturer and Operator Manuals

2.3 Definitions and Abbreviations

2.3.1 Definitions

HEAD OF DEICING TRAINING: The person responsible for ensuring the effective delivery of the deicing/anti-icing training of personnel for the whole organization. This person must have a complete understanding of the subject matter herein and a documented competence level. By agreement of the senior management team, this may also be the Program Manager/Responsible Person/Accountable Executive.

FLIGHTCREW TRAINER: The person responsible for deicing/anti-icing training for flightcrews.

QUALITY MANAGEMENT SYSTEM: The ability to demonstrate both management commitment to and the organizational ability to deliver the required level of product or service.

SENIOR MANAGEMENT TEAM: A team of individuals at the highest level of management of an organization who are responsible for ensuring the proper delegation and delivery of performance for the day-to-day tasks of managing winter operations.

WINTER PROGRAM MANAGER/RESPONSIBLE PERSON/ACCOUNTABLE EXECUTIVE/ACCOUNTABLE PERSON: The person responsible for ensuring that the processes needed to maintain the quality of systems to comply with the clean aircraft concept.

PREFLIGHT CONTAMINATION CHECK: A check of aircraft surfaces and components for contamination to establish the need for deicing.

2.3.2 Abbreviations

ATC	air traffic control
ATCT	air traffic control tower
CBDS	computer-based deicing simulator
CBT	computer-based training
QMS	quality management system

Refer to AS6285 for other definitions and abbreviations that are not listed within this section.

3. THE REQUIREMENTS FOR CLEAN AIRCRAFT IN WINTER - ORGANIZATION AND TRAINING

3.1 The Requirement for Clean Aircraft in Winter Operations

The smooth flow of air over the wings of an aircraft provides the lift necessary for flight. The continued optimization of aerodynamic surfaces over time has led to increasing efficiency gains and safety improvements. However, exposure to weather conditions on the ground that are conducive to ice formation can cause the accumulation of frost, snow, slush, or ice on aircraft critical surfaces and components that will adversely affect aircraft performance and control. The operation of mechanical devices, such as control surfaces, sensors, flaps, and landing gear, will also be affected. If frozen contamination is present, other than that approved via the aircraft certification process, the ability for the aircraft to fly safely may be greatly reduced and will cause potentially dangerous conditions. An aircraft ready for departure must be a clean aircraft that has no frozen contaminants adhering to any critical surface. Regulations governing aircraft operations in icing conditions shall be followed. The International Civil Aviation Organization ICAO "Annex 6, Part I" mandates specific rules for the safe operation of aircraft during ground icing conditions, and all member states are required to have regulations in place to ensure this:

4.3.5.6: A flight to be planned or expected to operate in suspected or known ground icing conditions shall not take off unless the aircraft has been inspected for icing and, if necessary, has been given appropriate deicing/anti-icing treatment. Accumulation of ice or other naturally occurring contaminants shall be removed so that the aircraft is kept in an airworthy condition prior to takeoff.

A critical surface or component is one which could adversely affect the mechanical or aerodynamic function of an aircraft. As frozen contaminants of almost any kind can compromise the safety of an aircraft, deicing and anti-icing methods are used to ensure that aircraft critical surfaces are clean for takeoff. The purpose of these deicing and anti-icing techniques is best described by the clean aircraft concept. The clean aircraft concept means that an aircraft must be free of all frozen contamination that could prevent a safe takeoff. The most common deicing and anti-icing (commonly combined as "deicing/anti-icing") technique is the application of deicing/anti-icing fluids, although other mechanical and physical methods may be used. SAE fluid types are both deicing and anti-icing fluids, but the different types are commonly used as one or the other; thus, two separate fluids are often used to ensure a clean aircraft.

Deicing fluids are used to remove existing contamination. They are normally supplied as a concentrate.

For maximum effect, deicing fluids shall be applied close to the surface to minimize heat loss. Fluid temperature and pressure should not exceed aircraft maintenance manual requirements. The heat in the fluid effectively melts any frost, as well as light deposits of snow, slush, and ice. Heavier accumulations require the heat to break the bond between the frozen deposits and the structure; the hydraulic force of the fluid spray is then used to flush off the contamination. The deicing fluid will prevent refreezing for a period of time, depending on aircraft skin and outside air temperature (OAT), the fluid used, the mixture strength, and the weather.

They are not primarily intended to prevent adherence of further active frozen contamination, although limited protection is afforded by the heat from the fluid. When that protection is relied upon to keep an aircraft clean for takeoff, then the Type I is being used as both a deicing and an anti-icing fluid. Other fluids and mixtures can be used to deice dependent on experience and availability, such as:

1. Heated water (only when above freezing conditions).
2. Heated mixture of water and Type I fluid.
3. Heated premix Type I fluid.
4. Heated Type II, III, or IV fluid.
5. Heated mixture of water and Types II, III, or IV fluid.

NOTE 1: All of the above have a specific effect (deicing or holdover time) based on the temperature in which they are used. These are all defined (except water which has no HOT) in the FAA and TC Holdover Time Tables. They are published each year, and only current tables shall be used for operational purposes.

NOTE 2: Unheated fluids are ineffective to deice.

Anti-icing fluids are designed and used to protect treated surfaces from contamination for a specified range of times (the “holdover time”). Fluid Types II, III, and IV are usually applied unheated. The holdover time allows the aircraft to move to the runway from the location where it was treated, and then remain in the takeoff queue for a limited time, without the danger of active frozen precipitation adhering to the treated surfaces prior to takeoff. Integral to the design of these fluids is that they must not excessively interfere with the smooth flow of air over the surfaces at takeoff. Anti-icing fluids therefore have two distinct performance criteria: (1) to remain on the aircraft, preventing active precipitation from adhering, until the start of the takeoff roll and (2) to flow off of the surfaces during the takeoff, which is referred to as the aerodynamic performance requirement. The SAE Standards AS6286, AS6285, and AS6332 have been written to give best-practice guidance for the use of deicing/anti-icing fluids to provide a clean aircraft for a safe takeoff.

3.2 Organizational Requirements

The organizational requirements for the effective and safe deicing/anti-icing of aircraft during winter weather are described in more detail in AS6332. A short summary is provided here as an introduction to these requirements. The main concepts contained in AS6332 are based on the quality management methods set out in ISO 9001 and can be summarized in two points:

- The need to demonstrate and consistently provide a product or service that meets customer and applicable regulatory requirements, plus
- Aims to enhance the product or service through effective systems and processes for continual improvement

For aircraft deicing/anti-icing, the safety-critical nature of this work requires complete conformance to the principle of the clean aircraft concept, as this is the critical customer and regulatory requirement. It involves both conformance to standards of operation and its continual improvement in line with the principles of quality management. The deicing service provider shall establish, document, implement, and maintain a quality management system (QMS) and continually improve its effectiveness. The deicing service provider shall:

- Determine the processes needed to manage effective aircraft deicing/anti-icing
- Determine the criteria and methods needed to ensure that the operation and control of these processes are effective
- Ensure the availability of resources necessary to support the operation and monitoring of these processes
- Monitor, measure (where applicable), and analyze these processes
- Implement actions necessary to achieve the planned results and to continually improve these processes

NOTE: The extent of the QMS documentation can differ from one organization to another due to:

- The size of the organization and types of activities
- The complexity of their processes and interactions and the competence of the personnel

3.3 The Essential Elements of a Deicing Training Program

3.3.1 Organization

An organization shall have in place within its management plan and organizational structure descriptions of key personnel (e.g., Head of Deicing Training, Program Manager, Deicing/Anti-Icing Training Instructor, etc.) and their duties pertaining to training, qualification, and oversight responsibilities. The management plan and the structure of the organization shall specify the individuals who are responsible for the deicing/anti-icing training program. The individuals specified with this responsibility shall have sufficient knowledge of deicing/anti-icing operations and training to be qualified for this position. Although this qualification may be renewed annually, it is recommended that the responsible individuals complete training and qualification on an annual basis through self-study, under the oversight of their superior or responsible designee (where applicable), as specified within the organization’s management plan and organizational structure.

Deicing/anti-icing training shall be conducted exclusively by personnel who are trained, qualified, and proficient within the relevant subjects applicable to the personnel they are designated to instruct (e.g., flightcrew, dispatch, or ground personnel) or by other personnel or through other means under the oversight of such qualified individuals. Individuals designated to develop or facilitate deicing/anti-icing training should have some familiarization, background, and training in the area of education and facilitation techniques through relevant experience or education. This training may be performed as part of a train-the-trainer program. Individuals designated to conduct deicing/anti-icing training within an organization's management plan and organizational structure shall be required to complete initial and subsequent annual recurrent training in order to maintain their qualification. This training shall be facilitated internally within an organization by an individual responsible for this function as specified within the organization's management plan and organizational structure (e.g., Training Manager/Head Trainer) or other personnel as designated, or by a third-party organization (e.g., air operator, contracted deicing/anti-icing training vendor, etc.).

3.3.2 Training of Deicing Personnel

Only trained and qualified personnel shall perform aircraft ground deicing/anti-icing procedures. A deicing training program shall be maintained and executed by the organization that performs the deicing. The training program shall address all elements of the training material, levels of qualifications, verification of success, functions, duties, responsibilities, quality control, and regular overview of instruction. The training program shall refer to current industry standards and regulations. All training records shall be kept as per the regulatory or company's recordkeeping policy. The training program shall be reviewed at least annually to ensure that it covers all current aspects of deicing/anti-icing operations.

The Head of Deicing Training is responsible for developing the training program. The Head of Deicing Training may also be the instructor. In that case, previous deicing experience is strongly recommended. The company shall evaluate and approve the Head of Deicing Training for the task according to established requirements. This approval by the senior management team shall be documented.

3.3.3 Computer-Based Training

Computer-based training (CBT), e-learning/distance learning, and computer-based deicing simulators (CBDS) may be utilized in place of traditional instructor-facilitated training for theoretical training components and limited practical training components (dependent on the CBDS level utilized). It is recommended that CBT/e-learning/distance learning or CBDS training be facilitated and administered under the oversight of suitably qualified training personnel.

To simulate classroom interactivity, it is recommended that when a trainee requires assistance or has a question, there be various means in place so that the assistance can be obtained or question can be answered prior to completion of the course and before exams or evaluation. This may include the use of poll questions, email, online assistance, etc.

It is recommended that if CBT/e-learning or CBDS is used as part of the examination or evaluation process, effective measures should be in place to prevent academic dishonesty and plagiarism (i.e., individual login/password, random questions drawn from a question pool, measures to prevent skipping/fast-tracking of training, oversight by a proctor, etc.).

It is the responsibility of the CBT/e-learning or CBDS manufacturer/developer and user to ensure that all applicable requirements as stated within this document are met, as applicable to the personnel they are intended to instruct.

3.4 The Complementary Fit between AS6286, AS6285, and AS6332

While the AS6286 standard deals with the key requirements for training personnel for aircraft ground deicing/anti-icing, it is complementary to two other standards with which it should be read, interpreted, and understood. The three complementary standards are:

- AS6285: Aircraft Ground Deicing/Anti-Icing Processes
- AS6286: Aircraft Ground Deicing/Anti-Icing Training and Qualification Program
- AS6332: Aircraft Ground Deicing/Anti-Icing Quality Management

While this standard focuses on the training aspect of aircraft ground deicing/anti-icing, a complete understanding of the processes and quality management aspects are only available through the full appreciation of the other two standards.

4. AUTHORITY AND ROLES IN DEICING/ANTI-ICING

4.1 Senior Management Team

Senior management shall:

- Provide evidence of its commitment to the development and implementation of a suitable management system for the effective deicing/anti-icing of aircraft.
- Ensure that responsibilities and authorities are defined and communicated within the organization.
- Appoint a manager on an annual basis who may be known by a title such as Program Manager, Responsible Person, Accountable Executive, Accountable Person, or some other title identifiable as the responsible person accountable to senior management for the effective delivery of this service.
- Establish position requirements for and appoint a Head of Deicing Training. If agreed by senior management, the Program Manager/Responsible Person/Accountable Executive/Accountable Person and the Head of Deicing Training may be the same person.

For more detailed and specific guidance on the roles of the senior management team, the Program Manager, and the Head of Deicing Training, refer to the appropriate section of AS6332.

4.2 Winter Program Manager and Head of Deicing Training

4.2.1 Winter Program Manager

Senior management shall appoint a manager on an annual basis who, irrespective of other responsibilities, shall be responsible for:

- Ensuring that the process needed to maintain the quality of systems to deliver clean aircraft during winter operations are established and maintained
- Reporting to senior management on the performance and effectiveness of these systems and any need for improvement
- Ensuring that the need to conform to the clean aircraft concept is communicated throughout the organization

This person may be known by the title “Winter Program Manager/Responsible Person/Accountable Executive/Accountable Person,” or some other title that identifies as responsible and accountable to senior management for the effective delivery of all winter services and activities.

4.2.2 Head of Deicing Training (see DI-L70, 4.11)

It is often common to abbreviate “deicing/anti-icing” as just “deicing,” such as for the title of this position. Thus, when the term “deicing” is used, one must be mindful of the context and know whether it is also meant to include anti-icing.

Senior management shall appoint a manager on an annual basis who, irrespective of other responsibilities, shall be responsible for:

- Ensuring that their own understanding and competence is sufficient to hold this position
- Ensuring the effective delivery of the training program for the organization

If agreed by senior management, the Program Manager, Responsible Person, Accountable Executive, Accountable Person, and the Head of Deicing Training may be the same person.

4.3 Operational and Support Levels of Training and Qualification

The qualification level for all operational positions shall be clearly defined. Qualified people shall be fully aware of their approved functions. A person may hold several approvals depending on the job function. A suggested structure for levels and groups of qualifications is (DI-L = De Icing - Level):

DI-L10	Deicing Vehicle Driver
DI-L20	Deicing Operator
DI-L30	Deicing Supervisor
DI-L30B	Pre/post deicing Inspector
DI-L40	Deicing Instructor
DI-L50	Deicing Coordinator
DI-L60	Fluid Quality Inspector (laboratory staff)
DI-L70	Head of Deicing Training
DI-L80	Flightcrew (winter operations) [basics of deicing/anti-icing]

Initial qualification is achieved after successful theoretical training (including a written examination) is completed, and practical training (including assessment where relevant) is also successful. Each qualification shall be renewed annually, including the theoretical instruction and written examination. The training topics do not need to be covered repeatedly for each initial level of qualification if the same person is performing several duties. In order to maintain each qualification, it is highly recommended that the company keep records of the experience of each individual. The level of experience is recommended to be such that each individual is familiar with all relevant elements of the qualification responsibilities and can perform the required task in a safe manner. The program and records shall reflect the experience in performing the tasks of the relevant qualification in actual conditions. If the experience is limited after the winter season, it is recommended that the annual recurrent training of the individual reflects this lack of adequate experience in order to have all relevant operational topics refreshed more thoroughly.

4.3.1 Duration and Content of Training

The length of time required for theoretical and practical training will vary among operators and will also vary depending on local conditions. All elements relevant to a specific deicing qualification level should be covered in training as recommended in Table 1 (see 5.2).

Guidance for course content to use in theoretical training is provided in Tables 2 and 3 (see 6.2). A written exam for theoretical training must be completed in accordance with the process described in 6.3. Tables 4 and 5 provide elements for practical training. Assessments of the trainee must be performed during practical training in accordance with the process described in 6.5.

4.4 Deicing Vehicle Driver, DI-L10

The deicing vehicle driver qualification (DI-L10) qualifies the person to maneuver the vehicle and perform the communication procedures, but it does not include any other deicing levels. There shall be a note of the restriction on this qualification if some of the duties are not performed as mentioned. The driver shall receive training covering relevant parts mentioned in the standard teaching plan. Also, where relevant, local procedures shall be taken into account and emphasized more than others.

Recommended times are in Appendix B.2 of this document. The practical part shall cover all types of vehicles and types of operation that can be in use, and it shall include an assessment. The length of training depends largely on the type of operation and number of different vehicles, but practical training shall not be shorter than the theoretical part. Local settings may demand more/less extensive training, and the recommendations given here are not binding. The qualification must be renewed annually, with a theoretical part including a written exam. All new equipment and operational changes require practical training as well.

4.5 Deicing Operator, DI-L20

The deicing operator qualification (DI-L20) includes the preflight contamination check (check for the need to deice the aircraft), performance of deicing/anti-icing treatment, and the post deicing/anti-icing check. This level of qualification includes driving the deicing vehicle (DI-L10) and the pre/post deicing inspector qualification level (DI-L30B). There shall be a note of restriction to this qualification if some of the duties are not performed as mentioned. The deicing operator shall receive training covering in detail all parts mentioned in the standard teaching plan (except coordination and instructional procedures). Where relevant, local procedures shall be taken into account and emphasized more than others (e.g., some airports perform only centralized deicing, and some perform a mixed gate and centralized operation).

Recommended times are in Appendix B.2 of this document. It is recommended that the practical part be adapted according to local requirements and operational needs. A qualified instructor shall assess the practical part with the trainee performing “a demonstration of skill” during actual deicing/anti-icing treatment of an aircraft. Prior to practical assessment, the trainee shall receive sufficient practical training in order to be able to perform deicing/anti-icing in a safe manner. The qualification must be renewed annually with a theoretical part including a written exam. All new equipment and operational changes may require additional practical training as well.

4.6 Deicing Supervisor, DI-L30

This level of qualification includes the performance of the post deicing/anti-icing check, driving the deicing vehicle (DI-L10) and the deicing operator qualification (DI-L20). There shall be a note of restriction to this qualification if some of the duties are not performed as mentioned. The person supervising the deicing/anti-icing and performing the required checks shall receive training covering relevant parts mentioned in the standard teaching plan. Local procedures shall be taken into account and emphasized more than others where relevant.

Recommended times are in Appendix B.2 of this document. This training is similar to that for the DI-L20 qualification, and there is therefore no need to hold two separate courses in order to be qualified for both levels. Local settings may demand a more extensive training, and these recommendations are not binding. It is recommended that the practical part be adapted according to local requirements and operational needs. A qualified instructor shall assess the practical part with the trainee performing “a demonstration of skill” during actual operation involving an aircraft. The qualification must be renewed annually with a theoretical part including a written exam.

4.7 Pre/Post Deicing Inspector, DI-L30B

This level of qualification includes the Contamination Check (check for the need to deice the aircraft) and the pre/post deicing/anti-icing checks. This level is more limited than the DI-L30 and is only focused on duties to determine the need for deicing/anti-icing and the checking procedures. There shall be a note of restriction to this qualification if some of the duties are not performed as mentioned. The person determining the need for deicing/anti-icing and performing the required checks shall receive training covering relevant parts mentioned in the standard teaching plan. Local procedures shall be taken into account and emphasized more than others where relevant.

Recommended times are in Appendix B.2 of this document. Practical training for licensed technical staff (e.g., aircraft mechanics) is not required. Theoretical and practical parts can be combined where relevant. This training is similar to that for the DI-L30 qualification, and there is therefore no need to hold two separate courses if the initial training is for DI-L30. Local settings may demand a more extensive training, and these recommendations are not binding. It is recommended that the practical part be adapted according to local requirements and operational needs. A qualified instructor shall assess the practical part with the trainee performing “a demonstration of skill” (excluding above mentioned licensed technical staff) during actual operation on an aircraft. The qualification must be renewed annually with a theoretical part including a written exam.

4.8 Deicing Instructor, DI-L40

Training shall be conducted by personnel who have demonstrated competence in the deicing/anti-icing subjects to be instructed and who have the skills to deliver the training effectively. The instructor shall have received the proper training for a DI-L20 qualification, including the performance of deicing/anti-icing treatment, supervision of deicing/anti-icing (DI-L30), and driving the deicing vehicle (DI-L10). The instructor shall have proper training in instructional methods and sufficient knowledge of the training subject (e.g., aircraft critical areas and systems, fluid types, deicing vehicles, etc.). It is also recommended that the instructor attends or performs practical training and deicing/anti-icing of an aircraft on an annual basis in order to maintain necessary experience and knowledge. There shall be a note of restriction to this qualification if some of the duties are not performed as mentioned. The deicing instructor shall receive training covering all parts mentioned in the standard teaching plan. Local procedures shall be taken into account and emphasized more than others where relevant. There may be cases where specialists in a related field (e.g., a meteorologist, air traffic control staff, etc.) are used as instructors for a particular subject. These specialists do not need to be qualified in deicing/anti-icing.

Recommended times are in Appendix B.2 of this document. If the instructor has previously had basic practical training, there is no need for a practical part unless there are changes in the procedures or the operation. The training for deicing instructors should be considered to be held as a separate session. The length of this training may be adjusted according to local demands. Local settings may also demand a more extensive training and these recommendations are not binding. The deicing instructor is qualified to assess any demonstration of skill where needed. The qualification must be renewed annually, with a theoretical part including a written exam. The annual recurrent training will renew all previous qualifications (DI-L10 to 40).

4.9 Deicing Coordinator, DI-L50

The deicing coordinator qualification (DI-L50) entitles the person to coordinate and manage the deicing/anti-icing operation and/or work as a team leader. This qualification is intended for coordinating deicing/anti-icing operations mainly at remote and/or centralized deicing facility areas or for other similar/anti-icing coordination functions at an airport. The qualification includes the performance of deicing/anti-icing treatment (DI-L20), supervision of deicing/anti-icing (DI-L30), and driving the deicing vehicle (DI-L10). There shall be a note of restriction to this qualification if some of the duties are not performed as mentioned. The deicing coordinator shall receive training covering in detail all parts mentioned in the standard teaching plan. Local procedures shall be taken into account and emphasized more than others where relevant.

Recommended times are in Appendix B.2 of this document. Local settings may demand a more extensive training, and these recommendations are not binding. The training for deicing coordinators should be considered to be held as a separate session where topics are covered regarding the appropriate way of coordination, management, and/or team leadership. The basic part of the training can otherwise be held together with the deicing training (DI-L20). The length of this training may be implemented according to local demands. The qualification must be renewed annually with a theoretical part including a written exam. The annual recurrent training will renew all previous qualifications (DI-L10 to 30B and DI-L50) unless specified otherwise (e.g., limited level).

4.10 Fluid Quality Inspector (Laboratory Staff Only), DI-L60

The fluid quality inspector (laboratory staff) qualification (DI-L60) includes the performance of the quality control of fluids. The qualification shall include training covering related parts mentioned in the standard teaching plan. Local procedures shall be taken into account. International standards and auditing requirements regarding fluid quality shall be taken into account. Fluid brand procedures shall be noted. In some cases, this qualification can be included in DI-L20 if local procedures so demand. However, appropriate training for quality checks and procedures shall be performed in any case. Both theoretical and practical training shall be performed. Local settings may demand more extensive training, and these recommendations are not binding. The qualification must be renewed annually with a theoretical part including a written exam. Any new fluid or procedural requirements need special attention.

NOTE: This level is not limited to laboratory staff. Anyone else having this qualification level would be considered as having an additional qualification, but it is not a mandatory requirement for staff outside of the laboratory.

4.11 Head of Deicing Training, DI-L70

The Head of Deicing Training is responsible for the deicing training program. The Head of Deicing Training shall have sufficient knowledge in deicing/anti-icing operations and training to be qualified for this position. The Head of Deicing Training qualification covers all other levels of qualification (DI-L10 to 50) with DI-L60 optional if required locally or for personal knowledge. The qualification must be renewed annually and will be renewed automatically as long as the responsibilities remain with the same person. These responsibilities include keeping up to date with the latest recommendations and standards involving relevant deicing/anti-icing issues. The Head of Deicing Training shall have received deicing instructor training and shall have sufficient knowledge in basic instructional methods (e.g., train the trainer) for this level of qualification. An annual refresher course is recommended but keeping up to date with deicing industry news and operational elements, as well as preparing the training program (and/or acting as an instructor), is sufficient.

The Head of Deicing Training may also be the instructor and, therefore, previous deicing experience is strongly recommended. The company shall evaluate and approve the Head of Deicing Training for the task, and this approval shall be documented. It is the responsibility of the Head of Deicing Training to review all related standards and recommendations in order to have the most up-to-date information at hand. All material used for training shall be reviewed and approved by the Head of Deicing Training. All training sessions shall receive appropriate material content according to the particular qualification. Any company standard training material shall be under revision control, and appropriate standards and recommendations shall be referred to.

4.12 Flightcrew (Winter Operations), DI-L80

The flightcrew is not normally engaged in daily ground deicing/anti-icing procedures, but knowledge of the process should be in place. The flightcrew may have their own company training regarding winter operations. This training should cover all relevant aspects of the ground deicing/anti-icing process. This is an important factor in order to be able to communicate with the ground crew about proper treatment procedures and to have sufficient general knowledge of these subjects. The person responsible for deicing/anti-icing training for flightcrews is the Flightcrew Trainer. The Flightcrew Trainer should agree and verify the training with the Head of Deicing Training and operation. The qualification must be renewed annually with a theoretical part including an examination.

4.13 Cabin Crew (Icing Awareness), DI-L80B

Cabin crews are required to have training in the awareness of the effects of frozen surface contaminants and the need to inform the flightcrew of any observed surface contamination. The cabin crew is not normally engaged in daily deicing/anti-icing procedures, but an awareness of the process should be in place. The cabin crew may have their own company training regarding winter operations. The ability to identify icing on an aircraft is an important factor in order to be able to communicate with the flightcrew about any ice contamination before and during flight.

5. TRAINING SUBJECTS AND THEIR FIT WITH DEICING ROLES

5.1 Recommended Elements of Deicing Training

The elements listed here are for use as a reference only. It is up to the individual instructors to give each and every one of the deicing operations the relevant instruction which can be based on the following subjects. These subjects shall be explained and understood according to the level of importance that each operation demands. The recommended area of operation may differ between regions, and it is thus important that the instructor notes local requirements and selects the level of instruction accordingly. Depending on the qualification being trained, the listed subjects are intended to be introduced during training but not necessarily mastered in some cases, as some elements can be for general knowledge.

In order to obtain an overview of the essential aspects of aircraft ground deicing/anti-icing, there are several elements that need to be appreciated. These include:

- The requirement for aircraft ground deicing/anti-icing
- The practical methodology for aircraft treatment with deicing/anti-icing fluids
- Special aspects of aircraft ground deicing/anti-icing
- Communication and pre/post deicing/anti-icing check procedures

While each of these areas can be expanded into further topics to discuss, these broad headings show the flow of what must be taught. Firstly, there needs to be an appreciation of why aircraft deicing/anti-icing is vital and the regulatory requirements in place to reinforce this. Secondly, while there are a number of techniques available for aircraft deicing, by far the most common method is the use of fluids, which is also the only way to provide anti-icing. Lastly, there are a number of precautions, restrictions, and a need to learn from both any newer standards and guidance, plus findings from operational events and audits to enable continual improvement of the operations to take place.

5.2 The Fit Between the Recommended Elements of Deicing Training and the Deicing Roles

Table 1 shows the fit between a more detailed list of deicing/anti-icing aspects and the operational roles outlined in Section 4. However, it should also be appreciated that outside of the operational roles listed in the table, there are two other roles which will be involved.

- Senior management team: As this team has the accountability for the overall operation of the airport and aircraft safety, there is a requirement to ensure that there is up-to-date guidance, regulatory understanding, and operational learning embedded in the planning from winter to winter and is reflected in appropriate procedures and training programs.
- Head of Deicing Training: This person shall ensure awareness of any need for updating both their own skills plus any theoretical and practical training for all of the other roles in the organization.
- The different training subjects required to obtain the different functions are often the same. The differentiation will be made by adapting the duration of the training subject to the specific needs of the function.

Table 1 - Fit between recommended elements of deicing training and deicing roles

Recommended Elements for Training	Deicing (DI-) Qualification Level Reference									
	L10	L20	L30	L30B	L40	L50	L60	L70	L80	L80B
A. The requirement for aircraft ground deicing/anti-icing										
Basic knowledge of aircraft performance		X	X	X	X	X		X		
Effects of frozen contamination on aircraft performance		X	X	X	X	X		X	X	
The clean aircraft concept, regulations, and recommendations	X	X	X	X	X	X	X	X	X	
Meteorological considerations on ice formation		X	X	X	X	X		X	X	X
B. The methods for checking the aircraft for contamination										
Contamination Check (to establish the need for deicing)		X	X	X	X	X		X	X	X
Post Deicing/Anti-Icing Check		X	X	X	X	X		X	X	X
C. The practical methods for aircraft treatment with deicing/anti-icing fluids										
General techniques for removing frozen deposits from aircraft surfaces		X	X		X	X		X	X	
Deicing/anti-icing by fluids - procedures in general	X	X	X	X	X	X		X	X	
Basic characteristics of aircraft deicing/anti-icing fluids		X	X		X	X	X	X	X	
Types of fluid checks required and the equipment for this		X	X	X	X	X	X	X	X	
Deicing/anti-icing equipment operating procedures	X	X			X	X		X		
Fluid application and the use plus the limitations of Holdover Time (HOT) tables		X	X		X	X		X	X	
Communication procedures and deicing/anti-icing code	X	X	X	X	X	X		X	X	
Aircraft in general and common critical areas of surfaces and instruments	X	X	X	X	X	X		X	X	X
D. Special aspects of aircraft deicing/anti-icing operations										
Safety precautions and human factors	X	X	X	X	X	X	X	X	X	
Environmental impact and mitigation	X	X	X	X	X	X	X	X	X	
Deicing facility operation	X	X	X	X	X	X	X	X	X	
Learning from season operations, audit findings, and updated standards for next season		X	X	X	X	X		X	X	
Local rules and restrictions and airport procedures	X	X	X	X	X	X		X	X	X

6. TRAINING AND QUALIFICATION PROCESS

6.1 Theoretical and Practical Training, Annual Assessments, and Record Keeping

Only trained and qualified personnel shall carry out aircraft ground deicing/anti-icing procedures. Theoretical and practical skills training shall be conducted by qualified instructors/trainers who have demonstrated the skills to deliver the training and who have competence (knowledge, skill, and experience) in the subjects to be instructed. Assessments shall be conducted by persons who have appropriate knowledge, skills, and experience in the functions being assessed. Training shall be a combination of theoretical (suitable and sufficient information and instruction relating to the topic being trained) and practical skills training to verify the trainees' understanding of, and ability to complete, the task being trained. Changes to methods and processes shall be communicated to relevant personnel, and additional information and training shall be delivered as appropriate. Companies providing deicing/anti-icing services shall have both a qualification program and a quality control program to monitor and maintain the level of competence.

Attendance at training sessions shall be recorded and kept for verification of the qualifications of each person. Records of theoretical sessions and exams, as well as records of practical training and training while working (where applicable), must be retained for each person qualified. The record shall clearly show that instruction has been given and received with signed documents the usual evidence. A training schedule for each qualified person shall be maintained. The record shall identify the date when the particular subject matter was delivered to the trainee. The trainer shall sign or initial that the training has been delivered. The trainee shall, as an acknowledgement and understanding of the training, sign or initial the appropriate subject matter on the training record form. Training content and records shall be made available for review by an authorized air operator representative or regulatory authority. Where electronic or computer-based training record systems are maintained, the content shall include, as a minimum, the trainee's name, test mark achieved, date of training, and course reference. The same procedure shall be followed where contract deicing is used. Names, dates, and the scope of training must be clearly stated. Practical evaluation and demonstration of skills for ground crew personnel shall be performed as part of a ground crew training and qualification program.

The area of deicing training shall be divided into the following parts:

- Theoretical
- Practical
- Annual Recurrent

Initial qualification of deicing/anti-icing personnel shall be accomplished under strict supervision of a qualified individual by at least one of the following:

1. On live aircraft during live deicing/anti-icing operations – recommended/preferred method
2. By spraying on a mock-up surface/aircraft or deicing simulators that would simulate an actual live deicing/anti-icing operation

If trainees have satisfactorily completed all simulated practical evaluations and demonstrations of skills required as part of the training and qualification program, then they may participate in deicing/anti-icing operations under strict supervision of a qualified individual, until such time as the final qualification can be achieved.

For annual recurrent qualification:

The practical evaluation and demonstration of skills for normal equipment and operational methods is expected.

The practical training and demonstration of knowledge or skills where new equipment or operational methods are utilized is required.

Both initial and annual recurrent training shall be conducted to ensure that all personnel obtain and retain a thorough knowledge of aircraft ground deicing/anti-icing policies and procedures, including new procedures and lessons learned.

Training programs must include a detailed description of initial and annual recurrent training and qualification concerning the specific requirements of the program and the duties, responsibilities, and functions detailed in the program. An ongoing review plan is advisable to evaluate the effectiveness of the deicing/anti-icing training received. The program shall have a tracking system that ensures all required personnel have been satisfactorily trained. Records of personnel training and qualification (see Figures 1 and 2) shall be maintained as proof of qualification. Where an individual has passed an examination but has not achieved a perfect grade, it is recommended that incorrect answers are reviewed with the individual to promote error-free learning. The training shall be divided into different groups according to levels of qualification and operational expertise.

COURSEWARE DEVELOPMENT GUIDE

Aircraft Deicing/Anti-icing Training Program

INSTRUCTIONAL AIDS	TOPIC / MAJOR POINTS	NOTES / REFERENCES
	EXAMPLE	

Figure 2 - Aircraft deicing/anti-icing training program

6.2 Theoretical Elements - Standard Teaching Plan

From Table 1 in Section 5, it is evident that there are a number of areas under each heading that can be taught as separate modules. This allows the personnel who may need to appreciate the different aspects of deicing to only need to be involved in their relevant subjects. Tables 2 and 3 offer guidance on how sessions may be run. Reference is made to the appropriate documents to support each session.

Table 2 - Theoretical elements - standard teaching plan (sections A, B, and C)

Subject	Guidance Content (References)
Course Introduction (AS6286)	
TE1. Introduction	Trainer to introduce themselves. They will explain how they are qualified to train the subject, plus their experience. They will give an overview of the course content, the teaching method, and the requirement for a validation exam and pass mark
A. The requirement for aircraft ground deicing/anti-icing (AS6286 Appendix A)	
TE2. Basic knowledge of aircraft performance	Four forces that act on an aircraft. Airflow over and under the wings. Why an aircraft can take off. How lift is generated. The critical angle of attack. The aerodynamic window of operation. The biggest contributor to aircraft lift.
TE3. Effects of frozen contamination on aircraft performance	The effect of frozen contamination on lift and drag and the aerodynamic window of operation. The critical component areas for lift and maneuverability of the aircraft. The effect of a small layer of frost. Other effects of frozen contamination.
TE4. The clean aircraft concept, regulations, and recommendations	The "clean aircraft" concept. The regulatory requirements of various national authorities. The role of SAE International and the key global aircraft ground deicing standards. The main purpose of aircraft deicing and anti-icing.
TE5. Meteorological considerations on ice formation	General weather conditions and ice formation. Typical weather types leading to frozen contamination on the aircraft. Weather situations needing special attention. Weather conditions included in/excluded from the holdover time tables. Some forms of weather reporting. Effects of weather on airport operation.
B. The methods for checking the aircraft for contamination	
TE6. Contamination check (to establish the need for deicing)	How to examine the aircraft critical flight surfaces (wings, vertical stabilizer, horizontal stabilizers), top fuselage, undercarriage, nose radome, pitot-static orifices, angle of attack devices, windscreens.
TE7. Post deicing/anti-icing check	How to perform a post deicing/anti-icing check of the aircraft to make sure that no contamination (frozen deposits) remains after deice/anti-ice, the aircraft is clean and in proper condition for flight.
C. The practical methods for aircraft cleaning with deicing/anti-icing fluids (ARP1971, AS6285)	
TE8. General techniques for removing frozen deposits from aircraft surfaces	The various ways in which deicing can be carried out. The only way in which anti-icing can be carried out. The need to prepare equipment, procedures, and people. The areas of an aircraft to check for frozen contamination. Descriptions of one-step and two-step deicing/anti-icing.
TE9. Deicing/anti-icing by fluids - procedures in general	Critical aspects of deicing and the general process. Special care for composite wing deicing. The general process for using anti-icing fluids effectively. Use of Type I for anti-icing. The general use of Type II, III, and IV fluids.
TE10. Basic characteristics of aircraft deicing/anti-icing fluids	Why deicing/anti-icing fluids are the most usual way of deicing aircraft. The three safety requirements of deicing/anti-icing fluids. The differences between Type I, II, III, and IV fluids, and the colors of these. The unusual characteristics of anti-icing fluids and the precautions needed. The two ways to classify fluid performance. Incompatibility of certain types of fluids, e.g., EG & PG are not compatible with acetate or formate based fluids. Understanding of AMS1424/1 & /2 and AMS1428/1 & /2 and what is allowed to be applied to the aircraft per the manufacturer's Aircraft Maintenance Manual.
TE11. Types of fluid checks required and the equipment for this	The general handling and storage requirements of deicing/anti-icing fluids. The quality control checks to be performed on these fluids. Pumping, heating, and storage tank requirements.
TE12. Deicing/anti-icing equipment operating procedures	The variations of deicing vehicles, and the types of safety precautions to be taken. The operation of filling stations. Clear communications with the flightcrew. Equipment use, spray alternatives, and data collection. Basic vehicle components and safety equipment. Refer to ARP1971.
TE13. Fluid application and the use plus the limitations of holdover time tables	Details of the "clean aircraft" concept. The main areas of the aircraft to spray. The key aircraft areas to anti-ice. The purpose of holdover time (HOT) tables and how to read these. The difference between generic and fluid brand HOT tables. The importance of using the correct dilution when reading the appropriate HOT table.
TE14. Deicing/anti-icing codes and communication procedures	The anti-icing code/post deicing report. Communication to flightcrew with reference to AS6285 . Operator/driver communication, two-way communication.
TE15. Aircraft in general and common critical surfaces and instruments	The critical aircraft surfaces to inspect. The precautions to take against clear ice. Critical areas not to spray. Understanding the use of the "no spray" diagrams in AS6286B (Revision B, dated 2016-11).

Table 3 - Theoretical elements - standard teaching plan (section D)

Subject	Guidance Content	Reference
D. Special aspects of aircraft deicing/anti-icing operations (ARP5660, AS6332, AS6286B [Revision B, dated 2016-11])		
TE16. Safety precautions and human factors	Safety assessment by hazard identification and risk management. Personal safety (contamination, working at height, etc.). Safety of others (contamination, struck by vehicle, etc.). Aircraft safety (damage prevention). Personal Protective Equipment (gloves, visors, clothing, etc.).	
TE17. Environmental impact and mitigation	Environmental impact and mitigation.	
TE18. Deicing facility operation	The need for special procedures for central deicing facilities and remote deicing facilities with reference to ARP5660 .	
TE19. Learning from season operations, audit findings, and updated procedures.	Review of season operational performance with reference to AS6332 . Review of any incidents, both local and in the industry. Review findings from internal and external audits as appropriate. Consolidate learning with updates to procedures and instructions for next winter season.	
TE20. Local rules and restrictions, airport procedures	Local procedures, permits, requirements, documentation, and operations. Compliance with all SAE Standards referenced.	

6.3 Theoretical Elements - Examination Process

The examination process contains a theoretical exam, for which a minimum passing score of 75% shall be required. The practical part (where applicable) only contains a pass/fail determination. Since 75% is a passing score for the theoretical part, this means that up to 25% may still be misunderstood. This “gap” shall be noted and wrong answers corrected with the trainee such that 100% understanding is achieved in order to secure a safe deicing operation. The written exam can be performed as an open-book exam so that pertinent holdover time tables and other data sources such as refractive index tables can be referenced. Normal deicing procedures should be basic knowledge, so there should not be any material available during the test explaining these subjects.

The examination for any particular course should be built so that all relevant subjects are covered by the questions. The level of difficulty per question should reflect the level of qualification and the relevance of the subject for that particular qualification. As a rule of thumb, a minimum of one question per subject relating to the qualification level should be included in the written exam. The minimum number of questions shall reflect the qualification level and may vary accordingly; however, this minimum amount should not be less than 15 questions (starting with the least demanding level of qualification/training hours). The theoretical examination shall be in accordance with national requirements and/or local regulations. The questions should be multiple choice containing a minimum of three possible answers per question. If there are differing procedures from normal deicing operations, then written answers can be used to explain this. The exam questions shall be periodically reviewed and updated to cover all current standards and regulations.

The Head of Deicing Training shall include the following elements in the training program:

- The questions should always be based on facts and not perceptions
- The question should not be misleading and should be clearly written such that it is not possible for it to be incorrectly interpreted
- Misinterpretations may lead to remembering the subject in an incorrect way
- The question series should cover all aspects of operation and include the local arrangements (if any)
- Evaluation should include oral quizzing where practical items are covered (e.g., reading holdover time tables and/or refractive index limits, etc.)

6.4 Practical Elements - Standard Teaching Plan

Upon the successful completion of the theoretical part of the training, practical training will need to be carried out at the airport. A standard teaching plan for this part of the training is shown in Tables 4 and 5. The following points shall be noted:

- The teaching plan shows most of the elements expected for practical hands-on training. However, this must also be subject to local management guidance, requirements, and resources.
- All elements in Tables 4 and 5 are applicable to DI-L10, DI-L20, DI-L40, and DI-L70. Any exceptions to this are noted in the appropriate element. These exceptions are noted for DI-L30, DI-L30B, DI-L50, and DI-L60.
- Most of the operations below require the use of a suitable deicing truck and aircraft.
- The timescale for most of these elements is open to allow for the development of the required level of skill for the trainee.

Table 4 - Practical elements - standard teaching plan, Part 1 of 2

Element		Content
PE1	Overview of deicing/anti-icing equipment and its operation plus facilities (e.g., storage tanks)	Deicing/anti-icing equipment, vehicle description (type, make, nozzles, guns, tanks, etc.). Vehicle operation. Safety features. Manual versus proportional mixing. Facilities. Storage requirements. Filling. Heating equipment (as applicable for engine ice removal).
PE2	Cab layout and operation	Pre-operation checks. Seat and mirror adjustment. Gear shift selection. Park brake. Heater and pump controls. Boom controls (if fitted). Communication and connections (headset). Start and stop procedures. Driving controls (wipers, lights, and indicators, etc.).
PE3	Deicing unit control panel	Start/restart/stop. Emergency stop procedures. System indicators. Switches.
PE4	Basket operation	Emergency stop procedures. Emergency boom lowering procedures. Harness attachment point(s) and harness use. Communications and connections (headset). Light switch operations. Pump delivery selection/pump override/pump operation. Anti-ice/deice and snow gun operation. Boom controls. Extend/retract/raise/lower/rotate. Personal Protective Equipment.
PE5	Auxiliary engine operation (if fitted)	Start/restart/stop/emergency stop procedures. Manual accelerator control. Fire extinguisher operation.
PE6	Fluid heater operation (if fitted)	Start/Shut down procedures. High flame/low flame indicators. No flow indicator. Low fluid indicator. Pump pressure gauge.
PE7	Ground hose operation	Position of hose. Operation of ground gun. Fluid flow rate.
PE8	Pre-Spray checks	All doors/hatches closed. All personnel clear. Aircraft configuration.
PE9	Communication (also, DI-L30, DI-L30B and DI-L50)	Communication with Flight Deck. Engineering (i.e., Aircraft Configuration). Anti-icing code/Post deicing report. Communication between driver and sprayer. Multiple vehicle operations, vehicle to vehicle Centralized operation. Coordination.
PE10	Vehicle positioning	Optimum positioning for spraying. Communication with operative. Driving safely around the aircraft.

Table 5 - Practical elements - standard teaching plan, Part 2 of 2

Element		Content
PE11	Vehicle safety around aircraft	Approaching aircraft (i.e., engines/anti-collision lights). Vehicle brake check. Vehicle height. Vehicle speed. Awareness of other ramp users. Accident/Incident reporting and safety reporting.
PE12	Fluid spraying	Critical surfaces. No-spray areas. Fluid temperature. Spraying distance (heat retention). Spray patterns (nozzle settings).
PE13	Other de/anti-icing procedures (also DI-L30B)	Pre-deicing treatments. Local frost prevention. Deicing engines, sensors, probes, etc. Related checks.
PE14	Driving the deicing truck	Maneuvering the vehicle. Handling characteristics. Emergency situations. Fault situation.
PE15	Deicing scenarios (where applicable)	Gate deicing. Remote/centralized deicing. Multiple vehicle deicing.
PE16	Emergency situations (clarify theoretical elements in practice) (also DI-L30)	Safety at work. Collisions and other accidents. Procedures and situations. Human Factor situations. Environmental control.
PE17	Quality checks (if applicable) (also DI-L60)	Fluids, limits, and reporting. Sampling. Measurement instruments and use. Filling station, fluid quality. Fluid delivery.
PE18	Contamination check (also DI-I30 and DI-L30B)	Different contaminations on the aircraft. Aircraft types. Clear ice checks, tactile check. Reporting/communication. Final release, anti-icing code. Safety elements, human factors.
PE19	Spraying and using hot air (practice as needed) (also DI-L30)	Fuselage, underwing, wing, and tail. Engine and propeller ice. Landing gear instruments.
PE20	Practical validation	Each trainee shall be able to demonstrate competence in: 1. Driving/positioning equipment/quality control and fluid handling/communication/reporting and/or spraying (as applicable)/pre-post check. 2. Trainees shall also be tested on the operation of the vehicle, in particular, safety aspects and features (as applicable). 3. Actual deicing/anti-icing operations on an aircraft (as applicable) shall be assessed before initial qualification and evaluated over a period of time (i.e., events), as applicable. 4. A verbal assessment of things learned during training shall be performed.

6.5 Practical Elements - Assessment Process

A practical assessment shall be performed as applicable for the qualification to be achieved. The practical assessment shall be performed in actual operational conditions involving an aircraft (as applicable) before initial qualification. Further evaluations may be performed as applicable for the local demands and/or company requirements. The practical assessment shall include a verbal assessment of the trained theoretical topics, as well as the practical parts trained. In order to have an "independent" evaluation, it is recommended that the assessment be performed by another qualified instructor rather than the instructor who has trained the trainee. The parts to be covered during the practical assessment shall include all of the material for the qualification level at hand. These are to demonstrate competence in (as applicable):

- Driving vehicles
- Positioning equipment
- Quality control and fluid handling
- Contamination check
- Post deicing/anti-icing check
- Communication
- Reporting and documentation
- Spraying
- No spray areas
- Local operational requirements

The trainees shall also be tested on the operation of the vehicle, in particular, its safety aspects and features. The practical assessment should focus on the most common operational aspects that are locally experienced, e.g., typical aircraft at the station and typical deicing/anti-icing operations. The training syllabus under 6.4 describes the practical training in more detail, and the assessment shall reflect those parts that were trained.

6.6 Training System and Records

6.6.1 Training System and Renewal

All training should be performed according to a pre-established training program. This program should include all levels of training and their relevant requirements. The theoretical part should be categorized according to the qualification, thus dividing the training sessions from each other. This training program will easily identify what course is leading to which qualification. This numbering system presented here does not need to be the same for every company but is a logical sequence to follow if desired. To remain qualified to perform certain deicing duties, annual recurrent training is required. An annual recurrent course should be presented as a training session that renews previous qualifications. This recurrent training does not have to be performed exactly or before the date of the previous qualification. A prior year's qualification remains valid for the beginning of the next deicing season but must be renewed before the year's end.

As an example: If a trainee was qualified on November 1, 2015, the qualification renewal shall be completed between November 1 and December 31, 2016. This date-range flexibility eases the burden of training large groups at the beginning of the deicing season. However, it is highly recommended that the training be performed as early in the season as practicable. Conducting training sessions before the beginning of the season is also an option for theoretical aspects.

Local regulation could overrule the end-of-year requirement.

NOTE: Initial and recurrent training courses:

Management (of the trainee's company) is responsible for the level of competence of staff attending courses. If employees are competent through continuous activity in deicing, they only require "refresher" training. If employees have a lengthy absence from practical activities (e.g., no active deicing was performed for two consecutive seasons), they would normally require initial or requalification training.

6.6.2 Records

Records shall be kept of all tests and scores, for both the theoretical exam and the practical assessment. A test record shall indicate the trainee, the qualification being sought, the date of the test, the evaluating instructor, and the score. A failed examination can be retaken, and this must be noted in the record. The evaluation process must lead to a qualification before the trainee shall be allowed to carry out the required role. Any restriction to a qualification shall be documented. A certificate should be given to the person to verify all training and qualifications. A copy of the certificate should be kept. All documentation for the current season should be kept easily at hand for verification by approved deicing staff. Records shall be retained in accordance with applicable timelines established by local regulatory, air operator, or organizational record retention requirements.

6.6.3 Quality of Training

Only trained and qualified persons shall perform deicing/anti-icing procedures. This applies to both ground and flightcrews. The deicing operator is responsible for performing, evaluating, and recording any and all training performed for company personnel and subcontractors, as well as developing and/or executing a training-quality program. Training subjects shall include those presented in Section 6. Both initial and annual recurrent training is required, including practical training where applicable. The training shall cover all relevant topics, and qualifications shall be issued to all trainees who pass the evaluations.

Material used for training shall be of the latest edition of any relevant standards and documentation, including customer manuals. A system of revision of manuals shall be established with the company concerned. Material used for reference or training only shall be marked accordingly.

A periodic quality review of the deicing/anti-icing training program shall be conducted and a training-quality program established. These should include a method of evaluating and monitoring the effectiveness of the deicing/anti-icing training delivered. Various measures of trainees' successful completion of their evaluations may be employed (e.g., score trends; percentage of first-try passes; re-takes and additional training required, etc.). Training records described in 6.6.2 should be maintained in a manner that ensures that they are easily retrievable by persons responsible for executing these program-quality reviews.

6.7 Computer-Based Deicing Simulator (CBDS) Standards

As computer-based deicing simulator (CBDS) systems are commonly used as part of deicing/anti-icing training programs, this section identifies which components of CBDS systems may be used in lieu of, or as a part of, a particular training curriculum. Due to their current limitations, CBDS systems cannot fully replicate all aspects of deicing vehicle familiarity training, and thus, the use of CBDS systems shall not replace the requirement to perform hands-on training on the actual deicing vehicle type for training aspects not encompassed by a CBDS's capabilities.

In order to determine and qualify a particular CBDS's capabilities, the capabilities are defined by "Levels." Levels A, B, C, and D (ranked by generic purpose and by realism to full-scale replica) CBDS systems are defined, and deicing training capabilities shall be categorized based on the capabilities of each level of simulator. Tables 6 and 7 define the minimum capability requirements for each CBDS level. Table 8 defines training requirements that CBDSs may be used in place of or to complement. Once a CBDS has been evaluated and qualified, based upon the operational/functional requirements specified in Tables 6 and 7, and the CBDS level has been established, Table 8 may then be utilized to determine the components of a training program for which the CBDS may be used in place of traditional real-world practical training. Regardless of level, a CBDS system may be used to complement theoretical, practical, and deicing vehicle familiarity training. Where a CBDS system is designed based on a specific equipment manufacturer's vehicle type, this system can still be utilized to complement some elements of training where other equipment types may be utilized, as they have the capability to demonstrate generic deicing and anti-icing requirements. The evaluation and qualification of a CBDS system in order to determine the level category based upon minimum operational/functional requirements specified in Tables 6 and 7, and subsequent training capabilities in Table 8 as determined through Tables 6 and 7, shall be the collaborative responsibility of the CBDS manufacturer and end CBDS user owner.

Table 6 - CBDS minimum operational and functional requirements, Part 1 of 2

Hardware Requirements	CBDS Level				Remarks
	A	B	C	D	
Contains a computer system and associated hardware (keyboard, mouse/track pad, monitor, and sound system), capable of operating system to potential required.	X	X	X	X	
Contains an audio and visual system capable of meeting all the standards of this appendix.	X	X	X	X	
Contains a sound system (i.e., speakers, headset) that is capable of replicating primary and secondary sounds.	X	X	X	X	
Contains a visual system (i.e., monitors, displays, goggles) that is capable of displaying all pertinent scenery and surroundings, additional controls and inputs as required, and relevant data as required by the operator.	X	X	X	X	
Contains a visual system whereby the operator can adjust viewing angles and directions as required.			X	X	
Has a multi-monitor visual system or head-motion-controlled goggles to depict 3D realism.				X	Optional
Contains a suitable workstation/platform to support the placement of equipment required to operate CBDS.	X	X	X	X	
Contains a seat position for operator.	X	X	X	X	
Contains a seat position for an instructor, in close proximity to the operator (either within workstation or adjacent to).	X	X	X	X	
Contains controls to simulate fluid application including nozzle and/or joystick (open bucket or enclosed cab types) and has capability to adjust between various nozzle settings.	X	X	X	X	
Contains controls to select between fluid types.	X	X	X	X	
Contains controls to simulate boom elevation/lowering, extension/retraction, spray arm extension/retraction, and basket/cab rotation.	X	X	X	X	
Contains full scale replica of equipment controls/joysticks, switches, and other devices as found in equipment type represented.			X	X	Controls provided by OEM manufacturer
Controls oriented and located relative to actual location found in equipment type represented.		X	X	X	Controls provided by OEM manufacturer
Controls feel dynamics which replicate the vehicle simulated.			X	X	Controls provided by OEM manufacturer
Control inputs shall mimic the logic and result in the same manner as found in the equipment type represented (e.g., "dead-man pedal," etc.).		X	X	X	Controls provided by OEM manufacturer
Contains an operating cab/basket position.	X	X	X	X	
Contains a driver position (not necessary for one person operation from the operating cab/basket position).			X	X	
Has the capability to network between multiple CBDS systems and display real-time activity of the primary and secondary users during a scenario/exercise.		X	X	X	Optional
Has a motion system that physically maneuvers the operating cab/basket platform amongst multiple degrees of freedom (3 or 6). Areas simulated include all vehicle centrifugal motions, and can also include wind, jet blast, and collision.				X	Optional

Table 7 - CBDS minimum operational and functional requirements, Part 2 of 2

Software Requirements	A	B	C	D	
Contains a computer system and associated software (CPU, graphics card, sound card, etc.), capable of operating system to potential required.	X	X	X	X	
Computer capacity, accuracy, resolution, and dynamic response sufficient for the qualification level sought.	X	X	X	X	
Real-time, in-the-loop simulation.		X	X	X	
Has the capability to network between multiple CBDS systems and display real-time activity of the primary and secondary users during a scenario/exercise.		X	X	X	Optional
Capable of setting predetermined scenarios.		X	X	X	
Capable of setting up individual operator login and password in order to track progress.		X	X	X	
Capability of recording participant activity for later playback and evaluation.			X	X	
Contains visual replica of operating cab/basket.		X	X	X	
Contains all relevant instrumentation and indications as on equipment, including lighting.			X	X	
Equipment depicted shall act and appear as equipment type represented.			X	X	
Motions associated with maneuvering of any component shall be precise to specifications of the equipment type represented (i.e., turning radius, operating height, etc.).			X	X	
Motion (force) cues perceived by the operator representative of the vehicle motions.		X	X	X	
Depicts ground maneuvering operating characteristics of equipment type represented, including motion when of parts and equipment when brought to a stop, deceleration, braking, and turning radius.		X	X	X	
Depicts boom/basket/spray arm maneuvering operating characteristics of equipment type represented.		X	X	X	
Contains any associated requirements applicable to the equipment type represented.		X	X	X	
Contains primary sounds, such as engine noise, ambient noise, vehicle component noises (boom, wipers, forced air blower, etc.), aircraft engine/APU noise, precipitation, wind noise, etc.		X	X	X	
Contains secondary sounds, including applicable equipment alarms, and warnings (i.e., spraying of a no-spray area), proximity sensor contact, and crash.		X	X	X	
Contains realistic aircraft with general permissible spray areas and no-spray areas.	X	X	X	X	
Accurately depicts permissible spray areas and no-spray areas specific to the aircraft type selected. Should a no-spray area be directly sprayed at, indicates a warning to the Operator.		X	X	X	
Depicts aircraft contamination and is removable once fluid applied.	X	X	X	X	
Accurately depicts various forms of aircraft contamination and contamination amount and type is adjustable.			X	X	
Demonstrates removal of contamination once fluid is applied.	X	X	X	X	
Accurately depicts the way in which deicing and anti-icing fluid moves through the air, flows across the surfaces of aircraft, and exchanges heat with the air, contaminates, and aircraft surface.			X	X	
Demonstrates removal of contamination using forced air (where equipped).	X	X	X	X	Optional
Accurately depicts the way in which forced air flows, including velocities, and removal of contamination relative to dispersion angle.			X	X	Optional
Contamination removable is variable, dependent on the quantity of fluid applied and the quantity of contamination present.			X	X	
Shows effects of winds (including cross wind, high wind speeds, and gusts), precipitation type and intensity, fog, and jet blast/prop wash (where engines-on deicing is simulated).			X	X	
Shows special effects associated with aircraft de/anti-icing, i.e., collision, braking, bumps, jet blast (both exhaust plumes and effects of maneuvering within).			X	X	
Outside air temperature is displayed and is adjustable.			X	X	
Fluid temperature is displayed, and visual cues (steam) are present where fluid is heated.			X	X	
Fluid quantities are displayed.			X	X	
Time from start of simulation scenario is displayed and tracked.		X	X	X	
Daylight/darkness capability, with artificial and non-artificial lighting.			X	X	
Scenery showing generic deicing location and common airport surroundings and fixtures.		X	X	X	
Scenery showing precise site-specific deicing location and specific airport surroundings and fixtures.			X	X	Optional
Scenery showing static positioned in proximity to a live aircraft, whereby precise equipment movement simulation is required in order to prevent conflict.			X	X	Optional