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INFOSERVICE

2014-2015
Cold Weather Operations

➔ **Learjet Series, Challenger 300, Challenger 350, Challenger 600 Series and Global Series**

Another winter will soon be upon us, and with it comes our annual Cold Weather Operation InfoService to help remind everyone of the operational difficulties that can accompany colder temperatures. Last year we combined all of our business aircraft platforms into a single edition for the first time and received a lot of positive feedback. Going forward we plan to keep the multi-platform format, and with the recent entry into service of the Learjet 70/75 and Challenger 350, they have been added to the mix this year.

The presence of ice, snow, slush, or water accumulation, may have serious consequences on critical systems such as the engines, the APU, the wings, the landing gear and the sensing elements. The recommendations contained in this newsletter supplement normal procedures and will help ensure satisfactory operation of the aircraft and its systems in cold climatic conditions. In case of a discrepancy between the aircraft manuals and the recommendations in this document, the aircraft manuals prevail.

The first section of this document is generally applicable to Learjet, Challenger 300, Challenger 350, Challenger 600 and Global series platforms. Additional precautions specific to each platform can be found in the Appendix at the end of the document, as well as references, definitions, useful links and contacts.



TABLE OF CONTENTS

OPERATIONAL PRECAUTIONS.....3	CHALLENGER 600 SERIES14
APPENDIX..... 9	GLOBAL SERIES17
LEARJET SERIES.....10	REFERENCES - ALL PLATFORMS.....19
CHALLENGER 300 & CHALLENGER 350..... 12	BOMBARDIER CONTACTS..... 23

For Cold Weather Operations information for the Challenger 800 series and Challenger 800 SE platforms, please consult ISAR Issue 2014-08 - Winterization Edition. Please visit <https://customer.aero.bombardier.com/racs/private/technical-library/newsletters> to access the report.

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The following table will help you go directly to the appropriate sections of the document by selecting the hyperlinks.

Precautions by Flight Phase	Impact of cold weather conditions on...	
	Operations	Systems
Exterior Inspection	<ul style="list-style-type: none"> • “Clean Aircraft” concept 	<ul style="list-style-type: none"> • Fuselage, • Control Surfaces, • Air Inlets/exits • Landing Gears, • Tires, • Engines, • Wings, • Transparencies
Pre-Taxi	<ul style="list-style-type: none"> • Runway inspection • Engine acceleration 	<ul style="list-style-type: none"> • Cabin Interior warm-up
Ramp De-icing/Anti-icing	<ul style="list-style-type: none"> • De-icing and Anti-icing fluid application • De-icing and Anti-icing fluid level of concentration • Hold Over Times (HOT) 	<ul style="list-style-type: none"> • APU • Inlets/Exhausts • Brakes • Bleed • Transparencies • Wings • Horizontal Stabilizer
Taxiing	<ul style="list-style-type: none"> • Engine ignition • Steering • Braking • Reduced Speed • Thrust 	
Pre-Takeoff	<ul style="list-style-type: none"> • Respect HOT • AFM check for Operations on contaminated runways • Weather conditions at arrival and fuel for alternates 	
Takeoff	<ul style="list-style-type: none"> • A/I system • Engine 	<ul style="list-style-type: none"> • Wings • Control Surfaces • Horizontal Stabilizer • Elevators
After Takeoff	<ul style="list-style-type: none"> • Landing Gear retraction 	
In-Flight	<ul style="list-style-type: none"> • A/I system 	
Landing	<ul style="list-style-type: none"> • Touchdown • Directional control • Speed • Braking 	<ul style="list-style-type: none"> • Brakes
After Clearing Runway	<ul style="list-style-type: none"> • Flap Retraction 	<ul style="list-style-type: none"> • Flaps • Wing Trailing Edges
Shutdown, Post-Flight and Parking	<ul style="list-style-type: none"> • Hangar parking if possible • Engine Covers • A/C protective covers • Regular snow removal • Tire inspection 	<ul style="list-style-type: none"> • Slat/Flaps inspection • Landing Gears • Wheels • Tires • Water & Toilet system • Batteries

OPERATIONAL PRECAUTIONS

Exterior Inspection

- Regulatory Authorities require that crews use the “clean aircraft” concept: no pilot may take off in an airplane that has snow or ice adhering to the wings, stabilizer, or control surfaces.
- Conduct exterior preflight inspection as defined in the Flight Manuals.
- Check the aircraft for ice, snow, and frost. Brush off light snow. Remove all encrusted snow and ice.
- Make sure that all control surfaces are clean; that all protective covers are removed; that pitot heads, static ports, fuel tank vents and air conditioning inlets/exits are clear of snow, ice and slush.
- Clear ice may be present below a layer of snow and slush. Visually and manually check to ensure removal of all ice after de-icing/anti-icing procedures.
- Remove ice, snow, and dirt from landing gear shock struts, latching mechanisms (uplocks/downlocks), electrical components, wheel wells and gear doors.
- Make sure that tires are inflated to the correct pressure and that they are not frozen to the ground.
- Make sure that landing gear shock strut extension is correct.
- Carefully inspect engines for frozen precipitation in the fan duct and tailpipe. Under certain climatic conditions, ice can form on the back of fan blades and cause vibrations during start-up.
- Pilots must be aware of the effect that cold fuel in the tanks may have on moisture present on the wing upper and lower surfaces. If fuel temperature is 0 °C (32 °F) it is possible to have clear ice on the wing with the temperature above freezing. Ensure that the wing upper surface is free of clear ice by means of a tactile (touch) check. Clear ice must be removed. It should be noted that ice and frost may continue to adhere to wing surfaces for some time even at outside air temperatures above 5°C (41°F).
- Snow and ice should be removed from the transparencies as much as possible with a soft broom or brush. Do not use sharp objects when removing snow and ice and, when cleaning, never use a dry cloth on a dry windshield surface
- The windshield/side window heat systems should not be used to melt large amounts of snow and ice. Windshield heat should be selected to “ON” during initial power up only if the windshield is devoid of snow and ice.
- Operators are also reminded to be diligent in ensuring the windshield and side window aerodynamic seals are inspected regularly. Look for lifting, cracking or separation from the outer ply. Prolonged exposure to cold, freezing precipitation and de-icing fluids generally causes more transparency removals in the winter months.

CAUTION: If any doubt remains as to the aerodynamic cleanliness of your aircraft, request de-icing/anti-icing or proceed to a de-icing/anti-icing facility. NEVER assume that snow will blow off, as there could be a layer of ice under it. DO NOT underestimate the effect of even a thin layer of ice on wing surfaces.

Pre-taxi Precautions

- Review the Aircraft Flight Manual (AFM) regarding cold weather engine starts and use of Ground Power Units (GPUs). During engine starts in cold weather, engine acceleration can be much slower than normal, and Interstage Turbine Temperature (ITT) has a tendency to increase more rapidly due to slower spool-up. Higher than normal oil pressure can be expected which may exceed the maximum allowable transients.
- To ensure proper operation of aircraft interior components (EXIT signs, monitors, Cabin Entertainment System, etc.) it is suggested to warm the cabin interior prior to dispatch. This should be carried out when outside temperature reaches 10°C (50°F) or lower.
- When subjected to very cold temperatures or extreme temperature variations, the varnish finishing of the cabin interior may be prone to cracking. In order to preserve the integrity of your aircraft interior, we recommend to only use the aircraft heating systems for cabin heating when preparing the aircraft in cold weather conditions.
- The use of any exterior and/or portable heating devices to heat the cabin may cause damage to the interior finish.
- When operating at airports with minimal services, it might be necessary to request that you be taken physically out to the runway to accurately assess the runway conditions, i.e. high drifts, pools of slush, etc.

Ramp De-icing/Anti-icing Procedures

- If possible, do not operate engines or APU during the de-icing/anti-icing procedures (NOTE: on the Challenger 300/Challenger 350 and Learjet 45/75, the APU must be shut down during the de-icing/anti-icing procedures - refer to CL300 and Learjet sections of the Appendix).
- Do not spray de-icing/anti-icing fluid directly into engine or APU inlets, exhausts, brakes, probe inlets, scoops, vents, and drains.
- Do not force ice and snow into openings around flight control surfaces and air inlets of APU and engines during removal procedures.
- Select bleed air "OFF" if engines or APU are running while de-icing/anti-icing.
- Refer to the Flight Manuals for the fluid applying sequence.
- Do not spray fluid directly on cockpit or cabin windows.
- Do not direct a high-pressure stream of fluid perpendicular to aircraft surfaces, as it could damage them.
- De-icing should be continued until the surface is clean. Anti-icing should be applied in an even thick coat.
- Both wings and both horizontal stabilizers must receive equal and complete de-icing and anti-icing treatment.
- Know what type and concentration level of de-icing/anti-icing fluid has been applied so that you can determine the Hold Over Time (HOT).

WARNING: Even small accumulations of ice on the wing leading edge can change stall characteristics, stall speeds or stall warning margins prior to activation of the stick shaker, and/or pusher. These ice accumulations can also cause angle-of-attack indicator information to be unreliable, and if not removed could ultimately negate stall warning.

Taxiing

- If airport operations/local traffic permits, taxi on the runway. It may have less snow/slush than ramps and taxiways.
- Engine ignition should be "OFF" for taxi, and set as required by the AFM Limitations section for takeoff. Igniters "ON" during taxi may mask an engine problem.
- Nose wheel steering should be exercised in both directions before taxi.
- Avoid large steering inputs while taxiing at higher speeds.
- If it is necessary to taxi on ice, snow, slush, or water, taxi at reduced speed and allow greater distance for braking.
- Maintain greater separation between aircraft while taxiing to aid in stopping, turning and to reduce the possibility of anti-icing fluid being blown from the critical surfaces or snow/slush being sprayed onto your aircraft.
- Do not use high thrust or high taxi speed in order to avoid displacement of applied de-icing/anti-icing fluids.
- During taxi, avoid using reverse thrust on snow or slush-covered runways, taxiways or ramps unless absolutely necessary. Using reverse thrust on snow/slush-covered ground can cause slush and water to become airborne, to be drawn into the engine intakes and to adhere to wings and other critical surfaces.
- If you have been de-iced, or have taxied in snow/slush and the runway is reasonably clear, consider stopping at the end of your taxi for an extra control check before takeoff and removing snow/slush from the landing gear, wheel wells and brakes.

Pre-Takeoff Precautions

- If the aircraft has been de-iced, make sure the Hold Over Time (HOT) has not been exceeded. Refer to the Flight Manuals.
- Snow, slush, or water on the runway will decrease acceleration and increase stopping distance. Runway requirements will be greater than normal balanced field lengths. Refer to the AFM for operations on contaminated runways.
- Make sure that runway conditions are satisfactory at your alternate airport, and be sure to have enough fuel for alternates in the event weather prohibits landing at your destination.

Takeoff Precautions

- Do not take off with frost, snow, or ice on the wings or aircraft control surfaces, including the horizontal stabilizer and elevators.
- If anti-ice systems are required for takeoff, refer to the Flight Manuals for specific procedures.
- Accelerating the engines for a short period before takeoff can better ensure engine fan de-icing. Engine and wing anti-ice should always be “ON” for takeoff when the Outside Air Temperature (OAT) drops below a certain threshold and there is visible moisture in any form, or surface snow, ice, standing water or slush. Refer to the AFM for the detailed procedures. (NOTE: this is NOT applicable to Learjet 60/60XR - refer to Learjet section of the Appendix).
- When Type II, III and IV fluids are used, the wing anti-ice should be switched “ON” prior to increasing thrust for takeoff. Operation of the system during taxi may cause the Type II, III or IV fluid to dry and leave deposits on the wing surfaces.

After Takeoff

- After takeoff from a snow-covered or slush-covered runway, if possible, delay retracting the landing gear to allow residual slush to be thrown or blown off.

In-Flight Precautions

- Keep informed of changing weather at destination and alternate.
- Avoid holding in icing conditions longer than necessary.
- Use anti-ice systems before entering icing conditions (i.e. don't wait until ice has accumulated before selecting the anti-ice system “ON”).
- Anticipate the need for engine/nacelle anti-ice at all times, especially during low speed hold or approach in Instrument Meteorological Conditions (IMC) or during flight through precipitation.

Landing Precautions

- The aircraft should be flown to a firm touchdown.
- Immediately after main wheel touchdown, lower the nose wheel to the runway to enhance directional control.
- Maintain directional control with the rudder as long as possible and use nose wheel steering with great care.
- Anticipate skidding and hydroplaning to occur, be prepared to make necessary corrections.
- Do not attempt to steer off the runway until speed has been reduced to a manageable level.
- During the landing roll and subsequent taxi, use the brakes to prevent progressive build-up of ice on the wheels and brakes. (NOTE: this is NOT applicable to Learjet 45/75 - refer to Learjet section of the Appendix)
- Let the anti-skid system do its work. Do not “pump” brake pedals. The anti-skid system will monitor the onset of tire skidding and modulate brake pressures to achieve maximum braking.

After Clearing Runway

- To prevent possible damage to flaps and wing trailing edges, when landing in heavy slush, do not retract flaps until after-landing inspection and removal of any slush has been accomplished.

Shutdown, Post-Flight and Parking

- Aircraft parking in the hangar is recommended during extreme cold weather conditions.

When the aircraft must be parked outside in extremely cold or fluctuating freeze/thaw temperatures perform the following in addition to the normal shutdown and post-flight procedures:

- Park the aircraft on a clear or sanded spot and into the wind if possible.
- The use of engine covers is recommended as it will reduce the risk of snow and ice accumulation inside the intake and exhaust.



Aircraft parked without engine covers, allowing snow/ice accumulation inside the engine.

- Installation of aircraft protective covers is also recommended.
- Remove ice, snow, and dirt from slats/flaps and slat/flap tracks before retracting.
- Snow should be removed from parked aircraft at regular intervals to prevent a large build-up, and possible freezing to the aircraft surfaces.
- Chock main gear wheels before releasing parking brake. Do not leave aircraft parked for extended periods in subfreezing weather with parking brake set.
- Remove ice, snow, and dirt from landing gear shock struts and wheel wells. Check gear doors, switches, wheels and tires.
- Following takeoff or landing on wet, snow or slush-covered runways and taxiways, tires should be inspected for flat spotting prior to the next flight.
- Aircraft parked and exposed to cold temperature for a period of 1 hour or more should have tire pressure checked and adjusted accordingly.
- An important fact to remember is that every 3°C (5°F) change in temperature will result in a corresponding 1% change in tire pressure.

NOTE: Do not reduce the inflation pressure of a cold tire that is subjected to frequent changes in ambient temperature.

- When tires will be subjected to ground temperature changes in excess of 27°C (48°F) because of a flight to a different climate, inflation pressures should be adjusted for the worst case prior to takeoff. The minimum required inflation pressure must be maintained for the cooler climate; pressure can be readjusted in the warmer climate. Before returning to the cooler climate, adjust inflation pressure for the lower temperature.
- If the aircraft is to remain in subfreezing temperatures for an extended period, water and toilet systems are to be serviced as per Aircraft Maintenance Manual (AMM) requirement.
- Flight crews should familiarize themselves with the instructions and tooling necessary to purge the water system and refer to maintenance and applicable Supplemental Maintenance Manuals (SMM).
- If the aircraft will be exposed to extremely cold temperatures for an extended period, it is recommended that the batteries be removed and stored in a warm area if possible.

NOTE: when using Type II, III and Type IV anti-icing fluid, in aerodynamically quiet areas, cavities and gaps, any fluid that collects will not be sheared and may stick to the aircraft. These fluids, if not cleaned off, will gel, dry out, and eventually become a powder. There have been cases of this gel or powder re-hydrating during subsequent anti-ice procedures or in rain/snow conditions and swelling to greater than its original size. This substance can freeze and possibly interfere with flight controls. It is recommended to clean at the earliest convenience.

Final Thoughts

- When operating in cold weather conditions, Flight Crews, Operations and Maintenance personnel must always pay particular attention to the hazards imposed by the weather. Always remember to “play it SAFE, play it CLEAN”.



APPENDIX

PLATFORM SPECIFIC RECOMMENDATIONS

LEARJET SERIES

CHALLENGER 300 & CHALLENGER 350

CHALLENGER 600 SERIES

GLOBAL SERIES

REFERENCES

BOMBARDIER CONTACTS





LEARJET SERIES

Pre-Taxi Precautions - Learjet 31/31A, Learjet 35/36, Learjet 45/75 and Learjet 55 Series

- Exceeding idle power with oil temperature below 30°C (86°F) is not recommended. However, if ambient temperature prevents attainment of 30°C (86°F), idle power may be exceeded, as required, to further warm the oil to normal operating limits prior to takeoff.
- Remember that you may need to operate the engines a minimum of three minutes to bring the hydraulic system up to normal operating temperature.

Ramp De-icing/Anti-icing Procedures - Learjet 45/75

- Learjet 45/75 - Operation of the APU during fluid de-icing is prohibited. It is also recommended that the application of de-icing /anti-icing fluid be carried out with the engines shutdown.

CAUTION: Do not allow de-icing fluid to come in contact with the brakes.

Taxiing - Learjet 60/60XR Only

- Do not operate nacelle heat system:
 - for more than 5 seconds when the associated engine is not running.
 - for more than 30 seconds when static air temperature is above 15°C (59°F).
- Except for takeoff, do not operate nacelle heat system when engine RPM is greater than 65% N1.

Taxiing - Learjet 45/75 Only

CAUTION: Very light braking or dragging the brakes may not warm all four brakes evenly and can cause excessive brake wear.

In-Flight Precautions - Learjet all A/C except Learjet 45/75

- Wing heat bleed air exits overboard through the center wing/wheel well area. If takeoff was made from a snow or slush covered runway, activation of wing heat for approximately 10 minutes may help clear moisture from the wheels and brakes.
- On aircraft with radome anti-icing, do not forget to use anti-icing in climb and descent to prevent radome icing.

In-Flight Precautions - Learjet 60/60XR

- It is not recommended to turn "ON" the Anti-Ice system at high engine power settings. Engine power settings should be reduced below Take-Off and MCR power settings prior to turning "ON" the Anti-Ice system. Allow the bleed air system to stabilize prior to returning the engines to high power settings.

Landing Precautions

- For landing on a slippery runway, minimum ground roll can be realized when the following procedure is used:
 - Final Approach Speed - VREF.
 - Make firm touchdown and extend spoilers immediately after touchdown.
 - Brakes - as required.

NOTE: The anti-skid system will automatically modulate wheel brake pressure to prevent skids and provide maximum braking for any runway surface condition.

- Crew masks should be stowed in a heated room or the cabin should be warmed to at least -6.7°C (20°F) before flight.
- Bombardier Customer Support has received reports of salt type de-icing products being applied in Eastern Europe as well as other locations. After an aircraft is exposed to them, corrosion is a concern, especially in the wheel well areas. The best way to control this is by adhering to the corrosion control program which is launched via an unscheduled maintenance item in Chapter 5-50-00 of the AMM, "Aircraft operations with-in salt influenced environments". This directs one to cleaning instructions for removal of residue from those runway de-icing products and application of corrosion preventative compounds, as a corrosion preventative measure.



CHALLENGER 300 CHALLENGER 350

Ramp De-icing/Anti-icing Procedures

- The APU must be shut down during the de-icing/anti-icing procedures.
 - With the APU running, ingestion of de-icing fluid will contaminate the air-conditioning system and cause objectionable fumes and odors to enter the airplane. This may also cause erratic operation and possible damage to the APU.
 - To prevent smell or fumes from entering the cabin after de-icing, it is recommended to leave the APU bleed "OFF" for takeoff, climb and cruise.
- Application of fluids should follow the sequence below:
 - 1 - Horizontal stabilizer
 - 2 - Vertical stabilizer
 - 3 - Top of fuselage
 - 4 - Sides of fuselage
 - 5 - Wings
- Flaps should be set to 30 degrees. After completing de-icing/anti-icing, retract flaps to zero or set for takeoff as applicable.
- Stab Trim should be positioned to 0 (aircraft nose down) to avoid de-icing fluid from draining into the APU inlet.
- The flight controls on the Challenger 300/Challenger 350 are hydraulically powered, except for the ailerons. The mechanical portion (cables, pulleys, quadrants etc.) could be affected by re-hydrated fluids, so care should be taken during periods of repeated use of Type II, III and Type IV anti-icing fluids. During these periods of repeated use of anti-icing fluids, periodically wash the aircraft with hot water or a diluted Type I fluid to rinse off any residual anti-icing fluids. Both the top and bottom surfaces of wings, stabilizers and flight controls must be cleaned, with particular attention paid to flight control hinge points. This can be part of a two-step de-icing/anti-icing procedure when using hot water or diluted Type I fluid to de-ice.

Taxiing

- Whenever possible, taxi on snow or slush covered surfaces should be accomplished with the flaps up. Do not accomplish takeoff checklist until flaps are extended to takeoff setting.
- If conditions exist that could result in water-saturated brakes, perform seven consecutive brake applications from 20 knots to 5 knots. Perform the brake applications during the last mile/kilometer of taxi prior to and not including the final stop or snub before takeoff; do not drag the brakes. Warming of the brakes will preclude the chance of water-saturated brakes freezing at altitude and being locked for touchdown.

CAUTION: Very light braking or dragging the brakes may not warm all four brakes evenly and can cause excessive brake wear.

- Use both engines for taxi on slippery surfaces. Directional control may be difficult to maintain during one-engine taxi on a slick surface.
- The engine anti-ice system must be “ON” when:
 - the OAT is 10 °C (50 °F) or below and visible moisture in any form is present (such as fog with visibility of 1,500 m (one mile) or less, rain, snow, slush, sleet, and ice crystals)
 - the OAT is 10 °C (50 °F) or below when operating on runways, ramps, or taxiways where surface snow, ice, standing water, or slush is present.

Takeoff Precautions

- The wing anti-ice system must be “ON” for takeoff when:
 - the OAT is 5 °C (41 °F) or below and visible moisture in any form is present (such as fog with visibility of 1,500 m (one mile) or less, rain, snow, slush, sleet, and ice crystals).
 - the OAT is 5 °C (41 °F) or below and the runway is contaminated with surface snow, slush or standing water.

In-Flight Precautions

- Flaps should not be extended for holding in icing conditions.

Shutdown, Post-Flight and Parking

- For detailed steps to purge the potable water and waste system and prevent damage to system components, refer to the Supplemental Maintenance Manual (SMM) Task 12-31-50-610-801 - Configuration for Cold Weather.
- For the landing gear, Messier-Dowty Inc. has released a service letter (M-DT SL100-32-003 Rev.1, 2013-01-13) with information pertaining to the effects of environmentally-friendly Runway De-Icing (RDI) fluids on the cadmium-protected components. They recommend cleaning and lubrication of the landing gears at the earliest convenience after operation in such an environment.
- Goodrich Corporation has released a service letter (SL 2095, Rev. 1, 2009-12-22) with instructions for inspecting the brakes for evidence of catalytic oxidation and procedures if catalytic oxidation is found. The Aircraft Maintenance Manual (AMM) has been revised in accordance with this service letter. It contains instructions on how to inspect the brakes for catalytic oxidation at every wheel change.



CHALLENGER 600 SERIES

Exterior inspection

- In addition to the visual check, a tactile check of the wing leading edge and wing rear upper surface should be done during the external walk-around inspection to determine that the wing is free of frost, ice, snow or slush when:
 - The outside air temperature is 5°C (41°F) or less, or
 - It cannot be determined that the wing fuel temperature is greater than 0°C (32°F) and there is visible moisture (rain, drizzle, sleet, snow, fog, or water) present on the wing, or
 - The difference between the dew point temperature and outside air temperature is 3°C (5°F) or less, or
 - The atmospheric conditions have been conducive to frost formation.

Pre-Taxi Precautions

- **Challenger 604 & Challenger 605** - Some operators have reported engine start failure during cold weather. If there is no evidence of engine rotation, then it is suspected that the Air Turbine Start Valve (ATSV) remains closed due to freezing. The Operating Manuals (FCOM/OM) state that “during cold weather operation it may be necessary to use ground heating to warm the ATSV”.

Taxiing

- If taxi is to be accomplished through slush or snow, use the brakes to create some friction-induced heating of the brake discs to prevent the brakes from freezing.
- If conditions exist that could result in water-saturated brakes, perform 7 consecutive brake applications from 20 knots to 5 knots. Perform the brake applications during the last mile/kilometer of taxi prior to and not including the final stop or snub before takeoff; do not drag the brakes. Warming of the brakes will preclude the chance of water-saturated brakes freezing at altitude and being locked for touchdown.

Pre-Takeoff Precautions

- The wing anti-ice system must be selected to “ON”, for final taxi prior to takeoff, if the OAT is 5°C (41°F) or below, unless Type II, III or IV anti-icing fluids have been applied. Single engine taxi operations are prohibited in these conditions. L (R) WING A/ICE caution messages may be posted or L HEAT or R HEAT lights may go out during taxi but caution messages must be verified out and WING A/ICE ON or WING/COWL A/ICE ON advisory message and L HEAT and R HEAT lights must be verified on, prior to takeoff. If wing anti-ice is not required for takeoff it should be selected “OFF” just prior to takeoff.
- The Engine Cowl Anti-ice System must be “ON” when (refer to the applicable AFM operating limitations):
 - the OAT is 10 °C (50 °F) or below and visible moisture in any form is present (such as fog with visibility of one mile or less, rain, snow, slush, sleet, and ice crystals)
 - the OAT is 10 °C (50 °F) or below when operating on runways, ramps, or taxiways where surface snow, ice, standing water, or slush is present.
- Use the Wing Anti-ice system when the on-ground OAT is 5°C (41°F) or below, and any of the following conditions is met (refer to the applicable AFM operating limitations):
 - visible moisture in any form (such as clouds, fog or mist) is present below 400 feet above ground level, or
 - the runway is wet or contaminated, or
 - in the presence of any precipitation.

Takeoff Precautions

- Pilots should be aware that during the takeoff roll, anti-ice fluid on the fuselage can flow back and a small amount may enter the APU intake. This can sometimes lead to an objectionable cabin odor for a short period if bleed air for the ECS is being provided by the APU. If the odor persists, the Smoke/Fire/Fumes procedures should be actioned as appropriate.

In-Flight Precautions

- Using Cowl Anti-ice and Wing Anti-ice Systems affects engine and airplane performance. It is recommended that operators familiarize themselves with the AFM Ice and Rain Protection and the AFM Chapter 6: PERFORMANCE, for applicable factors.

Shutdown, Post-Flight and Parking

- Messier-Dowty has issued a Service Letter giving maintenance instructions for landing gear in contact with runway de-icing products. This Service Letter provides recommendations in terms of landing gear cleaning after operation in snowy environment. It is recommended that operators familiarize themselves with this Service Letter ref. M-DT SLCL600/601/604/605/850-32-5, Initial Issue: Jan 20, 2010.
- Meggit Aircraft Braking Systems has issued a Service Letter giving maintenance instruction for the correct protection of the carbon disk stack when the wheel is removed and when the aircraft is washed or de-iced. It is recommended that operators familiarize themselves with this Service Letter ref. GS-SL-41.
- For detailed steps to purge the potable water and waste system and prevent damage to system components, refer to the Supplemental Maintenance Manual (SMM) Task 12-31-50-610-801 - Configuration for Cold Weather.



GLOBAL SERIES

Ramp De-icing/Anti-icing Procedures

- If the APU is running, stab trim should be positioned to 0 (aircraft nose down) and rudder trim full left to avoid de-icing fluid from draining into the APU inlet.
- Application of fluids should follow the sequence below:
 - 1 - Horizontal stabilizer
 - 2 - Vertical stabilizer
 - 3 - Top of fuselage
 - 4 - Sides of fuselage
 - 5 - Wings

NOTE: On wings and stabilizers, application should always be from leading edge to trailing edge and from outer panels to inner panels

Taxiing

- If operating from runways and taxiways with standing or puddle water or snow-covered or slush covered, use sufficient brake applications during taxi to warm the brakes to approximately 4 units BTMS prior to takeoff. This will preclude the chance of water-saturated brakes freezing at altitude and being locked for landing touchdown.
- In all freezing or near freezing precipitation conditions, up to 10 °C (50 °F) or below, operate engines with cowl anti-ice "ON".
- Re-check full and free movement of the flight controls to ensure that no contaminants have impeded the movement of any control surfaces.
- Whenever possible, taxi on snow or slush covered surfaces should be accomplished with the flaps up. Do not accomplish takeoff checklist until flaps are extended to takeoff settings.

In-Flight Precautions

- Do not hold in icing conditions with slats extended.
- In icing conditions use landing and taxi lights, where practical, to minimize ice accumulation on that portion of the wing leading edge.
- For the last leg of the day and if the aircraft is to be parked outside in subfreezing conditions, consider purging the water system in flight before landing. It is also recommended to perform a line purge following the water system purge.

Landing Precautions

- Use maximum reverse thrust as soon as possible after touchdown. Thrust reversers are most effective at high speed. At low speed, minimize the intensity and duration of reverse thrust, however, maximum reverse thrust may be used to a complete stop in case of an emergency situation.

CAUTION: Use of thrust reversers on snow covered surfaces can create a white-out situation which can compromise the safety of the airplane and the passengers.

- Lower the nose wheel immediately and hold light forward control column pressure.
- When landing, carry out a positive landing to ensure initial wheel spin-up and breakout of frozen brakes if icing has occurred.

Shutdown, Post-Flight and Parking

- On aircraft 9002 to 9169 that have UV filters type NPS-A3, the units must be removed if the aircraft is to be parked in subfreezing conditions for prolonged period of time. Water inside the units can freeze and expand resulting in water leakage inside the aircraft.
- If the water system has not been purged during flight, perform a system purge. It is also recommended to perform a line purge following the water system purge.
- In order to prevent the possibility of water freezing the handrail's telescoping tubes, it is recommended to remove any standing water from the passenger door handrails with a cloth before closing it. Routine lubrication of the handrail telescopic struts in accordance with AMM Task 12-22-00-640-837 should help minimize the potential of water/ice adhering to the handrail as well as keep the handrails moving freely.
- For the landing gear, Messier-Dowty Inc. have also released a service letter (MD-T SL700-32-010) with information pertaining to the effects of environmentally-friendly Runway De-Icing (RDI) fluids on the cadmium-protected components. They recommend cleaning and lubrication of the landing gears at the earliest convenience after operation in such an environment.
- Goodrich Corporation has released a service letter (SL 2095) with instructions for inspecting the brakes for evidence of catalytic oxidation and procedures if catalytic oxidation is found. The Aircraft Maintenance Manual (AMM) has been revised in accordance with this service letter. It contains instructions on how to inspect the brakes for catalytic oxidation at every wheel change.

REFERENCES - ALL PLATFORMS

Please refer to and be familiar with the information contained in the AFM, Ground De-Icing/Anti-Icing addendum, and in the Chapter 12 of the AMM.

For water system purge and cabin related topics, refer to the cabin handbook and Supplemental Maintenance Manual (SMM)

During winter, flight crew and maintenance personnel must pay particular attention to the hazards imposed by the season. The following additional information is available for your reference.

Icing Precautions and Procedures

The following precautions and procedures regarding use of ANTI-ICING/DE-ICING fluids and ICING PRECAUTIONS in general are drawn from, but do not supersede, the relevant aircraft manuals.

Classification and Use of Type I / II / III / IV Fluids

- Type I de-icing fluids provide minimal anti-icing capability, leading to very short holdover times. Type I fluids are generally used heated, either diluted with water, or as supplied in concentrated form depending on the outside air temperature.
- Type II anti-icing fluids provide longer holdover times. Type II fluids may be used in the concentration supplied or be diluted with water depending on outside air temperature.
- Type III has a longer holdover time than Type I but a lower viscosity than Type II or Type IV. The application procedure for Type III fluid is the same as the application procedure for Type II and Type IV fluids.
- Type IV anti-icing fluids provide greater protection than Type II in most circumstances.

Infrared De-icing Systems

- Bombardier Aerospace accepts the use of the Infrared Energy De-icing System as a de-icing method. However, since the Infrared Energy System can support only the de-icing process, aircraft requiring anti-icing protection will still need the application of an appropriate anti-icing Freezing Point Depressant (FPD) fluid.
- Infrared de-icing is acceptable for use on aircraft when it follows the acceptable industry standard practices, such as SAE ARP 4737, and conforms to the applicable FAA documents, such as FAA Advisory Circular No. 150/5300-14B, and Advisory Circular No. 120-89.
- When de-icing the aircraft using the Infrared Energy System, make sure to obey all safety precautions as stated in SAE ARP 4737.
- When applicable, the Flight Crew Operating Manual (FCOM) and Aircraft Maintenance Manual (AMM) have been revised to include instructions for Infrared Energy De-icing.

Effects of Environmentally-Friendly Runway De-icing Fluids

In recent years, new environmentally friendly RDI (Runway De-icing) fluids which contain potassium formate, acetate and other alkalis have been introduced at airports in different parts of the world. These products contribute to heightened in-service reports attesting to aircraft landing gear and undercarriage equipment/metal corrosion and related electrical component malfunctions. They also work as a carbon oxidation catalyst which can lead to carbon disk deterioration and failure.

Basic aircraft actions for mitigating the effects of these RDIs include:

Landing Gear

Clean and lubricate the landing gear per applicable AMM procedures at the earliest convenience after operation in such an environment.

Carbon Brakes

Operators should be aware of the EASA (Information Bulletin No. 2008-19R2), FAA (SAIB NM-08-27R1) and TC (Service Difficulty Advisory AV2009-03) publications pertaining to the effects of environmentally friendly RDI fluids. As already contained in the AMM, these publications suggest performing a visual inspection of the brake unit at each tire change for obvious damage, distortion, missing elements or corrosion on aircraft operated to/from airports using RDI fluids.

General Airframe

- Aircraft soap-water washing, fresh water rinse and re-lubrication. This includes, but is not limited to wheel wells, wing trailing edge and undercarriage areas exposed to runway de-icing fluids.
- Increased frequency of inspection/application of protection of electrical equipment and connectors.
- Maintain the aircraft anti-corrosion protections, example: paint primer and corrosion inhibit compound condition etc.

All Business aircraft platforms are currently working on adding an inspection and cleaning procedure for undercarriage area that is exposed to runway de-icing fluids. New AMM procedures will be available in Q4 2014. The Learjet platform has airframe cleaning and restoration procedures already incorporated in maintenance publications (refer to AMM chapter 5, Unscheduled Maintenance Checks).

Highlights on 2014-2015 Holdover Times (HOT) Guidelines and Tables

The following is a summary of the significant changes made this year by Transport Canada and the Federal Aviation Authority to the 2014-2015 HOT publications. Of course, the full document should be consulted for changes specific to your own operations. Unless otherwise noted, the comments below consider both TC and FAA publications.

• Clarification for use of Type I Fluids on Composite Surfaces

Based on this guidance, BA considers that the "aluminum" data should continue to be used for our aircraft.

• Additional guidance for Snowfall Intensity and Visibility

Specifically, it is stated that Runway Visual Range (RVR) is not permitted for use in determining HOT.

• Ice Pellets and Small Hail

Small hail is considered equivalent to moderate ice pellets and is added to the HOT and allowance time tables.

- **Deployed Slats and Flaps**

Deployed slats and flaps will in practice result in reduced Hold Over Times.

- Transport Canada continues to recommend that slat and flap deployment be delayed in order to reduce the impact of this effect.
- FAA recommends that slat and flap deployment be delayed “as close to departure as safety allows”. FAA also requires that if this is not done, then reduced HOT data must be applied.

Definitions

- **DE-ICING** is a procedure by which ice, snow and/or frost is removed from the aircraft by applying hot water or a hot mixture of water and de-icing fluid. De-icing may also be conducted by mechanical means for the removal of loose snow or contaminants from the airframe.
- **ANTI-ICING** consists of the application of an anti-icing fluid after de-icing at recommended concentration levels to the aircraft surfaces to protect against the accumulation and adherence of ice, snow and/or frost. Prior to application of anti-icing fluids the surfaces must be free of any accumulation of ice, snow and/or frost.
- **ONE-STEP DE-ICING/ANTI-ICING** consists of the application of a mixture of anti-icing fluid and hot water at the recommended concentration level necessary to provide a freezing point 10°C (18°F) below ambient temperature. This application takes into account the prevailing weather conditions, and removes ice, snow, and/or frost from the aircraft’s surfaces and protects those surfaces from further contaminant accumulation for a limited duration.
- **TWO-STEP DE-ICING/ANTI-ICING** consists of de-icing with hot water only or a mixture of hot water and de-icing fluid, followed closely by an application of anti-icing fluid. Care must be taken not to allow the aircraft surfaces to re-freeze between the de-icing and anti-icing processes. To delay re-freezing, the de-icing fluid concentration should provide a freezing point not more than 3°C (5°F) above ambient temperature. If hot water alone is used the ambient temperature must be not less than - 3°C (27°F) and particular care should be taken against the possibility of refreezing on cold aircraft surfaces.
- **HOLDOVER TIME (HOT)** is the estimated time a de-icing/anti-icing fluid will prevent ice, snow, and/or frost from forming or accumulating on the treated surfaces of an aircraft. The protection time is dependent upon the ambient and surface temperature, the type and intensity of precipitation and the type and concentration of fluid. Refer to Chapter 12 of the AMM for instructions and approximate holdover times. Reference to cold weather operations can also be found in the FCOM, Volume 1, Operating Limitations and the Supplements chapter. The Holdover Time obtained from the tables is only a guide to the expected safe period; flight crews should be aware of other factors, such as wind speed and direction, which can adversely affect anti-icing fluid performance.

Bombardier website

In addition to our annual newsletter, Bombardier is pleased to announce the availability of a website dedicated to supporting our customers in continuing to operate safely in winter conditions. Please visit the following web address to obtain details on a range of training and awareness materials being made available free of charge.

<http://www.batraining.com/elearning/freecourses>

- Winter Operations Awareness - Takeoff Safety Enhancement
- Ice Awareness: Preflight Considerations
- HOT Holdover Time Guidelines

Learjet 40/45/XR & Learjet 60/60XR Smart Card Handbook

De-icing Guidelines for the Learjet 40/45/XR and Learjet 60/60XR aircraft models have been created and are part of the Smart Card Handbook. Handbooks are available for ordering through Technical Publications at: lj.tech.pubs.orders@aero.bombardier.com

De-icing/Anti-icing Application Guide and Water Service Reference Guide

Available for download on Bombardier's CIC website > Technical Library > [Quick Reference Cards](#)

Federal Aviation Administration (FAA)

A winter operations reference page can be found at the following link:

[FAA AC 120-89 - Ground De-icing Using Infrared Energy](#)

[Holdover Times \(HOT\) Guidelines](#)

[FAA SAFO 06002](#)

[FAA SAFO 09004](#)

Transport Canada

[Holdover Time \(HOT\) Guidelines](#)

[De-icing/Anti-icing Fluids](#)

For any other information contact: <http://www.tc.gc.ca/eng/contact-us.htm>

Email: questions@tc.gc.ca

European Aviation Safety Agency (EASA)

You can find some information on the EASA website at:

<http://ad.easa.europa.eu/search/sib-docs/simple>

Civil Aviation Authority (CAA) focal points for winter operations and icing:

A winter operations reference page can be found at the following link:

[Winter Operations](#) > Operations & Safety > Airport Safety > Winter Operations

National Aeronautics and Space Administration (NASA)

A tutorial is available on the NASA website that gives operational guidelines for cold weather operations.

<http://aircrafticing.grc.nasa.gov/courses.html>

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