CESSNA CARAVAN

Cessna
A Textron Company

1000 *Count On It!*

Caravan

Cold-Weather Operations

September 1998

Caravan Cold-Weather Operations

Table of Contents

Forward

Since the first Caravan's Captain Course Seminar in 1993, additional experiences have been shared with us by our operators in dealing with cold weather encounters. From extreme Siberian climates to those of Canada, each bit of information has been retained and readied to share with all that may experience cold weather environments.

The information collected since the last seminar has been compiled into a revised Cold Weather Operations Manual. Additional topics have been added that we feel will strengthen and broaden cold weather knowledge for Cessna operators as well as the aviation community in general.

Updating important techniques and procedures to ensure the safest and most reliable operation of the Caravan Fleet is continuous. With your input, we hope to provide the most complete information toward making every flight on-schedule and without incident.

We at Cessna are committed to being reactive to your concerns and proactive as leaders in the industry. Should we bring one of our seminars be in your area, please be ready to share your experiences with cold weather - we are ready to listen.

GROUND OPERATIONS

Parking/Storing

When ice, snow or heavy frost is forecast, the use of a hangar is recommended, where available. In many cases, the use of a hangar would be more economical than the use of a de-icing service.

If the aircraft was stored in a warm hangar, be alert for ice formation when moving aircraft from warm hangar to snow conditions.

If no hangar is available, be alert for snow, ice or hoarfrost on the wings and fuselage. When the aircraft is parked for extended periods make sure that all water and other liquids (including sodas, wine/beer/milk, etc.) are removed from the aircraft and stored in a area in which they will not freeze.

Use engine covers, pitot covers and windshield covers, if extended parking is anticipated. These covers reduce the need to de-ice these areas.

Use chocks. Do not set brakes as they may freeze after exposure to ice or snow.

One operator reported that, upon setting the brakes for parking shortly after landing on a very cold day, the aircraft started rolling. Apparently the brakes had cooled down at a faster than typical rate and released enough to allow the aircraft to move on the inclined ramp. Another good reason to always use chocks when parking.

Remove oxygen masks and personal gear in extreme cold.

Filling fuel tanks at low temperatures then moving aircraft into a warm hangar can cause a fire hazard with fuel expansion and overflow.

Tires will appear to have low pressure in cold weather; use a tire gage and verify pressures. A good rule-of-thumb is that the tire pressure will drop one PSI for every ten degrees F drop in ambient temperature.

When parking the airplane on a slick ramp, position it so that the airplane will not have to make sharp turns during taxiing to exit the parking area. Aiming the airplane directly at a taxi-way will minimize turns and allow for lower power settings which reduce blowing snow and Foreign Object Damage (FOD).

Towing

During the winter months, there are many additional concerns for maintenance personnel. The operation of towing and fueling equipment is one thing which is particularly affected by winter weather. During winter, darkness, reduced visibility, and poor traction are added hazards. Stopping distances are also greatly increased. Maintaining your equipment in good condition helps prevent unnecessary delays or potential accidents.

Use proper tow bar. Have someone in the cockpit. Use proper tow vehicle with chains, when appropriate. Remember, the presence of ice will cause wheel chocks to slide.

Dry snow gives better towing traction than wet snow. The wet snow thaws and refreezes to cause hazardous driving conditions. In any snow, however, heavy traffic or the exhaust from parked vehicles can warm an ice or snow covered ramp and make it wet and slippery. Traction is lost with fast starts that spin the wheels of a vehicle. Make gradual turns and steer smoothly.

Approach the stopping area slowly. Stopping distances on a slick surface can be as much as ten times greater that on dry surface. Try brakes occasionally while driving at slow speeds to get a feel of the roadway and find out how slippery the surface is. If the brakes must be used on a slippery surface, use a fast, light-pumping action. This shortens stopping distances and keeps the vehicle under control.

When towing, there is a tendency for the towed vehicle to jackknife, if brakes are applied suddenly or too hard. On hard-packed snow, apply brakes until wheels start to slide, then release them slightly to slow down and keep the vehicle under control.

Preheating

Preheat is recommended when the ambient temperature is below 0°F (-18°C), apply heat to engines, cabin, and cockpit. Engine preheating is best accomplished by installing the engine covers and directing hot air through the inertial separator exit. (ensure the inertial separator is in BYPASS position) The use of an external pre-heater reduces wear and abuse to the engine and the electrical system. Pre-heat will reduce the viscosity of the oil trapped in the oil cooler, prior to starting in extremely cold temperatures.

With sufficient hose length, the cabin and cockpit area can be warmed through the pilot's or front passenger door. Preheating may be accomplished by propping the cabin door(s) closed as much as possible and shielding the open space with canvas.

Use of a GPU is recommended for starting the engine when ambient temperatures are below 0°F (-18°C). Assure that oil temperature is in the green arc (10°C to 99°C) prior to takeoff. If a start is attempted and the starter will not motor to 12 percent Ng minimum, terminate the start. Advancing the Fuel Condition Lever below 12 percent Ng can be damaging to the engine.

A warm cabin and cockpit prevents fogging-over of instruments and windows from condensation, after crew and passengers board the aircraft. Extremely cold temperatures reduce fuel/water solubility and super-cools any water particles in the fuel, increasing the possibility of fuel system icing. The tank and fuel filter drains should be drained frequently and thoroughly. It is possible for water to settle in the sump and freeze, blocking the drain. Heat should be applied until fuel flows freely. Maintain heat after flow begins to ensure that all particles have melted and collect the drainage in a clear, clean container to inspect for water globules.

After the engine is running, allow enough time to warm instruments and avionics before taxi-out. The cabin can be heated more quickly, after engine start, by using a high idle, ramp and taxi-way conditions permitting, to get maximum bleed air from the engine. However, consider icy taxi-ways and runways as previously mentioned.

GROUND DE-ICING/ANTI-ICING

Complete de-icing/anti-icing procedures may be found in the Caravan Maintenance Manual **Chapter 12, Servicing** and the **Pilot's Operating Handbook (POH) Section 8 Handling, Service, and Maintenance.**

When operating in cold weather conditions, airplane downtime/delays can be minimized by a program of preventive servicing.

* Be aware that some facilities located at warmer geographical locations may not have appropriate de-icing/anti-icing equipment. Calling ahead may save valuable time and money in the event adverse cold weather conditions strike.

De-icing fluid is classified as Type I (De-icing) and Type II and Type IV (Anti-Icing). There are two methods of airplane de-icing. The one-step method of airplane de-icing utilizes only Type I fluid. The two-step approach to airplane de-icing utilizes Type I fluid to de-ice the plane, followed by application of Type II or Type IV fluid to delay the onset of refreezing.

Type I, Type II and Type IV fluids have time limitations before refreezing begins. This time limitation is referred to as "holdover time", and Type II or Type IV anti-icing fluids have a much longer holdover time than Type I de-icing fluids. Because holdover time is highly dependent on a number of factors, charts can provide only approximate estimates. Refer to specific manufacturer's data sheets for holdover times. It remains the responsibility of the flight crew to determine the effectiveness of any de-icing or anti-icing procedures.

CAUTION: TYPE I, TYPE II AND TYPE IV FLUIDS ARE NOT COMPATIBLE AND MAY NOT BE MIXED. ADDITIONALLY, MOST MANUFACTURERS PROHIBIT MIXING OF BRANDS WITHIN A TYPE.

De-icing

De-icing may be accomplished using the ambient temperature available from a heated hangar or by mechanical means using a glycol-based Freezing Point Depressant (FPD) Type I fluid.

> A heated hangar is an excellent option to de-ice airplanes and should be utilized whenever possible. Care must be exercised, however, to ensure that all melted precipitation is removed from the airplane to prevent refreezing once the airplane is moved from the hangar to the flight line.

Type I de-icing fluids are applied in a temperature range from 160°F to 180°F (71°C to 82°C) using a moderate to high pressure washer. Heated solutions of Freezing Point Depressant are more effective than unheated solutions because thermal energy is used to melt the ice, snow or frost formations. Type I de-icing fluids are used in the diluted state, with specific ratios of fluid-to-water dependent on ambient temperature. Type I de-icing fluids have a very limited holdover time.

NOTE: It is the heat of the de-icing fluid that melts ice and snow. The only function of the glycol in the de-icing solution is to lower the freezing point of the fluid which remains on the airplane.

Anti-Icing

Anti-Icing is accomplished by using Type II or Type IV fluids, and their purpose is to delay the reformation of ice, snow or frost on the airplane. This is accomplished by using chemically thickened formulas with pseudo-plastic properties. This feature enables the fluid to form a protective film on treated surfaces of the airplane, and is designed to flow off airplane surfaces at high speeds.

CAUTION: TYPE II AND TYPE IV FLUIDS ARE DESIGNED FOR USE ON AIRPLANES WITH A V_R SPEED OF 85 KNOTS OR GREATER. TYPE II AND TYPE IV FLUIDS ARE USED UNDILUTED AND ARE TYPICALLY APPLIED TO THE AIRPLANE UNHEATED. HOLDOVER TIMES FOR TYPE II AND TYPE IV FLUID CAN VARY WIDELY BASE ON ATMOSPHERIC CONDITIONS. CONSULT SPECIFIC MANUFACTURER'S CHARTS FOR HOLDOVER TIME.

NOTE: Type II and Type IV Fluid may not be readily available at all locations. If this is the case, unheated Type I Fluids may be used for anti-icing, but provide very limited anti-icing protection.

Type II or Type IV anti-icing fluid should be applied within three minutes after de-icing is completed due to the limited holdover time of Type I de-icing fluid. If Type II or Type IV anti-icing fluid has been applied and the airplane has not been dispatched before new ice has formed, the airplane must be completely de-iced again and a second Type II or Type IV anti-icing treatment be applied immediately. **Holdover time starts when application has begun.**

Example of holdover time charts for Type I, Type II or Type IV fluids.

TYPE I FLUID

OAT		Approximate Holdover Times Anticipated Under Various Weather Conditions (hours:minutes)				
°C	°F	FROST	FREEZING FOG	SNOW	FREEZING RAIN	RAIN ON COLD SOAKED WING
0 & Above	32 & Above	0:18-0:45	0:12-0:30	0:06-0:15	0:02-0:05	0:06-0:15
Below 0 to -7	Below 32 to 19	0:18-0:45	0:06-0:15	0:06-0:15	0:01-0:03	CAUTION Clear Ice may require touch for confirmation
Below -7	Below 19	0:12-0:30	0:06-0:15	0:06-0:15		

TYPE II FLUID

OAT		Type II Fluid Concentration Neat-Fluid/Water (% by Volume)	Approximate Holdover Times Anticipated Under Various Weather Conditions (hours:minutes)				
°C	°F		FROST	FREEZING FOG	SNOW	FREEZING RAIN	RAIN ON COLD SOAKED WING
0 & Above	32 & Above	100/0	12:00	1:15 - 3:00	0:25 - 1:00	0:08 - 0:20	0:24 - 1:00
		75/25	6:00	0:50 - 2:00	0:20 - 0:45	0:04 - 0:10	0:18 - 0:45
		50/50	4:00	0:35 - 1:30	0:15 - 0:30	0:02 - 0:05	0:12 - 0:30
Below 0 to -7	Below 32 to 19	100/0	8:00	0:35 - 1:30	0:20 - 0:45	0:08 - 0:20	CAUTION Clear Ice May require touch for confirmation
		75/25	5:00	0:25 - 1:00	0:15 - 0:30	0:04 - 0:10	
		50/50	3:00	0:20 - 0:45	0:05 - 0:15	0:01 - 0:03	
Below -7 to -14	Below 19 to 7	100/0	8:00	0:35 - 1:30	0:20 - 0:45		
		75/25	5:00	0:25 - 1:00	0:15 - 0:30		
Below -14 to -25	Below 7 to -13	100/0	8:00	0:35 - 1:30	0:20 - 0:45		
Below -25	Below -13	100/0 If 7° C (13° F) Buffer is maintained	A Buffer of at least 7°C (13°F) is maintained for TypeII used for anti-icing at OAT below -25°C (-13° F). Consider use of Type I fluids where SAE or ISO Type II cannot be used.				

TYPE IV ANTI-ICE FLUID

OAT		SAE Type IV Fluid Concentration	Approximate Holdover Times Under Various Weather Conditions (hours-minutes)					
°C	°F	Neat-Fluid/Water (Vol%/Vol%)	*Frost	Freezing Fog	Snow	***Freezing Drizzle	Light Freezing Rain	Rain on Cold Soaked Wing
Above 0	Above 32	100/0	10:00	2:00-3:00	0:55-1:40	0:45-1:50	0:30-1:00	0:20-0:40
		75/25	6:00	0:40-2:00	0:20-1:00	0:20-1:00	0:15-0:30	0:10-0:25
		50/50	4:00	0:15-0:45	0:05-0:25	0:07-0:15	0:05-0:10	CAUTION Clear Ice May Require Touch for Confirmation
0 to -3	32 to 27	100/0	12:00	2:00-3:00	0:45-1:40	0:45-1:50	0:30-1:00	
		75/25	5:00	0:40-2:00	0:15-1:00	0:20-1:00	0:15-0:30	
		50/50	3:00	0:15-0:45	0:05-0:20	0:07-0:15	0:05-0:10	
Below -3 to -14	Below 27 to 7	100/0	12:00	2:00-3:00	0:35-1:15	**0:45-1:50	**0:30-0:55	
		75/25	5:00	0:40-2:00	0:15-1:00	**0:20-1:00	**0:10-0:25	
Below -14 to -25	Below 7 to -13	100/0	12:00	1:00-2:00	0:30-1:10			
Below -25	Below -13	100/0	SAE Type IV fluid may be used below -25°C (-13°F) provided the freezing point of the fluid is at least 7°C (13°F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of SAE Type I where SAE Type IV fluids cannot be used.					

Vol - Volume

* - During conditions that apply to aircraft protection for ACTIVE FROST

** - The lowest use temperature is limited to -10°C (14°F)

*** - Use light freezing rain holdover times if positive identification of freezing drizzle is not possible

Aircraft operators are solely responsible for ensuring that holdover timetables contain current data. The tables are for use in departure planning only and should be used in conjunction with pretakeoff contamination check procedures. The time of protection will be shortened in heavy weather conditions. High wind velocity may cause degradation of the protective film.

De-icing and anti-icing procedures must be closely coordinated between the pilot in command and ground crews, and carried out in a timely manner. The first area to be de-iced and anti-iced should be visible from the cockpit and should be used to provide a conservative estimate for subsequent ice accumulations on unseen areas of the airplane before initiating takeoff. Due to weight and CG changes that occur while de-icing the airplane, a tail stand should be used.

De-icing and anti-icing fluids are not intended for use in removing snow deposits. Snow is best removed by mechanically sweeping or brushing it from the airplane structure.

Ultimate responsibility for safety of flight rests with the flight crew, and any decisions to de-ice/anti-ice an airplane must be accomplished under their direct supervision. **A pretakeoff contamination check should be conducted by the pilot in command within 5 minutes of takeoff, preferably just prior to taxing onto the active runway.**

De-icing/Anti-Icing Materials

Currently available Type I, II, and IV De-icing/Anti-icing Fluids are listed in Table 1, 2, and 3:

Table 1. SAE Type I De-icing Fluids and ISO Type I De-icing Fluids

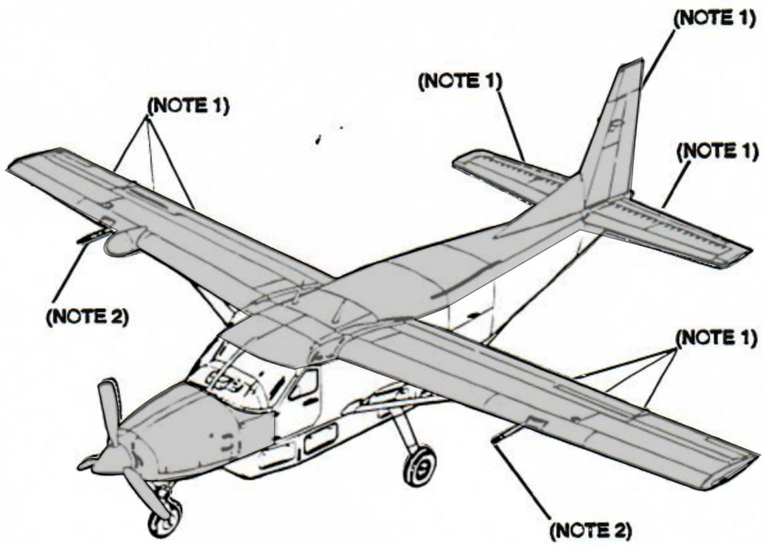
NAME	MANUFACTURER	COLOR	CHEMICAL BASE
UCAR ADF Concentrate	Union Carbide 10235 West Little York Rd. Suite 300 Houston, TX 77040	Orange	Ethylene-glycol
UCAR ADF 50/50	Union Carbide	Orange	Ethylene-glycol
ARCOPLUS Dilute	ARCO Chemical Co. 3801 West Chester Pike Newtown Square, PA 19073	Orange	Propylene-glycol
ARCOPLUS	ARCO Chemical Co.	Orange	Propylene-glycol

Table 2. SAE Type II Anti-Icing Fluids

NAME	MANUFACTURER	COLOR	CHEMICAL BASE
KILFROST ABC-3	ARCO Chemical Co. 3801 West Chester Pike Newton Square, PA 19073	Pale Amber	Propylene-glycol
UCAR UC5-1	Union Carbide 10235 West Little York Rd. Houston, TX 77040	Pale Yellow	Ethylene-glycol
UCAR AAF ULTRA	Union Carbide	Emerald Green	Ethylene-glycol

Table 3. SAE Type IV De-icing/Anti-Icing Fluids

UCAR ADF/AAF ULTRA+	Union Carbide 10235 West Little York Suite 300 Houston, TX 77040	Emerald Green	Ethylene-glycol



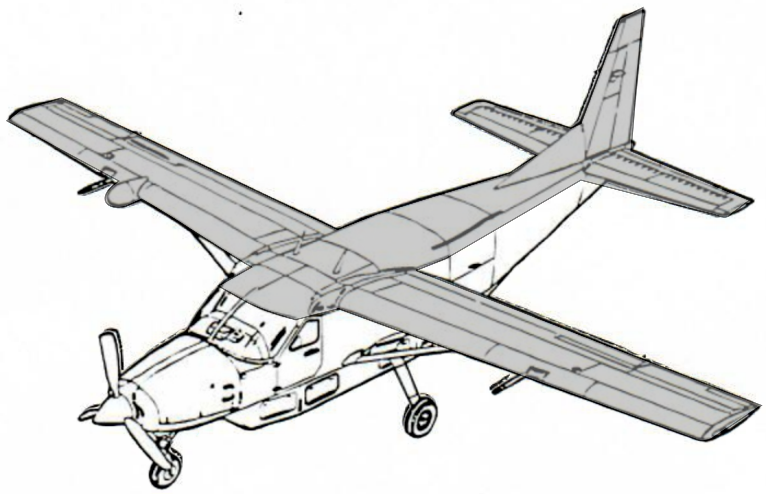
NOTE 1: GIVE SPECIAL ATTENTION TO THE GAPS BETWEEN THE FLIGHT CONTROLS. ALL SNOW, ICE AND SLUSH MUST BE REMOVED FROM THESE GAPS.

NOTE 2: REMOVE SNOW, ICE AND SLUSH FROM PITOT TUBES BY HAND ONLY.

SHADED AREAS INDICATE ESSENTIAL AREAS TO BE DEICED.

DIRECT SPRAY AVOIDANCE AREAS:	ENGINE INLETS AND EXHAUST, BRAKES, PITOT STATIC TUBES, WINDSHIELDS, CABIN WINDOWS, AND STALL WARNING VANE.

Essential Areas to be De-iced

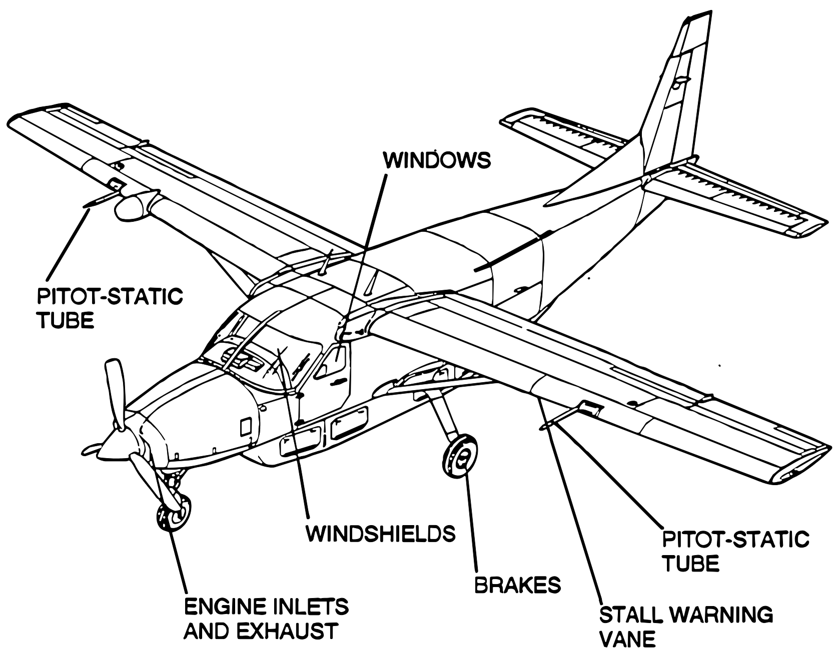


NOTE: ANTI-ICE FLUID SHOULD BE APPLIED AT LOW PRESSURE TO FORM A THIN FILM ON SURFACES. FLUID SHOULD JUST COVER AIRPLANE WITHOUT RUNOFF.

SHADED AREAS INDICATE ESSENTIAL AREAS WHERE ANTI-ICE FLUID IS APPLIED.

DIRECT SPRAY AVOIDANCE AREAS:	PITOT STATIC TUBES, WINDSHIELDS, CABIN WINDOWS, AND STALL WARNING VANE.

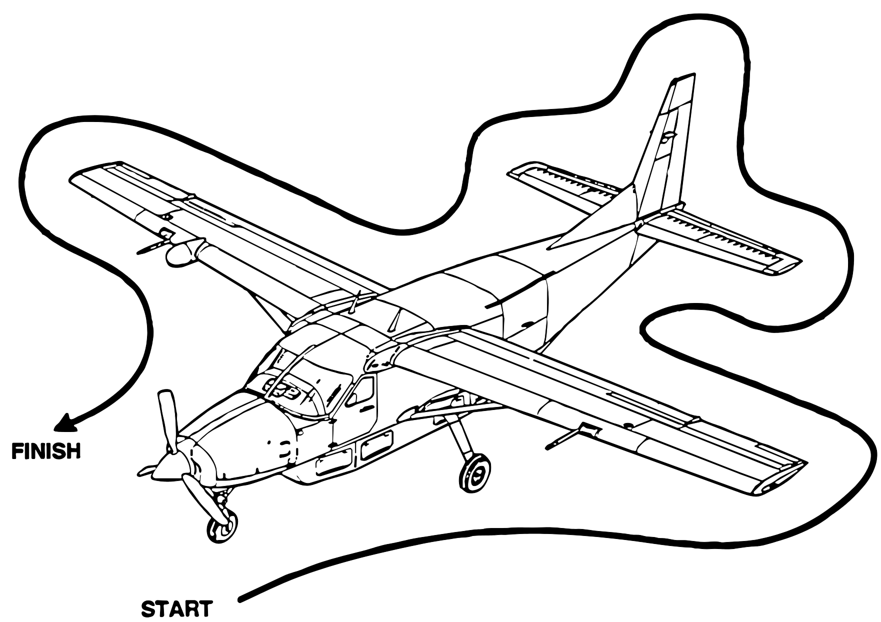
Essential Areas to Apply Anti-ice Fluid



DIRECT SPRAY AVOIDANCE AREAS:	ENGINE INLETS AND EXHAUST, BRAKES, PITOT STATIC TUBES, WINDSHIELDS, CABIN WINDOWS, AND STALL WARNING VANE.

De-ice and Anti-ice Fluid Direct Spray Avoidance Areas

NOTE: BY STARTING DEICE AND ANTI-ICE APPLICATION AT THE LEFT-FRONT AREA OF THE AIRPLANE, THE PILOT CAN GET A CONSERVATIVE ESTIMATE OF ICE REFORMATION FROM INSIDE THE COCKPIT. SINCE THIS WAS THE FIRST AREA DEICED OR ANTI-ICED, IT WILL BE THE FIRST AREA WHERE ICE WILL REFORM.



De-icing and Anti-icing Application

The effectiveness of any Freezing Point Depressant (FPD) de-icing or anti-icing treatment can only be estimated because of the many variables that influence holdover time. Those variables are:

- Ambient Temperature
- Airplane surface temperature
- Freezing Point Depressant fluid application procedure
- Freezing Point Depressant solution strength
- Freezing Point Depressant film thickness
- Freezing Point Depressant fluid temperature
- Freezing Point Depressant fluid type
- Operation in close proximity to other airplanes, equipment and structures
- Operation on snow, slush, wet ramps, taxiways and runways
- Precipitation type and rate
- Residual moisture on airplane surface
- Relative humidity
- Solar radiation
- Wind velocity and direction

Before Type I de-icing procedures begin, maintenance personnel should familiarize themselves with areas to be sprayed and areas to avoid a direct spray of fluid. Refer to Figure 1 for areas to de-iced. Refer to Figure 2 for areas to be anti-iced.

Type I de-icing fluids should never be used full strength (undiluted). Undiluted glycol fluid is quite viscous below 14°F (-10°C) and can actually produce lift restrictions of about 20 percent. Additionally, undiluted glycol has a higher freezing point than glycol/water mixture.

If de-icing/anti-icing procedures are performed with engines running, all cabin air intakes and bleed air valves should be turned off.

It should be understood that even high concentrates provide protection from further adherence of ice, snow or frost for only approximately 15 minutes. A pretakeoff check should be conducted by the PIC/SIC within 5 minutes of takeoff, preferable just prior to taxiing onto the active runway. Critical areas of the aircraft such as the empennage, wing, windshield and control surfaces should be checked to ensure they are free of ice, slush and snow or that the de-ice/anti-ice fluids are still protecting the aircraft.

When Type II or Type IV fluid is applied to the airplane, a rotation speed of **83 KIAS** with **0°** flaps is required. Use of 0° flaps allows the airplane to accelerate to a high rotation speed without any liftoff tendencies, which is required for the Type II or Type IV fluid to be effective. Takeoff performance data shown in Section 5 of the POH is based on this speed and configuration.

Airworthiness Directive 96-09-15 - Icing Conditions

96-09-15 Cessna Aircraft Company: Amendment 39-9591; Docket No. 96-CE-05-AD.
{As corrected at 61-30505}
{As corrected at 61-26425}
Applicability: Models 208 and 208B airplanes (all serial numbers), certificated in any category.

Note 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (d) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless accomplished previously.

To minimize the potential hazards associated with operating the airplane in severe icing conditions by providing more clearly defined procedures and limitations associated with such conditions, accomplish the following:

(a) Within 30 days after the effective date of this AD, accomplish the requirements of paragraphs (a)(1) and (a)(2) of this AD.

Note 2: Operators must initiate action to notify and ensure that flight crewmembers are apprised of this change.

(1) Revise the FAA-approved Airplane Flight Manual (AFM) by incorporating the following into the Limitations Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

* During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions. --Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.

--Accumulation of ice on the lower surface of the wing aft of the protected area. {Was, "--Accumulation of ice on the upper surface...". - Ed.}

{Beginning of old text deleted at 61-30505}

--Accumulation of ice on the propeller spinner farther aft than normally observed.

* Since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions.
* All icing detection lights must be operative prior to flight into icing conditions at night. [NOTE: This supersedes any relief provided by the Master Minimum Equipment List (MMEL).]"

(2) Revise the FAA-approved AFM by incorporating the following into the Procedures Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"THE FOLLOWING WEATHER CONDITIONS MAY BE CONDUCIVE TO SEVERE IN-FLIGHT ICING:

* Visible rain at temperatures below 0 degrees Celsius ambient air temperature.
* Droplets that splash or splatter on impact at temperatures below 0 degrees Celsius ambient air temperature.

PROCEDURES FOR EXITING THE SEVERE ICING ENVIRONMENT:

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in the Limitations Section of the AFM for identifying severe icing conditions are observed, accomplish the following:

* Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.
* Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
* Do not engage the autopilot.
* If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.
* If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.

* Do not extend flaps during extended operation in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.
* If the flaps are extended, do not retract them until the airframe is clear of ice.
* Report these weather conditions to Air Traffic Control."(b) Incorporating the AFM revisions, as required by this AD, may be performed by the owner/operator holding at least a private pilot certificate as authorized by section 43.7 of the Federal Aviation Regulations (14 CFR 43.7), and must be entered into the aircraft records showing compliance with this AD in accordance with section 43.11 of the Federal Aviation Regulations (14 CFR 43.11).

(c) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(d) All persons affected by this directive may examine information related to this AD at the FAA, Central Region, Office of the Assistant Chief Counsel, Room 1558, 601 E. 12th Street, Kansas City, Missouri 64106.

Preflight

Preflight Planning

- Plan the flight to spend the least amount of time possible in the icing conditions. Treat all icing conditions as conditions to be penetrated, not for sustained flight.
- When preflight planning, look for exit routes from the icing conditions. Departures from icing conditions along the route should always be planned for in the event of deteriorating conditions or ice protection system failures.
- Thoroughly de-ice aircraft prior to departure
- Avoid freezing drizzle and freezing rain
- Avoid building cumulus clouds
- Avoid orographic lifting clouds around mountain ranges, they may contain large amounts of moisture
- Avoid the tops of stratus icing clouds, these are likely to contain the most moisture
- Penetrate any suspected or known icing cloud by the shortest possible route. This may be horizontally, vertically, or perhaps a combination of both.
- Stay alert for abnormal performance losses such as unrecoverable speed losses or loss of climb rate. These are cues to depart the icing conditions.
- Disconnect the autopilot periodically to detect any out of trim conditions.
- Maintain minimum speeds in icing conditions.
- Be aware that PIREPS are aircraft dependent. Light icing in a transport category aircraft would likely be reported as moderate or severe in a smaller aircraft.
- Plan extra fuel to offset performance losses due to drag.

Preflight (cont.)

Rapid changes in ceiling, visibilities, freezing levels, winds and runway conditions are typical of winter weather. Additional time must be allotted to preflight planning, with special emphasis on obtaining the latest most complete information concerning field condition, braking-action reports, facility status, weather, alternates and fuel requirements. Allow extra time, also, to complete a more careful walk-around inspection.

- Ensure brakes, windshield, empennage, wings, and flaps are free of snow or ice.
- Ensure engine air inlet, propeller blades and control surfaces are free of snow or ice.
- Ensure critical areas are de-iced. (Refer to Section 8 in the Pilot Information Manual)
- Use GPU after extended cold soak below -18°C (0°F).
- Minimize drain on aircraft battery prior to start.
- Ensure that heavy clothing and plenty of food are on board.

ATC has implemented procedures that provide priority handling when ground icing conditions are present. ATC will provide a hard departure time that will eliminate ground delays. The crew should request a departure slot and be prepared to meet that time.

Taxiing

Reduce taxi speeds on snow or ice and keep engine and taxi operations to a minimum on ice or snow covered ramps. In addition to normal "blasting" dangers when pulling away from ramp, ice or snow being blown about constitutes a hazard to personnel and equipment. Also, be aware your propeller blast may "ice up" adjacent aircraft and ground equipment.

Do not use so much power starting into a turn that the turn cannot be stopped without excessive braking.

Avoid taxiing in deep snow; more power is required, steering is more difficult and there is always the danger of becoming mired down. Also, strain on the gear is increased and snow may lodge in brake assemblies with subsequent freezing. Taxi at slow speeds with caution; remember that braking and nose-wheel steering may be poor or non-existent.

Watch for snow banks, runway or taxi lights, etc. Spotty ice cover on taxi surfaces may be difficult to see at night or during bright sunshine, when the glare of white snow makes it difficult to see. Ice may be covered by a thin layer of light snow. Exercise care when taxiing behind jet aircraft when snow is falling. Heat from jet blast may cause snow to melt and refreeze on your aircraft.

Even though the latest weather reports have not indicated a hazardous runway condition, the approach end of the runway is usually more slippery than other areas because of the melting and refreezing of ice and snow after each aircraft takeoff and landing.

Some of the taxi rules-of-thumb to follow are:

- Allow greater distance between parked aircraft.
- Use care taxiing through snow or near snow banks.
- Snow or slush can freeze up brakes or flaps.
- Check and verify that icing systems are working.
- Ensure pitot heaters are operational and ON before takeoff.

Takeoff and Climb

Advisory Circulars AC91-6A (Water, Slush and Snow on the Runway) and AC91-13C (Cold Weather Operation of Aircraft) provide additional cold weather information.

Check and comply with the requirements of the Adverse Weather Chart. Remember that these are minimum restrictions - feel free to be more stringent, if (in your judgment) it is necessary.

Before takeoff, be sure runway is free of such hazards as snowdrifts, glazed ice and ruts. When taking off from an icy runway, maintain directional control with rudder, rather than depending on nose-wheel steering.

Optimum performance of the de-ice and anti-ice boots is dependent on keeping the boots clean and coated with an ice adhesion depressant such as ICEX II. Snow, slush or standing water may have the viscosity and resistance of molasses. They create wheel drag, which increases takeoff distance considerably.

No attempt should be made to takeoff with a load of ice or snow. Ice and snow on the wings will change the shape of the airfoil and disturb the flow of air over the wings, reducing available lift and airspeeds. Do not assume that light snow will melt or blow off during taxi-out or the takeoff run. Even if it does, it may reveal ice or frost beneath.

Prior to takeoff, as mentioned earlier, ensure that pitot heat is ON and operating. Additionally, engine ignition should be ON. Monitor all applicable anti-icing and de-icing systems as soon as practical. Inertial separator and anti-icing systems should be operated in anticipation of operating in icing conditions.

When setting takeoff power on extremely cold days, make sure that the engine power does not exceed the maximum allowable. Be especially vigilant when setting Torque that the other engine instruments confirm the takeoff power setting.

Remember that maximum icing occurs when OAT is between 0° and -10°C. The cockpit temperature gauge may have errors. Watch those temperatures just above freezing, as well as those below.

When ice accumulation develops, increased thrust (rather than increasing angle-of-attack) should be used to maintain altitude and airspeed. However, if large or continual increases of thrust are required, take alternative action such as leaving the icing environment.

Some of the takeoff/climb rules-of-thumb are:

- Don't go in freezing rain.
- Be aware of runway condition - standing water?
- What is the reported braking action - refused takeoff?
- Is the runway grooved?
- What adverse runway factors should I use? (Consult Airplane POH)

Operating in Icing Conditions

Flight into known icing is the intentional flight into icing conditions that are known to exist by either visual observation or pilot weather report information. Icing conditions exist any time the OAT is +10°C to -30°C, and visible moisture in any form is present. Cessna Caravans, which have properly installed and operating anti-ice and de-ice equipment, are approved to operate in maximum intermittent and maximum continuous icing conditions as defined by FAR 25, Appendix C. The equipment has not been designed to provide protection against freezing rain or severe conditions of mixed or clear ice. During all operations, the pilot is expected to exercise good judgement and be prepared to alter the flight plan if conditions exceed the capability of the aircraft and equipment.

Ice accumulations significantly alter the shape of airfoils and increases the weight of the aircraft. Flight with ice accumulated on the aircraft will increase stall speeds and alter the speeds for optimum performance. Flight at high angle-of-attack (low airspeed) can result in ice building on the underside of the wings and the horizontal tail aft of areas protected by boots or leading edge anti-ice systems. Prolonged flight with the flaps extended is not recommended. Trace or light amounts of icing on the horizontal tail can significantly alter airfoil characteristics which will affect stability and control of the aircraft.

The autopilot may be used in icing conditions. However, every 10 - 15 minutes the autopilot should be disconnected to detect any out of trim conditions caused by ice build up. If significant out of trim conditions are detected, the autopilot should remain off for the remainder of the icing encounter so that the pilot may monitor for additional force build up. Autopilot operation is prohibited when operating in icing conditions that are outside the envelope defined by FAR Part 25, Appendix C.

Aircraft should not depart, continue to operate enroute or land when, in the opinion of the Pilot, icing conditions are expected to be met which might adversely affect the safety of the flight.

> *One of the best ways of determining existing icing conditions along your route is through the pilot report or PIREP. Giving and receiving pilot reports of conditions encountered during flight is valuable information to other pilots and to air traffic controllers assisting in weather avoidance.*

Aircraft shall not takeoff when frost, snow or ice is adhering to the wings or control surfaces.

Aircraft shall not land at an airport where moderate or heavy freezing rain or moderate or heavy freezing drizzle is falling.

The Caravan POH recommended minimum airspeed in sustained flight in icing conditions is as follows:

Caravan **105 KIAS** (Minimizes ice build up on the underside of wings and fuselage)

When holding in icing conditions, the flaps must be up. Autopilot operation is prohibited when operating in icing conditions that are outside the envelope defined by FAR Part 25, Appendix C.

Terminology for reporting the intensity and type of icing

A. **Trace** - Ice becomes perceptible. Rate of accumulation is slightly greater than the rate of sublimation. It is not hazardous even though de-icing/anti-icing equipment is not utilized unless encountered for an extended period of time (over 1 hour).

B. **Light** - The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of de-icing/anti-icing equipment removes/prevents accumulation. It does not present a problem if the de-icing/anti-icing equipment is used.

C. **Moderate** - The rate of accumulation is such that even short encounters become potentially hazardous and use of de-icing/anti-icing equipment or flight diversion is necessary.

D. **Severe** - The rate of accumulation is such that de-icing/anti-icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.

Type of Ice

A. **Rime Ice** - Pure rime; hard, porous, whitish, opaque ice consisting of small grains, air space and frostline crystals. usually forms on the leading edges of wings, tail surfaces, wing struts, engine inlets, antennas, etc.

B. **Clear Ice** - A hard, clear ice; solid. Freezing rain and clear ice will be deposited in layers over the entire surface of the airplane and can "run back" over control surfaces before freezing.

C. **Mix Ice** - A mixture of rime and clear.

Know your systems. Are they de-icers or anti-icers?

Anti-Ice for Caravans

Pitot Tubes
Static Ports
Engine Inertial Separator
Windshield Anti-ice Panel
Stall Warning System
Propeller Anti-ice Boots

De-ice for Caravans

Wing De-ice Boots
Wing Strut De-ice Boots
Horizontal Stab De-ice Boots
Vertical Stab De-ice Boots
Cargo Pod Nose Cap De-ice Boot
Main Landing Gear De-ice Boots

Approach and Landing

Plan Instrument approaches ahead, with respect to minima. Review missed approach procedures. Remember that, with lighting aids inoperative or obscured by snow, minima may be changed.

A slight propeller vibration occurring at the start of the propeller anti-ice ON cycle and lasting 20-30 seconds is due to propeller blade anti-ice shedding characteristics and is considered normal. Rapid cycling of the propeller control lever from 1900 RPM to 1600 RPM and back to 1900 RPM will aid the propeller anti-ice boots in shedding any residual ice.

NOTE

Large changes in performance may occur with ice accumulation. Make appropriate allowances for the possibility of these losses occurring when planning a flight into or through forecast or reported icing conditions.

When making a landing approach using a 10 KIAS higher airspeed than normal, expect a 25% increase in landing distance. Use the engine anti-ice system as recommended in the POH and select continuous ignition, when applicable.

Observe applicable notes in the Performance section of the basic handbook for performance losses associated with the inertial separator in bypass and cabin heat on. If going into icing conditions, use and monitor anti-ice and de-ice systems.

If a landing is performed with flaps up, increase the approach speed by 15 KIAS and allow for 40% longer landing distances and use the conservative runway (if practical).

After a light rime ice encounter, maintain extra airspeed (10-20 KIAS) on approach to compensate for the increased pre-stall buffet associated with ice on the unprotected areas and the increased weight. Under moderate or severe rime icing conditions, limit flap setting to no more than required by available field length. With flaps up, maintain a **MINIMUM** approach speed of **105 KIAS**.

Before Landing – SELECT MINIMUM FLAP SETTING AND MAINTAIN EXTRA AIR-SPEED consistent with available field length. Do not extend flaps during **extended** operation in icing conditions. Operation with flaps extended can result in a reduced AOA, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area. If the flaps are extended, do not retract them until the airframe is clear of ice.

Be aware of the possibility of tail plane icing during the landing approach. Ice formed on the tail plane may be of an amount that will not aerodynamically affect the airplane <u>until flaps are lowered to the approach or landing position.</u> At this time, a downward pitching may occur which must be counteracted by the retraction of flaps to a lesser setting. Judicious use of the anti-icing systems and stabilizing flap settings and airspeed farther out will guard against this danger.

Wind shear on the approach or near the threshold is unpredictable and intensity will vary with wind speed. Wind shear on the tail or letdown tends to produce runway overshoot; on the nose, be alert for a momentary increase in performance and short landing. Surface winds are hazardous because they consist of countless eddies and currents, continually changing in velocity and direction. Unfortunately, the pilot cannot predict the exact wind speed which will be encountered during the approach and landing flare.

The pilot will often find it impossible to judge height above the ground due to snow not serving as a solid reference. Featureless terrain or snow can give the illusion of the aircraft being higher than actual. A runway may be clearly visible from directly above. During the approach, however, the runway may "disappear" because the white runway with its plowed banks and the white terrain all blend together. Visibility is impaired not only from the glare, but the usual visual clues are hard to distinguish. Snow contours are especially difficult to differentiate at night and on heavily overcast days because terrain appears flat. Lighting at night plays tricks, when obscured or reflected by snow moving through the air or lying on the ground.

Drifting snow also reduces visibility. Winds of 9 to 12 mph raise the snow a few feet off the ground, and the blowing snow obscures surface objects such as ruts and runway markers. This is particularly true where there is nothing to break the wind. Winds of 15 mph raise snow high enough to obscure buildings. Fine blowing snow, suspended in the air by winds of 20 mph or more, reflects and diffuses sunlight, greatly reducing visibility.

Whiteout - A visibility restricting phenomenon that occurs in the Arctic when a layer of cloudiness of uniform thickness overlies a snow or ice covered surface. The result is a loss of depth perception that make takeoff or landing on snow covered surfaces very dangerous.

During Landing Rollout – DO NOT USE REVERSE THRUST, unless required, to prevent residual ice on the airframe from being drawn into the propeller.

Leave inertial separator in BYPASS mode after landing to preclude any possible ingestion of ice being shed from internal inlet ducting.

Landing on a slush-covered runway is another problem. The first 200 feet of roll is the most critical, since most airplanes tend to hydroplane at high speeds. Wheel braking during this period would be ineffective because the wheels would not be making contact with the runway. If the airplane should begin to skid or yaw, directional control must be maintained by use of the rudder until the tires make solid contact with the runway surface and begin to maintain control. Then, wheel braking can be used cautiously. Reverse power under skidding conditions can increase the rate at which an airplane slides off the side of the runway.

Because of the relatively low landing speeds, Caravan aircraft are not as susceptible to hydroplaning as some other aircraft. However, hydroplaning can and does occur. In wet-runway conditions, make firm contact landings to break through the water and make firm contact with hard surfaces. Keep tire pressure up and make sure tires have good tread depth.

Wing flaps should generally be raised as soon as practical after touchdown to increase braking coefficient and prevent sideways sliding, due to crosswinds, acting against the flaps. Clear the runway slowly.

Reminders and Checklist items for Approach and Landing:

- If going into icing conditions, use de-ice and anti-ice systems. Monitor anti-ice systems.
- Keep Power UP!

NOTE: Published checklist takes priority over all suggestions

Quick Turnarounds

Ensure all ice is removed from aircraft. Ensure flaps, landing gear, and brakes are free of excess slush or snow buildups.

The decision to takeoff or land, under marginal airport or runway conditions, rests finally with the Captain. It is not a responsibility which can be taken lightly. The Captain must assess the situation based on runway conditions, braking action and wind reports.

AVIONICS, ELECTRICAL AND INSTRUMENT SYSTEM CONSIDERATIONS

Some extreme cold weather conditions to look for are:

1. Sluggish motor movements - all types of analog indication.
2. Sluggish antenna scan - radar
3. Wires become brittle in extreme cold and are easy to break.
4. Possible lack of indications until units have warmed.
5. ON/OFF and volume controls hard to turn.
6. Gyros may take longer to erect (horizontal and vertical).
7. Cockpit indicator lights may be dim, due to poor contacts during extreme cold.
8. Indicator glasses may fog in units not hermetically sealed.
9. Contraction of avionic mounting racks is possible during extreme cold. This can cause multiple intermittent malfunctions in any avionic/instrument system.
10. A cold engine requires more starter torque, and has higher current drain on the battery or GPU.
11. Sluggish operation of start relays and power relays can cause arcing at relay contacts with possible welding of contacts.
12. A warm battery provides some benefit, and the heater hose can be placed in the engine cowl with the door propped close as far as possible to minimize heat loss.

The avionics may require warmup after cold soak. Over twenty minutes may be required at temperatures below -30°C (-22°F). Proper warmup is indicated by the following:

a. Frequency/code displays illuminate normally with pilot control of brightness.

b. Audio reception is available on all applicable avionics. In the absence of a suitable station, background static on each applicable avionics radio is an acceptable demonstration of reception.

Take care in blowing snow that the static ports have not been obstructed or had an ice buildup form around them. Check especially if it has been necessary to brush snow off the fuselage.

Battery connections, engine and other ground wire terminals should be checked regularly for corrosion and/or loose connections.

ENGINE CONSIDERATIONS

Operators report that, in severe cold (-25° to -45°C) the engines can produce blue smoke from the exhaust. Pratt & Whitney says this is a function of the fuel and has no effect on the engine or its performance.

MAINTENANCE PRACTICES

Potential Cold-Weather Operating Symptoms:

A. Mechanical Systems and Components:

1. Hydraulic components develop leaks more rapidly. Nose strut and bottles should be serviced to the top limit in a warm hangar. Cold hydraulic fluid and cold components should operate normally after fluid and components become warmer.

2. Flaps are slow to operate.

3. Hydroplaning.

   Cause: Tires are under-inflated. Service tires to the correct pressure. As operating temperatures decrease, the pressure in tires, struts, and oxygen bottles will decrease. These items must be periodically reserviced.

FUEL ANTI-ICE ADDITIVE CONSIDERATIONS

Fuel Temperatures

Good judgement should be used in determining whether or not the actual fuel temperatures are acceptable for aircraft start, takeoff and enroute operation.

Models 208. 208A. 208B

FUEL GRADE	FUEL SPECIFICATION	MINIMUM FUEL TEMPERATURE FOR TAKEOFF- °C	SPECIFIC WEIGHT (POUNDS PER U.S. GALLON AT 15° C)	COLOR
JET A	ASTM-D1655	-35	6.7	COLORLESS
JET A-1	ASTM-D1655	-40	6.7	COLORLESS
JET B	ASTM-D1655	-45	6.5	COLORLESS
JP-1	MIL-L-5616	-35	6.7	COLORLESS
JP-4	MIL-T-5616	-54	6.5	COLORLESS
JP-5	MIL-T-5624	-40	6.8	COLORLESS
JP-8	MIL-T-83133	-40	6.7	COLORLESS
AVIATION GASOLINE (ALL GRADES) (3)	MIL-G-5572 ASTM-D910	-54	6.0	80/87 Red 100 LL Blue 100/130 Green

Specific fuel temperature operating limits may be found in the applicable Limitations section of the approved Airplane Flight Manual.

Fuel Anti-Ice Additives

Fuel used must contain anti-icing fuel additive in compliance with MIL-I-27686 (EGME), MIL-I-85470 (DIEGME), or Phillips PFA 55MB.

Some fuels such as JP4 and JP5 per MIL-T-5624 and JP8 fuel per MIL-T-83133A contain the correct premixed quantity of an approved type of anti-icing fuel additive and no additional anti-ice compounds should be added.

Minimum starting temperature is that given or the minimum allowable oil temperature (-40°C), whichever is warmer. Starts may be attempted with fuel at lower temperatures providing other specified engine limitations are not exceeded.

ANTI-ICING ADDITIVES CONTAINING Ethylene Glycol Monomethyl Ether (EGME) OR Diethylene Glycol Monomethyl Ether (DIEGME) ARE HARMFUL IF INHALED, SWALLOWED, OR ABSORBED THROUGH THE SKIN, AND WILL CAUSE EYE IRRITATION. ALSO, THEY ARE COMBUSTIBLE. BEFORE USING THESE

CAUTION

ENSURE THAT THE ADDITIVE IS DIRECTED INTO THE FLOWING FUEL STREAM AND THAT THE ADDITIVE IS STARTED AFTER THE FUEL FLOW STARTS AND IS STOPPED BEFORE FUEL FLOW STOPS. DO NOT ALLOW CONCENTRATED ADDITIVE TO CONTACT COATED INTERIOR OF FUEL TANK OR AIRPLANE PAINTED SURFACE. USE NOT LESS THAN 20 FLUID OUNCES OF ADDITIVE PER 156 GALLONS OF FUEL OR MORE THAN 20 FLUID OUNCES OF ADDITIVE PER 104 GALLONS OF FUEL.

Insufficient additive concentrations may result in fuel system icing. Excessive additive may cause fuel tank damage or erroneous fuel quantity indications.

Procedure for Checking Fuel Additive

1. Prolonged storage of the airplane will result in a water buildup in the fuel which "leaches out" the additive. An indication of this is when an excessive amount of water accumulates in the fuel tank sumps.

The minimum additive concentration shall be 0.10 percent by volume and maximum concentration shall be 0.15 percent by volume. Fuel, when added to the tank, should have a minimum concentration of 0.10 percent by volume.

Fueling Note: Some operators have reported that when over-the-wing fueling is used and the fueling equipment incorporates automatic anti-ice additive dispensing, fueling at lower flow rates may not properly dispense the additive. Proper dispensing of the additive may be verified by the audible "whish" sound heard indicating the additive pump is actuating.

Proper fueling flow rates for aerosol can additive dispensing are specified by the additive manufacturer. For example, the fuel flow rate when using a can of additive meeting MIL-I-27686 (EGME) should be 30-60 GPM (gallons per minute). The fuel flow rate when using a can of additive meeting MIL-I-85470 (DiEGME) should be 30-45 GPM.

Proper mixing of EGME or DIEGME compound with the fuel is extremely important. A concentration in excess of that recommended (0.15 percent by volume maximum.) will result in detrimental effects to the fuel tanks, such as deterioration of protective primer and sealants and damage to o-rings and seals in the fuel system and engine components. Use only blending equipment that is recommended by the manufacture to obtain proper proportioning.

Attach additive to refuel nozzle, making sure blender tube discharges in the refueling stream. Start refueling while simultaneously fully depressing and slipping ring over trigger of blender.

Situational Awareness

One "Buzz" phrase of today's aviation industry. Simply put, to know exactly what your current situation is at all times while exercising your profession. The actions you take may positively or negatively affect your outcome. To anticipate the consequences of your decisions and actions is to be in control of the situation.

Knowing intimately what you and your machine's capabilities are during any operation, not just cold weather, increases your awareness toward a given situation. Complacency could be called the carbon monoxide of any safety-critical profession; odorless, colorless, tasteless-it just sneaks in. However, with a deliberate and conscious effort to be aware of what is going on around us, complacency can be thwarted.

Know yourself, your machine, and your situation at all times. Leaving yourself an "out" still applies. Which alternate course of action should be taken depends on each situation. Better yet, think of the possibilities toward avoiding a negative situation instead of having to act on one.

Situational Awareness is not just a phrase, it is a practice. You can only get better!

Tailwinds and Happy Landings