

**Transport Canada  
Holdover Time (HOT) Guidelines  
Winter 2003-2004**

**Original Issue, July 2003**  
**Revision 1.0, December 2003**

**CHANGE CONTROL RECORDS**

A new complete revision of this document will not necessarily be reissued when there are changes. This page will serve to indicate the changes made to individual pages within the document and those changed pages will have the appropriate date in the footer. Sidebars are shown to assist in identifying the changes from the previous version.

<i>REVISION</i>	<i>DATE</i>	<i>DESCRIPTION OF CHANGES</i>	<i>AFFECTED PAGES</i>	<i>AUTHOR</i>
1.0	Dec. 2003	Minor editorial changes: - Added new note no. 6; - Added new note no. 7; - Other minor editorial changes.	2, 3, 4, 6 to 24, 27	TC / APS
		- Table 2-SAE changed to Table 2-Generic; - Table 4-SAE changed to Table 4-Generic.	11, 21	TC / APS
		Table 4U has been changed: - Added new note no. 7 to reflect the LOU of -24°C.	22	TC / APS
		Table 5 has been updated to reflect newly qualified fluids.	23, 24	TC / APS

## SUMMARY OF CHANGES FROM PREVIOUS YEAR

The principal changes from the previous year are briefly indicated herein.

### General

Previously Holdover Time (HOT) Guidelines were attached to the Commercial & Business Aviation Advisory Circular (CBAAC) entitled *Aircraft Ground Icing Update*. The CBAAC contained both reference information relating to Ground Icing Operations and the HOT Guidelines. A decision was made to do away with the CBAAC, and move the contents of the CBAAC into two separate documents. The two documents complement each other and, for a more thorough understanding of the subject matter, should be used together. The first document (TP 14052E) includes reference material related to Ground Icing Operations. The second document consists of the HOT Guidelines. It was determined that the dissemination of current HOT Guideline information would be accomplished in a more timely and effective manner by the use of a dedicated website. Therefore, commencing this year (2003), the Holdover Time Table Guidelines can be found at this website, and TP 14052E will be published containing only reference information relating to Ground Icing Operations.

### Type I Fluid

The Type I fluid HOT table has been changed this year. A new temperature breakdown was introduced by splitting the  $-3$  to  $-10^{\circ}\text{C}$  interval into (*below  $-3$  to  $-6^{\circ}\text{C}$* ) and (*below  $-6$  to  $-10^{\circ}\text{C}$* ) temperature ranges. Apart from the existing light snow and moderate snow columns, a new column for very light snow was introduced.

### Type II Fluid

A new Type II fluid (Clariant Safewing MP II 2025 ECO) has been tested and will be introduced for the 2003-04 winter season. The introduction of this new fluid did not have an impact on the generic Type II holdover guideline values from last year.

### Type III Fluid

No changes were made to the HOT values from last year (no Type III fluids are known to be qualified for use).

### Type IV Fluid

The Type IV fluid HOT table has been changed this year. A new Type IV fluid (Clariant Safewing MP IV 2030 ECO) has been tested and a HOT guideline will be introduced for the 2003-04 winter season. One Type IV fluid, which was tested for holdover times in 1997-98 (SPCA AD-404) but never produced commercially, was removed from the Type IV analysis. Its removal resulted in two increases to the generic Type IV values.

### Visibility Table

The visibility table (Table 8), which provides information on the variability of snowfall intensities, has been updated following analysis of new data (see TC report TP 14151E, *Relationship between Visibility and Snowfall Intensity*, November 2003). In addition, a new column was introduced to provide guidance to pilots when using the new "very light snow" column for Type I fluids. This table should be consulted for an accurate estimation of snowfall intensity.

**HOLDOVER TIME (HOT) GUIDELINES FOR WINTER 2003-2004**

Table 1	SAE Type I Fluid Holdover Guidelines
Table 2C-2025	Clariant Type II Fluid Holdover Guidelines Safewing MP II 2025 ECO
Table 2-OEM	Octagon Type II Fluid Holdover Guidelines E Max II
Table 2K-ABC-2000	Kilfrost Type II Fluid Holdover Guidelines ABC-2000
Table 2K-ABC-II+	Kilfrost Type II Fluid Holdover Guidelines ABC-II PLUS
Table 2S-E26	SPCA Type II Fluid Holdover Guidelines Ecowing 26
Table 2-Generic	SAE Type II Fluid Holdover Guidelines
Table 3	SAE Type III Fluid Holdover Guidelines
Table 4C-a	Clariant Type IV Fluid Holdover Guidelines Safewing MP IV 1957
Table 4C-b	Clariant Type IV Fluid Holdover Guidelines Safewing MP IV 2001
Table 4C-c	Clariant Type IV Fluid Holdover Guidelines Safewing Four
Table 4C-d	Clariant Type IV Fluid Holdover Guidelines Safewing MP IV 2012 Protect
Table 4C-e	Clariant Type IV Fluid Holdover Guidelines Safewing MP IV 2030 ECO
Table 4K	Kilfrost Type IV Fluid Holdover Guidelines ABC-S
Table 4-OM	Octagon Type IV Fluid Holdover Guidelines Max-Flight
Table 4S	SPCA Type IV Fluid Holdover Guidelines AD-480
Table 4-Generic	SAE Type IV Fluid Holdover Guidelines
Table 4U	Dow Chemical Type IV Fluid Holdover Guidelines UCAR™ ADF/AAF ULTRA+
Table 5	Currently Qualified Fluids
Table 6	SAE Type I Deicing Fluid Application Procedures
Table 7	SAE Type II and Type IV Anti-Icing Fluid Application Procedures
Table 8	Visibility in Snow Vs. Snowfall Intensity Chart

TABLE 1

**SAE TYPE I<sup>5</sup> FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Approximate Holdover Times Under Various Weather Conditions (minutes)								
°C	°F	Frost <sup>2</sup>	Freezing Fog	Very Light Snow <sup>1</sup>	Light Snow <sup>1</sup>	Moderate Snow <sup>1</sup>	Freezing Drizzle <sup>3</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>4</sup>
-3 and above	27 and above	45	11 – 17	18	11 – 18	6 – 11	9 – 13	4 – 6	2 – 5	
below -3 to -6	below 27 to 21	45	8 – 13	14	8 – 14	5 – 8	5 – 9	4 – 6	CAUTION: No holdover time guidelines exist	
below -6 to -10	below 21 to 14	45	6 – 10	11	6 – 11	4 – 6	4 – 7	2 – 5		
below -10	below 14	45	5 – 9	7	4 – 7	2 – 4				

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    FP = Freezing Point

**NOTES**

- 1 To use these times, the fluid must be heated to a minimum temperature providing 60°C (140°F) at the nozzle and an average rate of at least 1 L/m<sup>2</sup> (2 gal./100 sq. ft.) must be applied to deiced surfaces, OTHERWISE TIMES WILL BE SHORTER.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 4 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 5 Type I Fluid / Water Mixture is selected so that the FP of the mixture is at least 10°C (18°F) below OAT.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 2C-2025

**CLARIANT TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004  
SAFEWING MP II 2025 ECO (5,500 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type II Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	12:00	1:30 – 2:05	0:45 – 1:20	0:40 – 1:00	0:25 – 0:35	0:10 – 1:15	CAUTION: No holdover time guidelines exist
		75/25	6:00	0:55 – 1:45	0:25 – 0:45	0:25 – 0:45	0:20 – 0:25	0:05 – 0:50	
		50/50	4:00	0:20 – 0:35	0:10 – 0:20	0:10 – 0:15	0:05 – 0:10		
0 to -3	32 to 27	100/0	8:00	1:30 – 2:05	0:40 – 1:10	0:40 – 1:00	0:25 – 0:35		
		75/25	5:00	0:55 – 1:45	0:25 – 0:45	0:25 – 0:45	0:20 – 0:25		
		50/50	3:00	0:20 – 0:35	0:05 – 0:15	0:10 – 0:15	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	8:00	0:45 – 1:50	0:35 – 1:00	0:35 – 1:05 <sup>3</sup>	0:20 – 0:35 <sup>3</sup>		
		75/25	5:00	0:40 – 1:20	0:25 – 0:45	0:30 – 0:40 <sup>3</sup>	0:15 – 0:25 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	8:00	0:25 – 0:45	0:15 – 0:30				
below -25	below -13	100/0	Type II 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 Type I when Type II fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 2-OEM

**OCTAGON TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**E MAX II (13,520 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type II Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	12:00	2:05 – 3:45	0:45 – 1:30	0:45 – 1:35	0:30 – 0:40	0:15 – 1:30	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:25 – 2:50	0:30 – 1:00	0:40 – 1:10	0:20 – 0:30	0:10 – 1:05	
		50/50	4:00	0:30 – 0:55	0:15 – 0:30	0:15 – 0:30	0:10 – 0:15		
0 to -3	32 to 27	100/0	8:00	2:05 – 3:45	0:40 – 1:20	0:45 – 1:35	0:30 – 0:40		
		75/25	5:00	1:25 – 2:50	0:25 – 0:55	0:40 – 1:10	0:20 – 0:30		
		50/50	3:00	0:30 – 0:55	0:10 – 0:25	0:15 – 0:30	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	8:00	0:50 – 1:45	0:35 – 1:10	0:35 – 1:00 <sup>3</sup>	0:20 – 0:30 <sup>3</sup>		
		75/25	5:00	0:30 – 1:20	0:25 – 0:50	0:35 – 1:05 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	8:00	0:20 – 0:35	0:15 – 0:30				
below -25	below -13	100/0	Type II 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 Type I when Type II fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle LV1 with guard leg, 500 mL of neat fluid, at 20°C, 0.3 rpm, 33 minutes 20 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 2K-ABC-2000

**KILFROST TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**ABC-2000 (2,350 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type II Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	12:00	1:30 – 3:05	0:40 – 1:15	0:55 – 1:35	0:40 – 0:50	0:15 – 1:10	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:40 – 3:30	0:40 – 1:15	0:45 – 1:15	0:40 – 0:50	0:15 – 1:40	
		50/50	4:00	1:00 – 2:10	0:15 – 0:30	0:15 – 0:25	0:05 – 0:15		
0 to -3	32 to 27	100/0	8:00	1:30 – 3:05	0:30 – 1:00	0:55 – 1:35	0:40 – 0:50		
		75/25	5:00	1:40 – 3:30	0:30 – 1:05	0:45 – 1:15	0:40 – 0:50		
		50/50	3:00	1:00 – 2:10	0:15 – 0:30	0:15 – 0:25	0:05 – 0:15		
below -3 to -14	below 27 to 7	100/0	8:00	0:35 – 1:25	0:25 – 0:45	0:25 – 0:50 <sup>3</sup>	0:10 – 0:30 <sup>3</sup>		
		75/25	5:00	0:35 – 1:15	0:25 – 0:50	0:25 – 0:55 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	8:00	0:20 – 0:45	0:15 – 0:30				
below -25	below -13	100/0	Type II 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 Type I when Type II fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle LV2 with guard leg, 150 mL of neat fluid, at 20°C, 0.3 rpm, 10 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.



TABLE 2K-ABC-II+

**KILFROST TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004  
ABC-II PLUS (3,600 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type II Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	12:00	1:10 – 2:25	0:35 – 1:20	0:35 – 1:10	0:30 – 0:40	0:05 – 1:00	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:10 – 2:25	0:35 – 1:10	0:30 – 1:00	0:20 – 0:40	0:05 – 0:50	
		50/50	4:00	0:15 – 0:45	0:20 – 0:40	0:05 – 0:25	0:05 – 0:15		
0 to -3	32 to 27	100/0	8:00	1:10 – 2:25	0:25 – 0:55	0:35 – 1:10	0:30 – 0:40		
		75/25	5:00	1:10 – 2:25	0:25 – 0:50	0:30 – 1:00	0:20 – 0:40		
		50/50	3:00	0:15 – 0:45	0:15 – 0:35	0:05 – 0:25	0:05 – 0:15		
below -3 to -14	below 27 to 7	100/0	8:00	0:30 – 1:05	0:15 – 0:35	0:15 – 0:45 <sup>3</sup>	0:10 – 0:30 <sup>3</sup>		
		75/25	5:00	0:20 – 0:55	0:15 – 0:35	0:15 – 0:30 <sup>3</sup>	0:10 – 0:20 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	8:00	0:15 – 0:20	0:15 – 0:30				
below -25	below -13	100/0	Type II 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 Type I when Type II fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle LV2 with guard leg, 150 mL of neat fluid, at 20°C, 0.3 rpm, 10 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 2S-E26

**SPCA TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**Ecowing 26 (4,900 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type II Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	12:00	1:25 – 2:35	0:40 – 1:05	0:50 – 1:35	0:40 – 0:50	0:20 – 1:20	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:05 – 1:55	0:30 – 0:50	0:45 – 1:05	0:25 – 0:35	0:10 – 1:00	
		50/50	4:00	0:30 – 0:45	0:10 – 0:20	0:15 – 0:25	0:05 – 0:10		
0 to -3	32 to 27	100/0	8:00	1:25 – 2:35	0:40 – 1:00	0:50 – 1:35	0:40 – 0:50		
		75/25	5:00	1:05 – 1:55	0:25 – 0:35	0:45 – 1:05	0:25 – 0:35		
		50/50	3:00	0:30 – 0:45	0:10 – 0:20	0:15 – 0:25	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	8:00	0:45 – 2:15	0:35 – 0:55	0:30 – 1:10 <sup>3</sup>	0:15 – 0:35 <sup>3</sup>		
		75/25	5:00	0:35 – 1:15	0:25 – 0:40	0:20 – 0:50 <sup>3</sup>	0:15 – 0:25 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	8:00	0:25 – 0:45	0:30 – 0:50				
below -25	below -13	100/0	Type II 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 Type I when Type II fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 30 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 2-Generic

**SAE TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type II Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	12:00	0:35 – 1:30	0:20 – 0:55	0:30 – 0:55	0:15 – 0:30	0:05 – 0:40	CAUTION: No holdover time guidelines exist
		75/25	6:00	0:25 – 1:00	0:15 – 0:40	0:20 – 0:45	0:10 – 0:25	0:05 – 0:25	
		50/50	4:00	0:15 – 0:30	0:05 – 0:15	0:05 – 0:15	0:05 – 0:10		
0 to -3	32 to 27	100/0	8:00	0:35 – 1:30	0:20 – 0:45	0:30 – 0:55	0:15 – 0:30		
		75/25	5:00	0:25 – 1:00	0:15 – 0:30	0:20 – 0:45	0:10 – 0:25		
		50/50	3:00	0:15 – 0:30	0:05 – 0:15	0:05 – 0:15	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	8:00	0:20 – 1:05	0:15 – 0:35	0:15 – 0:45 <sup>3</sup>	0:10 – 0:25 <sup>3</sup>		
		75/25	5:00	0:20 – 0:55	0:15 – 0:25	0:15 – 0:30 <sup>3</sup>	0:10 – 0:20 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	8:00 <sup>7</sup>	0:15 – 0:20 <sup>7</sup>	0:15 – 0:30 <sup>7</sup>				
below -25	below -13	100/0	Type II 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 Type I when Type II fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Based on tests of neat fluids with the lowest viscosity deliverable on the aircraft, yet meeting Type II WSET and HHET.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.
- 7 Ensure that the lowest operational use temperature (LOUT) is respected.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 3

**SAE TYPE III FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F	Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	5:00	0:50 – 1:30	0:15 – 0:30	0:25 – 0:50	0:15 – 0:25	0:05 – 0:35	
0 to -3	32 to 27	4:00	0:50 – 1:30	0:15 – 0:25	0:25 – 0:50	0:15 – 0:25	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	4:00	0:30 – 1:00	0:10 – 0:20	0:15 – 0:30 <sup>3</sup>	0:10 – 0:20 <sup>3</sup>		
below -14	below 7	Type III fluid may be used below -14°C (7°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 Type I when Type III fluid cannot be used.						

°C = Degrees Celsius      °F = Degrees Fahrenheit      OAT = Outside Air Temperature

**NOTES**

- 1 Based on tests of neat fluids meeting Type III WSET and HHET.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4C-a

**CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**SAFEWING MP IV 1957 (16,200 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:05 – 2:15	0:35 – 1:05	0:40 – 1:10	0:30 – 0:45	0:15 – 1:10	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:10 – 2:10	0:35 – 1:05	0:35 – 1:05	0:25 – 0:40	0:10 – 1:00	
		50/50	4:00	0:25 – 0:50	0:15 – 0:30	0:15 – 0:25	0:05 – 0:15		
0 to -3	32 to 27	100/0	12:00	1:05 – 2:15	0:30 – 0:55	0:40 – 1:10	0:30 – 0:45		
		75/25	5:00	1:10 – 2:10	0:30 – 0:50	0:35 – 1:05	0:25 – 0:40		
		50/50	3:00	0:25 – 0:50	0:10 – 0:20	0:15 – 0:25	0:05 – 0:15		
below -3 to -14	below 27 to 7	100/0	12:00	0:45 – 1:30	0:30 – 0:50	0:35 – 0:55 <sup>3</sup>	0:20 – 0:35 <sup>3</sup>		
		75/25	5:00	0:25 – 1:10	0:20 – 0:40	0:25 – 0:55 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:25 – 0:40	0:25 – 0:45				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4C-b

**CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004  
SAFEWING MP IV 2001 (18,000 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:20 – 3:20	1:55 – 2:00	0:55 – 1:55	0:40 – 1:00	0:15 – 2:00	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:20 – 2:00	0:50 – 1:25	0:35 – 1:10	0:25 – 0:35	0:10 – 1:25	
		50/50	4:00	0:15 – 0:40	0:10 – 0:20	0:10 – 0:20	0:05 – 0:15		
0 to -3	32 to 27	100/0	12:00	1:20 – 3:20	1:00 – 1:55	0:55 – 1:55	0:40 – 1:00		
		75/25	5:00	1:20 – 2:00	0:35 – 1:00	0:35 – 1:10	0:25 – 0:35		
		50/50	3:00	0:15 – 0:40	0:10 – 0:20	0:10 – 0:20	0:05 – 0:15		
below -3 to -14	below 27 to 7	100/0	12:00	0:45 – 1:35	0:30 – 0:50	0:55 – 1:35 <sup>3</sup>	0:30 – 0:45 <sup>3</sup>		
		75/25	5:00	0:30 – 1:00	0:20 – 0:35	0:40 – 1:10 <sup>3</sup>	0:20 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:20 – 0:45	0:20 – 0:35				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4C-c

**CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004  
SAFEWING FOUR (6,400 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:50 – 2:45	0:45 – 1:45	1:05 – 1:45	0:50 – 1:05	0:10 – 1:20	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:45 – 2:25	0:40 – 1:25	0:50 – 1:30	0:30 – 0:45	0:15 – 1:25	
		50/50	4:00	0:30 – 0:45	0:15 – 0:25	0:15 – 0:25	0:10 – 0:15		
0 to -3	32 to 27	100/0	12:00	1:50 – 2:45	0:35 – 1:20	1:05 – 1:45	0:50 – 1:05		
		75/25	5:00	1:45 – 2:25	0:30 – 1:05	0:50 – 1:30	0:30 – 0:45		
		50/50	3:00	0:30 – 0:45	0:10 – 0:20	0:15 – 0:25	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	12:00	0:30 – 1:30	0:25 – 0:55	0:25 – 1:05 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
		75/25	5:00	0:30 – 1:05	0:20 – 0:45	0:20 – 0:50 <sup>3</sup>	0:15 – 0:25 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:20 – 0:45	0:20 – 0:45				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4C-d

**CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004  
SAFEWING MP IV 2012 PROTECT (7,800 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:15 – 2:30	1:05 – 2:00	0:40 – 1:10	0:25 – 0:45	0:10 – 1:05	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:10 – 2:05	0:35 – 1:10	0:35 – 0:50	0:15 – 0:30	0:05 – 0:40	
		50/50	4:00	0:25 – 0:45	0:15 – 0:25	0:15 – 0:20	0:05 – 0:10		
0 to -3	32 to 27	100/0	12:00	1:15 – 2:30	0:40 – 1:15	0:40 – 1:10	0:25 – 0:45		
		75/25	5:00	1:10 – 2:05	0:25 – 0:55	0:35 – 0:50	0:15 – 0:30		
		50/50	3:00	0:25 – 0:45	0:15 – 0:25	0:15 – 0:20	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	12:00	0:45 – 1:35	0:20 – 0:40	0:25 – 0:45 <sup>3</sup>	0:15 – 0:25 <sup>3</sup>		
		75/25	5:00	0:25 – 1:05	0:20 – 0:40	0:15 – 0:30 <sup>3</sup>	0:10 – 0:20 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:20 – 0:45	0:15 – 0:30				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.



TABLE 4C-e

**CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004  
SAFEWING MP IV 2030 ECO (10,500 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:55 – 3:20	0:50 – 1:35	0:55 – 2:00	0:40 – 0:50	0:15 – 1:40	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:15 – 2:05	0:35 – 1:05	0:40 – 1:05	0:25 – 0:35	0:10 – 1:00	
		50/50	4:00	0:30 – 0:45	0:15 – 0:25	0:15 – 0:25	0:05 – 0:10		
0 to -3	32 to 27	100/0	12:00	1:55 – 3:20	0:50 – 1:30	0:55 – 2:00	0:40 – 0:50		
		75/25	5:00	1:15 – 2:05	0:35 – 1:05	0:40 – 1:05	0:25 – 0:35		
		50/50	3:00	0:30 – 0:45	0:15 – 0:25	0:15 – 0:25	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	12:00	0:50 – 2:00	0:45 – 1:25	0:30 – 1:10 <sup>3</sup>	0:20 – 0:35 <sup>3</sup>		
		75/25	5:00	0:40 – 1:30	0:35 – 1:05	0:35 – 1:20 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:25 – 0:45	0:15 – 0:30				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4K

**KILFROST TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**ABC-S (17,000 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	2:35 – 4:00	1:10 – 2:00	1:20 – 1:50	1:00 – 1:25	0:20 – 1:15	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:05 – 1:45	0:30 – 1:05	0:45 – 1:10	0:35 – 0:50	0:10 – 0:50	
		50/50	4:00	0:20 – 0:35	0:05 – 0:20	0:15 – 0:20	0:05 – 0:10		
0 to -3	32 to 27	100/0	12:00	2:35 – 4:00	1:00 – 1:40	1:20 – 1:50	1:00 – 1:25		
		75/25	5:00	1:05 – 1:45	0:30 – 0:55	0:45 – 1:10	0:35 – 0:50		
		50/50	3:00	0:20 – 0:35	0:05 – 0:15	0:15 – 0:20	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	12:00	0:45 – 2:05	0:45 – 1:20	0:20 – 1:00 <sup>3</sup>	0:10 – 0:30 <sup>3</sup>		
		75/25	5:00	0:25 – 1:00	0:25 – 0:50	0:20 – 1:10 <sup>3</sup>	0:10 – 0:35 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:20 – 0:40	0:40 – 1:10				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle LV2 with guard leg, 150 mL of neat fluid, at 20°C, 0.3 rpm, for 10 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4-OM

**OCTAGON TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**MAX-FLIGHT (5,540 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	2:40 – 4:00	1:15 – 2:00	0:55 – 2:00	0:35 – 1:00	0:15 – 1:15	CAUTION: No holdover time guidelines exist
		75/25	6:00	2:05 – 3:15	1:20 – 2:00	1:15 – 2:00	0:35 – 1:10	0:10 – 0:40	
		50/50	4:00	0:55 – 1:45	0:40 – 1:20	0:35 – 1:00	0:15 – 0:30		
0 to -3	32 to 27	100/0	12:00	2:40 – 4:00	0:50 – 1:35	0:55 – 2:00	0:35 – 1:00		
		75/25	5:00	2:05 – 3:15	0:45 – 1:45	1:15 – 2:00	0:35 – 1:10		
		50/50	3:00	0:55 – 1:45	0:25 – 1:15	0:35 – 1:00	0:15 – 0:30		
below -3 to -14	below 27 to 7	100/0	12:00	0:50 – 2:30	0:25 – 0:50	0:25 – 1:10 <sup>3</sup>	0:20 – 0:40 <sup>3</sup>		
		75/25	5:00	0:30 – 1:05	0:20 – 0:50	0:20 – 1:00 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:20 – 0:45	0:20 – 0:40				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle LV1 with guard leg, 500 mL of neat fluid, at 20°C, 0.3 rpm, 33 minutes 20 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4S

**SPCA TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**AD-480 (15,200 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	2:00 – 3:30	0:55 – 1:50	0:50 – 1:30	0:35 – 0:55	0:15 – 1:35	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:30 – 2:45	0:40 – 1:20	0:50 – 1:15	0:30 – 0:45	0:10 – 1:15	
		50/50	4:00	0:30 – 0:45	0:15 – 0:30	0:15 – 0:25	0:05 – 0:15		
0 to -3	32 to 27	100/0	12:00	2:00 – 3:30	0:40 – 1:20	0:50 – 1:30	0:35 – 0:55		
		75/25	5:00	1:30 – 2:45	0:30 – 1:05	0:50 – 1:15	0:30 – 0:45		
		50/50	3:00	0:30 – 0:45	0:10 – 0:20	0:15 – 0:25	0:05 – 0:15		
below -3 to -14	below 27 to 7	100/0	12:00	0:20 – 1:20	0:30 – 0:55	0:25 – 1:20 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
		75/25	5:00	0:25 – 0:50	0:20 – 0:45	0:25 – 1:05 <sup>3</sup>	0:15 – 0:30 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00	0:15 – 0:40	0:25 – 0:40				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of neat fluid, at 20°C, 0.3 rpm, for 30 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4-Generic

**SAE TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:05 – 2:15	0:35 – 1:05	0:40 – 1:10	0:25 – 0:40	0:10 – 0:50	CAUTION: No holdover time guidelines exist
		75/25	6:00	1:05 – 1:45	0:30 – 1:05	0:35 – 0:50	0:15 – 0:30	0:05 – 0:35	
		50/50	4:00	0:15 – 0:35	0:05 – 0:20	0:10 – 0:20	0:05 – 0:10		
0 to -3	32 to 27	100/0	12:00	1:05 – 2:15	0:30 – 0:55	0:40 – 1:10	0:25 – 0:40		
		75/25	5:00	1:05 – 1:45	0:25 – 0:50	0:35 – 0:50	0:15 – 0:30		
		50/50	3:00	0:15 – 0:35	0:05 – 0:15	0:10 – 0:20	0:05 – 0:10		
below -3 to -14	below 27 to 7	100/0	12:00	0:20 – 1:20	0:20 – 0:40	0:20 – 0:45 <sup>3</sup>	0:10 – 0:25 <sup>3</sup>		
		75/25	5:00	0:25 – 0:50	0:20 – 0:35	0:15 – 0:30 <sup>3</sup>	0:10 – 0:20 <sup>3</sup>		
below -14 to -25	below 7 to -13	100/0	12:00 <sup>7</sup>	0:15 – 0:40 <sup>7</sup>	0:15 – 0:30 <sup>7</sup>				
below -25	below -13	100/0	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 Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Based on tests of neat fluids with the lowest viscosity deliverable on the aircraft, yet meeting Type IV WSET and HHET.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.
- 7 Ensure that the lowest operational use temperature (LOUT) is respected.

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 4U

**DOW CHEMICAL TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2003-2004**  
**UCAR™ ADF/AAF ULTRA+ (36,000 mPa.s viscosity)<sup>1</sup>**

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

OAT		Type IV Fluid Concentration Neat Fluid/Water (Vol% / Vol%)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)						
°C	°F		Frost <sup>2</sup>	Freezing Fog	Snow <sup>6</sup>	Freezing Drizzle <sup>4</sup>	Light Freezing Rain	Rain on Cold Soaked Wing	Other <sup>5</sup>
above 0	above 32	100/0	18:00	1:35 – 3:35	0:40 – 1:25	0:45 – 1:35	0:25 – 0:40	0:10 – 1:20	CAUTION: No holdover time guidelines exist
		75/25							
		50/50							
0 to -3	32 to 27	100/0	12:00	1:35 – 3:35	0:35 – 1:15	0:45 – 1:35	0:25 – 0:40		
		75/25							
		50/50							
below -3 to -14	below 27 to 7	100/0	12:00	1:25 – 3:00	0:25 – 0:55	0:45 – 1:25 <sup>3</sup>	0:30 – 0:45 <sup>3</sup>		
		75/25							
below -14 to -25	below 7 to -13	100/0	12:00 <sup>7</sup>	0:40 – 2:10 <sup>7</sup>	0:20 – 0:45 <sup>7</sup>				
below -25	below -13	100/0	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. <sup>7</sup> Consider use of Type I when Type IV fluid cannot be used.						

°C = Degrees Celsius    °F = Degrees Fahrenheit    OAT = Outside Air Temperature    Vol = Volume

**NOTES**

- 1 Lowest on-wing viscosity - Brookfield Spindle SC4-31/13R, small sample adapter, 10 mL of neat fluid, at 0°C, 0.3 rpm, for 10 minutes 0 seconds.
- 2 During conditions that apply to aircraft protection for ACTIVE FROST.
- 3 The lowest use temperature is limited to -10°C (14°F) under freezing drizzle and light freezing rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, and hail.
- 6 Snow includes snow grains.
- 7 The lowest operational use temperature (LOUT) for this fluid is -24°C (-11°F).

**CAUTIONS**

- The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content. High wind velocity or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT.
- The only acceptable decision criteria time is the shortest time within the applicable holdover time table cell.
- Fluids used during ground deicing do not provide ice protection during flight.

TABLE 5

CURRENTLY QUALIFIED FLUIDS (2003-2004)

NOTE

Concentrate fluids have also been qualified at 50/50 (glycol/water) dilution.

Table 5-1: Qualified Type I Anti-icing Fluids <sup>†</sup>			
#	COMPANY NAME	FLUID NAME	EXPIRY (Y-M-D)
1-1	Aviation Xi' an High-tech	KHF-1	05-02-24
1-2	Beijing Wangye Aviation Chemical Product Co. Ltd.	KLA-1	05-09-26
1-3	Clariant GmbH	Clariant Safewing MP I 1938 TF	04-07-29
1-4	Clariant GmbH	Clariant Safewing MP I 1938 PRE-MIX (60%IG) Ready-to-use	04-07-30
1-5	Clariant GmbH	Clariant Safewing MP I 1938 ECO	04-08-05
1-6	Clariant GmbH	Clariant Safewing EG I 1996	04-07-10
1-7	Dow Chemical Company	Dow UCAR™ Aircraft Deicing Fluid Concentrate	04-12-09
1-8	Dow Chemical Company	Dow UCAR™ PG Aircraft Deicing Fluid	05-07-16
1-9	Dow Chemical Company	Dow UCAR™ ADF XL-54	04-08-07
1-10	HOC Industries	HOC SafeTemp I ES	04-08-22
1-11	Inland Technologies Inc.	Inland Duragly-P ready to use	05-09-12
1-12	Inland Technologies Inc.	Inland Duragly-E ready to use	05-10-20
1-13	Kilfrost Limited	Kilfrost DF PLUS	05-09-24
1-14	Kilfrost Limited	Kilfrost DF PLUS (80)	04-06-20
1-15	Kilfrost Limited	Kilfrost DF PLUS (88)	05-09-19
1-16	Lyondell Chemical Co.	Lyondell ARCOPlus	04-04-15
1-17	Metss Corporation	Metss ADF-2	04-07-11
1-18	Newave Aerochemical Co. Ltd.	FCY-1A	05-06-04
1-19	Octagon Process Inc.	Octagon Octaflo EF	05-07-25
1-20	Octagon Process Inc.	Octagon Octaflo EG	05-07-24
1-21	SPCA	SPCA DE-950	04-07-08

<sup>†</sup> Qualified solely with respect to anti-icing performance and aerodynamic acceptance by the Anti-icing Materials International Laboratory, Université du Québec à Chicoutimi.  
 Web site: <http://www.ugac.quebec.ca/amil/>  
 For other specification requirements for Type I fluids, see SAE AMS 1424 (latest version).

TABLE 5 (cont.)

CURRENTLY QUALIFIED FLUIDS (2003-2004)

Table 5-2: Qualified Type II Anti-icing Fluids <sup>†</sup>			
#	COMPANY NAME	FLUID NAME	EXPIRY (Y-M-D)
2-1	Clariant GmbH	Clariant Safewing MP II 1951	05-07-11
2-2	Clariant GmbH	Clariant Safewing MP II 2025 ECO	04-10-29
2-3	Kilfrost Limited	Kilfrost ABC-II PLUS	05-10-29
2-4	Kilfrost Limited	Kilfrost ABC-3	04-08-22
2-5	Kilfrost Limited	Kilfrost ABC-2000	04-05-31
2-6	Octagon Process Inc.	Octagon E Max II	04-07-09
2-7	SPCA	SPCA Ecowing 26	05-06-03

Table 5-3: Qualified Type III Anti-icing Fluids <sup>†</sup>			
#	COMPANY NAME	FLUID NAME	EXPIRY (Y-M-D)

Table 5-4: Qualified Type IV Anti-icing Fluids <sup>†</sup>			
#	COMPANY NAME	FLUID NAME	EXPIRY (Y-M-D)
4-1	Clariant GmbH	Clariant Safewing MP IV 2001	04-05-13
4-2	Clariant GmbH	Clariant Safewing MP IV 2012 Protect	05-04-08
4-3	Clariant GmbH	Clariant Safewing MP IV 2030 ECO	04-11-22
4-4	Dow Chemical Company	Dow UCAR™ ADF/AAF ULTRA+	04-04-30
4-5	Ely Chemical Company	Octagon Max-Flight	04-09-24
4-6	Kilfrost Limited	Kilfrost ABC-S	05-08-06
4-7	Octagon Process Inc.	Octagon Max-Flight	05-09-09
4-8	SPCA	SPCA AD-480	05-07-01

<sup>†</sup> Qualified solely with respect to anti-icing performance and aerodynamic acceptance by the Anti-icing Materials International Laboratory, Université du Québec à Chicoutimi.  
 Web site: <http://www.uqac.quebec.ca/amil/>  
 For other specification requirements for Type II, III or IV fluids, see SAE AMS 1428 (latest version).



TABLE 6

**SAE TYPE I DEICING FLUID APPLICATION PROCEDURES**

Guidelines for the application of SAE Type I fluid mixtures at minimum concentrations for the prevailing outside air temperature (OAT)

Outside Air Temperature OAT	One-Step Procedure Deicing/Anti-icing	Two-Step Procedure	
		First Step: Deicing	Second Step: Anti-icing <sup>1</sup>
-3°C (27°F) and above	Mix of fluid and water heated to 60°C (140°F) minimum at the nozzle,	Water or a mix of fluid and water heated to 60°C (140°F) minimum at the nozzle	Mix of fluid and water heated to 60°C (140°F) minimum at the nozzle,
Below -3°C (27°F)	with a freeze point of at least 10°C (18°F) below OAT	Freeze point of heated fluid mixture shall not be more than 3°C (5°F) above OAT	with a freeze point of at least 10°C (18°F) below OAT

1 To be applied before first step fluid freezes, typically within 3 minutes.

**NOTE**

Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.

**NOTE**

This table is applicable for the use of Type I Holdover Time Guidelines. If holdover times are not required, a temperature of 60°C (140°F) at the nozzle is desirable.

**CAUTION**

- Wing skin temperatures may differ and in some cases may be lower than OAT; a stronger mix may be needed under these conditions.

TABLE 7

**SAE TYPE II and TYPE IV ANTI-ICING FLUID APPLICATION PROCEDURES**

Guidelines for the application of SAE Type II and IV fluid mixtures  
(minimum concentrations in % by volume) as a function of outside air temperature (OAT)

Outside Air Temperature (OAT)	One-Step Procedure Deicing/Anti-icing	Two-Step Procedure	
		First Step: Deicing	Second Step: Anti-icing <sup>1</sup>
-3°C (27°F) and above	50/50 Heated <sup>2</sup> Type II/IV	Heated water or a heated mix of Type I, II or IV with water	50/50 Type II/IV
-14°C (7°F) and above	75/25 Heated <sup>2</sup> Type II/IV	Heated suitable mix of Type I, Type II/IV and water with FP not more than 3°C (5°F) above actual OAT	75/25 Type II/IV
-25°C (-13°F) and above	100/0 Heated <sup>2</sup> Type II/IV	Heated suitable mix of Type I, Type II/IV and water with FP not more than 3°C (5°F) above actual OAT	100/0 Type II/IV
Below -25°C (-13°F)	Type II/IV fluid may be used below -25°C (-13°F) provided that the freezing point of the fluid is at least 7°C (13°F) below OAT and that aerodynamic acceptance criteria are met. Consider the use of Type I when Type II/IV fluid cannot be used (see Table 6).		

- 1 To be applied before first step fluid freezes, typically within 3 minutes.
- 2 Clean aircraft may be anti-iced with unheated fluid.

**NOTE**

For heated fluids, a fluid temperature not less than 60°C (140°F) at the nozzle is desirable. Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.

**CAUTION**

- Wing skin temperatures may differ and in some cases may be lower than OAT; a stronger mix may be needed under these conditions.
- Whenever frost or ice occurs on the lower surface of the wing in the area of the fuel tank, indicating a cold soaked wing, the 50/50 dilutions of Type II or IV should not be used for the anti-icing step because fluid freezing may occur.
- An insufficient amount of anti-icing fluid may cause a substantial loss of holdover time. This is particularly true when using a Type I fluid mixture for the first step in a two-step procedure.

TABLE 8  
VISIBILITY IN SNOW VS. SNOWFALL INTENSITY CHART<sup>1</sup>

Lighting	Temperature Range		Visibility in Snow (Statute Miles)			
	°C	°F	Heavy	Moderate	Light	Very Light
Darkness	-1 and above	30 and above	≤1	>1 to 2½	>2½ to 4	>4
	Below -1	Below 30	≤¾	>¾ to 1½	>1½ to 3	>3
Daylight	-1 and above	30 and above	≤½	>½ to 1½	>1½ to 3	>3
	Below -1	Below 30	≤¾	>¾ to 7/8	>7/8 to 2	>2

1 Based on: *Relationship between Visibility and Snowfall Intensity* (TP 14151E), Transportation Development Centre, Transport Canada, November 2003; and *Theoretical Considerations in the Estimation of Snowfall Rate Using Visibility* (TP 12893E), Transportation Development Centre, Transport Canada, November 1998.

**HOW TO READ THE TABLE**

Assume that the daytime visibility in snowfall is 1 statute mile and the temperature is -7°C. Based on these conditions, the snowfall intensity is light. This snowfall intensity is used to determine which holdover time guideline value is appropriate for the fluid in use.