




FRAMEWORK SALES CONTRACT
No. Z/BTS/DLPR/116/2023

Seller: **Proviron Functional Chemicals nv**
Seat: Ostend, Belgium
ID Number: 03 023 8797
Tax ID: BF 0456 880 201
Bank Details: 
Account Number: 
Registered in: Commercial Register of Belgium (FPS Economy, self employed and energy)
Represented by: Business Unit Manager David Carbonez

as the seller (hereinafter referred to as the “**Seller**”)

and

Buyer: **M.R.Stefanik Airport - Airport Bratislava, a.s. (BTS)**
Seat: M. R. Stefanik Airport, Bratislava II, 823 11
ID Number: 35 884 916
Tax ID: SK2021812682
Bank Details: 
IBAN: 
Registered in: Commercial Register of the Municipal Court Bratislava III, Section: Sa,
Insert No. 3327/B
Represented by: Ing. Dusan Keketi - Chairman of the Board
Ing. Gabriel Domsitz - Member of the Board

as the buyer (hereinafter referred to as the “**Buyer**”)

The Buyer and the Seller, hereinafter also referred to as the “**Parties**”, conclude pursuant to Sec. 409 et seq. of the Commercial Code this

Framework Sales Contract (hereinafter referred to as the “**Contract**”):

Art. I - Subject Matter of the Contract

1. By concluding the Contract, the Parties express their will to be governed by the Contract when concluding individual partial purchase contracts, on the basis of which the Seller undertakes to deliver the goods to the Buyer, to transfer the ownership right to the goods to the Buyer, and the Buyer undertakes to pay the agreed purchase price for the goods to the Seller and to agree in advance on part of the content of these purchase contracts.
Annex 1 to this Contract is the Goods Specification, which contains a more detailed specification of the range of goods, estimated quantities and other terms and conditions for each type of goods.
The Seller undertakes to deliver to the Buyer only goods of the agreed quality, which corresponds to the successfully tested sample of the goods by the Buyer and the agreed documentation with the Buyer (specification of the goods, analytical certificate, or others as required by the Buyer), meeting the purpose of use.

Art. II - Conclusion of Individual (Partial) Purchase Contracts

1. The proposal for the conclusion of an individual purchase contract with the Seller shall be submitted by the Buyer in the form of a written (electronic) order for the delivery of goods. An individual pur-

chase contract is deemed to be concluded when the Seller confirms (accepts) the Buyer's order in writing.

2. The Buyer undertakes to deliver the order to the Seller no later than 5 working days before the requested delivery date specified in the order, by post to the Seller's address or electronically to the e-mail address **Provifrost@proviron.com**.
3. The time limit for order confirmation is 1 working day, starting from the day of its delivery to the Seller.

Art. III - Basic Conditions Applicable to Individual Purchase Contracts

1. The Seller undertakes to deliver the ordered goods to the Buyer, to transfer to the Buyer the ownership right to these goods and the Buyer undertakes to accept the ordered goods and to pay the Seller the purchase price in the amount notified by the Seller to the Buyer in accordance with Article IV of this Contract.
2. The Seller undertakes to deliver the goods to the Buyer at the time specified in the confirmed order and at the agreed place of delivery, which is the Buyer's headquarters, the premises of the M.R.Stefanik Airport - Airport Bratislava, a.s. By signing this Contract, the Seller declares that the place of delivery is known to him/her.
3. The Seller's obligation to deliver the goods to the Buyer is fulfilled by allowing the Buyer to dispose of the goods (i.e. take possession of the goods) at the agreed place of delivery.
4. The Buyer undertakes to take delivery of the goods at the agreed place of delivery and to inspect the goods upon receipt for their apparent integrity and to confirm receipt of the delivered goods in writing on the delivery note.
5. The risk of damage to the goods and the title to the goods shall pass to the Buyer at the moment of written confirmation of receipt of the goods by the Buyer on the delivery note.
6. The Seller is liable for defects that the goods have at the moment when the risk of damage to the goods passes to the Buyer as well as for defects that occur after the goods have been received within the warranty period of 2 years.
7. The Buyer is obliged to notify the Seller in writing of any defects in the goods without undue delay after their discovery. In the notification of defects of the goods, the Buyer must specify the defects to the Seller (describe them, state how they manifest themselves and state what claim he claims from the defects).
8. The Seller undertakes to settle the Buyer's complaints without undue delay after its receipt; however, no later than within 30 calendar days. If the Seller is in delay with the processing of the complaint, the Buyer is entitled to claim a contractual penalty in the amount of EUR 50.00 (in words: fifty euros) for each started day of delay. The right to compensation for damages even to the extent exceeding the amount of the contractual penalty is not affected. In the event of a legitimate claim by the Buyer who requests the replacement of defective goods with goods without defects (delivery of replacement goods), the Seller undertakes to deliver the replacement goods to the Buyer as soon as possible and to pay all costs associated with the replacement of the defective goods.
9. The supplier undertakes to comply with all procedures as per the current version of SAE AS 6285 - Fluid Delivery/Acceptance.

Art. IV - Purchase Price and Payment Terms

1. For the delivered goods, the Buyer undertakes to pay the Seller the agreed purchase price, to which VAT shall be added in accordance with the currently applicable regulations.
2. The supplier is obliged to notify the Buyer of the current price of the goods on 3rd (third) day of each calendar month. The price is always valid until the new price of the goods is announced. Notification of the new valid price of the goods shall be made by e-mail to the following e-mail address obstaravanie@bts.aero. The purchase price does not include the statutory value added tax.
3. The Seller shall be entitled to payment of the purchase price upon delivery of the goods (fulfilment) ordered under the individual purchase contract concluded on the basis of the Contract to the agreed place of delivery, namely for the goods that have been delivered according to the delivery note confirmed by the Buyer.

4. The purchase price for the goods delivered under the individual purchase contract concluded on the basis of the Contract shall then be payable upon entitlement to payment thereof (clause 2. of this Article) within 30 days from the date of delivery of the Seller's invoice to the Buyer.
5. The Seller's invoice shall contain the details according to the relevant legislation. If the invoice does not contain all the details specified in the provisions of Sec. 74 (1) of Act No. 222/2004 Coll. on VAT as amended, the Buyer is entitled to return such invoice to the Seller. The invoice must be returned no later than the due date of the invoice. The Seller shall be obliged to remedy the deficiencies to which it has been called in connection with the return of the invoice within 3 (in word: three) working days from the date of receipt of the said call. The new due date will begin on the date of delivery of the corrected invoice to the Buyer.
6. The Buyer's monetary obligation to pay the Seller the purchase price through the payment order is fulfilled by debiting the amount paid from the Buyer's account.
7. The Seller, who is a VAT payer, hereby declares and assures the Buyer that prior to the signing of this Contract, the Seller did not have reasons for cancellation of the Seller's registration for value added tax pursuant to Sec. 81(4)(b)(2) of Act No. 222/2004 Coll. as amended. Should the Seller plan to cancel its VAT registration in the future, it shall immediately inform the Buyer of the said fact.
8. The invoice shall be accompanied by a copy of the delivery note relevant to the invoiced subcontract.

Art. V - Contractual Penalties

1. In the event that the Seller is in delay with the delivery of the goods according to the confirmed order and the Buyer decides to accept the delivery of the goods, the Buyer is entitled to claim a contractual penalty in the amount of 0.3% of the purchase price of the goods for each day of delay.
2. In the event of delay in delivery of the goods by the Seller, the Buyer shall have the right to withdraw from the purchase contract concluded on the basis of the confirmed order and return the delayed goods to the Seller at the Seller's expense and risk.
3. If the Buyer is in default in payment of the purchase price, the Seller shall be entitled to claim interest on the overdue amount at the statutory rate for each day of delay.
4. The Parties agree that the claim for payment of the contractual penalty shall be without prejudice to the right of the Party concerned to claim compensation for damages in excess of the contractual penalty which have arisen as a result of the breach of the obligation of the breaching Party secured by the contractual penalty. The implementation of the replacement purchase is without prejudice to the Buyer's right to contractual penalty, compensation for damages or lost profits.

Art. VI - Other Arrangements

1. The Parties undertake that for the purpose of exercising their rights and performing their obligations under this Contract, they will provide each other with the necessary cooperation in any form and take all actions necessary to achieve the purpose of this Contract.
 2. The Parties agree that any information which they provide to each other in connection with this Contract which they designate as confidential or the nature of which indicates that it is confidential shall be used only in connection with the performance of their obligations and the exercise of their rights under this Contract or in securing the protection of their rights under this Contract and shall not be used in a manner inconsistent with its purpose; the following shall not be deemed a breach of this obligation:
 - (a) disclosure of information to third parties in the cases and to the extent required by law or to third parties who are or will be (by law or by agreement with the Party providing the information) bound by confidentiality; and
 - b) publication of the Contract in the Central Register of Contracts maintained by the Office of the Government of the Slovak Republic.
- This obligation of confidentiality and secrecy shall survive the termination of this Contract.

Art. VII - Duration of the Contract

1. The Contract is concluded for a definite term - from the effective date until 31/08/2024 or until the financial limit of EUR 344,63.00 excluding VAT is reached, whichever is earlier.
2. The contractual relationship established by this Contract may be terminated by written agreement of the Parties or by withdrawal from this Contract in the event of a material breach of the obligations under this Contract, whereby a material breach of the obligations under this Contract shall be deemed to be, in particular, a delay by the Seller in fulfilling its obligation to deliver the goods in a proper and timely manner pursuant to the individual purchase contract.
3. Withdrawal from this Contract must be in writing and delivered to the other Party. The effects of the withdrawal shall commence on the date of delivery of the written withdrawal to the other Party. The consequences of withdrawal from this Contract shall be governed by the relevant provisions of the Commercial Code. Termination of this Contract shall not extinguish arrangements which, by the will of the Parties or by their nature, are intended to survive the termination of this Contract
4. The termination of this Contract shall not affect the rights and obligations of the Parties arising from individual purchase contracts already concluded, nor the rights and obligations of the Parties arising from orders already delivered by the Buyer to the Seller, unless otherwise agreed by the Parties.

Art. VIII - Common and Final Provisions

1. Delivery of Documents
 - 1.1. The Parties agree to deliver documents containing legally significant facts under the Contract to each other by post, by registered mail, unless otherwise agreed. For the purposes of this Contract, a document containing legally significant facts means, for example, withdrawal from the Contract, demands for payment and any calls for performance.
 - 1.2. For the purposes of postal delivery, the addresses of the registered offices of the Parties or the correspondence addresses specified in the header of the Contract shall be used, unless the addressee of the document has notified the sending Party of a new registered office address or other new correspondence address for the service of documents. In the event of any change of address for the service of documents under the Contract, the Party concerned undertakes to inform the other Party in writing without delay of the change of address or Contact details; in such case, the new address, duly notified to the Party prior to the dispatch of the documents, shall be decisive for the service of documents. The sending Party shall not be liable for any legal consequences arising from the failure of the addressee to comply with the notification obligation under this clause.
 - 1.3. In the case of postal delivery, the consignment shall be deemed to have been delivered on the date of its delivery to the address specified in the header of the Contract.
 - 1.4. The day on which the Party to whom the consignment is addressed refuses to take delivery of the consignment shall also be deemed to be the day on which the consignment is delivered, or 3rd (in words: third) working day from the day of the start of the subscription period for picking up the parcel at the post office.
 - 1.5. For other methods of delivery of messages (delivery by sending an e-mail message), they shall be deemed to have been delivered by displaying a confirmation of the sending of the e-mail message on the sender's technical device.
2. If the Contract does not provide for an e-mail address or fax number for the purpose of serving only some or even all of the documents under the Contract, or if the Parties wish to serve notices under the Contract on an e-mail address other than that specified in the Contract, they shall complete the following information:

On the Seller's side:

e-mail address:

On the Buyer's side:

e-mail address:

and at the same time shall be delivered

info@bts.aero

3. This Contract is concluded on the date of its signing by both Parties and enters into legal effect in accordance with the provisions of Sec. 47a of Act No. 40/1964 Coll., the Civil Code, as amended, and related applicable legislation on the day following the date of its publication in the Central Register of Contracts maintained by the Office of the Government of the Slovak Republic.
4. Any changes and/or additions to this Contract may only be made by agreement of both Parties in the form of written successively numbered amendments to the Contract signed by authorised representatives of both Parties - this does not apply in the case of the electronic notification of changes in the prices of goods agreed by the Parties in Article 2 of the Contract, which is referred to in Article 2 of the Contract. 4 - Purchase price payment terms clause 2.
5. In the event that any provision of this Contract becomes invalid or unenforceable, the validity of this Contract as a whole shall not be affected. In this case, the Parties undertake to replace such invalid or unenforceable provision with another provision that supersedes it in a legal sense.
6. The Parties undertake to use their best endeavours to resolve any disputes arising between them in connection with this Contract, in the first instance and in particular by agreement between the Parties. The Parties expressly agree that the court of the Buyer's place of residence and the Slovak law shall be competent for the settlement of any disputes.
7. The provisions of Act No. 513/1991 Coll., the Commercial Code, as amended, the provisions of Act No. 40/1964 Coll., the Civil Code, as amended, and other related applicable legislation shall apply to the legal relations not specifically regulated in this Contract.
8. This Contract is drawn up in four (4) counterparts, two (2) counterparts for each of the Parties.
9. The Parties declare that they have duly read the Contract, understand its contents, that it has been concluded by mutual consent, and sign it without reservation as a token of their agreement.
10. The annexes are an integral part of the Contract:
 - Annex 1 - Goods Specification
 - Annex 2 - Product Safety Data Sheets and Technical Specification

On behalf of the Seller:

In _____

bratislava, a.s. (BTS)

tislava, a.s. (BTS)

Annex 1

Goods Specification

Name of goods*	Packaging	Delivery Condition**	Valid for plants
Cryotech Polar Plus (LT) 80	Tankers	DDP buyer	M.R.Stefanik Airport - Airport Bratislava, a.s.
Cryotech Polar Guard II	Tankers	DDP buyer	M.R.Stefanik Airport - Airport Bratislava, a.s.



Cryotech Polar Guard[®] Advance Type IV Aircraft De-/Anti-icing Fluid Dilution table 75/25 and 50/50

Concentration (% vol)	Refractive Index (20° C)	Freeze Point (°C)	Concentration (% vol)	Refractive Index (20° C)	Freeze Point (°C)	Concentration (% vol)	Refractive Index (20° C)	Freeze Point (°C)	Concentration (% vol)	Refractive Index (20° C)	Freeze Point (°C)
1	1.3336	-0.2	26	1.3482	-4.5	51	1.3628	-10.9	76	1.3774	-21.5
2	1.3342	-0.3	27	1.3488	-4.7	52	1.3634	-11.3	77	1.3780	-22.1
3	1.3348	-0.5	28	1.3494	-4.9	53	1.3640	-11.6	78	1.3786	-22.6
4	1.3353	-0.6	29	1.3500	-5.1	54	1.3646	-11.9	79	1.3792	-23.2
5	1.3359	-0.8	30	1.3505	-5.3	55	1.3652	-12.3	80	1.3798	-23.8
6	1.3365	-1.0	31	1.3511	-5.6	56	1.3657	-12.6	81	1.3804	-24.3
7	1.3371	-1.1	32	1.3517	-5.8	57	1.3663	-13.0	82	1.3809	-24.9
8	1.3377	-1.3	33	1.3523	-6.0	58	1.3669	-13.4	83	1.3815	-25.5
9	1.3383	-1.4	34	1.3529	-6.2	59	1.3675	-13.8	84	1.3821	-26.2
10	1.3388	-1.6	35	1.3535	-6.5	60	1.3681	-14.2	85	1.3827	-26.8
11	1.3394	-1.8	36	1.3540	-6.7	61	1.3687	-14.5	86	1.3833	-27.4
12	1.3400	-1.9	37	1.3546	-6.9	62	1.3692	-15.0	87	1.3839	-28.1
13	1.3406	-2.1	38	1.3552	-7.2	63	1.3698	-15.4	88	1.3844	-28.7
14	1.3412	-2.3	39	1.3558	-7.4	64	1.3704	-15.8	89	1.3850	-29.4
15	1.3418	-2.5	40	1.3564	-7.7	65	1.3710	-16.2	90	1.3856	-30.1
16	1.3424	-2.6	41	1.3570	-8.0	66	1.3716	-16.7	91	1.3862	-30.8
17	1.3429	-2.8	42	1.3576	-8.2	67	1.3722	-17.1	92	1.3868	-31.5
18	1.3435	-3.0	43	1.3581	-8.5	68	1.3728	-17.6	93	1.3874	-32.2
19	1.3441	-3.2	44	1.3587	-8.8	69	1.3733	-18.0	94	1.3879	-32.9
20	1.3447	-3.3	45	1.3593	-9.1	70	1.3739	-18.5	95	1.3885	-33.7
21	1.3453	-3.5	46	1.3599	-9.4	71	1.3745	-19.0	96	1.3891	-34.4
22	1.3459	-3.7	47	1.3605	-9.7	72	1.3751	-19.5	97	1.3897	-35.2
23	1.3464	-3.9	48	1.3611	-10.0	73	1.3757	-20.0	98	1.3903	-36.0
24	1.3470	-4.1	49	1.3616	-10.3	74	1.3763	-20.5	99	1.3909	-36.8
25	1.3476	-4.3	50	1.3622	-10.6	75	1.3768	-21.0	100	1.3915	-37.6

The **highlighted** figures show the allowable plus 7% concentration bands for 50/50 and 75/25 diluted fluids.

This data was developed for a midrange production sample having a Refractive Index value of 1.3915.

To allow for normal variances in blending and instrument accuracy, the acceptable Refractive Index for the neat fluid is 1.3900 – 1.3930.

Note: Type IV fluids can be sensitive to hard water. Contact Proviron for more information.

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture
Trade name : Cryotech Polar Guard Advance Type IV

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Use of the substance/mixture : Aircraft Deicing/Ant-icing Fluid - complies with specification AMS 1428

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

Proviron Functional Chemicals N.V.
Oudenburgsesteenweg 100
BE- B-8400 Oostende
Belgium
T + 32 59 56 21 00 - F + 32 59 56 21 33
info@proviron.com - www.proviron.com

1.4. Emergency telephone number

Emergency number : + 32 59 56 21 00

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [EU-GHS/CLP]

Not classified

Adverse physicochemical, human health and environmental effects

No additional information available

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [EU-GHS/CLP]

No labelling required

2.3. Other hazards

Other hazards which do not result in classification : May cause eye irritation.

Contains no PBT/vPvB substances $\geq 0.1\%$ assessed in accordance with REACH Annex XIII

The mixture does not contain substance(s) included in the list established in accordance with Article 59(1) of REACH for having endocrine disrupting properties, or is not identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at a concentration equal to or greater than 0,1 %

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

3.2. Mixtures

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [EU-GHS/CLP]
Propylene glycol	CAS: 57-55-6 EC/EINECS/ELINS: 200-338-0	50	Not classified

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation	: Remove person to fresh air and keep comfortable for breathing. Get medical advice/attention if you feel unwell.
First-aid measures after skin contact	: Take off immediately all contaminated clothing. After contact with skin, wash immediately with plenty of water and soap. Get medical advice/attention if you feel unwell.
First-aid measures after eye contact	: Rinse immediately with plenty of water for 15 minutes.
First-aid measures after ingestion	: If swallowed, rinse mouth with water (only if the person is conscious). Do not induce vomiting. Get immediate medical advice and attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects after inhalation	: No significant signs or symptoms indicative of any adverse health hazard are expected to occur as a result of inhalation exposure.
Symptoms/effects after skin contact	: Not expected to be an irritant.
Symptoms/effects after eye contact	: mild eye irritation.
Symptoms/effects after ingestion	: practically non-toxic.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	: Dry powder. Carbon dioxide (CO ₂). Water spray. Alcohol-resistant foam.
Unsuitable extinguishing media	: Strong water jet.

5.2. Special hazards arising from the substance or mixture

Explosion hazard	: Aqueous solution.
------------------	---------------------

5.3. Advice for firefighters

Firefighting instructions	: Suitable extinguishing media.
Protection during firefighting	: Wear fire resistant or flame retardant clothing. Self-contained breathing apparatus.
Other information	: Do not allow run-off from fire fighting to enter drains or water courses.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	: Wear recommended personal protective equipment.
----------------------	---

6.1.2. For emergency responders

Protective equipment	: Wear recommended personal protective equipment.
----------------------	---

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

6.2. Environmental precautions

Do not discharge into drains or the environment.

6.3. Methods and material for containment and cleaning up

- | | |
|-------------------------|---|
| For containment | : Absorb remaining liquid with sand or inert absorbent and remove to safe place. Collect leaking liquid in sealable containers. |
| Methods for cleaning up | : After cleaning, flush traces away with water. |

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

- | | |
|-------------------------------|--|
| Precautions for safe handling | : Avoid contact with skin, eyes and clothing. Avoid breathing dust/fume/gas/mist/vapours/spray. |
| Hygiene measures | : Wash hands immediately after handling the product. Do not eat, drink or smoke when using this product. |

7.2. Conditions for safe storage, including any incompatibilities

- | | |
|------------------------------|--|
| Storage conditions | : Store in original container. Keep container tightly closed. Do not expose to heat. |
| Incompatible materials | : Mild steel. |
| Storage temperature | : -30 – 50 °C |
| Information on mixed storage | : Keep away from oxidizing agents. |

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 National occupational exposure and biological limit values

No additional information available

8.1.2. Recommended monitoring procedures

No additional information available

8.1.3. Air contaminants formed

No additional information available

8.1.4. DNEL and PNEC

No additional information available

8.1.5. Control banding

No additional information available

8.2. Exposure controls

8.2.1. Appropriate engineering controls

No additional information available

8.2.2. Personal protection equipment

8.2.2.1. Eye and face protection

Eye protection:

Safety glasses with side shields. (EN 166)

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

8.2.2.2. Skin protection

Skin and body protection:

Avoid repeated or prolonged skin contact. Wear suitable protective clothing

Hand protection:

Single-use gloves. PVC (Polyvinyl chloride). (EN 374)

8.2.2.3. Respiratory protection

Respiratory protection:

In order to avoid inhalation of mist/vapour, all spraying must be done wearing adequate respirator. Breathing equipment. P2

8.2.2.4. Thermal hazards

No additional information available

8.2.3. Environmental exposure controls

No additional information available

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Colour	: Green.
Odour	: odourless.
Odour threshold	: No data available
Melting point	: No data available
Freezing point	: - 37 °C
Boiling point	: > 100 °C
Flammability	: Not available
Explosive properties	: No data available.
Oxidising properties	: No data available.
Explosive limits	: No data available
Lower explosion limit	: Not available
Upper explosion limit	: Not available
Flash point	: > 100 °C No flash point - measurement carried out until boiling temperature.
Auto-ignition temperature	: > 400 °C
Decomposition temperature	: Not available
pH	: 6,4 – 7,4
Viscosity, kinematic	: Not available
Solubility	: Water: completely miscible
Partition coefficient n-octanol/water (Log Kow)	: Not available
Partition coefficient n-octanol/water (Log Pow)	: No data available
Vapour pressure	: No data available
Vapour pressure at 50°C	: Not available
Density	: Not available
Relative density	: 1,04 (20°C)
Relative vapour density at 20°C	: Not available
Particle characteristics	: Not applicable

9.2. Other information

9.2.1. Information with regard to physical hazard classes

No additional information available

9.2.2. Other safety characteristics

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

10.2. Chemical stability

Stable in use and storage conditions as recommended in item 7.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

No additional information available

10.5. Incompatible materials

Oxidizing agent.

10.6. Hazardous decomposition products

On burning: release of harmful/irritant gases/vapours e.g.: carbon monoxide - carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Acute toxicity (oral) : Not classified
Acute toxicity (dermal) : Not classified
Acute toxicity (inhalation) : Not classified

Propylene glycol (57-55-6)

LD50 oral rat	22000 mg/kg bodyweight
LD50 dermal rabbit	> 2000 mg/kg bodyweight

Skin corrosion/irritation : Not classified
pH: 6,4 – 7,4
Serious eye damage/irritation : Not classified
pH: 6,4 – 7,4
Respiratory or skin sensitisation : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified
Reproductive toxicity : Not classified
STOT-single exposure : Not classified
STOT-repeated exposure : Not classified
Aspiration hazard : Not classified

11.2. Information on other hazards

No additional information available

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : highly soluble.
Hazardous to the aquatic environment, short-term (acute) : Not classified
Hazardous to the aquatic environment, long-term (chronic) : Not classified

Cryotech Polar Guard Advance Type IV

LC50 - Fish [1]	707 mg/l (Pimephales promelas, 96 h, OECD 203)
LC50 - Other aquatic organisms [1]	> 1000 mg/l (Daphnia Magna, 48 h, OECD 202)

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

Propylene glycol (57-55-6)

LC50 - Fish [1]	40613 mg/l (Oncorhynchus mykiss, 96 h)
LC50 - Other aquatic organisms [1]	18800 mg/l (Americamysis bahia, 96 h)

12.2. Persistence and degradability

Cryotech Polar Guard Advance Type IV

Persistence and degradability	Readily biodegradable, according to appropriate OECD test.
Biochemical oxygen demand (BOD)	0,4 g O ₂ /g substance (20°C)
Chemical oxygen demand (COD)	0,82 g O ₂ /g substance (20°C)

Propylene glycol (57-55-6)

Persistence and degradability	Readily biodegradable, according to appropriate OECD test.
-------------------------------	--

12.3. Bioaccumulative potential

Cryotech Polar Guard Advance Type IV

Partition coefficient n-octanol/water (Log Pow)	No data available
---	-------------------

Propylene glycol (57-55-6)

Partition coefficient n-octanol/water (Log Pow)	- 1,07 (20.5 °C)
Bioaccumulative potential	Not expected considering the low log Pow value.

12.4. Mobility in soil

No additional information available

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Endocrine disrupting properties

No additional information available

12.7. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Regional legislation (waste)	: Disposal must be done according to official regulations.
Sewage disposal recommendations	: Sewage treatment plant.
Product/Packaging disposal recommendations	: Collect all waste in suitable and labelled containers and dispose according to local legislation.

SECTION 14: Transport information

In accordance with ADR / IMDG / IATA / ADN / RID

14.1. UN number or ID number

UN-No. (ADR)	: Not applicable
UN-No. (IMDG)	: Not applicable
UN-No. (IATA)	: Not applicable
UN-No. (ADN)	: Not applicable

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

UN-No. (RID) : Not applicable

14.2. UN proper shipping name

Proper Shipping Name (ADR) : Not applicable
Proper Shipping Name (IMDG) : Not applicable
Proper Shipping Name (IATA) : Not applicable
Proper Shipping Name (ADN) : Not applicable
Proper Shipping Name (RID) : Not applicable

14.3. Transport hazard class(es)

ADR
Transport hazard class(es) (ADR) : Not applicable

IMDG
Transport hazard class(es) (IMDG) : Not applicable

IATA
Transport hazard class(es) (IATA) : Not applicable

ADN
Transport hazard class(es) (ADN) : Not applicable

RID
Transport hazard class(es) (RID) : Not applicable

14.4. Packing group

Packing group (ADR) : Not applicable
Packing group (IMDG) : Not applicable
Packing group (IATA) : Not applicable
Packing group (ADN) : Not applicable
Packing group (RID) : Not applicable

14.5. Environmental hazards

Dangerous for the environment : No
Marine pollutant : No
Other information : No supplementary information available

14.6. Special precautions for user

Overland transport
No data available

Transport by sea
No data available

Air transport
No data available

Inland waterway transport
No data available

Rail transport
No data available

14.7. Maritime transport in bulk according to IMO instruments

Not applicable

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

REACH Annex XVII (Restriction List)

Contains no substance(s) listed on REACH Annex XVII (Restriction Conditions)

REACH Annex XIV (Authorisation List)

Contains no substance(s) listed on REACH Annex XIV (Authorisation List)

REACH Candidate List (SVHC)

Contains no substance(s) listed on the REACH Candidate List

PIC Regulation (Prior Informed Consent)

Contains no substance(s) listed on the PIC list (Regulation EU 649/2012 concerning the export and import of hazardous chemicals)

POP Regulation (Persistent Organic Pollutants)

Contains no substance(s) listed on the POP list (Regulation EU 2019/1021 on persistent organic pollutants)

Ozone Regulation (1005/2009)

Contains no substance(s) listed on the Ozone Depletion list (Regulation EU 1005/2009 on substances that deplete the ozone layer)

Explosives Precursors Regulation (2019/1148)

Contains no substance(s) listed on the Explosives Precursors list (Regulation EU 2019/1148 on the marketing and use of explosives precursors)

Drug Precursors Regulation (273/2004)

Contains no substance(s) listed on the Drug Precursors list (Regulation EC 273/2004 on the manufacture and the placing on market of certain substances used in the illicit manufacture of narcotic drugs and psychotropic substances)

15.1.2. National regulations

France

Occupational diseases	
Code	Description
RG 84	Conditions caused by liquid organic solvents for professional use: saturated or unsaturated aliphatic or cyclic liquid hydrocarbons and mixtures thereof; liquid halogenated hydrocarbons; nitrated derivatives of aliphatic hydrocarbons; alcohols; glycols, glycol ethers; ketones; aldehydes; aliphatic and cyclic ethers, including tetrahydrofuran; esters; dimethylformamide and dimethylacetamine; acetonitrile and propionitrile; pyridine; dimethylsulfone and dimethylsulfoxide

Germany

Water hazard class (WGK) : WGK 1, Slightly hazardous to water (Classification according to AwSV, Annex 1).
Hazardous Incident Ordinance (12. BImSchV) : Is not subject of the Hazardous Incident Ordinance (12. BImSchV)

Netherlands

SZW-lijst van kankerverwekkende stoffen : None of the components are listed
SZW-lijst van mutagene stoffen : None of the components are listed
SZW-lijst van reprotoxische stoffen – Borstvoeding : None of the components are listed
SZW-lijst van reprotoxische stoffen – Vruchtbaarheid : None of the components are listed
SZW-lijst van reprotoxische stoffen – Ontwikkeling : None of the components are listed

Switzerland

Storage class (LK) : LK 10/12 - Liquids

15.2. Chemical safety assessment

No additional information available

Cryotech Polar Guard Advance Type IV

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

SECTION 16: Other information

No additional information available

Safety Data Sheet (SDS), EU

Disclaimer:

The purpose of this safety data sheet is to provide information about the safety, health and environmental aspects of the product concerned. The information in this safety data sheet is based on current expertise. Proviron provides this information in good faith and to the best of its ability.

This data sheet contains no guarantees as to the suitability of the product for a particular purpose or about any particular characteristics of the product. The purchaser/consumer is personally responsible for his/her use of the product and for taking precautions appropriate to its use.

This safety data sheet was originally drafted in Dutch or English. The translations were produced using professional language databanks intended specifically for the drafting of a safety data sheet.

Proviron is not liable for any damage that may result from the use of the information in this safety data sheet.

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture
Trade name : Cryotech Polar Plus LT (80)

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Use of the substance/mixture : Aircraft Deicing/Anti-icing Fluid - complies with AMS 1424/1

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

Proviron Functional Chemicals N.V.
Oudenburgsesteenweg 100
BE- B-8400 Oostende
Belgium
T + 32 59 56 21 00 - F + 32 59 56 21 33
info@proviron.com - www.proviron.com

1.4. Emergency telephone number

Emergency number : + 32 59 56 21 00

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [EU-GHS/CLP]

Not classified

Adverse physicochemical, human health and environmental effects

No additional information available

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [EU-GHS/CLP]

No labelling required

2.3. Other hazards

Other hazards which do not result in classification : May cause eye irritation.

Contains no PBT/vPvB substances $\geq 0.1\%$ assessed in accordance with REACH Annex XIII

The mixture does not contain substance(s) included in the list established in accordance with Article 59(1) of REACH for having endocrine disrupting properties, or is not identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at a concentration equal to or greater than 0,1 %

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

3.2. Mixtures

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [EU-GHS/CLP]
Propylene glycol	CAS: 57-55-6 EC/EINECS/ELINS: 200-338-0	80	Not classified

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation	: Remove person to fresh air and keep comfortable for breathing. Get medical advice/attention if you feel unwell.
First-aid measures after skin contact	: Take off immediately all contaminated clothing. After contact with skin, wash immediately with plenty of water and soap. Wash contaminated clothing immediately.
First-aid measures after eye contact	: Rinse immediately with plenty of water for 15 minutes.
First-aid measures after ingestion	: If swallowed, rinse mouth with water (only if the person is conscious). Do not induce vomiting. Get immediate medical advice and attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects after inhalation	: Not expected to present a significant inhalation hazard under anticipated conditions of normal use.
Symptoms/effects after skin contact	: May cause slight irritation.
Symptoms/effects after eye contact	: mild eye irritation.
Symptoms/effects after ingestion	: Not expected to present a significant ingestion hazard under anticipated conditions of normal use.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	: Atomized water. Foam. Carbon dioxide (CO ₂). Dry powder.
Unsuitable extinguishing media	: Strong water jet.

5.2. Special hazards arising from the substance or mixture

Explosion hazard	: Aqueous solution.
------------------	---------------------

5.3. Advice for firefighters

Firefighting instructions	: Suitable extinguishing media.
Protection during firefighting	: Wear fire resistant or flame retardant clothing. Self-contained breathing apparatus.
Other information	: Do not allow run-off from fire fighting to enter drains or water courses.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	: Wear recommended personal protective equipment.
----------------------	---

6.1.2. For emergency responders

Protective equipment	: Wear recommended personal protective equipment.
----------------------	---

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

6.2. Environmental precautions

Do not discharge into drains or the environment.

6.3. Methods and material for containment and cleaning up

- For containment : Absorb remaining liquid with sand or inert absorbent and remove to safe place. Collect leaking liquid in sealable containers.
- Methods for cleaning up : After cleaning, flush traces away with water.

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

- Precautions for safe handling : Avoid contact with skin, eyes and clothing. Avoid breathing dust/fume/gas/mist/vapours/spray. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
- Hygiene measures : Wash hands immediately after handling the product. Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

- Storage conditions : Store in original container. Keep container tightly closed. Keep away from heat and direct sunlight.
- Storage temperature : -45 – 60 °C
- Information on mixed storage : Keep away from oxidizing agents. (strong) acids.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 National occupational exposure and biological limit values

No additional information available

8.1.2. Recommended monitoring procedures

No additional information available

8.1.3. Air contaminants formed

No additional information available

8.1.4. DNEL and PNEC

No additional information available

8.1.5. Control banding

No additional information available

8.2. Exposure controls

8.2.1. Appropriate engineering controls

No additional information available

8.2.2. Personal protection equipment

8.2.2.1. Eye and face protection

Eye protection:

Safety glasses with side shields

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

8.2.2.2. Skin protection

Skin and body protection:

Avoid repeated or prolonged skin contact. Wear suitable protective clothing

Hand protection:

Single-use gloves. PVC (Polyvinyl chloride). (EN 374)

8.2.2.3. Respiratory protection

Respiratory protection:

In order to avoid inhalation of mist/vapour, all spraying must be done wearing adequate respirator. Breathing equipment. P2

8.2.2.4. Thermal hazards

No additional information available

8.2.3. Environmental exposure controls

No additional information available

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Colour	: Orange.
Odour	: odourless.
Odour threshold	: No data available
Melting point	: No data available
Freezing point	: < -60 °C
Boiling point	: ≈ 125 °C
Flammability	: Not available
Explosive properties	: No data available.
Oxidising properties	: No data available.
Explosive limits	: No data available
Lower explosion limit	: Not available
Upper explosion limit	: Not available
Flash point	: > 100 °C
Auto-ignition temperature	: > 400 °C
Decomposition temperature	: Not available
pH	: 8,2 – 9,2
Viscosity, kinematic	: Not available
Viscosity, dynamic	: 25 cP (20°C)
Solubility	: Water: completely miscible
Partition coefficient n-octanol/water (Log Kow)	: Not available
Partition coefficient n-octanol/water (Log Pow)	: No data available
Vapour pressure	: ≈ 10 mm Hg
Vapour pressure at 50°C	: Not available
Density	: Not available
Relative density	: 1,045 (20°C)
Relative vapour density at 20°C	: Not available
Particle characteristics	: Not applicable

9.2. Other information

9.2.1. Information with regard to physical hazard classes

No additional information available

9.2.2. Other safety characteristics

No additional information available

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Stable in use and storage conditions as recommended in item 7.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

Avoid high temperatures.

10.5. Incompatible materials

Oxidizing agent. Strong acid.

10.6. Hazardous decomposition products

On burning: release of harmful/irritant gases/vapours e.g.: carbon monoxide - carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Acute toxicity (oral) : Not classified
Acute toxicity (dermal) : Not classified
Acute toxicity (inhalation) : Not classified

Cryotech Polar Plus LT (80)

LD50 oral rat	> 22 g/kg
---------------	-----------

Propylene glycol (57-55-6)

LD50 oral rat	22000 mg/kg bodyweight
---------------	------------------------

LD50 dermal rabbit	> 2000 mg/kg bodyweight
--------------------	-------------------------

Skin corrosion/irritation : Not classified
pH: 8,2 – 9,2
Serious eye damage/irritation : Not classified
pH: 8,2 – 9,2
Respiratory or skin sensitisation : Not classified
Germ cell mutagenicity : Not classified
Carcinogenicity : Not classified
Reproductive toxicity : Not classified
STOT-single exposure : Not classified
STOT-repeated exposure : Not classified
Aspiration hazard : Not classified

11.2. Information on other hazards

No additional information available

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : highly soluble.

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

Hazardous to the aquatic environment, short-term (acute) : Not classified

Hazardous to the aquatic environment, long-term (chronic) : Not classified

Cryotech Polar Plus LT (80)	
LC50 - Fish [1]	47525 mg/l (Pimephales promelas, 96h)
LC50 - Other aquatic organisms [1]	15250 mg/l (Daphnia Magnia, 48h)

Propylene glycol (57-55-6)	
LC50 - Fish [1]	40613 mg/l (Oncorhynchus mykiss, 96 h)
LC50 - Other aquatic organisms [1]	18800 mg/l (Americamysis bahia, 96 h)

12.2. Persistence and degradability

Cryotech Polar Plus LT (80)	
Persistence and degradability	Readily biodegradable, according to appropriate OECD test.
Biochemical oxygen demand (BOD)	0,64 g O ₂ /g substance (20°C,)
Chemical oxygen demand (COD)	1,24 g O ₂ /g substance (20°C)

Propylene glycol (57-55-6)	
Persistence and degradability	Readily biodegradable, according to appropriate OECD test.

12.3. Bioaccumulative potential

Cryotech Polar Plus LT (80)	
Partition coefficient n-octanol/water (Log Pow)	No data available

Propylene glycol (57-55-6)	
Partition coefficient n-octanol/water (Log Pow)	- 1,07 (20.5 °C)
Bioaccumulative potential	Not expected considering the low log Pow value.

12.4. Mobility in soil

No additional information available

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Endocrine disrupting properties

No additional information available

12.7. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Regional legislation (waste)	: Disposal must be done according to official regulations.
Sewage disposal recommendations	: Sewage treatment plant.
Product/Packaging disposal recommendations	: Collect all waste in suitable and labelled containers and dispose according to local legislation.

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

SECTION 14: Transport information

In accordance with ADR / IMDG / IATA / ADN / RID

14.1. UN number or ID number

UN-No. (ADR)	: Not applicable
UN-No. (IMDG)	: Not applicable
UN-No. (IATA)	: Not applicable
UN-No. (ADN)	: Not applicable
UN-No. (RID)	: Not applicable

14.2. UN proper shipping name

Proper Shipping Name (ADR)	: Not applicable
Proper Shipping Name (IMDG)	: Not applicable
Proper Shipping Name (IATA)	: Not applicable
Proper Shipping Name (ADN)	: Not applicable
Proper Shipping Name (RID)	: Not applicable

14.3. Transport hazard class(es)

ADR

Transport hazard class(es) (ADR)	: Not applicable
----------------------------------	------------------

IMDG

Transport hazard class(es) (IMDG)	: Not applicable
-----------------------------------	------------------

IATA

Transport hazard class(es) (IATA)	: Not applicable
-----------------------------------	------------------

ADN

Transport hazard class(es) (ADN)	: Not applicable
----------------------------------	------------------

RID

Transport hazard class(es) (RID)	: Not applicable
----------------------------------	------------------

14.4. Packing group

Packing group (ADR)	: Not applicable
Packing group (IMDG)	: Not applicable
Packing group (IATA)	: Not applicable
Packing group (ADN)	: Not applicable
Packing group (RID)	: Not applicable

14.5. Environmental hazards

Dangerous for the environment	: No
Marine pollutant	: No
Other information	: No supplementary information available

14.6. Special precautions for user

Overland transport

No data available

Transport by sea

No data available

Air transport

No data available

Inland waterway transport

No data available

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

Rail transport

No data available

14.7. Maritime transport in bulk according to IMO instruments

Not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

REACH Annex XVII (Restriction List)

Contains no substance(s) listed on REACH Annex XVII (Restriction Conditions)

REACH Annex XIV (Authorisation List)

Contains no substance(s) listed on REACH Annex XIV (Authorisation List)

REACH Candidate List (SVHC)

Contains no substance(s) listed on the REACH Candidate List

PIC Regulation (Prior Informed Consent)

Contains no substance(s) listed on the PIC list (Regulation EU 649/2012 concerning the export and import of hazardous chemicals)

POP Regulation (Persistent Organic Pollutants)

Contains no substance(s) listed on the POP list (Regulation EU 2019/1021 on persistent organic pollutants)

Ozone Regulation (1005/2009)

Contains no substance(s) listed on the Ozone Depletion list (Regulation EU 1005/2009 on substances that deplete the ozone layer)

Explosives Precursors Regulation (2019/1148)

Contains no substance(s) listed on the Explosives Precursors list (Regulation EU 2019/1148 on the marketing and use of explosives precursors)

Drug Precursors Regulation (273/2004)

Contains no substance(s) listed on the Drug Precursors list (Regulation EC 273/2004 on the manufacture and the placing on market of certain substances used in the illicit manufacture of narcotic drugs and psychotropic substances)

15.1.2. National regulations

France

Occupational diseases	
Code	Description
RG 84	Conditions caused by liquid organic solvents for professional use: saturated or unsaturated aliphatic or cyclic liquid hydrocarbons and mixtures thereof; liquid halogenated hydrocarbons; nitrated derivatives of aliphatic hydrocarbons; alcohols; glycols, glycol ethers; ketones; aldehydes; aliphatic and cyclic ethers, including tetrahydrofuran; esters; dimethylformamide and dimethylacetamine; acetonitrile and propionitrile; pyridine; dimethylsulfone and dimethylsulfoxide

Germany

Water hazard class (WGK) : WGK 1, Slightly hazardous to water (Classification according to AwSV, Annex 1).
Hazardous Incident Ordinance (12. BImSchV) : Is not subject of the Hazardous Incident Ordinance (12. BImSchV)

Netherlands

SZW-lijst van kankerverwekkende stoffen : None of the components are listed
SZW-lijst van mutagene stoffen : None of the components are listed
SZW-lijst van reprotoxische stoffen – Borstvoeding : None of the components are listed
SZW-lijst van reprotoxische stoffen – Vruchtbaarheid : None of the components are listed
SZW-lijst van reprotoxische stoffen – Ontwikkeling : None of the components are listed

Cryotech Polar Plus LT (80)

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

Switzerland

Storage class (LK) : LK 10/12 - Liquids

15.2. Chemical safety assessment

No additional information available

SECTION 16: Other information

No additional information available

Safety Data Sheet (SDS), EU

Disclaimer:

The purpose of this safety data sheet is to provide information about the safety, health and environmental aspects of the product concerned. The information in this safety data sheet is based on current expertise. Proviron provides this information in good faith and to the best of its ability.

This data sheet contains no guarantees as to the suitability of the product for a particular purpose or about any particular characteristics of the product. The purchaser/consumer is personally responsible for his/her use of the product and for taking precautions appropriate to its use.

This safety data sheet was originally drafted in Dutch or English. The translations were produced using professional language databanks intended specifically for the drafting of a safety data sheet.

Proviron is not liable for any damage that may result from the use of the information in this safety data sheet.

Cryotech Polar Plus® LT (80) Type I Aircraft De-/Anti-icing Fluid

Concentration (% Volume)	Refractive Index (20°C)	Freeze Point (°C)	LOUT (°C)	Concentration (% Volume)	Refractive Index (20°C)	Freeze Point (°C)	LOUT (°C)	Concentration (% Volume)	Refractive Index (20°C)	Freeze Point (°C)	LOUT (°C)
0	1,3330	0,0	10,0	25	1,3552	-7,3	2,7	50	1,3781	-23,3	-13,3
1	1,3338	0,0	10,0	26	1,3561	-7,8	2,2	51	1,3790	-24,2	-14,2
2	1,3347	-0,1	9,9	27	1,3570	-8,3	1,7	52	1,3799	-25,1	-15,1
3	1,3356	-0,1	9,9	28	1,3579	-8,8	1,2	53	1,3808	-25,9	-15,9
4	1,3364	-0,2	9,8	29	1,3589	-9,3	0,7	54	1,3817	-26,8	-16,8
5	1,3373	-0,4	9,6	30	1,3598	-9,9	0,1	55	1,3826	-27,8	-17,8
6	1,3382	-0,6	9,4	31	1,3607	-10,4	-0,4	56	1,3835	-28,7	-18,7
7	1,3391	-0,7	9,3	32	1,3616	-11,0	-1,0	57	1,3844	-29,7	-19,7
8	1,3400	-0,9	9,1	33	1,3625	-11,6	-1,6	58	1,3852	-30,7	-20,7
9	1,3408	-1,2	8,8	34	1,3635	-12,2	-2,2	59	1,3861	-31,7	-21,7
10	1,3417	-1,4	8,6	35	1,3644	-12,7	-2,7	60	1,3870	-32,8	-22,8
11	1,3426	-1,7	8,3	36	1,3653	-13,3	-3,3	61	1,3879	-33,9	-23,9
12	1,3435	-2,0	8,0	37	1,3662	-14,0	-4,0	62	1,3887	-35,1	-25,1
13	1,3444	-2,3	7,7	38	1,3671	-14,6	-4,6	63	1,3896	-36,2	-26,2
14	1,3453	-2,6	7,4	39	1,3681	-15,3	-5,3	64	1,3904	-37,4	-27,4
15	1,3462	-2,9	7,1	40	1,3690	-15,9	-5,9	65	1,3913	-38,7	-28,7
16	1,3470	-3,3	6,7	41	1,3699	-16,6	-6,6	66	1,3922	-40,0	-30,0
17	1,3480	-3,7	6,3	42	1,3708	-17,3	-7,3	67	1,3930	-41,3	-31,3
18	1,3488	-4,1	5,9	43	1,3717	-18,0	-8,0	68	1,3938	-42,7	-32,5
19	1,3498	-4,5	5,5	44	1,3727	-18,7	-8,7	69	1,3946	-44,1	-32,5
20	1,3506	-4,9	5,1	45	1,3736	-19,4	-9,4	70	1,3955	-45,6	-33,0
21	1,3516	-5,4	4,6	46	1,3745	-20,2	-10,2				
22	1,3525	-5,8	4,2	47	1,3754	-20,9	-10,9				
23	1,3534	-6,3	3,7	48	1,3763	-21,7	-11,7				
24	1,3543	-6,8	3,2	49	1,3772	-22,5	-12,5				

**Cryotech Polar Plus® LT (80)
Type I Aircraft De-/Anti-icing Fluid**

In-Service Limits		
100% Polar Plus LT (80) @ 20°C	pH	8,0 - 9,2
	Refractive Index	1,4165 - 1,4195
	Specific Gravity	1,03 - 1,06
Polar Plus LT (80) all dilutions @ 20°C	pH	6,5 - 9,2
70% Polar Plus LT (80)	LOUT	-33° C



provifrost

a proviron brand



Cryotech

POLAR GUARD[®] ADVANCE

Type IV Aircraft De- / Anti-icing Fluid
AMS 1428 Certified

Benefits

- Lowest LOU^T in the Industry
- Good storage / shear stability
- Long Holdover Times in all weather conditions
- Low viscosity provides easier handling and application
- Dedicated technical support; experienced with product transitions
- Certified propylene glycol based Type IV aircraft de-icing / anti-icing fluid



Performance

- Superior sprayability - low foaming
- May be applied heated or cold, diluted or neat
- Low dry out residues
- Lowest Operational Use Temperature (LOUT) is:

Dilution	Temperature
Neat	-30,5°C
75/25	-14° C
50/50	-3° C

- Two year product warranty (original sealed container; stored within temperature storage limits)

Environment

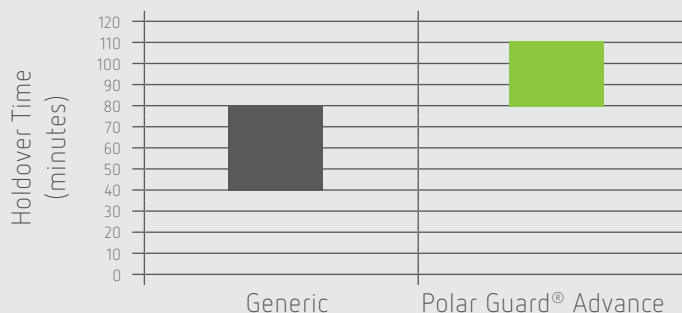
- Triazole free
- Does not contain nonyl phenol ethoxalate surfactants
- Readily biodegradable
- Classified as non-hazardous

Handling

- Avoid contact with skin and eyes
- Avoid breathing mists/vapors when spraying
- Keep in tightly sealed containers, away from direct heat, sunlight, and strong oxidizing agents
- Do not store in extreme temperatures; below -30°C or above 60°C
- Contact Provion for advice on bulk and/or heated storage

Cryotech Polar Guard® Advance specifications	
Composition	Contains minimum 50% propylene glycol
Appearance	Semi-transparent, green colour (or colourless)
Viscosity*	Minimum on-wing 4050 mPa.s
	In Service Limits
	Neat 4050 - 16200 mPa.s
	75/25 9750 - 38000 mPa.s
50/50 80 - 48000 mPa.s	
Sales specification	8000 - 15000 mPa.s
*Brookfield LVT, Spindle No. 1 @ 0,3 rpm @ 20°C	
Flash point	Not lower than 100°C
Freezing point	100/0 = Below -37,6°C 50/50 = -10,6°C
Temperature storage limits	Minimum -30°C Maximum 60°C
Refractive index	At 20°C Neat = 1,3900 - 1,3930 75/25 = 1,3768 - 1,3809 50/50 = 1,3622 - 1,3663
Surface tension	At 20°C = 31,3 dynes/cm
pH at 20°C	Neat = 6,4 - 7,4 75/25 = 6,4 - 7,4 50/50 = 6,0 - 7,4
Storage stability	2 years in the original sealed container when stored within temperature storage limits
Specific gravity	At 20°C = 1,040 ± 0,015
Packaging	1000 liter IBC Bulk

Snow/Snow Grains -3°C and Above 100/0





provifrost

a proviron brand



Cryotech

POLAR PLUS[®] LT (80)

Type I Aircraft De- / Anti-icing Fluid
AMS 1424/1 certified

Benefits

- Even dispersal for superior wetting
- Industry leading low Aquatic Toxicity
- Easy to apply with existing equipment
- Dilutes to required temperature for economical savings
- Certified propylene glycol based Type I aircraft de-icing / anti-icing fluid
- Extremely low foaming fluid (easier handling, better visual contamination check)



Performance

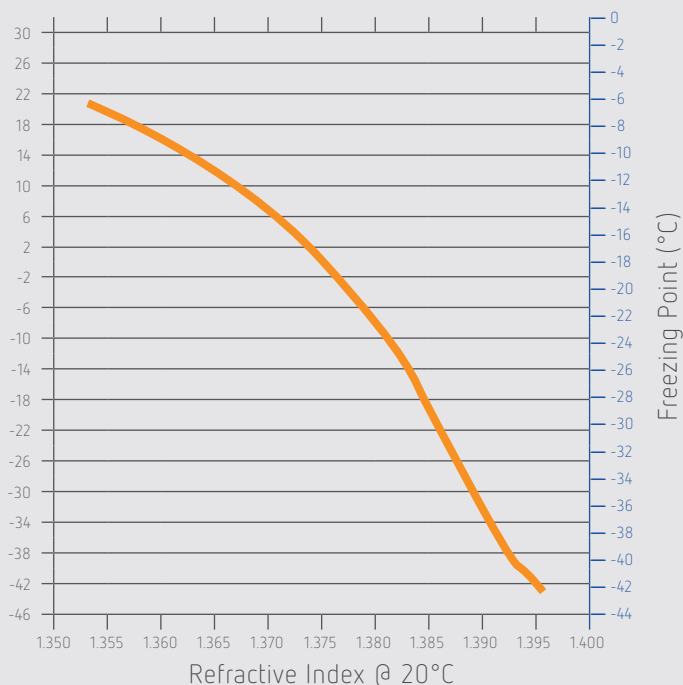
- Two year product warranty (original sealed container; stored within temperature storage limits)
- Exhibits a Lowest Operational Use Temperature (LOUT) of -33°C at a 70% Polar Plus LT (80)/30% water dilution

Environment

- Triazole free
- Does not contain nonyl phenol ethoxylate surfactants
- Readily biodegradable
- Classified as non-hazardous
- Aquatic Toxicity:

Aquatic Species	Test Duration Hours	LC 50 Concentrate Fluid mg/L	Test Method
Pimephales promelas	96	47525	EPA 40CFR797.1400
Daphnia magna	48	15250	EPA 40CFR797.1300

Freezing Point vs. Refractive Index @ 20°C



Handling

- Avoid contact with skin and eyes
- Avoid breathing mists/vapors when spraying
- Keep in tightly sealed containers, away from direct heat, sunlight, and strong oxidizing agents
- Store away from extreme temperatures; below -45°C or above 60°C
- Contact Proviron for advice on bulk and/or heated storage

Cryotech Polar Plus® LT (80) specifications

Composition	Contains minimum 80% propylene glycol
Appearance	Orange liquid
Viscosity	Brookfield LV DV-1, Spindle No. LV1 @ 12rpm @ 20°C = 25 mPa.s
Flash point	Not lower than 100°C
Freezing point	100/0 = Below -53,9°C 50/50 = Not higher than -23,3°C
Refractive index	At 20°C = 1,4165 - 1,4195
Surface tension	At 20°C = 37,1 dynes/cm
Storage stability	2 years under normal storage conditions
Typical pH	At 20°C = 8,2 - 9,2
Specific gravity	At 20°C = 1,045
Packaging	1000 liter IBC Bulk

**MULTIPLE LOCATION
QUALIFICATION TEST REPORT**

**FW-15-101
LARGE TRANSPORT TYPE JET
AIRCRAFT AERODYNAMIC AND
ANTI-ICING ENDURANCE TIME TESTING
OF THE CANDIDATE TYPE I FLUID**

**Polar Plus® LT (80)
lot # 20150817GVH**

Produced at Proviron, Oostende

for

**CRYOTECH DEICING TECHNOLOGY
6103 Orthoway
Fort Madison IA 52627 USA**

by

**Diane Paradis
Marc Mario Tremblay**



Laboratoire international
des matériaux antigivre

LIMA  AMIL

Anti-icing Materials
International Laboratory

September 2015

MULTIPLE LOCATION QUALIFICATION

This report presents results of aerodynamic and anti-icing endurance testing performed on samples of the candidate Type I fluid **CRYOTECH DEICING TECHNOLOGY Polar Plus® LT (80) lot # 20150817GVH**, produced at **Proviron, Oostende**. These tests were performed according to a multiple location qualification (section 4.4.3 of AMS 1424L); for the original qualification of this fluid, see AMIL reports WH-14-97, FP-14-97 and FP-14-98.

To evaluate the anti-icing endurance, a single Water Spray Endurance Test (WSET) was performed in a climatic chamber according to the latest revision of the SAE AMS 1424L specification [1] and AS5901C standard [2]. This fluid was diluted 50/50 with hard water and sheared prior to the test. The required minimum anti-icing endurance time for a Type I fluid is 3 minutes. **The candidate Type I fluid, CRYOTECH DEICING TECHNOLOGY Polar Plus® LT (80) lot # 20150817GVH, average WSET anti-icing endurance time for the 50/50 dilution is 4 min 52 s ± 8 s.**

The high speed ramp aerodynamic acceptance tests, using Boundary Layer Displacement Thickness (BLDT) values, are performed on the candidate fluid diluted with ASTM D1193 [3] TYPE IV water according to the latest revision of the SAE AMS 1424L specification [1] and AS5900B standard [4]. The aerodynamic tests were performed between 0°C and -34°C within a ± 2°C range, using the flat plate set-up in the Luan Phan refrigerated wind tunnel at the Anti-icing Materials International Laboratory (AMIL) research laboratory. AMIL is independent from fluid manufacturers and was found qualified on September 11, 1997 (reconfirmed September 13, 2012) by the Performance Review Institute according to PRI document AC3001, “audit criteria for compliance to SAE AMS 1424 and AMS 1428”.

On the basis of the acceptance criteria, the candidate Type I fluid CRYOTECH DEICING TECHNOLOGY Polar Plus® LT (80) lot # 20150817GVH, qualifies according to AMS 1424L specification for use on large transport type jet aircraft in the following temperature ranges:

- above -32°C in the case of the 70/30 dilution,
- above -20°C in the case of the 50/50 dilution.

Final Fluid Thickness (paragraph 3.5.3.1)

The final fluid thickness, based on an initial thickness of 2000 µm, was measured to be from 25 µm to 254 µm for all dilutions, therefore is not greater than the maximum acceptable thickness of 400 µm.

This fluid is qualified from 2015 September 22, under section 4.4.3 of AMS 1424L.

FW-15-101



AMIL, 2015-09-22

Attn: Quality Manager
Cryotech Deicing Technology
6103 Orthoway
Ft. Madison, IA 52627-9415

Date: 13-Jun-2011

SMI/REF: 1104-340_{R2}
Report revised for product name change

Product: **Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)***
**Additional sample received 06-Jun-2011 &, 21-Jun-2011*

Dilution: Per specification

Page 1 of 16

AMS 1428G

FLUID, AIRCRAFT DEICING/ANTI-ICING,
NON-NEWTONIAN, (PSEUDOPLASTIC), SAE TYPES II, III, AND IV

3.1.3 Appearance	<u>Conforms</u>
3.1.4 Environmental Information	
3.1.4.1 Biological Oxygen Demand (BOD)	<u>Informational</u>
3.1.4.2 Total Oxygen Demand (TOD)	<u>Informational</u>
3.1.4.3 Biodegradability	<u>Informational</u>
3.1.4.4 Aquatic Toxicity	<u>Informational</u>
3.1.5 Trace Contaminants	<u>Informational</u>
3.2 Physical Properties	
3.2.1 Fluid As Received in Neat Form	
3.2.1.1 Flash Point	<u>Conforms</u>
3.2.1.2 Specific Gravity	<u>Informational</u>
3.2.1.3 pH	<u>Informational</u>
3.2.1.4 Refractive Index	<u>Informational</u>
3.2.1.5 Surface Tension	<u>Informational</u>
3.2.2 Fluid Stability	
3.2.2.1 Thermal Stability - Accelerated Aging	<u>Conforms</u>
3.2.2.2 Exposure to Dry Air	<u>¹Does not conform (3.2.2.2.1)</u>
3.2.2.3 Dry-out by Exposure to Cold Dry Air	<u>Conforms</u>
3.2.2.4 Successive Dryout and Rehydration	<u>Conforms</u>
3.2.2.5 Thin Film Thermal Stability	<u>Conforms</u>
3.2.2.6 Storage Stability	<u>Not performed</u>
3.2.2.7 Shear Stability	<u>Not performed</u>
3.2.2.8 Hard Water Stability	<u>Conforms</u>
3.2.2.9 Tendency to Foam	<u>Not performed</u>
3.2.2.10 Cold Storage Stability	<u>Informational</u>

¹Note: Fluid exceeds viscosity limit and therefore must be tested in accordance with 3.2.2.2.2 to determine the percent weight loss and aerodynamic performance after exposure to a simulated dry air environment.

Client: Cryotech Deicing Technology Date: 13-Jun-2011
 Product: **Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)***
 Dilution: Per specification SMI/REF: 1104-340R2
 Report revised for product name change


AMS 1428G

Page 2 of 19

3.2.3 Rheological Properties	
3.2.3.1 Viscosity	<u>Informational</u>
3.2.4 Anti-icing Performance	<u>Not performed</u>
3.2.5 Aerodynamic Acceptance	<u>Not performed</u>
3.3 Fluid Tested Both Neat and as a Diluted Solution	
3.3.1 Freezing Point	<u>Conforms</u>
3.3.2 Effect on Aircraft Materials	
3.3.2.1 Sandwich Corrosion	<u>Conforms</u>
3.3.2.2 Total Immersion Corrosion	<u>Does not conform (AMS 5045)²</u>
3.3.2.2 Total Immersion Corrosion	<u>Conforms (AMS 5045)²</u>
3.3.2.3 Low Embrittling Cadmium Plate	<u>Conforms</u>
3.3.2.4 Stress-Corrosion Resistance	
AMS 4911	<u>Conforms</u>
AMS 4916	<u>Informational</u>
3.3.2.5 Hydrogen Embrittlement (as received)	<u>Does not conform³</u>
3.3.2.5 Hydrogen Embrittlement (dilute 1:1)	<u>Conforms³</u>
3.3.2.5 Hydrogen Embrittlement (as received)	<u>Conforms³</u>
3.3.2.5 Hydrogen Embrittlement (dilute 1:1)	<u>Not performed³</u>
3.3.2.6 Effect on Transparent Plastics	
MIL-P-25690	<u>Conforms</u>
MIL-P-83310	<u>Conforms</u>
3.3.3 Effect on Painted Surfaces	<u>Conforms</u>
3.3.4 Effect on Unpainted Surfaces	<u>Conforms</u>
3.3.5 Pavement Compatibility	
3.3.5.1 Runway Concrete Scaling Resistance	<u>Conforms</u>

²Note: Original sample submitted on 19-Apr-2011 did not conform on AMS 5045 carbon steel alloy. Additional sample received 21-Jun-2011 conformed on AMS 5045 carbon steel alloy.

³Note: Original sample submitted on 19-Apr-2011 did not conform on Hydrogen Embrittlement using the product "as received". Additional sample received 06-Jun-2011 conformed on Hydrogen Embrittlement using the product "as received".

Respectfully submitted,

 Patricia D. Viani, SMI Inc.

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 3 of 16

3.1.3 Appearance: Fluid, as received by purchaser, shall be homogeneous, uniform in color, see Table 1, and free from skins, lumps, and foreign materials, which would be detrimental to usage of the product. Fluid may be clear or translucent - as described by the manufacturer.

As received fluid: Green (Type IV), homogeneous, free from foreign materials.

Result Conforms

3.1.4 Environmental Information: Formulated fluid shall be tested in accordance with APHA "Standard Methods for the Examination of Water and Waste Water". The manufacturer shall provide results for not less than the following:

3.1.4.1 Biochemical Oxygen Demand of fluid shall be determined. The test solution shall be incubated at 20°C (68°F) for 5, 15, 20, or 28 days dependent upon the method chosen.

BOD = 0.40 kg O₂/kg fluid

Result Informational

3.1.4.2 Total Oxygen Demand (TOD) or Chemical Oxygen Demand (COD) of the fluid, expressed in Kilograms of oxygen per kilogram of fluid.

COD = 0.82 kg O₂/kg fluid

Result Informational

3.1.4.3 Biodegradability: This characteristic can be approximated by determining the ratio of BOD and TOD or COD. The percent of fluid biodegraded can be calculated by dividing BOD by TOD or COD, and shall be reported for all incubation time periods.

BOD/COD = 0.40 / 0.82 = 0.49

Result Informational

3.1.4.4 Aquatic Toxicity: Formulated fluids shall be tested in accordance with EPA 40 CFR 797.1300 and 794.14, revised July 1, 1989, or OECD (Organization for Economic Cooperation and Development Guidelines for Testing of Chemicals), methods 202 and 203 using test species required by regulatory agencies for permitted discharges. Examples include: fathead minnows, daphnia magna and rainbow trout. The LC₅₀ concentration, (the highest concentration at which 50% of the organisms do not survive the test period) shall be stated in milligrams per liter.

EPA 40 CFR 797.1300 DAPHNID ACUTE TOXICITY TEST

Daphnia magna, static system: **48 hour LC₅₀: 1,825 mg/L**

EPA 40 CFR 797.1400 FISH ACUTE TOXICITY TEST

Pimephales promelas, static system: **96 hour LC₅₀: 225 mg/L**

Result Informational

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 4 of 16

3.1.5 Trace Contaminants: Report the presence, in percentages by weight or parts per million by weight, of sulfur, halogens, phosphate, nitrate, and heavy metals (lead, chromium, cadmium, and mercury). Report the test method used and detection limits.

Sulfur:	<2 ppm (<0.0002 %)
Halogens:	<10 ppm (<0.0010 %)
Phosphate (P as P₂O₅):	158 ppm (0.0158 %)
Nitrate (as NO₃ - N):	< 2 ppm (< 0.0002 %)
Heavy Metals:	
Lead (Pb):	< 1 ppm (< 0.0001 %)
Chromium (Cr):	< 1 ppm (< 0.0001 %)
Cadmium (Cd):	< 1 ppm (< 0.0001 %)
Mercury (Hg):	< 1 ppm (< 0.0001 %)

Result Informational

3.2 Physical Properties: The fluid shall conform to the following requirements; tests shall be performed in accordance with specified test methods.

3.2.1 Fluid As Received in Neat Form: Shall be as follows.

3.2.1.1 Flash Point: Shall be not lower than 100°C (212°F), determined in accordance with ASTM D 93 or ASTM D 3278. In case of dispute, flash point determined in accordance with ASTM D93 shall apply.

No flash to 100°C (212°F)

Result Conforms

3.2.1.2 Specific Gravity: Shall be within ± 0.015 units of the preproduction value, determined in accordance with ASTM D 891, Method C, or ASTM D 4052.

Specific gravity: 1.058

Result Informational

3.2.1.3 pH: Shall be within ± 0.5 units of the preproduction value, determined in accordance with ASTM E70.

pH: 6.8

Result Conforms

3.2.1.4 Refractive Index: Shall be within ± 0.0015 units of the preproduction value, determined in accordance with ASTM D 1747.

Refractive index: 1.3885

Result Informational

Client: Cryotech Deicing Technology
 Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
 Dilution: Per specification

Date: 13-Jun-2011
 SMI/REF: 1104-340R2
 Report revised for product name change

AMS 1428G

Page 5 of 16

3.2.1.5 Surface Tension: Shall be within $\pm 10\%$ of the preproduction value at $20^{\circ}\text{C} \pm 2$ ($68^{\circ}\text{F} \pm 4$), determined in accordance with ASTM D 1331.

Surface tension: 31.3 dynes / cm

Result Informational

3.2.2 Fluid stability:

3.2.2.1 Thermal stability - Accelerated Aging (to simulate long term heated storage without water loss): Age sample, as in 3.2.2.1.1 and examine as in 3.2.2.1.2.

3.2.2.1.1 Transfer 800 ± 10 ml of fluid into a 1-liter borosilicate bottle (e.g., Pyrex® brand or equivalent) fitted with a tight, heat-resistant plastic seal and tightly close. For the reference sample, also keep 800 ± 10 ml of the fluid in an identical bottle and store at room temperature until the completion of 3.2.2.1.2 Transfer the other closed bottle containing the test fluid to a circulating-air oven or heated oil or water bath. Elevate the temperature to $70^{\circ}\text{C} \pm 2$ ($158^{\circ}\text{F} \pm 4$) and maintain the test sample in this environment for 30 days.

3.2.2.1.2 After 30 days, remove the test sample from the heated environment and examine the contents for evidence of separation, precipitation, or insoluble deposits. Report any evidence of these factors. Allow the sample to cool to $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($68^{\circ}\text{F} \pm 4^{\circ}\text{F}$). Turn the test sample bottle upside down and then right side up. Repeat this rotation procedure three additional times and then examine the contents for evidence of separation, precipitation or insoluble deposits versus the un-heated reference sample. Report findings. Determine the refractive index of the test and reference samples as in 3.2.1.4 If the test and reference samples have a refractive index difference of greater than 0.0020, the test is invalid. If the test is valid, measure viscosity at $0^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($32^{\circ}\text{F} \pm 4^{\circ}\text{F}$) as in 3.2.3.2 using a spindle speed of 0.3 rpm and pH as in 3.2.1.3. Compare and record the results of the heat-aged test sample and the unheated reference sample. The viscosity shall neither be reduced by more than 20% nor be increased by more than 10%. The pH difference shall not be greater than 1.0 unit. The heat-aged test sample shall be tested according to AS 5901 (WSET only) using one set of three plates. Report the results of the test.

THERMAL STABILITY RESULTS

	UNHEATED REFERENCE (AS RECEIVED)	HEAT-AGED 30 DAYS/ 70°C (AS RECEIVED)
Separation, precipitation or insoluble deposits (examined after 30 days)	None	None
Separation, precipitation or insoluble deposits after cooling to 20°C and inverting four times	None	None
Refractive index	1.3885	1.3886
pH	6.8	6.7
Viscosity (LV2, 0.3 rpm, 0°C)	39,891 cPs	43,390 cPs

Test is valid since values for refractive index are within 0.0020.

pH difference is not greater than 1.0 unit. Viscosity increased by 8.8%

Result Conforms

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 6 of 16

3.2.2.1 Thermal stability - Accelerated Aging (continued):

WSET testing of Thermal Stability Sample

Result Not performed

3.2.2.2 Exposure to Dry Air (to simulate fluid behavior following overnight exposure to dry air):

The fluid shall be tested in accordance with 3.2.2.2.1. If the fluid after losing 20% of its original weight, exceeds the viscosity limit defined in 3.2.2.2.1, the fluid shall then be tested in accordance with 3.2.2.2.2 to determine the percent weight loss and aerodynamic performance after exposure to a simulated dry air environment. Results from Successive Dryout & Rehydration (3.2.2.4) test should also be reviewed to ensure that any fluid that fails to meet the viscosity limit defined in 3.2.2.2.1 will not result in high levels of dried residue and/or gel formation.

3.2.2.2.1 The fluid, after exposure to a dry air environment which results in a weight reduction of $20\% \pm 1$, shall have a viscosity not exceeding 500 mPa.s, when measured at 3.0 rpm and with spindle LV1 with sample at $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($68^{\circ}\text{F} \pm 4^{\circ}\text{F}$) using the method described in 3.2.3.2.1.

3.2.2.2.1.1 Pour approximately 800 ml of fluid into a pre-weighted glass tray with the following approximate dimensions 200 x 200 x 50 mm. Weigh the tray and contents to the nearest 2 grams, record the weight. Place this tray with its contents into an environment with air temperature at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 6^{\circ}\text{F}$) and the relative humidity not greater than 50% and preferably in the 30 to 45% range. Periodically weigh the tray and contents. When the weight of the fluid is $20\% \pm 1$ lower than its initial weight, pour 500 ml ± 10 of the fluid into a 600 ml beaker. Allow to cool to $20^{\circ}\text{C} \pm 2$ ($68^{\circ}\text{F} \pm 4$) and test for viscosity.

Viscosity after weight reduction = 1078 mPa.s (1078 cPs)

Result ³Does not conform (3.2.2.2.1)

³Note: Fluid exceeds viscosity limit and therefore must be tested in accordance with 3.2.2.2.2 to determine the percent weight loss and aerodynamic performance after exposure to a simulated dry air environment.

3.2.2.2.2 The fluid shall be tested to determine the percent weight loss obtained under simulated conditions defined in 3.2.2.2.2.1. Fluid at this weight loss shall meet aerodynamic performance requirements in accordance with AS59000 by performing three runs of the aerodynamic acceptance test (3.2.5.2) at $-5^{\circ} \pm 2$ ($23^{\circ}\text{F} \pm 4$) and speed ramp(s) used for preproduction tests of the Neat fluid.

Result Test to be performed by AMIL

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 7 of 16

3.2.2.3 Dry-out by Exposure to Cold Dry Air (to simulate fluid dry out in cold air on the ramp and on the aircraft including aerodynamically quiet areas): Test as per 3.2.2.3.1 and 3.2.2.3.2.

3.2.2.3.1 Using a cold chamber, position three plates, inclined at an angle of 2 degrees from the horizontal. Pour 100 to 150 ml of fluid on each plate. Set the air and plate temperatures at $1^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ($34^{\circ}\text{F} \pm 2^{\circ}\text{F}$). Relative humidity less than 40%, and the air moving from the top over the surface towards the bottom of the plates at approximately 2.5 m/s (5.6 mph). Maintain these conditions until the fluid has dried or for 24 hours. Examine the remaining residues. A gel, gum (tacky feel), hard granular solid, or peelable film are not acceptable

3.2.2.3.2. Remove the plates from cold chamber and allow them to warm to $5^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($41^{\circ}\text{F} \pm 4^{\circ}\text{F}$) and rinse each plate with 500 ml water, conforming to ASTM D 1193 Type IV, at $15^{\circ}\text{C} \pm 10^{\circ}\text{C}$ ($59^{\circ}\text{F} \pm 18^{\circ}\text{F}$) from a 1 liter squeeze bottle. Report the appearance of the plates after rinsing. Only plates free of residue are acceptable. After rinsing allow the plates to dry at room temperature. Report the appearance of the plates after drying.

***Gels, gums, hard or peelable films did not form.
Plates were free from residue after rinsing.***

Result Conforms

3.2.2.4 Successive Dryout and Rehydration (to simulate the formation of dried residues and for such to form gels upon rehydration): Fluid shall be tested in accordance with Appendix A and results reported. The weight on rehydration for all 10 dips must not be greater than 4 g.

***100% - maximum weight on rehydration: 1.6 grams
75% - maximum weight on rehydration: 1.9 grams
50% - maximum weight on rehydration: 1.9 grams***

See "Appendix A" for data (attached)

Result Conforms

3.2.2.5 Thin Film Thermal Stability (to simulate heated leading edge dryout)

Test as per 3.2.2.5.1, 3.2.2.5.2 and 3.2.2.5.3

3.2.2.5.1 At ambient temperature pour 40 to 50 ml of the fluid on to each of two unpainted aluminum or aluminum alloy test panels, approximately 152.5 x 50 mm (6inches x 2 inches). After 5 minutes, place the panels, inclined at an angle of 10 degrees from the horizontal, in an oven maintained at $95^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($203^{\circ}\text{F} \pm 4^{\circ}\text{F}$). After 60 minutes ± 1 , remove the panels, allow them to cool to ambient temperature, and inspect. Report the appearance. A gel, gum (tacky feel), hard granular solid or peelable film are not acceptable.

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 8 of 16

3.2.2.5.2 Rinse each plate with 500 ml water, conforming to ASTM D 1193 Type IV, at $15^{\circ}\text{C} \pm 10^{\circ}\text{C}$ ($59^{\circ}\text{F} \pm 18^{\circ}\text{F}$) from a 1 liter squeeze bottle positioned not closer than 20 cm from the surface. Report the appearance of the plates after rinsing. Only plates free of residue are acceptable. After rinsing, allow the plates to dry at room temperature. Report the appearance of the plates after drying.

Gels, gums, hard or peelable films did not form.
Plates were free from residue after rinsing.

Result Conforms

3.2.2.5.3 Repeat test as in 3.2.2.5.1 and 3.2.2.5.2 except the oven temperature shall be at $48^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($118^{\circ}\text{F} \pm 4^{\circ}\text{F}$). Report results of both tests

Gels, gums, hard or peelable films did not form.
Plates were free from residue after rinsing.

Result Conforms

3.2.2.6 Storage Stability (to simulate storage in tanks):

Prior to the start of this test, the viscosity shall be determined at $20^{\circ}\text{C} \pm 2$ ($68^{\circ}\text{F} \pm 4$) in accordance with 3.2.3.2. The fluid shall be tested in accordance with ASTM F1105, except that the sample shall be protected from exposure to UV light. Upon completion of the test, the fluid shall be retested for viscosity as before and the result compared to the original values. Both results shall fall within the limits determined in 3.2.3.3.

Result Not performed

3.2.2.7 Shear Stability:

The anti-icing performance tests as in 3.2.4 shall start within 2 hours after the product has been sheared, but not within the first 20 minutes after shearing using the laboratory method as in 3.2.2.7.1.

3.2.2.7.1 Run a laboratory blender (Waring model number 7012G or equivalent) with the 1 liter glass mixing container removed for a 5 minute warming period at $3000 \text{ rpm} \pm 100 \text{ rpm}$. Pour $500 \text{ ml} \pm 5 \text{ ml}$ of fluid at $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($68^{\circ}\text{F} \pm 4^{\circ}\text{F}$) into the 1 liter mixing container. Mix for $5 \text{ minutes} \pm 10 \text{ seconds}$ at 2000 rpm . The blender shall be calibrated using a non-contact optical tachometer to provide a mix speed of $2000 \text{ rpm} \pm 100 \text{ rpm}$ using 500 ml of water. This non-contact calibration can be performed by placing the blender on a stand and elongating the rotating shaft at the base to measure the rotation speed with the mixing container in place.

Result Not performed

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 10 of 16

3.2.2.9 Tendency to Foam: At the option of the user, the vendor shall demonstrate that fluid as supplied or in intended use dilutions and heated to intended use temperatures, applied through commercial deicing/anti-icing vehicle systems to an inclined flat or curved surface, preferably an aircraft wing or horizontal stabilizer, at pressures and flow rates normal for the intended use, does not cause foam which does not rapidly collapse, and fluid surface shall not have the appearance of snow or slush.

Result Not performed

Cold Storage Stability (to simulate the stability of the fluid cycling between cold temperature and room temperature).

Prior to the start of this test the sample shall be visually examined to determine freedom from insoluble deposits. Report any evidence of these factors. Determine the pH in accordance with 3.2.1.3. Determine the refractive index in accordance with 3.2.1.4. Determine the viscosity in accordance with 3.2.3. 2, ASTM D2196, Method B, except the sample shall not be shaken, using a Brookfield LV viscometer or equivalent, fitted with the guardleg and appropriate spindle for the speed selected. Values shall be taken at a spindle speed of 0.3 rpm at 20° C ± 2° C (68° F ± 4° F). The report shall clearly state the size and type of spindle used.

3.2.2.10.1 Transfer 2.0 liters of fluid in an appropriate 2.5 liter container (ex: high density polyethylene-HDPE, glass separatory funnel, etc.) with a well-closed cap. Transfer the closed container containing the sample of fluid to a freezer. Maintain the sample at - 20° C ± 2° C (- 4° F ± 4° F) for 24 hours. After 24 hours, remove the closed container containing the fluid sample from the freezer. Allow the sample to stand at 20° C ± 2° C (68° F ± 4° F) for 24 hours. Repeat the cycling between - 20° C and 20° C for 5 complete cycles. An example of the cycling period is shown in Table 2.

Table 2 – FLUID CYCLING PERIOD

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
- 20° C	20° C	- 20° C	20° C	- 20° C	20° C	- 20° C	20° C	- 20° C	20° C

3.2.2.10.2 Upon completion of the cycling, the fluid shall be visually examined for evidence of separation, precipitation or insoluble deposits. Report any visual observations. Allow fluid to equilibrate to room temperature. Siphon/extract 1 liter from the top portion of the fluid sample, ensuring that the tip of the siphon hose remains 2 inches beneath the surface of the fluid, and transfer the top portion into a separate container (labeled top). Siphon/extract 1 liter from the bottom portion, ensuring that the tip of the siphon hose remains at the bottom of the container, and transfer the bottom portion into a separate container (labeled bottom). The top and bottom portions of the fluid sample shall be retested as before for pH, refractive index, and viscosity in accordance with 3.2.2.10 and the results compared to the original values.

Client: Cryotech Deicing Technology
 Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
 Dilution: Per specification

Date: 13-Jun-2011
 SMI/REF: 1104-340R2
 Report revised for product name change

AMS 1428G

Page 11 of 16

	Original values	Cycled product	
		Top portion	Bottom portion
pH	6.8	6.9	6.9
refractive index	1.3885	1.3884	1.3883
Viscosity (LV2 , 0.3 rpm, 20°C)	15,900	15,696	15,496
separation/ insoluble deposits	none	none	none

"Top" viscosity decreased by 1.3%

"Bottom" viscosity decreased by 2.5%

Result Informational

3.2.3 Rheological Properties: The special rheological properties defined in 3.2.3.1 and relate to thickened fluids which are classed as non-Newtonian, pseudoplastic as defined in 1.1.2 and 1.1.3 and are specified to ensure the flow of the film when sufficient shear stress is induced. The exposure of a film of the applied fluid to different environmental factors shall not impair this performance, (either by buildup of film thickness due to consecutive applications) or by forming a gel, when tested in accordance with 3.2.2.2 3.2.2.3. Fluids of all types shall be tested as in 3.2.3.2.

3.2.3.1 Viscosity: The fluid shall exhibit non-Newtonian flow behavior over the temperature range at which the fluid has been tested and certified as acceptable in accordance with the Aerodynamic Acceptance test (3.2.5). The viscosity of any neat fluid as supplied shall fall within the limits of the high and low viscosity values defined by the pre-production samples (4.2.3) and the viscosity limits shall be reported. For quality control purposes the manufacturer shall specify the typical viscosity range a user can expect to obtain from fluid being delivered for use.

3.2.3.2 Viscosity measurement: The sample will not be shaken prior to testing. Test at 20°C ± 2°C (68°F ± 4 °F), 0°C ± 2 °C (32°F ± 4 °F), and in 10°C (18°F) increments down to the lowest usable temperature identified by the manufacturer. The viscosity shall be measured using a Brookfield LV viscometer at 0.3, 6 and 30 rpm. The viscosity may be measured using the Brookfield small sample adapter or as specified in 3.2.3.2.1. The report shall state if the small sample adapter was used and shall detail the spindle size, container size, volume of fluid employed, and the rotation duration. In case of dispute the method described in 3.2.3.2.1 shall prevail.

Client: Cryotech Deicing Technology
 Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
 Dilution: Per specification

Date: 13-Jun-2011
 SMI/REF: 1104-340R2
 Report revised for product name change

AMS 1428G

Page 12 of 16

3.2.3.2.1 Using a Brookfield LV viscometer fitted with the guard leg and using a sample of approximately 500 ml or sufficient quantity to accommodate the selected spindle and guard leg, contained in an 85 mm diameter, straight sided 600 ml beaker. The test shall be run using the appropriate spindle in accordance with ASTM D 2196, Method B, except the samples shall not be shaken. The reporting requirements are the same as in 3.2.3.2.

Spindle	Speed (RPM)	Temp (C°)	Viscosity (cps)
LV2	0.3	+ 20	15,900
LV2	6.0		2,020
LV2	30.0		825
LV2	0.3	0	39,891
LV2	6.0		4,315
LV3	30.0		1,695
LV2	0.3	- 10	41,525
LV2	6.0		4,920
LV3	30.0		1,985
LV2	0.3	- 20	27,794
LV3	6.0		4,570
LV3	30.0		2,045
LV2	0.3	- 30	4,700
LV2	6.0		1,550
LV3	30.0		1,245

Result Informational

3.2.4 Anti-icing Performance:

Result Not performed

3.2.5 Aerodynamic Acceptance:

Result Not performed

3.3 Fluid Tested Both Neat and as a Diluted Solution:

Tests shall be conducted using the neat fluid and using a solution compromised of the neat fluid diluted 1:1 by weight with ASTM D 1193 Type IV, water.

Client: Cryotech Deicing Technology
 Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
 Dilution: Per specification

Date: 13-Jun-2011
 SMI/REF: 1104-340R2
 Report revised for product name change

AMS 1428G

Page 13 of 16

3.3.1 **Freezing Point:** For the neat fluid, the freezing point shall be not higher than -32°C (-26°F). When diluted at a ratio of 1:1 by weight with ASTM D1193, Type IV water, the freezing point shall be not higher than -10°C (+14°F), determined in accordance with ASTM D1177. Report freezing points for both the neat and 1:1 diluted fluid.

As received: Freezing point: -34°C (-29.2°F)

Diluted (1:1): Freezing point: -10°C (14°F)

Result Conforms

3.3.2 **Effect on Aircraft Materials:**

3.3.2.1 **Sandwich Corrosion:** After testing in accordance with ASTM F1110, the test specimens shall not show corrosion worse than controls, when control panels are tested using water conforming to ASTM D 1193.

	2024-T3 Bare Anodized	2024-T3 Alclad	7075-T6 Bare Anodized	7075-T6 Alclad
AS RECEIVED	1	1	1	1
DILUTE (1:1)	1	1	1	1
CONTROL	1	1	1	1

Result Conforms

3.3.2.2 **Total Immersion Corrosion:** The fluid, tested in accordance with ASTM F483, shall neither produce evidence of corrosion of test panels nor cause a weight change of any test panel greater than shown in Table 4.

TABLE 4 - Total Immersion Corrosion

ALLOY	WEIGHT CHANGE (mg/cm ² /24hrs)		
	ALLOWABLE	RESULTS	
		AS RECEIVED	DILUTE (1:1)
AMS 4037 Aluminum anodized per AMS 2470	0.3	0.01	0.01
AMS 4041 Aluminum	0.3	0.01	+ 0.01
AMS 4049 Aluminum	0.3	0.01	0.01
AMS 4376 Magnesium dichromate treated per AMS 2475	0.2	+ 0.01	0.01
AMS 4911 Titanium	0.1	< 0.01	0.02
AMS 5045 Carbon Steel	0.8	0.03*	0.02*

*Discolored / etched / corrosion products; non-conformance based on appearance.

Result *Does not conform

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 15 of 16

3.3.2.5 Hydrogen Embrittlement: The fluid shall be non-embrittling determined in accordance with ASTM F519, Types 1a, 1c, or 2a specimens, cadmium plated in accordance with MIL-STD-870, Class 1, Type I. In case of dispute, the Type 1c bar shall be used. Type 1a and 1c specimens shall be loaded to 45% of the predetermined notched fracture strength, and Type 2a specimens loaded to 80% of the yield strength. The entire 2a stressed specimen, or just the notched area of the 1a and 1c stresses specimen, shall be immersed continuously in the fluid under test for 150 hours at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($77^{\circ}\text{F} \pm 9^{\circ}\text{F}$) The test specimens shall be galvanically isolated. Galvanic reactions can be prevented by confining the test sample to the test specimen using a chemically inert cup.

Specimens: Type 1c, cadmium plated per MIL-STD-870.

AS RECEIVED: *Four failures within 144 hours.
DILUTE (1:1): No failures within 150 hours.

Result *Does not conform

Specimens: Type 1c, cadmium plated per MIL-STD-870.

AS RECEIVED: ** No failures within 150 hours.
DILUTE (1:1): **Not performed.

Result **Conforms (As received)

****Test performed on product submitted 06-Jun-2011, "as received" only.**

3.3.2.6 Effect on Transparent Plastics: When heated to $65^{\circ}\text{C} \pm 2$ ($149^{\circ}\text{F} \pm 5$) the fluid shall not craze, stain, or discolor MIL-P-25690, stretched acrylic plastic, determined in accordance with ASTM F484.

AS RECEIVED: No craze, stain or discolor
DILUTE (1:1): No craze, stain or discolor

Result Conforms

3.3.2.6.1 Similarly fluid shall not craze, stain, nor discolor AMS-P-83310 polycarbonate plastic, determined in accordance with procedures in ASTM F484 except the specimens shall be stressed for 30 minutes ± 1 to an outer fiber stress level of 13.8 MPa (2000 psi).

AS RECEIVED: No craze, stain or discolor
DILUTE (1:1): No craze, stain or discolor

Result Conforms

Client: Cryotech Deicing Technology
Product: Polar Guard® Advance (Lot 10511) / Polar Guard® II (received 19-Apr-2011)*
Dilution: Per specification

Date: 13-Jun-2011
SMI/REF: 1104-340R2
Report revised for product name change

AMS 1428G

Page 16 of 16

3.3.3 Effect on Painted Surfaces: When heated to $65^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($149^{\circ}\text{F} \pm 4^{\circ}\text{F}$) and applied to a painted surface having an initial surface temperature of $22^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($72^{\circ}\text{F} \pm 4^{\circ}\text{F}$), the fluid shall not produce any streaking, discoloration, or blistering of the paint film, and shall not decrease paint film hardness by more than two pencil hardness numbers, determined in accordance with ASTM F502.

AS RECEIVED: *No discoloration, no hardness change.*
DILUTE (1:1): *No discoloration, no hardness change.*

Result Conforms

3.3.4 Effect on Unpainted Surfaces: The fluid, tested in accordance with ASTM F485, shall neither produce streaking nor leave any stains, which require polishing to remove.

AMS 4911/ AMS 4049:

AS RECEIVED: *No streaking or stains.*
DILUTE (1:1): *No streaking or stains.*

Result Conforms

3.3.5 Pavement Compatibility:

3.3.5.1 Runway Concrete Scaling Resistance: The condition of the runway concrete surface shall have a rating not greater than 1 for 50 freeze - thaw cycles, determined in accordance with ASTM C 672, except that the concrete shall be air- entrained with an air content as in ASTM C 672, have a minimum cement content of $302 \text{ kg/m}^3 \pm 4.5$ ($510 \text{ lb/yd}^3 \pm 10$) and a slump, $38 \text{ mm} \pm 13$ ($1.5 \text{ inches} \pm 0.5$). A $25\% \pm 1\%$ by volume solution of the neat fluid prepared using tap water, shall be substituted for the specified calcium chloride. Performing more than one freeze/thaw cycle per day is acceptable.

25% v/v solution

Rating after 50 freeze-thaw cycles: 1

Result Conforms

**MULTIPLE LOCATION
QUALIFICATION TEST REPORT**

**FW-22-62
LARGE TRANSPORT TYPE JET
AIRCRAFT AERODYNAMIC AND
ANTI-ICING ENDURANCE TIME TESTING
OF THE CANDIDATE AMS1428/1 FLUID**

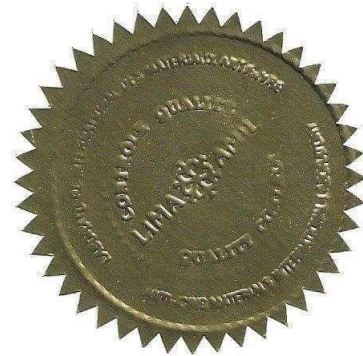
**Polar Guard® Advance
lot # PL220505**

Produced at Proviron, Oostende, Belgium

for

**CRYOTECH DEICING TECHNOLOGY
6103 Orthoway
Fort Madison, IA 52627 USA**

by



Marc Mario Tremblay

MULTIPLE LOCATION QUALIFICATION

This report presents results of aerodynamic and anti-icing endurance testing performed on samples of the candidate Type II fluid **CRYOTECH DEICING TECHNOLOGY Polar Guard® Advance Lot # PL220505**, produced at **Proviron, Oostende, Belgium**. These tests were performed according to a multiple location qualification (section 4.4.3 of AMS1428K); for the initial qualification of this fluid, see AMIL reports reports WH-19-13 and FP-19-13.

To evaluate the anti-icing endurance, a single Water Spray Endurance Test (WSET) was performed in a climatic chamber according to the latest revision of the SAE AMS1428K specification [1] and AS5901D standard [2]. This fluid was tested as a Neat fluid and sheared prior to the test Required minimum anti-icing endurance times in WSET for a Type II fluid is 30 minutes for the Neat fluid. **The candidate Type II fluid, CRYOTECH DEICING TECHNOLOGY Polar Guard® Advance Lot # PL220505, average WSET anti-icing endurance time for the Neat fluid is 83 min ± 6 min.**

The high speed ramp aerodynamic acceptance tests, using Boundary Layer Displacement Thickness (BLDT) values, are performed on the candidate fluid concentrated and diluted with ASTM D1193 [3] **TYPE IV** water according to the latest revision of the SAE AMS1428K specification [1] and AS5900C standard [4]. The aerodynamic tests were performed between 0°C and -31.4°C within a ± 2°C range, using the flat plate set-up in the Luan Phan refrigerated wind tunnel at the Anti-icing Materials International Laboratory (AMIL) research laboratory, which is located at the Université du Québec à Chicoutimi (UQAC). AMIL is independent of fluid manufacturers and was found qualified on September 11, 1997 (reconfirmed November 20, 2017) by the Performance Review Institute according to PRI document AC3001, “audit criteria for compliance to SAE AS5900” of AMS1424 and AMS1428.

On the basis of the acceptance criteria, the candidate AMS1428/1 [5] fluid CRYOTECH DEICING TECHNOLOGY Polar Guard® Advance Lot # PL220505, qualifies according to AMS1428K specification for use on large transport type jet aircraft in the following temperature ranges:

- above -31°C in the case of the Neat Fluid,
- above -19.5°C in the case of the 75/25 dilution,
- above -9.5°C in the case of the 50/50 dilution.

Fluid Elimination (paragraph 3.2.5.4)

The final fluid thickness, based on an initial thickness of 2000 μm, was measured to be from 211 μm to 356 μm for all dilutions, therefore is not greater than the maximum acceptable thickness of 520 μm.

This fluid is qualified from 2022 September 9, for a two year period, under section 4.4.3 of AMS1428K.



SMI, Inc.

12219 SW 131 Avenue
Miami, Florida 33186-6401 USA

Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Quality Manager
Cryotech Deicing Technology
6103 Orthoway
Ft. Madison, IA 52627-9415

Date: 07-Nov-2014

SMI/REF: 1408-060

Product: **POLAR PLUS® LT (80)** [produced at Ft Madison] (received 28-Aug-2014)
Dilution: Per specification

Page 1 of 13

Testing in accordance with

AMS 1424K

Deicing/Anti-icing, Fluid, Aircraft SAE Type I
(FLUID CONCENTRATE)

3.1.1	Non-glycol Based Fluids (AMS 5886 alloy corrosion)	<u>Not applicable</u>
3.1.2	Appearance	<u>Conforms</u>
3.1.3	Toxicity	<u>To be certified by manufacturer</u>
3.1.4	Environmental Information	
3.1.4.1	Biochemical Oxygen Demand (BOD)	<u>Informational</u>
3.1.4.2	Chemical Oxygen Demand (COD)	<u>Informational</u>
3.1.4.3	Biodegradability	<u>Informational</u>
3.1.4.4	Aquatic Toxicity	<u>Informational</u>
3.1.5	Trace Contaminants	<u>Informational</u>
3.2	<u>Physical Properties</u>	
3.2.1	Flash Point	<u>Conforms</u>
3.2.2	Specific Gravity	<u>Informational</u>
3.2.3	pH	<u>Informational</u>
3.2.4	Refractive Index	<u>Informational</u>
3.2.5	Freezing Point	<u>Informational</u>
3.2.6	Surface Tension	<u>Informational</u>
3.2.7	Viscosity	<u>Informational</u>

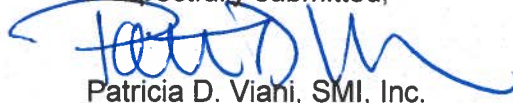
Client: Cryotech
Product: POLAR PLUS® LT (80) [produced at Ft Madison]
Dilution: Per specification
AMS 1424K

Date: 07-Nov-2014
SMI/REF: 1408-060

Page 2 of 13

3.3	<u>Fluid Stability</u>	
3.3.1	Storage Stability	<u>Not performed</u>
3.3.2	Thermal Stability (<i>WSET testing not performed</i>)	<u>Conforms</u>
3.3.3	Hard Water Stability (<i>WSET testing not performed</i>)	<u>Conforms</u>
3.3.4	Shear Stability	<u>Not performed</u>
3.3.5	Foam Stability	<u>Not performed</u>
3.4	<u>Effect on Aircraft Materials</u>	
3.4.1	Sandwich Corrosion	<u>Conforms</u>
3.4.2	Total Immersion Corrosion	<u>Conforms</u>
3.4.3	Low Embrittling Cadmium Plate	<u>Conforms</u>
3.4.4	Stress Corrosion Resistance AMS 4911 AMS 4916	<u>Conforms</u> <u>Informational</u>
3.4.5	Hydrogen Embrittlement	<u>Conforms</u>
3.4.6	Effect on Transparent Plastics	<u>Conforms</u>
3.4.7	Effect on Painted Surfaces	<u>Conforms</u>
3.4.8	Effect on Unpainted Surfaces	<u>Conforms</u>
3.4.9	Runway Concrete Scaling Resistance	<u>Conforms</u>
3.5	<u>Performance Properties</u>	
3.5.1	Freezing Point (concentrates)	<u>Conforms</u>
3.5.1.1	Freezing Point (ready to use fluids)	<u>Not applicable</u>
3.5.2	Anti-icing Performance	<u>Not performed</u>
3.5.3	Aerodynamic Acceptance Test	<u>Not performed</u>

Respectfully submitted,



Patricia D. Viahi, SMI, Inc.

Client: Cryotech
Product: POLAR PLUS® LT (80) [produced at Ft Madison]
Dilution: Per specification
AMS 1424K

Date: 07-Nov-2014
SMI/REF: 1408-060

Page 3 of 13

3. TECHNICAL REQUIREMENTS

3.1 Material

3.1.1 Non-glycol Based Fluids: A fluid based on non-glycol freezing point depressants shall be tested as follows: Two pieces of AMS 5886 bar, 35 mm diameter and 15 mm long shall have one end of each machined flat. An 8.5 mm drill shall then be used to drill a centered hole 6.5 mm deep in one end to allow the milling of a cup-shaped depression. A 12.5 mm bull nosed end mill shall be used to open up the drilled hole to produce a 7 mm deep depression. The cup shall then be finished by improving the surface with 600, 180 and 6 micron diamond paste. The cups shall be cleaned and degreased using a suitable solvent and allowed to dry. One cup shall be filled with the candidate test fluid, the other with water conforming to ASTM D 1193 Type IV. Both test pieces shall then be placed in an oven at 221°F ± 5°F (105°C ± 2°C). The fluid shall then be allowed to evaporate by progressive increase in oven temperature at the rate of 18°F (10°C) degrees per minute to a final temperature of 482°F ± 10°F (250°C ± 5°C) where they shall be held at this temperature for 15 minutes ± 1 min.. Test pieces shall then be transferred to an air furnace set at 1904°F ± 5°F (1040°C ± 10°C) and held at this temperature for 2 hours ± 5 minutes.

Test pieces shall be removed and allowed to cool to ambient temperature. Microscopic examination of the polished cups at 500 magnification shall be undertaken - no corrosion worse than control shall be evident in the candidate test fluid cup.

Not applicable for glycol-based fluids.

Result Not applicable

3.1.2 Appearance: The fluid, as received by purchaser, shall be homogeneous, uniform in color and free from skins, lumps and from foreign materials detrimental to usage of the product. If the fluid is colored, it shall be orange.

Fluid, as received: Appears orange in color, homogeneous, free from skins, lumps and foreign materials.

Result Conforms

3.1.3 Toxicity: The user shall ensure that the fluid meets all local, state and federal toxicity regulations. The information to satisfy the federal, state and provincial requirements shall be provided by the manufacturer; and for local requirements upon request from the user.

Result To be certified by manufacturer

3.1.4 Environmental Information:

Formulated fluid shall be tested in accordance with APHA "Standard Methods for the Examination of Water and Waste Water" unless otherwise specified in Annex A. The manufacturer shall supply not less than the following:

Client: Cryotech
 Product: **POLAR PLUS® LT (80)** [produced at Ft Madison]
 Dilution: Per specification
 AMS 1424K

Date: 07-Nov-2014
 SMI/REF: 1408-060

3.1.4.1 Biological Oxygen Demand (BOD) of fluid shall be determined at both 41°F (5°C) and 68°F (20°C). The test solutions shall be incubated at the designated temperatures for 5 and 28 days. The results shall be reported in terms of kg of oxygen per kg of concentrate and kg of oxygen per kg of mixture of fluid and water to formulate a freezing point of -15°F (-26°C).*

<u>5°C:</u>	5 day BOD/COD:	< 0.01 kg O₂/kg concentrate
	28 day BOD/COD:	< 0.01 kg O₂/kg concentrate
<u>20°C:</u>	5 day BOD/COD:	0.64 kg O₂/kg concentrate
	28 day BOD/COD:	0.69 kg O₂/kg concentrate

*Information regarding the dilution required to formulate a -26°C freezing point was not supplied by manufacturer; therefore, results reflect testing of fluid as received (neat).

Result Informational

3.1.4.2 Chemical Oxygen Demand (COD) of the fluid, expressed in kilograms of oxygen per kilogram of fluid and kilograms of oxygen per kilogram of mixture of fluid and water to formulate a freezing point of -15°F (-26°C).*

COD = 1.24 kg O₂/kg fluid

*Information regarding the dilution required to formulate a -26°C freezing point was not supplied by manufacturer; therefore, results reflect testing of fluid as received (neat).

Result Informational

3.1.4.3 Biodegradability: This characteristic can be approximated by determining the ratio of the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The percent of fluid biodegraded can be calculated by dividing BOD by COD and shall be reported for all incubation time periods.

<u>5°C:</u>	5 day BOD/COD:	<0.01/1.24 = <0.01
	28 day BOD/COD:	<0.01/1.24 = <0.01
<u>20°C:</u>	5 day BOD/COD:	0.64/1.24 = 0.52
	28 day BOD/COD:	0.69/1.24 = 0.56

Result Informational

3.1.4.4 Aquatic Toxicity: Formulated fluid shall be tested in accordance with EPA (40CFR 797.1300 and 797.1400, revised July 1, 1989 and 40 CFR 136.3) or OECD (Organization for Economic Cooperation and Development Guidelines for Testing of Chemicals, Methods 202 and 203) procedures using test species required by regulatory agencies for permitted discharges. Examples include: fathead minnows (96-hour LC₅₀), *Ceriodaphnia dubia* (48-hour EC₅₀), *Daphnia magna* (48-hour EC₅₀) and rainbow trout (96-hour LC₅₀). The LC₅₀ (for fish) or EC₅₀ (for invertebrates) concentration (the highest concentration at which 50% of the organisms do not survive the test period) shall be given in milligrams per liter.

EPA 40 CFR 797.1300 DAPHNID ACUTE TOXICITY TEST	
<i>Daphnia magna</i> , static system	48 hour LC₅₀: 15,250 mg/L
EPA 40 CFR 797.1400 FISH ACUTE TOXICITY TEST	
<i>Pimephales promelas</i> , static system	96 hour LC₅₀: 47,525 mg/L

Result Informational

Client: Cryotech
Product: POLAR PLUS® LT (80) [produced at Ft Madison]
Dilution: Per specification
AMS 1424K

Date: 07-Nov-2014
SMI/REF: 1408-060

3.1.5 Trace Contaminants: Report the presence, in percentage by weight or ppm by weight, of sulfur, halogens, total phosphorus, nitrate, total kjeldahl nitrogen and metals (lead, chromium, cadmium, and mercury). Report the test method used and detection limits.
Method: ICP Inductive-Coupled Plasma Spectrometry (Detection Limit: 1 ppm)

	<i>ppm</i>	<i>%</i>
Sulfur	10	0.0010
Halogens	< 10	< 0.0010
Total Phosphorus	163	0.0163
Nitrate (as NO₃)	< 2	< 0.0002
Total kjeldahl nitrogen	134	0.0134
Heavy Metals:		
Lead (Pb)	< 1	< 0.0001
Chromium (Cr)	< 1	< 0.0001
Cadmium (Cd)	< 1	< 0.0001
Mercury (Hg)	< 1	< 0.0001

Result Informational

3.2 Physical Properties:

The fluid as supplied by the vendor, unless specified otherwise shall conform to the following requirements:

3.2.1 Flash Point: Shall be not lower than 212°F (100°C), determined in accordance with ASTM D 93 or ASTM D 3278. In case of dispute, the flash point in accordance with ASTM D 93 shall apply.

No flash to 100°C.

Result Conforms

3.2.2 Specific Gravity: Shall be within ±0.015 units of the preproduction value, determined in accordance with ASTM D 891 or ASTM D 4052.

1.050 @ 60/60°F

Result Informational

3.2.3 pH: Shall be within ± 0.5 units of the preproduction value, determined in accordance with ASTM E 70.

As received: pH = 6.7

Result Informational

3.2.4 Refractive Index: Shall be within ± 0.0015 units of the preproduction value, determined in accordance with ASTM D 1747.

As received: RI = 1.4169 @ 25°C
RI = 1.4188 @ 20°C

Result Informational

Client: Cryotech
 Product: **POLAR PLUS® LT (80)** [produced at Ft Madison]
 Dilution: Per specification
 AMS 1424K

Date: 07-Nov-2014
 SMI/REF: 1408-060

3.2.5 **Freezing Point:** Shall be within $\pm 5^{\circ}\text{F}$ ($\pm 3^{\circ}\text{C}$) of the preproduction value, determined in accordance with ASTM D 1177.

Note: If the fluid supplied by the vendor is a concentrate intended to be diluted prior to use, the freezing point shall be determined after dilution 1:1 by volume with ASTM D 1193, Type IV water. The refractive index of the diluted fluid that is tested shall also be reported.

Diluted 1:1 by volume: Freezing point = -20°C (-4°F)

Refractive Index (1:1 by volume) = 1.3782 @ 25°C

Result Informational

3.2.6 **Surface Tension:** Shall be within $\pm 10\%$ of the preproduction value.

As received: Surface Tension = 37.1 dynes/cm

Result Informational

3.2.7 **Viscosity:** Shall be within $\pm 5\%$ of the preproduction value at 68, 32, 14, and -4°F ($+20$, 0, -10 , and -20°C), determined in accordance with ASTM D 445.

Note: Test was performed using Brookfield Model DV-II+ Viscometer, fitted with the LV1, LV2, or LV3 spindle in a sample of 500 mL contained in a 600 mL beaker.

Spindle	Speed (RPM)	Temp ($^{\circ}\text{C}$)	Viscosity (cps)
LV1	6.0	+ 20	27
LV1	12.0		22
LV1	30.0		20
LV1	6.0	0	52
LV1	12.0		52
LV1	30.0		48
LV1	6.0	- 10	82
LV1	12.0		88
LV1	30.0		89
LV1	6.0	- 20	199
LV1	12.0		202
LV2	30.0		196

Result Informational

3.3 Fluid Stability:

The fluid, as supplied by the vendor, shall conform to the following requirements:

- 3.3.1 Storage Stability: Prior to the start of this test, determine the viscosity at 68°F (20°C) in accordance with ASTM D 445. The fluid shall then be subject to one complete cycle as outlined in ASTM F 1105. On completion of the cycle, the fluid shall be retested for viscosity as before and the result compared to the original values. These results shall not vary by more than +10% or -20%. The pH of the aged fluid, determined as in 3.2.3, shall be within ± 0.5 units of the unaged sample. A portion of the fluid shall then be diluted 1:1 with ASTM D 1193, Type IV, water. There shall be no evidence of separation, precipitation or evidence of insoluble deposits in the fluid or in the 1:1 dilution.

Result Not performed

- 3.3.2 Thermal Stability -Accelerated Aging: Accelerated Aging for Concentrates and Ready-to-Use Fluids (to simulate long term heated storage without water loss). Age sample as in 3.3.2.1 and examine as in 3.3.2.2.

3.3.2.1 Transfer 800 mL \pm 10 mL of fluid to a 1 liter borosilicate bottle (e.g., Pyrex® brand or equivalent) fitted with a tight, heat-resistant plastic seal and tightly close. For the reference sample, also keep 800 mL \pm 10 mL of the fluid in an identical bottle and store at room temperature until the completion of 3.3.2.2. Transfer the other closed bottle containing the test fluid to a circulating-air oven or heated oil or water bath. Elevate the temperature to 176°F \pm 4°F (80°C \pm 2°C) and maintain the sample in this environment for 30 days.

3.3.2.2 After 30 days, remove the test sample from the heated environment, and examine the contents for evidence of separation, precipitation, or insoluble deposits. Report any evidence of these factors. Allow the test sample to cool to 68°F \pm 4°F (20°C \pm 2°C). Turn the test sample bottle upside down and then right side up. Repeat the rotation procedure three additional times and then examine the contents for evidence of separation, precipitation, or insoluble deposits versus the unheated reference sample. Report findings. Determine the refractive index of the test and reference samples as in 3.2.4. If the test and reference samples have a refractive index difference of greater than 0.0020, the test is invalid. If the test is valid and the fluid tested is a concentrate intended to be diluted, dilute both the test and reference fluids 50/50 by volume with ASTM D1193, Type IV water and measure the pH as in 3.2.3. If the test fluid is a ready-to-use fluid, no further dilution is necessary and the pH should be measured as in 3.2.3. The pH difference between the heat-aged test sample and the unheated reference sample shall not be greater than 1.0 unit. The heat-aged test sample shall be tested according to AS 901 (WSET only) using one set of three plates and shall have a minimum time of 3 minutes. Report the results of the test.

Client: Cryotech
 Product: POLAR PLUS® LT (80) [produced at Ft Madison]
 Dilution: Per specification
 AMS 1424K

Date: 07-Nov-2014
 SMI/REF: 1408-060

3.3.2 Thermal Stability -Accelerated Aging (continued):

THERMAL STABILITY RESULTS

	UNHEATED REFERENCE (AS RECEIVED)	HEAT-AGED 30 DAYS/ 80°C (AS RECEIVED)
Separation/ insoluble deposits	None	None
Separation/ insoluble deposits after cooling & inverting four times	None	None
Refractive index	1.4188	1.4187
	UNHEATED REFERENCE (DILUTED 50/50)	HEAT-AGED 30 DAYS/ 80°C (DILUTED 50/50)
pH	8.5	8.5

***Test is valid since values for refractive index are within 0.0020.
 pH difference is not greater than 1.0 unit***

AS 5901 (WSET) Test on Heat-Aged Fluid

Result Conforms
 Result Not performed

3.3.3 Hard Water Stability: Fluid supplied as concentrate and intended to be diluted with water before use shall be diluted 1:1 by volume with standard hard water made up as in 3.3.3.1. Determine the refractive index of the diluted fluid as in 3.2.4 and the pH as in 3.2.3. Age the diluted fluid as in 3.3.2.1 but at a storage temperature of 203 ± 4°F (95 ± 2°C). After 30 days, remove the bottle from the heated environment and examine the contents for evidence of separation or insoluble deposits. Report any evidence of these factors. Allow the sample to cool to 68 ± 4°F (20 ± 2°C). Turn the test bottle upside down then right side up. Repeat this rotation procedure three additional times. Re-examine and report any evidence of separation or insoluble deposits. Retest for refractive index as before and record the result. If the refractive index of the aged fluid has increased by more than 0.0020 the test is invalid. If the refractive index is within limits, the pH of the aged fluid shall be determined as before and shall not vary by more than 1.0 units from the unaged value. The aged sample(s) shall be tested according to AS5901(WSET only) using one set of three plates and shall have a minimum time of 3 minutes. Report the results of the test.

Note: Additional testing to demonstrate fluid stability with softer water (as designated by the user) may be required as agreed to by the user and the fluid manufacturer

3.3.3.1 Composition of Hard Water:

Dissolve 400 ± 5 mg calcium acetate dihydrate [Ca(C₂H₃O₂)₂·2H₂O] or 363 ± 5 mg calcium acetate monohydrate [Ca(C₂H₃O₂)₂·H₂O], and 280 ± 5mg magnesium sulfate heptahydrate (MgSO₄·7H₂O), both of analytical reagent quality, in 1 liter of ASTM D 1193 Type IV water.

Client: Cryotech
 Product: POLAR PLUS® LT (80) [produced at Ft Madison]
 Dilution: Per specification
 AMS 1424K

Date: 07-Nov-2014
 SMI/REF: 1408-060

3.3.3 Hard Water Stability (continued):

HARD WATER STABILITY RESULTS

	FLUID (DILUTED 1:1 with Hard Water)
Refractive index, Day 0	1.3808 @ 20°C
pH, Day 0 (prior to heating)	8.3
Separation/ insoluble deposits immediately after removal from heated environment, (30 days at 95°C)	None
Separation/ insoluble deposits after cooling, then inverting four times (heat aged sample)	None
Refractive index (heat aged sample)	1.3807 @ 20°C
pH (heat-aged sample)	8.1

***Test is valid since values for refractive index are within 0.0020.
 pH values do not vary by more than 1.0 units***

Water Spray Endurance Test

Result Conforms
 Result Not performed

3.3.4 Shear Stability:

Result Not performed

3.3.5 Foam Stability:

Result Not performed

3.4 Effect on Aircraft Materials: The fluid shall conform to the following requirements in the form supplied by vendor and, if a concentrate intended to be diluted prior to use, diluted 1:1 by volume with ASTM D 1193, Type IV, water, except as noted.

3.4.1 Sandwich Corrosion: Specimens after testing in accordance with ASTM F 1110, shall not show corrosion worse than control panels run using ASTM D 1193, Type IV, water.

	2024-T3 Bare Anodized	2024-T3 Alclad	7075-T6 Bare Anodized	7075-T6 Alclad
As received	1	1	1	1
Diluted (1:1 v/v)	1	1	1	1
CONTROL	1	1	1	1

Result Conforms

Client: Cryotech
 Product: POLAR PLUS® LT (80) [produced at Ft Madison]
 Dilution: Per specification
 AMS 1424K

Date: 07-Nov-2014
 SMI/REF: 1408-060

3.4.2 Total Immersion Corrosion Test: The fluid, tested in accordance with ASTM F 483, shall neither show evidence of corrosion of panels nor cause a weight change of any test panel greater than as shown in Table I.

Table I - TOTAL IMMERSION CORROSION

Test Panel	Weight change allowed (mg/cm ² /24 hrs)	Weight change mg/cm ² /24 hrs	
		AS RECEIVED	DILUTE (1:1)
AMS 4037 Aluminum Alloy, Anodized as in AMS 2470	0.3	< 0.01	< 0.01
AMS 4041 Aluminum Alloy	0.3	< 0.01	< 0.01
AMS 4049 Aluminum Alloy	0.3	< 0.01	< 0.01
AMS 4376 Magnesium Alloy, dichromate treated as in AMS 2475	0.2	+ 0.05	0.01
AMS 4911 Titanium Alloy	0.1	< 0.01	< 0.01
AMS 5045 Carbon Steel	0.8	< 0.01	< 0.01

Result Conforms

3.4.3 Low Embrittling Cadmium Plate: Test panels, coated with low-embrittling cadmium plate, shall not show a weight change greater than 0.3 mg/cm² per 24 hours, determined in accordance with ASTM F1111.

	mg/cm ² /24hrs
As received	< 0.01
Dilute (1:1)	0.01

Result Conforms

3.4.4 Stress Corrosion Resistance: The fluid shall not cause cracks in AMS 4911, titanium alloy specimens determined in accordance with ASTM F 945, Method A.

	AMS 4911
CONTROL, BLANK:	No cracking evident
CONTROL, 3% SALT:	Cracking evident
As received	No cracking evident
Dilute	No cracking evident

Result Conforms

3.4.4.1 Stress Corrosion Resistance: The fluid shall be tested in accordance with ASTM F945, Method A using AMS 4916 specimens. Report shall detail the effect of the fluid and the effect of control solution.

	AMS 4916
CONTROL, BLANK:	No cracking evident
CONTROL, 100 ppm SALT:	Cracking evident
As received	No cracking evident
Dilute	No cracking evident

Result Informational

Client: Cryotech Date: 07-Nov-2014
Product: POLAR PLUS® LT (80) [produced at Ft Madison] SMI/REF: 1408-060
Dilution: Per specification

AMS 1424K

Page 11 of 13

3.4.5 Hydrogen Embrittlement: The fluid shall be non-embrittling, determined in accordance with ASTM F 519, utilizing Type 1a, 1c, or 2a specimens, cadmium plated in accordance with MIL-STD-870, Class 1, Type 1. In case of dispute, the 1c bar shall be used. Type 1a and Type 1c specimens shall be loaded to 45% of the predetermined notched fracture strength, and Type 2a specimens loaded to 80% of the yield strength. The entire 2a stressed specimen, or just the notched area of the 1a and 1c stressed specimen, shall be immersed continuously in the fluid under test for 150 hours at a temperature of $77 \pm 9^\circ\text{F}$ ($25 \pm 5^\circ\text{C}$). The test specimens shall be galvanically isolated. Galvanic reactions can be prevented by confining the test sample to the test specimen using a chemically inert cup.

Specimens: Type 1c, cadmium plated in accordance with MIL-STD-870, Type I

As received No failures within 150 hours
Dilute (1:1) No failures within 150 hours

Result _____ Conforms _____

3.4.6 Effect on Transparent Plastics:

3.4.6.1 Fluid shall be diluted with ASTM D 1193, Type IV, water to the maximum intended fluid/water concentration recommended for use by the manufacturer. The diluted fluid, heated to and applied at $149^\circ\text{F} \pm 4^\circ\text{F}$ ($65^\circ\text{C} \pm 2^\circ\text{C}$), and then allowed to cool naturally to the test temperature specified in ASTM F 484, shall not craze, stain, or discolor MIL-PRF-25690 stretched acrylic plastic, determined in accordance with ASTM F 484.

Note: Maximum intended fluid/water concentration assumed to be 70/30.

70% by volume:

MIL-PRF-25690 (Type C) 4500 psi/8 hours: No crazing, stains, or discoloration.

Result _____ Conforms _____

3.4.6.2 Fluid, supplied as concentrate and intended to be diluted with water before use, shall be diluted to the maximum intended fluid/water concentration with standard hard water made up as in 3.3.3.1. The diluted fluid or the ready-to-use fluid, heated to and applied at $149 \pm 4^\circ\text{F}$ ($65 \pm 2^\circ\text{C}$), and then allowed to cool naturally to test temperature specified in ASTM F 484, shall not craze, stain, or discolor AMS-P-83310 polycarbonate plastic, determined in accordance with ASTM F484, except that the specimens shall be stressed for 30 ± 2 minutes to an outer fiber stress level of 13.8 Mpa (2000 psi).

Note: Maximum intended fluid/water concentration assumed to be 70/30

70% by volume:

MIL-P-83310 (2000 psi/ 30 minutes): No crazing, stains, or discoloration.

Result _____ Conforms _____

Client: Cryotech
Product: POLAR PLUS® LT (80) [produced at Ft Madison]
Dilution: Per specification

Date: 07-Nov-2014
SMI/REF: 1408-060

AMS 1424K

Page 12 of 13

3.4.7 Effect on Painted Surfaces: Fluid, heated to 149°F ± 4°F (65°C ± 2°C), and applied to a painted surface having an initial surface temperature of 72°F ± 2°F (22°C ± 1°C), shall not produce any streaking, discoloration, or blistering of the paint film, and shall not decrease paint film hardness by more than two pencil hardness numbers, determined in accordance with ASTM F 502.

**As received: No streaks, discoloration, blistering
No decrease in film hardness**
**Dilute (1:1) No streaks, discoloration, blistering
No decrease in film hardness**

Result _____ Conforms _____

3.4.8 Effect on Unpainted Surfaces: Fluid, tested in accordance with ASTM F 485, shall neither produce streaking nor leave stains which require polishing to remove.

**As received: AMS 4049: No streaks nor stains
AMS 4911: No streaks nor stains**
**Dilute (1:1): AMS 4049: No streaks nor stains
AMS 4911: No streaks nor stains**

Result _____ Conforms _____

3.4.9 Runway Concrete Scaling Resistance: The condition of the runway concrete surface shall have a rating not greater than 1 for fifty freeze-thaw cycles determined in accordance with ASTM C 672, except that the concrete shall be air-entrained with an air content as specified in ASTM C 672, have a minimum cement content of 510 lb/yd³ ± 10 lb/yd³ (302 kg/m³ ± 6 kg/m³) and a slump of 1.5 inches ± 0.5 inches (38 mm ± 13 mm). A 25% ± 1 volume solution of the fluid prepared using tap water shall be substituted for the specified calcium chloride solution. Performing more than one freeze-thaw cycle per day is acceptable.

Rating after 50 freeze-thaw cycles: 1

Result _____ Conforms _____

Client: Cryotech
Product: **POLAR PLUS® LT (80)** [produced at Ft Madison]
Dilution: Per specification
AMS 1424K

Date: 07-Nov-2014
SMI/REF: 1408-060

3.5 Performance Properties

The fluid shall conform to the following requirements:

3.5.1 Freezing Point: Fluid supplied as concentrate shall, after dilution 1:1 by volume with ASTM D 1193, Type IV water, have a freezing point not higher than -4°F (-20°C), determined in accordance with ASTM D 1177. Freezing point shall be expressed as a function of volume dilution with water and shall be reported from 100:0 to 0:100, with each increment of 10% expressed.

DILUTION (by volume)	FREEZING POINT
10%	-2°C
20%	-6°C
30%	-10°C
40%	-15°C
50%	-20°C
60%	-31°C
70%	-41°C
80%	-42°C
90%	-43°C
100% (undiluted)	-42°C

Freezing point of 1:1 (50%v/v) dilution is not higher than -20°C

Result Conforms

3.5.1.1 For fluid supplied in a ready-to-use form, the freezing point shall be determined on the fluid in the as supplied, undiluted form, and have a freezing point not higher than -4°F (-20°C), determined in ASTM D 1177.

Result Not applicable

3.5.2 Anti-Icing Performance

Result Not performed

3.5.3 Aerodynamic Acceptance Test

Result Not performed