

**Committee of Experts on the Transport of Dangerous Goods
and on the Globally Harmonized System of Classification
and Labelling of Chemicals**

Sub-Committee of Experts on the Transport of Dangerous Goods

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Geneva, 24–28 June 2013

Item 3 (c) of the provisional agenda

Listing, classification and packing: miscellaneous

Packing requirements for UN1873

**Transmitted by the Council on Safe Transportation of
Hazardous Articles (COSTHA)**

**UNITED NATIONS / DOT
PERFORMANCE TEST AND IMPACT
RESISTANCE EVALUATIONS**



**1 x 500 mL FEP Bottle Packaging
and
1 x 1 Liter PFA Bottle Packaging**

TEST REPORT #: 13-1086

TESTING PERFORMED FOR:

SEASTAR CHEMICALS, INC.
10005 McDonald Park Rd.,
Sidney
British Columbia, V8L 5Y2 Canada

ATTN: James Scott

TESTING PERFORMED BY:

TEN-E PACKAGING SERVICES, INC.
1666 County Road 74
Newport, MN 55055
Phone: 651-459-0671
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March 20, 2013

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*Note: As numbered by Excel Software

NOTES AND COMMENTS

Seastar Chemicals submitted a 1 x 500 mL FEP Bottle Packaging and 1 x 1 Liter PFA Bottle Packaging for evaluation under the guidelines of DOT/UN 4G drop, stack and pressure differential test requirements. Additionally, impact resistance tests were conducted on the 500 mL FEP bottle.

All bottles used in this evaluation had been subjected to a storage evaluation with Perchloric Acid (HClO₄) by Seastar Chemicals.

The purpose of this performance evaluation is to demonstrate the resistance of the PFA and FEP bottles to Perchloric Acid.

SECTION I: DISCLAIMER OF WARRANTIES

TEN-E PACKAGING SERVICES, INC. certifies that the previously described testing services have been performed in accordance with standard good laboratory practices and under the guidelines of the test requirements set forth in the Department of Transportation's Title 49 CFR; Part 178 and ASTM D2463. The results included within this test report relate only to the items tested. **ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY THAT THE PACKAGING TESTED IS MERCHANTABLE, FIT FOR A PARTICULAR PURPOSE OR IN COMPLIANCE WITH ANY FEDERAL OR STATE REGULATIONS, ARE DISCLAIMED.** In no event shall TEN-E Packaging Services, Inc. liability exceed the total amount paid by **Seastar Chemicals Inc.** for services rendered.

In the event of future changes to the above referenced test standard, it is the responsibility of **Seastar Chemicals Inc.** to determine whether additional testing or updating of past testing is necessary to verify that the packaging we have tested remains in compliance with those standards.

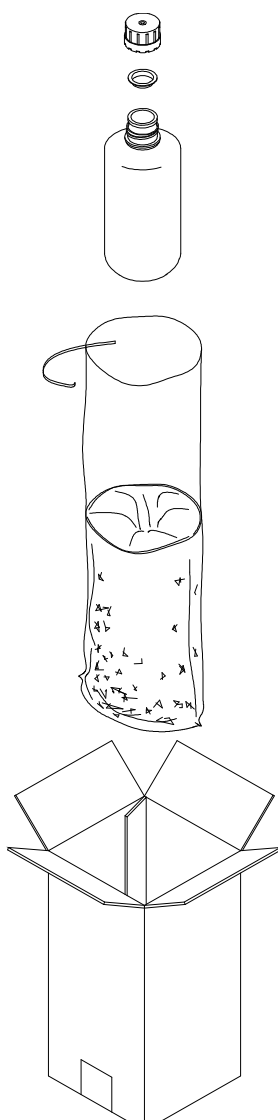


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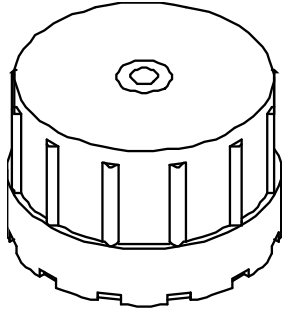
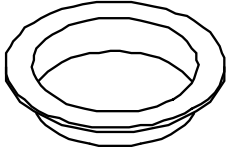
SECTIONS II: PACKAGING DESCRIPTIONS / COMPONENT DRAWINGS

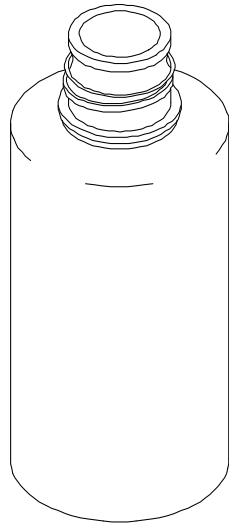
1 x 500 mL FEP Bottle Packaging		
ASSEMBLY DRAWING	TEST LEVELS	
<p>The assembly drawing illustrates the packaging components. At the top, a small 500 mL FEP bottle is shown with its cap. Below it is a larger, clear cylindrical container. At the bottom, a cardboard shipping box is shown with its top flaps open, indicating the final packaging stage.</p>	Packaging Code Designation: 4G	
	Packing Group: I	
	Specific Gravity: 1.7	
	Internal Pressure: 95 kPa	
	TEST SAMPLE PREPARATION (Refer to Appendix IV)	
	Overall Packaging Tare Weight: 599.0 Grams	
	Fill Capacity (98% Maximum Capacity): Methanol/Water 528.0 Grams	
	Package Test Weight: Methanol/Water 1.1 Kg 2.4 Lbs	
	CLOSING METHODS – INNER PACKAGING	
	38mm Closure:	
	Application Torque: 33 In-Lbs.	
	Equipment: Torque Meter #714	
	CLOSING METHODS – SHIPPER	
	Top Flaps:	
	Type: 3M #375 Pressure Sensitive Tape	
Width: 48 mm (2")		
Overlap: 2" Minimum		
Tape Pattern: Center Seam		
Inner Flaps: Meet		
Outer Flaps: Meet		
Bottom Flaps:		
Type: 3M #375 Pressure Sensitive Tape		
Width: 48 mm (2")		
Overlap: 2" Minimum		
Tape Pattern: Center Seam		
Inner Flaps: Meet		
Outer Flaps: Meet		

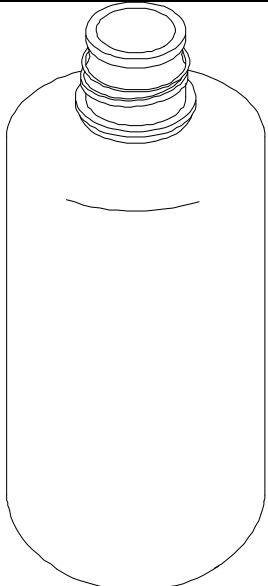
1 x 1 Liter PFA Bottle Packaging

ASSEMBLY DRAWING	TEST LEVELS
	Packaging Code Designation: 4G
	Packing Group: I
	Specific Gravity: 1.7
	Internal Pressure: 95 kPa
	TEST SAMPLE PREPARATION (Refer to Appendix IV)
	Overall Packaging Tare Weight: 666.0 Grams
	Fill Capacity (98% Maximum Capacity): Methanol/Water 997.1 Grams
	Package Test Weight: Methanol/Water 1.6 Kg 3.5 Lbs
	CLOSING METHODS – INNER PACKAGING
	38mm Closure:
	Application Torque: 33 In-Lbs.
	Equipment: Torque Meter #714
	CLOSING METHODS – SHIPPER
	Top Flaps:
	Type: 3M #375 Pressure Sensitive Tape
Width: 48 mm (2")	
Overlap: 2" Minimum	
Tape Pattern: Center Seam	
Inner Flaps: Meet	
Outer Flaps: Meet	
Bottom Flaps:	
Type: 3M #375 Pressure Sensitive Tape	
Width: 48 mm (2")	
Overlap: 2" Minimum	
Tape Pattern: Center Seam	
Inner Flaps: Meet	
Outer Flaps: Meet	

COMPONENT INFORMATION

CLOSURE (500mL and 1 L Bottles)		DRAWING	
Description:	38mm Nalgene Threaded Closure with Valve Seal		
Material:	Tefzel		
Tare Weight:	16.676 Grams		
Overall Dimensions:			
• Height	1.208"		
• Diameter	1.664"		
Finish Dimensions:			
• T	1.495"		
• E	1.394"		
Markings (QC Audit):	Nalgene® 38		
NECK PLUG (500mL and 1 L Bottles)			
Description:	Friction Fit Neck Plug		
Material:	PFA		
Tare Weight:	0.903 Grams		
Overall Dimensions:			
• Height	0.319"		
• Top Diameter	1.328"		
• Bottom Diameter	1.003"		
• Thickness	0.011"		
Markings (QC Audit):	N		

500 mL PLASTIC BOTTLE		DRAWING
Description:	500 mL Nalgene Bottle	
Material:	FEP, Natural	
Method of Manufacture:	Blow Molded	
Tare Weight:	103 Grams	
Capacity:		
• Rated	500 mL	
• Overflow	556 mL	
Overall Dimensions:		
• Height	6.928"	
• Diameter	2.906"	
Thread Dimensions:		
• T	1.463"	
• E	1.364"	
Wall Thickness:		
• Minimum	.025"	
Markings (QC Audit):	NALGENE® FEP-C 16-500 SPI "7" Other Recycling Symbol	

1 Liter PLASTIC BOTTLE		DRAWING
Description:	1 Liter Nalgene Bottle	
Material:	PFA, Natural	
Method of Manufacture:	Blow Molded	
Tare Weight:	172 Grams	
Capacity:		
• Rated	1000 mL	
• Overflow	1050 mL	
Overall Dimensions:		
• Height	8.245"	
• Diameter	3.552"	
Thread Dimensions:		
• T	1.470"	
• E	1.377"	
Wall Thickness:		
• Minimum	.026"	
Markings (QC Audit):	NALGENE® PFA-C 32-1000 SPI "7" Other Recycling Symbol	

ABSORBENT POLYPROPYLENE/LDPE BAG (1 x 500 mL and 1 x 1 Liter Packages)		DRAWING
Description:	LDPE Bag with Sewn in Polypropylene Absorbent Liner	
Material:	Absorbent: Gray/Yellow Polypropylene Bag: LDPE	
Tare Weight:	303 Grams	
Overall Dimensions:		
• Length	26"	
• Width	10-1/8"	
Sealing Method:	Plastic Coated Wire Twist Tie	
Markings (QC Audit):	None	

SHIPPER (1 x 500 mL and 1 x 1 Liter Packages)	
Description:	Regular Slotted Container
Material:	200 Lb. Test Single-Wall Natural Kraft Corrugated Fiberboard; C -Flute
Tare Weight:	179 Grams
Outside Dimensions:	6-1/4" (L) x 6-1/4" (W) x 13-1/4" (H)
Board Caliper:	.1560"
Manufacturer's Joint:	Inside Glued, 1-1/4" Lap
Markings (QC Audit):	<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; display: flex; flex-direction: column; justify-content: center; align-items: center; margin-right: 5px;"> u n </div> <div> <p>4G/X4.3/S/12 USA+AA5031</p> <p>SturdeSeal® 11-29-12</p> </div> </div>

BOX CERTIFICATE		
(A) Corrugated Manufacturer:	Berlin Packaging	
(B) Structure:	Single-Wall	
(C) Bursting Test	200 Lbs. Per Sq Inch	
(D) Min comb Wt Facings:	84 Lbs. Per M Sq Ft	
(E) Size Limit:	75"	
(F) Gross Wt Lt:	65 Lbs.	
(G) Location:	Bridgeville, PA	

SECTION III: TEST PROCEDURES AND RESULTS

STORAGE TESTS

Storage Tests were completed by Seastar Chemicals on the 500 mL FEP and 1 Liter PFA bottles used for the DOT/UN 4G performance and impact resistance tests per the data submitted to TEN-E below.

Bottle Type	Product	SAMPLES TESTED		Fill Date	Comments
		Assay (% w/w)	Lot No.		
1L PFA	HClO ₄	70	2201080	Mar-04	
500mL FEP	HClO ₄	69	GFS L609188	Pre 1998	Sample from GFS - Exact fill date unavailable
500mL FEP	HClO ₄	72	GFS L711551	1998	Sample from GFS - Exact fill date unavailable
500mL FEP	HClO ₄	67	227042	08/20/1998	
500mL FEP	HClO ₄	68	2204090	01/27/2005	
500mL FEP	HClO ₄	70	2205020	5/8/2005	
500mL FEP	HClO ₄	70	2206020	03/20/2006	
500mL FEP	HClO ₄	70	2205021	04/21/2007	


Storage Temperature Graphs and Raw data submitted by Seastar Chemicals are located in Appendix A and B.

TEST NO. 1 - STACKING TEST

1 x 500 mL FEP Bottle Packaging

STACKING TEST INFORMATION		TEST CRITERIA
SAMPLE SIZE:	3	<ul style="list-style-type: none"> • There must be no leakage of the filling substance from the inner receptacle, or inner packaging. • There can be no deterioration that could adversely affect transport safety or any distortion liable to reduce the package's strength, cause instability in stacks of packages, or cause damage to inner packagings that is likely to reduce safety in transport. (§178.606)
TEST CONTENTS:	Methanol/Water Solution (0.969 SG)	
SAMPLE PREPARATION:	Refer to Section II	
CONDITIONING:	73°F / 50% RH Chamber #215	
TEST LOAD APPLIED:	45.4 Kg (100 Lbs.) (Refer to Section IV)	
TEST DURATION:	24 Hours	
TEST EQUIPMENT:	Dead Load Weights	


STACKING TEST SET-UP & RESULTS

	Sample #	Maximum Deflection After 24 Hours	Results
	1 Btl 227042	0"	PASS
	2 Btl 2204090	0"	PASS
	3 Btl 2205020	0"	PASS

Stacking Stability: Not conducted; required only for guided load tests.

1 x 1 Liter PFA Bottle Packaging

STACKING TEST INFORMATION		TEST CRITERIA
SAMPLE SIZE:	1	<ul style="list-style-type: none"> • There must be no leakage of the filling substance from the inner receptacle, or inner packaging. • There can be no deterioration that could adversely affect transport safety or any distortion liable to reduce the package's strength, cause instability in stacks of packages, or cause damage to inner packagings that is likely to reduce safety in transport. (§178.606)
TEST CONTENTS:	Methanol/Water Solution (0.969 SG)	
SAMPLE PREPARATION:	Refer to Section II	
CONDITIONING:	73°F / 50% RH Chamber #215	
TEST LOAD APPLIED:	22.7 Kg (50 Lbs.) (Refer to Section IV)	
TEST DURATION:	24 Hours	
TEST EQUIPMENT:	Dead Load Weights	

STACKING TEST SET-UP & RESULTS			
	Sample #	Maximum Deflection After 24 Hours	Results
		1 Btl 2201080	0"







Stacking Stability: Not conducted; required only for guided load tests.

TEST NO. 2 - DROP TEST

1 x 500 mL FEP Bottle Packaging

DROP TEST INFORMATION		TEST CRITERIA
SAMPLE SIZE:	7*	<ul style="list-style-type: none"> For packaging containing liquid, each packaging does not leak. There can be no damage to the outer packaging likely to adversely affect safety during transport. Inner receptacles, inner packagings or articles must remain completely within the outer packaging and there must be no leakage of the filling substance from the inner packaging. Any discharge from a closure is slight and ceases immediately after impact with no further leakage. No rupture is permitted in packagings for materials in Class 1 which would permit spillage of loose explosive substances or articles from the outer packaging. (§178.603)
TEST CONTENTS:	Methanol/Water Solution (0.969 SG)	
SAMPLE PREPARATION:	Refer to Section II	
CONDITIONING:	-18°C (0°F) Chamber #202	
CONTENTS TEMP.:	-19.2°C (-2.6°F)	
DROP HEIGHT:	2.55 Meters (101") (Refer to Section IV)	
TEST EQUIPMENT:	L.A.B. Accu Drop 160	

***Note:** The three (3) samples subjected to the 24-hour stack test and four (4) additional samples were subjected to the drop test. Each package was subjected to all six (6) drop orientations.







DROP ORIENTATIONS TEST SET-UPS		
Flat on Bottom	Flat on Top	Flat on Long Side
		
Flat on Short Side	Bottom Corner	Top Corner
		

Refer to Page 14 for Test Results.

1 x 1 Liter PFA Bottle Packaging

DROP TEST INFORMATION		TEST CRITERIA
SAMPLE SIZE:	1*	<ul style="list-style-type: none"> • For packaging containing liquid, each packaging does not leak. • There can be no damage to the outer packaging likely to adversely affect safety during transport. Inner receptacles, inner packagings or articles must remain completely within the outer packaging and there must be no leakage of the filling substance from the inner packaging. • Any discharge from a closure is slight and ceases immediately after impact with no further leakage. • No rupture is permitted in packagings for materials in Class 1 which would permit spillage of loose explosive substances or articles from the outer packaging. (§178.603)
TEST CONTENTS:	Methanol/Water Solution (0.969 SG)	
SAMPLE PREPARATION:	Refer to Section II	
CONDITIONING:	-18°C (0°F) Chamber #202	
CONTENTS TEMP.:	-19°C (-2.2°F)	
DROP HEIGHT:	2.55 Meters (101") (Refer to Section IV)	
TEST EQUIPMENT:	L.A.B. Accu Drop 160	

***Note:** The sample subjected to the 24-hour stack was subjected to the drop test. The package was subjected to all six (6) drop orientations.

DROP ORIENTATIONS TEST SET-UPS		
Flat on Bottom	Flat on Top	Flat on Long Side
		
Flat on Short Side	Bottom Corner	Top Corner
		

Refer to following page for Test Results.

DROP TEST RESULTS
1 x 500 mL FEP Bottle Packaging

Drop Orientation	Sample 1 227042	Sample 2 2204090	Sample 3 2205020	Sample 4 L609188	Sample 5 L711551	Sample 6 2205021	Sample 7 2206020
Flat on Bottom	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Flat on Top	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Flat on Long Side	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Flat on Short Side	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Btm Corner (Mfg. Joint)	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Top Corner (Mfg. Joint)	Pass	Pass	Pass	Pass	Pass	Pass	Pass

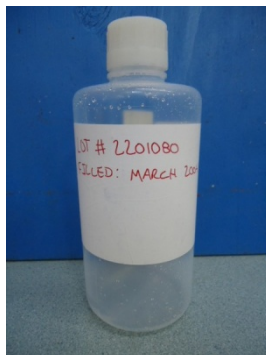
Comments / Observations

Following the six-drop sequence conducted on each packaging, there was slight deformation noted to the impact faces and corners on the outer shipper. There was no leakage or damage to the 500 mL FEP bottles in any of the packages.

DROP TEST RESULTS
1 x 1 Liter PFA Bottle Packaging

Drop Orientation	Sample 1 2201080	Comments / Observations
Flat on Bottom	Pass	Following the six-drop sequence conducted on the packaging, there was slight deformation noted to the impact faces and corners on the outer shipper. There was no leakage or damage to the 1L PFA bottle.
Flat on Top	Pass	
Flat on Long Side	Pass	
Flat on Short Side	Pass	
Btm Corner (Mfg. Joint)	Pass	
Top Corner (Mfg. Joint)	Pass	

CONDITION OF 1 LITER BOTTLE FOLLOWING DROP TESTS

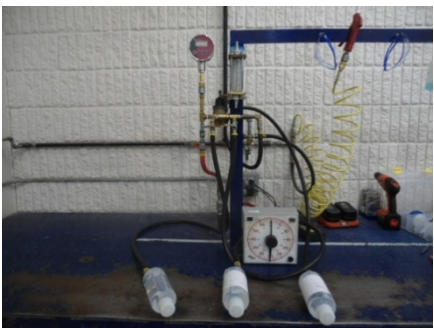


TEST NO. 3 - PRESSURE DIFFERENTIAL TEST


TEST INFORMATION		TEST CRITERIA
SAMPLE SIZE:	500 mL Bottle: 4* 1 Liter Bottle: 1*	<ul style="list-style-type: none"> • Packaging for which retention of liquid is a basic function must be capable of withstanding the pressure requirements without leakage. (§173.27(c))
TEST CONTENTS:	Water	
FILL CAPACITY:	Maximum Capacity	
CLOSURE APPLICATION:	Refer to Section II	
CONDITIONING:	Ambient	
TEST PRESSURE:	95 kPa	
TEST DURATION:	30 Minutes	
AREA OF PRESSURIZATION:	Through the Bottom	
TEST EQUIPMENT:	Regulated Water Source Digital Pressure Gauge	

*Note: The bottles subjected to the 95 kPa pressure test had also been subjected to the stack and/or drop test.

HYDROSTATIC PRESSURE TEST SET-UP AND RESULTS – 500 mL FEP Bottle

	Sample #	Results	Comments/Observations
	1 227042	PASS	All samples maintained the 95 kPa test pressure for 30 minutes without leakage.
	2 2204090	PASS	
	3 2205020	PASS	
	4 L609188	PASS	

HYDROSTATIC PRESSURE TEST SET-UP AND RESULTS – 1 Liter PFA Bottle

	Sample #	Results	Comments/Observations
	1 2201080	PASS	The sample maintained the 95 kPa test pressure for 30 minutes without leakage.





TEST NO. 4 – IMPACT RESISTANCE TEST - 500 mL FEP Bottle

TEST INFORMATION		TEST PROCEDURE
SAMPLE SIZE:	3	<p>Due to the limited sample size, testing was conducted under the guidelines of ASTM D2463 – Standard Test Method for Drop Impact Resistance of Blow Molded Thermoplastic Containers.</p> <p>Individual samples were subjected to 32" Flat on Bottom impact.</p> <p>If sample passed this drop, the drop height was increased by 12" and the drop repeated on the same sample.</p> <p>This procedure was continued, increasing the drop height in 12" increments until failure occurred or the maximum equipment drop height of 128" was reached.</p> <p>Failure was defined as any visible rupture or liquid noted on the outside of the container through any aperture other than the molded opening</p>
TEST CONTENTS:	Water	
SAMPLE PREPARATION:	Refer to Section II	
CONDITIONING:	Ambient	
STARTING DROP HEIGHT:	32"	
DROP HEIGHT INCREMENT:	12"	
DROP ORIENTATION:	Flat on Bottom	
TEST EQUIPMENT:	L.A.B. Accu Drop 160	

***Note:** The bottles subjected to the impact resistance test had also been subjected to the stack and/or drop test.

Refer to Page 17 for Test Set-Ups and Page 18 for Impact Resistance Test Results.

**IMPACT RESISTANCE TEST
FLAT ON BOTTOM DROP TEST SET-UPS**

32"	44"	56"
		
68"	80"	92"
		
104"	116"	128"
		


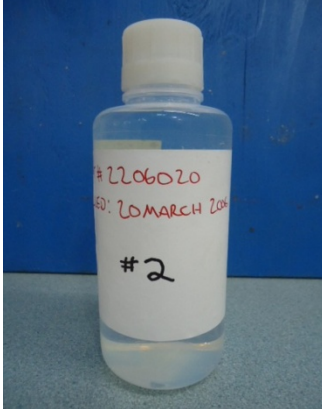

DROP IMPACT RESISTANCE TEST RESULTS
500 mL FEP Bottle

Flat on Bottom Drop Height	Sample 1 (2205021)	Sample 2 (2206020)	Sample 3 (L711551)
32"	Pass	Pass	Pass
44"	Pass	Pass	Pass
56"	Pass	Pass	Pass
68"	Pass	Pass	Pass
80"	Pass	Pass	Pass
92"	Pass	Pass	Pass
104"	Pass	Pass	Pass
116"	Pass	Pass	Pass
128"	Pass	Pass	Pass

Comments / Observations

Following each impact no leakage or damage was noted on any of the 500 mL FEP bottles.

CONDITION OF BOTTLES FOLLOWING IMPACT RESISTANCE TEST

Sample 1	Sample 2	Sample 3
		

REGULATORY AND INDUSTRY STANDARD REFERENCES

REGULATORY REFERENCES

TEST	49 CFR ^①	UN ^②	IMDG ^③	ICAO ^④	IATA ^⑤
	October 2012 Edition	17 th Edition	2012 Edition	2013-2014 Edition	54th Edition
Drop:	178.603	6.1.5.3	6.1.5.3	6; 4.3	6.3.3
Stacking:	178.606	6.1.5.6	6.1.5.6	6; 4.6	6.3.6
Pressure:	173.27(c)	4.1.1.4.1	4.1.1.4.1	4; 1.1.6	5.0.2.9

- ① United States Department of Transportation Code of Federal Regulations (CFR) Title 49, Transportation, Parts 100-185
 ② The United Nations Recommendations on the Transport of Dangerous Goods – Model Regulations (UN – Orange Book)
 ③ International Maritime Dangerous Goods Code (IMDG)
 ④ Technical Instructions for the Safe Transport of Dangerous Good by Air (ICAO)
 ⑤ International Air Transport Association (IATA) Dangerous Goods Regulations

INDUSTRY STANDARD REFERENCES

Drop:	ASTM ^⑥ D5276:	Standard Test Method for Drop Test of Loaded Containers by Free Fall
	ISO ^⑦ 2248:	Packaging – Complete, Filled Transport Packages – Vertical Impact Test by Dropping
Stacking:	ASTM ^⑥ D4577:	Standard Test Method for Compression Resistance of a Container Under Constant Load
	ISO ^⑦ 2234:	Packaging – Complete, Filled Transport Packages – Stacking Test using Static Load
Hydrostatic Pressure:	ASTM ^⑥ D7660:	Standard Guide for Conducting Internal Pressure Tests on United Nations (UN) Packagings
Impact Resistance:	ASTM ^⑥ D2463:	Standard Test Method for Drop Impact Resistance of Blow-Molded Thermoplastic Containers

- ⑥ American Society for Testing and Materials (ASTM)
 ⑦ International Organization for Standardization (ISO)

EQUIPMENT

All inspection, measuring and test equipment that can affect product quality is calibrated and adjusted at prescribed intervals, or prior to use, and is traceable to NIST, using ANSI Z540 as an overall guide for calibration certification.

SECTION IV: MATHEMATICAL CALCULATIONS

1 x 500 mL FEP Bottle Packaging

INFORMATION USED FOR CALCULATIONS		
Overall Packaging Tare Weight (PTW):	599.0 Grams	
Overflow Capacity (OFC):		<u>Methanol/Water SG</u>
Methanol/Water	538.7 Grams	SG: 0.969
Water	556.0 Grams	
Number of Inner Packagings (# IP):	1	
Packing Group	I	
Product Specific Gravity (PSG):	1.700	
Packing Group Multiplication Factor (MF):	1.50	
Overall Height of one Package (OH):	13.13 Inches	
Stack Test-# of Samples Tested Simultaneously:	3	

98% OF OVERFLOW				
Overflow Capacity (OFC) x 98%				
<u>OFC</u>	x	<u>98%</u>		
538.7	x	98% =	528.0 Grams	Methanol/Water
556.0	x	98% =	544.9 Grams	Water

PACKAGE TEST WEIGHTS					
Overall Pkg Tare Weight (PTW) + (98% Overflow Capacity (OFC) x # of Inner Pkg (# IP))					
<u>PTW</u>	+	<u>(98% OFC)</u>	x	<u># IP</u>	
599	+	528.0	x	1	Methanol/Water
599	+	544.9	x	1	Water
Methanol/Water:		1.1	Kg	2.4	Lbs.
Water:		1.1	Kg	2.4	Lbs.



TEN-E Packaging Services, Inc.

DROP HEIGHT				
Calculation For Product Specific Gravities Exceeding 1.2				
Product Specific Gravity (PSG) x Packing Group Multiplication Factor (MF)				
<u>PSG</u>	x	<u>MF</u>	Packing Group: I	
1.7	x	1.50	<u>Required Drop Height</u>	<u>Actual Drop Height</u>
		2.55 Meter	100.4 Inches	101 Inches

STACKING TEST MINIMUM LOAD CALCULATIONS				
Number of Packages in a 3m High Stack (118 / Overall Pkg Height (OH) -1)				
118 / Overall Height of one Pkg (OH) - 1				
<u>(118</u>	/	<u>OH)</u>	-1	= <u># 3m HS</u>
118	/	13.13	-1	= 8.0
Stacking Test Load Calculation (Individual Package)				
Authorized Pkg Gross Mass (APGM) x # of Pkg in a 3m High Stack (# 3m HS)				
<u>APGM</u>	x	<u># 3m HS</u>		
1.5	x	8.0		
		12.0 Kg	26.5 Lbs.	

Stacking Test Load Calculation				
Samples x Authorized Pkg Gross Mass (APGM) x # of Pkg in a 3m High Stack (# 3m HS)				
<u>Samples</u>	x	<u>(APGM</u>	x	<u># 3m HS)</u>
3	x	1.5	x	8.0
		36.0 Kg	79.4 Lbs.	

1 x 1 Liter PFA Bottle Packaging

INFORMATION USED FOR CALCULATIONS		
Overall Packaging Tare Weight (PTW):	666.0 Grams	
Overflow Capacity (OFC):		<u>Methanol/Water SG</u>
Methanol/Water	1,017.4 Grams	SG: 0.969
Water	1,050.0 Grams	
Number of Inner Packagings (# IP):	1	
Packing Group	I	
Product Specific Gravity (PSG):	1.700	
Packing Group Multiplication Factor (MF):	1.50	
Overall Height of one Package (OH):	13.13 Inches	
Stack Test-# of Samples Tested Simultaneously:	0	

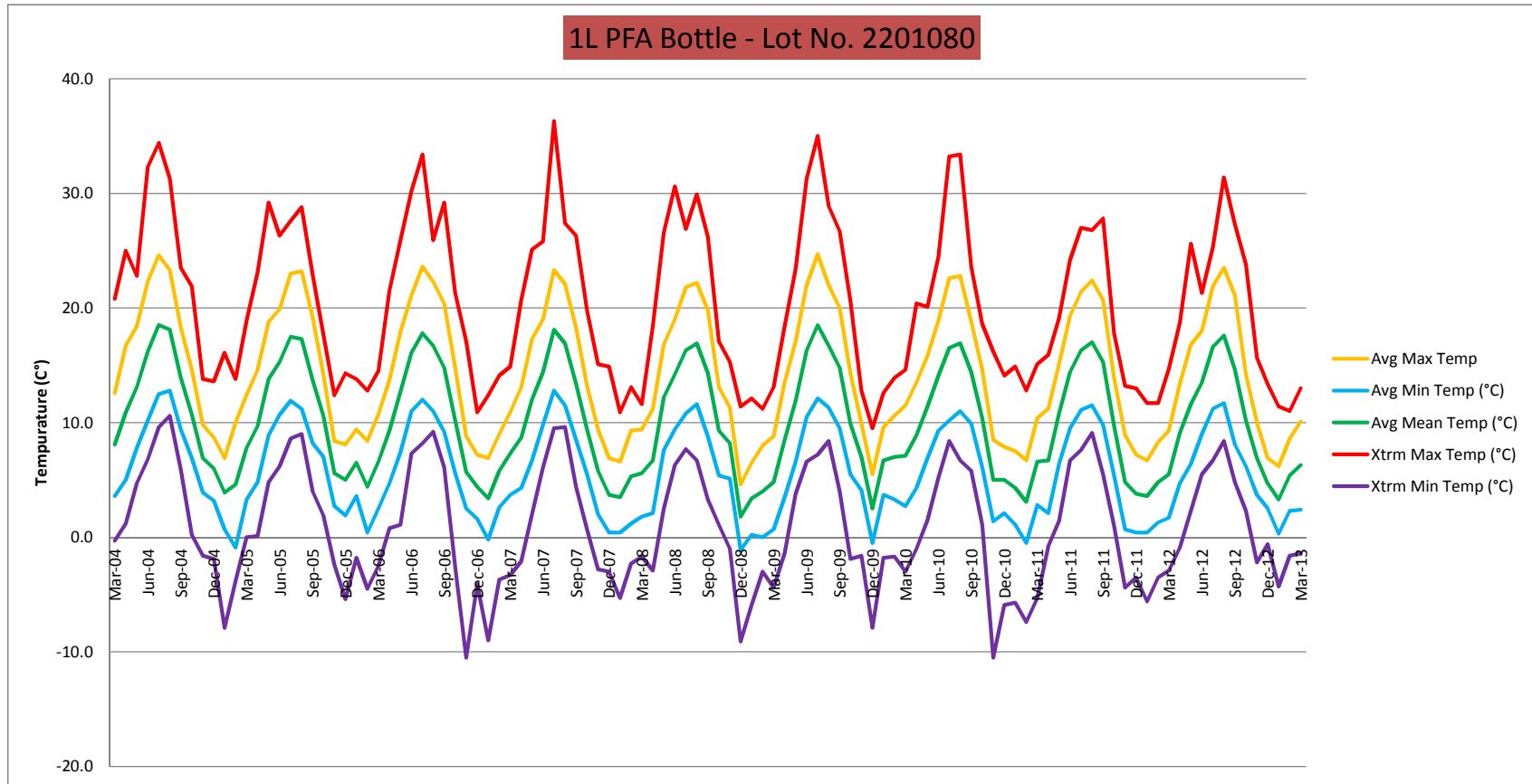
98% OF OVERFLOW				
Overflow Capacity (OFC) x 98%				
<u>OFC</u>	x	<u>98%</u>		
1,017.4	x	98% =	997.1 Grams	Methanol/Water
1,050.0	x	98% =	1,029.0 Grams	Water

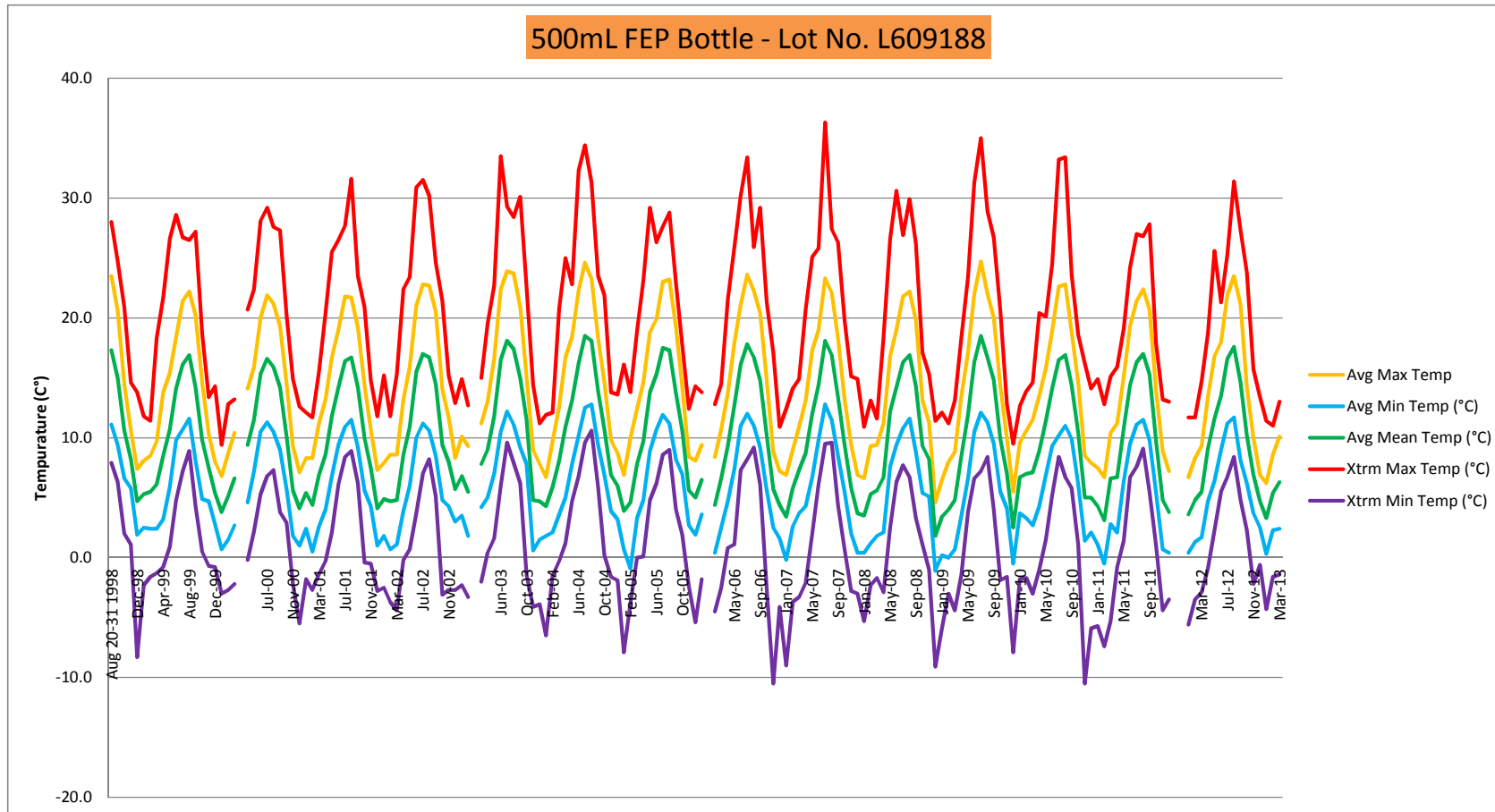
PACKAGE TEST WEIGHTS					
Overall Pkg Tare Weight (PTW) + (98% Overflow Capacity (OFC) x # of Inner Pkg (# IP))					
<u>PTW</u>	+	<u>(98% OFC)</u>	x	<u># IP</u>	
666	+	997.1	x	1	Methanol/Water
666	+	1,029.0	x	1	Water
Methanol/Water:		1.6	Kg	3.5	Lbs.
Water:		1.6	Kg	3.5	Lbs.

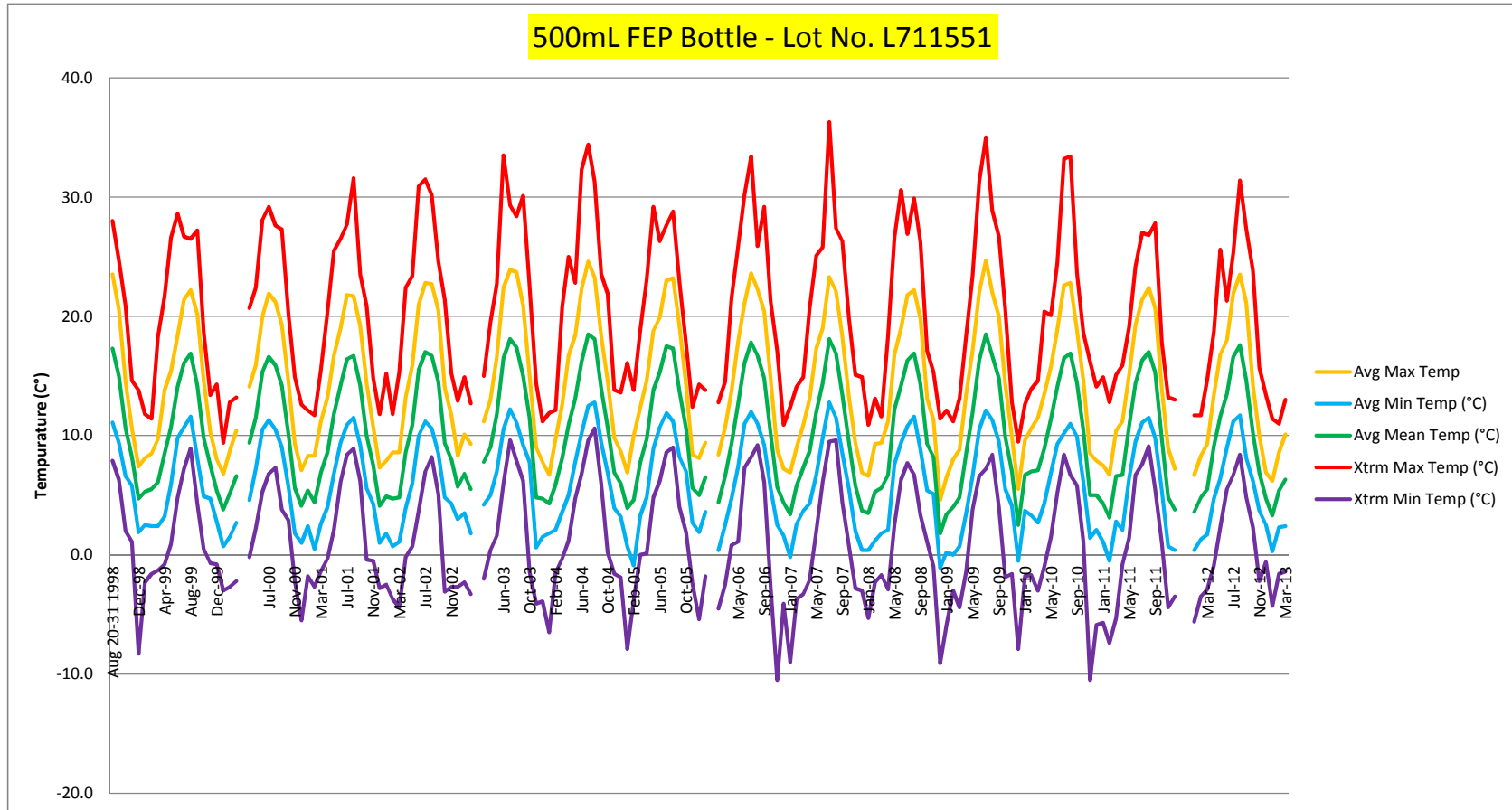


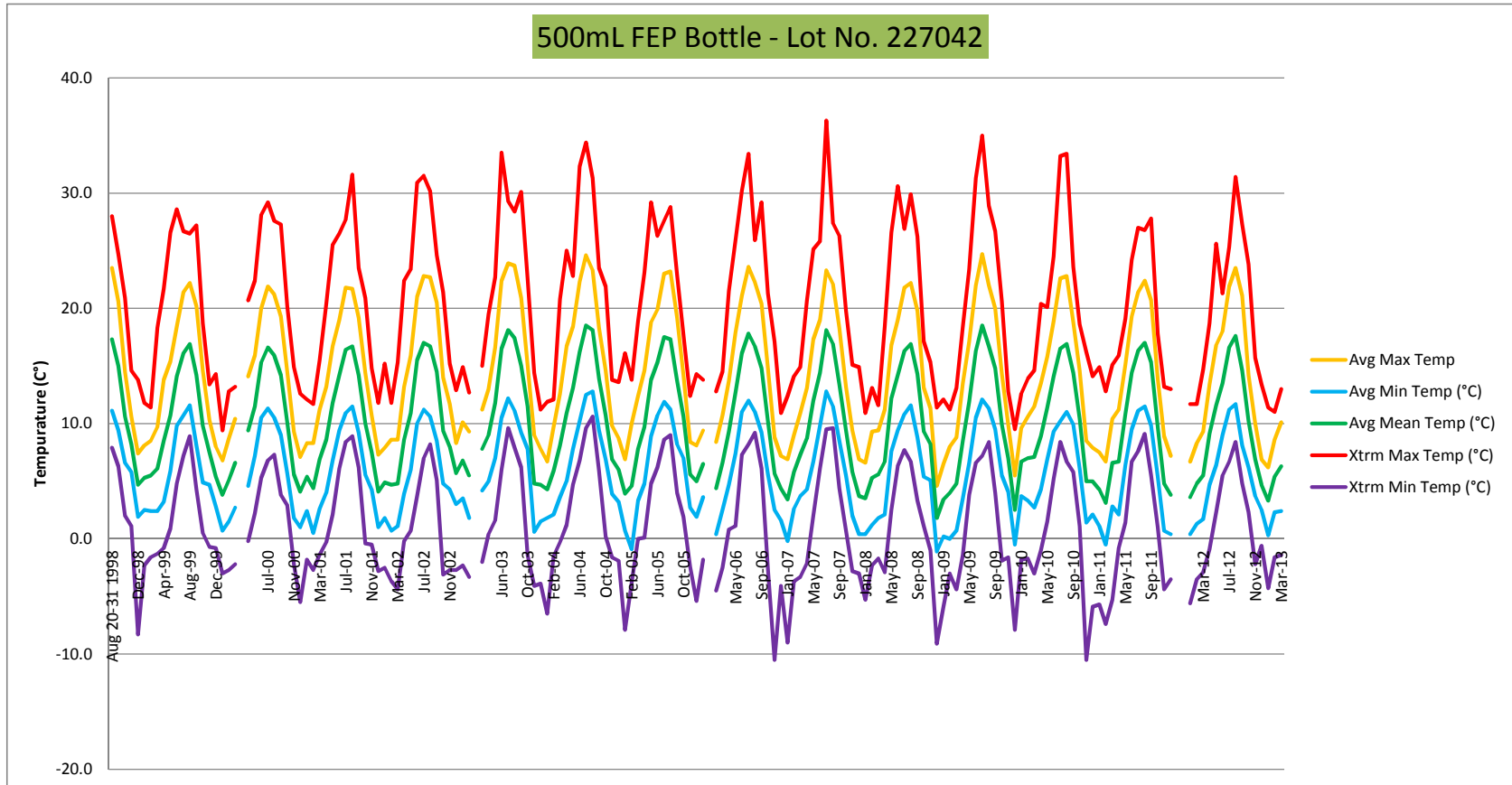
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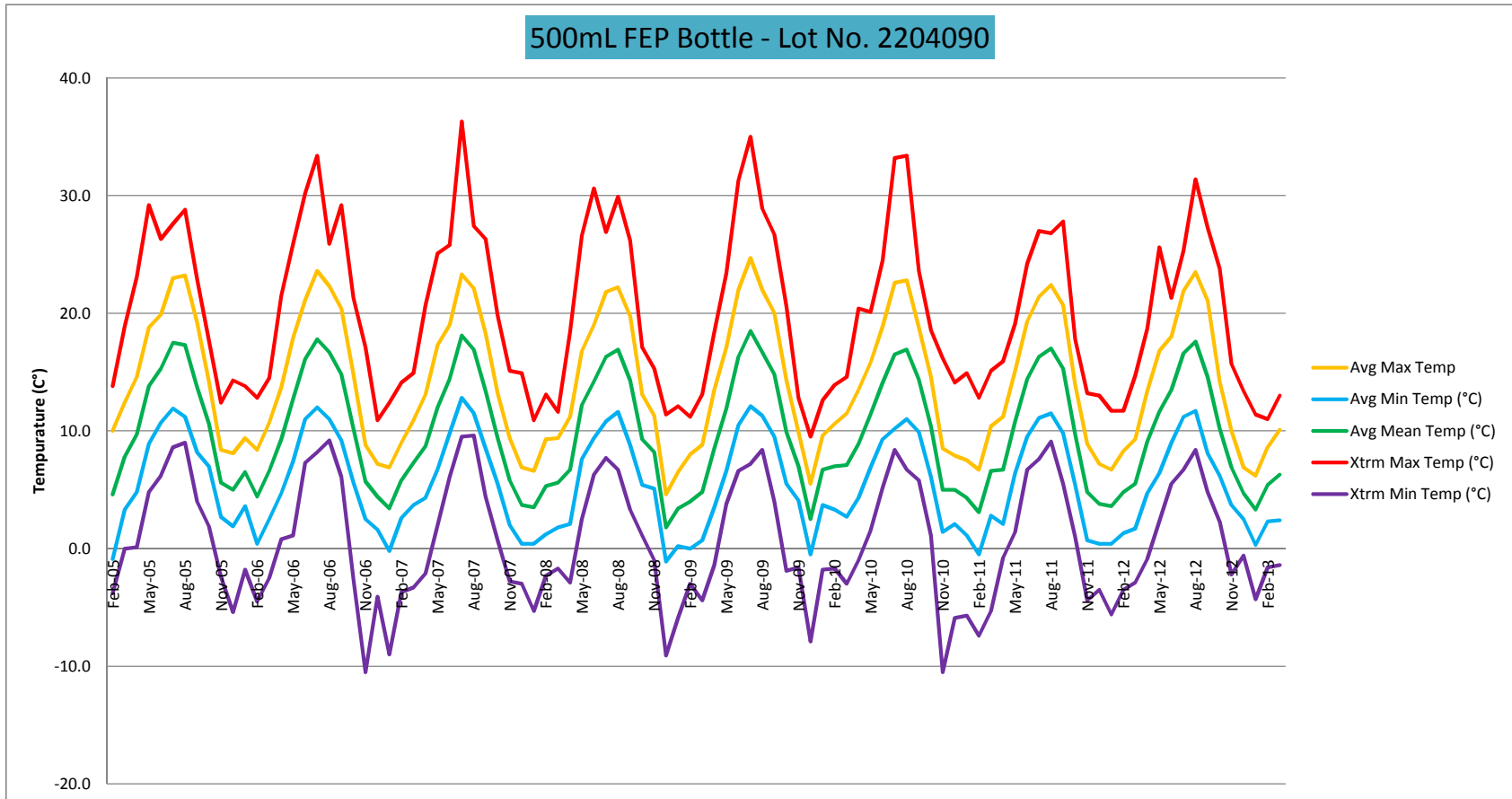
APPENDIX A: STORAGE TEMPERATURE GRAPHS FROM SEASTAR CHEMICALS

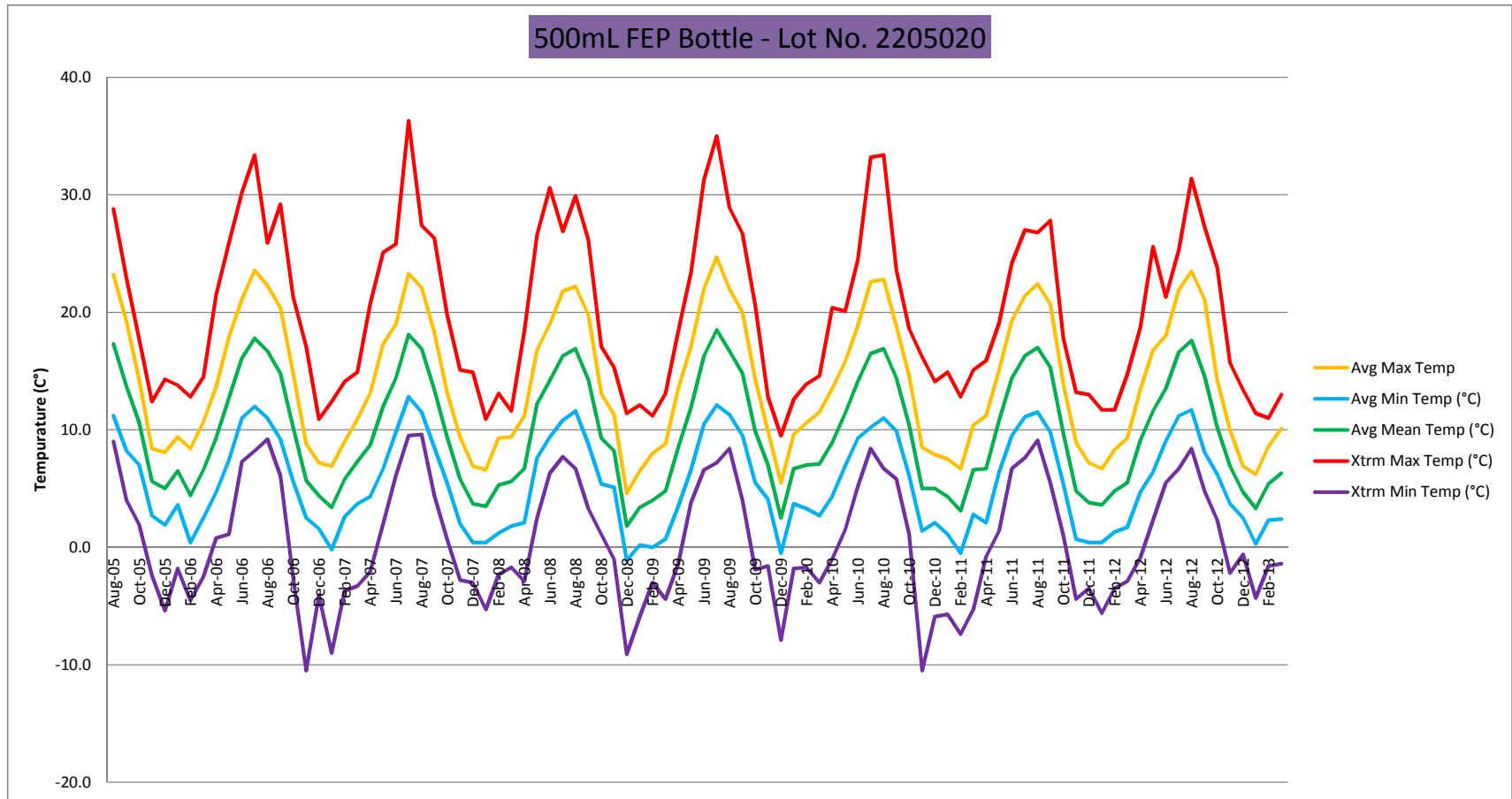


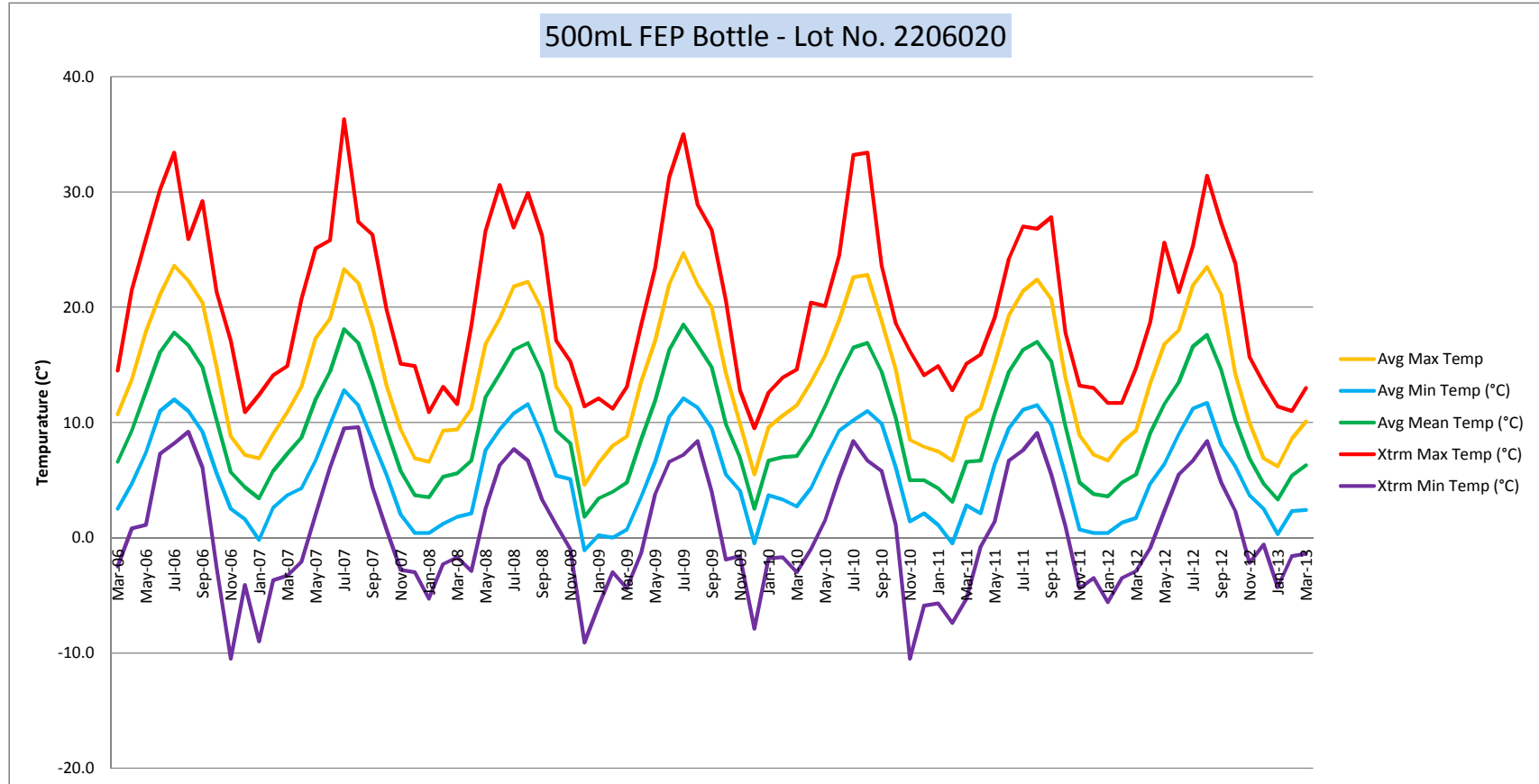


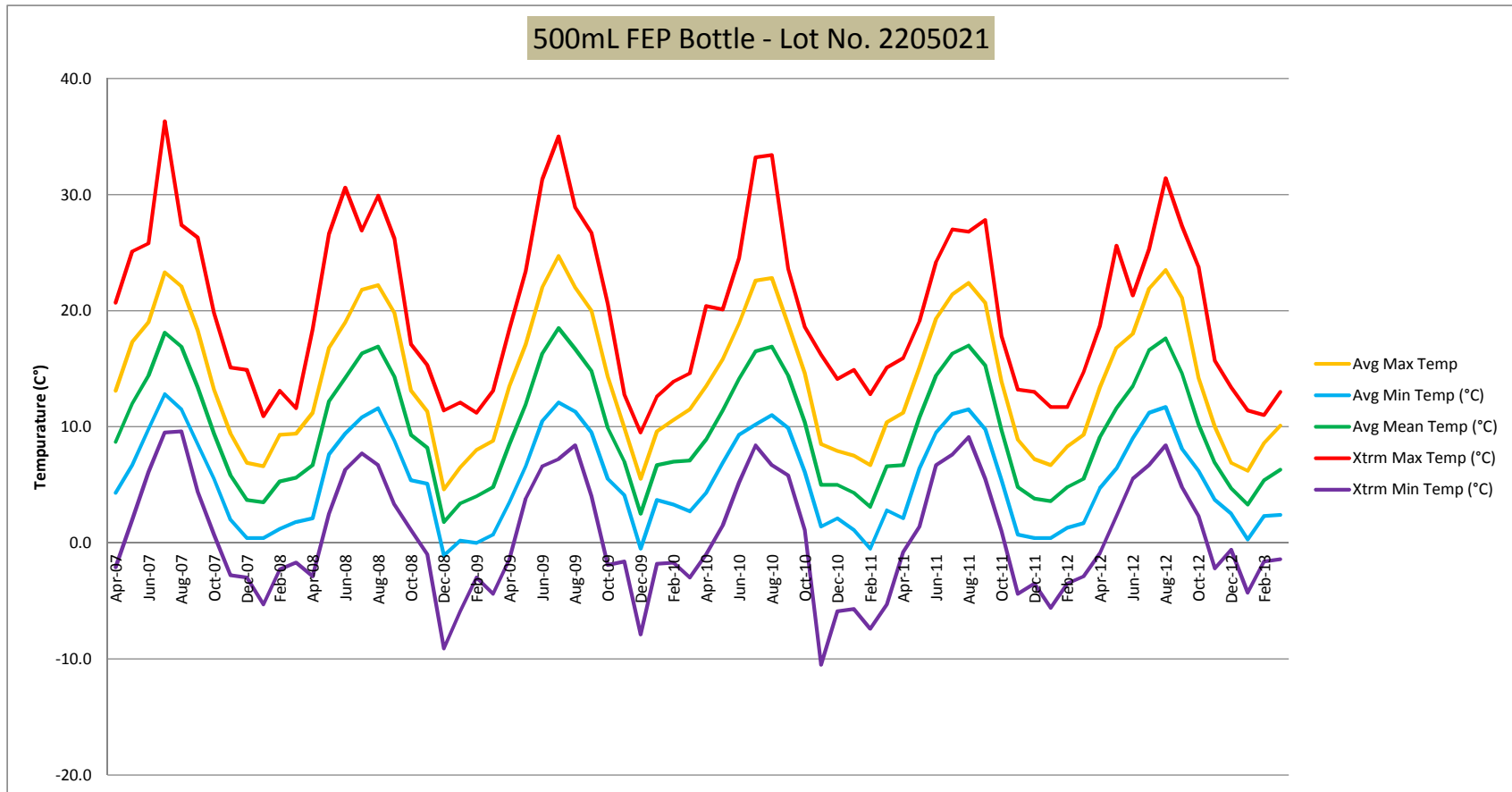














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APPENDIX B: STORAGE TEMPERATURE RAW DATA FROM SEASTAR CHEMICALS

STORAGE TEMPERATURES

Month/Year	Avg Max Temp	Avg Min Temp (°C)	Avg Mean Temp (°C)	Xtrm Max Temp (°C)	Xtrm Min Temp (°C)
Aug 20-31 1998	23.5	11.1	17.3	28.0	7.9
Sep-98	20.6	9.4	15.0	24.7	6.3
Oct-98	14.5	6.6	10.6	20.9	2.0
Nov-98	10.6	5.8	8.2	14.6	1.1
Dec-98	7.4	1.9	4.7	13.8	-8.3
Jan-99	8.1	2.5	5.3	11.8	-2.3
Feb-99	8.5	2.4	5.5	11.4	-1.6
Mar-99	9.7	2.4	6.1	18.3	-1.3
Apr-99	13.8	3.2	8.5	21.7	-0.8
May-99	15.4	5.9	10.7	26.6	0.9
Jun-99	18.4	9.8	14.1	28.6	4.8
Jul-99	21.4	10.7	16.1	26.7	7.2
Aug-99	22.2	11.6	16.9	26.5	8.9
Sep-99	20.2	8.1	14.2	27.2	4.3
Oct-99	14.6	4.9	9.8	18.7	0.5
Nov-99	10.3	4.7	7.5	13.4	-0.7
Dec-99	8.0	2.8	5.4	14.3	-0.8
Jan-00	6.8	0.7	3.8	9.4	-3.0
Feb-00	8.7	1.5	5.1	12.8	-2.7
Mar-00	10.4	2.7	6.6	13.2	-2.2
Apr-00	14.1	4.6	9.4	20.7	-0.2
May-00	15.9	7.2	11.5	22.4	2.2
Jun-00	20.0	10.5	15.3	28.1	5.3
Jul-00	21.9	11.3	16.6	29.2	6.8
Aug-00	21.2	10.5	15.9	27.6	7.3
Sep-00	19.3	9.0	14.2	27.3	3.8
Oct-00	14.5	5.7	10.1	20.2	2.9
Nov-00	9.3	1.8	5.6	14.9	-2.2
Dec-00	7.1	1.0	4.1	12.6	-5.5
Jan-01	8.3	2.4	5.4	12.1	-1.8
Feb-01	8.3	0.5	4.4	11.7	-2.7
Mar-01	11.2	2.6	6.9	15.5	-1.4
Apr-01	13.2	4.0	8.6	20.4	-0.3
May-01	16.7	6.8	11.8	25.5	2.1
Jun-01	19.0	9.4	14.2	26.5	6.1
Jul-01	21.8	10.9	16.4	27.7	8.4
Aug-01	21.7	11.5	16.7	31.6	8.9
Sep-01	19.2	9.2	14.2	23.5	6.2
Oct-01	14.4	5.6	10.0	20.9	-0.4
Nov-01	10.7	4.3	7.5	14.8	-0.5
Dec-01	7.3	1.0	4.1	11.8	-2.8



STORAGE TEMPERATURES

Month/Year	Avg Max Temp	Avg Min Temp (°C)	Avg Mean Temp (°C)	Xtrm Max Temp (°C)	Xtrm Min Temp (°C)
Jan-02	7.9	1.8	4.9	15.2	-2.5
Feb-02	8.6	0.7	4.7	11.8	-3.7
Mar-02	8.6	1.1	4.8	15.3	-4.4
Apr-02	13.2	3.9	8.6	22.4	-0.2
May-02	15.9	6.0	10.9	23.4	0.7
Jun-02	21.0	10.0	15.5	30.9	3.7
Jul-02	22.8	11.2	17.0	31.5	7.0
Aug-02	22.7	10.6	16.7	30.2	8.2
Sep-02	20.5	8.5	14.5	24.6	5.1
Oct-02	14.0	4.8	9.4	21.4	-3.1
Nov-02	11.7	4.3	8.0	15.2	-2.7
Dec-02	8.3	3.0	5.7	12.9	-2.7
Jan-03	10.1	3.5	6.8	14.9	-2.3
Feb-03	9.3	1.8	5.5	12.7	-3.3
Mar-03	11.2	4.2	7.8	15.0	-2.0
Apr-03	13.0	5.0	9.0	19.5	0.4
May-03	16.6	7.0	11.8	22.7	1.6
Jun-03	22.4	10.5	16.5	33.5	6.0
Jul-03	23.9	12.2	18.1	29.3	9.6
Aug-03	23.7	11.1	17.4	28.4	7.9
Sep-03	20.9	9.2	15.0	30.1	6.2
Oct-03	15.1	7.8	11.5	22.6	-1.4
Nov-03	9.0	0.6	4.8	14.4	-4.1
Dec-03	7.8	1.5	4.7	11.2	-3.9
Jan-04	6.7	1.8	4.3	11.9	-6.5
Feb-04	9.7	2.1	5.9	12.1	-1.5
Mar-04	12.6	3.6	8.1	20.8	-0.3
Apr-04	16.7	5.0	10.9	25.0	1.2
May-04	18.4	7.8	13.1	22.8	4.7
Jun-04	22.3	10.2	16.2	32.3	6.8
Jul-04	24.6	12.5	18.5	34.4	9.6
Aug-04	23.3	12.8	18.1	31.3	10.6
Sep-04	18.3	9.4	13.9	23.5	5.9
Oct-04	14.6	6.9	10.7	21.9	0.2
Nov-04	9.8	3.9	6.9	13.8	-1.6
Dec-04	8.7	3.2	6.0	13.6	-1.9
Jan-05	6.9	0.7	3.9	16.1	-7.9
Feb-05	10.0	-0.9	4.6	13.8	-3.8
Mar-05	12.4	3.3	7.8	18.9	0.0
Apr-05	14.6	4.8	9.7	23.1	0.1
May-05	18.8	8.9	13.8	29.2	4.8



STORAGE TEMPERATURES

Month/Year	Avg Max Temp	Avg Min Temp (°C)	Avg Mean Temp (°C)	Xtrm Max Temp (°C)	Xtrm Min Temp (°C)
Jun-05	19.9	10.7	15.3	26.3	6.2
Jul-05	23.0	11.9	17.5	27.6	8.6
Aug-05	23.2	11.2	17.3	28.8	9.0
Sep-05	19.2	8.2	13.7	22.9	4.0
Oct-05	14.2	7.0	10.6	17.7	1.9
Nov-05	8.4	2.7	5.6	12.4	-2.4
Dec-05	8.1	1.9	5.0	14.3	-5.4
Jan-06	9.4	3.6	6.5	13.8	-1.8
Feb-06	8.4	0.4	4.4	12.8	-4.5
Mar-06	10.7	2.5	6.6	14.5	-2.5
Apr-06	13.7	4.7	9.3	21.5	0.8
May-06	17.9	7.4	12.7	25.9	1.1
Jun-06	21.1	11.0	16.1	30.2	7.3
Jul-06	23.6	12.0	17.8	33.4	8.2
Aug-06	22.3	11.0	16.7	25.9	9.2
Sep-06	20.4	9.2	14.8	29.2	6.1
Oct-06	14.8	5.6	10.2	21.3	-2.6
Nov-06	8.8	2.5	5.7	17.1	-10.5
Dec-06	7.2	1.6	4.4	10.9	-4.1
Jan-07	6.9	-0.2	3.4	12.4	-9.0
Feb-07	9.0	2.6	5.8	14.1	-3.7
Mar-07	10.9	3.7	7.3	14.9	-3.3
Apr-07	13.1	4.3	8.7	20.7	-2.1
May-07	17.3	6.7	12.0	25.1	2.0
Jun-07	19.0	9.8	14.4	25.8	6.1
Jul-07	23.3	12.8	18.1	36.3	9.5
Aug-07	22.1	11.5	16.9	27.4	9.6
Sep-07	18.3	8.5	13.4	26.3	4.4
Oct-07	13.2	5.5	9.4	19.8	0.7
Nov-07	9.4	2.0	5.8	15.1	-2.8
Dec-07	6.9	0.4	3.7	14.9	-3.0
Jan-08	6.6	0.4	3.5	10.9	-5.3
Feb-08	9.3	1.2	5.3	13.1	-2.3
Mar-08	9.4	1.8	5.6	11.6	-1.7
Apr-08	11.2	2.1	6.7	18.4	-2.9
May-08	16.8	7.6	12.2	26.6	2.5
Jun-08	19.0	9.4	14.2	30.6	6.3
Jul-08	21.8	10.8	16.3	26.9	7.7
Aug-08	22.2	11.6	16.9	29.9	6.7
Sep-08	19.8	8.8	14.3	26.2	3.3
Oct-08	13.1	5.4	9.3	17.1	1.1



STORAGE TEMPERATURES

Month/Year	Avg Max Temp	Avg Min Temp (°C)	Avg Mean Temp (°C)	Xtrm Max Temp (°C)	Xtrm Min Temp (°C)
Nov-08	11.3	5.1	8.2	15.3	-1.0
Dec-08	4.6	-1.1	1.8	11.4	-9.1
Jan-09	6.5	0.2	3.4	12.1	-5.9
Feb-09	8.0	0.0	4.0	11.2	-3.0
Mar-09	8.8	0.7	4.8	13.1	-4.4
Apr-09	13.5	3.5	8.5	18.4	-1.4
May-09	17.1	6.6	11.9	23.4	3.8
Jun-09	22.0	10.5	16.3	31.3	6.6
Jul-09	24.7	12.1	18.5	35.0	7.2
Aug-09	22.0	11.3	16.7	28.9	8.4
Sep-09	20.0	9.5	14.8	26.7	4.0
Oct-09	14.3	5.5	9.9	20.6	-1.9
Nov-09	9.9	4.1	7.0	12.8	-1.6
Dec-09	5.5	-0.5	2.5	9.5	-7.9
Jan-10	9.6	3.7	6.7	12.6	-1.8
Feb-10	10.6	3.3	7.0	13.9	-1.7
Mar-10	11.5	2.7	7.1	14.6	-3.0
Apr-10	13.5	4.3	8.9	20.4	-1.0
May-10	15.8	6.9	11.4	20.1	1.5
Jun-10	18.9	9.3	14.1	24.5	5.2
Jul-10	22.6	10.2	16.5	33.2	8.4
Aug-10	22.8	11.0	16.9	33.4	6.7
Sep-10	18.8	9.9	14.4	23.6	5.8
Oct-10	14.6	6.1	10.4	18.6	1.1
Nov-10	8.5	1.4	5.0	16.2	-10.5
Dec-10	7.9	2.1	5.0	14.1	-5.9
Jan-11	7.5	1.1	4.3	14.9	-5.7
Feb-11	6.7	-0.5	3.1	12.8	-7.4
Mar-11	10.4	2.8	6.6	15.1	-5.3
Apr-11	11.2	2.1	6.7	15.9	-0.8
May-11	15.1	6.4	10.8	19.1	1.4
Jun-11	19.3	9.5	14.4	24.2	6.7
Jul-11	21.4	11.1	16.3	27.0	7.6
Aug-11	22.4	11.5	17.0	26.8	9.1
Sep-11	20.7	9.8	15.3	27.8	5.5
Oct-11	13.9	5.4	9.7	17.8	1.0
Nov-11	8.9	0.7	4.8	13.2	-4.4
Dec-11	7.2	0.4	3.8	13.0	-3.5
Jan-12	6.7	0.4	3.6	11.7	-5.6
Feb-12	8.3	1.3	4.8	11.7	-3.5
Mar-12	9.3	1.7	5.5	14.7	-2.9



STORAGE TEMPERATURES

Month/Year	Avg Max Temp	Avg Min Temp (°C)	Avg Mean Temp (°C)	Xtrm Max Temp (°C)	Xtrm Min Temp (°C)
Apr-12	13.4	4.7	9.1	18.7	-0.9
May-12	16.8	6.4	11.6	25.6	2.3
Jun-12	18.0	9.0	13.5	21.3	5.5
Jul-12	21.9	11.2	16.6	25.3	6.7
Aug-12	23.5	11.7	17.6	31.4	8.4
Sep-12	21.1	8.1	14.6	27.3	4.8
Oct-12	14.2	6.2	10.2	23.8	2.3
Nov-12	10.0	3.7	6.9	15.7	-2.2
Dec-12	6.9	2.5	4.7	13.4	-0.6
Jan-13	6.2	0.3	3.3	11.4	-4.3
Feb-13	8.6	2.3	5.4	11.0	-1.6
Mar-13	10.1	2.4	6.3	13.0	-1.4

