	SPIRE FM 1 **Sorption Cooler** ***EIDP***	DOC N°: HSO-SBT-ADP-108 Iss/Rev : 1.0 DATE : 7 / 10 / 2004 PAGE : 1
SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]		

SPIRE FM1 Sorption Cooler EIDP

SBT internal ref. SBT / CT / 2004-66

	Name & Function	Date	Signature
Prepared	M.DUBOIS – Cooler PA manager	18/11/04	
Verified	M.DUBOIS – Cooler PA manager	18/11/04	
Project Approval	L. DUBAND Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

Lionel DUBAND
Signature numérique de Lionel DUBAND
ID : CN = Lionel DUBAND, C = FR, OU = CEA-SBT
Date : 2004.11.19 14:58:26 +01'00'

Document Status

Issue	Revision	Date	Number of pages	Modifications
1	0	7 / 10 / 2004	19	First issue

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1 - CERTIFICATE OF CONFORMANCE

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Project name : **SPIRE**	**COC / COA CERTIFICATE OF CONFORMITY / ACCEPTANCE**	*Doc N° :* **HSO-SBT-COC-112** *Date :* **8 / 10 / 2004**

THE ENDORSEMENT HEREIN CERTIFY THAT THE ITEM OFFERED FOR ACCEPTANCE HAS BEEN DESIGNED, MANUFACTURED, ASSEMBLED AND TESTED IN ACCORDANCE WITH APPROVED CONFIGURATION AND COMPLIES IN ALL RESPECTS WITH CONTRACT REQUIREMENTS EXCEPT AS RECORDED IN THE LIST OF EXCEPTIONS OF THIS CERTIFICATE

Designation :	*Originator :*	*Model :*	*Ref N° :*
SORPTION COOLER	**CEA GRENOBLE (SBT)**	**FM**	**1**
Part N° :	*Contract N° :*	*Spec N° :*	*CI N° :*
2000-14 B 000	-	-	

The following is certified	**Exceptions**
1. All exceptions listed against lower level item configurations have been resolved and closed out. 2. A configuration verification has been performed and the item complies with configuration baseline, and it is accurately described by the configuration documents 3. Each departure from specification and drawings has been approved. 4. Verification including acceptance testing has been successfully completed and all discrepancies have been resolved and corrective actions implemented. 5. The CI complies with the PA requirements for mechanical parts, materials and processes. 6. The CI design complies with requirements for safety. 7. All identified hazards are solved/closed 8. The CI has been cleaned and complies with the requirements for cleanliness. 9. The Acceptance Data Package ADP reference **HSO-SBT-ADP-108** is complete and is available for shipment with the CI. 10. Open work/tests and unresolved non conformances defined in ADP are acceptable for transfer to the user site. 11. Packaging and shipping arrangements are defined and agreed 12. Qualification of the item is satisfactory and recorded in document **HSO-SBT-RP-085**	

CONTRACTOR : **CEA GRENOBLE (SBT)**		CUSTOMER : **RUTHERFORD & APPLETON Laboratory**	
PA Manager **M.DUBOIS**	**Date :**18/11/04 	**PA Manager**	**Date :**
Project Manager **L.DUBAND**	**Date** :18/11/04 	**Project Manager**	**Date :**

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2 – SHIPPING DOCUMENT

To see copy of Shipping Document here attached

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DIRECTION DES SCIENCES DE LA MATIERE
DEPARTEMENT DE RECHERCHE FONDAMENTALE SUR LA MATIERE CONDENSEE
SERVICE DES BASSES TEMPERATURES

BON DE LIVRAISON

Date : November 18th, 2004

Objet : SPIRE FM1 Sorption Cooler delivery to SPIRE Project

N/Réf : 2004-247

V/Réf :

Date de livraison : 18/11/2004	**Réf. Commande CEA : Réaffectation DAPNIA/SAp Date :**
Identifiant TVA : FR43 775 685 019	SIRET : 775 685 019 00 298
Adresse de Livraison : Rutherford Appleton Laboratory (RAL) Chilton Didcot - UK	Transporteur : Doug GRIFFIN (RAL)
	Nombre de colis : 1

Quantité Commandée	Quantité Livrée	Référence	Désignation	Observations
1	1	Sorption cooler FM Ref.: 2000-14B 000 S/N : 1	sorption cooler FM – SPIRE Unit in its transportation container	Including documentation : EIDP (ref. HSO-SBT-ADP-108)

Client	Fournisseur
Nom : Doug GRIFFIN - RAL	Nom : L. Duband – Service des Basses Températures CEA-Grenoble.
Signature : Date : 18/11/04	Signature : Date : 18/11/04

Vous trouverez ce bordereau de livraison en deux exemplaires, vous voudrez bien nous en retourner un signé.

Commissariat à l'Energie Atomique
Centre de Grenoble - 17 rue des Martyrs - 38054 GRENOBLE CEDEX 9
Secrétariat - Tél. : 04 38 78 44 31 - Fax : 04 38 78 51 71 - E-mail: sbt@cea.fr

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3 - OPEN WORK / DEFERRED WORK / OPEN TESTS

No open work
No deferred work
No open test

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4 - TRANSPORTATION / PACKAGING / HANDLING PROCEDURE

Procedure reference HSO-SBT-PR-119

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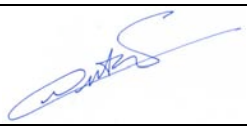
SPIRE Sorption Cooler
FM unit - Handling, packing, transportation and storage manual

SBT internal ref : SBT/CT/2004-69

	Name & Function	Date	Signature
Prepared	L. Duband – Cooler project manager	18/11/04	
PA Check	M. Dubois – Cooler PA manager	18/11/04	
SPIRE Approval			
PACS Approval			
PA Approval			
Project Approval			
Project Approval	L. Duband - Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.
Secretary office - Phone : (33) 438.78.44.31- Fax : (33) 438.78.51.71 – mail : SBT@cea.fr

Document Status

Issue	Revision	Date	Nb of pages	Modifications
1	0	15/11/2004		First issue

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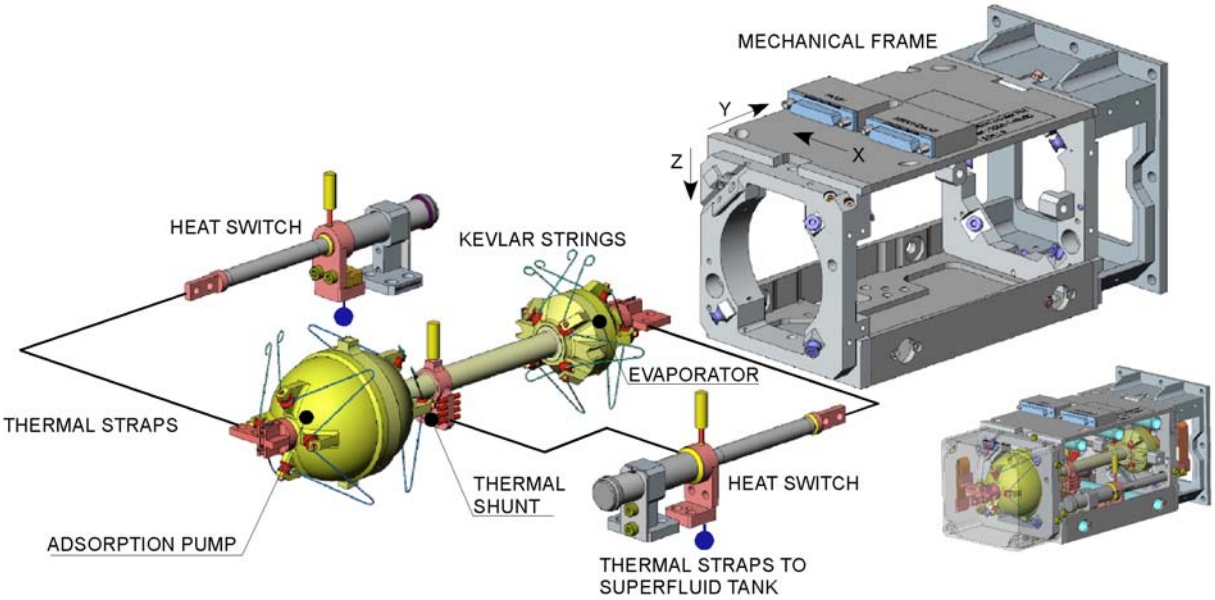
List of Acronyms

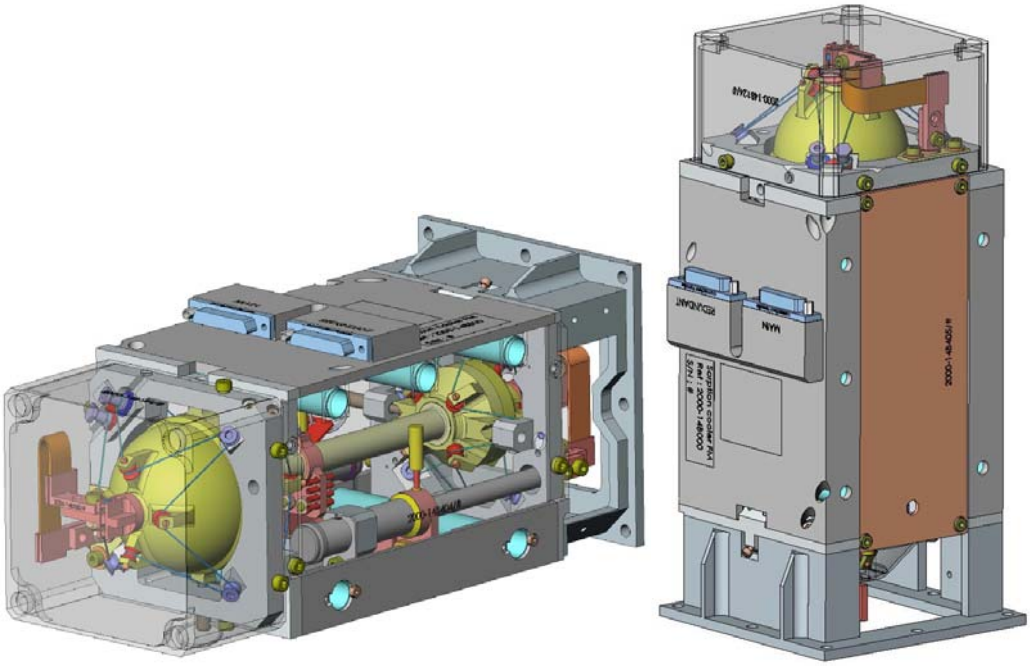
AD	Applicable Document		
ADP	Acceptance Data Package		
CEA	Commissariat à l' Energie Atomique		
CDR	Critical Design Review	Revue de conception détaillée	RCD
CQM	Cryogenic Qualification Model		
CVCM	Collected Volatile Condensable Material		
DML	Declared Material List		
ECSS	European Cooperation for Space Standardisation		
ETF	Environmental Test Facility		
EV	Evaporator		
FIRST	Far Infrared and SubmillimetreTelescope		
FS	Flight spare		
HIFI	Heterodyne Instrument for FIrst		
MGSE	Mechanical Ground Support Equipment		
MOP	Maximum Operating Pressure		
MPM	Material, Processes, Mechanical Parts		
N/A	Not Applicable		
PACS	Photoconductor. Array Camera and Spectrometer		
PFM	ProtoFlight Model		
PSS	Product Assurance Specification System		
RD	Reference Document		
RFA	Request For Approval		
SCC	Stress Corrosion Cracking		
S/C	SpaceCraft		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
SP	Sorption pump		
SPIRE	Spectral & Photometric Imaging Receiver		
SST	Support Structure		

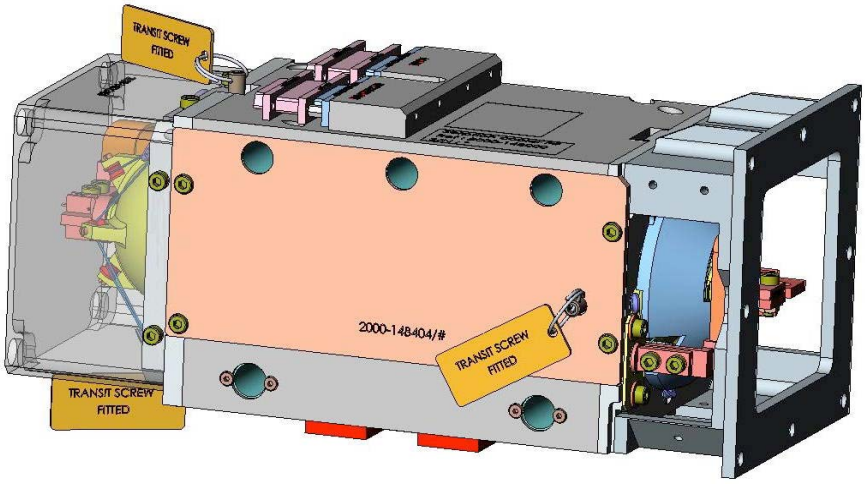
1. Scope of the document

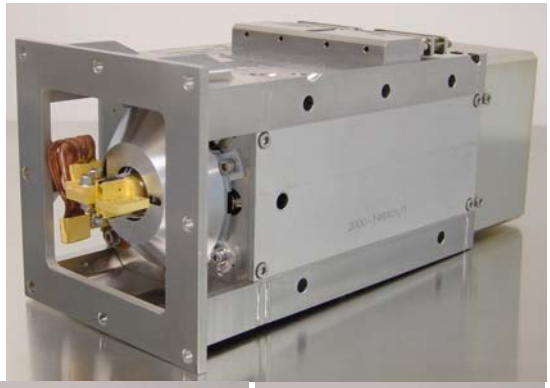
This document contains the specifications and the rules related to the handling, packing, transportation and storage of the flight model (FM) of the sorption coolers developed for the SPIRE and PACS instruments on board the Herschel satellite.

An overall 3D view as well as pictures of the FM are given hereafter. The FM required volume is a rectangle parallelepiped of dimensions 228.5 mm x 100 mm x 100 mm. Reference drawing : 2000-14 B 000. ***Throughout this document, unless otherwise specified, all dimensions are in millimeters***. The total overall mass of the FM is 1749 grams.









2. Documents

2.1. Applicable documents

N/A

2.2. Reference documents

N/A

3. Handling, packing and storage

The full cooler has been assembled in a controlled environment (namely Class 10 000 and 100). Consequently any operations on the cooler must be perform in a clean environment (class 10 000 or below is recommended) and all exposure times must be recorded in the appropriate logbook.

In addition the full cooler has been cleaned following SBT procedure ref. HSO-SBT-PR-026; to avoid any molecular contamination and consequently for any cooler manipulation **the use of gloves is mandatory**. We recommend latex or cotton gloves. (The structural box is made out of titanium and is very sensitive to finger prints).

The mechanical frame is robust. But all the internal elements, mostly the Kevlar suspension system and the thin walled titanium tubes, are fragile. Whenever possible protective covers have been added. These covers must remain in place – they can only be removed by qualified personal.

Never introduce fingers or any external tools within the structural box (Risk of damaging the Kevlar cords).

3.1. Temperature

The sorption cooler is a pressure vessel at ambient temperature. Its internal pressure is in the range 8 to 9 MPa (80-90 bars) at 20°C. Any temperature increase will increase the pressure. A **maximum temperature of 80°C** is set.

In **storage** conditions, the maximum acceptable continuous temperature is 60°C.

For safety reasons the cooler cannot stay continuously at a temperature higher than 60°C (140 °F).

3.2. Humidity

No humidity specifications are stipulated. Yet to avoid cleanliness troubles with condensation, an upper relative humidity limit of about 60% can be considered as an objective.

3.3. Particular contamination

The overall particular contamination budget has been estimated for the AIV. It falls below 300 ppm.

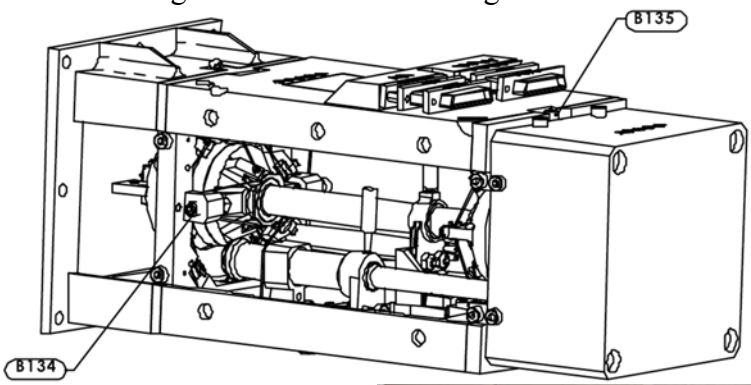
3.4. Cleaning

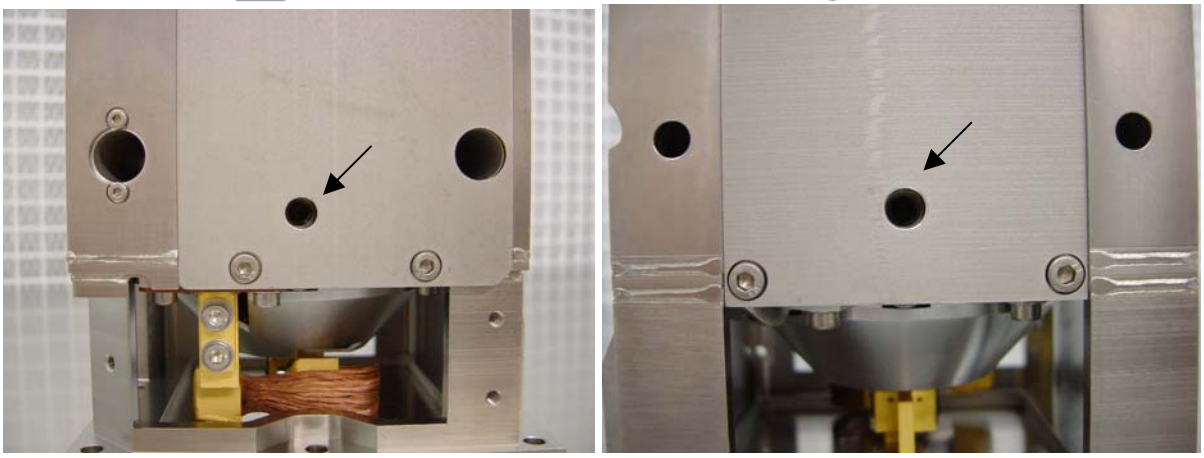
The cooler has been cleaned following SBT procedure HSO-SBT-PR-026. The external faces can be cleaned if necessary with a clean texture lightly dampened with alcohol (removal of finger prints for instance).

Cleaning with a vacuum cleaner is allowed, however direct contact with the cold tip (evaporator) must be avoided.

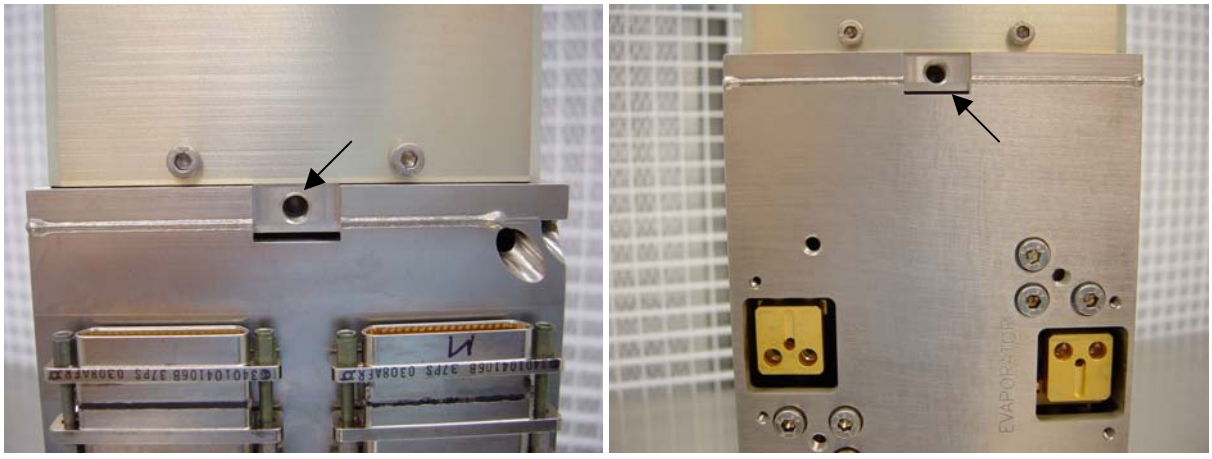
3.5. Prior to integration or transportation

The various interfaces are described in the Interface Control Document (HSO-SBT-ICD-012). The FM features centering screws and anti rotating tools.

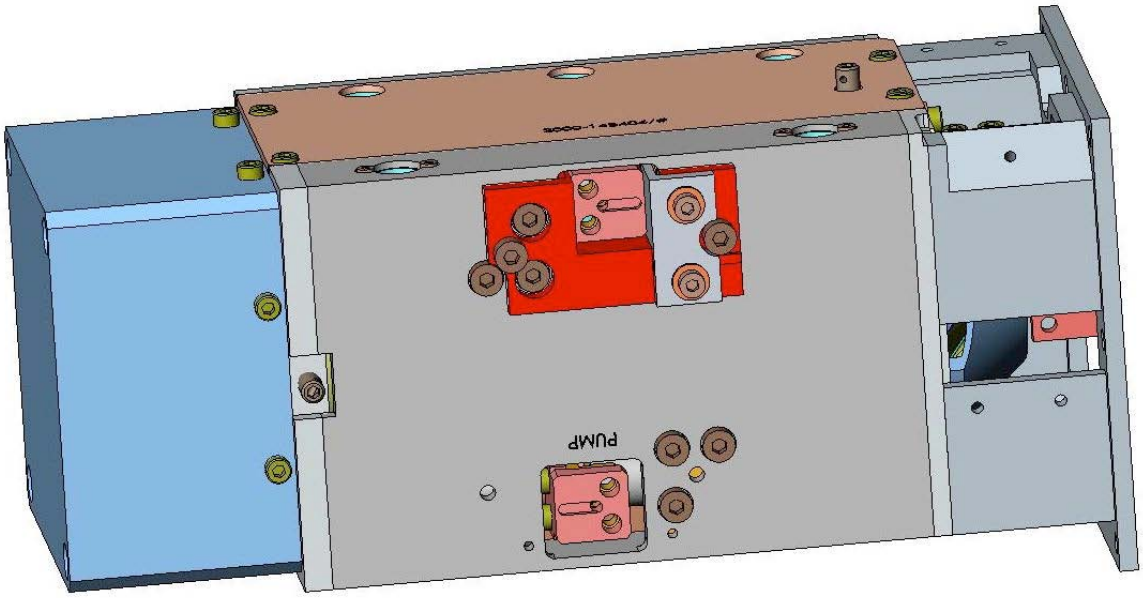




Centering screws – evaporator side



Centering screws – pump side



Anti rotating tool shown mounted

The centering screws are used to initially install the Kevlar strings and then to secure the cooler heart whenever needed (transportation and possibly storage).
Two centering screws can be found on the pump side and two on the evaporator side as shown on the following figures.

These screws must be removed before integration of the cooler in the instrument or before any functional test (thermal or mechanical).

If the screws are needed again, the following procedure applies :

- long screws go to evaporator side
- short screws go to pump side
- screw in first screw (anyone) until you can feel the end screw is touching the pump or evaporator
- screw in the opposite screw
- repeat this operation for the other side (evaporator or pump)
- very slightly tighten the screws – Absolutely avoid pushing on the pump or evaporator. Tighten just to prevent loosing the screw.

The anti rotating tools are used only during integration in the test cryostat or instrument. Their use is described in the FM operating manual (see ref. HSO-SBT-TN-120 (SPIRE) or HSO-SBT-TN-124 (PACS)).

4. Transportation

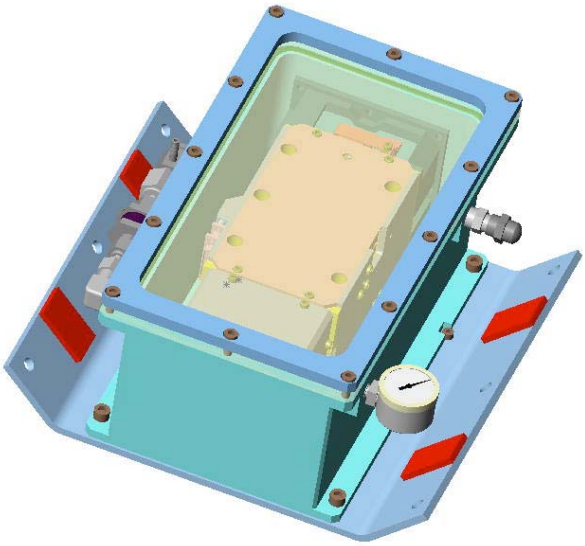
This chapter defines the transportation philosophy adopted for the SPIRE and PACS Sorption Coolers. The transport container is the master piece of our transportation design. This container is also used as the nominal storage condition as long as the cooler is not within a test cryostat or integrated in the instrument.

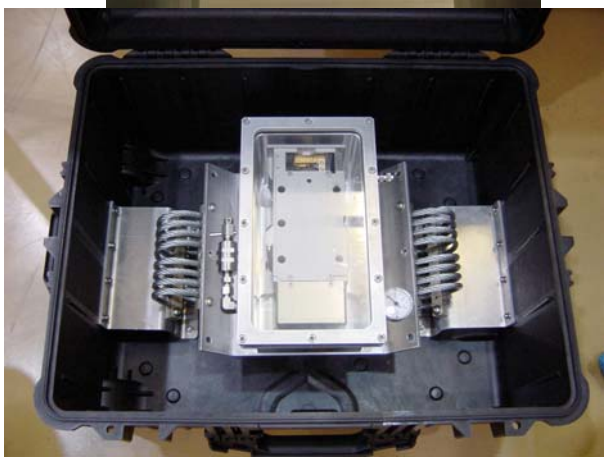
4.1. Transport container

Each sorption cooler features it's own transport container. The container is a double container. The internal container is leak-tight and holds the sorption cooler. This container is slightly pressurized under controlled atmosphere (any neutral gas – preferably nitrogen).

This container rests on a set of springs, designed to limit the resulting acceleration to 40 G in case of a 75 cm high free fall (drop of the transport container from a table). Each box features Shock watch detectors.

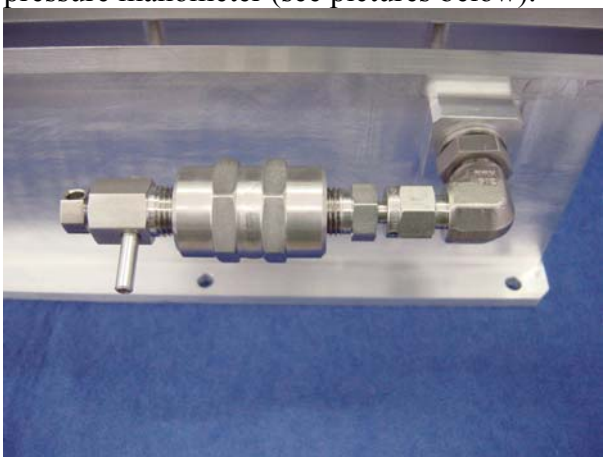
The springs are mounted within the external container, which acts as a further mechanical protection. 3D views as well as photographic records are shown hereafter.



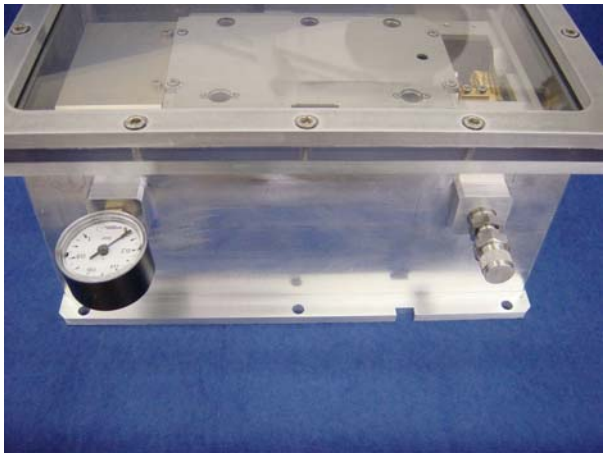


4.2. Using the transport container

The transport container is first introduced in a clean room (at least 100 000). The internal container features two valves , one for the filling and one for the purging, and a relative pressure manometer (see pictures below).



Fill port



Manometer and exhaust port

The following operation can be carried out :

Removing of FM from container

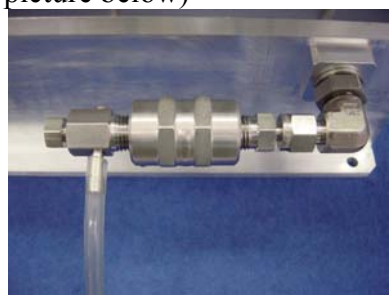
- open the main container (large external black case)
- open the exhaust port. Gas is exhausted until the pressure reaches atmospheric pressure.
- open the internal container : remove the 12 CHc M5 screws, Allen type
- remove the macrolon window and counter aluminum flange
- the cooler is mounted using the PACS interface (see ICD if necessary - HSO-SBT-ICD-012). Remove the 5 CHc M5 screws, Allen type– see previous pictures)
- remove the cooler from the container - then turn it upside down to recover the screws – WARNING : prevent any screws to get inside the cooler (titanium box)

It is recommended then to close the container (macrolon window and aluminum flange).

Mounting the FM in the container

- mount the cooler in the container using the 5 CHc M5 Allen screws (see picture previous page) - cooler is mounted using the PACS interface (see ICD if necessary - HSO-SBT-ICD-012)
- put back the macrolon window and counter aluminum flange (make sure the O ring is cleaned)
- put back the 12 CHc M5 screws, Allen type

- connect a nitrogen gas supply (or other inert gas – to the exception of helium) to the fill port (the container is pressurized to 200 mbar above atmospheric pressure, so plastic tubing is OK – see picture below)



- open the exhaust valve and fill port (turn counter-clockwise the end "screw" with hole).
- purge : let the gas flows for a minute or so.
- close the exhaust valve using a wrench (not too tight)
- fill the container to 1.2 bar absolute (200 mbar above atmospheric pressure)
- close the fill port (turn clockwise end "screw" with hole).

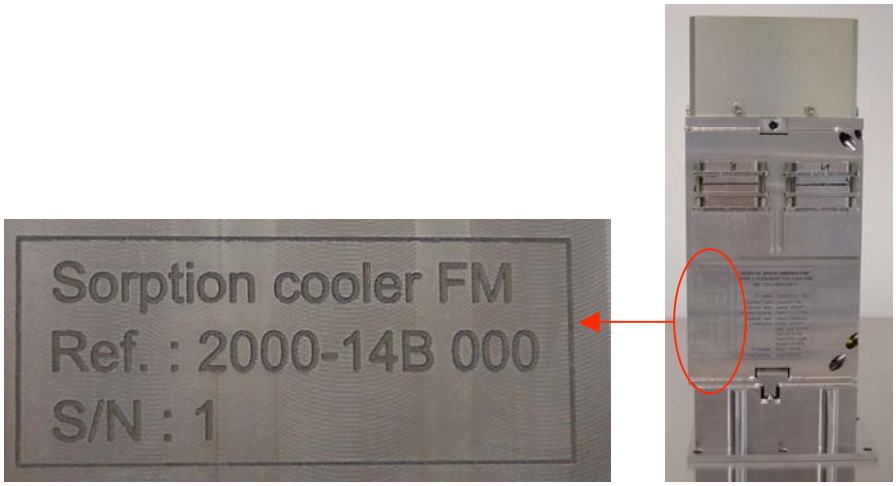
4.3. Delivery packing

The transport container is also our delivery packing

4.4. Marking identification

Each main FM components is laser marked. The overall reference for the FM is indicated on the structure on the upper plate. The marking is as follow:

Sorption Cooler FM
Ref. : 2000-14 B 000
S/N : 1



5. No nominal situation

5.1. shocks

In case of excessive shocks on the equipment, the customer will advise CEA-SBT. A decision for possible investigation (geometry control, material control, etc…) will be discussed between parties.

Note that the transport container is instrumented with shock detectors (triggers at 50 G).

5.2. Excessive temperature

If the equipment undergoes a temperature higher than 80°C, the customer will advise CEA-SBT. A decision for possible investigation will be discussed between parties.

5 - CONFIGURATION

Three documents are attached in this chapter :

- C.I.D.L./ A.B.C.L. : document reference HSO-SBT-LI-110 Is./Rev. 1/0
- Declared Material List : document reference HSO-SBT-LI-004 Is./Rev. 2/0
- Declared Processes List : document reference HSO-SBT-LI-005 Is./Rev. 3/0

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SPIRE FM1 Sorption Cooler
Configuration Item Data List / As Built Configuration List

SBT internal ref. SBT / CT / 2004-67

	Name & Function	Date	Signature
Prepared	M.Dubois – Cooler PA manager	18/11/04	
SBT PA Check	M.Dubois – Cooler PA manager	18/11/04	
PACS Approval			
Project Approval	L. Duband - Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

Document Status

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1	0	7 / 10 / 04	11	First Issue

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2 – Acronyms

3 – C.I.D.L. Status

- 3.1 – Documents
  - 3.1.1 – Customers documents
  - 3.1.2 – Supplier documents
- 3.2 – Product Tree

4 – A.B.C.L.

1 – Scope of the document

The C.I.D.L. identifies the applicable issue/revision of requirement documents, specifications, drawings and engineering lists that represent the "as designed" configuration of the sorption cooler.
The A.B.C.L. identifies for each unit, the applied issues and revisions of the above documents plus any major NCR and RFW.

2 – Acronyms

AD / RD	Applicable / Reference Document	HSP	Heat Switch (on sorption pump)
ADP (EIDP)	Acceptance (End Item) Data Package	ICD	Interface Control Document
AIT/(M)AIV	(Manufacturing,) Assembly, Integration & Test / Verification	KIP / MIP	Key / Mandatory Inspection Point
CDR (DDR)	Critical (Detailed) Design Review	MRB	Material Review Board
CEA	Commissariat à l' Energie Atomique	N/A	Not Applicable
CIDL / ABCL	Configuration Items Data List / As Built Configuration List	NCR	Non Conformance Report
CN	Change Notice	PACS	Photoconductor. Array Camera and Spectrometer
CQM	Cryogenic Qualification Model	PDR	Preliminary Design Review
DML / DPL	Declared Material / Process List	PTR	Post Test Review
DRB	Delivery Review Board	QA / PA	Quality / Product Assurance
EM/(P)FM/SM	Engineering / (Proto)Flight / Spare Model	RFA	Request For Approval
ETF	Environmental Test Facility	SAp	Service d'Astrophysique
EV	Evaporator	SBT	Service des Basses Températures
FI	Fiche d'Inspection	SCO	Sorption Cooler (full unit)
FIRST	Far Infrared and SubmillimetreTelescope	S/C	SpaceCraft
FMECA	Failure Mode Effects and Criticality Analysis	SP	Sorption pump
(M)GSE	(Mechanical) Ground Support Equipment	SPIRE	Spectral & Photometric Imaging Receiver
H/W	Hardware	TRR	Test Readiness Review
HIFI	Heterodyne Instrument for FIrst		
HSE	Heat Switch (on evaporator)		

3 – C.I.D.L. Status

3.1 – Documents

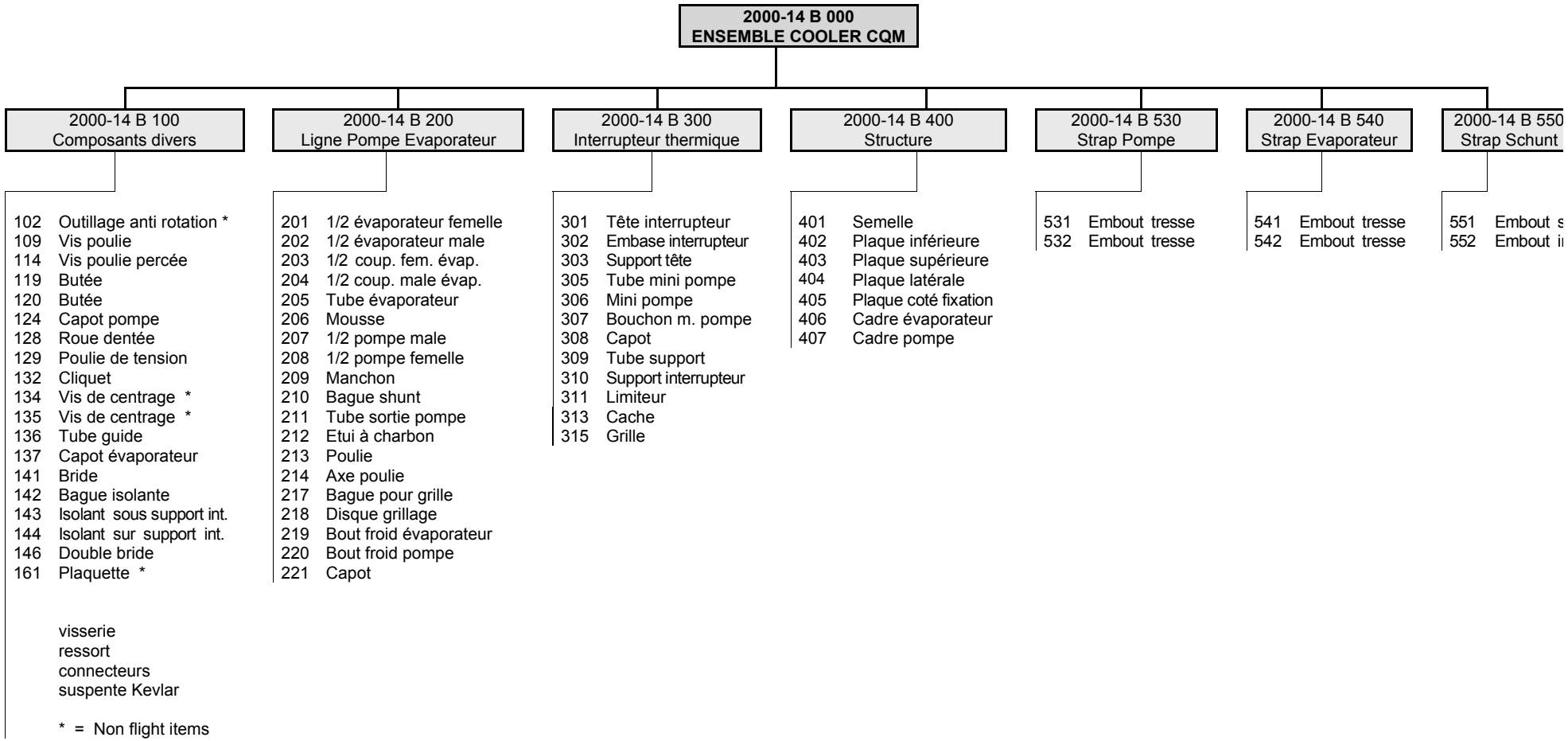
3.1.1 – Customers Documents

Document name	Reference	Iss	Rev	Date
ESA				
Herschel / Planck Instrument Interface Document IID PART A	PT-IID-A-04624	2	0	1/02
Herschel / Planck Instrument Interface Document PART B Instrument "Pacs"	PT-IIDB/PACS-02126	0	5	17/07/00
Product Assurance Requirements for FIRST / PLANCK Scientific Instruments	PT-RQ-04410	2		
PACS / SPIRE				
TBD	TBD			
Sap				
Standard Product Assurance Plan	SAP-GERES-Flo-436-00	1	0	07/11/00

3.1.2 – Supplier (SBT) documents

Document name	Reference	Iss	Rev	Date
Spire & Pacs Sorption cooler Specifications	HSO-SBT-SP-001	3	7	5/8/04
Spire & Pacs Sorption cooler Development Plan	HSO-SBT-PL-002	4	1	3/11/03
Manufacturing, Assembly, Integration & Test (MAIV) flow chart	HSO-SBT-FC-003	1	3	7/12/01
Declared Material List (DML)	HSO-SBT-LI-004	2	0	18/10/02
Declared Process List (DPL)	HSO-SBT-LI-005	3	0	8/7/03
Product Assurance Plan	HSO-SBT-PL-006	1	2	6/12/01
Cryogenic Sorption cooler Architectural Analysis Report	HSO-SBT-RP-007	1	0	29/10/01
Cryogenic Sorption cooler FMECA report	HSO-SBT-RP-008	1	0	29/10/01
H/W Tree / Drawing list	HSO-SBT-LI-009	0	0	25/4/01
Spire & Pacs Sorption cooler Interface Control Document	HSO-SBT-ICD-012	2	1	3/3/04
Spire & Pacs Sorption cooler AIV Plan	HSO-SBT-PL-013	2	4	5/8/04

3.2 – Product Tree



4 – A.B.C.L. :

PART DRAWING IDENTIFICATION NUMBER	ISSUE	A.B.C.L.	Remarks (NCR/FA, RFW, ECR, …)
2000-14 B 000	E	As built is as design	
2000-14 B 100 Pl. 1/3	I	As built is as design	
2000-14 B 100 Pl. 2/3	I	As built is as design	
2000-14 B 100 Pl. 3/3	A		
2000-14 B 102	A	Non conformance	FA # 104 . Non flight item
2000-14 B 109	C	As built is as design	
2000-14 B 114	B	As built is as design	
2000-14 B 119	C	As built is as design	
2000-14 B 120	C	As built is as design	
2000-14 B 124	C	As built is as design	
2000-14 B 128	B	As built is as design	
2000-14 B 129	B	As built is as design	
2000-14 B 132	B	As built is as design	
2000-14 B 134	D	As built is as design	
2000-14 B 135	C	As built is as design	
2000-14 B 136	C	As built is as design	
2000-14 B 137	E	As built is as design	
2000-14 B 141	A	As built is as design	
2000-14 B 142	A	As built is as design	
2000-14 B 143	A	As built is as design	
2000-14 B 144	A	As built is as design	
2000-14 B 146	C	As built is as design	
2000-14 B 161	A	As built is as design	

2000-14 B 200 Pl.1/2 2000-14 B 200 Pl.2/2	F C	As built is as design As built is as design	**Serial Number n° 2**
2000-14 B 201	B	As built is as design	
2000-14 B 202	B	As built is as design	
2000-14 B 203	F	As built is as design	ECR 003
2000-14 B 204	C	As built is as design	
2000-14 B 205	B	As built is as design	
2000-14 B 206	B	As built is as design	
2000-14 B 207	B	As built is as design	
2000-14 B 208	C	As built is as design	
2000-14 B 209	B	As built is as design	
2000-14 B 210	E	As built is as design	
2000-14 B 211	B	As built is as design	
2000-14 B 212	C	As built is as design	
2000-14 B 213	B	As built is as design	
2000-14 B 214	B	Non Conformance	FA # 104
2000-14 B 217	B	As built is as design	
2000-14 B 218	B	As built is as design	
2000-14 B 219	E	As built is as design	FA # 103 Pièce retouchée pour la rendre conforme
2000-14 B 220	E	As built is as design	
2000-14 B 221	B	As built is as design	
2000-14 B 300	G	Non Conformance	**Serial Numbers n° 2 and 8** FA # 108
2000-14 B 301	B	As built is as design	
2000-14 B 302	F	As built is as design	
2000-14 B 303	B	As built is as design	
2000-14 B 305	D	As built is as design	

2000-14 B 306	D	As built is as design	
2000-14 B 307	B	As built is as design	
2000-14 B 308	B	As built is as design	
2000-14 B 309	C	As built is as design	
2000-14 B 310	F	Non Conformance	FA # 103 – Appairage pièce S/Nn° 8 avec B 309 n° 5
2000-14 B 311	C	As built is as design	
2000-14 B 313	B	As built is as design	
2000-14 B 315	B	As built is as design	
2000-14 B 400	E	As built is as design	**Serial Number n° 1**
2000-14 B 401	D	As built is as design	
2000-14 B 402	C	As built is as design	ECR 001
2000-14 B 403	G	Non Conformance	ECR 002 FA # 102 : Pièce retouchée pour la rendre conforme
2000-14 B 404	D	As built is as design	
2000-14 B 405	D	Non Conformance	FA # 100 Pièce retouchée pour la rendre conforme
2000-14 B 406	F	As built is as design	
2000-14 B 407	D	As built is as design	
2000-14 B 530	D	As built is as design	
2000-14 B 531	D	As built is as design	
2000-14 B 532	D	As built is as design	
2000-14 B 540	D	As built is as design	
2000-14 B 541	D	As built is as design	
2000-14 B 542	D	As built is as design	
2000-14 B 550	B	As built is as design	
2000-14 B 551	A	As built is as design	
2000-14 B 552	B	As built is as design	

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SPIRE & PACS Sorption Coolers DECLARED MATERIAL LIST (D.M.L.)

SBT internal ref : SBT/CT/2001-19

	Name & Function	Date	Signature
Prepared	M. Dubois – Cooler PA manager	18/11/04	
SBT PA Check	M. Dubois – Cooler PA manager	18/11/04	
SPIRE Approval			
PACS Approval			
PA Approval			
Project Approval			
Project Approval	L. Duband - Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

Document Status

Issue	Revision	Date	Nb of Pages	Modifications
Draft		April 4th, 2001		First draft – released for comments
0	0	April 25th, 2001	16	First Issue
1	0	October 29th, 2001	16	Update of the document (see marking bar on the right)
1	1	December 12th, 2001	16	Update of the document (released after SAp comments)
1	2	February 28th, 2002	16	Update of doc wrt to IBDR RIDs Nota: marking bar removed – not convenient !
2	0	October 18th,2002	16	Information modification for items # 1-1, 1-2, 2-1, 6-2, 10-1, 20-5. Addition of item # 20-6

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1. Scope of the document....1
2. Documents....2
   2.1 Applicable documents....2
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3. Declared Material List....3

List of Acronyms

AD / RD	Applicable / Reference Document		
ADP (EIDP)	Acceptance (End Item) Data Package		
AIT / (M)AIV	(Manufacturing,) Assembly, Integration & Test / Verification		
CADM	Configuration and Data Management		
CDR (DDR)	Critical (Detailed) Design Review	Revue de conception détaillée	RCD
CEA	Commissariat à l' Energie Atomique		
CIDL / ABCL	(As Built) Configuration Items Data List		
CN	Change Notice	Demande de Modification	DM
CQM	Cryogenic Qualification Model		
DML / DPL	Declared Material / Process List		
DRB	Delivery Review Board	Revue de Qualification	RQ
EM / (P)FM / FS	Engineering / (Proto)Flight / Spare Model		
ETF	Environmental Test Facility		
EV	Evaporator		
FI	Fiche d'Inspection		
FIRST	Far Infrared and SubmillimetreTelescope		
FMECA	Failure Mode Effects and Criticity Analysis		AMDEC
(M)GSE	(Mechanical) Ground Support Equipment		
H/W	Hardware		
HIFI	Heterodyne Instrument for FIrst		
HSE	Heat Switch (on evaporator)		
HSP	Heat Switch (on sorption pump)		
ICD	Interface Control Document	Dossier de Contrôle des Interfaces	DCI
KIP / MIP	Key / Mandatory Inspection Point		
MRB	Material Review Board		
N/A	Not Applicable		
NCR	Non Conformance Report	Fiche d'Anomalie	FA
PACS	Photoconductor. Array Camera and Spectrometer		
PDR	Preliminary Design Review	Revue de Définition Préliminaire	RDP
PTR	Post Test Review	Comité de Revue et d'essai	CRE
PFM	ProtoFlight Model		

QA / PA	Quality / Product Assurance	Assurance Qualité / Produit	AQ / AP
RFA	Request For Approval		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
S/C	SpaceCraft		
SNLS	Subcontractor for TiG welding & brazing		
SP	Sorption pump		
SPIRE	Spectral & Photometric Imaging Receiver		
TRR	Test Readiness Review	Bilan Technique	BT

1. SCOPE OF THE DOCUMENT

This document lists all the materials (machined items, end items) used on the SBT Sorption Coolers Project for the following models: CQM, FM & FS.

2. DOCUMENTS

2.1 Applicable documents

All Applicable Documents are listed in the AD chapter of the CIDL (HSO-SBT-LI-010).

2.2 Reference documents

	Title	*Reference*	*Iss*	*Rev*	*Date*
RD01	Data for Selection of Space Materials	ESA PSS-01-701	1	3	January 94
RD02	Materials, Mechanical Parts & Processes	ECSS-Q-70A			19/04/96
RD03	Guide pour les Projets Scientifiques				
RD04	Materials selection for controling stress-corrosion cracking	ECSS-Q-70-36-A			

3. DECLARED MATERIAL LIST

The SCO Declared Material List, which consists of several arrays of 10 columns that shall be completed as indicated in doc. Ref. [RD02] & [RD03], is presented herebelow.

Furthermore, similar materials shall be grouped together, according to the following group definition:

Group Type	*Used*	*Item Id.*
1. Aluminum & Aluminum alloys,	✓	2017-A
2. Copper & Copper alloys,	✓	CuC1, Cu A1
3. Nickel & Nickel alloys,	N/A	
4. Titanium & Titanium alloys,	✓	TA6V-ELI
5. Steels,	N/A	
6. Stainless Steels,	✓	AISI 304L
7. Filler metals & solders,	✓	Tin, Silver
8. Miscellaneous metallic materials,	N/A	
9. Optical materials,	N/A	
10. Adhesives, coatings & varnishes,	✓	STYCAST 2850/FT9
11. Adhesive Tapes,	N/A	
12. Paints, primer & inks,	N/A	
13. Lubricants,	N/A	
14. Potting Compounds,	N/A	
15. Reinforced Plastics,	N/A	
16. Rubbers & Elastomers,	N/A	
17. Thermoplastics,	N/A	
18. Thermosets Plastics,	N/A	
19. Wires & Cables,	✓	Manganin Wires
20. Miscellaneous nonmetallic materials.	✓	Kevlar, Procelit P160, Vegetal Charcoal, He3, PTFE Housing

Group 1 – Aluminum & Aluminum Alloys																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1- Manuf / Supplier 2- Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
1-1	EN-AW 2017A	Cu: 4.35 % Mg: 0.80 % Mn: 0.75 % Si: 0.51% Fe: 0.21% Zn: 0.23% Al: rem.	1- ANFI 2- NF EN 485-2	Machined Anti corrosion treatment (Alodine 1200)	Guiding tubes (136)		V	1	W2	N/A	N/A	N/A	3	P	ESA PSS-01 701		No structural use
1-2	EN-AW 2017A (T451)	Cu: 4.20 % Mg: 0.66 % Mn: 0.85 % Si: 0.60% Fe: 0.40% Zn: 0.01% Al: rem.	1- KUMW 2- NF EN 485-2	Machined Anti corrosion treatment (Alodine 1200)	Evaporator cover (137) Pump cover (124)		V	1	W2	N/A	N/A	N/A	3	P	ESA PSS-01 701		No structural use

Group 2 – Copper & Copper alloys																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
2-1	High purity electrolytic copper CuC1	Cu: 99.99% O < 0.0005%	1 - OUTOKUMPU/SISO 2 - THERMOCOMPACT (FI 024)	1- Machined 2- Gold plated	Strap ends (531, 532, 541, 542) 1/2 female (203) & 1/2 male (204) evaporator cups Shunt (210) Charcoal casing (212) Evaporator (219) & Pump (220) Cold Tips Switch Heads (301) & Bases (302)		V	1	W3	N/A	N/A	N/A		P	ESA PSS-01-701		FI 007
2-2	CuA1	Copper alloy	1 – SOTELEM 2 -	1- Machined 2- Gold plated	Strap (138)		V	1	W1	N/A	N/A	N/A		P			

Group 4 – Titanium & Titanium alloys																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
4-1	Ti-6Al-4V ELI, Diam. 200 mm	Al: 6.09 % V: 3.82 % C: 80 ppm Fe: 1402 ppm N: 20 ppm O2: 1095 ppm H2: 60 ppm	1 - FORTECH/TIMET 2 -	1- Machined 2- EB welding	Structural parts (401 to 407) Miscellaneous components Pump-tubing-Evaporator parts Heat Switches parts		V	1	W4	N/A	N/A	N/A	1	P	ESA PSS-01-701		Coulée # 293147C Lot # T03290
4-2	Ti-6Al-4V ELI, diam. 10 & 20 mm	Al: 5.9 % V: 3.8 % C: 0.029% Fe: 0.18 % H: 0.0016% N: 0.010 % O: 0.12% Y: <0.005%	1 - TIMET UK 2	1- Machined 2- EB Welding	Structural parts		V	1	W4	N/A	N/A	N/A	1	P	ESA PSS-01-701		Coulée # CU67913 Lot # SC1513 (10 mm) Lot # SC1421 (20 mm)

Group 6 – Stainless Steels																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
6-1	AISI 304L	Ni: 8.51% Cr: 18.29% C: 0.018% Mn: 1.87% Si: 0.44% S: 0.025%	1 – COGNE 2 - EN 10088	Machined	Minipump (306), Minipump tube (305) & cap (307) Grid Mesh (218)		V	1	W1	N/A	N/A	N/A	1	P			Lot # 12470
6-2	A4-80 / A4-70		1 – FILA 2 – DIN 912, 915, 125 & 234		Screws Nuts Washers		V	1	W2	N/A	N/A	N/A	1	P			Titanium parts assembly
6-3			1 – VANEL 2 –		Springs		V	1	W1	N/A	N/A	N/A	1	P			
6-4			1 – 2 –		Helicoïl		V	1	W2	N/A	N/A	N/A	1	P			

Group 7 – Filler Metals & Solders																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
7-1	Tin Sn60Pb40	Sn: 60.15% Pb: 39.79% Cu: 0.005%	1 – RADIEL/ RADIOSPARE 2 - NF EN 29453	HSO-SBT-PR-034	Soldering of manganin wires into connectors		V	1	W1	N/A	N/A	N/A	N/A	P			
7-2	ARGECO 1441	Silver alloy Ag: 72% Cu: 28%	1 – SNLS/PROTECHNO 2 – AFNOR A81362	Subcontractor procedure CI-92.01	Brazing		V	1	W1	N/A	N/A	N/A	N/A	P			

Group 10 – Adhesives, Coatings & Varnishes																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
10-1	Stycast 2850/FT9	Epoxy resin	1 – EMERSON & CUMING 2 -	HSO-SBT-PR-024 HSO-SBT-PR-033	Gluing of charcoal onto/into housing Gluing of heaters & thermometers		V	1	W1	P	P	P	N/A	N/A	ESA-PSS-01-701		

Group 19 – Wires & Cables																	
1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
19-1	Manganin Wires 2.1362	Cu: 86% Mn: 12% Ni: 2% Varnish insulator	1 – ISABELLENHUTTE/ TECHNICOME 2	HSO-SBT-PR-034	Heaters & thermometers wires		V	1	W1	N/A	N/A	N/A	N/A	P			

Group 20 – Miscellaneous Nonmetallic Materials

1	2	3	4	5	6	7			8	9							10
Item #	Commercial Id.	Chemical Nature	Procurement Information	Summary of Processing Parameters	Use & Location	Environment Code			Size Code	9.1					9.2	9.3	Comment
		1- Chemical Products 2- Type of Product	1 - Manuf / Supplier 2 - Specification			R	A	T		Outg	Flam	Offg	SCC	Corr	Justification for Approval	Approval Status	
20-1	Kevlar cord 11T28 & 34T28		1- DuPONT/COUSIN 2-	HSO-SBT-PR-028	Suspension wires		V	1	W1				N/A	N/A			
20-2	Procelit P160	Al2O3: 91% SiO2: 9% impurities <0.1%	1- KAPYROK 2-		Evaporator Retention of liquid He by capillary attraction		V	1	W1				N/A	N/A	Located into sealed cooler heart		
20-3	Vegetal Charcoal	C	1- PROLABO 2-	HSO-SBT-PR-024	Pump Adsorption of gaseous He		V	1	W1				N/A	N/A	Located into sealed cooler heart		Lot # 97037
20-4	^{3}He	3He: 99.9965% 4He: 0.0035% N2, CO2, H2 < 1Vpm	1- EURISO-TOP 2-	HSO-SBT-PR-029	Filling of Cooler		V	1					N/A	N/A			Batch # AA-97084
20-5	PTFE housing		1 - TECHNOFLUOR 2 -				V	1	W1	P	P	P	N/A	N/A	ESA-PSS-01-701		
20-6	Vespel SP1	Polyimide	1 - GOODFELLOW		Insulating ring		V	1	W1				N/A	N/A			

SPIRE & PACS Sorption Coolers DECLARED PROCESSES LIST (D.P.L.)

SBT internal ref : SBT/CT/2001-20

	Name & Function	Date	Signature
Prepared	M.Dubois – Cooler PA manager	18/11/04	
SBT PA Check	M.Dubois – Cooler PA manager	18/11/04	
SPIRE Approval			
PACS Approval			
Project Approval			
Project Approval	L. Duband - Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

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Draft		April 4th, 2001		First draft – released for comments
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1	2	February 28th, 2002	20	Update of doc wrt to IBDR RIDs Nota: marking bar removed – not convenient !
2	0	October 18th, 2002	20	Data modification concerning items # 1-1, 6-1, 6-2, 8-1, 10-1. Creation of items # 13-2 and 13-3
3	0	July 8th , 2003	20	Update of doc wrt to IHDR RIDs

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1. Scope of the document....1
2. Documents....2
   2.1 Applicable documents....2
   2.2 Reference documents....2
3. Declared Processes List....3

List of Acronyms

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EV	Evaporator		
FIRST	Far Infrared and SubmillimetreTelescope		
FMECA	Failure Mode Effects and Criticity Analysis		AMDEC
(M)GSE	(Mechanical) Ground Support Equipment		
H/W	Hardware		
HIFI	Heterodyne Instrument for FIrst		
HSE	Heat Switch (on evaporator)		
HSP	Heat Switch (on sorption pump)		
ICD	Interface Control Document	Dossier de Contrôle des Interfaces	DCI
KIP / MIP	Key / Mandatory Inspection Point		
MRB	Material Review Board		
N/A	Not Applicable		
NCR	Non Conformance Report	Fiche d'Anomalie	FA
PACS	Photoconductor. Array Camera and Spectrometer		
PDR	Preliminary Design Review	Revue de Définition Préliminaire	RDP
PTR	Post Test Review	Comité de Revue et d'essai	CRE
PFM	ProtoFlight Model		
QA / PA	Quality / Product Assurance	Assurance Qualité / Produit	AQ / AP

RFA	Request For Approval		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
S/C	SpaceCraft		
SP	Sorption pump		
SPIRE	Spectral & Photometric Imaging Receiver		
TRR	Test Readiness Review	Bilan Technique	BT

1. SCOPE OF THE DOCUMENT

This document lists all the processes to be used all along the SBT Sorption Coolers Project.

2. DOCUMENTS

2.1 Applicable documents

All Applicable Documents are listed in the AD chapter of the CIDL (HSO-SBT-LI-010).

2.2 Reference documents

	Title	*Reference*	*Iss*	*Rev*	*Date*
RD01	Materials, Mechanical Parts & Processes	ECSS-Q-70A			19/04/96
RD02	Guide pour les Projets Scientifiques				

3. DECLARED PROCESSES LIST

The SCO Declared Processes List, which consists of mutiple arrays of 10 columns that shall be completed as indicated in doc. Ref. [RD01] & [RD02], is presented herebelow.

Processes should be grouped as explained in the table below:

Group Type	*Used*
1. Adhesive Bonding	✓
2. Composite Manufacturing	N/A
3. Encapsulation / Molding	N/A
4. Painting / Coating	N/A
5. Cleaning	✓
6. Welding / Brazing	✓
7. Crimping / Stripping / Wire Wrapping	✓
8. Soldering	✓
9. Surface Treatment	N/A
10. Plating	✓
11. Machining	✓
12. Forming	N/A
13. Heat Treatment	✓
14. Special Fabrication	N/A
15. Marking	✓
16. Miscellaneous Processes	✓
17. Inspection Procedure	✓

Group 1 – Adhesive Bonding										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
1-1	Use of STYCAST 2850/FT9	1- SBT 2- HSO-SBT-SP-001	HSO-SBT-PR- 024 HSO-SBT-PR- 029 HSO-SBT-PR- 030 HSO-SBT-PR- 033	1- Pump 2- Gluing of charcoal onto/into Pump housing	N/A	1- 2-1 2- DML # 10-1	Not Critical	Common practice @ SBT		
				1- SCO 2- Gluing of Thermal Parts	N/A	1- N/A 2- DML # 10-1	Not Critical	Common practice @ SBT Performance Test		
				1- SCO 2- Gluing of covers onto filling tubes after crimping	N/A	1- 4-1 2- DML # 10-1	Not Critical	Common practice @ SBT		
				1- Pump 2- Gluing of Grid & Grid Cover	N/A	1- 4-1 & 6-1 2- DML # 10-1	Not Critical	Common practice @ SBT		

Group 5 – Cleaning										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
5-1	Cleaning of individual items	1- SBT 2- HSO-SBT-QA-040	HSO-SBT-PR-026	1- all single items 2- Cleaning of individual items before assembly/integration	N/A	1- N/A 2- DML # 1-1, 1-2, 2-1, 2-2, 4-1, 4-2, 6-1, 6-2, 6-3, 6-4	Not Critical			

Group 6 – Welding / Brazing										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
6-1	TIG Welding	1- SDMS 2- HSO-SBT-FC-023		1- Evaporator 2- Assembly of Evaporator-sphere (S8)	SDMS		Not Critical	LeakTightness Test		
				1- Pump 2- Assembly of Pump - sphere (S6)	SDMS		Not Critical	LeakTightness Test		
				1- Evaporator 2- Assembly of Evaporator - sphere (S7)	SDMS		Not Critical	LeakTightness Test		
				1- Braided Copper & Copper Ends 2- Welding of Braided Copper onto Copper Ends	SDMS		Not Critical			

Group 6 – Welding / Brazing										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
6-2	Silver Soldering	1 - SDMS 2 – HSO-SBT-FC-023		1 – Pumping line 2 – Mounting of thermal shunt & crimped tube (B3, B4, B5)	SDMS		Not Critical	Leak tightness test		
				1 – Evaporator 2 – Assembly of evaporator-sphere (B2)	SDMS		Not Critical	Leak tightness test		
				1 – Pump 2 – Assembly of pump-sphere (B1)	SDMS		Not Critical	Leak tightness test		
6-3	EB Welding	1- TECHMETA 2- HSO-SBT-FC-023	FA 09001	1- Pumping Line 2- Pump & Evaporator Pre-assembly (S1, S2 & S3)	TECHMETA		Not Critical	LeakTightness Test		
				1- Cooler Heart 2- Closing of Cooler (S4, S5)	TECHMETA		Not Critical	LeakTightness Test & Pressure Test @ 200 bars		

Group 7 – Crimping / Stripping / Wire Wrapping										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
7-1	Stripping of Manganin Wires	1- SBT 2- HSO-SBT-SP-001	HSO-SBT-PR-034	1- Manganin Wires 2- Removal of protective varnish before soldering	N/A	1- N/A 2- DML # 19-1	Not Critical			
7-2	Crimping of filling Tubes	1- SBT 2- HSO-SBT-SP-001	HSO-SBT-PR-030	1- Cooler 2- Crimping of filling Tubes after filling of Cooler with 3He	N/A		Not Critical	Common practice @ SBT Leaktightness Test		
				1- Heat Switch 2- Crimping of filling Tubes after filling of Heat Switch with 3He	N/A		Not Critical	Common practice @ SBT Leaktightness Test		

Group 8 – Soldering									
1	2	3	4	5	6	7	8	9	10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status	Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval / Status	
8-1	Soldering of Heaters, Thermometers & Connectors wires	1- SBT 2- ESA PSS-01-708	HSO-SBT-PR-034	1- Manganin Wires, Heaters, Thermometers & Connectors 2- Soldering of Heaters, Thermometers & Connectors wires	N/A	1- N/A 2- DML # 19-1	Not Critical	Performed by certified operator	

Group 10 - Plating										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
10-1	Gold Plating of Copper Parts	1- THERMOCOMPACT (FI 024) 2- Subcontractor specification		1- Copper Parts 2- Gold Plating of Copper Parts to avoid corrosion	N/A	1- N/A 2- DML # 2-1, 2-2	Not Critical			

Group 11 - Machining										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
11-1	Machining of Mechanical Parts	1- OMG 2-		1- see Drawing List 2- Machining of Mechanical Parts (wire machining, classical machining)	N/A	1- N/A 2- DML # 1-1, 1-2, 2-1, 2-2, 4-1, 4-2, 6-1	Not Critical	Dimensional Check & Certificate of Conformity		
11-2	Final Machining of Structure after welding	1- OMG 2-		1- Structure 2- Removal of excess material in order to reach dimensional specification		1- Structure B 400 2- DML # 4.1, 4.2	Not Critical	Dimensional Check & Certificate of Conformity		

Group 13 – Heat Treatment										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
13-1	Baking of SCO under vacuum	1 - SBT 2 - HSO-SBT-SP-001	HSO-SBT-PR-035	1- SCO 2- Removal of water	N/A	1- SCO 2- N/A	Not Critical			
13-2	Baking of Vegetal Charcoal	1- SBT 2 - HSO-SBT-SP-001	HSO-SBT-PR-024	1- Vegetal Charcoal 2- Removal of water	N/A	1- N/A 2- DML # 20-3	Not Critical			
13-3	Baking of PROCELIT	1- SBT 2 - HSO-SBT-SP-001	HSO-SBT-PR-024	1- PROCELIT 2- Removal of water	N/A	1- N/A 2- DML # 20-2	Not Critical			

Group 15 - Marking										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
15-1	Marking of Individual Items	1- IDLas 2 – Subcontractor specification	HSO-SBT-SP-039	1- all removable items 2- Marking of Individual Items	N/A		Not critical			

Group 16 – Miscellaneous Processes										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
16-1	Assembly of Kevlar suspension system	1- SBT 2- HSO-SBT-SP-001	HSO-SBT-PR-028	2- Suspension of cooler heart into structure		2 – DML # 20.1	Critical	Performed by certified operator		
16-2	Filling of Cooler & HS with 3He	1- SBT 2- HSO-SBT-SP-001	HSO-SBT-PR-029 & 036	Filling of Cooler & HS with 3He		2 – DML # 20.2	Not Critical			

Group 17 – Inspection Procedure										
1	2	3	4	5	6	7	8	9		10
Item #	Process Id.	Specification	Process Description	Location & Use	Subcontractor Name	Associated Item	Criticality of Process	Approval Status		Comment
		1- Manufacturer 2- Specification		1- Equipment 2- Use		1- Mech.Part 2- Material		Justif. for Approval	Status	
17-1	Welding Inspection	1- SBT 2- HSO-SBT-PR-025	Inspection of Pump & Evaporator after EB Welding	1- Pump & Evaporator 2- see 4	N/A		Not Critical	LeakTightness Test		
17-2	Verification of tension into Kevlar cords	1- SBT 2 – HSO-SBT-SP-001	HSO-SBT-PR-028	1- Kevlar cords 2- To verify tension into Kevlar cords	N/A	2 – DML # 20.1	Critical	Measurement of tension with specific tool		

6 - INTERFACE AND TOP LEVEL DRAWINGS

Following drawings are attached here after :

- 2000-14 B 000 - Ind.E : Ensemble Cooler

- 2000-14 B 100 Pl. 1/3 - Ind.I : Sous ensemble Composants divers
- Pl. 2/3 - Ind.I
- Pl. 3/3 - Ind.A

- 2000-14 B 200 Pl.1/2 - Ind.F : Ligne Pompe – Evaporateur
- Pl.2/2 - Ind.C

- 2000-14 B 300 - Ind.G : Interrupteur Thermique

- 2000-14 B 400 - Ind.E: Structure

- 2000-14 B 530 - Ind.D : Strap Pompe (*)
- 2000-14 B 540 - Ind.D : Strap Evaporateur (*)
- 2000-14 B 550 - Ind.B : Strap Shunt (*)

(*) : to be delivered with EIDP next issue

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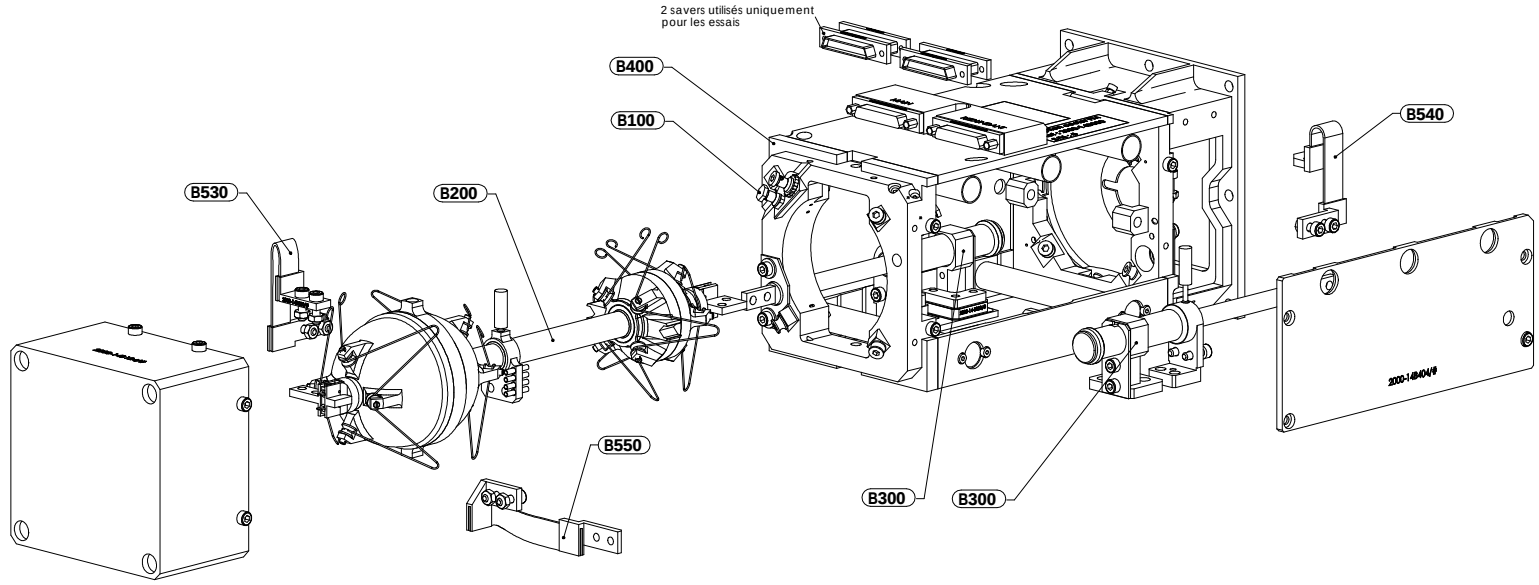
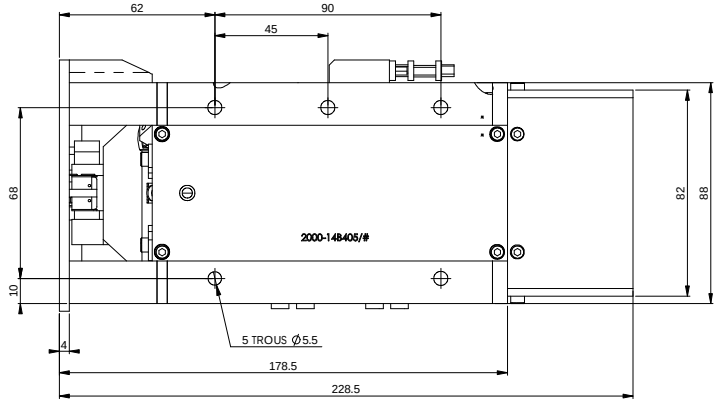
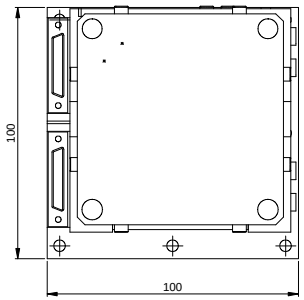
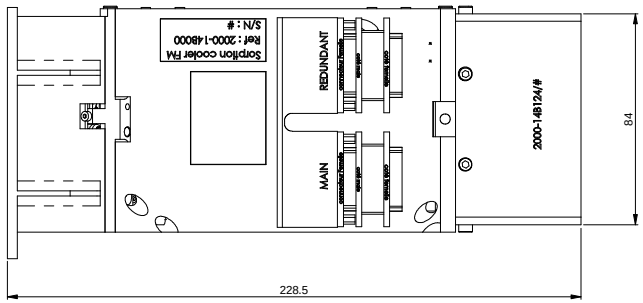
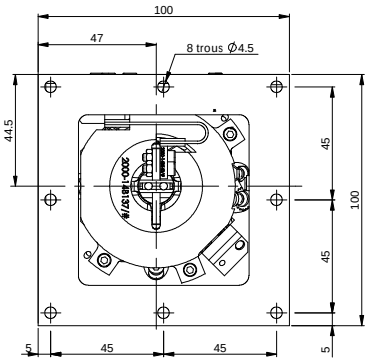










REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
B550	1	STRAP SCHUNT		CuC1+CuA1	0.02
B540	1	STRAP EVAPORATEUR		CuC1+CuA1	0.02
B530	1	STRAP POMPE		CuC1+CuA1	0.02
B400	1	STRUCTURE		Ta6V ell	1.05
B300	2	INTERRUPTEUR THERMIQUE			0.08
B200	1	LIGNE POMPE EVAPORATEUR			0.26
B100	1	COMPOSANTS DIVERS			

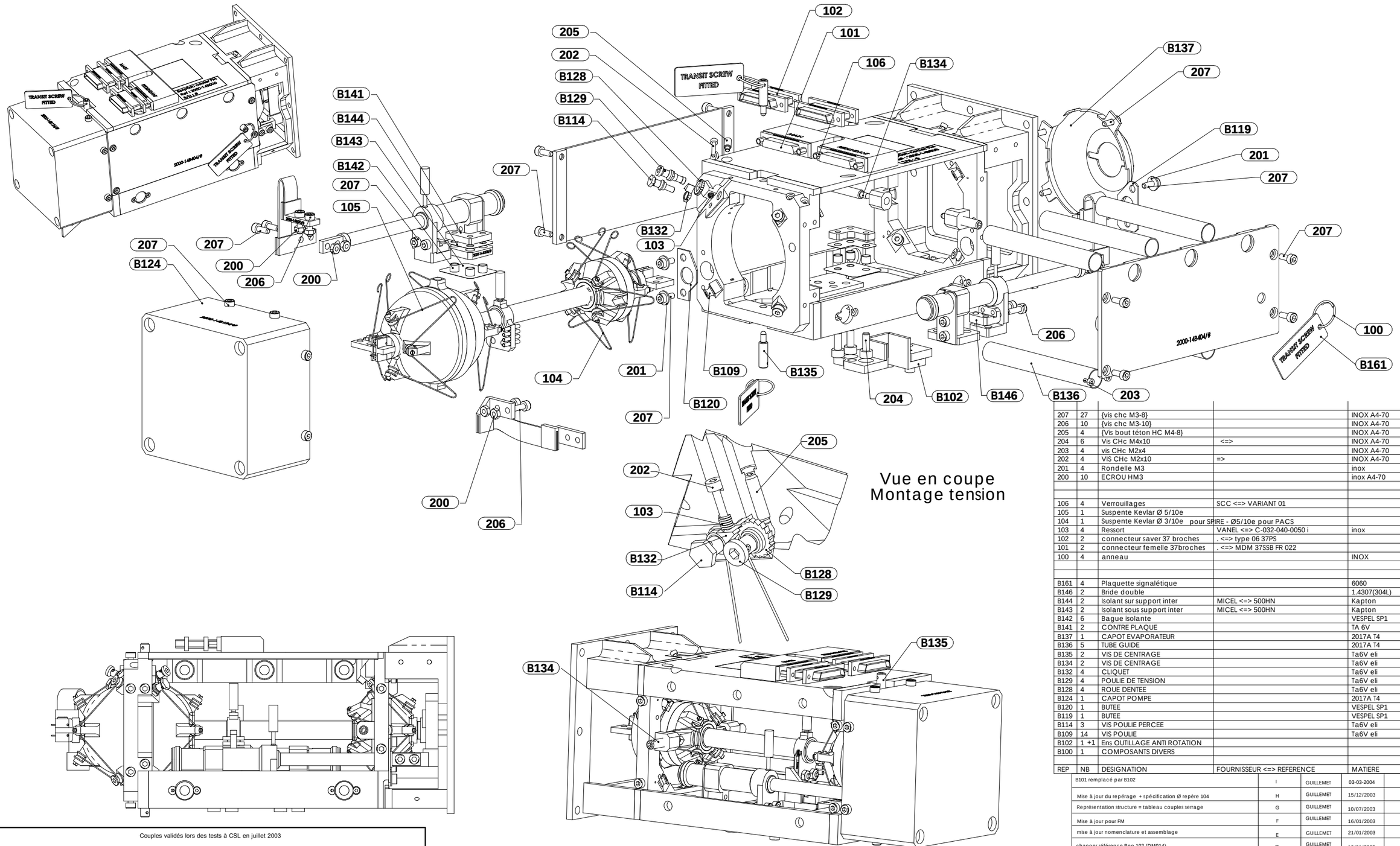
Représentation structure	E	GUILLEMET	10/07/2003	
mise à jour structure pour FM	D	GUILLEMET	24/01/2003	
mise à jour pour FM	C	GUILLEMET	16/01/2003	
mise à jour pour fabrication	B	GUILLEMET	28/06/01	
Désignation des modifications	Indice	Emetteur	Date	Visa

Matière :
Nombre :
Tolérance générale : **Js11**
Ebavurage : **Oui**
Ra générale : **3,2**
Poids : **0.0026**
Traitement :

Dessiné par **E.ALONSO** Validé par **B.CLAVEL** Date **13/06/01**

Ensemble **FRIGO SPIRE/PACS**
Echelle 1/ 1
CEA-G SBT
Titre **ENSEMBLE COOLER**
N° d'étude **2000-14** | Ens. **B** | N° de pièce **000** | Indice B C D E

SOLIDWORKS



207	27	{vis chc M3-8}		INOX A4-70	
206	10	{vis chc M3-10}		INOX A4-70	
205	4	{Vis bout téton HC M4-8}		INOX A4-70	
204	6	Vis CHc M4x10	<=>	INOX A4-70	
203	4	vis CHc M2x4		INOX A4-70	
202	4	VIS CHc M2x10	=>	INOX A4-70	
201	4	Rondelle M3		inox	
200	10	ECROU HM3		inox A4-70	
106	4	Verrouillages	SCC <=> VARIANT 01		
105	1	Suspente Kevlar Ø 5/10e			
104	1	Suspente Kevlar Ø 3/10e pour SPIRE - Ø5/10e pour PACS			
103	4	Ressort	VANEL <=> C-032-040-0050 i	inox	
102	2	connecteur saver 37 broches	. <=> type 06 37PS		
101	2	connecteur femelle 37broches	. <=> MDM 37SSB FR 022		
100	4	anneau		INOX	0.0004
B161	4	Plaquette signalétique		6060	0.0018
B146	2	Bride double		1.4307(304L)	0.0056
B144	2	Isolant sur support inter	MICEL <=> 500HN	Kapton	
B143	2	Isolant sous support inter	MICEL <=> 500HN	Kapton	0.0001
B142	6	Bague isolante		VESPEL SP1	
B141	2	CONTRE PLAQUE		TA 6V	0.0033
B137	1	CAPOT EVAPORATEUR		2017A T4	0.0123
B136	5	TUBE GUIDE		2017A T4	0.0038
B135	2	VIS DE CENTRAGE		Ta6V eli	0.0014
B134	2	VIS DE CENTRAGE		Ta6V eli	0.0022
B132	4	CLIQUET		Ta6V eli	0.0003
B129	4	POULIE DE TENSION		Ta6V eli	0.0011
B128	4	ROUE DENTEE		Ta6V eli	0.0003
B124	1	CAPOT POMPE		2017A T4	0.0739
B120	1	BUTEE		VESPEL SP1	0.0004
B119	1	BUTEE		VESPEL SP1	0.0004
B114	3	VIS POULIE PERCEE		Ta6V eli	0.0009
B109	14	VIS POULIE		Ta6V eli	0.0005
B102	1 +1	Ens OUTILLAGE ANTI ROTATION			0.0573
B100	1	COMPOSANTS DIVERS			
REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE

Désignation des modifications	Indice	Emetteur	Date	Visa
B101 remplacé par B102	I	GUILLEMET	03-03-2004	
Mise à jour du repérage + spécification Ø repère 104	H	GUILLEMET	15/12/2003	
Représentation structure = tableau couples serrage	G	GUILLEMET	10/07/2003	
Mise à jour pour FM	F	GUILLEMET	16/01/2003	
mise à jour nomenclature et assemblage	E	GUILLEMET	21/01/2003	
changer référence Rep 102 (DM014)	D	GUILLEMET	16/01/2003	

Matière :
Nombre :
Tolérance générale :
Ebavurage :
Ra générale : **3,2**
Poids : **1.8004**
Traitement :

PLANCHE 1/3

Dessiné par **ERIA** | Vérifié par **B.CLAVEL** | Date: **13/06/01**

Ensemble **FRIGO SPIRE/PACS**
Echelle 1/ 1
CEA-G SBT
Titre **S/Ens COMPOSANTS DIVERS**

N° d'étude	S/Ensemble	N° de pièce	Indice
2000-14	B	100	I F H G

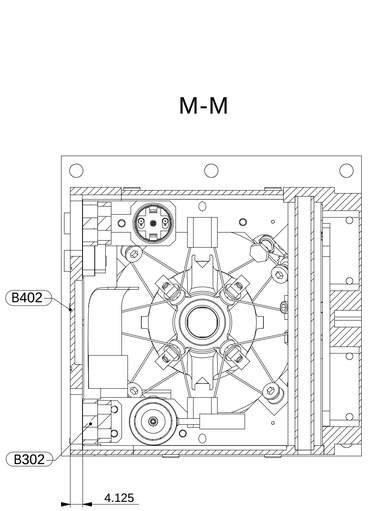
Couples validés lors des tests à CSL en juillet 2003

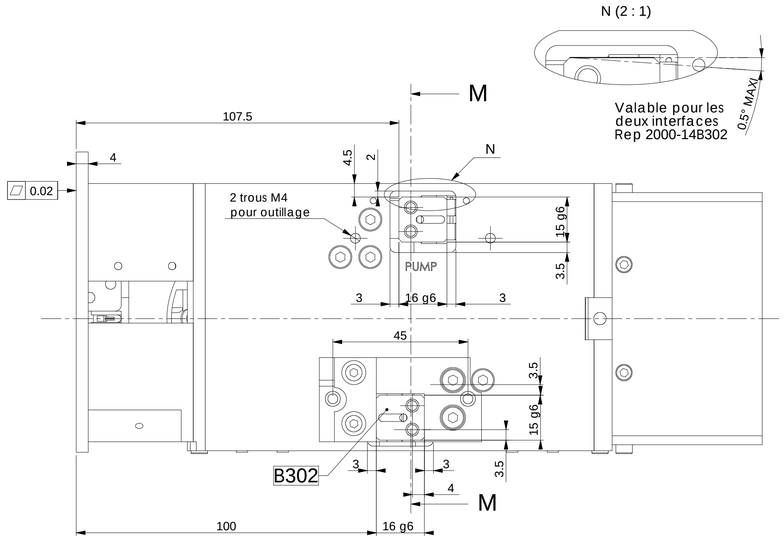
Couples de serrage pour Coolers HERSCHEL

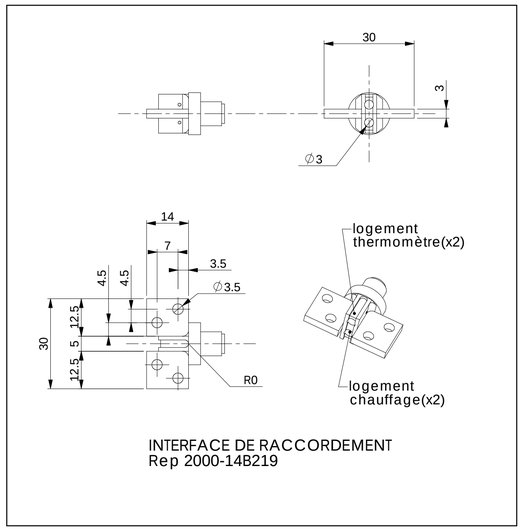
Désignation	Rep.	Désign.	Valeur (N/m)	
Vis palque latérale	205	M3	1.41	
Vis capot alu EV/SP	205	M3	1.41	
Vis snubber HS	205	M3	0.92	1 vis sur 4 est sérrée au couple. Les autres ne sont pas accessibles.
Vis snubber minipompe	200	M3	2.4	
Vis embase HS	206	M4	2.11	
Vis schunt	205	M3	n.a.	
Vis strap EV/SP	205	M3	n.a.	
Vis cliquet	201	M2	0.25	2 vis sur 4 sérrées au couple.
Vis cabestan	203	M4	n.a.	
Vis tube guidage	201	M2	0.34	
Vis connecteur 37 broches	105	2.56 UNC	n.a	
Axe poulie	B214	M2,5	n.a	
Poulie	B109	M3	n.a	
Vis poulie	B114	M3	n.a	

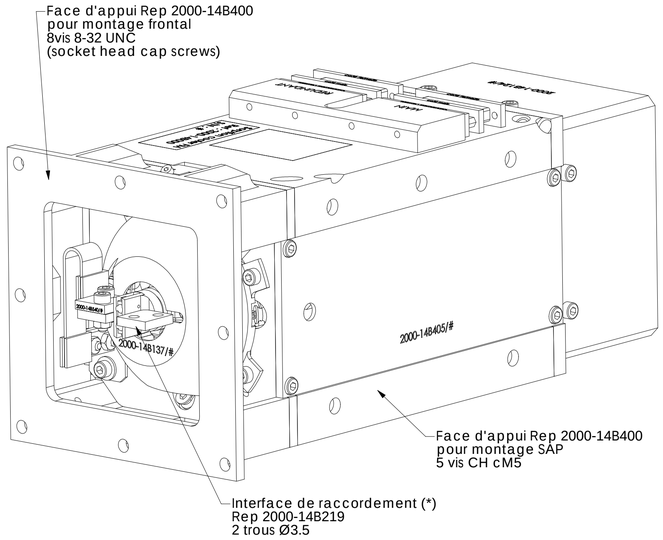
NOTA : A l'intégration de l'ensemble les 4 Rep 100 +B161 + 2 vis Rep B134 + 2 vis Rep B135 seront DEMONTES

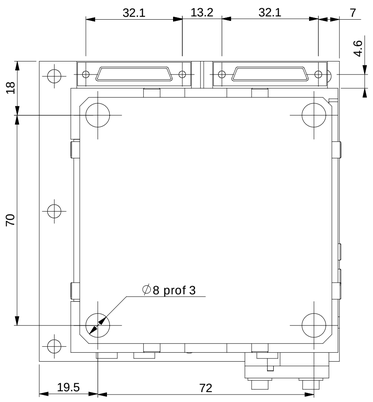
Tous les Rep B136 seront equipés de ruban Kapton adhésif à chaque extrémité (largeur 5mm)(longueur à adapter) pour supprimer le jeu radial aux emboitements

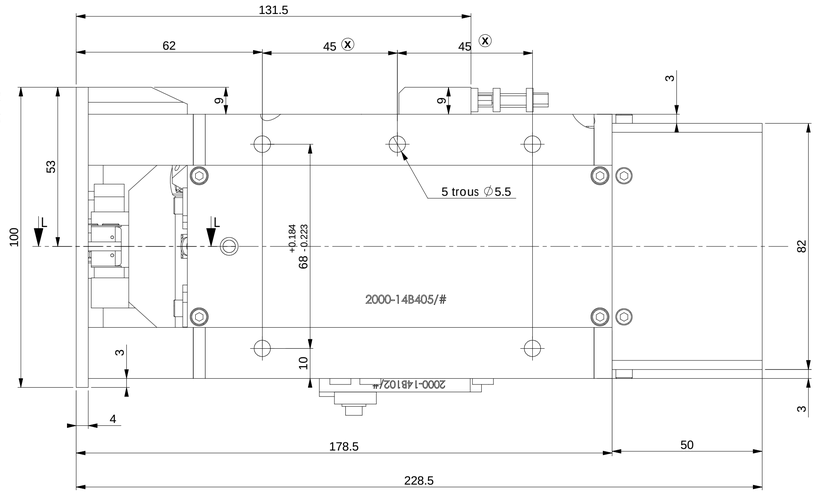


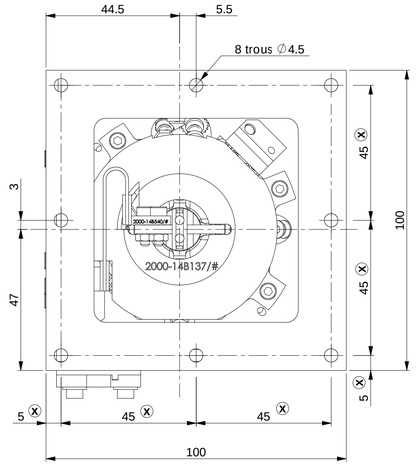


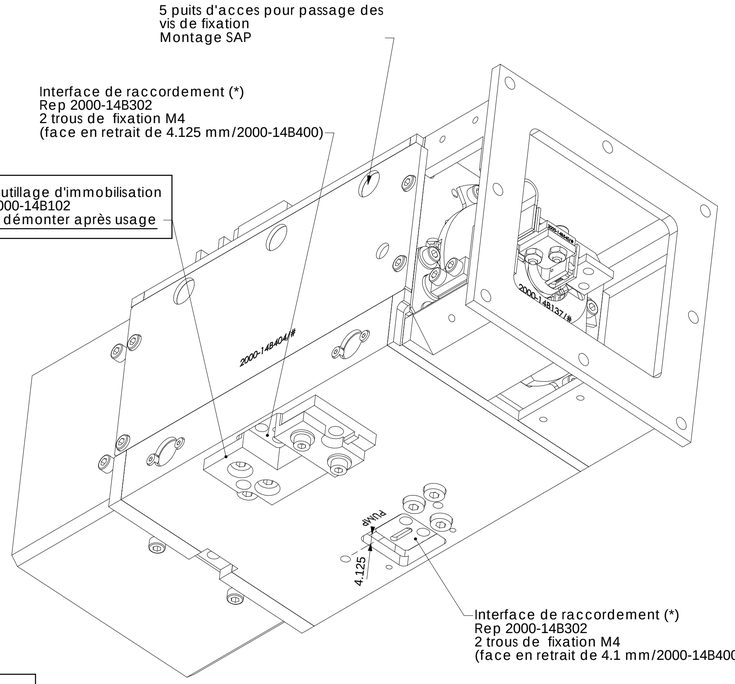












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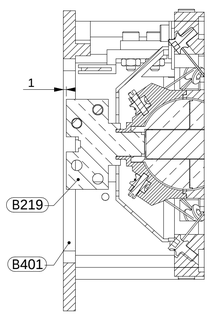
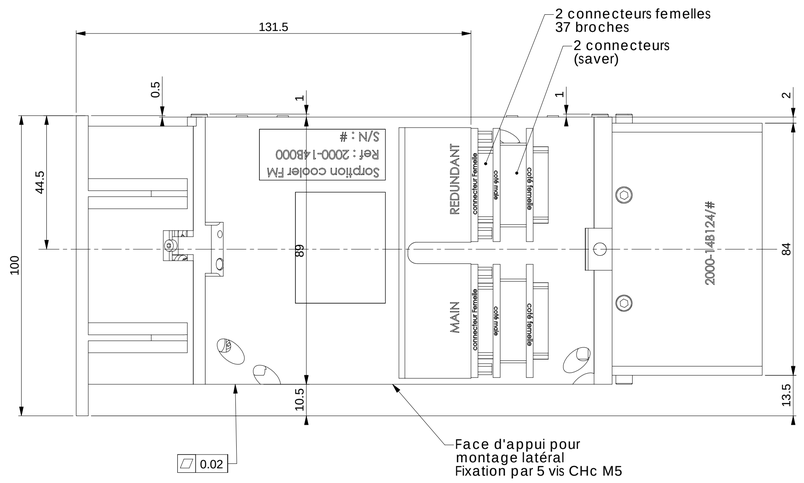
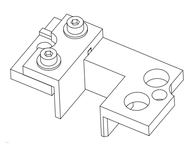




Ⓧ = COTES AVEC TOLERANCE : Js11

(*):
TRAITEMENT DE SURFACE SUR INTERFACES CUIVRE DE RACCORDEMENT
Rep : 2000-14B302 & 2000-14B219
DORURE,épaisseur de dépot ~10 microns

2000-14B102
OUTILLAGE D'IMMOBILISATION DES EMBASES Rep 2000-14B302



A DEMONTER APRES USAGE

Désignation des modifications	Indice	Emetteur	Date	Visa
Ajouté spécifications géométriques - changé outillage	I	GUILLEMET	03-03-2004	
Ajouté coupes LL & MM	H	GUILLEMET	01-03-2004	
Planche 2/2 devient Planche 2/3	G	GUILLEMET	15-12-2003	
représentation de la structure	F	GUILLEMET	07/07/2003	
Mise à jour pour FM	E	GUILLEMET	16/01/2003	
Changer référence Rep 102 (DM014)	D	GUILLEMET	22/01/02	
Mise à jour nomenclature (DM012)	C	GUILLEMET	11/12/01	

Matière :	Nombre :
Tolérance générale :	Ebavurage :
Ra générale : **3,2**	Poids : **1.8004**
Traitement :	

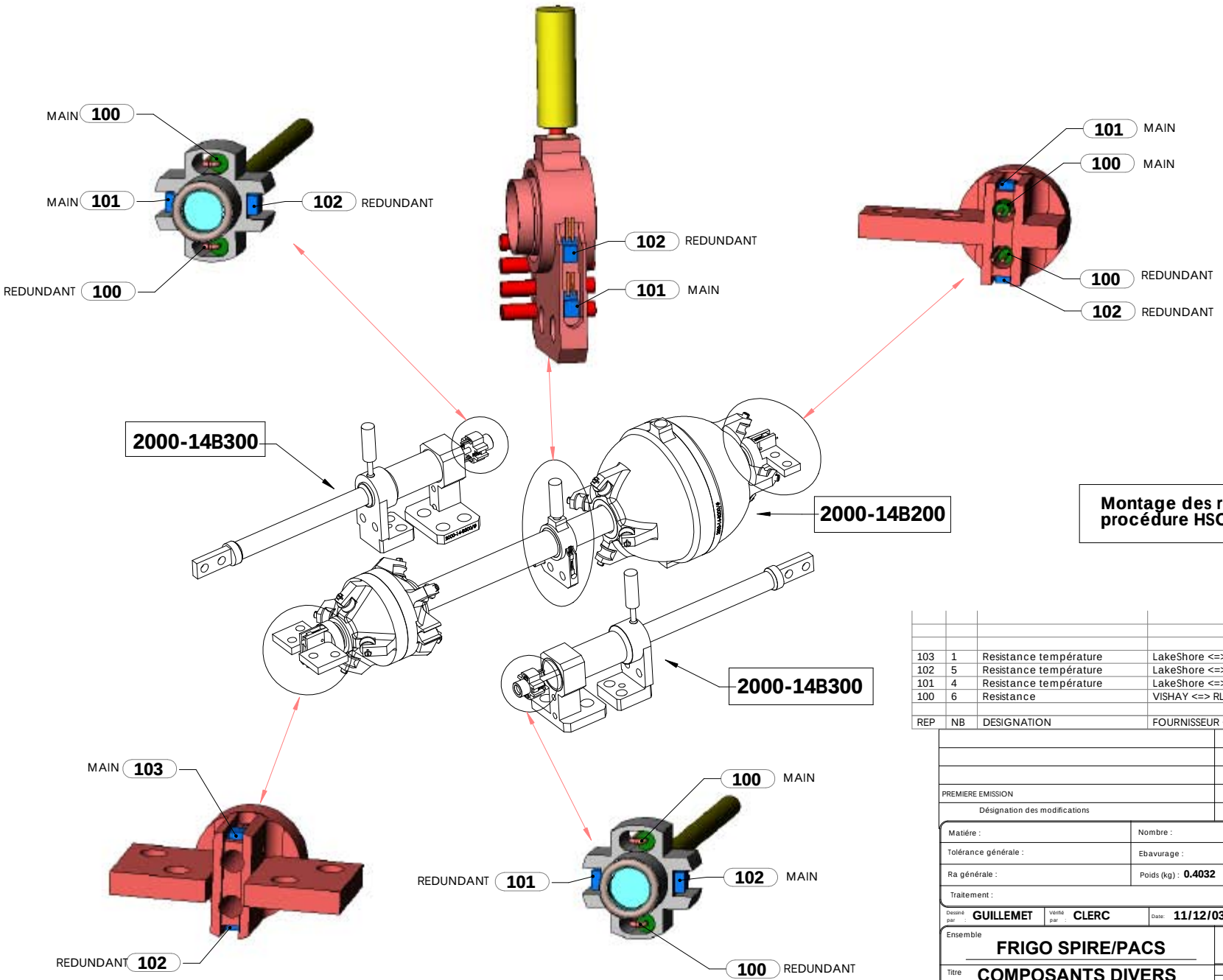
PLANCHE 2/3

Dessiné par : **GUILLEMET** Vérifié par **GUILLEMET** Date: **13/06/01**

Ensemble **FRIGO SPIRE/PACS** | Echelle 1/ 1 | **CEA-G SBT**

Titre **S/Ens COMPOSANTS DIVERS INTERFACE DE MONTAGE**

N° d'étude	S/Ensemble	N° de pièce	Indice
2000-14	B	100	H I G F



Montage des repères 100 à 103 suivant procédure HSO-SBT-PR-033

REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
103	1	Resistance température	LakeShore <=> CX - 1030-SD-0.3L		
102	5	Resistance température	LakeShore <=> CX - 1030-SD		
101	4	Resistance température	LakeShore <=> CX - 1030-SD-1.4L		
100	6	Resistance	VISHAY <=> RLR 05-402 Ohm		

Désignation des modifications	Indice	Emetteur	Date	Visa
PREMIERE EMISSION	A	GUILLEMET	11/12/03	

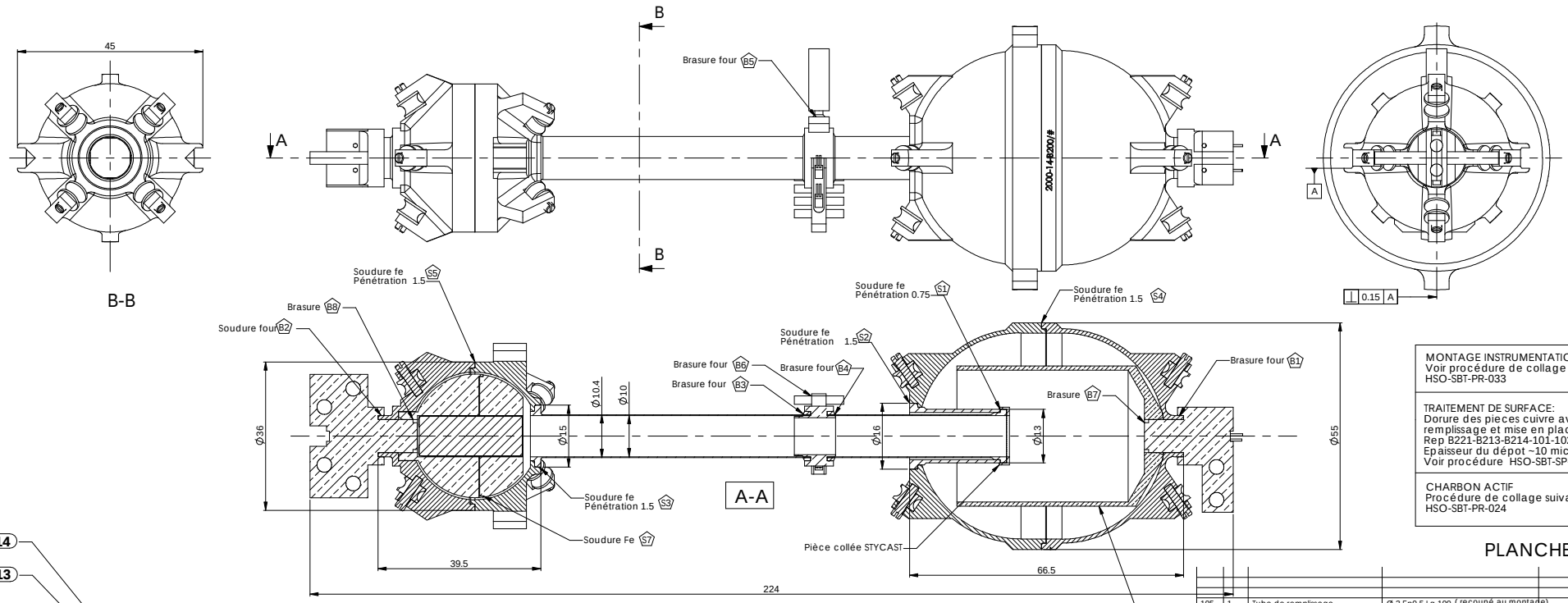
Matière :
Nombre :
Tolérance générale :
Ebavurage :
Ra générale :
Poids (kg) : 0.4032
Traitement :

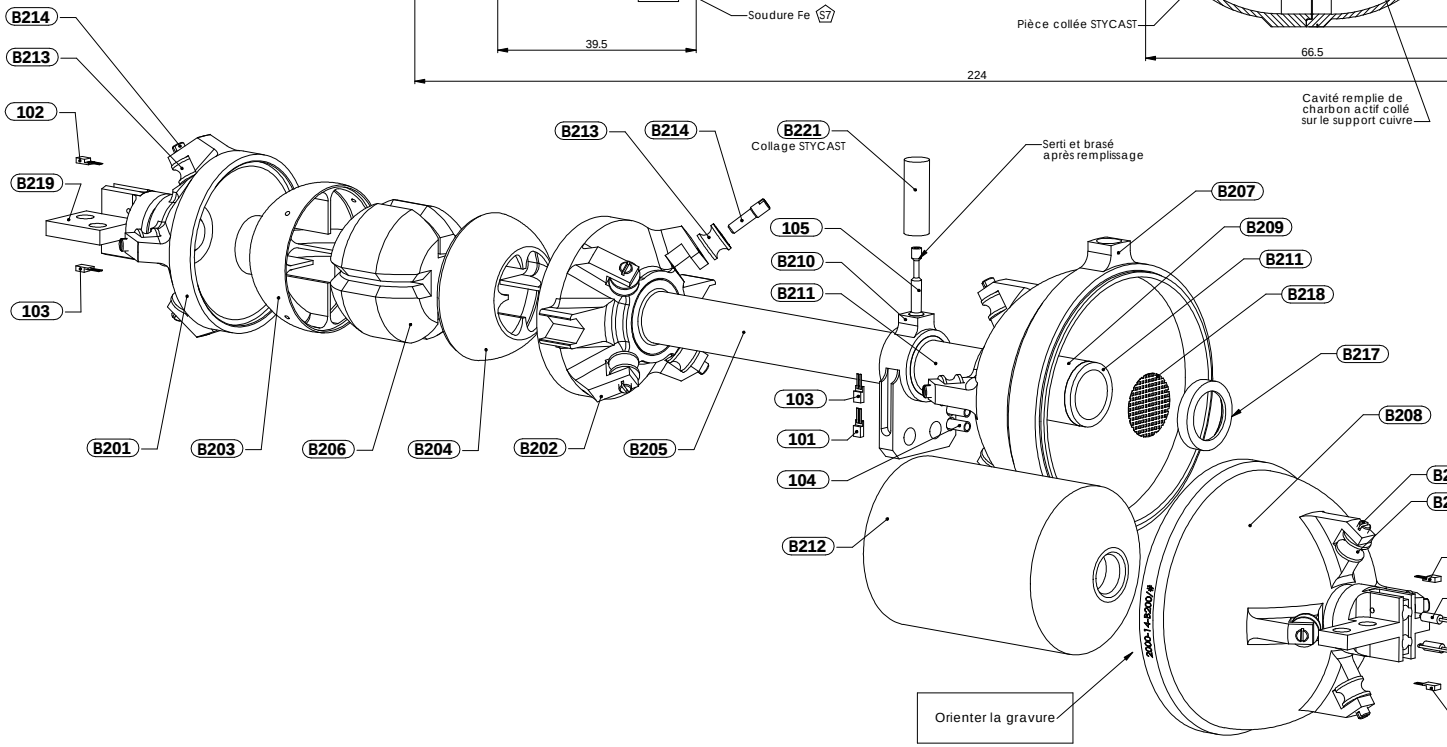
PLANCHE 3/3

Dessiné par : GUILLEMET | Vérifié par : CLERC | Date : 11/12/03

Ensemble : FRIGO SPIRE/PACS
Echelle : 1/ 1
CEA-G SBT
Titre : COMPOSANTS DIVERS IMPLANTATION THERMOMETRIE
N° d'étude : 2000-14
S/Ensemble : B
N° de pièce : 100
Indice : A

SOLIDWORKS





REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
105	1	Tube de remplissage	Ø 2 Ep0.5 Lg 100 (recoupé au montage)		0.0003
104	4	Tube Cuivre	Ø2 ep 0.25 Lg 12		
103	3	Resistance température	LakeShore <=> CX - 1030-SD		
102	1	Resistance température	LakeShore <=> CX - 1030-SD-0.3L		
101	2	Resistance température	LakeShore <=> CX - 1030-SD-1.4L		
100	2	Resistance	VISHAY <=> RLR 05-402 Ohm		
B221	1	CAPOT		Ta 6V eli	0.0006
B220	1	BOUT FROID POMPE		Cuc1(99,95%)	0.0169
B219	1	BOUT FROID EVAPORATEUR		Cuc1(99,95%)	0.0216
B218	1	DISQUE GRILLAGE		1.4307(304L)	0.0004
B217	1	BAGUE POUR GRILLE		Ta6V eli	0.0004
B214	16	AXE POULIE		Ta 6V eli	0.0001
B213	16	POULIE		Ta 6V eli	0.0003
B212	1	ETUI A CHARBON		Cuc1(99,95%)	0.0588
B211	1	TUBE SORTIE POMPE		Ta6V eli	0.0017
B210	1	BAGUE SCHUNT		Cuc1(99,95%)	0.0104
B209	1	MANCHON		Ta6V eli	0.0036
B208	1	1/2 POMPE FEMELLE		Ta6V eli	0.0311
B207	1	1/2 POMPE MALE		Ta6V eli	0.0373
B206	1	MOUSSE		PROCELIT P160	0.0034
B205	1	TUBE EVAPORATEUR		Ta6V eli	0.0027
B204	1	1/2 COUP. MALE EVAP.		Cuc1(99,95%)	0.0079
B203	1	1/2 COUP. FEM. EVAPORATEUR		Cuc1(99,95%)	0.0145
B202	1	1/2 EVAPORATEUR MALE		Ta6V eli	0.0223
B201	1	1/2 EVAPORATEUR FEMELLE		Ta6V eli	0.0208

Désignation des modifications	Indice	Emetteur	Date	Visa
Mise à jour thermométrie ; repérage; nomenclature	F	GUILLEMET	15-12-2003	
modifié Rep 102 -103-119-120	E	GUILLEMET	06-01-03	
Ajouté procédure de dorure	D	GUILLEMET	06-01-03	
Mise à jour vue éclatée(DM013)	C	GUILLEMET	20/12/01	
mise à jour pour fabrication	B	GUILLEMET	28/06/01	
PREMIERE EMISSION	A	E.ALONSO	12/06/01	

Matière :
Nombre :
Tolérance générale :
Ebavurage :
Ra générale : **3,2**
Poids : **0.2629**
Traitement :

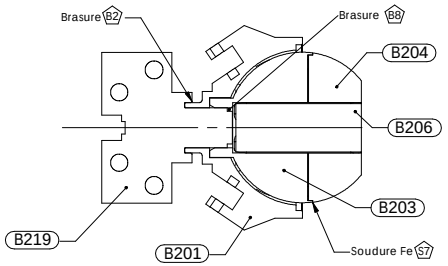
CONTROLER L'ETANCHEITE AU VIDE DE LA PIECE PAR TEST HELIUM 10^{-9} mbar.L.s^{-1}

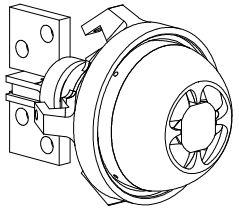
Dessiné par **E.ALONSO** Vérifié par **B.CLAVEL** Date **14/06/01**

Reproduction interdite sans autorisation (loi du 11 Mars 1957)

Ensemble **FRIGO SPIRE/PACS**
Echelle 2/ 1
CEA-G SBT
Titre **S/Ens LIGNE POMPE EVAP. LIGNE POMPE EVAPORATEUR**
N° d'étude **2000-14**
Ensemble **B**
N° de pièce **200**
Indice E F D C

SOLIDWORKS





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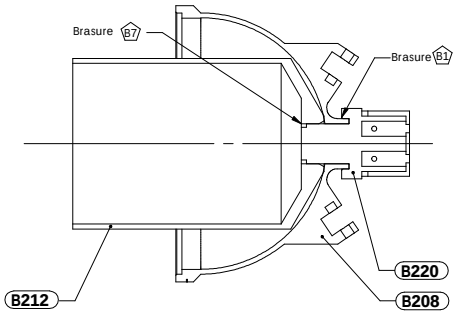

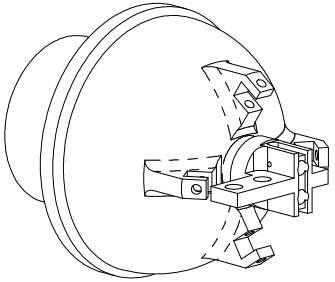

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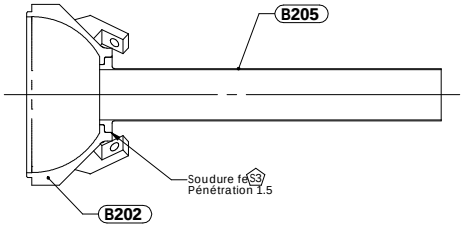

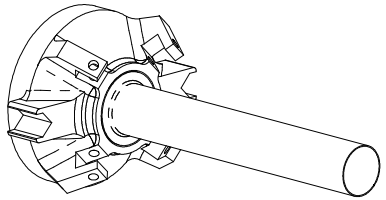

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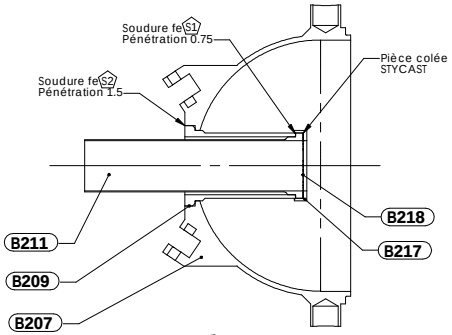

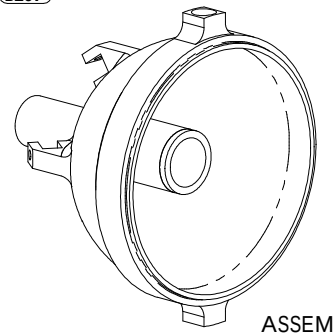

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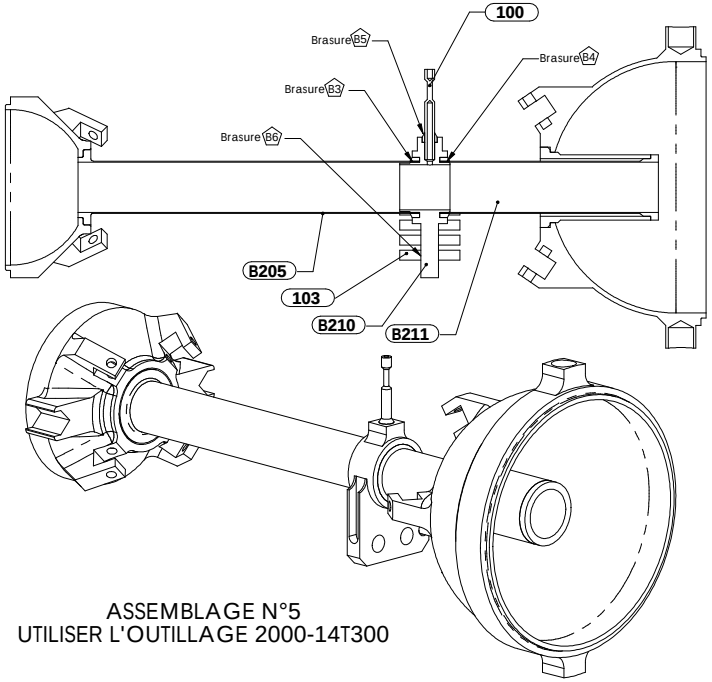
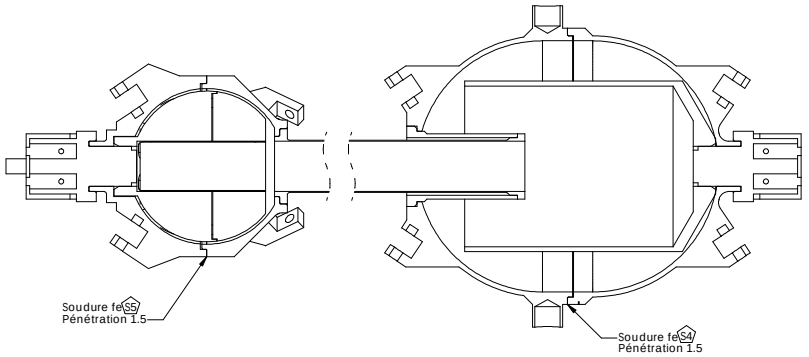


ASSEMBLAGE N°5
UTILISER L'OUTILLAGE 2000-14T300



ASSEMBLAGE N°6

PLANCHE 2/2

Désignation des modifications	Indice	Emetteur	Date	Visa
soudure Tig (S7) devient soudure Fe	C	GUILLEMET	14-10-2003	
mise à jour pour fabrication	B	GUILLEMET	28/06/01	
PREMIERE EMISSION	A	E.ALONSO	12/06/01	

Matière :	Nombre :
Tolérance générale :	Ebavurage :
Ra générale : 3,2	Poids : 0.2629
Traitement :	

Dessiné par : E.ALONSO | Validé par : B.CLAVEL | Date : 14/06/01

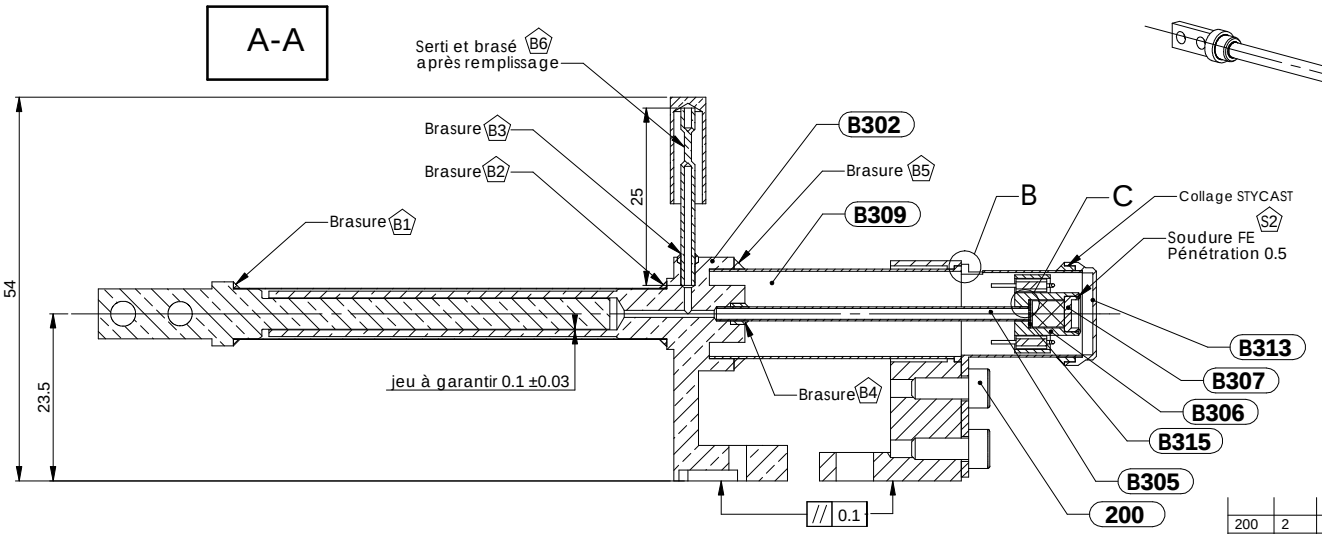
Reproduction interdite sans autorisation (cf. Art 11 Mars 1957)

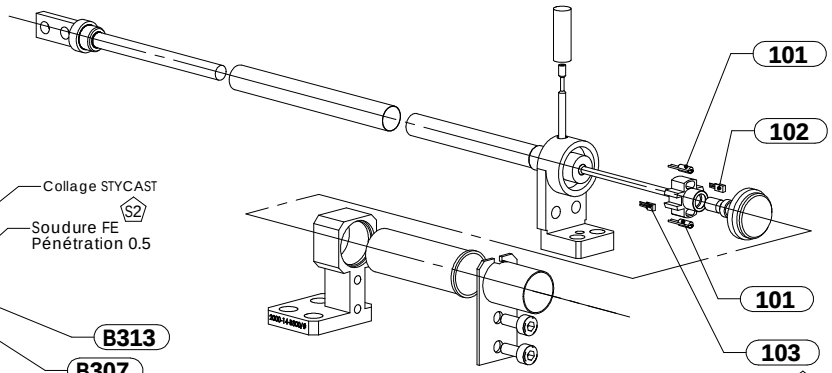
Ensemble : FRIGO SPIRE/PACS | Echelle : 2/ 1 | CEA-G SBT

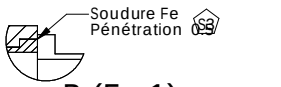
Titre : S/Ens LIGNE POMPE EVAP.
LIGNE POMPE EVAPORATEUR

N° d'étude : 2000-14 | Ensemble : B | N° de pièce : 200 | Indice : A B C

SOLIDWORKS







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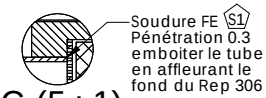
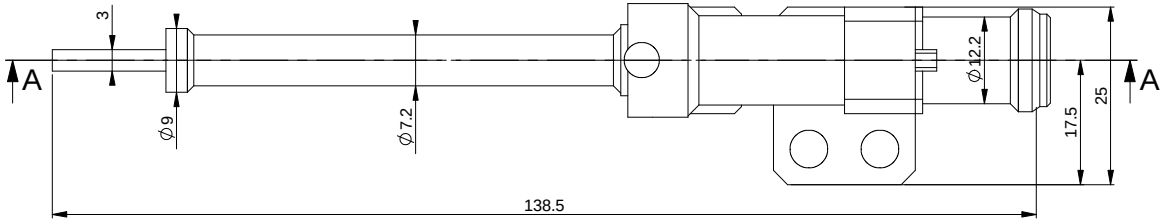
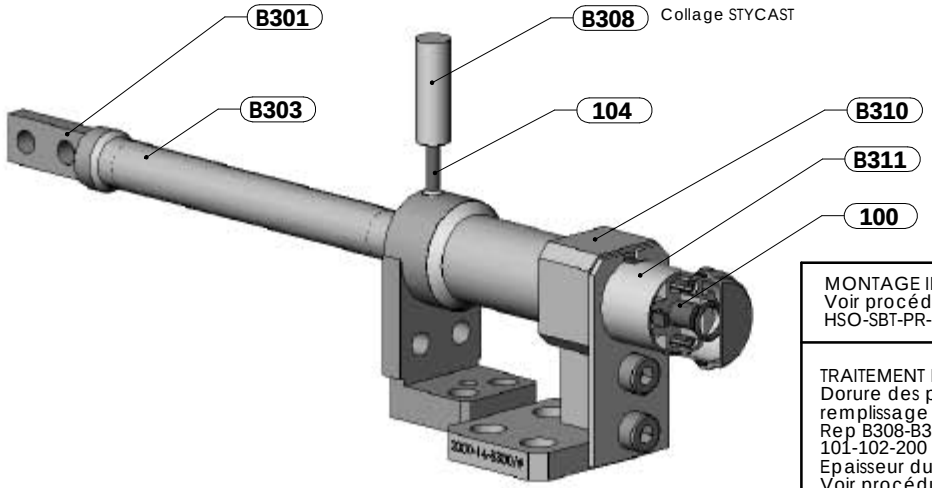


C (5 : 1)





200	2	{vis chc M3-8}		INOX A4-70	
104	1	Tube de Remplissage	Ø 2 Ep 0.5 Lg 18 (après recoupe)	Cu	
103	1	Resistance température	LakeShore <=> CX - 1030-SD-1.4L		
102	1	Resistance température	LakeShore <=> CX - 1030-SD		
101	2	Resistance	VISHAY <=> RLR 05-402 Ohm		
100	1	CHARBON ACTIF			
B315	1	Grille		1.4307(304L)	
B313	1	CACHE		Ta 6V eli	0.0008
B311	1	LIMITEUR		Ta6V eli	0.0022
B310	1	SUPPORT INTERRUPTEUR		Ta6V eli	0.0148
B309	1	TUBE SUPPORT		Ta6V eli	0.0019
B308	1	CAPOT		Ta 6V eli	0.0006
B307	1	BOUCHON Mini Pompe		1.4307(304L)	0.0002
B306	1	MINI POMPE		1.4307(304L)	0.0024
B305	1	TUBE Mini Pompe		1.4307(304L)	0.0005
B303	1	SUPPORT TETE		Ta6V eli	0.0006
B302	1	EMBASE INTERRUPTEUR		Cuc1(99,95%)	0.0391
B301	1	TETE INTERRUPTEUR		Cuc1(99,95%)	0.0119
REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE

Désignation des modifications	Indice	Emetteur	Date	Visa
Changé références thermométrie--Mise à jour repérage & nomenclature	G	GUILLEMET	15/12/2003	
Ajouté Rep 315	F	GUILLEMET	14-10-2003	
Ajouté procédure de dorure	E	GUILLEMET	07-01-2003	
Modifié pieces et préparations de soudures FE pour S1-S2-S3(DM026)	D	GUILLEMET	04/07/2002	
modifié B306-Changer Lg B305 (DM 001)	C	GUILLEMET	24/08/01	

MONTAGE INSTRUMENTATION
Voir procédure de collage
HSO-SBT-PR-033

TRAITEMENT DE SURFACE:
Dorure des pieces cuivre avant remplissage et mise en place des Rep B308-B311-B313
101-102-200
Epaisseur du dépot ~10 microns
Voir procédure HSO-SBT-SP-044

Matière :	Nombre :
Tolérance générale :	Ebavurage :
Ra générale : **3,2**	Poids (kg) : **0.0751**
Traitement :	

CONTROLER L'ETANCHEITE AU VIDE DE LA PIECE PAR TEST HELIUM
10^{-9} mbar.L.s^{1}

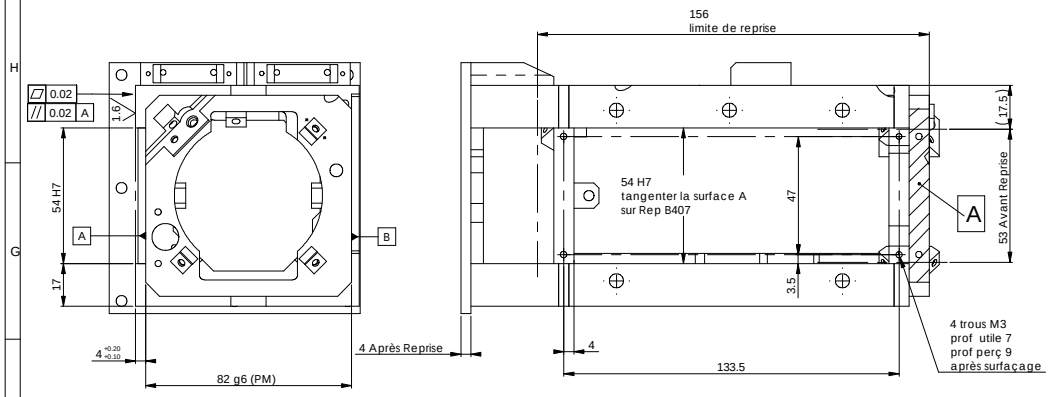
Dessiné par : **E.ALONSO** | Vérifié par : **B.CLAVEL** | Date: **12/06/01**

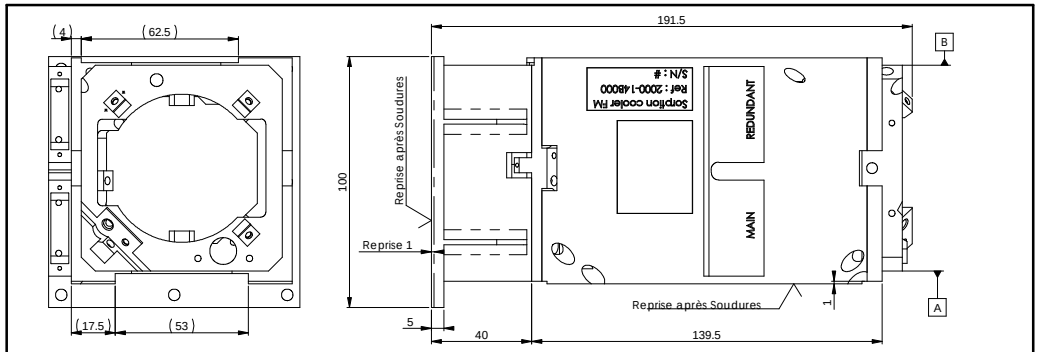
Ensemble **FRIGO SPIRE/PACS** | Echelle 2/ 1 | **CEA-G SBT**

S/e INTERRUPTEUR THERMIQUE
INTERRUPTEUR THERMIQUE

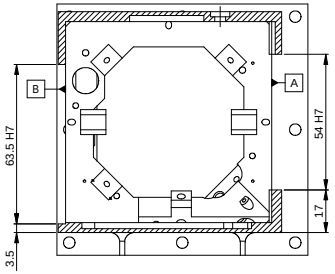
N° d'étude	S/Ensemble	N° de pièce	Indice
2000-14	B	300	E F D G

SOLIDWORKS

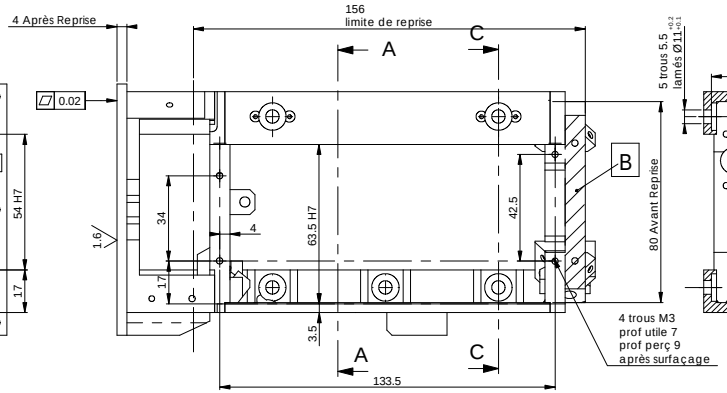


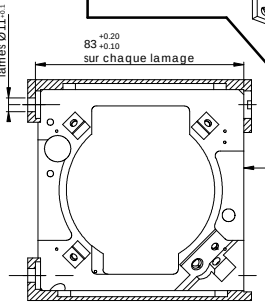


Ces 2 vues (et seulement celles ci) sont représentées avec les surépaisseurs d'usinage



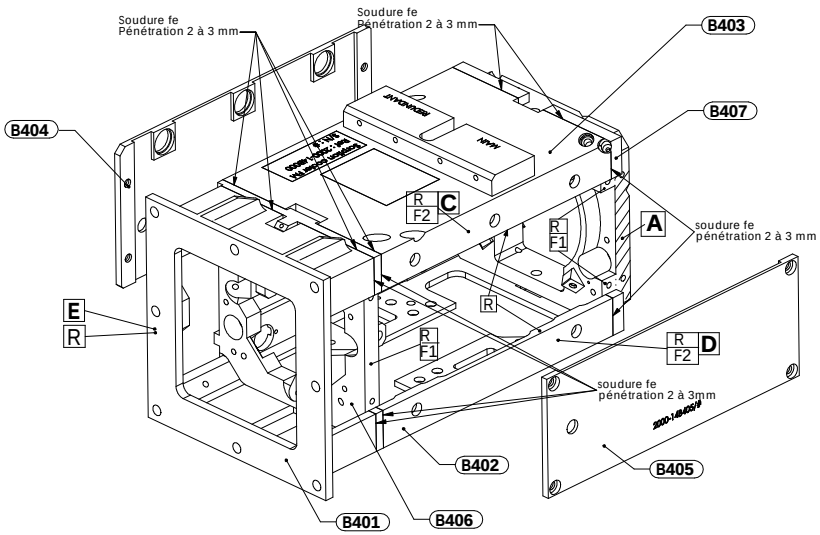
A-A

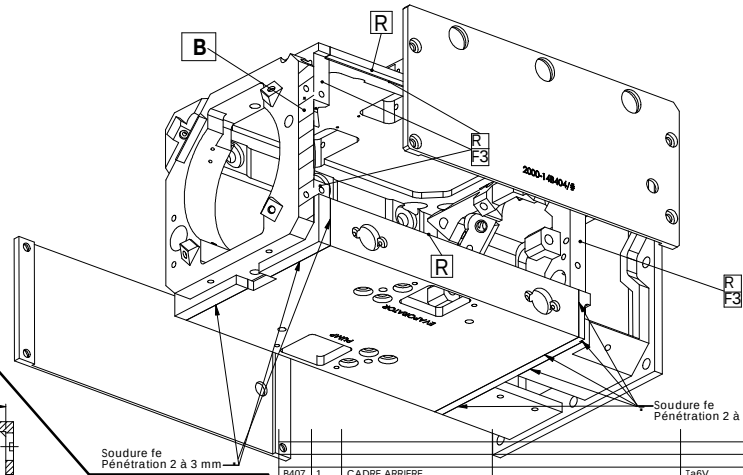




C-C

R	Surfaces reprises après soudure	REPRISES D'USINAGE
A + F1	Surfaces coplanaires	Surfaçage face E bride 100x100
F2	Surfaces coplanaires	Surfaçage des faces C et D
B + F3	Surfaces coplanaires	Surfaçage des encastrements des Rep B404 et B405 (surfaces F1&F3 cotes 63.5H7-54H7)
		Perçage de 8 trous M3
		lamer 5 trous Ø5.5(lamé Ø11)cote 83





REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
B407	1	CADRE ARRIERE		Ta6V	0.221
B406	1	CADRE AVANT		Ta6V	0.140
B405	1	PLAQUE COTE FIXATION		Ta6V	0.056
B404	1	PLAQUE LATERALE		Ta6V	0.082
B403	1	PLAQUE SUPERIEURE		Ta6V	0.164
B402	1	PLAQUE INFERIEURE		Ta6V	0.162
B401	1	SEMELLE		Ta6V	0.235

Désignation des modifications	Indice	Emetteur	Date	Visa
ajouté tolérance générale	E	GUILLEMET	27/01/2004	
mise à jour pour FM	D	GUILLEMET	22-01-2003	
Ajouté structure renforcée	C	GUILLEMET	22-01-2003	
Mise à jour pour fabrication	B	GUILLEMET	28-06-2001	

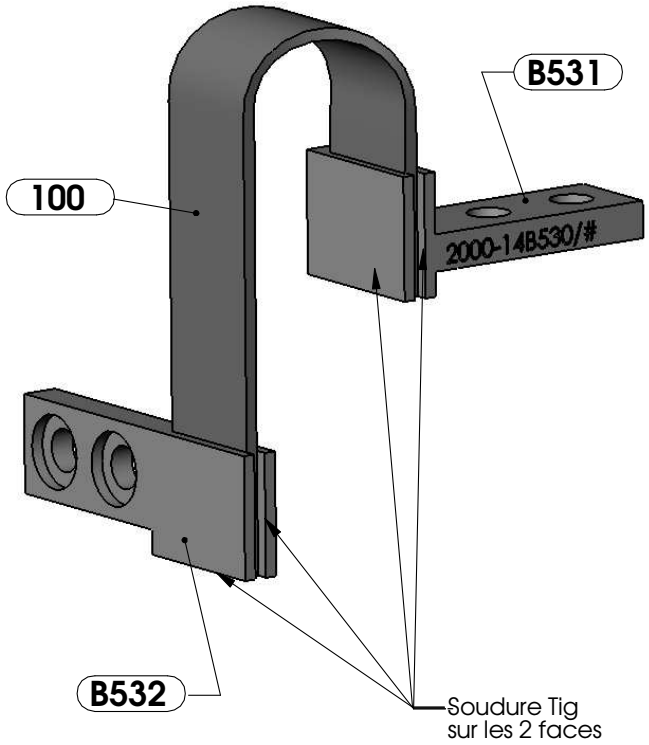
Matière :	**Ta6V eli**
Tolérance générale :	**±0,1**
Ra générale :	**3,2**
Traitement :	
Nombre :	
Ebavurage :	
Poids :	**1.0518**

Dessiné par **E.ALONSO** — Validé par **B.CLAVEL** — Date **11/06/01**

Ensemble **FRIGO SPIRE/PACS** — Echelle 1/ 1 — **CEA-G SBT**

Titre **S/Ens STRUCTURE STRUCTURE FM** — N° d'étude **2000-14** — S/Ensemble **B** — N° de pièce **400** — Indice B C E D

SOLIDWORKS



TRAITEMENT THERMIQUE
Voir procédure de recuit aprés soudure Ref: HSO-SBT-PR-080

TRAITEMENT DE SURFACE:
Dorure après traitement thermique
Epaisseur du dépot ~10 microns
Voir procédure HSO-SBT-SP-044

REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
100	1	TRESSE Cuivre Lg 75	CEA <=> Section 2x2.5 (5 mm^2)		
B532	1	EMBOUT DE TRESSE		Cu c1 (99,95%)	0.01
B531	1	EMBOUT DE TRESSE		Cu c1 (99,95%)	0.01

Désignation des modifications	Indice	Emetteur	Date	Visa
modifié embouts et tresse	D	GUILLEMET	06-02-04	
Ajouté procédure de dorure et Traitement Thermique	C	GUILLEMET	06-01-03	
mise à jour pour fabrication	B	GUILLEMET	28/06/01	
PREMIERE EMISSION	A	E.ALONSO	11/06/01	

Matiére : **CuC1+CuA1**	Nombre :
Tolérance générale :	Ebavurage :
Ra générale :	Poids (kg) : **0.0121**
Traitement :	

Dessiné par : **E.ALONSO** | Vérifié par : **B.CLAVEL** | Date: **11/06/01**

Ensemble: **FRIGO SPIRE/PACS**

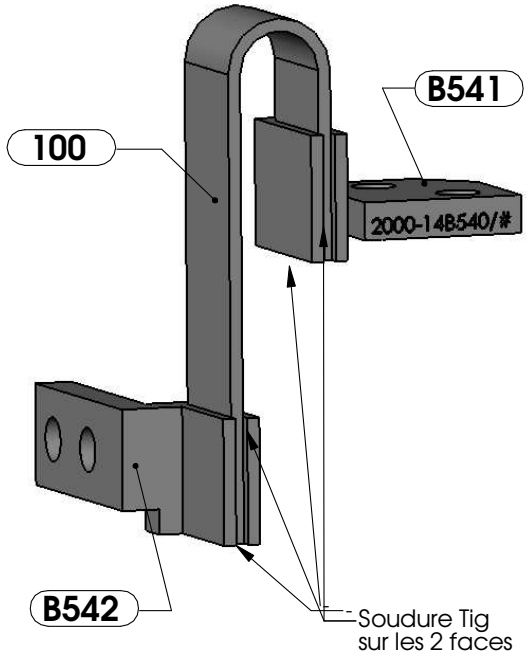
Echelle: 2.5/ 1

CEA-G SBT

Titre: **S/Ens STRAP POMPE**
STRAP POMPE

N° d'Etude	S/Ensemble	N° de piéce	Indice
2000-14	**B**	**530**	A B C D

SOLIDWORKS



TRAITEMENT THERMIQUE
Voir procédure de recuit aprés soudure Ref: HSO-SBT-PR-080

TRAITEMENT DE SURFACE:
Dorure après traitement thermique
Epaisseur du dépot ~10 microns
Voir procédure HSO-SBT-SP-044

REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
B542	1	EMBOUT DE TRESSE		Cuc1(99,95%)	0.01
B541	1	EMBOUT DE TRESSE		Cuc1(99,95%)	0.01
100	1	TRESSE Cuivre Lg 65	CEA <=> Section 1 x 10 (5mm²)		

Désignation des modifications	Indice	Emetteur	Date	Visa
modifié embouts et tresse	D	GUILLEMET	06/02/2004	
Ajouté procédure de dorure et traitement thermique	C	GUILLEMET	06-01-03	
mise à jour pour fabrication	B	GUILLEMET	28/06/01	
PREMIERE EMISSION	A	E.ALONSO	11/06/01	

Matiére : **CuC1+CuA1** | Nombre :
Tolérance générale : | Ebavurage :
Ra générale : | Poids (kg) : **0.0151**
Traitement :

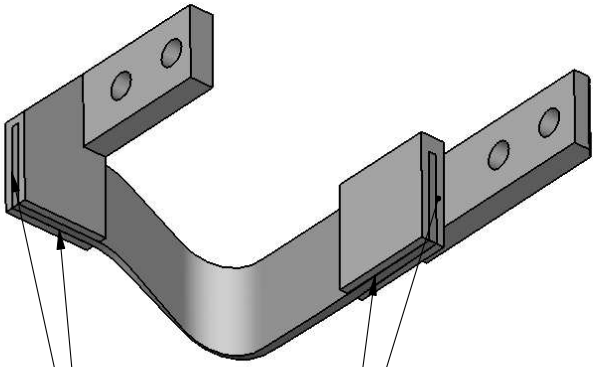
Dessiné par : **E.ALONSO** | Vérifié par : **B.CLAVEL** | Date: **11/06/01**

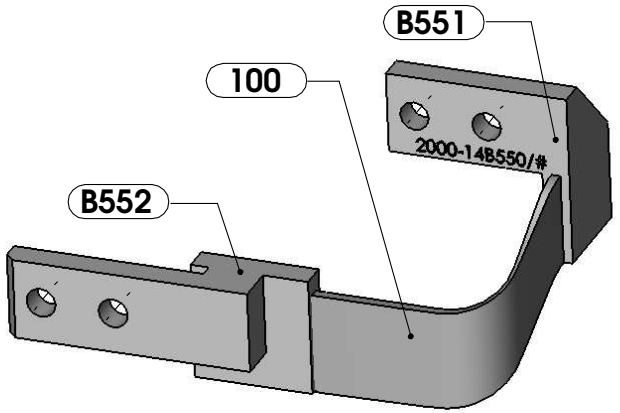
Ensemble: **FRIGO SPIRE/PACS** | Echelle: 2.5/ 1 | **CEA-G SBT**

Titre: **S/Ens STRAP EVAPORATEUR**
STRAP EVAPORATEUR

N° d'Etude	S/Ensemble	N° de piéce	Indice
2000-14	B	540	A B C D

SOLIDWORKS





REP	NB	DESIGNATION	FOURNISSEUR <=> REFERENCE	MATIERE	MASSE
B552	1	EMBOUT STRAP		Cu-c1 en plaque	0.01
B551	1	EMBOUT STRAP		Cu-c1 en plaque	0.01
100	1	tresse	CEA-SBT <=> 5x1xL65- S Cu 5mm2	Cuivre	0.01

TRAITEMENT THERMIQUE
Voir procédure de recuit aprés soudure Ref: HSO-SBT-PR-080

TRAITEMENT DE SURFACE:
Dorure après traitement thermique
Epaisseur du dépot ~10 microns
Voir procédure HSO-SBT-SP-044

Désignation des modifications	Indice	Emetteur	Date	Visa
modifié embouts et tresse	B	Guillemet	06-02-04	
PREMIERE EMISSION	A	Guillemet	14-05-03	

Matiére : **CuC1+CuA1** | Nombre :
Tolérance générale : | Ebavurage : **Oui**
Ra générale : **+/-0.1** | Poids (kg) : **-**
Traitement : **DECAPAGE PASSIVATION**

Dessiné par : **Guillemet** | Vérifié par : **Clerc** | Date: **14-05-03**

Ensemble: **FRIGO SPIRE/PACS**
Echelle: 2
CEA-G SBT
Titre: **S/Ens STRAP SCHUNT**
STRAP SCHUNT

N° d'Etude	S/Ensemble	N° de pléce	Indice
2000-14	**B**	**550**	A B -

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7 - AGE SENSITIVE ITEMS RECORD

None

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8 - TEMPORARY INSTALLATION

Following items must be removed before any test at next level :

- 2000-14 B 102 : Outillage anti rotation
- 2000-14 B 134 : Vis de centrage (Qty = 2)
- 2000-14 B 135 : Vis de centrage (Qty = 2)
- 2000-14 B 161 : Plaquette signalétique (Qty = 4)
- Saver connectors (Qty = 2)

To see related paragraph of “Operating Manual” reference HSO-SBT-TN-120 attached in Chapter 14 of this EIDP

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9 - HISTORICAL RECORD and LOGBOOK

Two documents are attached in this chapter :

- Historical Record, reference HSO-SBT-HR-098
- Logbook, reference HSO-SBT-LB-114

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	Historical Record	HSO - SBT - HR - 098 1

Project : **SPIRE**	*Item :* **SORPTION COOLER**	*Drawing / ident. N° :* **2000-14 B 000**	*Model :* **FM 1**	*Visa (Project and PA) :*

Acronyms : *LLB = Laboratory Log Book*
LLSB = Lob Book "Salle blanche"
FI = Fiche d' Inspection
FA = Fiche d' Anomalie

Reference Document : AIV Plan HSO-SBT-PL-013

MAIN TASKS with related AIV number	Applicable Document	Operator	Date	Inspection / Anomaly / Test Report / Comments
PARTS MANUFACTURING				
MA 010 – Inspection and Cleaning	Drawings / HSO-SBT-PR-026	SBT	1 to 3 / 04	FI # 100/101/102/103 FA # 102/103/104
MA 020 – Laser Marking of specific parts	HSO-SBT-SP-039	ID Las	3 / 04	
STRUCTURE ASSEMBLY				
ST 010 – EB Welding of main structure	HSO-SBT-SP-014 / FC-023	Techmeta	4 / 04	CoC n° AQCC7562 du 15/4/04
ST 020 – Final machining of main structure	Drawings	OMG	4 / 04	CoC n° 04.0187 du 29/4/04
ST 030 – Cleaning		OMG	4 / 04	CoC n° 04.0187 du 29/4/04
COOLER HEART ASSEMBLY and TEST				
CO 010 – Pump and Evaporator pre-assembly (EB welding)	HSO-SBT-SP-014 / FC-023	Techmeta	5 / 04	CoC n° AQCC7587 du 3/5/04
CO 020 – Welding inspection and leaktightness tests		SBT	5 / 04	FI # 104
CO 030 – Soldering of thermal shunt and Fill tube	HSO-SBT-SP-014 / FC-023	SDMS	5 – 6 / 04	CoC n° 29035-CF-02
CO 040 – Assembly of Pump and Evaporator half sphere (brazing)	HSO-SBT-SP-014 / FC-023	SDMS	5 – 6 / 04	CoC n° 29035-CF-02
CO 050 – Baking and mounting of Procelit		SBT	11 / 6 / 04	LLB 04 page 4
CO 060 – Charcoal gluing onto Pump copper casing	HSO-SBT-PR-024	SBT	23-24 / 6 / 04	LLB 04 page 26 à 31
CO 070 – Gluing of grid and cover	Drawings	SBT	25 / 6 / 04	LLB 04 page 31
CO 080 – Assembly of evaporator copper half sphere	HSO-SBT-SP-014 / FC-023	Techmeta	14 / 6 / 04	CoC n° AQCC7650 du 14/6/04
CO 090 – Closing of cooler (EB welding)	HSO-SBT-SP-014 / FC-023	Techmeta	9 / 7 / 04	CoC n° AQCC7683 du 9/7/04 FI # 105
CO 100 – Assembly and heat treatment of straps	HSO-SBT-FC-023	SBT	21 / 7 / 04	LLB 04 page 49

MAIN TASKS with AIV number	Applicable Document	Operator	Date	Inspection / Anomaly / Test Report / Comments
CO 110 – Gold plating of all external copper surfaces	HSO-SBT-SP-044	Thermocompact	28-29/ 7/ 04	
CO 120 – Leaktightness and proof pressure at 20 MPa	HSO-SBT-PR-025	SBT	3-5 / 8 / 04	FI # 108 LLB 04 pages 56 à 59
CO 130 – Cleaning and baking of Cooler / Structure	HSO-SBT-PR-026 / 035	SBT	2 / 8 – 17/ 8	LLB 04 page 55 et 68 à 70
CO 140 – Gluing of thermal parts / Pre wiring	HSO-SBT-PR-033	SBT	18 / 8 / 04	LLB 04 page 69 à 74
CO 150 – Performance test (cooler empty)	HSO-SBT-PR-029	SBT	-	Non effectué
CO 160 – ^{3}He filling of cooler / pre test (cold phase)	HSO-SBT-PR-029	SBT	30 / 8 – 1 / 9	LLB 04 page 86 à 92
CO 170 – Crimping of cooler	HSO-SBT-PR-030	SBT	3 / 9 / 04	FI # 110
CO 180 – Mounting of mechanical items (pulleys,…)	Drawings	SBT	7 – 8 / 9 / 04	LLSB 2 page 10 et 11
HEAT SWITCHES ASSEMBLY and TEST				
HS 010 – Pre assembly Switch base (EB Welding)	HSO-SBT-SP-014 / FC-023	Techmeta	5 / 04	CoC ref. AQCC7588 du 3/5/04
HS 020 – Brazing of parts	HSO-SBT-SP-014 / FC-023	SDMS	6 / 04	CoC n° 29035-CF-02 FA # 108
HS 030 – Leak tightness test		SBT	7/6 à 26/7/04	FI # 106
HS 040 – Charcoal mounting		SBT	26 / 7 / 04	LLB 04 page 51
HS 050 – Closing of mini Pump (EB welding)	HSO-SBT-SP-014 / FC-023	Techmeta	27 / 7 / 04	CoC n° AQCC 7728
HS 060 – Leak tightness test		SBT	27 / 7 / 04	FI # 107 LLB 04 pages 52-53
HS 070 – Gold plating of all external copper surfaces	HSO-SBT-SP-044	Thermocompact	28-29/ 7/ 04	
HS 080 – Baking and cleaning of switch	HSO-SBT-PR-026	SBT	5 / 8 / 04	LLB 04 page 59
HS 090 – Filling / Crimping of Heat Switch	HSO-SBT-PR-030 / 036	SBT	6 / 8 / 04	FI # 109
HS 100 – Gluing of thermal parts / Pre wiring	HSO-SBT-PR-033	SBT	7 – 8 / 9 / 04	LLB 04 page 96 à 98
HS 110 – Thermal characterization of Heat switch		SBT	24 / 8 / 04	SBT Test Report HSO-SBT-TN-107
GENERAL ASSEMBLY				
CO 190 – Mounting of Cooler into main Structure (installation of Kevlar cables)	HSO-SBT-PR-028	SBT	16 / 9 / 04	LLB 04 page 106
CO 200 – Processing of Kevlar cables	HSO-SBT-PR-028	SBT	16-21/ 9/ 04	FI # 111

MAIN TASKS with AIV number	Applicable Document	Operator	Date	Inspection / Anomaly / Test Report / Comments
CO 210 – Integration of Heat Switches	Drawings	SBT	21 / 9 / 04	LLSB 2 page 17
CO 220 – Cabling and soldering of connectors and thermal parts	HSO-SBT-PR-033	SBT	21-22/9/04	FI # 113
CO 230 – Mounting and adjustment of Snubbers	Drawings	SBT	21 / 9 / 04	LLSB 2 page 17
CO 240 – Integration of thermal straps	Drawings	SBT	21 / 9 / 04	LLSB 2 page 17
CO 250 – Final assembly	Drawings	SBT	21 / 9 / 04	LLSB 2 page 17
TESTS OPERATIONS and DELIVERY				
CO 260 – Thermal Test # 1	HSO-SBT-PR-031	SBT	24 / 9 / 04	Health Check Report # 101
CO 270 – Thermal Vacuum (80° C)	HSO-SBT-PR-035	SBT	29/9-4/10/04	LLB 04 page 121 à 129
CO 280 – Thermal Test # 2	HSO-SBT-PR-031	SBT	7-10/10/04	Health Check Report # 102 (LLB 04 page 134-135)
Change of redundant heater of heat switch pump		SBT	11-15/10/04	FA # 110 et RW # 100
CO 290 – Vibration Test	HSO-SBT-PR-045 HSO-SBT-SP-001	CSL / SBT	19-21/10/04	Test Report reference HSO-SBT-RP-118
CO 300 – Thermal Test # 3	HSO-SBT-PR-031	SBT	25/10-8/11/04	Health Check Report # 103 (LLB 04 page 151 à 166)
CO 310 – Performance test	HSO-SBT-SP-001	SBT		Test Report reference HSO-SBT-RP-118
CO 320 – Packing	HSO-SBT-PR-119	SBT	18/11/04	
CO 330 – Delivery to RAL			18/11/04	

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	SPIRE **FM1 Sorption Cooler** ***LOGBOOK***	**HSO -SBT-LB-114** **Issue/Rev. : 1.0** **Date : 8/10/2004** **PAGE :** 1

PREPARED BY : **M.DUBOIS**		APPROVED BY : **L.DUBAND**	

PART NUMBER :	**2000 – 14 B 000**	MODEL :	**FM**
RELATED EIDP :	**HSO –SBT-ADP-108**	TECHNICAL SPECIFICATION	HSO-SBT-SP-001

This document shall follow the specified material. At any evolution of the document, the table here after will be signed .

DATE									
VISA									

SUMMARY

1 - LIMITED LIFE ITEMS
2 - LIMITED OPERATING ITEMS
3 - DELIVERED PROCEDURES
4 – CONNECTORS MATING/DEMATING RECORDS
5 - CONFIGURATION MODIFICATION RECORDS (after delivery)
6 - WAIVERS/DEVIATIONS RECORDS (after delivery)
7 - CONTROLS/TESTS RECORDS (after delivery)
8 - OPERATIONS RECORDS (after delivery)

1 - LIMITED LIFE ITEMS

No limited life item.

2 - LIMITED OPERATING ITEMS

No limited operating item.

3 - DELIVERED PROCEDURES

HSO-SBT-PR-119 "Handling, Packing, transportation and storage manual"

4 – CONNECTORS MATING/DEMATING RECORDS

CONNECTOR IDENTIFICATION : MAIN										
Operation type (*)	1 MATING	2 DEMATING	3 MATING	4 DEMATING	5 MATING	6 DEMATING	7 MATING	8 DEMATING	9 MATING	10
Date	22/9/04	19/10/04	19/10/04	19/10/04	20/10/04	17/11/04	17/11/04	18/11/04	18/11/04	
Operation type	11	12	13	14	15	16	17	18	19	20
Date										
Operation type	21	22	23	24	25	26	27	28	29	30
Date										
Operation type	31	32	33	34	35	36	37	38	39	40
Date										
CONNECTOR IDENTIFICATION : REDUNDANT										
Operation type	1 MATING	2 DEMATING	3 MATING	4 DEMATING	5 MATING	6 DEMATING	7 MATING	8 DEMATING	9 MATING	10
Date	22/9/04	19/10/04	19/10/04	19/10/04	20/10/04	17/11/04	17/11/04	18/11/04	18/11/04	
Operation type	11	12	13	14	15	16	17	18	19	20
Date										
Operation type	21	22	23	24	25	26	27	28	29	30
Date										
Operation type	31	32	33	34	35	36	37	38	39	40
Date										

(*) : MATING – DEMATING - INSPECTION

5 - CONFIGURATION MODIFICATION RECORDS (after delivery)

N°	ITEM	REFERENCE	SERIAL N°	REMOVAL DATE	MOUNTING DATE

6 - WAIVERS / DEVIATIONS RECORDS (after delivery)

N°	RFW/D N°	Item concerned	Description	Class	Origin	Opening Date	Closing Date

7 - CONTROLS / TESTS RECORDS (after delivery)

N°	Tests / Controls	Date	Document N°	Results	Remarks

8 - OPERATIONS RECORDS (after delivery)

N°	Operation	Date	Description	Document N°	Remarks	Visa

10 - LIST OF WAIVERS

One waiver at the instant of delivery

HSO-SBT-RW-100 No thermal test after cooler repair and before Vibration test

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	SPIRE & PACS Sorption Coolers ***REQUEST for WAIVER (RW)***	**Référence :** **HSO-SBT-RW-100** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 18/10/2004 *Nom de l'émetteur :* M.DUBOIS

Intitulé fiche d'anomalie : No thermal test after repair and before Vibration test

Renseignements concernant l'équipement :

Modèle concerné : Spire FM1

Nom et réf. item : Ensemble cooler 2000-14 B 100

Nom et réf. item :

Phase de constat et conditions d'environnement :

☐ *Fabrication*	☐ *Recette*	☐ *Intégration*	X *Test*	☐ *Autre*
☐ *Ambiante*	☐ *Vide thermique*	☐ *Vibration*	☐ *Vide / Pression*	

Description de l'anomalie :

The redundant heater of heat switch pump was changed, due to failure described in non conformance report (FA) reference HSO-SBT-FA-110.
After the repair operation, no thermal test were performed and the cooler was sent to CSL for its vibration test.

Analyse :

Classification ☐ *Majeure* **X** *Mineure*

Actions correctives :

Actions préventives :

Recommandations :

To perform a cold functional test after vibration test to check cooler performance. If there is any suspicion that performance is degraded, the cooler will be refurbished with new heat switch.

	SPIRE & PACS Sorption Coolers ***REQUEST for WAIVER (RW)***	**Référence :** **HSO-SBT-RW-100** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	
25-26/10/2004	Cold functional test at SBT after vibration test : no performance degradation

Référence DM :

Dispositions finales :

X *En l'état* *Modification* *Réparation* *Dérogation* *Rebut*

	Responsable technique	Responsable AP	Chef de projet
Autorisation pour dispositions et actions		M.DUBOIS	L. DUBAND
Niveau supérieur			

Clos le : ***Par :*** ***Visa :***

11 - LIST of NON-CONFORMANCE REPORTS and COPIES

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SPIRE
FM 1 Sorption Cooler
Non-Conformance Reports List

NCR internal Reference	DATE	CLASS	STATUS	TITLE	Action description / Comments
HSO-SBT-FA-100	29/01/04	minor	Closed	Mechanical items manufacturing	Machining retouching of B405 item
HSO-SBT-FA-102	25/02/04	minor	Closed	Mechanical items manufacturing	Machining retouching of B403 item
HSO-SBT-FA-103	4/03/04	minor	Closed	Mechanical items manufacturing	“Appairage” of B310 item with B309 and retouching of B219
HSO-SBT-FA-104	4/03/04	minor	Closed	Mechanical items manufacturing	Use as is
HSO-SBT-FA-108	18/6/04	minor	Closed	Geometrical non conformance on switch n° 2	No consequence on structure/switch assembly
HSO-SBT-FA-109	8/10/04	minor	Closed	Difficulty to integrate “tube guides”	Design evolution and remanufacturing of parts
HSO-SBT-FA-110	11/10/04	Major	Closed	Redundant heater failure	Change of the heater. To see waiver RW100

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Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-100** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 29 / 01 / 2004 *Nom de l'émetteur :* L.CLERC / M.DUBOIS

Intitulé fiche d'anomalie : Fabrication pièces élémentaires

Renseignements concernant l'équipement :

Modèle concerné : FMs (affectations à renseigner ultérieurement)

Nom et réf. item : 2000-14B 204 / 212 / 402 / 404 / 405 / 407

Nom et réf. item :

Phase de constat et conditions d'environnement :

X *Fabrication* X *Recette* ☐ *Intégration* ☐ *Test* ☐ *Autre*

☐ *Ambiante* ☐ *Vide thermique* ☐ *Vibration* ☐ *Vide / Pression*

Description de l'anomalie :

1) Informations erronées sur les PV de métrologie des pièces 2000-14 B 204/ 212 / 404 / 405.
2) Cotes hors tolérances sur 2 pièces B 402 (n° 2 et 3), 1 pièce B 404 (n° 2), 4 pièces B 405, 1 pièce B 407 (n° 2)

Voir FI # 100 pour informations détaillées

Analyse :

Classification ☐ *Majeure* **X** *Mineure*

Actions correctives :

1) Mettre à jour les PV
2) Pièces B 402 : à retoucher
   Pièces B 405 : à retoucher
   Pièce B 404 : acceptée en l'état
   Pièce B 407 : mensuration refaite => pièce bonne

Actions préventives :

Nouvelle sensibilisation du fabricant OMG aux exigences qualité

Recommandations :

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-100** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	
17/02/2004	Réception des PV modifiés et des pièces retouchées par OMG – OK –

Référence DM :

Dispositions finales :

X *En l'état* *Modification* X *Retouche* *Dérogation* *Rebut*

	Responsable technique	Responsable AP	Chef de projet
Autorisation pour dispositions et actions		M.DUBOIS	L. DUBAND
Niveau supérieur			

Clos le : 26/02/2004 ***Par : M. DUBOIS*** ***Visa :***

Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-102** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 25/02/2004 *Nom de l'émetteur :* L.CLERC / M.DUBOIS

Intitulé fiche d'anomalie : Fabrication pièces élémentaires

Renseignements concernant l'équipement :

Modèle concerné : FMs (affectations à renseigner ultérieurement)

Nom et réf. item : 2000-14 B 128 / 209 / 214 / 403

Nom et réf. item :

Phase de constat et conditions d'environnement :

X *Fabrication*	X *Recette*	☐ *Intégration*	☐ *Test*	☐ *Autre*
☐ *Ambiante*	☐ *Vide thermique*	☐ *Vibration*	☐ *Vide / Pression*	

Description de l'anomalie :

1) Informations insuffisantes sur PV de métrologie des pièces B 128 et B 214.
2) Sur les 4 pièces B 209, les chanfreins 0,25 x 0,25 sont mesurés 0,45 x 0,45
3) Sur les 4 pièces B 403, les taraudages 2-56 UNC ne sont pas assez profonds (≈ 5 mm pour 6/7 mm demandés)

Voir FI # 101

Analyse :

Classification ☐ *Majeure* **X** *Mineure*

Actions correctives :

1) Compléter les PV de métrologie
2) Pièces à refaire
3) Pièces à retoucher

Actions préventives :

Recommandations :

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-102** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	
3 / 2004	1 - OK – PV OMG 03.0601 et 03.0606 2 - OK – Pièces refaites 3 - OK – PV OMG 03.0603

Référence DM :

Dispositions finales :

En l'état X *Modification* X *Retouche* *Dérogation* X *Rebut*

Autorisation pour dispositions et actions	Responsable technique	Responsable AP M.DUBOIS	Chef de projet L. DUBAND
Niveau supérieur			

Clos le : 23/04/2004 ***Par : M. DUBOIS*** ***Visa***

Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-103** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 4 / 03/ 2004 *Nom de l'émetteur :* L.CLERC / M.DUBOIS

Intitulé fiche d'anomalie : Fabrication pièces élémentaires

Renseignements concernant l'équipement :

Modèle concerné : FMs (affectations à renseigner ultérieurement)

Nom et réf. item : 2000-14 B 219 / 309 / 310

Nom et réf. item :

Phase de constat et conditions d'environnement :

X *Fabrication* X *Recette* ☐ *Intégration* ☐ *Test* ☐ *Autre*

☐ *Ambiante* ☐ *Vide thermique* ☐ *Vibration* ☐ *Vide / Pression*

Description de l'anomalie :

1) Informations insuffisantes et erreur écriture sur PV de métrologie des pièces B 309.
2) Sur les 10 pièces B 310, la cote Φ 13,5 H7 est hors tolérance.
3) La pièce B 219 n° 2 ne se monte sur aucune des pièces B 201.

Voir FI # 102

Analyse :

Classification ☐ *Majeure* **X** *Mineure*

Actions correctives :

1) Compléter le PV de métrologie
2) Accepté en l'état, avec appairage des pièces :
   - B 310 n° 6 avec B 309 n° 1
   - B 310 n° 8 avec B 309 n° 5
   - B 310 n° 5 avec B 309 n° 6
   - B 310 n° 1 avec B 309 n° 8
3) Pièces à retoucher

Actions préventives :

Recommandations :

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-103** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	1 - OK – PV OMG 03.0608 2 - Appairages faits 3 - OK – PV OMG 03.0607

Référence DM :

Dispositions finales :

X *En l'état* X *Modification* X *Retouche* ☐ *Dérogation* ☐ *Rebut*

Autorisation pour dispositions et actions	Responsable technique	Responsable AP M.DUBOIS	Chef de projet L. DUBAND
Niveau supérieur			

Clos le : 23/04/2004 ***Par : M. Dubois*** ***Visa***

Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-104** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 4 / 03/ 2004 *Nom de l'émetteur :* L.CLERC / M.DUBOIS

Intitulé fiche d'anomalie : Fabrication pièces élémentaires

Renseignements concernant l'équipement :

Modèle concerné : FMs (affectations à renseigner ultérieurement)

Nom et réf. item : 2000-14 B 102 / 214 / 302

Nom et réf. item :

Phase de constat et conditions d'environnement :

X *Fabrication* X *Recette* ☐ *Intégration* ☐ *Test* ☐ *Autre*

☐ *Ambiante* ☐ *Vide thermique* ☐ *Vibration* ☐ *Vide / Pression*

Description de l'anomalie :

1) Les pièces B 102 (outillage anti rotation) ont été fabriquées en 35NCD16 au lieu de 45NCD16.
2) Pièces B 214 (axe poulie) : la cote Φ 2 g6 est hors tolérance sur les 10 pièces :
   - 2μ / - 8μ demandé, - 10μ à - 15μ mesuré.
3) Pièce B 302 n° 3 :
   - la cote de 16 g6 est hors tolérance (- 6μ / - 17μ demandé, - 35μ mesuré)
4) Pièces B 302 n° 6 et n° 10 :
   - la profondeur de l'alésage Φ 4,5 H7 est hors tolérance : respectivement 49,9 et 49,2 pour 49 + 0/+ 100μ

Voir FI # 103

Analyse :

Classification ☐ *Majeure* **X** *Mineure*

Actions correctives :

1) Accepté en l'état
2) Accepté en l'état
3) Accepté en l'état
4) Accepté en l'état

Actions préventives :

Recommandations :

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-104** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions : Pas d'action

Date :

Référence DM :

Dispositions finales :

X *En l'état* ☐ *Modification* ☐ *Retouche* ☐ *Dérogation* ☐ *Rebut*

	Responsable technique	Responsable AP	Chef de projet
Autorisation pour dispositions et actions		M.DUBOIS	L. DUBAND
Niveau supérieur			

Clos le : 23/04/2004 ***Par : M. Dubois*** ***Visa***

Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-108** **Issue : 2** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date création : 18 / 6 / 04 *Issue 2* : 8 / 10 / 04 *Nom de l'émetteur :* M.DUBOIS

Intitulé fiche d'anomalie : Interrupteur thermique n° 2 après brasure

Renseignements concernant l'équipement :

Modèle concerné : FM (utilisation sur FM à confirmer)

Nom et réf. item : Interrupteur thermique 2000-14 B 300

Nom et réf. item : Embase interrupteur B 302 et support interrupteur B 310

Phase de constat et conditions d'environnement :

X *Fabrication* **X** *Recette* ☐ *Intégration* ☐ *Test* ☐ *Autre*

☐ *Ambiante* ☐ *Vide thermique* ☐ *Vibration* ☐ *Vide / Pression*

Description de l'anomalie :

Sur pièce terminée, il est constaté :

- Un écart de 0,15 mm maxi des plans d'appuis des pièces B302 et B310, théoriquement coplanaires.

Analyse :

Deux éléments peuvent expliquer le défaut :

- les conditions d'installation des pièces dans leur outillage
- les conditions partiellement maîtrisées du refroidissement dans le four

Classification ☐ *~~Majeure~~* ☐ *Mineure*

Actions correctives :

Néant

Actions préventives :

Pour la fabrication des autres switches :

- attention particulière pour l'installation des pièces dans les outillages
- maîtrise du cycle de refroidissement et enregistrement (

(voir conclusions des compte rendus de réunion HSO-SBT-MoM-104 et 105)

Recommandations :

- vérification des performances du switch avant son montage sur structure B400
- s'assurer du bon montage du switch dans la structure B400

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-108** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	
24 / 8 / 2004	Caractérisation/performance du switch : OK
21 / 9 / 04	Montage du switch dans la structure B400 S/N 1 : RAS

Référence DM :

Dispositions finales :

X *En l'état* *Modification* *Réparation* *Dérogation* *Rebut*

Autorisation pour dispositions et actions	Responsable technique	Responsable AP M.DUBOIS	Chef de projet L. DUBAND
Niveau supérieur			

Clos le : 21/09/2004 ***Par : M. Dubois*** ***Visa***

Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE*** ***(FA)***	**Référence :** **HSO-SBT-FA-109** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 8/10/2004 *Nom de l'émetteur :* M.DUBOIS

Intitulé fiche d'anomalie : Difficulté de montage des tubes guides 2000-14 B136

Renseignements concernant l'équipement :

Modèle concerné : Tous FM

Nom et réf. item :

Nom et réf. item :

Phase de constat et conditions d'environnement :

☐ *Fabrication* ☐ *Recette* ☐ *Intégration* ☐ *Test* ☐ *Autre*

☐ *Ambiante* ☐ *Vide thermique* ☐ *Vibration* ☐ *Vide / Pression*

Description de l'anomalie :

Les 2 tubes guides B136 sont installés en passant à travers les alésages ϕ 11 (+ 0,2/ - 0,1) de la plaque inférieure B402.
Le diamètre extérieur des tubes est de ϕ 11 g6 (- 6μ / -17μ) aux extrémités seulement. Ailleurs le diamètre est de ϕ 11 $\pm$ 55μ.
Dans le cas pire, les tubes ne peuvent donc pas passer au travers des alésages de la plaque.

Analyse :

Classification ☐ *Majeure* ☐ *Mineure*

Actions correctives :

Modification de la définition : le diamètre extérieur des tubes est de ϕ 11 g6 partout.
Fabrication des nouvelles pièces

Actions préventives :

Recommandations :

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-109** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	
10 / 2004	Fabrication puis montage des nouvelles pièces

Référence DM :

Dispositions finales :

En l'état **X** *Modification définition* *Réparation* *Dérogation* **X** *Rebut*

	Responsable technique	Responsable AP	Chef de projet
Autorisation pour dispositions et actions		M.DUBOIS	L. DUBAND
Niveau supérieur			

Clos le : **07/10/2004** ***Par : M. Dubois*** ***Visa***

Grenoble	***SPIRE & PACS Sorption Coolers*** ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-110** **Page 1/2**

SERVICE DES BASSES TEMPERATURES

Date : 11/10/2004 *Nom de l'émetteur :* M.DUBOIS

Intitulé fiche d'anomalie : Redundant heater failure

Renseignements concernant l'équipement :

Modèle concerné : Spire FM1

Nom et réf. item : 2000-14 B 300 Heat switch assembly

Nom et réf. item :

Phase de constat et conditions d'environnement :

☐ *Fabrication*	☐ *Recette*	☐ *Intégration*	X *Test*	☐ *Autre*
☐ *Ambiante*	☐ *Vide thermique*	☐ *Vibration*	☐ *Vide / Pression*	

Description de l'anomalie :

After autonomy test, a mistake was made during the warming up operation of the cooler. The current sent to the big heaters in the cryostat cold plate was accidently sent to the redundant heater on the heat switch pump. The mistake was quickly noticed but the heater was supplied with several watts for a couple minutes.
As a result, this heater is not working anymore

Analyse :

Classification **X** *Majeure* ☐ *Mineure*

Actions correctives :

Change of the heater

Actions préventives :

1- Two persons attendance mandatory before any change in the experiments
2- The connectors will be coloured (male and female) to avoid any mixing
3- When the redundant circuit is not used, caps will be put on the end connectors

Recommandations :

	SPIRE & PACS Sorption Coolers ***FICHE D'ANOMALIE (FA)***	**Référence :** **HSO-SBT-FA-110** **Page 2/2**

SERVICE DES BASSES TEMPERATURES

Suivi des actions :

Date :	
11-15/10/2004	• Remove of heat switch, • Remove of end cap • Inspection of other heaters and wires : OK • Remove of damaged heater and mounting of a new one. • Note : the cooler was sent to CSL for its vibration test without any other cold functional test => to see Request for Waiver RW100

Référence DM :

Dispositions finales :

En l'état *Modification* X *Réparation* X *Dérogation* *Rebut*

	Responsable technique	Responsable AP	Chef de projet
Autorisation pour dispositions et actions		M.DUBOIS	L. DUBAND
Niveau supérieur			

Clos le : 15/10/2004 ***Par : M. Dubois*** ***Visa***

12 - MASS RECORDS, C.o.G., M.o.I.

- Measurement of Total Mass : **1748,7 g**
- For C.o.G, to see document reference 2000-14 B 100-cdg.jpg attached to this section (2 pages)

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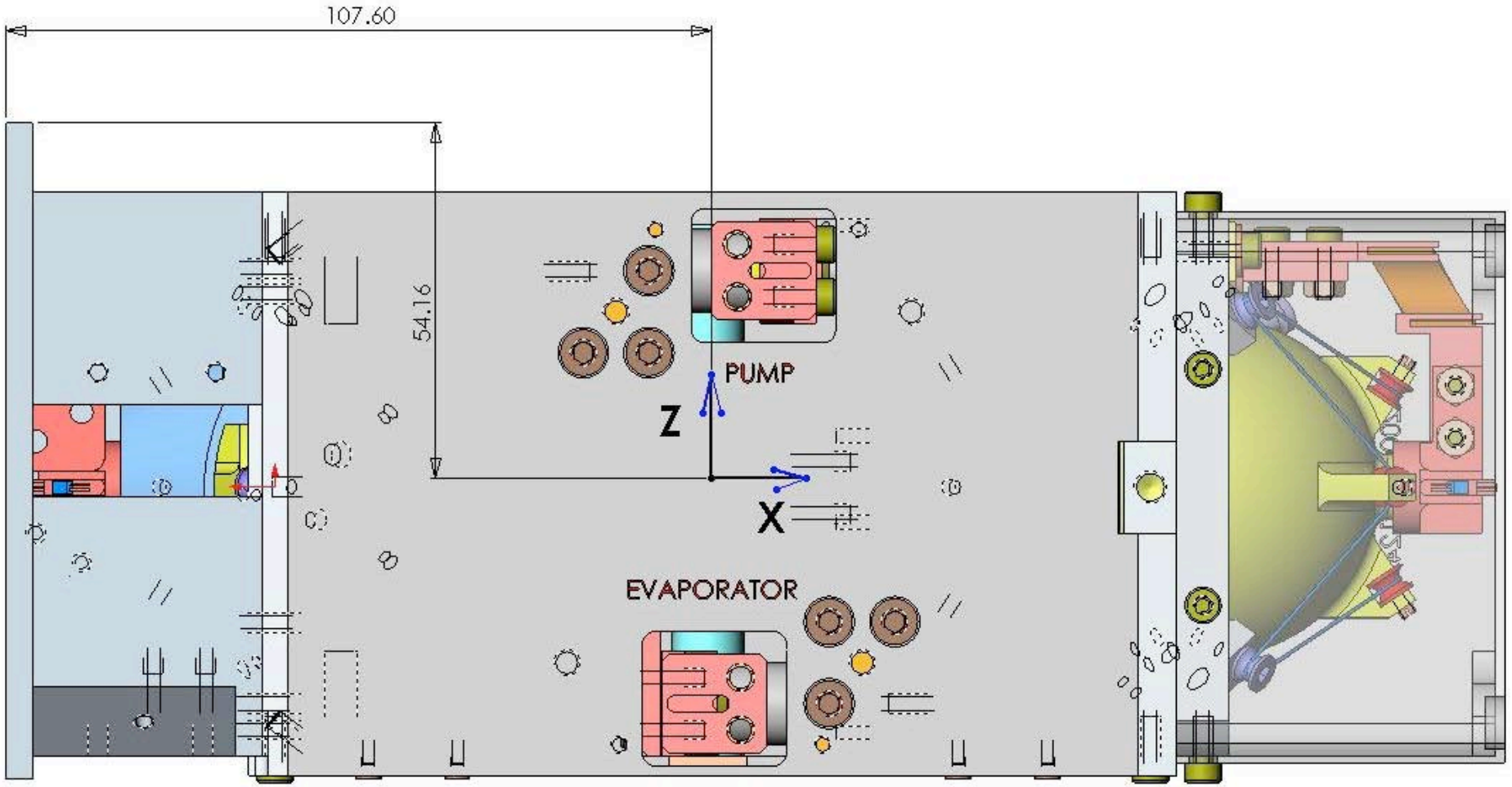
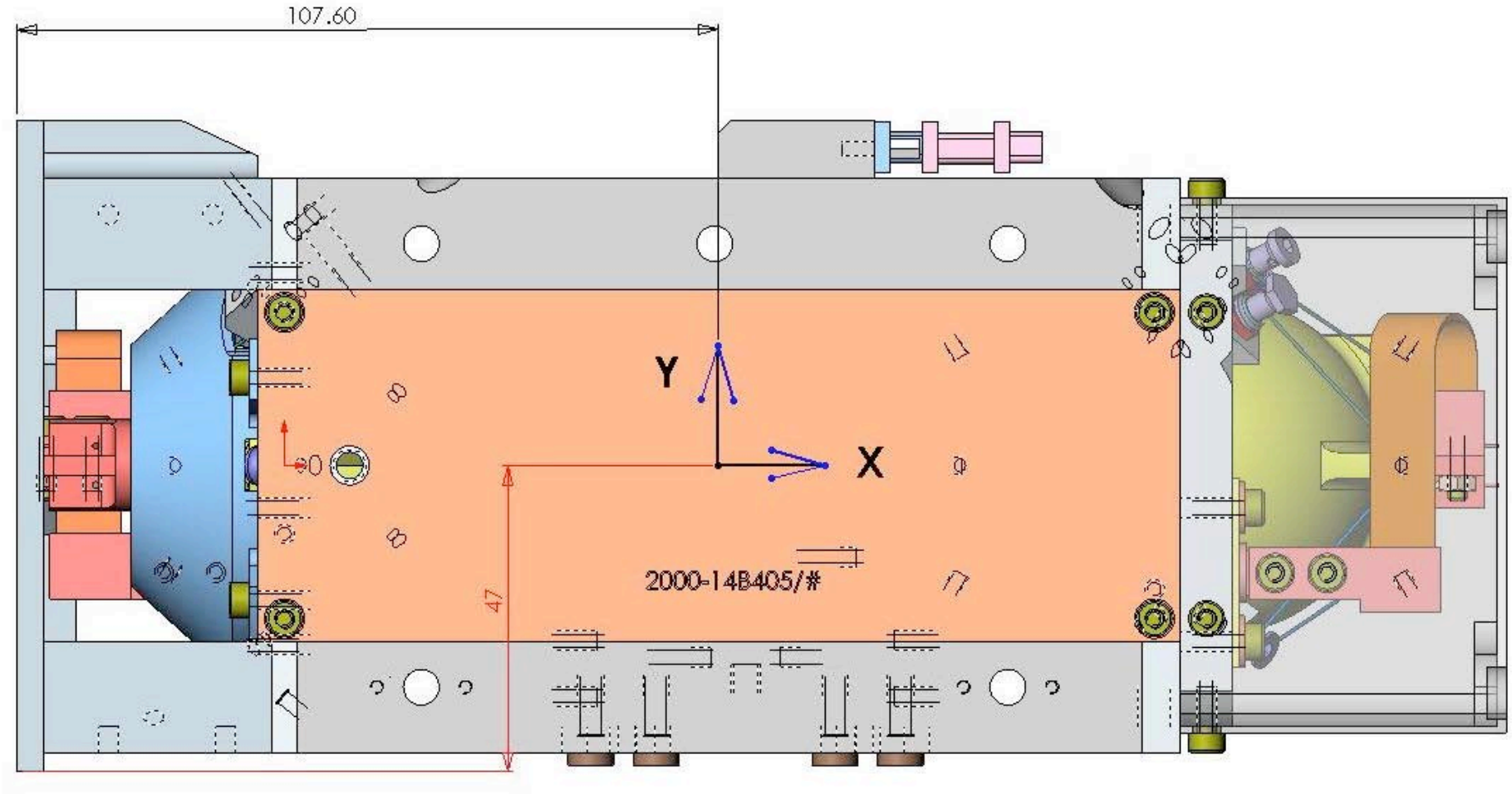
SPIRE and PACS Sorption Coolers - Cooler C.O.G



2000-14 B 100 CDG-1.jpg

IMPORTANT : The axis reported are only related to the software used to produce the 3D views (SolidWorks)



2000-14 B 100 CDG-2.jpg

IMPORTANT : The axis reported are only related to the software used to produce the 3D views (SolidWorks)

13 - CLEANLINESS STATEMENT

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Sorption Cooler

CERTIFICATE OF CLEANLINESS

PROJECT NAME : **SPIRE**	***MODEL :*** **FM**	***SERIAL NUMBER :*** **1**

Control Description	***Reference Document***	***Requirement***	***Result***	***Acceptance***
CLEANLINESS CONTROL	HSO-SBT-PR-026	No contamination	Free from visible contamination	Conform

CERTIFICATE OF CLEANLINESS

CEA CERTIFIES THAT THE SORPTION COOLER REFERENCED HEREABOVE HAS BEEN INSPECTED AS WRITTEN IN REFERENCE DOCUMENT AND THAT ALL ITS EXTERNAL SURFACES HAVE BEEN FOUND FREE FROM VISIBLE CONTAMINATION SUCH AS SCALE, PARTICLE, RUST , DIRT, GREASE, OIL AND OTHER FOREIGN MATERIALS.

NAME and FUNCTION : M.DUBOIS – PA manager	*DATE :* 18/11/04	*SIGNATURE* 

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14 - OPERATING MANUAL

Document reference HSO-SBT- TN-120

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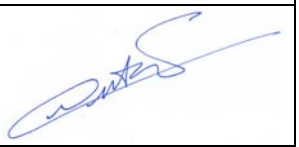
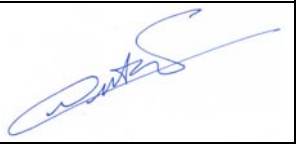
SPIRE Sorption Cooler
FM OPERATING MANUAL

SBT internal ref : SBT/CT/2004-70

	Name & Function	Date	Signature
Prepared	L. Duband - Cooler project manager	18/11/04	
SBT PA Check	M. Dubois – Cooler PA manager	18/11/04	
SPIRE Approval			
PACS Approval			
PA Approval			
Project Approval			
Project Approval	L. Duband - Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

Document Status

Issue	Revision	Date	Nb of pages	Modifications
1	0	15/11/2004		First issue

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List of Acronyms

AD	Applicable Document		
CEA	Commissariat à l' Energie Atomique		
CDE	Cooler Drive Electronic		
CDR	Critical Design Review	Revue de conception détaillée	RCD
CQM	Cryogenic Qualification Model		
ECSS	European Cooperation for Space Standardisation		
FIRST	Far Infrared and SubmillimetreTelescope		
FS	Flight spare		
HSO	Herschel Space Observatory		
N/A	Not Applicable		
PACS	Photoconductor. Array Camera and Spectrometer		
PFM	ProtoFlight Model		
PSS	Product Assurance Specification System		
RD	Reference Document		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
SPIRE	Spectral & Photometric Imaging Receiver		

1 Scope of the document

This note is the operating manual of the flight model of the sorption cooler. It deals with the mechanical integration as well as the thermal operation.

2 Documents

2.1 Applicable documents

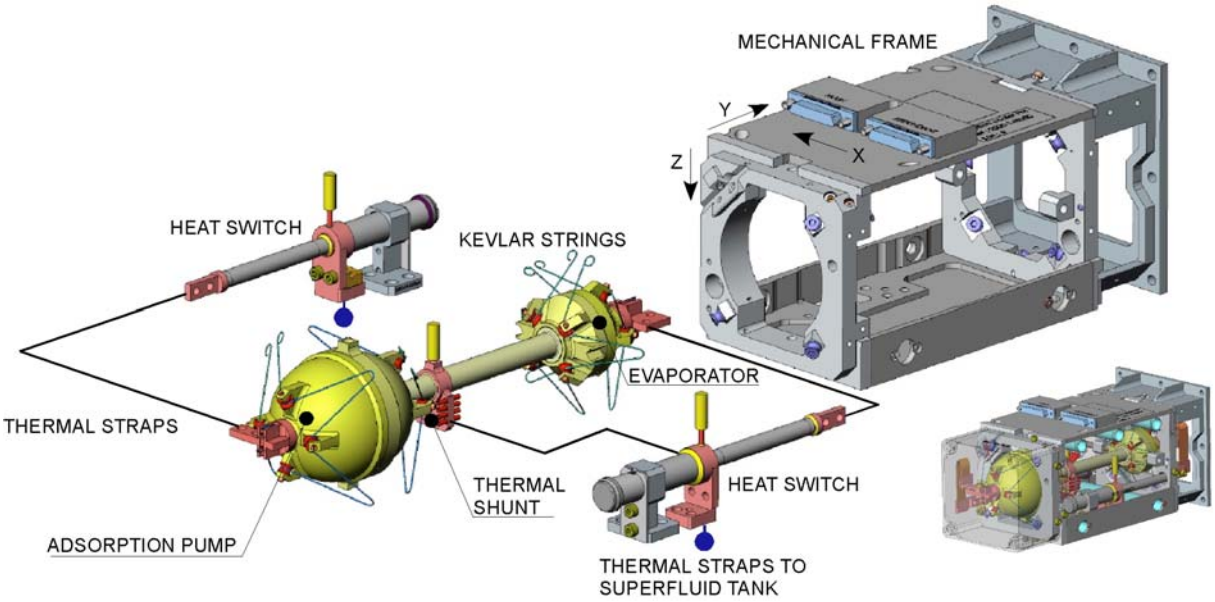
	Title	*Reference*
AD01	Interface Control Document (ICD)	HSO-SBT-ICD-012
AD02	FM unit – Handling, packing, transportation and storage manual	HSO-SBT-PR-119

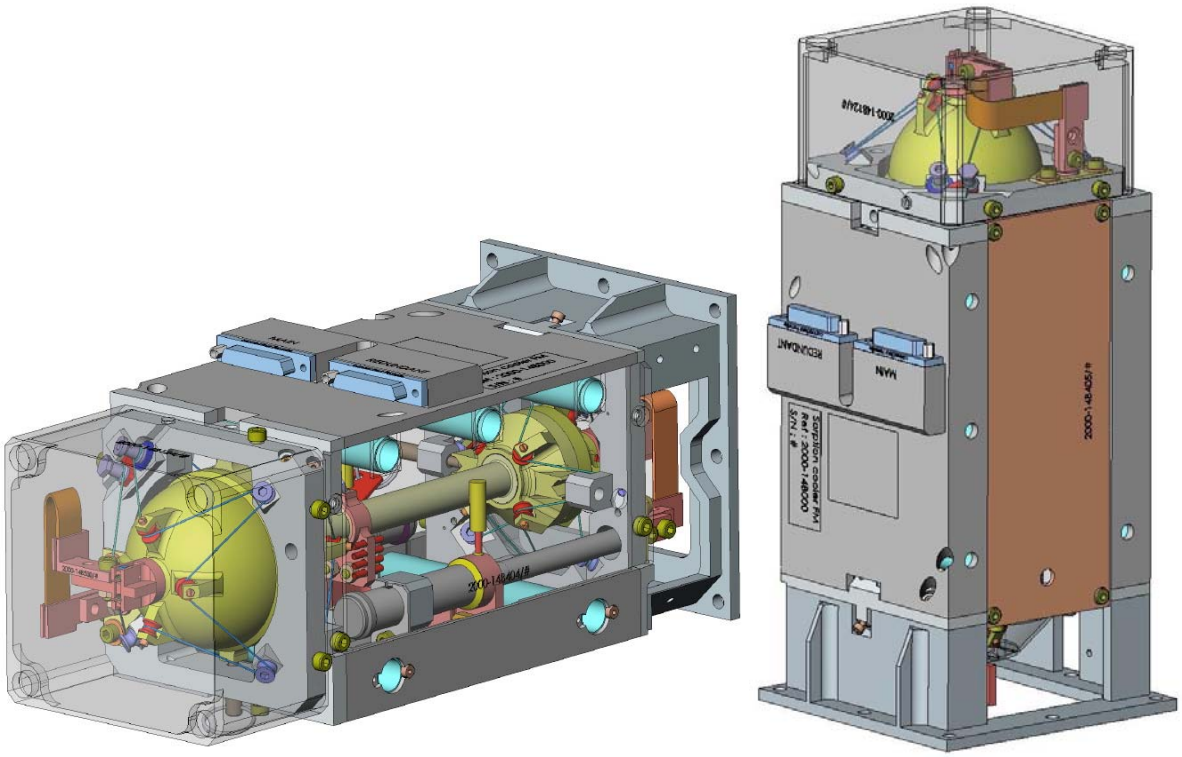
2.2 Reference documents

	Title	*Reference*
RD01	Drive electronic specifications	HSO-SBT-SP-015
RD02		

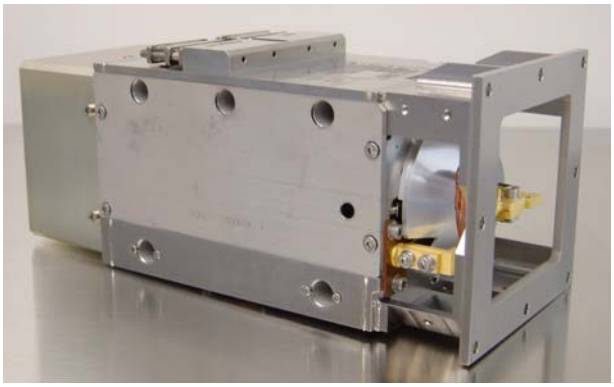
3 3D views and photographic records of sorption cooler

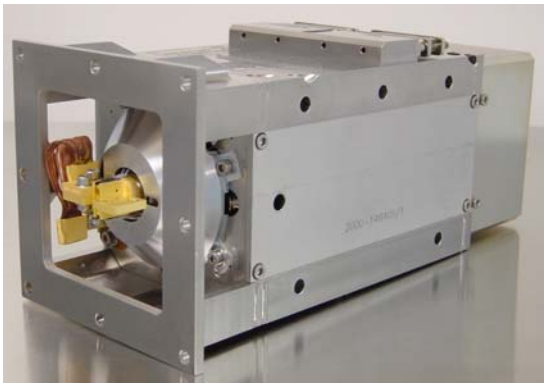
The following figure shows some 3D views of the actual cooler.





The following set of pictures shows the FM unit. The FM required volume is a rectangle parallelepiped of dimensions 228.5 mm x 100 mm x 100 mm. Reference drawing : 2000-14 B 000. ***Throughout this document, unless otherwise specified, all dimensions are in millimeters***. The total overall mass of the FM is about 1748 grams.





4 Mechanical integration

4.1 Handling

For transportation, storage or handling, the reader is referred to AD02. The handling aspects are summarized below.

The full cooler has been assembled in a controlled environment (namely Class 10 000 and 100). Consequently any operations on the cooler must be perform in a clean environment (class 10 000 or below is recommended) and all exposure times must be recorded in the appropriate logbook.

In addition the full cooler has been cleaned following SBT procedure ref. HSO-SBT-PR-026; to avoid any molecular contamination and consequently for any cooler manipulation **the use of gloves is mandatory**. We recommend latex or cotton gloves. (The structural box is made out of titanium and is very sensitive to finger prints).

The mechanical frame is robust. But all the internal elements, mostly the Kevlar suspension system and the thin walled titanium tubes, are fragile. Whenever possible protective covers have been added. These covers must remain in place – they can only be removed by qualified personal.

Never introduce fingers or any external tools within the structural box (Risk of damaging the Kevlar cords).

The sorption cooler is a pressure vessel at ambient temperature. Its internal pressure is 8.6 MPa (86 bars) at 20°C. Any temperature increase will increase the pressure. A **maximum temperature of 80°C** is set.

In **storage** conditions, the maximum acceptable continuous temperature is 60°C.

For safety reasons the cooler cannot stay continuously at a temperature higher than 60°C (140 °F).

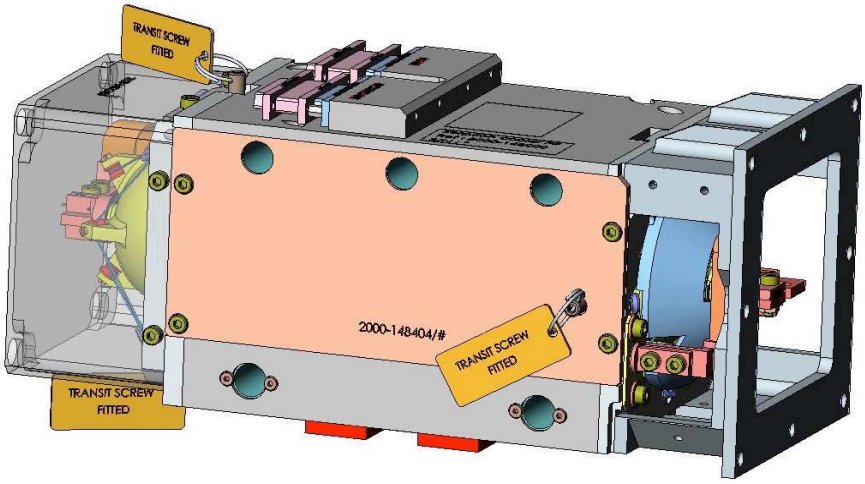
4.2 Integration

The various interfaces are described in the Interface Control Document (HSO-SBT-ICD-012).

The cooler features transit screws (see AD02 and figure hereafter).Theses screws are used to secure the cooler heart whenever needed (transportation and possibly storage). They can also be used (recommended if possible) during the integration of the thermal bus bar on the cooler cold tip.

Each screw features a label “transit screw fitted” (see next figure).

These screws must be removed before integration of the cooler in the instrument or before any functional test (thermal or mechanical).



4.2.1 Anti rotating tools

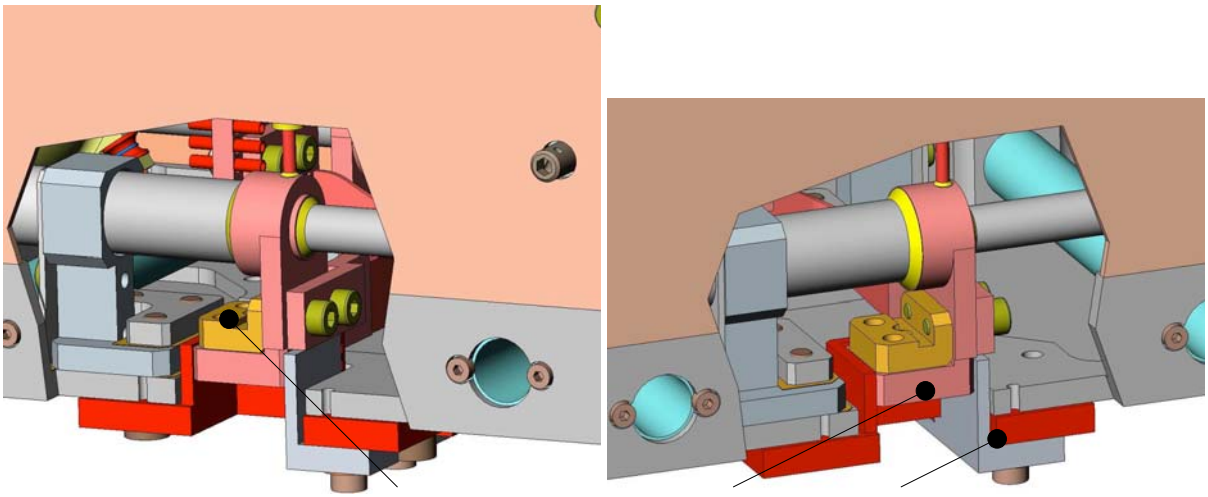
The cooler comprises two gas gap heat switches located inside the structural box. The box then features two cuts to provide access to the switch interface. Each heat switch interfaces with a thermal strap (connected to the superfluid cryostat). The mechanical interface for both switches is similar and is a copper plate gold plated 15 mm x 16 mm , 5 mm thick, featuring two 4.3 mm through holes. In the back of this copper plate is a stainless steel counter flange, 3.8 mm thick, featuring two M4 holes.

ATTENTION : *the length of the screws to be used to connect the Level 0 straps to these switch interfaces must be such as not to stick out of the counter flange by more than 4 mm.*

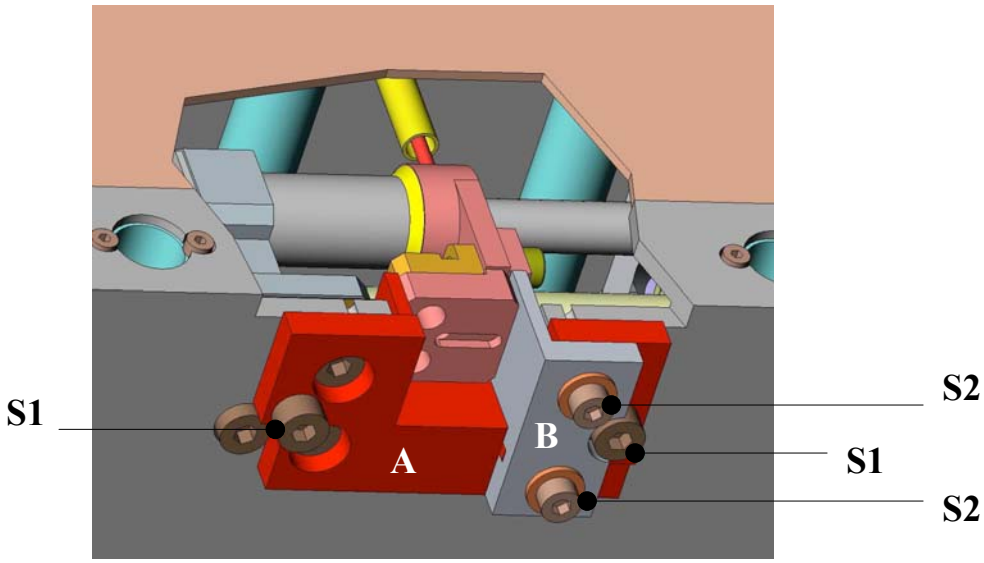
The maximum recommended torque for the screws is 2.2 Nm. The maximum additional mass which can be supported is 50 grams. This interface also features a tool designed to prevent any excessive torque on the gas gap heat switch when mounting the thermal strap.
These anti rotating tools are used only during integration in the test cryostat or instrument. If they cannot be used for access problem, **a similar tool must be used.**

This tool is intended to be used only while screwing the strap and must be removed before cooler operation – the drawing hereafter shows this tool in place.

It is important to note that any excessive mechanical load on this interface must be avoided and shall in any case never exceeds 50 N in any directions.



Counter flange, gold plated copper plate and mounting tool

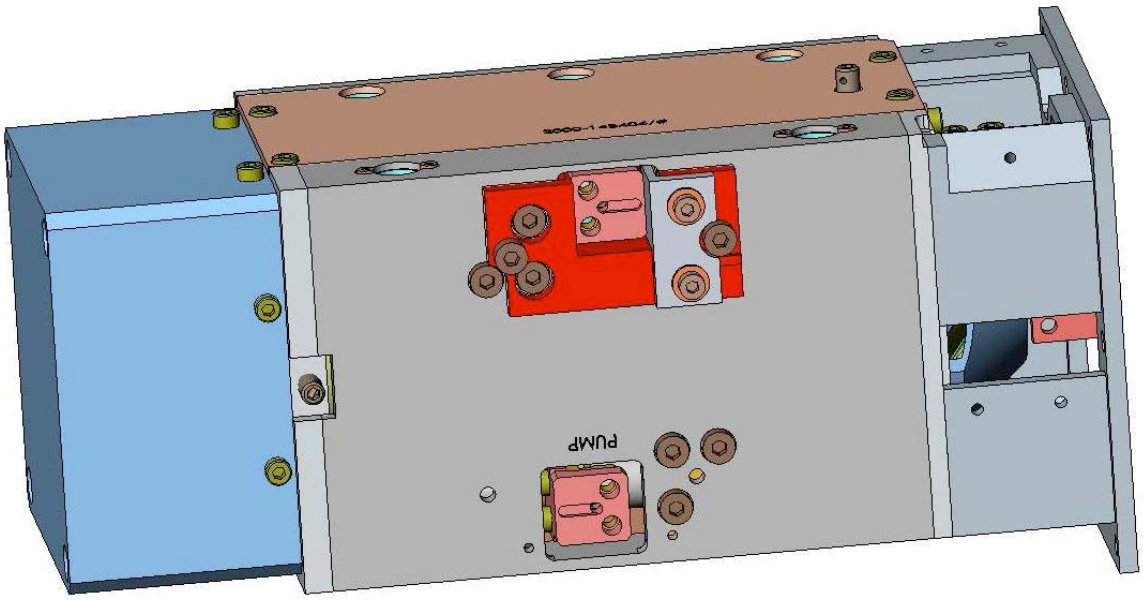


The tool comprises two parts; the first one (largest one – shown in red) is identified as A, as the second one (shown in grey) which mounts on A is identified as B.
To mount the tool follow these steps :

- initially B is mounted on A but the screws are loose (B can slide on A)
- mount part A on the structure : insert it in between the titanium structure and the switch base
- Gently push part A against the switch interface so that the switch interface perfectly fits in the corner
- Tighten the S1 screws
- Gently push part B against the switch interface
- Hold it there and tighten the S2 screws

To remove the tool simply follow the reverse procedure.

The tool must be set in place and remove with great care. These two interfaces, particularly the interface on the evaporator switch, are critical to the performance of the cooler.



3D view of interface without and with mounting tool

Once the tool is installed, integration of the thermal strap can be carried out.
In the event this particular tool cannot be used, it is mandatory to use a similar tool which will prevent any mechanical constraint on the interface while mounting the thermal straps.

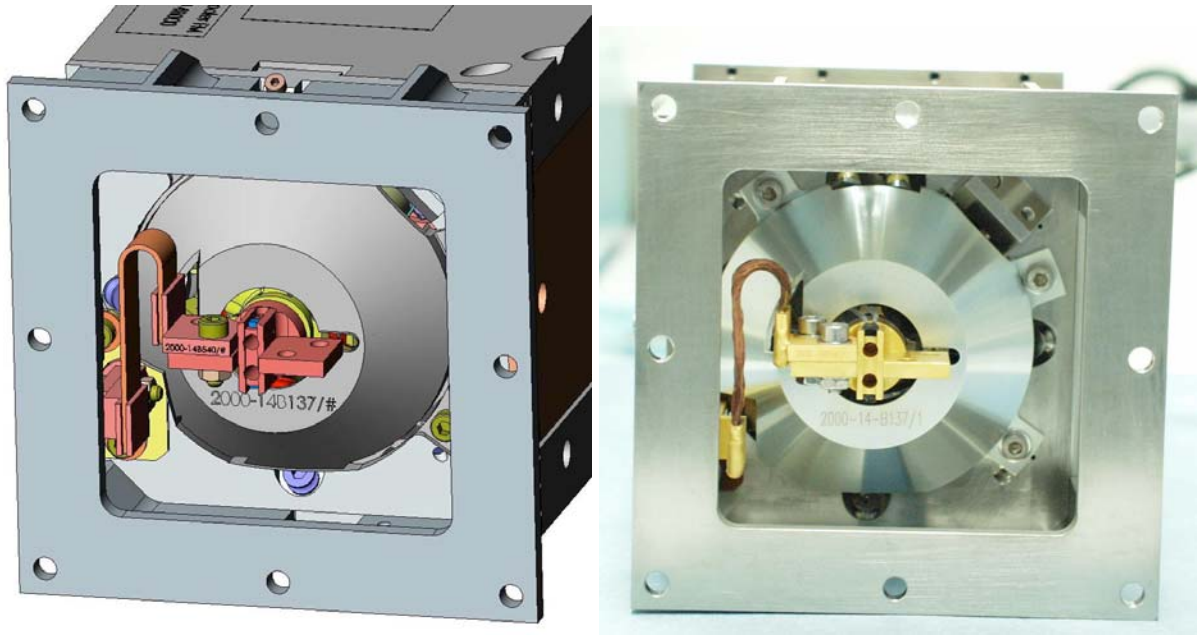
4.2.2 Mounting of thermal strap on evaporator cold tip

The evaporator cold end interfaces with a 300 mK thermal strap which is then connected to the detectors. This interface is a copper piece gold plated 14 mm x 12.5 mm, 3 mm thick, featuring two through holes 3.2 mm in diameter. Each side of the copper piece is available as a contacting area. The maximum recommended torque for the screws is 0.33 Nm.

- ***The thermal quality of this interface is critical to the performance of the cooler (cleanliness, contact force)***

- ***Any excessive torque or bending force on this interface is prohibited. Always use two wrenches (one on each side) when tightening screws on the cold head. Prevent any nuts to fall inside the cooler***

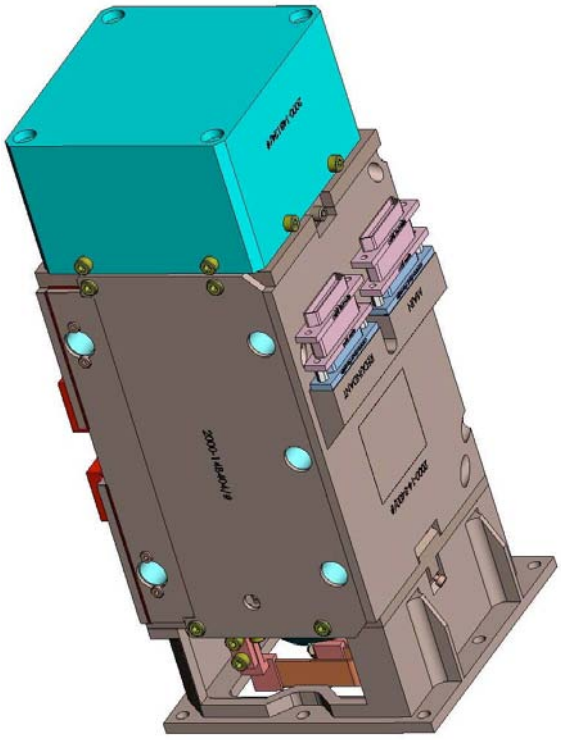
- ***The mounting of the 300 mK thermal strap to the cold end must be performed by trained people***



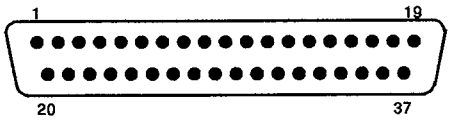
If possible**, it is highly recommended to lock the cooler heart with the centering screws** during the integration of the thermal bus bar on the cooler cold tip.
The cooler cold tip is thermally and mechanically linked to the heat switch end : any displacement of the cold tip may induce stress on the heat switch and degrade its performance.

5 Electrical connection – Instrumentation

Two electrical connectors type MDM 37 pins female type (S) (main and redundant) are provided for the cooler operation. These connectors are located on the side of the cooler as shown on the following drawing and picture.

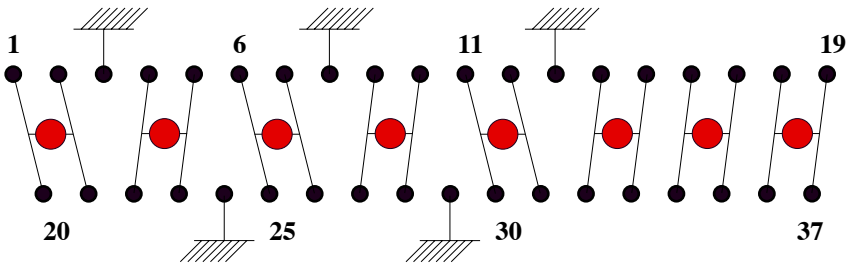


The wiring of both connectors is identical. The pins out is arranged such that each set of wires per component is grouped (see schematic and table hereafter). All wiring is made using twisted manganin wires.



37 CONTACTS

Contact arrangement for MDM 37 pins



Connector wiring (red dot features thermometer or heater)

Signal	Pin n°	Max. current	Max. Ohms
SP temperature I+ (Drive)	20	1 µA	1000
SP temperature V+ (Sens)	1	N/A	1000
SP temperature V- (Sens Return)	2	N/A	1000
SP temperature I- (Return)	21	1 µA	1000
Shield SP temperature	3	N/A	N/A
EV temperature I+ (Drive)	22	250 nA	30 000
EV temperature V+ (Sens)	4	N/A	30 000
EV temperature V- (Sens Return)	5	N/A	30 000
EV temperature I-(Return)	23	250 nA	30 000
Shield EV temperature	24	N/A	N/A
HSP pump temperature I+ (Drive)	25	1 µA	1000
HSP pump temperature V+ (Sens)	6	N/A	1000
HSP pump temperature V- (Sens Return)	7	N/A	1000
HSP pump temperature I-(Return)	26	1 µA	1000
Shield HSP temperature	8	N/A	N/A
HSE pump temperature I+ (Drive)	27	1 µA	1000
HSE pump temperature V+ (Sens)	9	N/A	1000
HSE pump temperature V- (Sens Return)	10	N/A	1000
HSE pump temperature I-(Return)	28	1 µA	1000
Shield HSE temperature	29	N/A	N/A
Thermal shunt temperature I+ (Drive)	30	1 µA	1000
Thermal shunt temperature V+ (Sens)	11	N/A	1000
Thermal shunt temperature V- (Sens Return)	12	N/A	1000
Thermal shunt temperature I-(Return)	31	1 µA	1000
Shield Thermal shunt temperature	13	N/A	N/A
SP heater I+ (Drive)	14	25 mA	500
SP heater I+ (Drive)	32	"	500
SP heater I- (Return)	15	"	500
SP heater I- (Return)	33	"	500
HSE heater I+ (Drive)	16	1.5 mA	500
HSE heater I+ (Drive)	34	"	500
HSE heater I- (Return)	17	"	500
HSE heater I- (Return)	35	"	500
HSP heater I+ (Drive)	18	1.5 mA	500
HSP heater I+ (Drive)	36	"	500
HSP heater I- (Return)	19	"	500
HSP heater I- (Return)	37	"	500

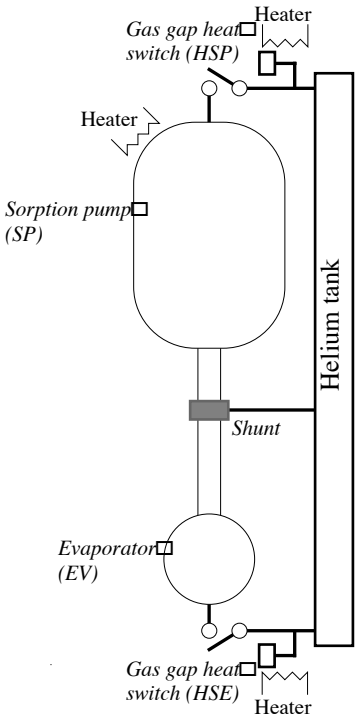
All thermometers used are Cernox thermometers type 1030 with SD package (supplier : LakeShore) measured in four wires mode. The location, reference and calibration curve/data for each thermometer (main circuit only) are given in the following paragraph.
All heaters used are high reliability metal film resistors 402 Ohms resistance driven by four wires (supplier : Vishay/Sfernice).

5.1 Thermometers : reference and calibration curves

	Thermometer reference	
Location	**Main circuit**	**Redundant circuit**
Main sorption pump	Cernox CX 29559	Cernox CX 29580
Thermal shunt	Cernox CX 29577	Cernox CX 29571
Evaporator – cold tip	Cernox CX 29558	Cernox CX 29548
Miniature sorption pump – Pump heat switch	Cernox CX 29554	Cernox CX 29549
Miniature sorption pump – Evaporator heat switch	Cernox CX 29546	Cernox CX 29578

The calibration curves and data for each of the Cernox thermometers are given in Appendix A.

6 Thermal operation



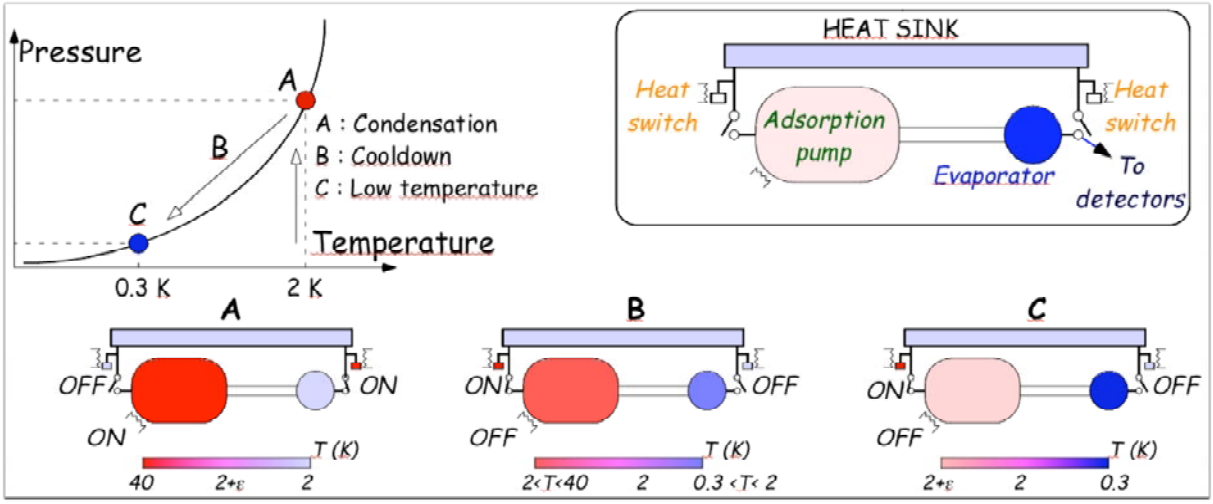
The cooler is basically made of four components designated as a sorption pump SP, an evaporator EV, two heat switches HSP and HSE respectively connected to the sorption pump (SP) and evaporator (EV). It also features a support structure not shown on the figure. SP, EV, the thermal shunt and the pumping line are assembled to form a unique component which is the actual "heart" of the cooler. This component is held within the structure, which provides firm mechanical support (launch environment) while minimizing any parasitic conductive load on the cooler (low temperature environment). The two switches are used to control the temperature gradient. During the condensation phase they are set such that the sorption pump SP can be heated to release the helium gas and such that liquid condensation occurs into the evaporator EV maintained as the coldest point (HSP OFF and HSE ON). The liquid is held into EV by capillary attraction inside a porous material : both the surface tension and the vapor pressure provide forces that drive and hold the liquid at the coldest point. Then the switches are set such that the sorption pump is thermally grounded to the heat sink and such that the evaporator is thermally isolated (HSP ON and HSE OFF). The sorption pump provides an evaporative pumping on the liquid helium bath which temperature quickly drops to sub-Kelvin temperature.

The heat switches are of gas gap type. Gas gap heat switch utilizes concentric copper cylinders separated by a small gap which is filled with or emptied of He gas to achieve the switching action. The thermal separation between the two ends is achieved by a thin-walled tube which also provides the mechanical support. The presence or absence of gas is controlled by a miniature cryogenic adsorption pump that can be temperature regulated.

6.1 Typical Recycling

A typical recycling begins when all these components are at a temperature below 3 K (i.e. below the ^{3}He critical temperature). At this temperature both heat switches HSP and HSE are OFF, and all of the helium gas is stored in the sorption pump. The sequence of operation is then :

Sequence #	***Action***
1	power is applied to HSE to turn it ON (HSP is OFF)
2	power is applied to SP until SP reaches 40-45 K (^{3}He)
3	when SP reaches 40-45 K power is reduced to maintain this temperature until EV reaches a reasonable temperature (around or below 2 K)
4	power on SP is then turned OFF
5	power on HSE is turned OFF to switch to OFF position
6	power is applied to HSP to turn it ON

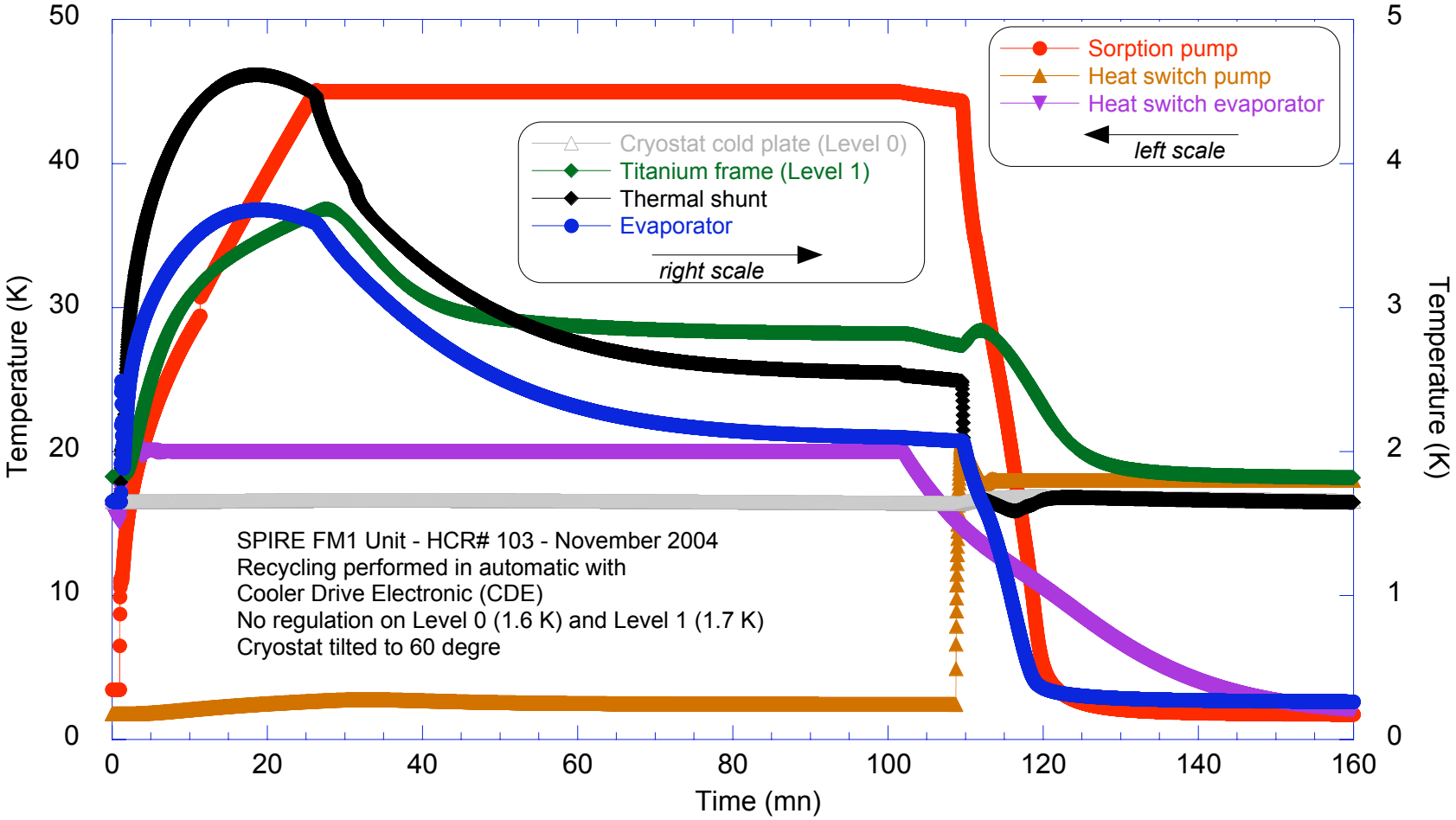


Following this sequence of actions the cooler reaches its ultimate temperature (low temperature phase) and remains there until all the liquid helium is exhausted. During this phase, basic operation of the cooler only requires to keep HSP ON.

The heat switches have been tuned to provide a switching temperature around 15 K, requiring 400 µW of input power. However to speed up the switching time, we recommend an input power of 800 µW until the switch is ON, at which point this power can be reduced to 400 µW.
During the acceptance program a cooler drive electronic (CDE) was used and the operation of the cooler was fully automatic. For instance the heat switches were turned ON and OFF not based on a power but on a temperature set point (20 K for HSE, 18 K for HSP). HSP set point can be lowered to 15 K (see HSO-SBT-RP-118 § 9.6).

Action	*Result / Comments*
HSE is turned ON	T HSE is regulated at 20 K (HSE is ON)
400 mW input to SP (400 mW is set as a maximum for the CDE)	T SP increases fairly quickly (≈ 1.5 K/mn on average)
CDE regulates T SP at 45 K	SP remains at ≈ 45 K
wait until T EV falls below 2.1 K	(this temperature is related to the thermal straps and SBT test cryostat performance – lower would be better of course).
Turn OFF power on SP	
Turn OFF power on HSE	
When T HSE reaches below 15 K : HSP is turned ON	turn ON HSP

A typical recycling is displayed on the following page.

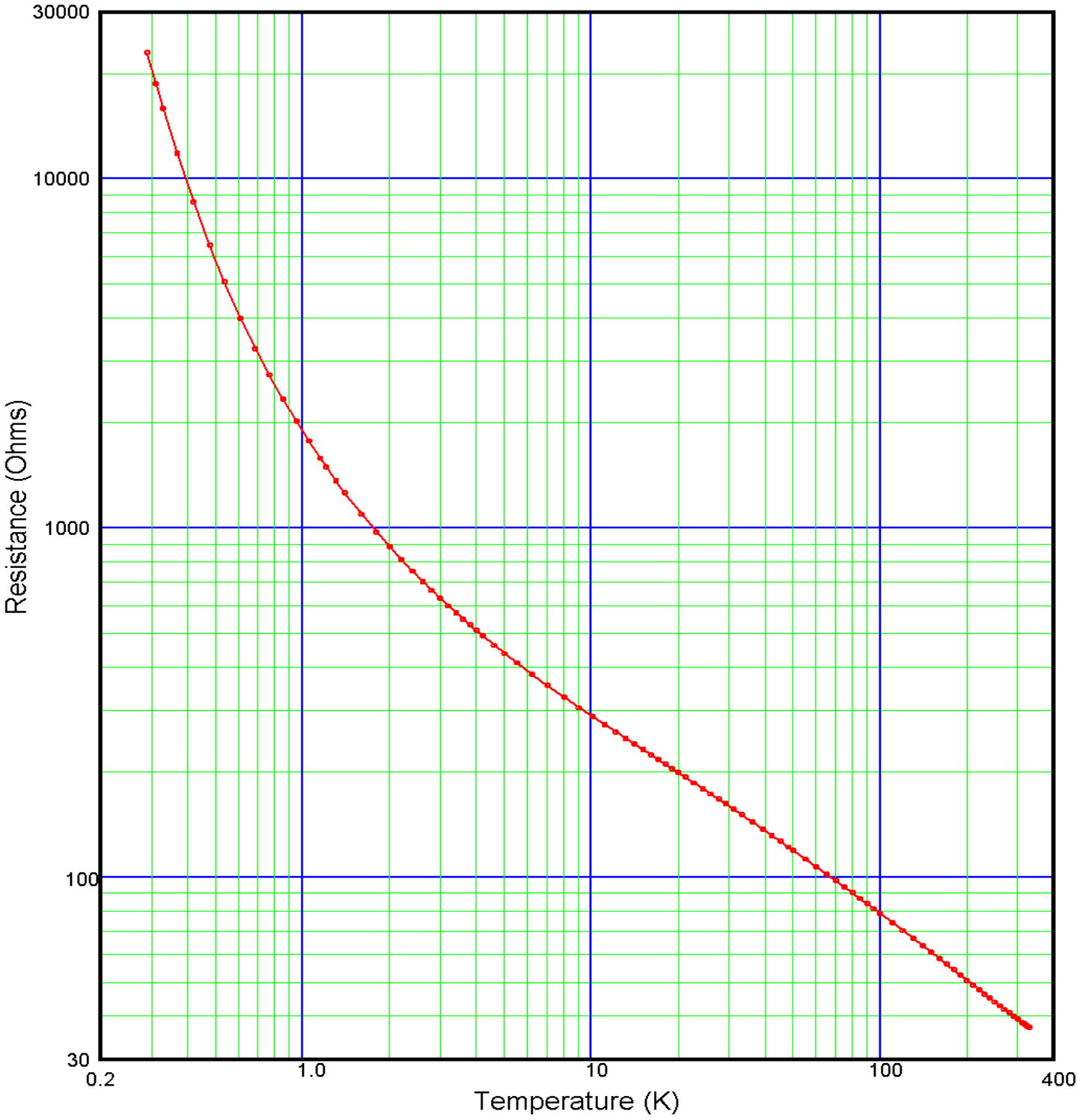


7 Appendix A – Cernox Data

DATA PLOT

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.289682	23001.5	51	22.7172	186.274
2	0.310454	18698.7	52	24.3172	179.487
3	0.329207	15901.9	53	25.9534	173.182
4	0.367410	11849.5	54	27.5939	167.481
5	0.418616	8598.50	55	29.2177	162.264
6	0.476427	6457.80	56	31.0429	156.860
7	0.536443	5064.07	57	33.1613	151.165
8	0.610234	3983.43	58	36.1778	143.889
9	0.686002	3269.19	59	39.1709	137.510
10	0.766484	2747.54	60	42.1723	131.811
11	0.856107	2341.86	61	45.1739	126.678
12	0.951427	2025.75	62	48.1702	122.035
13	1.05120	1776.61	63	50.1666	119.187
14	1.15210	1583.53	64	55.1535	112.736
15	1.20654	1497.38	65	60.1484	107.123
16	1.30498	1364.54	66	65.1522	102.169
17	1.39964	1262.71	67	70.1498	97.7674
18	1.60144	1095.59	68	75.1521	93.8071
19	1.80313	974.730	69	80.1458	90.2438
20	2.00451	882.609	70	85.1376	87.0041
21	2.20010	811.822	71	90.1323	84.0446
22	2.39966	753.133	72	95.1217	81.3171
23	2.60496	703.321	73	100.111	78.7944
24	2.80252	663.123	74	110.211	74.2435
25	2.99760	628.906	75	120.110	70.3621
26	3.19989	598.455	76	130.109	66.8946
27	3.39996	571.963	77	140.109	63.8215
28	3.59937	548.723	78	150.105	61.0707
29	3.80048	527.859	79	160.101	58.5843
30	4.00103	509.041	80	170.095	56.3400
31	4.19993	492.246	81	180.090	54.2955
32	4.62146	461.587	82	190.081	52.4273
33	5.01910	437.211	83	200.071	50.7141
34	5.52127	411.385	84	210.080	49.1342
35	6.24181	381.181	85	220.090	47.6826
36	7.04452	354.429	86	230.096	46.3320
37	8.06075	327.548	87	240.100	45.0863
38	9.08320	305.988	88	250.097	43.9265
39	10.1044	288.386	89	260.088	42.8453
40	11.1167	273.628	90	270.096	41.8419
41	12.1249	260.983	91	280.093	40.8989
42	13.1248	250.022	92	290.095	40.0194
43	14.1222	240.396	93	300.098	39.1938
44	15.1152	231.752	94	310.078	38.4171
45	16.1011	224.065	95	315.084	38.0489
46	17.0851	217.066	96	320.089	37.6908
47	18.0676	210.646	97	325.749	37.2960
48	19.0536	204.745	98	328.415	37.1154
49	20.0389	199.267			
50	21.1275	193.694			

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POLYNOMIAL EQUATION

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.20K
2.063e+4 Ohms	to	598.5 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.73935301839 ZU = 4.36175615865

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.200325	2.4492E-04	4900.81
1	-1.355819	3.7698E-04	-3596.53
2	0.634074	3.5611E-04	1780.58
3	-0.261013	3.5479E-04	-735.69
4	0.097569	3.4309E-04	284.38
5	-0.034688	3.2010E-04	-108.36
6	0.011373	3.1088E-04	36.58
7	-0.002698	3.2455E-04	-8.31
8	0.000646	3.1652E-04	2.04

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 8
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	23001.50	0.28968	0.28977	-0.09
2	18698.70	0.31045	0.31024	0.21
3	15901.90	0.32921	0.32914	0.07
4	11849.50	0.36741	0.36790	-0.49
5	8598.500	0.41862	0.41865	-0.04
6	6457.800	0.47643	0.47558	0.85
7	5064.070	0.53644	0.53621	0.23
8	3983.430	0.61023	0.61094	-0.71
9	3269.190	0.68600	0.68685	-0.85
10	2747.540	0.76648	0.76732	-0.84
11	2341.860	0.85611	0.85539	0.72
12	2025.750	0.95143	0.94981	1.62
13	1776.610	1.05120	1.04989	1.30
14	1583.530	1.15210	1.15159	0.51
15	1497.380	1.20654	1.20657	-0.03
16	1364.543	1.30498	1.30715	-2.16
17	1262.709	1.39964	1.40124	-1.61
18	1095.585	1.60144	1.60233	-0.89
19	974.7305	1.80313	1.80245	0.68
20	882.6089	2.00451	2.00321	1.31
21	811.8218	2.20010	2.19889	1.21
22	753.1328	2.39966	2.39908	0.59
23	703.3209	2.60496	2.60513	-0.17
24	663.1227	2.80252	2.80285	-0.34
25	628.9057	2.99760	2.99909	-1.49
26	598.4550	3.19989	3.20038	-0.50
27	571.9626	3.39996	3.40025	-0.28
28	548.7228	3.59937	3.59821	1.16

Order of Fit = 8 RMS error of fit = .93 mK
Largest absolute error = -2.16 mK at data point no. 16

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POLYNOMIAL EQUATION

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

3.20K	to	20.0K
598.5 Ohms	to	199.3 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.27015192913 ZU = 2.82159392547

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.887111	3.6354E-04	27196.88
1	-9.390365	5.6968E-04	-16483.47
2	2.808792	5.5479E-04	5062.80
3	-0.567637	5.0385E-04	-1126.61
4	0.064755	4.8322E-04	134.01
5	0.002097	4.6963E-04	4.46

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	663.1227	2.80285	2.80475	-1.90
25	628.9057	2.99909	2.99745	1.64
26	598.4550	3.20038	3.19836	2.02
27	571.9626	3.39996	3.39942	0.54
28	548.7228	3.59937	3.59932	0.04
29	527.8594	3.80048	3.80062	-0.14
30	509.0411	4.00103	4.00277	-1.74
31	492.2460	4.19993	4.20224	-2.31
32	461.5874	4.62146	4.62209	-0.63
33	437.2108	5.01910	5.01947	-0.37
34	411.3849	5.52127	5.51961	1.65
35	381.1808	6.24181	6.24007	1.74
36	354.4294	7.04452	7.04215	2.37
37	327.5482	8.06075	8.06105	-0.30
38	305.9882	9.08320	9.08639	-3.18
39	288.3865	10.10445	10.10441	0.04
40	273.6284	11.11667	11.11667	0.00
41	260.9826	12.12487	12.12547	-0.60
42	250.0222	13.12479	13.12642	-1.64
43	240.3962	14.12223	14.11960	2.63
44	231.7518	15.11519	15.11685	-1.66
45	224.0649	16.10109	16.09944	1.65
46	217.0660	17.08509	17.08290	2.19
47	210.6465	18.06763	18.06841	-0.79
48	204.7446	19.05361	19.05296	0.65
49	199.2668	20.03889	20.04122	-2.32
50	193.6944	21.12746	21.12773	-0.27
51	186.2739	22.71721	22.71656	0.65

Order of Fit = 5 RMS error of fit = 1.56 mK
Largest absolute error = -3.18 mK at data point no. 38

POLYNOMIAL EQUATION

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.0K	to	95.1K
199.3 Ohms	to	81.32 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.87065817139 ZU = 2.32355417185

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	55.071554	1.0451E-03	52694.45
1	-44.946755	1.6876E-03	-26633.07
2	8.977949	1.5713E-03	5713.55
3	-1.133289	1.4691E-03	-771.43
4	0.091439	1.3557E-03	67.45
5	0.010374	1.3484E-03	7.69

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
47	210.6465	18.06841	18.07127	-2.86
48	204.7446	19.05296	19.05263	0.32
49	199.2668	20.04122	20.03958	1.64
50	193.6944	21.12746	21.12513	2.33
51	186.2739	22.71721	22.71121	6.00
52	179.4871	24.31715	24.31864	-1.49
53	173.1819	25.95345	25.96357	-10.13
54	167.4811	27.59393	27.59232	1.61
55	162.2637	29.21772	29.21513	2.59
56	156.8596	31.04290	31.04532	-2.42
57	151.1652	33.16126	33.15932	1.94
58	143.8891	36.17777	36.17998	-2.21
59	137.5100	39.17088	39.17345	-2.58
60	131.8107	42.17229	42.16946	2.83
61	126.6782	45.17386	45.17010	3.76
62	122.0349	48.17020	48.16988	0.32
63	119.1867	50.16663	50.16105	5.58
64	112.7361	55.15348	55.15878	-5.31
65	107.1225	60.14839	60.15096	-2.58
66	102.1688	65.15224	65.15151	0.73
67	97.76745	70.14976	70.14661	3.15
68	93.80710	75.15205	75.15828	-6.23
69	90.24382	80.14585	80.14936	-3.51
70	87.00410	85.13765	85.13886	-1.21
71	84.04456	90.13232	90.12165	10.67
72	81.31710	95.12167	95.11655	5.12
73	78.79437	100.11108	100.11979	-8.71
74	74.24345	110.21123	110.21061	0.62

Order of Fit = 5 RMS error of fit = 4.45 mK
Largest absolute error = 10.67 mK at data point no. 71

POLYNOMIAL EQUATION

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

95.1K	to	325.K
81.32 Ohms	to	37.35 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.56955455001 ZU = 1.93953969591

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.743225	2.6661E-03	70044.85
1	-118.662773	4.0520E-03	-29284.95
2	19.442407	3.8256E-03	5082.21
3	-2.860649	3.8115E-03	-750.53
4	0.570046	3.6900E-03	154.48
5	-0.110218	3.5468E-03	-31.08
6	0.022060	3.4558E-03	6.38

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
70	87.00410	85.13886	85.14410	-5.24
71	84.04456	90.12165	90.11460	7.05
72	81.31710	95.11655	95.10956	6.98
73	78.79437	100.11108	100.11738	-6.30
74	74.24345	110.21123	110.21940	-8.16
75	70.36214	120.10971	120.10302	6.69
76	66.89462	130.10865	130.11789	-9.24
77	63.82145	140.10920	140.10532	3.87
78	61.07066	150.10511	150.09000	15.11
79	58.58426	160.10079	160.10891	-8.12
80	56.33996	170.09545	170.09402	1.43
81	54.29547	180.09022	180.08892	1.30
82	52.42725	190.08125	190.08364	-2.40
83	50.71407	200.07111	200.07732	-6.21
84	49.13421	210.08045	210.09493	-14.48
85	47.68264	220.09030	220.07066	19.64
86	46.33203	230.09623	230.10546	-9.23
87	45.08634	240.10001	240.08853	11.48
88	43.92647	250.09692	250.09233	4.59
89	42.84528	260.08758	260.10945	-21.87
90	41.84187	270.09644	270.07584	20.60
91	40.89887	280.09301	280.09962	-6.61
92	40.01938	290.09468	290.08831	6.37
93	39.19377	300.09766	300.08962	8.04
94	38.41712	310.07782	310.10965	-31.84
95	38.04893	315.08404	315.08518	-1.15
96	37.69077	320.08945	320.07358	15.87
97	37.29595	325.74893	325.75077	-1.84
98	37.11543	328.41500	328.41138	3.62

Order of Fit = 6 RMS error of fit = 11.58 mK
Largest absolute error = -31.84 mK at data point no. 94

INTERPOLATION TABLE

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	20628.3	-2.0779e+5	-3.0219	48.00	122.286	-1.4828	-0.58202
0.4000	9596.96	-58829.	-2.4520	49.00	120.826	-1.4373	-0.58290
0.5000	5817.87	-23752.	-2.0413	50.00	119.411	-1.3942	-0.58376
0.6000	4112.52	-12173.	-1.7760	51.00	118.037	-1.3530	-0.58460
0.7000	3170.65	-7267.7	-1.6045	52.00	116.704	-1.3138	-0.58539
0.8000	2581.03	-4777.8	-1.4809	53.00	115.409	-1.2763	-0.58614
0.9000	2180.35	-3357.2	-1.3858	54.00	114.151	-1.2406	-0.58689
1.000	1891.93	-2476.1	-1.3087	55.00	112.927	-1.2066	-0.58764
2.000	883.907	-405.35	-0.91718	56.00	111.737	-1.1740	-0.58839
3.000	628.758	-163.07	-0.77806	57.00	110.579	-1.1428	-0.58910
4.000	509.286	-88.503	-0.69512	58.00	109.451	-1.1130	-0.58979
4.200	492.426	-80.313	-0.68500	59.00	108.352	-1.0844	-0.59047
5.000	438.317	-57.037	-0.65064	60.00	107.282	-1.0570	-0.59116
6.000	390.479	-40.195	-0.61762	61.00	106.238	-1.0308	-0.59184
7.000	355.694	-30.161	-0.59357	62.00	105.220	-1.0055	-0.59250
8.000	328.985	-23.687	-0.57600	63.00	104.227	-0.98129	-0.59314
9.000	307.638	-19.259	-0.56343	64.00	103.257	-0.95800	-0.59378
10.00	290.050	-16.077	-0.55430	65.00	102.310	-0.93563	-0.59443
11.00	275.213	-13.704	-0.54772	66.00	101.385	-0.91413	-0.59508
12.00	262.460	-11.877	-0.54302	67.00	100.482	-0.89341	-0.59571
13.00	251.331	-10.435	-0.53972	68.00	99.5984	-0.87344	-0.59633
14.00	241.498	-9.2718	-0.53750	69.00	98.7347	-0.85420	-0.59695
15.00	232.718	-8.3176	-0.53612	70.00	97.8898	-0.83568	-0.59759
16.00	224.809	-7.5223	-0.53537	71.00	97.0631	-0.81782	-0.59822
17.00	217.632	-6.8513	-0.53518	72.00	96.2539	-0.80056	-0.59884
18.00	211.075	-6.2765	-0.53525	73.00	95.4618	-0.78389	-0.59945
19.00	205.050	-5.7874	-0.53626	74.00	94.6860	-0.76780	-0.60006
20.00	199.479	-5.3607	-0.53747	75.00	93.9260	-0.75225	-0.60067
21.00	194.315	-4.9781	-0.53800	76.00	93.1813	-0.73723	-0.60129
22.00	189.504	-4.6492	-0.53973	77.00	92.4514	-0.72269	-0.60191
23.00	185.004	-4.3570	-0.54167	77.35	92.1993	-0.71772	-0.60213
24.00	180.780	-4.0960	-0.54378	78.00	91.7357	-0.70863	-0.60253
25.00	176.803	-3.8619	-0.54607	79.00	91.0339	-0.69503	-0.60315
26.00	173.049	-3.6498	-0.54837	80.00	90.3455	-0.68188	-0.60379
27.00	169.497	-3.4568	-0.55066	81.00	89.6700	-0.66913	-0.60444
28.00	166.130	-3.2806	-0.55292	82.00	89.0071	-0.65675	-0.60505
29.00	162.931	-3.1187	-0.55510	83.00	88.3564	-0.64471	-0.60563
30.00	159.888	-2.9697	-0.55722	84.00	87.7176	-0.63301	-0.60618
31.00	156.988	-2.8320	-0.55924	85.00	87.0903	-0.62164	-0.60672
32.00	154.220	-2.7045	-0.56117	86.00	86.4742	-0.61062	-0.60728
33.00	151.576	-2.5861	-0.56302	87.00	85.8689	-0.60002	-0.60792
34.00	149.045	-2.4759	-0.56479	88.00	85.2740	-0.58982	-0.60867
35.00	146.622	-2.3729	-0.56643	89.00	84.6892	-0.58000	-0.60953
36.00	144.297	-2.2767	-0.56801	90.00	84.1139	-0.57057	-0.61050
37.00	142.066	-2.1868	-0.56953	91.00	83.5479	-0.56140	-0.61147
38.00	139.922	-2.1023	-0.57095	92.00	82.9911	-0.55230	-0.61225
39.00	137.860	-2.0230	-0.57230	93.00	82.4433	-0.54328	-0.61284
40.00	135.874	-1.9484	-0.57360	94.00	81.9045	-0.53433	-0.61324
41.00	133.961	-1.8781	-0.57481	95.00	81.3746	-0.52546	-0.61344
42.00	132.117	-1.8118	-0.57598	96.00	80.8535	-0.51676	-0.61357
43.00	130.337	-1.7493	-0.57711	97.00	80.3410	-0.50840	-0.61381
44.00	128.617	-1.6900	-0.57817	98.00	79.8366	-0.50035	-0.61419
45.00	126.955	-1.6340	-0.57919	99.00	79.3402	-0.49263	-0.61470
46.00	125.348	-1.5810	-0.58018	100.0	78.8513	-0.48521	-0.61535
47.00	123.793	-1.5306	-0.58111	101.0	78.3697	-0.47804	-0.61609

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INTERPOLATION TABLE

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	77.8951	-0.47104	-0.61680	157.0	59.3290	-0.24329	-0.64381
103.0	77.4275	-0.46419	-0.61750	158.0	59.0869	-0.24086	-0.64407
104.0	76.9667	-0.45750	-0.61818	159.0	58.8473	-0.23847	-0.64433
105.0	76.5125	-0.45095	-0.61886	160.0	58.6100	-0.23612	-0.64458
106.0	76.0647	-0.44456	-0.61952	161.0	58.3750	-0.23380	-0.64482
107.0	75.6233	-0.43831	-0.62017	162.0	58.1424	-0.23151	-0.64506
108.0	75.1881	-0.43220	-0.62082	163.0	57.9120	-0.22926	-0.64528
109.0	74.7589	-0.42624	-0.62146	164.0	57.6838	-0.22704	-0.64550
110.0	74.3356	-0.42041	-0.62211	165.0	57.4579	-0.22485	-0.64571
111.0	73.9180	-0.41471	-0.62275	166.0	57.2341	-0.22270	-0.64591
112.0	73.5061	-0.40913	-0.62338	167.0	57.0125	-0.22057	-0.64610
113.0	73.0997	-0.40367	-0.62400	168.0	56.7929	-0.21848	-0.64628
114.0	72.6987	-0.39832	-0.62461	169.0	56.5755	-0.21641	-0.64646
115.0	72.3030	-0.39308	-0.62521	170.0	56.3601	-0.21438	-0.64664
116.0	71.9125	-0.38796	-0.62581	171.0	56.1467	-0.21237	-0.64680
117.0	71.5271	-0.38295	-0.62640	172.0	55.9354	-0.21040	-0.64696
118.0	71.1466	-0.37804	-0.62700	173.0	55.7259	-0.20844	-0.64711
119.0	70.7710	-0.37324	-0.62759	174.0	55.5185	-0.20652	-0.64725
120.0	70.4001	-0.36854	-0.62819	175.0	55.3129	-0.20462	-0.64738
121.0	70.0339	-0.36393	-0.62878	176.0	55.1092	-0.20275	-0.64750
122.0	69.6722	-0.35942	-0.62936	177.0	54.9074	-0.20090	-0.64761
123.0	69.3150	-0.35498	-0.62992	178.0	54.7074	-0.19907	-0.64772
124.0	68.9622	-0.35063	-0.63047	179.0	54.5092	-0.19728	-0.64782
125.0	68.6137	-0.34637	-0.63101	180.0	54.3128	-0.19550	-0.64792
126.0	68.2694	-0.34218	-0.63154	181.0	54.1182	-0.19375	-0.64801
127.0	67.9293	-0.33807	-0.63206	182.0	53.9253	-0.19203	-0.64809
128.0	67.5933	-0.33404	-0.63257	183.0	53.7342	-0.19032	-0.64816
129.0	67.2612	-0.33009	-0.63308	184.0	53.5447	-0.18864	-0.64822
130.0	66.9330	-0.32621	-0.63358	185.0	53.3569	-0.18697	-0.64828
131.0	66.6087	-0.32241	-0.63408	186.0	53.1707	-0.18533	-0.64833
132.0	66.2882	-0.31867	-0.63456	187.0	52.9862	-0.18371	-0.64836
133.0	65.9714	-0.31499	-0.63503	188.0	52.8033	-0.18211	-0.64840
134.0	65.6582	-0.31138	-0.63549	189.0	52.6220	-0.18054	-0.64842
135.0	65.3486	-0.30784	-0.63594	190.0	52.4422	-0.17898	-0.64844
136.0	65.0425	-0.30435	-0.63638	191.0	52.2640	-0.17744	-0.64846
137.0	64.7399	-0.30093	-0.63682	192.0	52.0873	-0.17592	-0.64846
138.0	64.4406	-0.29757	-0.63724	193.0	51.9122	-0.17442	-0.64846
139.0	64.1447	-0.29426	-0.63766	194.0	51.7385	-0.17294	-0.64844
140.0	63.8521	-0.29102	-0.63808	195.0	51.5663	-0.17147	-0.64842
141.0	63.5627	-0.28783	-0.63849	196.0	51.3955	-0.17002	-0.64839
142.0	63.2764	-0.28469	-0.63889	197.0	51.2262	-0.16859	-0.64836
143.0	62.9933	-0.28161	-0.63927	198.0	51.0584	-0.16718	-0.64831
144.0	62.7132	-0.27857	-0.63965	199.0	50.8919	-0.16579	-0.64827
145.0	62.4361	-0.27559	-0.64002	200.0	50.7268	-0.16441	-0.64821
146.0	62.1620	-0.27265	-0.64037	201.0	50.5630	-0.16305	-0.64815
147.0	61.8908	-0.26976	-0.64072	202.0	50.4007	-0.16170	-0.64808
148.0	61.6224	-0.26692	-0.64107	203.0	50.2396	-0.16037	-0.64800
149.0	61.3569	-0.26412	-0.64140	204.0	50.0799	-0.15906	-0.64791
150.0	61.0942	-0.26138	-0.64174	205.0	49.9215	-0.15776	-0.64782
151.0	60.8342	-0.25867	-0.64206	206.0	49.7644	-0.15647	-0.64771
152.0	60.5768	-0.25601	-0.64238	207.0	49.6086	-0.15520	-0.64761
153.0	60.3221	-0.25338	-0.64268	208.0	49.4540	-0.15395	-0.64749
154.0	60.0700	-0.25080	-0.64297	209.0	49.3007	-0.15271	-0.64737
155.0	59.8205	-0.24826	-0.64326	210.0	49.1486	-0.15148	-0.64724
156.0	59.5735	-0.24575	-0.64354	211.0	48.9977	-0.15027	-0.64710

INTERPOLATION TABLE

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29559
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	48.8480	-0.14907	-0.64696	267.0	42.1443	-9.9344e-2	-0.62938
213.0	48.6996	-0.14788	-0.64681	268.0	42.0452	-9.8668e-2	-0.62892
214.0	48.5523	-0.14671	-0.64665	269.0	41.9469	-9.7998e-2	-0.62845
215.0	48.4061	-0.14555	-0.64649	270.0	41.8493	-9.7334e-2	-0.62797
216.0	48.2612	-0.14441	-0.64631	271.0	41.7522	-9.6677e-2	-0.62750
217.0	48.1173	-0.14327	-0.64613	272.0	41.6559	-9.6026e-2	-0.62702
218.0	47.9746	-0.14215	-0.64595	273.0	41.5602	-9.5380e-2	-0.62653
219.0	47.8330	-0.14104	-0.64575	274.0	41.4651	-9.4741e-2	-0.62604
220.0	47.6925	-0.13995	-0.64555	275.0	41.3707	-9.4107e-2	-0.62555
221.0	47.5531	-0.13886	-0.64535	276.0	41.2769	-9.3479e-2	-0.62505
222.0	47.4148	-0.13779	-0.64514	277.0	41.1837	-9.2857e-2	-0.62455
223.0	47.2775	-0.13673	-0.64492	278.0	41.0912	-9.2241e-2	-0.62405
224.0	47.1413	-0.13568	-0.64469	279.0	40.9993	-9.1630e-2	-0.62355
225.0	47.0062	-0.13464	-0.64446	280.0	40.9079	-9.1026e-2	-0.62304
226.0	46.8721	-0.13361	-0.64421	281.0	40.8172	-9.0426e-2	-0.62252
227.0	46.7390	-0.13259	-0.64397	282.0	40.7271	-8.9832e-2	-0.62201
228.0	46.6069	-0.13159	-0.64371	283.0	40.6375	-8.9243e-2	-0.62149
229.0	46.4758	-0.13059	-0.64346	284.0	40.5486	-8.8660e-2	-0.62097
230.0	46.3457	-0.12960	-0.64319	285.0	40.4602	-8.8082e-2	-0.62044
231.0	46.2166	-0.12863	-0.64292	286.0	40.3724	-8.7509e-2	-0.61991
232.0	46.0884	-0.12767	-0.64264	287.0	40.2852	-8.6941e-2	-0.61938
233.0	45.9612	-0.12671	-0.64236	288.0	40.1985	-8.6378e-2	-0.61885
234.0	45.8350	-0.12577	-0.64207	289.0	40.1124	-8.5820e-2	-0.61831
235.0	45.7097	-0.12483	-0.64177	290.0	40.0269	-8.5268e-2	-0.61778
236.0	45.5853	-0.12390	-0.64147	291.0	39.9419	-8.4720e-2	-0.61723
237.0	45.4619	-0.12299	-0.64116	292.0	39.8575	-8.4177e-2	-0.61669
238.0	45.3394	-0.12208	-0.64084	293.0	39.7736	-8.3639e-2	-0.61614
239.0	45.2177	-0.12118	-0.64052	294.0	39.6902	-8.3106e-2	-0.61560
240.0	45.0970	-0.12030	-0.64019	295.0	39.6073	-8.2577e-2	-0.61504
241.0	44.9771	-0.11942	-0.63986	296.0	39.5250	-8.2053e-2	-0.61449
242.0	44.8582	-0.11855	-0.63953	297.0	39.4432	-8.1534e-2	-0.61393
243.0	44.7400	-0.11768	-0.63918	298.0	39.3620	-8.1019e-2	-0.61338
244.0	44.6228	-0.11683	-0.63883	299.0	39.2812	-8.0509e-2	-0.61282
245.0	44.5064	-0.11598	-0.63848	300.0	39.2009	-8.0003e-2	-0.61226
246.0	44.3908	-0.11515	-0.63811	301.0	39.1212	-7.9502e-2	-0.61169
247.0	44.2761	-0.11432	-0.63775	302.0	39.0419	-7.9005e-2	-0.61113
248.0	44.1622	-0.11350	-0.63738	303.0	38.9632	-7.8513e-2	-0.61056
249.0	44.0491	-0.11269	-0.63700	304.0	38.8849	-7.8024e-2	-0.60999
250.0	43.9368	-0.11188	-0.63662	305.0	38.8071	-7.7540e-2	-0.60942
251.0	43.8253	-0.11109	-0.63623	305.0	38.8071	-7.7540e-2	-0.60942
252.0	43.7146	-0.11030	-0.63584	306.0	38.7298	-7.7060e-2	-0.60884
253.0	43.6047	-0.10952	-0.63544	307.0	38.6530	-7.6584e-2	-0.60827
254.0	43.4956	-0.10875	-0.63504	308.0	38.5767	-7.6113e-2	-0.60769
255.0	43.3872	-0.10798	-0.63463	309.0	38.5008	-7.5645e-2	-0.60711
256.0	43.2796	-0.10722	-0.63422	310.0	38.4254	-7.5182e-2	-0.60653
257.0	43.1728	-0.10647	-0.63380	311.0	38.3504	-7.4722e-2	-0.60595
258.0	43.0667	-0.10573	-0.63338	312.0	38.2759	-7.4267e-2	-0.60537
259.0	42.9613	-0.10499	-0.63295	313.0	38.2019	-7.3815e-2	-0.60479
260.0	42.8567	-0.10426	-0.63252	314.0	38.1283	-7.3367e-2	-0.60420
261.0	42.7528	-0.10354	-0.63209	315.0	38.0551	-7.2923e-2	-0.60362
262.0	42.6496	-0.10282	-0.63165	316.0	37.9824	-7.2483e-2	-0.60303
263.0	42.5471	-0.10211	-0.63120	317.0	37.9102	-7.2046e-2	-0.60244
264.0	42.4454	-0.10141	-0.63076	318.0	37.8383	-7.1614e-2	-0.60185
265.0	42.3443	-0.10072	-0.63030	319.0	37.7669	-7.1184e-2	-0.60126
266.0	42.2439	-0.10003	-0.62984	320.0	37.6960	-7.0759e-2	-0.60067

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INTERPOLATION TABLE

Calibration Report: 430425
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

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Serial Number: X29559
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	37.6254	-7.0337e-2	-0.60008				
322.0	37.5553	-6.9919e-2	-0.59948				
323.0	37.4856	-6.9504e-2	-0.59889				
324.0	37.4163	-6.9093e-2	-0.59830				
325.0	37.3474	-6.8685e-2	-0.59770				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29559
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.57225,325.000	Point 56: 1.95426, 80.500	Point 111: 2.48395, 9.150	Point 166: 3.75584, 0.505
Point 2: 1.57710,319.000	Point 57: 1.96252, 78.000	Point 112: 2.49630, 8.700	Point 167: 3.78637, 0.488
Point 3: 1.58166,313.500	Point 58: 1.96932, 76.000	Point 113: 2.50795, 8.300	Point 168: 3.82085, 0.470
Point 4: 1.58632,308.000	Point 59: 1.97627, 74.000	Point 114: 2.52027, 7.900	Point 169: 3.85787, 0.452
Point 5: 1.59108,302.500	Point 60: 1.98341, 72.000	Point 115: 2.53337, 7.500	Point 170: 3.89320, 0.436
Point 6: 1.59596,297.000	Point 61: 1.99073, 70.000	Point 116: 2.54735, 7.100	Point 171: 3.93092, 0.420
Point 7: 1.60096,291.500	Point 62: 1.99824, 68.000	Point 117: 2.56044, 6.750	Point 172: 3.97137, 0.404
Point 8: 1.60608,286.000	Point 63: 2.00596, 66.000	Point 118: 2.57436, 6.400	Point 173: 4.01469, 0.388
Point 9: 1.61132,280.500	Point 64: 2.01391, 64.000	Point 119: 2.58930, 6.050	Point 174: 4.06107, 0.372
Point 10: 1.61619,275.500	Point 65: 2.02208, 62.000	Point 120: 2.60441, 5.720	Point 175: 4.11066, 0.356
Point 11: 1.62117,270.500	Point 66: 2.03051, 60.000	Point 121: 2.62019, 5.400	Point 176: 4.17024, 0.338
Point 12: 1.62627,265.500	Point 67: 2.03832, 58.200	Point 122: 2.63612, 5.100	Point 177: 4.23408, 0.320
Point 13: 1.63148,260.500	Point 68: 2.04636, 56.400	Point 123: 2.65328, 4.800	Point 178: 4.28053, 0.308
Point 14: 1.63681,255.500	Point 69: 2.05464, 54.600	Point 124: 2.67190, 4.500	Point 179: 4.30578, 0.302
Point 15: 1.64227,250.500	Point 70: 2.06318, 52.800	Point 125: 2.69081, 4.220	Point 180: 4.31446, 0.300
Point 16: 1.64785,245.500	Point 71: 2.07200, 51.000	Point 126: 2.70764, 3.990	Point 181: 4.31446, 0.300
Point 17: 1.65356,240.500	Point 72: 2.08111, 49.200	Point 127: 2.72249, 3.800	
Point 18: 1.65941,235.500	Point 73: 2.09053, 47.400	Point 128: 2.73749, 3.620	
Point 19: 1.66539,230.500	Point 74: 2.10029, 45.600	Point 129: 2.75351, 3.440	
Point 20: 1.67152,225.500	Point 75: 2.11041, 43.800	Point 130: 2.76971, 3.270	
Point 21: 1.67780,220.500	Point 76: 2.11975, 42.200	Point 131: 2.78517, 3.120	
Point 22: 1.68424,215.500	Point 77: 2.12940, 40.600	Point 132: 2.80520, 2.940	
Point 23: 1.69083,210.500	Point 78: 2.13941, 39.000	Point 133: 2.82430, 2.780	
Point 24: 1.69759,205.500	Point 79: 2.14980, 37.400	Point 134: 2.84367, 2.630	
Point 25: 1.70452,200.500	Point 80: 2.16060, 35.800	Point 135: 2.86464, 2.480	
Point 26: 1.71163,195.500	Point 81: 2.17113, 34.300	Point 136: 2.88593, 2.340	
Point 27: 1.71893,190.500	Point 82: 2.18208, 32.800	Point 137: 2.90910, 2.200	
Point 28: 1.72642,185.500	Point 83: 2.19349, 31.300	Point 138: 2.93266, 2.070	
Point 29: 1.73333,181.000	Point 84: 2.20459, 29.900	Point 139: 2.95842, 1.940	
Point 30: 1.74041,176.500	Point 85: 2.21615, 28.500	Point 140: 2.98465, 1.820	
Point 31: 1.74767,172.000	Point 86: 2.22824, 27.100	Point 141: 3.01351, 1.700	
Point 32: 1.75512,167.500	Point 87: 2.23997, 25.800	Point 142: 3.04562, 1.580	
Point 33: 1.76275,163.000	Point 88: 2.25223, 24.500	Point 143: 3.07851, 1.470	
Point 34: 1.77059,158.500	Point 89: 2.26509, 23.200	Point 144: 3.11528, 1.360	
Point 35: 1.77864,154.000	Point 90: 2.27757, 22.000	Point 145: 3.15297, 1.260	
Point 36: 1.78691,149.500	Point 91: 2.29069, 20.800	Point 146: 3.18022, 1.195	
Point 37: 1.79542,145.000	Point 92: 2.30105, 19.900	Point 147: 3.20027, 1.150	
Point 38: 1.80417,140.500	Point 93: 2.30940, 19.200	Point 148: 3.21914, 1.110	
Point 39: 1.81318,136.000	Point 94: 2.31804, 18.500	Point 149: 3.23905, 1.070	
Point 40: 1.82142,132.000	Point 95: 2.32636, 17.850	Point 150: 3.26015, 1.030	
Point 41: 1.82989,128.000	Point 96: 2.33498, 17.200	Point 151: 3.28253, 0.990	
Point 42: 1.83859,124.000	Point 97: 2.34393, 16.550	Point 152: 3.30635, 0.950	
Point 43: 1.84755,120.000	Point 98: 2.35252, 15.950	Point 153: 3.33177, 0.910	
Point 44: 1.85678,116.000	Point 99: 2.36143, 15.350	Point 154: 3.35552, 0.875	
Point 45: 1.86630,112.000	Point 100: 2.37071, 14.750	Point 155: 3.38073, 0.840	
Point 46: 1.87613,108.000	Point 101: 2.38039, 14.150	Point 156: 3.40766, 0.805	
Point 47: 1.88628,104.000	Point 102: 2.38966, 13.600	Point 157: 3.43650, 0.770	
Point 48: 1.89546,100.500	Point 103: 2.39931, 13.050	Point 158: 3.46749, 0.735	
Point 49: 1.90219, 98.000	Point 104: 2.40942, 12.500	Point 159: 3.50095, 0.700	
Point 50: 1.90908, 95.500	Point 105: 2.41903, 12.000	Point 160: 3.53195, 0.670	
Point 51: 1.91614, 93.000	Point 106: 2.42908, 11.500	Point 161: 3.56521, 0.640	
Point 52: 1.92339, 90.500	Point 107: 2.43963, 11.000	Point 162: 3.60123, 0.610	
Point 53: 1.93080, 88.000	Point 108: 2.45072, 10.500	Point 163: 3.64033, 0.580	
Point 54: 1.93841, 85.500	Point 109: 2.46124, 10.050	Point 164: 3.68312, 0.550	
Point 55: 1.94622, 83.000	Point 110: 2.47228, 9.600	Point 165: 3.72218, 0.525	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 55

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.57226	325.0	31	2.44404	10.8
2	1.57306	324.0	32	2.49636	8.7
3	1.58547	309.0	33	2.54384	7.2
4	1.59868	294.0	34	2.59160	6.0
5	1.61278	279.0	35	2.63621	5.1
6	1.62783	264.0	36	2.67860	4.4
7	1.64394	249.0	37	2.72257	3.8
8	1.66120	234.0	38	2.75731	3.4
9	1.67973	219.0	39	2.79848	3.0
10	1.69966	204.0	40	2.86188	2.5
11	1.72117	189.0	41	2.90927	2.2
12	1.74444	174.0	42	2.96709	1.9
13	1.76973	159.0	43	3.01375	1.7
14	1.79736	144.0	44	3.06945	1.5
15	1.82776	129.0	45	3.10173	1.4
16	1.86153	114.0	46	3.13770	1.3
17	1.89949	99.0	47	3.17815	1.2
18	1.94309	84.0	48	3.22409	1.1
19	1.99447	69.0	49	3.27690	1.0
20	2.03267	59.5	50	3.33853	.9
21	2.07704	50.0	51	3.41179	.8
22	2.08320	48.8	52	3.50115	.7
23	2.08738	48.0	53	3.61411	.6
24	2.11507	43.0	54	3.98213	.4
25	2.14589	38.0	55	4.31446	.3
26	2.18063	33.0			
27	2.22045	28.0			
28	2.26718	23.0			
29	2.32444	18.0			
30	2.38459	13.9			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	67.540
1000	1.755
10000	0.394

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BREAKPOINTS 234 FORMAT

Calibration Report: 430425 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29559
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.006K
10 - 20K:	0.011K
20 - 40K:	0.017K
40 - 100K:	0.038K
> 100K:	0.165K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	315.498	38.01894	1.580	51	6.267	380.1894	2.580
2	292.562	39.81072	1.600	52	5.816	398.1072	2.600
3	271.681	41.68694	1.620	53	5.406	416.8694	2.620
4	252.569	43.65158	1.640	54	5.032	436.5158	2.640
5	235.003	45.70882	1.660	55	4.691	457.0882	2.660
6	218.791	47.86301	1.680	56	4.379	478.6301	2.680
7	203.752	50.11872	1.700	57	4.093	501.1872	2.700
8	189.785	52.48075	1.720	58	3.832	524.8075	2.720
9	176.769	54.95409	1.740	59	3.592	549.5409	2.740
10	164.615	57.54399	1.760	60	3.372	575.4399	2.760
11	153.262	60.25596	1.780	61	3.170	602.5596	2.780
12	142.640	63.09573	1.800	62	2.986	630.9573	2.800
13	132.686	66.06934	1.820	63	2.816	660.6934	2.820
14	123.373	69.18310	1.840	64	2.659	691.8310	2.840
15	114.646	72.44360	1.860	65	2.513	724.4360	2.860
16	106.461	75.85776	1.880	66	2.379	758.5776	2.880
17	98.812	79.43282	1.900	67	2.255	794.3282	2.900
18	91.668	83.17638	1.920	68	2.139	831.7638	2.920
19	84.990	87.09636	1.940	69	2.033	870.9636	2.940
20	78.760	91.20108	1.960	70	1.934	912.0108	2.960
21	72.952	95.49926	1.980	71	1.841	954.9926	2.980
22	67.544	100.0000	2.000	72	1.756	1000.000	3.000
23	62.507	104.7129	2.020	73	1.601	1096.478	3.040
24	57.822	109.6478	2.040	74	1.466	1202.264	3.080
25	53.469	114.8154	2.060	75	1.348	1318.257	3.120
26	49.420	120.2264	2.080	76	1.243	1445.440	3.160
27	45.657	125.8925	2.100	77	1.151	1584.893	3.200
28	42.161	131.8257	2.120	78	1.068	1737.801	3.240
29	38.911	138.0384	2.140	79	0.995	1905.461	3.280
30	35.892	144.5440	2.160	80	0.928	2089.296	3.320
31	33.085	151.3561	2.180	81	0.869	2290.868	3.360
32	30.476	158.4893	2.200	82	0.815	2511.886	3.400
33	28.054	165.9587	2.220	83	0.766	2754.229	3.440
34	25.800	173.7801	2.240	84	0.722	3019.952	3.480
35	23.713	181.9701	2.260	85	0.681	3311.311	3.520
36	21.778	190.5461	2.280	86	0.645	3630.781	3.560
37	19.991	199.5262	2.300	87	0.611	3981.072	3.600
38	18.347	208.9296	2.320	88	0.580	4365.158	3.640
39	16.835	218.7762	2.340	89	0.552	4786.301	3.680
40	15.446	229.0868	2.360	90	0.527	5248.075	3.720
41	14.176	239.8833	2.380	91	0.503	5754.399	3.760
42	13.013	251.1886	2.400	92	0.481	6309.573	3.800
43	11.953	263.0268	2.420	93	0.461	6918.310	3.840
44	10.985	275.4229	2.440	94	0.442	7585.776	3.880
45	10.103	288.4032	2.460	95	0.425	8317.638	3.920
46	9.301	301.9952	2.480	96	0.408	9120.108	3.960
47	8.572	316.2278	2.500	97	0.393	10000.00	4.000
48	7.911	331.1311	2.520	98	0.359	12589.25	4.100
49	7.309	346.7369	2.540	99	0.330	15848.93	4.200
50	6.763	363.0781	2.560	100	0.303	19952.62	4.300

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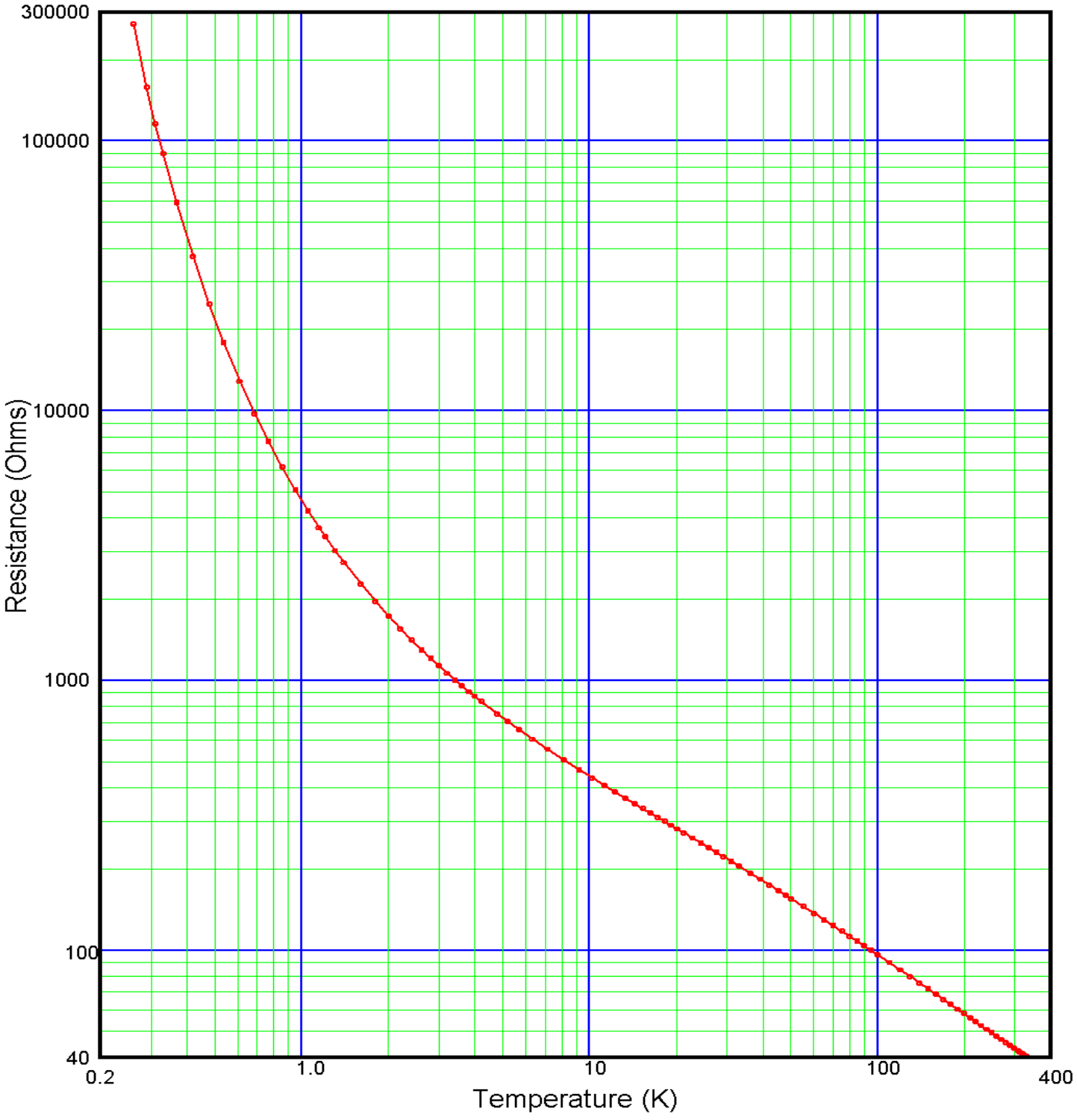
DATA PLOT

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260627	270457.	51	21.1955	272.795
2	0.289219	157819.	52	22.7441	260.836
3	0.309679	115822.	53	24.3107	249.978
4	0.330457	89836.0	54	25.9096	239.954
5	0.367734	59116.2	55	27.5339	230.749
6	0.418493	37414.4	56	29.1485	222.412
7	0.476550	24824.8	57	30.9432	213.922
8	0.534421	17949.2	58	33.0430	204.920
9	0.608538	12838.4	59	36.0623	193.426
10	0.684954	9743.50	60	39.0780	183.396
11	0.765752	7704.60	61	42.0924	174.527
12	0.854438	6177.20	62	45.1021	166.660
13	0.950501	5075.94	63	48.1173	159.542
14	1.04994	4266.70	64	50.1177	155.214
15	1.14852	3678.87	65	55.1053	145.564
16	1.20561	3414.02	66	60.0822	137.225
17	1.30548	3026.65	67	65.0501	129.946
18	1.40027	2736.00	68	70.0206	123.549
19	1.60243	2279.27	69	74.9921	117.835
20	1.80106	1966.69	70	79.9560	112.715
21	2.00135	1734.16	71	84.9203	108.078
22	2.20063	1557.16	72	89.8867	103.866
23	2.40474	1414.19	73	94.8522	100.008
24	2.60565	1300.21	74	99.8251	96.4572
25	2.80653	1206.65	75	109.868	90.0996
26	2.99348	1133.22	76	119.710	84.7259
27	3.20094	1063.61	77	129.645	79.9782
28	3.40035	1005.99	78	139.580	75.7911
29	3.59972	955.721	79	149.514	72.0662
30	3.80510	910.210	80	159.451	68.7355
31	3.98421	874.823	81	169.387	65.7222
32	4.19818	836.740	82	179.322	63.0001
33	4.78107	752.345	83	189.248	60.5279
34	5.17113	707.078	84	199.161	58.2747
35	5.66401	659.280	85	209.094	56.2092
36	6.34618	605.592	86	219.025	54.3112
37	7.14089	556.026	87	228.945	52.5641
38	8.14416	507.064	88	238.867	50.9475
39	9.16883	467.780	89	248.794	49.4477
40	10.1971	435.758	90	258.703	48.0566
41	11.2326	408.973	91	268.636	46.7593
42	12.2583	386.445	92	278.546	45.5563
43	13.2754	367.128	93	288.483	44.4274
44	14.2820	350.385	94	298.402	43.3704
45	15.2771	335.689	95	308.328	42.3823
46	16.2599	322.672	96	313.293	41.9105
47	17.2371	310.935	97	318.249	41.4539
48	18.2074	300.389	98	324.187	40.9247
49	19.1731	290.761	99	328.171	40.5807
50	20.1351	281.851			

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POLYNOMIAL EQUATION

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	2.99K
1.331e+5 Ohms	to	1133. Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 3.00259451851 ZU = 5.43209822638

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.071157	2.0847E-04	5138.18
1	-1.234786	3.4948E-04	-3533.17
2	0.621930	2.9541E-04	2105.30
3	-0.281153	2.2682E-04	-1239.53
4	0.118264	1.8321E-04	645.50
5	-0.046330	1.9459E-04	-238.09
6	0.017495	2.2422E-04	78.03
7	-0.006133	2.6134E-04	-23.47
8	0.001412	2.6670E-04	5.29
9	-0.001242	2.2756E-04	-5.46

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 9
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	270457.0	0.26063	0.26061	0.01
2	157819.0	0.28922	0.28934	-0.12
3	115822.0	0.30968	0.30965	0.02
4	89836.00	0.33046	0.33001	0.44
5	59116.20	0.36773	0.36839	-0.66
6	37414.40	0.41849	0.41845	0.04
7	24824.80	0.47655	0.47601	0.54
8	17949.20	0.53442	0.53405	0.37
9	12838.40	0.60854	0.60924	-0.70
10	9743.500	0.68495	0.68596	-1.01
11	7704.600	0.76575	0.76501	0.74
12	6177.200	0.85444	0.85441	0.03
13	5075.940	0.95050	0.94960	0.90
14	4266.700	1.04994	1.04948	0.46
15	3678.870	1.14852	1.14920	-0.68
16	3414.019	1.20561	1.20545	0.16
17	3026.646	1.30548	1.30595	-0.47
18	2736.003	1.40027	1.40090	-0.63
19	2279.271	1.60243	1.60275	-0.32
20	1966.688	1.80106	1.80076	0.30
21	1734.163	2.00135	2.00086	0.50
22	1557.162	2.20063	2.19998	0.65
23	1414.188	2.40474	2.40426	0.48
24	1300.210	2.60565	2.60621	-0.56
25	1206.652	2.80653	2.80714	-0.61
26	1133.223	2.99348	2.99385	-0.37
27	1063.606	3.20094	3.20092	0.02
28	1005.992	3.40035	3.39990	0.45

Order of Fit = 9 RMS error of fit = .51 mK
Largest absolute error = -1.01 mK at data point no. 10

POLYNOMIAL EQUATION

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

2.99K	to	20.1K
1133. Ohms	to	281.9 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.41636756857 ZU = 3.11401360277

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.596472	5.2897E-04	18141.66
1	-9.409009	8.2293E-04	-11433.51
2	2.993024	8.0446E-04	3720.53
3	-0.660469	7.2264E-04	-913.97
4	0.089213	6.9762E-04	127.88

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 4
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1300.210	2.60621	2.60923	-3.02
25	1206.652	2.80714	2.80484	2.30
26	1133.223	2.99385	2.99085	3.00
27	1063.606	3.20094	3.19915	1.79
28	1005.992	3.40035	3.39996	0.39
29	955.7211	3.59972	3.60063	-0.91
30	910.2104	3.80510	3.80685	-1.75
31	874.8226	3.98421	3.98631	-2.10
32	836.7402	4.19818	4.20146	-3.27
33	752.3447	4.78107	4.78207	-0.99
34	707.0784	5.17113	5.17106	0.07
35	659.2797	5.66401	5.66185	2.16
36	605.5925	6.34618	6.34310	3.08
37	556.0264	7.14089	7.13856	2.32
38	507.0640	8.14416	8.14380	0.36
39	467.7798	9.16883	9.16856	0.28
40	435.7578	10.19710	10.19825	-1.15
41	408.9732	11.23256	11.23387	-1.31
42	386.4449	12.25832	12.25969	-1.38
43	367.1278	13.27539	13.27742	-2.04
44	350.3852	14.28204	14.28330	-1.26
45	335.6887	15.27709	15.27792	-0.83
46	322.6716	16.25994	16.26014	-0.20
47	310.9355	17.23711	17.23922	-2.11
48	300.3890	18.20743	18.20495	2.48
49	290.7614	19.17309	19.16641	6.68
50	281.8509	20.13508	20.13215	2.94
51	272.7949	21.19554	21.19693	-1.39
52	260.8360	22.74405	22.74819	-4.14

Order of Fit = 4 RMS error of fit = 2.36 mK
Largest absolute error = 6.68 mK at data point no. 49

POLYNOMIAL EQUATION

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	94.9K
281.9 Ohms	to	100.0 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.95472302615 ZU = 2.47768402928

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.911320	9.6470E-04	56920.42
1	-44.682951	1.5564E-03	-28708.28
2	9.032297	1.4510E-03	6224.84
3	-1.156483	1.3569E-03	-852.28
4	0.093887	1.2529E-03	74.93
5	0.009633	1.2464E-03	7.73

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	300.3890	18.20495	18.20770	-2.75
49	290.7614	19.16641	19.16546	0.95
50	281.8509	20.13215	20.12967	2.47
51	272.7949	21.19554	21.19368	1.86
52	260.8360	22.74405	22.74325	0.80
53	249.9777	24.31071	24.31120	-0.49
54	239.9540	25.90965	25.91416	-4.51
55	230.7494	27.53385	27.53608	-2.23
56	222.4117	29.14845	29.14595	2.50
57	213.9224	30.94321	30.94110	2.11
58	204.9197	33.04305	33.04115	1.90
59	193.4258	36.06228	36.06605	-3.77
60	183.3955	39.07804	39.08076	-2.72
61	174.5273	42.09241	42.09548	-3.07
62	166.6599	45.10211	45.09492	7.19
63	159.5422	48.11730	48.11679	0.51
64	155.2141	50.11766	50.11771	-0.06
65	145.5644	55.10533	55.09712	8.21
66	137.2252	60.08220	60.08246	-0.26
67	129.9457	65.05008	65.06389	-13.81
68	123.5487	70.02061	70.02166	-1.05
69	117.8350	74.99212	74.99156	0.56
70	112.7148	79.95596	79.95154	4.42
71	108.0775	84.92028	84.92027	0.01
72	103.8658	89.88666	89.88181	4.85
73	100.0082	94.85216	94.85132	0.84
74	96.45722	99.82506	99.83042	-5.35
75	90.09963	109.86819	109.86731	0.89

Order of Fit = 5 RMS error of fit = 4.12 mK
Largest absolute error = -13.81 mK at data point no. 67

POLYNOMIAL EQUATION

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

94.8K	to	325.K
100.0 Ohms	to	40.85 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.60831986552 ZU = 2.03373530587

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.575278	1.8696E-03	99794.61
1	-118.759676	2.8500E-03	-41670.62
2	19.432472	2.6997E-03	7198.11
3	-2.767647	2.6889E-03	-1029.29
4	0.523337	2.6187E-03	199.84
5	-0.090996	2.4961E-03	-36.46
6	0.015814	2.4535E-03	6.45
7	-0.009403	2.4340E-03	-3.86

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

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Sales: (614) 891-2244 • Fax: (614) 891-1392 • sales@lakeshore.com • www.lakeshore.com

POLYNOMIAL EQUATION

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	108.0775	84.92027	84.91918	1.10
72	103.8658	89.88181	89.88500	-3.20
73	100.0082	94.85132	94.84958	1.73
74	96.45722	99.82506	99.82452	0.54
75	90.09963	109.86819	109.86726	0.94
76	84.72587	119.71022	119.70757	2.65
77	79.97816	129.64495	129.65074	-5.79
78	75.79107	139.58032	139.58542	-5.10
79	72.06623	149.51434	149.51689	-2.55
80	68.73545	159.45078	159.43006	20.72
81	65.72220	169.38696	169.38663	0.33
82	63.00014	179.32173	179.32549	-3.76
83	60.52785	189.24810	189.25597	-7.87
84	58.27473	199.16112	199.17216	-11.03
85	56.20925	209.09355	209.09667	-3.12
86	54.31118	219.02458	219.02149	3.09
87	52.56413	228.94500	228.93232	12.68
88	50.94747	238.86732	238.85475	12.57
89	49.44767	248.79398	248.78988	4.11
90	48.05656	258.70295	258.71258	-9.64
91	46.75927	268.63632	268.65575	-19.43
92	45.55626	278.54561	278.54304	2.57
93	44.42740	288.48284	288.47345	9.40
94	43.37045	298.40153	298.41029	-8.76
95	42.38226	308.32849	308.32327	5.22
96	41.91045	313.29347	313.28802	5.45
97	41.45394	318.24948	318.24473	4.75
98	40.92465	324.18673	324.19060	-3.87
99	40.58073	328.17091	328.17462	-3.72

Order of Fit = 7 RMS error of fit = 7.92 mK
Largest absolute error = 20.72 mK at data point no. 80

INTERPOLATION TABLE

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	133127.	-2.0184e+6	-4.5485	48.00	159.804	-2.2443	-0.67412
0.4000	43774.3	-3.8850e+5	-3.5500	49.00	157.597	-2.1708	-0.67493
0.5000	21520.4	-1.2211e+5	-2.8371	50.00	155.461	-2.1010	-0.67574
0.6000	13324.9	-54341.	-2.4469	51.00	153.393	-2.0348	-0.67652
0.7000	9315.47	-29316.	-2.2029	52.00	151.390	-1.9717	-0.67725
0.8000	7031.52	-17694.	-2.0132	53.00	149.449	-1.9117	-0.67794
0.9000	5598.41	-11567.	-1.8595	54.00	147.566	-1.8545	-0.67863
1.000	4633.33	-8034.8	-1.7341	55.00	145.739	-1.8001	-0.67935
2.000	1735.03	-1008.3	-1.1623	56.00	143.965	-1.7483	-0.68006
3.000	1129.88	-363.93	-0.96630	57.00	142.242	-1.6987	-0.68073
4.000	872.265	-186.05	-0.85316	58.00	140.567	-1.6514	-0.68138
4.200	836.984	-167.29	-0.83946	59.00	138.938	-1.6061	-0.68202
5.000	726.064	-115.01	-0.79204	60.00	137.354	-1.5628	-0.68268
6.000	631.065	-78.591	-0.74722	61.00	135.812	-1.5214	-0.68335
7.000	563.852	-57.578	-0.71481	62.00	134.311	-1.4817	-0.68398
8.000	513.337	-44.370	-0.69147	63.00	132.848	-1.4436	-0.68460
9.000	473.663	-35.509	-0.67470	64.00	131.423	-1.4071	-0.68522
10.00	441.453	-29.242	-0.66240	65.00	130.033	-1.3721	-0.68586
11.00	414.626	-24.628	-0.65338	66.00	128.678	-1.3384	-0.68650
12.00	391.827	-21.118	-0.64676	67.00	127.356	-1.3061	-0.68712
13.00	372.134	-18.375	-0.64192	68.00	126.066	-1.2750	-0.68773
14.00	354.893	-16.184	-0.63843	69.00	124.806	-1.2451	-0.68835
15.00	339.630	-14.400	-0.63600	70.00	123.575	-1.2163	-0.68898
16.00	325.989	-12.925	-0.63438	71.00	122.373	-1.1886	-0.68962
17.00	313.700	-11.689	-0.63344	72.00	121.198	-1.1619	-0.69024
18.00	302.549	-10.638	-0.63290	73.00	120.049	-1.1361	-0.69085
19.00	292.372	-9.7466	-0.63339	74.00	118.925	-1.1113	-0.69147
20.00	283.010	-8.9835	-0.63485	75.00	117.826	-1.0873	-0.69210
21.00	274.387	-8.2827	-0.63391	76.00	116.750	-1.0642	-0.69274
22.00	266.406	-7.6934	-0.63533	77.00	115.697	-1.0418	-0.69337
23.00	258.978	-7.1711	-0.63687	77.35	115.334	-1.0342	-0.69358
24.00	252.044	-6.7069	-0.63864	78.00	114.666	-1.0202	-0.69399
25.00	245.548	-6.2929	-0.64070	79.00	113.656	-0.99934	-0.69462
26.00	239.445	-5.9199	-0.64281	80.00	112.667	-0.97917	-0.69527
27.00	233.696	-5.5820	-0.64492	81.00	111.698	-0.95965	-0.69591
28.00	228.270	-5.2749	-0.64703	82.00	110.748	-0.94074	-0.69655
29.00	223.138	-4.9942	-0.64907	83.00	109.816	-0.92243	-0.69718
30.00	218.274	-4.7370	-0.65106	84.00	108.903	-0.90468	-0.69781
31.00	213.657	-4.5003	-0.65296	85.00	108.007	-0.88750	-0.69845
32.00	209.267	-4.2820	-0.65478	86.00	107.128	-0.87085	-0.69910
33.00	205.087	-4.0801	-0.65652	87.00	106.265	-0.85471	-0.69976
34.00	201.102	-3.8929	-0.65817	88.00	105.418	-0.83906	-0.70042
35.00	197.297	-3.7188	-0.65970	89.00	104.587	-0.82389	-0.70110
36.00	193.660	-3.5568	-0.66118	90.00	103.770	-0.80918	-0.70181
37.00	190.180	-3.4058	-0.66260	91.00	102.968	-0.79492	-0.70253
38.00	186.846	-3.2644	-0.66391	92.00	102.180	-0.78107	-0.70326
39.00	183.648	-3.1322	-0.66516	93.00	101.406	-0.76763	-0.70400
40.00	180.578	-3.0083	-0.66637	94.00	100.645	-0.75459	-0.70477
41.00	177.629	-2.8918	-0.66748	95.00	99.8965	-0.74193	-0.70556
42.00	174.792	-2.7824	-0.66856	96.00	99.1607	-0.72959	-0.70633
43.00	172.062	-2.6794	-0.66960	97.00	98.4372	-0.71751	-0.70704
44.00	169.432	-2.5822	-0.67057	98.00	97.7256	-0.70570	-0.70768
45.00	166.896	-2.4905	-0.67152	99.00	97.0257	-0.69415	-0.70828
46.00	164.449	-2.4039	-0.67243	100.0	96.3372	-0.68286	-0.70882
47.00	162.087	-2.3219	-0.67328	101.0	95.6599	-0.67183	-0.70933

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INTERPOLATION TABLE

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	94.9935	-0.66109	-0.70985	157.0	69.5194	-0.32679	-0.73801
103.0	94.3376	-0.65061	-0.71035	158.0	69.1944	-0.32334	-0.73832
104.0	93.6921	-0.64041	-0.71086	159.0	68.8727	-0.31994	-0.73862
105.0	93.0567	-0.63046	-0.71138	160.0	68.5545	-0.31660	-0.73892
106.0	92.4311	-0.62077	-0.71190	161.0	68.2395	-0.31331	-0.73920
107.0	91.8151	-0.61133	-0.71243	162.0	67.9278	-0.31006	-0.73946
108.0	91.2084	-0.60213	-0.71299	163.0	67.6194	-0.30687	-0.73972
109.0	90.6108	-0.59317	-0.71355	164.0	67.3141	-0.30372	-0.73996
110.0	90.0220	-0.58444	-0.71415	165.0	67.0119	-0.30062	-0.74020
111.0	89.4418	-0.57593	-0.71474	166.0	66.7128	-0.29756	-0.74042
112.0	88.8701	-0.56760	-0.71533	167.0	66.4168	-0.29455	-0.74063
113.0	88.3065	-0.55946	-0.71591	168.0	66.1237	-0.29159	-0.74084
114.0	87.7511	-0.55151	-0.71648	169.0	65.8336	-0.28867	-0.74103
115.0	87.2035	-0.54374	-0.71706	170.0	65.5464	-0.28579	-0.74122
116.0	86.6635	-0.53615	-0.71764	171.0	65.2620	-0.28295	-0.74140
117.0	86.1311	-0.52873	-0.71822	172.0	64.9804	-0.28016	-0.74156
118.0	85.6060	-0.52148	-0.71881	173.0	64.7017	-0.27740	-0.74171
119.0	85.0881	-0.51439	-0.71941	174.0	64.4256	-0.27468	-0.74186
120.0	84.5772	-0.50747	-0.72001	175.0	64.1523	-0.27200	-0.74199
121.0	84.0731	-0.50070	-0.72062	176.0	63.8816	-0.26936	-0.74211
122.0	83.5757	-0.49406	-0.72121	177.0	63.6136	-0.26676	-0.74223
123.0	83.0849	-0.48756	-0.72180	178.0	63.3481	-0.26419	-0.74233
124.0	82.6006	-0.48120	-0.72238	179.0	63.0852	-0.26166	-0.74243
125.0	82.1225	-0.47497	-0.72295	180.0	62.8248	-0.25916	-0.74252
126.0	81.6506	-0.46886	-0.72353	181.0	62.5668	-0.25670	-0.74261
127.0	81.1847	-0.46288	-0.72410	182.0	62.3114	-0.25427	-0.74268
128.0	80.7248	-0.45702	-0.72467	183.0	62.0583	-0.25187	-0.74274
129.0	80.2706	-0.45129	-0.72525	184.0	61.8076	-0.24951	-0.74279
130.0	79.8222	-0.44567	-0.72583	185.0	61.5593	-0.24718	-0.74283
131.0	79.3793	-0.44016	-0.72641	186.0	61.3132	-0.24488	-0.74286
132.0	78.9418	-0.43476	-0.72697	187.0	61.0695	-0.24261	-0.74289
133.0	78.5097	-0.42945	-0.72751	188.0	60.8280	-0.24037	-0.74291
134.0	78.0829	-0.42424	-0.72805	189.0	60.5887	-0.23816	-0.74292
135.0	77.6612	-0.41913	-0.72858	190.0	60.3517	-0.23598	-0.74293
136.0	77.2446	-0.41411	-0.72910	191.0	60.1168	-0.23383	-0.74292
137.0	76.8329	-0.40919	-0.72962	192.0	59.8840	-0.23171	-0.74291
138.0	76.4262	-0.40435	-0.73013	193.0	59.6533	-0.22961	-0.74289
139.0	76.0242	-0.39961	-0.73063	194.0	59.4248	-0.22755	-0.74286
140.0	75.6269	-0.39496	-0.73114	195.0	59.1982	-0.22551	-0.74282
141.0	75.2343	-0.39038	-0.73163	196.0	58.9737	-0.22349	-0.74277
142.0	74.8461	-0.38588	-0.73211	197.0	58.7512	-0.22150	-0.74272
143.0	74.4625	-0.38146	-0.73257	198.0	58.5307	-0.21954	-0.74266
144.0	74.0832	-0.37712	-0.73302	199.0	58.3122	-0.21760	-0.74260
145.0	73.7082	-0.37284	-0.73347	200.0	58.0955	-0.21569	-0.74253
146.0	73.3375	-0.36865	-0.73390	201.0	57.8808	-0.21380	-0.74245
147.0	72.9709	-0.36452	-0.73432	202.0	57.6679	-0.21193	-0.74236
148.0	72.6084	-0.36046	-0.73474	203.0	57.4569	-0.21009	-0.74226
149.0	72.2500	-0.35647	-0.73515	204.0	57.2477	-0.20827	-0.74216
150.0	71.8955	-0.35255	-0.73555	205.0	57.0404	-0.20647	-0.74205
151.0	71.5448	-0.34869	-0.73594	206.0	56.8348	-0.20470	-0.74193
152.0	71.1980	-0.34490	-0.73631	207.0	56.6310	-0.20294	-0.74181
153.0	70.8550	-0.34116	-0.73668	208.0	56.4289	-0.20121	-0.74168
154.0	70.5157	-0.33748	-0.73703	209.0	56.2285	-0.19950	-0.74155
155.0	70.1800	-0.33386	-0.73737	210.0	56.0299	-0.19782	-0.74141
156.0	69.8480	-0.33030	-0.73769	211.0	55.8329	-0.19615	-0.74127

INTERPOLATION TABLE

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	55.6376	-0.19450	-0.74111	267.0	46.9690	-0.12740	-0.72420
213.0	55.4439	-0.19287	-0.74095	268.0	46.8420	-0.12650	-0.72375
214.0	55.2518	-0.19126	-0.74078	269.0	46.7160	-0.12561	-0.72330
215.0	55.0614	-0.18967	-0.74061	270.0	46.5908	-0.12473	-0.72285
216.0	54.8725	-0.18810	-0.74043	271.0	46.4665	-0.12386	-0.72239
217.0	54.6852	-0.18655	-0.74025	272.0	46.3431	-0.12300	-0.72193
218.0	54.4994	-0.18501	-0.74006	273.0	46.2205	-0.12215	-0.72146
219.0	54.3151	-0.18350	-0.73986	274.0	46.0988	-0.12130	-0.72099
220.0	54.1324	-0.18200	-0.73966	275.0	45.9779	-0.12046	-0.72051
221.0	53.9511	-0.18052	-0.73945	276.0	45.8578	-0.11963	-0.72003
222.0	53.7713	-0.17905	-0.73924	277.0	45.7386	-0.11881	-0.71954
223.0	53.5930	-0.17761	-0.73902	278.0	45.6202	-0.11800	-0.71906
224.0	53.4161	-0.17618	-0.73879	279.0	45.5026	-0.11719	-0.71856
225.0	53.2406	-0.17476	-0.73856	280.0	45.3858	-0.11639	-0.71807
226.0	53.0666	-0.17336	-0.73832	281.0	45.2698	-0.11560	-0.71756
227.0	52.8939	-0.17198	-0.73808	282.0	45.1546	-0.11482	-0.71706
228.0	52.7226	-0.17062	-0.73784	283.0	45.0402	-0.11404	-0.71655
229.0	52.5527	-0.16927	-0.73758	284.0	44.9265	-0.11327	-0.71603
230.0	52.3841	-0.16793	-0.73733	285.0	44.8137	-0.11251	-0.71551
231.0	52.2168	-0.16661	-0.73706	286.0	44.7015	-0.11175	-0.71499
232.0	52.0508	-0.16531	-0.73679	287.0	44.5902	-0.11100	-0.71446
233.0	51.8862	-0.16401	-0.73652	288.0	44.4795	-0.11026	-0.71393
234.0	51.7228	-0.16274	-0.73624	289.0	44.3696	-0.10953	-0.71340
235.0	51.5607	-0.16147	-0.73595	290.0	44.2605	-0.10880	-0.71286
236.0	51.3999	-0.16022	-0.73566	291.0	44.1520	-0.10808	-0.71232
237.0	51.2403	-0.15899	-0.73537	292.0	44.0443	-0.10736	-0.71177
238.0	51.0819	-0.15777	-0.73507	293.0	43.9373	-0.10665	-0.71122
239.0	50.9247	-0.15656	-0.73476	294.0	43.8310	-0.10595	-0.71066
240.0	50.7688	-0.15536	-0.73445	295.0	43.7254	-0.10525	-0.71011
241.0	50.6140	-0.15418	-0.73414	296.0	43.6205	-0.10456	-0.70954
242.0	50.4604	-0.15301	-0.73381	297.0	43.5163	-0.10388	-0.70898
243.0	50.3080	-0.15185	-0.73349	298.0	43.4127	-0.10320	-0.70841
244.0	50.1567	-0.15071	-0.73315	299.0	43.3099	-0.10253	-0.70784
245.0	50.0065	-0.14957	-0.73282	300.0	43.2077	-0.10186	-0.70726
246.0	49.8575	-0.14845	-0.73248	301.0	43.1061	-0.10120	-0.70668
247.0	49.7096	-0.14734	-0.73213	302.0	43.0053	-0.10055	-0.70609
248.0	49.5628	-0.14625	-0.73178	303.0	42.9050	-9.9900e-2	-0.70551
249.0	49.4171	-0.14516	-0.73142	304.0	42.8055	-9.9257e-2	-0.70491
250.0	49.2725	-0.14409	-0.73106	305.0	42.7065	-9.8620e-2	-0.70432
251.0	49.1290	-0.14302	-0.73070	305.0	42.7065	-9.8620e-2	-0.70432
252.0	48.9865	-0.14197	-0.73033	306.0	42.6082	-9.7988e-2	-0.70372
253.0	48.8450	-0.14093	-0.72995	307.0	42.5105	-9.7361e-2	-0.70312
254.0	48.7046	-0.13990	-0.72957	308.0	42.4135	-9.6740e-2	-0.70251
255.0	48.5652	-0.13887	-0.72918	309.0	42.3171	-9.6124e-2	-0.70190
256.0	48.4269	-0.13786	-0.72879	310.0	42.2212	-9.5514e-2	-0.70129
257.0	48.2895	-0.13686	-0.72840	311.0	42.1260	-9.4909e-2	-0.70067
258.0	48.1531	-0.13587	-0.72800	312.0	42.0314	-9.4309e-2	-0.70006
259.0	48.0177	-0.13489	-0.72760	313.0	41.9374	-9.3714e-2	-0.69943
260.0	47.8833	-0.13392	-0.72719	314.0	41.8440	-9.3124e-2	-0.69881
261.0	47.7499	-0.13296	-0.72678	315.0	41.7512	-9.2539e-2	-0.69818
262.0	47.6174	-0.13201	-0.72636	316.0	41.6589	-9.1959e-2	-0.69755
263.0	47.4859	-0.13107	-0.72594	317.0	41.5672	-9.1384e-2	-0.69691
264.0	47.3553	-0.13014	-0.72551	318.0	41.4761	-9.0814e-2	-0.69627
265.0	47.2256	-0.12922	-0.72507	319.0	41.3856	-9.0248e-2	-0.69563
266.0	47.0968	-0.12830	-0.72464	320.0	41.2957	-8.9687e-2	-0.69499

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Sales: (614) 891-2244 • Fax: (614) 891-1392 • sales@lakeshore.com • www.lakeshore.com

INTERPOLATION TABLE

Calibration Report: 430503
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29558
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	41.2062	-8.9131e-2	-0.69434				
322.0	41.1174	-8.8580e-2	-0.69369				
323.0	41.0291	-8.8033e-2	-0.69304				
324.0	40.9413	-8.7491e-2	-0.69238				
325.0	40.8541	-8.6953e-2	-0.69172				

BREAKPOINTS 340 FORMAT

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29558
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.61122,325.000	Point 56: 2.04990, 80.500	Point 111: 2.66427, 9.350	Point 166: 4.27380, 0.525
Point 2: 1.61684,319.000	Point 57: 2.05942, 78.000	Point 112: 2.67868, 8.900	Point 167: 4.32045, 0.505
Point 3: 1.62211,313.500	Point 58: 2.06725, 76.000	Point 113: 2.69226, 8.500	Point 168: 4.36292, 0.488
Point 4: 1.62749,308.000	Point 59: 2.07526, 74.000	Point 114: 2.70661, 8.100	Point 169: 4.40566, 0.472
Point 5: 1.63300,302.500	Point 60: 2.08348, 72.000	Point 115: 2.72186, 7.700	Point 170: 4.45133, 0.456
Point 6: 1.63864,297.000	Point 61: 2.09192, 70.000	Point 116: 2.73812, 7.300	Point 171: 4.50044, 0.440
Point 7: 1.64441,291.500	Point 62: 2.10058, 68.000	Point 117: 2.75333, 6.950	Point 172: 4.55339, 0.424
Point 8: 1.65031,286.000	Point 63: 2.10949, 66.000	Point 118: 2.76950, 6.600	Point 173: 4.61061, 0.408
Point 9: 1.65635,280.500	Point 64: 2.11865, 64.000	Point 119: 2.78682, 6.250	Point 174: 4.67229, 0.392
Point 10: 1.66254,275.000	Point 65: 2.12809, 62.000	Point 120: 2.80545, 5.900	Point 175: 4.73839, 0.376
Point 11: 1.66887,269.500	Point 66: 2.13782, 60.000	Point 121: 2.82378, 5.580	Point 176: 4.81793, 0.358
Point 12: 1.67536,264.000	Point 67: 2.14684, 58.200	Point 122: 2.84356, 5.260	Point 177: 4.90328, 0.340
Point 13: 1.68139,259.000	Point 68: 2.15613, 56.400	Point 123: 2.86362, 4.960	Point 178: 4.98399, 0.324
Point 14: 1.68756,254.000	Point 69: 2.16571, 54.600	Point 124: 2.88533, 4.660	Point 179: 5.04951, 0.312
Point 15: 1.69387,249.000	Point 70: 2.17558, 52.800	Point 125: 2.90738, 4.380	Point 180: 5.11081, 0.302
Point 16: 1.70032,244.000	Point 71: 2.18578, 51.000	Point 126: 2.93136, 4.100	Point 181: 5.12427, 0.300
Point 17: 1.70692,239.000	Point 72: 2.19633, 49.200	Point 127: 2.95190, 3.880	Point 182: 5.12427, 0.300
Point 18: 1.71367,234.000	Point 73: 2.20724, 47.400	Point 128: 2.96984, 3.700	
Point 19: 1.72058,229.000	Point 74: 2.21855, 45.600	Point 129: 2.98896, 3.520	
Point 20: 1.72766,224.000	Point 75: 2.22897, 44.000	Point 130: 3.00832, 3.350	
Point 21: 1.73491,219.000	Point 76: 2.23974, 42.400	Point 131: 3.02908, 3.180	
Point 22: 1.74233,214.000	Point 77: 2.25090, 40.800	Point 132: 3.04874, 3.030	
Point 23: 1.74994,209.000	Point 78: 2.26248, 39.200	Point 133: 3.06884, 2.890	
Point 24: 1.75774,204.000	Point 79: 2.27450, 37.600	Point 134: 3.09672, 2.710	
Point 25: 1.76574,199.000	Point 80: 2.28621, 36.100	Point 135: 3.12181, 2.560	
Point 26: 1.77395,194.000	Point 81: 2.29837, 34.600	Point 136: 3.14734, 2.420	
Point 27: 1.78238,189.000	Point 82: 2.31104, 33.100	Point 137: 3.17509, 2.280	
Point 28: 1.79102,184.000	Point 83: 2.32423, 31.600	Point 138: 3.20327, 2.150	
Point 29: 1.79901,179.500	Point 84: 2.33708, 30.200	Point 139: 3.23406, 2.020	
Point 30: 1.80720,175.000	Point 85: 2.35048, 28.800	Point 140: 3.26800, 1.890	
Point 31: 1.81559,170.500	Point 86: 2.36448, 27.400	Point 141: 3.30270, 1.770	
Point 32: 1.82419,166.000	Point 87: 2.37809, 26.100	Point 142: 3.33780, 1.660	
Point 33: 1.83302,161.500	Point 88: 2.39232, 24.800	Point 143: 3.37662, 1.550	
Point 34: 1.84209,157.000	Point 89: 2.40725, 23.500	Point 144: 3.41999, 1.440	
Point 35: 1.85140,152.500	Point 90: 2.42175, 22.300	Point 145: 3.46431, 1.340	
Point 36: 1.86097,148.000	Point 91: 2.43699, 21.100	Point 146: 3.51401, 1.240	
Point 37: 1.87081,143.500	Point 92: 2.45038, 20.100	Point 147: 3.54756, 1.180	
Point 38: 1.88093,139.000	Point 93: 2.46089, 19.350	Point 148: 3.57116, 1.140	
Point 39: 1.89135,134.500	Point 94: 2.47102, 18.650	Point 149: 3.59618, 1.100	
Point 40: 1.90090,130.500	Point 95: 2.48077, 18.000	Point 150: 3.62271, 1.060	
Point 41: 1.91069,126.500	Point 96: 2.49088, 17.350	Point 151: 3.65094, 1.020	
Point 42: 1.92078,122.500	Point 97: 2.50138, 16.700	Point 152: 3.68106, 0.980	
Point 43: 1.93116,118.500	Point 98: 2.51146, 16.100	Point 153: 3.71329, 0.940	
Point 44: 1.94187,114.500	Point 99: 2.52192, 15.500	Point 154: 3.74347, 0.905	
Point 45: 1.95292,110.500	Point 100: 2.53282, 14.900	Point 155: 3.77560, 0.870	
Point 46: 1.96433,106.500	Point 101: 2.54323, 14.350	Point 156: 3.80998, 0.835	
Point 47: 1.97466,103.000	Point 102: 2.55405, 13.800	Point 157: 3.84685, 0.800	
Point 48: 1.98225,100.500	Point 103: 2.56535, 13.250	Point 158: 3.88654, 0.765	
Point 49: 1.99000, 98.000	Point 104: 2.57717, 12.700	Point 159: 3.92937, 0.730	
Point 50: 1.99793, 95.500	Point 105: 2.58842, 12.200	Point 160: 3.96903, 0.700	
Point 51: 2.00605, 93.000	Point 106: 2.60017, 11.700	Point 161: 4.01150, 0.670	
Point 52: 2.01437, 90.500	Point 107: 2.61250, 11.200	Point 162: 4.05732, 0.640	
Point 53: 2.02290, 88.000	Point 108: 2.62547, 10.700	Point 163: 4.10691, 0.610	
Point 54: 2.03166, 85.500	Point 109: 2.63775, 10.250	Point 164: 4.16080, 0.580	
Point 55: 2.04065, 83.000	Point 110: 2.65065, 9.800	Point 165: 4.21982, 0.550	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 54

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.61124	325.0	31	2.65970	9.5
2	1.61216	324.0	32	2.72193	7.7
3	1.62357	312.0	33	2.77933	6.4
4	1.63865	297.0	34	2.83483	5.4
5	1.65470	282.0	35	2.89005	4.6
6	1.67181	267.0	36	2.94065	4.0
7	1.69008	252.0	37	2.99127	3.5
8	1.70961	237.0	38	3.02667	3.2
9	1.73055	222.0	39	3.05303	3.0
10	1.75305	207.0	40	3.08269	2.8
11	1.77731	192.0	41	3.17117	2.3
12	1.80355	177.0	42	3.23931	2.0
13	1.83205	162.0	43	3.32490	1.7
14	1.86315	147.0	44	3.39608	1.5
15	1.89731	132.0	45	3.48388	1.3
16	1.93516	117.0	46	3.53630	1.2
17	1.97769	102.0	47	3.59628	1.1
18	2.02639	87.0	48	3.66589	1.0
19	2.08349	72.0	49	3.74806	.9
20	2.13294	61.0	50	3.84705	.8
21	2.16091	55.5	51	3.96920	.7
22	2.19162	50.0	52	4.12466	.6
23	2.22245	45.0	53	4.64122	.4
24	2.25667	40.0	54	5.12427	.3
25	2.29512	35.0			
26	2.33900	30.0			
27	2.39014	25.0			
28	2.45180	20.0			
29	2.52735	15.2			
30	2.59545	11.9			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	94.849
1000	3.422
10000	0.678
100000	0.325

BREAKPOINTS 234 FORMAT

Calibration Report: 430503 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29558
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.005K
10 - 20K:	0.008K
20 - 40K:	0.014K
40 - 100K:	0.028K
> 100K:	0.122K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	315.696	41.68694	1.620	56	7.749	524.8075	2.720
2	295.701	43.65158	1.640	57	7.258	549.5409	2.740
3	277.251	45.70882	1.660	58	6.805	575.4399	2.760
4	260.151	47.86301	1.680	59	6.387	602.5596	2.780
5	244.253	50.11872	1.700	60	6.002	630.9573	2.800
6	229.426	52.48075	1.720	61	5.646	660.6934	2.820
7	215.567	54.95409	1.740	62	5.318	691.8310	2.840
8	202.586	57.54399	1.760	63	5.014	724.4360	2.860
9	190.406	60.25596	1.780	64	4.733	758.5776	2.880
10	178.960	63.09573	1.800	65	4.472	794.3282	2.900
11	168.187	66.06934	1.820	66	4.231	831.7638	2.920
12	158.037	69.18310	1.840	67	4.007	870.9636	2.940
13	148.457	72.44360	1.860	68	3.798	912.0108	2.960
14	139.418	75.85776	1.880	69	3.604	954.9926	2.980
15	130.878	79.43282	1.900	70	3.423	1000.000	3.000
16	122.813	83.17638	1.920	71	3.097	1096.478	3.040
17	115.198	87.09636	1.940	72	2.817	1202.264	3.080
18	108.012	91.20108	1.960	73	2.571	1318.257	3.120
19	101.239	95.49926	1.980	74	2.356	1445.440	3.160
20	94.861	100.0000	2.000	75	2.165	1584.893	3.200
21	88.847	104.7129	2.020	76	1.997	1737.801	3.240
22	83.182	109.6478	2.040	77	1.848	1905.461	3.280
23	77.855	114.8154	2.060	78	1.715	2089.296	3.320
24	72.844	120.2264	2.080	79	1.597	2290.868	3.360
25	68.136	125.8925	2.100	80	1.490	2511.886	3.400
26	63.712	131.8257	2.120	81	1.394	2754.229	3.440
27	59.566	138.0384	2.140	82	1.308	3019.952	3.480
28	55.672	144.5440	2.160	83	1.230	3311.311	3.520
29	52.017	151.3561	2.180	84	1.159	3630.781	3.560
30	48.591	158.4893	2.200	85	1.094	3981.072	3.600
31	45.380	165.9587	2.220	86	1.036	4365.158	3.640
32	42.366	173.7801	2.240	87	0.982	4786.301	3.680
33	39.541	181.9701	2.260	88	0.932	5248.075	3.720
34	36.892	190.5461	2.280	89	0.887	5754.399	3.760
35	34.409	199.5262	2.300	90	0.845	6309.573	3.800
36	32.079	208.9296	2.320	91	0.807	6918.310	3.840
37	29.895	218.7762	2.340	92	0.771	7585.776	3.880
38	27.846	229.0868	2.360	93	0.738	8317.638	3.920
39	25.926	239.8833	2.380	94	0.707	9120.108	3.960
40	24.128	251.1886	2.400	95	0.678	10000.00	4.000
41	22.446	263.0268	2.420	96	0.614	12589.25	4.100
42	20.875	275.4229	2.440	97	0.560	15848.93	4.200
43	19.415	288.4032	2.460	98	0.514	19952.62	4.300
44	18.052	301.9952	2.480	99	0.474	25118.86	4.400
45	16.786	316.2278	2.500	100	0.440	31622.78	4.500
46	15.611	331.1311	2.520	101	0.411	39810.72	4.600
47	14.520	346.7369	2.540	102	0.385	50118.72	4.700
48	13.509	363.0781	2.560	103	0.362	63095.73	4.800
49	12.574	380.1894	2.580	104	0.341	79432.82	4.900
50	11.709	398.1072	2.600	105	0.321	100000.0	5.000
51	10.909	416.8694	2.620	106	0.304	125892.5	5.100
52	10.171	436.5158	2.640	107	0.289	158489.3	5.200
53	9.490	457.0882	2.660	108	0.276	199526.2	5.300
54	8.862	478.6301	2.680	109	0.265	251188.6	5.400
55	8.283	501.1872	2.700				

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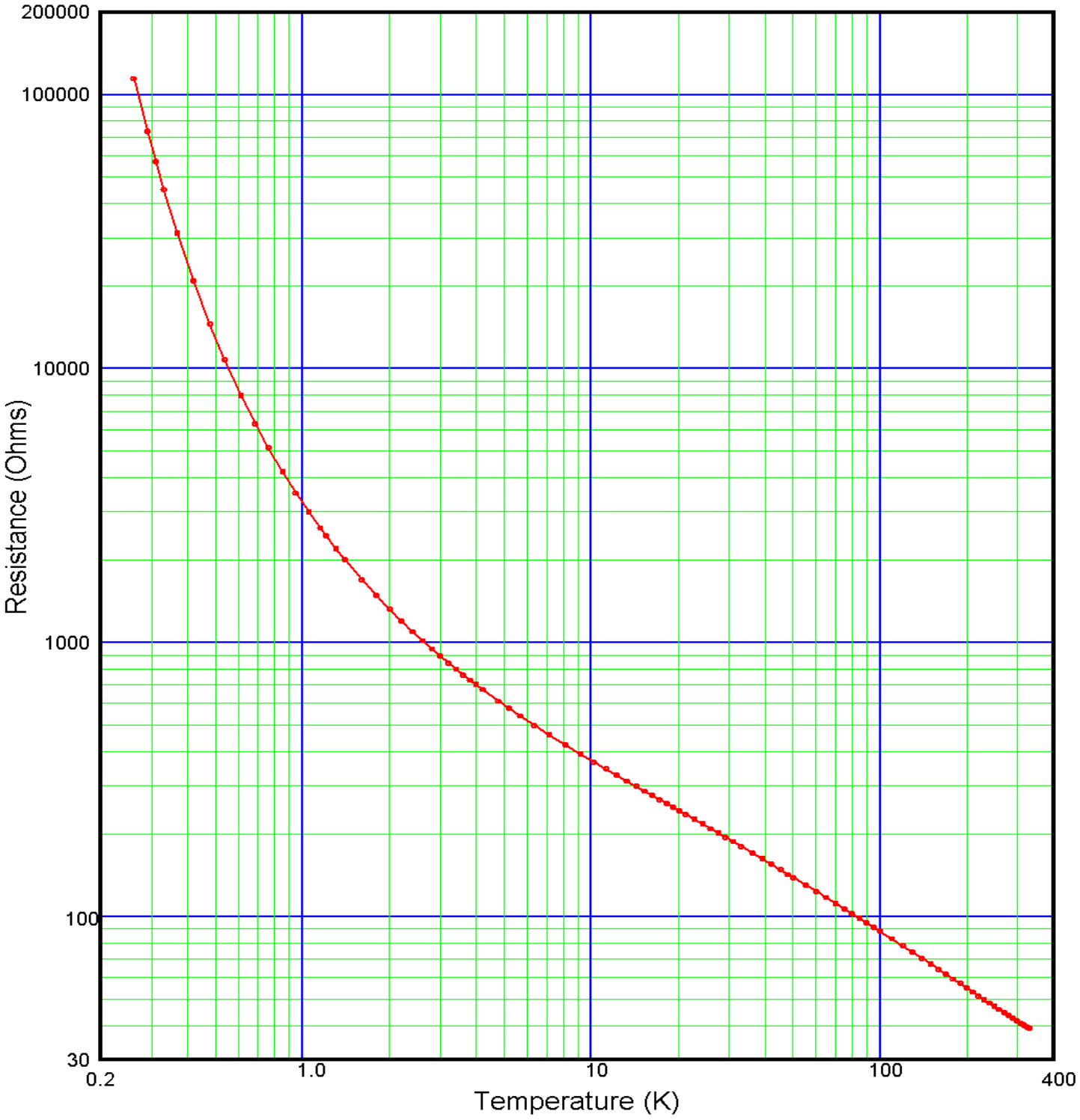
DATA PLOT

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260263	114482.	51	21.1957	236.310
2	0.290070	73403.0	52	22.7433	226.527
3	0.309924	56917.8	53	24.3124	217.633
4	0.330423	45030.0	54	25.9104	209.389
5	0.367681	31244.0	55	27.5351	201.824
6	0.418437	20865.8	56	29.1499	194.910
7	0.476695	14530.0	57	30.9456	187.887
8	0.535625	10808.9	58	33.0447	180.399
9	0.610598	7999.10	59	36.0631	170.870
10	0.685080	6293.90	60	39.0785	162.472
11	0.761444	5140.45	61	42.0928	155.046
12	0.852988	4203.13	62	45.1019	148.406
13	0.949559	3515.81	63	48.1165	142.425
14	1.04987	3003.76	64	50.1168	138.771
15	1.15095	2620.29	65	55.1048	130.574
16	1.20701	2449.76	66	60.0832	123.496
17	1.30428	2203.58	67	65.0494	117.299
18	1.40029	2006.82	68	70.0203	111.818
19	1.60142	1699.96	69	74.9898	106.922
20	1.80078	1484.59	70	79.9558	102.515
21	2.00117	1322.85	71	84.9194	98.5257
22	2.20047	1197.94	72	89.8852	94.8851
23	2.40411	1096.42	73	94.8510	91.5541
24	2.60440	1015.12	74	99.8244	88.4772
25	2.80621	947.162	75	109.872	82.9437
26	2.99429	893.421	76	119.711	78.2538
27	3.19996	843.033	77	129.646	74.1013
28	3.40053	800.389	78	139.580	70.4243
29	3.60041	763.179	79	149.515	67.1474
30	3.80476	729.577	80	159.452	64.2036
31	3.98589	702.839	81	169.388	61.5469
32	4.19792	674.667	82	179.323	59.1374
33	4.78124	611.103	83	189.249	56.9460
34	5.17097	576.778	84	199.163	54.9445
35	5.66400	540.306	85	209.095	53.1014
36	6.34608	499.141	86	219.026	51.4083
37	7.14136	460.822	87	228.945	49.8467
38	8.14378	422.795	88	238.869	48.3999
39	9.16813	392.057	89	248.794	47.0557
40	10.1984	366.844	90	258.705	45.8113
41	11.2327	345.658	91	268.638	44.6495
42	12.2578	327.727	92	278.545	43.5657
43	13.2748	312.356	93	288.484	42.5546
44	14.2821	298.982	94	298.403	41.6013
45	15.2778	287.200	95	308.331	40.7122
46	16.2644	276.649	96	313.294	40.2859
47	17.2365	267.264	97	318.251	39.8788
48	18.2062	258.709	98	324.189	39.4018
49	19.1720	250.883	99	328.173	39.0890
50	20.1355	243.653			

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POLYNOMIAL EQUATION

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	2.99K
6.431e+4 Ohms	to	893.4 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.90330088982 ZU = 5.05873720794

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.084627	1.6730E-04	6483.09
1	-1.247677	2.7734E-04	-4498.77
2	0.617727	2.4117E-04	2561.34
3	-0.273648	1.9482E-04	-1404.64
4	0.111019	1.6217E-04	684.57
5	-0.042494	1.6517E-04	-257.27
6	0.015468	1.8422E-04	83.97
7	-0.005407	2.1209E-04	-25.49
8	0.001354	2.1968E-04	6.16
9	-0.000728	1.9175E-04	-3.80

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 9
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	114482.0	0.26026	0.26024	0.02
2	73403.00	0.29007	0.29029	-0.22
3	56917.80	0.30992	0.30959	0.33
4	45030.00	0.33042	0.33036	0.06
5	31244.00	0.36768	0.36803	-0.35
6	20865.80	0.41844	0.41860	-0.17
7	14530.00	0.47669	0.47609	0.60
8	10808.90	0.53563	0.53539	0.24
9	7999.100	0.61060	0.61102	-0.43
10	6293.900	0.68508	0.68572	-0.64
11	5140.450	0.76144	0.76176	-0.31
12	4203.130	0.85299	0.85243	0.56
13	3515.810	0.94956	0.94878	0.78
14	3003.760	1.04987	1.04931	0.56
15	2620.290	1.15095	1.15115	-0.21
16	2449.760	1.20701	1.20721	-0.20
17	2203.583	1.30428	1.30457	-0.28
18	2006.819	1.40029	1.40113	-0.84
19	1699.962	1.60142	1.60195	-0.53
20	1484.586	1.80078	1.80047	0.30
21	1322.852	2.00117	2.00033	0.84
22	1197.944	2.20047	2.19989	0.58
23	1096.419	2.40411	2.40395	0.16
24	1015.118	2.60440	2.60476	-0.37
25	947.1618	2.80621	2.80672	-0.52
26	893.4212	2.99429	2.99479	-0.50
27	843.0333	3.19996	3.19982	0.15
28	800.3886	3.40053	3.40015	0.38

Order of Fit = 9 RMS error of fit = .45 mK
Largest absolute error = 0.84 mK at data point no. 21

POLYNOMIAL EQUATION

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

2.99K	to	20.1K
893.4 Ohms	to	243.7 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.35511962714 ZU = 3.0065164465

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.617173	5.1399E-04	18710.67
1	-9.421628	8.1114E-04	-11615.31
2	2.975224	7.8109E-04	3809.06
3	-0.649220	7.1150E-04	-912.46
4	0.085639	6.7789E-04	126.33
5	0.000719	6.6511E-04	1.08

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1015.118	2.60476	2.60791	-3.14
25	947.1618	2.80672	2.80444	2.28
26	893.4212	2.99479	2.99177	3.02
27	843.0333	3.19996	3.19796	2.00
28	800.3886	3.40053	3.40008	0.45
29	763.1791	3.60041	3.60116	-0.76
30	729.5771	3.80476	3.80632	-1.57
31	702.8392	3.98589	3.98836	-2.47
32	674.6669	4.19792	4.20127	-3.34
33	611.1032	4.78124	4.78208	-0.84
34	576.7780	5.17097	5.17104	-0.06
35	540.3061	5.66400	5.66220	1.81
36	499.1412	6.34608	6.34301	3.07
37	460.8220	7.14136	7.13927	2.09
38	422.7947	8.14378	8.14331	0.47
39	392.0573	9.16813	9.16768	0.44
40	366.8444	10.19845	10.19779	0.66
41	345.6580	11.23272	11.23365	-0.93
42	327.7265	12.25777	12.26198	-4.21
43	312.3562	13.27480	13.27802	-3.21
44	298.9821	14.28207	14.28251	-0.44
45	287.2001	15.27775	15.27612	1.63
46	276.6488	16.26439	16.26570	-1.31
47	267.2644	17.23650	17.23617	0.34
48	258.7093	18.20618	18.20458	1.60
49	250.8828	19.17204	19.16880	3.24
50	243.6529	20.13554	20.13346	2.08
51	236.3099	21.19571	21.19379	1.91
52	226.5268	22.74335	22.74816	-4.82

Order of Fit = 5 RMS error of fit = 2.24 mK
Largest absolute error = -4.82 mK at data point no. 52

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POLYNOMIAL EQUATION

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	94.8K
243.7 Ohms	to	91.55 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.91878342068 ZU = 2.41281205613

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.942476	4.9959E-04	109974.82
1	-44.688017	8.0613E-04	-55435.45
2	9.003185	7.5171E-04	11976.89
3	-1.155146	7.0395E-04	-1640.94
4	0.094909	6.5978E-04	143.85
5	0.009774	6.4540E-04	15.14
6	-0.002598	6.1298E-04	-4.24

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	258.7093	18.20458	18.20458	-0.01
49	250.8828	19.16880	19.16911	-0.31
50	243.6529	20.13346	20.13387	-0.41
51	236.3099	21.19571	21.19354	2.17
52	226.5268	22.74335	22.74481	-1.46
53	217.6333	24.31242	24.31126	1.16
54	209.3892	25.91042	25.91499	-4.57
55	201.8241	27.53514	27.53248	2.66
56	194.9102	29.14988	29.14879	1.10
57	187.8868	30.94560	30.94312	2.48
58	180.3995	33.04465	33.04815	-3.50
59	170.8697	36.06313	36.06083	2.29
60	162.4721	39.07849	39.08138	-2.89
61	155.0463	42.09276	42.09249	0.27
62	148.4063	45.10189	45.10322	-1.33
63	142.4247	48.11651	48.11505	1.45
64	138.7706	50.11676	50.11388	2.88
65	130.5741	55.10478	55.10551	-0.73
66	123.4956	60.08316	60.08271	0.45
67	117.2993	65.04943	65.05364	-4.21
68	111.8182	70.02028	70.02002	0.26
69	106.9222	74.98982	74.98709	2.74
70	102.5145	79.95579	79.95581	-0.01
71	98.52574	84.91945	84.91849	0.96
72	94.88512	89.88522	89.88769	-2.47
73	91.55414	94.85099	94.84890	2.10
74	88.47724	99.82444	99.82587	-1.42
75	82.94370	109.87170	109.87136	0.34

Order of Fit = 6 RMS error of fit = 2.08 mK
Largest absolute error = -4.57 mK at data point no. 54

POLYNOMIAL EQUATION

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

94.8K	to	325.K
91.55 Ohms	to	39.34 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.59205419835 ZU = 1.99354968507

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.422745	2.6682E-03	69867.58
1	-118.671993	4.0668E-03	-29181.00
2	19.559527	3.8423E-03	5090.60
3	-2.853102	3.8329E-03	-744.37
4	0.552756	3.7062E-03	149.14
5	-0.106285	3.5567E-03	-29.88
6	0.019216	3.4622E-03	5.55

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	98.52574	84.91849	84.92286	-4.38
72	94.88512	89.88769	89.88311	4.57
73	91.55414	94.84890	94.84365	5.24
74	88.47724	99.82444	99.82346	0.98
75	82.94370	109.87170	109.88146	-9.76
76	78.25378	119.71127	119.71652	-5.25
77	74.10127	129.64615	129.64228	3.87
78	70.42432	139.58011	139.57660	3.51
79	67.14739	149.51495	149.50749	7.46
80	64.20359	159.45198	159.44887	3.12
81	61.54686	169.38817	169.39004	-1.87
82	59.13736	179.32328	179.33030	-7.02
83	56.94602	189.24883	189.25293	-4.09
84	54.94452	199.16259	199.16100	1.59
85	53.10141	209.09494	209.10270	-7.76
86	51.40830	219.02558	219.02413	1.45
87	49.84672	228.94547	228.93695	8.52
88	48.39986	238.86856	238.86184	6.72
89	47.05573	248.79414	248.80336	-9.22
90	45.81128	258.70507	258.70577	-0.70
91	44.64953	268.63764	268.63073	6.92
92	43.56569	278.54523	278.55360	-8.36
93	42.55459	288.48364	288.45515	28.49
94	41.60133	298.40269	298.42433	-21.64
95	40.71221	308.33096	308.33807	-7.11
96	40.28594	313.29384	313.32028	-26.43
97	39.87880	318.25084	318.22695	23.89
98	39.40182	324.18878	324.16905	19.73
99	39.08897	328.17314	328.18562	-12.48

Order of Fit = 6 RMS error of fit = 11.57 mK
Largest absolute error = 28.49 mK at data point no. 93

INTERPOLATION TABLE

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	64307.8	-8.4895e+5	-3.9604	48.00	142.642	-1.8949	-0.63765
0.4000	23955.1	-1.8527e+5	-3.0937	49.00	140.778	-1.8344	-0.63849
0.5000	12795.1	-64994.	-2.5398	50.00	138.973	-1.7769	-0.63930
0.6000	8322.92	-30434.	-2.1940	51.00	137.223	-1.7222	-0.64008
0.7000	6042.08	-16982.	-1.9674	52.00	135.527	-1.6701	-0.64081
0.8000	4700.22	-10565.	-1.7982	53.00	133.882	-1.6205	-0.64150
0.9000	3833.41	-7096.9	-1.6662	54.00	132.286	-1.5732	-0.64218
1.000	3234.51	-5047.0	-1.5604	55.00	130.735	-1.5281	-0.64287
2.000	1323.08	-706.12	-1.0674	56.00	129.229	-1.4851	-0.64357
3.000	891.228	-265.37	-0.89328	57.00	127.764	-1.4440	-0.64421
4.000	701.217	-138.92	-0.79242	58.00	126.340	-1.4046	-0.64483
4.200	674.826	-125.37	-0.78028	59.00	124.954	-1.3670	-0.64545
5.000	591.196	-87.257	-0.73797	60.00	123.606	-1.3310	-0.64607
6.000	518.716	-60.310	-0.69760	61.00	122.292	-1.2965	-0.64669
7.000	466.913	-44.573	-0.66825	62.00	121.012	-1.2634	-0.64728
8.000	427.671	-34.592	-0.64707	63.00	119.765	-1.2316	-0.64786
9.000	396.649	-27.848	-0.63186	64.00	118.548	-1.2011	-0.64844
10.00	371.325	-23.050	-0.62075	65.00	117.362	-1.1719	-0.64902
11.00	350.132	-19.500	-0.61264	66.00	116.204	-1.1438	-0.64961
12.00	332.044	-16.788	-0.60672	67.00	115.074	-1.1167	-0.65018
13.00	316.360	-14.661	-0.60244	68.00	113.971	-1.0907	-0.65074
14.00	302.582	-12.955	-0.59942	69.00	112.893	-1.0656	-0.65131
15.00	290.345	-11.563	-0.59736	70.00	111.839	-1.0415	-0.65189
16.00	279.377	-10.408	-0.59605	71.00	110.809	-1.0183	-0.65246
17.00	269.468	-9.4368	-0.59534	72.00	109.802	-0.99589	-0.65303
18.00	260.455	-8.6114	-0.59513	73.00	108.817	-0.97427	-0.65359
19.00	252.207	-7.9006	-0.59519	74.00	107.853	-0.95341	-0.65415
20.00	244.623	-7.2846	-0.59558	75.00	106.910	-0.93329	-0.65472
21.00	237.608	-6.7559	-0.59709	76.00	105.987	-0.91386	-0.65530
22.00	231.091	-6.2874	-0.59856	77.00	105.082	-0.89508	-0.65588
23.00	225.015	-5.8734	-0.60036	77.35	104.770	-0.88865	-0.65608
24.00	219.330	-5.5041	-0.60228	78.00	104.196	-0.87692	-0.65645
25.00	213.994	-5.1726	-0.60429	79.00	103.328	-0.85938	-0.65704
26.00	208.974	-4.8733	-0.60632	80.00	102.477	-0.84243	-0.65765
27.00	204.238	-4.6019	-0.60836	81.00	101.643	-0.82602	-0.65826
28.00	199.762	-4.3547	-0.61039	82.00	100.825	-0.81009	-0.65884
29.00	195.522	-4.1286	-0.61235	83.00	100.023	-0.79464	-0.65940
30.00	191.499	-3.9211	-0.61428	84.00	99.2357	-0.77964	-0.65994
31.00	187.674	-3.7301	-0.61614	85.00	98.4633	-0.76509	-0.66048
32.00	184.034	-3.5537	-0.61792	86.00	97.7053	-0.75103	-0.66105
33.00	180.563	-3.3904	-0.61964	87.00	96.9611	-0.73747	-0.66170
34.00	177.249	-3.2389	-0.62129	88.00	96.2302	-0.72439	-0.66244
35.00	174.081	-3.0978	-0.62283	89.00	95.5122	-0.71180	-0.66327
36.00	171.050	-2.9664	-0.62433	90.00	94.8065	-0.69966	-0.66419
37.00	168.145	-2.8438	-0.62578	91.00	94.1127	-0.68782	-0.66507
38.00	165.360	-2.7289	-0.62712	92.00	93.4308	-0.67616	-0.66580
39.00	162.685	-2.6214	-0.62841	93.00	92.7604	-0.66467	-0.66639
40.00	160.115	-2.5204	-0.62965	94.00	92.1014	-0.65335	-0.66682
41.00	157.642	-2.4254	-0.63081	95.00	91.4536	-0.64221	-0.66711
42.00	155.262	-2.3361	-0.63193	96.00	90.8168	-0.63137	-0.66740
43.00	152.968	-2.2519	-0.63300	97.00	90.1907	-0.62091	-0.66778
44.00	150.757	-2.1723	-0.63401	98.00	89.5749	-0.61081	-0.66826
45.00	148.622	-2.0972	-0.63498	99.00	88.9690	-0.60107	-0.66884
46.00	146.561	-2.0261	-0.63593	100.0	88.3726	-0.59168	-0.66953
47.00	144.569	-1.9588	-0.63680	101.0	87.7855	-0.58255	-0.67025

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INTERPOLATION TABLE

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	87.2075	-0.57364	-0.67094	157.0	64.9004	-0.28816	-0.69709
103.0	86.6382	-0.56493	-0.67162	158.0	64.6137	-0.28518	-0.69735
104.0	86.0775	-0.55643	-0.67228	159.0	64.3300	-0.28224	-0.69759
105.0	85.5253	-0.54812	-0.67293	160.0	64.0492	-0.27935	-0.69783
106.0	84.9812	-0.54001	-0.67358	161.0	63.7713	-0.27650	-0.69807
107.0	84.4452	-0.53210	-0.67422	162.0	63.4962	-0.27369	-0.69829
108.0	83.9170	-0.52437	-0.67485	163.0	63.2239	-0.27093	-0.69850
109.0	83.3964	-0.51682	-0.67549	164.0	62.9543	-0.26821	-0.69870
110.0	82.8833	-0.50945	-0.67613	165.0	62.6874	-0.26553	-0.69889
111.0	82.3774	-0.50225	-0.67676	166.0	62.4232	-0.26288	-0.69908
112.0	81.8787	-0.49520	-0.67738	167.0	62.1617	-0.26028	-0.69926
113.0	81.3870	-0.48831	-0.67798	168.0	61.9027	-0.25772	-0.69943
114.0	80.9020	-0.48156	-0.67857	169.0	61.6462	-0.25519	-0.69960
115.0	80.4238	-0.47496	-0.67916	170.0	61.3923	-0.25271	-0.69976
116.0	79.9521	-0.46851	-0.67974	171.0	61.1408	-0.25025	-0.69992
117.0	79.4867	-0.46219	-0.68032	172.0	60.8917	-0.24784	-0.70006
118.0	79.0276	-0.45601	-0.68090	173.0	60.6451	-0.24545	-0.70019
119.0	78.5747	-0.44997	-0.68148	174.0	60.4008	-0.24310	-0.70031
120.0	78.1277	-0.44406	-0.68206	175.0	60.1589	-0.24078	-0.70043
121.0	77.6865	-0.43827	-0.68263	176.0	59.9193	-0.23850	-0.70054
122.0	77.2511	-0.43259	-0.68318	177.0	59.6819	-0.23625	-0.70064
123.0	76.8213	-0.42703	-0.68372	178.0	59.4467	-0.23402	-0.70074
124.0	76.3970	-0.42157	-0.68425	179.0	59.2138	-0.23184	-0.70082
125.0	75.9781	-0.41622	-0.68477	180.0	58.9831	-0.22968	-0.70091
126.0	75.5645	-0.41097	-0.68528	181.0	58.7545	-0.22755	-0.70098
127.0	75.1561	-0.40583	-0.68578	182.0	58.5280	-0.22544	-0.70105
128.0	74.7528	-0.40079	-0.68627	183.0	58.3036	-0.22337	-0.70110
129.0	74.3545	-0.39585	-0.68677	184.0	58.0812	-0.22132	-0.70115
130.0	73.9611	-0.39100	-0.68726	185.0	57.8609	-0.21930	-0.70119
131.0	73.5725	-0.38625	-0.68774	186.0	57.6426	-0.21731	-0.70122
132.0	73.1886	-0.38158	-0.68820	187.0	57.4263	-0.21535	-0.70124
133.0	72.8093	-0.37700	-0.68865	188.0	57.2119	-0.21341	-0.70126
134.0	72.4346	-0.37249	-0.68910	189.0	56.9995	-0.21149	-0.70127
135.0	72.0643	-0.36808	-0.68953	190.0	56.7889	-0.20960	-0.70127
136.0	71.6984	-0.36374	-0.68995	191.0	56.5802	-0.20774	-0.70127
137.0	71.3368	-0.35948	-0.69037	192.0	56.3734	-0.20590	-0.70126
138.0	70.9794	-0.35530	-0.69078	193.0	56.1684	-0.20408	-0.70123
139.0	70.6261	-0.35120	-0.69119	194.0	55.9653	-0.20228	-0.70120
140.0	70.2770	-0.34717	-0.69160	195.0	55.7639	-0.20051	-0.70116
141.0	69.9318	-0.34321	-0.69199	196.0	55.5642	-0.19876	-0.70112
142.0	69.5905	-0.33931	-0.69237	197.0	55.3663	-0.19703	-0.70107
143.0	69.2531	-0.33549	-0.69274	198.0	55.1702	-0.19533	-0.70101
144.0	68.9195	-0.33173	-0.69310	199.0	54.9757	-0.19364	-0.70094
145.0	68.5897	-0.32803	-0.69346	200.0	54.7829	-0.19198	-0.70087
146.0	68.2635	-0.32439	-0.69380	201.0	54.5917	-0.19033	-0.70079
147.0	67.9409	-0.32082	-0.69414	202.0	54.4022	-0.18871	-0.70070
148.0	67.6218	-0.31731	-0.69447	203.0	54.2143	-0.18711	-0.70060
149.0	67.3062	-0.31385	-0.69480	204.0	54.0280	-0.18552	-0.70050
150.0	66.9941	-0.31046	-0.69512	205.0	53.8432	-0.18396	-0.70038
151.0	66.6853	-0.30712	-0.69543	206.0	53.6601	-0.18241	-0.70026
152.0	66.3798	-0.30383	-0.69573	207.0	53.4784	-0.18088	-0.70013
153.0	66.0776	-0.30060	-0.69602	208.0	53.2983	-0.17937	-0.70000
154.0	65.7786	-0.29741	-0.69630	209.0	53.1197	-0.17788	-0.69986
155.0	65.4828	-0.29428	-0.69657	210.0	52.9425	-0.17640	-0.69971
156.0	65.1900	-0.29120	-0.69684	211.0	52.7669	-0.17495	-0.69956

INTERPOLATION TABLE

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	52.5926	-0.17351	-0.69940	267.0	44.8349	-0.11431	-0.68073
213.0	52.4198	-0.17208	-0.69922	268.0	44.7210	-0.11351	-0.68025
214.0	52.2485	-0.17067	-0.69905	269.0	44.6078	-0.11272	-0.67976
215.0	52.0785	-0.16928	-0.69886	270.0	44.4955	-0.11194	-0.67927
216.0	51.9099	-0.16791	-0.69867	271.0	44.3840	-0.11117	-0.67878
217.0	51.7427	-0.16655	-0.69847	272.0	44.2732	-0.11040	-0.67828
218.0	51.5768	-0.16520	-0.69826	273.0	44.1632	-0.10964	-0.67777
219.0	51.4123	-0.16387	-0.69805	274.0	44.0539	-0.10889	-0.67726
220.0	51.2490	-0.16256	-0.69783	275.0	43.9454	-0.10815	-0.67675
221.0	51.0871	-0.16126	-0.69761	276.0	43.8376	-0.10741	-0.67624
222.0	50.9265	-0.15998	-0.69738	277.0	43.7305	-0.10668	-0.67572
223.0	50.7672	-0.15871	-0.69713	278.0	43.6242	-0.10595	-0.67520
224.0	50.6091	-0.15745	-0.69689	279.0	43.5186	-0.10524	-0.67468
225.0	50.4523	-0.15621	-0.69663	280.0	43.4138	-0.10453	-0.67415
226.0	50.2967	-0.15498	-0.69637	281.0	43.3096	-0.10382	-0.67362
227.0	50.1423	-0.15376	-0.69611	282.0	43.2061	-0.10313	-0.67309
228.0	49.9891	-0.15256	-0.69583	283.0	43.1033	-0.10244	-0.67255
229.0	49.8372	-0.15137	-0.69556	284.0	43.0012	-0.10175	-0.67201
230.0	49.6864	-0.15020	-0.69527	285.0	42.8998	-0.10107	-0.67147
231.0	49.5368	-0.14903	-0.69498	286.0	42.7991	-0.10040	-0.67092
232.0	49.3883	-0.14788	-0.69468	287.0	42.6990	-9.9737e-2	-0.67038
233.0	49.2410	-0.14675	-0.69438	288.0	42.5996	-9.9077e-2	-0.66983
234.0	49.0948	-0.14562	-0.69406	289.0	42.5009	-9.8425e-2	-0.66927
235.0	48.9498	-0.14451	-0.69375	290.0	42.4028	-9.7778e-2	-0.66872
236.0	48.8058	-0.14340	-0.69342	291.0	42.3053	-9.7136e-2	-0.66816
237.0	48.6630	-0.14231	-0.69309	292.0	42.2085	-9.6501e-2	-0.66760
238.0	48.5212	-0.14123	-0.69276	293.0	42.1123	-9.5872e-2	-0.66703
239.0	48.3805	-0.14017	-0.69242	294.0	42.0167	-9.5248e-2	-0.66647
240.0	48.2408	-0.13911	-0.69207	295.0	41.9218	-9.4630e-2	-0.66590
241.0	48.1023	-0.13806	-0.69172	296.0	41.8275	-9.4017e-2	-0.66533
242.0	47.9647	-0.13703	-0.69136	297.0	41.7338	-9.3410e-2	-0.66476
243.0	47.8282	-0.13600	-0.69100	298.0	41.6407	-9.2809e-2	-0.66418
244.0	47.6927	-0.13499	-0.69063	299.0	41.5481	-9.2213e-2	-0.66361
245.0	47.5582	-0.13399	-0.69025	300.0	41.4562	-9.1623e-2	-0.66303
246.0	47.4247	-0.13300	-0.68987	301.0	41.3649	-9.1037e-2	-0.66245
247.0	47.2922	-0.13201	-0.68948	302.0	41.2742	-9.0457e-2	-0.66187
248.0	47.1607	-0.13104	-0.68909	303.0	41.1840	-8.9882e-2	-0.66128
249.0	47.0301	-0.13008	-0.68870	304.0	41.0944	-8.9312e-2	-0.66070
250.0	46.9005	-0.12913	-0.68830	305.0	41.0054	-8.8748e-2	-0.66011
251.0	46.7719	-0.12818	-0.68789	305.0	41.0054	-8.8748e-2	-0.66011
252.0	46.6442	-0.12725	-0.68748	306.0	40.9169	-8.8188e-2	-0.65952
253.0	46.5174	-0.12633	-0.68706	307.0	40.8290	-8.7633e-2	-0.65893
254.0	46.3915	-0.12541	-0.68664	308.0	40.7416	-8.7084e-2	-0.65834
255.0	46.2666	-0.12450	-0.68621	309.0	40.6548	-8.6539e-2	-0.65775
256.0	46.1425	-0.12361	-0.68578	310.0	40.5685	-8.5999e-2	-0.65715
257.0	46.0193	-0.12272	-0.68534	311.0	40.4828	-8.5463e-2	-0.65655
258.0	45.8971	-0.12184	-0.68490	312.0	40.3976	-8.4933e-2	-0.65596
259.0	45.7756	-0.12097	-0.68446	313.0	40.3129	-8.4407e-2	-0.65536
260.0	45.6551	-0.12011	-0.68401	314.0	40.2288	-8.3886e-2	-0.65476
261.0	45.5354	-0.11926	-0.68355	315.0	40.1452	-8.3369e-2	-0.65415
262.0	45.4166	-0.11841	-0.68309	316.0	40.0621	-8.2856e-2	-0.65355
263.0	45.2986	-0.11757	-0.68263	317.0	39.9795	-8.2349e-2	-0.65295
264.0	45.1814	-0.11675	-0.68216	318.0	39.8974	-8.1845e-2	-0.65234
265.0	45.0651	-0.11593	-0.68169	319.0	39.8158	-8.1346e-2	-0.65174
266.0	44.9496	-0.11511	-0.68121	320.0	39.7347	-8.0852e-2	-0.65113

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INTERPOLATION TABLE

Calibration Report: 430507
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29554
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	39.6541	-8.0361e-2	-0.65052				
322.0	39.5739	-7.9875e-2	-0.64991				
323.0	39.4943	-7.9393e-2	-0.64930				
324.0	39.4152	-7.8915e-2	-0.64869				
325.0	39.3365	-7.8441e-2	-0.64808				

BREAKPOINTS 340 FORMAT

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29554
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.59478,325.000	Point 56: 2.00883, 80.500	Point 111: 2.58647, 9.400	Point 166: 4.05411, 0.525
Point 2: 1.60005,319.000	Point 57: 2.01783, 78.000	Point 112: 2.59988, 8.950	Point 167: 4.09594, 0.505
Point 3: 1.60498,313.500	Point 58: 2.02524, 76.000	Point 113: 2.61251, 8.550	Point 168: 4.13394, 0.488
Point 4: 1.61003,308.000	Point 59: 2.03282, 74.000	Point 114: 2.62584, 8.150	Point 169: 4.17694, 0.470
Point 5: 1.61519,302.500	Point 60: 2.04060, 72.000	Point 115: 2.64000, 7.750	Point 170: 4.22322, 0.452
Point 6: 1.62048,297.000	Point 61: 2.04858, 70.000	Point 116: 2.65509, 7.350	Point 171: 4.26750, 0.436
Point 7: 1.62589,291.500	Point 62: 2.05678, 68.000	Point 117: 2.66918, 7.000	Point 172: 4.31488, 0.420
Point 8: 1.63142,286.000	Point 63: 2.06521, 66.000	Point 118: 2.68415, 6.650	Point 173: 4.36581, 0.404
Point 9: 1.63709,280.500	Point 64: 2.07388, 64.000	Point 119: 2.70017, 6.300	Point 174: 4.42051, 0.388
Point 10: 1.64290,275.000	Point 65: 2.08281, 62.000	Point 120: 2.71890, 5.920	Point 175: 4.47924, 0.372
Point 11: 1.64831,270.000	Point 66: 2.09202, 60.000	Point 121: 2.73596, 5.600	Point 176: 4.54225, 0.356
Point 12: 1.65383,265.000	Point 67: 2.10056, 58.200	Point 122: 2.75430, 5.280	Point 177: 4.60992, 0.340
Point 13: 1.65948,260.000	Point 68: 2.10935, 56.400	Point 123: 2.77291, 4.980	Point 178: 4.68273, 0.324
Point 14: 1.66526,255.000	Point 69: 2.11841, 54.600	Point 124: 2.79301, 4.680	Point 179: 4.74224, 0.312
Point 15: 1.67117,250.000	Point 70: 2.12775, 52.800	Point 125: 2.81342, 4.400	Point 180: 4.79659, 0.302
Point 16: 1.67721,245.000	Point 71: 2.13740, 51.000	Point 126: 2.83557, 4.120	Point 181: 4.80826, 0.300
Point 17: 1.68340,240.000	Point 72: 2.14738, 49.200	Point 127: 2.85452, 3.900	Point 182: 4.80826, 0.300
Point 18: 1.68974,235.000	Point 73: 2.15770, 47.400	Point 128: 2.87104, 3.720	
Point 19: 1.69623,230.000	Point 74: 2.16840, 45.600	Point 129: 2.88865, 3.540	
Point 20: 1.70287,225.000	Point 75: 2.17826, 44.000	Point 130: 2.90644, 3.370	
Point 21: 1.70967,220.000	Point 76: 2.18844, 42.400	Point 131: 2.92551, 3.200	
Point 22: 1.71665,215.000	Point 77: 2.19898, 40.800	Point 132: 2.94352, 3.050	
Point 23: 1.72379,210.000	Point 78: 2.20992, 39.200	Point 133: 2.96184, 2.910	
Point 24: 1.73112,205.000	Point 79: 2.22128, 37.600	Point 134: 2.98739, 2.730	
Point 25: 1.73863,200.000	Point 80: 2.23309, 36.000	Point 135: 3.01028, 2.580	
Point 26: 1.74634,195.000	Point 81: 2.24461, 34.500	Point 136: 3.03352, 2.440	
Point 27: 1.75425,190.000	Point 82: 2.25659, 33.000	Point 137: 3.05877, 2.300	
Point 28: 1.76237,185.000	Point 83: 2.26908, 31.500	Point 138: 3.08434, 2.170	
Point 29: 1.76987,180.500	Point 84: 2.28124, 30.100	Point 139: 3.11224, 2.040	
Point 30: 1.77755,176.000	Point 85: 2.29392, 28.700	Point 140: 3.14293, 1.910	
Point 31: 1.78543,171.500	Point 86: 2.30717, 27.300	Point 141: 3.17423, 1.790	
Point 32: 1.79351,167.000	Point 87: 2.32005, 26.000	Point 142: 3.20878, 1.670	
Point 33: 1.80180,162.500	Point 88: 2.33352, 24.700	Point 143: 3.24404, 1.560	
Point 34: 1.81031,158.000	Point 89: 2.34766, 23.400	Point 144: 3.28319, 1.450	
Point 35: 1.81905,153.500	Point 90: 2.36138, 22.200	Point 145: 3.32727, 1.340	
Point 36: 1.82804,149.000	Point 91: 2.37580, 21.000	Point 146: 3.37259, 1.240	
Point 37: 1.83728,144.500	Point 92: 2.38718, 20.100	Point 147: 3.40296, 1.180	
Point 38: 1.84679,140.000	Point 93: 2.39635, 19.400	Point 148: 3.42434, 1.140	
Point 39: 1.85659,135.500	Point 94: 2.40516, 18.750	Point 149: 3.44695, 1.100	
Point 40: 1.86556,131.500	Point 95: 2.41428, 18.100	Point 150: 3.47091, 1.060	
Point 41: 1.87477,127.500	Point 96: 2.42373, 17.450	Point 151: 3.49635, 1.020	
Point 42: 1.88426,123.500	Point 97: 2.43354, 16.800	Point 152: 3.52345, 0.980	
Point 43: 1.89402,119.500	Point 98: 2.44295, 16.200	Point 153: 3.55240, 0.940	
Point 44: 1.90408,115.500	Point 99: 2.45272, 15.600	Point 154: 3.57947, 0.905	
Point 45: 1.91446,111.500	Point 100: 2.46288, 15.000	Point 155: 3.60824, 0.870	
Point 46: 1.92518,107.500	Point 101: 2.47348, 14.400	Point 156: 3.63900, 0.835	
Point 47: 1.93627,103.500	Point 102: 2.48362, 13.850	Point 157: 3.67194, 0.800	
Point 48: 1.94486,100.500	Point 103: 2.49418, 13.300	Point 158: 3.70739, 0.765	
Point 49: 1.95218, 98.000	Point 104: 2.50523, 12.750	Point 159: 3.74562, 0.730	
Point 50: 1.95967, 95.500	Point 105: 2.51574, 12.250	Point 160: 3.78103, 0.700	
Point 51: 1.96735, 93.000	Point 106: 2.52671, 11.750	Point 161: 3.81897, 0.670	
Point 52: 1.97523, 90.500	Point 107: 2.53822, 11.250	Point 162: 3.85995, 0.640	
Point 53: 1.98330, 88.000	Point 108: 2.55031, 10.750	Point 163: 3.90436, 0.610	
Point 54: 1.99158, 85.500	Point 109: 2.56176, 10.300	Point 164: 3.95269, 0.580	
Point 55: 2.00008, 83.000	Point 110: 2.57378, 9.850	Point 165: 4.00566, 0.550	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 55

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.59480	325.0	31	2.58364	9.5
2	1.59566	324.0	32	2.64190	7.7
3	1.59917	320.0	33	2.69556	6.4
4	1.61284	305.0	34	2.74736	5.4
5	1.62739	290.0	35	2.79881	4.6
6	1.64291	275.0	36	2.84585	4.0
7	1.65949	260.0	37	2.89282	3.5
8	1.67723	245.0	38	2.92561	3.2
9	1.69624	230.0	39	2.94999	3.0
10	1.71666	215.0	40	2.97738	2.8
11	1.73864	200.0	41	3.04068	2.4
12	1.76239	185.0	42	3.09924	2.1
13	1.78811	170.0	43	3.17173	1.8
14	1.81613	155.0	44	3.23107	1.6
15	1.84681	140.0	45	3.30296	1.4
16	1.88069	125.0	46	3.34517	1.3
17	1.91847	110.0	47	3.39276	1.2
18	1.96120	95.0	48	3.44705	1.1
19	2.01063	80.0	49	3.50981	1.0
20	2.06953	65.0	50	3.58358	.9
21	2.10397	57.5	51	3.67212	.8
22	2.14293	50.0	52	3.78119	.7
23	2.17208	45.0	53	3.92028	.6
24	2.20443	40.0	54	4.37940	.4
25	2.24075	35.0	55	4.80826	.3
26	2.28217	30.0			
27	2.33040	25.0			
28	2.38850	20.0			
29	2.46291	15.0			
30	2.52340	11.9			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	83.022
1000	2.647
10000	0.553

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BREAKPOINTS 234 FORMAT

Calibration Report: 430507 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29554
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.005K
10 - 20K:	0.009K
20 - 40K:	0.015K
40 - 100K:	0.030K
> 100K:	0.139K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	319.068	39.81072	1.600	56	6.305	501.1872	2.700
2	297.499	41.68694	1.620	57	5.901	524.8075	2.720
3	277.739	43.65158	1.640	58	5.529	549.5409	2.740
4	259.554	45.70882	1.660	59	5.187	575.4399	2.760
5	242.744	47.86301	1.680	60	4.873	602.5596	2.780
6	227.154	50.11872	1.700	61	4.583	630.9573	2.800
7	212.645	52.48075	1.720	62	4.316	660.6934	2.820
8	199.112	54.95409	1.740	63	4.069	691.8310	2.840
9	186.454	57.54399	1.760	64	3.840	724.4360	2.860
10	174.597	60.25596	1.780	65	3.628	758.5776	2.880
11	163.474	63.09573	1.800	66	3.431	794.3282	2.900
12	153.028	66.06934	1.820	67	3.249	831.7638	2.920
13	143.209	69.18310	1.840	68	3.080	870.9636	2.940
14	133.976	72.44360	1.860	69	2.924	912.0108	2.960
15	125.291	75.85776	1.880	70	2.782	954.9926	2.980
16	117.116	79.43282	1.900	71	2.647	1000.000	3.000
17	109.427	83.17638	1.920	72	2.404	1096.478	3.040
18	102.192	87.09636	1.940	73	2.192	1202.264	3.080
19	95.395	91.20108	1.960	74	2.007	1318.257	3.120
20	89.017	95.49926	1.980	75	1.844	1445.440	3.160
21	83.029	100.0000	2.000	76	1.700	1584.893	3.200
22	77.414	104.7129	2.020	77	1.573	1737.801	3.240
23	72.156	109.6478	2.040	78	1.459	1905.461	3.280
24	67.232	114.8154	2.060	79	1.358	2089.296	3.320
25	62.627	120.2264	2.080	80	1.268	2290.868	3.360
26	58.320	125.8925	2.100	81	1.186	2511.886	3.400
27	54.293	131.8257	2.120	82	1.112	2754.229	3.440
28	50.530	138.0384	2.140	83	1.046	3019.952	3.480
29	47.012	144.5440	2.160	84	0.985	3311.311	3.520
30	43.726	151.3561	2.180	85	0.930	3630.781	3.560
31	40.653	158.4893	2.200	86	0.880	3981.072	3.600
32	37.782	165.9587	2.220	87	0.834	4365.158	3.640
33	35.098	173.7801	2.240	88	0.792	4786.301	3.680
34	32.588	181.9701	2.260	89	0.753	5248.075	3.720
35	30.245	190.5461	2.280	90	0.718	5754.399	3.760
36	28.055	199.5262	2.300	91	0.685	6309.573	3.800
37	26.009	208.9296	2.320	92	0.654	6918.310	3.840
38	24.101	218.7762	2.340	93	0.626	7585.776	3.880
39	22.322	229.0868	2.360	94	0.600	8317.638	3.920
40	20.667	239.8833	2.380	95	0.576	9120.108	3.960
41	19.130	251.1886	2.400	96	0.553	10000.00	4.000
42	17.705	263.0268	2.420	97	0.503	12589.25	4.100
43	16.387	275.4229	2.440	98	0.461	15848.93	4.200
44	15.170	288.4032	2.460	99	0.425	19952.62	4.300
45	14.045	301.9952	2.480	100	0.394	25118.86	4.400
46	13.009	316.2278	2.500	101	0.367	31622.78	4.500
47	12.054	331.1311	2.520	102	0.342	39810.72	4.600
48	11.177	346.7369	2.540	103	0.321	50118.72	4.700
49	10.370	363.0781	2.560	104	0.301	63095.73	4.800
50	9.628	380.1894	2.580	105	0.285	79432.82	4.900
51	8.948	398.1072	2.600	106	0.269	100000.0	5.000
52	8.324	416.8694	2.620				
53	7.752	436.5158	2.640				
54	7.227	457.0882	2.660				
55	6.747	478.6301	2.680				

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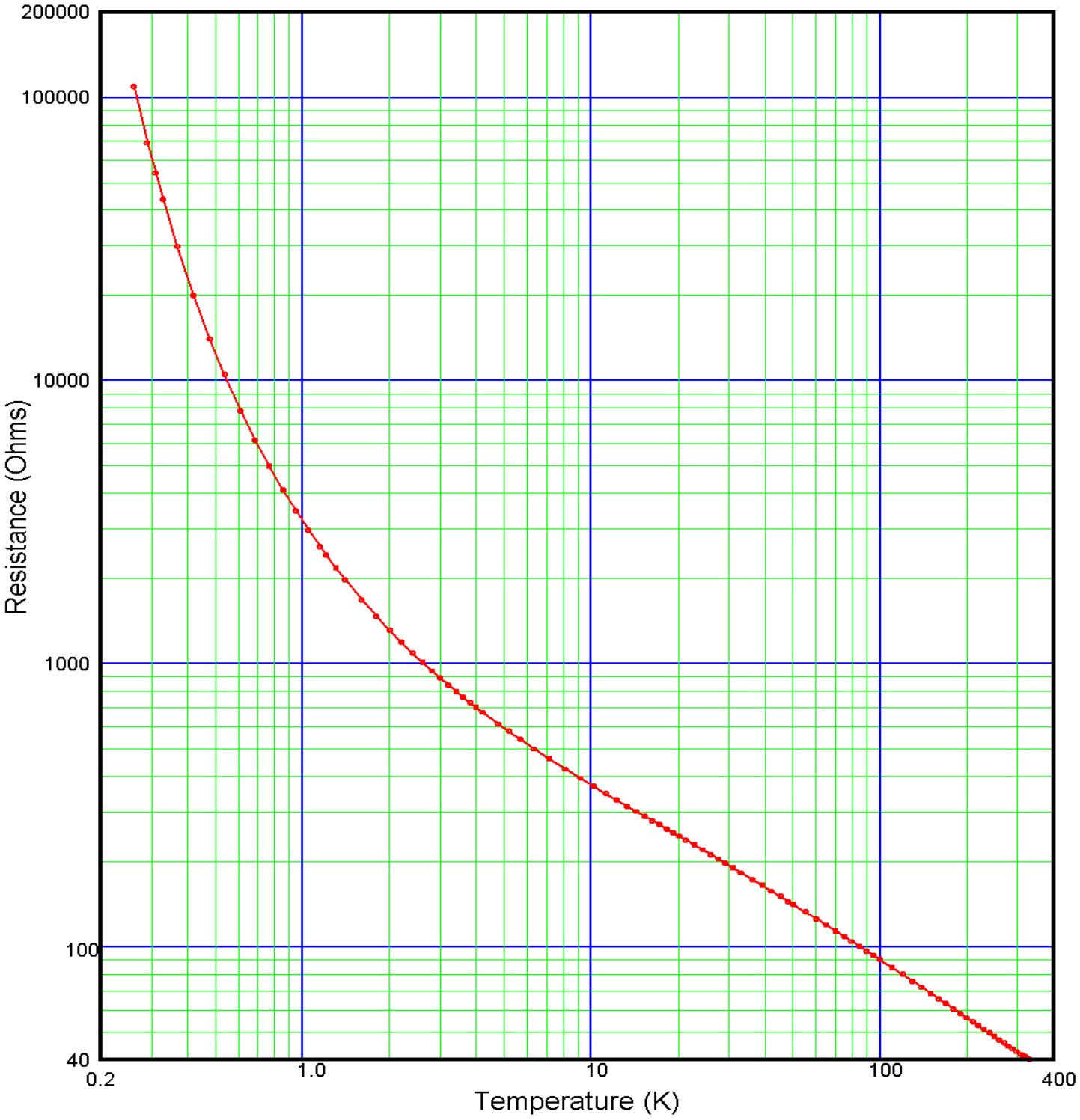
DATA PLOT

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260254	109543.	51	21.1960	239.216
2	0.289990	69183.0	52	22.7435	229.415
3	0.310566	54120.5	53	24.3107	220.478
4	0.329431	43633.6	54	25.9099	212.262
5	0.368156	29799.8	55	27.5345	204.634
6	0.419329	19969.6	56	29.1507	197.709
7	0.477074	14028.6	57	30.9447	190.660
8	0.535906	10502.4	58	33.0452	183.158
9	0.610134	7823.60	59	36.0631	173.574
10	0.685832	6148.80	60	39.0784	165.149
11	0.765839	5005.57	61	42.0934	157.675
12	0.854379	4115.64	62	45.1022	150.989
13	0.947846	3469.19	63	48.1162	144.961
14	1.04818	2966.41	64	50.1159	141.279
15	1.14785	2593.57	65	55.1040	133.018
16	1.20748	2417.68	66	60.0826	125.871
17	1.30381	2178.45	67	65.0496	119.624
18	1.40023	1984.98	68	70.0204	114.075
19	1.60130	1684.47	69	74.9892	109.125
20	1.80046	1473.37	70	79.9553	104.676
21	2.00096	1314.42	71	84.9194	100.635
22	2.20047	1191.63	72	89.8848	96.9495
23	2.40403	1091.54	73	94.8511	93.5686
24	2.60534	1010.93	74	99.8242	90.4566
25	2.80704	944.008	75	109.871	84.8485
26	2.99467	891.215	76	119.711	80.0937
27	3.19897	841.735	77	129.645	75.8763
28	3.40036	799.540	78	139.579	72.1396
29	3.59996	762.774	79	149.515	68.8099
30	3.80395	729.508	80	159.452	65.8123
31	3.98693	702.850	81	169.388	63.1096
32	4.19793	675.105	82	179.322	60.6538
33	4.78113	612.162	83	189.250	58.4193
34	5.17114	578.093	84	199.162	56.3806
35	5.66415	541.990	85	209.095	54.5015
36	6.34597	501.104	86	219.026	52.7741
37	7.14091	463.050	87	228.945	51.1792
38	8.14413	425.235	88	238.868	49.7031
39	9.16758	394.650	89	248.793	48.3319
40	10.1988	369.497	90	258.705	47.0581
41	11.2324	348.430	91	268.638	45.8686
42	12.2579	330.540	92	278.547	44.7637
43	13.2754	315.210	93	288.483	43.7266
44	14.2819	301.844	94	298.403	42.7526
45	15.2774	290.046	95	308.331	41.8435
46	16.2626	279.631	96	313.296	41.4097
47	17.2369	270.175	97	318.251	40.9873
48	18.2097	261.626	98	324.189	40.5009
49	19.1712	253.767	99	328.172	40.1812
50	20.1333	246.571			

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POLYNOMIAL EQUATION

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.00K
6.103e+4 Ohms	to	891.2 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.90284011534 ZU = 5.03958463056

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.083487	2.1951E-04	4935.84
1	-1.247330	3.6703E-04	-3398.48
2	0.617762	3.1427E-04	1965.72
3	-0.273835	2.4703E-04	-1108.50
4	0.111497	2.0075E-04	555.40
5	-0.042734	2.0896E-04	-204.51
6	0.015682	2.4027E-04	65.27
7	-0.005044	2.7749E-04	-18.18
8	0.001580	2.8299E-04	5.58
9	-0.000841	2.4380E-04	-3.45

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 9
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	109543.0	0.26025	0.26022	0.03
2	69183.00	0.28999	0.29035	-0.36
3	54120.50	0.31057	0.30993	0.63
4	43633.60	0.32943	0.32946	-0.02
5	29799.80	0.36816	0.36879	-0.64
6	19969.60	0.41933	0.41923	0.10
7	14028.60	0.47707	0.47638	0.69
8	10502.40	0.53591	0.53567	0.24
9	7823.600	0.61013	0.61090	-0.76
10	6148.800	0.68583	0.68685	-1.02
11	5005.570	0.76584	0.76507	0.76
12	4115.640	0.85438	0.85427	0.11
13	3469.190	0.94785	0.94711	0.74
14	2966.410	1.04818	1.04762	0.56
15	2593.570	1.14785	1.14835	-0.50
16	2417.684	1.20748	1.20732	0.15
17	2178.448	1.30381	1.30408	-0.27
18	1984.980	1.40023	1.40110	-0.87
19	1684.474	1.60130	1.60194	-0.64
20	1473.366	1.80046	1.80029	0.18
21	1314.419	2.00096	2.00017	0.79
22	1191.633	2.20047	2.19952	0.95
23	1091.540	2.40403	2.40375	0.28
24	1010.928	2.60534	2.60586	-0.52
25	944.0076	2.80704	2.80772	-0.68
26	891.2153	2.99467	2.99508	-0.41
27	841.7346	3.19897	3.19907	-0.09
28	799.5399	3.40036	3.39979	0.57

Order of Fit = 9 RMS error of fit = .57 mK
Largest absolute error = -1.02 mK at data point no. 10

POLYNOMIAL EQUATION

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

2.99K	to	20.1K
891.2 Ohms	to	246.6 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.36062262037 ZU = 3.00472016477

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.617925	5.9494E-04	16166.20
1	-9.421135	9.3883E-04	-10034.99
2	2.975153	9.0419E-04	3290.42
3	-0.649323	8.2381E-04	-788.19
4	0.085585	7.8483E-04	109.05
5	0.000938	7.6988E-04	1.22

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1010.928	2.60586	2.60914	-3.28
25	944.0076	2.80772	2.80538	2.34
26	891.2153	2.99508	2.99195	3.13
27	841.7346	3.19897	3.19706	1.92
28	799.5399	3.40036	3.39948	0.88
29	762.7739	3.59996	3.60052	-0.56
30	729.5084	3.80395	3.80592	-1.97
31	702.8502	3.98693	3.98947	-2.53
32	675.1047	4.19793	4.20143	-3.50
33	612.1618	4.78113	4.78217	-1.05
34	578.0934	5.17114	5.17165	-0.51
35	541.9902	5.66415	5.66179	2.36
36	501.1041	6.34597	6.34289	3.08
37	463.0500	7.14091	7.13875	2.16
38	425.2346	8.14413	8.14282	1.31
39	394.6498	9.16758	9.16707	0.51
40	369.4966	10.19879	10.19920	-0.41
41	348.4304	11.23245	11.23300	-0.55
42	330.5399	12.25790	12.26203	-4.12
43	315.2102	13.27539	13.27788	-2.49
44	301.8437	14.28194	14.28385	-1.91
45	290.0461	15.27743	15.28055	-3.12
46	279.6309	16.26255	16.25823	4.33
47	270.1745	17.23693	17.23639	0.54
48	261.6257	18.20969	18.20429	5.39
49	253.7674	19.17118	19.17239	-1.21
50	246.5711	20.13327	20.13213	1.14
51	239.2163	21.19597	21.19313	2.85
52	229.4154	22.74348	22.74818	-4.71

Order of Fit = 5 RMS error of fit = 2.59 mK
Largest absolute error = 5.39 mK at data point no. 48

POLYNOMIAL EQUATION

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	94.9K
246.6 Ohms	to	93.57 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.92864394222 ZU = 2.41768033143

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.957308	5.1456E-04	106803.53
1	-44.694688	8.3238E-04	-53695.07
2	8.987351	7.7517E-04	11594.10
3	-1.146493	7.2305E-04	-1585.64
4	0.095003	6.7857E-04	140.00
5	0.008879	6.6534E-04	13.35
6	-0.002521	6.3012E-04	-4.00
7	-0.001621	6.4913E-04	-2.50

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	261.6257	18.20429	18.20322	1.08
49	253.7674	19.17239	19.17390	-1.50
50	246.5711	20.13213	20.13382	-1.68
51	239.2163	21.19597	21.19317	2.81
52	229.4154	22.74348	22.74332	0.15
53	220.4784	24.31073	24.31349	-2.76
54	212.2619	25.90994	25.90775	2.19
55	204.6344	27.53449	27.53435	0.13
56	197.7087	29.15071	29.14932	1.38
57	190.6597	30.94472	30.94505	-0.34
58	183.1584	33.04515	33.04682	-1.67
59	173.5738	36.06313	36.06417	-1.04
60	165.1489	39.07843	39.07907	-0.64
61	157.6747	42.09345	42.09153	1.91
62	150.9886	45.10218	45.10280	-0.62
63	144.9607	48.11615	48.11587	0.28
64	141.2787	50.11591	50.11439	1.51
65	133.0180	55.10397	55.10364	0.33
66	125.8711	60.08258	60.08411	-1.52
67	119.6243	65.04960	65.04753	2.07
68	114.0747	70.02044	70.02466	-4.22
69	109.1254	74.98924	74.99200	-2.76
70	104.6762	79.95532	79.95004	5.28
71	100.6349	84.91938	84.91725	2.14
72	96.94949	89.88477	89.88448	0.29
73	93.56865	94.85106	94.85517	-4.11
74	90.45658	99.82418	99.82320	0.98
75	84.84846	109.87139	109.87106	0.33

Order of Fit = 7 RMS error of fit = 2.09 mK
Largest absolute error = 5.28 mK at data point no. 70

POLYNOMIAL EQUATION

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

94.9K	to	325.K
93.57 Ohms	to	40.43 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.60402272507 ZU = 2.0027487642

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.504449	1.9811E-03	94143.31
1	-118.705068	3.0198E-03	-39309.30
2	19.482583	2.8529E-03	6829.08
3	-2.823141	2.8456E-03	-992.09
4	0.545183	2.7521E-03	198.10
5	-0.101413	2.6411E-03	-38.40
6	0.019724	2.5707E-03	7.67

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	100.6349	84.91725	84.92232	-5.07
72	96.94949	89.88448	89.87854	5.94
73	93.56865	94.85517	94.85004	5.13
74	90.45658	99.82418	99.82329	0.88
75	84.84846	109.87139	109.88290	-11.51
76	80.09366	119.71054	119.71356	-3.02
77	75.87630	129.64546	129.64285	2.61
78	72.13960	139.57925	139.57866	0.59
79	68.80987	149.51475	149.50212	12.63
80	65.81230	159.45218	159.45083	1.36
81	63.10964	169.38776	169.38445	3.31
82	60.65383	179.32188	179.33114	-9.26
83	58.41931	189.24984	189.26118	-11.34
84	56.38060	199.16243	199.16166	0.77
85	54.50153	209.09544	209.10020	-4.76
86	52.77405	219.02560	219.02222	3.39
87	51.17920	228.94518	228.94178	3.40
88	49.70309	238.86848	238.85894	9.54
89	48.33190	248.79308	248.78744	5.64
90	47.05811	258.70529	258.70665	-1.36
91	45.86859	268.63755	268.64927	-11.72
92	44.76373	278.54662	278.54210	4.52
93	43.72662	288.48293	288.47156	11.38
94	42.75263	298.40348	298.42745	-23.97
95	41.84349	308.33087	308.33176	-0.89
96	41.40966	313.29572	313.28409	11.63
97	40.98729	318.25050	318.25565	-5.15
98	40.50087	324.18908	324.17396	15.12
99	40.18118	328.17178	328.18156	-9.78

Order of Fit = 6 RMS error of fit = 8.60 mK
Largest absolute error = -23.97 mK at data point no. 94

INTERPOLATION TABLE

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	61030.1	-7.6493e+5	-3.7601	48.00	145.181	-1.9093	-0.63126
0.4000	23007.2	-1.7725e+5	-3.0816	49.00	143.303	-1.8486	-0.63211
0.5000	12405.8	-61718.	-2.4875	50.00	141.483	-1.7910	-0.63293
0.6000	8132.33	-29319.	-2.1631	51.00	139.720	-1.7361	-0.63372
0.7000	5924.08	-16518.	-1.9518	52.00	138.010	-1.6839	-0.63445
0.8000	4616.28	-10313.	-1.7872	53.00	136.351	-1.6340	-0.63515
0.9000	3769.70	-6933.0	-1.6552	54.00	134.741	-1.5866	-0.63584
1.000	3184.63	-4930.2	-1.5481	55.00	133.177	-1.5413	-0.63654
2.000	1314.54	-694.23	-1.0562	56.00	131.658	-1.4982	-0.63724
3.000	889.099	-261.97	-0.88393	57.00	130.181	-1.4569	-0.63789
4.000	701.398	-137.43	-0.78375	58.00	128.744	-1.4173	-0.63852
4.200	675.282	-124.09	-0.77181	59.00	127.345	-1.3795	-0.63914
5.000	592.439	-86.505	-0.73008	60.00	125.984	-1.3434	-0.63977
6.000	520.534	-59.872	-0.69012	61.00	124.658	-1.3087	-0.64040
7.000	469.081	-44.295	-0.66100	62.00	123.366	-1.2755	-0.64101
8.000	430.068	-34.404	-0.63997	63.00	122.107	-1.2435	-0.64160
9.000	399.204	-27.717	-0.62487	64.00	120.879	-1.2129	-0.64219
10.00	373.991	-22.957	-0.61383	65.00	119.680	-1.1835	-0.64279
11.00	352.877	-19.433	-0.60578	66.00	118.511	-1.1553	-0.64340
12.00	334.847	-16.740	-0.59991	67.00	117.370	-1.1281	-0.64398
13.00	319.203	-14.626	-0.59568	68.00	116.255	-1.1020	-0.64456
14.00	305.454	-12.931	-0.59269	69.00	115.165	-1.0768	-0.64515
15.00	293.237	-11.547	-0.59066	70.00	114.101	-1.0526	-0.64575
16.00	282.282	-10.398	-0.58938	71.00	113.060	-1.0292	-0.64635
17.00	272.380	-9.4320	-0.58868	72.00	112.042	-1.0067	-0.64694
18.00	263.369	-8.6114	-0.58855	73.00	111.046	-0.98499	-0.64752
19.00	255.119	-7.8998	-0.58833	74.00	110.072	-0.96403	-0.64811
20.00	247.541	-7.2826	-0.58840	75.00	109.118	-0.94381	-0.64871
21.00	240.516	-6.7735	-0.59141	76.00	108.184	-0.92428	-0.64931
22.00	233.982	-6.3027	-0.59261	77.00	107.269	-0.90539	-0.64991
23.00	227.891	-5.8882	-0.59427	77.35	106.953	-0.89894	-0.65012
24.00	222.191	-5.5181	-0.59603	78.00	106.373	-0.88714	-0.65052
25.00	216.843	-5.1851	-0.59780	79.00	105.495	-0.86950	-0.65113
26.00	211.810	-4.8850	-0.59964	80.00	104.634	-0.85246	-0.65177
27.00	207.063	-4.6131	-0.60153	81.00	103.789	-0.83595	-0.65239
28.00	202.576	-4.3658	-0.60344	82.00	102.962	-0.81992	-0.65299
29.00	198.324	-4.1397	-0.60533	83.00	102.149	-0.80436	-0.65357
30.00	194.290	-3.9326	-0.60722	84.00	101.353	-0.78926	-0.65413
31.00	190.454	-3.7419	-0.60907	85.00	100.571	-0.77461	-0.65468
32.00	186.801	-3.5660	-0.61087	86.00	99.8033	-0.76044	-0.65527
33.00	183.318	-3.4032	-0.61262	87.00	99.0497	-0.74678	-0.65593
34.00	179.991	-3.2521	-0.61432	88.00	98.3096	-0.73362	-0.65669
35.00	176.810	-3.1114	-0.61590	89.00	97.5823	-0.72094	-0.65753
36.00	173.765	-2.9804	-0.61746	90.00	96.8675	-0.70873	-0.65848
37.00	170.846	-2.8581	-0.61897	91.00	96.1648	-0.69679	-0.65937
38.00	168.046	-2.7434	-0.62036	92.00	95.4739	-0.68500	-0.66008
39.00	165.357	-2.6360	-0.62171	93.00	94.7947	-0.67336	-0.66061
40.00	162.772	-2.5352	-0.62301	94.00	94.1271	-0.66186	-0.66097
41.00	160.285	-2.4403	-0.62421	95.00	93.4710	-0.65051	-0.66115
42.00	157.889	-2.3509	-0.62537	96.00	92.8260	-0.63947	-0.66133
43.00	155.581	-2.2667	-0.62649	97.00	92.1919	-0.62884	-0.66164
44.00	153.354	-2.1871	-0.62753	98.00	91.5682	-0.61861	-0.66206
45.00	151.205	-2.1119	-0.62853	99.00	90.9545	-0.60877	-0.66262
46.00	149.129	-2.0408	-0.62949	100.0	90.3505	-0.59931	-0.66331
47.00	147.123	-1.9733	-0.63039	101.0	89.7558	-0.59011	-0.66404

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INTERPOLATION TABLE

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	89.1702	-0.58114	-0.66475	157.0	66.5220	-0.29325	-0.69210
103.0	88.5935	-0.57237	-0.66544	158.0	66.2302	-0.29023	-0.69237
104.0	88.0254	-0.56381	-0.66612	159.0	65.9415	-0.28725	-0.69263
105.0	87.4658	-0.55544	-0.66679	160.0	65.6557	-0.28433	-0.69289
106.0	86.9145	-0.54728	-0.66745	161.0	65.3728	-0.28144	-0.69313
107.0	86.3712	-0.53930	-0.66811	162.0	65.0928	-0.27860	-0.69337
108.0	85.8358	-0.53152	-0.66876	163.0	64.8156	-0.27580	-0.69359
109.0	85.3081	-0.52391	-0.66942	164.0	64.5412	-0.27304	-0.69381
110.0	84.7879	-0.51649	-0.67008	165.0	64.2695	-0.27033	-0.69402
111.0	84.2751	-0.50924	-0.67073	166.0	64.0005	-0.26765	-0.69422
112.0	83.7694	-0.50214	-0.67136	167.0	63.7342	-0.26502	-0.69441
113.0	83.2707	-0.49520	-0.67199	168.0	63.4705	-0.26242	-0.69459
114.0	82.7790	-0.48840	-0.67261	169.0	63.2094	-0.25986	-0.69478
115.0	82.2939	-0.48176	-0.67322	170.0	62.9508	-0.25734	-0.69495
116.0	81.8154	-0.47525	-0.67383	171.0	62.6947	-0.25485	-0.69511
117.0	81.3433	-0.46889	-0.67443	172.0	62.4410	-0.25240	-0.69527
118.0	80.8776	-0.46267	-0.67504	173.0	62.1898	-0.24999	-0.69541
119.0	80.4179	-0.45659	-0.67564	174.0	61.9411	-0.24760	-0.69555
120.0	79.9643	-0.45063	-0.67625	175.0	61.6946	-0.24526	-0.69568
121.0	79.5166	-0.44480	-0.67685	176.0	61.4505	-0.24294	-0.69580
122.0	79.0747	-0.43908	-0.67744	177.0	61.2087	-0.24066	-0.69591
123.0	78.6384	-0.43347	-0.67801	178.0	60.9692	-0.23840	-0.69602
124.0	78.2077	-0.42797	-0.67856	179.0	60.7319	-0.23618	-0.69612
125.0	77.7824	-0.42258	-0.67911	180.0	60.4968	-0.23399	-0.69622
126.0	77.3625	-0.41729	-0.67964	181.0	60.2639	-0.23183	-0.69630
127.0	76.9478	-0.41211	-0.68017	182.0	60.0332	-0.22970	-0.69638
128.0	76.5383	-0.40703	-0.68070	183.0	59.8045	-0.22760	-0.69645
129.0	76.1337	-0.40204	-0.68122	184.0	59.5779	-0.22552	-0.69650
130.0	75.7342	-0.39716	-0.68173	185.0	59.3535	-0.22348	-0.69656
131.0	75.3394	-0.39236	-0.68223	186.0	59.1310	-0.22145	-0.69660
132.0	74.9494	-0.38765	-0.68272	187.0	58.9105	-0.21946	-0.69663
133.0	74.5641	-0.38302	-0.68320	188.0	58.6921	-0.21749	-0.69666
134.0	74.1833	-0.37848	-0.68367	189.0	58.4755	-0.21555	-0.69669
135.0	73.8071	-0.37402	-0.68412	190.0	58.2609	-0.21364	-0.69671
136.0	73.4353	-0.36964	-0.68457	191.0	58.0483	-0.21174	-0.69671
137.0	73.0678	-0.36535	-0.68501	192.0	57.8375	-0.20988	-0.69671
138.0	72.7045	-0.36112	-0.68545	193.0	57.6285	-0.20803	-0.69670
139.0	72.3455	-0.35698	-0.68588	194.0	57.4214	-0.20621	-0.69668
140.0	71.9906	-0.35291	-0.68631	195.0	57.2161	-0.20441	-0.69666
141.0	71.6396	-0.34891	-0.68672	196.0	57.0126	-0.20263	-0.69663
142.0	71.2927	-0.34498	-0.68712	197.0	56.8108	-0.20088	-0.69659
143.0	70.9497	-0.34111	-0.68751	198.0	56.6108	-0.19915	-0.69654
144.0	70.6105	-0.33731	-0.68789	199.0	56.4125	-0.19744	-0.69649
145.0	70.2750	-0.33357	-0.68826	200.0	56.2159	-0.19575	-0.69643
146.0	69.9433	-0.32990	-0.68863	201.0	56.0210	-0.19408	-0.69636
147.0	69.6152	-0.32628	-0.68898	202.0	55.8277	-0.19244	-0.69629
148.0	69.2907	-0.32273	-0.68933	203.0	55.6361	-0.19081	-0.69620
149.0	68.9697	-0.31924	-0.68968	204.0	55.4461	-0.18920	-0.69611
150.0	68.6522	-0.31581	-0.69002	205.0	55.2577	-0.18761	-0.69601
151.0	68.3381	-0.31243	-0.69034	206.0	55.0709	-0.18604	-0.69590
152.0	68.0273	-0.30910	-0.69066	207.0	54.8856	-0.18449	-0.69579
153.0	67.7199	-0.30583	-0.69097	208.0	54.7019	-0.18295	-0.69567
154.0	67.4157	-0.30261	-0.69126	209.0	54.5197	-0.18144	-0.69554
155.0	67.1146	-0.29944	-0.69155	210.0	54.3390	-0.17994	-0.69541
156.0	66.8168	-0.29632	-0.69183	211.0	54.1598	-0.17846	-0.69527

INTERPOLATION TABLE

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	53.9821	-0.17700	-0.69512	267.0	46.0602	-0.11686	-0.67739
213.0	53.8058	-0.17555	-0.69496	268.0	45.9438	-0.11605	-0.67692
214.0	53.6310	-0.17413	-0.69480	269.0	45.8281	-0.11524	-0.67645
215.0	53.4575	-0.17271	-0.69463	270.0	45.7133	-0.11445	-0.67598
216.0	53.2855	-0.17132	-0.69445	271.0	45.5992	-0.11366	-0.67550
217.0	53.1149	-0.16994	-0.69427	272.0	45.4859	-0.11288	-0.67502
218.0	52.9457	-0.16857	-0.69408	273.0	45.3735	-0.11211	-0.67453
219.0	52.7778	-0.16722	-0.69388	274.0	45.2617	-0.11134	-0.67404
220.0	52.6112	-0.16589	-0.69368	275.0	45.1508	-0.11059	-0.67355
221.0	52.4460	-0.16457	-0.69347	276.0	45.0406	-0.10984	-0.67305
222.0	52.2821	-0.16326	-0.69325	277.0	44.9311	-0.10909	-0.67255
223.0	52.1195	-0.16197	-0.69303	278.0	44.8224	-0.10836	-0.67205
224.0	51.9581	-0.16070	-0.69279	279.0	44.7144	-0.10763	-0.67154
225.0	51.7981	-0.15944	-0.69256	280.0	44.6071	-0.10690	-0.67104
226.0	51.6392	-0.15819	-0.69231	281.0	44.5006	-0.10619	-0.67052
227.0	51.4817	-0.15695	-0.69206	282.0	44.3947	-0.10548	-0.67001
228.0	51.3253	-0.15573	-0.69180	283.0	44.2896	-0.10477	-0.66949
229.0	51.1702	-0.15453	-0.69154	284.0	44.1852	-0.10408	-0.66896
230.0	51.0163	-0.15333	-0.69128	285.0	44.0814	-0.10339	-0.66844
231.0	50.8635	-0.15215	-0.69100	286.0	43.9784	-0.10271	-0.66791
232.0	50.7120	-0.15098	-0.69072	287.0	43.8760	-0.10203	-0.66738
233.0	50.5616	-0.14982	-0.69043	288.0	43.7743	-0.10136	-0.66685
234.0	50.4123	-0.14868	-0.69013	289.0	43.6733	-0.10069	-0.66631
235.0	50.2642	-0.14755	-0.68983	290.0	43.5730	-0.10003	-0.66577
236.0	50.1172	-0.14643	-0.68953	291.0	43.4733	-9.9381e-2	-0.66523
237.0	49.9713	-0.14532	-0.68921	292.0	43.3742	-9.8734e-2	-0.66469
238.0	49.8266	-0.14422	-0.68890	293.0	43.2758	-9.8093e-2	-0.66414
239.0	49.6829	-0.14314	-0.68857	294.0	43.1780	-9.7458e-2	-0.66359
240.0	49.5403	-0.14207	-0.68825	295.0	43.0809	-9.6828e-2	-0.66304
241.0	49.3988	-0.14100	-0.68791	296.0	42.9843	-9.6205e-2	-0.66249
242.0	49.2583	-0.13995	-0.68757	297.0	42.8885	-9.5587e-2	-0.66193
243.0	49.1188	-0.13891	-0.68722	298.0	42.7932	-9.4974e-2	-0.66137
244.0	48.9804	-0.13788	-0.68687	299.0	42.6985	-9.4367e-2	-0.66081
245.0	48.8431	-0.13686	-0.68651	300.0	42.6044	-9.3766e-2	-0.66025
246.0	48.7067	-0.13585	-0.68615	301.0	42.5110	-9.3169e-2	-0.65969
247.0	48.5714	-0.13486	-0.68578	302.0	42.4181	-9.2579e-2	-0.65912
248.0	48.4370	-0.13387	-0.68541	303.0	42.3258	-9.1993e-2	-0.65855
249.0	48.3036	-0.13289	-0.68503	304.0	42.2341	-9.1412e-2	-0.65798
250.0	48.1712	-0.13192	-0.68465	305.0	42.1430	-9.0837e-2	-0.65741
251.0	48.0398	-0.13096	-0.68426	305.0	42.1430	-9.0837e-2	-0.65741
252.0	47.9093	-0.13001	-0.68386	306.0	42.0524	-9.0267e-2	-0.65684
253.0	47.7798	-0.12907	-0.68346	307.0	41.9624	-8.9702e-2	-0.65626
254.0	47.6511	-0.12814	-0.68306	308.0	41.8730	-8.9142e-2	-0.65569
255.0	47.5235	-0.12722	-0.68265	309.0	41.7842	-8.8586e-2	-0.65511
256.0	47.3967	-0.12631	-0.68223	310.0	41.6959	-8.8036e-2	-0.65453
257.0	47.2708	-0.12541	-0.68182	311.0	41.6081	-8.7491e-2	-0.65395
258.0	47.1459	-0.12451	-0.68139	312.0	41.5209	-8.6950e-2	-0.65337
259.0	47.0218	-0.12363	-0.68097	313.0	41.4342	-8.6414e-2	-0.65278
260.0	46.8986	-0.12275	-0.68053	314.0	41.3480	-8.5882e-2	-0.65220
261.0	46.7763	-0.12189	-0.68010	315.0	41.2624	-8.5356e-2	-0.65161
262.0	46.6548	-0.12103	-0.67966	316.0	41.1773	-8.4833e-2	-0.65102
263.0	46.5342	-0.12018	-0.67921	317.0	41.0928	-8.4316e-2	-0.65043
264.0	46.4145	-0.11933	-0.67876	318.0	41.0087	-8.3802e-2	-0.64984
265.0	46.2956	-0.11850	-0.67831	319.0	40.9251	-8.3294e-2	-0.64925
266.0	46.1775	-0.11767	-0.67785	320.0	40.8421	-8.2789e-2	-0.64866

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INTERPOLATION TABLE

Calibration Report: 430509
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29546
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	40.7596	-8.2289e-2	-0.64807				
322.0	40.6775	-8.1794e-2	-0.64747				
323.0	40.5960	-8.1302e-2	-0.64688				
324.0	40.5149	-8.0815e-2	-0.64628				
325.0	40.4344	-8.0331e-2	-0.64568				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29546
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.60674,325.000	Point 56: 2.01789, 80.500	Point 111: 2.59227, 9.300	Point 166: 4.04177, 0.525
Point 2: 1.61198,319.000	Point 57: 2.02681, 78.000	Point 112: 2.60570, 8.850	Point 167: 4.08275, 0.505
Point 3: 1.61690,313.500	Point 58: 2.03415, 76.000	Point 113: 2.61837, 8.450	Point 168: 4.11997, 0.488
Point 4: 1.62193,308.000	Point 59: 2.04166, 74.000	Point 114: 2.63175, 8.050	Point 169: 4.16207, 0.470
Point 5: 1.62707,302.500	Point 60: 2.04937, 72.000	Point 115: 2.64597, 7.650	Point 170: 4.20229, 0.454
Point 6: 1.63233,297.000	Point 61: 2.05727, 70.000	Point 116: 2.66114, 7.250	Point 171: 4.24532, 0.438
Point 7: 1.63772,291.500	Point 62: 2.06540, 68.000	Point 117: 2.67533, 6.900	Point 172: 4.29171, 0.422
Point 8: 1.64323,286.000	Point 63: 2.07374, 66.000	Point 118: 2.69042, 6.550	Point 173: 4.34178, 0.406
Point 9: 1.64887,280.500	Point 64: 2.08233, 64.000	Point 119: 2.70659, 6.200	Point 174: 4.39582, 0.390
Point 10: 1.65465,275.000	Point 65: 2.09118, 62.000	Point 120: 2.72346, 5.860	Point 175: 4.45402, 0.374
Point 11: 1.66003,270.000	Point 66: 2.10030, 60.000	Point 121: 2.74054, 5.540	Point 176: 4.51660, 0.358
Point 12: 1.66553,265.000	Point 67: 2.10875, 58.200	Point 122: 2.75896, 5.220	Point 177: 4.58369, 0.342
Point 13: 1.67115,260.000	Point 68: 2.11746, 56.400	Point 123: 2.77766, 4.920	Point 178: 4.65536, 0.326
Point 14: 1.67690,255.000	Point 69: 2.12643, 54.600	Point 124: 2.79788, 4.620	Point 179: 4.72255, 0.312
Point 15: 1.68278,250.000	Point 70: 2.13568, 52.800	Point 125: 2.81842, 4.340	Point 180: 4.77455, 0.302
Point 16: 1.68879,245.000	Point 71: 2.14523, 51.000	Point 126: 2.84075, 4.060	Point 181: 4.78554, 0.300
Point 17: 1.69495,240.000	Point 72: 2.15511, 49.200	Point 127: 2.85898, 3.850	Point 182: 4.78554, 0.300
Point 18: 1.70125,235.000	Point 73: 2.16533, 47.400	Point 128: 2.87560, 3.670	
Point 19: 1.70770,230.000	Point 74: 2.17592, 45.600	Point 129: 2.89334, 3.490	
Point 20: 1.71430,225.000	Point 75: 2.18691, 43.800	Point 130: 2.91130, 3.320	
Point 21: 1.72107,220.000	Point 76: 2.19704, 42.200	Point 131: 2.93053, 3.150	
Point 22: 1.72800,215.000	Point 77: 2.20752, 40.600	Point 132: 2.94756, 3.010	
Point 23: 1.73510,210.000	Point 78: 2.21839, 39.000	Point 133: 2.96616, 2.870	
Point 24: 1.74238,205.000	Point 79: 2.22968, 37.400	Point 134: 2.99037, 2.700	
Point 25: 1.74984,200.000	Point 80: 2.24142, 35.800	Point 135: 3.01180, 2.560	
Point 26: 1.75750,195.000	Point 81: 2.25287, 34.300	Point 136: 3.03505, 2.420	
Point 27: 1.76536,190.000	Point 82: 2.26478, 32.800	Point 137: 3.06036, 2.280	
Point 28: 1.77343,185.000	Point 83: 2.27720, 31.300	Point 138: 3.08600, 2.150	
Point 29: 1.78088,180.500	Point 84: 2.28929, 29.900	Point 139: 3.11400, 2.020	
Point 30: 1.78851,176.000	Point 85: 2.30190, 28.500	Point 140: 3.14484, 1.890	
Point 31: 1.79633,171.500	Point 86: 2.31509, 27.100	Point 141: 3.17631, 1.770	
Point 32: 1.80436,167.000	Point 87: 2.32791, 25.800	Point 142: 3.20812, 1.660	
Point 33: 1.81259,162.500	Point 88: 2.34133, 24.500	Point 143: 3.24323, 1.550	
Point 34: 1.82104,158.000	Point 89: 2.35434, 23.300	Point 144: 3.28239, 1.440	
Point 35: 1.82972,153.500	Point 90: 2.36796, 22.100	Point 145: 3.32234, 1.340	
Point 36: 1.83864,149.000	Point 91: 2.38231, 20.900	Point 146: 3.36705, 1.240	
Point 37: 1.84781,144.500	Point 92: 2.39426, 19.950	Point 147: 3.39716, 1.180	
Point 38: 1.85725,140.000	Point 93: 2.40338, 19.250	Point 148: 3.41833, 1.140	
Point 39: 1.86698,135.500	Point 94: 2.41216, 18.600	Point 149: 3.44073, 1.100	
Point 40: 1.87588,131.500	Point 95: 2.42125, 17.950	Point 150: 3.46448, 1.060	
Point 41: 1.88502,127.500	Point 96: 2.43068, 17.300	Point 151: 3.48971, 1.020	
Point 42: 1.89442,123.500	Point 97: 2.44046, 16.650	Point 152: 3.51660, 0.980	
Point 43: 1.90410,119.500	Point 98: 2.44986, 16.050	Point 153: 3.54534, 0.940	
Point 44: 1.91408,115.500	Point 99: 2.45961, 15.450	Point 154: 3.57222, 0.905	
Point 45: 1.92437,111.500	Point 100: 2.46977, 14.850	Point 155: 3.60081, 0.870	
Point 46: 1.93499,107.500	Point 101: 2.47946, 14.300	Point 156: 3.63137, 0.835	
Point 47: 1.94597,103.500	Point 102: 2.48955, 13.750	Point 157: 3.66412, 0.800	
Point 48: 1.95448,100.500	Point 103: 2.50008, 13.200	Point 158: 3.69934, 0.765	
Point 49: 1.96173, 98.000	Point 104: 2.51110, 12.650	Point 159: 3.73732, 0.730	
Point 50: 1.96916, 95.500	Point 105: 2.52158, 12.150	Point 160: 3.77247, 0.700	
Point 51: 1.97677, 93.000	Point 106: 2.53253, 11.650	Point 161: 3.81008, 0.670	
Point 52: 1.98458, 90.500	Point 107: 2.54402, 11.150	Point 162: 3.85065, 0.640	
Point 53: 1.99258, 88.000	Point 108: 2.55610, 10.650	Point 163: 3.89452, 0.610	
Point 54: 2.00079, 85.500	Point 109: 2.56755, 10.200	Point 164: 3.94215, 0.580	
Point 55: 2.00922, 83.000	Point 110: 2.57957, 9.750	Point 165: 3.99424, 0.550	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 55

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.60675	325.0	31	2.58378	9.6
2	1.60762	324.0	32	2.64059	7.8
3	1.61377	317.0	33	2.69274	6.5
4	1.62755	302.0	34	2.74287	5.5
5	1.64223	287.0	35	2.79245	4.7
6	1.65788	272.0	36	2.83759	4.1
7	1.67459	257.0	37	2.88245	3.6
8	1.69248	242.0	38	2.91359	3.3
9	1.71165	227.0	39	2.93656	3.1
10	1.73225	212.0	40	2.96217	2.9
11	1.75443	197.0	41	3.03870	2.4
12	1.77839	182.0	42	3.09665	2.1
13	1.80437	167.0	43	3.16839	1.8
14	1.83268	152.0	44	3.22709	1.6
15	1.86373	137.0	45	3.29819	1.4
16	1.89804	122.0	46	3.33995	1.3
17	1.93637	107.0	47	3.38706	1.2
18	1.97988	92.0	48	3.44083	1.1
19	2.03047	77.0	49	3.50306	1.0
20	2.08454	63.5	50	3.57631	.9
21	2.11455	57.0	51	3.66429	.8
22	2.15070	50.0	52	3.77262	.7
23	2.17957	45.0	53	3.91021	.6
24	2.21158	40.0	54	4.36186	.4
25	2.24751	35.0	55	4.78554	.3
26	2.28845	30.0			
27	2.33614	25.0			
28	2.38858	20.4			
29	2.46047	15.4			
30	2.52268	12.1			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	85.728
1000	2.636
10000	0.547

BREAKPOINTS 234 FORMAT

Calibration Report: 430509 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29546
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:	
1.4 - 10K:	0.005K
10 - 20K:	0.008K
20 - 40K:	0.015K
40 - 100K:	0.033K
> 100K:	0.138K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	310.105	41.68694	1.620	56	5.930	524.8075	2.720
2	289.217	43.65158	1.640	57	5.552	549.5409	2.740
3	270.037	45.70882	1.660	58	5.205	575.4399	2.760
4	252.357	47.86301	1.680	59	4.886	602.5596	2.780
5	235.990	50.11872	1.700	60	4.592	630.9573	2.800
6	220.789	52.48075	1.720	61	4.321	660.6934	2.820
7	206.629	54.95409	1.740	62	4.071	691.8310	2.840
8	193.408	57.54399	1.760	63	3.839	724.4360	2.860
9	181.033	60.25596	1.780	64	3.625	758.5776	2.880
10	169.438	63.09573	1.800	65	3.427	794.3282	2.900
11	158.556	66.06934	1.820	66	3.242	831.7638	2.920
12	148.335	69.18310	1.840	67	3.072	870.9636	2.940
13	138.725	72.44360	1.860	68	2.916	912.0108	2.960
14	129.689	75.85776	1.880	69	2.772	954.9926	2.980
15	121.189	79.43282	1.900	70	2.636	1000.000	3.000
16	113.189	83.17638	1.920	71	2.393	1096.478	3.040
17	105.668	87.09636	1.940	72	2.180	1202.264	3.080
18	98.597	91.20108	1.960	73	1.995	1318.257	3.120
19	91.963	95.49926	1.980	74	1.832	1445.440	3.160
20	85.742	100.0000	2.000	75	1.688	1584.893	3.200
21	79.907	104.7129	2.020	76	1.560	1737.801	3.240
22	74.441	109.6478	2.040	77	1.447	1905.461	3.280
23	69.326	114.8154	2.060	78	1.346	2089.296	3.320
24	64.542	120.2264	2.080	79	1.256	2290.868	3.360
25	60.068	125.8925	2.100	80	1.175	2511.886	3.400
26	55.888	131.8257	2.120	81	1.101	2754.229	3.440
27	51.984	138.0384	2.140	82	1.035	3019.952	3.480
28	48.336	144.5440	2.160	83	0.976	3311.311	3.520
29	44.929	151.3561	2.180	84	0.921	3630.781	3.560
30	41.746	158.4893	2.200	85	0.871	3981.072	3.600
31	38.773	165.9587	2.220	86	0.826	4365.158	3.640
32	35.995	173.7801	2.240	87	0.784	4786.301	3.680
33	33.400	181.9701	2.260	88	0.746	5248.075	3.720
34	30.975	190.5461	2.280	89	0.711	5754.399	3.760
35	28.712	199.5262	2.300	90	0.678	6309.573	3.800
36	26.600	208.9296	2.320	91	0.647	6918.310	3.840
37	24.631	218.7762	2.340	92	0.620	7585.776	3.880
38	22.798	229.0868	2.360	93	0.594	8317.638	3.920
39	21.094	239.8833	2.380	94	0.570	9120.108	3.960
40	19.507	251.1886	2.400	95	0.547	10000.00	4.000
41	18.040	263.0268	2.420	96	0.497	12589.25	4.100
42	16.682	275.4229	2.440	97	0.455	15848.93	4.200
43	15.428	288.4032	2.460	98	0.419	19952.62	4.300
44	14.272	301.9952	2.480	99	0.389	25118.86	4.400
45	13.206	316.2278	2.500	100	0.362	31622.78	4.500
46	12.225	331.1311	2.520	101	0.338	39810.72	4.600
47	11.324	346.7369	2.540	102	0.317	50118.72	4.700
48	10.496	363.0781	2.560	103	0.298	63095.73	4.800
49	9.736	380.1894	2.580	104	0.280	79432.82	4.900
50	9.040	398.1072	2.600	105	0.265	100000.0	5.000
51	8.401	416.8694	2.620				
52	7.817	436.5158	2.640				
53	7.281	457.0882	2.660				
54	6.791	478.6301	2.680				
55	6.341	501.1872	2.700				

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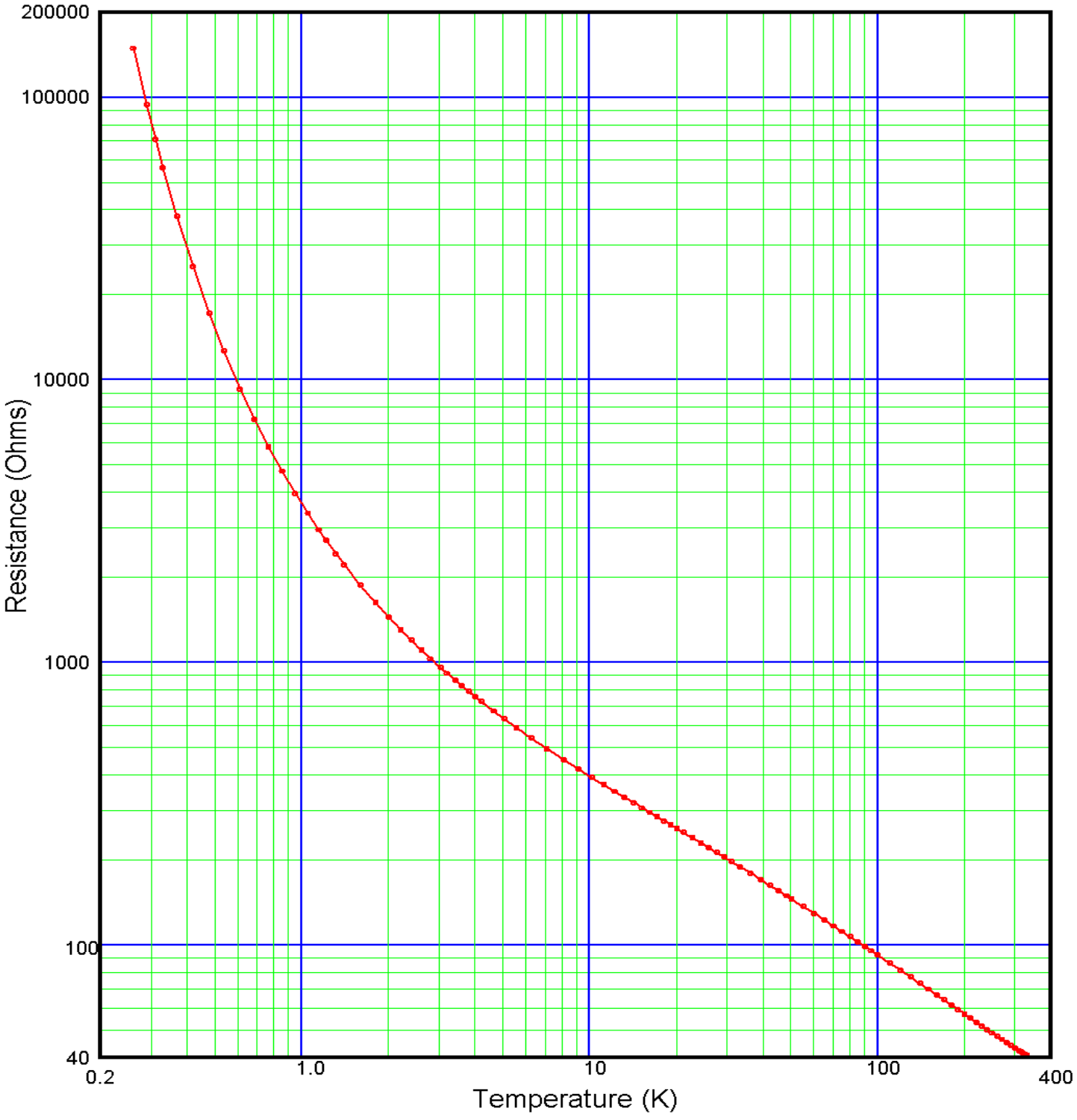
DATA PLOT

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260278	149111.	51	21.1533	250.763
2	0.289722	94528.0	52	22.7317	240.032
3	0.310331	71175.0	53	24.3272	230.278
4	0.329333	56338.4	54	25.9662	221.247
5	0.368023	38042.1	55	27.6109	213.014
6	0.418282	25206.2	56	29.2533	205.512
7	0.476553	17238.8	57	31.0872	197.852
8	0.535294	12688.2	58	33.2078	189.828
9	0.610136	9296.80	59	36.2253	179.706
10	0.685224	7239.20	60	39.2208	170.848
11	0.764984	5813.54	61	42.2139	163.013
12	0.854080	4761.43	62	45.2122	155.988
13	0.949271	3972.85	63	48.2059	149.673
14	1.05019	3379.08	64	50.1982	145.804
15	1.14261	2951.80	65	55.1892	137.089
16	1.21233	2717.58	66	60.1939	129.544
17	1.31324	2426.87	67	65.1883	122.948
18	1.40297	2220.18	68	70.1825	117.120
19	1.59973	1879.93	69	75.1670	111.934
20	1.80440	1630.39	70	80.1635	107.254
21	2.00026	1452.84	71	85.1602	103.016
22	2.20473	1309.23	72	90.1522	99.1666
23	2.40162	1199.42	73	95.1445	95.6413
24	2.60319	1107.71	74	100.132	92.3960
25	2.80419	1032.10	75	110.319	86.5170
26	3.03405	959.977	76	120.126	81.6256
27	3.19854	915.776	77	130.126	77.2512
28	3.40516	867.157	78	140.122	73.3803
29	3.60061	826.933	79	150.120	69.9390
30	3.80251	790.191	80	160.112	66.8565
31	3.99434	758.940	81	170.110	64.0669
32	4.20045	728.805	82	180.122	61.5388
33	4.63687	674.690	83	190.119	59.2447
34	5.04515	632.776	84	200.121	57.1473
35	5.55777	589.367	85	210.133	55.2202
36	6.27426	540.338	86	220.133	53.4533
37	7.08792	496.616	87	230.136	51.8227
38	8.11247	453.800	88	240.141	50.3143
39	9.14470	419.859	89	250.134	48.9184
40	10.1752	392.252	90	260.142	47.6150
41	11.1971	369.433	91	270.141	46.4079
42	12.2078	350.173	92	280.147	45.2782
43	13.2143	333.547	93	290.131	44.2272
44	14.2060	319.138	94	300.155	43.2395
45	15.1923	306.378	95	310.162	42.3138
46	16.1714	294.971	96	315.172	41.8729
47	17.1483	284.717	97	320.171	41.4443
48	18.1214	275.417	98	326.146	40.9518
49	19.0972	266.781	99	330.165	40.6314
50	20.0729	258.824			

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POLYNOMIAL EQUATION

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.03K
8.143e+4 Ohms	to	960.0 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.93809761579 ZU = 5.17350968278

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.081272	3.1973E-04	3381.88
1	-1.244580	5.2823E-04	-2356.14
2	0.620483	4.6087E-04	1346.32
3	-0.276879	3.7412E-04	-740.09
4	0.113646	3.1478E-04	361.03
5	-0.043956	3.2071E-04	-137.06
6	0.015851	3.5417E-04	44.76
7	-0.005776	4.0354E-04	-14.31
8	0.001070	4.1729E-04	2.56
9	-0.000885	3.7124E-04	-2.38

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 9
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	149111.0	0.26028	0.26025	0.03
2	94528.00	0.28972	0.29007	-0.34
3	71175.00	0.31033	0.30968	0.65
4	56338.40	0.32933	0.32943	-0.10
5	38042.10	0.36802	0.36860	-0.57
6	25206.20	0.41828	0.41819	0.09
7	17238.80	0.47655	0.47597	0.58
8	12688.20	0.53529	0.53507	0.22
9	9296.800	0.61014	0.61050	-0.37
10	7239.200	0.68522	0.68588	-0.66
11	5813.540	0.76498	0.76596	-0.98
12	4761.430	0.85408	0.85341	0.67
13	3972.850	0.94927	0.94795	1.32
14	3379.080	1.05019	1.04790	2.29
15	2951.800	1.14261	1.14513	-2.52
16	2717.580	1.21233	1.21192	0.41
17	2426.874	1.31324	1.31387	-0.62
18	2220.182	1.40297	1.40392	-0.94
19	1879.927	1.59973	1.60020	-0.47
20	1630.389	1.80440	1.80395	0.44
21	1452.841	2.00026	1.99923	1.04
22	1309.229	2.20473	2.20401	0.72
23	1199.416	2.40162	2.40134	0.28
24	1107.706	2.60319	2.60368	-0.50
25	1032.102	2.80419	2.80481	-0.62
26	959.9766	3.03405	3.03467	-0.62
27	915.7760	3.19854	3.19872	-0.18
28	867.1568	3.40516	3.40440	0.76

Order of Fit = 9 RMS error of fit = .88 mK
Largest absolute error = -2.52 mK at data point no. 15

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POLYNOMIAL EQUATION

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

3.03K	to	20.1K
960.0 Ohms	to	258.8 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.38026863048 ZU = 3.04442453131

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.601609	4.6544E-04	20628.91
1	-9.409289	7.2506E-04	-12977.17
2	2.980876	7.0847E-04	4207.51
3	-0.654554	6.2933E-04	-1040.09
4	0.087721	6.1265E-04	143.18

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 4
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1107.706	2.60368	2.60636	-2.68
25	1032.102	2.80481	2.80251	2.30
26	959.9766	3.03467	3.03200	2.68
27	915.7760	3.19854	3.19723	1.30
28	867.1568	3.40516	3.40501	0.15
29	826.9331	3.60061	3.60135	-0.74
30	790.1909	3.80251	3.80379	-1.28
31	758.9399	3.99434	3.99645	-2.11
32	728.8045	4.20045	4.20317	-2.72
33	674.6903	4.63687	4.63776	-0.89
34	632.7760	5.04515	5.04549	-0.33
35	589.3669	5.55777	5.55449	3.28
36	540.3382	6.27426	6.27198	2.28
37	496.6161	7.08792	7.08753	0.39
38	453.7998	8.11247	8.11203	0.44
39	419.8593	9.14470	9.14376	0.95
40	392.2522	10.17519	10.17597	-0.78
41	369.4325	11.19714	11.19807	-0.92
42	350.1729	12.20780	12.20938	-1.57
43	333.5465	13.21427	13.21570	-1.43
44	319.1377	14.20596	14.20690	-0.94
45	306.3783	15.19228	15.19287	-0.59
46	294.9706	16.17140	16.17391	-2.50
47	284.7173	17.14833	17.14730	1.03
48	275.4166	18.12144	18.11519	6.26
49	266.7809	19.09720	19.09511	2.09
50	258.8245	20.07292	20.07517	-2.24
51	250.7626	21.15326	21.15231	0.95
52	240.0317	22.73170	22.73405	-2.35

Order of Fit = 4 RMS error of fit = 2.06 mK
Largest absolute error = 6.26 mK at data point no. 48

POLYNOMIAL EQUATION

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	95.1K
258.8 Ohms	to	95.64 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.93710132657 ZU = 2.43999018042

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.980256	5.5408E-04	99227.92
1	-44.914856	8.9493E-04	-50188.30
2	9.134149	8.3333E-04	10960.99
3	-1.192881	7.8105E-04	-1527.29
4	0.103475	7.3193E-04	141.37
5	0.006593	7.1471E-04	9.22
6	-0.002021	6.7887E-04	-2.98

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	275.4166	18.11519	18.11472	0.47
49	266.7809	19.09511	19.09575	-0.64
50	258.8245	20.07517	20.07624	-1.07
51	250.7626	21.15326	21.15262	0.65
52	240.0317	22.73170	22.73036	1.34
53	230.2777	24.32724	24.32764	-0.39
54	221.2467	25.96616	25.96543	0.72
55	213.0135	27.61088	27.61053	0.35
56	205.5116	29.25333	29.25280	0.53
57	197.8524	31.08723	31.08937	-2.14
58	189.8283	33.20784	33.21085	-3.01
59	179.7061	36.22532	36.22285	2.47
60	170.8478	39.22083	39.22251	-1.68
61	163.0131	42.21386	42.21268	1.18
62	155.9881	45.21223	45.21056	1.67
63	149.6726	48.20587	48.20350	2.37
64	145.8036	50.19821	50.19542	2.79
65	137.0887	55.18918	55.19361	-4.44
66	129.5443	60.19392	60.19543	-1.52
67	122.9478	65.18830	65.19193	-3.63
68	117.1205	70.18255	70.18349	-0.94
69	111.9338	75.16700	75.16294	4.06
70	107.2539	80.16352	80.16057	2.95
71	103.0164	85.16015	85.16118	-1.03
72	99.16659	90.15222	90.15120	1.02
73	95.64126	95.14450	95.14271	1.79
74	92.39601	100.13246	100.13825	-5.79
75	86.51698	110.31893	110.31700	1.92

Order of Fit = 6 RMS error of fit = 2.31 mK
Largest absolute error = -5.79 mK at data point no. 74

POLYNOMIAL EQUATION

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

95.1K	to	325.K
95.64 Ohms	to	41.05 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.6088613452 ZU = 2.01290643242

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	187.129487	1.6585E-03	112830.70
1	-119.416582	2.5268E-03	-47260.33
2	19.926745	2.3947E-03	8321.22
3	-2.963303	2.3845E-03	-1242.73
4	0.579691	2.3214E-03	249.71
5	-0.108751	2.2123E-03	-49.16
6	0.022693	2.1752E-03	10.43
7	-0.009148	2.1597E-03	-4.24

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	103.0164	85.16118	85.16083	0.35
72	99.16659	90.15120	90.15264	-1.44
73	95.64126	95.14271	95.14043	2.29
74	92.39601	100.13246	100.13373	-1.27
75	86.51698	110.31893	110.32069	-1.76
76	81.62564	120.12648	120.12266	3.82
77	77.25118	130.12563	130.12259	3.04
78	73.38032	140.12228	140.13309	-10.81
79	69.93899	150.12034	150.12211	-1.77
80	66.85646	160.11215	160.09849	13.67
81	64.06692	170.10991	170.11089	-0.98
82	61.53885	180.12192	180.12785	-5.93
83	59.24467	190.11859	190.11857	0.02
84	57.14733	200.12141	200.11721	4.20
85	55.22016	210.13312	210.14072	-7.60
86	53.45331	220.13271	220.13438	-1.67
87	51.82268	230.13628	230.13399	2.30
88	50.31427	240.14125	240.13655	4.69
89	48.91837	250.13409	250.12108	13.01
90	47.61495	260.14189	260.15631	-14.42
91	46.40787	270.14073	270.13941	1.32
92	45.27816	280.14660	280.15639	-9.79
93	44.22724	290.13133	290.12913	2.20
94	43.23950	300.15460	300.14462	9.98
95	42.31379	310.16207	310.16044	1.63
96	41.87287	315.17200	315.16502	6.98
97	41.44427	320.17139	320.18495	-13.56
98	40.95176	326.14583	326.15314	-7.31
99	40.63136	330.16522	330.15640	8.82

Order of Fit = 7 RMS error of fit = 7.02 mK
Largest absolute error = -14.42 mK at data point no. 90

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INTERPOLATION TABLE

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	81428.3	-1.1845e+6	-4.3641	48.00	150.082	-2.0194	-0.64584
0.4000	29020.0	-2.3380e+5	-3.2225	49.00	148.096	-1.9544	-0.64664
0.5000	15092.5	-79642.	-2.6384	50.00	146.172	-1.8927	-0.64742
0.6000	9667.56	-36543.	-2.2680	51.00	144.309	-1.8341	-0.64817
0.7000	6943.42	-20171.	-2.0335	52.00	142.503	-1.7782	-0.64887
0.8000	5355.76	-12447.	-1.8593	53.00	140.752	-1.7250	-0.64953
0.9000	4337.97	-8301.0	-1.7222	54.00	139.053	-1.6743	-0.65018
1.000	3639.68	-5864.3	-1.6112	55.00	137.403	-1.6260	-0.65085
2.000	1452.23	-793.53	-1.0928	56.00	135.800	-1.5799	-0.65151
3.000	969.306	-295.96	-0.91599	57.00	134.242	-1.5359	-0.65214
4.000	758.395	-153.54	-0.80980	58.00	132.728	-1.4937	-0.65273
4.200	729.243	-138.39	-0.79704	59.00	131.254	-1.4534	-0.65332
5.000	637.100	-95.948	-0.75300	60.00	129.820	-1.4148	-0.65391
6.000	557.531	-66.088	-0.71122	61.00	128.424	-1.3779	-0.65450
7.000	500.830	-48.729	-0.68108	62.00	127.064	-1.3425	-0.65507
8.000	457.973	-37.739	-0.65924	63.00	125.738	-1.3085	-0.65562
9.000	424.157	-30.330	-0.64357	64.00	124.446	-1.2759	-0.65616
10.00	396.595	-25.067	-0.63206	65.00	123.186	-1.2446	-0.65672
11.00	373.562	-21.179	-0.62364	66.00	121.957	-1.2145	-0.65728
12.00	353.930	-18.211	-0.61745	67.00	120.757	-1.1856	-0.65782
13.00	336.926	-15.886	-0.61293	68.00	119.585	-1.1578	-0.65834
14.00	322.004	-14.023	-0.60970	69.00	118.441	-1.1310	-0.65887
15.00	308.765	-12.504	-0.60745	70.00	117.323	-1.1052	-0.65941
16.00	296.909	-11.245	-0.60597	71.00	116.230	-1.0804	-0.65995
17.00	286.207	-10.187	-0.60509	72.00	115.162	-1.0564	-0.66048
18.00	276.481	-9.2897	-0.60480	73.00	114.117	-1.0333	-0.66100
19.00	267.587	-8.5129	-0.60446	74.00	113.095	-1.0110	-0.66152
20.00	259.421	-7.8429	-0.60465	75.00	112.095	-0.98950	-0.66205
21.00	251.867	-7.2752	-0.60659	76.00	111.116	-0.96874	-0.66259
22.00	244.851	-6.7671	-0.60803	77.00	110.157	-0.94866	-0.66312
23.00	238.312	-6.3190	-0.60986	77.35	109.826	-0.94180	-0.66330
24.00	232.197	-5.9191	-0.61180	78.00	109.218	-0.92926	-0.66364
25.00	226.461	-5.5599	-0.61378	79.00	108.298	-0.91049	-0.66418
26.00	221.066	-5.2356	-0.61577	80.00	107.397	-0.89236	-0.66472
27.00	215.979	-4.9416	-0.61776	81.00	106.513	-0.87482	-0.66527
28.00	211.174	-4.6739	-0.61973	82.00	105.647	-0.85781	-0.66580
29.00	206.624	-4.4290	-0.62162	83.00	104.798	-0.84132	-0.66633
30.00	202.309	-4.2045	-0.62348	84.00	103.964	-0.82535	-0.66686
31.00	198.209	-3.9978	-0.62526	85.00	103.147	-0.80987	-0.66738
32.00	194.308	-3.8071	-0.62697	86.00	102.344	-0.79486	-0.66792
33.00	190.590	-3.6305	-0.62861	87.00	101.557	-0.78033	-0.66848
34.00	187.042	-3.4669	-0.63020	88.00	100.784	-0.76625	-0.66906
35.00	183.653	-3.3145	-0.63167	89.00	100.024	-0.75262	-0.66967
36.00	180.410	-3.1727	-0.63309	90.00	99.2782	-0.73942	-0.67031
37.00	177.304	-3.0404	-0.63448	91.00	98.5452	-0.72661	-0.67097
38.00	174.326	-2.9166	-0.63576	92.00	97.8249	-0.71413	-0.67161
39.00	171.468	-2.8006	-0.63699	93.00	97.1169	-0.70199	-0.67223
40.00	168.723	-2.6919	-0.63818	94.00	96.4208	-0.69016	-0.67283
41.00	166.082	-2.5896	-0.63929	95.00	95.7364	-0.67864	-0.67342
42.00	163.541	-2.4934	-0.64035	96.00	95.0634	-0.66742	-0.67399
43.00	161.094	-2.4029	-0.64138	97.00	94.4015	-0.65648	-0.67455
44.00	158.734	-2.3173	-0.64235	98.00	93.7504	-0.64580	-0.67508
45.00	156.457	-2.2366	-0.64328	99.00	93.1098	-0.63539	-0.67559
46.00	154.259	-2.1602	-0.64418	100.0	92.4795	-0.62524	-0.67609
47.00	152.136	-2.0879	-0.64503	101.0	91.8593	-0.61535	-0.67658

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INTERPOLATION TABLE

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	91.2488	-0.60569	-0.67706	157.0	67.7793	-0.30267	-0.70108
103.0	90.6478	-0.59628	-0.67753	158.0	67.4782	-0.29951	-0.70131
104.0	90.0561	-0.58710	-0.67800	159.0	67.1802	-0.29641	-0.70152
105.0	89.4735	-0.57815	-0.67848	160.0	66.8853	-0.29335	-0.70173
106.0	88.8997	-0.56942	-0.67896	161.0	66.5935	-0.29034	-0.70193
107.0	88.3346	-0.56092	-0.67944	162.0	66.3046	-0.28737	-0.70212
108.0	87.7778	-0.55262	-0.67994	163.0	66.0187	-0.28445	-0.70230
109.0	87.2293	-0.54454	-0.68045	164.0	65.7357	-0.28157	-0.70246
110.0	86.6887	-0.53666	-0.68098	165.0	65.4556	-0.27873	-0.70262
111.0	86.1559	-0.52898	-0.68152	166.0	65.1783	-0.27593	-0.70276
112.0	85.6307	-0.52147	-0.68205	167.0	64.9037	-0.27318	-0.70290
113.0	85.1129	-0.51413	-0.68258	168.0	64.6319	-0.27046	-0.70302
114.0	84.6023	-0.50695	-0.68310	169.0	64.3628	-0.26779	-0.70314
115.0	84.0989	-0.49993	-0.68362	170.0	64.0963	-0.26515	-0.70326
116.0	83.6024	-0.49306	-0.68413	171.0	63.8325	-0.26256	-0.70336
117.0	83.1128	-0.48635	-0.68465	172.0	63.5712	-0.26000	-0.70345
118.0	82.6297	-0.47979	-0.68517	173.0	63.3125	-0.25747	-0.70354
119.0	82.1531	-0.47338	-0.68570	174.0	63.0562	-0.25498	-0.70361
120.0	81.6829	-0.46711	-0.68623	175.0	62.8025	-0.25253	-0.70367
121.0	81.2188	-0.46098	-0.68677	176.0	62.5512	-0.25011	-0.70372
122.0	80.7609	-0.45497	-0.68730	177.0	62.3023	-0.24772	-0.70377
123.0	80.3089	-0.44908	-0.68781	178.0	62.0557	-0.24537	-0.70381
124.0	79.8627	-0.44331	-0.68832	179.0	61.8115	-0.24305	-0.70384
125.0	79.4222	-0.43766	-0.68882	180.0	61.5696	-0.24076	-0.70386
126.0	78.9873	-0.43212	-0.68931	181.0	61.3300	-0.23850	-0.70388
127.0	78.5579	-0.42669	-0.68981	182.0	61.0926	-0.23628	-0.70389
128.0	78.1339	-0.42137	-0.69030	183.0	60.8574	-0.23408	-0.70388
129.0	77.7151	-0.41616	-0.69079	184.0	60.6244	-0.23191	-0.70387
130.0	77.3015	-0.41106	-0.69128	185.0	60.3936	-0.22977	-0.70385
131.0	76.8930	-0.40605	-0.69177	186.0	60.1649	-0.22766	-0.70382
132.0	76.4894	-0.40113	-0.69225	187.0	59.9382	-0.22558	-0.70379
133.0	76.0907	-0.39631	-0.69271	188.0	59.7137	-0.22353	-0.70374
134.0	75.6968	-0.39157	-0.69316	189.0	59.4912	-0.22150	-0.70369
135.0	75.3075	-0.38692	-0.69360	190.0	59.2707	-0.21950	-0.70364
136.0	74.9229	-0.38235	-0.69404	191.0	59.0522	-0.21753	-0.70358
137.0	74.5428	-0.37786	-0.69446	192.0	58.8356	-0.21558	-0.70351
138.0	74.1671	-0.37346	-0.69488	193.0	58.6210	-0.21366	-0.70343
139.0	73.7959	-0.36914	-0.69530	194.0	58.4083	-0.21176	-0.70334
140.0	73.4289	-0.36489	-0.69571	195.0	58.1975	-0.20988	-0.70325
141.0	73.0660	-0.36072	-0.69611	196.0	57.9885	-0.20803	-0.70314
142.0	72.7074	-0.35662	-0.69650	197.0	57.7814	-0.20620	-0.70304
143.0	72.3528	-0.35259	-0.69688	198.0	57.5761	-0.20440	-0.70292
144.0	72.0022	-0.34863	-0.69724	199.0	57.3726	-0.20262	-0.70280
145.0	71.6555	-0.34473	-0.69759	200.0	57.1709	-0.20086	-0.70267
146.0	71.3127	-0.34090	-0.69793	201.0	56.9709	-0.19913	-0.70254
147.0	70.9737	-0.33713	-0.69827	202.0	56.7726	-0.19741	-0.70240
148.0	70.6384	-0.33343	-0.69859	203.0	56.5760	-0.19572	-0.70225
149.0	70.3068	-0.32979	-0.69891	204.0	56.3812	-0.19404	-0.70210
150.0	69.9788	-0.32620	-0.69922	205.0	56.1879	-0.19239	-0.70194
151.0	69.6544	-0.32268	-0.69953	206.0	55.9964	-0.19076	-0.70177
152.0	69.3334	-0.31921	-0.69981	207.0	55.8064	-0.18915	-0.70159
153.0	69.0159	-0.31580	-0.70009	208.0	55.6181	-0.18755	-0.70141
154.0	68.7018	-0.31244	-0.70036	209.0	55.4313	-0.18598	-0.70123
155.0	68.3910	-0.30913	-0.70061	210.0	55.2461	-0.18443	-0.70104
156.0	68.0835	-0.30587	-0.70085	211.0	55.0624	-0.18289	-0.70084

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INTERPOLATION TABLE

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	54.8803	-0.18137	-0.70064	267.0	46.7784	-0.11931	-0.68101
213.0	54.6997	-0.17987	-0.70043	268.0	46.6595	-0.11848	-0.68052
214.0	54.5206	-0.17839	-0.70021	269.0	46.5414	-0.11765	-0.68002
215.0	54.3429	-0.17693	-0.69999	270.0	46.4241	-0.11684	-0.67952
216.0	54.1667	-0.17548	-0.69976	271.0	46.3077	-0.11603	-0.67901
217.0	53.9919	-0.17405	-0.69952	272.0	46.1921	-0.11523	-0.67850
218.0	53.8186	-0.17263	-0.69928	273.0	46.0773	-0.11443	-0.67798
219.0	53.6467	-0.17124	-0.69903	274.0	45.9632	-0.11364	-0.67746
220.0	53.4761	-0.16986	-0.69878	275.0	45.8500	-0.11286	-0.67694
221.0	53.3069	-0.16849	-0.69853	276.0	45.7375	-0.11209	-0.67641
222.0	53.1391	-0.16714	-0.69827	277.0	45.6258	-0.11133	-0.67587
223.0	52.9727	-0.16581	-0.69800	278.0	45.5148	-0.11057	-0.67534
224.0	52.8075	-0.16449	-0.69772	279.0	45.4046	-0.10982	-0.67480
225.0	52.6437	-0.16318	-0.69744	280.0	45.2952	-0.10907	-0.67425
226.0	52.4811	-0.16189	-0.69716	281.0	45.1865	-0.10834	-0.67370
227.0	52.3199	-0.16062	-0.69686	282.0	45.0785	-0.10760	-0.67315
228.0	52.1599	-0.15935	-0.69657	283.0	44.9713	-0.10688	-0.67259
229.0	52.0012	-0.15811	-0.69626	284.0	44.8648	-0.10616	-0.67203
230.0	51.8437	-0.15687	-0.69596	285.0	44.7590	-0.10545	-0.67146
231.0	51.6874	-0.15565	-0.69565	286.0	44.6539	-0.10475	-0.67089
232.0	51.5324	-0.15445	-0.69533	287.0	44.5495	-0.10405	-0.67032
233.0	51.3785	-0.15326	-0.69501	288.0	44.4458	-0.10336	-0.66974
234.0	51.2259	-0.15207	-0.69468	289.0	44.3427	-0.10267	-0.66916
235.0	51.0744	-0.15091	-0.69434	290.0	44.2404	-0.10199	-0.66858
236.0	50.9240	-0.14975	-0.69400	291.0	44.1388	-0.10132	-0.66799
237.0	50.7749	-0.14861	-0.69366	292.0	44.0378	-0.10065	-0.66740
238.0	50.6268	-0.14748	-0.69331	293.0	43.9374	-9.9992e-2	-0.66680
239.0	50.4799	-0.14636	-0.69295	294.0	43.8378	-9.9336e-2	-0.66620
240.0	50.3341	-0.14525	-0.69259	295.0	43.7388	-9.8687e-2	-0.66560
241.0	50.1894	-0.14416	-0.69223	296.0	43.6404	-9.8042e-2	-0.66499
242.0	50.0458	-0.14308	-0.69186	297.0	43.5427	-9.7404e-2	-0.66438
243.0	49.9032	-0.14201	-0.69149	298.0	43.4456	-9.6771e-2	-0.66377
244.0	49.7618	-0.14094	-0.69110	299.0	43.3491	-9.6144e-2	-0.66315
245.0	49.6213	-0.13990	-0.69072	300.0	43.2533	-9.5523e-2	-0.66253
246.0	49.4820	-0.13886	-0.69033	301.0	43.1581	-9.4906e-2	-0.66191
247.0	49.3436	-0.13783	-0.68993	302.0	43.0635	-9.4295e-2	-0.66128
248.0	49.2063	-0.13681	-0.68953	303.0	42.9695	-9.3690e-2	-0.66065
249.0	49.0700	-0.13580	-0.68912	304.0	42.8761	-9.3089e-2	-0.66002
250.0	48.9347	-0.13481	-0.68872	305.0	42.7833	-9.2494e-2	-0.65938
251.0	48.8004	-0.13382	-0.68830	306.0	42.6911	-9.1904e-2	-0.65874
252.0	48.6670	-0.13285	-0.68788	307.0	42.5995	-9.1318e-2	-0.65810
253.0	48.5347	-0.13188	-0.68746	308.0	42.5085	-9.0738e-2	-0.65745
254.0	48.4033	-0.13092	-0.68703	309.0	42.4180	-9.0163e-2	-0.65681
255.0	48.2728	-0.12998	-0.68659	310.0	42.3282	-8.9593e-2	-0.65615
256.0	48.1433	-0.12904	-0.68615	311.0	42.2388	-8.9028e-2	-0.65550
257.0	48.0148	-0.12811	-0.68571	312.0	42.1501	-8.8467e-2	-0.65484
258.0	47.8871	-0.12719	-0.68526	313.0	42.0619	-8.7911e-2	-0.65418
259.0	47.7604	-0.12628	-0.68481	314.0	41.9743	-8.7360e-2	-0.65352
260.0	47.6345	-0.12538	-0.68435	315.0	41.8872	-8.6813e-2	-0.65285
261.0	47.5096	-0.12449	-0.68389	316.0	41.8006	-8.6271e-2	-0.65219
262.0	47.3856	-0.12360	-0.68342	317.0	41.7146	-8.5734e-2	-0.65151
263.0	47.2624	-0.12273	-0.68295	318.0	41.6292	-8.5201e-2	-0.65084
264.0	47.1401	-0.12186	-0.68247	319.0	41.5442	-8.4673e-2	-0.65016
265.0	47.0187	-0.12100	-0.68199	320.0	41.4598	-8.4149e-2	-0.64948
266.0	46.8981	-0.12016	-0.68150	321.0	41.3759	-8.3629e-2	-0.64880

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INTERPOLATION TABLE

Calibration Report: 430820
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29577
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
322.0	41.2926	-8.3113e-2	-0.64812				
323.0	41.2097	-8.2602e-2	-0.64743				
324.0	41.1274	-8.2095e-2	-0.64674				
325.0	41.0455	-8.1593e-2	-0.64605				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29577
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.61325,325.000	Point 56: 2.02739, 81.000	Point 111: 2.61685, 9.350	Point 166: 4.11343, 0.530
Point 2: 1.61850,319.000	Point 57: 2.03643, 78.500	Point 112: 2.63059, 8.900	Point 167: 4.16708, 0.505
Point 3: 1.62343,313.500	Point 58: 2.04388, 76.500	Point 113: 2.64354, 8.500	Point 168: 4.21153, 0.486
Point 4: 1.62847,308.000	Point 59: 2.05150, 74.500	Point 114: 2.65723, 8.100	Point 169: 4.25668, 0.468
Point 5: 1.63363,302.500	Point 60: 2.05931, 72.500	Point 115: 2.67176, 7.700	Point 170: 4.29984, 0.452
Point 6: 1.63891,297.000	Point 61: 2.06733, 70.500	Point 116: 2.68726, 7.300	Point 171: 4.34594, 0.436
Point 7: 1.64431,291.500	Point 62: 2.07557, 68.500	Point 117: 2.70176, 6.950	Point 172: 4.39543, 0.420
Point 8: 1.64985,286.000	Point 63: 2.08404, 66.500	Point 118: 2.71715, 6.600	Point 173: 4.44854, 0.404
Point 9: 1.65552,280.500	Point 64: 2.09275, 64.500	Point 119: 2.73365, 6.250	Point 174: 4.50550, 0.388
Point 10: 1.66080,275.500	Point 65: 2.10172, 62.500	Point 120: 2.75139, 5.900	Point 175: 4.56646, 0.372
Point 11: 1.66619,270.500	Point 66: 2.11097, 60.500	Point 121: 2.76883, 5.580	Point 176: 4.63162, 0.356
Point 12: 1.67170,265.500	Point 67: 2.12002, 58.600	Point 122: 2.78764, 5.260	Point 177: 4.70144, 0.340
Point 13: 1.67734,260.500	Point 68: 2.12887, 56.800	Point 123: 2.80672, 4.960	Point 178: 4.77653, 0.324
Point 14: 1.68311,255.500	Point 69: 2.13797, 55.000	Point 124: 2.82736, 4.660	Point 179: 4.82805, 0.314
Point 15: 1.68901,250.500	Point 70: 2.14737, 53.200	Point 125: 2.84831, 4.380	Point 180: 4.88540, 0.304
Point 16: 1.69505,245.500	Point 71: 2.15707, 51.400	Point 126: 2.87108, 4.100	Point 181: 4.89824, 0.302
Point 17: 1.70123,240.500	Point 72: 2.16710, 49.600	Point 127: 2.89057, 3.880	Point 182: 4.91078, 0.300
Point 18: 1.70755,235.500	Point 73: 2.17747, 47.800	Point 128: 2.90855, 3.690	Point 183: 4.91078, 0.300
Point 19: 1.71403,230.500	Point 74: 2.18822, 46.000	Point 129: 2.92677, 3.510	
Point 20: 1.72066,225.500	Point 75: 2.19937, 44.200	Point 130: 2.94519, 3.340	
Point 21: 1.72746,220.500	Point 76: 2.20966, 42.600	Point 131: 2.96494, 3.170	
Point 22: 1.73442,215.500	Point 77: 2.22029, 41.000	Point 132: 2.98241, 3.030	
Point 23: 1.74156,210.500	Point 78: 2.23203, 39.300	Point 133: 3.00278, 2.880	
Point 24: 1.74889,205.500	Point 79: 2.24352, 37.700	Point 134: 3.02769, 2.710	
Point 25: 1.75640,200.500	Point 80: 2.25470, 36.200	Point 135: 3.05138, 2.560	
Point 26: 1.76411,195.500	Point 81: 2.26632, 34.700	Point 136: 3.07546, 2.420	
Point 27: 1.77202,190.500	Point 82: 2.27841, 33.200	Point 137: 3.10161, 2.280	
Point 28: 1.77933,186.000	Point 83: 2.29101, 31.700	Point 138: 3.12814, 2.150	
Point 29: 1.78682,181.500	Point 84: 2.30328, 30.300	Point 139: 3.15710, 2.020	
Point 30: 1.79449,177.000	Point 85: 2.31607, 28.900	Point 140: 3.18901, 1.890	
Point 31: 1.80236,172.500	Point 86: 2.32944, 27.500	Point 141: 3.22160, 1.770	
Point 32: 1.81043,168.000	Point 87: 2.34243, 26.200	Point 142: 3.25454, 1.660	
Point 33: 1.81872,163.500	Point 88: 2.35601, 24.900	Point 143: 3.29095, 1.550	
Point 34: 1.82722,159.000	Point 89: 2.37026, 23.600	Point 144: 3.33159, 1.440	
Point 35: 1.83596,154.500	Point 90: 2.38409, 22.400	Point 145: 3.37307, 1.340	
Point 36: 1.84495,150.000	Point 91: 2.39861, 21.200	Point 146: 3.41954, 1.240	
Point 37: 1.85419,145.500	Point 92: 2.41265, 20.100	Point 147: 3.45087, 1.180	
Point 38: 1.86369,141.000	Point 93: 2.42333, 19.300	Point 148: 3.47289, 1.140	
Point 39: 1.87349,136.500	Point 94: 2.43232, 18.650	Point 149: 3.49620, 1.100	
Point 40: 1.88245,132.500	Point 95: 2.44164, 18.000	Point 150: 3.52091, 1.060	
Point 41: 1.89165,128.500	Point 96: 2.45130, 17.350	Point 151: 3.54717, 1.020	
Point 42: 1.90112,124.500	Point 97: 2.46133, 16.700	Point 152: 3.57515, 0.980	
Point 43: 1.91087,120.500	Point 98: 2.47096, 16.100	Point 153: 3.60506, 0.940	
Point 44: 1.92092,116.500	Point 99: 2.48095, 15.500	Point 154: 3.63304, 0.905	
Point 45: 1.93128,112.500	Point 100: 2.49136, 14.900	Point 155: 3.66278, 0.870	
Point 46: 1.94199,108.500	Point 101: 2.50130, 14.350	Point 156: 3.69458, 0.835	
Point 47: 1.95168,105.000	Point 102: 2.51164, 13.800	Point 157: 3.72864, 0.800	
Point 48: 1.96165,101.500	Point 103: 2.52243, 13.250	Point 158: 3.76528, 0.765	
Point 49: 1.97047, 98.500	Point 104: 2.53371, 12.700	Point 159: 3.80481, 0.730	
Point 50: 1.97800, 96.000	Point 105: 2.54446, 12.200	Point 160: 3.84141, 0.700	
Point 51: 1.98572, 93.500	Point 106: 2.55567, 11.700	Point 161: 3.88062, 0.670	
Point 52: 1.99362, 91.000	Point 107: 2.56744, 11.200	Point 162: 3.92297, 0.640	
Point 53: 2.00173, 88.500	Point 108: 2.57982, 10.700	Point 163: 3.96886, 0.610	
Point 54: 2.01005, 86.000	Point 109: 2.59154, 10.250	Point 164: 4.01882, 0.580	
Point 55: 2.01860, 83.500	Point 110: 2.60385, 9.800	Point 165: 4.06429, 0.555	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 54

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.61327	325.0	31	2.61542	9.4
2	1.61413	324.0	32	2.67183	7.7
3	1.62298	314.0	33	2.72652	6.4
4	1.63698	299.0	34	2.77935	5.4
5	1.65191	284.0	35	2.83185	4.6
6	1.66784	269.0	36	2.87990	4.0
7	1.68487	254.0	37	2.92792	3.5
8	1.70312	239.0	38	2.96146	3.2
9	1.72270	224.0	39	3.00011	2.9
10	1.74376	209.0	40	3.06161	2.5
11	1.76647	194.0	41	3.13915	2.1
12	1.79107	179.0	42	3.21339	1.8
13	1.81780	164.0	43	3.27421	1.6
14	1.84700	149.0	44	3.34799	1.4
15	1.87908	134.0	45	3.39137	1.3
16	1.91462	119.0	46	3.44036	1.2
17	1.95451	104.0	47	3.49630	1.1
18	2.00011	89.0	48	3.56106	1.0
19	2.05344	74.0	49	3.63729	.9
20	2.10402	62.0	50	3.72882	.8
21	2.13290	56.0	51	3.84157	.7
22	2.16487	50.0	52	3.98532	.6
23	2.19440	45.0	53	4.46270	.4
24	2.22717	40.0	54	4.91078	.3
25	2.26400	35.0			
26	2.30601	30.0			
27	2.35499	25.0			
28	2.41400	20.0			
29	2.48963	15.0			
30	2.55343	11.8			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	89.034
1000	2.901
10000	0.591

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BREAKPOINTS 234 FORMAT

Calibration Report: 430820 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29577
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.005K
10 - 20K:	0.009K
20 - 40K:	0.014K
40 - 100K:	0.030K
> 100K:	0.147K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	317.324	41.68694	1.620	56	6.539	524.8075	2.720
2	295.890	43.65158	1.640	57	6.124	549.5409	2.740
3	276.257	45.70882	1.660	58	5.742	575.4399	2.760
4	258.187	47.86301	1.680	59	5.389	602.5596	2.780
5	241.492	50.11872	1.700	60	5.065	630.9573	2.800
6	226.004	52.48075	1.720	61	4.766	660.6934	2.820
7	211.593	54.95409	1.740	62	4.490	691.8310	2.840
8	198.159	57.54399	1.760	63	4.235	724.4360	2.860
9	185.600	60.25596	1.780	64	3.999	758.5776	2.880
10	173.843	63.09573	1.800	65	3.780	794.3282	2.900
11	162.824	66.06934	1.820	66	3.576	831.7638	2.920
12	152.473	69.18310	1.840	67	3.388	870.9636	2.940
13	142.740	72.44360	1.860	68	3.212	912.0108	2.960
14	133.590	75.85776	1.880	69	3.050	954.9926	2.980
15	124.978	79.43282	1.900	70	2.901	1000.000	3.000
16	116.869	83.17638	1.920	71	2.631	1096.478	3.040
17	109.244	87.09636	1.940	72	2.396	1202.264	3.080
18	102.077	91.20108	1.960	73	2.190	1318.257	3.120
19	95.351	95.49926	1.980	74	2.009	1445.440	3.160
20	89.032	100.0000	2.000	75	1.849	1584.893	3.200
21	83.100	104.7129	2.020	76	1.708	1737.801	3.240
22	77.541	109.6478	2.040	77	1.583	1905.461	3.280
23	72.329	114.8154	2.060	78	1.471	2089.296	3.320
24	67.449	120.2264	2.080	79	1.371	2290.868	3.360
25	62.883	125.8925	2.100	80	1.282	2511.886	3.400
26	58.609	131.8257	2.120	81	1.201	2754.229	3.440
27	54.611	138.0384	2.140	82	1.127	3019.952	3.480
28	50.873	144.5440	2.160	83	1.062	3311.311	3.520
29	47.375	151.3561	2.180	84	1.003	3630.781	3.560
30	44.106	158.4893	2.200	85	0.947	3981.072	3.600
31	41.047	165.9587	2.220	86	0.897	4365.158	3.640
32	38.188	173.7801	2.240	87	0.851	4786.301	3.680
33	35.514	181.9701	2.260	88	0.809	5248.075	3.720
34	33.012	190.5461	2.280	89	0.770	5754.399	3.760
35	30.673	199.5262	2.300	90	0.734	6309.573	3.800
36	28.487	208.9296	2.320	91	0.701	6918.310	3.840
37	26.443	218.7762	2.340	92	0.671	7585.776	3.880
38	24.534	229.0868	2.360	93	0.642	8317.638	3.920
39	22.753	239.8833	2.380	94	0.616	9120.108	3.960
40	21.093	251.1886	2.400	95	0.591	10000.00	4.000
41	19.548	263.0268	2.420	96	0.537	12589.25	4.100
42	18.115	275.4229	2.440	97	0.491	15848.93	4.200
43	16.786	288.4032	2.460	98	0.452	19952.62	4.300
44	15.558	301.9952	2.480	99	0.419	25118.86	4.400
45	14.422	316.2278	2.500	100	0.389	31622.78	4.500
46	13.374	331.1311	2.520	101	0.364	39810.72	4.600
47	12.406	346.7369	2.540	102	0.340	50118.72	4.700
48	11.515	363.0781	2.560	103	0.320	63095.73	4.800
49	10.695	380.1894	2.580	104	0.302	79432.82	4.900
50	9.940	398.1072	2.600	105	0.286	100000.0	5.000
51	9.246	416.8694	2.620	106	0.271	125892.5	5.100
52	8.609	436.5158	2.640				
53	8.023	457.0882	2.660				
54	7.486	478.6301	2.680				
55	6.993	501.1872	2.700				

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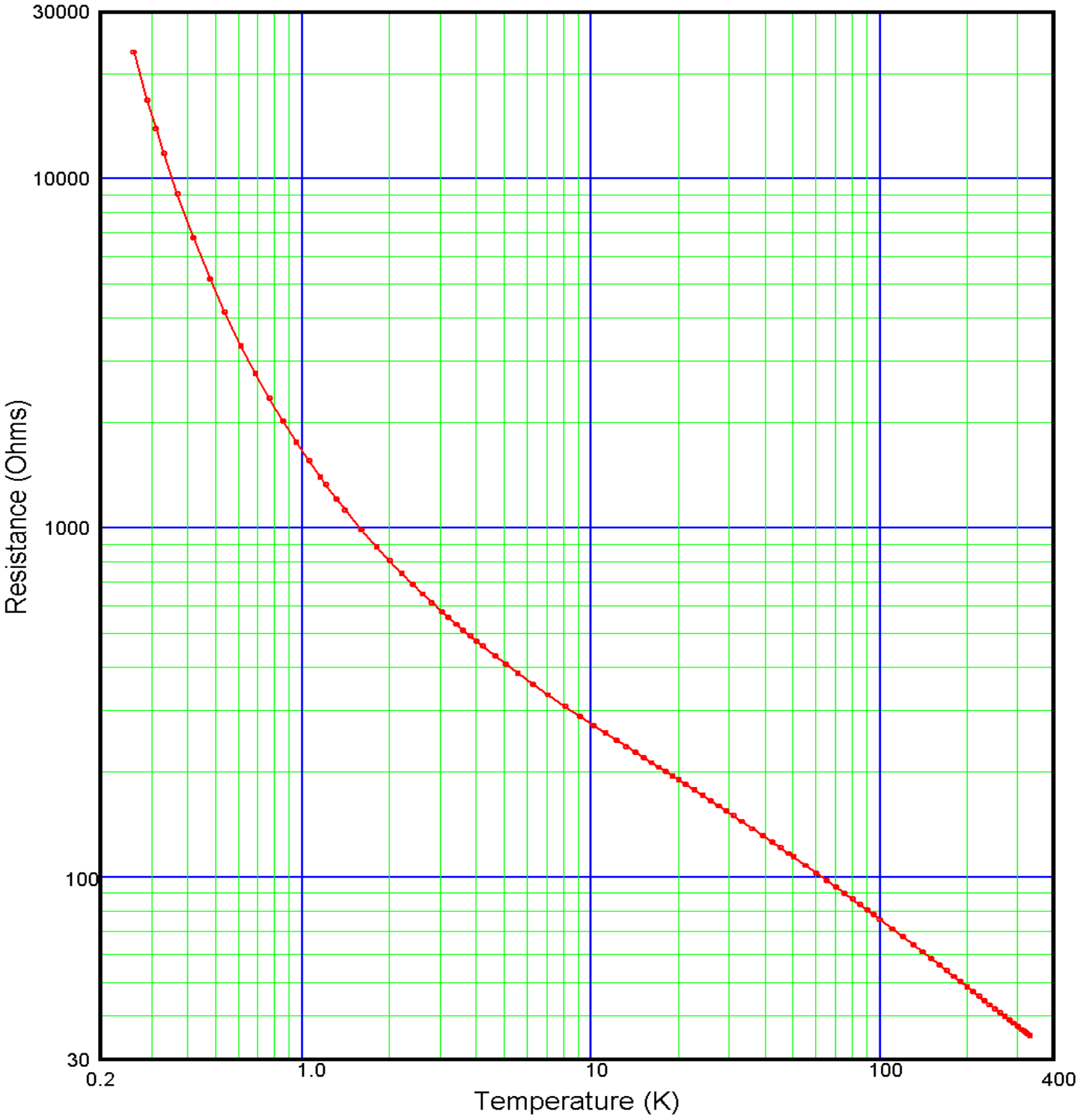
DATA PLOT

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260377	23073.2	51	21.1524	184.784
2	0.289736	16833.4	52	22.7310	177.831
3	0.310286	13939.5	53	24.3282	171.477
4	0.330075	11832.2	54	25.9662	165.550
5	0.367975	9056.10	55	27.6097	160.110
6	0.418698	6772.10	56	29.2531	155.125
7	0.477832	5164.64	57	31.0872	149.999
8	0.535936	4162.93	58	33.2083	144.594
9	0.610801	3322.58	59	36.2262	137.738
10	0.686097	2765.42	60	39.2206	131.684
11	0.765890	2352.85	61	42.2142	126.271
12	0.854344	2025.23	62	45.2121	121.400
13	0.950887	1763.95	63	48.2062	116.991
14	1.05136	1559.11	64	50.1987	114.288
15	1.15173	1400.38	65	55.1895	108.128
16	1.20401	1330.23	66	60.1937	102.753
17	1.31286	1207.65	67	65.1878	98.0279
18	1.40248	1126.68	68	70.1820	93.8175
19	1.59977	988.445	69	75.1665	90.0456
20	1.80473	883.176	70	80.1628	86.6266
21	2.00023	805.473	71	85.1594	83.5144
22	2.20476	741.051	72	90.1518	80.6659
23	2.40162	690.526	73	95.1443	78.0524
24	2.60322	647.523	74	100.131	75.6247
25	2.80424	611.270	75	110.321	71.2172
26	3.03391	576.257	76	120.126	67.5139
27	3.19826	554.455	77	130.126	64.1786
28	3.40490	530.158	78	140.123	61.2058
29	3.60054	509.800	79	150.119	58.5522
30	3.80273	491.023	80	160.112	56.1540
31	3.99445	474.905	81	170.109	53.9835
32	4.20058	459.222	82	180.122	52.0032
33	4.63684	430.671	83	190.118	50.1969
34	5.04510	408.205	84	200.121	48.5392
35	5.55754	384.605	85	210.133	47.0118
36	6.27454	357.479	86	220.133	45.6038
37	7.08794	332.868	87	230.136	44.3014
38	8.11261	308.299	88	240.141	43.0958
39	9.14471	288.592	89	250.132	41.9727
40	10.1749	272.261	90	260.141	40.9288
41	11.1971	258.580	91	270.141	39.9517
42	12.2074	246.938	92	280.147	39.0422
43	13.2112	236.772	93	290.133	38.1859
44	14.2061	227.913	94	300.155	37.3861
45	15.1937	219.979	95	310.164	36.6349
46	16.1717	212.887	96	315.172	36.2744
47	17.1472	206.427	97	320.171	35.9286
48	18.1208	200.512	98	326.145	35.5271
49	19.0967	195.067	99	330.167	35.2636
50	20.0717	189.979			

POLYNOMIAL EQUATION

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.04K
1.529e+4 Ohms	to	576.3 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.72440531697 ZU = 4.36310783058

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.115511	2.5895E-04	4307.77
1	-1.279967	4.0616E-04	-3151.41
2	0.608502	3.8395E-04	1584.83
3	-0.253842	3.4845E-04	-728.49
4	0.096419	3.1955E-04	301.73
5	-0.034376	3.2052E-04	-107.25
6	0.011344	3.3361E-04	34.01
7	-0.003313	3.3174E-04	-9.99

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	23073.20	0.26038	0.26028	0.10
2	16833.40	0.28974	0.29028	-0.55
3	13939.50	0.31029	0.30989	0.40
4	11832.20	0.33008	0.32971	0.37
5	9056.100	0.36797	0.36813	-0.15
6	6772.100	0.41870	0.41909	-0.39
7	5164.640	0.47783	0.47783	0.00
8	4162.930	0.53594	0.53564	0.29
9	3322.580	0.61080	0.61072	0.08
10	2765.420	0.68610	0.68625	-0.15
11	2352.850	0.76589	0.76627	-0.38
12	2025.230	0.85434	0.85446	-0.12
13	1763.950	0.95089	0.95024	0.64
14	1559.110	1.05136	1.05028	1.08
15	1400.380	1.15173	1.15078	0.95
16	1330.230	1.20401	1.20409	-0.08
17	1207.650	1.31286	1.31502	-2.16
18	1126.675	1.40248	1.40446	-1.99
19	988.4449	1.59977	1.60013	-0.36
20	883.1757	1.80473	1.80309	1.64
21	805.4733	2.00023	1.99872	1.51
22	741.0513	2.20476	2.20360	1.16
23	690.5259	2.40162	2.40143	0.19
24	647.5226	2.60322	2.60391	-0.69
25	611.2697	2.80424	2.80582	-1.58
26	576.2565	3.03391	3.03506	-1.16
27	554.4548	3.19826	3.19855	-0.29
28	530.1580	3.40490	3.40327	1.63

Order of Fit = 7 RMS error of fit = .96 mK
Largest absolute error = -2.16 mK at data point no. 17

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POLYNOMIAL EQUATION

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

3.03K	to	20.1K
576.3 Ohms	to	190.0 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.25000773317 ZU = 2.8112549546

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.691786	3.3673E-04	28781.88
1	-9.463025	5.3421E-04	-17714.11
2	2.907323	5.1675E-04	5626.14
3	-0.603228	4.6262E-04	-1303.95
4	0.071114	4.4697E-04	159.10
5	0.002407	4.3242E-04	5.57
6	-0.002348	4.2271E-04	-5.55

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	647.5226	2.60391	2.60403	-0.12
25	611.2697	2.80582	2.80555	0.27
26	576.2565	3.03506	3.03473	0.33
27	554.4548	3.19826	3.19880	-0.54
28	530.1580	3.40490	3.40515	-0.24
29	509.7998	3.60054	3.60057	-0.04
30	491.0233	3.80273	3.80229	0.44
31	474.9046	3.99445	3.99454	-0.09
32	459.2216	4.20058	4.20112	-0.54
33	430.6710	4.63684	4.63645	0.39
34	408.2054	5.04510	5.04536	-0.26
35	384.6046	5.55754	5.55556	1.98
36	357.4785	6.27454	6.27457	-0.03
37	332.8676	7.08794	7.09024	-2.31
38	308.2990	8.11261	8.11535	-2.74
39	288.5924	9.14471	9.14183	2.88
40	272.2611	10.17490	10.17315	1.75
41	258.5803	11.19705	11.19617	0.88
42	246.9381	12.20743	12.20664	0.80
43	236.7723	13.21119	13.21470	-3.52
44	227.9125	14.20607	14.20528	0.80
45	219.9791	15.19370	15.19442	-0.72
46	212.8869	16.17168	16.17165	0.03
47	206.4273	17.14718	17.14772	-0.54
48	200.5122	18.12083	18.12174	-0.91
49	195.0666	19.09674	19.09352	3.22
50	189.9787	20.07166	20.07302	-1.37
51	184.7835	21.15236	21.15140	0.96
52	177.8311	22.73097	22.73172	-0.75

Order of Fit = 6 RMS error of fit = 1.43 mK
Largest absolute error = -3.52 mK at data point no. 43

POLYNOMIAL EQUATION

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	95.1K
190.0 Ohms	to	78.05 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.8525850351 ZU = 2.30214081478

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	55.259593	1.1083E-03	49861.11
1	-45.014928	1.7894E-03	-25156.46
2	8.876583	1.6659E-03	5328.31
3	-1.091427	1.5565E-03	-701.20
4	0.084668	1.4357E-03	58.98
5	0.009617	1.4289E-03	6.73

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	200.5122	18.12174	18.12411	-2.37
49	195.0666	19.09352	19.09320	0.32
50	189.9787	20.07302	20.07175	1.27
51	184.7835	21.15236	21.14991	2.45
52	177.8311	22.73097	22.73004	0.93
53	171.4766	24.32817	24.32744	0.73
54	165.5498	25.96621	25.96589	0.32
55	160.1100	27.60975	27.61165	-1.90
56	155.1252	29.25307	29.25348	-0.42
57	149.9994	31.08720	31.09120	-4.00
58	144.5940	33.20830	33.21414	-5.84
59	137.7378	36.22619	36.22122	4.97
60	131.6844	39.22058	39.21739	3.20
61	126.2712	42.21424	42.21527	-1.03
62	121.3999	45.21205	45.21185	0.20
63	116.9912	48.20625	48.20490	1.34
64	114.2881	50.19866	50.18861	10.04
65	108.1275	55.18952	55.19372	-4.20
66	102.7532	60.19367	60.20005	-6.39
67	98.02787	65.18778	65.19077	-2.99
68	93.81749	70.18198	70.18438	-2.41
69	90.04561	75.16647	75.16653	-0.06
70	86.62657	80.16282	80.16012	2.70
71	83.51440	85.15937	85.15510	4.27
72	80.66587	90.15181	90.15108	0.73
73	78.05235	95.14434	95.13465	9.69
74	75.62469	100.13097	100.14559	-14.62
75	71.21722	110.32063	110.31758	3.05

Order of Fit = 5 RMS error of fit = 4.72 mK
Largest absolute error = -14.62 mK at data point no. 74

POLYNOMIAL EQUATION

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

95.1K	to	325.K
78.05 Ohms	to	35.60 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.54732624533 ZU = 1.92176137437

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	187.638302	2.2682E-03	82727.12
1	-119.555857	3.4559E-03	-34594.40
2	19.437020	3.2744E-03	5935.97
3	-2.838703	3.2619E-03	-870.25
4	0.564064	3.1804E-03	177.36
5	-0.106478	3.0331E-03	-35.11
6	0.024932	2.9766E-03	8.38
7	-0.007390	2.9533E-03	-2.50

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	83.51440	85.15510	85.15589	-0.79
72	80.66587	90.15108	90.14922	1.86
73	78.05235	95.13465	95.13056	4.08
74	75.62469	100.13097	100.14113	-10.16
75	71.21722	110.32063	110.31685	3.78
76	67.51387	120.12605	120.12128	4.76
77	64.17861	130.12577	130.12049	5.28
78	61.20583	140.12298	140.13781	-14.84
79	58.55220	150.11926	150.11534	3.92
80	56.15405	160.11211	160.11623	-4.12
81	53.98346	170.10916	170.10561	3.55
82	52.00320	180.12164	180.11861	3.03
83	50.19686	190.11810	190.11415	3.96
84	48.53918	200.12118	200.11628	4.90
85	47.01181	210.13304	210.13353	-0.49
86	45.60384	220.13261	220.14128	-8.67
87	44.30135	230.13614	230.14779	-11.65
88	43.09577	240.14150	240.13355	7.94
89	41.97273	250.13250	250.14059	-8.09
90	40.92876	260.14130	260.12797	13.33
91	39.95172	270.14115	270.14539	-4.25
92	39.04216	280.14674	280.12267	24.08
93	38.18589	290.13309	290.15647	-23.38
94	37.38608	300.15468	300.15467	0.01
95	36.63491	310.16352	310.15719	6.33
96	36.27436	315.17155	315.18804	-16.49
97	35.92858	320.17073	320.16297	7.76
98	35.52708	326.14479	326.13421	10.58
99	35.26357	330.16652	330.17275	-6.22

Order of Fit = 7 RMS error of fit = 9.63 mK
Largest absolute error = 24.08 mK at data point no. 92

INTERPOLATION TABLE

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	15285.3	-1.4767e+5	-2.8982	48.00	117.280	-1.4134	-0.57845
0.4000	7498.54	-41551.	-2.2165	49.00	115.888	-1.3705	-0.57947
0.5000	4730.05	-18019.	-1.9047	50.00	114.538	-1.3297	-0.58046
0.6000	3420.90	-9451.0	-1.6576	51.00	113.228	-1.2909	-0.58143
0.7000	2684.06	-5737.3	-1.4963	52.00	111.956	-1.2538	-0.58235
0.8000	2215.00	-3833.8	-1.3847	53.00	110.720	-1.2184	-0.58323
0.9000	1891.23	-2733.2	-1.3007	54.00	109.519	-1.1846	-0.58409
1.000	1655.04	-2039.9	-1.2326	55.00	108.350	-1.1524	-0.58497
2.000	805.024	-351.26	-0.87268	56.00	107.213	-1.1216	-0.58584
3.000	581.203	-144.21	-0.74436	57.00	106.107	-1.0921	-0.58667
4.000	474.470	-79.593	-0.67100	58.00	105.029	-1.0638	-0.58747
4.200	459.303	-72.271	-0.66086	59.00	103.979	-1.0367	-0.58826
5.000	410.524	-51.555	-0.62792	60.00	102.955	-1.0108	-0.58906
6.000	367.125	-36.615	-0.59841	61.00	101.957	-0.98589	-0.58985
7.000	335.335	-27.653	-0.57725	62.00	100.983	-0.96197	-0.59062
8.000	310.785	-21.822	-0.56174	63.00	100.032	-0.93897	-0.59136
9.000	291.084	-17.804	-0.55048	64.00	99.1045	-0.91688	-0.59210
10.00	274.804	-14.900	-0.54219	65.00	98.1984	-0.89565	-0.59285
11.00	261.041	-12.724	-0.53619	66.00	97.3130	-0.87523	-0.59360
12.00	249.189	-11.046	-0.53191	67.00	96.4476	-0.85555	-0.59433
13.00	238.832	-9.7181	-0.52897	68.00	95.6016	-0.83658	-0.59504
14.00	229.667	-8.6468	-0.52709	69.00	94.7743	-0.81830	-0.59576
15.00	221.474	-7.7670	-0.52604	70.00	93.9648	-0.80068	-0.59648
16.00	214.084	-7.0336	-0.52567	71.00	93.1727	-0.78370	-0.59720
17.00	207.369	-6.4147	-0.52588	72.00	92.3972	-0.76729	-0.59790
18.00	201.225	-5.8852	-0.52645	73.00	91.6379	-0.75143	-0.59860
19.00	195.573	-5.4328	-0.52780	74.00	90.8942	-0.73611	-0.59929
20.00	190.339	-5.0389	-0.52947	75.00	90.1655	-0.72131	-0.59999
21.00	185.482	-4.6847	-0.53039	76.00	89.4514	-0.70701	-0.60070
22.00	180.953	-4.3790	-0.53240	77.00	88.7514	-0.69317	-0.60139
23.00	176.713	-4.1072	-0.53457	77.35	88.5096	-0.68843	-0.60163
24.00	172.730	-3.8639	-0.53687	78.00	88.0649	-0.67977	-0.60208
25.00	168.977	-3.6453	-0.53932	79.00	87.3917	-0.66680	-0.60277
26.00	165.432	-3.4472	-0.54177	80.00	86.7312	-0.65425	-0.60348
27.00	162.076	-3.2668	-0.54420	81.00	86.0830	-0.64210	-0.60418
28.00	158.893	-3.1018	-0.54660	82.00	85.4469	-0.63029	-0.60486
29.00	155.868	-2.9503	-0.54892	83.00	84.8223	-0.61882	-0.60553
30.00	152.989	-2.8107	-0.55117	84.00	84.2091	-0.60769	-0.60618
31.00	150.243	-2.6817	-0.55332	85.00	83.6068	-0.59688	-0.60683
32.00	147.622	-2.5621	-0.55539	86.00	83.0152	-0.58640	-0.60749
33.00	145.116	-2.4510	-0.55737	87.00	82.4339	-0.57626	-0.60818
34.00	142.718	-2.3476	-0.55928	88.00	81.8626	-0.56646	-0.60893
35.00	140.419	-2.2509	-0.56106	89.00	81.3009	-0.55698	-0.60973
36.00	138.214	-2.1606	-0.56277	90.00	80.7485	-0.54782	-0.61058
37.00	136.096	-2.0761	-0.56444	91.00	80.2052	-0.53892	-0.61145
38.00	134.060	-1.9968	-0.56599	92.00	79.6706	-0.53019	-0.61224
39.00	132.101	-1.9222	-0.56748	93.00	79.1447	-0.52163	-0.61295
40.00	130.214	-1.8521	-0.56893	94.00	78.6273	-0.51323	-0.61358
41.00	128.395	-1.7859	-0.57028	95.00	78.1182	-0.50499	-0.61412
42.00	126.641	-1.7235	-0.57159	96.00	77.6173	-0.49694	-0.61463
43.00	124.947	-1.6646	-0.57286	97.00	77.1243	-0.48912	-0.61517
44.00	123.311	-1.6088	-0.57406	98.00	76.6390	-0.48153	-0.61575
45.00	121.728	-1.5560	-0.57522	99.00	76.1611	-0.47417	-0.61637
46.00	120.198	-1.5060	-0.57635	100.0	75.6905	-0.46703	-0.61703
47.00	118.716	-1.4585	-0.57742	101.0	75.2270	-0.46009	-0.61772

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INTERPOLATION TABLE

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	74.7703	-0.45331	-0.61840	157.0	56.8756	-0.23515	-0.64910
103.0	74.3203	-0.44669	-0.61907	158.0	56.6416	-0.23281	-0.64942
104.0	73.8769	-0.44023	-0.61973	159.0	56.4099	-0.23051	-0.64973
105.0	73.4398	-0.43392	-0.62039	160.0	56.1806	-0.22825	-0.65004
106.0	73.0090	-0.42776	-0.62105	161.0	55.9534	-0.22602	-0.65033
107.0	72.5842	-0.42174	-0.62171	162.0	55.7285	-0.22381	-0.65062
108.0	72.1654	-0.41587	-0.62237	163.0	55.5058	-0.22165	-0.65089
109.0	71.7525	-0.41014	-0.62304	164.0	55.2852	-0.21951	-0.65115
110.0	71.3451	-0.40454	-0.62373	165.0	55.0668	-0.21740	-0.65140
111.0	70.9433	-0.39908	-0.62442	166.0	54.8504	-0.21532	-0.65165
112.0	70.5469	-0.39374	-0.62510	167.0	54.6361	-0.21327	-0.65188
113.0	70.1558	-0.38851	-0.62577	168.0	54.4239	-0.21125	-0.65210
114.0	69.7699	-0.38339	-0.62643	169.0	54.2136	-0.20926	-0.65232
115.0	69.3890	-0.37838	-0.62709	170.0	54.0053	-0.20729	-0.65253
116.0	69.0131	-0.37347	-0.62775	171.0	53.7990	-0.20536	-0.65273
117.0	68.6420	-0.36868	-0.62841	172.0	53.5946	-0.20345	-0.65292
118.0	68.2757	-0.36398	-0.62907	173.0	53.3921	-0.20156	-0.65310
119.0	67.9140	-0.35939	-0.62973	174.0	53.1915	-0.19970	-0.65327
120.0	67.5569	-0.35490	-0.63040	175.0	52.9927	-0.19787	-0.65343
121.0	67.2042	-0.35050	-0.63106	176.0	52.7957	-0.19606	-0.65359
122.0	66.8559	-0.34618	-0.63172	177.0	52.6006	-0.19427	-0.65373
123.0	66.5118	-0.34195	-0.63236	178.0	52.4072	-0.19251	-0.65387
124.0	66.1719	-0.33779	-0.63299	179.0	52.2155	-0.19077	-0.65400
125.0	65.8362	-0.33372	-0.63361	180.0	52.0256	-0.18906	-0.65412
126.0	65.5045	-0.32972	-0.63423	181.0	51.8374	-0.18737	-0.65423
127.0	65.1767	-0.32580	-0.63484	182.0	51.6509	-0.18570	-0.65434
128.0	64.8529	-0.32195	-0.63544	183.0	51.4660	-0.18405	-0.65443
129.0	64.5328	-0.31818	-0.63604	184.0	51.2828	-0.18242	-0.65452
130.0	64.2165	-0.31448	-0.63664	185.0	51.1011	-0.18081	-0.65460
131.0	63.9038	-0.31085	-0.63724	186.0	50.9211	-0.17923	-0.65467
132.0	63.5947	-0.30729	-0.63782	187.0	50.7427	-0.17766	-0.65473
133.0	63.2892	-0.30378	-0.63839	188.0	50.5658	-0.17612	-0.65479
134.0	62.9872	-0.30034	-0.63894	189.0	50.3904	-0.17459	-0.65483
135.0	62.6885	-0.29695	-0.63949	190.0	50.2166	-0.17308	-0.65488
136.0	62.3932	-0.29363	-0.64002	191.0	50.0443	-0.17159	-0.65491
137.0	62.1013	-0.29036	-0.64055	192.0	49.8734	-0.17013	-0.65494
138.0	61.8125	-0.28715	-0.64107	193.0	49.7040	-0.16867	-0.65496
139.0	61.5269	-0.28399	-0.64158	194.0	49.5361	-0.16724	-0.65497
140.0	61.2445	-0.28089	-0.64209	195.0	49.3695	-0.16582	-0.65497
141.0	60.9651	-0.27784	-0.64259	196.0	49.2044	-0.16442	-0.65496
142.0	60.6888	-0.27484	-0.64308	197.0	49.0407	-0.16304	-0.65495
143.0	60.4154	-0.27189	-0.64355	198.0	48.8783	-0.16168	-0.65493
144.0	60.1450	-0.26899	-0.64401	199.0	48.7173	-0.16033	-0.65491
145.0	59.8775	-0.26613	-0.64446	200.0	48.5577	-0.15900	-0.65488
146.0	59.6127	-0.26332	-0.64490	201.0	48.3993	-0.15768	-0.65484
147.0	59.3508	-0.26055	-0.64533	202.0	48.2423	-0.15638	-0.65479
148.0	59.0916	-0.25783	-0.64575	203.0	48.0866	-0.15509	-0.65474
149.0	58.8351	-0.25515	-0.64616	204.0	47.9321	-0.15382	-0.65468
150.0	58.5813	-0.25251	-0.64657	205.0	47.7789	-0.15257	-0.65461
151.0	58.3301	-0.24992	-0.64697	206.0	47.6270	-0.15133	-0.65454
152.0	58.0815	-0.24736	-0.64735	207.0	47.4762	-0.15010	-0.65446
153.0	57.8354	-0.24485	-0.64772	208.0	47.3267	-0.14889	-0.65437
154.0	57.5918	-0.24237	-0.64808	209.0	47.1785	-0.14769	-0.65427
155.0	57.3506	-0.23992	-0.64843	210.0	47.0314	-0.14651	-0.65418
156.0	57.1119	-0.23752	-0.64877	211.0	46.8854	-0.14534	-0.65407

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INTERPOLATION TABLE

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	46.7407	-0.14418	-0.65396	267.0	40.2513	-9.6277e-2	-0.63863
213.0	46.5971	-0.14304	-0.65384	268.0	40.1554	-9.5624e-2	-0.63820
214.0	46.4546	-0.14191	-0.65371	269.0	40.0601	-9.4978e-2	-0.63777
215.0	46.3133	-0.14079	-0.65358	270.0	39.9654	-9.4338e-2	-0.63733
216.0	46.1730	-0.13968	-0.65344	271.0	39.8714	-9.3704e-2	-0.63689
217.0	46.0339	-0.13859	-0.65329	272.0	39.7780	-9.3075e-2	-0.63644
218.0	45.8958	-0.13751	-0.65314	273.0	39.6853	-9.2452e-2	-0.63599
219.0	45.7589	-0.13644	-0.65298	274.0	39.5931	-9.1834e-2	-0.63553
220.0	45.6230	-0.13538	-0.65282	275.0	39.5016	-9.1223e-2	-0.63507
221.0	45.4881	-0.13433	-0.65265	276.0	39.4107	-9.0616e-2	-0.63460
222.0	45.3543	-0.13330	-0.65248	277.0	39.3204	-9.0015e-2	-0.63413
223.0	45.2215	-0.13228	-0.65230	278.0	39.2306	-8.9420e-2	-0.63365
224.0	45.0897	-0.13126	-0.65211	279.0	39.1415	-8.8829e-2	-0.63317
225.0	44.9590	-0.13026	-0.65191	280.0	39.0530	-8.8244e-2	-0.63269
226.0	44.8292	-0.12927	-0.65171	281.0	38.9650	-8.7665e-2	-0.63220
227.0	44.7004	-0.12829	-0.65150	282.0	38.8776	-8.7090e-2	-0.63171
228.0	44.5726	-0.12732	-0.65129	283.0	38.7908	-8.6520e-2	-0.63121
229.0	44.4458	-0.12636	-0.65107	284.0	38.7046	-8.5955e-2	-0.63071
230.0	44.3199	-0.12542	-0.65085	285.0	38.6189	-8.5395e-2	-0.63020
231.0	44.1949	-0.12448	-0.65062	286.0	38.5338	-8.4840e-2	-0.62969
232.0	44.0709	-0.12355	-0.65038	287.0	38.4492	-8.4290e-2	-0.62918
233.0	43.9478	-0.12263	-0.65014	288.0	38.3652	-8.3745e-2	-0.62866
234.0	43.8257	-0.12172	-0.64989	289.0	38.2818	-8.3204e-2	-0.62813
235.0	43.7044	-0.12082	-0.64964	290.0	38.1988	-8.2668e-2	-0.62761
236.0	43.5840	-0.11993	-0.64938	291.0	38.1164	-8.2137e-2	-0.62708
237.0	43.4645	-0.11904	-0.64911	292.0	38.0345	-8.1611e-2	-0.62654
238.0	43.3459	-0.11817	-0.64884	293.0	37.9532	-8.1088e-2	-0.62600
239.0	43.2282	-0.11731	-0.64857	294.0	37.8724	-8.0570e-2	-0.62546
240.0	43.1113	-0.11645	-0.64829	295.0	37.7921	-8.0057e-2	-0.62491
241.0	42.9953	-0.11561	-0.64800	296.0	37.7123	-7.9548e-2	-0.62436
242.0	42.8801	-0.11477	-0.64771	297.0	37.6330	-7.9043e-2	-0.62381
243.0	42.7658	-0.11394	-0.64741	298.0	37.5542	-7.8543e-2	-0.62325
244.0	42.6522	-0.11312	-0.64710	299.0	37.4759	-7.8046e-2	-0.62269
245.0	42.5395	-0.11230	-0.64679	300.0	37.3981	-7.7554e-2	-0.62213
246.0	42.4276	-0.11150	-0.64648	301.0	37.3208	-7.7067e-2	-0.62156
247.0	42.3165	-0.11070	-0.64615	302.0	37.2439	-7.6583e-2	-0.62099
248.0	42.2062	-0.10991	-0.64583	303.0	37.1676	-7.6103e-2	-0.62041
249.0	42.0967	-0.10913	-0.64550	304.0	37.0917	-7.5627e-2	-0.61983
250.0	41.9880	-0.10836	-0.64516	305.0	37.0163	-7.5155e-2	-0.61925
251.0	41.8800	-0.10759	-0.64482	306.0	36.9414	-7.4687e-2	-0.61866
252.0	41.7728	-0.10683	-0.64447	307.0	36.8670	-7.4223e-2	-0.61807
253.0	41.6663	-0.10608	-0.64412	308.0	36.7930	-7.3763e-2	-0.61748
254.0	41.5606	-0.10533	-0.64376	309.0	36.7194	-7.3307e-2	-0.61689
255.0	41.4556	-0.10460	-0.64340	310.0	36.6464	-7.2854e-2	-0.61629
256.0	41.3514	-0.10387	-0.64303	311.0	36.5737	-7.2405e-2	-0.61569
257.0	41.2479	-0.10314	-0.64265	312.0	36.5015	-7.1960e-2	-0.61508
258.0	41.1451	-0.10243	-0.64227	313.0	36.4298	-7.1518e-2	-0.61448
259.0	41.0430	-0.10172	-0.64189	314.0	36.3585	-7.1080e-2	-0.61387
260.0	40.9417	-0.10102	-0.64150	315.0	36.2876	-7.0646e-2	-0.61325
261.0	40.8410	-0.10032	-0.64111	316.0	36.2172	-7.0215e-2	-0.61264
262.0	40.7410	-9.9630e-2	-0.64071	317.0	36.1472	-6.9788e-2	-0.61202
263.0	40.6418	-9.8947e-2	-0.64030	318.0	36.0776	-6.9364e-2	-0.61139
264.0	40.5431	-9.8270e-2	-0.63989	319.0	36.0085	-6.8943e-2	-0.61077
265.0	40.4452	-9.7599e-2	-0.63948	320.0	35.9397	-6.8526e-2	-0.61014
266.0	40.3479	-9.6935e-2	-0.63906	321.0	35.8714	-6.8112e-2	-0.60951

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INTERPOLATION TABLE

Calibration Report: 430819
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29580
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
322.0	35.8035	-6.7702e-2	-0.60888				
323.0	35.7360	-6.7295e-2	-0.60824				
324.0	35.6689	-6.6891e-2	-0.60761				
325.0	35.6022	-6.6490e-2	-0.60697				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29580
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.55146,325.000	Point 56: 1.93816, 80.000	Point 111: 2.46935, 8.800	Point 166: 3.65842, 0.510
Point 2: 1.55640,319.000	Point 57: 1.94647, 77.500	Point 112: 2.48057, 8.400	Point 167: 3.69155, 0.490
Point 3: 1.56102,313.500	Point 58: 1.95502, 75.000	Point 113: 2.49241, 8.000	Point 168: 3.72345, 0.472
Point 4: 1.56576,308.000	Point 59: 1.96207, 73.000	Point 114: 2.50498, 7.600	Point 169: 3.75751, 0.454
Point 5: 1.57060,302.500	Point 60: 1.96928, 71.000	Point 115: 2.51837, 7.200	Point 170: 3.79396, 0.436
Point 6: 1.57556,297.000	Point 61: 1.97668, 69.000	Point 116: 2.53087, 6.850	Point 171: 3.83296, 0.418
Point 7: 1.58064,291.500	Point 62: 1.98428, 67.000	Point 117: 2.54415, 6.500	Point 172: 3.87475, 0.400
Point 8: 1.58583,286.000	Point 63: 1.99209, 65.000	Point 118: 2.55835, 6.150	Point 173: 3.91967, 0.382
Point 9: 1.59115,280.500	Point 64: 2.00013, 63.000	Point 119: 2.57268, 5.820	Point 174: 3.96262, 0.366
Point 10: 1.59660,275.000	Point 65: 2.00840, 61.000	Point 120: 2.58760, 5.500	Point 175: 4.00860, 0.350
Point 11: 1.60219,269.500	Point 66: 2.01692, 59.000	Point 121: 2.60364, 5.180	Point 176: 4.05217, 0.336
Point 12: 1.60738,264.500	Point 67: 2.02572, 57.000	Point 122: 2.61989, 4.880	Point 177: 4.09917, 0.322
Point 13: 1.61269,259.500	Point 68: 2.03481, 55.000	Point 123: 2.63745, 4.580	Point 178: 4.14350, 0.310
Point 14: 1.61812,254.500	Point 69: 2.04325, 53.200	Point 124: 2.65526, 4.300	Point 179: 4.17587, 0.302
Point 15: 1.62368,249.500	Point 70: 2.05196, 51.400	Point 125: 2.67461, 4.020	Point 180: 4.18428, 0.300
Point 16: 1.62936,244.500	Point 71: 2.06095, 49.600	Point 126: 2.67918, 3.960	Point 181: 4.18428, 0.300
Point 17: 1.63517,239.500	Point 72: 2.07025, 47.800	Point 127: 2.68965, 3.820	
Point 18: 1.64112,234.500	Point 73: 2.07987, 46.000	Point 128: 2.70405, 3.640	
Point 19: 1.64720,229.500	Point 74: 2.08984, 44.200	Point 129: 2.71941, 3.460	
Point 20: 1.65344,224.500	Point 75: 2.09903, 42.600	Point 130: 2.73498, 3.290	
Point 21: 1.65982,219.500	Point 76: 2.10852, 41.000	Point 131: 2.75166, 3.120	
Point 22: 1.66635,214.500	Point 77: 2.11899, 39.300	Point 132: 2.76858, 2.960	
Point 23: 1.67305,209.500	Point 78: 2.12922, 37.700	Point 133: 2.78681, 2.800	
Point 24: 1.67992,204.500	Point 79: 2.13984, 36.100	Point 134: 2.80647, 2.640	
Point 25: 1.68696,199.500	Point 80: 2.15020, 34.600	Point 135: 2.82645, 2.490	
Point 26: 1.69418,194.500	Point 81: 2.16095, 33.100	Point 136: 2.84667, 2.350	
Point 27: 1.70158,189.500	Point 82: 2.17215, 31.600	Point 137: 2.86864, 2.210	
Point 28: 1.70918,184.500	Point 83: 2.18304, 30.200	Point 138: 2.89093, 2.080	
Point 29: 1.71699,179.500	Point 84: 2.19437, 28.800	Point 139: 2.91527, 1.950	
Point 30: 1.72420,175.000	Point 85: 2.20620, 27.400	Point 140: 2.94000, 1.830	
Point 31: 1.73159,170.500	Point 86: 2.21768, 26.100	Point 141: 2.96718, 1.710	
Point 32: 1.73917,166.000	Point 87: 2.22966, 24.800	Point 142: 2.99737, 1.590	
Point 33: 1.74694,161.500	Point 88: 2.24222, 23.500	Point 143: 3.02826, 1.480	
Point 34: 1.75491,157.000	Point 89: 2.25439, 22.300	Point 144: 3.06273, 1.370	
Point 35: 1.76310,152.500	Point 90: 2.26716, 21.100	Point 145: 3.09802, 1.270	
Point 36: 1.77151,148.000	Point 91: 2.27835, 20.100	Point 146: 3.12149, 1.210	
Point 37: 1.78015,143.500	Point 92: 2.28710, 19.350	Point 147: 3.13796, 1.170	
Point 38: 1.78905,139.000	Point 93: 2.29554, 18.650	Point 148: 3.15530, 1.130	
Point 39: 1.79820,134.500	Point 94: 2.30366, 18.000	Point 149: 3.17360, 1.090	
Point 40: 1.80763,130.000	Point 95: 2.31206, 17.350	Point 150: 3.19293, 1.050	
Point 41: 1.81626,126.000	Point 96: 2.32078, 16.700	Point 151: 3.21341, 1.010	
Point 42: 1.82512,122.000	Point 97: 2.32984, 16.050	Point 152: 3.23514, 0.970	
Point 43: 1.83425,118.000	Point 98: 2.33855, 15.450	Point 153: 3.25827, 0.930	
Point 44: 1.84365,114.000	Point 99: 2.34759, 14.850	Point 154: 3.28295, 0.890	
Point 45: 1.85334,110.000	Point 100: 2.35702, 14.250	Point 155: 3.30602, 0.855	
Point 46: 1.86335,106.000	Point 101: 2.36603, 13.700	Point 156: 3.33051, 0.820	
Point 47: 1.87240,102.500	Point 102: 2.37543, 13.150	Point 157: 3.35669, 0.785	
Point 48: 1.87903,100.000	Point 103: 2.38524, 12.600	Point 158: 3.38474, 0.750	
Point 49: 1.88581, 97.500	Point 104: 2.39458, 12.100	Point 159: 3.41493, 0.715	
Point 50: 1.89274, 95.000	Point 105: 2.40434, 11.600	Point 160: 3.44284, 0.685	
Point 51: 1.89985, 92.500	Point 106: 2.41456, 11.100	Point 161: 3.47271, 0.655	
Point 52: 1.90712, 90.000	Point 107: 2.42531, 10.600	Point 162: 3.50498, 0.625	
Point 53: 1.91458, 87.500	Point 108: 2.43549, 10.150	Point 163: 3.53997, 0.595	
Point 54: 1.92223, 85.000	Point 109: 2.44617, 9.700	Point 164: 3.57813, 0.565	
Point 55: 1.93008, 82.500	Point 110: 2.45744, 9.250	Point 165: 3.62005, 0.535	

BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 52

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.55148	325.0	31	2.45366	9.4
2	1.55229	324.0	32	2.50504	7.6
3	1.55976	315.0	33	2.55221	6.3
4	1.57285	300.0	34	2.59757	5.3
5	1.58680	285.0	35	2.64250	4.5
6	1.60168	270.0	36	2.69128	3.8
7	1.61758	255.0	37	2.74375	3.2
8	1.63459	240.0	38	2.78692	2.8
9	1.65282	225.0	39	2.85444	2.3
10	1.67239	210.0	40	2.90581	2.0
11	1.69346	195.0	41	2.96980	1.7
12	1.71622	180.0	42	3.02264	1.5
13	1.74089	165.0	43	3.08731	1.3
14	1.76776	150.0	44	3.12558	1.2
15	1.79719	135.0	45	3.16900	1.1
16	1.82967	120.0	46	3.21881	1.0
17	1.86593	105.0	47	3.27674	.9
18	1.90713	90.0	48	3.34537	.8
19	1.95504	75.0	49	3.42879	.7
20	2.00219	62.5	50	3.53414	.6
21	2.02799	56.5	51	3.87498	.4
22	2.05895	50.0	52	4.18428	.3
23	2.08539	45.0			
24	2.11466	40.0			
25	2.14743	35.0			
26	2.18466	30.0			
27	2.22783	25.0			
28	2.27953	20.0			
29	2.34230	15.2			
30	2.40041	11.8			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	63.035
1000	1.581
10000	0.357

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BREAKPOINTS 234 FORMAT

Calibration Report: 430819 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29580
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:	
1.4 - 10K:	0.006K
10 - 20K:	0.012K
20 - 40K:	0.019K
40 - 100K:	0.044K
> 100K:	0.157K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	314.713	36.30781	1.560	51	6.113	363.0781	2.560
2	292.185	38.01894	1.580	52	5.662	380.1894	2.580
3	271.648	39.81072	1.600	53	5.252	398.1072	2.600
4	252.805	41.68694	1.620	54	4.880	416.8694	2.620
5	235.441	43.65158	1.640	55	4.540	436.5158	2.640
6	219.368	45.70882	1.660	56	4.231	457.0882	2.660
7	204.451	47.86301	1.680	57	3.948	478.6301	2.680
8	190.567	50.11872	1.700	58	3.690	501.1872	2.700
9	177.619	52.48075	1.720	59	3.454	524.8075	2.720
10	165.519	54.95409	1.740	60	3.238	549.5409	2.740
11	154.199	57.54399	1.760	61	3.041	575.4399	2.760
12	143.587	60.25596	1.780	62	2.859	602.5596	2.780
13	133.638	63.09573	1.800	63	2.692	630.9573	2.800
14	124.306	66.06934	1.820	64	2.538	660.6934	2.820
15	115.548	69.18310	1.840	65	2.396	691.8310	2.840
16	107.331	72.44360	1.860	66	2.265	724.4360	2.860
17	99.643	75.85776	1.880	67	2.143	758.5776	2.880
18	92.452	79.43282	1.900	68	2.031	794.3282	2.900
19	85.726	83.17638	1.920	69	1.927	831.7638	2.920
20	79.445	87.09636	1.940	70	1.831	870.9636	2.940
21	73.585	91.20108	1.960	71	1.742	912.0108	2.960
22	68.123	95.49926	1.980	72	1.659	954.9926	2.980
23	63.035	100.0000	2.000	73	1.581	1000.000	3.000
24	58.296	104.7129	2.020	74	1.442	1096.478	3.040
25	53.893	109.6478	2.040	75	1.320	1202.264	3.080
26	49.793	114.8154	2.060	76	1.214	1318.257	3.120
27	45.980	120.2264	2.080	77	1.120	1445.440	3.160
28	42.437	125.8925	2.100	78	1.036	1584.893	3.200
29	39.144	131.8257	2.120	79	0.962	1737.801	3.240
30	36.081	138.0384	2.140	80	0.895	1905.461	3.280
31	33.235	144.5440	2.160	81	0.835	2089.296	3.320
32	30.589	151.3561	2.180	82	0.781	2290.868	3.360
33	28.131	158.4893	2.200	83	0.732	2511.886	3.400
34	25.848	165.9587	2.220	84	0.688	2754.229	3.440
35	23.730	173.7801	2.240	85	0.648	3019.952	3.480
36	21.770	181.9701	2.260	86	0.612	3311.311	3.520
37	19.959	190.5461	2.280	87	0.579	3630.781	3.560
38	18.292	199.5262	2.300	88	0.549	3981.072	3.600
39	16.760	208.9296	2.320	89	0.522	4365.158	3.640
40	15.353	218.7762	2.340	90	0.497	4786.301	3.680
41	14.068	229.0868	2.360	91	0.474	5248.075	3.720
42	12.892	239.8833	2.380	92	0.453	5754.399	3.760
43	11.822	251.1886	2.400	93	0.433	6309.573	3.800
44	10.845	263.0268	2.420	94	0.415	6918.310	3.840
45	9.959	275.4229	2.440	95	0.398	7585.776	3.880
46	9.153	288.4032	2.460	96	0.382	8317.638	3.920
47	8.421	301.9952	2.480	97	0.367	9120.108	3.960
48	7.756	316.2278	2.500	98	0.353	10000.00	4.000
49	7.155	331.1311	2.520	99	0.322	12589.25	4.100
50	6.608	346.7369	2.540	100	0.296	15848.93	4.200

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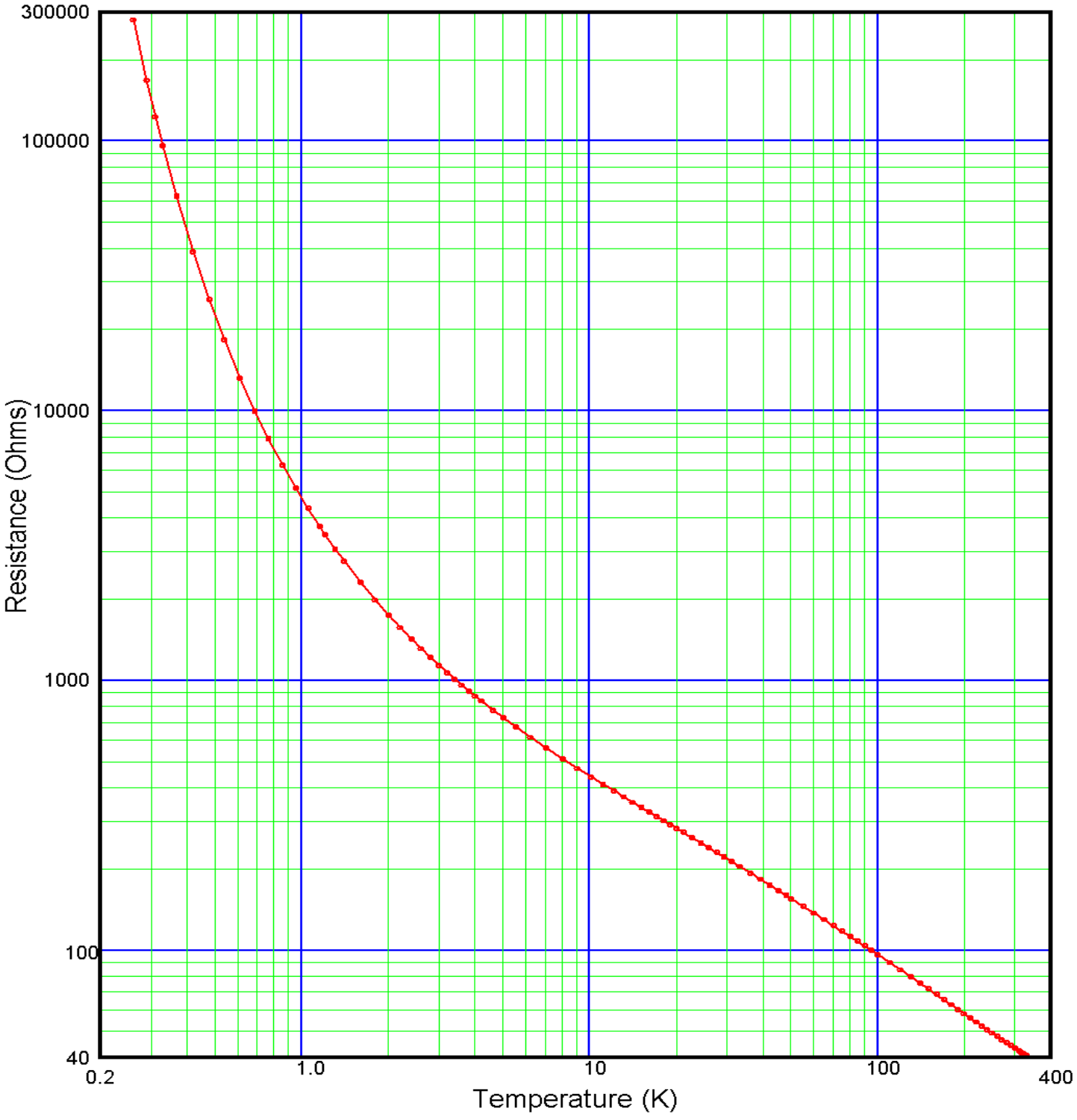
DATA PLOT

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260393	280890.	51	21.1279	273.772
2	0.289578	167810.	52	22.7154	261.451
3	0.310447	122725.	53	24.3160	250.264
4	0.329466	95854.0	54	25.9512	240.030
5	0.367268	62404.3	55	27.5945	230.704
6	0.419366	38874.0	56	29.2182	222.321
7	0.476436	25879.3	57	31.0430	213.667
8	0.537018	18331.3	58	33.1609	204.690
9	0.609733	13168.9	59	36.1788	193.224
10	0.686246	9966.10	60	39.1714	183.340
11	0.765201	7879.30	61	42.1747	174.542
12	0.856753	6292.61	62	45.1729	166.672
13	0.951769	5175.87	63	48.1708	159.645
14	1.05202	4343.81	64	50.1658	155.318
15	1.15265	3732.57	65	55.1521	145.643
16	1.20464	3478.02	66	60.1481	137.305
17	1.30506	3071.25	67	65.1512	130.008
18	1.40037	2771.24	68	70.1480	123.550
19	1.60132	2308.14	69	75.1505	117.813
20	1.80206	1986.39	70	80.1432	112.685
21	2.00221	1750.68	71	85.1351	108.046
22	2.19971	1571.74	72	90.1296	103.816
23	2.40224	1427.60	73	95.1190	99.9611
24	2.60252	1312.22	74	100.109	96.4107
25	2.80465	1216.70	75	110.209	90.0532
26	2.99836	1139.56	76	120.105	84.6648
27	3.20152	1070.38	77	130.103	79.9151
28	3.39736	1013.20	78	140.105	75.7240
29	3.60203	961.036	79	150.099	71.9946
30	3.80555	915.347	80	160.096	68.6524
31	4.00583	875.469	81	170.091	65.6538
32	4.19934	841.078	82	180.096	62.9304
33	4.62135	777.153	83	190.076	60.4607
34	5.01885	727.108	84	200.066	58.2060
35	5.52072	675.012	85	210.078	56.1368
36	6.24208	615.280	86	220.087	54.2382
37	7.04450	563.304	87	230.095	52.4867
38	8.06226	512.222	88	240.099	50.8725
39	9.08189	472.099	89	250.096	49.3717
40	10.1020	439.554	90	260.085	47.9842
41	11.1169	412.718	91	270.095	46.6920
42	12.1246	390.002	92	280.090	45.4830
43	13.1249	370.574	93	290.094	44.3583
44	14.1218	353.565	94	300.095	43.3054
45	15.1152	338.574	95	310.076	42.3210
46	16.1021	325.215	96	315.082	41.8494
47	17.0847	313.240	97	320.088	41.3946
48	18.0673	302.320	98	325.751	40.8946
49	19.0553	292.328	99	328.412	40.6661
50	20.0383	283.145			

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POLYNOMIAL EQUATION

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.00K
1.430e+5 Ohms	to	1140. Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 3.00569616076 ZU = 5.4485362781

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.071643	2.5083E-04	4272.38
1	-1.234270	4.1537E-04	-2971.50
2	0.619373	3.6593E-04	1692.58
3	-0.281009	3.1161E-04	-901.80
4	0.117592	2.7674E-04	424.91
5	-0.046602	2.8798E-04	-161.82
6	0.017810	3.1647E-04	56.28
7	-0.005865	3.2947E-04	-17.80
8	0.001756	3.1484E-04	5.58

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 8
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	280890.0	0.26039	0.26043	-0.04
2	167810.0	0.28958	0.28929	0.29
3	122725.0	0.31045	0.31086	-0.42
4	95854.00	0.32947	0.32948	-0.01
5	62404.30	0.36727	0.36703	0.24
6	38874.00	0.41937	0.41930	0.06
7	25879.30	0.47644	0.47645	-0.02
8	18331.30	0.53702	0.53706	-0.04
9	13168.90	0.60973	0.60991	-0.18
10	9966.100	0.68625	0.68654	-0.30
11	7879.300	0.76520	0.76540	-0.20
12	6292.610	0.85675	0.85642	0.33
13	5175.870	0.95177	0.95100	0.77
14	4343.810	1.05202	1.05113	0.89
15	3732.570	1.15265	1.15218	0.47
16	3478.020	1.20464	1.20466	-0.01
17	3071.249	1.30506	1.30685	-1.79
18	2771.241	1.40037	1.40217	-1.81
19	2308.139	1.60132	1.60156	-0.25
20	1986.390	1.80206	1.80099	1.06
21	1750.681	2.00221	2.00051	1.70
22	1571.737	2.19971	2.19893	0.78
23	1427.599	2.40224	2.40198	0.26
24	1312.221	2.60252	2.60343	-0.91
25	1216.697	2.80465	2.80554	-0.89
26	1139.556	2.99836	2.99917	-0.81
27	1070.381	3.20152	3.20216	-0.64
28	1013.202	3.39736	3.39592	1.44

Order of Fit = 8 RMS error of fit = .81 mK
Largest absolute error = -1.81 mK at data point no. 18

POLYNOMIAL EQUATION

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

3.00K	to	20.0K
1140. Ohms	to	283.1 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.41739036022 ZU = 3.11800688588

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.575778	4.1927E-04	22839.24
1	-9.390228	6.6170E-04	-14191.09
2	2.995037	6.3602E-04	4709.00
3	-0.664858	5.7536E-04	-1155.55
4	0.091607	5.5507E-04	165.04
5	-0.001131	5.3777E-04	-2.10

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1312.221	2.60343	2.60621	-2.78
25	1216.697	2.80554	2.80320	2.34
26	1139.556	2.99917	2.99620	2.97
27	1070.381	3.20152	3.20076	0.76
28	1013.202	3.39736	3.39718	0.18
29	961.0357	3.60203	3.60257	-0.54
30	915.3468	3.80555	3.80714	-1.59
31	875.4685	4.00583	4.00821	-2.38
32	841.0784	4.19934	4.20152	-2.18
33	777.1530	4.62135	4.62114	0.21
34	727.1081	5.01885	5.01913	-0.29
35	675.0122	5.52072	5.51957	1.15
36	615.2796	6.24208	6.23974	2.34
37	563.3040	7.04450	7.04321	1.29
38	512.2224	8.06226	8.06083	1.43
39	472.0993	9.08189	9.08133	0.56
40	439.5544	10.10203	10.10350	-1.47
41	412.7180	11.11686	11.11702	-0.16
42	390.0016	12.12463	12.12679	-2.16
43	370.5739	13.12486	13.12583	-0.97
44	353.5647	14.12179	14.12366	-1.86
45	338.5740	15.11517	15.11560	-0.43
46	325.2145	16.10209	16.10305	-0.96
47	313.2398	17.08467	17.08344	1.23
48	302.3196	18.06734	18.06694	0.40
49	292.3281	19.05526	19.05120	4.06
50	283.1452	20.03830	20.03559	2.71
51	273.7720	21.12789	21.12851	-0.62
52	261.4510	22.71540	22.71864	-3.24

Order of Fit = 5 RMS error of fit = 1.82 mK
Largest absolute error = 4.06 mK at data point no. 49

POLYNOMIAL EQUATION

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.0K	to	95.1K
283.1 Ohms	to	99.96 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.95449903162 ZU = 2.48046625025

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.897899	1.2830E-03	42787.71
1	-44.895555	2.0723E-03	-21664.77
2	9.140861	1.9288E-03	4739.17
3	-1.179373	1.8051E-03	-653.34
4	0.100597	1.6668E-03	60.35
5	0.005528	1.6556E-03	3.34

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	302.3196	18.06694	18.06996	-3.02
49	292.3281	19.05120	19.05144	-0.24
50	283.1452	20.03559	20.03402	1.57
51	273.7720	21.12789	21.12480	3.09
52	261.4510	22.71540	22.70990	5.50
53	250.2641	24.31599	24.31846	-2.47
54	240.0302	25.95121	25.95239	-1.18
55	230.7036	27.59454	27.59629	-1.75
56	222.3211	29.21821	29.21722	0.99
57	213.6674	31.04300	31.05270	-9.70
58	204.6901	33.16088	33.15572	5.16
59	193.2244	36.17880	36.18659	-7.79
60	183.3399	39.17140	39.16863	2.76
61	174.5424	42.17467	42.16699	7.68
62	166.6723	45.17288	45.17400	-1.11
63	159.6450	48.17076	48.16195	8.80
64	155.3176	50.16582	50.16409	1.73
65	145.6431	55.15213	55.16022	-8.09
66	137.3053	60.14814	60.14856	-0.42
67	130.0082	65.15117	65.14583	5.34
68	123.5500	70.14798	70.15800	-10.02
69	117.8132	75.15050	75.15928	-8.77
70	112.6853	80.14325	80.14015	3.10
71	108.0463	85.13505	85.12596	9.09
72	103.8162	90.12962	90.12722	2.40
73	99.96109	95.11901	95.11445	4.56
74	96.41066	100.10873	100.11610	-7.37
75	90.05318	110.20893	110.20876	0.18

Order of Fit = 5 RMS error of fit = 5.47 mK
Largest absolute error = -10.02 mK at data point no. 68

POLYNOMIAL EQUATION

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

95.1K	to	325.K
99.96 Ohms	to	40.96 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.60923278196 ZU = 2.03360992311

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.805333	1.7011E-03	109815.03
1	-118.771439	2.5872E-03	-45908.05
2	19.418965	2.4459E-03	7939.27
3	-2.769095	2.4382E-03	-1135.71
4	0.525723	2.3702E-03	221.80
5	-0.096345	2.2640E-03	-42.55
6	0.019616	2.2312E-03	8.79
7	-0.007442	2.2175E-03	-3.36

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	108.0463	85.12596	85.12532	0.65
72	103.8162	90.12722	90.12868	-1.46
73	99.96109	95.11445	95.11312	1.33
74	96.41066	100.10873	100.11173	-2.99
75	90.05318	110.20893	110.20105	7.88
76	84.66483	120.10500	120.11203	-7.02
77	79.91514	130.10337	130.10545	-2.09
78	75.72404	140.10517	140.09930	5.86
79	71.99458	150.09934	150.09831	1.03
80	68.65239	160.09551	160.10762	-12.10
81	65.65384	170.09098	170.08073	10.24
82	62.93044	180.09584	180.09049	5.35
83	60.46074	190.07573	190.07815	-2.42
84	58.20599	200.06633	200.07040	-4.07
85	56.13684	210.07803	210.08380	-5.77
86	54.23815	220.08740	220.08531	2.09
87	52.48670	230.09453	230.09744	-2.91
88	50.87250	240.09885	240.08354	15.31
89	49.37172	250.09617	250.10659	-10.43
90	47.98421	260.08493	260.08761	-2.68
91	46.69201	270.09478	270.07760	17.18
92	45.48304	280.08969	280.10496	-15.27
93	44.35829	290.09412	290.09560	-1.48
94	43.30537	300.09464	300.09409	0.55
95	42.32102	310.07577	310.07130	4.48
96	41.84939	315.08249	315.08735	-4.86
97	41.39458	320.08758	320.07968	7.91
98	40.89462	325.75133	325.75329	-1.96
99	40.66612	328.41161	328.41396	-2.35

Order of Fit = 7 RMS error of fit = 7.22 mK
Largest absolute error = 17.18 mK at data point no. 91

INTERPOLATION TABLE

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	142978.	-2.0640e+6	-4.3308	48.00	160.008	-2.2459	-0.67374
0.4000	45667.9	-3.9818e+5	-3.4877	49.00	157.799	-2.1724	-0.67457
0.5000	22430.3	-1.3041e+5	-2.9070	50.00	155.662	-2.1027	-0.67540
0.6000	13715.4	-57123.	-2.4989	51.00	153.592	-2.0365	-0.67620
0.7000	9543.50	-30215.	-2.2162	52.00	151.588	-1.9734	-0.67695
0.8000	7197.38	-18143.	-2.0166	53.00	149.645	-1.9134	-0.67767
0.9000	5727.02	-11886.	-1.8679	54.00	147.760	-1.8562	-0.67838
1.000	4733.70	-8284.7	-1.7501	55.00	145.931	-1.8019	-0.67911
2.000	1751.20	-1023.3	-1.1686	56.00	144.155	-1.7501	-0.67985
3.000	1138.15	-369.43	-0.97377	57.00	142.430	-1.7005	-0.68054
4.000	877.011	-188.19	-0.85832	58.00	140.754	-1.6531	-0.68120
4.200	841.335	-169.09	-0.84411	59.00	139.123	-1.6079	-0.68186
5.000	729.320	-116.05	-0.79557	60.00	137.537	-1.5646	-0.68254
6.000	633.520	-79.202	-0.75011	61.00	135.994	-1.5232	-0.68321
7.000	565.795	-58.006	-0.71765	62.00	134.490	-1.4834	-0.68386
8.000	514.921	-44.677	-0.69411	63.00	133.026	-1.4453	-0.68449
9.000	474.982	-35.739	-0.67718	64.00	131.599	-1.4088	-0.68511
10.00	442.571	-29.418	-0.66470	65.00	130.208	-1.3737	-0.68575
11.00	415.589	-24.765	-0.65550	66.00	128.851	-1.3401	-0.68640
12.00	392.668	-21.226	-0.64868	67.00	127.528	-1.3077	-0.68702
13.00	372.878	-18.461	-0.64364	68.00	126.236	-1.2765	-0.68763
14.00	355.559	-16.253	-0.63995	69.00	124.974	-1.2466	-0.68824
15.00	340.234	-14.456	-0.63732	70.00	123.742	-1.2177	-0.68886
16.00	326.544	-12.970	-0.63550	71.00	122.538	-1.1900	-0.68949
17.00	314.214	-11.725	-0.63436	72.00	121.362	-1.1632	-0.69010
18.00	303.031	-10.667	-0.63361	73.00	120.212	-1.1374	-0.69070
19.00	292.827	-9.7692	-0.63387	74.00	119.087	-1.1125	-0.69131
20.00	283.451	-8.9966	-0.63479	75.00	117.986	-1.0885	-0.69192
21.00	274.805	-8.3131	-0.63527	76.00	116.909	-1.0653	-0.69254
22.00	266.795	-7.7193	-0.63654	77.00	115.855	-1.0429	-0.69314
23.00	259.343	-7.1953	-0.63812	77.35	115.492	-1.0352	-0.69335
24.00	252.385	-6.7290	-0.63988	78.00	114.823	-1.0213	-0.69374
25.00	245.868	-6.3120	-0.64181	79.00	113.813	-1.0003	-0.69434
26.00	239.747	-5.9362	-0.64377	80.00	112.822	-0.98008	-0.69495
27.00	233.984	-5.5960	-0.64573	81.00	111.852	-0.96051	-0.69557
28.00	228.545	-5.2866	-0.64769	82.00	110.901	-0.94154	-0.69617
29.00	223.402	-5.0040	-0.64958	83.00	109.969	-0.92317	-0.69677
30.00	218.529	-4.7451	-0.65142	84.00	109.055	-0.90537	-0.69736
31.00	213.905	-4.5071	-0.65318	85.00	108.158	-0.88812	-0.69796
32.00	209.509	-4.2876	-0.65488	86.00	107.278	-0.87141	-0.69857
33.00	205.324	-4.0848	-0.65651	87.00	106.415	-0.85521	-0.69918
34.00	201.334	-3.8969	-0.65808	88.00	105.568	-0.83950	-0.69979
35.00	197.526	-3.7221	-0.65952	89.00	104.736	-0.82426	-0.70042
36.00	193.886	-3.5596	-0.66093	90.00	103.919	-0.80949	-0.70107
37.00	190.403	-3.4082	-0.66230	91.00	103.117	-0.79516	-0.70173
38.00	187.066	-3.2666	-0.66356	92.00	102.329	-0.78124	-0.70238
39.00	183.867	-3.1341	-0.66478	93.00	101.554	-0.76770	-0.70304
40.00	180.795	-3.0101	-0.66596	94.00	100.793	-0.75456	-0.70370
41.00	177.844	-2.8935	-0.66706	95.00	100.045	-0.74179	-0.70438
42.00	175.006	-2.7840	-0.66813	96.00	99.3094	-0.72936	-0.70506
43.00	172.274	-2.6809	-0.66917	97.00	98.5861	-0.71724	-0.70571
44.00	169.642	-2.5837	-0.67014	98.00	97.8748	-0.70543	-0.70633
45.00	167.105	-2.4921	-0.67109	99.00	97.1751	-0.69391	-0.70694
46.00	164.656	-2.4055	-0.67202	100.0	96.4869	-0.68268	-0.70753
47.00	162.292	-2.3235	-0.67289	101.0	95.8097	-0.67173	-0.70812

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INTERPOLATION TABLE

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	95.1433	-0.66105	-0.70869	157.0	69.6519	-0.32696	-0.73699
103.0	94.4875	-0.65064	-0.70925	158.0	69.3267	-0.32350	-0.73728
104.0	93.8420	-0.64049	-0.70982	159.0	69.0049	-0.32010	-0.73757
105.0	93.2064	-0.63059	-0.71038	160.0	68.6865	-0.31675	-0.73785
106.0	92.5807	-0.62094	-0.71095	161.0	68.3714	-0.31346	-0.73813
107.0	91.9645	-0.61154	-0.71153	162.0	68.0595	-0.31021	-0.73839
108.0	91.3575	-0.60238	-0.71211	163.0	67.7509	-0.30701	-0.73864
109.0	90.7596	-0.59345	-0.71272	164.0	67.4455	-0.30386	-0.73887
110.0	90.1706	-0.58475	-0.71334	165.0	67.1432	-0.30076	-0.73910
111.0	89.5901	-0.57626	-0.71397	166.0	66.8439	-0.29770	-0.73932
112.0	89.0180	-0.56796	-0.71459	167.0	66.5477	-0.29469	-0.73953
113.0	88.4541	-0.55985	-0.71521	168.0	66.2545	-0.29173	-0.73973
114.0	87.8982	-0.55192	-0.71581	169.0	65.9643	-0.28881	-0.73992
115.0	87.3502	-0.54416	-0.71641	170.0	65.6769	-0.28593	-0.74010
116.0	86.8098	-0.53658	-0.71701	171.0	65.3924	-0.28309	-0.74028
117.0	86.2770	-0.52917	-0.71761	172.0	65.1107	-0.28030	-0.74045
118.0	85.7514	-0.52193	-0.71821	173.0	64.8318	-0.27754	-0.74060
119.0	85.2331	-0.51485	-0.71882	174.0	64.5556	-0.27482	-0.74074
120.0	84.7217	-0.50793	-0.71943	175.0	64.2821	-0.27214	-0.74088
121.0	84.2172	-0.50116	-0.72005	176.0	64.0113	-0.26950	-0.74100
122.0	83.7193	-0.49453	-0.72065	177.0	63.7431	-0.26690	-0.74112
123.0	83.2281	-0.48803	-0.72125	178.0	63.4775	-0.26433	-0.74123
124.0	82.7432	-0.48166	-0.72183	179.0	63.2144	-0.26180	-0.74133
125.0	82.2647	-0.47543	-0.72240	180.0	62.9539	-0.25931	-0.74143
126.0	81.7923	-0.46932	-0.72297	181.0	62.6958	-0.25685	-0.74151
127.0	81.3260	-0.46333	-0.72354	182.0	62.4402	-0.25442	-0.74159
128.0	80.8656	-0.45746	-0.72411	183.0	62.1870	-0.25203	-0.74166
129.0	80.4110	-0.45172	-0.72467	184.0	61.9361	-0.24967	-0.74172
130.0	79.9622	-0.44609	-0.72524	185.0	61.6876	-0.24734	-0.74177
131.0	79.5188	-0.44057	-0.72580	186.0	61.4414	-0.24504	-0.74181
132.0	79.0810	-0.43515	-0.72635	187.0	61.1975	-0.24277	-0.74184
133.0	78.6485	-0.42984	-0.72689	188.0	60.9559	-0.24054	-0.74187
134.0	78.2213	-0.42462	-0.72741	189.0	60.7164	-0.23833	-0.74189
135.0	77.7992	-0.41949	-0.72792	190.0	60.4792	-0.23616	-0.74190
136.0	77.3822	-0.41447	-0.72843	191.0	60.2441	-0.23401	-0.74191
137.0	76.9703	-0.40953	-0.72892	192.0	60.0112	-0.23189	-0.74190
138.0	76.5632	-0.40468	-0.72942	193.0	59.7803	-0.22980	-0.74189
139.0	76.1609	-0.39993	-0.72990	194.0	59.5516	-0.22773	-0.74187
140.0	75.7633	-0.39526	-0.73038	195.0	59.3249	-0.22569	-0.74184
141.0	75.3703	-0.39067	-0.73086	196.0	59.1002	-0.22368	-0.74181
142.0	74.9819	-0.38617	-0.73132	197.0	58.8775	-0.22169	-0.74177
143.0	74.5980	-0.38174	-0.73177	198.0	58.6568	-0.21973	-0.74172
144.0	74.2184	-0.37738	-0.73220	199.0	58.4380	-0.21780	-0.74166
145.0	73.8432	-0.37310	-0.73263	200.0	58.2212	-0.21588	-0.74160
146.0	73.4722	-0.36889	-0.73304	201.0	58.0062	-0.21400	-0.74154
147.0	73.1054	-0.36475	-0.73345	202.0	57.7932	-0.21214	-0.74146
148.0	72.7426	-0.36069	-0.73384	203.0	57.5820	-0.21029	-0.74138
149.0	72.3840	-0.35669	-0.73423	204.0	57.3726	-0.20848	-0.74128
150.0	72.0292	-0.35276	-0.73462	205.0	57.1650	-0.20668	-0.74119
151.0	71.6784	-0.34890	-0.73499	206.0	56.9592	-0.20491	-0.74108
152.0	71.3314	-0.34509	-0.73536	207.0	56.7552	-0.20316	-0.74097
153.0	70.9882	-0.34135	-0.73570	208.0	56.5529	-0.20143	-0.74085
154.0	70.6487	-0.33766	-0.73604	209.0	56.3523	-0.19972	-0.74073
155.0	70.3129	-0.33404	-0.73637	210.0	56.1534	-0.19803	-0.74060
156.0	69.9806	-0.33047	-0.73668	211.0	55.9562	-0.19637	-0.74046

INTERPOLATION TABLE

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	55.7607	-0.19472	-0.74032	267.0	47.0804	-0.12756	-0.72343
213.0	55.5668	-0.19309	-0.74017	268.0	46.9533	-0.12666	-0.72298
214.0	55.3745	-0.19148	-0.74001	269.0	46.8270	-0.12577	-0.72252
215.0	55.1838	-0.18990	-0.73985	270.0	46.7017	-0.12489	-0.72206
216.0	54.9947	-0.18833	-0.73968	271.0	46.5772	-0.12402	-0.72159
217.0	54.8072	-0.18677	-0.73950	272.0	46.4537	-0.12316	-0.72111
218.0	54.6211	-0.18524	-0.73932	273.0	46.3309	-0.12230	-0.72064
219.0	54.4367	-0.18373	-0.73913	274.0	46.2091	-0.12145	-0.72015
220.0	54.2537	-0.18223	-0.73894	275.0	46.0880	-0.12061	-0.71966
221.0	54.0722	-0.18075	-0.73874	276.0	45.9678	-0.11978	-0.71917
222.0	53.8922	-0.17928	-0.73853	277.0	45.8485	-0.11895	-0.71867
223.0	53.7136	-0.17784	-0.73832	278.0	45.7299	-0.11814	-0.71817
224.0	53.5365	-0.17641	-0.73810	279.0	45.6122	-0.11733	-0.71767
225.0	53.3608	-0.17499	-0.73788	280.0	45.4953	-0.11653	-0.71716
226.0	53.1865	-0.17360	-0.73765	281.0	45.3791	-0.11573	-0.71664
227.0	53.0136	-0.17221	-0.73741	282.0	45.2638	-0.11495	-0.71612
228.0	52.8421	-0.17085	-0.73717	283.0	45.1492	-0.11417	-0.71560
229.0	52.6719	-0.16950	-0.73692	284.0	45.0355	-0.11339	-0.71507
230.0	52.5031	-0.16816	-0.73667	285.0	44.9225	-0.11263	-0.71454
231.0	52.3356	-0.16684	-0.73641	286.0	44.8102	-0.11187	-0.71400
232.0	52.1694	-0.16554	-0.73614	287.0	44.6987	-0.11112	-0.71346
233.0	52.0045	-0.16424	-0.73587	288.0	44.5880	-0.11037	-0.71292
234.0	51.8409	-0.16297	-0.73560	289.0	44.4780	-0.10964	-0.71237
235.0	51.6786	-0.16170	-0.73531	290.0	44.3687	-0.10890	-0.71182
236.0	51.5175	-0.16045	-0.73502	291.0	44.2602	-0.10818	-0.71126
237.0	51.3577	-0.15921	-0.73473	292.0	44.1523	-0.10746	-0.71070
238.0	51.1991	-0.15799	-0.73443	293.0	44.0452	-0.10675	-0.71014
239.0	51.0417	-0.15678	-0.73412	294.0	43.9388	-0.10605	-0.70957
240.0	50.8855	-0.15559	-0.73381	295.0	43.8331	-0.10535	-0.70899
241.0	50.7305	-0.15440	-0.73350	296.0	43.7281	-0.10465	-0.70842
242.0	50.5767	-0.15323	-0.73318	297.0	43.6238	-0.10397	-0.70784
243.0	50.4240	-0.15207	-0.73285	298.0	43.5202	-0.10329	-0.70725
244.0	50.2725	-0.15092	-0.73252	299.0	43.4172	-0.10261	-0.70666
245.0	50.1222	-0.14979	-0.73218	300.0	43.3150	-0.10195	-0.70607
246.0	49.9730	-0.14867	-0.73184	301.0	43.2134	-0.10128	-0.70548
247.0	49.8248	-0.14756	-0.73149	302.0	43.1124	-0.10063	-0.70488
248.0	49.6778	-0.14646	-0.73113	303.0	43.0121	-9.9975e-2	-0.70428
249.0	49.5319	-0.14537	-0.73077	304.0	42.9124	-9.9330e-2	-0.70367
250.0	49.3871	-0.14429	-0.73041	305.0	42.8134	-9.8690e-2	-0.70306
251.0	49.2433	-0.14323	-0.73004	305.0	42.8134	-9.8690e-2	-0.70306
252.0	49.1006	-0.14217	-0.72967	306.0	42.7151	-9.8056e-2	-0.70245
253.0	48.9590	-0.14113	-0.72929	307.0	42.6173	-9.7427e-2	-0.70183
254.0	48.8184	-0.14009	-0.72890	308.0	42.5202	-9.6804e-2	-0.70121
255.0	48.6788	-0.13907	-0.72851	309.0	42.4237	-9.6186e-2	-0.70059
256.0	48.5402	-0.13806	-0.72812	310.0	42.3278	-9.5574e-2	-0.69996
257.0	48.4027	-0.13706	-0.72771	311.0	42.2326	-9.4967e-2	-0.69933
258.0	48.2661	-0.13606	-0.72731	312.0	42.1379	-9.4365e-2	-0.69870
259.0	48.1306	-0.13508	-0.72690	313.0	42.0438	-9.3768e-2	-0.69807
260.0	47.9960	-0.13411	-0.72648	314.0	41.9504	-9.3176e-2	-0.69743
261.0	47.8623	-0.13315	-0.72606	315.0	41.8575	-9.2589e-2	-0.69678
262.0	47.7297	-0.13219	-0.72564	316.0	41.7652	-9.2007e-2	-0.69614
263.0	47.5979	-0.13125	-0.72521	317.0	41.6735	-9.1430e-2	-0.69549
264.0	47.4672	-0.13031	-0.72477	318.0	41.5823	-9.0858e-2	-0.69484
265.0	47.3373	-0.12939	-0.72433	319.0	41.4917	-9.0291e-2	-0.69418
266.0	47.2084	-0.12847	-0.72388	320.0	41.4017	-8.9729e-2	-0.69353

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INTERPOLATION TABLE

Calibration Report: 430404
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29548
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	41.3123	-8.9171e-2	-0.69287				
322.0	41.2234	-8.8618e-2	-0.69220				
323.0	41.1350	-8.8070e-2	-0.69154				
324.0	41.0472	-8.7526e-2	-0.69087				
325.0	40.9600	-8.6986e-2	-0.69020				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29548
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.61235,325.000	Point 56: 2.05050, 80.500	Point 111: 2.65475, 9.700	Point 166: 4.24559, 0.545
Point 2: 1.61795,319.000	Point 57: 2.06001, 78.000	Point 112: 2.66858, 9.250	Point 167: 4.30177, 0.520
Point 3: 1.62321,313.500	Point 58: 2.06784, 76.000	Point 113: 2.68323, 8.800	Point 168: 4.35569, 0.498
Point 4: 1.62859,308.000	Point 59: 2.07585, 74.000	Point 114: 2.69706, 8.400	Point 169: 4.40300, 0.480
Point 5: 1.63409,302.500	Point 60: 2.08407, 72.000	Point 115: 2.71167, 8.000	Point 170: 4.45362, 0.462
Point 6: 1.63971,297.000	Point 61: 2.09250, 70.000	Point 116: 2.72722, 7.600	Point 171: 4.50793, 0.444
Point 7: 1.64547,291.500	Point 62: 2.10117, 68.000	Point 117: 2.74382, 7.200	Point 172: 4.56641, 0.426
Point 8: 1.65137,286.000	Point 63: 2.11007, 66.000	Point 118: 2.75937, 6.850	Point 173: 4.62236, 0.410
Point 9: 1.65740,280.500	Point 64: 2.11924, 64.000	Point 119: 2.77591, 6.500	Point 174: 4.68230, 0.394
Point 10: 1.66358,275.000	Point 65: 2.12867, 62.000	Point 120: 2.79365, 6.150	Point 175: 4.74717, 0.378
Point 11: 1.66990,269.500	Point 66: 2.13840, 60.000	Point 121: 2.81163, 5.820	Point 176: 4.81756, 0.362
Point 12: 1.67638,264.000	Point 67: 2.14742, 58.200	Point 122: 2.83039, 5.500	Point 177: 4.88446, 0.348
Point 13: 1.68241,259.000	Point 68: 2.15671, 56.400	Point 123: 2.84935, 5.200	Point 178: 4.95659, 0.334
Point 14: 1.68857,254.000	Point 69: 2.16628, 54.600	Point 124: 2.86979, 4.900	Point 179: 5.04622, 0.318
Point 15: 1.69487,249.000	Point 70: 2.17615, 52.800	Point 125: 2.89198, 4.600	Point 180: 5.14245, 0.302
Point 16: 1.70132,244.000	Point 71: 2.18634, 51.000	Point 126: 2.91455, 4.320	Point 181: 5.15527, 0.300
Point 17: 1.70791,239.000	Point 72: 2.19688, 49.200	Point 127: 2.93912, 4.040	Point 182: 5.15527, 0.300
Point 18: 1.71466,234.000	Point 73: 2.20779, 47.400	Point 128: 2.95923, 3.830	
Point 19: 1.72157,229.000	Point 74: 2.21910, 45.600	Point 129: 2.97759, 3.650	
Point 20: 1.72864,224.000	Point 75: 2.22951, 44.000	Point 130: 2.99723, 3.470	
Point 21: 1.73588,219.000	Point 76: 2.24027, 42.400	Point 131: 3.01714, 3.300	
Point 22: 1.74330,214.000	Point 77: 2.25143, 40.800	Point 132: 3.03849, 3.130	
Point 23: 1.75090,209.000	Point 78: 2.26299, 39.200	Point 133: 3.05748, 2.990	
Point 24: 1.75869,204.000	Point 79: 2.27501, 37.600	Point 134: 3.07972, 2.840	
Point 25: 1.76668,199.000	Point 80: 2.28672, 36.100	Point 135: 3.10668, 2.670	
Point 26: 1.77488,194.000	Point 81: 2.29888, 34.600	Point 136: 3.13069, 2.530	
Point 27: 1.78329,189.000	Point 82: 2.31154, 33.100	Point 137: 3.15675, 2.390	
Point 28: 1.79193,184.000	Point 83: 2.32384, 31.700	Point 138: 3.18514, 2.250	
Point 29: 1.79991,179.500	Point 84: 2.33665, 30.300	Point 139: 3.21401, 2.120	
Point 30: 1.80807,175.000	Point 85: 2.35002, 28.900	Point 140: 3.24563, 1.990	
Point 31: 1.81645,170.500	Point 86: 2.36399, 27.500	Point 141: 3.27784, 1.870	
Point 32: 1.82505,166.000	Point 87: 2.37757, 26.200	Point 142: 3.31332, 1.750	
Point 33: 1.83386,161.500	Point 88: 2.39176, 24.900	Point 143: 3.34946, 1.640	
Point 34: 1.84291,157.000	Point 89: 2.40667, 23.600	Point 144: 3.38950, 1.530	
Point 35: 1.85221,152.500	Point 90: 2.42114, 22.400	Point 145: 3.43443, 1.420	
Point 36: 1.86177,148.000	Point 91: 2.43634, 21.200	Point 146: 3.48046, 1.320	
Point 37: 1.87160,143.500	Point 92: 2.45105, 20.100	Point 147: 3.53223, 1.220	
Point 38: 1.88171,139.000	Point 93: 2.45596, 19.750	Point 148: 3.56721, 1.160	
Point 39: 1.89212,134.500	Point 94: 2.46370, 19.200	Point 149: 3.59184, 1.120	
Point 40: 1.90166,130.500	Point 95: 2.47392, 18.500	Point 150: 3.61794, 1.080	
Point 41: 1.91145,126.500	Point 96: 2.48376, 17.850	Point 151: 3.64562, 1.040	
Point 42: 1.92152,122.500	Point 97: 2.49397, 17.200	Point 152: 3.67506, 1.000	
Point 43: 1.93190,118.500	Point 98: 2.50459, 16.550	Point 153: 3.70647, 0.960	
Point 44: 1.94259,114.500	Point 99: 2.51478, 15.950	Point 154: 3.73578, 0.925	
Point 45: 1.95363,110.500	Point 100: 2.52536, 15.350	Point 155: 3.76687, 0.890	
Point 46: 1.96504,106.500	Point 101: 2.53640, 14.750	Point 156: 3.80007, 0.855	
Point 47: 1.97535,103.000	Point 102: 2.54694, 14.200	Point 157: 3.83555, 0.820	
Point 48: 1.98293,100.500	Point 103: 2.55792, 13.650	Point 158: 3.87365, 0.785	
Point 49: 1.99066, 98.000	Point 104: 2.56939, 13.100	Point 159: 3.91473, 0.750	
Point 50: 1.99858, 95.500	Point 105: 2.58139, 12.550	Point 160: 3.95271, 0.720	
Point 51: 2.00668, 93.000	Point 106: 2.59282, 12.050	Point 161: 3.99340, 0.690	
Point 52: 2.01499, 90.500	Point 107: 2.60477, 11.550	Point 162: 4.03735, 0.660	
Point 53: 2.02352, 88.000	Point 108: 2.61733, 11.050	Point 163: 4.08498, 0.630	
Point 54: 2.03226, 85.500	Point 109: 2.62920, 10.600	Point 164: 4.13688, 0.600	
Point 55: 2.04125, 83.000	Point 110: 2.64164, 10.150	Point 165: 4.19368, 0.570	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 54

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.61236	325.0	31	2.66085	9.5
2	1.61328	324.0	32	2.72331	7.7
3	1.62565	311.0	33	2.78094	6.4
4	1.64076	296.0	34	2.83666	5.4
5	1.65686	281.0	35	2.89213	4.6
6	1.67402	266.0	36	2.94300	4.0
7	1.69235	251.0	37	2.99397	3.5
8	1.71195	236.0	38	3.02963	3.2
9	1.73297	221.0	39	3.07075	2.9
10	1.75556	206.0	40	3.13625	2.5
11	1.77991	191.0	41	3.21889	2.1
12	1.80626	176.0	42	3.29836	1.8
13	1.83487	161.0	43	3.36382	1.6
14	1.86612	146.0	44	3.44364	1.4
15	1.90047	131.0	45	3.49072	1.3
16	1.93857	116.0	46	3.54397	1.2
17	1.98141	101.0	47	3.60481	1.1
18	2.03051	86.0	48	3.67520	1.0
19	2.08827	71.0	49	3.75793	.9
20	2.13596	60.5	50	3.85717	.8
21	2.16148	55.5	51	3.97971	.7
22	2.19218	50.0	52	4.13721	.6
23	2.22299	45.0	53	4.65961	.4
24	2.25719	40.0	54	5.15527	.3
25	2.29562	35.0			
26	2.33951	30.0			
27	2.39070	25.0			
28	2.45248	20.0			
29	2.53178	15.0			
30	2.59876	11.8			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	95.051
1000	3.447
10000	0.686
100000	0.331

BREAKPOINTS 234 FORMAT

Calibration Report: 430404 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29548
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.005K
10 - 20K:	0.008K
20 - 40K:	0.014K
40 - 100K:	0.027K
> 100K:	0.123K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	316.852	41.68694	1.620	56	7.784	524.8075	2.720
2	296.733	43.65158	1.640	57	7.292	549.5409	2.740
3	278.177	45.70882	1.660	58	6.838	575.4399	2.760
4	260.996	47.86301	1.680	59	6.419	602.5596	2.780
5	245.025	50.11872	1.700	60	6.033	630.9573	2.800
6	230.133	52.48075	1.720	61	5.676	660.6934	2.820
7	216.217	54.95409	1.740	62	5.347	691.8310	2.840
8	203.180	57.54399	1.760	63	5.042	724.4360	2.860
9	190.949	60.25596	1.780	64	4.761	758.5776	2.880
10	179.455	63.09573	1.800	65	4.500	794.3282	2.900
11	168.638	66.06934	1.820	66	4.257	831.7638	2.920
12	158.442	69.18310	1.840	67	4.032	870.9636	2.940
13	148.834	72.44360	1.860	68	3.823	912.0108	2.960
14	139.761	75.85776	1.880	69	3.628	954.9926	2.980
15	131.196	79.43282	1.900	70	3.447	1000.000	3.000
16	123.104	83.17638	1.920	71	3.120	1096.478	3.040
17	115.469	87.09636	1.940	72	2.839	1202.264	3.080
18	108.261	91.20108	1.960	73	2.592	1318.257	3.120
19	101.462	95.49926	1.980	74	2.374	1445.440	3.160
20	95.061	100.0000	2.000	75	2.183	1584.893	3.200
21	89.027	104.7129	2.020	76	2.013	1737.801	3.240
22	83.351	109.6478	2.040	77	1.863	1905.461	3.280
23	78.007	114.8154	2.060	78	1.730	2089.296	3.320
24	72.985	120.2264	2.080	79	1.611	2290.868	3.360
25	68.270	125.8925	2.100	80	1.504	2511.886	3.400
26	63.842	131.8257	2.120	81	1.408	2754.229	3.440
27	59.681	138.0384	2.140	82	1.322	3019.952	3.480
28	55.778	144.5440	2.160	83	1.243	3311.311	3.520
29	52.115	151.3561	2.180	84	1.172	3630.781	3.560
30	48.685	158.4893	2.200	85	1.107	3981.072	3.600
31	45.463	165.9587	2.220	86	1.048	4365.158	3.640
32	42.444	173.7801	2.240	87	0.994	4786.301	3.680
33	39.614	181.9701	2.260	88	0.944	5248.075	3.720
34	36.955	190.5461	2.280	89	0.898	5754.399	3.760
35	34.471	199.5262	2.300	90	0.855	6309.573	3.800
36	32.135	208.9296	2.320	91	0.816	6918.310	3.840
37	29.947	218.7762	2.340	92	0.780	7585.776	3.880
38	27.898	229.0868	2.360	93	0.746	8317.638	3.920
39	25.977	239.8833	2.380	94	0.715	9120.108	3.960
40	24.179	251.1886	2.400	95	0.686	10000.00	4.000
41	22.497	263.0268	2.420	96	0.621	12589.25	4.100
42	20.926	275.4229	2.440	97	0.567	15848.93	4.200
43	19.462	288.4032	2.460	98	0.521	19952.62	4.300
44	18.098	301.9952	2.480	99	0.481	25118.86	4.400
45	16.830	316.2278	2.500	100	0.447	31622.78	4.500
46	15.653	331.1311	2.520	101	0.416	39810.72	4.600
47	14.561	346.7369	2.540	102	0.390	50118.72	4.700
48	13.550	363.0781	2.560	103	0.366	63095.73	4.800
49	12.614	380.1894	2.580	104	0.345	79432.82	4.900
50	11.748	398.1072	2.600	105	0.326	100000.0	5.000
51	10.949	416.8694	2.620	106	0.309	125892.5	5.100
52	10.210	436.5158	2.640	107	0.293	158489.3	5.200
53	9.528	457.0882	2.660	108	0.279	199526.2	5.300
54	8.899	478.6301	2.680	109	0.266	251188.6	5.400
55	8.319	501.1872	2.700				

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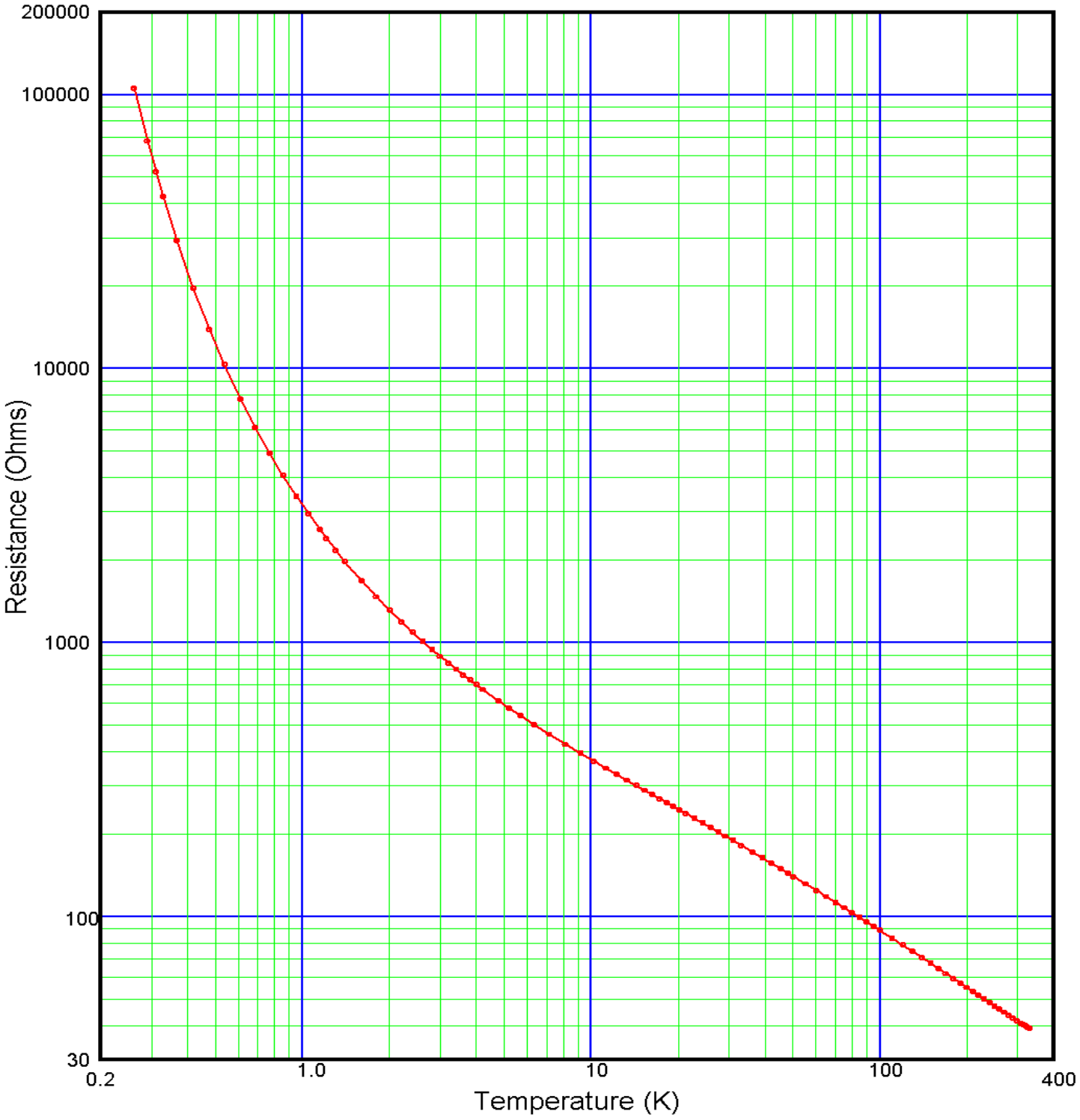
DATA PLOT

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260059	105669.	51	21.1957	238.281
2	0.289847	67753.0	52	22.7435	228.455
3	0.310260	52395.9	53	24.3103	219.489
4	0.328820	42474.6	54	25.9108	211.205
5	0.367045	29350.9	55	27.5344	203.552
6	0.417980	19731.3	56	29.1506	196.597
7	0.474798	13926.7	57	30.9447	189.520
8	0.535233	10345.9	58	33.0445	181.966
9	0.609447	7726.10	59	36.0624	172.344
10	0.685442	6079.85	60	39.0780	163.897
11	0.767720	4915.48	61	42.0941	156.385
12	0.854537	4078.50	62	45.1031	149.688
13	0.950833	3428.98	63	48.1174	143.641
14	1.04610	2958.49	64	50.1168	139.952
15	1.14660	2586.17	65	55.1035	131.678
16	1.20759	2405.28	66	60.0816	124.523
17	1.30290	2171.14	67	65.0490	118.264
18	1.40017	1977.97	68	70.0216	112.716
19	1.60153	1679.72	69	74.9881	107.775
20	1.80011	1470.98	70	79.9558	103.315
21	2.00016	1313.20	71	84.9201	99.2738
22	2.19971	1190.88	72	89.8851	95.6037
23	2.40392	1090.88	73	94.8517	92.2192
24	2.60688	1010.13	74	99.8233	89.1105
25	2.80845	943.581	75	109.868	83.5164
26	2.99472	891.238	76	119.709	78.7700
27	3.20204	841.173	77	129.644	74.5652
28	3.39911	799.953	78	139.579	70.8509
29	3.60121	762.754	79	149.515	67.5294
30	3.80247	730.047	80	159.452	64.5532
31	3.98864	702.816	81	169.387	61.8667
32	4.19775	675.421	82	179.323	59.4302
33	4.78123	612.407	83	189.249	57.2117
34	5.17110	578.262	84	199.163	55.1846
35	5.66381	542.137	85	209.095	53.3214
36	6.34614	501.157	86	219.027	51.6082
37	7.14034	463.047	87	228.946	50.0289
38	8.14410	425.113	88	238.869	48.5668
39	9.16799	394.438	89	248.795	47.2121
40	10.2002	369.137	90	258.704	45.9493
41	11.2315	348.034	91	268.636	44.7759
42	12.2582	330.084	92	278.548	43.6798
43	13.2754	314.628	93	288.486	42.6546
44	14.2816	301.230	94	298.403	41.6945
45	15.2773	289.361	95	308.331	40.7947
46	16.2600	278.872	96	313.295	40.3654
47	17.2370	269.357	97	318.250	39.9525
48	18.2071	260.779	98	324.188	39.4696
49	19.1728	252.929	99	328.172	39.1578
50	20.1334	245.662			

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POLYNOMIAL EQUATION

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.00K
5.940e+4 Ohms	to	891.2 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.9030646142 ZU = 5.02394759749

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.084095	2.0650E-04	5249.77
1	-1.248817	3.4301E-04	-3640.78
2	0.617317	3.0347E-04	2034.21
3	-0.273144	2.5926E-04	-1053.55
4	0.110498	2.2992E-04	480.60
5	-0.042129	2.3697E-04	-177.78
6	0.015413	2.6239E-04	58.74
7	-0.004818	2.7316E-04	-17.64
8	0.001693	2.6025E-04	6.50

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 8
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	105669.0	0.26006	0.26011	-0.05
2	67753.00	0.28985	0.28949	0.36
3	52395.90	0.31026	0.31060	-0.34
4	42474.60	0.32882	0.32913	-0.31
5	29350.90	0.36704	0.36668	0.36
6	19731.30	0.41798	0.41772	0.26
7	13926.70	0.47480	0.47482	-0.02
8	10345.90	0.53523	0.53553	-0.30
9	7726.100	0.60945	0.60986	-0.41
10	6079.850	0.68544	0.68560	-0.16
11	4915.480	0.76772	0.76753	0.19
12	4078.500	0.85454	0.85406	0.48
13	3428.980	0.95083	0.94980	1.03
14	2958.490	1.04610	1.04562	0.48
15	2586.170	1.14660	1.14699	-0.40
16	2405.280	1.20759	1.20819	-0.60
17	2171.143	1.30290	1.30372	-0.83
18	1977.966	1.40017	1.40126	-1.09
19	1679.718	1.60153	1.60192	-0.39
20	1470.985	1.80011	1.79924	0.87
21	1313.203	2.00016	1.99880	1.36
22	1190.879	2.19971	2.19858	1.13
23	1090.876	2.40392	2.40390	0.02
24	1010.132	2.60688	2.60761	-0.72
25	943.5808	2.80845	2.80940	-0.95
26	891.2378	2.99472	2.99566	-0.94
27	841.1733	3.20204	3.20226	-0.22
28	799.9533	3.39911	3.39792	1.19

Order of Fit = 8 RMS error of fit = .67 mK
Largest absolute error = 1.36 mK at data point no. 21

POLYNOMIAL EQUATION

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

2.99K	to	20.1K
891.2 Ohms	to	245.7 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.35880137843 ZU = 3.00437833453

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.633722	4.2632E-04	22597.63
1	-9.429079	6.6269E-04	-14228.49
2	2.962013	6.4885E-04	4565.02
3	-0.639779	5.8308E-04	-1097.24
4	0.083019	5.6267E-04	147.54

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 4
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1010.132	2.60761	2.60990	-2.29
25	943.5808	2.80940	2.80743	1.97
26	891.2378	2.99566	2.99324	2.43
27	841.1733	3.20204	3.20113	0.91
28	799.9533	3.39911	3.39885	0.26
29	762.7543	3.60121	3.60200	-0.79
30	730.0468	3.80247	3.80366	-1.20
31	702.8161	3.98864	3.99093	-2.29
32	675.4209	4.19775	4.20011	-2.36
33	612.4066	4.78123	4.78110	0.13
34	578.2624	5.17110	5.17131	-0.22
35	542.1368	5.66381	5.66155	2.26
36	501.1567	6.34614	6.34362	2.52
37	463.0473	7.14034	7.13932	1.02
38	425.1128	8.14410	8.14391	0.19
39	394.4380	9.16799	9.16752	0.47
40	369.1366	10.20018	10.20146	-1.27
41	348.0335	11.23148	11.23228	-0.80
42	330.0844	12.25824	12.25929	-1.05
43	314.6275	13.27538	13.27823	-2.85
44	301.2300	14.28161	14.28131	0.31
45	289.3611	15.27725	15.27881	-1.56
46	278.8720	16.25995	16.25858	1.37
47	269.3567	17.23697	17.23834	-1.37
48	260.7787	18.20707	18.20532	1.75
49	252.9288	19.17283	19.16812	4.71
50	245.6616	20.13343	20.13326	0.17
51	238.2811	21.19571	21.19400	1.71
52	228.4554	22.74348	22.74761	-4.13

Order of Fit = 4 RMS error of fit = 1.90 mK
Largest absolute error = 4.71 mK at data point no. 49

POLYNOMIAL EQUATION

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	94.9K
245.7 Ohms	to	92.22 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.92177193967 ZU = 2.41627207533

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.986730	8.2951E-04	66288.31
1	-44.701476	1.3381E-03	-33406.22
2	8.960185	1.2477E-03	7181.39
3	-1.137737	1.1665E-03	-975.32
4	0.090940	1.0769E-03	84.44
5	0.009405	1.0717E-03	8.78

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	260.7787	18.20532	18.20805	-2.73
49	252.9288	19.16812	19.16828	-0.16
50	245.6616	20.13326	20.13213	1.14
51	238.2811	21.19571	21.19145	4.26
52	228.4554	22.74348	22.74107	2.41
53	219.4892	24.31031	24.31117	-0.86
54	211.2048	25.91077	25.91236	-1.59
55	203.5524	27.53437	27.53701	-2.64
56	196.5966	29.15058	29.15085	-0.27
57	189.5198	30.94466	30.94414	0.52
58	181.9664	33.04449	33.04951	-5.03
59	172.3441	36.06237	36.06445	-2.07
60	163.8974	39.07797	39.07452	3.46
61	156.3849	42.09412	42.09196	2.15
62	149.6875	45.10307	45.10000	3.07
63	143.6414	48.11744	48.11538	2.05
64	139.9523	50.11684	50.11407	2.77
65	131.6781	55.10350	55.10396	-0.47
66	124.5227	60.08165	60.08486	-3.22
67	118.2640	65.04904	65.05375	-4.71
68	112.7158	70.02164	70.02716	-5.53
69	107.7751	74.98812	74.98398	4.14
70	103.3152	79.95584	79.95389	1.95
71	99.27376	84.92012	84.92372	-3.59
72	95.60370	89.88505	89.87397	11.08
73	92.21922	94.85173	94.85542	-3.69
74	89.11052	99.82329	99.82579	-2.50
75	83.51643	109.86772	109.86766	0.06

Order of Fit = 5 RMS error of fit = 3.54 mK
Largest absolute error = 11.08 mK at data point no. 72

POLYNOMIAL EQUATION

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

94.9K	to	325.K
92.22 Ohms	to	39.41 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.59281882501 ZU = 1.99683448958

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.485296	1.6547E-03	112700.97
1	-118.676562	2.5213E-03	-47069.96
2	19.487255	2.3889E-03	8157.52
3	-2.830828	2.3797E-03	-1189.58
4	0.551418	2.3176E-03	237.93
5	-0.106346	2.2096E-03	-48.13
6	0.020297	2.1721E-03	9.34
7	-0.008738	2.1552E-03	-4.05

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	99.27376	84.92372	84.92179	1.93
72	95.60370	89.87397	89.87777	-3.80
73	92.21922	94.85542	94.85565	-0.23
74	89.11052	99.82329	99.82187	1.42
75	83.51643	109.86772	109.86526	2.46
76	78.77005	119.70927	119.70755	1.72
77	74.56516	129.64431	129.65003	-5.71
78	70.85087	139.57868	139.57345	5.23
79	67.52935	149.51497	149.52261	-7.64
80	64.55320	159.45192	159.45364	-1.72
81	61.86672	169.38713	169.38470	2.43
82	59.43017	179.32259	179.31565	6.94
83	57.21174	189.24945	189.24278	6.67
84	55.18462	199.16299	199.16347	-0.48
85	53.32136	209.09517	209.10262	-7.45
86	51.60821	219.02689	219.03237	-5.48
87	50.02892	228.94564	228.94968	-4.04
88	48.56678	238.86861	238.87099	-2.38
89	47.21211	248.79468	248.77967	15.02
90	45.94932	258.70417	258.71545	-11.28
91	44.77594	268.63647	268.62721	9.26
92	43.67979	278.54794	278.54928	-1.34
93	42.65461	288.48550	288.47717	8.34
94	41.69447	298.40307	298.40931	-6.24
95	40.79465	308.33148	308.33767	-6.19
96	40.36540	313.29466	313.30502	-10.36
97	39.95253	318.25001	318.23380	16.22
98	39.46963	324.18807	324.19704	-8.97
99	39.15785	328.17242	328.16674	5.68

Order of Fit = 7 RMS error of fit = 7.01 mK
Largest absolute error = 16.22 mK at data point no. 97

INTERPOLATION TABLE

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	59400.7	-7.1886e+5	-3.6306	48.00	143.862	-1.9131	-0.63832
0.4000	22394.0	-1.6672e+5	-2.9779	49.00	141.979	-1.8521	-0.63918
0.5000	12216.9	-60727.	-2.4854	50.00	140.157	-1.7941	-0.64003
0.6000	8001.71	-28852.	-2.1634	51.00	138.390	-1.7390	-0.64085
0.7000	5838.93	-16108.	-1.9311	52.00	136.678	-1.6865	-0.64162
0.8000	4564.98	-10048.	-1.7609	53.00	135.017	-1.6364	-0.64236
0.9000	3738.75	-6782.9	-1.6328	54.00	133.404	-1.5887	-0.64309
1.000	3164.94	-4849.0	-1.5321	55.00	131.838	-1.5433	-0.64384
2.000	1312.37	-689.08	-1.0501	56.00	130.317	-1.5000	-0.64459
3.000	889.465	-261.33	-0.88142	57.00	128.838	-1.4586	-0.64529
4.000	701.566	-137.53	-0.78413	58.00	127.399	-1.4189	-0.64597
4.200	675.435	-124.14	-0.77195	59.00	125.999	-1.3810	-0.64665
5.000	592.582	-86.510	-0.72994	60.00	124.637	-1.3447	-0.64733
6.000	520.648	-59.929	-0.69062	61.00	123.309	-1.3100	-0.64802
7.000	469.117	-44.391	-0.66238	62.00	122.016	-1.2766	-0.64868
8.000	429.999	-34.515	-0.64214	63.00	120.756	-1.2446	-0.64932
9.000	399.023	-27.828	-0.62766	64.00	119.527	-1.2139	-0.64996
10.00	373.702	-23.061	-0.61709	65.00	118.328	-1.1844	-0.65062
11.00	352.488	-19.528	-0.60940	66.00	117.157	-1.1561	-0.65128
12.00	334.368	-16.824	-0.60380	67.00	116.015	-1.1288	-0.65192
13.00	318.646	-14.701	-0.59976	68.00	114.899	-1.1026	-0.65255
14.00	304.827	-12.997	-0.59692	69.00	113.810	-1.0774	-0.65318
15.00	292.548	-11.604	-0.59499	70.00	112.744	-1.0531	-0.65382
16.00	281.539	-10.448	-0.59378	71.00	111.703	-1.0297	-0.65447
17.00	271.590	-9.4762	-0.59315	72.00	110.685	-1.0071	-0.65510
18.00	262.538	-8.6482	-0.59293	73.00	109.689	-0.98527	-0.65572
19.00	254.255	-7.9395	-0.59331	74.00	108.714	-0.96425	-0.65635
20.00	246.625	-7.3302	-0.59444	75.00	107.760	-0.94396	-0.65699
21.00	239.572	-6.7896	-0.59515	76.00	106.826	-0.92437	-0.65763
22.00	233.022	-6.3204	-0.59672	77.00	105.911	-0.90542	-0.65826
23.00	226.913	-5.9058	-0.59862	77.35	105.595	-0.89893	-0.65848
24.00	221.195	-5.5364	-0.60071	78.00	105.015	-0.88709	-0.65889
25.00	215.827	-5.2055	-0.60297	79.00	104.137	-0.86937	-0.65952
26.00	210.774	-4.9066	-0.60525	80.00	103.276	-0.85223	-0.66016
27.00	206.005	-4.6353	-0.60752	81.00	102.432	-0.83564	-0.66080
28.00	201.495	-4.3880	-0.60976	82.00	101.604	-0.81957	-0.66144
29.00	197.222	-4.1616	-0.61193	83.00	100.793	-0.80401	-0.66208
30.00	193.166	-3.9536	-0.61402	84.00	99.9962	-0.78893	-0.66273
31.00	189.309	-3.7619	-0.61602	85.00	99.2147	-0.77433	-0.66339
32.00	185.637	-3.5847	-0.61793	86.00	98.4474	-0.76016	-0.66405
33.00	182.136	-3.4206	-0.61975	87.00	97.6942	-0.74639	-0.66468
34.00	178.792	-3.2682	-0.62149	88.00	96.9545	-0.73300	-0.66530
35.00	175.596	-3.1261	-0.62310	89.00	96.2281	-0.71999	-0.66590
36.00	172.537	-2.9938	-0.62465	90.00	95.5145	-0.70734	-0.66650
37.00	169.605	-2.8702	-0.62614	91.00	94.8133	-0.69508	-0.66713
38.00	166.794	-2.7544	-0.62752	92.00	94.1242	-0.68322	-0.66780
39.00	164.094	-2.6459	-0.62884	93.00	93.4467	-0.67174	-0.66853
40.00	161.500	-2.5441	-0.63011	94.00	92.7805	-0.66064	-0.66933
41.00	159.004	-2.4482	-0.63129	95.00	92.1253	-0.64991	-0.67019
42.00	156.601	-2.3581	-0.63243	96.00	91.4806	-0.63944	-0.67103
43.00	154.286	-2.2731	-0.63353	97.00	90.8463	-0.62919	-0.67181
44.00	152.054	-2.1929	-0.63456	98.00	90.2222	-0.61914	-0.67251
45.00	149.899	-2.1171	-0.63556	99.00	89.6080	-0.60929	-0.67315
46.00	147.818	-2.0454	-0.63653	100.0	89.0036	-0.59963	-0.67372
47.00	145.807	-1.9775	-0.63744	101.0	88.4087	-0.59020	-0.67426

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INTERPOLATION TABLE

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	87.8231	-0.58101	-0.67479	157.0	65.2598	-0.29168	-0.70172
103.0	87.2466	-0.57204	-0.67533	158.0	64.9697	-0.28866	-0.70200
104.0	86.6789	-0.56329	-0.67586	159.0	64.6825	-0.28569	-0.70228
105.0	86.1199	-0.55477	-0.67639	160.0	64.3983	-0.28277	-0.70255
106.0	85.5693	-0.54646	-0.67693	161.0	64.1170	-0.27989	-0.70280
107.0	85.0269	-0.53836	-0.67748	162.0	63.8385	-0.27705	-0.70305
108.0	84.4925	-0.53046	-0.67805	163.0	63.5628	-0.27425	-0.70328
109.0	83.9659	-0.52277	-0.67863	164.0	63.2900	-0.27149	-0.70350
110.0	83.4469	-0.51527	-0.67923	165.0	63.0198	-0.26877	-0.70371
111.0	82.9354	-0.50794	-0.67983	166.0	62.7524	-0.26610	-0.70392
112.0	82.4310	-0.50078	-0.68041	167.0	62.4876	-0.26346	-0.70411
113.0	81.9337	-0.49377	-0.68099	168.0	62.2255	-0.26086	-0.70430
114.0	81.4434	-0.48692	-0.68157	169.0	61.9659	-0.25830	-0.70447
115.0	80.9598	-0.48022	-0.68214	170.0	61.7089	-0.25578	-0.70465
116.0	80.4829	-0.47367	-0.68270	171.0	61.4543	-0.25329	-0.70481
117.0	80.0125	-0.46727	-0.68327	172.0	61.2023	-0.25084	-0.70496
118.0	79.5483	-0.46101	-0.68384	173.0	60.9526	-0.24842	-0.70509
119.0	79.0904	-0.45488	-0.68442	174.0	60.7054	-0.24604	-0.70522
120.0	78.6385	-0.44890	-0.68500	175.0	60.4605	-0.24369	-0.70534
121.0	78.1926	-0.44304	-0.68558	176.0	60.2180	-0.24137	-0.70545
122.0	77.7524	-0.43729	-0.68615	177.0	59.9778	-0.23908	-0.70556
123.0	77.3179	-0.43166	-0.68671	178.0	59.7398	-0.23683	-0.70565
124.0	76.8890	-0.42615	-0.68726	179.0	59.5041	-0.23461	-0.70574
125.0	76.4656	-0.42074	-0.68780	180.0	59.2706	-0.23241	-0.70583
126.0	76.0475	-0.41545	-0.68834	181.0	59.0393	-0.23025	-0.70590
127.0	75.6347	-0.41026	-0.68888	182.0	58.8101	-0.22812	-0.70596
128.0	75.2270	-0.40518	-0.68942	183.0	58.5830	-0.22601	-0.70601
129.0	74.8243	-0.40020	-0.68996	184.0	58.3581	-0.22393	-0.70605
130.0	74.4265	-0.39532	-0.69051	185.0	58.1352	-0.22188	-0.70609
131.0	74.0336	-0.39054	-0.69104	186.0	57.9143	-0.21986	-0.70612
132.0	73.6454	-0.38584	-0.69156	187.0	57.6954	-0.21787	-0.70614
133.0	73.2619	-0.38122	-0.69207	188.0	57.4785	-0.21590	-0.70615
134.0	72.8829	-0.37669	-0.69257	189.0	57.2636	-0.21395	-0.70616
135.0	72.5085	-0.37224	-0.69306	190.0	57.0506	-0.21203	-0.70616
136.0	72.1384	-0.36788	-0.69354	191.0	56.8395	-0.21014	-0.70615
137.0	71.7727	-0.36359	-0.69402	192.0	56.6303	-0.20827	-0.70613
138.0	71.4112	-0.35938	-0.69449	193.0	56.4230	-0.20643	-0.70610
139.0	71.0539	-0.35525	-0.69496	194.0	56.2175	-0.20460	-0.70607
140.0	70.7007	-0.35119	-0.69542	195.0	56.0138	-0.20281	-0.70602
141.0	70.3515	-0.34721	-0.69588	196.0	55.8119	-0.20103	-0.70597
142.0	70.0063	-0.34328	-0.69631	197.0	55.6117	-0.19928	-0.70592
143.0	69.6649	-0.33943	-0.69674	198.0	55.4133	-0.19754	-0.70586
144.0	69.3274	-0.33564	-0.69716	199.0	55.2166	-0.19584	-0.70579
145.0	68.9936	-0.33191	-0.69756	200.0	55.0216	-0.19415	-0.70571
146.0	68.6635	-0.32825	-0.69796	201.0	54.8283	-0.19248	-0.70563
147.0	68.3371	-0.32465	-0.69834	202.0	54.6367	-0.19083	-0.70554
148.0	68.0142	-0.32110	-0.69873	203.0	54.4466	-0.18921	-0.70544
149.0	67.6949	-0.31762	-0.69910	204.0	54.2582	-0.18760	-0.70533
150.0	67.3790	-0.31420	-0.69947	205.0	54.0714	-0.18601	-0.70522
151.0	67.0665	-0.31083	-0.69983	206.0	53.8862	-0.18444	-0.70510
152.0	66.7573	-0.30751	-0.70017	207.0	53.7025	-0.18289	-0.70497
153.0	66.4514	-0.30424	-0.70050	208.0	53.5204	-0.18136	-0.70484
154.0	66.1488	-0.30103	-0.70082	209.0	53.3398	-0.17985	-0.70471
155.0	65.8494	-0.29786	-0.70113	210.0	53.1607	-0.17836	-0.70456
156.0	65.5531	-0.29475	-0.70143	211.0	52.9831	-0.17688	-0.70441

INTERPOLATION TABLE

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	52.8069	-0.17542	-0.70425	267.0	44.9630	-0.11561	-0.68654
213.0	52.6322	-0.17398	-0.70409	268.0	44.8478	-0.11481	-0.68607
214.0	52.4590	-0.17255	-0.70391	269.0	44.7334	-0.11401	-0.68559
215.0	52.2871	-0.17115	-0.70374	270.0	44.6198	-0.11322	-0.68511
216.0	52.1167	-0.16975	-0.70355	271.0	44.5069	-0.11244	-0.68463
217.0	51.9476	-0.16838	-0.70336	272.0	44.3949	-0.11166	-0.68414
218.0	51.7799	-0.16702	-0.70316	273.0	44.2836	-0.11089	-0.68364
219.0	51.6136	-0.16567	-0.70296	274.0	44.1731	-0.11013	-0.68314
220.0	51.4486	-0.16434	-0.70276	275.0	44.0633	-0.10938	-0.68264
221.0	51.2849	-0.16303	-0.70254	276.0	43.9543	-0.10863	-0.68213
222.0	51.1225	-0.16173	-0.70232	277.0	43.8461	-0.10789	-0.68162
223.0	50.9614	-0.16045	-0.70209	278.0	43.7385	-0.10716	-0.68110
224.0	50.8016	-0.15918	-0.70186	279.0	43.6317	-0.10643	-0.68058
225.0	50.6431	-0.15792	-0.70162	280.0	43.5257	-0.10571	-0.68006
226.0	50.4858	-0.15668	-0.70137	281.0	43.4203	-0.10500	-0.67953
227.0	50.3297	-0.15545	-0.70112	282.0	43.3157	-0.10429	-0.67899
228.0	50.1749	-0.15424	-0.70086	283.0	43.2117	-0.10359	-0.67845
229.0	50.0212	-0.15303	-0.70060	284.0	43.1085	-0.10290	-0.67791
230.0	49.8688	-0.15185	-0.70034	285.0	43.0059	-0.10221	-0.67736
231.0	49.7175	-0.15067	-0.70006	286.0	42.9040	-0.10153	-0.67681
232.0	49.5674	-0.14951	-0.69978	287.0	42.8029	-0.10086	-0.67626
233.0	49.4185	-0.14836	-0.69949	288.0	42.7023	-0.10019	-0.67570
234.0	49.2707	-0.14722	-0.69920	289.0	42.6025	-9.9524e-2	-0.67513
235.0	49.1240	-0.14610	-0.69890	290.0	42.5033	-9.8866e-2	-0.67457
236.0	48.9785	-0.14498	-0.69860	291.0	42.4047	-9.8215e-2	-0.67399
237.0	48.8341	-0.14388	-0.69829	292.0	42.3069	-9.7569e-2	-0.67342
238.0	48.6907	-0.14279	-0.69798	293.0	42.2096	-9.6929e-2	-0.67284
239.0	48.5485	-0.14172	-0.69766	294.0	42.1130	-9.6294e-2	-0.67225
240.0	48.4073	-0.14065	-0.69733	295.0	42.0170	-9.5665e-2	-0.67166
241.0	48.2672	-0.13959	-0.69700	296.0	41.9217	-9.5042e-2	-0.67107
242.0	48.1281	-0.13855	-0.69667	297.0	41.8269	-9.4424e-2	-0.67048
243.0	47.9901	-0.13752	-0.69632	298.0	41.7328	-9.3812e-2	-0.66988
244.0	47.8531	-0.13649	-0.69598	299.0	41.6393	-9.3205e-2	-0.66928
245.0	47.7171	-0.13548	-0.69562	300.0	41.5464	-9.2603e-2	-0.66867
246.0	47.5821	-0.13448	-0.69526	301.0	41.4541	-9.2006e-2	-0.66806
247.0	47.4481	-0.13349	-0.69490	302.0	41.3624	-9.1414e-2	-0.66745
248.0	47.3151	-0.13251	-0.69453	303.0	41.2713	-9.0828e-2	-0.66683
249.0	47.1831	-0.13154	-0.69416	304.0	41.1807	-9.0246e-2	-0.66621
250.0	47.0520	-0.13057	-0.69378	305.0	41.0908	-8.9670e-2	-0.66558
251.0	46.9219	-0.12962	-0.69339	305.0	41.0908	-8.9670e-2	-0.66558
252.0	46.7928	-0.12868	-0.69300	306.0	41.0014	-8.9098e-2	-0.66495
253.0	46.6646	-0.12775	-0.69261	307.0	40.9126	-8.8531e-2	-0.66432
254.0	46.5373	-0.12682	-0.69221	308.0	40.8243	-8.7970e-2	-0.66369
255.0	46.4109	-0.12591	-0.69180	309.0	40.7366	-8.7413e-2	-0.66305
256.0	46.2855	-0.12500	-0.69139	310.0	40.6495	-8.6860e-2	-0.66241
257.0	46.1609	-0.12411	-0.69097	311.0	40.5629	-8.6313e-2	-0.66177
258.0	46.0373	-0.12322	-0.69055	312.0	40.4769	-8.5769e-2	-0.66112
259.0	45.9145	-0.12234	-0.69013	313.0	40.3914	-8.5231e-2	-0.66047
260.0	45.7926	-0.12147	-0.68970	314.0	40.3064	-8.4697e-2	-0.65982
261.0	45.6715	-0.12061	-0.68926	315.0	40.2220	-8.4167e-2	-0.65916
262.0	45.5513	-0.11976	-0.68882	316.0	40.1381	-8.3642e-2	-0.65850
263.0	45.4320	-0.11891	-0.68837	317.0	40.0547	-8.3121e-2	-0.65784
264.0	45.3135	-0.11808	-0.68792	318.0	39.9718	-8.2605e-2	-0.65717
265.0	45.1959	-0.11725	-0.68746	319.0	39.8895	-8.2093e-2	-0.65651
266.0	45.0790	-0.11643	-0.68700	320.0	39.8076	-8.1585e-2	-0.65583

INTERPOLATION TABLE

Calibration Report: 430514
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29549
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	39.7263	-8.1081e-2	-0.65516				
322.0	39.6455	-8.0582e-2	-0.65448				
323.0	39.5651	-8.0086e-2	-0.65381				
324.0	39.4853	-7.9595e-2	-0.65312				
325.0	39.4060	-7.9108e-2	-0.65244				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29549
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.59555,325.000	Point 56: 2.01398, 80.000	Point 111: 2.59943, 9.050	Point 166: 4.04503, 0.520
Point 2: 1.60085,319.000	Point 57: 2.02307, 77.500	Point 112: 2.61180, 8.650	Point 167: 4.09110, 0.498
Point 3: 1.60582,313.500	Point 58: 2.03055, 75.500	Point 113: 2.62485, 8.250	Point 168: 4.13152, 0.480
Point 4: 1.61091,308.000	Point 59: 2.03820, 73.500	Point 114: 2.63869, 7.850	Point 169: 4.17465, 0.462
Point 5: 1.61612,302.500	Point 60: 2.04606, 71.500	Point 115: 2.65342, 7.450	Point 170: 4.22087, 0.444
Point 6: 1.62145,297.000	Point 61: 2.05412, 69.500	Point 116: 2.66915, 7.050	Point 171: 4.26502, 0.428
Point 7: 1.62690,291.500	Point 62: 2.06239, 67.500	Point 117: 2.68389, 6.700	Point 172: 4.31217, 0.412
Point 8: 1.63249,286.000	Point 63: 2.07091, 65.500	Point 118: 2.69959, 6.350	Point 173: 4.36290, 0.396
Point 9: 1.63821,280.500	Point 64: 2.07966, 63.500	Point 119: 2.71745, 5.980	Point 174: 4.41782, 0.380
Point 10: 1.64407,275.000	Point 65: 2.08868, 61.500	Point 120: 2.73410, 5.660	Point 175: 4.46999, 0.366
Point 11: 1.64952,270.000	Point 66: 2.09845, 59.400	Point 121: 2.75199, 5.340	Point 176: 4.52613, 0.352
Point 12: 1.65509,265.000	Point 67: 2.10806, 57.400	Point 122: 2.77012, 5.040	Point 177: 4.58685, 0.338
Point 13: 1.66079,260.000	Point 68: 2.11799, 55.400	Point 123: 2.78969, 4.740	Point 178: 4.65238, 0.324
Point 14: 1.66661,255.000	Point 69: 2.12723, 53.600	Point 124: 2.80952, 4.460	Point 179: 4.75253, 0.304
Point 15: 1.67257,250.000	Point 70: 2.13675, 51.800	Point 125: 2.83103, 4.180	Point 180: 4.76333, 0.302
Point 16: 1.67866,245.000	Point 71: 2.14659, 50.000	Point 126: 2.85028, 3.950	Point 181: 4.77379, 0.300
Point 17: 1.68490,240.000	Point 72: 2.15677, 48.200	Point 127: 2.86726, 3.760	Point 182: 4.77379, 0.300
Point 18: 1.69128,235.000	Point 73: 2.16730, 46.400	Point 128: 2.88446, 3.580	
Point 19: 1.69782,230.000	Point 74: 2.17823, 44.600	Point 129: 2.90179, 3.410	
Point 20: 1.70451,225.000	Point 75: 2.18830, 43.000	Point 130: 2.92036, 3.240	
Point 21: 1.71136,220.000	Point 76: 2.19872, 41.400	Point 131: 2.93906, 3.080	
Point 22: 1.71838,215.000	Point 77: 2.21020, 39.700	Point 132: 2.95681, 2.940	
Point 23: 1.72558,210.000	Point 78: 2.22143, 38.100	Point 133: 2.98022, 2.770	
Point 24: 1.73295,205.000	Point 79: 2.23310, 36.500	Point 134: 3.00235, 2.620	
Point 25: 1.74052,200.000	Point 80: 2.24448, 35.000	Point 135: 3.02468, 2.480	
Point 26: 1.74828,195.000	Point 81: 2.25631, 33.500	Point 136: 3.04895, 2.340	
Point 27: 1.75624,190.000	Point 82: 2.26862, 32.000	Point 137: 3.07539, 2.200	
Point 28: 1.76442,185.000	Point 83: 2.28061, 30.600	Point 138: 3.10231, 2.070	
Point 29: 1.77198,180.500	Point 84: 2.29309, 29.200	Point 139: 3.13182, 1.940	
Point 30: 1.77971,176.000	Point 85: 2.30612, 27.800	Point 140: 3.16189, 1.820	
Point 31: 1.78764,171.500	Point 86: 2.31876, 26.500	Point 141: 3.19503, 1.700	
Point 32: 1.79578,167.000	Point 87: 2.33197, 25.200	Point 142: 3.22881, 1.590	
Point 33: 1.80413,162.500	Point 88: 2.34581, 23.900	Point 143: 3.26625, 1.480	
Point 34: 1.81269,158.000	Point 89: 2.35922, 22.700	Point 144: 3.30831, 1.370	
Point 35: 1.82149,153.500	Point 90: 2.37329, 21.500	Point 145: 3.35142, 1.270	
Point 36: 1.83054,149.000	Point 91: 2.38688, 20.400	Point 146: 3.38021, 1.210	
Point 37: 1.83984,144.500	Point 92: 2.39723, 19.600	Point 147: 3.40043, 1.170	
Point 38: 1.84940,140.000	Point 93: 2.40660, 18.900	Point 148: 3.42179, 1.130	
Point 39: 1.85925,135.500	Point 94: 2.41562, 18.250	Point 149: 3.44435, 1.090	
Point 40: 1.86827,131.500	Point 95: 2.42495, 17.600	Point 150: 3.46826, 1.050	
Point 41: 1.87753,127.500	Point 96: 2.43464, 16.950	Point 151: 3.49365, 1.010	
Point 42: 1.88705,123.500	Point 97: 2.44393, 16.350	Point 152: 3.52069, 0.970	
Point 43: 1.89686,119.500	Point 98: 2.45357, 15.750	Point 153: 3.54957, 0.930	
Point 44: 1.90696,115.500	Point 99: 2.46360, 15.150	Point 154: 3.57657, 0.895	
Point 45: 1.91739,111.500	Point 100: 2.47404, 14.550	Point 155: 3.60529, 0.860	
Point 46: 1.92816,107.500	Point 101: 2.48402, 14.000	Point 156: 3.63599, 0.825	
Point 47: 1.93789,104.000	Point 102: 2.49442, 13.450	Point 157: 3.66892, 0.790	
Point 48: 1.94792,100.500	Point 103: 2.50528, 12.900	Point 158: 3.70438, 0.755	
Point 49: 1.95679, 97.500	Point 104: 2.51665, 12.350	Point 159: 3.73713, 0.725	
Point 50: 1.96437, 95.000	Point 105: 2.52749, 11.850	Point 160: 3.77217, 0.695	
Point 51: 1.97212, 92.500	Point 106: 2.53883, 11.350	Point 161: 3.80995, 0.665	
Point 52: 1.98006, 90.000	Point 107: 2.55074, 10.850	Point 162: 3.85078, 0.635	
Point 53: 1.98820, 87.500	Point 108: 2.56200, 10.400	Point 163: 3.89514, 0.605	
Point 54: 1.99656, 85.000	Point 109: 2.57382, 9.950	Point 164: 3.94351, 0.575	
Point 55: 2.00515, 82.500	Point 110: 2.58628, 9.500	Point 165: 3.99656, 0.545	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 54

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.59556	325.0	31	2.58919	9.4
2	1.59644	324.0	32	2.64785	7.6
3	1.60086	319.0	33	2.70201	6.3
4	1.61469	304.0	34	2.75444	5.3
5	1.62943	289.0	35	2.80671	4.5
6	1.64516	274.0	36	2.86368	3.8
7	1.66195	259.0	37	2.90294	3.4
8	1.67991	244.0	38	2.93675	3.1
9	1.69915	229.0	39	2.96228	2.9
10	1.71982	214.0	40	3.03845	2.4
11	1.74207	199.0	41	3.09607	2.1
12	1.76610	184.0	42	3.16741	1.8
13	1.79215	169.0	43	3.22585	1.6
14	1.82052	154.0	44	3.29671	1.4
15	1.85159	139.0	45	3.33833	1.3
16	1.88586	124.0	46	3.38524	1.2
17	1.92410	109.0	47	3.43868	1.1
18	1.96746	94.0	48	3.50037	1.0
19	2.01760	79.0	49	3.57273	.9
20	2.07527	64.5	50	3.65944	.8
21	2.10759	57.5	51	3.76633	.7
22	2.14661	50.0	52	3.90318	.6
23	2.17580	45.0	53	4.35013	.4
24	2.20817	40.0	54	4.77379	.3
25	2.24451	35.0			
26	2.28593	30.0			
27	2.33411	25.0			
28	2.39204	20.0			
29	2.46620	15.0			
30	2.52864	11.8			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	83.986
1000	2.635
10000	0.542

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BREAKPOINTS 234 FORMAT

Calibration Report: 430514 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29549
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.004K
10 - 20K:	0.009K
20 - 40K:	0.015K
40 - 100K:	0.031K
> 100K:	0.143K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	319.967	39.81072	1.600	56	6.343	501.1872	2.700
2	298.490	41.68694	1.620	57	5.932	524.8075	2.720
3	278.813	43.65158	1.640	58	5.554	549.5409	2.740
4	260.689	45.70882	1.660	59	5.206	575.4399	2.760
5	243.931	47.86301	1.680	60	4.887	602.5596	2.780
6	228.365	50.11872	1.700	61	4.594	630.9573	2.800
7	213.873	52.48075	1.720	62	4.322	660.6934	2.820
8	200.348	54.95409	1.740	63	4.072	691.8310	2.840
9	187.698	57.54399	1.760	64	3.841	724.4360	2.860
10	175.843	60.25596	1.780	65	3.626	758.5776	2.880
11	164.718	63.09573	1.800	66	3.428	794.3282	2.900
12	154.263	66.06934	1.820	67	3.244	831.7638	2.920
13	144.431	69.18310	1.840	68	3.074	870.9636	2.940
14	135.176	72.44360	1.860	69	2.917	912.0108	2.960
15	126.456	75.85776	1.880	70	2.772	954.9926	2.980
16	118.252	79.43282	1.900	71	2.636	1000.000	3.000
17	110.527	83.17638	1.920	72	2.391	1096.478	3.040
18	103.266	87.09636	1.940	73	2.178	1202.264	3.080
19	96.436	91.20108	1.960	74	1.992	1318.257	3.120
20	90.022	95.49926	1.980	75	1.828	1445.440	3.160
21	83.993	100.0000	2.000	76	1.684	1584.893	3.200
22	78.343	104.7129	2.020	77	1.557	1737.801	3.240
23	73.042	109.6478	2.040	78	1.443	1905.461	3.280
24	68.075	114.8154	2.060	79	1.343	2089.296	3.320
25	63.428	120.2264	2.080	80	1.252	2290.868	3.360
26	59.077	125.8925	2.100	81	1.171	2511.886	3.400
27	55.008	131.8257	2.120	82	1.098	2754.229	3.440
28	51.204	138.0384	2.140	83	1.031	3019.952	3.480
29	47.645	144.5440	2.160	84	0.971	3311.311	3.520
30	44.320	151.3561	2.180	85	0.916	3630.781	3.560
31	41.211	158.4893	2.200	86	0.866	3981.072	3.600
32	38.306	165.9587	2.220	87	0.821	4365.158	3.640
33	35.588	173.7801	2.240	88	0.779	4786.301	3.680
34	33.048	181.9701	2.260	89	0.741	5248.075	3.720
35	30.674	190.5461	2.280	90	0.705	5754.399	3.760
36	28.454	199.5262	2.300	91	0.673	6309.573	3.800
37	26.380	208.9296	2.320	92	0.643	6918.310	3.840
38	24.443	218.7762	2.340	93	0.615	7585.776	3.880
39	22.637	229.0868	2.360	94	0.589	8317.638	3.920
40	20.954	239.8833	2.380	95	0.566	9120.108	3.960
41	19.392	251.1886	2.400	96	0.543	10000.00	4.000
42	17.943	263.0268	2.420	97	0.494	12589.25	4.100
43	16.603	275.4229	2.440	98	0.452	15848.93	4.200
44	15.364	288.4032	2.460	99	0.416	19952.62	4.300
45	14.221	301.9952	2.480	100	0.385	25118.86	4.400
46	13.166	316.2278	2.500	101	0.358	31622.78	4.500
47	12.195	331.1311	2.520	102	0.335	39810.72	4.600
48	11.302	346.7369	2.540	103	0.314	50118.72	4.700
49	10.480	363.0781	2.560	104	0.295	63095.73	4.800
50	9.725	380.1894	2.580	105	0.278	79432.82	4.900
51	9.033	398.1072	2.600	106	0.263	100000.0	5.000
52	8.398	416.8694	2.620				
53	7.815	436.5158	2.640				
54	7.281	457.0882	2.660				
55	6.792	478.6301	2.680				

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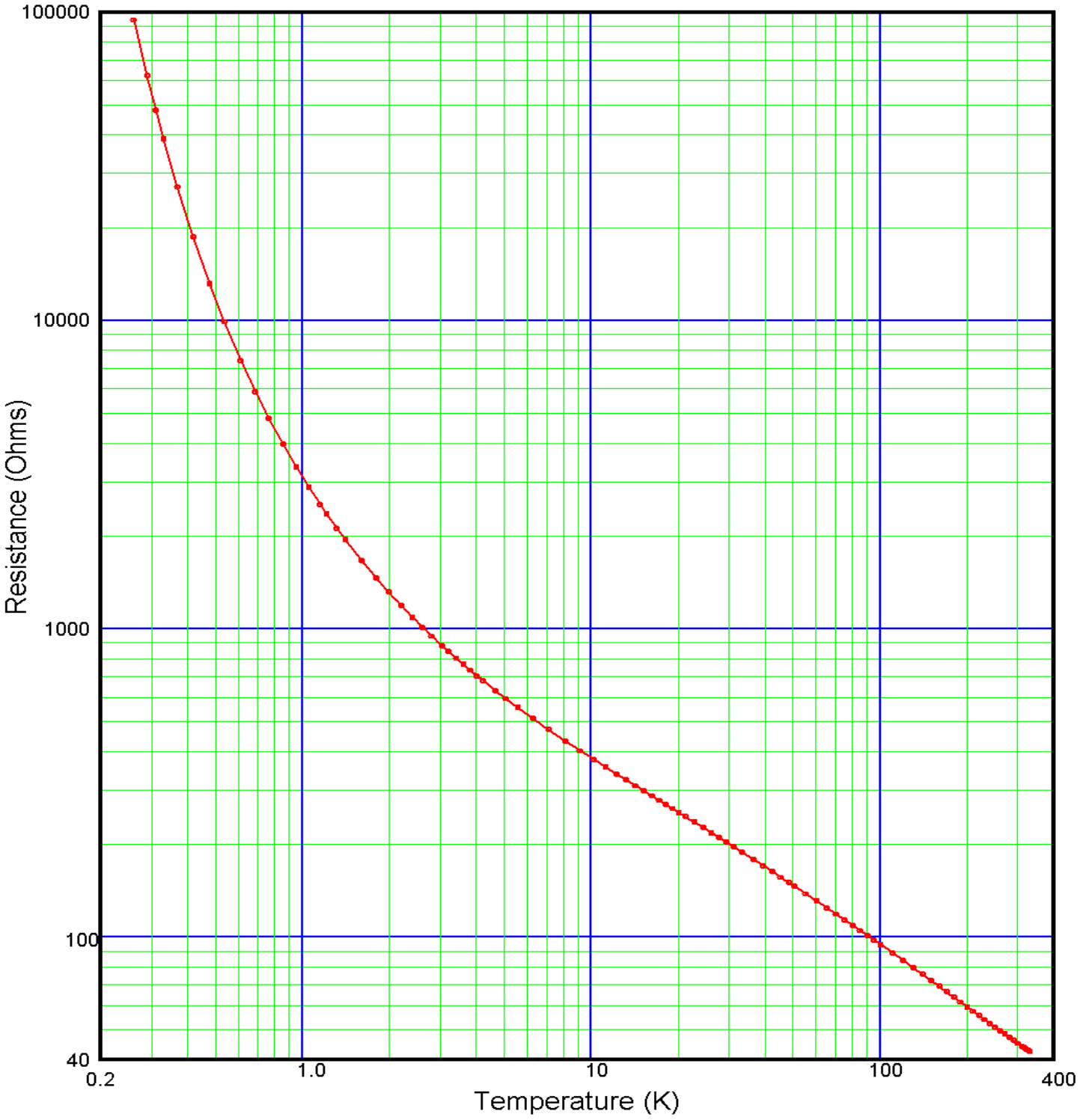
DATA PLOT

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260335	94387.0	51	21.1627	246.305
2	0.289230	62279.3	52	22.7397	236.232
3	0.310281	48003.4	53	24.3459	227.036
4	0.329853	38785.8	54	26.0121	218.380
5	0.367934	27160.3	55	27.6769	210.529
6	0.417528	18688.9	56	29.3327	203.434
7	0.475943	13184.3	57	31.1782	196.155
8	0.535271	9912.00	58	33.3063	188.530
9	0.609820	7431.00	59	36.3323	178.930
10	0.685390	5879.21	60	39.3312	170.502
11	0.763811	4814.33	61	42.3277	163.035
12	0.854555	3976.07	62	45.3224	156.329
13	0.949742	3356.04	63	48.3168	150.274
14	1.05065	2881.64	64	50.3096	146.562
15	1.14855	2533.21	65	55.2982	138.175
16	1.21113	2360.17	66	60.2988	130.908
17	1.31316	2121.01	67	65.2918	124.531
18	1.40492	1947.80	68	70.2860	118.859
19	1.60065	1665.37	69	75.2665	113.811
20	1.80052	1460.91	70	80.2606	109.256
21	1.98297	1319.22	71	85.2549	105.116
22	2.19736	1188.93	72	90.2450	101.337
23	2.39863	1091.92	73	95.2369	97.8655
24	2.60145	1012.18	74	100.223	94.6732
25	2.80328	946.181	75	110.406	88.8686
26	3.03686	882.682	76	120.208	84.0199
27	3.19665	845.166	77	130.206	79.6662
28	3.40168	802.810	78	140.202	75.8060
29	3.60326	766.319	79	150.195	72.3620
30	3.79938	734.806	80	160.187	69.2630
31	4.01398	704.173	81	170.186	66.4642
32	4.20802	679.240	82	180.194	63.9162
33	4.64456	631.404	83	190.189	61.5931
34	5.05204	594.131	84	200.192	59.4667
35	5.56359	555.394	85	210.199	57.5137
36	6.27944	511.555	86	220.198	55.7137
37	7.09306	472.135	87	230.200	54.0516
38	8.11839	433.269	88	240.203	52.5106
39	9.15072	402.422	89	250.193	51.0796
40	10.1824	377.185	90	260.202	49.7462
41	11.2043	356.254	91	270.197	48.5073
42	12.2140	338.550	92	280.202	47.3429
43	13.2168	323.321	93	290.188	46.2588
44	14.2139	309.854	94	300.206	45.2421
45	15.2026	298.057	95	310.205	44.2853
46	16.1815	287.525	96	315.218	43.8277
47	17.1576	277.941	97	320.223	43.3894
48	18.1320	269.253	98	326.196	42.8755
49	19.1078	261.218	99	330.219	42.5394
50	20.0831	253.833			

POLYNOMIAL EQUATION

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.04K
5.420e+4 Ohms	to	882.7 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.90461284077 ZU = 4.97491218268

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.087725	2.0079E-04	5417.33
1	-1.251160	3.3142E-04	-3775.18
2	0.617087	2.9035E-04	2125.29
3	-0.271761	2.3758E-04	-1143.87
4	0.109761	2.0110E-04	545.80
5	-0.041551	2.0378E-04	-203.91
6	0.014899	2.2374E-04	66.59
7	-0.005222	2.5375E-04	-20.58
8	0.001278	2.6281E-04	4.86
9	-0.000743	2.3450E-04	-3.17

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 9
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	94387.00	0.26034	0.26031	0.02
2	62279.30	0.28923	0.28945	-0.22
3	48003.40	0.31028	0.30994	0.34
4	38785.80	0.32985	0.32976	0.10
5	27160.30	0.36793	0.36839	-0.46
6	18688.90	0.41753	0.41758	-0.05
7	13184.30	0.47594	0.47543	0.52
8	9912.000	0.53527	0.53500	0.27
9	7431.000	0.60982	0.61023	-0.41
10	5879.210	0.68539	0.68603	-0.64
11	4814.330	0.76381	0.76418	-0.37
12	3976.070	0.85455	0.85394	0.62
13	3356.040	0.94974	0.94897	0.77
14	2881.640	1.05065	1.04999	0.66
15	2533.210	1.14855	1.14957	-1.02
16	2360.171	1.21113	1.21076	0.37
17	2121.013	1.31316	1.31333	-0.17
18	1947.796	1.40492	1.40515	-0.23
19	1665.367	1.60065	1.60190	-1.25
20	1460.911	1.80052	1.80050	0.02
21	1319.218	1.98297	1.98200	0.98
22	1188.929	2.19736	2.19643	0.93
23	1091.923	2.39863	2.39834	0.30
24	1012.183	2.60145	2.60179	-0.34
25	946.1808	2.80328	2.80424	-0.96
26	882.6824	3.03686	3.03708	-0.22
27	845.1664	3.19665	3.19670	-0.05
28	802.8101	3.40168	3.40119	0.50

Order of Fit = 9 RMS error of fit = .56 mK
Largest absolute error = -1.25 mK at data point no. 19

POLYNOMIAL EQUATION

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

3.03K	to	20.1K
882.7 Ohms	to	253.8 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.37333792165 ZU = 3.00525886437

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.609909	4.4622E-04	21536.28
1	-9.417607	6.9526E-04	-13545.36
2	2.976854	6.7918E-04	4383.03
3	-0.651644	6.0359E-04	-1079.62
4	0.087104	5.8755E-04	148.25

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 4
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	1012.183	2.60179	2.60462	-2.82
25	946.1808	2.80424	2.80206	2.18
26	882.6824	3.03708	3.03441	2.67
27	845.1664	3.19665	3.19502	1.63
28	802.8101	3.40168	3.40127	0.41
29	766.3189	3.60326	3.60396	-0.70
30	734.8061	3.79938	3.80110	-1.72
31	704.1732	4.01398	4.01594	-1.96
32	679.2399	4.20802	4.21056	-2.54
33	631.4037	4.64456	4.64471	-0.15
34	594.1311	5.05204	5.05268	-0.64
35	555.3940	5.56359	5.56169	1.90
36	511.5546	6.27944	6.27698	2.46
37	472.1349	7.09306	7.09244	0.62
38	433.2687	8.11839	8.11901	-0.62
39	402.4222	9.15072	9.14939	1.33
40	377.1849	10.18242	10.18213	0.29
41	356.2538	11.20429	11.20484	-0.55
42	338.5500	12.21396	12.21599	-2.03
43	323.3215	13.21678	13.21548	1.31
44	309.8541	14.21390	14.21800	-4.10
45	298.0566	15.20255	15.20300	-0.45
46	287.5249	16.18154	16.17937	2.17
47	277.9414	17.15758	17.15841	-0.83
48	269.2529	18.13204	18.13016	1.88
49	261.2177	19.10776	19.10859	-0.82
50	253.8326	20.08313	20.08299	0.15
51	246.3055	21.16266	21.15827	4.38
52	236.2316	22.73966	22.74312	-3.46

Order of Fit = 4 RMS error of fit = 1.97 mK
Largest absolute error = 4.38 mK at data point no. 51

POLYNOMIAL EQUATION

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.1K	to	95.2K
253.8 Ohms	to	97.87 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.94874834531 ZU = 2.43016046746

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	55.090417	1.1599E-03	47494.38
1	-44.983680	1.8734E-03	-24012.30
2	9.084709	1.7435E-03	5210.74
3	-1.161413	1.6322E-03	-711.57
4	0.094305	1.5066E-03	62.60
5	0.009062	1.4960E-03	6.06

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	269.2529	18.13016	18.13340	-3.24
49	261.2177	19.10859	19.10918	-0.59
50	253.8326	20.08299	20.08239	0.60
51	246.3055	21.16266	21.15649	6.16
52	236.2316	22.73966	22.73780	1.86
53	227.0359	24.34594	24.34279	3.15
54	218.3797	26.01210	26.01404	-1.94
55	210.5294	27.67688	27.68249	-5.62
56	203.4335	29.33272	29.33211	0.61
57	196.1548	31.17818	31.18203	-3.85
58	188.5305	33.30630	33.31451	-8.21
59	178.9302	36.33227	36.32871	3.56
60	170.5018	39.33118	39.33130	-0.12
61	163.0352	42.32768	42.32136	6.32
62	156.3292	45.32245	45.31654	5.91
63	150.2742	48.31677	48.31298	3.78
64	146.5618	50.30958	50.30529	4.29
65	138.1748	55.29822	55.30760	-9.38
66	130.9076	60.29882	60.30120	-2.38
67	124.5312	65.29183	65.29016	1.66
68	118.8590	70.28600	70.29440	-8.40
69	113.8105	75.26645	75.27317	-6.72
70	109.2560	80.26063	80.25544	5.19
71	105.1164	85.25488	85.24615	8.73
72	101.3369	90.24498	90.23930	5.68
73	97.86554	95.23693	95.23911	-2.17
74	94.67324	100.22276	100.22832	-5.56
75	88.86860	110.40611	110.40546	0.65

Order of Fit = 5 RMS error of fit = 4.94 mK
Largest absolute error = -9.38 mK at data point no. 65

POLYNOMIAL EQUATION

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

95.2K	to	325.K
97.87 Ohms	to	42.98 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.62879098094 ZU = 2.02167045176

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	187.677055	2.5176E-03	74546.98
1	-119.615154	3.8387E-03	-31159.94
2	19.517283	3.6254E-03	5383.47
3	-2.779361	3.6160E-03	-768.63
4	0.528372	3.4997E-03	150.98
5	-0.096877	3.3588E-03	-28.84
6	0.020062	3.2665E-03	6.14

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 6
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	105.1164	85.24615	85.25138	-5.23
72	101.3369	90.23930	90.23243	6.86
73	97.86554	95.23911	95.23279	6.31
74	94.67324	100.22276	100.22696	-4.20
75	88.86860	110.40611	110.41450	-8.39
76	84.01991	120.20810	120.20831	-0.21
77	79.66624	130.20634	130.20382	2.52
78	75.80600	140.20193	140.20218	-0.25
79	72.36201	150.19525	150.19003	5.23
80	69.26297	160.18738	160.18854	-1.16
81	66.46425	170.18598	170.17794	8.03
82	63.91621	180.19380	180.19071	3.09
83	61.59312	190.18924	190.19865	-9.42
84	59.46669	200.19184	200.20279	-10.95
85	57.51368	210.19932	210.20269	-3.37
86	55.71367	220.19832	220.20275	-4.43
87	54.05161	230.20022	230.19373	6.49
88	52.51062	240.20294	240.19173	11.21
89	51.07956	250.19343	250.19048	2.95
90	49.74619	260.20235	260.20237	-0.02
91	48.50726	270.19729	270.17927	18.02
92	47.34289	280.20179	280.21746	-15.67
93	46.25885	290.18774	290.20525	-17.51
94	45.24205	300.20633	300.19878	7.55
95	44.28528	310.20487	310.21449	-9.62
96	43.82774	315.21772	315.23213	-14.40
97	43.38935	320.22253	320.18750	35.03
98	42.87554	326.19566	326.18894	6.72
99	42.53936	330.21897	330.23416	-15.20

Order of Fit = 6 RMS error of fit = 10.93 mK
Largest absolute error = 35.03 mK at data point no. 97

INTERPOLATION TABLE

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	54203.4	-6.8917e+5	-3.8144	48.00	150.879	-1.9425	-0.61796
0.4000	21165.4	-1.5570e+5	-2.9426	49.00	148.968	-1.8812	-0.61878
0.5000	11632.0	-56588.	-2.4324	50.00	147.116	-1.8230	-0.61957
0.6000	7699.17	-27063.	-2.1090	51.00	145.321	-1.7676	-0.62035
0.7000	5657.34	-15313.	-1.8947	52.00	143.580	-1.7149	-0.62108
0.8000	4441.46	-9622.3	-1.7332	53.00	141.890	-1.6646	-0.62178
0.9000	3649.04	-6513.3	-1.6064	54.00	140.250	-1.6167	-0.62246
1.000	3097.73	-4660.7	-1.5046	55.00	138.656	-1.5710	-0.62316
2.000	1306.93	-675.05	-1.0330	56.00	137.107	-1.5274	-0.62387
3.000	891.417	-257.85	-0.86777	57.00	135.600	-1.4857	-0.62454
4.000	706.327	-135.71	-0.76856	58.00	134.135	-1.4458	-0.62518
4.200	680.531	-122.60	-0.75662	59.00	132.708	-1.4076	-0.62582
5.000	598.595	-85.652	-0.71544	60.00	131.319	-1.3711	-0.62646
6.000	527.304	-59.440	-0.67634	61.00	129.965	-1.3361	-0.62711
7.000	476.160	-44.084	-0.64807	62.00	128.646	-1.3025	-0.62774
8.000	437.296	-34.305	-0.62758	63.00	127.360	-1.2703	-0.62835
9.000	406.497	-27.680	-0.61286	64.00	126.105	-1.2393	-0.62895
10.00	381.300	-22.956	-0.60204	65.00	124.881	-1.2096	-0.62957
11.00	360.176	-19.454	-0.59412	66.00	123.686	-1.1810	-0.63020
12.00	342.119	-16.772	-0.58830	67.00	122.519	-1.1535	-0.63080
13.00	326.439	-14.666	-0.58407	68.00	121.378	-1.1270	-0.63140
14.00	312.647	-12.976	-0.58103	69.00	120.264	-1.1015	-0.63199
15.00	300.385	-11.593	-0.57893	70.00	119.175	-1.0770	-0.63260
16.00	289.382	-10.446	-0.57755	71.00	118.110	-1.0534	-0.63321
17.00	279.432	-9.4803	-0.57676	72.00	117.068	-1.0305	-0.63381
18.00	270.373	-8.6579	-0.57640	73.00	116.049	-1.0085	-0.63440
19.00	262.077	-7.9527	-0.57655	74.00	115.051	-0.98725	-0.63499
20.00	254.436	-7.3438	-0.57726	75.00	114.074	-0.96672	-0.63559
21.00	247.365	-6.8095	-0.57809	76.00	113.117	-0.94690	-0.63619
22.00	240.794	-6.3415	-0.57939	77.00	112.180	-0.92773	-0.63679
23.00	234.664	-5.9288	-0.58110	77.35	111.856	-0.92117	-0.63700
24.00	228.922	-5.5610	-0.58301	78.00	111.261	-0.90920	-0.63739
25.00	223.529	-5.2313	-0.58508	79.00	110.361	-0.89128	-0.63800
26.00	218.449	-4.9333	-0.58717	80.00	109.479	-0.87395	-0.63863
27.00	213.653	-4.6629	-0.58927	81.00	108.613	-0.85719	-0.63926
28.00	209.115	-4.4164	-0.59134	82.00	107.764	-0.84090	-0.63986
29.00	204.813	-4.1905	-0.59334	83.00	106.931	-0.82509	-0.64043
30.00	200.728	-3.9830	-0.59528	84.00	106.114	-0.80972	-0.64098
31.00	196.842	-3.7916	-0.59713	85.00	105.312	-0.79480	-0.64151
32.00	193.140	-3.6148	-0.59892	86.00	104.524	-0.78035	-0.64205
33.00	189.608	-3.4509	-0.60060	87.00	103.751	-0.76642	-0.64268
34.00	186.234	-3.2987	-0.60223	88.00	102.991	-0.75301	-0.64340
35.00	183.007	-3.1568	-0.60373	89.00	102.245	-0.74010	-0.64423
36.00	179.917	-3.0244	-0.60516	90.00	101.511	-0.72768	-0.64517
37.00	176.955	-2.9009	-0.60656	91.00	100.789	-0.71564	-0.64614
38.00	174.113	-2.7851	-0.60785	92.00	100.079	-0.70374	-0.64693
39.00	171.383	-2.6766	-0.60908	93.00	99.3815	-0.69195	-0.64752
40.00	168.758	-2.5747	-0.61027	94.00	98.6954	-0.68029	-0.64792
41.00	166.231	-2.4788	-0.61138	95.00	98.0209	-0.66874	-0.64813
42.00	163.798	-2.3885	-0.61244	96.00	97.3579	-0.65740	-0.64823
43.00	161.453	-2.3034	-0.61347	97.00	96.7060	-0.64648	-0.64844
44.00	159.190	-2.2230	-0.61444	98.00	96.0648	-0.63598	-0.64879
45.00	157.005	-2.1470	-0.61537	99.00	95.4339	-0.62590	-0.64928
46.00	154.894	-2.0752	-0.61628	100.0	94.8129	-0.61621	-0.64993
47.00	152.854	-2.0071	-0.61714	101.0	94.2013	-0.60687	-0.65067

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INTERPOLATION TABLE

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	93.5990	-0.59775	-0.65140	157.0	70.2167	-0.30400	-0.67973
103.0	93.0058	-0.58883	-0.65211	158.0	69.9142	-0.30091	-0.68002
104.0	92.4213	-0.58012	-0.65280	159.0	69.6149	-0.29786	-0.68030
105.0	91.8455	-0.57162	-0.65349	160.0	69.3185	-0.29486	-0.68058
106.0	91.2780	-0.56331	-0.65416	161.0	69.0251	-0.29190	-0.68085
107.0	90.7188	-0.55519	-0.65483	162.0	68.7347	-0.28899	-0.68111
108.0	90.1676	-0.54726	-0.65549	163.0	68.4471	-0.28612	-0.68136
109.0	89.6242	-0.53952	-0.65616	164.0	68.1624	-0.28329	-0.68160
110.0	89.0885	-0.53196	-0.65682	165.0	67.8806	-0.28051	-0.68184
111.0	88.5602	-0.52457	-0.65749	166.0	67.6014	-0.27776	-0.68206
112.0	88.0393	-0.51734	-0.65814	167.0	67.3250	-0.27506	-0.68228
113.0	87.5255	-0.51027	-0.65879	168.0	67.0513	-0.27239	-0.68249
114.0	87.0187	-0.50335	-0.65942	169.0	66.7802	-0.26977	-0.68269
115.0	86.5187	-0.49658	-0.66005	170.0	66.5118	-0.26718	-0.68289
116.0	86.0255	-0.48995	-0.66067	171.0	66.2459	-0.26463	-0.68309
117.0	85.5388	-0.48347	-0.66129	172.0	65.9825	-0.26212	-0.68327
118.0	85.0585	-0.47712	-0.66190	173.0	65.7216	-0.25964	-0.68344
119.0	84.5845	-0.47092	-0.66252	174.0	65.4632	-0.25719	-0.68361
120.0	84.1166	-0.46485	-0.66314	175.0	65.2072	-0.25478	-0.68377
121.0	83.6547	-0.45890	-0.66377	176.0	64.9536	-0.25240	-0.68392
122.0	83.1988	-0.45307	-0.66437	177.0	64.7024	-0.25006	-0.68406
123.0	82.7486	-0.44735	-0.66496	178.0	64.4535	-0.24775	-0.68419
124.0	82.3040	-0.44175	-0.66554	179.0	64.2069	-0.24547	-0.68432
125.0	81.8650	-0.43624	-0.66610	180.0	63.9626	-0.24322	-0.68445
126.0	81.4315	-0.43085	-0.66666	181.0	63.7205	-0.24100	-0.68457
127.0	81.0033	-0.42556	-0.66721	182.0	63.4805	-0.23881	-0.68468
128.0	80.5804	-0.42037	-0.66775	183.0	63.2428	-0.23665	-0.68478
129.0	80.1625	-0.41528	-0.66828	184.0	63.0072	-0.23452	-0.68487
130.0	79.7498	-0.41029	-0.66881	185.0	62.7738	-0.23242	-0.68495
131.0	79.3419	-0.40539	-0.66934	186.0	62.5424	-0.23034	-0.68503
132.0	78.9389	-0.40058	-0.66985	187.0	62.3131	-0.22829	-0.68510
133.0	78.5407	-0.39586	-0.67034	188.0	62.0858	-0.22627	-0.68516
134.0	78.1472	-0.39122	-0.67083	189.0	61.8605	-0.22427	-0.68522
135.0	77.7583	-0.38666	-0.67131	190.0	61.6372	-0.22231	-0.68527
136.0	77.3738	-0.38219	-0.67177	191.0	61.4159	-0.22036	-0.68531
137.0	76.9939	-0.37779	-0.67223	192.0	61.1965	-0.21844	-0.68535
138.0	76.6182	-0.37348	-0.67268	193.0	60.9790	-0.21655	-0.68538
139.0	76.2469	-0.36924	-0.67313	194.0	60.7634	-0.21468	-0.68540
140.0	75.8797	-0.36508	-0.67358	195.0	60.5497	-0.21283	-0.68541
141.0	75.5167	-0.36099	-0.67401	196.0	60.3377	-0.21100	-0.68541
142.0	75.1577	-0.35697	-0.67444	197.0	60.1276	-0.20920	-0.68541
143.0	74.8027	-0.35301	-0.67485	198.0	59.9193	-0.20742	-0.68540
144.0	74.4517	-0.34912	-0.67525	199.0	59.7128	-0.20566	-0.68539
145.0	74.1045	-0.34530	-0.67564	200.0	59.5080	-0.20392	-0.68537
146.0	73.7611	-0.34154	-0.67602	201.0	59.3049	-0.20221	-0.68534
147.0	73.4214	-0.33784	-0.67640	202.0	59.1036	-0.20052	-0.68531
148.0	73.0854	-0.33420	-0.67677	203.0	58.9039	-0.19884	-0.68526
149.0	72.7530	-0.33063	-0.67713	204.0	58.7059	-0.19719	-0.68521
150.0	72.4241	-0.32711	-0.67749	205.0	58.5095	-0.19555	-0.68515
151.0	72.0987	-0.32365	-0.67784	206.0	58.3148	-0.19394	-0.68509
152.0	71.7768	-0.32025	-0.67818	207.0	58.1217	-0.19234	-0.68502
153.0	71.4582	-0.31690	-0.67851	208.0	57.9301	-0.19076	-0.68494
154.0	71.1430	-0.31360	-0.67883	209.0	57.7401	-0.18920	-0.68485
155.0	70.8310	-0.31035	-0.67914	210.0	57.5517	-0.18766	-0.68476
156.0	70.5223	-0.30715	-0.67944	211.0	57.3648	-0.18614	-0.68467

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INTERPOLATION TABLE

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	57.1794	-0.18464	-0.68456	267.0	48.8928	-0.12261	-0.66955
213.0	56.9955	-0.18315	-0.68445	268.0	48.7707	-0.12177	-0.66914
214.0	56.8131	-0.18168	-0.68433	269.0	48.6493	-0.12094	-0.66872
215.0	56.6321	-0.18022	-0.68421	270.0	48.5288	-0.12012	-0.66829
216.0	56.4526	-0.17879	-0.68408	271.0	48.4091	-0.11930	-0.66787
217.0	56.2746	-0.17737	-0.68394	272.0	48.2902	-0.11849	-0.66744
218.0	56.0979	-0.17596	-0.68379	273.0	48.1721	-0.11770	-0.66700
219.0	55.9226	-0.17457	-0.68364	274.0	48.0548	-0.11690	-0.66656
220.0	55.7488	-0.17320	-0.68348	275.0	47.9383	-0.11612	-0.66612
221.0	55.5762	-0.17184	-0.68332	276.0	47.8225	-0.11534	-0.66567
222.0	55.4051	-0.17050	-0.68315	277.0	47.7076	-0.11457	-0.66522
223.0	55.2352	-0.16917	-0.68298	278.0	47.5934	-0.11381	-0.66477
224.0	55.0667	-0.16785	-0.68279	279.0	47.4800	-0.11305	-0.66431
225.0	54.8995	-0.16655	-0.68260	280.0	47.3673	-0.11230	-0.66385
226.0	54.7336	-0.16527	-0.68240	281.0	47.2554	-0.11156	-0.66339
227.0	54.5690	-0.16400	-0.68220	282.0	47.1442	-0.11083	-0.66292
228.0	54.4056	-0.16274	-0.68199	283.0	47.0337	-0.11010	-0.66245
229.0	54.2435	-0.16149	-0.68178	284.0	46.9240	-0.10938	-0.66198
230.0	54.0826	-0.16026	-0.68156	285.0	46.8150	-0.10866	-0.66150
231.0	53.9230	-0.15905	-0.68133	286.0	46.7066	-0.10795	-0.66102
232.0	53.7645	-0.15784	-0.68110	287.0	46.5991	-0.10725	-0.66054
233.0	53.6073	-0.15665	-0.68086	288.0	46.4922	-0.10655	-0.66005
234.0	53.4512	-0.15547	-0.68062	289.0	46.3859	-0.10586	-0.65956
235.0	53.2964	-0.15430	-0.68037	290.0	46.2804	-0.10518	-0.65907
236.0	53.1426	-0.15315	-0.68011	291.0	46.1756	-0.10450	-0.65858
237.0	52.9901	-0.15200	-0.67985	292.0	46.0714	-0.10383	-0.65808
238.0	52.8386	-0.15087	-0.67958	293.0	45.9679	-0.10317	-0.65758
239.0	52.6883	-0.14976	-0.67931	294.0	45.8651	-0.10251	-0.65708
240.0	52.5391	-0.14865	-0.67903	295.0	45.7629	-0.10185	-0.65657
241.0	52.3910	-0.14755	-0.67875	296.0	45.6614	-0.10121	-0.65606
242.0	52.2440	-0.14647	-0.67846	297.0	45.5605	-0.10056	-0.65555
243.0	52.0981	-0.14539	-0.67816	298.0	45.4602	-9.9927e-2	-0.65504
244.0	51.9532	-0.14433	-0.67786	299.0	45.3606	-9.9297e-2	-0.65453
245.0	51.8094	-0.14328	-0.67755	300.0	45.2617	-9.8672e-2	-0.65401
246.0	51.6666	-0.14224	-0.67724	301.0	45.1633	-9.8052e-2	-0.65349
247.0	51.5249	-0.14121	-0.67692	302.0	45.0655	-9.7438e-2	-0.65297
248.0	51.3842	-0.14019	-0.67660	303.0	44.9684	-9.6830e-2	-0.65244
249.0	51.2445	-0.13918	-0.67627	304.0	44.8719	-9.6226e-2	-0.65192
250.0	51.1059	-0.13818	-0.67594	305.0	44.7760	-9.5628e-2	-0.65139
251.0	50.9682	-0.13719	-0.67560	306.0	44.6806	-9.5035e-2	-0.65086
252.0	50.8315	-0.13621	-0.67526	307.0	44.5859	-9.4448e-2	-0.65033
253.0	50.6958	-0.13524	-0.67491	308.0	44.4917	-9.3865e-2	-0.64979
254.0	50.5610	-0.13428	-0.67456	309.0	44.3982	-9.3287e-2	-0.64926
255.0	50.4272	-0.13333	-0.67420	310.0	44.3052	-9.2715e-2	-0.64872
256.0	50.2943	-0.13238	-0.67384	311.0	44.2127	-9.2147e-2	-0.64818
257.0	50.1624	-0.13145	-0.67347	312.0	44.1209	-9.1585e-2	-0.64764
258.0	50.0314	-0.13053	-0.67310	313.0	44.0296	-9.1027e-2	-0.64710
259.0	49.9014	-0.12961	-0.67272	314.0	43.9388	-9.0474e-2	-0.64655
260.0	49.7722	-0.12871	-0.67234	315.0	43.8486	-8.9926e-2	-0.64601
261.0	49.6440	-0.12781	-0.67196	316.0	43.7589	-8.9382e-2	-0.64546
262.0	49.5166	-0.12692	-0.67157	317.0	43.6698	-8.8843e-2	-0.64491
263.0	49.3901	-0.12604	-0.67117	318.0	43.5813	-8.8308e-2	-0.64436
264.0	49.2645	-0.12517	-0.67077	319.0	43.4932	-8.7778e-2	-0.64381
265.0	49.1398	-0.12431	-0.67037	320.0	43.4057	-8.7253e-2	-0.64326
266.0	49.0159	-0.12345	-0.66996	321.0	43.3187	-8.6732e-2	-0.64270

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INTERPOLATION TABLE

Calibration Report: 431319
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29578
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
322.0	43.2322	-8.6216e-2	-0.64215				
323.0	43.1463	-8.5703e-2	-0.64159				
324.0	43.0608	-8.5196e-2	-0.64103				
325.0	42.9759	-8.4692e-2	-0.64047				

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BREAKPOINTS 340 FORMAT

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29578
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.63321,325.000	Point 56: 2.04105, 79.500	Point 111: 2.61198, 8.900	Point 166: 4.07827, 0.494
Point 2: 1.63841,319.000	Point 57: 2.04990, 77.000	Point 112: 2.62431, 8.500	Point 167: 4.11852, 0.476
Point 3: 1.64329,313.500	Point 58: 2.05718, 75.000	Point 113: 2.63734, 8.100	Point 168: 4.16168, 0.458
Point 4: 1.64827,308.000	Point 59: 2.06463, 73.000	Point 114: 2.65117, 7.700	Point 169: 4.20289, 0.442
Point 5: 1.65337,302.500	Point 60: 2.07227, 71.000	Point 115: 2.66593, 7.300	Point 170: 4.24690, 0.426
Point 6: 1.65858,297.000	Point 61: 2.08012, 69.000	Point 116: 2.67972, 6.950	Point 171: 4.29413, 0.410
Point 7: 1.66391,291.500	Point 62: 2.08819, 67.000	Point 117: 2.69437, 6.600	Point 172: 4.34479, 0.394
Point 8: 1.66937,286.000	Point 63: 2.09648, 65.000	Point 118: 2.71006, 6.250	Point 173: 4.39913, 0.378
Point 9: 1.67495,280.500	Point 64: 2.10502, 63.000	Point 119: 2.72693, 5.900	Point 174: 4.45741, 0.362
Point 10: 1.68067,275.000	Point 65: 2.11381, 61.000	Point 120: 2.74351, 5.580	Point 175: 4.51993, 0.346
Point 11: 1.68653,269.500	Point 66: 2.12288, 59.000	Point 121: 2.76139, 5.260	Point 176: 4.58723, 0.330
Point 12: 1.69252,264.000	Point 67: 2.13224, 57.000	Point 122: 2.77952, 4.960	Point 177: 4.65096, 0.316
Point 13: 1.69810,259.000	Point 68: 2.14094, 55.200	Point 123: 2.79913, 4.660	Point 178: 4.71180, 0.304
Point 14: 1.70381,254.000	Point 69: 2.14990, 53.400	Point 124: 2.81903, 4.380	Point 179: 4.72306, 0.302
Point 15: 1.70964,249.000	Point 70: 2.15915, 51.600	Point 125: 2.84064, 4.100	Point 180: 4.73403, 0.300
Point 16: 1.71560,244.000	Point 71: 2.16871, 49.800	Point 126: 2.85914, 3.880	Point 181: 4.73403, 0.300
Point 17: 1.72170,239.000	Point 72: 2.17860, 48.000	Point 127: 2.87620, 3.690	
Point 18: 1.72795,234.000	Point 73: 2.18885, 46.200	Point 128: 2.89349, 3.510	
Point 19: 1.73434,229.000	Point 74: 2.19947, 44.400	Point 129: 2.91095, 3.340	
Point 20: 1.74088,224.000	Point 75: 2.20926, 42.800	Point 130: 2.92968, 3.170	
Point 21: 1.74758,219.000	Point 76: 2.21939, 41.200	Point 131: 2.94625, 3.030	
Point 22: 1.75444,214.000	Point 77: 2.23057, 39.500	Point 132: 2.96554, 2.880	
Point 23: 1.76146,209.000	Point 78: 2.24149, 37.900	Point 133: 2.98912, 2.710	
Point 24: 1.76867,204.000	Point 79: 2.25286, 36.300	Point 134: 3.01155, 2.560	
Point 25: 1.77605,199.000	Point 80: 2.26394, 34.800	Point 135: 3.03435, 2.420	
Point 26: 1.78363,194.000	Point 81: 2.27546, 33.300	Point 136: 3.05910, 2.280	
Point 27: 1.79140,189.000	Point 82: 2.28746, 31.800	Point 137: 3.08420, 2.150	
Point 28: 1.79937,184.000	Point 83: 2.29915, 30.400	Point 138: 3.11159, 2.020	
Point 29: 1.80674,179.500	Point 84: 2.31132, 29.000	Point 139: 3.14174, 1.890	
Point 30: 1.81428,175.000	Point 85: 2.32403, 27.600	Point 140: 3.17250, 1.770	
Point 31: 1.82201,170.500	Point 86: 2.33638, 26.300	Point 141: 3.20649, 1.650	
Point 32: 1.82994,166.000	Point 87: 2.34929, 25.000	Point 142: 3.24120, 1.540	
Point 33: 1.83807,161.500	Point 88: 2.36282, 23.700	Point 143: 3.27980, 1.430	
Point 34: 1.84642,157.000	Point 89: 2.37594, 22.500	Point 144: 3.31922, 1.330	
Point 35: 1.85500,152.500	Point 90: 2.38972, 21.300	Point 145: 3.36334, 1.230	
Point 36: 1.86381,148.000	Point 91: 2.40303, 20.200	Point 146: 3.39306, 1.170	
Point 37: 1.87288,143.500	Point 92: 2.41319, 19.400	Point 147: 3.41396, 1.130	
Point 38: 1.88220,139.000	Point 93: 2.42239, 18.700	Point 148: 3.43608, 1.090	
Point 39: 1.89181,134.500	Point 94: 2.43125, 18.050	Point 149: 3.45953, 1.050	
Point 40: 1.90060,130.500	Point 95: 2.44042, 17.400	Point 150: 3.48445, 1.010	
Point 41: 1.90963,126.500	Point 96: 2.44996, 16.750	Point 151: 3.51100, 0.970	
Point 42: 1.91892,122.500	Point 97: 2.45911, 16.150	Point 152: 3.53939, 0.930	
Point 43: 1.92848,118.500	Point 98: 2.46860, 15.550	Point 153: 3.56596, 0.895	
Point 44: 1.93834,114.500	Point 99: 2.47849, 14.950	Point 154: 3.59422, 0.860	
Point 45: 1.94850,110.500	Point 100: 2.48879, 14.350	Point 155: 3.62445, 0.825	
Point 46: 1.95900,106.500	Point 101: 2.49866, 13.800	Point 156: 3.65686, 0.790	
Point 47: 1.96986,102.500	Point 102: 2.50894, 13.250	Point 157: 3.69175, 0.755	
Point 48: 1.97827, 99.500	Point 103: 2.51969, 12.700	Point 158: 3.72943, 0.720	
Point 49: 1.98544, 97.000	Point 104: 2.52993, 12.200	Point 159: 3.76436, 0.690	
Point 50: 1.99279, 94.500	Point 105: 2.54061, 11.700	Point 160: 3.80179, 0.660	
Point 51: 2.00033, 92.000	Point 106: 2.55183, 11.200	Point 161: 3.84228, 0.630	
Point 52: 2.00806, 89.500	Point 107: 2.56362, 10.700	Point 162: 3.88618, 0.600	
Point 53: 2.01598, 87.000	Point 108: 2.57479, 10.250	Point 163: 3.93402, 0.570	
Point 54: 2.02410, 84.500	Point 109: 2.58651, 9.800	Point 164: 3.98653, 0.540	
Point 55: 2.03246, 82.000	Point 110: 2.59889, 9.350	Point 165: 4.03458, 0.515	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 53

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.63322	325.0	31	2.65124	7.7
2	1.63408	324.0	32	2.70328	6.4
3	1.64736	309.0	33	2.75351	5.4
4	1.66148	294.0	34	2.80339	4.6
5	1.67651	279.0	35	2.84901	4.0
6	1.69253	264.0	36	2.89457	3.5
7	1.70965	249.0	37	2.92638	3.2
8	1.72796	234.0	38	2.96300	2.9
9	1.74759	219.0	39	3.02124	2.5
10	1.76868	204.0	40	3.09462	2.1
11	1.79141	189.0	41	3.16476	1.8
12	1.81600	174.0	42	3.22211	1.6
13	1.84270	159.0	43	3.29152	1.4
14	1.87187	144.0	44	3.33225	1.3
15	1.90397	129.0	45	3.37817	1.2
16	1.93961	114.0	46	3.43052	1.1
17	1.97970	99.0	47	3.49104	1.0
18	2.02577	84.0	48	3.56218	.9
19	2.08014	69.0	49	3.64753	.8
20	2.12060	59.5	50	3.75261	.7
21	2.16766	50.0	51	3.88644	.6
22	2.19591	45.0	52	4.32563	.4
23	2.22726	40.0	53	4.73403	.3
24	2.26247	35.0			
25	2.30261	30.0			
26	2.34933	25.0			
27	2.40558	20.0			
28	2.47768	15.0			
29	2.54065	11.7			
30	2.59473	9.5			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	92.103
1000	2.636
10000	0.532

BREAKPOINTS 234 FORMAT

Calibration Report: 431319 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29578
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.005K
10 - 20K:	0.010K
20 - 40K:	0.016K
40 - 100K:	0.035K
> 100K:	0.139K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	317.206	43.65158	1.640	56	5.648	549.5409	2.740
2	295.533	45.70882	1.660	57	5.286	575.4399	2.760
3	275.652	47.86301	1.680	58	4.954	602.5596	2.780
4	257.329	50.11872	1.700	59	4.649	630.9573	2.800
5	240.393	52.48075	1.720	60	4.368	660.6934	2.820
6	224.672	54.95409	1.740	61	4.110	691.8310	2.840
7	210.041	57.54399	1.760	62	3.871	724.4360	2.860
8	196.386	60.25596	1.780	63	3.650	758.5776	2.880
9	183.623	63.09573	1.800	64	3.446	794.3282	2.900
10	171.670	66.06934	1.820	65	3.257	831.7638	2.920
11	160.460	69.18310	1.840	66	3.083	870.9636	2.940
12	149.941	72.44360	1.860	67	2.923	912.0108	2.960
13	140.060	75.85776	1.880	68	2.775	954.9926	2.980
14	130.776	79.43282	1.900	69	2.637	1000.000	3.000
15	122.050	83.17638	1.920	70	2.388	1096.478	3.040
16	113.845	87.09636	1.940	71	2.172	1202.264	3.080
17	106.134	91.20108	1.960	72	1.983	1318.257	3.120
18	98.896	95.49926	1.980	73	1.818	1445.440	3.160
19	92.113	100.0000	2.000	74	1.673	1584.893	3.200
20	85.759	104.7129	2.020	75	1.544	1737.801	3.240
21	79.807	109.6478	2.040	76	1.430	1905.461	3.280
22	74.238	114.8154	2.060	77	1.329	2089.296	3.320
23	69.034	120.2264	2.080	78	1.238	2290.868	3.360
24	64.174	125.8925	2.100	79	1.157	2511.886	3.400
25	59.632	131.8257	2.120	80	1.083	2754.229	3.440
26	55.395	138.0384	2.140	81	1.017	3019.952	3.480
27	51.443	144.5440	2.160	82	0.957	3311.311	3.520
28	47.755	151.3561	2.180	83	0.903	3630.781	3.560
29	44.318	158.4893	2.200	84	0.853	3981.072	3.600
30	41.110	165.9587	2.220	85	0.808	4365.158	3.640
31	38.120	173.7801	2.240	86	0.767	4786.301	3.680
32	35.332	181.9701	2.260	87	0.729	5248.075	3.720
33	32.728	190.5461	2.280	88	0.694	5754.399	3.760
34	30.305	199.5262	2.300	89	0.662	6309.573	3.800
35	28.042	208.9296	2.320	90	0.632	6918.310	3.840
36	25.934	218.7762	2.340	91	0.604	7585.776	3.880
37	23.970	229.0868	2.360	92	0.579	8317.638	3.920
38	22.145	239.8833	2.380	93	0.555	9120.108	3.960
39	20.450	251.1886	2.400	94	0.533	10000.00	4.000
40	18.881	263.0268	2.420	95	0.484	12589.25	4.100
41	17.431	275.4229	2.440	96	0.443	15848.93	4.200
42	16.094	288.4032	2.460	97	0.408	19952.62	4.300
43	14.861	301.9952	2.480	98	0.378	25118.86	4.400
44	13.728	316.2278	2.500	99	0.351	31622.78	4.500
45	12.687	331.1311	2.520	100	0.327	39810.72	4.600
46	11.729	346.7369	2.540	101	0.306	50118.72	4.700
47	10.853	363.0781	2.560	102	0.288	63095.73	4.800
48	10.049	380.1894	2.580	103	0.272	79432.82	4.900
49	9.313	398.1072	2.600				
50	8.639	416.8694	2.620				
51	8.023	436.5158	2.640				
52	7.459	457.0882	2.660				
53	6.944	478.6301	2.680				
54	6.473	501.1872	2.700				
55	6.043	524.8075	2.720				

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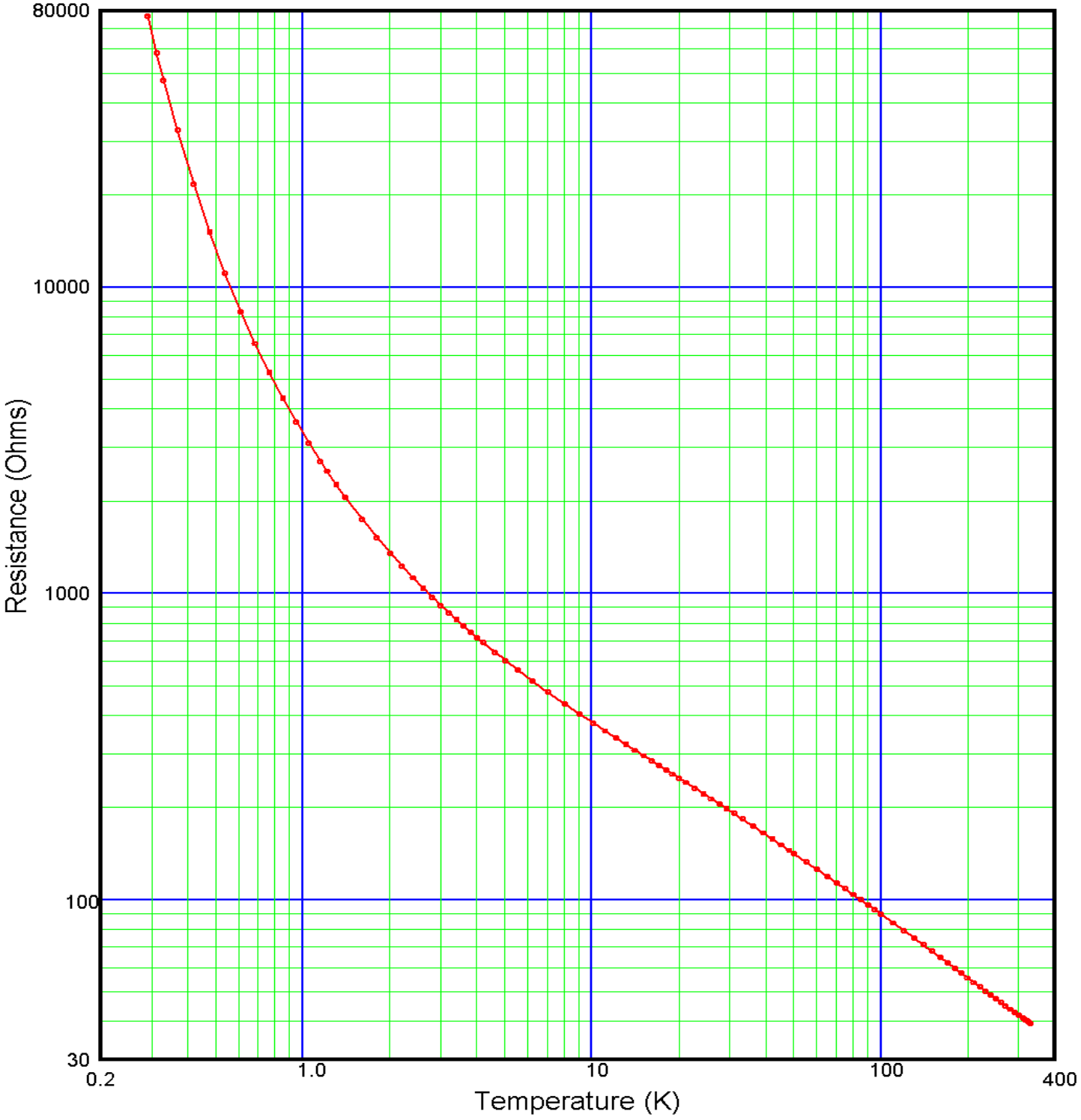
DATA PLOT

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%



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TEST DATA

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.289832	76944.0	51	22.7140	231.238
2	0.311361	58244.0	52	24.3157	221.886
3	0.329303	47387.2	53	25.9541	213.321
4	0.368663	32567.2	54	27.5947	205.471
5	0.419381	21730.9	55	29.2181	198.384
6	0.475569	15144.4	56	31.0427	191.104
7	0.536848	11131.7	57	33.1615	183.424
8	0.609863	8306.60	58	36.1769	173.717
9	0.683047	6553.20	59	39.1708	165.229
10	0.765198	5263.67	60	42.1733	157.683
11	0.853037	4332.96	61	45.1741	150.952
12	0.948409	3631.14	62	48.1704	144.864
13	1.04914	3096.86	63	50.1668	141.141
14	1.14958	2702.28	64	55.1532	132.762
15	1.21269	2508.76	65	60.1480	125.520
16	1.30499	2263.90	66	65.1524	119.146
17	1.40017	2062.37	67	70.1500	113.534
18	1.60140	1745.87	68	75.1531	108.494
19	1.80301	1521.77	69	80.1449	104.005
20	2.00434	1355.10	70	85.1372	99.9223
21	2.20020	1229.26	71	90.1313	96.1957
22	2.39984	1126.65	72	95.1213	92.7809
23	2.60489	1040.74	73	100.111	89.6396
24	2.80264	972.121	74	110.211	83.9960
25	2.99823	914.506	75	120.109	79.2089
26	3.20076	863.734	76	130.108	74.9648
27	3.39884	820.350	77	140.109	71.2124
28	3.59802	782.122	78	150.105	67.8676
29	3.80225	747.690	79	160.101	64.8638
30	4.00120	717.597	80	170.096	62.1657
31	4.19961	690.636	81	180.090	59.7101
32	4.62162	641.833	82	190.081	57.4800
33	5.01914	603.307	83	200.070	55.4374
34	5.52096	562.998	84	210.080	53.5664
35	6.24186	516.507	85	220.090	51.8407
36	7.04461	475.592	86	230.095	50.2555
37	8.06127	435.216	87	240.100	48.7844
38	9.08354	403.144	88	250.096	47.4229
39	10.1042	377.034	89	260.086	46.1587
40	11.1169	355.428	90	270.098	44.9790
41	12.1253	337.059	91	280.092	43.8812
42	13.1250	321.241	92	290.096	42.8509
43	14.1239	307.313	93	300.097	41.8904
44	15.1160	295.107	94	310.079	40.9903
45	16.1019	284.110	95	315.085	40.5623
46	17.0852	274.269	96	320.089	40.1463
47	18.0673	265.274	97	325.750	39.6894
48	19.0533	256.944	98	328.416	39.4805
49	20.0398	249.297			
50	21.1270	241.523			

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POLYNOMIAL EQUATION

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

0.300K	to	3.20K
6.648e+4 Ohms	to	863.7 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.8932746022 ZU = 4.88617475973

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.177273	1.7738E-04	6636.89
1	-1.333281	2.7425E-04	-4861.54
2	0.642756	2.5968E-04	2475.22
3	-0.276352	2.5684E-04	-1075.96
4	0.108020	2.4555E-04	439.91
5	-0.040058	2.2934E-04	-174.67
6	0.014164	2.2492E-04	62.97
7	-0.003979	2.3735E-04	-16.76
8	0.001441	2.3273E-04	6.19

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 8
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	76944.00	0.28983	0.28998	-0.15
2	58244.00	0.31136	0.31063	0.73
3	47387.20	0.32930	0.33005	-0.75
4	32567.20	0.36866	0.36883	-0.17
5	21730.90	0.41938	0.41870	0.68
6	15144.40	0.47557	0.47563	-0.06
7	11131.70	0.53685	0.53710	-0.26
8	8306.600	0.60986	0.61019	-0.33
9	6553.200	0.68305	0.68320	-0.15
10	5263.670	0.76520	0.76512	0.08
11	4332.960	0.85304	0.85278	0.26
12	3631.140	0.94841	0.94776	0.65
13	3096.860	1.04914	1.04890	0.24
14	2702.280	1.14958	1.14992	-0.34
15	2508.760	1.21269	1.21162	1.07
16	2263.895	1.30499	1.30582	-0.83
17	2062.373	1.40017	1.40159	-1.43
18	1745.875	1.60140	1.60214	-0.74
19	1521.773	1.80301	1.80271	0.30
20	1355.099	2.00434	2.00339	0.95
21	1229.263	2.20020	2.19910	1.10
22	1126.650	2.39984	2.39914	0.70
23	1040.739	2.60489	2.60516	-0.27
24	972.1208	2.80264	2.80333	-0.69
25	914.5058	2.99823	2.99953	-1.30
26	863.7339	3.20076	3.20081	-0.05
27	820.3499	3.39884	3.39879	0.05
28	782.1222	3.59802	3.59732	0.69

Order of Fit = 8 RMS error of fit = .66 mK
Largest absolute error = -1.43 mK at data point no. 17

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POLYNOMIAL EQUATION

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

3.20K	to	20.0K
863.7 Ohms	to	249.3 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 2.3640594099 ZU = 2.98772023263

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.847764	4.6478E-04	21187.90
1	-9.368625	7.2838E-04	-12862.31
2	2.842211	7.0883E-04	4009.70
3	-0.588039	6.4347E-04	-913.85
4	0.070904	6.1741E-04	114.84
5	0.001625	6.0017E-04	2.71

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	972.1208	2.80333	2.80584	-2.51
25	914.5058	2.99953	2.99771	1.83
26	863.7339	3.20081	3.19835	2.46
27	820.3499	3.39884	3.39751	1.34
28	782.1222	3.59802	3.59805	-0.03
29	747.6904	3.80225	3.80241	-0.16
30	717.5967	4.00120	4.00270	-1.50
31	690.6359	4.19961	4.20220	-2.59
32	641.8330	4.62162	4.62205	-0.42
33	603.3069	5.01914	5.02065	-1.50
34	562.9985	5.52096	5.52094	0.02
35	516.5071	6.24186	6.23942	2.45
36	475.5920	7.04461	7.04379	0.81
37	435.2158	8.06127	8.05924	2.03
38	403.1437	9.08354	9.08215	1.39
39	377.0336	10.10415	10.10498	-0.82
40	355.4276	11.11692	11.11756	-0.65
41	337.0593	12.12530	12.12606	-0.76
42	321.2412	13.12504	13.12669	-1.65
43	307.3131	14.12388	14.12838	-4.50
44	295.1068	15.11596	15.11502	0.93
45	284.1101	16.10193	16.10448	-2.56
46	274.2687	17.08520	17.08232	2.88
47	265.2737	18.06733	18.06238	4.95
48	256.9436	19.05330	19.05253	0.77
49	249.2967	20.03984	20.03940	0.43
50	241.5229	21.12703	21.12770	-0.67
51	231.2381	22.71395	22.71592	-1.96

Order of Fit = 5 RMS error of fit = 2.00 mK
Largest absolute error = 4.95 mK at data point no. 47

POLYNOMIAL EQUATION

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

20.0K	to	95.1K
249.3 Ohms	to	92.78 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.9242583541 ZU = 2.42369422668

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	54.952378	1.3606E-03	40389.05
1	-44.914101	2.1976E-03	-20437.65
2	9.087396	2.0458E-03	4441.95
3	-1.167372	1.9137E-03	-610.01
4	0.097726	1.7664E-03	55.32
5	0.010227	1.7554E-03	5.83

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 5
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
47	265.2737	18.06238	18.06626	-3.88
48	256.9436	19.05253	19.05156	0.97
49	249.2967	20.03940	20.03653	2.88
50	241.5229	21.12703	21.12417	2.86
51	231.2381	22.71395	22.71152	2.43
52	221.8858	24.31573	24.32024	-4.51
53	213.3209	25.95410	25.95094	3.16
54	205.4706	27.59474	27.59579	-1.05
55	198.3840	29.21810	29.22019	-2.09
56	191.1045	31.04271	31.04483	-2.12
57	183.4242	33.16150	33.16488	-3.38
58	173.7169	36.17688	36.17792	-1.04
59	165.2292	39.17082	39.17331	-2.49
60	157.6832	42.17326	42.17313	0.13
61	150.9523	45.17407	45.16375	10.32
62	144.8640	48.17037	48.16647	3.90
63	141.1408	50.16679	50.16107	5.72
64	132.7621	55.15321	55.15890	-5.69
65	125.5204	60.14800	60.14772	0.28
66	119.1456	65.15237	65.16142	-9.04
67	113.5339	70.15003	70.14945	0.57
68	108.4944	75.15314	75.16783	-14.70
69	104.0046	80.14493	80.13778	7.14
70	99.92226	85.13715	85.12570	11.45
71	96.19567	90.13127	90.12320	8.07
72	92.78088	95.12133	95.12324	-1.91
73	89.63957	100.11143	100.12158	-10.16
74	83.99595	110.21089	110.20875	2.15

Order of Fit = 5 RMS error of fit = 5.80 mK
Largest absolute error = -14.70 mK at data point no. 68

POLYNOMIAL EQUATION

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor Sensor Excitation: 2mV±50%
Temperature Range: 0.30K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

95.1K	to	325.K
92.78 Ohms	to	39.75 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.59638230144 ZU = 1.99966225658

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	186.633962	1.8040E-03	103456.92
1	-118.664994	2.7426E-03	-43267.13
2	19.554840	2.5939E-03	7538.68
3	-2.865284	2.5854E-03	-1108.27
4	0.558289	2.5127E-03	222.19
5	-0.105473	2.4005E-03	-43.94
6	0.024501	2.3666E-03	10.35
7	-0.010390	2.3521E-03	-4.42

Z = Log(resistance)

X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(X)), where 0 <= i <= 7
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev
Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
70	99.92226	85.12570	85.12545	0.25
71	96.19567	90.12320	90.12419	-1.00
72	92.78088	95.12324	95.11996	3.28
73	89.63957	100.11143	100.11583	-4.40
74	83.99595	110.21089	110.21044	0.46
75	79.20885	120.10905	120.10441	4.64
76	74.96477	130.10758	130.10923	-1.64
77	71.21240	140.10901	140.10861	0.40
78	67.86755	150.10506	150.10693	-1.87
79	64.86383	160.10098	160.11539	-14.41
80	62.16571	170.09570	170.08114	14.57
81	59.71006	180.09035	180.08782	2.53
82	57.48002	190.08091	190.07177	9.15
83	55.43745	200.06993	200.07980	-9.87
84	53.56640	210.08036	210.07824	2.12
85	51.84073	220.09023	220.10397	-13.74
86	50.25550	230.09548	230.08684	8.65
87	48.78443	240.09991	240.10146	-1.55
88	47.42286	250.09564	250.09798	-2.34
89	46.15869	260.08603	260.08497	1.07
90	44.97902	270.09755	270.09352	4.04
91	43.88121	280.09190	280.07818	13.73
92	42.85092	290.09617	290.10768	-11.51
93	41.89045	300.09674	300.09989	-3.15
94	40.99029	310.07922	310.09277	-13.55
95	40.56232	315.08491	315.07709	7.82
96	40.14630	320.08897	320.07701	11.96
97	39.68938	325.75022	325.75411	-3.90
98	39.48047	328.41602	328.41773	-1.71

Order of Fit = 7 RMS error of fit = 7.65 mK
Largest absolute error = 14.57 mK at data point no. 80

INTERPOLATION TABLE

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
0.3000	66476.5	-8.9309e+5	-4.0304	48.00	145.186	-1.9381	-0.64074
0.4000	25018.5	-1.9688e+5	-3.1477	49.00	143.279	-1.8760	-0.64157
0.5000	13293.5	-67904.	-2.5540	50.00	141.433	-1.8171	-0.64239
0.6000	8620.02	-31785.	-2.2124	51.00	139.644	-1.7611	-0.64318
0.7000	6242.97	-17652.	-1.9793	52.00	137.910	-1.7077	-0.64392
0.8000	4850.75	-10944.	-1.8049	53.00	136.227	-1.6569	-0.64462
0.9000	3953.42	-7343.0	-1.6716	54.00	134.595	-1.6085	-0.64532
1.000	3333.78	-5222.2	-1.5664	55.00	133.010	-1.5623	-0.64603
2.000	1357.56	-726.79	-1.0707	56.00	131.470	-1.5183	-0.64675
3.000	914.377	-273.62	-0.89774	57.00	129.972	-1.4763	-0.64742
4.000	717.981	-142.47	-0.79375	58.00	128.517	-1.4360	-0.64806
4.200	690.918	-128.54	-0.78137	59.00	127.100	-1.3975	-0.64870
5.000	605.147	-89.518	-0.73964	60.00	125.721	-1.3606	-0.64936
6.000	530.762	-61.901	-0.69976	61.00	124.378	-1.3254	-0.65001
7.000	477.584	-45.761	-0.67072	62.00	123.070	-1.2915	-0.65063
8.000	437.305	-35.503	-0.64948	63.00	121.795	-1.2590	-0.65124
9.000	405.472	-28.572	-0.63420	64.00	120.551	-1.2278	-0.65185
10.00	379.493	-23.643	-0.62301	65.00	119.339	-1.1979	-0.65247
11.00	357.757	-19.998	-0.61487	66.00	118.155	-1.1692	-0.65310
12.00	339.210	-17.213	-0.60894	67.00	117.000	-1.1415	-0.65371
13.00	323.130	-15.030	-0.60468	68.00	115.872	-1.1149	-0.65430
14.00	309.005	-13.280	-0.60169	69.00	114.770	-1.0893	-0.65490
15.00	296.462	-11.852	-0.59969	70.00	113.693	-1.0647	-0.65551
16.00	285.219	-10.668	-0.59845	71.00	112.640	-1.0409	-0.65613
17.00	275.062	-9.6739	-0.59789	72.00	111.611	-1.0180	-0.65673
18.00	265.823	-8.8240	-0.59751	73.00	110.604	-0.99592	-0.65732
19.00	257.369	-8.1112	-0.59880	74.00	109.618	-0.97459	-0.65792
20.00	249.570	-7.4869	-0.59999	75.00	108.654	-0.95402	-0.65852
21.00	242.378	-6.9162	-0.59924	76.00	107.710	-0.93415	-0.65914
22.00	235.706	-6.4362	-0.60073	77.00	106.786	-0.91495	-0.65974
23.00	229.487	-6.0099	-0.60234	77.35	106.467	-0.90837	-0.65995
24.00	223.671	-5.6306	-0.60416	78.00	105.880	-0.89637	-0.66034
25.00	218.213	-5.2920	-0.60629	79.00	104.993	-0.87842	-0.66095
26.00	213.076	-4.9864	-0.60845	80.00	104.123	-0.86106	-0.66157
27.00	208.230	-4.7093	-0.61062	81.00	103.270	-0.84426	-0.66220
28.00	203.649	-4.4570	-0.61280	82.00	102.434	-0.82797	-0.66280
29.00	199.309	-4.2260	-0.61490	83.00	101.614	-0.81218	-0.66340
30.00	195.191	-4.0141	-0.61695	84.00	100.810	-0.79686	-0.66399
31.00	191.276	-3.8188	-0.61891	85.00	100.020	-0.78201	-0.66458
32.00	187.548	-3.6384	-0.62079	86.00	99.2457	-0.76763	-0.66518
33.00	183.994	-3.4712	-0.62258	87.00	98.4850	-0.75370	-0.66581
34.00	180.602	-3.3161	-0.62429	88.00	97.7381	-0.74022	-0.66647
35.00	177.359	-3.1716	-0.62588	89.00	97.0044	-0.72718	-0.66718
36.00	174.255	-3.0369	-0.62740	90.00	96.2836	-0.71457	-0.66793
37.00	171.282	-2.9112	-0.62887	91.00	95.5752	-0.70233	-0.66871
38.00	168.430	-2.7934	-0.63023	92.00	94.8789	-0.69038	-0.66943
39.00	165.693	-2.6830	-0.63152	93.00	94.1943	-0.67873	-0.67012
40.00	163.062	-2.5795	-0.63277	94.00	93.5213	-0.66735	-0.67077
41.00	160.532	-2.4821	-0.63392	95.00	92.8595	-0.65626	-0.67139
42.00	158.096	-2.3904	-0.63503	96.00	92.2087	-0.64544	-0.67197
43.00	155.749	-2.3040	-0.63611	97.00	91.5686	-0.63489	-0.67255
44.00	153.486	-2.2224	-0.63711	98.00	90.9388	-0.62461	-0.67311
45.00	151.303	-2.1454	-0.63808	99.00	90.3193	-0.61459	-0.67366
46.00	149.194	-2.0725	-0.63901	100.0	89.7096	-0.60483	-0.67421
47.00	147.156	-2.0035	-0.63989	101.0	89.1095	-0.59531	-0.67475

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INTERPOLATION TABLE

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
102.0	88.5189	-0.58603	-0.67528	157.0	65.7651	-0.29401	-0.70189
103.0	87.9374	-0.57698	-0.67581	158.0	65.4726	-0.29096	-0.70215
104.0	87.3648	-0.56816	-0.67634	159.0	65.1832	-0.28795	-0.70240
105.0	86.8010	-0.55955	-0.67686	160.0	64.8967	-0.28499	-0.70264
106.0	86.2457	-0.55116	-0.67740	161.0	64.6132	-0.28208	-0.70287
107.0	85.6986	-0.54297	-0.67793	162.0	64.3325	-0.27921	-0.70309
108.0	85.1596	-0.53500	-0.67848	163.0	64.0547	-0.27638	-0.70330
109.0	84.6286	-0.52722	-0.67905	164.0	63.7798	-0.27359	-0.70349
110.0	84.1051	-0.51964	-0.67963	165.0	63.5075	-0.27084	-0.70367
111.0	83.5892	-0.51225	-0.68022	166.0	63.2381	-0.26813	-0.70385
112.0	83.0806	-0.50502	-0.68081	167.0	62.9713	-0.26547	-0.70401
113.0	82.5791	-0.49795	-0.68138	168.0	62.7071	-0.26284	-0.70417
114.0	82.0846	-0.49103	-0.68195	169.0	62.4456	-0.26025	-0.70432
115.0	81.5970	-0.48428	-0.68252	170.0	62.1866	-0.25769	-0.70446
116.0	81.1160	-0.47767	-0.68309	171.0	61.9302	-0.25518	-0.70459
117.0	80.6416	-0.47121	-0.68366	172.0	61.6762	-0.25270	-0.70471
118.0	80.1736	-0.46489	-0.68423	173.0	61.4248	-0.25025	-0.70482
119.0	79.7118	-0.45872	-0.68482	174.0	61.1757	-0.24784	-0.70492
120.0	79.2561	-0.45269	-0.68541	175.0	60.9291	-0.24546	-0.70501
121.0	78.8064	-0.44679	-0.68600	176.0	60.6848	-0.24312	-0.70510
122.0	78.3625	-0.44100	-0.68658	177.0	60.4428	-0.24080	-0.70517
123.0	77.9243	-0.43533	-0.68715	178.0	60.2032	-0.23852	-0.70523
124.0	77.4918	-0.42977	-0.68771	179.0	59.9658	-0.23628	-0.70529
125.0	77.0647	-0.42433	-0.68826	180.0	59.7306	-0.23406	-0.70534
126.0	76.6431	-0.41899	-0.68881	181.0	59.4976	-0.23187	-0.70539
127.0	76.2267	-0.41376	-0.68935	182.0	59.2669	-0.22971	-0.70542
128.0	75.8155	-0.40863	-0.68990	183.0	59.0382	-0.22759	-0.70545
129.0	75.4094	-0.40361	-0.69044	184.0	58.8117	-0.22549	-0.70546
130.0	75.0083	-0.39869	-0.69098	185.0	58.5872	-0.22341	-0.70547
131.0	74.6120	-0.39386	-0.69152	186.0	58.3648	-0.22137	-0.70547
132.0	74.2205	-0.38912	-0.69204	187.0	58.1445	-0.21935	-0.70546
133.0	73.8337	-0.38447	-0.69256	188.0	57.9261	-0.21736	-0.70544
134.0	73.4516	-0.37990	-0.69306	189.0	57.7098	-0.21539	-0.70542
135.0	73.0739	-0.37541	-0.69354	190.0	57.4953	-0.21346	-0.70539
136.0	72.7007	-0.37100	-0.69402	191.0	57.2828	-0.21154	-0.70536
137.0	72.3319	-0.36667	-0.69449	192.0	57.0722	-0.20966	-0.70531
138.0	71.9674	-0.36242	-0.69496	193.0	56.8635	-0.20779	-0.70526
139.0	71.6070	-0.35825	-0.69542	194.0	56.6566	-0.20595	-0.70520
140.0	71.2508	-0.35415	-0.69587	195.0	56.4516	-0.20413	-0.70514
141.0	70.8987	-0.35013	-0.69632	196.0	56.2484	-0.20234	-0.70506
142.0	70.5506	-0.34617	-0.69675	197.0	56.0469	-0.20057	-0.70498
143.0	70.2063	-0.34228	-0.69717	198.0	55.8472	-0.19882	-0.70489
144.0	69.8660	-0.33845	-0.69757	199.0	55.6493	-0.19709	-0.70480
145.0	69.5294	-0.33468	-0.69796	200.0	55.4530	-0.19539	-0.70470
146.0	69.1966	-0.33098	-0.69835	201.0	55.2585	-0.19371	-0.70460
147.0	68.8674	-0.32734	-0.69872	202.0	55.0656	-0.19204	-0.70449
148.0	68.5419	-0.32376	-0.69908	203.0	54.8744	-0.19040	-0.70437
149.0	68.2199	-0.32024	-0.69944	204.0	54.6848	-0.18878	-0.70424
150.0	67.9014	-0.31678	-0.69979	205.0	54.4968	-0.18718	-0.70410
151.0	67.5863	-0.31337	-0.70013	206.0	54.3104	-0.18560	-0.70396
152.0	67.2746	-0.31002	-0.70045	207.0	54.1256	-0.18403	-0.70382
153.0	66.9663	-0.30672	-0.70076	208.0	53.9424	-0.18249	-0.70367
154.0	66.6612	-0.30346	-0.70106	209.0	53.7606	-0.18096	-0.70351
155.0	66.3593	-0.30026	-0.70135	210.0	53.5804	-0.17946	-0.70335
156.0	66.0607	-0.29711	-0.70162	211.0	53.4017	-0.17797	-0.70318

INTERPOLATION TABLE

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
212.0	53.2245	-0.17650	-0.70300	267.0	45.3348	-0.11626	-0.68473
213.0	53.0487	-0.17504	-0.70282	268.0	45.2190	-0.11545	-0.68425
214.0	52.8744	-0.17360	-0.70263	269.0	45.1039	-0.11465	-0.68376
215.0	52.7015	-0.17218	-0.70244	270.0	44.9897	-0.11385	-0.68327
216.0	52.5300	-0.17078	-0.70224	271.0	44.8762	-0.11306	-0.68278
217.0	52.3600	-0.16939	-0.70203	272.0	44.7635	-0.11228	-0.68228
218.0	52.1912	-0.16802	-0.70182	273.0	44.6516	-0.11151	-0.68178
219.0	52.0239	-0.16667	-0.70160	274.0	44.5405	-0.11074	-0.68127
220.0	51.8579	-0.16533	-0.70138	275.0	44.4301	-0.10999	-0.68075
221.0	51.6932	-0.16400	-0.70115	276.0	44.3205	-0.10923	-0.68023
222.0	51.5299	-0.16269	-0.70092	277.0	44.2117	-0.10849	-0.67971
223.0	51.3678	-0.16140	-0.70068	278.0	44.1036	-0.10775	-0.67918
224.0	51.2071	-0.16012	-0.70043	279.0	43.9962	-0.10702	-0.67865
225.0	51.0476	-0.15886	-0.70018	280.0	43.8895	-0.10629	-0.67811
226.0	50.8894	-0.15760	-0.69992	281.0	43.7836	-0.10557	-0.67757
227.0	50.7324	-0.15637	-0.69966	282.0	43.6784	-0.10486	-0.67702
228.0	50.5766	-0.15514	-0.69939	283.0	43.5739	-0.10416	-0.67647
229.0	50.4221	-0.15393	-0.69911	284.0	43.4701	-0.10346	-0.67591
230.0	50.2688	-0.15274	-0.69884	285.0	43.3669	-0.10276	-0.67535
231.0	50.1166	-0.15155	-0.69855	286.0	43.2645	-0.10208	-0.67479
232.0	49.9657	-0.15038	-0.69826	287.0	43.1628	-0.10140	-0.67422
233.0	49.8158	-0.14923	-0.69797	288.0	43.0617	-0.10072	-0.67364
234.0	49.6672	-0.14808	-0.69766	289.0	42.9613	-0.10005	-0.67306
235.0	49.5197	-0.14695	-0.69736	290.0	42.8616	-9.9392e-2	-0.67248
236.0	49.3733	-0.14583	-0.69704	291.0	42.7626	-9.8735e-2	-0.67189
237.0	49.2280	-0.14472	-0.69672	292.0	42.6641	-9.8084e-2	-0.67130
238.0	49.0839	-0.14362	-0.69640	293.0	42.5664	-9.7438e-2	-0.67070
239.0	48.9408	-0.14254	-0.69607	294.0	42.4693	-9.6799e-2	-0.67010
240.0	48.7988	-0.14146	-0.69574	295.0	42.3728	-9.6164e-2	-0.66950
241.0	48.6578	-0.14040	-0.69540	296.0	42.2769	-9.5536e-2	-0.66889
242.0	48.5180	-0.13935	-0.69506	297.0	42.1817	-9.4912e-2	-0.66827
243.0	48.3791	-0.13831	-0.69471	298.0	42.0871	-9.4294e-2	-0.66766
244.0	48.2413	-0.13728	-0.69435	299.0	41.9931	-9.3682e-2	-0.66704
245.0	48.1046	-0.13626	-0.69399	300.0	41.8997	-9.3075e-2	-0.66641
246.0	47.9688	-0.13525	-0.69362	301.0	41.8070	-9.2473e-2	-0.66578
247.0	47.8341	-0.13425	-0.69325	302.0	41.7148	-9.1876e-2	-0.66515
248.0	47.7003	-0.13327	-0.69287	303.0	41.6232	-9.1284e-2	-0.66451
249.0	47.5675	-0.13229	-0.69249	304.0	41.5322	-9.0697e-2	-0.66387
250.0	47.4357	-0.13132	-0.69210	305.0	41.4418	-9.0115e-2	-0.66322
251.0	47.3049	-0.13036	-0.69171	305.0	41.4418	-9.0115e-2	-0.66322
252.0	47.1750	-0.12942	-0.69132	306.0	41.3520	-8.9538e-2	-0.66257
253.0	47.0460	-0.12848	-0.69091	307.0	41.2627	-8.8966e-2	-0.66192
254.0	46.9180	-0.12755	-0.69050	308.0	41.1741	-8.8399e-2	-0.66126
255.0	46.7909	-0.12663	-0.69009	309.0	41.0859	-8.7837e-2	-0.66060
256.0	46.6648	-0.12572	-0.68967	310.0	40.9984	-8.7279e-2	-0.65994
257.0	46.5395	-0.12481	-0.68925	311.0	40.9114	-8.6726e-2	-0.65927
258.0	46.4151	-0.12392	-0.68882	312.0	40.8249	-8.6178e-2	-0.65860
259.0	46.2917	-0.12304	-0.68838	313.0	40.7390	-8.5634e-2	-0.65793
260.0	46.1691	-0.12216	-0.68794	314.0	40.6537	-8.5094e-2	-0.65725
261.0	46.0473	-0.12129	-0.68750	315.0	40.5688	-8.4559e-2	-0.65657
262.0	45.9265	-0.12043	-0.68705	316.0	40.4845	-8.4029e-2	-0.65588
263.0	45.8065	-0.11958	-0.68660	317.0	40.4008	-8.3503e-2	-0.65520
264.0	45.6873	-0.11874	-0.68614	318.0	40.3175	-8.2981e-2	-0.65450
265.0	45.5690	-0.11791	-0.68567	319.0	40.2348	-8.2464e-2	-0.65381
266.0	45.4515	-0.11708	-0.68520	320.0	40.1526	-8.1950e-2	-0.65311

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INTERPOLATION TABLE

Calibration Report: 430423
Sensor Model: XCX-1030-TOPREL-71
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Sales Order: 11367
Serial Number: X29571
Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
321.0	40.0709	-8.1441e-2	-0.65241				
322.0	39.9897	-8.0937e-2	-0.65171				
323.0	39.9090	-8.0436e-2	-0.65100				
324.0	39.8288	-7.9939e-2	-0.65029				
325.0	39.7492	-7.9446e-2	-0.64958				

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BREAKPOINTS 340 FORMAT

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Name: XCX-1030-TOPREL-71
Serial number: X29571
Format: 4 ;Log Ohms/Kelvin
Limit: 325.
Coefficient: 1 ;Negative

Point 1: 1.59931,325.000	Point 56: 2.01574, 80.500	Point 111: 2.59743, 9.350	Point 166: 4.08061, 0.520
Point 2: 1.60459,319.000	Point 57: 2.02480, 78.000	Point 112: 2.61098, 8.900	Point 167: 4.12788, 0.498
Point 3: 1.60955,313.500	Point 58: 2.03225, 76.000	Point 113: 2.62374, 8.500	Point 168: 4.16951, 0.480
Point 4: 1.61461,308.000	Point 59: 2.03987, 74.000	Point 114: 2.63722, 8.100	Point 169: 4.21410, 0.462
Point 5: 1.61980,302.500	Point 60: 2.04769, 72.000	Point 115: 2.65154, 7.700	Point 170: 4.25673, 0.446
Point 6: 1.62511,297.000	Point 61: 2.05572, 70.000	Point 116: 2.66681, 7.300	Point 171: 4.30240, 0.430
Point 7: 1.63055,291.500	Point 62: 2.06396, 68.000	Point 117: 2.68108, 6.950	Point 172: 4.35168, 0.414
Point 8: 1.63612,286.000	Point 63: 2.07244, 66.000	Point 118: 2.69624, 6.600	Point 173: 4.40483, 0.398
Point 9: 1.64183,280.500	Point 64: 2.08116, 64.000	Point 119: 2.71248, 6.250	Point 174: 4.46210, 0.382
Point 10: 1.64767,275.000	Point 65: 2.09013, 62.000	Point 120: 2.73095, 5.880	Point 175: 4.52368, 0.366
Point 11: 1.65310,270.000	Point 66: 2.09939, 60.000	Point 121: 2.74822, 5.560	Point 176: 4.59784, 0.348
Point 12: 1.65866,265.000	Point 67: 2.10797, 58.200	Point 122: 2.76679, 5.240	Point 177: 4.70199, 0.324
Point 13: 1.66434,260.000	Point 68: 2.11681, 56.400	Point 123: 2.78564, 4.940	Point 178: 4.75799, 0.312
Point 14: 1.67015,255.000	Point 69: 2.12591, 54.600	Point 124: 2.80601, 4.640	Point 179: 4.81068, 0.302
Point 15: 1.67610,250.000	Point 70: 2.13530, 52.800	Point 125: 2.82669, 4.360	Point 180: 4.82267, 0.300
Point 16: 1.68218,245.000	Point 71: 2.14500, 51.000	Point 126: 2.84915, 4.080	Point 181: 4.82267, 0.300
Point 17: 1.68840,240.000	Point 72: 2.15502, 49.200	Point 127: 2.86749, 3.870	
Point 18: 1.69477,235.000	Point 73: 2.16540, 47.400	Point 128: 2.88421, 3.690	
Point 19: 1.70129,230.000	Point 74: 2.17614, 45.600	Point 129: 2.90208, 3.510	
Point 20: 1.70796,225.000	Point 75: 2.18605, 44.000	Point 130: 2.92124, 3.330	
Point 21: 1.71480,220.000	Point 76: 2.19628, 42.400	Point 131: 2.93845, 3.180	
Point 22: 1.72181,215.000	Point 77: 2.20688, 40.800	Point 132: 2.95842, 3.020	
Point 23: 1.72899,210.000	Point 78: 2.21787, 39.200	Point 133: 2.98106, 2.850	
Point 24: 1.73636,205.000	Point 79: 2.22928, 37.600	Point 134: 3.00263, 2.700	
Point 25: 1.74391,200.000	Point 80: 2.24115, 36.000	Point 135: 3.02602, 2.550	
Point 26: 1.75166,195.000	Point 81: 2.25273, 34.500	Point 136: 3.04972, 2.410	
Point 27: 1.75962,190.000	Point 82: 2.26476, 33.000	Point 137: 3.07548, 2.270	
Point 28: 1.76696,185.500	Point 83: 2.27731, 31.500	Point 138: 3.10165, 2.140	
Point 29: 1.77449,181.000	Point 84: 2.28953, 30.100	Point 139: 3.13022, 2.010	
Point 30: 1.78220,176.500	Point 85: 2.30226, 28.700	Point 140: 3.15924, 1.890	
Point 31: 1.79010,172.000	Point 86: 2.31556, 27.300	Point 141: 3.19111, 1.770	
Point 32: 1.79821,167.500	Point 87: 2.32849, 26.000	Point 142: 3.22647, 1.650	
Point 33: 1.80653,163.000	Point 88: 2.34201, 24.700	Point 143: 3.26258, 1.540	
Point 34: 1.81508,158.500	Point 89: 2.35619, 23.400	Point 144: 3.30279, 1.430	
Point 35: 1.82386,154.000	Point 90: 2.36996, 22.200	Point 145: 3.34388, 1.330	
Point 36: 1.83287,149.500	Point 91: 2.38443, 21.000	Point 146: 3.38987, 1.230	
Point 37: 1.84215,145.000	Point 92: 2.39586, 20.100	Point 147: 3.42086, 1.170	
Point 38: 1.85169,140.500	Point 93: 2.40511, 19.400	Point 148: 3.44265, 1.130	
Point 39: 1.86152,136.000	Point 94: 2.41467, 18.700	Point 149: 3.46569, 1.090	
Point 40: 1.87051,132.000	Point 95: 2.42385, 18.050	Point 150: 3.49012, 1.050	
Point 41: 1.87974,128.000	Point 96: 2.43336, 17.400	Point 151: 3.51607, 1.010	
Point 42: 1.88924,124.000	Point 97: 2.44325, 16.750	Point 152: 3.54372, 0.970	
Point 43: 1.89901,120.000	Point 98: 2.45273, 16.150	Point 153: 3.57326, 0.930	
Point 44: 1.90908,116.000	Point 99: 2.46256, 15.550	Point 154: 3.60091, 0.895	
Point 45: 1.91948,112.000	Point 100: 2.47281, 14.950	Point 155: 3.63032, 0.860	
Point 46: 1.93021,108.000	Point 101: 2.48348, 14.350	Point 156: 3.66178, 0.825	
Point 47: 1.93991,104.500	Point 102: 2.49370, 13.800	Point 157: 3.69553, 0.790	
Point 48: 1.94990,101.000	Point 103: 2.50434, 13.250	Point 158: 3.73188, 0.755	
Point 49: 1.95874, 98.000	Point 104: 2.51547, 12.700	Point 159: 3.76546, 0.725	
Point 50: 1.96628, 95.500	Point 105: 2.52607, 12.200	Point 160: 3.80137, 0.695	
Point 51: 1.97401, 93.000	Point 106: 2.53713, 11.700	Point 161: 3.84008, 0.665	
Point 52: 1.98193, 90.500	Point 107: 2.54874, 11.200	Point 162: 3.88190, 0.635	
Point 53: 1.99005, 88.000	Point 108: 2.56094, 10.700	Point 163: 3.92729, 0.605	
Point 54: 1.99838, 85.500	Point 109: 2.57250, 10.250	Point 164: 3.97675, 0.575	
Point 55: 2.00694, 83.000	Point 110: 2.58463, 9.800	Point 165: 4.03100, 0.545	

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Interpolation Method: Lagrangian
Limit: 325. (Kelvin)
Format: 4 (Log Ohms/Kelvin)
Number of Breakpoints: 54

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.59933	325.0	31	2.65912	7.5
2	1.60020	324.0	32	2.71498	6.2
3	1.61369	309.0	33	2.76331	5.3
4	1.62807	294.0	34	2.81627	4.5
5	1.64341	279.0	35	2.86488	3.9
6	1.65980	264.0	36	2.89308	3.6
7	1.67731	249.0	37	2.92468	3.3
8	1.69607	234.0	38	2.94837	3.1
9	1.71620	219.0	39	3.01816	2.6
10	1.73787	204.0	40	3.08946	2.2
11	1.76125	189.0	41	3.15692	1.9
12	1.78658	174.0	42	3.21156	1.7
13	1.81414	159.0	43	3.27699	1.5
14	1.84427	144.0	44	3.31501	1.4
15	1.87743	129.0	45	3.35746	1.3
16	1.91426	114.0	46	3.40534	1.2
17	1.95578	99.0	47	3.45990	1.1
18	2.00350	84.0	48	3.52294	1.0
19	2.05983	69.0	49	3.59697	.9
20	2.10177	59.5	50	3.68581	.8
21	2.15055	50.0	51	3.79539	.7
22	2.17985	45.0	52	3.93551	.6
23	2.21235	40.0	53	4.39826	.4
24	2.24885	35.0	54	4.82267	.3
25	2.29046	30.0			
26	2.33888	25.0			
27	2.39719	20.0			
28	2.47024	15.1			
29	2.53945	11.6			
30	2.60192	9.2			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	85.023
1000	2.718
10000	0.562

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BREAKPOINTS 234 FORMAT

Calibration Report: 430423 Sales Order: 11367
Sensor Model: XCX-1030-TOPREL-71 Serial Number: X29571
Sensor Type: Cernox Resistor
Temperature Range: 0.30K to 325K

Maximum Temperature Error:

1.4 - 10K:	0.005K
10 - 20K:	0.010K
20 - 40K:	0.016K
40 - 100K:	0.031K
> 100K:	0.152K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	324.226	39.81072	1.600	56	6.519	501.1872	2.700
2	302.302	41.68694	1.620	57	6.098	524.8075	2.720
3	282.256	43.65158	1.640	58	5.712	549.5409	2.740
4	263.818	45.70882	1.660	59	5.356	575.4399	2.760
5	246.783	47.86301	1.680	60	5.029	602.5596	2.780
6	230.988	50.11872	1.700	61	4.728	630.9573	2.800
7	216.287	52.48075	1.720	62	4.450	660.6934	2.820
8	202.581	54.95409	1.740	63	4.193	691.8310	2.840
9	189.773	57.54399	1.760	64	3.955	724.4360	2.860
10	177.778	60.25596	1.780	65	3.735	758.5776	2.880
11	166.534	63.09573	1.800	66	3.531	794.3282	2.900
12	155.966	66.06934	1.820	67	3.343	831.7638	2.920
13	146.044	69.18310	1.840	68	3.168	870.9636	2.940
14	136.695	72.44360	1.860	69	3.009	912.0108	2.960
15	127.897	75.85776	1.880	70	2.858	954.9926	2.980
16	119.611	79.43282	1.900	71	2.719	1000.000	3.000
17	111.811	83.17638	1.920	72	2.467	1096.478	3.040
18	104.473	87.09636	1.940	73	2.248	1202.264	3.080
19	97.581	91.20108	1.960	74	2.056	1318.257	3.120
20	91.108	95.49926	1.980	75	1.888	1445.440	3.160
21	85.026	100.0000	2.000	76	1.740	1584.893	3.200
22	79.320	104.7129	2.020	77	1.608	1737.801	3.240
23	73.968	109.6478	2.040	78	1.492	1905.461	3.280
24	68.960	114.8154	2.060	79	1.388	2089.296	3.320
25	64.264	120.2264	2.080	80	1.294	2290.868	3.360
26	59.875	125.8925	2.100	81	1.211	2511.886	3.400
27	55.766	131.8257	2.120	82	1.135	2754.229	3.440
28	51.926	138.0384	2.140	83	1.066	3019.952	3.480
29	48.333	144.5440	2.160	84	1.005	3311.311	3.520
30	44.976	151.3561	2.180	85	0.948	3630.781	3.560
31	41.835	158.4893	2.200	86	0.896	3981.072	3.600
32	38.901	165.9587	2.220	87	0.849	4365.158	3.640
33	36.157	173.7801	2.240	88	0.806	4786.301	3.680
34	33.591	181.9701	2.260	89	0.766	5248.075	3.720
35	31.192	190.5461	2.280	90	0.730	5754.399	3.760
36	28.948	199.5262	2.300	91	0.696	6309.573	3.800
37	26.853	208.9296	2.320	92	0.665	6918.310	3.840
38	24.893	218.7762	2.340	93	0.636	7585.776	3.880
39	23.067	229.0868	2.360	94	0.610	8317.638	3.920
40	21.366	239.8833	2.380	95	0.585	9120.108	3.960
41	19.786	251.1886	2.400	96	0.562	10000.00	4.000
42	18.321	263.0268	2.420	97	0.511	12589.25	4.100
43	16.963	275.4229	2.440	98	0.468	15848.93	4.200
44	15.706	288.4032	2.460	99	0.431	19952.62	4.300
45	14.545	301.9952	2.480	100	0.400	25118.86	4.400
46	13.473	316.2278	2.500	101	0.372	31622.78	4.500
47	12.486	331.1311	2.520	102	0.347	39810.72	4.600
48	11.576	346.7369	2.540	103	0.325	50118.72	4.700
49	10.739	363.0781	2.560	104	0.304	63095.73	4.800
50	9.970	380.1894	2.580				
51	9.265	398.1072	2.600				
52	8.617	416.8694	2.620				
53	8.022	436.5158	2.640				
54	7.477	457.0882	2.660				
55	6.977	478.6301	2.680				

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15 – TEST RECORDS

- HSO-SBT-RP-107 “Heat switch 1-10 tests report
- HSO-SBT-RP-118 “Spire FM1 Tests Report”

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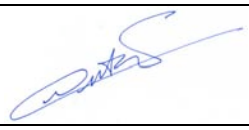
SPIRE & PACS Sorption Coolers HEAT SWITCH [1 – 10] – TESTS REPORT

SBT internal ref : SBT/CT/2004-65

	Name & Function	Date	Signature
Prepared	L. Duband - Cooler project manager	18/11/04	
SBT PA Check	M. Dubois – Cooler PA manager	18/11/04	
SPIRE Approval	N/A		
PACS Approval	N/A		
PA Approval	N/A		
Project Approval	N/A		
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Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

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List of Acronyms

AD	Applicable Document		
CEA	Commissariat à l' Energie Atomique		
CDR	Critical Design Review	Revue de conception détaillée	RCD
CQM	Cryogenic Qualification Model		
EV	Evaporator		
FIRST	Far Infrared and SubmillimetreTelescope		
FS	Flight spare		
HSE	Heat Switch (on evaporator)		
HSP	Heat Switch (on sorption pump)		
N/A	Not Applicable		
PACS	Photoconductor. Array Camera and Spectrometer		
PFM	ProtoFlight Model		
RD	Reference Document		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
SP	Sorption pump		
SPIRE	Spectral & Photometric Imaging Receiver		
SST	Support Structure		
TS	Thermal Shunt		
TSES	Thermal Strap to Evaporator Switch		
TSPS	Thermal Strap to Pump Switch		

1 Scope of the document

This note summarizes the performance characterization carried out on the heat switches to be used on the sorption coolers for the SPIRE and PACS instruments onboard HERSCHEL. Each cooler model requires two heat switches and consequently 10 switches have been manufactured (2 flight and 2 spare models = 8 switches + 2 spare switch).

2 Documents

2.1 Applicable documents

N/A

2.2 Reference documents

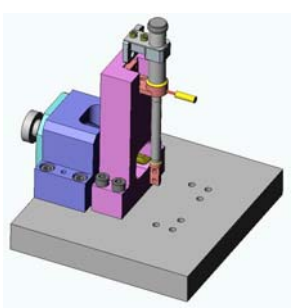
3 Geometrical characterization

3.1 Assembling phase

The heat switches are assembled (oven brazing) following a precise procedure. At this stage of the manufacturing phase, besides a visual check, the flatness and alignment of the titanium and copper interfaces are verified before and after brazing; they must be in the same plane within 100 µm. To the exception of the switch #1 and #2, the remaining switches are within tolerance. For HS#1 and HS#2, the two interfaces are shifted by 250 µm – 400 µm and 150 µm respectively. However this discrepancy does not mean these two switches are defective, but that depending on to which cooler (instruments) they will be affected, actions may be necessary to adjust the interfacing with the level 0 straps.

3.2 Centering aspect

A tool has been developed to check whether or not the switch interlocked copper parts are centered. The tool comprises two sensors which measure respectively the force and the displacement on a moving part. This moving part is used to push gently on the switch end (see figures hereafter) in all four directions (perpendicular to the switch axis) : 0°, 90°, 180° and 270° (in fact to be consistent with the figures, the angles are set following 45°, 135°, 225° and 315°). The recording of the force versus displacement should then allow to determine the position of the inner copper part. In theory one would expect a first mode related to the bending of the thin walled titanium tube until the two copper parts touch, at which point in a second mode any further displacement requires a substantially higher force. In practice the results indeed reveal two modes but the displacement at which the change occurs is unexpected; the two copper parts are separated by a gap of a 100 µm and thus one would expect to see the point of inflexion in this region. Our measurements, displayed on the following pages for the 10 switches, show data sometimes above 200 µm. These peculiar results have not been investigated further, as the objective is to sort out the switches.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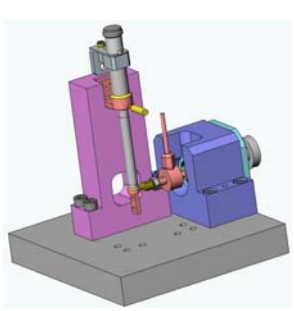
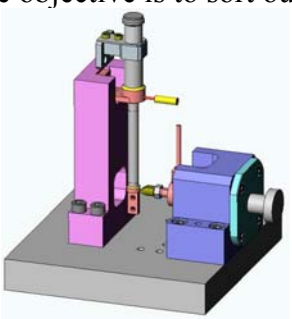
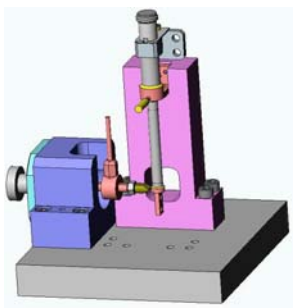
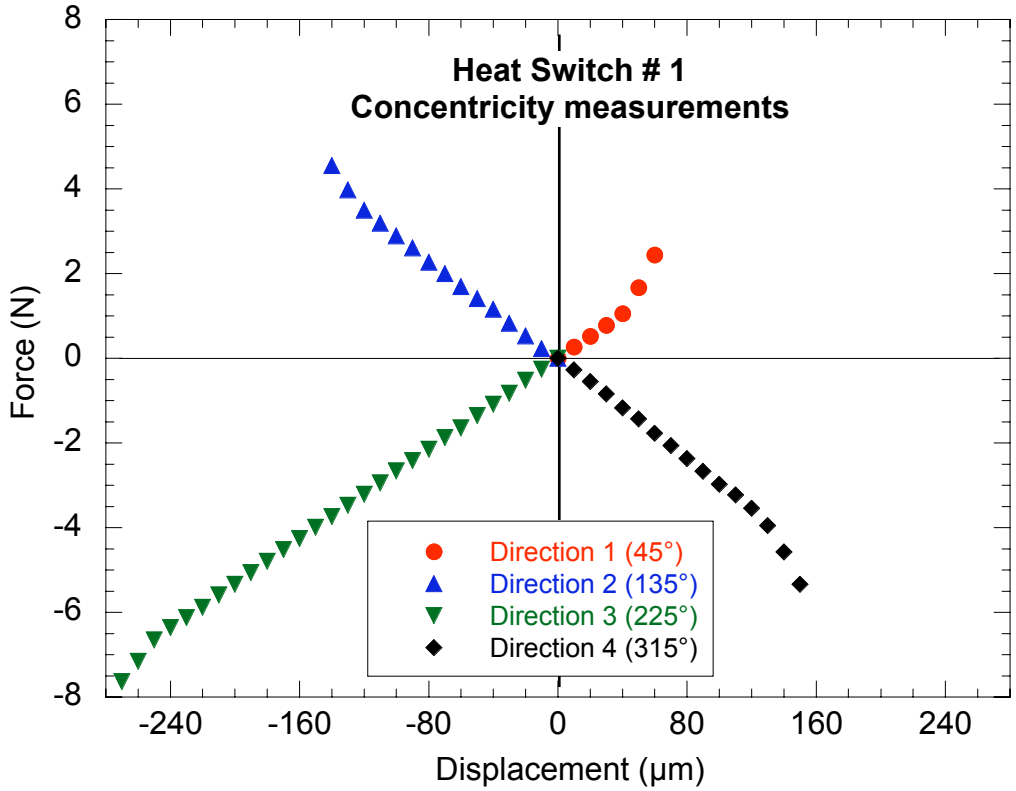
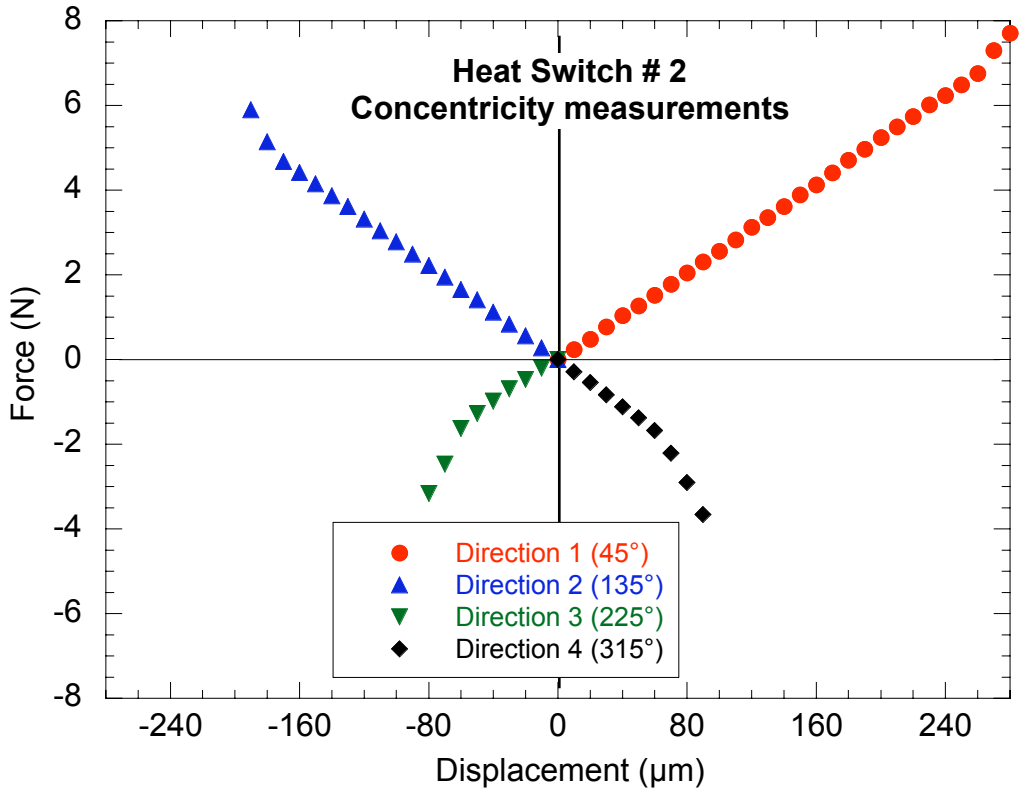

2 (135°)

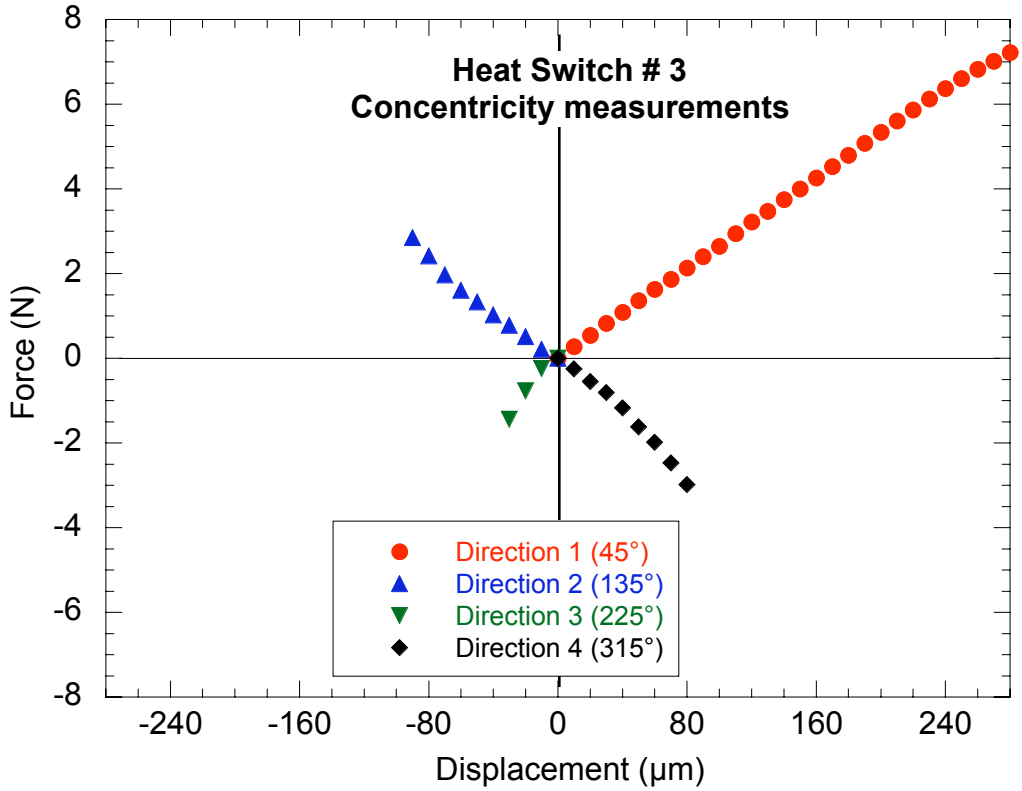

3 (225°)

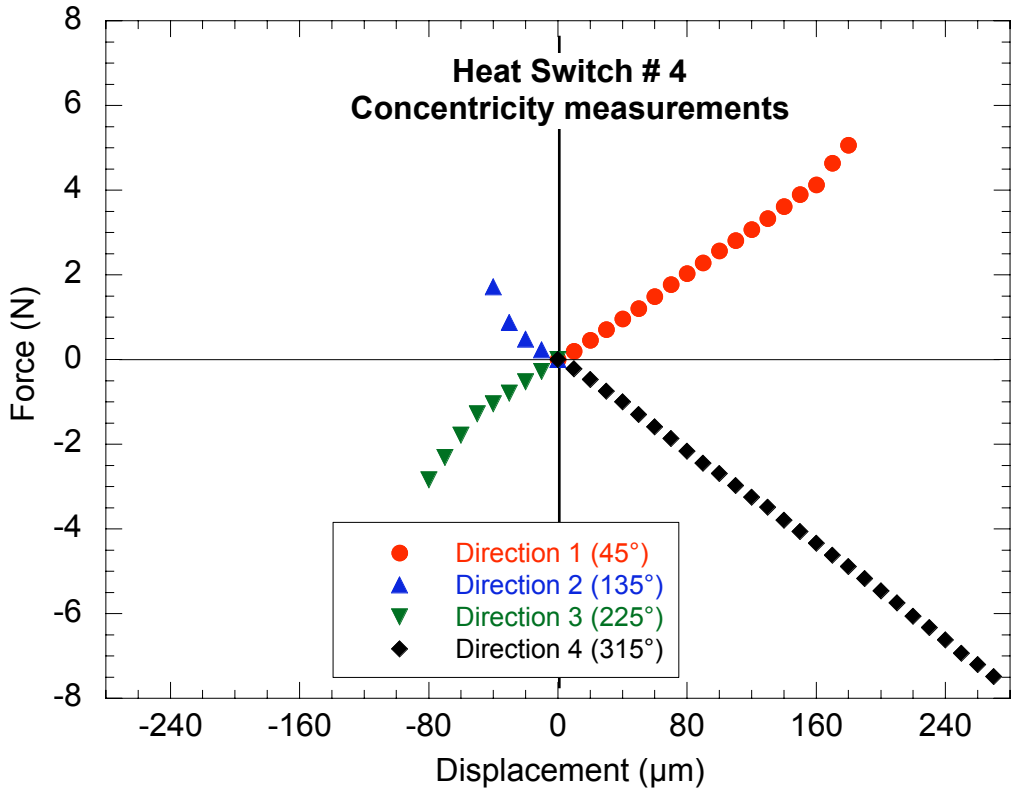

4 (315°)

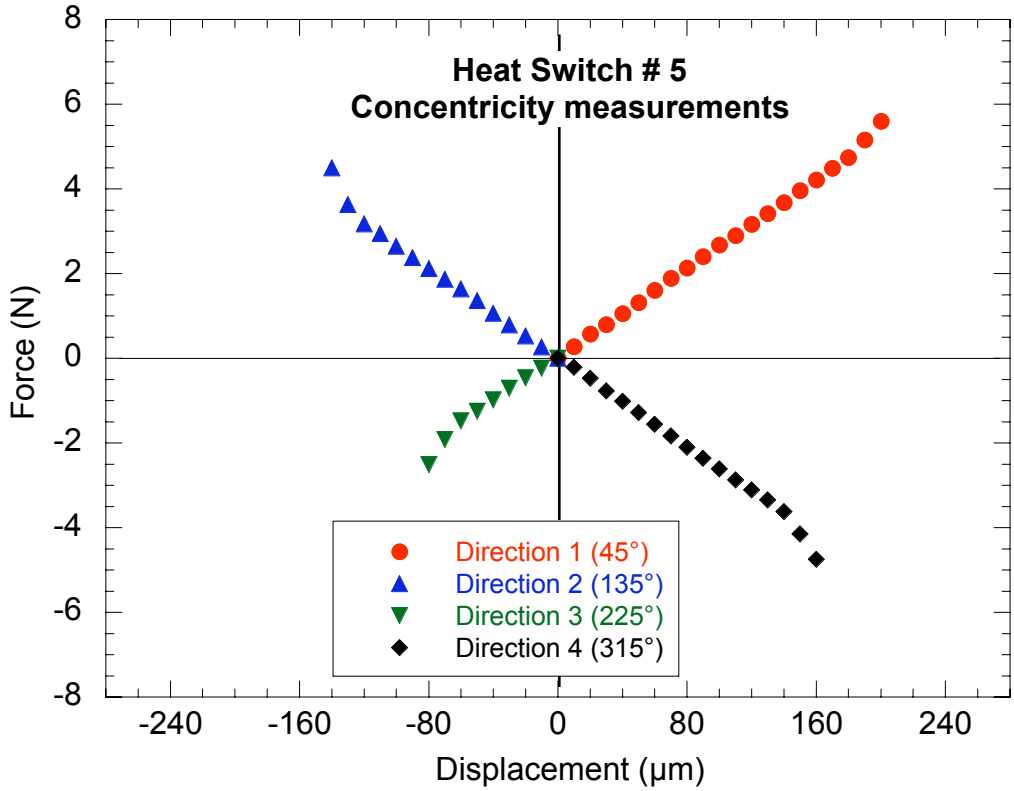
For each opposite axis (i.e. 45°-225° and 135°-315°), the two point of inflexion are determined from the curves. It is then assumed the position of the inner copper part in this particular direction is given by the midpoint (m_1). The two other axis give m_2; then the distance by which the inner part is off centered is simply given by $(m_1^2 + m_2^2)^{0.5}$.
This analysis is reported after the set of figures and allows the heat switches to be ranked from a geometrical point of view.

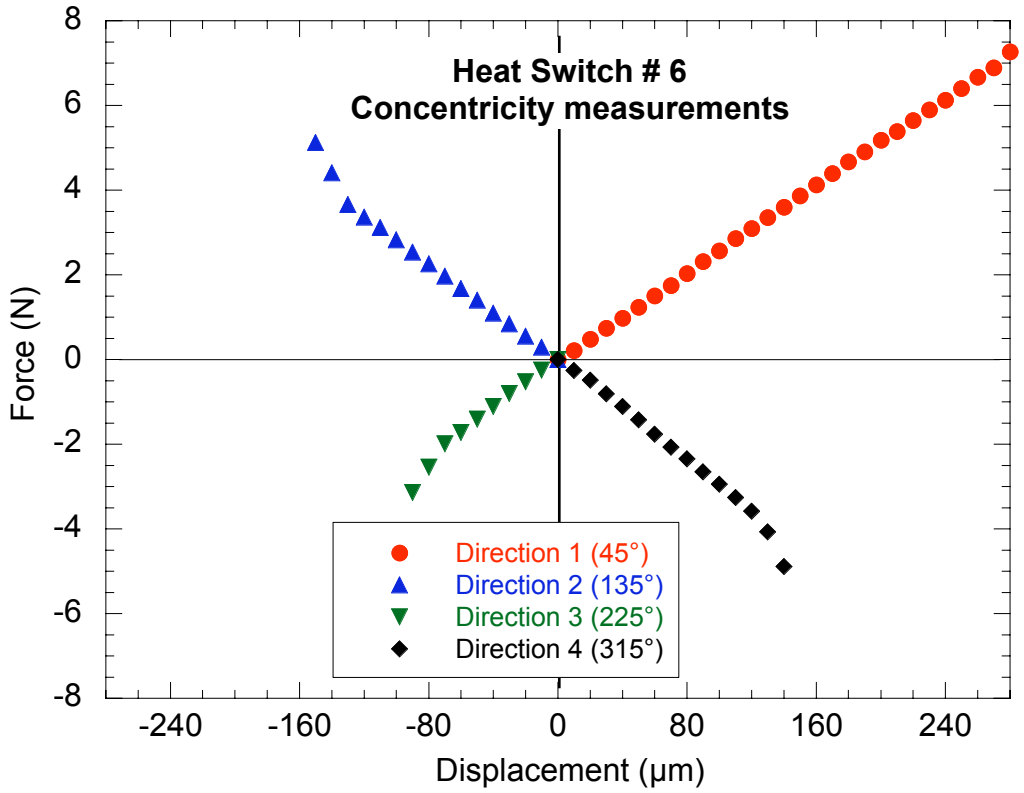


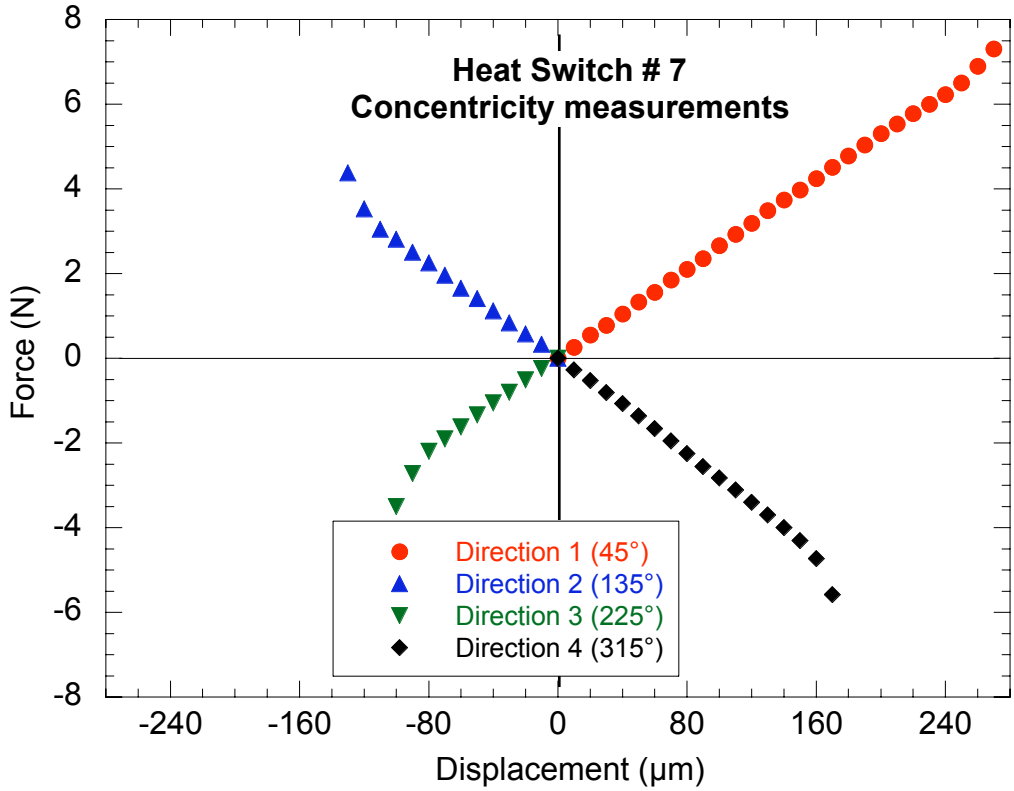


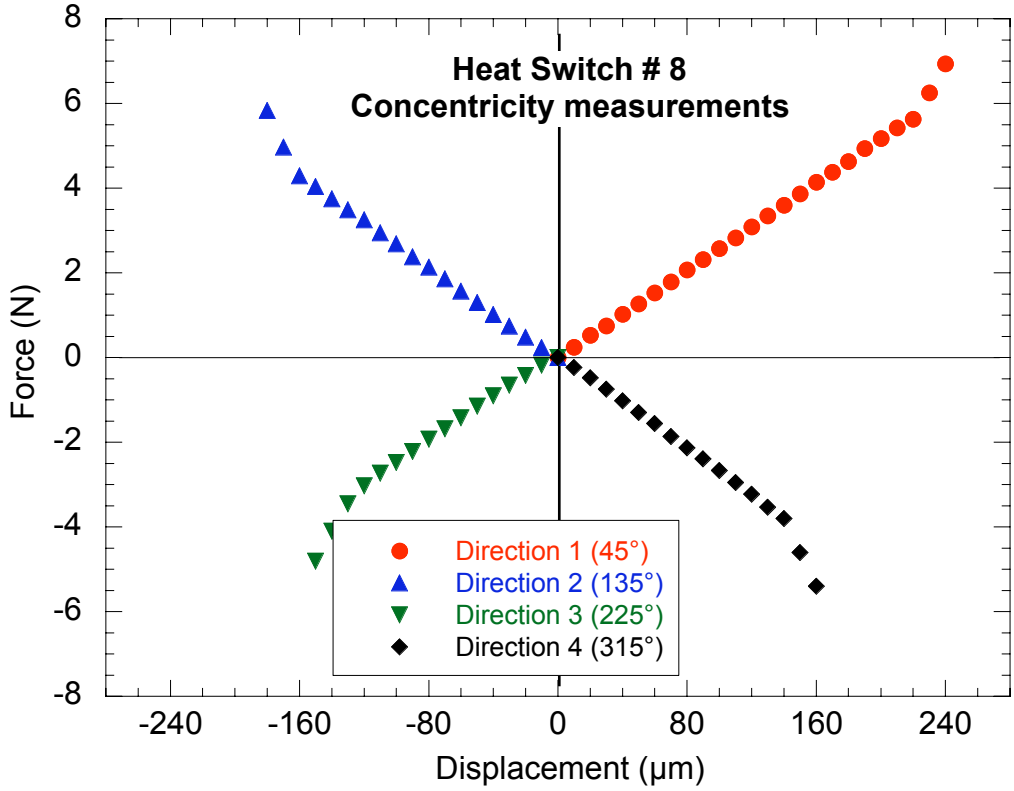


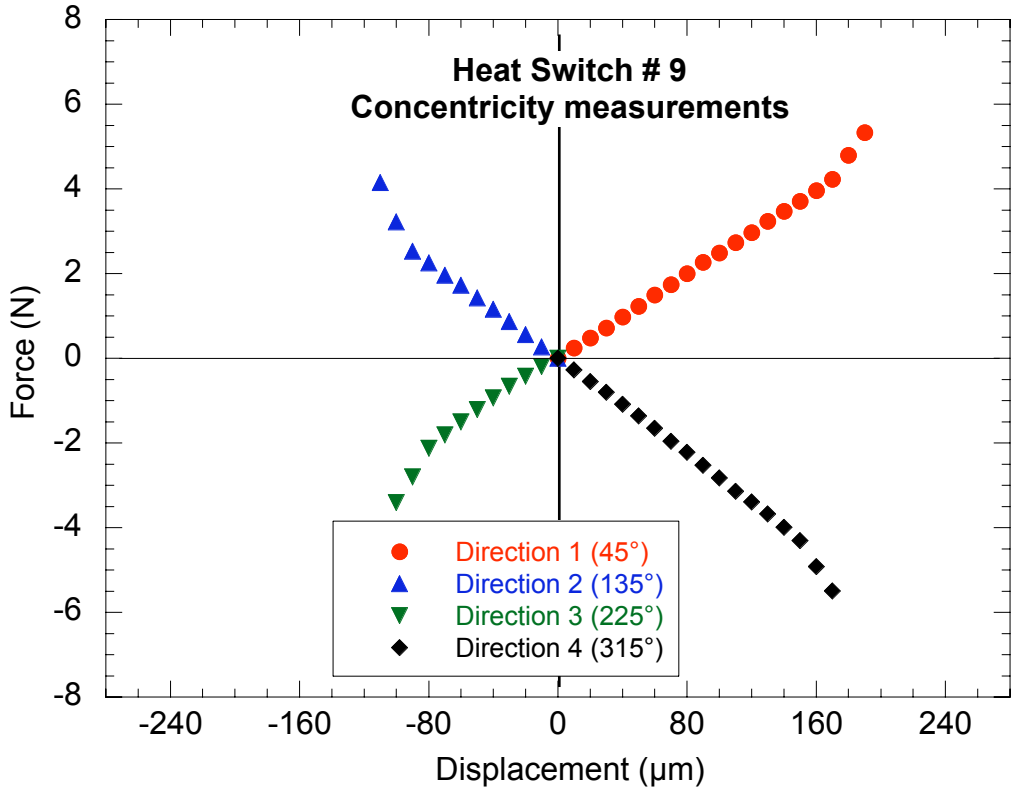


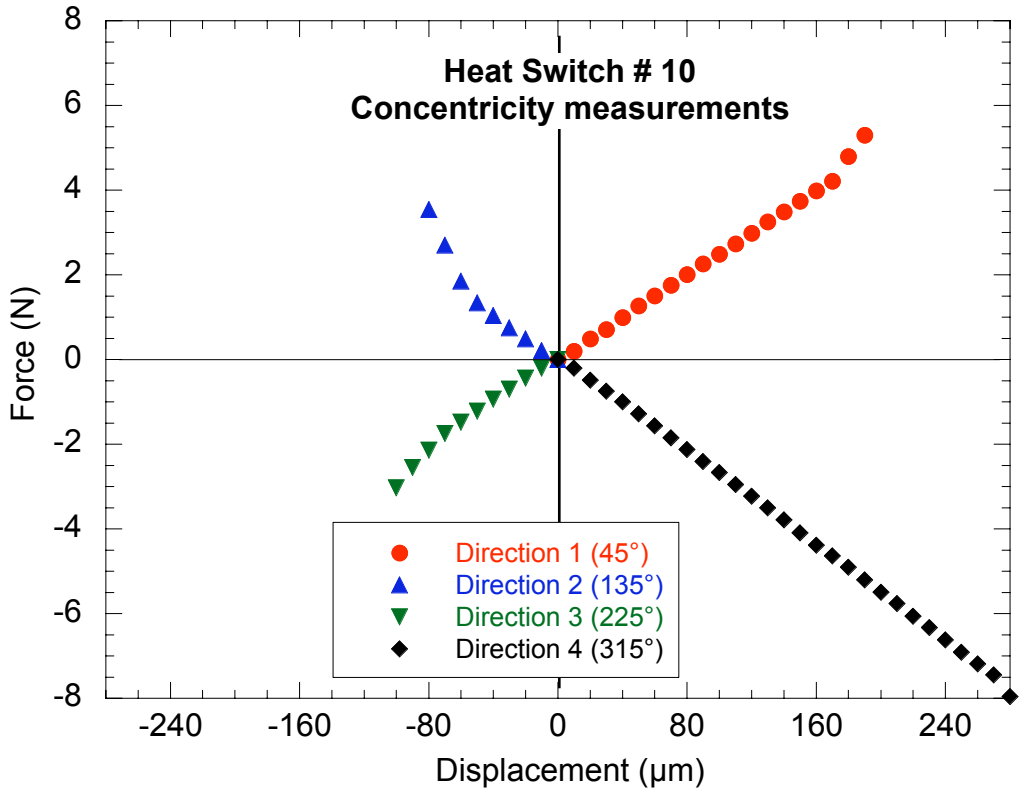










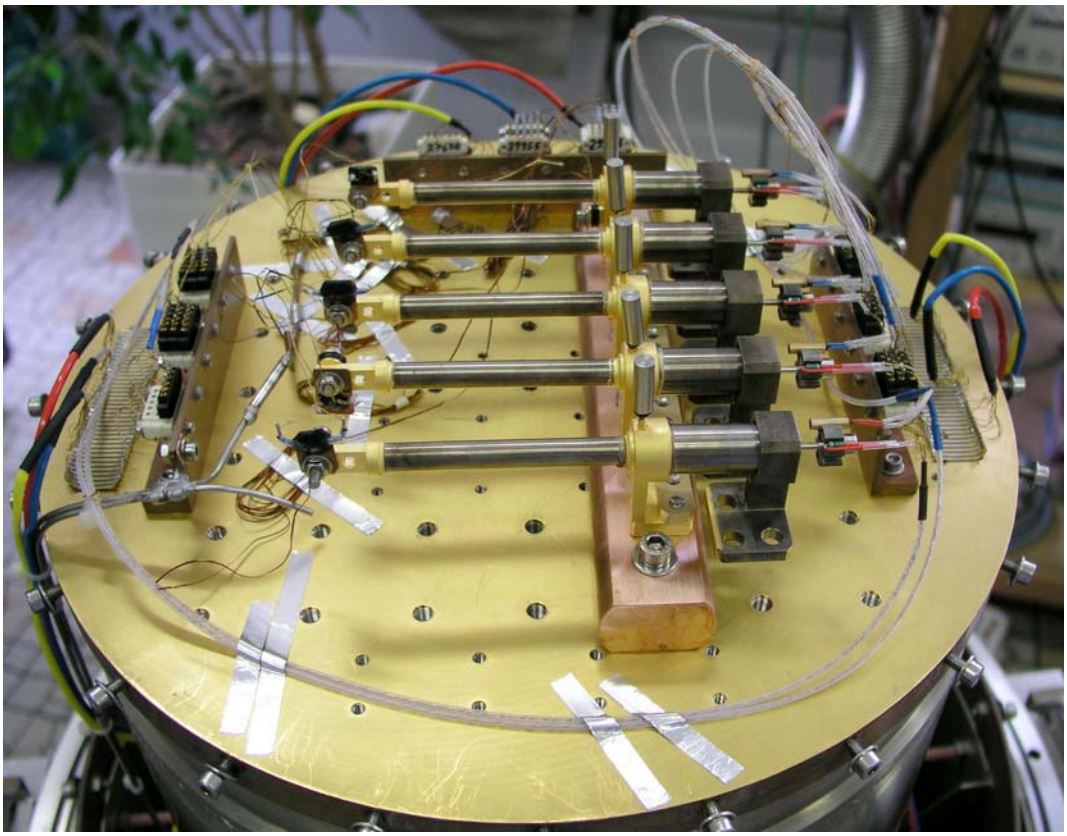


Switch #	*Relative position axis 1 – 3*	*Relative position axis 2 – 4*	*Off centered*
1	100	0	100,0
2	101	54,5	114,8
3	144	16	144,9
4	53	119,5	130,7
5	56	10	56,9
6	115	4	115,1
7	83,5	17,5	85,3
8	44,5	9,5	45,5
9	46,5	28,5	54,5
10	49	106	116,8

Rank	*Switch #*	*"Position" normalized to best one*
1	***8***	***100***
2	***9***	***83,5***
3	***5***	***80***
4	***7***	***53,3***
5	***1***	***45,5***
6	***2***	***39,6***
7	***6***	***39,5***
8	***10***	***39***
9	***4***	***34,8***
10	***3***	***31,4***

4 Thermal performance

The 10 gas gap heat switches were all characterized in a test cryostat. The switches were tested 5 by 5 (2 set of experiments). The first batch of switches mounted in the test cryostat is shown on the following picture.

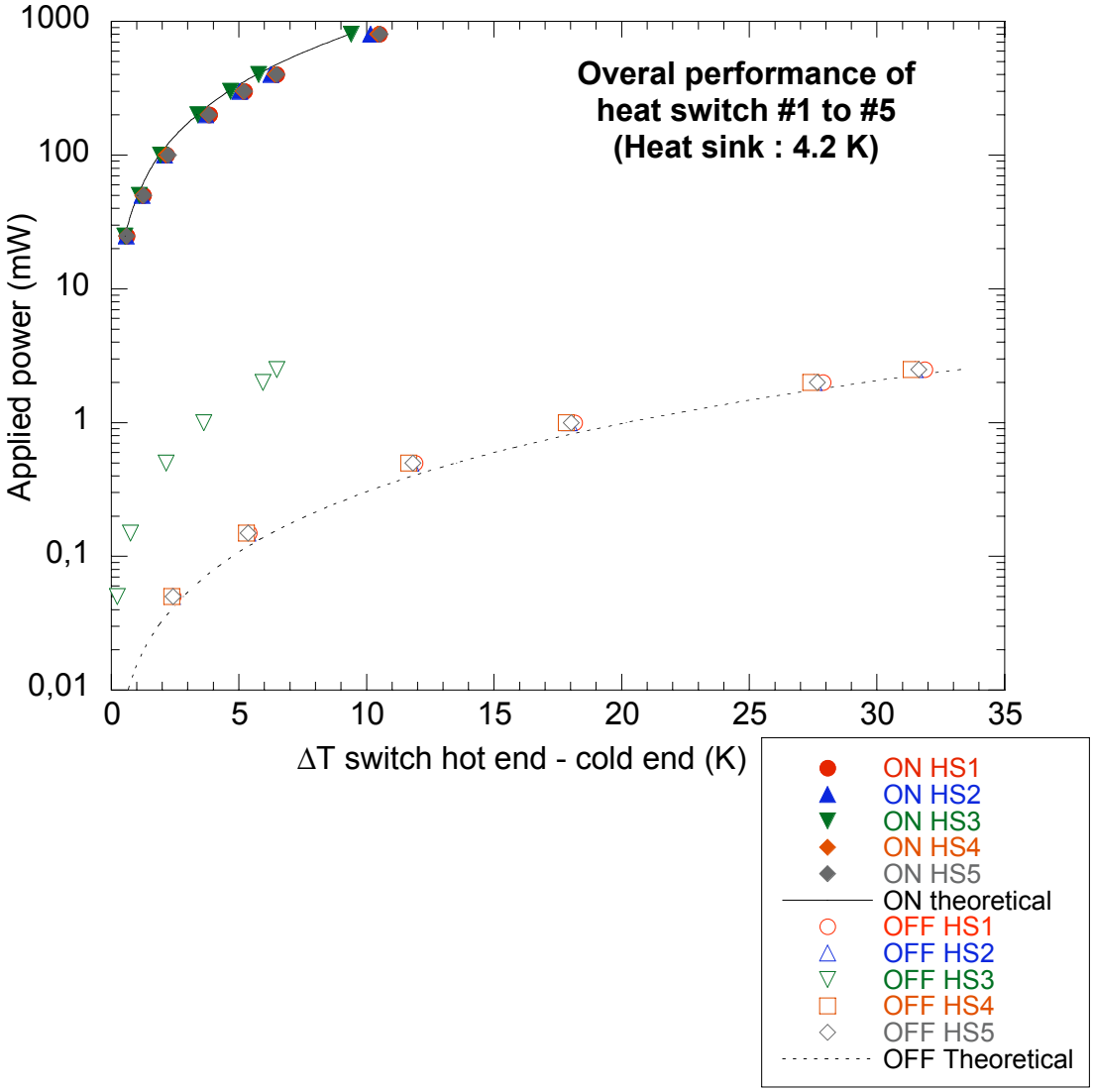


The experiments were carried out at 4.2 K. In addition tests were performed at 1.6 K for the OFF position to get data in the microwatt range.

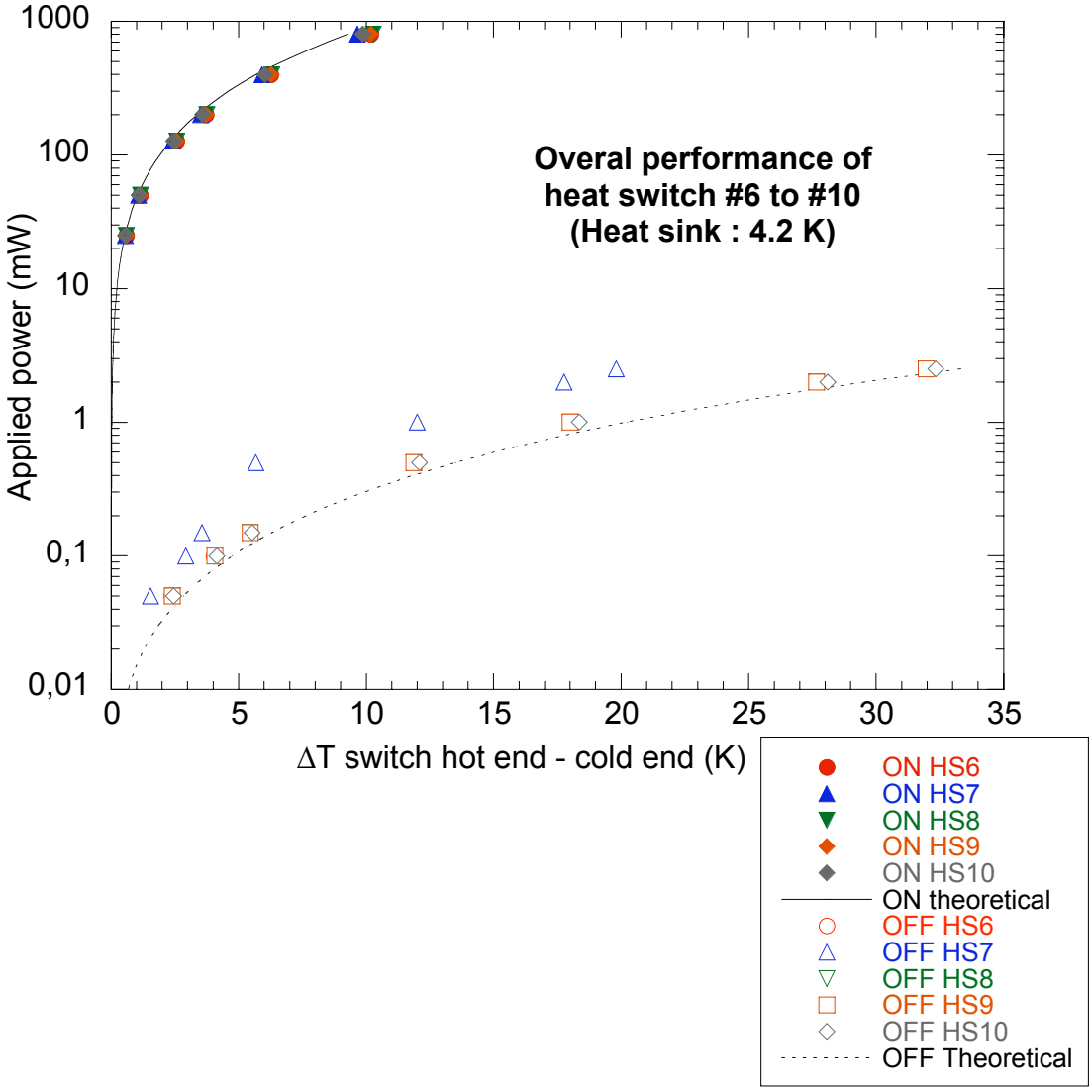
The switch bases are thermally grounded to the cryostat cold plate. Each switch end is then instrumented with a thermometer and a heater. Similarly the miniature sorption pump features a heater and a thermometer. This arrangement allows to characterize the ON and OFF conductance of the switch and to determine the switching temperature.

4.1 ON and OFF position

The results are reported in the following curves.

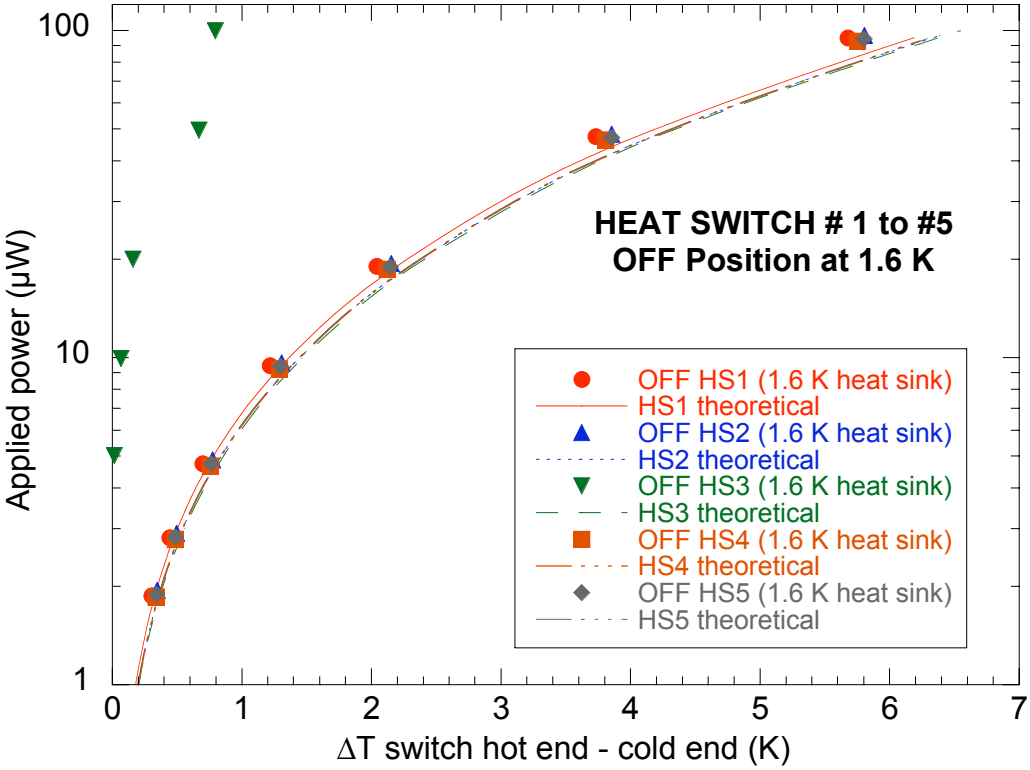


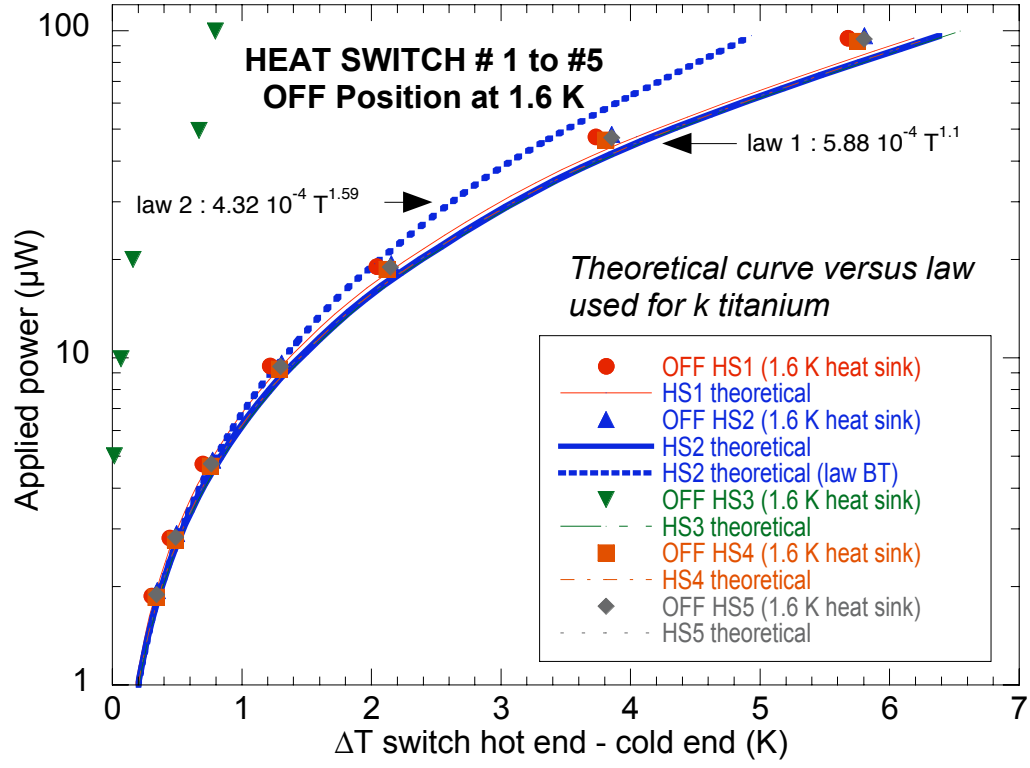
On this first set it clearly appears the heat switch #3 is not properly functioning. This was expected as the geometrical characterization shows this switch is the worst one.

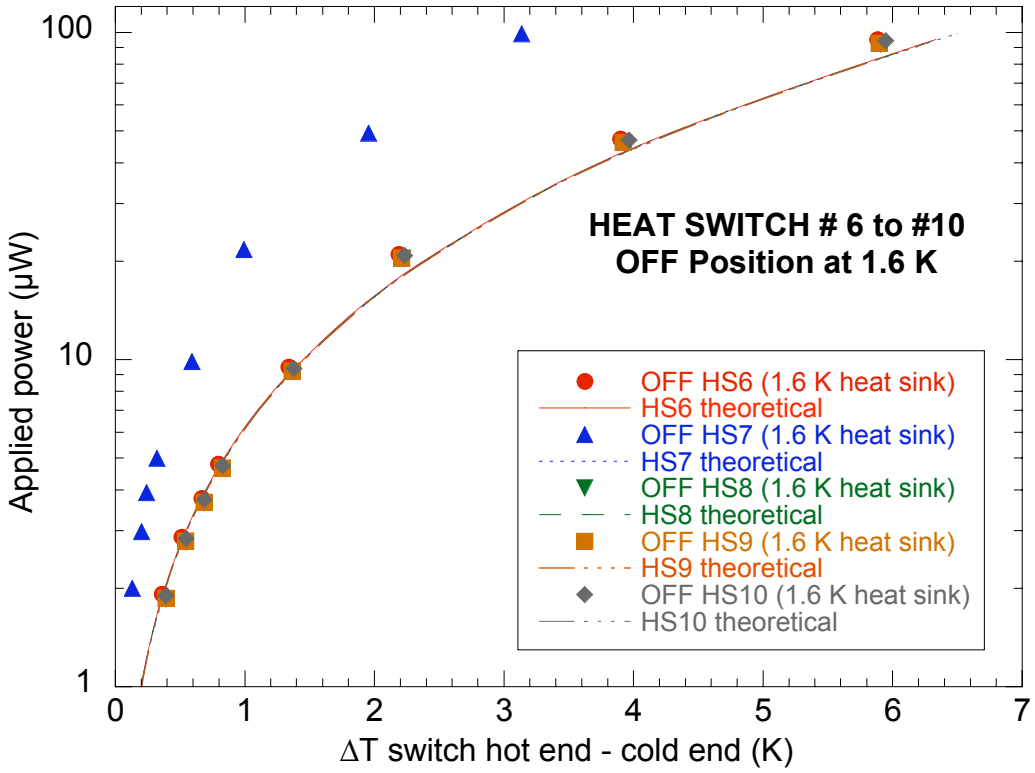


On this batch the heat switch #7 is defective. This is unexpected as the geometrical measurements did not reveal any significant deviation (switch was ranked 4).

The following curves deal with the performance at 1.6 K. Obviously HS#3 and HS#7 are found defective again. The thermal conductivity of titanium can be described by a series of mathematical fit associated to temperature ranges. In the 2 K range two laws overlap and although we use the most pertinent one, it is interesting to plot both theoretical curves (see figure). Note that the contributions from the manganin (heaters) and phosphor bronze (thermometers) wires are subtracted out from the overall power.
The experimental data are in fairly good agreement with predictions.

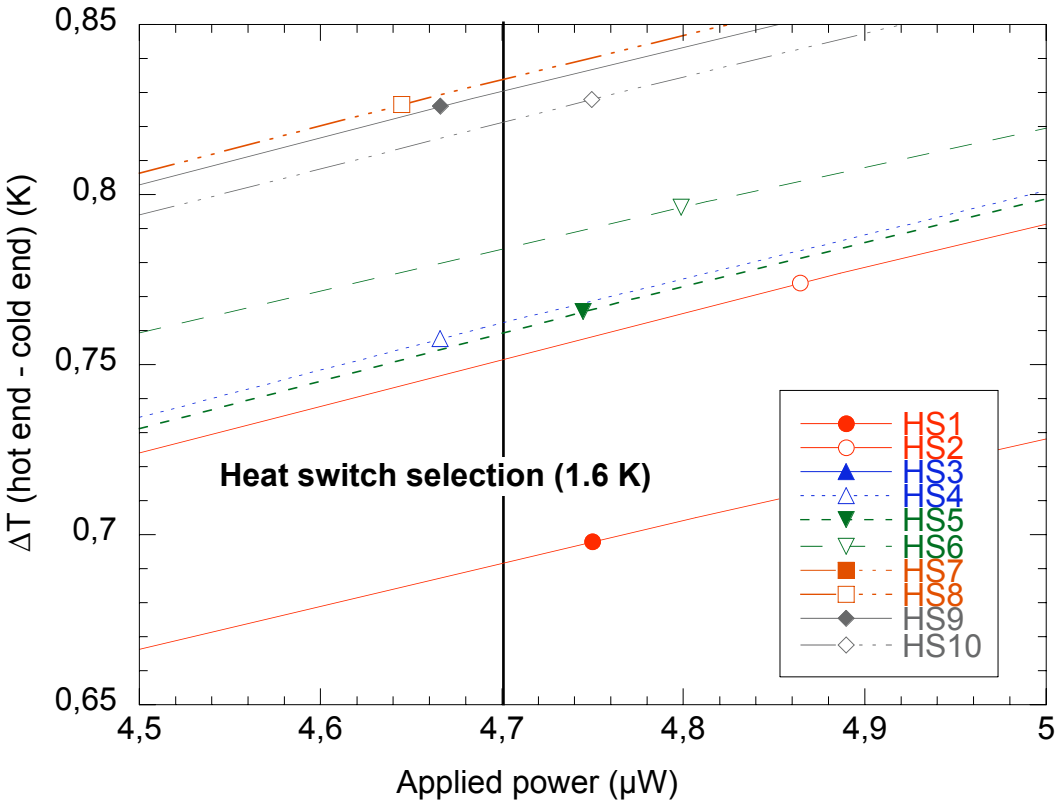






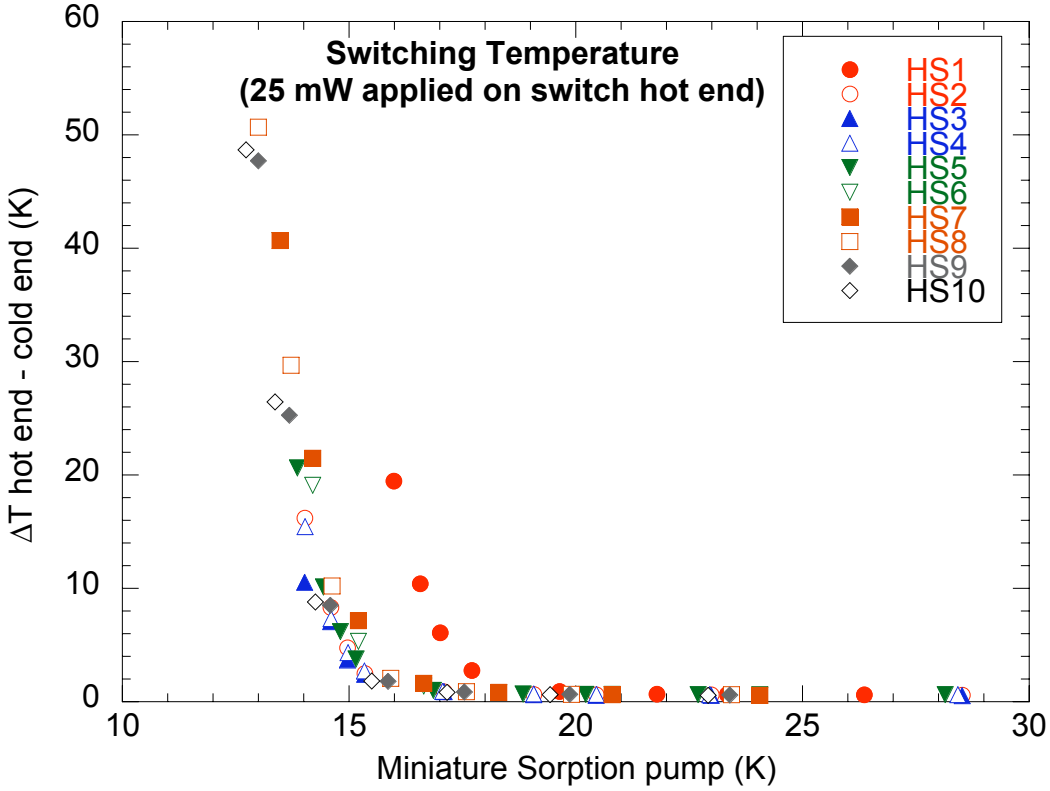
At these scales all switches to the exception of #3 and #7 seem to work properly with the same performance. In order to rank them, we have zoomed on the temperature difference between the hot and cold end for a couple of applied power (low values). This has been done for three applied loads : 2.8, 4.7 and 9.4 µW. The figure hereafter displays the results obtained for the 4.7 µW case, as the first table below summarizes the ranking for each case. Furthermore to get a better view of the ranking, the ΔT for the 4.7 µw case has been measured for each switch and has been normalized according to the largest one (best switch).

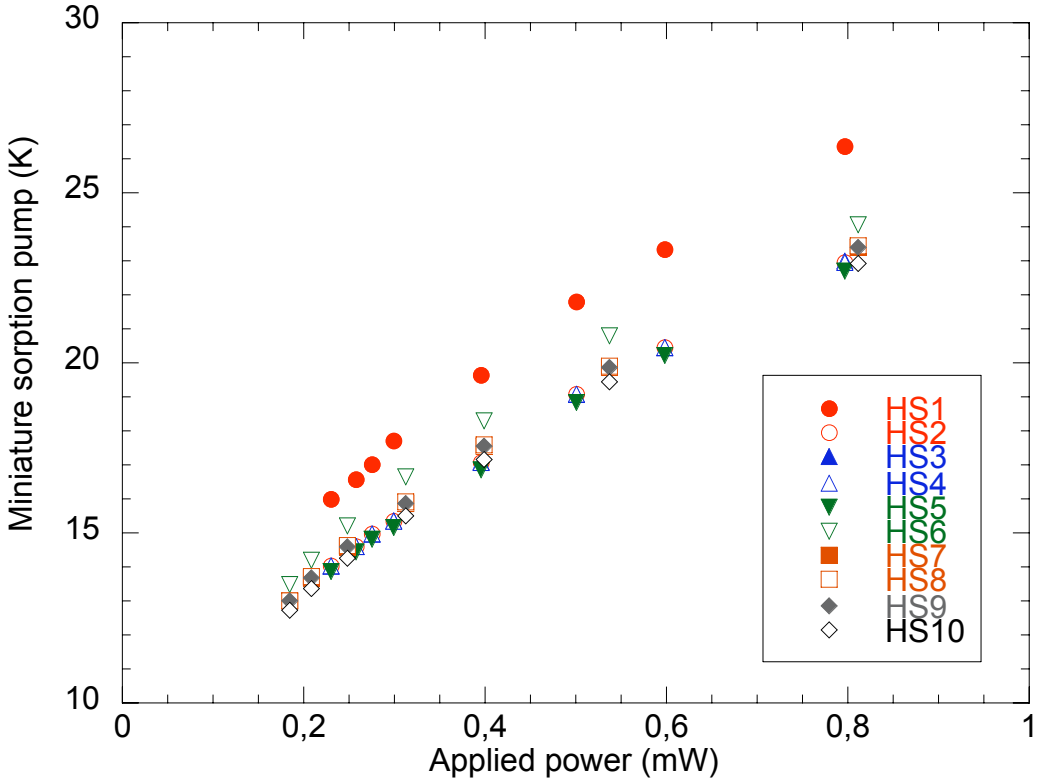
	Case and switch number				*Case 4.7 µW*	
Rank	*2.8 µW*	*4.7 µW*	*9.4 µW*		*ΔT*	*Normalized*
1	*8*	*8*	*8*		*0,833*	*100*
2	*9*	*9*	*9*		*0,83*	*99,6*
3	*10*	*10*	*10*		*0,821*	*98,6*
4	*6*	*6*	*6*		*0,784*	*94,1*
5	*4*	*4*	*4*		*0,762*	*91,5*
6	*5*	*5*	*5*		*0,759*	*91,1*
7	*2*	*2*	*2*		*0,751*	*90,2*
8	*1*	*1*	*1*		*0,691*	*83,0*
9	*7*	*7*	*7*		*0,3*	*36,0*
10	*3*	*3*	*3*		*0,013*	*1,6*



4.2 Switching temperature and kinetic

The objective of this first set of experiments is to "qualify" and select the best switches. Consequently the miniature sorption pump were instrumented with temporary heaters and thermometers (carbon thermometer calibrated to within ± 2 K). Thus the measurements on the switching temperature reported hereafter must be considered with great care and only show these temperatures are within expectations. Tests were also carried out to check the time response of each unit to switch from OFF to ON. All switches to the exception of HS#7 exhibited switching time of less than 1 mn once the temperature of the miniature sorption pump had raised above the switching temperature. For HS#7 the switching time remains within acceptable limit (< 5 mn); anyway this switch is defective (see thermal performance).





5 Overall ranking – switch selection

Heat switch #	Interfaces alignment	Centering aspect		OFF position (1.6 K)		Average mark	Switching time	**Overall Ranking**
		Result	Rank	Result	Rank			
1	***250-400 µm***	***45,5***	**5**	***83***	**8**	***64,3***	√	**8**
2	***150 µm***	***39,6***	**6**	***90,2***	**7**	***64,9***	√	**7**
3	√	***31,4***	**10**	***1,6***	**X 10 X**	***16,5***	√	**X 10 X**
4	√	***34,8***	**9**	***91,5***	**5**	***63,2***	√	**6**
5	√	***80***	**3**	***91,1***	**6**	***85,6***	√	**3**
6	√	***39,5***	**7**	***94,1***	**4**	***66,8***	√	**5**
7	√	***53,3***	**4**	***36***	**X 9 X**	***44,7***	≈√	**X 9 X**
8	√	***100***	**1**	***100***	**1**	***100***	√	**1**
9	√	***83,5***	**2**	***99,6***	**2**	***91,6***	√	**2**
10	√	***39***	**8**	***98,6***	**3**	***68,8***	√	**4**

The table below summarizes the final ranking of the switches as well as their allocation.

Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Switch #	HS 8	HS 9	HS 5	HS 10	HS 6	HS 4	HS 2	HS 1	HS 7	HS 3
Allocation	FM SPIRE evap.	FM PACS evap.	FS SPIRE evap.	FS PACS evap.	FM PACS pump	FS PACS pump	FM SPIRE pump	FS SPIRE pump	Defective	Defective

Note : HS 6 and HS 4 have been preferably attributed to PACS as the design constraint on the L0 interface are less flexible than with SPIRE. It is assumed here SPIRE design can compensate for the slight misalignment of the L0 interface. Note also that the switches will be eventually mounted in the structure on top of Kapton sheet (electrical isolation) and that the final geometrical characteristic of this interface will only be known then.

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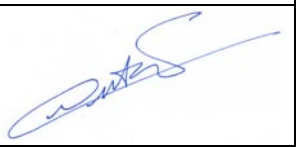
SPIRE Sorption Cooler
FM1 TESTS REPORT

SBT internal ref : SBT/CT/2004-68

	Name & Function	Date	Signature
Prepared	L. Duband - Cooler project manager	18/11/04	
SBT PA Check	M. Dubois – Cooler PA manager	18/11/04	
SPIRE Approval			
PACS Approval			
PA Approval			
Project Approval			
Project Approval	L. Duband - Cooler project manager	18/11/04	

Service des Basses Températures (SBT)
Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)
COMMISSARIAT A L'ENERGIE ATOMIQUE - GRENOBLE (CEA-Grenoble)
17, rue des Martyrs 38054 GRENOBLE Cédex 9, France.

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Issue	Revision	Date	Nb of pages	Modifications
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1	0	17/11/2004		First Issue

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List of Acronyms

AD	Applicable Document		
CEA	Commissariat à l' Energie Atomique		
CDE	Cooler Drive Electronic		
CDR	Critical Design Review	Revue de conception détaillée	RCD
CQM	Cryogenic Qualification Model		
ECSS	European Cooperation for Space Standardisation		
FIRST	Far Infrared and SubmillimetreTelescope		
FS	Flight spare		
HSO	Herschel Space Observatory		
N/A	Not Applicable		
PACS	Photoconductor. Array Camera and Spectrometer		
FM	Flight Model		
PSS	Product Assurance Specification System		
RD	Reference Document		
SAp	Service d'Astrophysique		
SBT	Service des Basses Températures		
SCO	Sorption Cooler (full unit)		
SPIRE	Spectral & Photometric Imaging Receiver		

1 Scope of the document

This note summarizes the experimental results obtained during the acceptance program carried out on the SPIRE flight model cooler (FM1).

This cooler is referenced “Sorption cooler FM Ref.: 2000-14B 000 S/N : 1” and has been attributed to the SPIRE project. As such it features 0.5 mm Kevlar strings on the sorption pump side, and 0.29 mm Kevlar strings on the evaporator side.

2 Documents

2.1 Applicable documents

2.2 Reference documents

	Title	*Reference*
RD01	SPIRE and PACS Sorption Coolers – AIV Plan	HSO-SBT-PL-013
RD02	SPIRE and PACS Sorption Coolers – Health Check	HSO-SBT-PR-031
RD03	SPIRE CQM Tests report	HSO-SBT-RP-085
RD04	Hold time anomaly - Analysis	HSO-SBT-TN-091
RD05	Heat switch [1-10] Tests Report	HSO-SBT-RP-107

3 Test sequence

The tests sequence performed on the sorption cooler which contributes, together with analysis and other verification methods, to qualification, is summarized in the table below.

Thermal characterization of the heat switches
Cooler empty – 20 MPa proof pressure test
Cooler heart filling and pre-thermal test

Assembly is then completed (cooler filled, integration of heat switches, suspension system, etc…)

Health Check – Reference test
5 days bake out at 80°C under vacuum
Health Check #2
Vibration tests
Health Check #3
Nominal test (hold time under 10 µW heat load)

A recurrent task has been defined and corresponds to a test referenced as the "Health Check". This test allows to verify nominal operation of the cooler from a mechanical, leaktightness and thermal point of view. A specific data sheet referenced as "Health Check Report" has been established, in which the experimental results are reported (see for instance § 6.3). This health check has been performed initially after FM assembly and then after the bake out and vibration tests to check for the integrity of the cooler. To differentiate them from the test carried out on the CQM, the FM HCR are labeled following HCR#N0n, where N is the S/N number and n the sequence number (the first FM1 SPIRE HCR will thus be referenced HCR#101).

4 Test cryostat

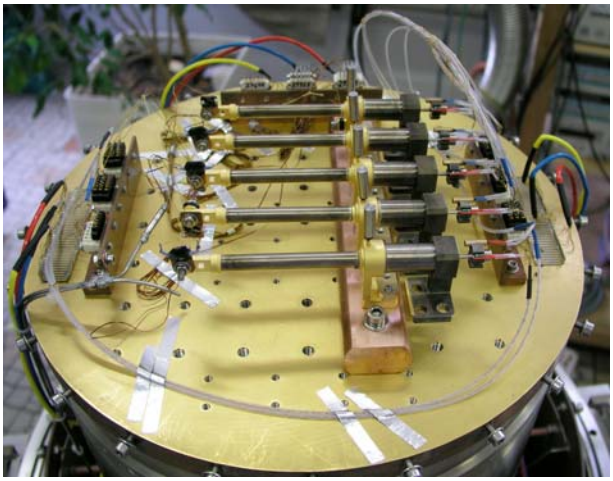
A test cryostat, CRYOTEDI III, has been designed and manufactured. This cryostat contains a nitrogen and a helium tank, both supporting thermal shields. The useful volume on the cold plate is about 300 mm in diameter and 200 mm height.
A particular feature of this test cryostat is the possibility to operate in any orientation between –90° and +90° as long as the liquid level is equals or below 50% (which is usually the case once the helium bath has been brought down from 4.2 K to 1.8 K). This feature allows to test the sorption cooler in any orientation. A schematic as well as a picture of this test cryostat are shown hereafter.

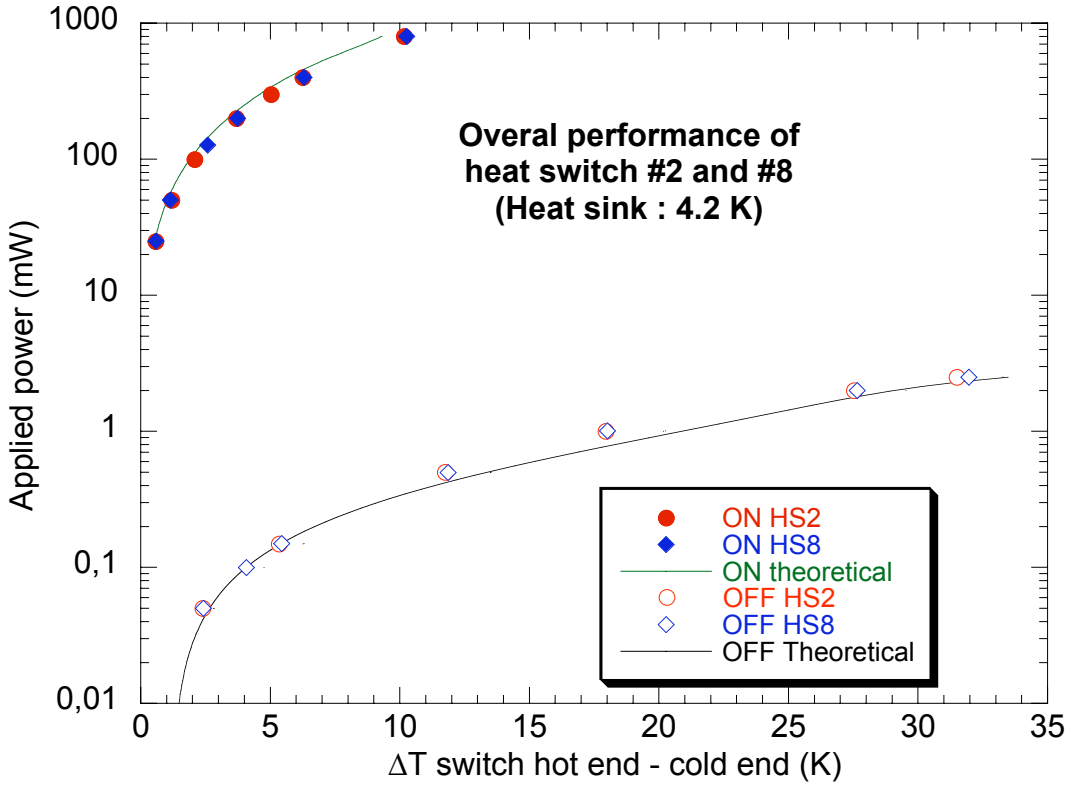
This cryostat provides autonomy of about a week at 1.7 K.

5 Thermal characterization of the heat switches

10 heat switches have been manufactured and characterized. Details on the experiments carried out and on the results obtained can be found in RD05. The two best heat switches (HS #8 and 9) were selected to be used on both flight models evaporator (SPIRE and PACS).

The curve hereafter displays the performance of the two switches used on FM1 (SPIRE); HS #2 is mounted on the sorption pump side and HS #8 on the evaporator. For this experiment the switch bases are thermally grounded to the cryostat cold plate at 4.2 K. Each switch end as well as the miniature sorption pump are instrumented with a thermometer and a heater. This arrangement allows to characterize the ON and OFF conductance of the switch and to determine the switching temperature. The switching temperatures are in the 15 K range as expected (see RD05).





6 20 MPa Proof Pressure test

The cooler heart has been helium pressure tested at 200 Bars (20 MPa) in a dedicated box. This test is carried out following the SBT procedure HSO-SBT-PR-025.
The test box is connected to helium leak detector and is maintained under vacuum. The helium leak rate is recorded during the test.
The inspection sheet (FI) associated with this test is reproduced below.

SPIRE & PACS Sorption Coolers
FICHE D'INSPECTION (FI)

Référence : **HSO-SBT-FI-108**

SERVICE DES BASSES TEMPERATURES

Type d'inspection :
~~*1. Approvisionnement*~~ — *3. Réception pièces*
~~*2. Equipement*~~ — ~~*4. Autre*~~

Type de contrôle :
~~*1. Visuel*~~ — ~~*3. Fonctionnel*~~
~~*2. Dimensionnel*~~ — *4. Autre : essai de fuite*

Date : 5 / 8 / 2004
Nom : L.CLERC
Signature :

Renseignements concernant l'équipement à inspecter :
Modèle concerné : FMs
Nom et réf. item : Ligne Pompe Evaporateur 2000-14 B 200
Fabriquant : *Sous traitant :*

Renseignements qualité : Essais de fuite réalisés par le SBT (tache CO 120 de AIV)
PV contrôle : *Référence spéc. :*

Rapport :

Essais de fuite à 200 bars suivant procédure HSO-SBT-PR-025.

FM1 – 2 minutes à 203 bars : Niveau de fuite 1.10^{-10} mbarl/s
FM2 – 2 minutes à 200 bars : Niveau de fuite 10^{-9} mbarl/s
FM3 – 2 minutes à 202 bars : Niveau de fuite 10^{-9} mbarl/s
FM4 – 2 minutes à 200 bars : Niveau de fuite 9.10^{-10} mbarl/s

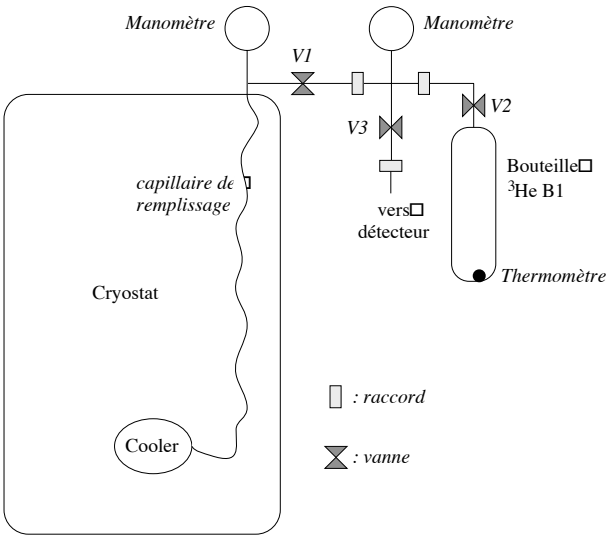
Anomalie(s) : ~~*OUI*~~ *NON* ***Si oui, Ref FA :***

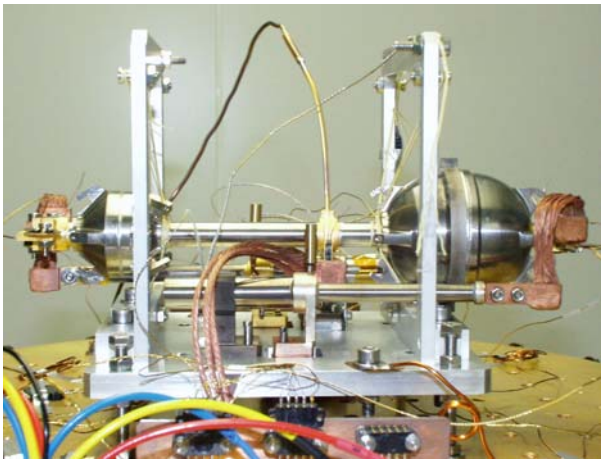
Visa Projet *Nom, date et signature :* D JOBAND 5/08/04

Visa Qualité *Nom, date et signature :* DUBOIS – 5/8/2004

7 Cooler heart filling and preliminary thermal tests

As it is rather difficult to obtain helium 3 gas bottle under high pressure (> 100 bars) and additionally since this pressure would eventually become lower than the required cooler fill pressure, the cooler is filled cold. The cooler heart is mounted in the test cryostat using a simple aluminium structure and two heat switches (from a thermal point of view this set-up is almost identical to the flight configuration). The cooler heart is then connected to the outside world via a small capillary – at the end of this capillary a manometer and a valve.
A helium 3 gas bottle is connected to a circuitry comprising the necessary manometers and valves, so this set up can be mounted on the cryostat (connection to the above mentioned capillary) and to a helium 3 (4) leak detector.





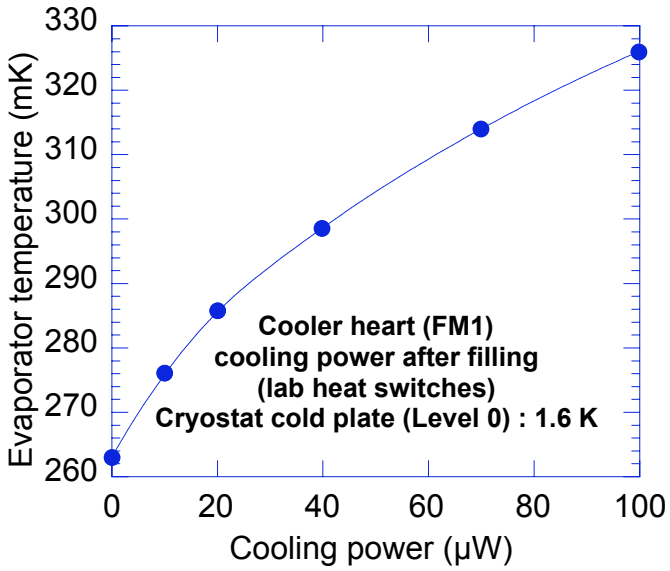
Once the sorption pump is cold (≈ 4 K), it is used to suck in the required amount of gas. The amount to be injected is calculated using the perfect gas law (fine for 3He at 300 K).

Following the results obtained with the CQM units (slight under filling - see RD03 and RD04) the filling procedure (HSO-SBT-PR-029) has been revisited and in addition an engineering change request (ref. HR-SP-RAL-ECR-078) was issued by the SPIRE project to slightly overfill the cooler.

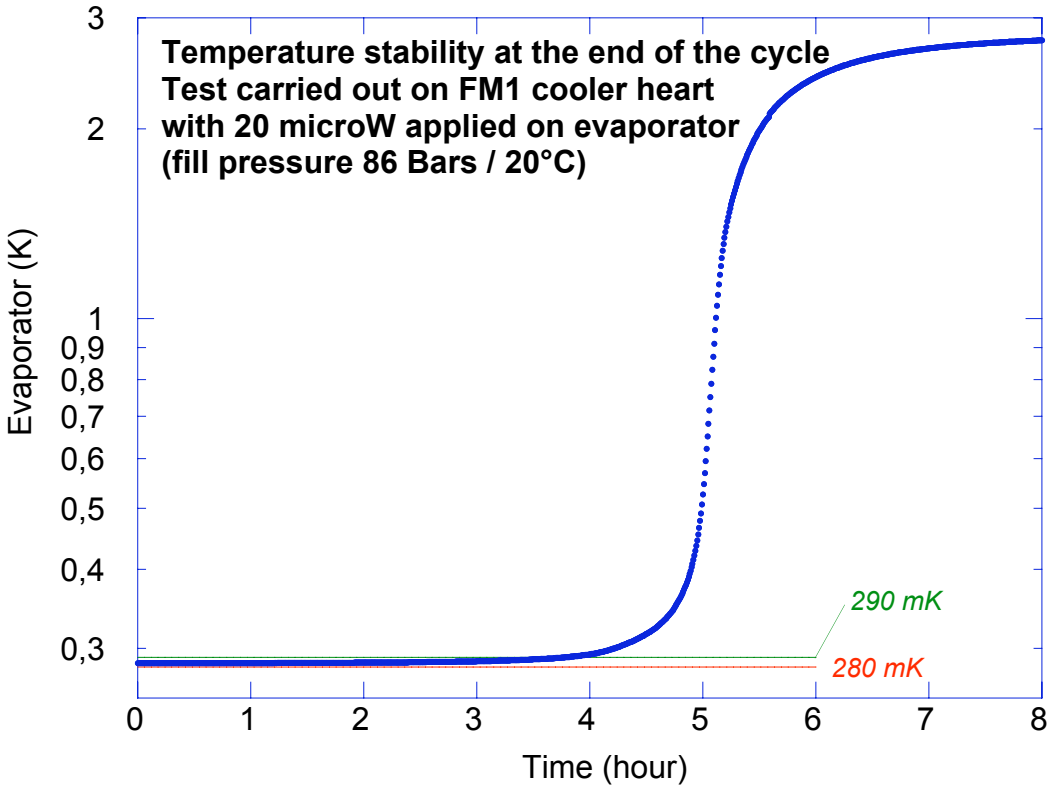
Calculations performed by CEA-SBT indicate a 10% overfilling of the cooler is acceptable. The main issue is the temperature stability at the end of the cycle, as it can be impacted by a change in the ratio of the amount of helium to the mass of activated charcoal. Although calculations show there should not be any substantial effect, the uncertainties on the helium 3 adsorption isotherms calls for caution.
Of course a 10% overfilling increases the energy needed per cooler operation.

For the SPIRE CQM unit the fill pressure was 7.54 MPa at 20°C, and consequently for the FM filling an objective around 8.5 MPa has been set. The cooler heart was filled and the resulting fill pressure measured once the FM cooler heart was back at room temperature (20°C) is 8.6 MPa. As the results on the CQM indicated the cooler charge was ≈ 5.52 l STP, we can now assume the current charge is 5.52*(86/75.4) = 6.3 liters STP. This number must be considered correct within ± 5%.

The thermal performance of the cooler heart was measured. It should be noted that for these preliminary tests, laboratory heat switches are used.

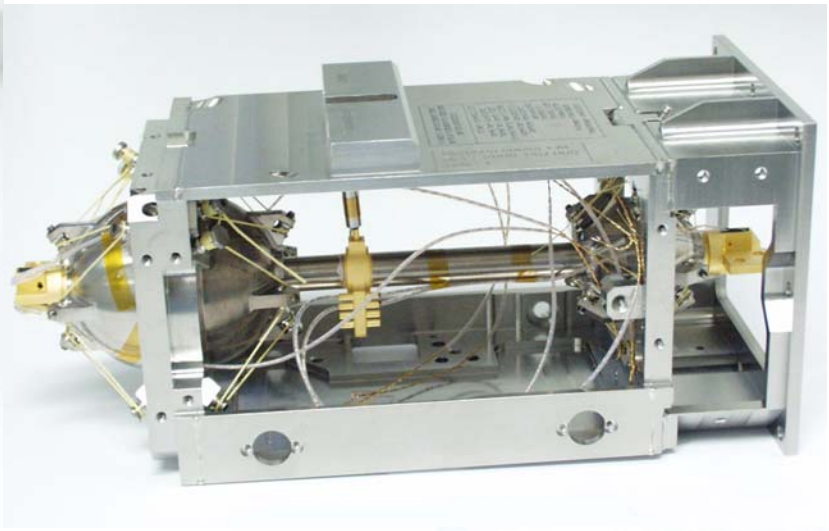


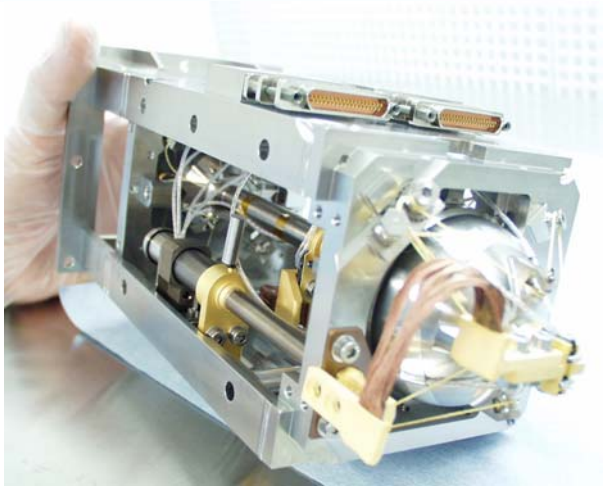
The tests results are satisfactory and no particular problem was spotted. A stability test on the evaporator temperature at the end of a typical cycle (few hours prior the cooler ran out of liquid helium 3), with 20 microwatts of power applied to the cold tip, did not show any peculiar temperature drift : once the liquid helium 3 is exhausted the evaporator temperature raises back to the cryostat cold plate (or above as power is applied to the evaporator) in the course of an hour. This behavior is similar to what has been measured in the past for the CQM units.



8 Final cooler assembly

Following the filling process, the cooler heart was integrated in the flight structure and the suspension system was mounted. Once the strings were pretensioned, the partly assembled cooler went through the Kevlar training process (procedure HSO-SBT-PR-028). The heat switches were then integrated and the final assembly of the flight cooler was finished.

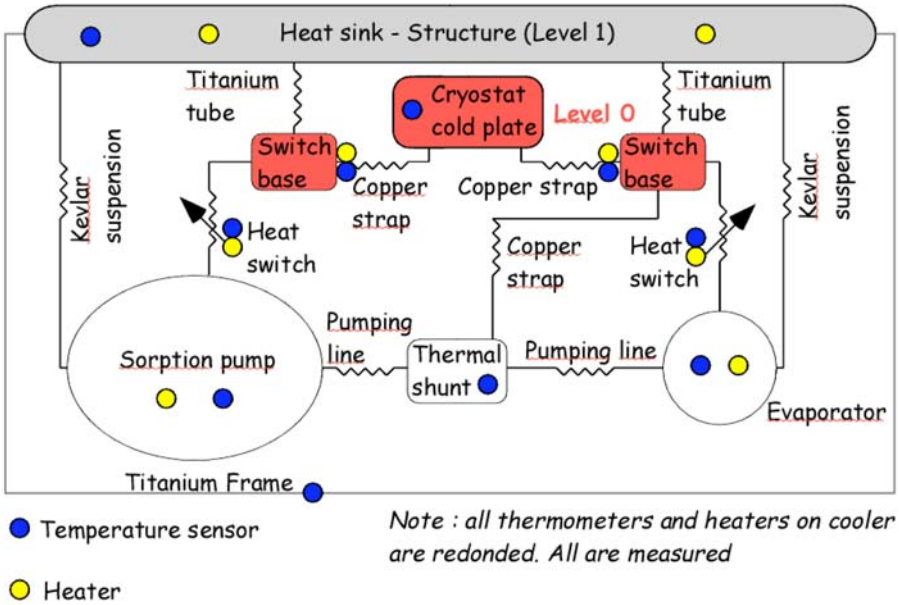




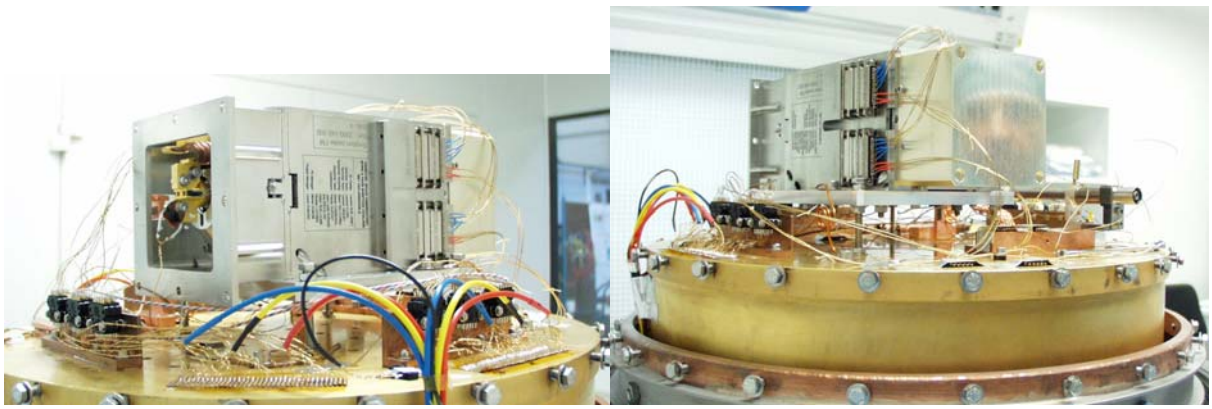
9 Acceptance program

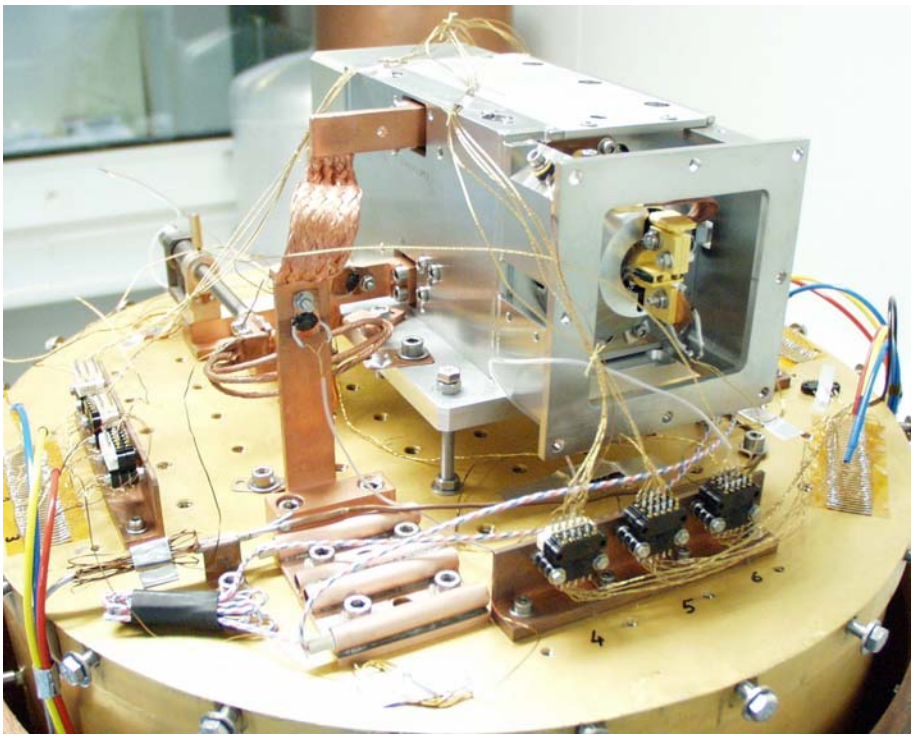
9.1 Initial thermal characterization – Health check HCR#101

The thermal architecture of the sorption cooler mounted in the test cryostat (representative as much as possible of the real instrument) as well as a set of pictures of the cooler in the test cryostat are shown hereafter.

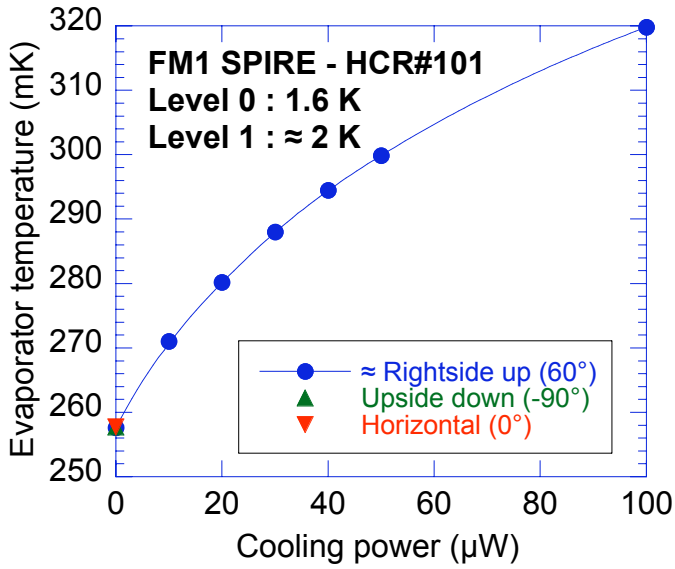


The cooler is mounted on an aluminum interface plate which can be temperature regulated in the range [2 K – 10] (or above if necessary). This interface acts as the level 1 interface. Then two copper straps thermally grounded to the cryostat cold plate (level 0) on one side, are connected to the heat switch interfaces on the other side. Both straps feature a thermometer and a heater, so they can thermally characterized and used later as thermal shunts to determine the heats flowing during the recycling process. Finally the heater and thermometer on the evaporator switch interface are used to regulate this interface (level 1) to 1.7 K or else when necessary.

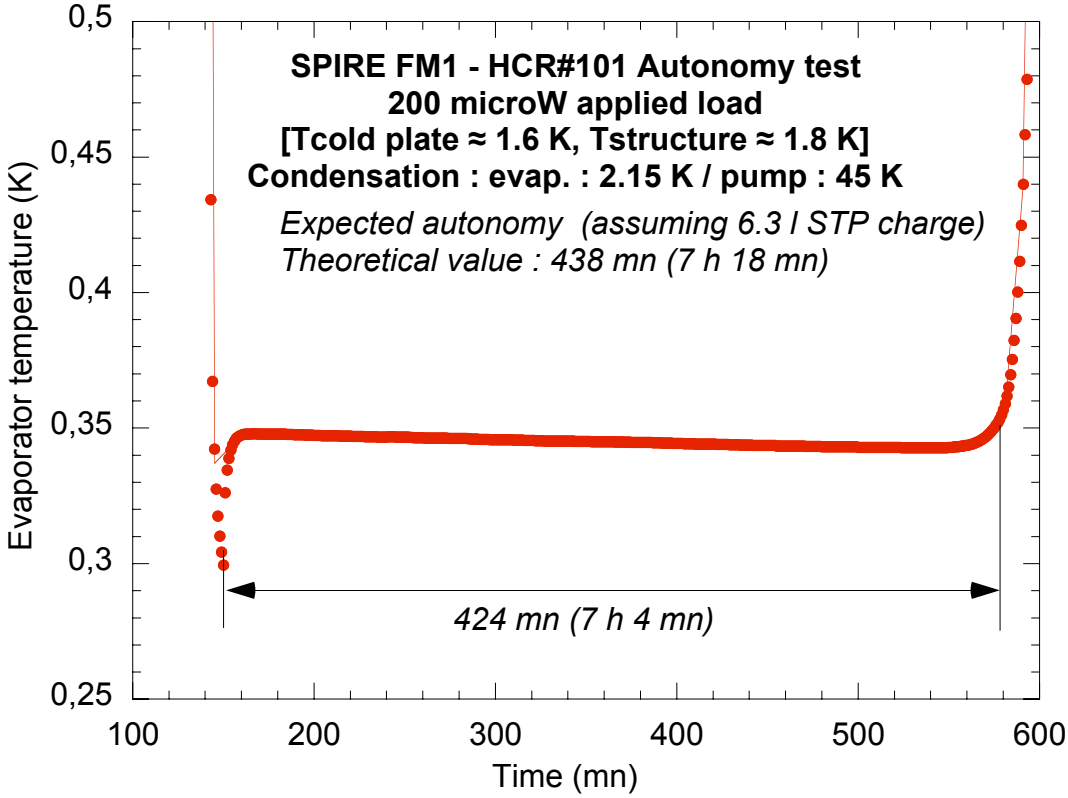


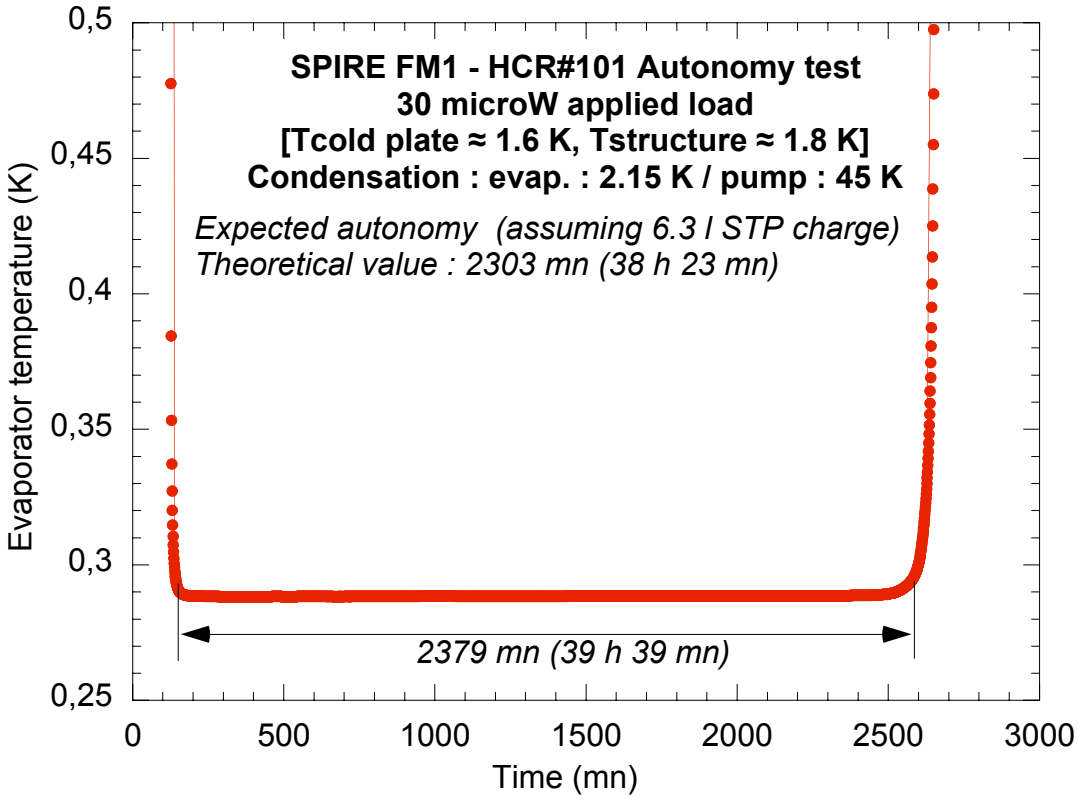


During the CQM program, both coolers (SPIRE and PACS) were extensively characterized.

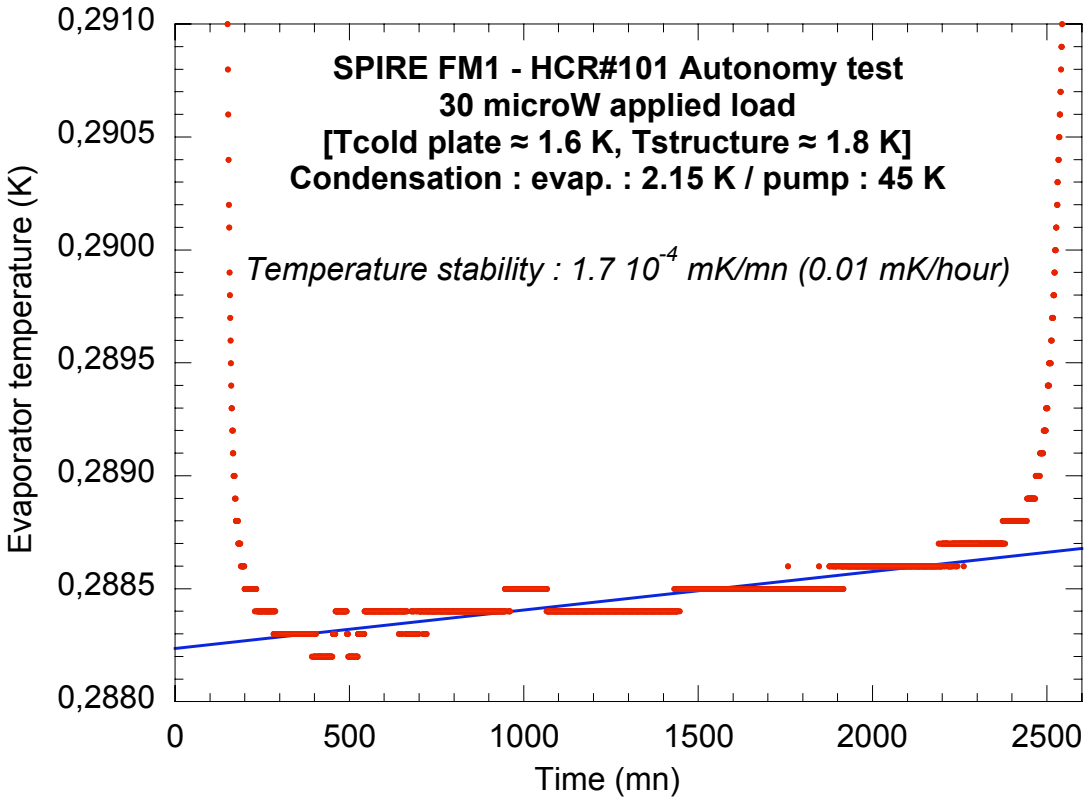


In particular the effects of the interfaces temperature were investigated. These experiments have not been repeated for this acceptance program and the tests carried out here focus on the actual performance of the cooler. For additional information the reader is referred to RD03 and RD04. § 9.5 (HCR#103) features some curves on the recycling process and energy aspects.
The cooling power curve of the cooler is shown on the opposite figure.
No difference were seen between the various orientation of the cooler (right side up, horizontal or upside down). The insensivity to orientation is further discussed in § 9.5 (HCR#103).
The ultimate temperature obtained is fairly low and is already a good indication of the absence of any significant unexpected parasitic load.
Two autonomy tests were then performed, respectively with a 200 µW and 30 µW applied heat load. The results are displayed in the following curve. Note that for the predictions we are assuming a 6.3 l STP charge.





If we assume for now the cooler charge is 6.3 l STP, the experimental results are in excess of a few percents of the predictions and demonstrate the cooler is operating correctly. It should be noted that when the cooler runs out of liquid helium, there is no sharp temperature rise and thus the estimation of the experimental hold time can vary more or less by one hour (30 µW case) depending what is the temperature scale used. To try to be as close as possible to "reality" we assume the cooler is out of liquid once the temperature has raised by 1% (i.e. 3 mK for the 30 µW case). This is illustrated in the following figure where we have also plotted the temperature stability over the entire cycle for the 30 µW case.

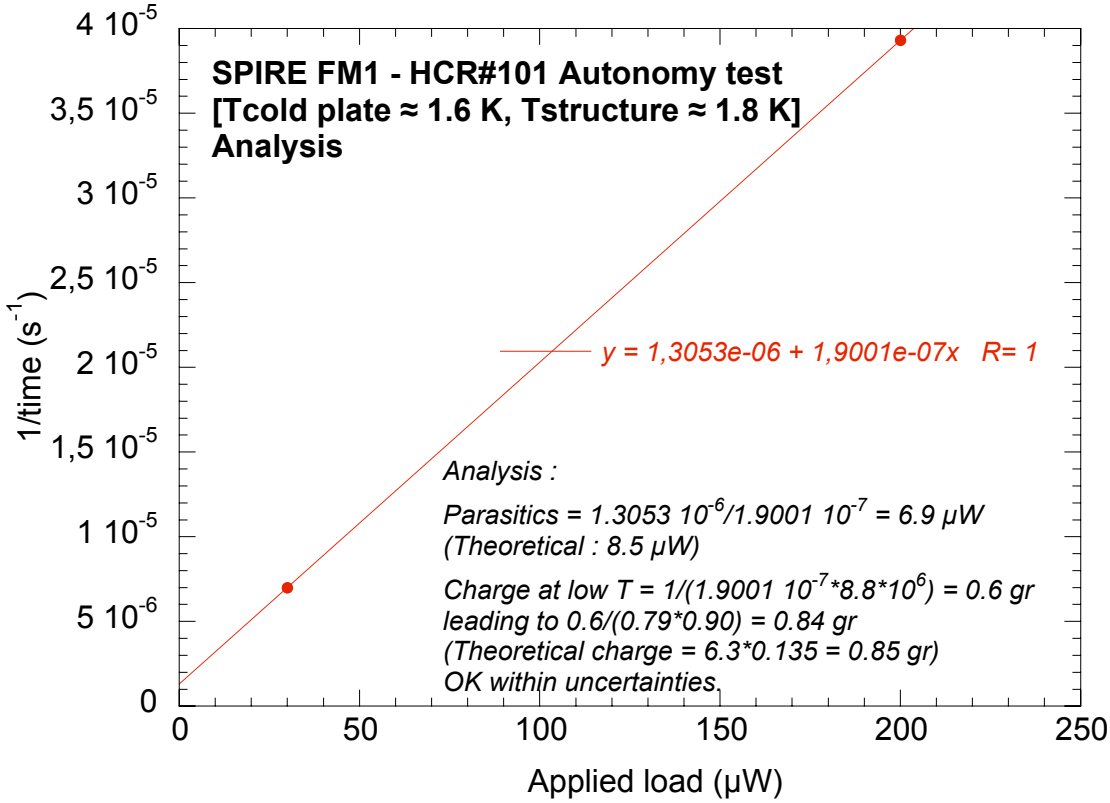


Although we only have two data points, one can produce an estimation of the parasitic load and the charge of helium gas in the cooler. This analysis has been presented in RD03. The basic idea is to perform the different recycling process in the same exact thermodynamic conditions. One can then assume the amount of liquid at ≈ 300 mK at the beginning of the low temperature phase is the same. In addition the operating temperatures are close enough the latent heat (L) can be considered constant to within 5%.

We can then simply write the amount of "cold" joules produced is equals to the total load times the autonomy : $m_0 \times L = (P_{applied} + P_{parasitics}) \times time$ (where m_0 is quantity of liquid at the beginning of the low temperature phase).

Plotting 1/time versus $P_{applied}$ should then gives a curve of slope $1/(m_0 \times L)$ and of ordinate $P_{parasitics} /(m_0 \times L)$.

This analysis is reported on the following figure and indeed indicate the performance of the cooler are satisfactory.



The health check report sheet associated with these first set of tests is displayed on the following page. In addition to the thermal performance, this sheet features information on the leaktighness of the cooler, Kevlar strings suspension, etc….

At the outcome of this first phase we can conclude the cooler is operating as expected.

Grenoble

SPIRE & PACS Sorption Coolers HEALTH CHECK REPORT (HCR)

(Version 2.1)

Référence : HCR# 101

Référence cryoréfrigérateur : ***Sorption Cooler FM Ref.: 2000-14 B 000 S/N : 1***

Raison du contrôle :

Premier tests thermiques sur FM1 (SPIRE)

Date : 23-26 Sept. 2004

Nom : CLERC / DUBAND

Signature :

Contrôle mécanique / électrique Visuel : OK R.A.S

Tension des brins Kevlar (Newton) (mesurée coté pompe)

Avant test Fil 1/8 : 128 Fil 6/8 : 99 Après test Fil 1/8 : 121 Fil 6/8 : 93

Contrôle impédance thermomètres (T) et chauffages (C) (à T ambiante, et comprenant les fils de mesures)
(indiquer pour chaque composants les valeurs en Ohm prises au connecteur principal (P) et redondé (R) (P/R))

T pompe	C pompe	T inter P	C inter. P	T évaporat.	T inter évap.	C inter évap.	T shunt
44.9 / 43.7	*406 / 407.4*	*47.2 / 48*	*407 /409*	*51.6 / 51.1*	*48.2 / 49.9*	*407.3 / 406.9*	*47.8 / 46*

Vérification isolation électrique : OK R.A.S (Sept. 21st 2004)

Remarques :

Contrôle de fuite Référence détecteur : ALCATEL ASM 180

Valeur de fuite mesurée / Avant : $6\ 10^{-10}$ mB.l.s^{-1} Après : $3.5\ 10^{-10}$ mB.l.s^{-1} Commentaires : OK

Contrôle thermique

Cycle A – *Phase de condensation :*

T bain ^{4}He	T structure	T pompe/Puiss.	T évaporateur	T inter P	T inter E/Puiss.	T shunt
1.75	*≈ 3*	*40*	*2.2*	*10*	*20*	*≈ 2.5*

Phase basse température – T bain : 1.6 K

Orientation	+90° (Endroit)	0° (Horizontal)	- 90° (Envers)	Commentaires :
T mini (mK)	*258*	*258.6*	*257.7*	

Courbe de puissance - Orientation : vertical évaporateur en bas (***+90***) et vertical évaporateur en haut (***-90***)

Charge (µW)	0 (Tmini)	10	20	30	40	50	100
T (mK) / ***+90***	*257.6*	*271*	*280.2*	*288*	*294.5*	*299.9*	*319.8*
T (mK) / ***-90***	*257.7*						

Cycle B – *Phase de condensation :*

T bain ^{4}He	T structure	T pompe/Puiss.	T évaporateur	T inter P	T inter E/Puiss.	T shunt
1.6	*≈ 2.8*	*45*	*2.15*	*5*	*20*	*≈ 2.5*

Phase basse température – T bain : 1.6 K (Level 0 et Level 1 non régulés)
Autonomie et température sous 200 µW de charge appliquée : 7h 4mn à 345 mK (calculé 7h 18mn)
Autonomie et température sous 30 µW de charge appliquée : 39h 39mn à 288.5 mK (calculé 38h 23 mn)

Conformité ***OUI*** ~~***NON***~~

RAPPORT :

Performances conformes aux prédictions. OK.

Visa Projet - Nom, date et signature : Lionel DUBAND

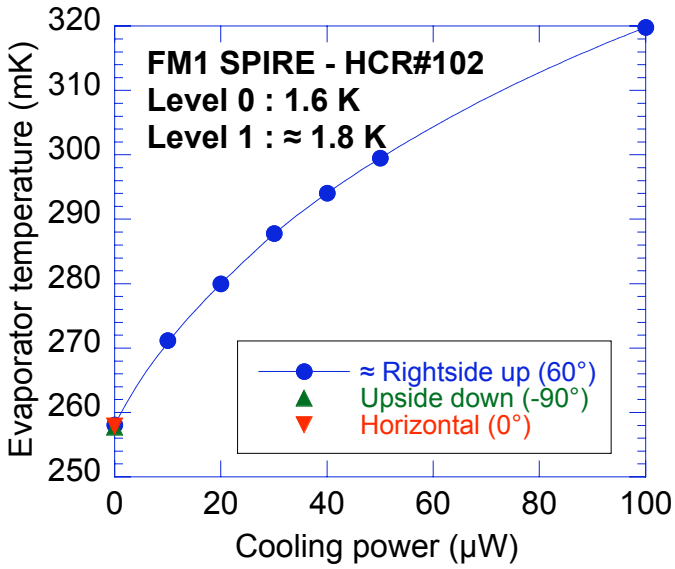
9.2 80°C Bake out

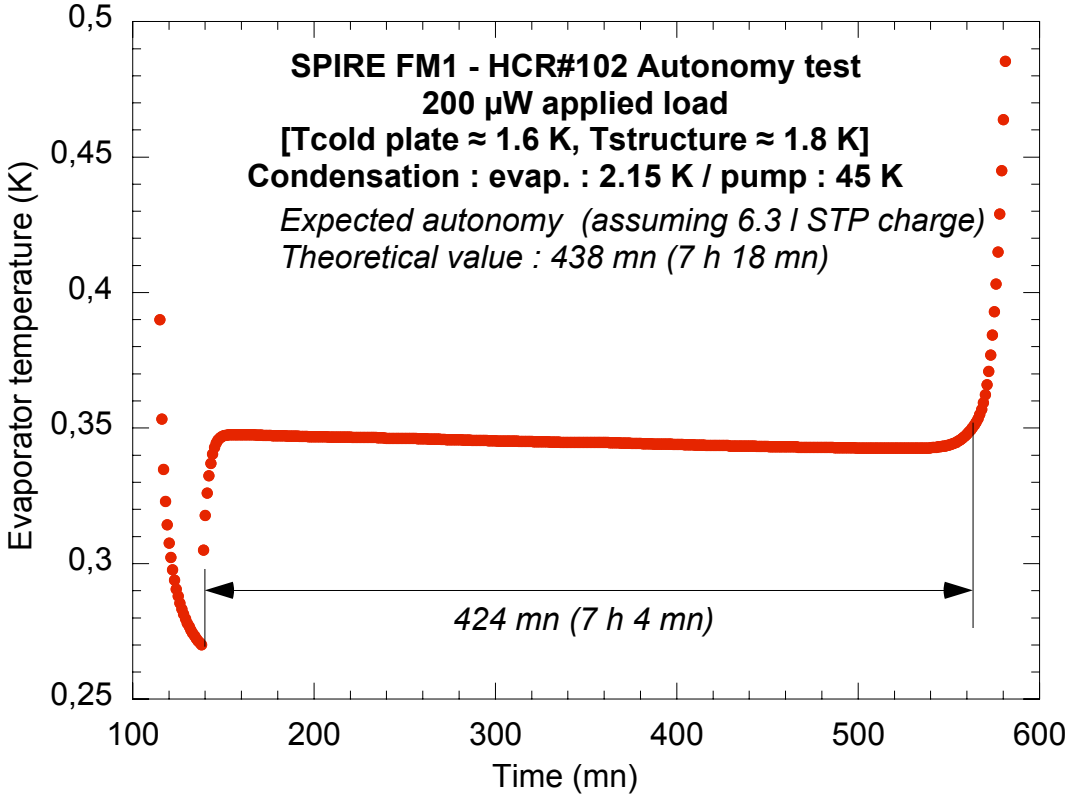
A 5 days bake out at 80°C under vacuum (primary) was then carried out on the cooler. The experimental set up is shown on the next picture.

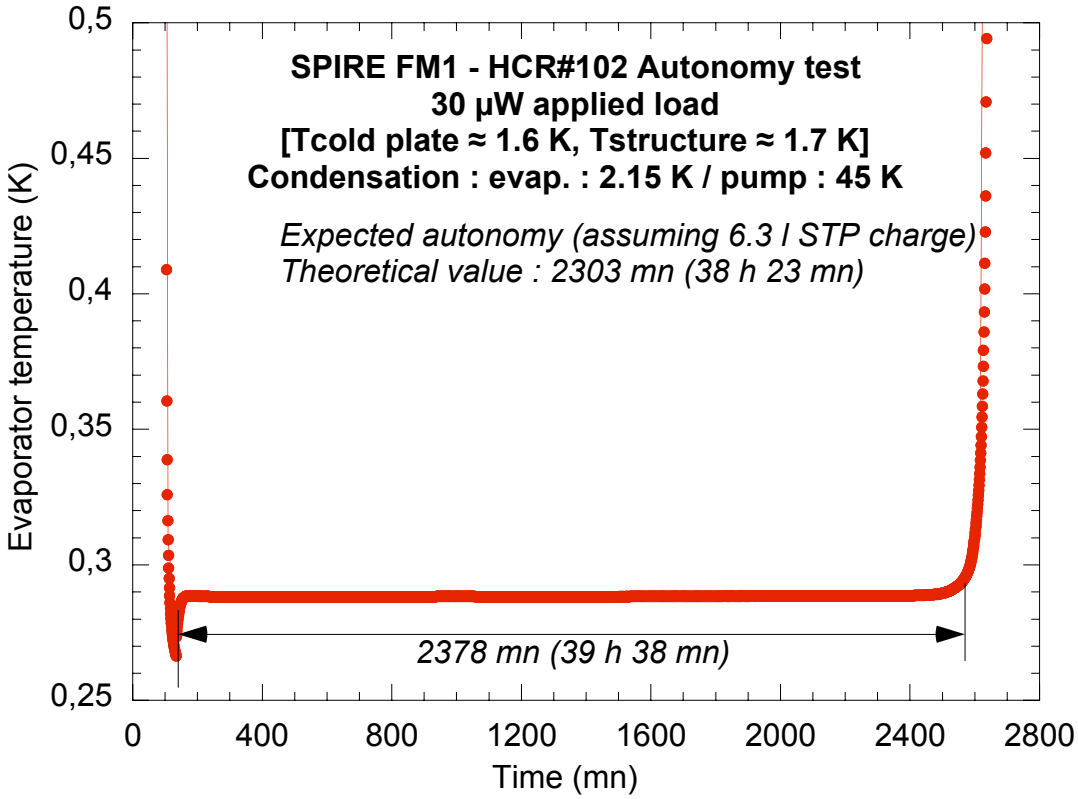
At the outcome of the bake out the cooler was successfully leak checked and the tension in the Kevlar strings was verified. No particular problem was spotted. The resulting values are reported in the HCR#102 sheet (data prior to thermal tests).

9.3 Health Check HCR#102

Following the 80°C bake out, a second set of thermal tests were carried out to check for the cooler integrity. No significant difference were seen with the first set (HCR#101).







Once this set of tests was over, the cooler and cryostat were warmed up. During this process, the redundant heater on the pump heat switch was inadvertently supply with a large power and as consequence the miniature sorption temperature raised above 100°C for several minutes. The redundant heater was damaged but the remaining components (main heater and thermometers) were still functional. This problem was reported to the project which agreed with SBT's proposition that this heater could be replaced with limited risk and with no impact on the cooler performance. The removal of the damaged heater and its replacement was then successfully carried out. This anomaly is traced and the related documentation can be found in the EIDP. The following pictures show this heater replacement process.

Due to a tight schedule, the thermal performance of the cooler could not be verified after this intervention. The cooler went through the vibration tests campaign and it is only during the third and last set of tests that we were able to confirm that indeed the performance of the cooler remained unchanged and the pump heat switch was behaving as before.

The health check report sheet for the second set of thermal test (HCR#102) is displayed on the following page.

SPIRE & PACS Sorption Coolers HEALTH CHECK REPORT (HCR)

(Version 2.1)

Référence : HCR# 102

Référence cryoréfrigérateur : ***Sorption Cooler FM Ref.: 2000-14 B 000 S/N : 1***
Raison du contrôle :
Deuxième campagne de tests thermiques sur FM1 (SPIRE)
Tests après 5 jours d'étuvage à 80°C sous vide

Date : 05-10 Oct. 2004
Nom : CLERC / DUBAND
Signature :

Contrôle mécanique / électrique

Visuel : OK R.A.S

Tension des brins Kevlar (Newton) (mesurée coté pompe)

Avant test Fil 1/8 : 120.6 Fil 6/8 : 85.7 Après test Fil 1/8 : 123 Fil 6/8 : 86.5

Contrôle impédance thermomètres (T) et chauffages (C) (à T ambiante, et comprenant les fils de mesures)
(indiquer pour chaque composants les valeurs en Ohm prises au connecteur principal (P) et redondé (R) (P/R))

T pompe	C pompe	T inter P	C inter. P	T évaporat.	T inter évap.	C inter évap.	T shunt
44.9 / 43.7	*406 / 407.4*	*47.2 / 48*	*407 /(***)*	*51.6 / 51.1*	*48.2 / 49.9*	*407.3 / 406.9*	*47.8 / 46*

Vérification isolation électrique : OK R.A.S

Remarques : (***) : suite erreur de manipulation chauffage redundant sur pompe miniature inter pompe est hors service.
Chauffage remplacé sans problème particulier (voir HCR#103)

Contrôle de fuite

Référence détecteur : ALCATEL ASM 180

Valeur de fuite mesurée / Avant : 3.5 10^{-10} mB.l.s^{-1} Après : 10^{-10} mB.l.s^{-1} Commentaires : OK

Contrôle thermique

Cycle A – *Phase de condensation :*

T bain ^{4}He	T structure	T pompe/Puiss.	T évaporateur	T inter P	T inter E/Puiss.	T shunt
1.69	*≈ 3*	*45*	*2,17*	*4*	*20*	*≈ 2.5*

Phase basse température – T bain : 1.59 K

Orientation	+90° (Endroit)	0° (Horizontal)	- 90° (Envers)	Commentaires :
T mini (mK)	*258.1*	*257.9*	*257.7*	

Courbe de puissance - Orientation : vertical évaporateur en bas (***+90***) et vertical évaporateur en haut (***-90***)

Charge (µW)	0 (Tmini)	10	20	30	40	50	100
T (mK) / ***+90***	*258.1*	*271.2*	*280*	*287.8*	*294.1*	*299.5*	*319.8*
T (mK) / ***-90***	*257.7*						

Cycle B – *Phase de condensation :*

T bain ^{4}He	T structure	T pompe/Puiss.	T évaporateur	T inter P	T inter E/Puiss.	T shunt
1.6	*≈ 2.8*	*45*	*2.15*	*5*	*20*	*≈ 2.5*

Phase basse température – T bain : 1.6 K (Level 0 et Level 1 non régulés)
Autonomie et température sous 200 µW de charge appliquée : 7h04 à 344.5 mK (calculé 7h18)
Autonomie et température sous 30 µW de charge appliquée : 39h38 à 288 mK (calculé 38h23)

Conformité

OUI ~~NON~~

RAPPORT :

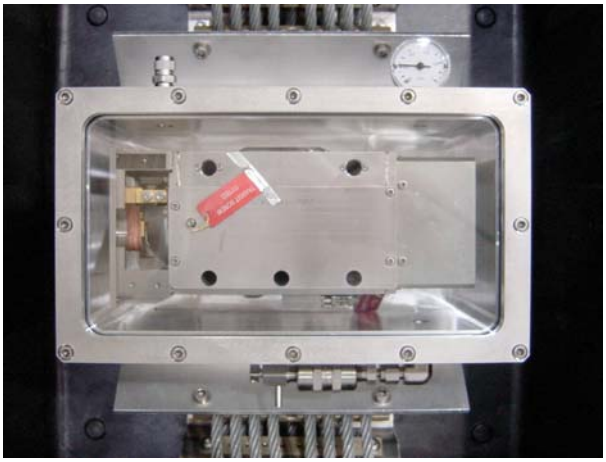
Performances conformes aux prédictions et similaires HCR#101. OK.

Visa Projet - Nom, date et signature : L. DUBAND

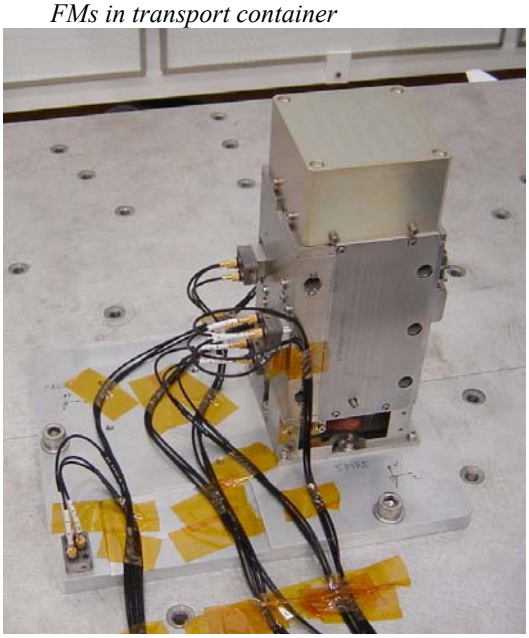
9.4 Vibration tests

Both flight models, FM1 and FM2, were successfully vibration tested at the CSL premises on October 18 – 21 2004.

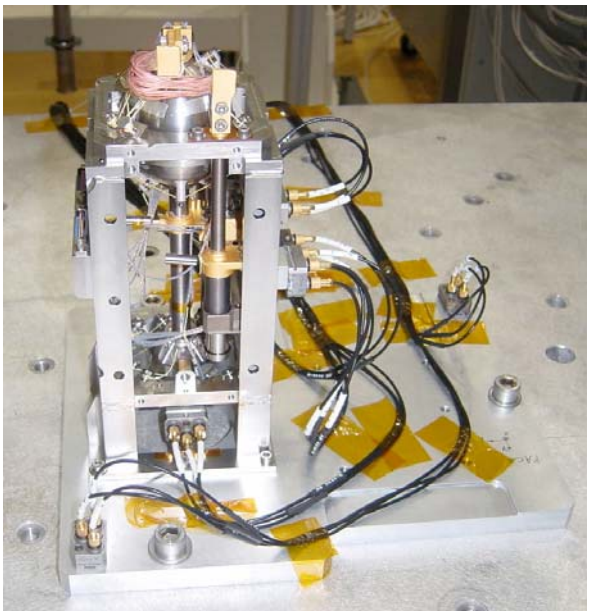
FMs in transport container



SPIRE unit

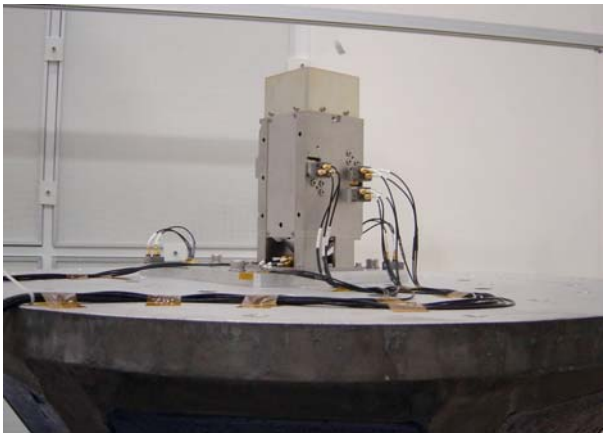


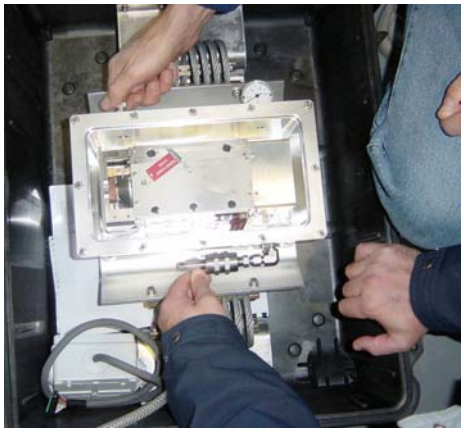
SPIRE – Z axis



SPIRE – Z axis : lateral plates removed

Shaker not running : FM with cover



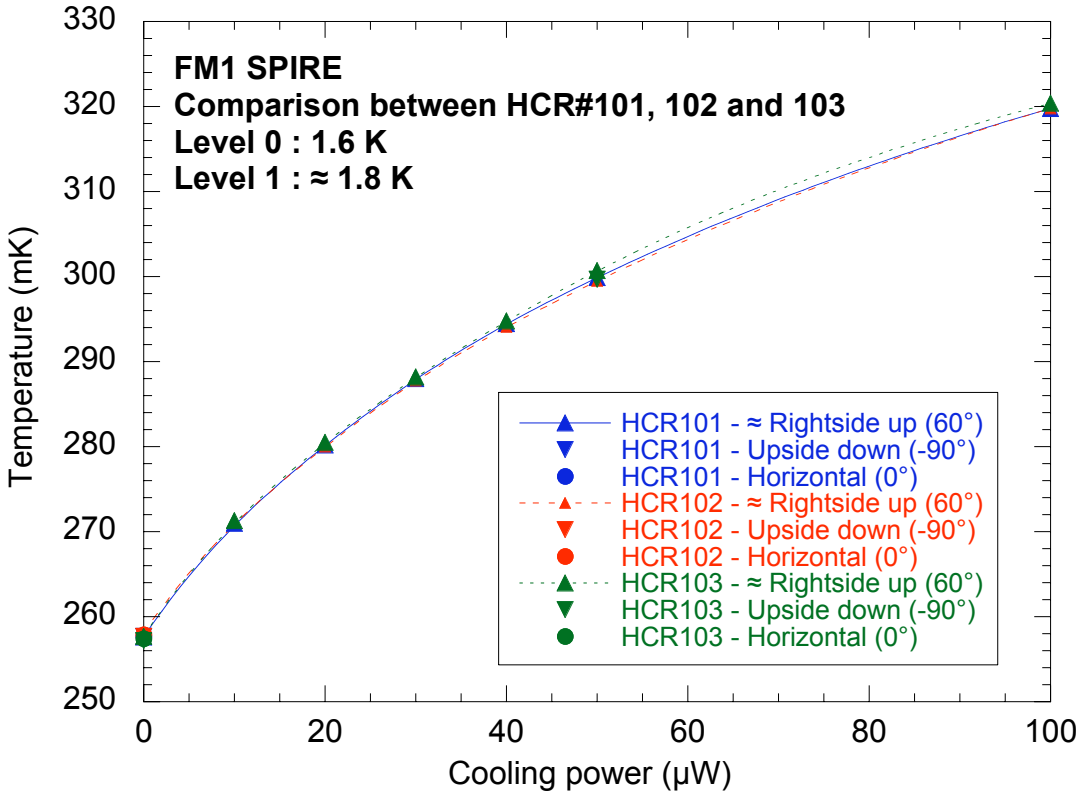


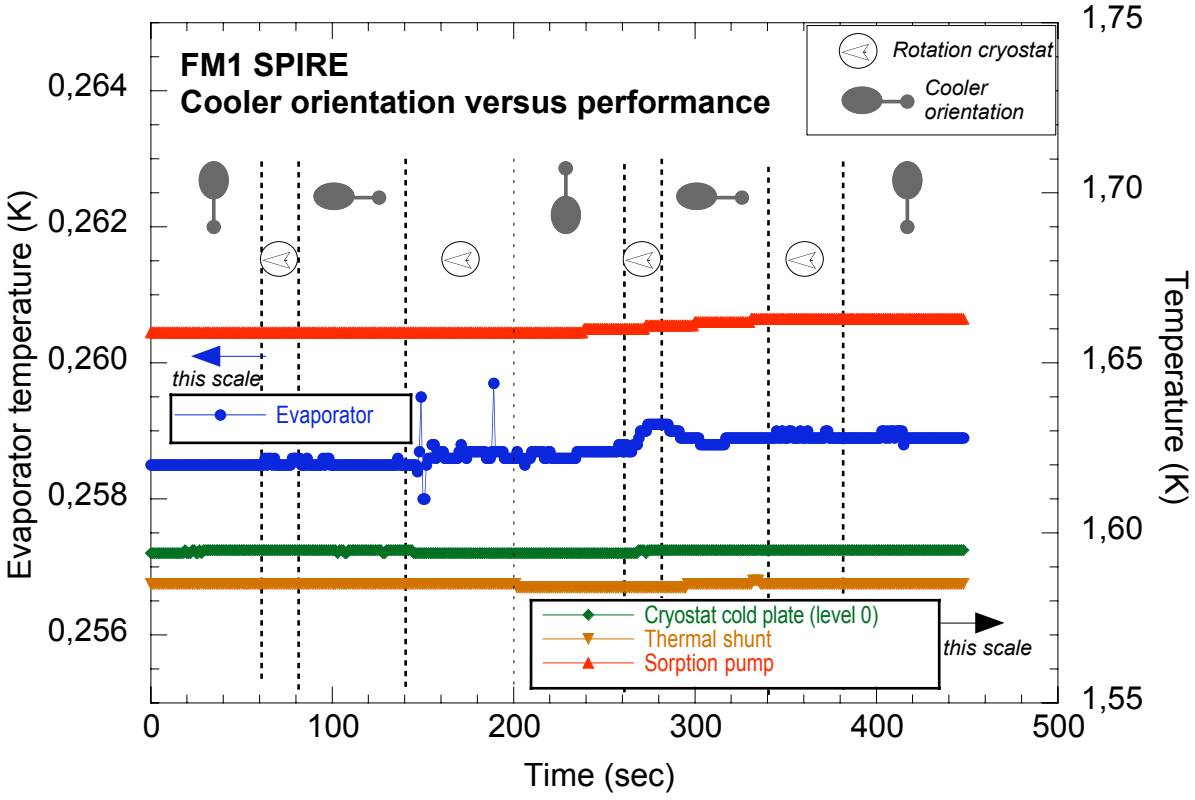
Container is pressurized to ≈ 200 mB with nitrogen gas prior to transport

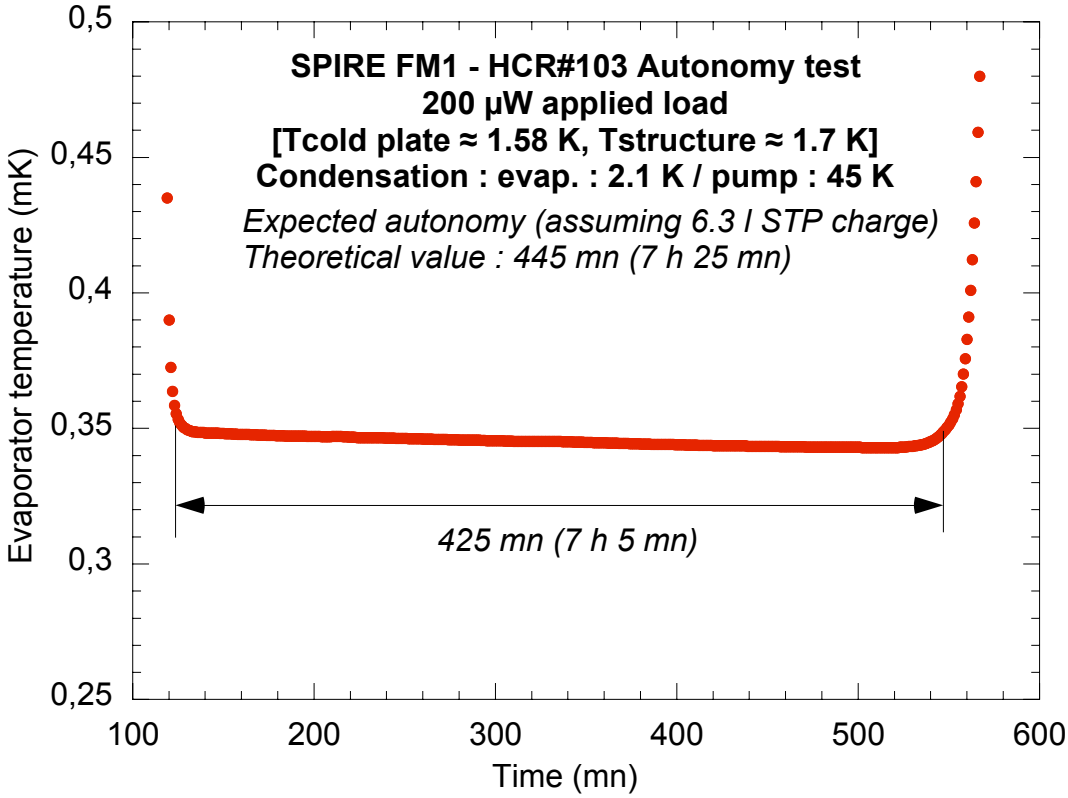
The test results are reported in the CSL technical note ref. RP-CSL-SHK-04013.
A summary can also be found in the minutes : "TRR Tests vibratoires modèles FM", HSO-SBT-MoM-116, October 19th, 2004 and "TRB Tests vibratoires FM", HSO-SBT-MoM-117, October 19-21st, 2004. The TRB minutes are appended in Appendix A.

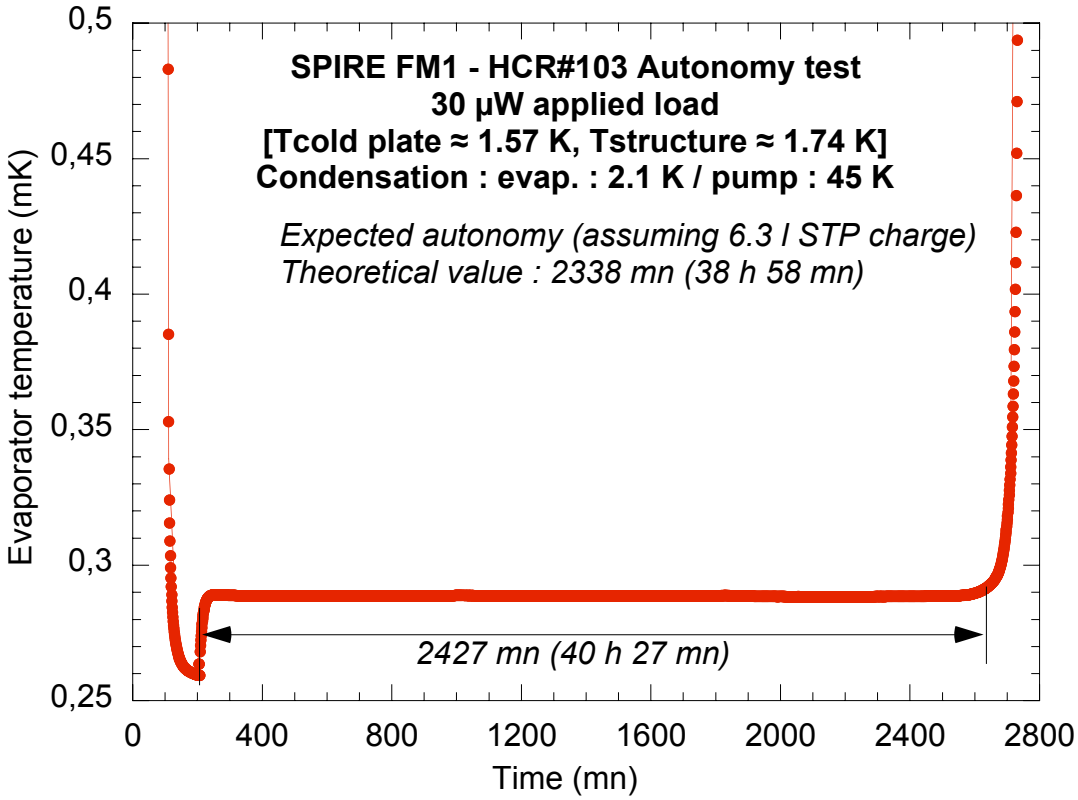
9.5 Health Check HCR103 and hold time tests

Following the vibration tests, a third set of thermal tests was carried out to check for the cooler integrity. No significant difference with the first and second set (HCR#101 & #102). As can be seen on the next figure the curves are pretty much superimposed. The behavior of the cooler under various orientation are further depicted in the second curve; in particular in this curve it can be seen that when the cooler is moved from rightside up to upside down, there is no trace of liquid droplet "traveling" from the evaporator to the pump.
The autonomy tests under 200 and 30 µW were repeated and results similar to HCR101 and 102 were found (see figures). The slight difference is due to the fact the condensation were done at 2.1 K rather than 2.15 K for HCR#101 and 102.









The cooler hold time was then tested under 10 µW applied load, under the nominal conditions : Level 0 interface (heat switch base) and Level 1 (Structure) regulated respectively at 1.7 K and 4 K.

It is important to emphasize that the condensation temperature for all the tests carried out on the FM1 unit has been around 2.1 K. This temperature is set by the performance of the cryostat and the various thermal bus between the cryostat cold plate and the evaporator. If this temperature could be reduced to 1.9 K for instance the gain in hold time would be ≈ 5%.

On the following figures we have displayed a typical recycling process and the associated energy, the 10 µW cycle and the overall autonomy and a zoom on the temperature stability.

An hold time of 4145 mn (69 hours 5 mn) was experimentally measured, as the cooler software predicted 70 hours and 1 mn. Again the end of experimental hold time is defined by a 1% temperature variation (i.e. once T has reached 279 mK in this case).

As the measured autonomy is very close to the predicted one, we can assume the predicted parasitics internal to the cooler are correct, i.e. 11.3 µW. Consequently the "cold" Joules produced (gross energy) is 5.3 J and complies with the 5 J requirement (HSO-SBT-SP-001).

The heat flows and associated energies are slightly larger than with the CQM unit, simply due to the fact that this FM unit has been overcharged by 14% (compare to the CQM).

For the CQM unit the energy associated with both straps was 173 + 340 = 513 Joules, which then should lead to 513 * 1.14 = 585 Joules; indeed in the present case we have measured 584 Joules total !.

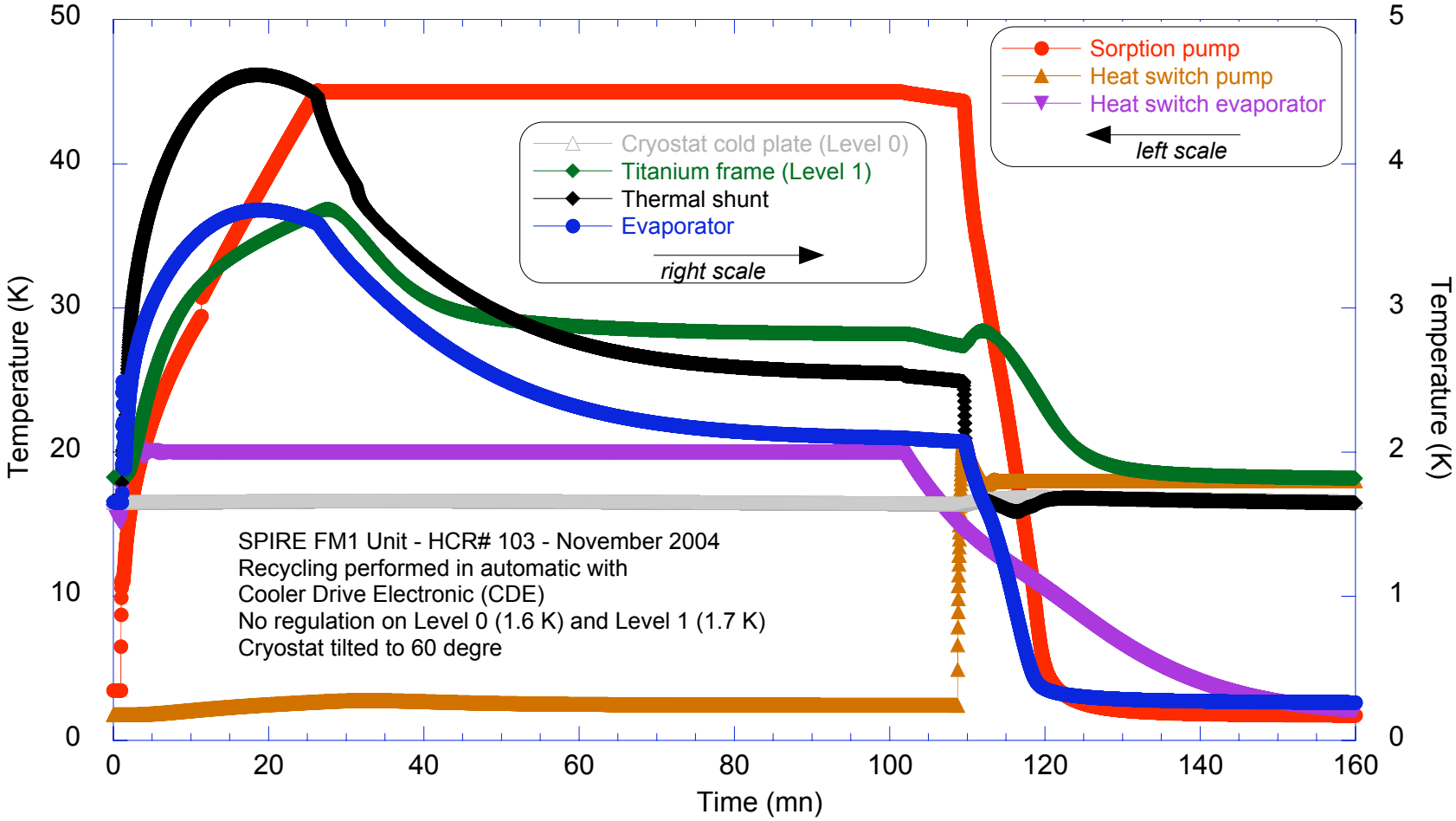
We can then estimate the total energy dissipated over the entire cycle. The condensation phase accounts for 584 Joules as discussed above. During the low temperature phase the applied load to the evaporator is 10 µW and the predicted parasitics internal to the cooler are 11.3 µW (case level 0 at 1.7 K and level 1 at 4 K).

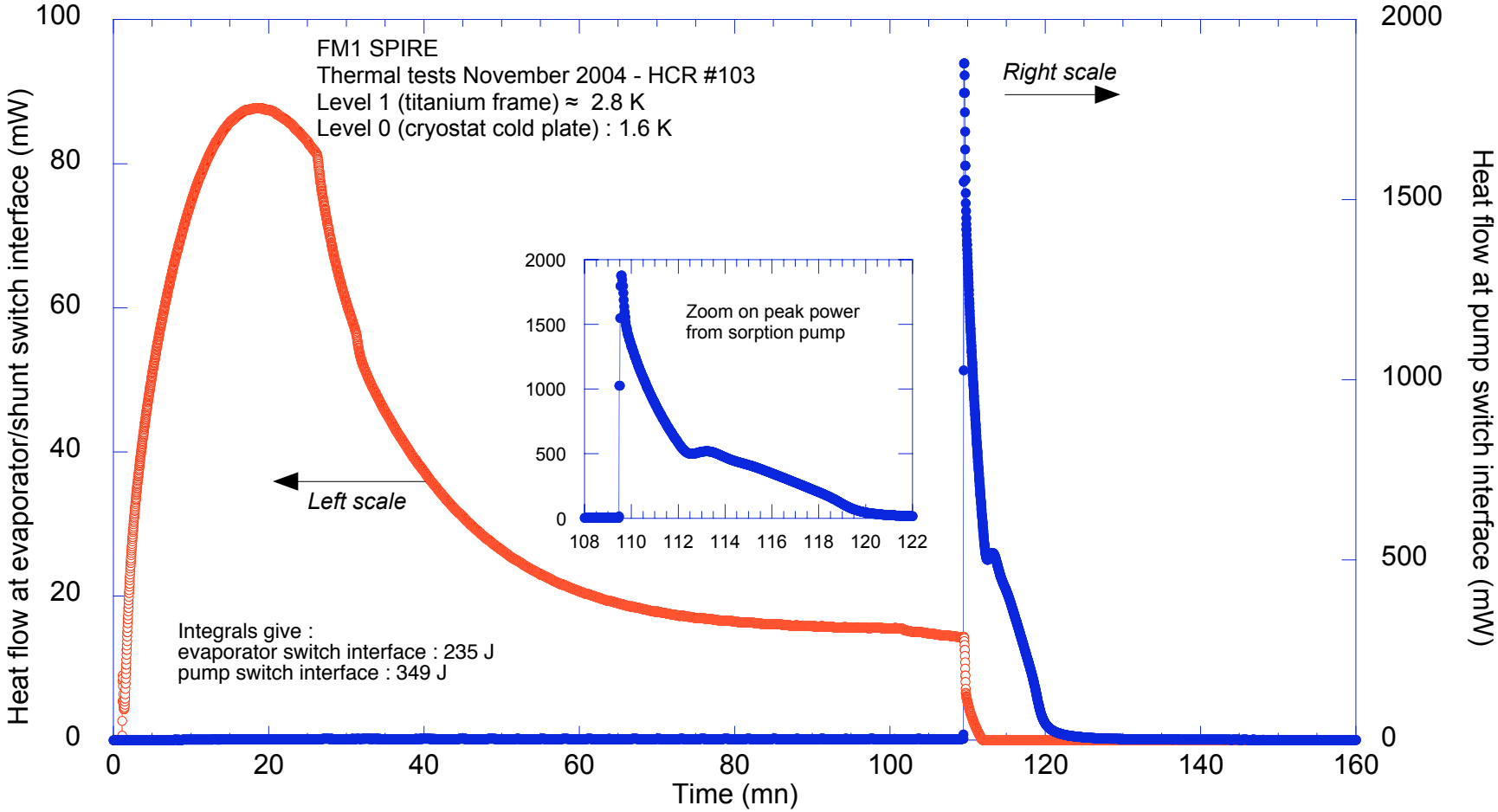
Then the heat switch on the pump is ON and can be maintained in this state with 420 µW (see § 10), leading to a grand total of 927 joules. This results is also summarized in the table below.

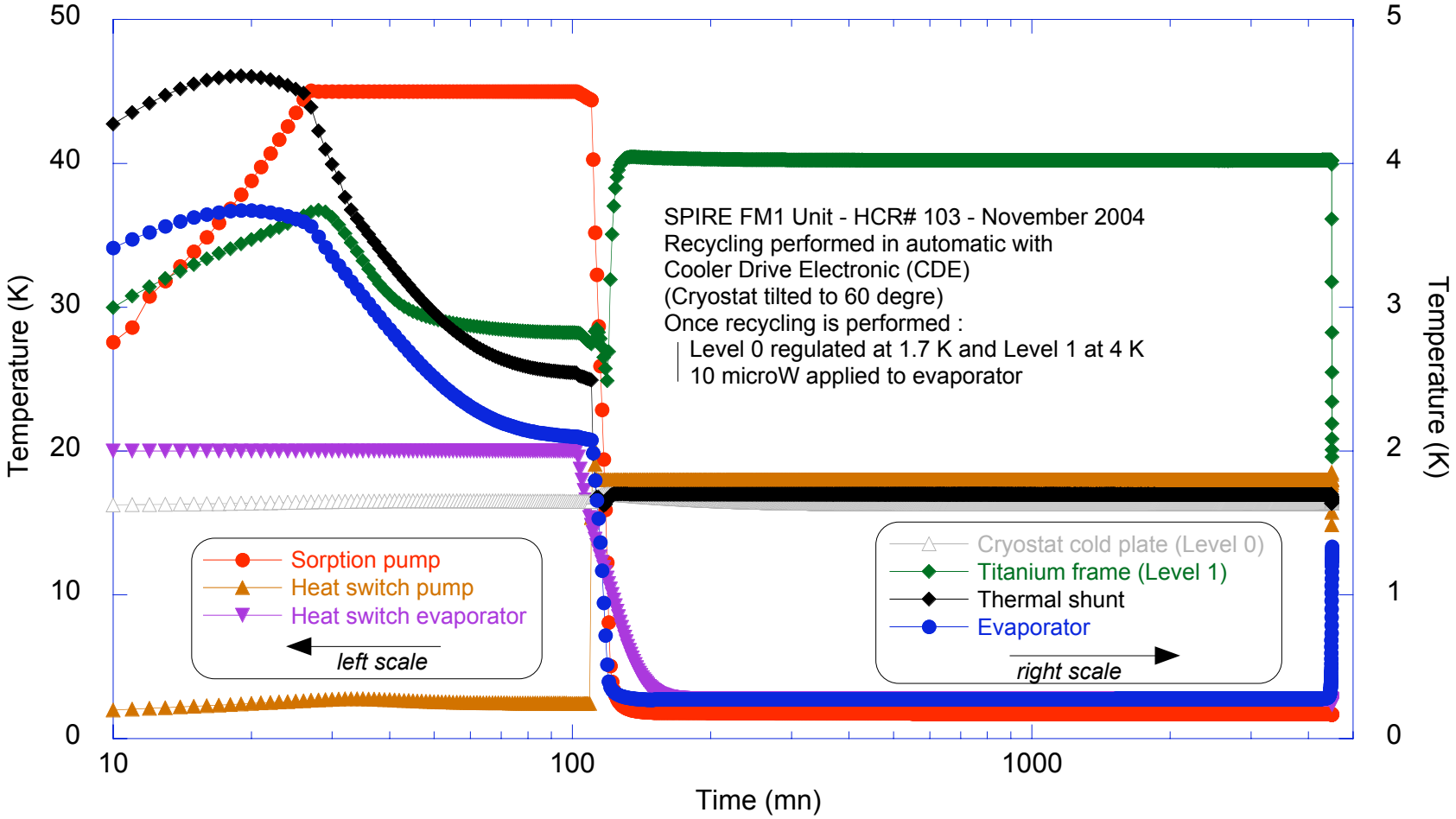
Condensation phase	From thermal bus on evaporator side	235 J
	From thermal bus on pump side	349 J
Low temperature phase	10 µW applied load during 4145 mn	10 10^{-6} x 45* x 4145 x 60 = 111.9 J
	11.3 µW parasitics during 4145 mn	11.3 10^{-6} x 45 x 4145 x 60 = 126.5 J
	HS ON state, 420 µW during 4145 mn	420 10-6 x 4145 x 60 = 104.4
Grand Total		927 Joules

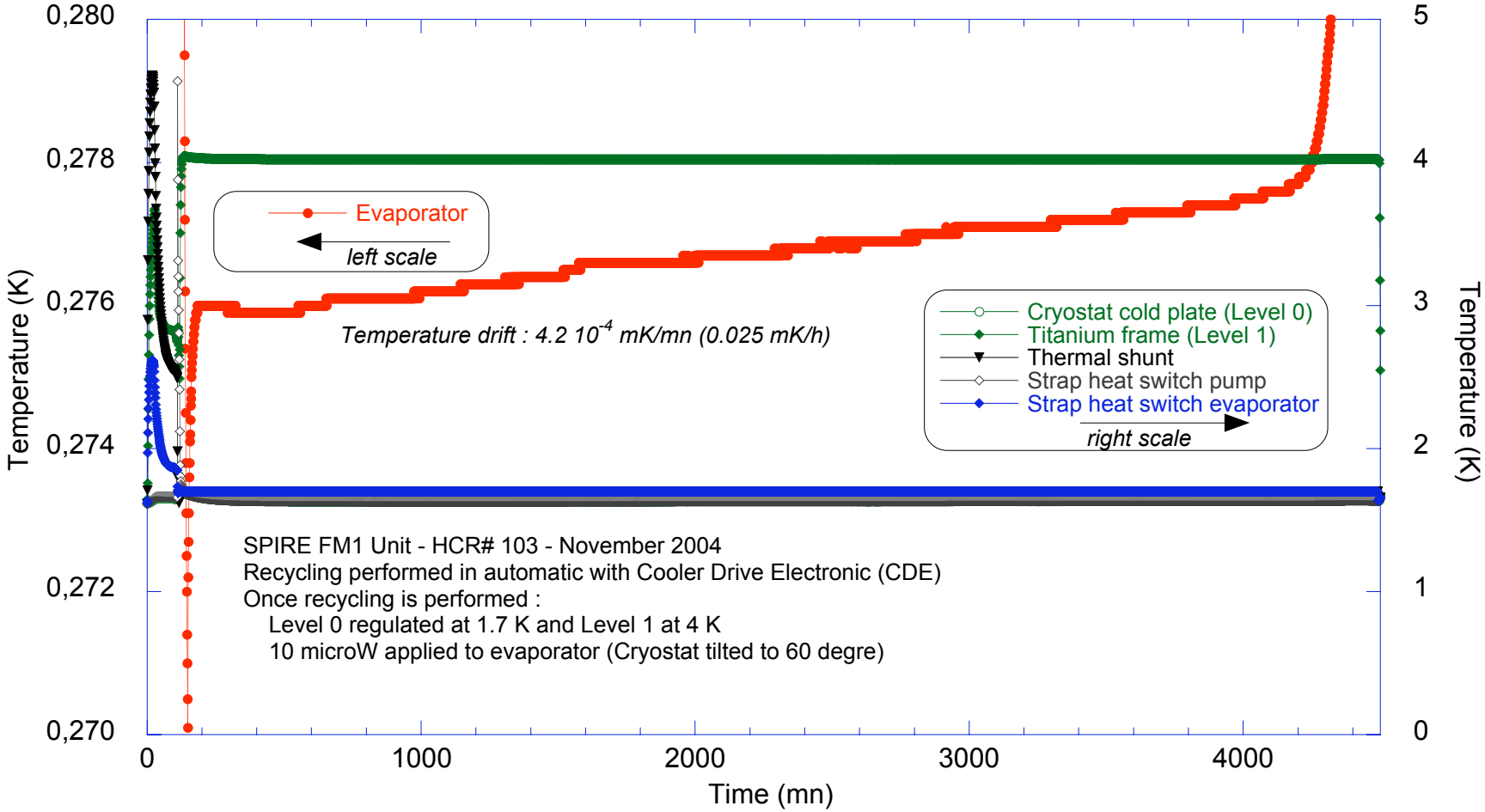
(: typical "amplification" factor – see RD03)*

This number is slightly larger than the value specified – 860 Joules (from HSO-SBT-SP-001) – but is consistent as the current cooler has been overcharged. In addition as the hold time of the cooler exceeds the specification, if necessary the recycling process can be adjusted to remain within the 860 J.









SPIRE & PACS Sorption Coolers HEALTH CHECK REPORT (HCR)

(Version 2.1)

Référence : HCR# 103

Référence cryoréfrigérateur : ***Sorption Cooler FM Ref.: 2000-14 B 000 S/N : 1***

Raison du contrôle :
Troisième campagne de tests thermiques sur FM1 (SPIRE)
Tests après tests vibratoires au Centre Spatial de Liège

Date : 25 Oct -15 Nov 2004
Nom : CLERC / DUBAND
Signature :

Contrôle mécanique / électrique

Visuel : OK R.A.S

Tension des brins Kevlar (Newton) (mesurée coté pompe)

Avant test Fil 1/8 : 100.8 Fil 6/8 : 80.7 Après test Fil 1/8 : 107 Fil 6/8 : 79.5

Contrôle impédance thermomètres (T) et chauffages (C) (à T ambiante, et comprenant les fils de mesures)
(indiquer pour chaque composants les valeurs en Ohm prises au connecteur principal (P) et redondé (R) (P/R))

T pompe	C pompe	T inter P	C inter. P	T évaporat.	T inter évap.	C inter évap.	T shunt
45.2 / 43.7	*407 / 407.4*	*47.1 / 48.2*	*407 /408*	*51.5 / 51*	*48.1 / 49.8*	*407.1 / 407*	*47.8 / 45.9*

Vérification isolation électrique : OK R.A.S

Remarques :

Contrôle de fuite

Référence détecteur : ALCATEL ASM 180

Valeur de fuite mesurée / Avant : 4 10^{-10} mB.l.s^{-1} Après : 5 10^{-10} mB.l.s^{-1} Commentaires : OK

Contrôle thermique

Cycle A – *Phase de condensation :*

T bain ^{4}He	T structure	T pompe/Puiss.	T évaporateur	T inter P	T inter E/Puiss.	T shunt
1.69	*≈ 3*	*45*	*2,17*	*4*	*20*	*≈ 2.5*

Phase basse température – T bain : 1.56 K

Orientation	+90° (Endroit)	0° (Horizontal)	- 90° (Envers)	Commentaires :
T mini (mK)	*257.7*	*257.4*	*257.2*	

Courbe de puissance - Orientation : vertical évaporateur en bas (***+90***) et vertical évaporateur en haut (***-90***)

Charge (µW)	0 (Tmini)	10	20	30	40	50	100
T (mK) / ***+90***	*257.7*	*271.3*	*280.5*	*288.2*	*294.8*	*300.7*	*320.4*
T (mK) / ***-90***	*257.2*					*299.7*	

Cycle B – *Phase de condensation :*

T bain ^{4}He	T structure	T pompe/Puiss.	T évaporateur	T inter P	T inter E/Puiss.	T shunt
1.6	*≈ 2.8*	*45*	*2.1*	*5*	*20*	*≈ 2.5*

Phase basse température – T bain : 1.6 K (Level 0 et Level 1 non régulés)
Autonomie et température sous 200 µW de charge appliquée : 7h05 à 345 mK (calculé 7h25)
Autonomie et température sous 30 µW de charge appliquée : 40h27 à 288.5 mK (calculé 38h58)

Conformité

OUI ~~NON~~

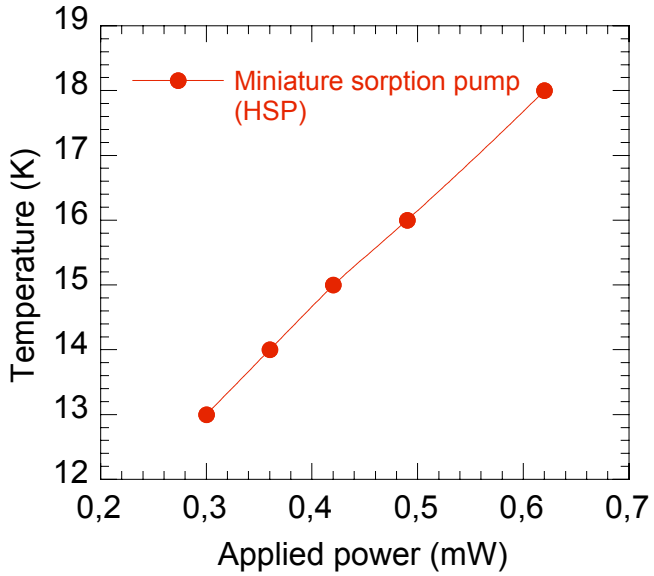
RAPPORT :

Performances conformes aux predictions et similaires HCR#101 et HCR#102. OK.

Visa Projet - Nom, date et signature : LIONEL DUBAND

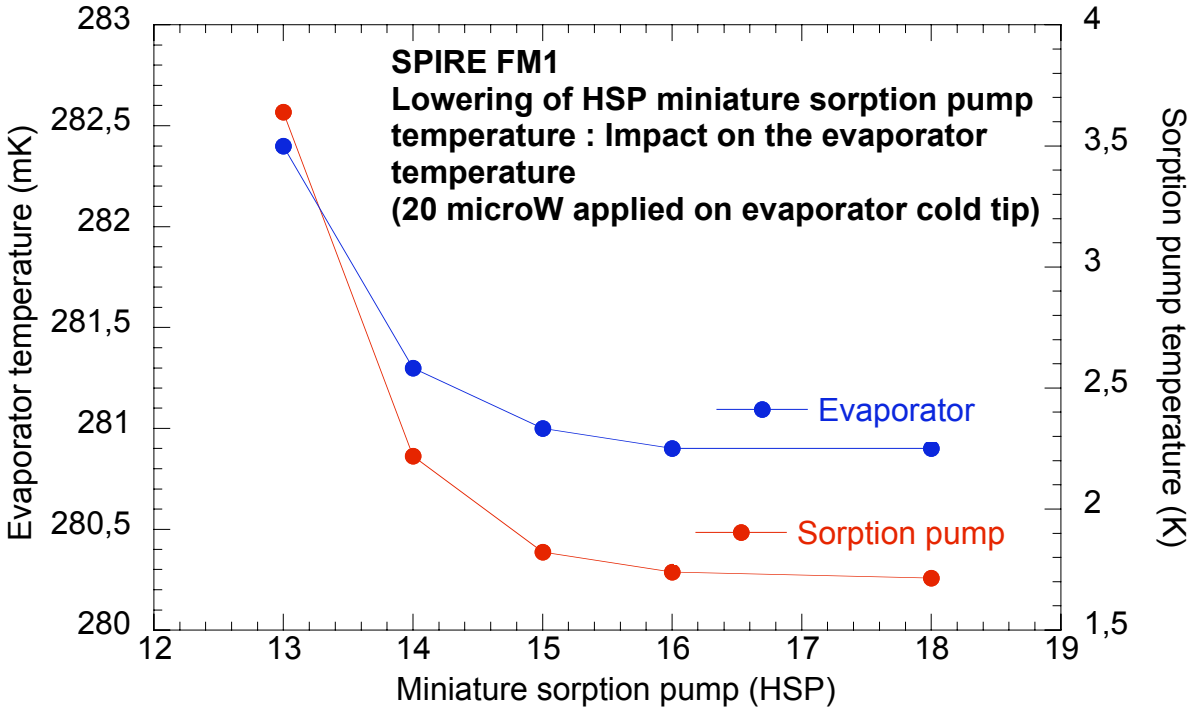
10 Additional thermal tests

For all the tests carried out on the cooler, the cooler drive electronic was set such that the switching temperature of the evaporator and the pump heat switches were respectively 20 and 18 K. These temperatures allow for very efficient operation of the cooler in terms of kinetic and thermal performance. However once the cooler is cold (low temperature phase) it is possible to lower the temperature of the miniature pump on the pump heat switch, without impacting the ultimate temperature of the cooler.



A reduction of this temperature leads to a reduction of the power required to maintain the miniature pump at this temperature and thus increase the efficiency of the cooler in terms of energy.

This is illustrated on the two figures.. These tests were performed with a 20 µW applied load on the evaporator.



From these results it can be seen that the miniature sorption pump temperature can be decreased to roughly 15 K (420 µW) without significantly impacting the performance.

11 Cleanliness aspect

At the outcome of the manufacturing and assembling phase, each cooler components has been carefully cleaned following SBT procedure HSO-SBT-PR-026. the components are then stored in our clean room in dedicated boxes (no contamination). Our clean room has been designed as a class 10 000 overall with a class 100 laminar flow bench; The main room has been measured as a class 1000 (however we assume 10 000 in our analysis).

As the components become necessary they are integrated in the cooler. Of course all manipulations are carried out using gloves. Since the cooler comprises a number of components and requires several manipulations, it is difficult if not impossible to track the particular contamination during these phases.

As a minimum we can start to track this contamination once the full cooler is assembled. This analysis is reported in the table below.

Activity	Conditions (class)	Date	Duration (h)	Comments	Calculated contamination (ppm) (ESA PSS-01-204)
End of assembling phase	10000	21/09/04	24	Integration of heat switches	60
Connector wiring	10000	22/09/04	17		42,5
Integration in test cryostat	10000	22/09/04	1	preparation for HCR#101	2,5
Thermal tests	0	22 - 28/09/04		141 hours in cryostat under vacuum (class 0)	0
Remove from cryostat	10000	28/09/04	1		2,5
Kevlar tension checking	100000	28/09/04	0,16		1,5
Transfert into baking chamber	100000	28/09/04	0,08		0,75
80°C Bake-out	0	28/09 - 04/10/04		5 days at 80°C under vacuum (class 0)	0
Remove from baking chamber	100000	4/10/04	0,08	Cooler transfered in lock chamber	0,75
Kevlar tension checking	100000	4/10/04	0,16		1,5
Cooler stored under la minar flow bench	100	04 - 05/10/04	18,5		1,15625
Integration in test cryostat	100	5/10/04	1	preparation for HCR#102	0,0625
Thermal tests	0	05 - 11/10/04		142 hours in cryostat under vacuum (class 0)	0
Remove from cryostat	10000	11/10/04	1		2,5
Kevlar tension checking	100000	11/10/04	0,16		1,5
Cooler stored under la minar flow bench	100	11 - 15/10/04	100	Fixing of redondant heater HSP	6,25
Leak test	0	15/10/04		3h35mn in box under vacuum (class 0)	0
Kevlar tension checking	100000	15/10/04	0,16		1,5
Cooler stored in transport container	0	15 - 16/10/04	0	16h15mn in container (200 mB N2 pressurised)	0
Leak test	0	16 - 18/10/04		48h in box under vacuum (class 0)	0
Cooler stored in transport container	0	18 - 19/10/04	0	24h in. Transport to CSL	0
Vibrations tests	10000	19/10/04	4,75		11,875
Cooler stored in transport container	0	19 - 20/10/04	0	13h45mn in container (200 mB N2 pressurised)	0
Vibrations tests	10000	20/10/04	3,75		9,375
Cooler stored in transport container	0	20 - 22/10/04		37h in container (200 mB N2 pressurised)	0
Leak test	0	22/10/04		3h in box under vacuum (class 0)	0
Kevlar tension checking	100000	22/10/04	0,16		1,5
Integration in test cryostat	100	22/10/04	1	preparation for HCR#103	0,0625
Thermal tests	0	22 - 10/11/04		240 hours in cryostat under vacuum (class 0)	0
Remove from cryostat	100	10/11/04	0,5		0,03125
Kevlar tension checking	10000	10/11/04	0,16		0,4
Leak test	0	10/11/04			0
Cooler stored in test box	0	10-15/11/2004		141h in box under vacuum (class 0)	0
Photographic records & cleaning	1000	16/11/04	0,25	Checked with UV lamp - Ext. surfaces cleaned	0,125
Cooler stored under la minar flow bench	100	16-17/11/04	33		2,0625
Cooler stored in transport container	0	17-18/11/04			0
				Overall contamination budget (ppm)	**150,400**

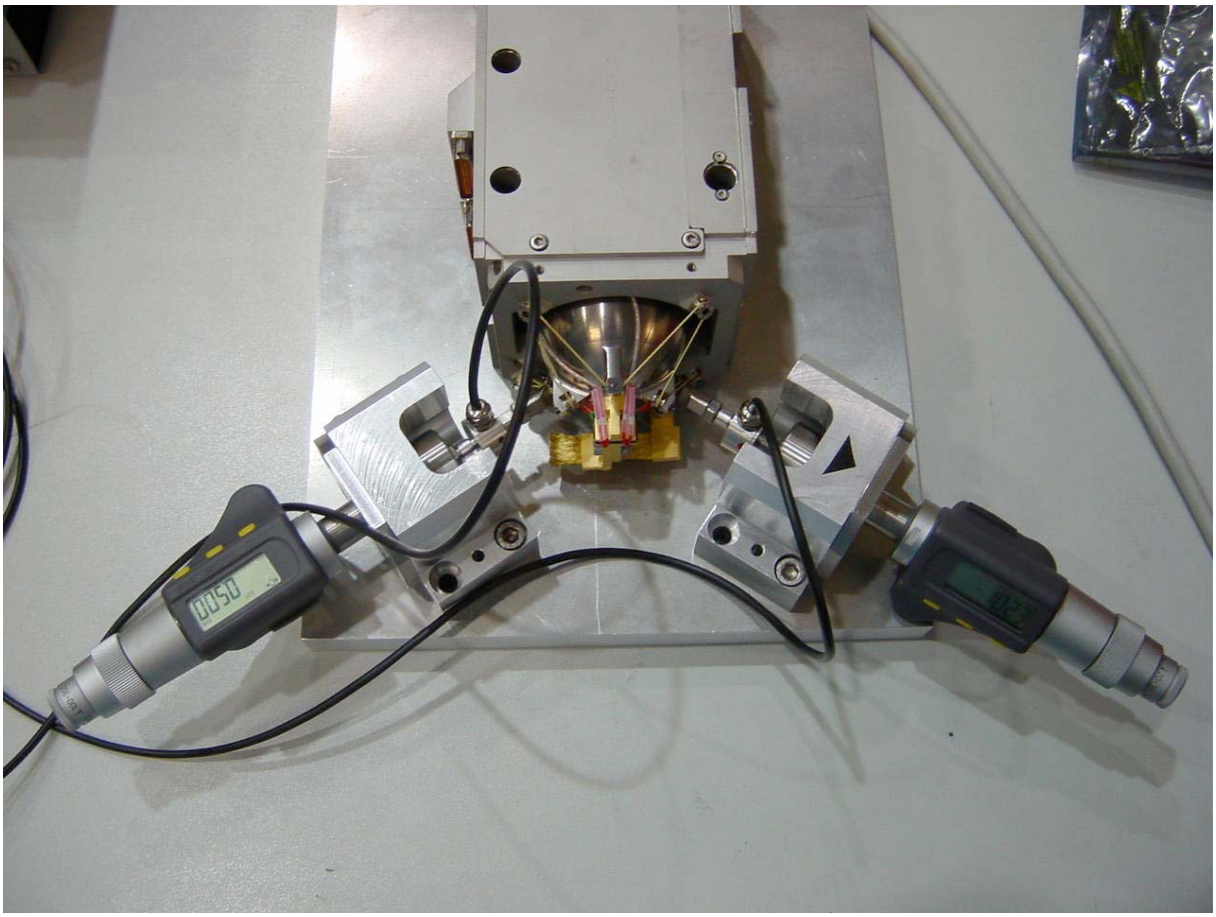
Under these circumstances the overall particular contamination is found to be 150 ppm.

Prior to delivery the cooler has been inspected using a 365 nm UV lamp. The few visible dust spotted on the external surfaces were removed using a clean texture lightly dampened with alcohol.
The cooler internal was briefly checked – Kevlar is supposedly sensitive to UV light and thus extended exposure should be avoided – and appeared to be relatively clean (several dust spotted).

12 Kevlar strings tension history

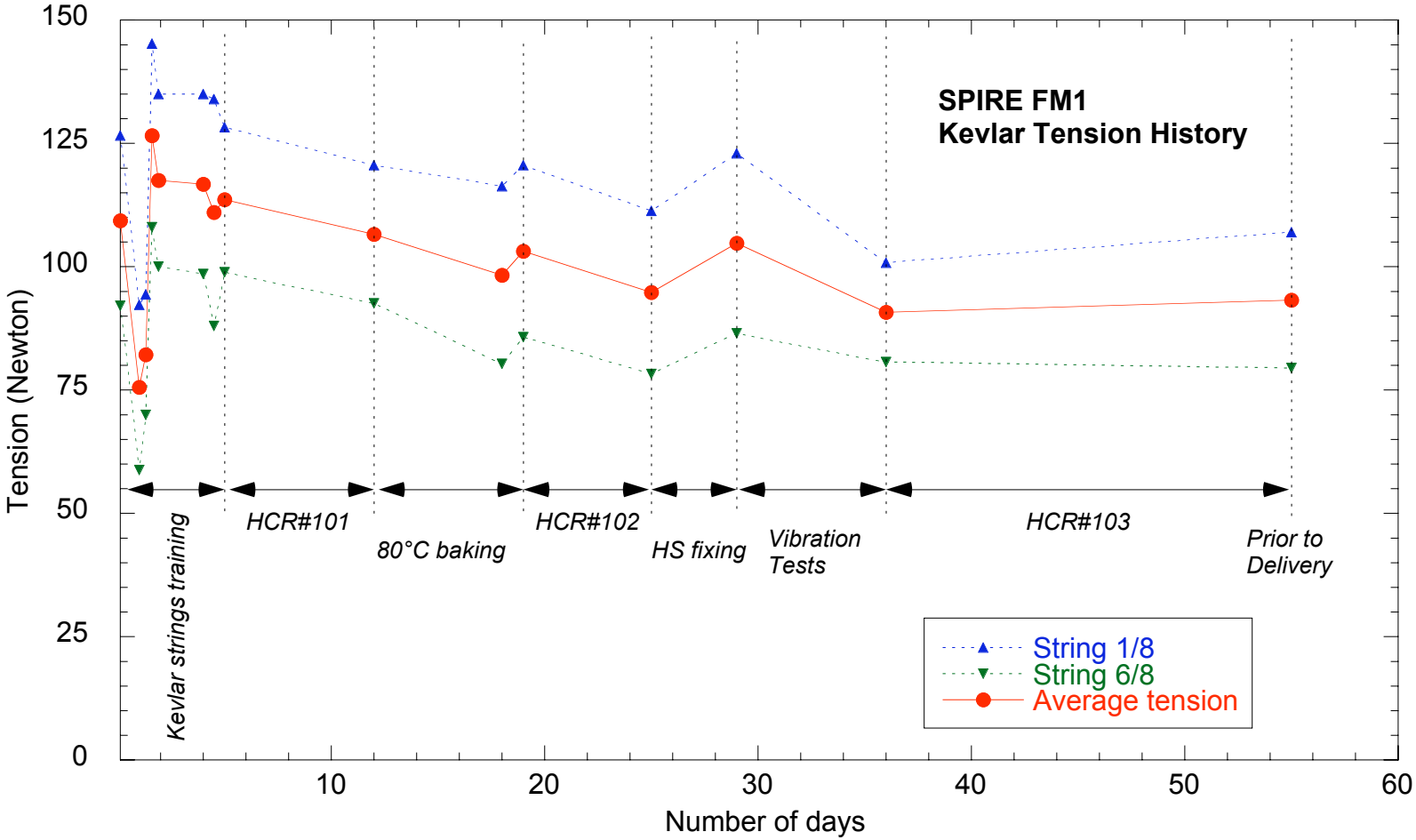
During all the acceptance program the tension of the Kevlar string on the pump side (external string) was measured after each major test.
This tension is measured at two location using a dedicated tool developed by CEA-SBT (see picture) :

- first section of string after capstan
- sixth section of cord after capstan



(CQM unit depicted)

The tension history is reported on the following figure.

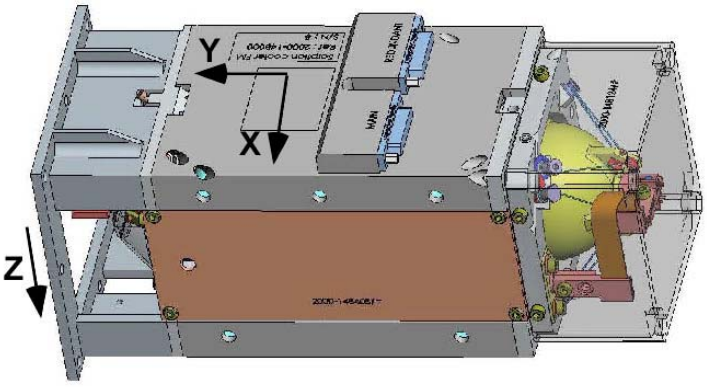


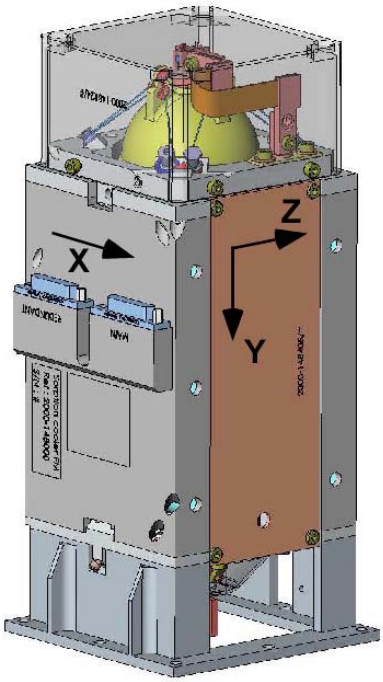
13 Control of mechanical interfaces

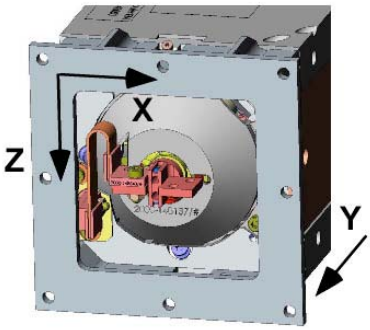
A number of selected interfaces have been verified. These verifications include :

- overall dimensions (length, height and depth)
- PACS mounting interface : position of holes and distance between holes
- SPIRE mounting interface : position of holes and distance between holes
- Heat switches interfaces (see drawing hereafter for axis definition)
    - X and Y axis : Position of interface with regards to structure (gap and angular position)
    - X and Y axis : distance from structure base plate (SPIRE interface)
    - Z axis : distance between structure plate and switch interface – measured at the four corner on the gold plated switch interface
- cold tip
    - Y axis : distance between cold tip end and structure base plate (SPIRE interface)
    - X and Z axis : position of cold tip with regards to structure base plate

All these results are displayed on the drawing in appendix B.







14 Conclusion

The SPIRE Flight Model sorption cooler successfully went through its acceptance program. Its thermal performance are compliant with the predicted one and the vibration test campaign did not lead to any failure.
The problem which occurred at the outcome of the second set of thermal tests – failure of redundant heater on heat switch miniature sorption pump (HSP) – was successfully fixed and the subsequent tests did not reveal any impact on the performance.

A verification matrix (ref. HSO-SBT-LI-121) featuring all specifications, the verification method and the associated results has been established and can be found in the EIDP (HSO-SBT-ADP-108).

15 Appendix

15.1 A – Minutes of Vibration tests TRB (HSO-SBT-MoM-117)

See following pages (document comprises 14 pages)

15.2 B - Interface control drawing

See following pages after MoM117. Drawing is one page (last page of this document)

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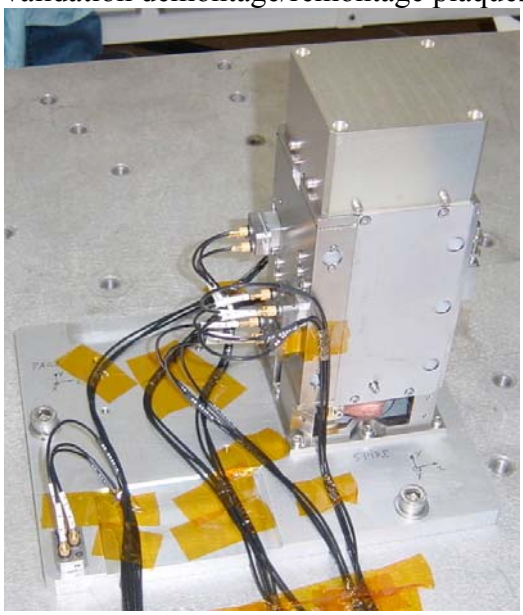
DSM/DRFMC/***Service des Basses Températures***

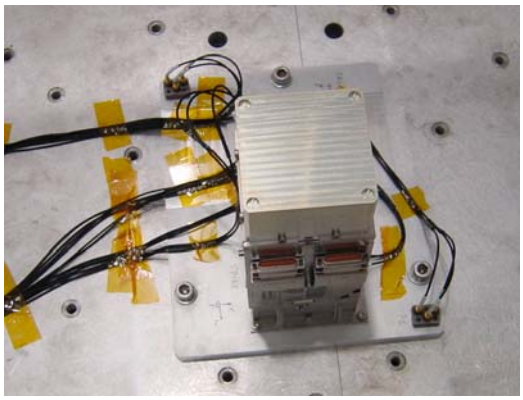
Minutes of Meeting ref. : HSO-SBT-MoM 117
Date : 19-21/10/04

Subject : TRB Tests Vibratoires FM	
Meeting date : 19-21/10/04	***Place : CSL (Belgique)***
Chair : L. DUBAND ***Present :*** *Jean Sébastien SERVAYE - CSL* *Laurent CLERC – CEA/SBT* *Eric ERCOLANI – CEA/SBT* *Lionel DUBAND – CEA/SBT*	***Copies : Those present +***

Description	Action/Date

Mardi 19 Octobre 2004
16:35
Début des essais – TRR (BT) tenue, voir HSO-SBT-MoM116
Le shaker est en position horizontale. On commence par FM1 SPIRE axe Z pour validation démontage/remontage plaques latérales + capot pompe.





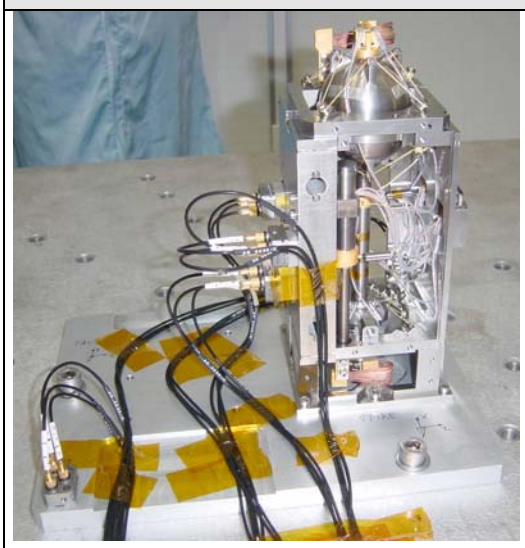
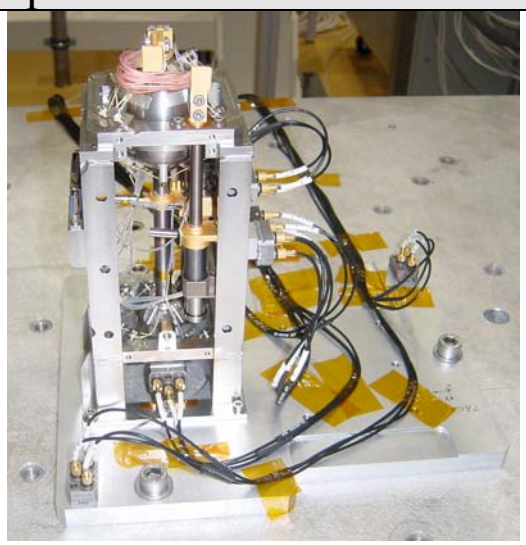
Test #1 – FM1 SPIRE – Axe Z – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (Z_{SPIRE}) - 2 oct/min
Signatures (fréquences majeures):

- evaporateur : 370 Hz / 13.7 G
- embase inter evap. : 129.8 Hz / 2.28 G, Plus importante 292.9 Hz / 6.8 G
- embase inter pompe : 124 Hz/2.5 G. Plus importante : 314 Hz / 8.68 G
- structure : Plus importante 605 Hz / 2.68 G

Remarque : savers ont été laissés en place pour cet essai. On les démonte pour la suite (ne devrait pas avoir d'influence et autant éviter des contraintes sur les connecteurs – on remontera les savers pour la vérification des circuits électriques en fin de test).
Démontage plaques latérales et capot pompe pour test #2.

Description	Action/Date

17:00

Test #2 – FM1 SPIRE – Axe Z (sans plaques latérales et capot)

Bas niveau sinus 0.5 G 0-2000 Hz (Z_{SPIRE}) - 2 oct/min
Manifestement les plaques contribuent à la rigidité de l'ensemble ; la signature structure est différente.

17:23

Test #3 - FM1 SPIRE – Axe Z (FM remis en nominal)

Bas niveau sinus 0.5 G 0-2000 Hz (Z_{SPIRE}) - 2 oct/min
OK : Signatures quasi identiques au test #1 avec quelques variations de niveaux à haute fréquence pour la structure – les fréquences de résonance par contre sont identiques.
On refait un test avec saver pour vérification.

17:35

Test #4 - FM1 SPIRE – Axe Z (FM nominal avec savers)

Bas niveau sinus 0.5 G 0-2000 Hz (Z_{SPIRE}) - 2 oct/min
OK résultats similaires au test #3. On décide d'enlever les savers pour la suite des essais.

Montage/démontage plaques et capot validé

17:53

Test #5 - FM1 SPIRE – Axe Z – haut niveau sinus

Haut niveau sinus 12 G 25-60 Hz (Z_{SPIRE}) – 4 oct/min
OK RAS en visuel.

Description	Action/Date
18:05 **Test #6 - FM1 SPIRE – Axe Z – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Z_{SPIRE}) - 2 oct/min OK signatures quasiment identiques au test #3. 18:24 **Test #7 - FM1 SPIRE – Axe Z – haut niveau random** Haut niveau random 3.476 Grms 20-2000 Hz (Z_{SPIRE}) – 60 secondes OK RAS en visuel 18:32 **Test #8 - FM1 SPIRE – Axe Z – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Z_{SPIRE}) - 2 oct/min OK signatures sont quasi identiques au test #6. Quelques légers décalages sur la structure par exemple mais inférieur à 5% (12 Hz à 400 Hz). 18:45 Arrêt des essais pour la journée. FM2 PACS est dans son container de transport et FM1 SPIRE est sur le shaker sous son capot plexiglas.  Discussion technique sur pertinence des essais avec et sans plaques pour PACS : une fois le cooler monté sur la plaque d'interface, on ne pourra démonter que une seule plaque latérale (plaque inférieure et capot sont inaccessibles). Démonter le cooler du shaker peut impacter les signatures, ce qui rend difficile l'interprétation des résultats. Par ailleurs la validation sur SPIRE représente le cas pire (structure verticale). L'intêrêt de répéter ces essais semblent très limité. OK : ne seront pas faits	

Description	Action/Date

Mercredi 20 Octobre 2004

8:30

Préparation FM2 PACS : montage support accéléro sur embases switch. Une fois terminé, FM2 remis dans son container.

8:50

Rotation plaque d'interface pour test FM1 SPIRE axe X

9:05

Test #9 – FM1 SPIRE – Axe X – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (X_{SPIRE}) - 2 oct/min

Rappel : savers enlevés

Signatures (fréquences majeures):

- evaporateur : 421 Hz / 4.9 G
- embase inter evap. : 137.6 Hz / 2 G, + importante 321.7 Hz / 14.2 G
- embase inter pompe : 136.8 Hz / 1.7 G. + importante : 351 Hz / 20.2 G
- structure : beaucoup de fréquences peu amplifiées – première à 418 Hz / 1.5 G, + importante 605 Hz / 2.68 G

9:22

Test #10 – FM1 SPIRE – Axe X – haut niveau sinus

Haut niveau sinus 18 G 25-60 Hz (X_{SPIRE}) – 4 oct/min

RAS en visuel.

Description	Action/Date

9:25

Test #11 – FM1 SPIRE – Axe X – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (X_{SPIRE}) - 2 oct/min
Signatures identiques test #9

9:42

Test #12 – FM1 SPIRE – Axe X – haut niveau random

Haut niveau random 5.01 Grms 20-2000 Hz (X_{SPIRE}) – 60 secondes
RAS en visuel – 24 Grms vu sur les switch !.

9:50

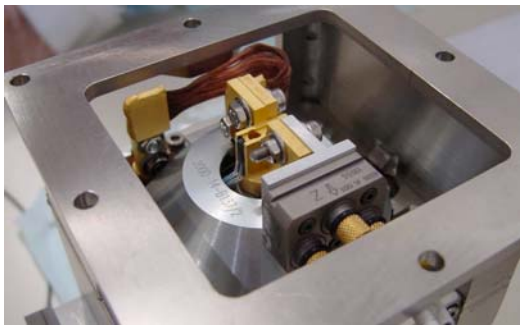
Test #13 – FM1 SPIRE – Axe X – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (X_{SPIRE}) - 2 oct/min
Signatures quasi identiques sur structure et embases interrupteurs. Sur évaporateur signatures OK avec un léger glissement de ≈ 10 Hz sur deux fréquences secondaires vers 450 Hz.

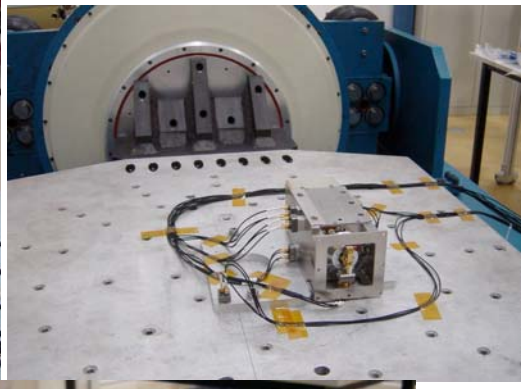
OK FM1 SPIRE a subit avec succés les tests sur les axes Z et X (axe Y sera fait plus tard – nécessite rotation en verticale du shaker).

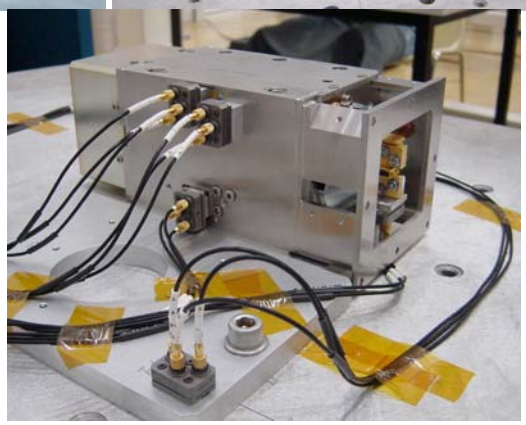
10:02
Démontage accéléromètres de FM1 SPIRE et montage sur FM2 PACS (axe Y)

OK



Description	Action/Date





11:05

Test #14 – FM2 PACS – Axe Y – bas niveau sinus

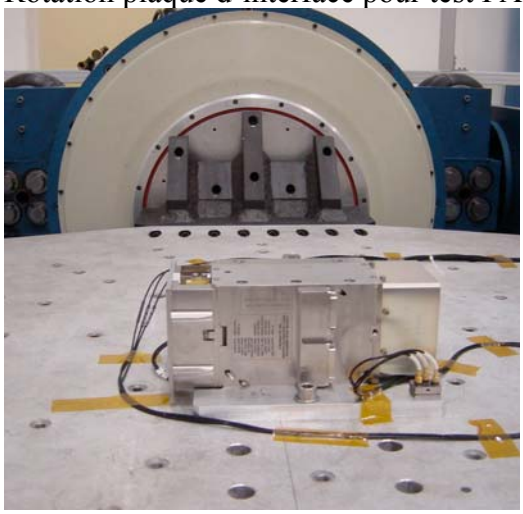
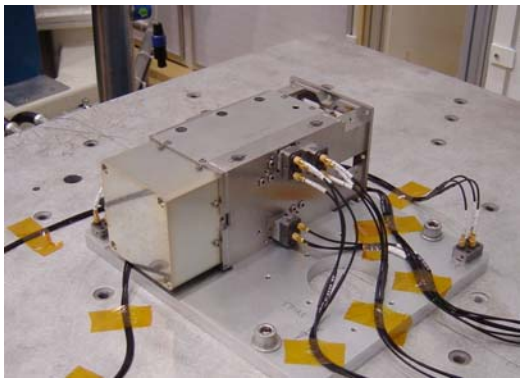
Bas niveau sinus 0.5 G 0-2000 Hz (Y_{PACS}) - 2 oct/min
Signatures (fréquences majeures):

- evaporateur : 653 Hz / 10.6 G
- embase inter evap. : 298 Hz / 2,8 G, + importante 598 Hz / 17.4 G
- embase inter pompe : 323.6 Hz / 2.1 G. + importante : 642 Hz / 10.5 G
- structure : + importante à 591 Hz / 1.6 G

11:15

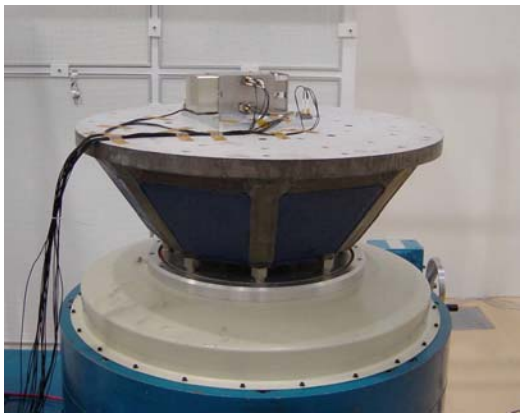
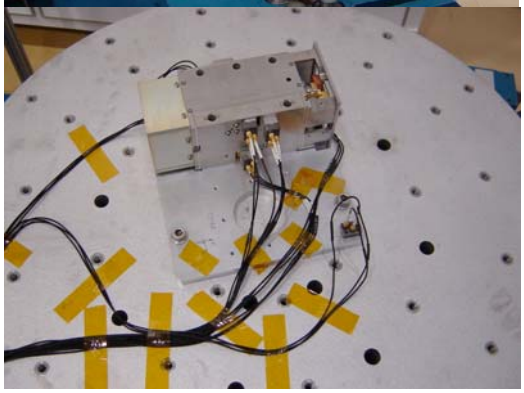
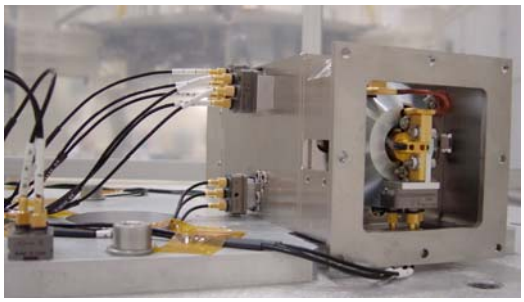
Test #15 – FM2 PACS – Axe Y – haut niveau sinus

Haut niveau sinus 6.84 G 5-100 Hz (Y_{PACS}) - 4 oct/min
RAS en visuel

Description	Action/Date
11:22 **Test #16 – FM2 PACS – Axe Y – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Y_{PACS}) - 2 oct/min OK signatures identiques avec pour embase switch pompe un shift sur une fréquence de 20 Hz à 642 Hz (nouvelle fréq. à 620 Hz avec courbe plus propre !). 11:45 **Test #17 – FM2 PACS – Axe Y – haut niveau random** Les données SAp ne sont pas cohérentes : le profil proposé conduit à 4.64 Grms au lieu des 4.9 noté. J. Martignac propose que l'on se base sur le profil, soit 4.6 Grms (avant réduction par 1.25). Confirmation téléphonique par T. Tourrette. Haut niveau random 3.71 Grms 20-2000 Hz (Y_{PACS}) – 60 secondes 10 Grms vu sur embase switch evap. et 7 Grms sur evap. 11:54 **Test #18 – FM2 PACS – Axe Y – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Y_{PACS}) - 2 oct/min OK signatures parfaitement identiques 12:00 Rotation plaque d'interface pour test PACS axe Z  	

Description	Action/Date
12:15 **Test #19 – FM2 PACS – Axe Z – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Z_{PACS}) - 2 oct/min Signatures (fréquences majeures): - evaporateur : 459 Hz / 9.3 G, 479 Hz / 7.8 G, 508 Hz / 22 G - embase inter evap. : 120 Hz / 1.9 G, + importante 298 Hz / 7.4 G - embase inter pompe : 134 Hz / 1.9 G. + importante : 319 Hz / 5.4 G - structure : + importante à 923 Hz / 13.8 G 12:25 **Test #20 – FM2 PACS – Axe Z – haut niveau sinus** Haut niveau sinus 6.84 G 5-100 Hz (Z_{PACS}) - 4 oct/min RAS en visuel 12:30 **Test #21 – FM2 PACS – Axe Z – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Z_{PACS}) - 2 oct/min OK signatures parfaitement superposées. 12:40 **Test #22 – FM2 PACS – Axe Z – haut niveau random** Haut niveau random 2.03 Grms 20-2000 Hz (Z_{PACS}) – 60 secondes 10.97 Grms vu sur evap. 12:47 **Test #23 – FM2 PACS – Axe Z – bas niveau sinus** Bas niveau sinus 0.5 G 0-2000 Hz (Z_{PACS}) - 2 oct/min OK signatures identiques ; glissement de 10 Hz sur une des fréquences de l'évaporateur (450 Hz) 13:00 Arrêt déjeuner (FM2 mis sous capot plexiglas) Retour : démontage plaque d'interface du shaker (on laisse FM2 PACS monté sur plaque) Désolidarisation plateau et shaker. Rotation shaker : mis en position verticale	

Description	Action/Date

16:03 Reprise des essais

16:08

Test #24 – FM2 PACS – Axe X – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (X_{PACS}) - 2 oct/min
Signatures (fréquences majeures):

- evaporateur : 514 Hz / 20.6 G
- embase inter evap. : 133.6 Hz / 1.6 G, + importante 329 Hz / 16.4 G
- embase inter pompe : 141 Hz / 2 G. + importante : 355 Hz / 19 G
- structure : 1300 Hz / 4.4 G, + importante à 1592 Hz / 6.3 G

Description	Action/Date

16:18

Test #25 – FM2 PACS – Axe X – haut niveau sinus

Haut niveau sinus 14.4 G 5-100 Hz (X_{PACS}) - 4 oct/min
Test effectué en deux fois : à 64 Hz, défaut d'overload sur une des voies. Vérification connectique et reprise test à 64 Hz (jusqu'à 100 Hz). OK.

16:25

Test #26 – FM2 PACS – Axe X – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (X_{PACS}) - 2 oct/min
OK signatures quasiment identiques

16:46

Test #27 – FM2 PACS – Axe X – haut niveau random

Haut niveau random 9.2 Grms 20-2000 Hz (X_{PACS}) – 60 secondes
45 Grms vu sur embase switch évaporateur, 35 Grms sur embase switch pompe et ≈ 20 Grms sur évaporateur

16:54

Test #28 – FM2 PACS – Axe X – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (X_{PACS}) - 2 oct/min
OK signatures identiques ; glissement de 15 Hz (3%) sur une des fréquences de l'évaporateur (499 au lieu de 514 Hz)

OK fin des essais pour FM2 PACS.

Conclusion : Pour chaque axe les signatures en fréquence bas niveaux sont restées similaires. Quelques glissements mais inférieurs à 5%.

Vérification circuit électrique (valeurs en Ohm - 1ère ligne = main, 2ème = redondant)

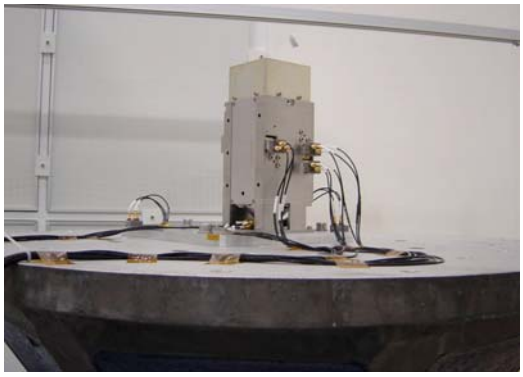
T_{pompe}	C_{pompe}	$T_{inter\ P}$	$C_{inter\ P}$	T_{evap}	$T_{inter\ E}$	$C_{inter\ E}$	T_{shunt}
45.1	409.8	50.4	407.6	52.6	48.1	409.3	48.2
49.4	409.4	48.2	409.8	54	48.7	408.7	47.6

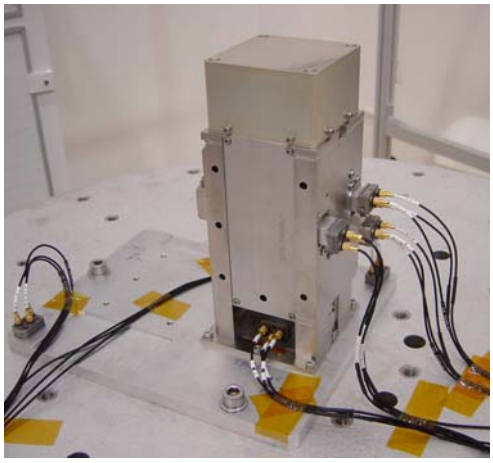
Vérification défaut de masse : Main : OK RAS – Redondant : OK RAS
Vérification isolation électrique : OK

FM2 PACS a passé les essais vibratoires sans rupture ni défaut apparent. Vérification thermique à venir (HCR#3) confirmera l'intégrité du FM2.

Description	Action/Date

17:02
Démontage FM2 PACS de la plaque d'interface. Démontage accéléromètres + support.
Dépose FM2 et vérification circuit électrique (remet en place les savers).
Dépose FM2 dans son container (avec les transit screws).
Montage accéléromètres sur FM1 SPIRE et montage FM1 sur plaque d'interface.





17:44
Test #29 – FM1 SPIRE – Axe Y – bas niveau sinus
Bas niveau sinus 0.5 G 0-2000 Hz (Y_{SPIRE}) - 2 oct/min
Signatures (fréquences majeures):

- evaporateur : 558 Hz / 20 G
- embase inter evap. : 116 Hz / 0.9 G, 294.6 Hz / 1.87 G, + importante 616 Hz / 7.8 G
- embase inter pompe : 120 Hz / 0.94 G. 311 Hz / 1.7 G, + importante : 627 Hz / 9.81 G
- structure : 538 Hz / 1 G, + importante à 1555 Hz / 2 G

17:57
Test #30 – FM1 SPIRE – Axe Y – haut niveau sinus
Haut niveau sinus 12 G 25-60 Hz (Y_{SPIRE}) - 4 oct/min

18:05
Test #31 – FM1 SPIRE – Axe Y – bas niveau sinus
Bas niveau sinus 0.5 G 0-2000 Hz (Y_{SPIRE}) - 2 oct/min
OK signatures identiques

Description	Action/Date

18:14

Test #32 – FM1 SPIRE – Axe Y – haut niveau random

Haut niveau random 4.88 Grms 20-2000 Hz (Y_{SPIRE}) – 60 secondes
19 Grms vu sur les embases des switch , 29 Grms sur évaporateur

18:20

Test #33 – FM1 SPIRE – Axe Y – bas niveau sinus

Bas niveau sinus 0.5 G 0-2000 Hz (Y_{SPIRE}) - 2 oct/min
OK signatures identiques – quasiment aucun glissement en fréquence

OK fin des essais pour FM1 SPIRE.

Conclusion : Pour chaque axe les signatures en fréquence bas niveaux sont restées similaires.

18:35
Démontage FM1 de la plaque d'interface et démontage plaque d'interface. Démontage supports + accéléromètres. Montage savers sur FM1 et contrôle circuit électrique.

Vérification circuit électrique (valeurs en Ohm - 1ère ligne = main, 2ème = redondant)

T_{pompe}	C_{pompe}	$T_{inter\ P}$	$C_{inter\ P}$	T_{evap}	$T_{inter\ E}$	$C_{inter\ E}$	T_{shunt}
45.2	406.9	47.1	407.1	51.5	48.1	407.1	47.8
43.7	407.4	48.2	408	51	49.8	407	45.9

Vérification défaut de masse : Main : OK RAS – Redondant : OK RAS
Vérification isolation électrique : OK

FM1 SPIRE a passé les essais vibratoires sans rupture ni défaut apparent. Vérification thermique à venir (HCR#3) confirmera l'intégrité du FM1. On note toutefois que la tresse coté évaporateur (et cela s'applique aussi à FM2) à un peu foisonnée – elle est proche de la structure (reste quand même ≈ 2 mm). Deux actions possibles : 1) mettre un film Kapton sur structure en regard de la tresse (permettra de garantir l'isolation électrique en cas de contact affleurant) et 2) éventuellement mettre une boucle de fil Kevlar autour de la tresse pour éviter qu'elle ne s'expande.

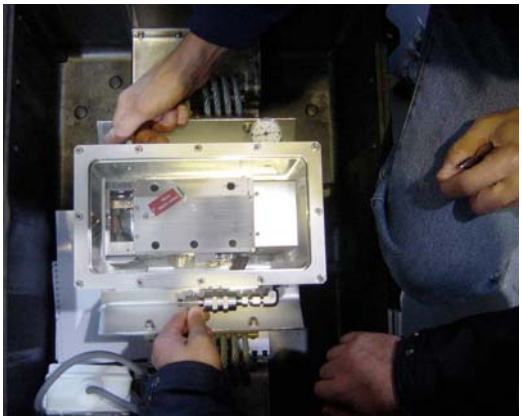
FM1 est déposé dans son container (transit screws fitted). Chargement en gaz demain matin. Démontage capot plexiglas
19:20 – Sortie CSL

Description	Action/Date

Jeudi 21 Octobre 2004

10:00

Chargement en gaz azote des deux containers. 200 mB.



Chargement caisses de transport dans Citroën C8 (pousse les bières…)

Actions pour essais vibratoires futurs (modèles SPARE) :

- prévoir outillage pour le maintien des supports accéléromètres sur les embases switch (lors du montage des support, afin d'éviter couple sur embase)
- prévoir bouteille B1 avec mano détendeur et flexible pour chargement container en azote (plus pratique que passage en sas CSL et connection grosse bouteille)
- regarder possibilité de modifier les supports accéléromètres sur le bout froid (actuels : très près capot alu et/ou structure).

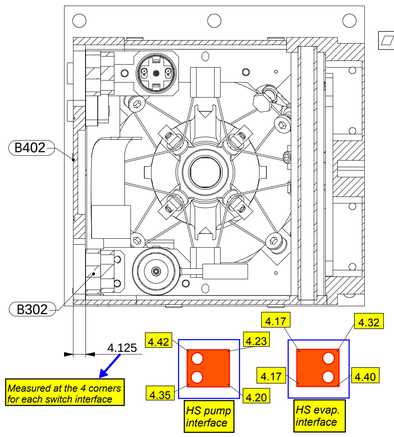
10:30

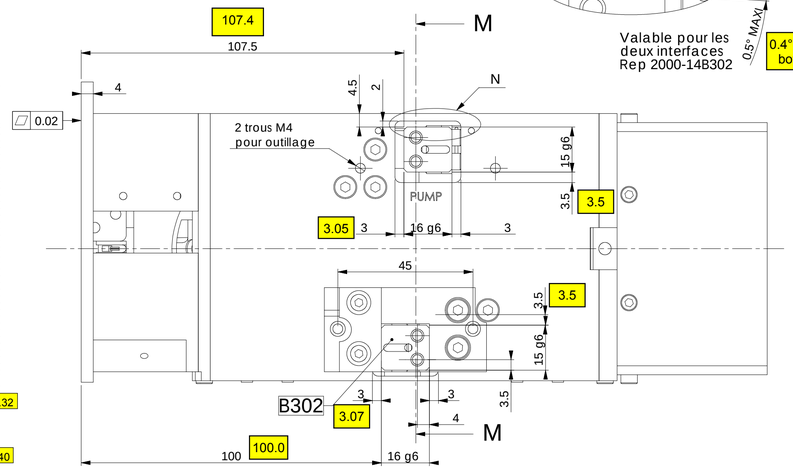
Départ de CSL – retour Grenoble.

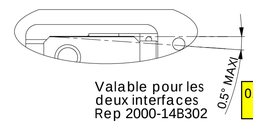
FM1 SPIRE - Interfaces Control

Actual measurements are reported in the square with the yellow background

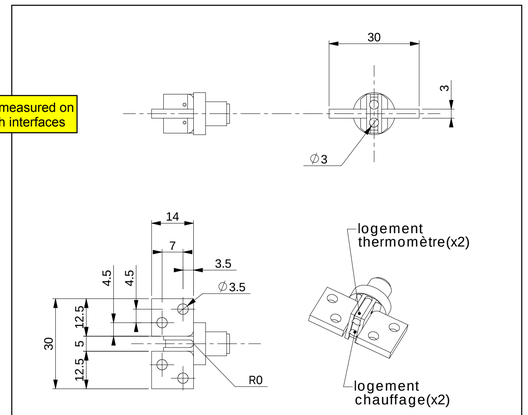
M-M



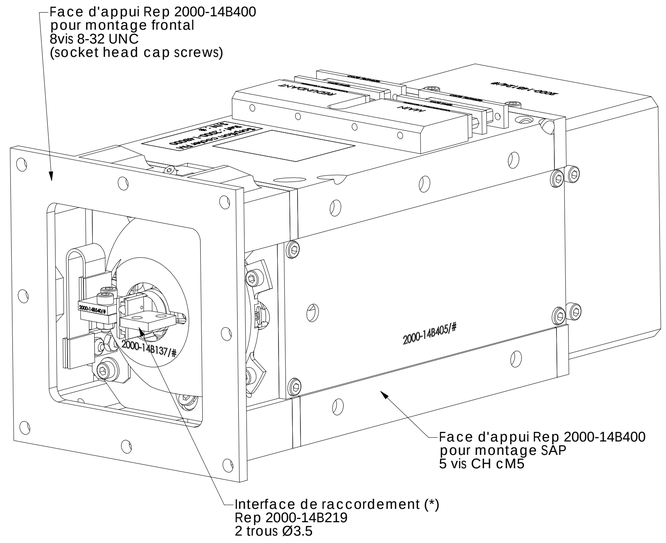


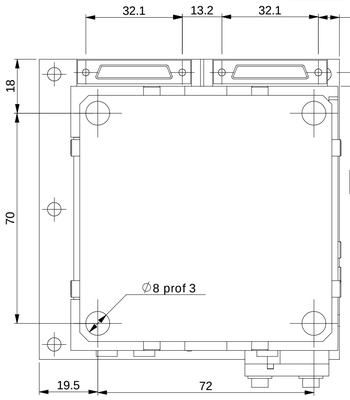


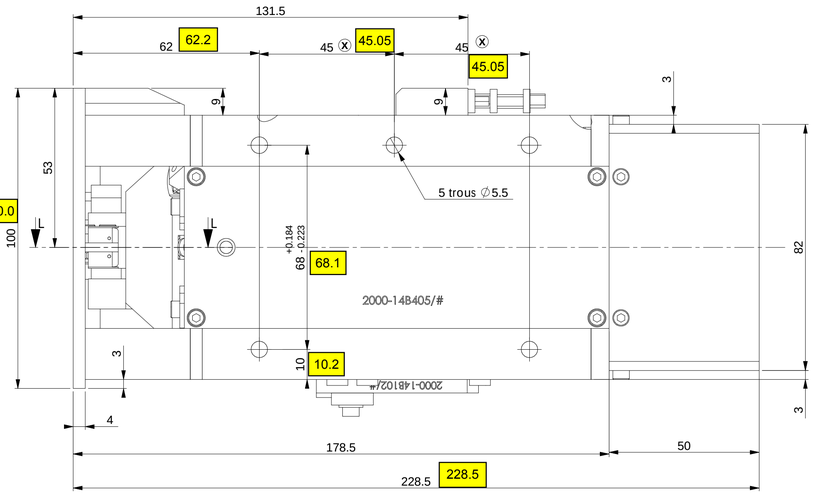
0.4° measured on both interfaces

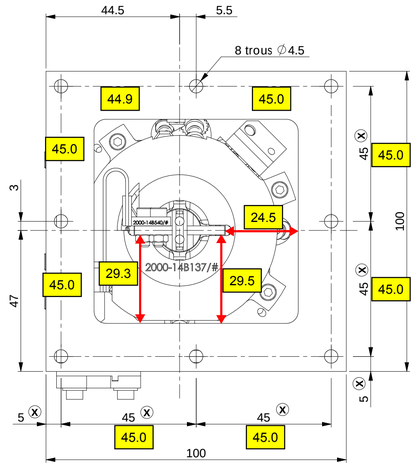


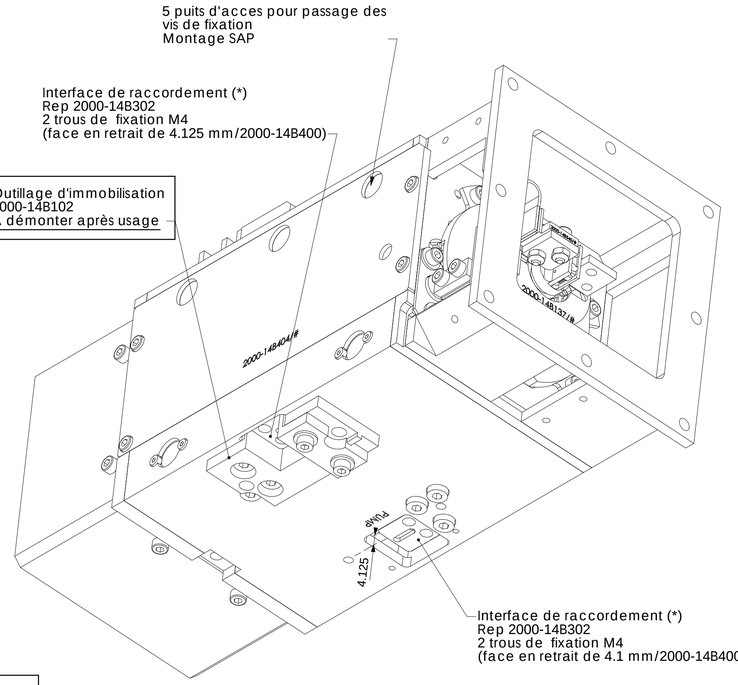
INTERFACE DE RACCORDEMENT
Rep 2000-14B219



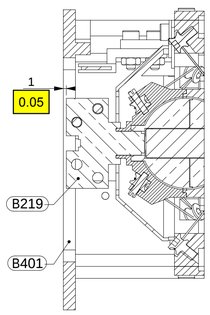


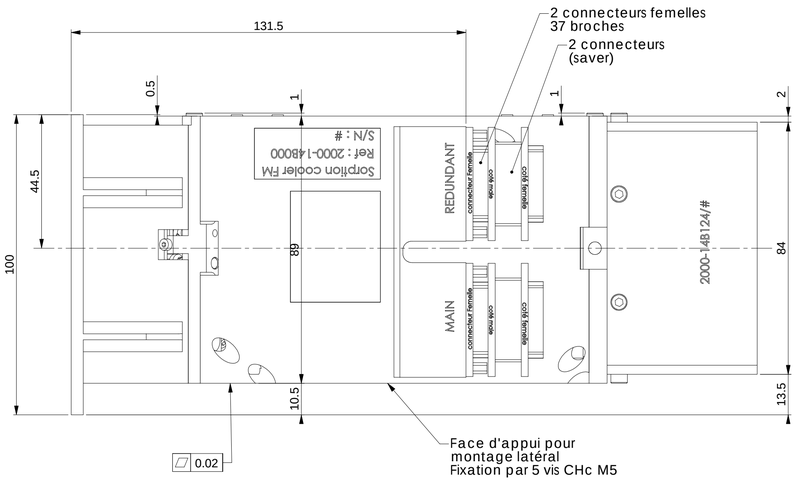






L-L

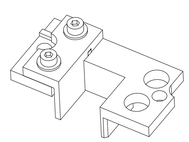




X = COTES AVEC TOLERANCE : Js11

(*):
TRAITEMENT DE SURFACE SUR INTERFACES CUIVRE DE RACCORDEMENT
Rep : 2000-14B302 & 2000-14B219
DORURE,épaisseur de dépot ~10 microns

2000-14B102
OUTILLAGE D'IMMOBILISATION DES EMBASES Rep 2000-14B302



A DEMONTER APRES USAGE

Désignation des modifications	Indice	Emetteur	Date	Visa
Ajouté spécifications géométriques - changé outillage	I	GUILLEMET	03-03-2004	
Ajouté coupes LL & MM	H	GUILLEMET	01-03-2004	
Planche 2/2 devient Planche 2/3	G	GUILLEMET	15-12-2003	
représentation de la structure	F	GUILLEMET	07/07/2003	
Mise à jour pour FM	E	GUILLEMET	16/01/2003	
Changer référence Rep 102 (DM014)	D	GUILLEMET	22/01/02	
Mise à jour nomenclature (DM012)	C	GUILLEMET	11/12/01	

Matière :	Nombre :
Tolérance générale :	Ebavurage :
Ra générale : **3,2**	Poids : **1.8004**
Traitement :	

PLANCHE 2/3

Dessiné par : **GUILLEMET** | Vérifié par **GUILLEMET** | Date: **13/06/01**

Ensemble **FRIGO SPIRE/PACS** | Echelle 1/ 1 | **CEA-G SBT**

Titre **S/Ens COMPOSANTS DIVERS INTERFACE DE MONTAGE**

N° d'étude	S/Ensemble	N° de pièce	Indice
2000-14	B	100	H I G F

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16 – VERIFICATION MATRIX

Document reference HSO-SBT-LI-121

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Project :	Item : **SORPTION COOLER**	Drawing / ident. N° : **2000-14 B 000**	Model : **FM1**	Visa (Project and PA) :

Reference Document : SPIRE and PACS Sorption Coolers – SPECIFICATIONS (HSO-SBT-SP-001 Issue 3.7)

		Verification method				Output	
§ Spec	**Heading**	**Analysis**	**Design**	**Test**	**Inspection**	**Results**	**Ref. Doc.**
4.1	***Functional requirements***						
4.1 a)	Thermal architecture (4K / 1.7 K)		X			Test cryostat features set-up simulating thermal architecture	HSO-SBT-RP-118
4.1 b)	Performance versus orientation (low T)		X	X		OK : No effect of orientation	HSO-SBT-RP-118
4.1 c)	Ground tests : orientation aspects	X				N/A	
4.1 d)	Design"plug in" type		X			OK - See general drawing	HSO-SBT-ADP-108
4.1.1 a)	Recycling time ≤ 2 h		X	X		≤ 2 h	HSO-SBT-RP-118
4.1.1 b)	5 J of gross cooling at 300 mK		X	X		5.3 J	HSO-SBT-RP-118
4.1.1 c)	12/14 µW maximum parasitic load		X	X		11.3 µW	HSO-SBT-RP-118
4.1.1 d)	10 µW net heat lift @ 290 mK		X	X		10 µW @ 277 mK	HSO-SBT-RP-118
4.1.1 e)	Energy per cycle ≤ 860 J		X	X		927 J but cooler overcharged	HSO-SBT-RP-118
4.2	***Operational requirements***						
4.2.1	Safety : Leak Before Burst	X	X	X		Tests carried out on representative sample	HSO-SBT-TN-076 (safety issues)
4.2.2	Lifetime	X	X			N/A	
4.2.3	Operating modes		X	X		By essence (driven by physics)	
4.2.4	Commands : thermometers & heaters		X			By construction. Thermometers referenced in operating manual	HSO-SBT-TN-120
4.2.5	Monitoring : thermometers accuracy		X			Thermometers chosen by SAp	SAp-PACS-ED-0330-04
4.3	***Environmental requirements***						
4.3.1 a)	Ground & launch thermal environment		X	X		OK	HSO-SBT-RP-118
4.3.1 b)	Storage & handling		X			OK	HSO-SBT-PR-119
4.3.1 c)	Humidity		X			OK	HSO-SBT-PR-119
4.3.1 d)	Test or orbit (idem 4.1 a)		X			OK	HSO-SBT-RP-118
4.3.2.1	Limit loads and launch levels	X	X	X	X	Vtest successfully passed	HSO-SBT-RP-118
4.3.2.2	Orbit		X	X		Expected to be OK – Cooler operated upside down	HSO-SBT-RP-118

		Verification method				*Output*	
§ Spec	**Heading**	**Analysis**	**Design**	**Test**	**Inspection**	**Results**	**Ref. Doc.**
4.3.2.3	Ground		X	X		OK	HSO-SBT-PR-119
4.3.3	Electrical environment		X			Electrical circuit checked	See HCR in test report
4.3.4	Radiation environment		X			≈ OK	
4.4	***Design & construction requirements***						
4.4.1	Interchangeability		X			OK See general drawing	HSO-SBT-ADP-108
4.4.2	Control electronics	Under SAp responsability					
4.4.3.1	Maximum operating pressure		X			OK	HSO-SBT-RP-118
4.4.3.2	Proof pressure and Burst pressure	X	X	X		Proof pressure tested to 2 MPa	HSO-SBT-RP-118
4.4.4	Mass		X			1748 grams	HSO-SBT-ADP-108
4.4.5	Size		X			OK : 228.5 x 100 x 100	HSO-SBT-ADP-108
4.4.6	Mechanical stiffness requirement	X	X	X		OK see MoM of Vtest in test report	HSO-SBT-RP-118
4.4.7.1	Design margin – Structural	X	X	X		OK	HSO-SBT-TN-076
4.4.8.1	Parts, Material and processes	X	X		X	See DML and DPL	
4.4.8.2	Magnetic materials		X			N/A	
4.4.8.3	Fungus Nutrient Materials		X			N/A	
4.4.8.4	Flammable, toxic & unstable materials		X			N/A	
4.4.8.5	Cleanliness			X	X	OK	HSO-SBT-RP-118
4.4.8.6	Finish		X			OK copper surface are gold plated and aluminum surface are alodine	
4.4.8.7	Outgassing		X			Demonstrated during ESA TRP	
4.4.8.8	Susceptibility to stress corrosion		X			By design	
4.8.8.9	Limited lifetime materials		X			N/A	
4.5	***Interface requirements***						
4.5.1	Thermal interface to detector		X			OK See general drawing	HSO-SBT-ADP-108
4.5.2	Mechanical interface to the heat sink		X			OK See general drawing	HSO-SBT-ADP-108
4.5.3	Thermal interface to the heat sink		X			OK See general drawing	HSO-SBT-ADP-108
4.5.4	Electrical interface		X	X		OK from thermal performance	HSO-SBT-RP-118
4.6	Logistic requirements		X		X	Dedicated container with shock absorber	HSO-SBT-PR-119