



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
 Iss/Rev : 1.0  
 DATE : 28/06/2004  
 PAGE : I

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

***SPIRE & PACS Sorption Coolers***  
***SPIRE CQM OPERATING MANUAL***

SBT internal ref : SBT/CT/2003-52

	Name & Function	Date	Signature
<b>Prepared</b>	L. Duband - Cooler project manager		
<b>SBT PA Check</b>	M. Dubois – Cooler PA manager		
<b>SPIRE Approval</b>			
<b>PACS Approval</b>			
<b>PA Approval</b>		N/A	
<b>Project Approval</b>	J.L Augueres - SAp HSO project manager	N/A	
<b>Project Approval</b>	L. Duband - Cooler project manager		

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.



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : II

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/GBT]**

***Document Status***

<b>Issue</b>	<b>Revision</b>	<b>Date</b>	<b>Nb of pages</b>	<b>Modifications</b>
0	0	20/08/2003		First draft
1	0	28/06/2004		First issue (no modification from 0.0)



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : III

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

**CONTENTS**

1	Scope of the document.....	5
2	Documents .....	6
2.1	Applicable documents.....	6
2.2	Reference documents.....	6
3	Description and photographic records of sorption cooler.....	7
4	Mechanical integration .....	9
4.1	Handling.....	9
4.2	Integration .....	9
4.2.1	Centering screws.....	11
4.2.2	Anti rotating tools .....	13
4.2.3	Mounting of thermal strap on evaporator cold tip .....	14
5	Electrical connection – Instrumentation .....	16
5.1	Thermometers : reference and calibration curves.....	17
6	Thermal operation .....	19
6.1	Typical Recycling.....	19
7	Appendix A – Cernox Data.....	22



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
 Iss/Rev : 1.0  
 DATE : 28/06/2004  
 PAGE : IV

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/ST]**

*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		
ECSS	European Cooperation for Space Standardisation		
FIRST	Far Infrared and Submillimetre Telescope		
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		



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 5

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/GBT]**

## **1 Scope of the document**

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



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 6

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

## 2 Documents

### 2.1 Applicable documents

	<i>Title</i>	<i>Reference</i>
AD01	Interface Control Document (ICD)	HSO-SBT-ICD-012
AD02	CQM unit – Handling, packing, transportation and storage manual	HSO-SBT-PR-077

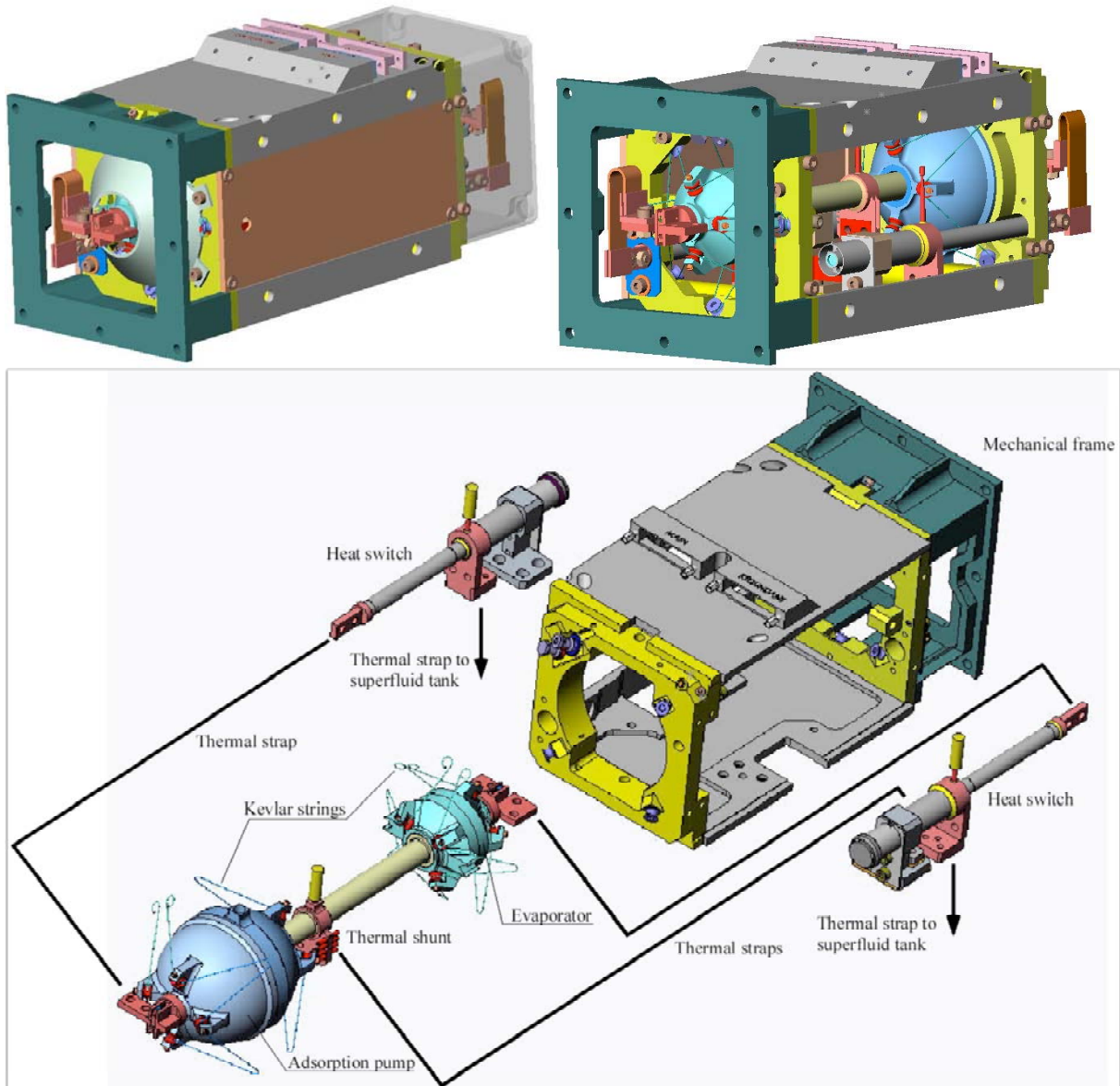
### 2.2 Reference documents

	<i>Title</i>	<i>Reference</i>
RD01	Drive electronic specifications	HSO-SBT-SP-015
RD02		

### 3 Description and photographic records of sorption cooler

The cooling of the SPIRE and PACS detectors down to 300 mK will be effected by a helium three sorption cooler. This sub-Kelvin sorption cooler provides a wide range of heat lift capability at temperature below 400 mK. It relies on the capability of porous materials to adsorb or release a gas when cyclically cooled or heated. Using this physical process one can design a compressor/pump which by managing the gas pressure in a closed system, can condense liquid at some appropriate location and then perform an evaporative pumping on the liquid bath to reduce its temperature. Helium sorption refrigerators have no moving parts, are vibrationless and can be designed to be self contained and compact with a high duty cycle efficiency.

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



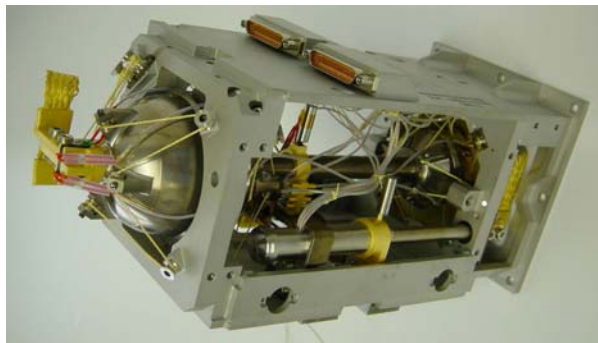


**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

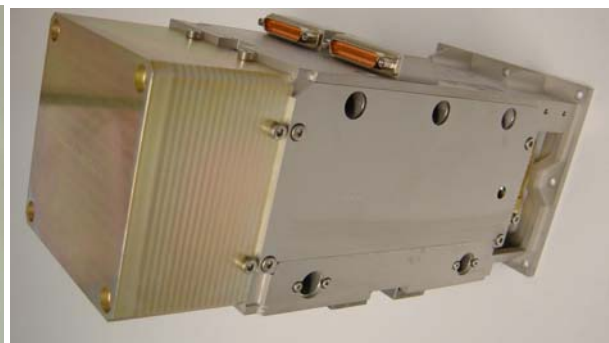
DOC N°: HSO-SBT-TN-086  
 Iss/Rev : 1.0  
 DATE : 28/06/2004  
 PAGE : 8

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

The following set of pictures shows the CQM unit. The CQM 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 CQM is about 1740 grams.



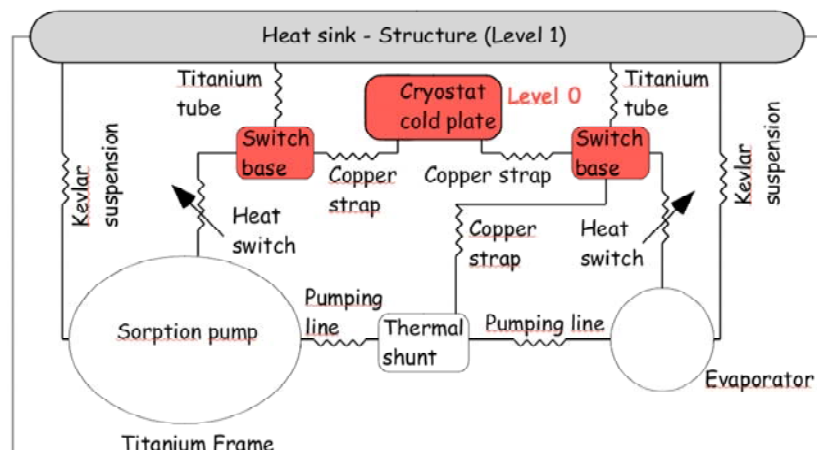
*without protective covers*



*with protective covers*



Within the instruments (SPIRE and PACS) a specific thermal architecture is used (see fig.). The cooler is mechanically mounted off the optical bench (Level 1) and is thermally connected to the cryostat (Level 0) via two straps.







**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 9

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

## **4 Mechanical integration**

### **4.1 Handling**

For transportation or storage, 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 performed 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 of the order of 8 MPa (80 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).

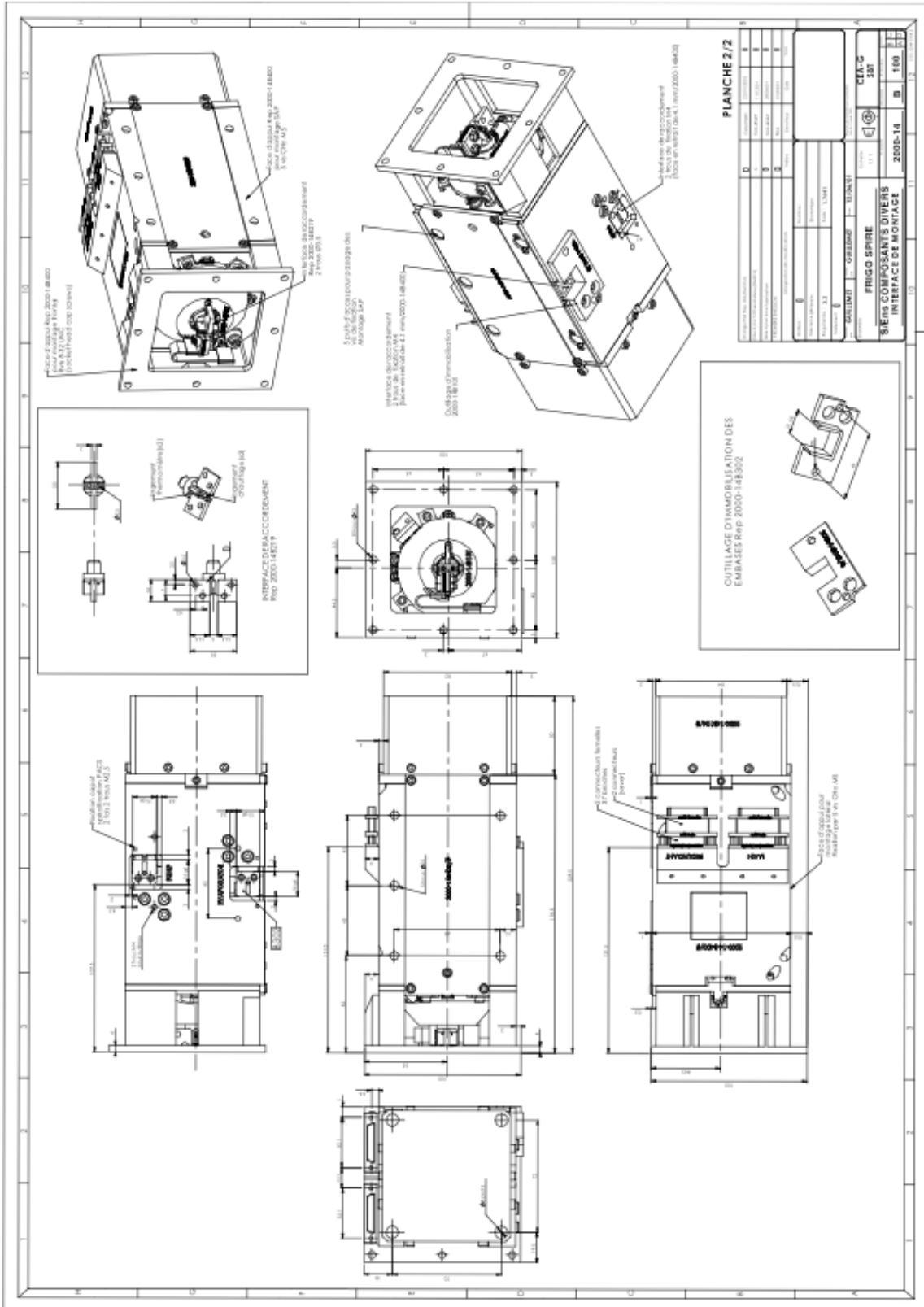
A general overview drawings featuring the interfaces is given hereafter.



# SPIRE & PACS Sorption Coolers *SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 10

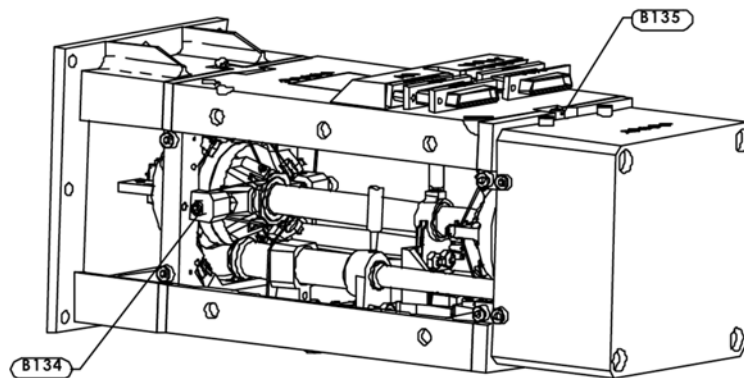
SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]



The CQM features centering screws and anti rotating tools.

#### 4.2.1 Centering screws

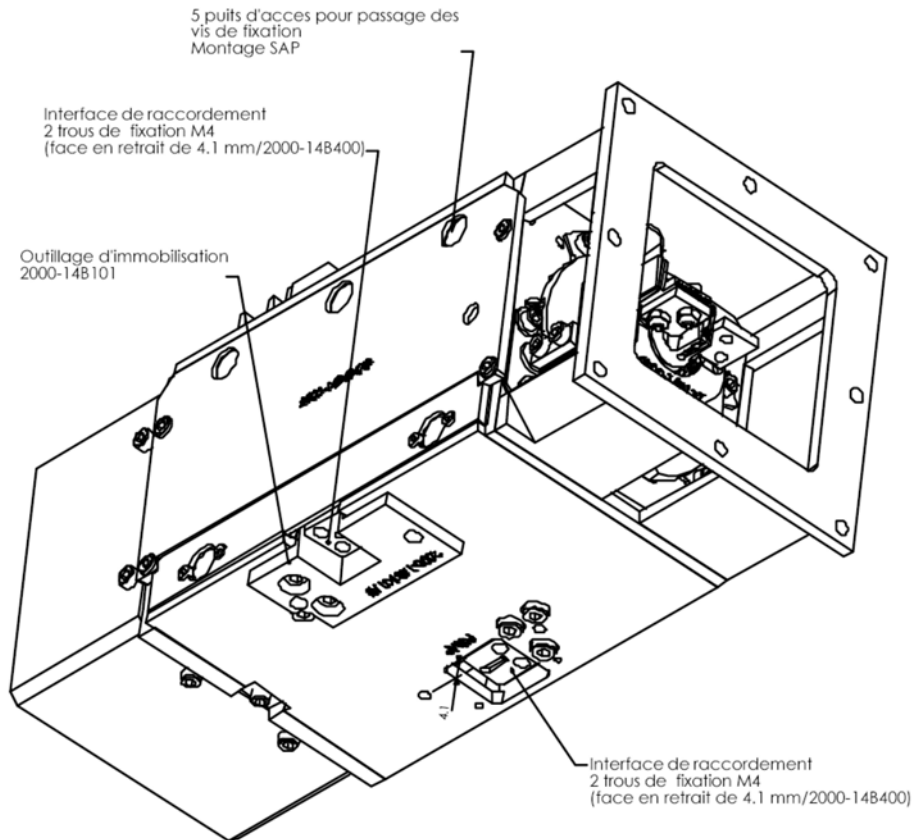
The centering screws are used to initially install the Kevlar strings and then to secure the cooler heart whenever needed (transportation and possibly storage). They can also be used (recommended if possible) during the integration of the thermal bus bar on the cooler cold tip.



*Centering screws – evaporator side*



*Centering screws – pump side*



Two centering screws can be found on the pump side and two on the evaporator side as shown on the previous 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 opposite screw (slight touching again)
- very slightly tighten the screws – Absolutely avoid pushing on the pump or evaporator. Tighten just to prevent losing the screw.
- repeat previous operations for the other component (pump or evap.)

#### 4.2.2 Anti rotating tools

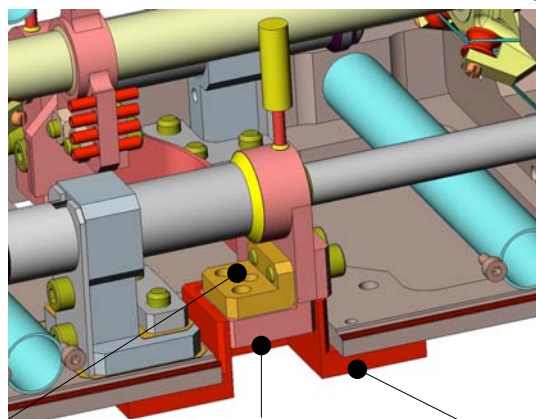
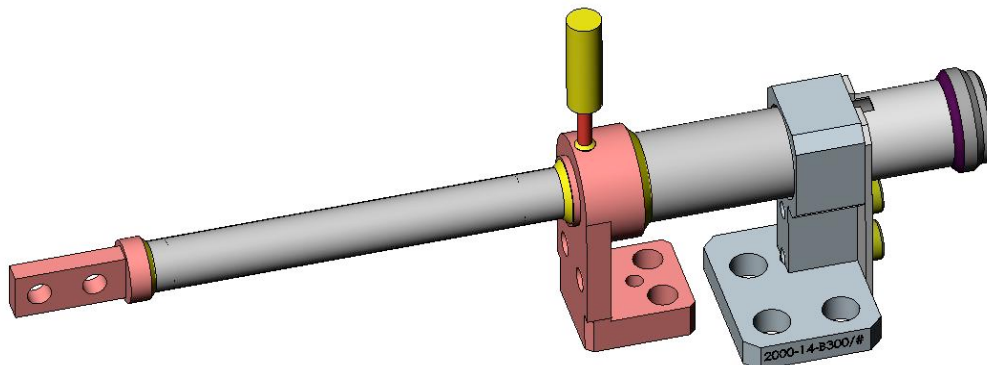
The cooler comprises two gas gap heat switches located inside the structural box. The box then features two cuts to provide access to the switch interface. Each heat switch interfaces with a thermal strap (connected to the superfluid cryostat). The mechanical interface for both switches is similar and 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

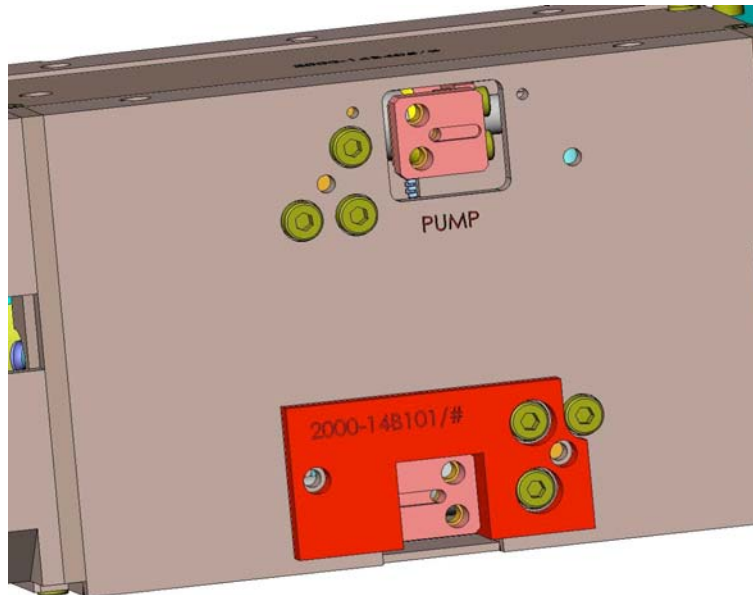
**This tool is intended to be used only while screwing the strap and must be removed before cooler operation – the drawing hereafter shows this tool in place.**

**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*





*3D view of interface without and with mounting tool (screws not shown)*

The tool is tight fitted to the switch interface plate and consequently a slight resistance is possible when inserting or removing it. In any case it must be installed or removed with great care.

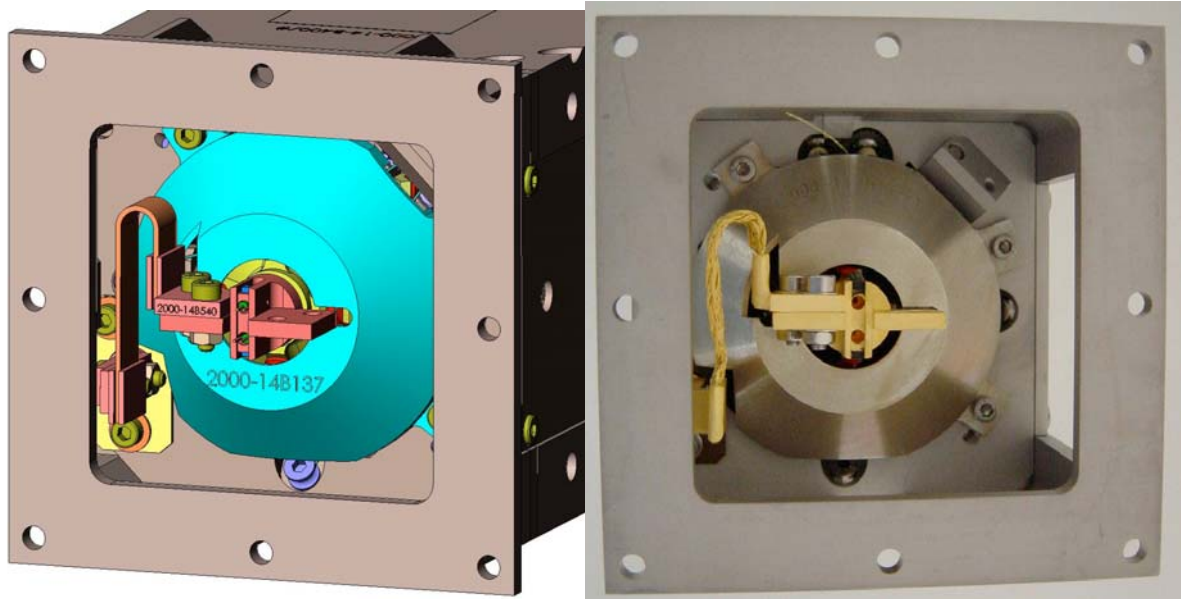
Once in place, the tool is held in place by two M4 screws.

Integration of the thermal strap can then be carried out.

#### **4.2.3 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.

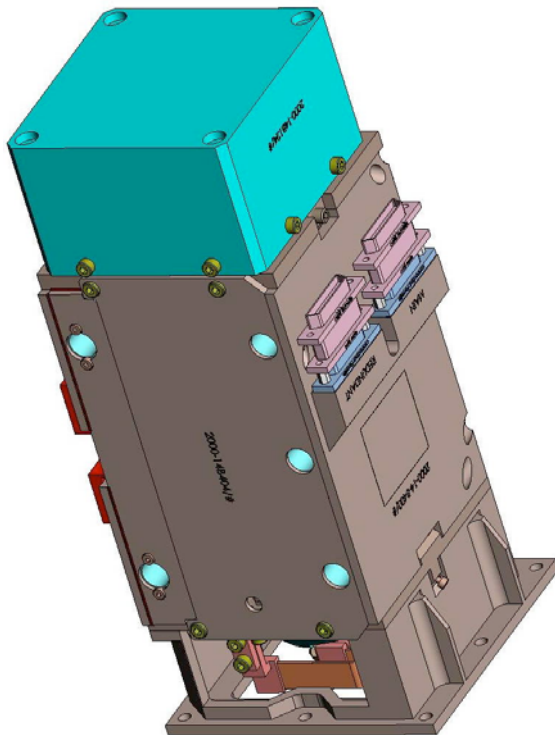
- ***The thermal quality of this interface is critical to the performance of the cooler (cleanliness, contact force)***
- ***Any excessive torque or bending force on this interface is prohibited. Always use two wrenches (one on each side) when tightening screws on the cold head. Prevent any nuts to fall inside the cooler***
- ***The mounting of the 300 mK thermal strap to the cold end must be performed by trained people***



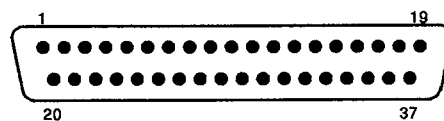
If possible, it is **highly recommended to lock the cooler heart with the centering screws** during the integration of the thermal bus bar on the cooler cold tip. The cooler cold tip is thermally and mechanically linked to the heat switch end : any displacement of the cold tip may induce stress on the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

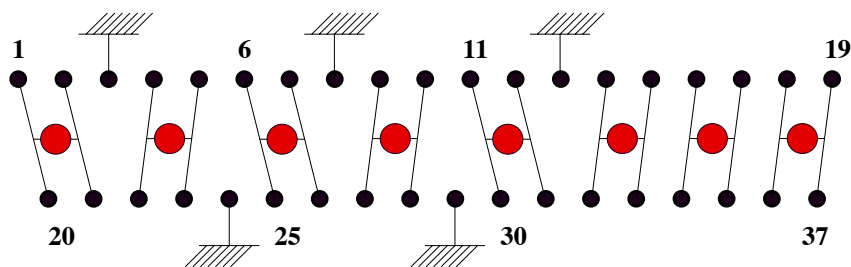


The wiring of both connectors is identical. The pins out is arranged such that each set of wires per component is grouped (see schematic and table hereafter). All wiring is made using twisted manganin wires.



**37 CONTACTS**

*Contact arrangement for MDM 37 pins*



*Connector wiring (red dot features thermometer or heater)*





**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
 Iss/Rev : 1.0  
 DATE : 28/06/2004  
 PAGE : 17

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

Signal	Pin n°	Max. current	Max. Ohms
SP temperature I+ (Drive)	20	1 $\mu$ A	1000
SP temperature V+ (Sens)	1	N/A	1000
SP temperature V- (Sens Return)	2	N/A	1000
SP temperature I- (Return)	21	1 $\mu$ A	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 $\mu$ A	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 $\mu$ A	1000
Shield HSP temperature	8	N/A	N/A
HSE pump temperature I+ (Drive)	27	1 $\mu$ A	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 $\mu$ A	1000
Shield HSE temperature	29	N/A	N/A
Thermal shunt temperature I+ (Drive)	30	1 $\mu$ A	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 $\mu$ A	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**



**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

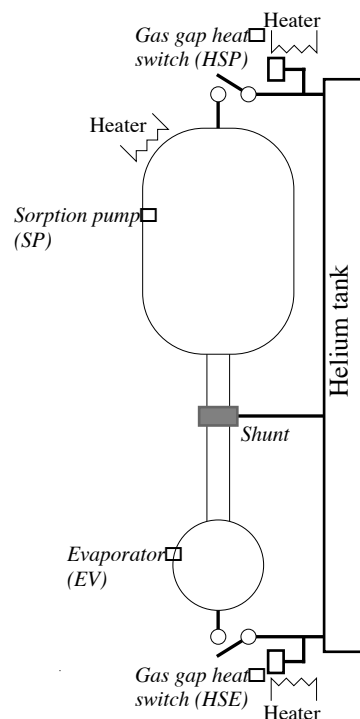
DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 18

**SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]**

<b>Location</b>	<b>Thermometer reference</b>
Main sorption pump	Cernox CX 14909
Thermal shunt	Cernox CX 25347
Evaporator – cold tip	Cernox CX 16965
Miniature sorption pump – Pump heat switch	Cernox CX 15986
Miniature sorption pump – Evaporator heat switch	Cernox CX 15984

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

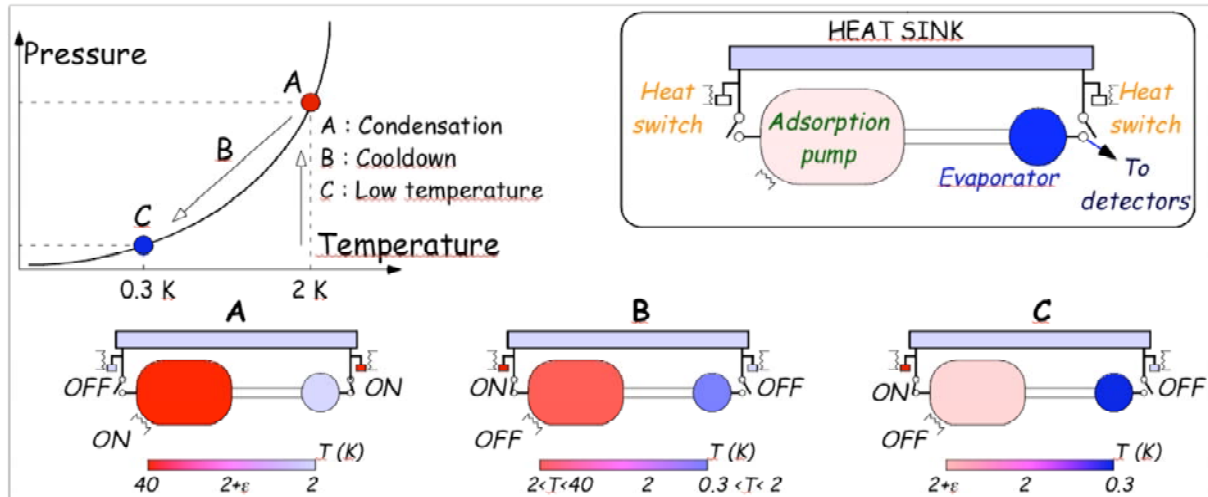
sorption pump provides an evaporative pumping on the liquid helium bath which temperature quickly drops to sub-Kelvin temperature.

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 <sup>3</sup>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 :

<i>Sequence #</i>	<i>Action</i>
<b>1</b>	power is applied to HSE to turn it ON (HSP is OFF)
<b>2</b>	power is applied to SP until SP reaches 40-45 K ( <sup>3</sup> He)
<b>3</b>	when SP reaches 40-45 K power is reduced to maintain this temperature until EV reaches a reasonable temperature (typically below 2 K)
<b>4</b>	power on SP is then turned OFF
<b>5</b>	power on HSE is turned OFF to switch to OFF position
<b>6</b>	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  $\mu$ W of input power. However to speed up the switching time, we recommend an input power of 800  $\mu$ W until the switch is ON, at which point this power can be reduced to 400  $\mu$ W.

For most of the recycling performed, the sequence of operation have been (performed in manual mode with current supplies and temperature bridges) :

<i>Action</i>	<i>Result / Comments</i>
800 $\mu$ W input to HSE (1.4 mA)	T HSE raises to about 20 K (HSE is ON)
300 mW input to SP (27.3 mA)	T SP increases fairly quickly ( $\approx$ 1 K/mn on average)
power reduced to 20 mW (7 mA) once SP reaches 45 K	SP remains at $\approx$ 45 K
wait until T EV falls below 1.95 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 18 K : 800 $\mu$ W (1.4 mA) to HSP	turn ON HSP

A typical recycling is displayed on the following page.

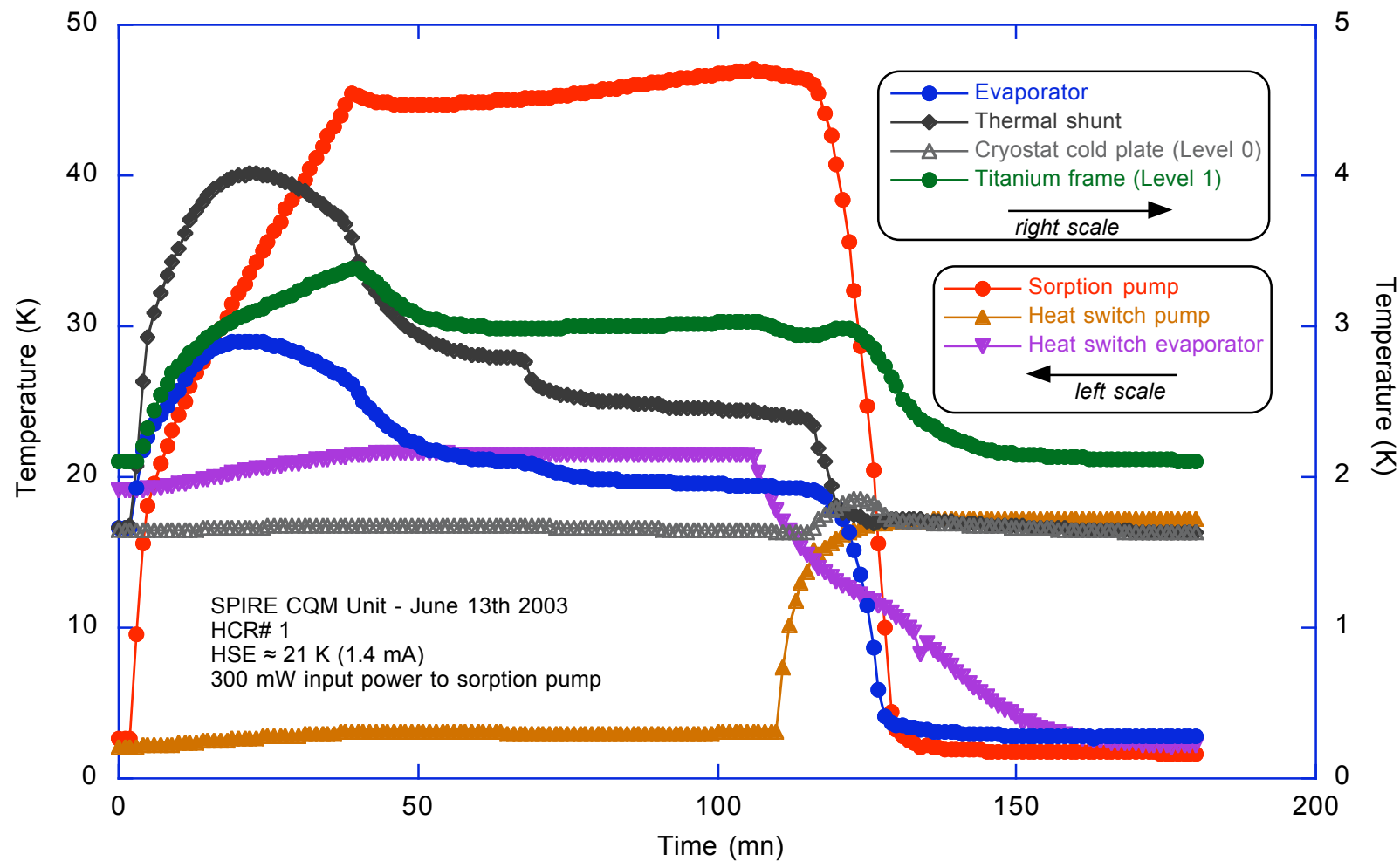
This sequence of operations have been provided for pedagogic purpose since it is foreseen a drive electronic (flight and ground) will deal with the cooler recycling. The controlled algorithms will be then directly implemented in the software control.



# SPIRE & PACS Sorption Coolers SPIRE CQM Operating manual

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 21

SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/SBT]





**SPIRE & PACS**  
**Sorption Coolers**  
*SPIRE CQM Operating manual*

DOC N°: HSO-SBT-TN-086  
Iss/Rev : 1.0  
DATE : 28/06/2004  
PAGE : 22

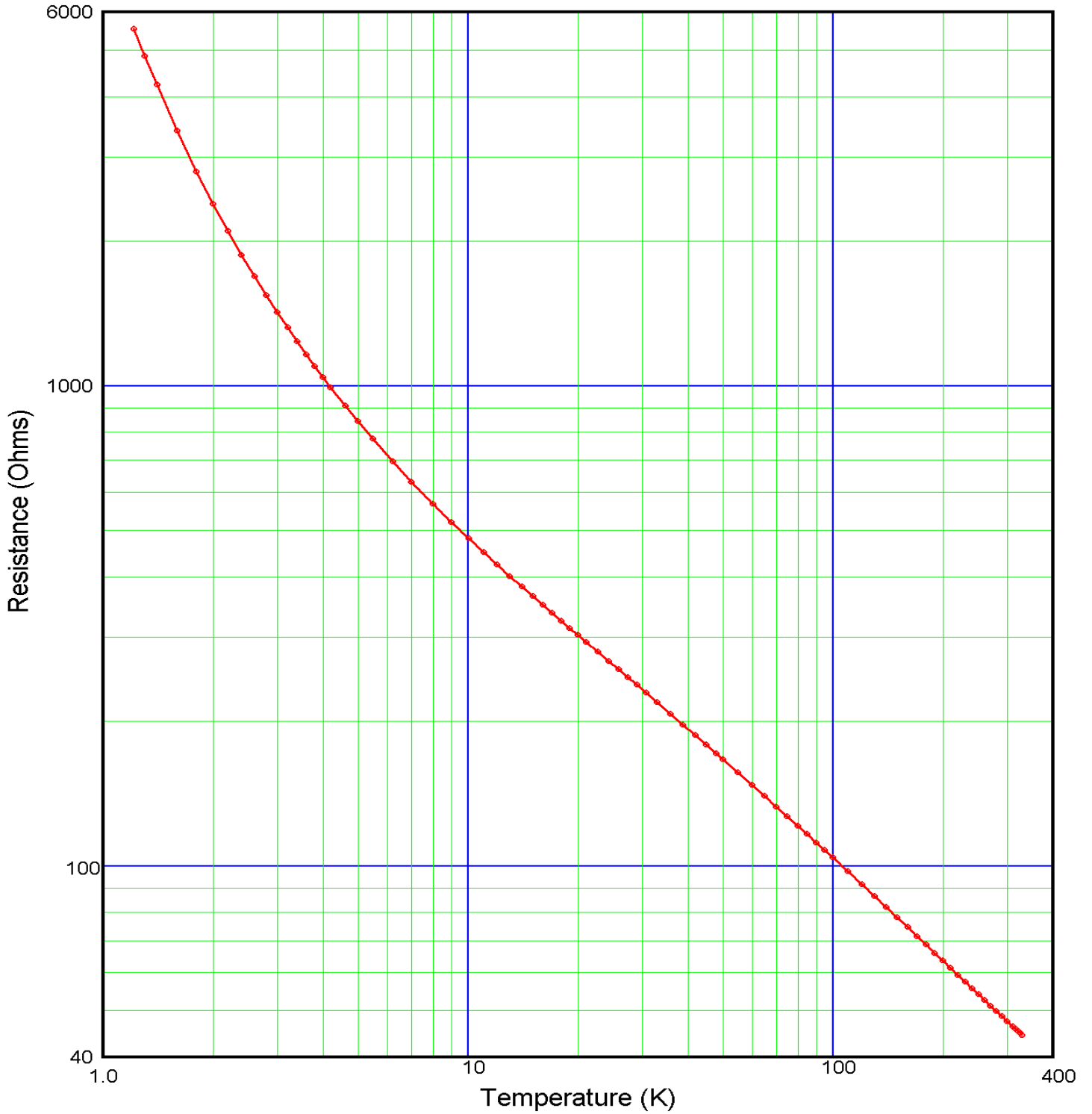
*SERVICE DES BASSES TEMPERATURES [CEA/DSM/DRFMC/GBT]*

**7 Appendix A – Cernox Data**

# DATA PLOT

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%



# TEST DATA

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	1.21421	5536.35	46	41.8728	187.364
2	1.29965	4870.03	47	44.8759	178.996
3	1.40342	4234.11	48	47.8781	171.447
4	1.59661	3396.09	49	49.8873	166.811
5	1.80514	2796.07	50	54.8824	156.499
6	2.00342	2396.46	51	59.8901	147.592
7	2.19921	2103.19	52	64.8956	139.835
8	2.39755	1874.44	53	69.8929	133.014
9	2.59801	1691.60	54	74.9498	126.866
10	2.79933	1544.15	55	79.9716	121.395
11	2.99928	1423.60	56	84.9704	116.476
12	3.20290	1320.86	57	89.9205	112.029
13	3.40014	1236.45	58	94.9153	107.962
14	3.59879	1163.20	59	99.9142	104.187
15	3.80049	1098.51	60	109.932	97.4884
16	3.99790	1043.08	61	119.944	91.7194
17	4.20609	991.494	62	129.950	86.6777
18	4.60882	908.094	63	140.123	82.1452
19	4.98723	843.416	64	149.952	78.2530
20	5.48238	775.034	65	160.046	74.6652
21	6.21238	696.256	66	170.063	71.4600
22	7.00175	631.207	67	180.058	68.5608
23	8.00768	568.412	68	190.049	65.9213
24	9.01696	519.985	69	200.031	63.5167
25	10.0225	481.517	70	210.027	61.3045
26	11.0256	450.065	71	220.036	59.2690
27	12.0264	423.774	72	230.028	57.3916
28	13.0262	401.362	73	240.023	55.6543
29	14.0264	381.979	74	250.016	54.0448
30	15.0262	364.952	75	260.006	52.5413
31	16.0216	349.850	76	270.009	51.1459
32	17.0139	336.388	77	279.997	49.8408
33	18.0070	324.196	78	289.992	48.6294
34	19.0012	313.064	79	299.988	47.4866
35	19.9974	302.883	80	309.975	46.4135
36	21.0965	292.634	81	314.973	45.9044
37	22.6931	279.287	82	319.966	45.4066
38	24.2790	267.349	83	325.959	44.8386
39	25.8470	256.785	84	330.005	44.4631
40	27.4263	247.117			
41	29.0081	238.318			
42	30.7956	229.229			
43	32.8866	219.656			
44	35.8839	207.434			
45	38.8690	196.825			





# POLYNOMIAL EQUATION

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

1.40K to 14.0K  
4251. Ohms to 382.0 Ohms

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

ZL = 2.5438814597      ZU = 3.74322349584

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.528728	2.6682E-04	20721.15
1	-6.317798	4.2499E-04	-14865.91
2	2.766091	3.7049E-04	7466.12
3	-1.008071	3.7735E-04	-2671.48
4	0.310323	3.6319E-04	854.44
5	-0.078287	3.4097E-04	-229.60
6	0.014179	3.3009E-04	42.95

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i * \text{COS}(i * \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	5536.349	1.21421	1.21516	-0.96
2	4870.028	1.29965	1.29790	1.75
3	4234.113	1.40342	1.40313	0.30
4	3396.088	1.59661	1.59826	-1.64
5	2796.074	1.80514	1.80614	-1.00
6	2396.461	2.00342	2.00308	0.34
7	2103.189	2.19921	2.19813	1.08
8	1874.435	2.39755	2.39642	1.12
9	1691.597	2.59801	2.59771	0.30
10	1544.154	2.79933	2.79913	0.20
11	1423.600	2.99928	2.99922	0.06
12	1320.857	3.20290	3.20312	-0.23
13	1236.454	3.40014	3.40039	-0.25
14	1163.199	3.59879	3.59921	-0.42
15	1098.512	3.80049	3.80135	-0.87
16	1043.082	3.99790	3.99891	-1.01
17	991.4944	4.20609	4.20732	-1.23
18	908.0937	4.60882	4.60750	1.31
19	843.4157	4.98723	4.98799	-0.76
20	775.0342	5.48238	5.48099	1.38
21	696.2559	6.21238	6.21085	1.53
22	631.2065	7.00175	7.00244	-0.69
23	568.4119	8.00768	8.00725	0.43
24	519.9851	9.01696	9.01633	0.63
25	481.5171	10.02253	10.02279	-0.25
26	450.0654	11.02564	11.02676	-1.13
27	423.7744	12.02643	12.02776	-1.33
28	401.3618	13.02616	13.02725	-1.08
29	381.9786	14.02641	14.02475	1.66
30	364.9522	15.02625	15.02364	2.60
31	349.8497	16.02162	16.02348	-1.85

Order of Fit = 6                      RMS error of fit = 1.12 mK  
Largest absolute error = 2.60 mK at data point no. 30



# POLYNOMIAL EQUATION

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

14.0K to 80.0K  
382.0 Ohms to 121.4 Ohms

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

ZL = 2.04933027378      ZU = 2.62713469428

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	41.975102	7.8646E-04	53372.51
1	-37.663280	1.2859E-03	-29289.74
2	8.851372	1.1670E-03	7584.60
3	-1.276719	1.0964E-03	-1164.51
4	0.157999	1.0537E-03	149.95
5	-0.010696	1.0124E-03	-10.57
6	-0.009472	9.8717E-04	-9.60
7	0.003002	9.7261E-04	3.09

$Z = \text{Log}(\text{resistance})$

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 7$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	423.7744	12.02776	12.02731	0.46
28	401.3618	13.02725	13.02830	-1.05
29	381.9786	14.02475	14.02616	-1.41
30	364.9522	15.02625	15.02386	2.39
31	349.8497	16.02162	16.02062	1.00
32	336.3880	17.01389	17.01204	1.85
33	324.1957	18.00702	18.00608	0.95
34	313.0638	19.00123	19.00428	-3.05
35	302.8829	19.99737	20.00250	-5.13
36	292.6336	21.09646	21.09973	-3.27
37	279.2867	22.69311	22.68619	6.92
38	267.3489	24.27902	24.27852	0.50
39	256.7851	25.84696	25.84518	1.78
40	247.1173	27.42626	27.42729	-1.03
41	238.3181	29.00813	29.00703	1.10
42	229.2291	30.79556	30.79737	-1.82
43	219.6556	32.88660	32.88166	4.94
44	207.4341	35.88388	35.88808	-4.20
45	196.8254	38.86901	38.87090	-1.89
46	187.3639	41.87277	41.88161	-8.83
47	178.9965	44.87594	44.87008	5.87
48	171.4466	47.87807	47.87425	3.82
49	166.8113	49.88728	49.88395	3.34
50	156.4989	54.88239	54.88179	0.61
51	147.5923	59.89007	59.89290	-2.83
52	139.8347	64.89560	64.89855	-2.95
53	133.0141	69.89285	69.89099	1.86
54	126.8659	74.94984	74.95084	-1.00
55	121.3947	79.97165	79.97264	-0.99
56	116.4759	84.97038	84.96616	4.22
57	112.0290	89.92053	89.92269	-2.16

Order of Fit = 7                      RMS error of fit = 3.34 mK  
Largest absolute error = -8.83 mK at data point no. 46



# POLYNOMIAL EQUATION

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

80.0K to 325.K  
121.4 Ohms to 44.93 Ohms

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

ZL = 1.64799969165      ZU = 2.12389753318

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	176.101750	3.1775E-03	55421.17
1	-126.498606	4.9098E-03	-25764.38
2	23.133257	4.7124E-03	4909.07
3	-3.392998	4.4577E-03	-761.16
4	0.675513	4.2451E-03	159.13
5	-0.144968	4.2611E-03	-34.02
6	0.027724	4.2049E-03	6.59
7	-0.014921	4.0646E-03	-3.67

$Z = \text{Log}(\text{resistance})$

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 7$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	133.0141	69.89099	69.88675	4.24
54	126.8659	74.95084	74.95934	-8.50
55	121.3947	79.97264	79.97481	-2.17
56	116.4759	84.97038	84.96417	6.21
57	112.0290	89.92053	89.92771	-7.18
58	107.9620	94.91528	94.89460	20.68
59	104.1871	99.91420	99.91565	-1.45
60	97.48838	109.93212	109.94828	-16.16
61	91.71943	119.94396	119.95001	-6.04
62	86.67766	129.94973	129.94259	7.14
63	82.14523	140.12305	140.12395	-0.90
64	78.25302	149.95194	149.94592	6.02
65	74.66520	160.04568	160.04386	1.83
66	71.46005	170.06346	170.05806	5.40
67	68.56078	180.05850	180.05749	1.01
68	65.92129	190.04862	190.06050	-11.88
69	63.51666	200.03109	200.03202	-0.93
70	61.30450	210.02721	210.03290	-5.69
71	59.26903	220.03568	220.03312	2.56
72	57.39162	230.02765	230.02675	0.90
73	55.65433	240.02315	240.01922	3.94
74	54.04479	250.01556	249.99758	17.98
75	52.54125	260.00560	260.02341	-17.81
76	51.14591	270.00867	270.01151	-2.84
77	49.84078	279.99735	280.02129	-23.94
78	48.62941	289.99169	289.95721	34.48
79	47.48662	299.98815	299.96600	22.15
80	46.41354	309.97530	309.98931	-14.01
81	45.90440	314.97269	314.97651	-3.82
82	45.40662	319.96567	320.00670	-41.03
83	44.83856	325.95880	325.94412	14.68
84	44.46310	330.00489	329.98974	15.16

Order of Fit = 7      RMS error of fit = 14.22 mK  
Largest absolute error = -41.03 mK at data point no. 82



# INTERPOLATION TABLE

Calibration Report: 364513  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X14909  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
1.400	4250.64	-5301.1	-1.7460	15.50	357.522	-15.176	-0.65792
1.500	3775.05	-4260.5	-1.6929	16.00	350.145	-14.345	-0.65552
1.600	3390.02	-3476.5	-1.6408	16.50	343.164	-13.591	-0.65350
1.700	3073.71	-2874.5	-1.5898	17.00	336.543	-12.901	-0.65167
1.800	2810.76	-2403.7	-1.5393	17.50	330.253	-12.268	-0.65007
1.900	2589.66	-2032.2	-1.4910	18.00	324.267	-11.686	-0.64871
2.000	2401.80	-1736.1	-1.4457	18.50	318.559	-11.151	-0.64756
2.100	2240.51	-1497.9	-1.4040	19.00	313.109	-10.655	-0.64658
2.200	2100.74	-1304.2	-1.3659	19.50	307.898	-10.197	-0.64578
2.300	1978.52	-1145.2	-1.3313	20.00	302.907	-9.7709	-0.64514
2.400	1870.80	-1013.1	-1.2997	21.00	293.528	-9.0053	-0.64427
2.500	1775.18	-902.47	-1.2710	22.00	284.864	-8.3369	-0.64386
2.600	1689.74	-808.83	-1.2445	23.00	276.827	-7.7494	-0.64385
2.700	1612.95	-728.96	-1.2202	24.00	269.343	-7.2287	-0.64411
2.800	1543.58	-660.26	-1.1977	25.00	262.351	-6.7650	-0.64466
2.900	1480.60	-600.78	-1.1767	26.00	255.797	-6.3495	-0.64538
3.000	1423.17	-548.92	-1.1571	27.00	249.638	-5.9750	-0.64623
3.100	1370.60	-503.45	-1.1387	28.00	243.835	-5.6363	-0.64722
3.200	1322.30	-463.34	-1.1213	29.00	238.356	-5.3282	-0.64827
3.300	1277.78	-427.82	-1.1049	30.00	233.170	-5.0471	-0.64937
3.400	1236.61	-396.20	-1.0893	31.00	228.253	-4.7897	-0.65051
3.500	1198.43	-367.92	-1.0745	32.00	223.584	-4.5531	-0.65165
3.600	1162.93	-342.55	-1.0604	33.00	219.141	-4.3351	-0.65281
3.700	1129.83	-319.69	-1.0469	34.00	214.908	-4.1335	-0.65394
3.800	1098.92	-299.04	-1.0341	35.00	210.869	-3.9464	-0.65501
3.900	1069.96	-280.31	-1.0217	36.00	207.011	-3.7729	-0.65612
4.000	1042.80	-263.28	-1.0099	37.00	203.320	-3.6113	-0.65718
4.200	993.199	-233.58	-0.98776	38.00	199.785	-3.4603	-0.65816
4.400	949.048	-208.62	-0.96721	39.00	196.396	-3.3193	-0.65915
4.600	909.498	-187.47	-0.94816	40.00	193.143	-3.1872	-0.66008
4.800	873.854	-169.42	-0.93063	42.00	187.014	-2.9468	-0.66179
5.000	841.562	-153.89	-0.91430	44.00	181.338	-2.7338	-0.66334
5.200	812.162	-140.42	-0.89905	46.00	176.063	-2.5443	-0.66476
5.400	785.280	-128.67	-0.88482	48.00	171.147	-2.3747	-0.66600
5.600	760.593	-118.41	-0.87185	50.00	166.553	-2.2224	-0.66718
5.800	737.837	-109.32	-0.85934	52.00	162.248	-2.0849	-0.66820
6.000	716.796	-101.25	-0.84753	54.00	158.205	-1.9603	-0.66911
6.500	670.477	-84.787	-0.82198	56.00	154.399	-1.8474	-0.67005
7.000	631.382	-72.146	-0.79987	58.00	150.809	-1.7444	-0.67088
7.500	597.876	-62.245	-0.78083	60.00	147.415	-1.6503	-0.67171
8.000	568.805	-54.338	-0.76424	65.00	139.688	-1.4478	-0.67372
8.500	543.287	-47.939	-0.75003	70.00	132.874	-1.2832	-0.67599
9.000	520.680	-42.659	-0.73736	75.00	126.810	-1.1465	-0.67809
9.500	500.480	-38.264	-0.72631	77.35	124.182	-1.0905	-0.67927
10.00	482.303	-34.554	-0.71643	80.00	121.369	-1.0340	-0.68153
10.50	465.834	-31.398	-0.70773	85.00	116.442	-0.93815	-0.68483
11.00	450.831	-28.682	-0.69982	90.00	111.967	-0.85427	-0.68867
11.50	437.091	-26.334	-0.69284	95.00	107.879	-0.78250	-0.68908
12.00	424.447	-24.288	-0.68667	100.0	104.126	-0.72027	-0.69173
12.50	412.762	-22.487	-0.68098	105.0	100.664	-0.66590	-0.69459
13.00	401.929	-20.873	-0.67510	110.0	97.4564	-0.61805	-0.69760
13.50	391.858	-19.444	-0.66987	115.0	94.4742	-0.57564	-0.70070
14.00	382.454	-18.203	-0.66635	120.0	91.6925	-0.53772	-0.70373
14.50	373.631	-17.103	-0.66374	125.0	89.0905	-0.50366	-0.70667
15.00	365.336	-16.095	-0.66081	130.0	86.6505	-0.47287	-0.70944



# INTERPOLATION TABLE

Calibration Report: 364513  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X14909  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
135.0	84.3571	-0.44492	-0.71203	235.0	56.5104	-0.17383	-0.72288
140.0	82.1972	-0.41944	-0.71439	240.0	55.6576	-0.16738	-0.72176
145.0	80.1591	-0.39613	-0.71655	245.0	54.8361	-0.16126	-0.72050
150.0	78.2327	-0.37472	-0.71848	250.0	54.0444	-0.15545	-0.71910
155.0	76.4090	-0.35502	-0.72019	255.0	53.2811	-0.14993	-0.71757
160.0	74.6800	-0.33684	-0.72167	260.0	52.5446	-0.14468	-0.71590
165.0	73.0383	-0.32002	-0.72296	265.0	51.8338	-0.13968	-0.71411
170.0	71.4777	-0.30443	-0.72404	270.0	51.1475	-0.13491	-0.71218
175.0	69.9922	-0.28994	-0.72492	273.15	50.7271	-0.13202	-0.71091
180.0	68.5767	-0.27645	-0.72563	275.0	50.4844	-0.13037	-0.71013
185.0	67.2262	-0.26387	-0.72616	280.0	49.8435	-0.12603	-0.70796
190.0	65.9365	-0.25213	-0.72652	285.0	49.2238	-0.12188	-0.70567
195.0	64.7037	-0.24113	-0.72671	290.0	48.6244	-0.11792	-0.70326
200.0	63.5241	-0.23083	-0.72675	295.0	48.0443	-0.11412	-0.70074
205.0	62.3943	-0.22116	-0.72664	300.0	47.4829	-0.11049	-0.69811
210.0	61.3115	-0.21207	-0.72637	305.0	46.9391	-0.10702	-0.69538
215.0	60.2727	-0.20351	-0.72596	310.0	46.4124	-0.10369	-0.69255
220.0	59.2755	-0.19545	-0.72540	315.0	45.9020	-0.10049	-0.68964
225.0	58.3175	-0.18784	-0.72470	320.0	45.4073	-9.7432e-2	-0.68663
230.0	57.3965	-0.18064	-0.72386	325.0	44.9275	-9.4492e-2	-0.68355





# THERMAL CYCLE TESTING

Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor

Serial Number: X14909

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Room Temperature:	46.8 $\Omega$
Liquid Nitrogen:	124 $\Omega$
Liquid Helium:	992 $\Omega$

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip test values should not be made.

## Recommended Operating Parameters:

For sensors calibrated by LSCI the current to the sensor is adjusted to maintain the sensor output voltage at the values listed below. In order to minimize possible self-heating errors, we suggest that these same guidelines be followed in using the sensor:

Above 1K:	1 to 3 mV
0.1 to 1K:	0.1 mV
Below 0.1K:	0.03 mV

## Lead Identification:

NONE

To avoid possible damage to the sensor, do not exceed 1 Volt and do not exceed 100 mA current.



# BREAKPOINTS 340 FORMAT

Calibration Report: 364513  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X14909

Name: CX-1030-SD-1.4L  
Serial number: X14909  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.

Coefficient: 1 ;Negative

Point 1: 1.65250,325.000	Point 56: 2.08409, 80.000	Point 111: 2.69439, 9.650
Point 2: 1.65805,319.000	Point 57: 2.09347, 77.500	Point 112: 2.70778, 9.250
Point 3: 1.66325,313.500	Point 58: 2.10119, 75.500	Point 113: 2.72190, 8.850
Point 4: 1.66857,308.000	Point 59: 2.10909, 73.500	Point 114: 2.73689, 8.450
Point 5: 1.67401,302.500	Point 60: 2.11720, 71.500	Point 115: 2.75282, 8.050
Point 6: 1.67958,297.000	Point 61: 2.12553, 69.500	Point 116: 2.76983, 7.650
Point 7: 1.68527,291.500	Point 62: 2.13409, 67.500	Point 117: 2.78575, 7.300
Point 8: 1.69109,286.000	Point 63: 2.14290, 65.500	Point 118: 2.80270, 6.950
Point 9: 1.69705,280.500	Point 64: 2.15197, 63.500	Point 119: 2.82086, 6.600
Point 10: 1.70315,275.000	Point 65: 2.16132, 61.500	Point 120: 2.84038, 6.250
Point 11: 1.70939,269.500	Point 66: 2.17145, 59.400	Point 121: 2.86149, 5.900
Point 12: 1.71577,264.000	Point 67: 2.18042, 57.600	Point 122: 2.88104, 5.600
Point 13: 1.72232,258.500	Point 68: 2.18966, 55.800	Point 123: 2.90210, 5.300
Point 14: 1.72902,253.000	Point 69: 2.19920, 54.000	Point 124: 2.92493, 5.000
Point 15: 1.73525,248.000	Point 70: 2.20904, 52.200	Point 125: 2.94811, 4.720
Point 16: 1.74162,243.000	Point 71: 2.21922, 50.400	Point 126: 2.97331, 4.440
Point 17: 1.74814,238.000	Point 72: 2.22975, 48.600	Point 127: 2.99892, 4.180
Point 18: 1.75480,233.000	Point 73: 2.24066, 46.800	Point 128: 3.02251, 3.960
Point 19: 1.76162,228.000	Point 74: 2.25198, 45.000	Point 129: 3.04323, 3.780
Point 20: 1.76860,223.000	Point 75: 2.26242, 43.400	Point 130: 3.06417, 3.610
Point 21: 1.77574,218.000	Point 76: 2.27322, 41.800	Point 131: 3.08658, 3.440
Point 22: 1.78305,213.000	Point 77: 2.28442, 40.200	Point 132: 3.11070, 3.270
Point 23: 1.79055,208.000	Point 78: 2.29605, 38.600	Point 133: 3.13518, 3.110
Point 24: 1.79822,203.000	Point 79: 2.30814, 37.000	Point 134: 3.15988, 2.960
Point 25: 1.80610,198.000	Point 80: 2.31994, 35.500	Point 135: 3.18651, 2.810
Point 26: 1.81417,193.000	Point 81: 2.33221, 34.000	Point 136: 3.21537, 2.660
Point 27: 1.82245,188.000	Point 82: 2.34501, 32.500	Point 137: 3.24467, 2.520
Point 28: 1.83095,183.000	Point 83: 2.35747, 31.100	Point 138: 3.27653, 2.380
Point 29: 1.83880,178.500	Point 84: 2.37046, 29.700	Point 139: 3.30891, 2.250
Point 30: 1.84684,174.000	Point 85: 2.38405, 28.300	Point 140: 3.34431, 2.120
Point 31: 1.85508,169.500	Point 86: 2.39727, 27.000	Point 141: 3.38029, 2.000
Point 32: 1.86353,165.000	Point 87: 2.41109, 25.700	Point 142: 3.41979, 1.880
Point 33: 1.87221,160.500	Point 88: 2.42449, 24.500	Point 143: 3.46358, 1.760
Point 34: 1.88112,156.000	Point 89: 2.43853, 23.300	Point 144: 3.51229, 1.640
Point 35: 1.89026,151.500	Point 90: 2.45331, 22.100	Point 145: 3.56206, 1.530
Point 36: 1.89967,147.000	Point 91: 2.46760, 21.000	Point 146: 3.61724, 1.420
Point 37: 1.90934,142.500	Point 92: 2.47988, 20.100	Point 147: 3.62854, 1.400
Point 38: 1.91930,138.000	Point 93: 2.48982, 19.400	
Point 39: 1.92840,134.000	Point 94: 2.49939, 18.750	
Point 40: 1.93775,130.000	Point 95: 2.50931, 18.100	
Point 41: 1.94737,126.000	Point 96: 2.51962, 17.450	
Point 42: 1.95726,122.000	Point 97: 2.52952, 16.850	
Point 43: 1.96744,118.000	Point 98: 2.53980, 16.250	
Point 44: 1.97795,114.000	Point 99: 2.55052, 15.650	
Point 45: 1.98878,110.000	Point 100: 2.56076, 15.100	
Point 46: 1.99998,106.000	Point 101: 2.57142, 14.550	
Point 47: 2.01011,102.500	Point 102: 2.58254, 14.000	
Point 48: 2.01755,100.000	Point 103: 2.59417, 13.450	
Point 49: 2.02515, 97.500	Point 104: 2.60524, 12.950	
Point 50: 2.03293, 95.000	Point 105: 2.61684, 12.450	
Point 51: 2.04090, 92.500	Point 106: 2.62902, 11.950	
Point 52: 2.04908, 90.000	Point 107: 2.64183, 11.450	
Point 53: 2.05747, 87.500	Point 108: 2.65397, 11.000	
Point 54: 2.06609, 85.000	Point 109: 2.66672, 10.550	
Point 55: 2.07497, 82.500	Point 110: 2.68017, 10.100	



# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 364513  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X14909

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

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.65251	325.0	31	2.60415	13.0
2	1.65343	324.0	32	2.65127	11.1
3	1.65994	317.0	33	2.69609	9.6
4	1.67452	302.0	34	2.74281	8.3
5	1.69003	287.0	35	2.78582	7.3
6	1.70654	272.0	36	2.83193	6.4
7	1.72414	257.0	37	2.87447	5.7
8	1.74292	242.0	38	2.91726	5.1
9	1.76301	227.0	39	2.95880	4.6
10	1.78455	212.0	40	3.00743	4.1
11	1.80771	197.0	41	3.05301	3.7
12	1.83269	182.0	42	3.09223	3.4
13	1.85977	167.0	43	3.13691	3.1
14	1.88925	152.0	44	3.17044	2.9
15	1.92157	137.0	45	3.20762	2.7
16	1.95728	122.0	46	3.24924	2.5
17	1.99718	107.0	47	3.29634	2.3
18	2.04253	92.0	48	3.32237	2.2
19	2.09540	77.0	49	3.38054	2.0
20	2.15199	63.5	50	3.41324	1.9
21	2.18349	57.0	51	3.44882	1.8
22	2.22155	50.0	52	3.48766	1.7
23	2.25201	45.0	53	3.57692	1.5
24	2.28588	40.0	54	3.62845	1.4
25	2.32401	35.0			
26	2.36767	30.0			
27	2.41665	25.2			
28	2.46368	21.3			
29	2.51090	18.0			
30	2.55702	15.3			

## Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	106.004
1000	4.171



# BREAKPOINTS 234 FORMAT

Calibration Report: 364513  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X14909

Maximum Temperature Error:

1.4 - 10K: 0.004K  
 10 - 20K: 0.007K  
 20 - 40K: 0.013K  
 40 - 100K: 0.035K  
 > 100K: 0.135K

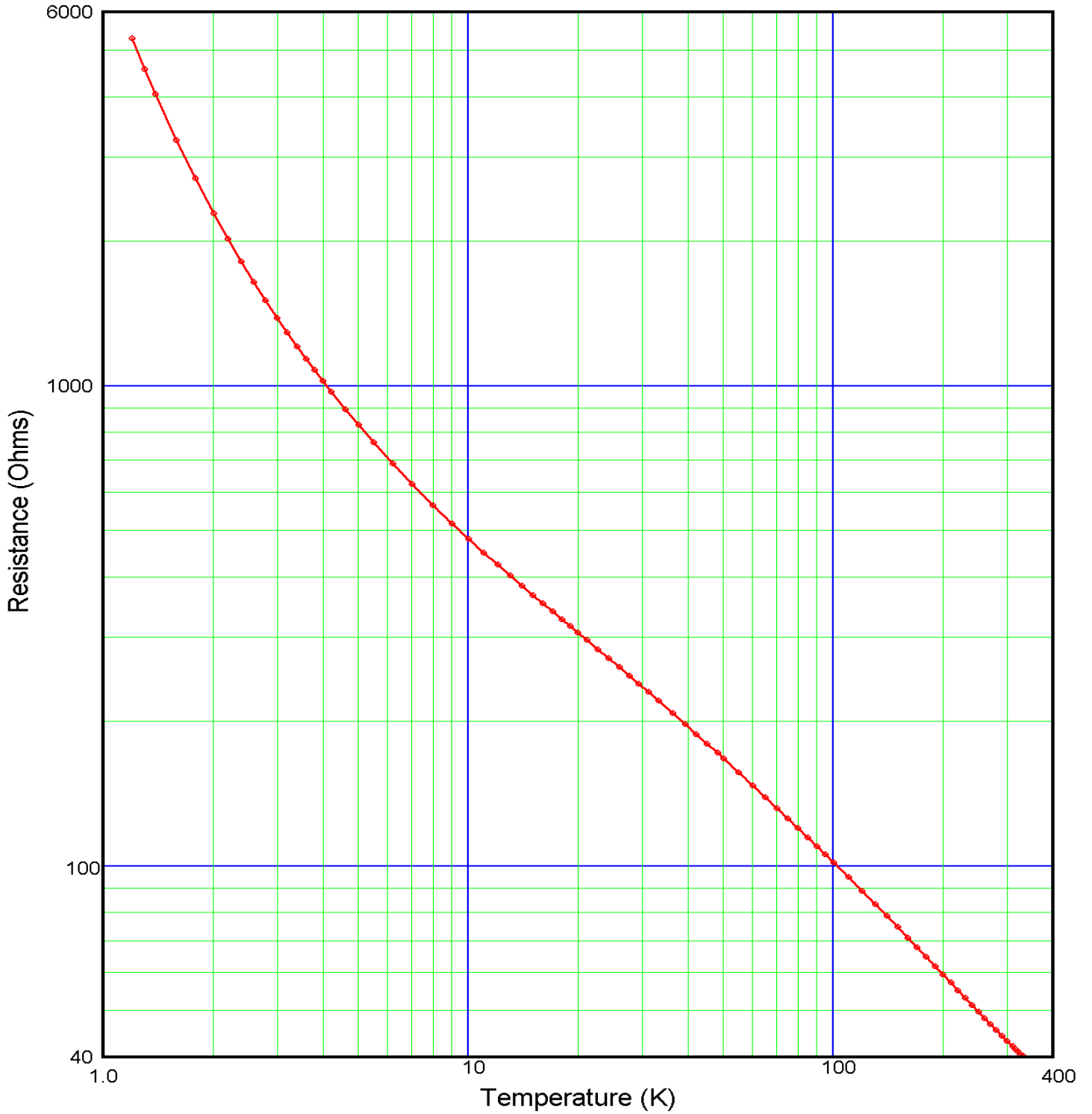
BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	316.933	45.70882	1.660	46	15.142	363.0781	2.560
2	296.608	47.86301	1.680	47	14.125	380.1894	2.580
3	277.826	50.11872	1.700	48	13.186	398.1072	2.600
4	260.442	52.48075	1.720	49	12.320	416.8694	2.620
5	244.275	54.95409	1.740	50	11.522	436.5158	2.640
6	229.186	57.54399	1.760	51	10.786	457.0882	2.660
7	215.082	60.25596	1.780	52	10.107	478.6301	2.680
8	201.871	63.09573	1.800	53	9.482	501.1872	2.700
9	189.474	66.06934	1.820	54	8.904	524.8075	2.720
10	177.831	69.18310	1.840	55	8.372	549.5409	2.740
11	166.876	72.44360	1.860	56	7.880	575.4399	2.760
12	156.566	75.85776	1.880	57	7.425	602.5596	2.780
13	146.853	79.43282	1.900	58	7.006	630.9573	2.800
14	137.696	83.17638	1.920	59	6.618	660.6934	2.820
15	129.064	87.09636	1.940	60	6.258	691.8310	2.840
16	120.920	91.20108	1.960	61	5.926	724.4360	2.860
17	113.240	95.49926	1.980	62	5.618	758.5776	2.880
18	105.998	100.0000	2.000	63	5.330	794.3282	2.900
19	99.192	104.7129	2.020	64	5.064	831.7638	2.920
20	92.784	109.6478	2.040	65	4.817	870.9636	2.940
21	86.762	114.8154	2.060	66	4.587	912.0108	2.960
22	81.118	120.2264	2.080	67	4.372	954.9926	2.980
23	75.806	125.8925	2.100	68	4.171	1000.000	3.000
24	70.826	131.8257	2.120	69	3.808	1096.478	3.040
25	66.156	138.0384	2.140	70	3.490	1202.264	3.080
26	61.781	144.5440	2.160	71	3.209	1318.257	3.120
27	57.687	151.3561	2.180	72	2.960	1445.440	3.160
28	53.855	158.4893	2.200	73	2.739	1584.893	3.200
29	50.269	165.9587	2.220	74	2.542	1737.801	3.240
30	46.913	173.7801	2.240	75	2.367	1905.461	3.280
31	43.770	181.9701	2.260	76	2.209	2089.296	3.320
32	40.827	190.5461	2.280	77	2.067	2290.868	3.360
33	38.076	199.5262	2.300	78	1.940	2511.886	3.400
34	35.497	208.9296	2.320	79	1.824	2754.229	3.440
35	33.085	218.7762	2.340	80	1.719	3019.952	3.480
36	30.827	229.0868	2.360	81	1.623	3311.311	3.520
37	28.716	239.8833	2.380	82	1.535	3630.781	3.560
38	26.742	251.1886	2.400	83	1.454	3981.072	3.600
39	24.900	263.0268	2.420	84	1.379	4365.158	3.640
40	23.183	275.4229	2.440	85	1.310	4786.301	3.680
41	21.583	288.4032	2.460	86	1.249	5248.075	3.720
42	20.093	301.9952	2.480				
43	18.711	316.2278	2.500				
44	17.429	331.1311	2.520				
45	16.241	346.7369	2.540				



# DATA PLOT

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%



# TEST DATA

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	1.20091	5283.11	46	42.2787	188.227
2	1.30102	4562.57	47	45.2600	179.675
3	1.39036	4056.46	48	48.2481	172.001
4	1.58919	3244.64	49	50.2394	167.232
5	1.79057	2704.15	50	55.2474	156.579
6	2.01251	2286.96	51	60.2623	147.288
7	2.20276	2023.28	52	65.2778	139.191
8	2.39410	1816.17	53	70.2879	132.024
9	2.59062	1645.17	54	75.2865	125.663
10	2.78728	1507.46	55	80.2871	119.939
11	2.99733	1386.57	56	85.2820	114.776
12	3.19412	1291.97	57	90.2725	110.064
13	3.39842	1208.56	58	95.2740	105.740
14	3.59875	1138.33	59	100.272	101.788
15	3.79546	1077.98	60	110.254	94.7715
16	3.99382	1024.43	61	120.234	88.7027
17	4.21699	971.736	62	130.228	83.4139
18	4.61216	892.922	63	140.223	78.7546
19	5.00994	828.133	64	150.219	74.6262
20	5.51410	761.455	65	160.213	70.9359
21	6.22056	688.490	66	170.210	67.6064
22	7.02582	624.745	67	180.209	64.6109
23	8.03356	564.127	68	190.209	61.8905
24	9.04174	517.299	69	200.211	59.4027
25	10.0515	479.969	70	210.208	57.1454
26	11.0628	449.373	71	220.195	55.0700
27	12.0703	423.820	72	230.210	53.1555
28	13.0726	402.040	73	240.214	51.3992
29	14.0722	383.133	74	250.213	49.7724
30	15.0683	366.551	75	260.216	48.2644
31	16.0633	351.812	76	270.209	46.8659
32	17.0593	338.525	77	280.223	45.5599
33	18.0531	326.592	78	290.213	44.3496
34	19.0473	315.712	79	300.236	43.2128
35	20.0453	305.681	80	310.234	42.1486
36	21.1406	295.585	81	315.243	41.6503
37	22.7333	282.233	82	320.256	41.1572
38	24.3200	270.433	83	326.255	40.5958
39	25.9629	259.359	84	330.250	40.2257
40	27.6556	249.012			
41	29.3226	239.815			
42	31.1778	230.425			
43	33.3112	220.638			
44	36.3202	208.384			
45	39.3078	197.677			



# POLYNOMIAL EQUATION

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

1.40K to 14.1K  
4009. Ohms to 383.1 Ohms

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

ZL = 2.54631116952      ZU = 3.72288945324

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.522170	4.5697E-04	12084.25
1	-6.332794	7.2967E-04	-8679.04
2	2.780870	6.3952E-04	4348.37
3	-1.019395	6.4912E-04	-1570.43
4	0.317281	6.1656E-04	514.60
5	-0.080831	5.7521E-04	-140.52
6	0.014119	5.5929E-04	25.24

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	5283.108	1.20091	1.20142	-0.51
2	4562.574	1.30102	1.29964	1.38
3	4056.461	1.39036	1.39037	0.00
4	3244.639	1.58919	1.59163	-2.44
5	2704.148	1.79057	1.79069	-0.13
6	2286.962	2.01251	2.01100	1.50
7	2023.281	2.20276	2.20076	2.00
8	1816.170	2.39410	2.39237	1.73
9	1645.168	2.59062	2.59126	-0.64
10	1507.457	2.78728	2.78863	-1.35
11	1386.567	2.99733	2.99907	-1.74
12	1291.971	3.19412	3.19578	-1.66
13	1208.559	3.39842	3.39951	-1.08
14	1138.326	3.59875	3.59887	-0.12
15	1077.978	3.79546	3.79547	-0.02
16	1024.428	3.99382	3.99390	-0.08
17	971.7360	4.21699	4.21589	1.10
18	892.9219	4.61216	4.61066	1.49
19	828.1334	5.00994	5.00886	1.08
20	761.4549	5.51410	5.51338	0.72
21	688.4896	6.22056	6.21931	1.25
22	624.7449	7.02582	7.02536	0.46
23	564.1273	8.03356	8.03328	0.29
24	517.2988	9.04174	9.04496	-3.22
25	479.9689	10.05153	10.05562	-4.10
26	449.3731	11.06280	11.06472	-1.92
27	423.8201	12.07033	12.06836	1.97
28	402.0402	13.07255	13.06853	4.02
29	383.1327	14.07216	14.06888	3.28
30	366.5512	15.06835	15.06745	0.90
31	351.8124	16.06331	16.06746	-4.15

Order of Fit = 6                      RMS error of fit = 1.91 mK  
Largest absolute error = -4.15 mK at data point no. 31





# POLYNOMIAL EQUATION

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

14.1K to 80.3K  
383.1 Ohms to 119.9 Ohms

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

ZL = 2.0416463175      ZU = 2.62718157124

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	42.678983	9.7163E-04	43925.04
1	-38.092626	1.5865E-03	-24010.45
2	8.387147	1.4457E-03	5801.59
3	-1.002058	1.3593E-03	-737.21
4	0.112761	1.3005E-03	86.70
5	-0.010947	1.2233E-03	-8.95
6	-0.006447	1.2234E-03	-5.27

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	423.8201	12.06836	12.06681	1.55
28	402.0402	13.06853	13.07054	-2.01
29	383.1327	14.06888	14.07054	-1.66
30	366.5512	15.06835	15.06660	1.75
31	351.8124	16.06331	16.06195	1.35
32	338.5252	17.05935	17.06180	-2.45
33	326.5917	18.05308	18.05411	-1.03
34	315.7123	19.04731	19.04638	0.93
35	305.6814	20.04529	20.04389	1.40
36	295.5854	21.14056	21.13686	3.70
37	282.2333	22.73325	22.73661	-3.36
38	270.4327	24.32001	24.31668	3.33
39	259.3594	25.96290	25.96189	1.01
40	249.0123	27.65558	27.66119	-5.61
41	239.8151	29.32262	29.32055	2.07
42	230.4248	31.17778	31.17839	-0.61
43	220.6384	33.31116	33.31436	-3.20
44	208.3837	36.32023	36.32259	-2.35
45	197.6765	39.30779	39.30815	-0.36
46	188.2266	42.27866	42.27106	7.61
47	179.6746	45.26002	45.26315	-3.13
48	172.0012	48.24811	48.23964	8.47
49	167.2325	50.23944	50.24732	-7.88
50	156.5791	55.24743	55.23968	7.74
51	147.2884	60.26234	60.26930	-6.96
52	139.1913	65.27777	65.27766	0.11
53	132.0241	70.28786	70.29291	-5.05
54	125.6630	75.28652	75.28541	1.11
55	119.9387	80.28707	80.28648	0.59
56	114.7765	85.28205	85.27354	8.51
57	110.0643	90.27253	90.27807	-5.54

Order of Fit = 6                      RMS error of fit = 4.22 mK  
Largest absolute error = 8.51 mK at data point no. 56



# POLYNOMIAL EQUATION

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

80.3K to 325.K  
119.9 Ohms to 40.71 Ohms

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

ZL = 1.60450357492      ZU = 2.12065330027

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	176.831462	3.4658E-03	51021.97
1	-126.371756	5.3577E-03	-23586.82
2	22.708108	5.1527E-03	4407.05
3	-3.457506	4.8992E-03	-705.73
4	0.712193	4.6644E-03	152.69
5	-0.152455	4.6533E-03	-32.76
6	0.024976	4.5836E-03	5.45

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	132.0241	70.29291	70.29502	-2.12
54	125.6630	75.28541	75.28488	0.53
55	119.9387	80.28648	80.28621	0.26
56	114.7765	85.28205	85.27166	10.39
57	110.0643	90.27253	90.27130	1.24
58	105.7404	95.27396	95.28676	-12.80
59	101.7883	100.27203	100.27590	-3.87
60	94.77150	110.25407	110.24486	9.21
61	88.70267	120.23361	120.24108	-7.48
62	83.41387	130.22817	130.23023	-2.06
63	78.75463	140.22298	140.22670	-3.72
64	74.62620	150.21851	150.20815	10.36
65	70.93590	160.21323	160.19339	19.84
66	67.60638	170.20963	170.21924	-9.60
67	64.61087	180.20899	180.20651	2.48
68	61.89051	190.20865	190.20291	5.74
69	59.40271	200.21095	200.24158	-30.64
70	57.14536	210.20829	210.20780	0.49
71	55.06996	220.19516	220.19967	-4.51
72	53.15554	230.20958	230.22426	-14.68
73	51.39920	240.21385	240.20013	13.73
74	49.77244	250.21307	250.19708	15.99
75	48.26436	260.21632	260.20224	14.08
76	46.86588	270.20877	270.19672	12.06
77	45.55988	280.22269	280.23118	-8.49
78	44.34959	290.21341	290.20815	5.26
79	43.21282	300.23606	300.24289	-6.83
80	42.14857	310.23415	310.28654	-52.39
81	41.65035	315.24325	315.22391	19.35
82	41.15719	320.25554	320.26936	-13.82
83	40.59582	326.25488	326.21487	40.00
84	40.22570	330.25045	330.25846	-8.00

Order of Fit = 6      RMS error of fit = 15.98 mK  
Largest absolute error = -52.39 mK at data point no. 80



# INTERPOLATION TABLE

Calibration Report: 366512  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15984  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
1.400	4009.06	-4868.2	-1.7000	15.50	359.928	-14.901	-0.64172
1.500	3571.99	-3918.4	-1.6455	16.00	352.683	-14.095	-0.63942
1.600	3217.62	-3202.1	-1.5923	16.50	345.820	-13.365	-0.63768
1.700	2926.09	-2651.5	-1.5405	17.00	339.307	-12.697	-0.63615
1.800	2683.31	-2221.6	-1.4903	17.50	333.114	-12.085	-0.63490
1.900	2478.76	-1882.2	-1.4428	18.00	327.214	-11.524	-0.63392
2.000	2304.56	-1612.1	-1.3991	18.50	321.583	-11.007	-0.63324
2.100	2154.57	-1395.1	-1.3598	19.00	316.200	-10.530	-0.63276
2.200	2024.21	-1218.2	-1.3240	19.50	311.046	-10.089	-0.63250
2.300	1909.89	-1072.5	-1.2916	20.00	306.105	-9.6792	-0.63241
2.400	1808.88	-951.37	-1.2623	21.00	296.803	-8.9428	-0.63274
2.500	1718.98	-849.49	-1.2355	22.00	288.188	-8.2998	-0.63360
2.600	1638.47	-763.07	-1.2109	23.00	280.178	-7.7340	-0.63489
2.700	1565.95	-689.11	-1.1882	24.00	272.699	-7.2320	-0.63648
2.800	1500.31	-625.36	-1.1671	25.00	265.695	-6.7842	-0.63835
2.900	1440.60	-569.97	-1.1474	26.00	259.116	-6.3821	-0.64039
3.000	1386.08	-521.57	-1.1289	27.00	252.918	-6.0191	-0.64257
3.100	1336.09	-479.04	-1.1115	28.00	247.066	-5.6901	-0.64486
3.200	1290.11	-441.45	-1.0950	29.00	241.528	-5.3902	-0.64719
3.300	1247.66	-408.07	-1.0793	30.00	236.277	-5.1161	-0.64959
3.400	1208.37	-378.29	-1.0644	31.00	231.289	-4.8644	-0.65198
3.500	1171.90	-351.63	-1.0502	32.00	226.542	-4.6327	-0.65440
3.600	1137.96	-327.66	-1.0366	33.00	222.017	-4.4187	-0.65678
3.700	1106.29	-306.04	-1.0236	34.00	217.699	-4.2206	-0.65917
3.800	1076.68	-286.48	-1.0111	35.00	213.572	-4.0364	-0.66148
3.900	1048.93	-268.71	-0.99909	36.00	209.622	-3.8650	-0.66376
4.000	1022.88	-252.54	-0.98757	37.00	205.838	-3.7053	-0.66605
4.200	975.285	-224.29	-0.96589	38.00	202.208	-3.5559	-0.66824
4.400	932.869	-200.51	-0.94575	39.00	198.723	-3.4159	-0.67039
4.600	894.840	-180.33	-0.92701	40.00	195.373	-3.2848	-0.67251
4.800	860.539	-163.09	-0.90972	42.00	189.048	-3.0452	-0.67654
5.000	829.444	-148.23	-0.89357	44.00	183.174	-2.8325	-0.68039
5.200	801.114	-135.35	-0.87855	46.00	177.703	-2.6426	-0.68405
5.400	775.196	-124.09	-0.86442	48.00	172.591	-2.4719	-0.68748
5.600	751.382	-114.26	-0.85155	50.00	167.804	-2.3183	-0.69077
5.800	729.419	-105.54	-0.83923	52.00	163.308	-2.1792	-0.69389
6.000	709.100	-97.803	-0.82755	54.00	159.078	-2.0527	-0.69680
6.500	664.333	-81.992	-0.80223	56.00	155.090	-1.9377	-0.69966
7.000	626.509	-69.836	-0.78027	58.00	151.321	-1.8324	-0.70235
7.500	594.057	-60.319	-0.76153	60.00	147.754	-1.7360	-0.70494
8.000	565.874	-52.704	-0.74509	65.00	139.614	-1.5272	-0.71103
8.500	541.110	-46.543	-0.73111	70.00	132.420	-1.3558	-0.71668
9.000	519.153	-41.451	-0.71860	75.00	126.008	-1.2131	-0.72205
9.500	499.516	-37.214	-0.70776	77.35	123.227	-1.1543	-0.72453
10.00	481.830	-33.633	-0.69802	80.00	120.251	-1.0932	-0.72731
10.50	465.793	-30.587	-0.68950	85.00	115.045	-0.99171	-0.73272
11.00	451.173	-27.961	-0.68173	90.00	110.309	-0.90482	-0.73823
11.50	437.772	-25.691	-0.67489	95.00	105.978	-0.82947	-0.74355
12.00	425.433	-23.713	-0.66887	100.0	101.999	-0.76363	-0.74867
12.50	414.019	-21.972	-0.66339	105.0	98.3284	-0.70562	-0.75349
13.00	403.432	-20.404	-0.65749	110.0	94.9314	-0.65420	-0.75805
13.50	393.585	-19.014	-0.65219	115.0	91.7769	-0.60842	-0.76238
14.00	384.384	-17.821	-0.64909	120.0	88.8392	-0.56740	-0.76642
14.50	375.739	-16.773	-0.64729	125.0	86.0960	-0.53051	-0.77024
15.00	367.599	-15.798	-0.64465	130.0	83.5282	-0.49718	-0.77379



# INTERPOLATION TABLE

Calibration Report: 366512  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15984  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
135.0	81.1190	-0.46695	-0.77712	235.0	52.2972	-0.17629	-0.79218
140.0	78.8541	-0.43944	-0.78019	240.0	51.4331	-0.16942	-0.79058
145.0	76.7207	-0.41431	-0.78303	245.0	50.6024	-0.16292	-0.78881
150.0	74.7075	-0.39128	-0.78562	250.0	49.8033	-0.15676	-0.78687
155.0	72.8048	-0.37012	-0.78797	255.0	49.0343	-0.15091	-0.78479
160.0	71.0036	-0.35061	-0.79007	260.0	48.2937	-0.14536	-0.78257
165.0	69.2962	-0.33259	-0.79192	265.0	47.5802	-0.14009	-0.78022
170.0	67.6756	-0.31589	-0.79351	270.0	46.8924	-0.13508	-0.77775
175.0	66.1353	-0.30039	-0.79486	273.15	46.4717	-0.13205	-0.77614
180.0	64.6699	-0.28596	-0.79595	275.0	46.2291	-0.13031	-0.77517
185.0	63.2740	-0.27252	-0.79679	280.0	45.5889	-0.12578	-0.77250
190.0	61.9432	-0.25996	-0.79737	285.0	44.9709	-0.12146	-0.76974
195.0	60.6731	-0.24820	-0.79771	290.0	44.3740	-0.11735	-0.76690
200.0	59.4600	-0.23719	-0.79780	295.0	43.7971	-0.11343	-0.76399
205.0	58.3001	-0.22685	-0.79766	300.0	43.2394	-0.10969	-0.76102
210.0	57.1904	-0.21713	-0.79729	305.0	42.7000	-0.10612	-0.75800
215.0	56.1279	-0.20798	-0.79668	310.0	42.1780	-0.10271	-0.75493
220.0	55.1097	-0.19936	-0.79586	315.0	41.6726	-9.9461e-2	-0.75182
225.0	54.1334	-0.19123	-0.79483	320.0	41.1831	-9.6354e-2	-0.74868
230.0	53.1967	-0.18355	-0.79360	325.0	40.7088	-9.3383e-2	-0.74552



# THERMAL CYCLE TESTING

Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor

Serial Number: X15984

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Room Temperature:	42.6 $\Omega$
Liquid Nitrogen:	123 $\Omega$
Liquid Helium:	973 $\Omega$

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip test values should not be made.

## Recommended Operating Parameters:

For sensors calibrated by LSCI the current to the sensor is adjusted to maintain the sensor output voltage at the values listed below. In order to minimize possible self-heating errors, we suggest that these same guidelines be followed in using the sensor:

Above 1K:	1 to 3 mV
0.1 to 1K:	0.1 mV
Below 0.1K:	0.03 mV

## Lead Identification:

NONE

To avoid possible damage to the sensor, do not exceed 1 Volt and do not exceed 100 mA current.



# BREAKPOINTS 340 FORMAT

Calibration Report: 366512  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15984

Name: CX-1030-SD-1.4L  
Serial number: X15984  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.

Coefficient: 1 ;Negative

Point 1: 1.60967,325.000	Point 56: 2.08404, 79.000	Point 111: 2.71698, 8.950
Point 2: 1.61573,319.000	Point 57: 2.09416, 76.500	Point 112: 2.73136, 8.550
Point 3: 1.62140,313.500	Point 58: 2.10458, 74.000	Point 113: 2.74665, 8.150
Point 4: 1.62720,308.000	Point 59: 2.11316, 72.000	Point 114: 2.76296, 7.750
Point 5: 1.63313,302.500	Point 60: 2.12194, 70.000	Point 115: 2.77822, 7.400
Point 6: 1.63920,297.000	Point 61: 2.13095, 68.000	Point 116: 2.79444, 7.050
Point 7: 1.64540,291.500	Point 62: 2.14019, 66.000	Point 117: 2.81180, 6.700
Point 8: 1.65175,286.000	Point 63: 2.14970, 64.000	Point 118: 2.83045, 6.350
Point 9: 1.65825,280.500	Point 64: 2.15947, 62.000	Point 119: 2.85179, 5.980
Point 10: 1.66490,275.000	Point 65: 2.17054, 59.800	Point 120: 2.87181, 5.660
Point 11: 1.67172,269.500	Point 66: 2.18093, 57.800	Point 121: 2.89209, 5.360
Point 12: 1.67870,264.000	Point 67: 2.19164, 55.800	Point 122: 2.91402, 5.060
Point 13: 1.68519,259.000	Point 68: 2.20271, 53.800	Point 123: 2.93628, 4.780
Point 14: 1.69183,254.000	Point 69: 2.21299, 52.000	Point 124: 2.96046, 4.500
Point 15: 1.69862,249.000	Point 70: 2.22358, 50.200	Point 125: 2.98500, 4.240
Point 16: 1.70556,244.000	Point 71: 2.23451, 48.400	Point 126: 3.00757, 4.020
Point 17: 1.71266,239.000	Point 72: 2.24581, 46.600	Point 127: 3.02740, 3.840
Point 18: 1.71993,234.000	Point 73: 2.25750, 44.800	Point 128: 3.04739, 3.670
Point 19: 1.72737,229.000	Point 74: 2.26962, 43.000	Point 129: 3.06877, 3.500
Point 20: 1.73499,224.000	Point 75: 2.28077, 41.400	Point 130: 3.09173, 3.330
Point 21: 1.74279,219.000	Point 76: 2.29303, 39.700	Point 131: 3.11499, 3.170
Point 22: 1.75078,214.000	Point 77: 2.30500, 38.100	Point 132: 3.14000, 3.010
Point 23: 1.75896,209.000	Point 78: 2.31742, 36.500	Point 133: 3.16534, 2.860
Point 24: 1.76735,204.000	Point 79: 2.33032, 34.900	Point 134: 3.19269, 2.710
Point 25: 1.77595,199.000	Point 80: 2.34291, 33.400	Point 135: 3.22242, 2.560
Point 26: 1.78476,194.000	Point 81: 2.35599, 31.900	Point 136: 3.25267, 2.420
Point 27: 1.79380,189.000	Point 82: 2.36964, 30.400	Point 137: 3.28325, 2.290
Point 28: 1.80308,184.000	Point 83: 2.38293, 29.000	Point 138: 3.31661, 2.160
Point 29: 1.81261,179.000	Point 84: 2.39679, 27.600	Point 139: 3.35329, 2.030
Point 30: 1.82141,174.500	Point 85: 2.41026, 26.300	Point 140: 3.39068, 1.910
Point 31: 1.83041,170.000	Point 86: 2.42433, 25.000	Point 141: 3.43193, 1.790
Point 32: 1.83965,165.500	Point 87: 2.43910, 23.700	Point 142: 3.47786, 1.670
Point 33: 1.84912,161.000	Point 88: 2.45344, 22.500	Point 143: 3.52480, 1.560
Point 34: 1.85884,156.500	Point 89: 2.46723, 21.400	Point 144: 3.57687, 1.450
Point 35: 1.86882,152.000	Point 90: 2.48172, 20.300	Point 145: 3.60309, 1.400
Point 36: 1.87907,147.500	Point 91: 2.49280, 19.500	
Point 37: 1.88961,143.000	Point 92: 2.50212, 18.850	
Point 38: 1.90045,138.500	Point 93: 2.51176, 18.200	
Point 39: 1.91161,134.000	Point 94: 2.52178, 17.550	
Point 40: 1.92181,130.000	Point 95: 2.53138, 16.950	
Point 41: 1.93229,126.000	Point 96: 2.54135, 16.350	
Point 42: 1.94307,122.000	Point 97: 2.55173, 15.750	
Point 43: 1.95417,118.000	Point 98: 2.56164, 15.200	
Point 44: 1.96560,114.000	Point 99: 2.57196, 14.650	
Point 45: 1.97738,110.000	Point 100: 2.58273, 14.100	
Point 46: 1.98955,106.000	Point 101: 2.59395, 13.550	
Point 47: 2.00212,102.000	Point 102: 2.60464, 13.050	
Point 48: 2.01185, 99.000	Point 103: 2.61583, 12.550	
Point 49: 2.02014, 96.500	Point 104: 2.62758, 12.050	
Point 50: 2.02862, 94.000	Point 105: 2.63993, 11.550	
Point 51: 2.03729, 91.500	Point 106: 2.65163, 11.100	
Point 52: 2.04618, 89.000	Point 107: 2.66390, 10.650	
Point 53: 2.05528, 86.500	Point 108: 2.67685, 10.200	
Point 54: 2.06462, 84.000	Point 109: 2.69053, 9.750	
Point 55: 2.07420, 81.500	Point 110: 2.70341, 9.350	





# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 366512  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15984

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

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.60969	325.0	31	2.65979	10.8
2	1.61069	324.0	32	2.70511	9.3
3	1.62615	309.0	33	2.75272	8.0
4	1.64257	294.0	34	2.79693	7.0
5	1.66006	279.0	35	2.84479	6.1
6	1.67871	264.0	36	2.88941	5.4
7	1.69863	249.0	37	2.93477	4.8
8	1.71995	234.0	38	2.97931	4.3
9	1.74280	219.0	39	3.02075	3.9
10	1.76736	204.0	40	3.06889	3.5
11	1.79382	189.0	41	3.11063	3.2
12	1.82241	174.0	42	3.15854	2.9
13	1.85343	159.0	43	3.19478	2.7
14	1.88726	144.0	44	3.23527	2.5
15	1.92443	129.0	45	3.28101	2.3
16	1.96562	114.0	46	3.30625	2.2
17	2.01186	99.0	47	3.36259	2.0
18	2.06463	84.0	48	3.39423	1.9
19	2.12643	69.0	49	3.42867	1.8
20	2.17210	59.5	50	3.46629	1.7
21	2.22480	50.0	51	3.55291	1.5
22	2.25621	45.0	52	3.60304	1.4
23	2.29086	40.0			
24	2.32954	35.0			
25	2.37342	30.0			
26	2.42328	25.1			
27	2.46986	21.2			
28	2.51791	17.8			
29	2.56537	15.0			
30	2.61245	12.7			

## Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	102.670
1000	4.093



# BREAKPOINTS 234 FORMAT

Calibration Report: 366512  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15984

Maximum Temperature Error:

1.4 - 10K: 0.004K  
 10 - 20K: 0.008K  
 20 - 40K: 0.012K  
 40 - 100K: 0.026K  
 > 100K: 0.119K

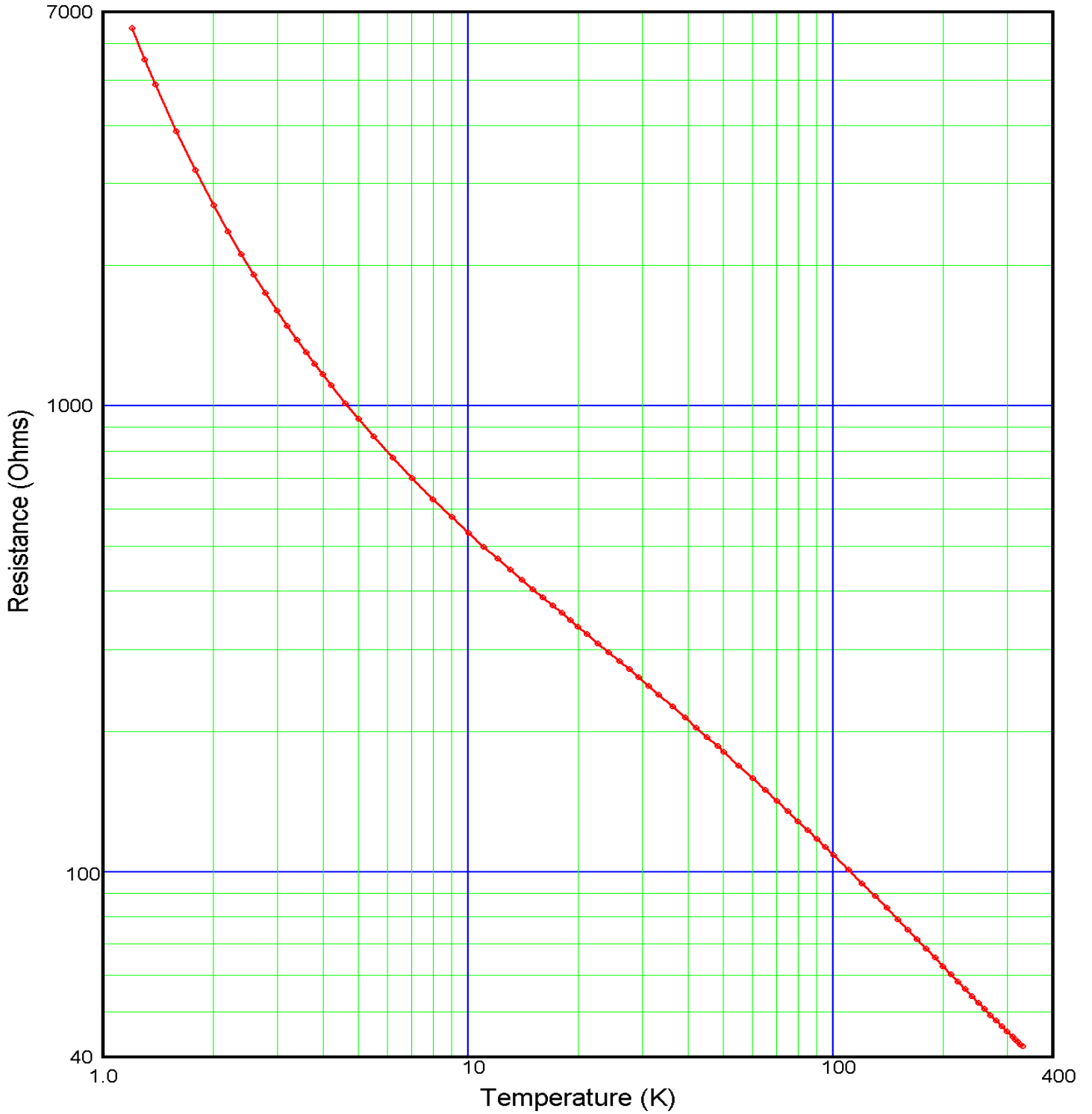
BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	314.860	41.68694	1.620	46	17.665	331.1311	2.520
2	296.303	43.65158	1.640	47	16.432	346.7369	2.540
3	279.049	45.70882	1.660	48	15.291	363.0781	2.560
4	262.998	47.86301	1.680	49	14.239	380.1894	2.580
5	248.005	50.11872	1.700	50	13.266	398.1072	2.600
6	233.962	52.48075	1.720	51	12.372	416.8694	2.620
7	220.783	54.95409	1.740	52	11.549	436.5158	2.640
8	208.383	57.54399	1.760	53	10.792	457.0882	2.660
9	196.689	60.25596	1.780	54	10.096	478.6301	2.680
10	185.663	63.09573	1.800	55	9.455	501.1872	2.700
11	175.215	66.06934	1.820	56	8.866	524.8075	2.720
12	165.340	69.18310	1.840	57	8.323	549.5409	2.740
13	155.986	72.44360	1.860	58	7.823	575.4399	2.760
14	147.106	75.85776	1.880	59	7.362	602.5596	2.780
15	138.693	79.43282	1.900	60	6.937	630.9573	2.800
16	130.711	83.17638	1.920	61	6.545	660.6934	2.820
17	123.136	87.09636	1.940	62	6.183	691.8310	2.840
18	115.952	91.20108	1.960	63	5.848	724.4360	2.860
19	109.140	95.49926	1.980	64	5.538	758.5776	2.880
20	102.677	100.0000	2.000	65	5.251	794.3282	2.900
21	96.543	104.7129	2.020	66	4.984	831.7638	2.920
22	90.735	109.6478	2.040	67	4.737	870.9636	2.940
23	85.232	114.8154	2.060	68	4.507	912.0108	2.960
24	80.022	120.2264	2.080	69	4.293	954.9926	2.980
25	75.096	125.8925	2.100	70	4.093	1000.000	3.000
26	70.440	131.8257	2.120	71	3.732	1096.478	3.040
27	66.046	138.0384	2.140	72	3.416	1202.264	3.080
28	61.894	144.5440	2.160	73	3.138	1318.257	3.120
29	57.982	151.3561	2.180	74	2.892	1445.440	3.160
30	54.288	158.4893	2.200	75	2.673	1584.893	3.200
31	50.802	165.9587	2.220	76	2.478	1737.801	3.240
32	47.526	173.7801	2.240	77	2.304	1905.461	3.280
33	44.426	181.9701	2.260	78	2.148	2089.296	3.320
34	41.515	190.5461	2.280	79	2.009	2290.868	3.360
35	38.765	199.5262	2.300	80	1.883	2511.886	3.400
36	36.180	208.9296	2.320	81	1.769	2754.229	3.440
37	33.746	218.7762	2.340	82	1.665	3019.952	3.480
38	31.457	229.0868	2.360	83	1.571	3311.311	3.520
39	29.308	239.8833	2.380	84	1.485	3630.781	3.560
40	27.288	251.1886	2.400	85	1.406	3981.072	3.600
41	25.400	263.0268	2.420	86	1.333	4365.158	3.640
42	23.627	275.4229	2.440	87	1.266	4786.301	3.680
43	21.974	288.4032	2.460	88	1.206	5248.075	3.720
44	20.432	301.9952	2.480				
45	18.997	316.2278	2.500				



# DATA PLOT

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%



# TEST DATA

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	1.20094	6462.40	46	42.2784	203.727
2	1.30093	5541.77	47	45.2596	194.260
3	1.39003	4899.51	48	48.2492	185.786
4	1.58926	3878.53	49	50.2390	180.532
5	1.79062	3206.19	50	55.2473	168.710
6	2.01297	2690.14	51	60.2628	158.493
7	2.20280	2368.80	52	65.2767	149.571
8	2.39417	2115.35	53	70.2884	141.687
9	2.59067	1909.30	54	75.2879	134.697
10	2.78730	1743.28	55	80.2850	128.423
11	2.99721	1598.44	56	85.2815	122.754
12	3.19430	1484.85	57	90.2744	117.607
13	3.39883	1385.70	58	95.2737	112.888
14	3.59828	1302.25	59	100.270	108.572
15	3.79536	1230.67	60	110.254	100.915
16	3.99495	1167.09	61	120.232	94.3331
17	4.21680	1105.39	62	130.230	88.5878
18	4.61192	1012.58	63	140.223	83.5444
19	5.01004	936.582	64	150.218	79.0701
20	5.51429	858.716	65	160.214	75.0766
21	6.22024	773.949	66	170.209	71.5017
22	7.02614	700.056	67	180.208	68.2717
23	8.03352	630.053	68	190.209	65.3396
24	9.04063	576.265	69	200.212	62.6787
25	10.0522	533.478	70	210.208	60.2524
26	11.0629	498.430	71	220.196	58.0298
27	12.0704	469.262	72	230.209	55.9823
28	13.0730	444.434	73	240.212	54.0975
29	14.0711	422.911	74	250.212	52.3573
30	15.0686	404.124	75	260.218	50.7518
31	16.0642	387.421	76	270.206	49.2538
32	17.0599	372.386	77	280.222	47.8605
33	18.0542	358.879	78	290.211	46.5723
34	19.0477	346.577	79	300.236	45.3601
35	20.0458	335.267	80	310.236	44.2348
36	21.1407	323.861	81	315.243	43.6948
37	22.7330	309.004	82	320.254	43.1756
38	24.3194	295.633	83	326.257	42.5744
39	25.9635	283.117	84	330.250	42.1834
40	27.6557	271.628			
41	29.3236	261.258			
42	31.1782	250.713			
43	33.3105	239.855			
44	36.3203	226.149			
45	39.3086	214.297			



# POLYNOMIAL EQUATION

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

1.40K to 14.1K  
4838. Ohms to 422.9 Ohms

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

ZL = 2.58818366022      ZU = 3.81039377511

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.505731	3.7755E-04	14582.61
1	-6.318538	6.0266E-04	-10484.48
2	2.789693	5.2829E-04	5280.62
3	-1.030675	5.3614E-04	-1922.41
4	0.323701	5.0899E-04	635.97
5	-0.083394	4.7459E-04	-175.72
6	0.015113	4.6182E-04	32.72

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	6462.399	1.20094	1.20163	-0.69
2	5541.774	1.30093	1.29917	1.76
3	4899.508	1.39003	1.39009	-0.06
4	3878.527	1.58926	1.59183	-2.57
5	3206.194	1.79062	1.79082	-0.20
6	2690.137	2.01297	2.01166	1.31
7	2368.803	2.20280	2.20045	2.35
8	2115.352	2.39417	2.39306	1.11
9	1909.297	2.59067	2.59104	-0.37
10	1743.277	2.78730	2.78846	-1.16
11	1598.438	2.99721	2.99852	-1.31
12	1484.851	3.19430	3.19611	-1.81
13	1385.696	3.39883	3.39938	-0.56
14	1302.250	3.59828	3.59876	-0.48
15	1230.668	3.79536	3.79557	-0.21
16	1167.088	3.99495	3.99495	0.00
17	1105.391	4.21680	4.21540	1.40
18	1012.580	4.61192	4.61071	1.20
19	936.5818	5.01004	5.00938	0.66
20	858.7162	5.51429	5.51401	0.28
21	773.9490	6.22024	6.21899	1.25
22	700.0556	7.02614	7.02530	0.84
23	630.0529	8.03352	8.03379	-0.26
24	576.2653	9.04063	9.04412	-3.49
25	533.4781	10.05223	10.05411	-1.88
26	498.4297	11.06291	11.06457	-1.66
27	469.2621	12.07044	12.06834	2.10
28	444.4335	13.07303	13.06932	3.71
29	422.9112	14.07107	14.07084	0.23
30	404.1237	15.06858	15.06743	1.15
31	387.4214	16.06420	16.06685	-2.65

Order of Fit = 6                      RMS error of fit = 1.58 mK  
Largest absolute error = 3.71 mK at data point no. 28



# POLYNOMIAL EQUATION

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

14.1K to 80.3K  
422.9 Ohms to 128.4 Ohms

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

ZL = 2.07043403171      ZU = 2.67141549457

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	42.648452	1.1447E-03	37256.21
1	-38.079878	1.8693E-03	-20371.04
2	8.416278	1.7031E-03	4941.73
3	-1.014345	1.6010E-03	-633.58
4	0.112013	1.5321E-03	73.11
5	-0.009358	1.4413E-03	-6.49
6	-0.004670	1.4407E-03	-3.24

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	469.2621	12.06834	12.06849	-0.15
28	444.4335	13.06932	13.06978	-0.46
29	422.9112	14.07084	14.07080	0.04
30	404.1237	15.06858	15.06597	2.61
31	387.4214	16.06420	16.06216	2.03
32	372.3857	17.05988	17.06255	-2.67
33	358.8786	18.05423	18.05658	-2.36
34	346.5774	19.04765	19.05043	-2.78
35	335.2675	20.04578	20.04749	-1.71
36	323.8614	21.14070	21.14309	-2.40
37	309.0040	22.73296	22.72321	9.74
38	295.6333	24.31939	24.31397	5.42
39	283.1169	25.96350	25.96972	-6.22
40	271.6276	27.65569	27.65183	3.86
41	261.2581	29.32362	29.32164	1.97
42	250.7130	31.17815	31.18731	-9.15
43	239.8546	33.31050	33.30954	0.96
44	226.1495	36.32026	36.32734	-7.08
45	214.2966	39.30855	39.29752	11.04
46	203.7273	42.27844	42.28110	-2.67
47	194.2595	45.25960	45.26898	-9.38
48	185.7861	48.24919	48.23712	12.08
49	180.5325	50.23898	50.23606	2.92
50	168.7104	55.24733	55.25032	-2.99
51	158.4928	60.26281	60.26580	-2.99
52	149.5707	65.27667	65.27624	0.43
53	141.6873	70.28835	70.29168	-3.33
54	134.6969	75.28792	75.28635	1.57
55	128.4229	80.28497	80.28245	2.51
56	122.7536	85.28147	85.28111	0.36
57	117.6072	90.27444	90.27566	-1.21

Order of Fit = 6                      RMS error of fit = 4.98 mK  
Largest absolute error = 12.08 mK at data point no. 48





# POLYNOMIAL EQUATION

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

80.3K to 325.K  
128.4 Ohms to 42.70 Ohms

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

ZL = 1.62514165301      ZU = 2.15133099459

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	176.657823	2.2325E-03	79130.93
1	-126.304301	3.4421E-03	-36694.23
2	22.866762	3.3110E-03	6906.35
3	-3.520838	3.1416E-03	-1120.71
4	0.724252	2.9927E-03	242.01
5	-0.155353	3.0019E-03	-51.75
6	0.028310	2.9656E-03	9.55
7	-0.007570	2.8648E-03	-2.64

$Z = \text{Log}(\text{resistance})$

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 7$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	141.6873	70.29168	70.28908	2.60
54	134.6969	75.28635	75.29118	-4.82
55	128.4229	80.28245	80.28530	-2.85
56	122.7536	85.28147	85.27871	2.76
57	117.6072	90.27444	90.26705	7.39
58	112.8885	95.27368	95.27571	-2.02
59	108.5725	100.27041	100.26927	1.14
60	100.9155	110.25437	110.25944	-5.08
61	94.33314	120.23230	120.23473	-2.42
62	88.58778	130.22980	130.23296	-3.16
63	83.54444	140.22307	140.21729	5.79
64	79.07005	150.21841	150.21481	3.60
65	75.07658	160.21366	160.21911	-5.45
66	71.50171	170.20944	170.20056	8.88
67	68.27174	180.20787	180.20022	7.65
68	65.33958	190.20851	190.22176	-13.26
69	62.67875	200.21191	200.22067	-8.77
70	60.25238	210.20796	210.20736	0.59
71	58.02979	220.19592	220.19345	2.47
72	55.98234	230.20860	230.20656	2.04
73	54.09749	240.21219	240.21338	-1.19
74	52.35728	250.21229	250.21731	-5.02
75	50.75183	260.21780	260.18609	31.71
76	49.25375	270.20618	270.21242	-6.24
77	47.86046	280.22157	280.24547	-23.90
78	46.57229	290.21085	290.20420	6.65
79	45.36006	300.23562	300.24744	-11.82
80	44.23477	310.23642	310.22173	14.69
81	43.69482	315.24335	315.25155	-8.19
82	43.17560	320.25425	320.24845	5.80
83	42.57438	326.25718	326.24191	15.27
84	42.18341	330.25036	330.26521	-14.85

Order of Fit = 7      RMS error of fit = 10.03 mK  
Largest absolute error = 31.71 mK at data point no. 75



# INTERPOLATION TABLE

Calibration Report: 366514  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15986  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
1.400	4838.08	-6129.2	-1.7736	15.50	396.612	-16.873	-0.65943
1.500	4288.97	-4911.9	-1.7179	16.00	388.410	-15.952	-0.65712
1.600	3845.60	-3998.6	-1.6636	16.50	380.646	-15.117	-0.65527
1.700	3482.20	-3298.8	-1.6105	17.00	373.281	-14.355	-0.65374
1.800	3180.72	-2753.3	-1.5581	17.50	366.280	-13.658	-0.65254
1.900	2927.71	-2323.5	-1.5079	18.00	359.613	-13.018	-0.65162
2.000	2713.06	-1982.5	-1.4615	18.50	353.253	-12.430	-0.65098
2.100	2528.93	-1709.4	-1.4195	19.00	347.176	-11.887	-0.65055
2.200	2369.47	-1487.6	-1.3812	19.50	341.359	-11.385	-0.65034
2.300	2230.09	-1305.6	-1.3465	20.00	335.785	-10.918	-0.65030
2.400	2107.31	-1154.7	-1.3151	21.00	325.296	-10.080	-0.65071
2.500	1998.34	-1028.3	-1.2864	22.00	315.590	-9.3474	-0.65161
2.600	1901.00	-921.36	-1.2601	23.00	306.572	-8.7031	-0.65293
2.700	1813.54	-830.12	-1.2359	24.00	298.160	-8.1313	-0.65452
2.800	1734.55	-751.70	-1.2134	25.00	290.288	-7.6215	-0.65637
2.900	1662.86	-683.74	-1.1924	26.00	282.900	-7.1636	-0.65838
3.000	1597.51	-624.50	-1.1728	27.00	275.946	-6.7506	-0.66051
3.100	1537.71	-572.56	-1.1543	28.00	269.386	-6.3762	-0.66274
3.200	1482.80	-526.75	-1.1368	29.00	263.183	-6.0352	-0.66502
3.300	1432.19	-486.15	-1.1202	30.00	257.305	-5.7237	-0.66734
3.400	1385.42	-450.01	-1.1044	31.00	251.727	-5.4378	-0.66966
3.500	1342.06	-417.70	-1.0893	32.00	246.422	-5.1749	-0.67201
3.600	1301.77	-388.70	-1.0750	33.00	241.370	-4.9321	-0.67432
3.700	1264.23	-362.59	-1.0612	34.00	236.552	-4.7077	-0.67664
3.800	1229.17	-339.00	-1.0480	35.00	231.950	-4.4990	-0.67888
3.900	1196.35	-317.61	-1.0354	36.00	227.549	-4.3051	-0.68110
4.000	1165.58	-298.16	-1.0232	37.00	223.335	-4.1246	-0.68332
4.200	1109.44	-264.25	-1.0004	38.00	219.296	-3.9558	-0.68546
4.400	1059.52	-235.78	-0.97914	39.00	215.420	-3.7978	-0.68756
4.600	1014.84	-211.66	-0.95942	40.00	211.697	-3.6499	-0.68964
4.800	974.615	-191.11	-0.94123	42.00	204.672	-3.3800	-0.69359
5.000	938.205	-173.43	-0.92424	44.00	198.156	-3.1407	-0.69739
5.200	905.086	-158.12	-0.90845	46.00	192.092	-2.9274	-0.70101
5.400	874.827	-144.77	-0.89360	48.00	186.432	-2.7360	-0.70442
5.600	847.064	-133.12	-0.88009	50.00	181.135	-2.5639	-0.70772
5.800	821.490	-122.82	-0.86715	52.00	176.166	-2.4082	-0.71085
6.000	797.858	-113.68	-0.85490	54.00	171.493	-2.2668	-0.71378
6.500	745.891	-95.053	-0.82833	56.00	167.090	-2.1384	-0.71668
7.000	702.091	-80.773	-0.80532	58.00	162.932	-2.0209	-0.71941
7.500	664.596	-69.622	-0.78569	60.00	159.000	-1.9134	-0.72204
8.000	632.095	-60.719	-0.76848	65.00	150.033	-1.6809	-0.72823
8.500	603.590	-53.531	-0.75384	70.00	142.121	-1.4904	-0.73409
9.000	578.355	-47.602	-0.74076	75.00	135.077	-1.3313	-0.73919
9.500	555.820	-42.676	-0.72942	77.35	132.027	-1.2654	-0.74137
10.00	535.551	-38.518	-0.71922	80.00	128.764	-1.1986	-0.74467
10.50	517.197	-34.988	-0.71032	85.00	123.056	-1.0869	-0.75080
11.00	500.481	-31.951	-0.70224	90.00	117.871	-0.98955	-0.75557
11.50	485.177	-29.326	-0.69511	95.00	113.138	-0.90568	-0.76049
12.00	471.100	-27.034	-0.68863	100.0	108.796	-0.83256	-0.76525
12.50	458.095	-25.025	-0.68285	105.0	104.797	-0.76840	-0.76988
13.00	446.037	-23.244	-0.67747	110.0	101.100	-0.71170	-0.77435
13.50	434.817	-21.667	-0.67272	115.0	97.6695	-0.66134	-0.77868
14.00	424.340	-20.268	-0.66870	120.0	94.4776	-0.61627	-0.78275
14.50	414.523	-19.020	-0.66533	125.0	91.4991	-0.57578	-0.78660
15.00	405.299	-17.893	-0.66220	130.0	88.7132	-0.53921	-0.79015



# INTERPOLATION TABLE

Calibration Report: 366514  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15986  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
135.0	86.1013	-0.50606	-0.79346	235.0	55.0604	-0.18861	-0.80497
140.0	83.6477	-0.47587	-0.79646	240.0	54.1361	-0.18120	-0.80329
145.0	81.3383	-0.44831	-0.79918	245.0	53.2478	-0.17418	-0.80144
150.0	79.1608	-0.42304	-0.80162	250.0	52.3937	-0.16754	-0.79943
155.0	77.1044	-0.39984	-0.80378	255.0	51.5718	-0.16124	-0.79727
160.0	75.1594	-0.37845	-0.80565	260.0	50.7807	-0.15526	-0.79496
165.0	73.3172	-0.35870	-0.80726	265.0	50.0187	-0.14959	-0.79252
170.0	71.5699	-0.34042	-0.80860	270.0	49.2844	-0.14419	-0.78994
175.0	69.9107	-0.32346	-0.80969	273.15	48.8353	-0.14093	-0.78825
180.0	68.3333	-0.30770	-0.81053	275.0	48.5763	-0.13906	-0.78723
185.0	66.8319	-0.29302	-0.81112	280.0	47.8934	-0.13417	-0.78441
190.0	65.4015	-0.27932	-0.81147	285.0	47.2342	-0.12952	-0.78149
195.0	64.0372	-0.26652	-0.81159	290.0	46.5978	-0.12508	-0.77846
200.0	62.7349	-0.25454	-0.81149	295.0	45.9830	-0.12085	-0.77533
205.0	61.4905	-0.24331	-0.81116	300.0	45.3889	-0.11682	-0.77212
210.0	60.3006	-0.23277	-0.81063	305.0	44.8145	-0.11297	-0.76883
215.0	59.1618	-0.22286	-0.80988	310.0	44.2590	-0.10929	-0.76547
220.0	58.0711	-0.21353	-0.80894	315.0	43.7214	-0.10577	-0.76204
225.0	57.0256	-0.20474	-0.80780	320.0	43.2010	-0.10241	-0.75856
230.0	56.0229	-0.19644	-0.80648	325.0	42.6971	-9.9192e-2	-0.75502



# THERMAL CYCLE TESTING

Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor

Serial Number: X15986

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Room Temperature:	44.7 $\Omega$
Liquid Nitrogen:	132 $\Omega$
Liquid Helium:	1100 $\Omega$

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip test values should not be made.

## Recommended Operating Parameters:

For sensors calibrated by LSCI the current to the sensor is adjusted to maintain the sensor output voltage at the values listed below. In order to minimize possible self-heating errors, we suggest that these same guidelines be followed in using the sensor:

Above 1K:	1 to 3 mV
0.1 to 1K:	0.1 mV
Below 0.1K:	0.03 mV

## Lead Identification:

NONE

To avoid possible damage to the sensor, do not exceed 1 Volt and do not exceed 100 mA current.



# BREAKPOINTS 340 FORMAT

Calibration Report: 366514  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 69480  
Serial Number: X15986

Name: CX-1030-SD-1.4L  
Serial number: X15986  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.

Coefficient: 1 ;Negative

Point 1: 1.63038,325.000	Point 56: 2.11180, 79.500	Point 111: 2.75165, 9.300
Point 2: 1.63652,319.000	Point 57: 2.12210, 77.000	Point 112: 2.76573, 8.900
Point 3: 1.64227,313.500	Point 58: 2.13057, 75.000	Point 113: 2.78067, 8.500
Point 4: 1.64814,308.000	Point 59: 2.13923, 73.000	Point 114: 2.79657, 8.100
Point 5: 1.65416,302.500	Point 60: 2.14812, 71.000	Point 115: 2.81353, 7.700
Point 6: 1.66031,297.000	Point 61: 2.15723, 69.000	Point 116: 2.82941, 7.350
Point 7: 1.66661,291.500	Point 62: 2.16657, 67.000	Point 117: 2.84631, 7.000
Point 8: 1.67306,286.000	Point 63: 2.17617, 65.000	Point 118: 2.86441, 6.650
Point 9: 1.67966,280.500	Point 64: 2.18604, 63.000	Point 119: 2.88388, 6.300
Point 10: 1.68641,275.000	Point 65: 2.19619, 61.000	Point 120: 2.90555, 5.940
Point 11: 1.69333,269.500	Point 66: 2.20664, 59.000	Point 121: 2.92509, 5.640
Point 12: 1.69977,264.500	Point 67: 2.21741, 57.000	Point 122: 2.94613, 5.340
Point 13: 1.70635,259.500	Point 68: 2.22853, 55.000	Point 123: 2.96895, 5.040
Point 14: 1.71308,254.500	Point 69: 2.24001, 53.000	Point 124: 2.99211, 4.760
Point 15: 1.71996,249.500	Point 70: 2.25068, 51.200	Point 125: 3.01729, 4.480
Point 16: 1.72700,244.500	Point 71: 2.26168, 49.400	Point 126: 3.04288, 4.220
Point 17: 1.73420,239.500	Point 72: 2.27305, 47.600	Point 127: 3.06424, 4.020
Point 18: 1.74157,234.500	Point 73: 2.28481, 45.800	Point 128: 3.08474, 3.840
Point 19: 1.74911,229.500	Point 74: 2.29698, 44.000	Point 129: 3.10672, 3.660
Point 20: 1.75684,224.500	Point 75: 2.30959, 42.200	Point 130: 3.12901, 3.490
Point 21: 1.76474,219.500	Point 76: 2.32122, 40.600	Point 131: 3.15292, 3.320
Point 22: 1.77285,214.500	Point 77: 2.33325, 39.000	Point 132: 3.17718, 3.160
Point 23: 1.78115,209.500	Point 78: 2.34573, 37.400	Point 133: 3.20328, 3.000
Point 24: 1.78965,204.500	Point 79: 2.35868, 35.800	Point 134: 3.22975, 2.850
Point 25: 1.79837,199.500	Point 80: 2.37131, 34.300	Point 135: 3.25834, 2.700
Point 26: 1.80732,194.500	Point 81: 2.38442, 32.800	Point 136: 3.28733, 2.560
Point 27: 1.81650,189.500	Point 82: 2.39808, 31.300	Point 137: 3.31877, 2.420
Point 28: 1.82592,184.500	Point 83: 2.41138, 29.900	Point 138: 3.35319, 2.280
Point 29: 1.83559,179.500	Point 84: 2.42523, 28.500	Point 139: 3.38829, 2.150
Point 30: 1.84453,175.000	Point 85: 2.43971, 27.100	Point 140: 3.42380, 2.030
Point 31: 1.85368,170.500	Point 86: 2.45379, 25.800	Point 141: 3.46278, 1.910
Point 32: 1.86307,166.000	Point 87: 2.46853, 24.500	Point 142: 3.50594, 1.790
Point 33: 1.87270,161.500	Point 88: 2.48281, 23.300	Point 143: 3.55395, 1.670
Point 34: 1.88258,157.000	Point 89: 2.49778, 22.100	Point 144: 3.60300, 1.560
Point 35: 1.89273,152.500	Point 90: 2.51356, 20.900	Point 145: 3.65737, 1.450
Point 36: 1.90316,148.000	Point 91: 2.52464, 20.100	Point 146: 3.68472, 1.400
Point 37: 1.91388,143.500	Point 92: 2.53391, 19.450	
Point 38: 1.92491,139.000	Point 93: 2.54351, 18.800	
Point 39: 1.93626,134.500	Point 94: 2.55346, 18.150	
Point 40: 1.94665,130.500	Point 95: 2.56378, 17.500	
Point 41: 1.95732,126.500	Point 96: 2.57368, 16.900	
Point 42: 1.96829,122.500	Point 97: 2.58396, 16.300	
Point 43: 1.97958,118.500	Point 98: 2.59466, 15.700	
Point 44: 1.99121,114.500	Point 99: 2.60489, 15.150	
Point 45: 2.00320,110.500	Point 100: 2.61553, 14.600	
Point 46: 2.01557,106.500	Point 101: 2.62664, 14.050	
Point 47: 2.02836,102.500	Point 102: 2.63826, 13.500	
Point 48: 2.03827, 99.500	Point 103: 2.64934, 13.000	
Point 49: 2.04670, 97.000	Point 104: 2.66091, 12.500	
Point 50: 2.05534, 94.500	Point 105: 2.67307, 12.000	
Point 51: 2.06417, 92.000	Point 106: 2.68585, 11.500	
Point 52: 2.07322, 89.500	Point 107: 2.69796, 11.050	
Point 53: 2.08249, 87.000	Point 108: 2.71068, 10.600	
Point 54: 2.09201, 84.500	Point 109: 2.72410, 10.150	
Point 55: 2.10178, 82.000	Point 110: 2.73829, 9.700	



# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 366514  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15986

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

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.63040	325.0	31	2.70500	10.8
2	1.63141	324.0	32	2.75169	9.3
3	1.64708	309.0	33	2.80078	8.0
4	1.66374	294.0	34	2.84639	7.0
5	1.68149	279.0	35	2.89581	6.1
6	1.70043	264.0	36	2.94192	5.4
7	1.72067	249.0	37	2.98883	4.8
8	1.74233	234.0	38	3.03494	4.3
9	1.76556	219.0	39	3.07786	3.9
10	1.79053	204.0	40	3.12777	3.5
11	1.81745	189.0	41	3.17108	3.2
12	1.84656	174.0	42	3.22085	2.9
13	1.87818	159.0	43	3.25853	2.7
14	1.91270	144.0	44	3.30067	2.5
15	1.95064	129.0	45	3.34832	2.3
16	1.99271	114.0	46	3.37465	2.2
17	2.03995	99.0	47	3.43346	2.0
18	2.09396	84.0	48	3.46653	1.9
19	2.15724	69.0	49	3.50252	1.8
20	2.20402	59.5	50	3.54185	1.7
21	2.25800	50.0	51	3.63235	1.5
22	2.29019	45.0	52	3.68467	1.4
23	2.32571	40.0			
24	2.36539	35.0			
25	2.41045	30.0			
26	2.46169	25.1			
27	2.50960	21.2			
28	2.55900	17.8			
29	2.60778	15.0			
30	2.65626	12.7			

## Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	111.560
1000	4.671



# BREAKPOINTS 234 FORMAT

Calibration Report: 366514  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 69480  
 Serial Number: X15986

Maximum Temperature Error:

1.4 - 10K: 0.005K  
 10 - 20K: 0.007K  
 20 - 40K: 0.012K  
 40 - 100K: 0.023K  
 > 100K: 0.100K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	315.660	43.65158	1.640	46	19.037	346.7369	2.540
2	297.283	45.70882	1.660	47	17.737	363.0781	2.560
3	280.226	47.86301	1.680	48	16.530	380.1894	2.580
4	264.340	50.11872	1.700	49	15.413	398.1072	2.600
5	249.479	52.48075	1.720	50	14.377	416.8694	2.620
6	235.567	54.95409	1.740	51	13.422	436.5158	2.640
7	222.494	57.54399	1.760	52	12.541	457.0882	2.660
8	210.192	60.25596	1.780	53	11.727	478.6301	2.680
9	198.590	63.09573	1.800	54	10.978	501.1872	2.700
10	187.634	66.06934	1.820	55	10.287	524.8075	2.720
11	177.279	69.18310	1.840	56	9.649	549.5409	2.740
12	167.467	72.44360	1.860	57	9.062	575.4399	2.760
13	158.171	75.85776	1.880	58	8.519	602.5596	2.780
14	149.360	79.43282	1.900	59	8.019	630.9573	2.800
15	140.997	83.17638	1.920	60	7.557	660.6934	2.820
16	133.057	87.09636	1.940	61	7.130	691.8310	2.840
17	125.519	91.20108	1.960	62	6.735	724.4360	2.860
18	118.361	95.49926	1.980	63	6.370	758.5776	2.880
19	111.563	100.0000	2.000	64	6.031	794.3282	2.900
20	105.111	104.7129	2.020	65	5.718	831.7638	2.920
21	98.985	109.6478	2.040	66	5.427	870.9636	2.940
22	93.176	114.8154	2.060	67	5.157	912.0108	2.960
23	87.672	120.2264	2.080	68	4.905	954.9926	2.980
24	82.453	125.8925	2.100	69	4.671	1000.000	3.000
25	77.510	131.8257	2.120	70	4.250	1096.478	3.040
26	72.829	138.0384	2.140	71	3.881	1202.264	3.080
27	68.404	144.5440	2.160	72	3.558	1318.257	3.120
28	64.221	151.3561	2.180	73	3.273	1445.440	3.160
29	60.268	158.4893	2.200	74	3.020	1584.893	3.200
30	56.533	165.9587	2.220	75	2.796	1737.801	3.240
31	53.003	173.7801	2.240	76	2.595	1905.461	3.280
32	49.677	181.9701	2.260	77	2.416	2089.296	3.320
33	46.534	190.5461	2.280	78	2.255	2290.868	3.360
34	43.563	199.5262	2.300	79	2.110	2511.886	3.400
35	40.773	208.9296	2.320	80	1.980	2754.229	3.440
36	38.132	218.7762	2.340	81	1.862	3019.952	3.480
37	35.644	229.0868	2.360	82	1.754	3311.311	3.520
38	33.304	239.8833	2.380	83	1.657	3630.781	3.560
39	31.099	251.1886	2.400	84	1.567	3981.072	3.600
40	29.027	263.0268	2.420	85	1.484	4365.158	3.640
41	27.077	275.4229	2.440	86	1.408	4786.301	3.680
42	25.247	288.4032	2.460	87	1.338	5248.075	3.720
43	23.538	301.9952	2.480	88	1.274	5754.399	3.760
44	21.932	316.2278	2.500	89	1.216	6309.573	3.800
45	20.433	331.1311	2.520				

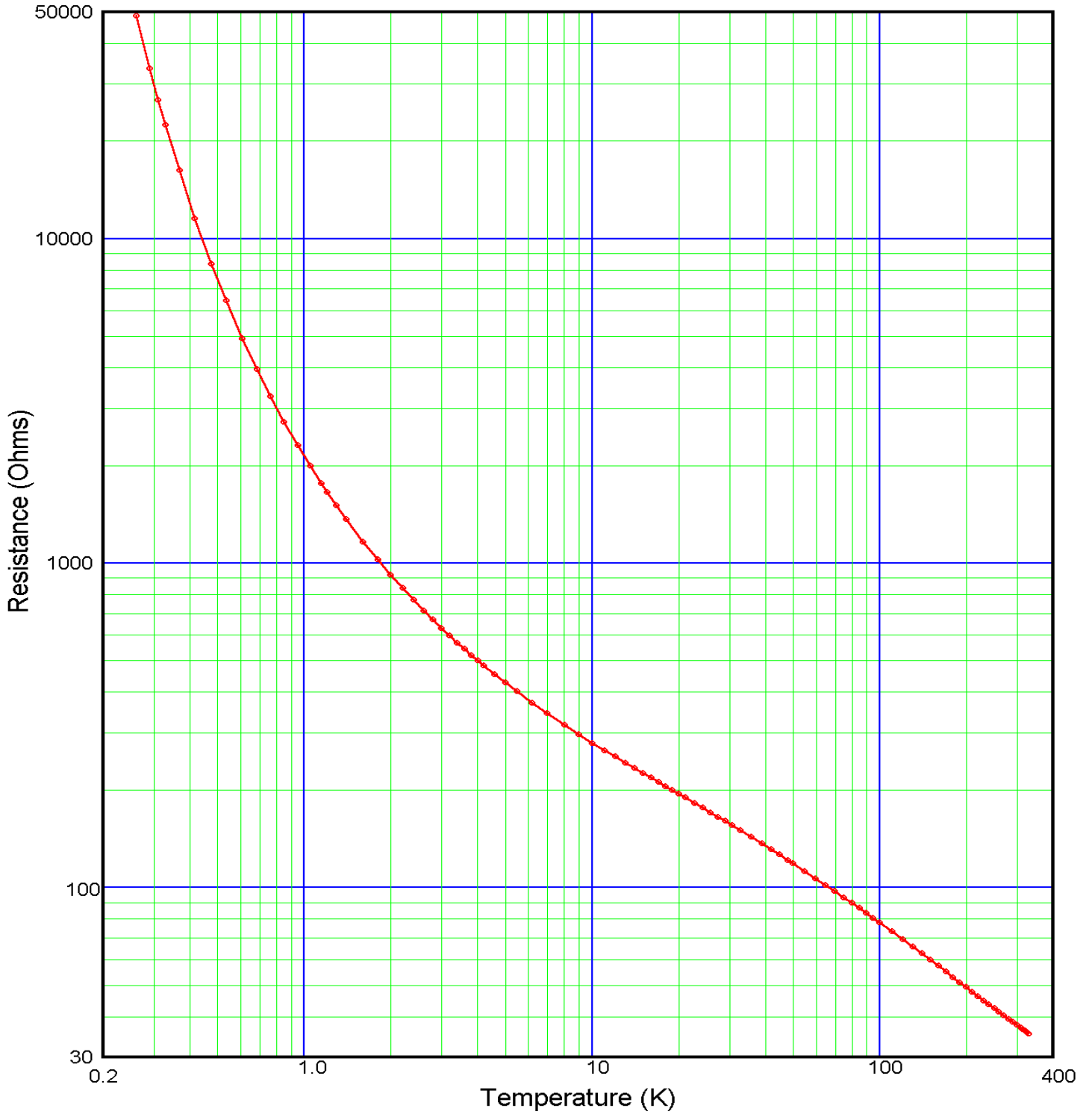




# DATA PLOT

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%



# TEST DATA

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	0.260373	48651.2	51	21.0960	189.425
2	0.290862	33548.5	52	22.6919	182.458
3	0.310719	26858.6	53	24.2764	176.211
4	0.329311	22441.5	54	25.8441	170.546
5	0.368686	16305.0	55	27.4229	165.264
6	0.415666	11575.6	56	29.0081	160.499
7	0.476380	8383.60	57	30.7971	155.434
8	0.535972	6443.60	58	32.8873	149.990
9	0.609603	4936.02	59	35.8914	143.053
10	0.684907	3965.18	60	39.0066	136.608
11	0.764692	3268.07	61	41.8715	131.292
12	0.851225	2728.04	62	44.8773	126.242
13	0.949220	2314.61	63	47.8793	121.665
14	1.04935	1999.49	64	49.8894	118.834
15	1.14739	1765.29	65	54.8828	112.418
16	1.20174	1659.89	66	59.8796	106.799
17	1.29582	1506.21	67	64.8979	101.813
18	1.40486	1362.99	68	69.9051	97.3712
19	1.60511	1165.50	69	74.9280	93.3626
20	1.80200	1026.20	70	79.9402	89.7409
21	1.99530	922.545	71	84.9591	86.4297
22	2.19899	837.251	72	89.9762	83.4075
23	2.40227	769.653	73	94.9995	80.6181
24	2.60250	715.084	74	100.033	78.0319
25	2.80371	669.367	75	110.146	73.3775
26	3.00356	630.934	76	120.286	69.3240
27	3.20403	597.866	77	130.447	65.7465
28	3.40347	569.210	78	140.258	62.6434
29	3.60544	543.787	79	150.017	59.9002
30	3.80958	521.093	80	160.083	57.3418
31	4.00751	501.400	81	170.061	55.0459
32	4.20084	484.166	82	180.037	52.9668
33	4.59762	453.578	83	190.014	51.0633
34	4.99006	428.439	84	199.994	49.3184
35	5.48244	402.018	85	210.025	47.7010
36	6.19929	371.175	86	220.031	46.2254
37	7.00419	344.040	87	230.033	44.8595
38	8.01140	317.466	88	240.014	43.5946
39	9.02182	296.648	89	250.030	42.4229
40	10.0320	279.412	90	260.047	41.3302
41	11.0374	265.206	91	270.046	40.3123
42	12.0399	253.158	92	280.036	39.3669
43	13.0386	242.763	93	290.005	38.4792
44	14.0363	233.530	94	300.017	37.6483
45	15.0348	225.405	95	310.005	36.8741
46	16.0277	218.070	96	315.015	36.5030
47	17.0205	211.468	97	320.033	36.1413
48	18.0111	205.439	98	326.071	35.7205
49	19.0043	199.832	99	330.053	35.4514
50	19.9973	194.702			



# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

0.300K to 3.00K  
3.020e+4 Ohms to 630.9 Ohms

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

ZL = 2.75527284503      ZU = 4.68709355677

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	1.108842	1.8778E-04	5904.99
1	-1.270323	3.0903E-04	-4110.66
2	0.607357	2.7326E-04	2222.63
3	-0.258402	2.2918E-04	-1127.52
4	0.100951	1.9602E-04	515.01
5	-0.037624	1.9507E-04	-192.87
6	0.013309	2.1232E-04	62.69
7	-0.004605	2.3839E-04	-19.32
8	0.001445	2.4668E-04	5.86
9	-0.000557	2.2188E-04	-2.51

$Z = \text{Log}(\text{resistance})$

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 9$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	48651.20	0.26037	0.26039	-0.02
2	33548.50	0.29086	0.29065	0.22
3	26858.60	0.31072	0.31104	-0.32
4	22441.50	0.32931	0.32958	-0.27
5	16305.00	0.36869	0.36750	1.19
6	11575.60	0.41567	0.41711	-1.44
7	8383.600	0.47638	0.47584	0.54
8	6443.600	0.53597	0.53549	0.48
9	4936.020	0.60960	0.60997	-0.36
10	3965.180	0.68491	0.68487	0.04
11	3268.070	0.76469	0.76427	0.42
12	2728.040	0.85123	0.85275	-1.53
13	2314.610	0.94922	0.94838	0.84
14	1999.490	1.04935	1.04861	0.75
15	1765.290	1.14739	1.14756	-0.17
16	1659.887	1.20174	1.20188	-0.13
17	1506.208	1.29582	1.29595	-0.12
18	1362.992	1.40486	1.40486	0.00
19	1165.502	1.60511	1.60544	-0.34
20	1026.200	1.80200	1.80194	0.06
21	922.5449	1.99530	1.99514	0.17
22	837.2509	2.19899	2.19911	-0.12
23	769.6529	2.40227	2.40199	0.28
24	715.0844	2.60250	2.60242	0.07
25	669.3672	2.80371	2.80387	-0.17
26	630.9340	3.00356	3.00377	-0.21
27	597.8655	3.20403	3.20394	0.10
28	569.2104	3.40347	3.40342	0.05

Order of Fit = 9                      RMS error of fit = .55 mK  
Largest absolute error = -1.53 mK at data point no. 12



# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

3.01K to 20.0K  
630.9 Ohms to 194.7 Ohms

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

ZL = 2.26116251242

ZU = 2.85435728

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	9.443615	6.0082E-04	15717.89
1	-9.294343	9.5352E-04	-9747.40
2	3.092775	9.1499E-04	3380.12
3	-0.750414	8.2066E-04	-914.41
4	0.116513	8.0097E-04	145.46
5	-0.001204	7.7056E-04	-1.56
6	-0.006214	7.4877E-04	-8.30

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
24	715.0844	2.60242	2.60073	1.70
25	669.3672	2.80387	2.80640	-2.53
26	630.9340	3.00377	3.00542	-1.65
27	597.8655	3.20403	3.20386	0.17
28	569.2104	3.40347	3.40223	1.24
29	543.7875	3.60544	3.60365	1.79
30	521.0928	3.80958	3.80781	1.77
31	501.4000	4.00751	4.00699	0.52
32	484.1661	4.20084	4.20090	-0.05
33	453.5780	4.59762	4.59931	-1.69
34	428.4391	4.99006	4.99119	-1.13
35	402.0184	5.48244	5.48432	-1.88
36	371.1746	6.19929	6.20066	-1.37
37	344.0399	7.00419	7.00352	0.67
38	317.4655	8.01140	8.01138	0.02
39	296.6481	9.02182	9.01330	8.52
40	279.4123	10.03202	10.03313	-1.11
41	265.2061	11.03741	11.04059	-3.19
42	253.1580	12.03987	12.04200	-2.14
43	242.7629	13.03859	13.03705	1.54
44	233.5300	14.03628	14.04118	-4.91
45	225.4050	15.03476	15.03363	1.13
46	218.0696	16.02768	16.02983	-2.15
47	211.4684	17.02047	17.01825	2.22
48	205.4391	18.01110	18.00624	4.86
49	199.8318	19.00435	19.00609	-1.74
50	194.7023	19.99733	19.99607	1.26
51	189.4247	21.09605	21.09716	-1.11
52	182.4578	22.69189	22.69265	-0.76

Order of Fit = 6                      RMS error of fit = 2.53 mK  
Largest absolute error = 8.52 mK at data point no. 39



# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

20.0K to 95.0K  
194.7 Ohms to 80.62 Ohms

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

ZL = 1.86556292187      ZU = 2.3126830567

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	55.526512	1.3454E-03	41270.14
1	-45.171656	2.1747E-03	-20771.30
2	8.478509	2.0239E-03	4189.12
3	-0.909301	1.8811E-03	-483.38
4	0.074965	1.7313E-03	43.30
5	0.011301	1.7295E-03	6.53

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 5$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
48	205.4391	18.00624	18.01033	-4.09
49	199.8318	19.00609	19.00519	0.90
50	194.7023	19.99607	19.99347	2.60
51	189.4247	21.09605	21.09427	1.78
52	182.4578	22.69189	22.68941	2.48
53	176.2113	24.27644	24.27113	5.31
54	170.5455	25.84411	25.84347	0.64
55	165.2641	27.42295	27.43991	-16.96
56	160.4990	29.00808	28.99979	8.29
57	155.4338	30.79714	30.79544	1.71
58	149.9900	32.88732	32.90104	-13.71
59	143.0530	35.89138	35.88419	7.19
60	136.6076	39.00663	39.00452	2.11
61	131.2923	41.87154	41.87156	-0.03
62	126.2419	44.87729	44.87961	-2.32
63	121.6646	47.87925	47.87867	0.58
64	118.8340	49.88943	49.87877	10.66
65	112.4177	54.88281	54.88216	0.65
66	106.7993	59.87957	59.88403	-4.46
67	101.8130	64.89786	64.90083	-2.97
68	97.37123	69.90513	69.90697	-1.84
69	93.36262	74.92804	74.92904	-1.00
70	89.74094	79.94019	79.93862	1.57
71	86.42970	84.95905	84.96526	-6.20
72	83.40746	89.97621	89.97335	2.86
73	80.61813	94.99946	94.99432	5.14
74	78.03195	100.03293	100.03051	2.42
75	73.37750	110.14633	110.14964	-3.31

Order of Fit = 5            RMS error of fit = 5.70 mK  
Largest absolute error = -16.96 mK at data point no. 55





# POLYNOMIAL EQUATION

Calibration Report: 368401  
 Sensor Model: CX-1030-SD-0.3L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 0.30K to 325K

Sales Order: 69480  
 Serial Number: X16965  
 Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
 Useful Range of Fit:

95.0K to 325.K  
 80.62 Ohms to 35.79 Ohms

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

ZL = 1.54963295307      ZU = 1.93666300242

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	187.501799	3.8185E-03	49103.08
1	-119.476766	5.8148E-03	-20547.14
2	19.392586	5.4941E-03	3529.70
3	-2.956919	5.4911E-03	-538.50
4	0.594382	5.3142E-03	111.85
5	-0.111760	5.0950E-03	-21.94
6	0.026630	4.9635E-03	5.37

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i * \text{COS}(i * \text{ARCCOS}(X))$ , where  $0 \leq i \leq 6$   
 and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
71	86.42970	84.96526	84.96995	-4.69
72	83.40746	89.97335	89.96587	7.48
73	80.61813	94.99432	94.99013	4.19
74	78.03195	100.03293	100.03429	-1.36
75	73.37750	110.14633	110.16711	-20.78
76	69.32402	120.28632	120.28110	5.22
77	65.74652	130.44680	130.40937	37.43
78	62.64338	140.25799	140.28623	-28.24
79	59.90018	150.01658	150.01744	-0.86
80	57.34179	160.08304	160.08623	-3.19
81	55.04587	170.06090	170.07444	-13.54
82	52.96679	180.03704	180.02180	15.24
83	51.06328	190.01438	189.99776	16.62
84	49.31835	199.99406	199.98111	12.94
85	47.70101	210.02501	210.05534	-30.33
86	46.22540	220.03053	220.03351	-2.98
87	44.85948	230.03334	230.03183	1.51
88	43.59455	240.01433	240.03233	-18.00
89	42.42290	250.03031	250.01531	15.01
90	41.33024	260.04721	260.02924	17.98
91	40.31233	270.04609	270.04602	0.07
92	39.36688	280.03616	280.01664	19.52
93	38.47924	290.00507	290.03136	-26.28
94	37.64826	300.01687	300.04668	-29.80
95	36.87409	310.00490	309.99590	9.00
96	36.50297	315.01468	314.99601	18.66
97	36.14128	320.03257	320.02286	9.70
98	35.72045	326.07067	326.07298	-2.31
99	35.45136	330.05264	330.06084	-8.21

Order of Fit = 6                      RMS error of fit = 16.59 mK  
Largest absolute error = 37.43 mK at data point no. 77



# INTERPOLATION TABLE

Calibration Report: 368401  
 Sensor Model: CX-1030-SD-0.3L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 0.30K to 325K

Sales Order: 69480  
 Serial Number: X16965  
 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	30198.1	-3.3116e+5	-3.2899	4.600	453.530	-69.785	-0.70781
0.3200	24565.8	-2.3805e+5	-3.1009	4.800	440.175	-63.900	-0.69681
0.3400	20437.3	-1.7899e+5	-2.9777	5.000	427.920	-58.760	-0.68658
0.3600	17291.7	-1.3784e+5	-2.8698	5.200	416.629	-54.241	-0.67698
0.3800	14847.9	-1.0806e+5	-2.7657	5.400	406.189	-50.241	-0.66792
0.4000	12918.1	-85992.	-2.6627	5.600	396.502	-46.701	-0.65958
0.4200	11371.6	-69430.	-2.5643	5.800	387.485	-43.521	-0.65143
0.4400	10114.7	-56816.	-2.4715	6.000	379.072	-40.664	-0.64364
0.4600	9079.75	-47098.	-2.3861	6.500	360.288	-34.719	-0.62636
0.4800	8216.28	-39562.	-2.3112	7.000	344.145	-30.039	-0.61101
0.5000	7486.99	-33587.	-2.2430	7.500	330.093	-26.299	-0.59753
0.5500	6088.78	-23241.	-2.0994	8.000	317.730	-23.260	-0.58565
0.6000	5098.88	-16834.	-1.9809	8.500	306.742	-20.765	-0.57541
0.6500	4368.30	-12659.	-1.8836	9.000	296.896	-18.683	-0.56634
0.7000	3811.31	-9794.1	-1.7988	9.500	288.004	-16.931	-0.55847
0.7500	3375.33	-7756.0	-1.7234	10.00	279.922	-15.438	-0.55152
0.8000	3026.49	-6270.4	-1.6575	10.50	272.530	-14.160	-0.54554
0.8500	2742.16	-5155.3	-1.5980	11.00	265.734	-13.051	-0.54025
0.9000	2506.58	-4303.3	-1.5451	11.50	259.455	-12.086	-0.53570
0.9500	2308.71	-3638.8	-1.4973	12.00	253.629	-11.238	-0.53169
1.000	2140.41	-3112.6	-1.4542	12.50	248.201	-10.489	-0.52825
1.050	1995.74	-2689.4	-1.4150	13.00	243.126	-9.8230	-0.52524
1.100	1870.16	-2344.8	-1.3792	13.50	238.366	-9.2287	-0.52267
1.150	1760.25	-2060.7	-1.3463	14.00	233.887	-8.6947	-0.52045
1.200	1663.30	-1824.3	-1.3162	14.50	229.662	-8.2136	-0.51858
1.300	1500.28	-1456.4	-1.2619	15.00	225.666	-7.7777	-0.51698
1.400	1368.74	-1187.9	-1.2150	15.50	221.878	-7.3817	-0.51567
1.500	1260.49	-985.94	-1.1733	16.00	218.279	-7.0200	-0.51457
1.600	1170.00	-830.53	-1.1358	16.50	214.853	-6.6892	-0.51371
1.700	1093.25	-709.07	-1.1026	17.00	211.585	-6.3861	-0.51310
1.800	1027.38	-611.90	-1.0721	17.50	208.463	-6.1062	-0.51260
1.900	970.253	-533.28	-1.0443	18.00	205.476	-5.8451	-0.51204
2.000	920.258	-468.77	-1.0188	18.50	202.614	-5.6066	-0.51192
2.100	876.135	-415.25	-0.99530	19.00	199.865	-5.3942	-0.51280
2.200	836.919	-370.40	-0.97368	19.50	197.217	-5.1949	-0.51365
2.300	801.826	-332.44	-0.95360	20.00	194.670	-4.9957	-0.51325
2.400	770.249	-299.93	-0.93455	21.00	189.860	-4.6356	-0.51273
2.500	741.682	-272.13	-0.91729	22.00	185.379	-4.3328	-0.51420
2.600	715.686	-248.44	-0.90254	23.00	181.183	-4.0644	-0.51595
2.700	691.907	-227.36	-0.88722	24.00	177.240	-3.8258	-0.51805
2.800	670.170	-207.59	-0.86732	25.00	173.523	-3.6128	-0.52051
2.900	650.297	-190.64	-0.85014	26.00	170.008	-3.4205	-0.52311
3.000	631.897	-178.05	-0.84531	27.00	166.676	-3.2458	-0.52580
3.100	614.623	-167.30	-0.84380	28.00	163.511	-3.0866	-0.52856
3.200	598.466	-155.73	-0.83266	29.00	160.498	-2.9406	-0.53133
3.300	583.467	-144.51	-0.81735	30.00	157.626	-2.8062	-0.53408
3.400	569.511	-134.86	-0.80512	31.00	154.883	-2.6820	-0.53681
3.500	556.457	-126.33	-0.79462	32.00	152.259	-2.5669	-0.53949
3.600	544.220	-118.53	-0.78408	33.00	149.746	-2.4600	-0.54213
3.700	532.728	-111.43	-0.77392	34.00	147.336	-2.3604	-0.54469
3.800	521.911	-105.02	-0.76461	35.00	145.023	-2.2672	-0.54716
3.900	511.705	-99.197	-0.75603	36.00	142.800	-2.1801	-0.54961
4.000	502.055	-93.873	-0.74791	37.00	140.661	-2.0984	-0.55198
4.200	484.242	-84.529	-0.73315	38.00	138.601	-2.0216	-0.55426
4.400	468.150	-76.592	-0.71986	39.00	136.616	-1.9494	-0.55648



# INTERPOLATION TABLE

Calibration Report: 368401  
 Sensor Model: CX-1030-SD-0.3L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 0.30K to 325K

Sales Order: 69480  
 Serial Number: X16965  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
40.00	134.701	-1.8813	-0.55865	180.0	52.9711	-0.19956	-0.67812
42.00	131.066	-1.7562	-0.56277	185.0	51.9956	-0.19074	-0.67863
44.00	127.668	-1.6441	-0.56665	190.0	51.0629	-0.18246	-0.67892
46.00	124.482	-1.5434	-0.57032	195.0	50.1702	-0.17469	-0.67898
48.00	121.488	-1.4522	-0.57377	200.0	49.3152	-0.16738	-0.67883
50.00	118.668	-1.3696	-0.57707	205.0	48.4957	-0.16050	-0.67847
52.00	116.005	-1.2943	-0.58018	210.0	47.7095	-0.15401	-0.67790
54.00	113.486	-1.2255	-0.58312	215.0	46.9549	-0.14788	-0.67713
56.00	111.099	-1.1626	-0.58600	220.0	46.2302	-0.14209	-0.67616
58.00	108.833	-1.1047	-0.58872	225.0	45.5336	-0.13660	-0.67501
60.00	106.677	-1.0514	-0.59135	230.0	44.8637	-0.13140	-0.67366
65.00	101.720	-0.93513	-0.59755	235.0	44.2191	-0.12648	-0.67215
70.00	97.2931	-0.83858	-0.60334	240.0	43.5985	-0.12180	-0.67046
75.00	93.3088	-0.75741	-0.60879	245.0	43.0007	-0.11735	-0.66861
77.35	91.5691	-0.72365	-0.61128	250.0	42.4246	-0.11312	-0.66661
80.00	89.6987	-0.68850	-0.61406	255.0	41.8692	-0.10910	-0.66446
85.00	86.4078	-0.62922	-0.61897	260.0	41.3333	-0.10527	-0.66217
90.00	83.3920	-0.57859	-0.62444	265.0	40.8162	-0.10162	-0.65976
95.00	80.6129	-0.53345	-0.62865	270.0	40.3168	-9.8138e-2	-0.65723
100.0	78.0489	-0.49348	-0.63227	273.15	40.0110	-9.6029e-2	-0.65558
105.0	75.6683	-0.45938	-0.63745	275.0	39.8345	-9.4819e-2	-0.65459
110.0	73.4491	-0.42888	-0.64230	280.0	39.3684	-9.1650e-2	-0.65184
115.0	71.3743	-0.40149	-0.64689	285.0	38.9178	-8.8625e-2	-0.64901
120.0	69.4297	-0.37677	-0.65120	290.0	38.4819	-8.5735e-2	-0.64610
125.0	67.6028	-0.35436	-0.65523	295.0	38.0602	-8.2972e-2	-0.64311
130.0	65.8829	-0.33390	-0.65885	300.0	37.6520	-8.0331e-2	-0.64005
135.0	64.2608	-0.31518	-0.66213	305.0	37.2567	-7.7804e-2	-0.63694
140.0	62.7285	-0.29799	-0.66506	310.0	36.8738	-7.5387e-2	-0.63378
145.0	61.2787	-0.28217	-0.66767	315.0	36.5027	-7.3072e-2	-0.63058
150.0	59.9048	-0.26756	-0.66997	320.0	36.1429	-7.0856e-2	-0.62734
155.0	58.6012	-0.25406	-0.67199	325.0	35.7940	-6.8733e-2	-0.62408
160.0	57.3626	-0.24154	-0.67372				
165.0	56.1843	-0.22991	-0.67519				
170.0	55.0622	-0.21909	-0.67641				
175.0	53.9923	-0.20899	-0.67739				



# THERMAL CYCLE TESTING

Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor

Serial Number: X16965

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Room Temperature:	37.2 $\Omega$
Liquid Nitrogen:	91.6 $\Omega$
Liquid Helium:	483 $\Omega$

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip test values should not be made.

## Recommended Operating Parameters:

For sensors calibrated by LSCI the current to the sensor is adjusted to maintain the sensor output voltage at the values listed below. In order to minimize possible self-heating errors, we suggest that these same guidelines be followed in using the sensor:

Above 1K:	1 to 3 mV
0.1 to 1K:	0.1 mV
Below 0.1K:	0.03 mV

## Lead Identification:

NONE

To avoid possible damage to the sensor, do not exceed 1 Volt and do not exceed 100 mA current.



# BREAKPOINTS 340 FORMAT

Calibration Report: 368401  
Sensor Model: CX-1030-SD-0.3L  
Sensor Type: Cernox Resistor  
Temperature Range: 0.30K to 325K

Sales Order: 69480  
Serial Number: X16965

Name: CX-1030-SD-0.3L  
Serial number: X16965  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.

Coefficient: 1 ;Negative

Point 1: 1.55380,325.000	Point 56: 1.95277, 80.000	Point 111: 2.48093, 8.700
Point 2: 1.55887,319.000	Point 57: 1.96122, 77.500	Point 112: 2.49269, 8.300
Point 3: 1.56362,313.500	Point 58: 1.96991, 75.000	Point 113: 2.50520, 7.900
Point 4: 1.56849,308.000	Point 59: 1.97885, 72.500	Point 114: 2.51687, 7.550
Point 5: 1.57348,302.500	Point 60: 1.98621, 70.500	Point 115: 2.52924, 7.200
Point 6: 1.57858,297.000	Point 61: 1.99374, 68.500	Point 116: 2.54245, 6.850
Point 7: 1.58380,291.500	Point 62: 2.00147, 66.500	Point 117: 2.55658, 6.500
Point 8: 1.58915,286.000	Point 63: 2.00940, 64.500	Point 118: 2.57177, 6.150
Point 9: 1.59413,281.000	Point 64: 2.01755, 62.500	Point 119: 2.58719, 5.820
Point 10: 1.59922,276.000	Point 65: 2.02592, 60.500	Point 120: 2.60332, 5.500
Point 11: 1.60442,271.000	Point 66: 2.03411, 58.600	Point 121: 2.61965, 5.200
Point 12: 1.60974,266.000	Point 67: 2.04297, 56.600	Point 122: 2.63729, 4.900
Point 13: 1.61519,261.000	Point 68: 2.05212, 54.600	Point 123: 2.65516, 4.620
Point 14: 1.62076,256.000	Point 69: 2.06156, 52.600	Point 124: 2.67455, 4.340
Point 15: 1.62645,251.000	Point 70: 2.07033, 50.800	Point 125: 2.69422, 4.080
Point 16: 1.63228,246.000	Point 71: 2.07937, 49.000	Point 126: 2.71063, 3.880
Point 17: 1.63825,241.000	Point 72: 2.08869, 47.200	Point 127: 2.72642, 3.700
Point 18: 1.64436,236.000	Point 73: 2.09833, 45.400	Point 128: 2.74241, 3.530
Point 19: 1.65061,231.000	Point 74: 2.10830, 43.600	Point 129: 2.75955, 3.360
Point 20: 1.65702,226.000	Point 75: 2.11863, 41.800	Point 130: 2.77693, 3.200
Point 21: 1.66358,221.000	Point 76: 2.12934, 40.000	Point 131: 2.79688, 3.030
Point 22: 1.67030,216.000	Point 77: 2.13984, 38.300	Point 132: 2.81813, 2.860
Point 23: 1.67719,211.000	Point 78: 2.15010, 36.700	Point 133: 2.83709, 2.720
Point 24: 1.68426,206.000	Point 79: 2.16073, 35.100	Point 134: 2.85913, 2.570
Point 25: 1.69150,201.000	Point 80: 2.17178, 33.500	Point 135: 2.88147, 2.430
Point 26: 1.69892,196.000	Point 81: 2.18255, 32.000	Point 136: 2.90571, 2.290
Point 27: 1.70654,191.000	Point 82: 2.19375, 30.500	Point 137: 2.93226, 2.150
Point 28: 1.71436,186.000	Point 83: 2.20543, 29.000	Point 138: 2.95933, 2.020
Point 29: 1.72239,181.000	Point 84: 2.21681, 27.600	Point 139: 2.98670, 1.900
Point 30: 1.72981,176.500	Point 85: 2.22783, 26.300	Point 140: 3.01671, 1.780
Point 31: 1.73740,172.000	Point 86: 2.23932, 25.000	Point 141: 3.04991, 1.660
Point 32: 1.74519,167.500	Point 87: 2.25135, 23.700	Point 142: 3.08372, 1.550
Point 33: 1.75317,163.000	Point 88: 2.26300, 22.500	Point 143: 3.12121, 1.440
Point 34: 1.76137,158.500	Point 89: 2.27522, 21.300	Point 144: 3.16334, 1.330
Point 35: 1.76978,154.000	Point 90: 2.28704, 20.200	Point 145: 3.20657, 1.230
Point 36: 1.77842,149.500	Point 91: 2.29607, 19.400	Point 146: 3.25280, 1.135
Point 37: 1.78729,145.000	Point 92: 2.30426, 18.700	Point 147: 3.30253, 1.045
Point 38: 1.79642,140.500	Point 93: 2.31212, 18.050	Point 148: 3.35600, 0.960
Point 39: 1.80580,136.000	Point 94: 2.32028, 17.400	Point 149: 3.41737, 0.875
Point 40: 1.81547,131.500	Point 95: 2.32876, 16.750	Point 150: 3.48463, 0.795
Point 41: 1.82542,127.000	Point 96: 2.33690, 16.150	Point 151: 3.55830, 0.720
Point 42: 1.83453,123.000	Point 97: 2.34537, 15.550	Point 152: 3.63923, 0.650
Point 43: 1.84389,119.000	Point 98: 2.35419, 14.950	Point 153: 3.72821, 0.585
Point 44: 1.85352,115.000	Point 99: 2.36262, 14.400	Point 154: 3.83483, 0.520
Point 45: 1.86344,111.000	Point 100: 2.37141, 13.850	Point 155: 3.95587, 0.460
Point 46: 1.87366,107.000	Point 101: 2.38060, 13.300	Point 156: 4.09151, 0.406
Point 47: 1.88420,103.000	Point 102: 2.38934, 12.800	Point 157: 4.25554, 0.354
Point 48: 1.89236,100.000	Point 103: 2.39847, 12.300	Point 158: 4.44766, 0.306
Point 49: 1.89930, 97.500	Point 104: 2.40805, 11.800	Point 159: 4.48112, 0.300
Point 50: 1.90639, 95.000	Point 105: 2.41811, 11.300	
Point 51: 1.91367, 92.500	Point 106: 2.42764, 10.850	
Point 52: 1.92111, 90.000	Point 107: 2.43764, 10.400	
Point 53: 1.92873, 87.500	Point 108: 2.44820, 9.950	
Point 54: 1.93654, 85.000	Point 109: 2.45935, 9.500	
Point 55: 1.94455, 82.500	Point 110: 2.46985, 9.100	



# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 368401  
 Sensor Model: CX-1030-SD-0.3L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 0.30K to 325K

Sales Order: 69480  
 Serial Number: X16965

Interpolation Method: Lagrangian  
 Limit: 325. (Kelvin)  
 Format: 4 (Log Ohms/Kelvin)  
 Number of Breakpoints: 56

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.55381	325.0	31	2.45436	9.7
2	1.55465	324.0	32	2.49890	8.1
3	1.56146	316.0	33	2.54057	6.9
4	1.57486	301.0	34	2.58343	5.9
5	1.58916	286.0	35	2.62548	5.1
6	1.60443	271.0	36	2.67038	4.4
7	1.62077	256.0	37	2.73577	3.6
8	1.63826	241.0	38	2.77704	3.2
9	1.65703	226.0	39	2.80065	3.0
10	1.67721	211.0	40	2.82619	2.8
11	1.69894	196.0	41	2.87022	2.5
12	1.72241	181.0	42	2.94257	2.1
13	1.74784	166.0	43	2.98688	1.9
14	1.77553	151.0	44	3.03872	1.7
15	1.80582	136.0	45	3.10054	1.5
16	1.83920	121.0	46	3.13632	1.4
17	1.87629	106.0	47	3.17617	1.3
18	1.91813	91.0	48	3.22097	1.2
19	1.96642	76.0	49	3.27188	1.1
20	2.01550	63.0	50	3.33050	1.0
21	2.04345	56.5	51	3.39908	.9
22	2.07433	50.0	52	3.48094	.8
23	2.10054	45.0	53	3.58107	.7
24	2.12937	40.0	54	3.70747	.6
25	2.16144	35.0	55	4.11120	.4
26	2.19763	30.0	56	4.47998	.3
27	2.23936	25.0			
28	2.27738	21.1			
29	2.33762	16.1			
30	2.40420	12.0			

### Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	66.873
1000	1.846
10000	0.439



# BREAKPOINTS 234 FORMAT

Calibration Report: 368401  
 Sensor Model: CX-1030-SD-0.3L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 0.30K to 325K

Sales Order: 69480  
 Serial Number: X16965

Maximum Temperature Error:

1.4 - 10K: 0.006K  
 10 - 20K: 0.013K  
 20 - 40K: 0.018K  
 40 - 100K: 0.034K  
 > 100K: 0.152K

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	317.690	36.30781	1.560	56	4.549	457.0882	2.660
2	295.490	38.01894	1.580	57	4.268	478.6301	2.680
3	275.255	39.81072	1.600	58	4.009	501.1872	2.700
4	256.686	41.68694	1.620	59	3.773	524.8075	2.720
5	239.564	43.65158	1.640	60	3.556	549.5409	2.740
6	223.730	45.70882	1.660	61	3.357	575.4399	2.760
7	209.005	47.86301	1.680	62	3.174	602.5596	2.780
8	195.300	50.11872	1.700	63	3.005	630.9573	2.800
9	182.487	52.48075	1.720	64	2.847	660.6934	2.820
10	170.494	54.95409	1.740	65	2.701	691.8310	2.840
11	159.253	57.54399	1.760	66	2.565	724.4360	2.860
12	148.696	60.25596	1.780	67	2.440	758.5776	2.880
13	138.772	63.09573	1.800	68	2.323	794.3282	2.900
14	129.449	66.06934	1.820	69	2.214	831.7638	2.920
15	120.658	69.18310	1.840	70	2.112	870.9636	2.940
16	112.377	72.44360	1.860	71	2.018	912.0108	2.960
17	104.586	75.85776	1.880	72	1.929	954.9926	2.980
18	97.254	79.43282	1.900	73	1.846	1000.000	3.000
19	90.374	83.17638	1.920	74	1.695	1096.478	3.040
20	83.915	87.09636	1.940	75	1.562	1202.264	3.080
21	77.862	91.20108	1.960	76	1.444	1318.257	3.120
22	72.188	95.49926	1.980	77	1.339	1445.440	3.160
23	66.879	100.0000	2.000	78	1.245	1584.893	3.200
24	61.911	104.7129	2.020	79	1.161	1737.801	3.240
25	57.267	109.6478	2.040	80	1.085	1905.461	3.280
26	52.934	114.8154	2.060	81	1.017	2089.296	3.320
27	48.880	120.2264	2.080	82	0.955	2290.868	3.360
28	45.099	125.8925	2.100	83	0.899	2511.886	3.400
29	41.571	131.8257	2.120	84	0.848	2754.229	3.440
30	38.281	138.0384	2.140	85	0.801	3019.952	3.480
31	35.213	144.5440	2.160	86	0.759	3311.311	3.520
32	32.352	151.3561	2.180	87	0.720	3630.781	3.560
33	29.700	158.4893	2.200	88	0.683	3981.072	3.600
34	27.220	165.9587	2.220	89	0.650	4365.158	3.640
35	24.932	173.7801	2.240	90	0.620	4786.301	3.680
36	22.808	181.9701	2.260	91	0.591	5248.075	3.720
37	20.853	190.5461	2.280	92	0.565	5754.399	3.760
38	19.063	199.5262	2.300	93	0.541	6309.573	3.800
39	17.425	208.9296	2.320	94	0.518	6918.310	3.840
40	15.929	218.7762	2.340	95	0.497	7585.776	3.880
41	14.570	229.0868	2.360	96	0.478	8317.638	3.920
42	13.337	239.8833	2.380	97	0.459	9120.108	3.960
43	12.221	251.1886	2.400	98	0.442	10000.00	4.000
44	11.211	263.0268	2.420	99	0.404	12589.25	4.100
45	10.298	275.4229	2.440	100	0.371	15848.93	4.200
46	9.477	288.4032	2.460	101	0.343	19952.62	4.300
47	8.736	301.9952	2.480	102	0.318	25118.86	4.400
48	8.065	316.2278	2.500	103	0.296	31622.78	4.500
49	7.460	331.1311	2.520	104	0.277	39810.72	4.600
50	6.915	346.7369	2.540				
51	6.421	363.0781	2.560				
52	5.972	380.1894	2.580				
53	5.566	398.1072	2.600				
54	5.196	416.8694	2.620				
55	4.858	436.5158	2.640				

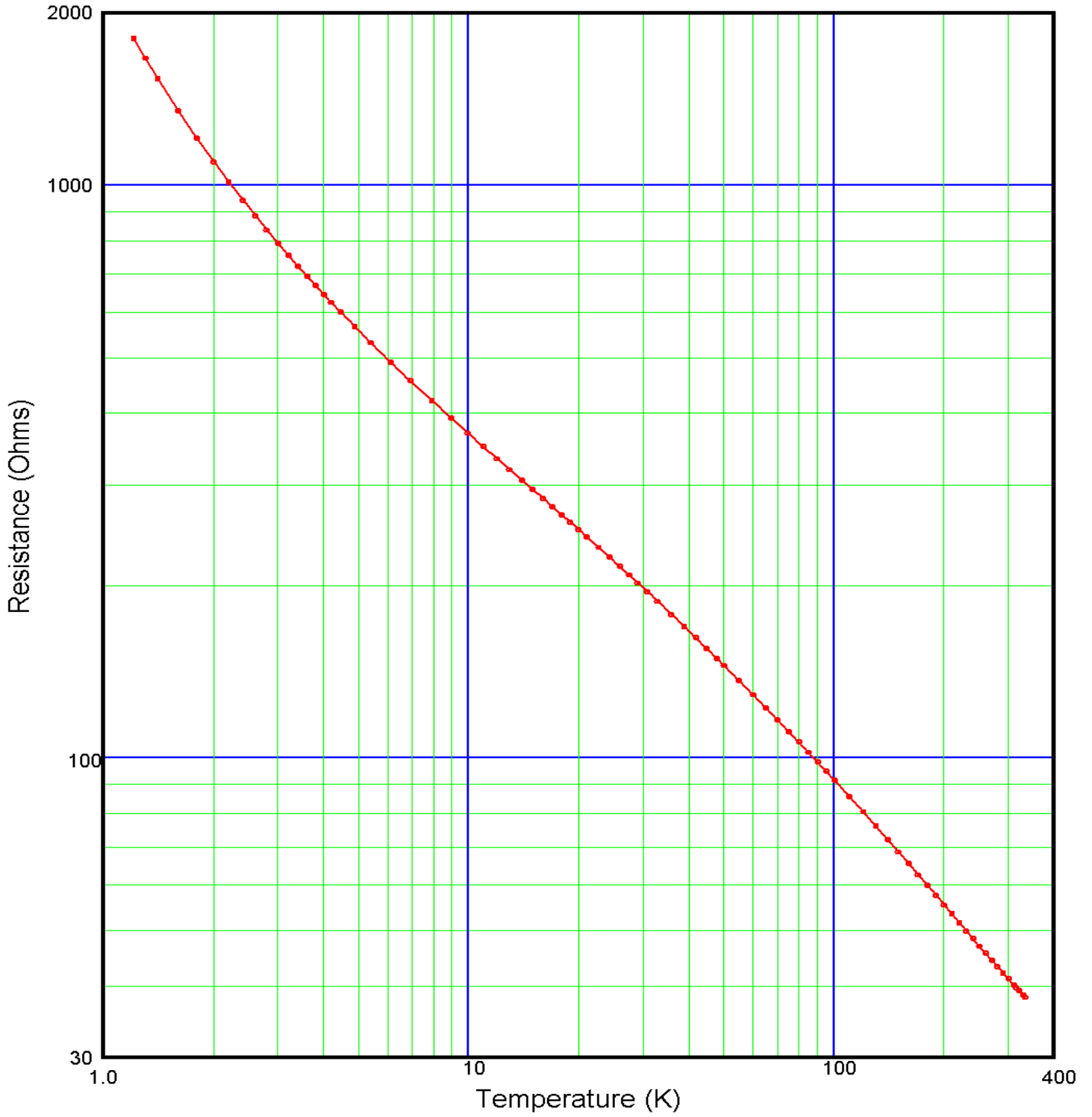




# DATA PLOT

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%



# TEST DATA

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

Index	Temperature (K)	Resistance (Ω)	Index	Temperature (K)	Resistance (Ω)
1	1.21025	1805.97	46	41.8110	162.258
2	1.30277	1667.65	47	44.8232	155.395
3	1.40788	1537.05	48	47.8487	149.159
4	1.60350	1349.19	49	49.8793	145.275
5	1.80033	1209.64	50	54.9432	136.610
6	2.00108	1100.35	51	59.9957	129.096
7	2.20059	1014.46	52	65.0342	122.500
8	2.40463	942.521	53	70.0656	116.647
9	2.60217	884.699	54	75.0922	111.407
10	2.80100	835.477	55	80.1099	106.693
11	3.00131	792.908	56	85.1204	102.416
12	3.20269	755.638	57	90.1342	98.5061
13	3.40153	723.500	58	95.1402	94.9341
14	3.60550	694.083	59	100.148	91.6229
15	3.80087	668.986	60	110.245	85.6880
16	4.00549	645.368	61	120.137	80.6293
17	4.19750	625.185	62	130.151	76.1308
18	4.45779	600.842	63	140.121	72.1678
19	4.86791	567.176	64	150.105	68.6264
20	5.38484	531.806	65	160.095	65.4485
21	6.10791	491.762	66	170.074	62.5760
22	6.90984	456.371	67	180.063	59.9787
23	7.92383	421.074	68	190.043	57.6147
24	8.93736	392.815	69	200.041	55.4498
25	9.94844	369.587	70	210.033	53.4717
26	10.9504	350.140	71	220.035	51.6456
27	11.9515	333.415	72	230.032	49.9685
28	12.9520	318.829	73	240.052	48.4142
29	13.9561	305.954	74	250.053	46.9799
30	14.9447	294.550	75	260.060	45.6446
31	15.9446	284.192	76	270.061	44.4106
32	16.9389	274.810	77	280.045	43.2583
33	17.9358	266.209	78	290.074	42.1789
34	18.9350	258.250	79	299.996	41.1800
35	19.9374	250.895	80	309.979	40.2397
36	21.0459	243.371	81	314.934	39.7968
37	22.6675	233.344	82	321.203	39.2573
38	24.2935	224.287	83	328.711	38.6318
39	25.8798	216.231	84	333.694	38.2369
40	27.4612	208.957			
41	29.0395	202.219			
42	30.8146	195.267			
43	32.8799	187.843			
44	35.8445	178.309			
45	38.8186	169.836			



# POLYNOMIAL EQUATION

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

1.40K to 14.0K  
1546. Ohms to 306.0 Ohms

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

ZL = 2.45361128209      ZU = 3.25670936294

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.850994	3.4326E-04	17045.58
1	-6.596962	5.5005E-04	-11993.31
2	2.565313	4.8175E-04	5325.02
3	-0.749575	4.8790E-04	-1536.35
4	0.162683	4.5156E-04	360.27
5	-0.022024	4.4207E-04	-49.82

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 5$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	1805.965	1.21025	1.21043	-0.17
2	1667.653	1.30277	1.30296	-0.19
3	1537.050	1.40788	1.40764	0.24
4	1349.188	1.60350	1.60296	0.53
5	1209.643	1.80033	1.79994	0.38
6	1100.351	2.00108	2.00104	0.04
7	1014.457	2.20059	2.20022	0.37
8	942.5206	2.40463	2.40518	-0.56
9	884.6989	2.60217	2.60327	-1.10
10	835.4768	2.80100	2.80205	-1.06
11	792.9077	3.00131	3.00205	-0.74
12	755.6379	3.20269	3.20355	-0.85
13	723.4998	3.40153	3.40130	0.24
14	694.0829	3.60550	3.60561	-0.11
15	668.9862	3.80087	3.80069	0.18
16	645.3680	4.00549	4.00466	0.82
17	625.1846	4.19750	4.19703	0.48
18	600.8416	4.45779	4.45466	3.13
19	567.1755	4.86791	4.86596	1.95
20	531.8055	5.38484	5.38373	1.12
21	491.7616	6.10791	6.10874	-0.83
22	456.3714	6.90984	6.91370	-3.86
23	421.0736	7.92383	7.92585	-2.01
24	392.8149	8.93736	8.93852	-1.16
25	369.5872	9.94844	9.94817	0.28
26	350.1397	10.95045	10.94947	0.97
27	333.4150	11.95151	11.95076	0.75
28	318.8287	12.95195	12.95160	0.35
29	305.9539	13.95613	13.95201	4.12
30	294.5502	14.94471	14.94507	-0.36
31	284.1916	15.94461	15.94755	-2.95

Order of Fit = 5                      RMS error of fit = 1.49 mK  
Largest absolute error = 4.12 mK at data point no. 29



# POLYNOMIAL EQUATION

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

13.9K to 80.1K  
306.0 Ohms to 106.7 Ohms

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

ZL = 1.99346330322      ZU = 2.52298511433

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	42.872239	1.2785E-03	33532.47
1	-38.130073	2.0819E-03	-18314.63
2	8.078921	1.9015E-03	4248.82
3	-0.963083	1.7940E-03	-536.82
4	0.098069	1.6799E-03	58.38
5	0.002670	1.6112E-03	1.66

Z = Log(resistance)

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 5$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	333.4150	11.95076	11.95874	-7.99
28	318.8287	12.95160	12.94888	2.72
29	305.9539	13.95201	13.94606	5.95
30	294.5502	14.94471	14.93826	6.45
31	284.1916	15.94461	15.93909	5.51
32	274.8099	16.93891	16.93682	2.10
33	266.2088	17.93584	17.93617	-0.33
34	258.2496	18.93497	18.94071	-5.73
35	250.8946	19.93740	19.94404	-6.64
36	243.3711	21.04587	21.05248	-6.61
37	233.3438	22.66755	22.67379	-6.24
38	224.2871	24.29351	24.29793	-4.42
39	216.2309	25.87978	25.88766	-7.87
40	208.9568	27.46120	27.45545	5.75
41	202.2185	29.03950	29.03342	6.08
42	195.2675	30.81457	30.80300	11.57
43	187.8426	32.87992	32.87212	7.80
44	178.3091	35.84455	35.84047	4.08
45	169.8361	38.81864	38.82188	-3.24
46	162.2582	41.81103	41.81012	0.92
47	155.3946	44.82323	44.82195	1.28
48	149.1594	47.84870	47.84820	0.51
49	145.2747	49.87931	49.89141	-12.10
50	136.6102	54.94325	54.95102	-7.77
51	129.0957	59.99568	59.99678	-1.10
52	122.5002	65.03420	65.03122	2.98
53	116.6468	70.06564	70.06171	3.93
54	111.4073	75.09221	75.08992	2.29
55	106.6925	80.10993	80.10623	3.70
56	102.4162	85.12036	85.11843	1.94
57	98.50614	90.13421	90.13972	-5.51

Order of Fit = 5                      RMS error of fit = 5.69 mK  
Largest absolute error = -12.10 mK at data point no. 49



# POLYNOMIAL EQUATION

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

Polynomial Type: Chebychev  
Useful Range of Fit:

80.1K to 325.K  
106.7 Ohms to 38.94 Ohms

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

ZL = 1.58248266937      ZU = 2.06687264606

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	178.009234	2.1578E-03	82496.30
1	-127.991443	3.3383E-03	-38340.07
2	23.022216	3.2159E-03	7158.93
3	-3.638882	3.0540E-03	-1191.52
4	0.806566	2.8996E-03	278.16
5	-0.172589	2.8934E-03	-59.65
6	0.035054	2.8538E-03	12.28
7	-0.009676	2.7491E-03	-3.52

$Z = \text{Log}(\text{resistance})$

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$ , where  $0 \leq i \leq 7$   
and the  $A_i$ 's are the coefficients in the table above.



# POLYNOMIAL EQUATION

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347  
Sensor Excitation: 2mV±50%

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	116.6468	70.06171	70.06048	1.23
54	111.4073	75.08992	75.09192	-2.00
55	106.6925	80.10623	80.10762	-1.39
56	102.4162	85.12036	85.11831	2.06
57	98.50614	90.13421	90.13674	-2.53
58	94.93414	95.14016	95.13198	8.19
59	91.62285	100.14802	100.15439	-6.38
60	85.68802	110.24521	110.24138	3.83
61	80.62930	120.13699	120.13833	-1.33
62	76.13084	130.15075	130.15641	-5.66
63	72.16777	140.12124	140.12193	-0.69
64	68.62642	150.10501	150.10348	1.52
65	65.44851	160.09476	160.08391	10.84
66	62.57601	170.07442	170.08416	-9.73
67	59.97873	180.06334	180.06135	1.99
68	57.61471	190.04263	190.03969	2.94
69	55.44984	200.04074	200.04489	-4.15
70	53.47172	210.03349	210.02196	11.53
71	51.64556	220.03471	220.04470	-9.99
72	49.96850	230.03231	230.03428	-1.97
73	48.41415	240.05156	240.05780	-6.23
74	46.97992	250.05349	250.04834	5.15
75	45.64457	260.05956	260.07483	-15.27
76	44.41063	270.06109	270.04156	19.53
77	43.25835	280.04463	280.03410	10.54
78	42.17886	290.07352	290.06954	3.97
79	41.17997	299.99573	300.00645	-10.73
80	40.23973	309.97946	309.99791	-18.46
81	39.79685	314.93433	314.93866	-4.33
82	39.25731	321.20295	321.17637	26.58
83	38.63180	328.71149	328.72867	-17.18
84	38.23690	333.69379	333.68566	8.13

Order of Fit = 7      RMS error of fit = 9.69 mK  
Largest absolute error = 26.58 mK at data point no. 82





# INTERPOLATION TABLE

Calibration Report: 405217  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 7819  
 Serial Number: X25347  
 Sensor Excitation: 2mV±50%

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
1.400	1545.76	-1148.7	-1.0404	15.50	288.610	-10.281	-0.55214
1.500	1440.50	-963.99	-1.0038	16.00	283.593	-9.7922	-0.55246
1.600	1351.61	-819.88	-0.97055	16.50	278.811	-9.3430	-0.55292
1.700	1275.51	-706.24	-0.94128	17.00	274.244	-8.9331	-0.55375
1.800	1209.61	-615.33	-0.91566	17.50	269.873	-8.5556	-0.55479
1.900	1151.88	-541.62	-0.89340	18.00	265.684	-8.2058	-0.55594
2.000	1100.85	-480.86	-0.87362	18.50	261.663	-7.8807	-0.55718
2.100	1055.37	-430.24	-0.85610	19.00	257.799	-7.5783	-0.55852
2.200	1014.54	-387.46	-0.84019	19.50	254.081	-7.2959	-0.55994
2.300	977.665	-351.01	-0.82576	20.00	250.500	-7.0316	-0.56140
2.400	944.173	-319.61	-0.81242	21.00	243.714	-6.5506	-0.56444
2.500	913.603	-292.41	-0.80016	22.00	237.381	-6.1239	-0.56756
2.600	885.577	-268.63	-0.78870	23.00	231.451	-5.7432	-0.57072
2.700	859.779	-247.75	-0.77801	24.00	225.882	-5.4008	-0.57384
2.800	835.947	-229.28	-0.76796	25.00	220.638	-5.0919	-0.57695
2.900	813.855	-212.87	-0.75852	26.00	215.689	-4.8115	-0.58000
3.000	793.315	-198.22	-0.74960	27.00	211.007	-4.5560	-0.58297
3.100	774.160	-185.09	-0.74118	28.00	206.569	-4.3224	-0.58589
3.200	756.252	-173.28	-0.73320	29.00	202.356	-4.1079	-0.58872
3.300	739.467	-162.60	-0.72565	30.00	198.348	-3.9105	-0.59147
3.400	723.698	-152.93	-0.71848	31.00	194.530	-3.7283	-0.59414
3.500	708.851	-144.13	-0.71167	32.00	190.887	-3.5596	-0.59673
3.600	694.845	-136.11	-0.70519	33.00	187.406	-3.4032	-0.59927
3.700	681.606	-128.78	-0.69904	34.00	184.077	-3.2577	-0.60171
3.800	669.070	-122.05	-0.69318	35.00	180.888	-3.1219	-0.60406
3.900	657.179	-115.86	-0.68759	36.00	177.830	-2.9953	-0.60638
4.000	645.881	-110.17	-0.68226	37.00	174.894	-2.8769	-0.60862
4.200	624.887	-100.03	-0.67235	38.00	172.074	-2.7658	-0.61078
4.400	605.773	-91.320	-0.66330	39.00	169.360	-2.6616	-0.61291
4.600	588.281	-83.775	-0.65507	40.00	166.748	-2.5636	-0.61497
4.800	572.200	-77.180	-0.64744	42.00	161.804	-2.3844	-0.61892
5.000	557.354	-71.407	-0.64059	44.00	157.198	-2.2246	-0.62266
5.200	543.594	-66.291	-0.63414	46.00	152.894	-2.0815	-0.62626
5.400	530.798	-61.767	-0.62838	48.00	148.862	-1.9528	-0.62966
5.600	518.855	-57.725	-0.62302	50.00	145.075	-1.8365	-0.63296
5.800	507.681	-54.084	-0.61788	52.00	141.509	-1.7310	-0.63609
6.000	497.197	-50.813	-0.61319	54.00	138.145	-1.6349	-0.63908
6.500	473.572	-43.950	-0.60324	56.00	134.964	-1.5473	-0.64204
7.000	453.012	-38.502	-0.59494	58.00	131.950	-1.4670	-0.64484
7.500	434.902	-34.082	-0.58776	60.00	129.091	-1.3933	-0.64757
8.000	418.797	-30.462	-0.58189	65.00	122.539	-1.2330	-0.65404
8.500	404.342	-27.442	-0.57688	70.00	116.715	-1.1007	-0.66015
9.000	391.275	-24.897	-0.57266	75.00	111.496	-0.98968	-0.66573
9.500	379.384	-22.723	-0.56901	77.35	109.225	-0.94359	-0.66822
10.00	368.502	-20.853	-0.56589	80.00	106.789	-0.89604	-0.67126
10.50	358.490	-19.231	-0.56326	85.00	102.513	-0.81628	-0.67683
11.00	349.236	-17.816	-0.56116	90.00	98.6082	-0.74725	-0.68201
11.50	340.647	-16.562	-0.55914	95.00	95.0248	-0.68748	-0.68731
12.00	332.652	-15.438	-0.55689	100.0	91.7208	-0.63525	-0.69259
12.50	325.185	-14.460	-0.55582	105.0	88.6620	-0.58920	-0.69778
13.00	318.167	-13.635	-0.55711	110.0	85.8202	-0.54833	-0.70282
13.50	311.541	-12.868	-0.55762	115.0	83.1713	-0.51185	-0.70773
14.00	305.299	-12.100	-0.55487	120.0	80.6955	-0.47904	-0.71237
14.50	299.429	-11.400	-0.55205	125.0	78.3756	-0.44941	-0.71676
15.00	293.881	-10.808	-0.55166	130.0	76.1969	-0.42250	-0.72083



# INTERPOLATION TABLE

Calibration Report: 405217  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 7819  
 Serial Number: X25347  
 Sensor Excitation: 2mV±50%

<u>Temp (K)</u>	<u>Res. (Ω)</u>	<u>dR/dT (Ω/K)</u>	<u>dlogR/dlogT</u>	<u>Temp (K)</u>	<u>Res. (Ω)</u>	<u>dR/dT (Ω/K)</u>	<u>dlogR/dlogT</u>
135.0	74.1465	-0.39799	-0.72462	235.0	49.1832	-0.15507	-0.74094
140.0	72.2135	-0.37555	-0.72808	240.0	48.4228	-0.14917	-0.73934
145.0	70.3880	-0.35496	-0.73123	245.0	47.6910	-0.14357	-0.73755
150.0	68.6612	-0.33601	-0.73406	250.0	46.9866	-0.13825	-0.73560
155.0	67.0254	-0.31851	-0.73658	255.0	46.3081	-0.13320	-0.73348
160.0	65.4739	-0.30232	-0.73879	260.0	45.6542	-0.12840	-0.73121
165.0	64.0002	-0.28731	-0.74072	265.0	45.0237	-0.12382	-0.72879
170.0	62.5990	-0.27335	-0.74235	270.0	44.4156	-0.11947	-0.72622
175.0	61.2651	-0.26036	-0.74370	273.15	44.0435	-0.11683	-0.72454
180.0	59.9940	-0.24824	-0.74478	275.0	43.8287	-0.11531	-0.72353
185.0	58.7814	-0.23691	-0.74560	280.0	43.2621	-0.11135	-0.72070
190.0	57.6237	-0.22630	-0.74617	285.0	42.7149	-0.10758	-0.71777
195.0	56.5173	-0.21636	-0.74648	290.0	42.1861	-0.10397	-0.71472
200.0	55.4591	-0.20702	-0.74656	295.0	41.6749	-0.10052	-0.71157
205.0	54.4462	-0.19824	-0.74640	300.0	41.1806	-9.7232e-2	-0.70833
210.0	53.4759	-0.18997	-0.74602	305.0	40.7024	-9.4083e-2	-0.70501
215.0	52.5457	-0.18218	-0.74542	310.0	40.2395	-9.1072e-2	-0.70160
220.0	51.6534	-0.17482	-0.74460	315.0	39.7914	-8.8190e-2	-0.69814
225.0	50.7968	-0.16787	-0.74358	320.0	39.3574	-8.5431e-2	-0.69460
230.0	49.9740	-0.16130	-0.74235	325.0	38.9369	-8.2788e-2	-0.69102



# THERMAL CYCLE TESTING

Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor

Serial Number: X25347

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Room Temperature:	40.6 $\Omega$
Liquid Nitrogen:	109 $\Omega$
Liquid Helium:	623 $\Omega$

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip test values should not be made.

## Recommended Operating Parameters:

For sensors calibrated by LSCI the current to the sensor is adjusted to maintain the sensor output voltage at the values listed below. In order to minimize possible self-heating errors, we suggest that these same guidelines be followed in using the sensor:

Above 1K:	1 to 3 mV
0.1 to 1K:	0.1 mV
Below 0.1K:	0.03 mV

## Lead Identification:

NONE

To avoid possible damage to the sensor, do not exceed 1 Volt and do not exceed 100 mA current.



# BREAKPOINTS 340 FORMAT

Calibration Report: 405217  
Sensor Model: CX-1030-SD-1.4L  
Sensor Type: Cernox Resistor  
Temperature Range: 1.40K to 325K

Sales Order: 7819  
Serial Number: X25347

Name: CX-1030-SD-1.4L  
Serial number: X25347  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.

Coefficient: 1 ;Negative

Point 1: 1.59035,325.000	Point 56: 2.03217, 79.000	Point 111: 2.61727, 8.150
Point 2: 1.59596,319.000	Point 57: 2.04151, 76.500	Point 112: 2.62999, 7.750
Point 3: 1.60123,313.500	Point 58: 2.05112, 74.000	Point 113: 2.64349, 7.350
Point 4: 1.60662,308.000	Point 59: 2.05902, 72.000	Point 114: 2.65789, 6.950
Point 5: 1.61213,302.500	Point 60: 2.06711, 70.000	Point 115: 2.67134, 6.600
Point 6: 1.61778,297.000	Point 61: 2.07541, 68.000	Point 116: 2.68563, 6.250
Point 7: 1.62356,291.500	Point 62: 2.08392, 66.000	Point 117: 2.70184, 5.880
Point 8: 1.62948,286.000	Point 63: 2.09266, 64.000	Point 118: 2.71787, 5.540
Point 9: 1.63554,280.500	Point 64: 2.10164, 62.000	Point 119: 2.73413, 5.220
Point 10: 1.64175,275.000	Point 65: 2.11182, 59.800	Point 120: 2.75053, 4.920
Point 11: 1.64753,270.000	Point 66: 2.12136, 57.800	Point 121: 2.76823, 4.620
Point 12: 1.65343,265.000	Point 67: 2.13119, 55.800	Point 122: 2.78616, 4.340
Point 13: 1.65947,260.000	Point 68: 2.14134, 53.800	Point 123: 2.80561, 4.060
Point 14: 1.66565,255.000	Point 69: 2.15182, 51.800	Point 124: 2.82148, 3.850
Point 15: 1.67196,250.000	Point 70: 2.16157, 50.000	Point 125: 2.83593, 3.670
Point 16: 1.67843,245.000	Point 71: 2.17162, 48.200	Point 126: 2.85136, 3.490
Point 17: 1.68504,240.000	Point 72: 2.18201, 46.400	Point 127: 2.86694, 3.320
Point 18: 1.69181,235.000	Point 73: 2.19275, 44.600	Point 128: 2.88360, 3.150
Point 19: 1.69873,230.000	Point 74: 2.20388, 42.800	Point 129: 2.90152, 2.980
Point 20: 1.70582,225.000	Point 75: 2.21542, 41.000	Point 130: 2.91970, 2.820
Point 21: 1.71309,220.000	Point 76: 2.22674, 39.300	Point 131: 2.93806, 2.670
Point 22: 1.72052,215.000	Point 77: 2.23778, 37.700	Point 132: 2.95786, 2.520
Point 23: 1.72814,210.000	Point 78: 2.24924, 36.100	Point 133: 2.97935, 2.370
Point 24: 1.73595,205.000	Point 79: 2.26114, 34.500	Point 134: 3.00120, 2.230
Point 25: 1.74396,200.000	Point 80: 2.27275, 33.000	Point 135: 3.02326, 2.100
Point 26: 1.75217,195.000	Point 81: 2.28481, 31.500	Point 136: 3.04730, 1.970
Point 27: 1.76058,190.000	Point 82: 2.29739, 30.000	Point 137: 3.07374, 1.840
Point 28: 1.76922,185.000	Point 83: 2.30963, 28.600	Point 138: 3.10072, 1.720
Point 29: 1.77809,180.000	Point 84: 2.32238, 27.200	Point 139: 3.12802, 1.610
Point 30: 1.78719,175.000	Point 85: 2.33572, 25.800	Point 140: 3.15825, 1.500
Point 31: 1.79561,170.500	Point 86: 2.34869, 24.500	Point 141: 3.18891, 1.400
Point 32: 1.80422,166.000	Point 87: 2.36226, 23.200	
Point 33: 1.81306,161.500	Point 88: 2.37540, 22.000	
Point 34: 1.82212,157.000	Point 89: 2.38917, 20.800	
Point 35: 1.83142,152.500	Point 90: 2.40062, 19.850	
Point 36: 1.84097,148.000	Point 91: 2.40935, 19.150	
Point 37: 1.85078,143.500	Point 92: 2.41837, 18.450	
Point 38: 1.86086,139.000	Point 93: 2.42771, 17.750	
Point 39: 1.87124,134.500	Point 94: 2.43670, 17.100	
Point 40: 1.88191,130.000	Point 95: 2.44601, 16.450	
Point 41: 1.89168,126.000	Point 96: 2.45568, 15.800	
Point 42: 1.90171,122.000	Point 97: 2.46497, 15.200	
Point 43: 1.91202,118.000	Point 98: 2.47461, 14.600	
Point 44: 1.92263,114.000	Point 99: 2.48384, 14.050	
Point 45: 1.93357,110.000	Point 100: 2.49348, 13.500	
Point 46: 1.94484,106.000	Point 101: 2.50449, 12.900	
Point 47: 1.95647,102.000	Point 102: 2.51501, 12.350	
Point 48: 1.96548, 99.000	Point 103: 2.52500, 11.850	
Point 49: 1.97314, 96.500	Point 104: 2.53546, 11.350	
Point 50: 1.98098, 94.000	Point 105: 2.54643, 10.850	
Point 51: 1.98900, 91.500	Point 106: 2.55795, 10.350	
Point 52: 1.99721, 89.000	Point 107: 2.56887, 9.900	
Point 53: 2.00562, 86.500	Point 108: 2.58034, 9.450	
Point 54: 2.01424, 84.000	Point 109: 2.59243, 9.000	
Point 55: 2.02309, 81.500	Point 110: 2.60522, 8.550	



# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 405217  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 7819  
 Serial Number: X25347

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

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.59036	325.0	31	2.47301	14.7
2	1.59129	324.0	32	2.50080	13.1
3	1.59692	318.0	33	2.54091	11.1
4	1.61164	303.0	34	2.57649	9.6
5	1.62732	288.0	35	2.61272	8.3
6	1.64405	273.0	36	2.64885	7.2
7	1.66193	258.0	37	2.68360	6.3
8	1.68106	243.0	38	2.71993	5.5
9	1.70156	228.0	39	2.75755	4.8
10	1.72356	213.0	40	2.78895	4.3
11	1.74723	198.0	41	2.82547	3.8
12	1.77276	183.0	42	2.85956	3.4
13	1.80038	168.0	43	2.88883	3.1
14	1.83039	153.0	44	2.92218	2.8
15	1.86316	138.0	45	2.96076	2.5
16	1.89920	123.0	46	2.99019	2.3
17	1.93918	108.0	47	3.02340	2.1
18	1.98418	93.0	48	3.06141	1.9
19	2.03589	78.0	49	3.08264	1.8
20	2.09267	64.0	50	3.10569	1.7
21	2.12528	57.0	51	3.15851	1.5
22	2.16159	50.0	52	3.18914	1.4
23	2.19036	45.0			
24	2.22206	40.0			
25	2.25741	35.0			
26	2.29657	30.1			
27	2.33383	26.0			
28	2.37210	22.3			
29	2.41001	19.1			
30	2.44531	16.5			

## Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	88.159
1000	2.238



# BREAKPOINTS 234 FORMAT

Calibration Report: 405217  
 Sensor Model: CX-1030-SD-1.4L  
 Sensor Type: Cernox Resistor  
 Temperature Range: 1.40K to 325K

Sales Order: 7819  
 Serial Number: X25347

Maximum Temperature Error:

1.4 - 10K: 0.006K  
 10 - 20K: 0.009K  
 20 - 40K: 0.015K  
 40 - 100K: 0.027K  
 > 100K: 0.126K

<u>BP #</u>	<u>Temp. (K)</u>	<u>Res. (Ω)</u>	<u>Log10 Res.</u>	<u>BP #</u>	<u>Temp. (K)</u>	<u>Res. (Ω)</u>	<u>Log10 Res.</u>
1	314.781	39.81072	1.600	41	19.902	251.1886	2.400
2	294.882	41.68694	1.620	42	18.328	263.0268	2.420
3	276.548	43.65158	1.640	43	16.869	275.4229	2.440
4	259.574	45.70882	1.660	44	15.520	288.4032	2.460
5	243.809	47.86301	1.680	45	14.279	301.9952	2.480
6	229.106	50.11872	1.700	46	13.143	316.2278	2.500
7	215.357	52.48075	1.720	47	12.099	331.1311	2.520
8	202.466	54.95409	1.740	48	11.142	346.7369	2.540
9	190.353	57.54399	1.760	49	10.266	363.0781	2.560
10	178.949	60.25596	1.780	50	9.465	380.1894	2.580
11	168.198	63.09573	1.800	51	8.733	398.1072	2.600
12	158.053	66.06934	1.820	52	8.064	416.8694	2.620
13	148.459	69.18310	1.840	53	7.453	436.5158	2.640
14	139.390	72.44360	1.860	54	6.895	457.0882	2.660
15	130.806	75.85776	1.880	55	6.387	478.6301	2.680
16	122.681	79.43282	1.900	56	5.923	501.1872	2.700
17	114.993	83.17638	1.920	57	5.499	524.8075	2.720
18	107.709	87.09636	1.940	58	5.112	549.5409	2.740
19	100.821	91.20108	1.960	59	4.759	575.4399	2.760
20	94.315	95.49926	1.980	60	4.436	602.5596	2.780
21	88.165	100.0000	2.000	61	4.140	630.9573	2.800
22	82.370	104.71129	2.020	62	3.870	660.6934	2.820
23	76.904	109.6478	2.040	63	3.622	691.8310	2.840
24	71.759	114.8154	2.060	64	3.395	724.4360	2.860
25	66.918	120.2264	2.080	65	3.187	758.5776	2.880
26	62.365	125.8925	2.100	66	2.995	794.3282	2.900
27	58.086	131.8257	2.120	67	2.818	831.7638	2.920
28	54.063	138.0384	2.140	68	2.656	870.9636	2.940
29	50.288	144.5440	2.160	69	2.505	912.0108	2.960
30	46.750	151.3561	2.180	70	2.367	954.9926	2.980
31	43.425	158.4893	2.200	71	2.238	1000.000	3.000
32	40.309	165.9587	2.220	72	2.009	1096.478	3.040
33	37.390	173.7801	2.240	73	1.812	1202.264	3.080
34	34.656	181.9701	2.260	74	1.642	1318.257	3.120
35	32.097	190.5461	2.280	75	1.495	1445.440	3.160
36	29.701	199.5262	2.300	76	1.367	1584.893	3.200
37	27.462	208.9296	2.320	77	1.254	1737.801	3.240
38	25.368	218.7762	2.340				
39	23.418	229.0868	2.360				
40	21.596	239.8833	2.380				

