DWG NO	0118MM	SH 1

REVISIONS (ALL SHEETS ARE SAME REV)

ZONE	REV	DESCRIPTION	CHG NO	APPD	DATE
—	L	REDRAWN TO PRO WITH CHANGES	A113890	MSS	040213
A8	M	NOTES 1 & 2 DELETED; MOVED TO SHEET 3	A115555	CTG	050408
C8		PARA. 1.4 DELETED; MOVED TO PARA. 5.6			
D7-D8		MODEL DESIGNATION CHANGED			
—		LAYOUT CHANGED; WORDING EDITTED			

SPECIFICATIONS

1.0 SCOPE:

1.1 GENERAL: THIS DOCUMENT COVERS THE REQUIREMENTS AND SCREENING REQUIREMENTS PER ESA 4006 QUALITY ASSURANCE PROVISIONS FOR A PLATINUM RESISTANCE SURFACE TEMPERATURE SENSOR TO MEASURE TEMPERATURE OVER A RANGE OF -269°C TO +400°C. THE SENSING ELEMENT IS MADE OF PURE PLATINUM WIRE (99.999% PURE) WOUND ON A CERAMIC INSULATOR IN A MANNER TO ENSURE STRAIN FREE OPERATION. IT MAY BE MOUNTED BY ADHESIVE BONDING.

1.2 CONFIGURATION: SEE FIGURE 1.

1.3 MODEL NUMBER KEY: 0118MM X_1 X_2 X_3 X_4 X_5 X_6 X_7

X_1 = NOMINAL ICE POINT RESISTANCE (PARA. 5.1; TABLE III)
X_2 = INTERCHANGEABILITY AT 0°C (PARA. 5.2; TABLE IV)
X_3 = TESTING OPTIONS (PARA 5.3; TABLE V)
X_4 = LEAD WIRE CONFIGURATION (PARA 5.4.1; TABLE VI)
X_5 = LEAD WIRE MATERIAL (PARA 5.4.2; TABLE VII)
X_6 = LEAD WIRE LENGTH (PARA 5.4.3; VIII)
X_7 = CALIBRATION SCHEDULE (TABLE IX)

1.4 DELETED

2.0 APPLICABLE DOCUMENTS: THE FOLLOWING DOCUMENTS OF THE ISSUE SHOWN FORM A PART OF THIS DOCUMENT TO THE EXTENT SPECIFIED HEREIN. DOCUMENTS NOT IDENTIFIED BY REVISION LETTER AND DATE SHALL BE OF THE ISSUE IN EFFECT ON THE DATE OF INVITATION FOR BID.

2.1 SPECIFICATIONS:

ESA:
ESA/SCC NO. 4006/007 DETAIL SPECIFICATION 0118MF STYLE SENSORS
ESA/SCC NO. 4006 THERMISTORS (RESISTORS, THERMALLY SENSITIVE)

NASA:
JSC SN-C-0005 CONTAMINATION CONTROL REQUIREMENTS

2.2 MILITARY STANDARDS:
MIL-STD-130 IDENTIFICATION MARKING OF U.S.MILITARY PROPERTY
MIL-STD-202 TEST METHODS FOR ELECTRONIC AND ELECTRICAL COMPONENT PARTS
MIL-STD-810 ENVIRONMENTAL TEST METHODS AND ENGINEERING GUIDELINES

2.3 OTHER GOVERNMENT PUBLICATIONS:
NHB6000.1 REQUIREMENTS FOR PACKAGING, HANDLING AND TRANSPORTATION

2.4 ROSEMOUNT AEROSPACE DOCUMENTS:
68023F TEMPERATURE CALIBRATION AND INTERPOLATION METHODS FOR PLATINUM RESISTANCE THERMOMETERS.

2.5 ORDER OF PRECEDENCE: IN THE EVENT OF CONFLICT BETWEEN THIS SPECIFICATION AND REFERENCES CITED HEREIN THIS SPECIFICATION SHALL TAKE PRECEDENCE.

3.0 REQUIREMENTS:

3.1 GENERAL DESCRIPTION: THE OUTPUT OF THE SENSOR FROM -183°C TO 400°C SHALL BE A CHANGE IN ELECTRICAL RESISTANCE AS A FUNCTION OF TEMPERATURE ACCORDING TO THE CALLENDAR-VAN DUSEN EQUATION:

$$R_T = R_0 + R_0 (\alpha) [T-(\delta)(T/100 -1)(T/100)-(\beta)(T/100 -1)(T/100)^3]$$

WHERE:
R_T = THE RESISTANCE OF RTD AT TEMPERATURE T
R_0 = THE RESISTANCE OF RTD AT 0°C (ICE POINT RESISTANCE)
T = TEMPERATURE (IN °C) THE RTD IS EXPOSED TO
α = CALIBRATION COEFFICIENT (VARIES WITH TEMPERATURE)
δ = CALIBRATION COEFFICIENT (VARIES WITH TEMPERATURE)
β = CALIBRATION COEFFICIENT (VARIES WITH TEMPERATURE)

THE NOMINAL RESISTANCE VS. TEMPERATURE CHARACTERISTICS ARE GIVEN IN TABLE I.

3.2 DEVICE PERFORMANCE CHARACTERISTICS

3.2.1 OUTPUT AT 0°C: WHEN ENERGIZED WITH A CURRENT LESS THAN 1.0 mA D.C. AND MEASURED WITHIN 0.2 INCHES OF THE DEVICE BODY, THE SENSOR SHALL HAVE A RESISTANCE AT 0°C WITHIN THE INTERCHANGEABILITY REQUIREMENTS SPECIFIED IN PARAGRAPH 5.2. THE HYSTERESIS ERROR IS NOT INCLUDED IN THIS VALUE.

3.2.2 TOTAL TEMPERATURE ERROR BAND: THE ERROR BAND SHALL INCLUDE ERRORS DUE TO CALIBRATION, INTERPOLATION, INTERCHANGEABILITY, REPEATABILITY AND SELF-HEATING. THE ERROR BAND VS. TEMPERATURE SHALL BE SPECIFIED IN TABLE II. SEE TABLE IX FOR SENSOR ACCURACY VS. VARIOUS TEMPERATURE SPANS WHICH INCLUDES HYSTERESIS ERROR.

3.2.3 TEMPERATURE RANGE: THE SENSOR SHALL NOT BE DEGRADED WHEN EXPOSED TO TEMPERATURES IN THE RANGE OF -269°C TO +400°C. TEMPERATURE LIMITS OF LEADWIRE MATERIALS ARE DEFINED IN SECTION 5.4.2.

3.2.3.1 LONG TERM DRIFT/HIGH TEMPERATURE EXPOSURE: THE SENSOR 0°C RESISTANCE SHALL DRIFT LESS THAN 0.03% AFTER 1000 HOURS EXPOSURE TO AIR AT 400°C.

3.2.3.2. LOW TEMPERATURE EXPOSURE: THE SENSOR 0°C RESISTANCE SHALL REPEAT ITS 0°C VALUE TO WITHIN 0.005% AFTER EXPOSURE TO GAS/LIQUID AT -269°C FOR FOUR HOURS.

3.2.4 RESPONSE TIME: THE TIME REQUIRED FOR A 63.2% RESPONSE OF AN UNMOUNTED SENSOR TO A STEP CHANGE IN TEMPERATURE FROM ROOM TEMPERATURE (25 ± 5°C) TO #200 DOW CORNING 1.5 CTSK OIL AT 76 ± 10°C FLOWING TRANSVERSE TO THE SENSING SURFACE AT 3 FEET PER SECOND (FPS), SHALL BE 0.7 SECONDS MAXIMUM.

3.2.5 SELF-HEATING ERROR: AN UNMOUNTED SENSOR IS CAPABLE OF DISSIPATING AN I^2R POWER OF 46 MILLIWATTS WITH A TEMPERATURE RISE OF LESS THAN 1°C WHEN SUBMERGED IN #200 DOW CORNING 1.5 CTSK OIL FLOWING TRANSVERSE TO THE SENSING SURFACE AT 3 FPS AND AT 25 ±5°C.

3.2.6 HYSTERESIS: THE SENSOR WILL REPEAT ITS 0°C OUTPUT RESISTANCE TO WITHIN 0.1% OF THE TEMPERTURE SPAN WHEN SUBJECTED TO A TEMPERATURE SPAN OF UP TO 392°C (-196°C TO +196°C).

3.2.7 INSULATION RESISTANCE: THE RESISTANCE BETWEEN ANY OF THE ELECTRICAL TERMINALS AND THE SENSOR SURFACE SHALL BE A MINIMUM OF 10 MEGOHMS AT 100 VDC FOR ONE MINUTE.

3.2.8 SHORT TERM OVERLOAD: THE 0°C RESISTANCE OF THE SENSOR SHALL SHIFT LESS THAN 0.005% AFTER BEING ENERGIZED BY A DC CURRENT OF 20mA FOR 8 HOURS IN STILL AIR AT 25°C.

3.2.9 THERMAL EMF: WITH THE SENSOR AT 25 ± 5°C, THE VOLTAGE DEVELOPED AT ZERO CURRENT WHEN SUBJECTED TO A STEP CHANGE IN TEMPERATURE OF -196°C MINIMUM SHALL NOT EXCEED 50 MICROVOLTS.

3.2.10 REPEATABILITY: THE SENSOR 0°C RESISTANCE SHALL DRIFT LESS THAN 0.039% AFTER 20 THERMAL CYCLES BETWEEN -196°C AND 200°C AT A RAMP RATE OF GREATER THAN 150°C PER MINUTE.

3.2.11 RESISTANCE TO SOLDERING HEAT: THE SENSOR SHALL BE CAPABLE OF WITHSTANDING THREE APPLICATIONS OF UP TO 260°C FOR 10 SECONDS DURATION TO EACH LEAD WIRE AT A POINT 0.3 INCHES FROM THE SENSOR BODY WITH A SHIFT OF LESS THAN 0.005% IN 0°C RESISTANCE.

3.2.12 DIELECTRIC WITHSTANDING VOLTAGE: THE SENSOR SHALL NOT EXHIBIT ANY INDICATIONS OF BREAKDOWN WITH 500 VAC APPLIED BETWEEN THE LEADS AND A METAL PLATE THE SENSOR IS MOUNTED TO AT AMBIENT PRESSURE AND TEMPERATURE.

3.2.13 IMMERSION: THE SENSOR WILL NOT BE PHYSICALLY DAMAGED WHEN IMMERSED IN THE FOLLOWING FLUIDS:

- SATURATED SOLUTION OF SODIUM CHLORIDE
- ALCOHOL
- 1,1,1 TRICHLOROETHYLENE
- LIQUID NITROGEN, OXYGEN, HELIUM

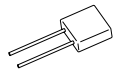
3.3 PHYSICAL CONFIGURATION:

3.3.1 OUTLINE DIMENSIONS: THE SENSOR OUTLINE DIMENSIONS SHALL BE IN ACCORDANCE WITH FIGURE 1.

3.3.2 LEAD WIRE MATERIAL: THE TWO LEAD WIRES EXITING THE BODY OF THE SENSOR SHALL BE 99.999% PURE PLATINUM.

3.3.3 WEIGHT: THE SENSOR EXCLUDING ANY ATTACHED LEAD WIRES SHALL BE 0.5 GRAMS MAXIMUM.

3.3.4 TENSION: THE SENSOR SHALL WITHSTAND A TENSION OF 0.5 POUNDS ON EACH LEAD WIRE WITHOUT DAMAGE TO THE SENSING ELEMENT.



3.4 RELIABILITY:

3.4.1 PREDICTED RELIABILITY: THE SENSOR SHALL BE DESIGNED TO HAVE A MEAN TIME BETWEEN FAILURES OF 10 YEARS USING MIL-HDBK-217E METHODS FOR MISSILE LAUNCH CONDITIONS AT 175°C.

3.5 ENVIRONMENTAL REQUIREMENTS: THE SENSOR SHALL BE CAPABLE OF MEETING ALL PERFORMANCE REQUIREMENTS SPECIFIED HEREIN DURING OR SUBSEQUENT TO EXPOSURE TO ANY RATIONAL COMBINATION OF THE ENVIRONMENTAL CONDITIONS SPECIFIED BELOW.

3.5.1 VIBRATION: THE SENSOR SHALL WITHSTAND AT LEAST 50G PEAK OR 0.5 INCH DOUBLE AMPLITUDE IN ANY AXIS WHEN CYCLED FROM 20 TO 2000 Hz OVER A 15 MINUTE TIME INTERVAL PROVIDING THE SENSOR AND LEADS ARE FIRMLY ATTACHED TO A SURFACE. THERE SHALL BE NO LOSS OF ELECTRICAL CONTINUITY AND NO EVIDENCE OF PHYSICAL DAMAGE DURING OR AFTER THE TEST.

3.5.2 SHOCK: THE SENSOR WHEN MOUNTED SECURELY TO A FLAT SURFACE SHALL BE DESIGNED TO OPERATE FOLLOWING EXPOSURE TO THREE 20G HALF SINE PULSES (DURATION 9 MILLISECONDS) IN BOTH DIRECTIONS IN EACH OF THREE ORTHOGONAL AXES (TOTAL OF 18 SHOCKS).

3.5.3 ACCELERATION: THE SENSOR SHALL WITHSTAND A 0G TO 12G CONSTANT ACCELERATION IN THREE AXES.

3.5.4 GROUND HANDLING AND TRANSPORTATION SHOCK: THE SENSOR SHALL MEET THE TEST REQUIREMENTS OF MIL-STD-810, METHOD 516.4, PROCEDURE VI.

3.5.5 RADIATION: THE SENSOR SHALL NOT EXHIBIT ANY MALFUNCTION OR DEGRADATION OF PERFORMANCE BEYOND THE SPECIFIED TOLERANCES FROM TOTAL DOSE EFFECTS. THE MAXIMUM TOTAL DOSE OVER A 10-YEAR PERIOD IS 300,000 KRAD.

3.5.6 AMBIENT PRESSURE: THE SENSOR SHALL PERFORM AS SPECIFIED DURING AND AFTER EXPOSURE TO AN EXTERNAL PRESSURE FROM 0.1 MILLITORR TO 60 PSIA.

3.5.7 HUMIDITY: THE SENSOR SHALL OPERATE IN AN ENVIRONMENT CHARACTERIZED BY 0% TO 99% RELATIVE HUMIDITY WITHOUT PERFORMANCE DEGRADATION. THE SENSOR ICE POINT RESISTANCE AND INSULATION RESISTANCE SHALL MEET THE SPECIFIED REQUIREMENTS WHEN TESTED PER MIL-STD-202, METHOD 106.

3.5.8 EXPLOSIVE ATMOSPHERE: THE SENSOR SHALL NOT CAUSE IGNITION OF AN EXPLOSIVE GASEOUS MIXTURE WHEN OPERATING IN SUCH AN ATMOSPHERE.

3.5.9 SALT ATMOSPHERE: THE RTD SHALL PERFORM AS SPECIFIED AFTER EXPOSURE TO SALT-SPRAY ATMOSPHERE WITHOUT PERFORMANCE DEGRADATION.

3.5.10 FUNGUS: THE SENSOR IS CONSTRUCTED WITH NON-NUTRIENT MATERIALS AND WILL NOT PROMOTE FUNGUS GROWTH.

2. DELETED

1. DELETED

NOTES: DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.

SPECIFICATION CONTROL DRAWING

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

NEXT ASSY | USED ON
APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES
REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125
-TOLERANCES-

DECIMALS	FRACTIONS
.X ± .1	± 1/32
.XX ± .02	ANGLES
.XXX ± .010	± 2°

DO NOT SCALE PRINT

CONTRACT NO		
DR L MILES	040108	
CHKD M SCHIRMERS	040213	
APPD M SCHIRMERS	040213	

THIRD ANGLE PROJECTION

Rosemount Aerospace Inc. BURNSVILLE MINNESOTA USA

TITLE: SURFACE SENSOR, TEMPERATURE

SIZE	CAGE CODE	DRAWING NO
D	60678	0118MM

SCALE: 1/1 | SHEET 1 OF 3

REVISIONS (ALL SHEETS ARE SAME REV)					
ZONE	REV	DESCRIPTION	CHG NO	APPD	DATE
--	L	REDRAWN TO PRO WITH CHANGES	AI13890	MSS	040213
---	M	LAYOUT CHANGED; WORDING EDITTED	AI15555	CTG	050408

SPECIFICATIONS (CONTINUED)

3.6 ELECTRICAL INTERFACE:

3.6.1 ALTERNATE ELECTRICAL INTERFACE: THE SENSOR SHALL BE CAPABLE OF CONNECTION TO UP TO 22 AWG WIRE IN A TWO, THREE OR FOUR WIRE CONNECTION. INDIVIDUAL WIRE, CABLE OR SHIELDED CABLE MAY BE USED. INTERFACE WIRING MAY BE BRAZED OR SOLDERED TO THE SENSOR LEAD WIRES.

3.7 IDENTIFICATION AND MARKING: EACH SENSOR SHALL BE IDENTIFIED BY A SERIAL NUMBER IN ACCORDANCE WITH MIL-STD-130. THE MATERIAL USED FOR THE IDENTIFICATION SHALL BE NON-OUTGASSING AND INDELIBLE AND SHALL NOT PREVENT NORMAL OPERATION OF THE SENSOR. DUE TO THE SMALL SIZE OF THE SENSOR, THE MODEL NUMBER AND SERIAL NUMBER SHALL BE IDENTIFIED ON EACH SHIPPING CONTAINER. THE LETTERING SIZE AND LOCATION SHALL BE CLEARLY VISIBLE TO CASUAL OBSERVATION.

3.8 WORKMANSHIP: SENSOR SHALL BE PROCESSED IN SUCH A MANNER AS TO BE FREE FROM CRACKS, HOLES OR CHIPS, AND OTHER DEFECTS THAT WILL AFFECT LIFE AND SERVICEABILITY. CLEANLINESS LEVEL SHALL BE LEVEL GC PER JSC SN-C-0005.

3.9 INSTALLED PERFORMANCE: THE SENSOR PERFORMANCE WILL IN GENERAL NOT BE DEGRADED WHEN MOUNTED WITH SUITABLE MATERIALS AND METHODS. PERFORMANCE SPECIFICATIONS FOR TEMPERATURE RANGE (3.2.3), RESPONSE TIME(3.2.4), SELF-HEATING ERROR (3.2.5), AND THERMAL SHOCK STABILITY (3.2.10) MAY BE DIRECTLY AFFECTED BY MOUNTING DEPENDING ON THE ADHESIVE USED.

4.0 QUALITY ASSURANCE PROVISIONS:

4.1 INSPECTION: UNLESS OTHERWISE SPECIFIED HEREIN, ROSEMOUNT AEROSPACE IS RESPONSIBLE FOR THE PERFORMANCE OF ALL INSPECTION REQUIREMENTS. INSPECTION AND TEST RECORDS SHALL BE MAINTAINED FOR 7 YEARS MINIMUM AND SHALL NOT BE DESTROYED UNLESS AUTHORIZED BY THE PROCURING AGENT.

4.2 VERIFICATION METHODS:

4.2.1 OUTPUT AT 0°C (ESA 4006, PARAGRAPH 9.3.1.1): SENSOR 0°C RESISTANCE SHALL BE MEASURED IN AN ICE BATH TO ±0.003°C WITH A MEASURING DEVICE WITH ±0.005% OF READING ACCURACY OR BETTER. DIFFERENT INTERCHANGEABILITIES ARE AVAILABLE AS LISTED IN THE THE TABLE BELOW.

INTERCHANGEABILITY	CODE
1%	A
0.25%	B
0.12%	C

4.2.2 ELECTRICAL MEASUREMENT AT HIGH & LOW TEMPERATURES (ESA 4006, PARAGRAPH 9.3.3): THE SENSOR RESISTANCE VERSUS TEMPERATURE CHARACTERISTIC SHALL BE DETERMINED UTILIZING THE METHODS DESCRIBED IN ROSEMOUNT AEROSPACE INC. REPORT 68023F. FIVE CALIBRATION POINTS WILL BE USED TO GENERATE THE R VS. T TABLE. CALIBRATION POINTS SHALL BE -269°C, -196°C, 0°C, 100°C, AND 260°C. WHEN THE SENSOR IS TO BE USED OVER A LIMITED TEMPERATURE SPAN, THE BEST ACCURACY WILL BE ACHIEVED BY PERFORMING CALIBRATION ON THE SENSOR WITHIN THIS RANGE, SEE TABLE IX.

4.2.3 TEMPERATURE RANGE:

4.2.3.1 LOW TEMPERATURE EXPOSURE: THE SENSOR SHALL BE COOLED TO -269°C FOR ONE HOUR. THE SENSOR IS THEN WARMED TO ROOM TEMPERATURE AND OUTPUT AT 0°C RECORDED. THE SENSOR SHALL THAN BE COOLED TO -269°C OR LESS FOR FOUR HOURS. THE SENSOR IS THEN WARMED TO ROOM TEMPERATURE AND OUTPUT AT 0°C RECORDED.

4.2.3.2 LONG TERM DRIFT/HIGH TEMPERATURE EXPOSURE (ESA 4006, 9.17): THE SENSOR IS PLACED IN AIR AT 400 ± 15°C FOR 2000 HOURS. 0°C RESISTANCE SHALL BE RECORDED AT 0 HOURS, APPROXIMATELY 500 HOURS AND AT THE COMPLETION OF THE TEST.

4.2.4 THERMAL TIME CONSTANT (ESA 4006, 9.3.1.3): THE SENSOR SHALL BE STABILIZED AT 25 ± 5°C. THE SENSOR RESISTANCE SHALL BE MONITORED WITH A RECORDING DEVICE WITH A SAMPLE RATE OF 100Hz MINIMUM. THE SENSOR IS THEN PLUNGED INTO OIL AT 76 ± 5°C FLOWING AT 3 ± 0.5 FEET PER SECOND AND THE SENSOR OUTPUT ALLOWED TO STABILIZE. THE TIME CONSTANT IS MEASURED AS THE TIME TO ACHIEVE 63.2% OF THE FINAL RESPONSE.

4.2.5 DISSIPATION CONSTANT (ESA 4006, 9.3.1.2): THE SENSOR RESISTANCE IS MEASURED IN OIL AT 3 ± 0.5 FEET PER SECOND AT A MEASURING CURRENT OF LESS THAN 1mA AND AGAIN WITH A SUFFICIENT CURRENT TO CAUSE A 1°C RISE IN INDICATED RESISTANCE. THE SELF-HEATING VALUE IS CALCULATED USING THE FOLLOWING EQUATION:

$$S.H. = \frac{I^2 R_2 (R_0 \alpha)}{R_2 - R_1}$$

R_1 = INITIAL RESISTANCE

R_2 = FINAL RESISTANCE

α = TEMPERATURE COEFFICIENT OF RESISTANCE

R_0 = RESISTANCE AT 0°C;

I = FINAL INPUT CURRENT

4.2.6 HYSTERESIS: THE SENSOR IS SUBJECTED TO A TEMPERATURE LESS THAN -100°C. THE SENSOR IS WARMED TO ROOM TEMPERATURE AND ITS 0°C RESISTANCE IS MEASURED. THE SENSOR IS THEN SUBJECTED TO A TEMPERATURE ABOVE 100°C. THE SENSOR IS COOLED TO ROOM TEMPERATURE AND ITS 0°C RESISTANCE IS MEASURED. THE HYSTERESIS IS CALCULATED FROM THE DIFFERENCE IN 0°C READINGS.

4.2.7 INSULATION RESISTANCE (ESA 4006, 9.3.1.4): THE INSULATION RESISTANCE TEST SHALL BE IN ACCORDANCE WITH MIL-STD-202, METHOD 302. THE TEST VOLTAGE SHALL BE 50 VDC APPLIED FOR ONE MINUTE BETWEEN THE SENSOR LEADS AND A METAL BLOCK.

4.2.8 SHORT TERM OVERLOAD (ESA 4006, 9.15): WITH THE SENSOR IN STILL AIR AT 25 ± 5°C A CURRENT OF 20mA IS APPLIED TO THE SENSOR FOR 8 HOURS MINIMUM. THE 0°C RESISTANCE SHALL BE MEASURED BEFORE AND AFTER THE TEST.

4.2.9 THERMAL EMF: THE SENSOR IS STABILIZED IN AIR AT 25 ± 5°C. A VOLTMETER WITH LOW THERMAL EMF CONNECTIONS IS CONNECTED TO THE LEAD WIRES OF THE DEVICE. THE SENSOR IS QUICKLY PLUNGED INTO LIQUID NITROGEN. THE MAXIMUM ABSOLUTE VALUE VOLTAGE READING ON THE VOLTMETER SHALL BE RECORDED.

4.2.10 REPEATABILITY: THE SENSOR SHALL BE SUBJECTED TO 20 CONSECUTIVE THERMAL SHOCKS FROM -196°C LIQUID NITROGEN TO 200 ± 10°C AIR. UP TO ONE MINUTE IS ALLOWED BETWEEN MEDIA AND THE EQUIVALENT RAMP RATE SHALL BE 150°C/MINUTE MINIMUM.

4.2.11 RESISTANCE TO SOLDERING HEAT (ESA 4006, 9.11): SENSOR LEAD WIRES SHALL BE SUBJECTED TO THREE 10-SECOND APPLICATIONS OF 300 ± 10°C APPLIED TO EACH LEAD AT A POINT 0.3 INCHES FROM THE BODY OF THE SENSOR. SENSOR 0°C RESISTANCE SHALL BE RECORDED BEFORE AND AFTER THE APPLICATION OF THE HEAT PULSES.

4.2.12 DIELECTRIC WITHSTANDING VOLTAGE (ESA 4006, 9.10): THE DIELECTRIC STRENGTH SHALL BE MEASURED PER MIL-STD-202, METHOD 301. THE TEST VOLTAGE SHALL BE 500 VAC,RMS,60Hz FOR 2 MINUTES BETWEEN THE SENSOR LEADS AND A METAL BLOCK. THE REDUCED BAROMETRIC PRESSURE DIELECTRIC TEST WILL NOT BE PERFORMED. THE SENSOR HAS NO INTERNAL CAVITIES, THEREFORE THE 500 VOLT TEST IS THE MORE SEVERE TEST.

4.2.13 IMMERSION: THE SENSOR SHALL BE TESTED PER MIL-STD-202, METHOD 104, TEST CONDITION B. THERE SHALL BE NO EVIDENCE OF DAMAGE WHEN VISUALLY EXAMINED AFTER THE TEST.

4.2.14 MOISTURE RESISTANCE (ESA 4006, 9.12): THE SENSOR SHALL BE TESTED PER MIL-STD-202, METHOD 106. THERE SHALL BE NO EVIDENCE OF PHYSICAL DAMAGE AFTER THE TEST. THE SENSOR ICE POINT RESISTANCE AND INSULATION RESISTANCE SHALL MEET THE REQUIREMENTS OF 3.2.1 AND 3.2.7 RESPECTIVELY.

4.2.15 OPERATING LIFE (ESA 4006, 9.14): SENSORS SHALL BE TESTED PER MIL-STD-202, METHOD 108. TEST TEMPERATURE SHALL BE 25 ± 10°C. ENERGIZING CURRENT SHALL BE SUCH AS TO DISSIPATE 27mW IN EACH SENSOR. SENSOR 0°C RESISTANCE AND INSULATION RESISTANCE SHALL BE MEASURED AT THE BEGINNING AND END OF TEST.

4.2.16 SOLDERABILITY (ESA 4006, 9.18): A SOLDERABILITY TEST PER MIL-STD-202, METHOD 208 SHALL BE PERFORMED ON SILVER COATED EXTENSION LEADWIRES. THE TEST WILL BE DONE ON 2 SAMPLES OF EXTENSION LEAD WIRE FROM EACH LOT, EXCEPT THAT STEAM AGING SHALL NOT BE PERFORMED. THE SAMPLES MAY BE DONE ANYTIME BEFORE THE EXTENSION LEAD WIRES ARE ATTACHED TO THE SENSOR.

4.2.17 RADIOGRAPHIC INSPECTION (ESA 4006, 9.6): RADIOGRAPHIC EXAMINATION AND X-RAY TECHNIQUE PER DOP 930.3 (WHICH MEETS THE INTENT OF ESA BASIC SPECIFICATION 20900) SHALL BE PERFORMED TO VERIFY THE BRAZE PENETRATION ON THE LEAD WIRE TO MANDREL BRAZE JOINT. X-RAYS WILL NOT BE RETAINED. THE X-RAY CHECK MAY BE PERFORMED ANYTIME BEFORE THE EXTENSION LEAD WIRES ARE ATTACHED TO SENSOR.

4.3 ACCEPTANCE TEST SEQUENCE: EACH SENSOR SHALL RECEIVE THE ACCEPTANCE TESTS DEFINED BY THE TESTING OPTIONS DESIGNATOR IN PARAGRAPH 5.3 WHICH SHALL BE SPECIFIED BY THE CUSTOMER.

TABLE I
RESISTANCE - TEMPERATURE RELATIONSHIP

TEMP. (°C)	ICE POINT RESISTANCE 100Ω	500Ω	1000Ω	2000Ω	5000Ω
-260.00	0.24	1.25	2.25	5.41	12.5
-240.00	2.53	12.67	25.14	50.43	126.7
-220.00	8.92	44.62	89.08	179.50	446.2
-200.00	17.22	86.10	172.07	345.62	861.0
-180.00	25.90	129.50	258.92	519.40	1295.0
-160.00	34.54	172.64	345.24	692.06	1726.4
-140.00	43.04	215.14	430.25	862.06	2151.4
-120.00	51.42	257.03	514.06	1029.60	2570.3
-100.00	59.69	298.43	596.86	1195.12	2984.3
-80.00	67.89	339.41	678.84	1358.89	3394.1
-60.00	76.01	380.03	760.09	1521.16	3800.3
-40.00	84.07	420.33	840.67	1682.04	4203.3
-20.00	92.06	460.31	920.63	1841.64	4603.1
0.00	100.00	500.00	1000.00	2000.00	5000.00
20.00	107.87	539.36	1078.62	2157.23	5393.6
40.00	115.69	578.49	1156.79	2313.56	5784.9
60.00	123.47	617.39	1234.53	2468.99	6173.9
80.00	131.21	656.05	1311.83	2623.54	6560.5
100.00	138.90	694.50	1388.70	2777.20	6945.0
120.00	146.55	732.72	1465.14	2929.98	7327.2
140.00	154.15	770.71	1541.15	3081.88	7707.1
160.00	161.71	808.48	1616.74	3232.92	8084.8
180.00	169.22	846.03	1691.89	3383.08	8460.3
200.00	176.69	883.36	1766.64	3532.38	8833.6
220.00	184.12	920.46	1840.96	3680.82	9204.6
240.00	191.51	957.34	1914.85	3828.40	9573.4
260.00	198.85	994.04	1988.33	3975.12	9940.1
280.00	206.15	1030.46	2061.39	4120.98	10304.6
300.00	213.40	1066.68	2134.03	4265.98	10666.8
320.00	220.61	1102.68	2206.24	4410.12	11026.8
340.00	227.78	1138.47	2278.04	4553.40	11384.7
360.00	234.91	1174.03	2349.42	4695.82	11740.3
380.00	241.99	1209.37	2420.37	4837.38	12093.7
400.00	249.03	1244.49	2490.91	4978.07	12444.9

TABLE II
TEMPERATURE ERROR BAND

TEMPERATURE (C°)	INHERENT ERRORS (±°C) (1)	INTERCHANGEABILITY (±°C) (2) 1%	0.25%	0.12%	HYSTERESIS (±°C) (3) 200°C SPAN
-260	0.057	6.26	6.26	6.26	
-220	0.046	0.64	0.47	0.44	
-196	0.039	0.78	0.45	0.39	
-180	0.043	0.92	0.47	0.39	
-140	0.057	1.30	0.55	0.41	
-100	0.051	1.70	0.61	0.42	0
-60	0.046	2.10	0.69	0.45	
0	0.039	2.54	0.63	0.30	0.20
40	0.052	3.18	0.95	0.56	
80	0.065	3.76	1.21	0.77	
100	0.072	4.05	1.33	0.85	0
120	0.075	4.33	1.44	0.94	
160	0.083	4.86	1.65	1.07	
200	0.090	5.37	1.71	1.19	
240	0.098	5.84	1.95	1.28	
260	0.102	6.10	2.02	1.31	
280	0.112	6.33	2.09	1.34	
320	0.131	6.82	2.21	1.41	
360	0.149	7.30	2.33	1.47	
400	0.169	7.78	2.46	1.54	

1. INHERENT ERRORS DUE TO:
   A. CALIBRATION
   B. INTERPOLATION
   C. REPEATABILITY
   D. SELF-HEATING (AT .94mW,47mW/°C)
2. TOTAL ERROR AT A TEMPERATURE IS THE RSS VALUE OF 1,2 AND 3.
3. ASSUMING A 200°C SPAN WITH 0.1% HYSTERESIS.

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

Rosemount Aerospace Inc.		SIZE	CAGE CODE	DRAWING NO
DR L MILES	040108	D	60678	0118MM
CHKD M SCHIRMERS	040213	SCALE: 1/1		SHEET 2

DWG NO	0118MM	SH 3

REVISIONS (ALL SHEETS ARE SAME REV)					
ZONE	REV	DESCRIPTION	CHG NO	APPD	DATE
--		REDRAWN TO PRO WITH CHANGES			
B2	L	CHANGED LEAD DIAMETER FROM .0125 TO .012	A113890	MSS	040213
B6		ADDED LEADWIRE OPTION K TO TABLE IV			
A4-A5		X DELETED FROM TABLE IX; TABLE FORMAT CHANGED			
A7-A8		PARA. 5.6 ADDED			
B2-B3		NOTES 3.1 & 3.2 ADDED			
B5		J CHANGED FROM CUSTOMER SPECIFIED AND K ADDED TO TABLE VIII			
C4-C5	M	E DELETED, L & M ADDED TO TABLE VII	A115555	CTG	050408
C7-C8		PARA. 5.4.1, 5.4.2 & 5.4.3 ADDED			
		PARA. 5.3 & 5.4 POSITION SWITCHED			
		LAYOUT CHANGED; WORDING EDITTED			
—		MODEL DESIGNATION & TABLES CHANGED AND RENUMBERED; ICE POINT RESISTANCE, INTERCHANGEABILITY AND TESTING TABLES ADDED			

SPECIFICATIONS (CONTINUED)

5.0 ORDERING INFORMATION: THE CONFIGURATION OF THE 0118MM IS DEFINED BY THE MODEL NUMBER DESIGNATION:

0118MM X_1 X_2 X_3 X_4 X_5 X_6 X_7

WHERE THE OPTION FIELDS ARE DEFINED AS FOLLOWS:

X_1 = NOMINAL ICE POINT RESISTANCE (PARA. 5.1; TABLE III)
X_2 = INTERCHANGEABILITY AT 0°C (PARA. 5.2; TABLE IV)
X_3 = TESTING OPTIONS (PARA. 5.3: TABLE V)
X_4 = LEAD WIRE CONFIGURATION (PARA. 5.4.1; TABLE VI)
X_5 = LEAD WIRE MATERIAL (PARA. 5.4.2; TABLE VII)
X_6 = LEAD WIRE LENGTH (PARA. 5.4.3; VIII)
X_7 = CALIBRATION SCHEDULE (TABLE IX)

5.1 ICE POINT RESISTANCE OPTION FIELD: THE 0118MM NOMINAL ICE POINT (0°C) RESISTANCE MAY BE SPECIFIED WITH THE FOLLOWING VALUES; 100,500,1000,2000, AND 5000 OHMS. SEE TABLE III.

5.2 INTERCHANGEABILITY AT ICE POINT OPTION FIELD: THE RESISTANCE TOLERANCE IN PERCENT OF NOMINAL R_0 MAY BE SPECIFIED AS IN TABLE IV.

FOR EXAMPLE, A 0118MM500B WOULD HAVE AN R_0 OF 500 ± 1.25 OHMS.

5.3 TESTING OPTIONS (PER ESA 4006): SEE TABLE V.

NOTE: SENSORS THAT DO NOT MEET THE 0.12% AND 0.25% INTERCHANGEABILITY REQUIREMENT WILL NOT BE COUNTED AGAINST LOT FAILURE CRITERIA. THESE TIGHT INTERCHANGEABILITY VALUES ARE DIFFICULT TO MAINTAIN WHEN TESTING THESE UNITS OVER WIDE TEMPERATURE RANGES. UNITS WHICH DO NOT MEET THE R VS. T REQUIREMENTS WILL NOT BE SHIPPED AS DELIVERABLE HARDWARE.

5.4 LEAD WIRE OPTIONS: LEAD WIRES SHALL BE DESIGNATED BY THREE ALPHA CHARACTERS. THE COMBINATION OF CHARACTERS WILL DEFINE THE NUMBER OF LEADS, THE LENGTH OF THE LEADS AND THE MATERIAL OF THE LEADS.

5.4.1 LEAD WIRE CONFIGURATION: SEE TABLE VI.

5.4.2 LEAD WIRE MATERIAL: SEE TABLE VII.

5.4.3 LEAD WIRE LENGTH: SEE TABLE VIII.

5.5 DATA DOCUMENTATION: A DATA PACKAGE WILL BE SHIPPED WITH EACH LOT OF SENSORS. THE DATA PACKAGE WILL INCLUDE THE FOLLOWING:

A. COVER LETTER*
B. RESISTANCE VERSUS TEMPERATURE TABLE FOR EACH SENSOR.
C. TEST DATA FOR CHART II, CHART III, AND DATA FOR THE REQUIRED LOT ACCEPTANCE TESTING
D. EQUIPMENT LIST
E. STATEMENT OF CONFORMITY
F. LOT DATE CODE
G. LOT NUMBER
H. LIST OF THE SERIAL NUMBERS OF THE SENSORS

* - COVER LETTER SHALL INCLUDE THE FOLLOWING:
ESA COMPONENT NUMBER IF APPLICABLE
MANUFACTURER'S NAME
DATE OF DOCUMENT

5.6 PREPARATION FOR DELIVERY: SENSORS WILL BE PACKAGED PER MIL-STD-794 AND MARKED IN ACCORDANCE WITH MIL-STD-129. EACH PACKAGE WILL BE LABELED WITH THE FOLLOWING INFORMATION:

MODEL 0118MM X_1 X_2 X_3 X_4 X_5 X_6 X_7

SERIAL NUMBER

ESA/SCC 4006/007

LOT DATE CODE YYXX WHERE YY = CALENDAR YEAR AND XX = WORK WEEK

NOTE: SENSORS USED AS TEST UNITS WILL BE LABELED AS FOLLOWS:
(SEE ESA/SC 4006 CHART V FOR DEFINITIONS OF SUBGROUPS)
ENV./ MECH. SUBGROUP
END. SUBGROUP
ELEC. SUBGROUP/ELEC. MEAS.
ELEC. SUBGROUP/ASSEM. CAP. TESTS

NOTE: ENV./ MECH SUBGROUP, END. SUBGROUP, AND ELEC. SUBGROUP/ ASSEM. CAP. TEST SENSORS ALSO NEED THE FOLLOWING LABEL:

DESTRUCTIVE SAMPLE
NOT FOR FLIGHT USE

0118MM	X_1	X_2	X_3	X_4	X_5	X_6	X_7

TABLE III
NOMINAL ICE POINT RESISTANCE

X_1	ICE POINT RESISTANCE
100	100Ω
500	500Ω
1000	1000Ω
2000	2000Ω
5000	5000Ω

TABLE IV
ICE POINT INTERCHANGEABILITY

X_2	INTERCHANGEABILITY
A	±1%
B	±0.25%
C	±0.12%

TABLE V
TESTING PER ESA 4006

X_3	SCREENING OPTION
A	NO TESTING, R_0 CALIBRATION ONLY
B	CHART II (FINAL PRODUCTION TESTS), CHART III - LEVEL B (BURN-IN AND ELECTRICAL MEASUREMENTS)
C	DELETED
D	CHART II, CHART III - LEVEL B AND CHART V - ENDURANCE SUBGROUP ONLY (LAT 2)
E	CHART II, CHART III - LEVEL B AND CHART V - LEVEL 3
F	CHART II, CHART III - LEVEL B AND CHART V - LEVEL 2
G	CHART II, CHART III - LEVEL B AND CHART V - LEVEL 1

TABLE VI
LEAD WIRE CONFIGURATION

X_4	LEAD WIRES
A	TWO WIRES
B	THREE WIRES
C	FOUR WIRES

TABLE VII
LEAD WIRE MATERIAL

X_5	MATERIAL	TEMPERATURE CAPABILITY °C
A	0.012 INCH DIAMETER PLATINUM	760
B	GOLD PLATED COPPER, 26 AWG PER MIL-STD-1276	600
C	26 GAGE TEFLON INSULATED, STRANDED NICKEL PLATED COPPER	260
D	26 GAGE SHIELDED CABLE, NICKEL PLATED COPPER	260
E	DELETED	
F	24 GAGE TEFLON INSULATED, STRANDED NICKEL PLATED COPPER	260
G	24 GAGE SHIELDED CABLE, NICKEL PLATED COPPER	260
H	DELETED	
J	DELETED	
K	26 GAGE TEFLON INSULATED, STRANDED SILVER PLATED COPPER	260
L	28 GAGE TEFZEL INSULATED, STRANDED SILVER COATED COPPER	260
M	28 GAGE NEXTEL JACKETED CABLE, STRANDED NICKEL	220

TABLE VIII
LEAD WIRE LENGTH

X_6	LENGTH (INCHES)
A	1.5 MIN
B	6.0 ± 0.5
C	12.0 ± 0.5
D	24 ± 1
E	48 ± 2
F	72 ± 4
G	120^{+12}_{-0}
H	240^{+12}_{-0}
J	400^{+12}_{-0}
K	600^{+12}_{-0}

TABLE IX
CALIBRATION OPTIONS

X_7	TEMPERATURE SPAN (°C)	CALIBRATION POINTS (°C)	ACCURACY EXCLUDING INTERCHANGEABILITY (°C) MAXIMUM CALIBRATION ERROR	ACCURACY EXCLUDING INTERCHANGEABILITY (°C) MAXIMUM HYSTERESIS	R VS. T TABLE POINTS
A	-50 TO +50	-50, 0, 50	0.067	0.10	10 POINTS
B	-196 TO +200	-196, 0, 100	0.068	0.40	20 POINTS FROM -200 TO +200
C	-196 TO +260	-196, 0, 100, 260	0.084	0.46	23 POINTS FROM -200 TO +260
D*	-269 TO +400	-269, -196, 0, 100, 260	0.100	0.67	26 POINTS FROM -260 TO +400
X	DELETED				

* BASIC CALIBRATION SCHEDULE

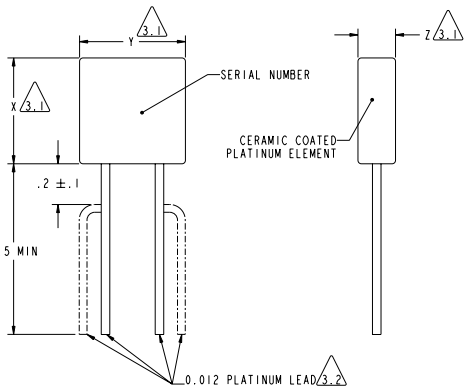


FIGURE 1

3.2 OPTIONAL LEAD ATTACHMENT IS AS SPECIFIED IN PARAGRAPH 5.4.

3.1 FOR SENSORS WITH ICE-POINT RESISTANCES OF 100 AND 500 OHMS:
X=.155 MAX, Y=.155 MAX, Z=.055 MAX.

FOR SENSORS WITH ICE-POINT RESISTANCES OF 1000 AND 2000 OHMS:
X=.450 MAX, Y=.155 MAX, Z=.055 MAX.

FOR SENSORS WITH ICE-POINT RESISTANCES OF 5000 OHMS:
X=.600 MAX, Y=.200 MAX, Z=.090 MAX.

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.

Rosemount Aerospace Inc.		SIZE	CAGE CODE	DRAWING NO
DR L MILES	040108	D	60678	0118MM
CHKD M SCHIRMERS	040213	SCALE: 1/1		SHEET 3