RESISTANCE TEMPERATURE DETECTORS (RTD's)

(THERMALLY SENSITIVE RESISTORS),

PTC 100, 1000, or 10000 OHMS AT 0°C

WITH A TEMPERATURE RANGE OF -196°C TO 200°C

BASED ON TYPE S220185PD, S220185PF, S220185PS

MINCO ESCC Detail Specification No. 4006/S220185

Revision	Description	Date	ECO
(–)	Original release.	02.09.2016	--
(A)	Update Figure 1 to allow leads to enter body in all configurations	11.02.2018	2819759
(B)	Change minimum temperature from -60°C to -196°C; remove PW element option	06.03.2024	3511297

CONTENTS

1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Resistance Temperature Detectors (RTDs - thermally sensitive resistors),100, 1000, or 10000 ohms at 0°C with a temperature range of -196°C to 200°C. It shall be read in conjunction with ESCC Generic Specification No. 4006, the requirements of which are supplemented and superseded herein.

1.2 TYPE VARIANTS

Variants of the basic type RTD specified herein which are also covered by this specification are given in the Minco S220185 specifications drawing.

1.3 MAXIMUM RATINGS

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the RTDs specified herein, are as scheduled in Table 1(b).

1.4 PHYSICAL DIMENSIONS

The physical dimensions of the RTDs specified herein are shown in FIGURE 1 and Minco S220185 specifications drawing.

1.5 FUNCTIONAL DIAGRAM

The functional diagram for the RTDs specified herein is shown in FIGURE 2 and Minco S220185 specifications drawing.

2 APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:
(a) ESCC Generic Specification No. 4006, Thermistors (Resistors, Thermally Sensitive)
(b) IEC 60410, Sampling Procedures and Tables for Inspections by Attributes
(c) MIL-STD-202, Test Methods for Electronic and Electrical Component Parts
(d) Minco specification drawing S220185
(e) IEC 60751, Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS, UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply. In addition, the following symbols are used:
NTC = Negative Temperature Coefficient
PTC = Positive Temperature Coefficient
R_Z = Zero Power Resistance
R_M = Minimum Temperature Resistance
R_L = Low Temperature Resistance
R_H = High Temperature Resistance
P_D = Power Dissipation
T_{OP} = Operating Temperature Range
T_{STG} = Storage Temperature Range
mW = Milliwatt
Ω = Ohms

TABLE 1(a) – Element Variant Resistance/Temperature Characteristics

Variant	R_Z	Resistance/Temperature Characteristics (Note 2)							Temperature Coefficient (Ω/Ω/°C)
		-196°C (Note 3)	-50°C	0°C (Note 1)	+25°C	+75°C	+100°C	+200°C	
PD	Nom. (Ω)	20.25	80.31	100.00	109.73	128.99	138.51	175.86	0.00385
	Tol. (±%)	5.45	.27	.12	.15	.20	.22	.27	
	Tol. (±°C)	2.56	.55	.30	.43	.68	.80	1.3	
PF	Nom. (Ω)	202.5	803.1	1000.0	1097.3	1289.9	1385.1	1758.6	0.00385
	Tol. (±%)	5.45	.27	.12	.15	.20	.22	.27	
	Tol. (±°C)	2.56	.55	.30	.43	.68	.80	1.3	
PS	Nom. (Ω)	2025	8031	10,000	10,973	12,899	13,851	17,586	0.00385
	Tol. (±%)	5.45	.27	.12	.15	.20	.22	.27	
	Tol. (±°C)	2.56	.55	.30	.43	.68	.80	1.3	

NOTES:

1. The reference resistance is specified at 0°C.
2. Resistance shall be measured as specified in 8.3.1.1 at 0°C, pursuant to the deviations of 4.2.2 herein.
3. IEC 60751 does not define class B (F 0.3) tolerance at temperatures below -50°C for thin-film elements. The stated tolerance for S220185 at -196°C is based on double the tolerance allowed for wire wound elements per IEC 60751 at the minimum temperature.

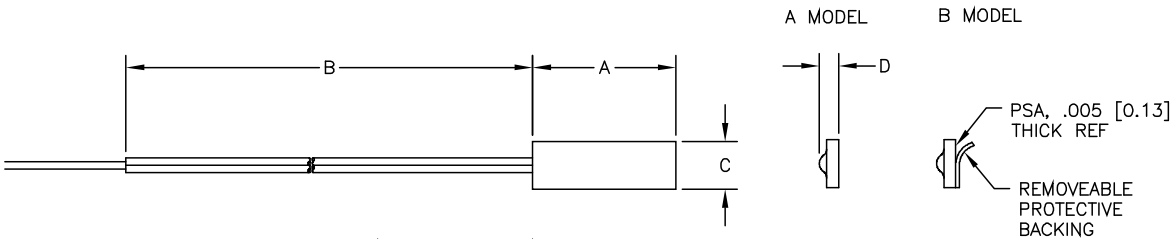
TABLE 1(b) – Maximum Ratings

Characteristic	Symbol	Maximum Ratings	Unit	Remarks
Power Dissipation	P_D	2	mW	Note 1, 2
Operating Temperature Range	T_{OP}	-196 to 200	°C	
Storage Temperature Range	T_{STG}	-196 to 200	°C	

NOTES:

1. Never to be exceeded in the temperature measurement mode. The RTDs specified herein shall not be used in the self-heat mode.
2. Assuming maximum excitation current of 1 mA for PD, PF, PW variants, and maximum excitation current of 0.3 mA for PS variant.

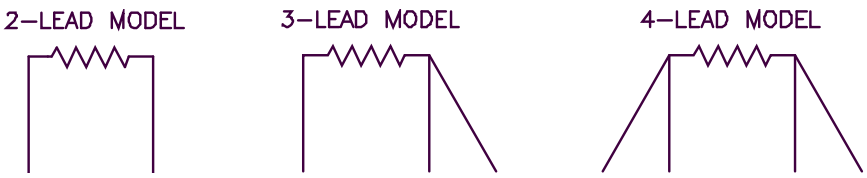
FIGURE 1 – PHYSICAL DIMENSIONS



Symbol	Millimeters	
	Min	Max
A	14.2	15.8
B	*	*
C	6.2	7.8
D	-	2.0

*Variable dimension as specified by model number.
See S220185 specifications drawing for complete details.

FIGURE 2 – FUNCTIONAL DIAGRAM



4 REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the RTDs specified herein are stated in this specification and ESCC Generic Specification No. 4006 for Thermistors (Resistors, Thermally Sensitive). Deviations from the Generic Specification, applicable to this specification only, are listed in Para. 4.2.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

4.2.1 Deviation from Marking (ESCC General Specification No. 4006 Para. 4.4)

The component is too small to accommodate all of the marking specified. The required marking information, in full, shall accompany the component in its primary package.

4.2.2 Deviation from Zero Power Resistance (ESCC General Specification No. 4006 Para. 8.3.1.1)

(a) Sensors will not be mounted on brass rods or mounting plates.
(b) Clips shall grip the leads within 13mm from the end of the leadwires.

4.2.3 Deviation from Insulation Resistance (ESCC General Specification No. 4006 Para. 8.3.1.4)

Sensors will be “immersed” in conductive metal shot “bath” in place of a V-block. Points of measurement shall be between sensor leads (shorted together) and metal shot “bath”.

4.2.4 Deviations from Production Control (Chart F2)

4.2.4.1 Internal Visual Inspection (ESCC General Specification No. 4006 Para. 5.2.1)

Not applicable. The cover material is transparent, allowing any non-conformance to be found in External Visual Inspection.

4.2.4.2 External Visual Inspection (ESCC General Specification No. 4006 Para. 5.2.4)

Visual inspection will be used to determine compliance to the following:

(a) No residue from manufacturing process(es)
(b) 0.005” minimum continuous seal (lamination)
(c) No tears or cuts with potential to propagate
(d) No crease or wrinkle that obstructs the contact surface of the sensing element, or covers more than 25% of the surface area
(e) No metallic foreign material that reduces spacing between un-insulated conductors to less than 0.002”, or reduces conductor/trim border to less than 0.005”
(f) No foreign material that crosses or potentially damages a conductor, or is visible with an unaided eye
(g) No cracks in thin-film ceramic substrate
(h) No displaced or missing thin-film glass
(i) No exposed bare leads

4.2.4.3 Weight (ESCC General Specification No. 4006 Para. 5.2.6)

Not applicable. Weight is dependent on variant selections.

4.2.5 Deviations from Screening Tests (Chart F3)

4.2.5.1 Radiographic Inspection (ESCC General Specification No. 4006 Para. 8.6)

Not applicable. The cover material is transparent, allowing any non-conformance to be found in External Visual Inspection.

4.2.5.2 External Visual Inspection (ESCC General Specification No. 4006 Para. 8.5)
Visual inspection will be used to determine compliance to the following:
(a) No residue from manufacturing process(es)
(b) 0.005” minimum continuous seal (lamination)
(c) No tears or cuts with potential to propagate
(d) No crease or wrinkle that obstructs the contact surface of the sensing element, or covers more than 25% of the surface area
(e) No metallic foreign material that reduces spacing between un-insulated conductors to less than 0.002”, or reduces conductor/trim border to less than 0.005”
(f) No foreign material that crosses or potentially damages a conductor, or is visible with an unaided eye
(g) No cracks in thin-film ceramic substrate
(h) No displaced or missing thin-film glass
(i) No exposed bare leads

4.2.6 Deviations from Qualification and Periodic Tests (Chart F4)

4.2.6.1 Shock (ESCC General Specification No. 4006 Para. 8.7)
Shock will not be performed.

4.2.6.2 Vibration (ESCC General Specification No. 4006 Para. 8.8)
Vibration will not be performed.

4.2.6.3 Dielectric Withstanding Voltage (ESCC General Specification No. 4006 Para. 8.9)
Dielectric Withstanding Voltage will not be performed.

4.2.6.4 External Visual Inspection (ESCC General Specification No. 4006 Para. 8.5)
Visual inspection will be used to determine compliance to the following:
(a) No residue from manufacturing process(es)
(b) 0.005” minimum continuous seal (lamination)
(c) No tears or cuts with potential to propagate
(d) No crease or wrinkle that obstructs the contact surface of the sensing element, or covers more than 25% of the surface area
(e) No metallic foreign material that reduces spacing between un-insulated conductors to less than 0.002”, or reduces conductor/trim border to less than 0.005”
(f) No foreign material that crosses or potentially damages a conductor, or is visible with an unaided eye
(g) No cracks in thin-film ceramic substrate
(h) No displaced or missing thin-film glass
(i) No exposed bare leads

4.2.6.5 Resistance to Soldering Heat (ESCC General Specification No. 4006 Para. 8.10)
Not applicable. Sensor body can never be exposed to solder within the distance specified. Minimum lead length variant is 1 inch (25.4mm).

4.2.6.6 Moisture Resistance (ESCC General Specification No. 4006 Para 8.11)
Moisture Resistance will not be performed.

4.2.6.7 Solderability (ESCC General Specification No. 4006 Para 8.14)
Stripped end of leads shall be immersed to within ±1.25mm of lead insulation.

4.2.6.8 Terminal Strength (ESCC General Specification No. 4006 Para 8.15)
Initial and final zero power resistance shall be measured as specified in 8.3.1.1 at 0°C, pursuant to the deviations of 4.2.2 herein.

4.2.6.9 Short Time Load (ESCC General Specification No. 4006 Para. 8.16)
Final zero power resistance shall be measured as specified in 8.3.1.1 at 0°C, pursuant to the deviations of 4.2.2 herein.

4.2.6.10 Low Temperature Storage (ESCC General Specification No. 4006 Para. 8.17)
Initial and final zero power resistance shall be measured as specified in 8.3.1.1 at 0°C, pursuant to the deviations of 4.2.2 herein.

4.2.6.11 Operating Life (ESCC General Specification No. 4006 Para. 8.18)
Ambient temperature shall be controlled by convection oven and sensors will be energized as specified in Table 3 herein.

4.2.6.12 Permanence of Marking (ESCC General Specification No. 4006 Para. 8.19)
Not applicable. The component is too small to accommodate all of the marking specified. The required marking information, in full, shall accompany the component in its primary package.

4.3 MARKING

4.3.1 General
The marking of all components delivered to this specification shall be in accordance with requirements of ESCC Basic Specification No. 21700 and the following:
The component is too small to accommodate all of the marking specified. The required marking information, in full, shall accompany the component in its primary package.
The information to be marked and the order of precedence shall be as follows:
(a) ESCC Component number
(b) Traceability Information
(c) Manufacturer's name or symbol
(order of precedence per ESCC 21700 para. 4.4)
Tolerance and temperature coefficient are as specified in Table 1(a) per the corresponding variant.

4.3.2 The ESCC Component Number
The ESCC Component Number shall be formed by grouping together the following:
(a) The number of the relevant Detail Specification excluding the /: 4006S220185
(b) Sensing element variant: PD, PF, PS, or PW [characteristics as defined in Table 1(a)]
(c) Number of leads variant: Y (2 leads), Z (3 leads), or X (4 leads)
(d) Lead insulation variant: T = PTFE or K = polyimide
(e) Lead length variant: specified in (whole) inches
(f) Outer surface type variant: A = non-adhering or B = adhering (one side)
(g) Testing level: F3 = Screening tests (Chart F3), F4 = Qualification and Periodic tests (Chart F4), or blank for Production Control (Chart F2) only
(h) The total dose radiation level letter
1. Blank if radiation test is not required
2. If radiation test has been specified, add suffix for total dose radiation level: add "-D" for lead insulation variant "T", add "-H" for lead insulation variant "K" (D=10k rads, H=1M rads per ESCC 22900)
Example: 4006S220185PFZK40AF3

4.3.3 Traceability Information
Traceability information shall be comprised of the following:
(a) Manufacturing date code (yyww)
(b) Lot/batch code
(c) Serial number
Example: 1223-379799-*-*-108

4.3.4 Manufacturer's Name or Symbol
Each component package will be marked with Minco's name and/or logo.

4.4 MATERIALS AND FINISHES
The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the sensors specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Body
The sensing element shall be laminated between layers of polyimide film.

4.4.2 Lead Material and Finish
The lead material shall be insulated stranded silver-plated copper wire.

4.5 TEST METHODS AND PROCEDURES

4.5.1 Production Control (Chart F2)

4.5.1.1 Thermal Shock
Thermal shock shall be performed in accordance with MIL-STD-202 Method 107 as directed by ESCC Generic Specification No. 4006. The test condition shall be C except sub-zero temperature will be -55°C, number of cycles will be 10, and exposure time at temperature extremes will be 15 minutes minimum.

4.5.1.2 Room Temperature Electrical Measurements
Unless otherwise specified, this will consist of zero-power resistance measurements at 0°C. Acceptable limits are as specified in Table 1(a).

4.5.1.3 Dimension Check
The dimensions shall conform to those specified in Figure 1 herein.

4.5.2 Screening Tests (Chart F3)

4.5.2.1 Parameter Drift Values
The maximum parameter drift values (Δ) are specified in Table 2 herein. Unless otherwise stated, measurements shall be performed at 0°C.

4.5.2.2 Burn-In
The conditions for burn-in shall be as specified in Table 3 herein.

4.5.2.3 High, Low, and Minimum Temperatures Electrical Measurements
The resistance at high, low, and minimum temperatures shall be measured in accordance with Table 1(a) herein.

4.5.2.4 Room Temperature Electrical Measurements
Unless otherwise specified, this will consist of zero-power resistance measurements at 0°C. Acceptable limits are as specified in Table 1(a).

4.5.3 Qualification and Periodic Tests (Chart F4)

4.5.3.1 Intermediate and End-Point Electrical Measurements
The parameters to be measured and inspections to be performed at intermediate and end points during qualification and periodic tests are scheduled in Table 6.

4.5.3.2 Terminal Strength
The test conditions for Terminal Strength shall be as follows:
Applied Force: 1 lb (4.4 N).
Duration: 5 seconds

4.5.3.3 Operating Life
The conditions for Operating Life testing shall be as specified in Table 3 herein.

TABLE 2 – Parameter Drift Values

No.	Characteristics	Symbol	ESCC 4006 Test Method and Conditions	Limits (Δ)	Unit
1	Zero Power Resistance Drift	$\Delta R_Z/R_Z$	Para. 8.3.2 Para. 8.3.1.1 (Note 1)	±0.2	%

NOTES:
1. Deviations to Para. 8.3.1.1 per Para. 4.2.2 herein.

TABLE 3 – Conditions for Burn-in and Operating Life Tests

No.	Characteristics	Symbol	Conditions	Unit
1	Elevated Ambient Temperature	T_{EA}	200 ±5	°C
2	Power Dissipation	P_D	2 (Note 1)	mW

NOTES:
1. Operating Life Test only. Burn-in Test is unpowered.

TABLE 4 – Production Control Test Summary (Chart F2)

ESCC Generic Specification No. 4006			Measurements and Inspections		Symbol	Limits		Unit
Test Title	Test Method and Procedure	Test Parameters	Identification	Conditions		Min.	Max.	
Pre-Encapsulation (Internal Visual) Inspection	5.2.1 / 8.1	Not performed (Note 1 per 4.2.4.1 herein)						
Thermal Shock	5.2.2 / 8.2	-55 +0/-5°C; 15 minutes min. 25 +10/-5°C; 10 minutes min. /15 minutes max. 200 +5/-0°C; 15 minutes min. 25 +10/-5°C; 10 minutes min. /15 minutes max. 10 cycles	None	None				
Room Temperature Electrical Measurements	5.2.3 / 8.3.4		Zero Power Resistance	0°C	R_Z	Per Table 1(a) herein for specified variant		Ω
External Visual Inspection	5.2.4 / 8.5	3 samples only (Note 1 per 4.2.4.2 herein)	ESCC20500/ ESCC2054000	Lot rejection for any failure				
Dimension Check	5.2.5 / 8.5	3 samples only	Dimensions	In the event of a failure, test 100%		Per Figure 1 herein, and S220185 specification drawing		
Weight	5.2.6	Dependent on variants (Note 1 per 4.2.4.3 herein)						

NOTES:

1. Denotes exception to ESCC Generic Specification No. 4006.

TABLE 5 – Screening Tests Summary (Chart F3)

ESCC Generic Specification No. 4006			Measurements and Inspections		Symbol	Limits		Unit
Test Title	Test Method and Procedure	Test Parameters	Identification	Conditions		Min.	Max.	
Parameter Drift Values (Initial Measurements)	8.3.2		Zero Power Resistance	0°C	R_Z	Per Table 1(a) herein for specified variant		Ω
Burn-in	8.4	200 ±5°C; 168 +14/-0 hours Unpowered						
Parameter Drift Values (Final Measurements)	8.3.2		Zero Power Resistance	0°C	R_Z	Per Table 1(a) herein for specified variant		Ω
High, Low, and Minimum Temperatures Electrical Measurements	8.3.3		Minimum Temperature Resistance	-196°C	R_M	Per Table 1(a) herein for specified variant		Ω
			Low Temperature Resistance	-50°C	R_L	Per Table 1(a) herein for specified variant		Ω
			High Temperature Resistance	200°C	R_H	Per Table 1(a) herein for specified variant		Ω
Room Temperature Electrical Measurements	8.3.4		Zero Power Resistance	0°C	R_Z	Per Table 1(a) herein for specified variant		Ω
Radiographic Inspection	8.6	Not performed (Note 1 per 4.2.5.1 herein)						
External Visual Inspection	8.5	(Note 1 per 4.2.5.2 herein)	ESCC 20500/ESCC2054000					
Dimension Check	8.5		ESCC 20500			Per Figure 1 herein, and S220185 specification drawing		

NOTES:

1. Denotes exception to ESCC Generic Specification No. 4006.

TABLE 6 – Intermediate and End-Point Electrical Measurements and Qualification and Periodic Tests Summary (Chart F4)

Subgroup 1 (12 pieces – no failures permitted)								
ESCC Generic Specification No. 4006			Measurements and Inspections		Symbol	Limits		Unit
Test Title	Test Method and Procedure	Test Parameters	Identification	Conditions		Min.	Max.	
Shock (Specified Pulse)	8.7	Not performed (Note 1 per 4.2.6.1 herein)						
Vibration	8.8	Not performed (Note 1 per 4.2.6.2 herein)						
Dielectric Withstanding Voltages	8.9	Not performed (Note 1 per 4.2.6.3 herein)						
External Visual Inspection	8.5	Not performed						
Subgroup 2 (12 pieces – no failures permitted)								
ESCC Generic Specification No. 4006			Measurements and Inspections		Symbol	Limits		Unit
Test Title	Test Method and Procedure	Test Parameters	Identification	Conditions		Min.	Max.	
Thermal Shock	8.2	-55 +0/-5°C; 15 minutes min. 25 +10/-5°C; 10 minutes min. /15 minutes max. 200 +5/-0°C; 15 minutes min. 25 +10/-5°C; 10 minutes min. /15 minutes max. 10 cycles	None	None				
Resistance to Soldering Heat	8.10	Not performed (Note 1 per 4.2.6.5 herein)						
Moisture Resistance	8.11	Not performed (Note 1 per 4.2.6.6 herein)						
External Visual Inspection	8.5	(Note 1 per 4.2.6.4 herein)	ESCC 20500/ESCC2054000					
Dimension Check	8.5		ESCC 20500			Per Figure 1 herein, and S220185 specification drawing		

NOTES:

1. Denotes exception to ESCC Generic Specification No. 4006.

TABLE 6 – Intermediate and End-Point Electrical Measurements and Qualification and Periodic Tests Summary (Chart F4)

Subgroup 3 (12 pieces – no failures permitted)								
ESCC Generic Specification No. 4006			**Measurements and Inspections**		**Symbol**	**Limits**		**Unit**
Test Title	**Test Method and Procedure**	**Test Parameters**	**Identification**	**Conditions**		**Min.**	**Max.**	
Dissipation Constant	8.12		Dissipation Constant		P(mW/°C)	3		mW/°C
Thermal Time Constant	8.13		Thermal Tiime Constant		τ		30	sec
Solderability	8.14	Leads immersed within ±1.25mm of lead insulation. (Note 1 per 4.2.6.7 herein)	Inspect per ANSI/J-STD-002			Per ANSI/J-STD-002		
Terminal Strength	8.15	1 lb. for 5 seconds (each lead) (Note 1 per 4.2.6.8 herein)	Zero Power Resistance (initial)	0°C	R_Z	(record only)		Ω
			Parameter Drift (final)	0°C	$\Delta R_Z/R_Z$	-0.2	+0.2	%
			Visual Examination (final)			No evidence of damage		
External Visual Inspection	8.5	(Note 1 per 4.2.6.4 herein)	ESCC 20500/ESCC2054000					
Dimension Check	8.5		ESCC 20500			Per Figure 1 herein, and S220185 specification drawing		
Subgroup 4 (20 pieces – no failures are permitted)								
ESCC Generic Specification No. 4006			**Measurements and Inspections**		**Symbol**	**Limits**		**Unit**
Test Title	**Test Method and Procedure**	**Test Parameters**	**Identification**	**Conditions**		**Min.**	**Max.**	
Short Time Load	8.16	Per Table 1(b) herein for specified variant (Note 1 per 4.2.6.9 herein)	Zero Power Resistance (final)	0°C	R_Z	Per Table 1(a) herein for specified variant		Ω
			Visual Examination (final)			No evidence of arcing, burning, or charring		
Low Temperature Storage	8.17	-62 ±3°C; 3 hours min (Note 1 per 4.2.6.10 herein)	Zero Power Resistance (initial)	0°C	R_Z	(record only)		Ω
			Parameter Drift (final)	0°C	$\Delta R_Z/R_Z$	-0.2	+0.2	%
			Visual Examination (final)			No evidence of damage		
Operating Life 2000 hours	8.18	200 ±5°C (convection oven); 2 mW energization (Note 1 per 4.2.6.11 herein)	Zero Power Resistance (initial)	0°C	R_Z	Per Table 1(a) herein for specified variant		Ω
			Parameter Drift (1000 ±48 hours)	0°C	$\Delta R_Z/R_Z$	-0.2	+0.2	%
			Parameter Drift (from initial) (2000 ±48 hours)	0°C	$\Delta R_Z/R_Z$	-0.2	+0.2	%
Permanence of Marking	8.19	Not performed (Note 1 per 4.2.6.12 herein)						
External Visual Inspection	8.5	(Note 1 per 4.2.6.4 herein)	ESCC 20500/ESCC2054000					
Dimension Check	8.5		ESCC 20500			Per Figure 1 herein, and S220185 specification drawing		

NOTES:

1. Denotes exception to ESCC Generic Specification No. 4006.