

Gemini 550 LRI Evaluation Report

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GEMINI 550 LRI S

EVALUATION REPORT

ISSUE 01

GEMINI 550 LRI S PERFORMANCE

The Gemini 550 LRI S (Large Removable Insert) is similar to the Gemini 550 but instead of having a fixed block it has a large removable insert which can be drilled to suit probe requirements especially if such probes have a shape which can not be accommodated in our standard models.

The insert is 64 x 160mm with eight pockets 8 x 154mm deep.

The performance is determined by the number of holes, depth of holes and consequent thermal loading. This Evaluation Report is valid for the standard insert which has 8 x 8mm ϕ holes.

AXIAL HOMOGENEITY

Method

Two type N thermocouples were placed in one of the 8mm pockets. Alumina Powder was added to fill the pocket and provide thermal transfer.

The thermocouples were connected differentially and the output variation was recorded as one thermocouple was raised in 10mm steps.

The top of the block was insulated.

DISTANCE MM	μ V FROM DIFFERENTIAL THERMOCOUPLE		
	35° C	275° C	550° C
0	0	0	0
10	0	5	-4
20	0	6	-7

30	1	7	-10	
40	0	8	-11	
50	0	7	-14	
60	1	3	-18	
MAXIMUM VARIATION,° C		35° C	275° C	550° C
		0.04	0.2	0.5

RADIAL HOMOGENEITY

Method

Two Semi Standard PRT's were placed in two holes 180° apart and measurements were made. Then the probes swapped between pockets and the procedure repeated. This removes the small calibration offsets between the probes.

The temperature difference between the pockets were then calculated.

DIFFERENCE BETWEEN POCKETS	35° C	275° C	550° C
	0	0.012	0.017

LOADING

A solid metal rod was introduced into a pocket between the standard thermometer and the units own external reference probe.

The difference in temperature (between the standard probe and the external reference probe) was recorded after the rod was added.

LOADING CHANGE	35° C	275° C	550° C
	0.1	0.1	0.2

STABILITY

The stability was recorded at three different temperatures over a 30 minute period.

STABILITY ±° C	35° C	275° C	550° C
	0.02	0.03	0.03

Heat up Time

35 to 550° C 60 minutes

Cool Down

550 to 275° C 132 minutes

550 to 60° C 420 minutes

Probe Ageing 8mK (10 hours at maximum 550° C operating temperature)

Hysteresis The difference between the actual temperature and the units own PRT and indicator changed by less than 0.1° C after the Gemini was cycled to the maximum temperature of 550° C.

CALCULATION OF THE UNCERTAINTY, DKD METHOD

CALIBRATION TEMPERATURE, 35° C

Ambient Temperature 23° C. Using 909/885 with TTI 2 and in built "external" indicator of Gemini 550 with reference probe 935-14-17-550/1.

SOURCE OF UCT	DETERMINATION OF UCT	PROBABILITY DISTRIBUTION	UNCERTAINTY ° C	DIVISOR	ui(t), ° C
Standard Thermometer including measurement with standard thermometer	NAMAS Schedule	Normal	0.02	2	0.01
Axial Temperature distribution	This evaluation report	Rectangular	0.04	$\sqrt{12}$	0.012
Radial Temperature distribution	This evaluation report	Rectangular	0.0005	$\sqrt{3}$	0
Loading of block	This evaluation report	Rectangular	0.1	$\sqrt{3}$	0.058
Stability with time	This evaluation report	Rectangular	0.02	$\sqrt{12}$	0.006
Ageing of reference thermometer	This evaluation report	Rectangular	0.04	$\sqrt{3}$	0.023
Repeatability (Hysteresis)	This evaluation report	Rectangular	0.1*	$\sqrt{3}$	0.058
Heat Conduction from	0.25% of	Rectangular	0.03	$\sqrt{3}$	0.017

thermometer	(T _{meas} -T _{env})				
Combined Uct		k=1	0.088		
Expanded Uct		k=2	0.177		

*Hysteresis figure is resolution of in built indicator.

Ignoring heat conduction from thermometer: the Expanded UCT = 0.172° C

CALIBRATION TEMPERATURE, 275° C

Ambient Temperature 23° C. Using 909/885 with TTI 2 and in built "external" indicator of Gemini 550 with reference probe 935-14-17-550/1.

SOURCE OF UCT	DETERMINATION OF UCT	PROBABILITY DISTRIBUTION	UNCERTAINTY ° C	DIVISOR	ui(t), ° C
Standard Thermometer including measurement with standard thermometer	NAMAS Schedule	Normal	0.04	2	0.020
Axial Temperature distribution	This evaluation report	Rectangular	0.2	√ 12	0.06
Radial Temperature distribution	This evaluation report	Rectangular	0.012	√ 3	0.007
Loading of block	This evaluation report	Rectangular	0.1	√ 3	0.058
Stability with time	This evaluation report	Rectangular	0.03	√ 12	0.009
Ageing of reference thermometer	This evaluation report	Rectangular	0.04	√ 3	0.023
Repeatability (Hysteresis)	This evaluation report	Rectangular	0.1*	√ 3	0.058

Heat Conduction from thermometer	0.25% of (Tmeas-Tenv)	Rectangular	1.32	$\sqrt{3}$	0.762
Combined Uct		k=1	0.77		
Expanded Uct		k=2	1.54		

*Hysteresis figure is resolution of in build indicator

Ignoring heat conduction from thermometer: the Expanded UCT = 0.210° C

CALIBRATION TEMPERATURE 550° C

Ambient Temperature 23° C. Using 909/885 with TTI 2 and in built "external" indicator of Gemini 550 with reference probe 935-14-17-550/1.

SOURCE OF UCT	DETERMINATION OF UCT	PROBABILITY DISTRIBUTION	UNCERTAINTY ° C	DIVISOR	ui(t), ° C
Standard Thermometer including measurement with standard thermometer	NAMAS Schedule	Normal	0.05	2	0.025
Axial Temperature distribution	This evaluation report	Rectangular	0.5	$\sqrt{12}$	0.144
Radial Temperature distribution	This evaluation report	Rectangular	0.017	$\sqrt{3}$	0.010
Loading of block	This evaluation report	Rectangular	0.2	$\sqrt{3}$	0.115
Stability with time	This evaluation report	Rectangular	0.03	$\sqrt{12}$	0.009
Ageing of reference thermometer	This evaluation report	Rectangular	0.04	$\sqrt{3}$	0.023

Repeatability (Hysteresis)	This evaluation report	Rectangular	0.1*	$\sqrt{3}$	0.058
Heat Conduction from thermometer	0.25% of (Tmeas-Tenv)	Rectangular	0.63	$\sqrt{3}$	0.36
Combined Uct		k=1	0.414		
Expanded Uct		k=2	0.827		

*Hysteresis figure is resolution of in built indicator.

Ignoring heat conduction from thermometer: the Expanded UCT = 0.393° C

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