6.1.17 Measuring junctions shall be made by 1) Any combination of twisting and/or welding the thermoelements provided there is no addition of filler metal (including ungrounded and grounded MIMS). 2) Spot welding the thermoelements directly to a part, simulated part, or heat sink is permitted for temperatures ≤2000 °F or 1100 °C.

6.1.18 Sensor and extension wire / connector as per below table

Sensor					Extension Wire		
Classification	Type	Positive Element Composition Nominal wt. %	Negative Element Composition Nominal wt. %	Element Color Code	Wire Code Positive/Negative	Jacket Color Code(1)	Connector Color Code(1)
Base Metal	J	Fe	55Cu/45Ni	White/Red	JPX/JNX	Black	Black
	E	90Ni/10Cr	55Cu/45Ni	Purple/Red	EPX/ENX	Purple	Purple
	K	90Ni/10Cr	95Ni/5, Al + Si	Yellow/Red	KPX/KNX	Yellow	Yellow
	N	84.5Ni/14Cr/1.5Si	95.4Ni/4.5Si/0.1Mg	Orange/Red	NPX/NNX	Orange	Orange
	M(3)	82Ni/18Mo	Ni	Yellow/Red	KPX/KNX	Yellow	Yellow
	T	Cu	55Cu/45Ni	Blue/Red	TPX/TNX	Blue	Blue
Noble Metal(2)	R	87Pt/13Rh	PT	Black/Red	RPX/RNX or SPX/SNX	Green	Green
	B	70Pt/30Rh	94Pt/6Rh	Gray/Red	BPX/BNX	Gray	Gray
	S	90Pt/10Rh	PT	Black/Red	PRX/RNX or SPX/SNX	Green	Green
Refractory(2)	C	95W/5Re	74W/26Re	Green/Red	CPX/CNX	Red	Red

Extension wire shall be of the same nominal composition as the sensor and instrumentation used , except when compatible compensating extension wire is allowed (e.g noble metals) . Extension wire shall meet the requirement of above table

6.1.19 Extension wire shall not be spliced other than using a compatible connector.

6.1.20 Wireless transmitters may be used as an alternative to extension wire.

6.1.21 Addition to above Sensor calibration certificate includes following points:

a. Identification of the sensor, batch of sensors or wire/cable rolls.
b. Sensor type; e.g., K, N, E, RTD, etc.
c. Date of calibration or recalibration.
d. Quantity or length of wire/cable rolls represented in calibration report.
e. Identification if the calibration was initial or a recalibration.
f. The required calibration accuracy.
g. Identification of the standard test sensor and standard test instrument used.
h. Nominal calibration temperatures.
i. Actual temperature readings of sensor under test.
j. Calibration technique referencing ASTM E220 or other internationally recognized standards.
k. Correction factors or deviations/errors for each calibration temperature, including the average correction factor representing both ends for wire/cable rolls.
l. Documentation shall clearly state deviation (error) or correction factor.
m. A statement of traceability to NIST or other internationally recognized standards organization.
n. Identification of the calibration agency.
o. Identification of technician performing calibration.
p. Approval of an authorized agent for the calibration agency.
q. User quality organization approval.

Refer Checklist QA/08/WI/34 for review of sensor calibration report

Note: - Qualified Operating Temperature range, Operating Temperature range, working Temperature range and Temperature range are referred as same in this manual.

6.2 Temperature Sensor Specific Requirement :

6.2.1 **Reference standard sensors**:

6.2.1.1 Reference standard sensors are those sensors which are used to calibrate primary standard. They are calibrated against NIST or national reference standard.

6.2.1.2 Types: These sensors are of Types R and S noble metal.

6.2.1.3 Calibration: These sensors are calibrated before first use.

6.2.1.4 Maximum permitted error: None

6.2.1.5 Recalibration: 5years

6.2.2 **Primary Standard sensors :**

6.2.2.1 Sensors with calibration directly traceable to a reference standard normally used to calibrate secondary test sensors.

6.2.2.2 Types: Theses sensors are of Types R and S noble metal.

6.2.2.3 Calibration: These sensors are calibrated before first use.

6.2.2.4 Maximum permitted error: $\pm 0.6^0$c or ±0.1% whichever is higher.

6.2.2.5 Recalibration: 3years.

6.2.3 **Secondary Standard Sensors:**

6.2.3.1 Secondary standard sensors are those sensors which are calibrated with primary or reference standards sensors and primary standard test instrument. They are calibrated against NIST or national reference standard.

6.2.3.2 Types: Theses sensors are of Types- base or R and S noble metal.

6.2.3.3 Calibration: These sensors are calibrated before first use.

6.2.3.4 Maximum permitted error:

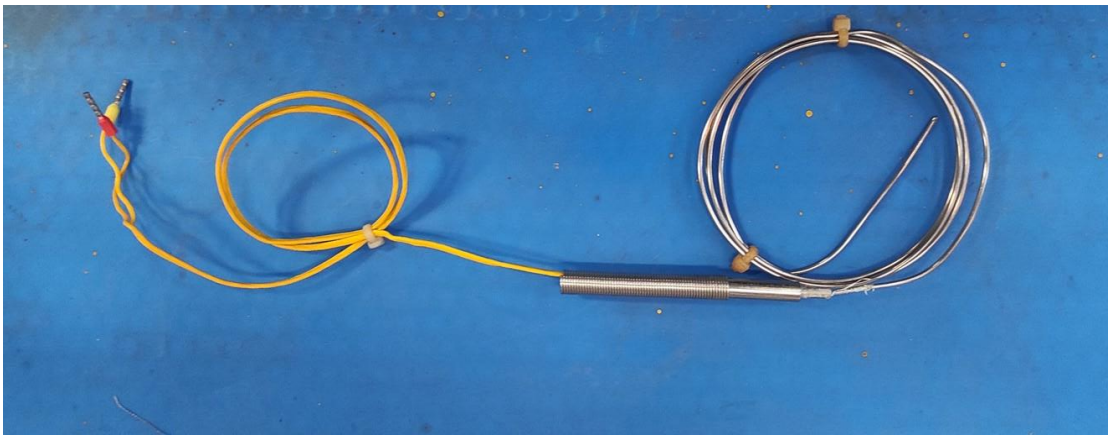
Base $\pm 1.1^0$c or ± 0.4% whichever is higher. Noble $\pm 0.6^0$C or ±0.1% whichever is higher.

6.2.3.5 Recalibration: Base 1 year, R and S noble metal 2 years.

NOTE: Though specification of reference standard sensors, primary standard sensors and secondary standard sensors are mentioned in this manual, However use of above sensors is not under GODREJ AEROSPACE scope of work under Pyrometry, as GODREJ AEROSPACE procures the calibrated thermocouple wire roll of max length 610m and calibration is from NABL accredited lab for various application likes TUS, SAT, Controlling , monitoring and recording purpose.

6.2.4 **Temperature uniformity Survey (TUS) sensors:**

6.2.4.1 A calibrated and traceable sensor with known deviations if any, that are used for conducting temperature uniformity surveys. They are calibrated against primary or secondary standard.



6.2.4.2 Types: Base metal like K type **Non-expendable** roll thermocouple.

6.2.4.3 Calibration: Rolls are sampled at both ends and average correction factor from both ends of roll is used if the individual correction factor from each end is within ±1.1ºC or 0.4% of reading. Difference between the highest and lowest calibration readings of the sample thermocouples at any calibration temperature shall not exceed 1.1ºc. These sensors are calibrated before first use by a NABL Accredited Lab over the working temperature range within which they are to be used (as mentioned below),

The average correction factor calculated from both ends of the roll at each calibration temperature and used for the entire length of the roll.

Recommended Approximate Calibration points for K type Roll Thermocouple (°C)			
-80	400	820	1200
40	485	900	1285
100	620	970	
200	650	1000	
300	750	1080	

6.2.4.4 Maximum Permissible error: The individual correction factor from each end is not exceeding ±1.1ºC or 0.4% of reading. The roll is not accepted if the difference between the highest and lowest calibration readings of the sample thermocouples at any calibration temperature exceeds 1.1ºC.

6.2.4.5 Recalibration: Not permitted.

Reuse: Reuse is allowed up to 3 months from the date of first use. Depth of insertion shall be equal to or greater than the depth of insertion of any previous use if used above 260ºC.

6.2.5 **System Accuracy Test (SAT) Sensors:**

6.2.5.1 A Calibrated and traceable sensors with known deviations if any, that are used for System Accuracy Test. They are calibrated against primary or secondary standard.