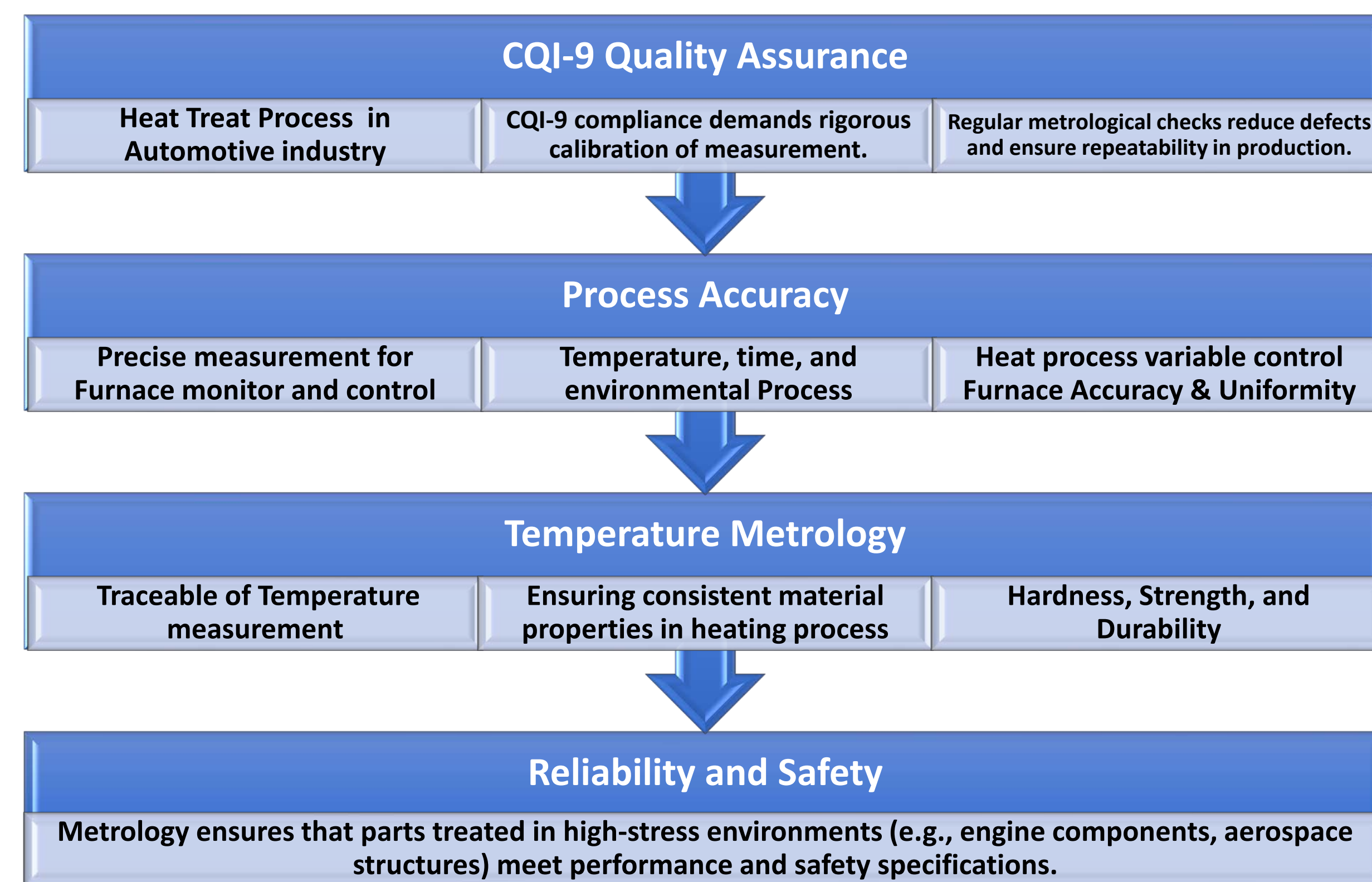


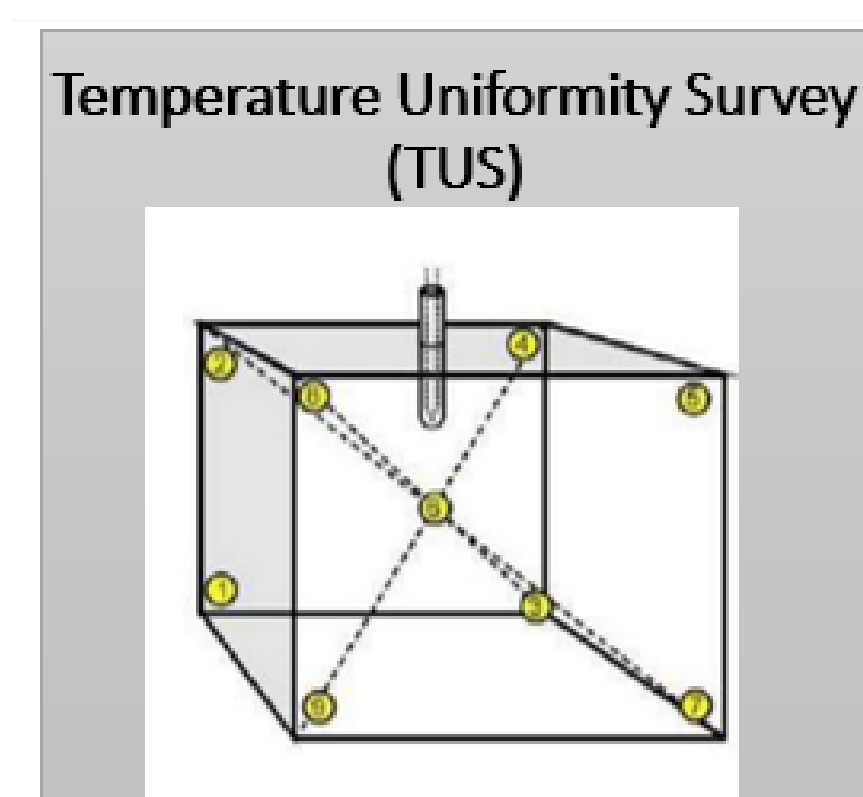
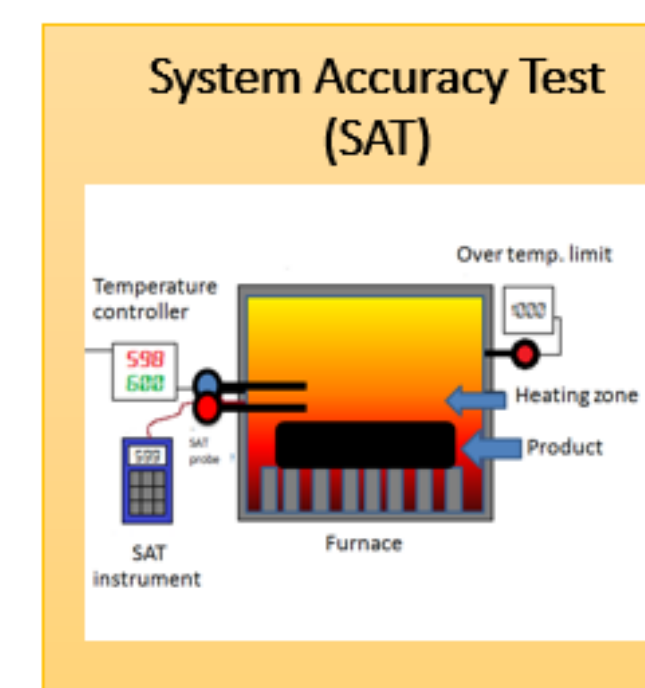
1. Introduction

Metrology is the science of measurement, and its role in heat treatment processes is indispensable for achieving precision and compliance with CQI-9 standards. By ensuring accurate control and measurement, metrology supports the production of reliable, high-quality components used in critical industries such as automotive, aerospace, and manufacturing.

2. Key Highlights



Industrial Heat Treating Furnace with CQI-9 requirement



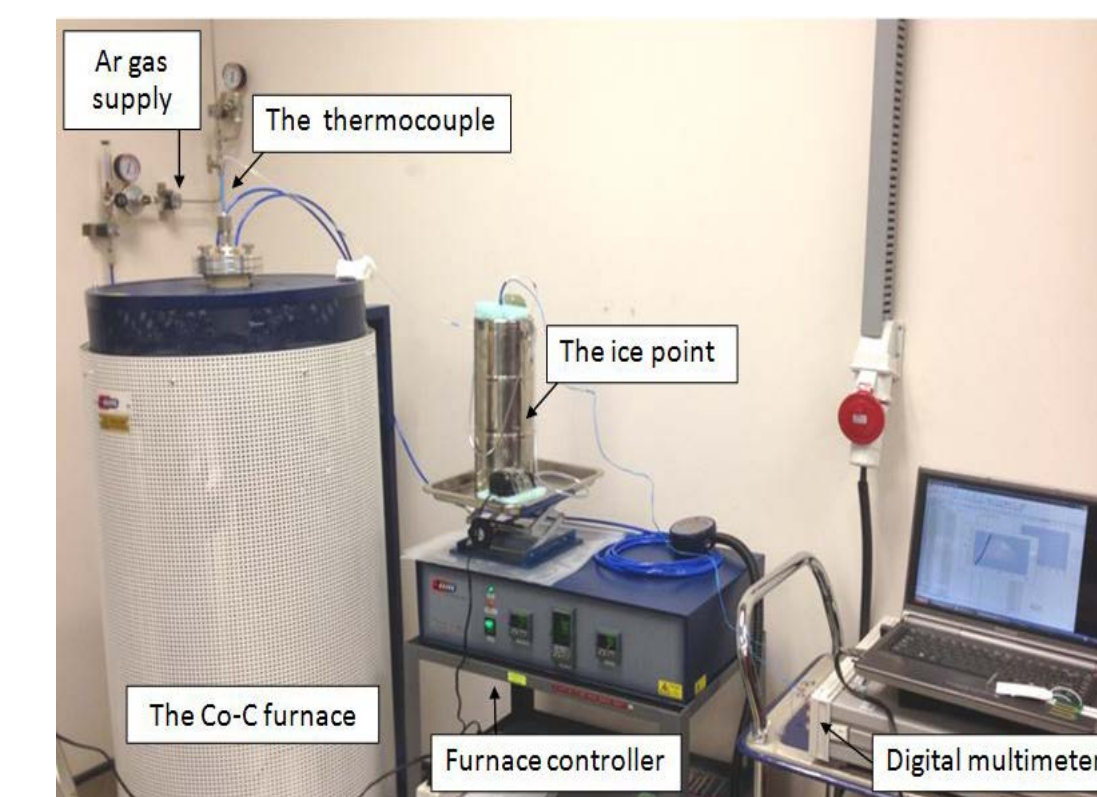
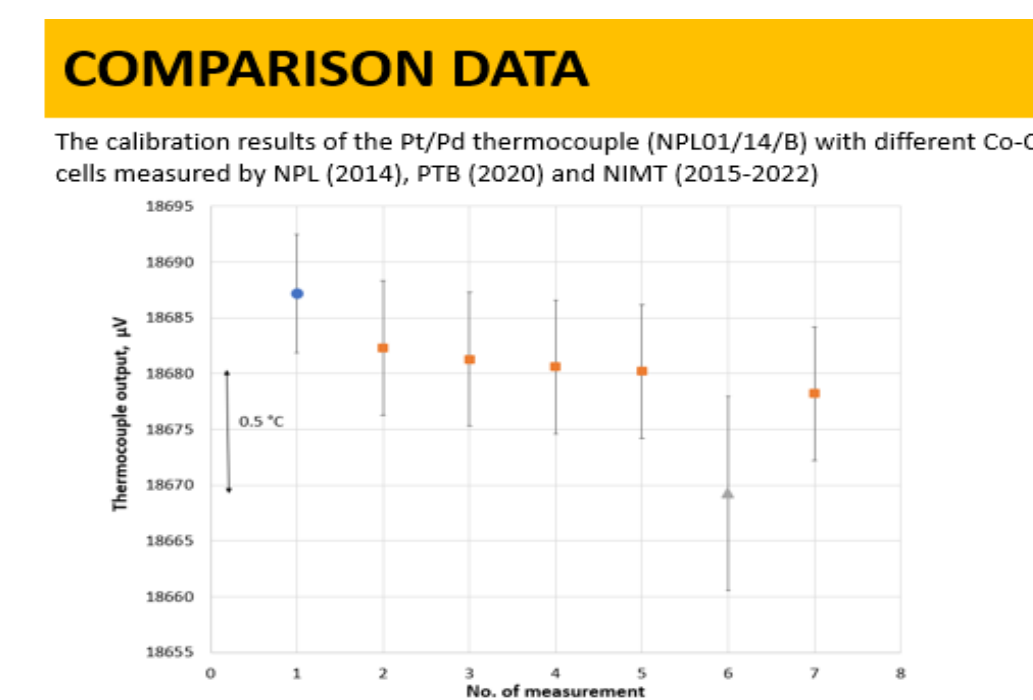
What is CQI-9

CQI-9 is a standard by the Automotive Industry Action Group (AIAG) for assessing and improving heat treatment processes in the automotive industry. It ensures consistent quality, process control, and compliance with industry requirements.



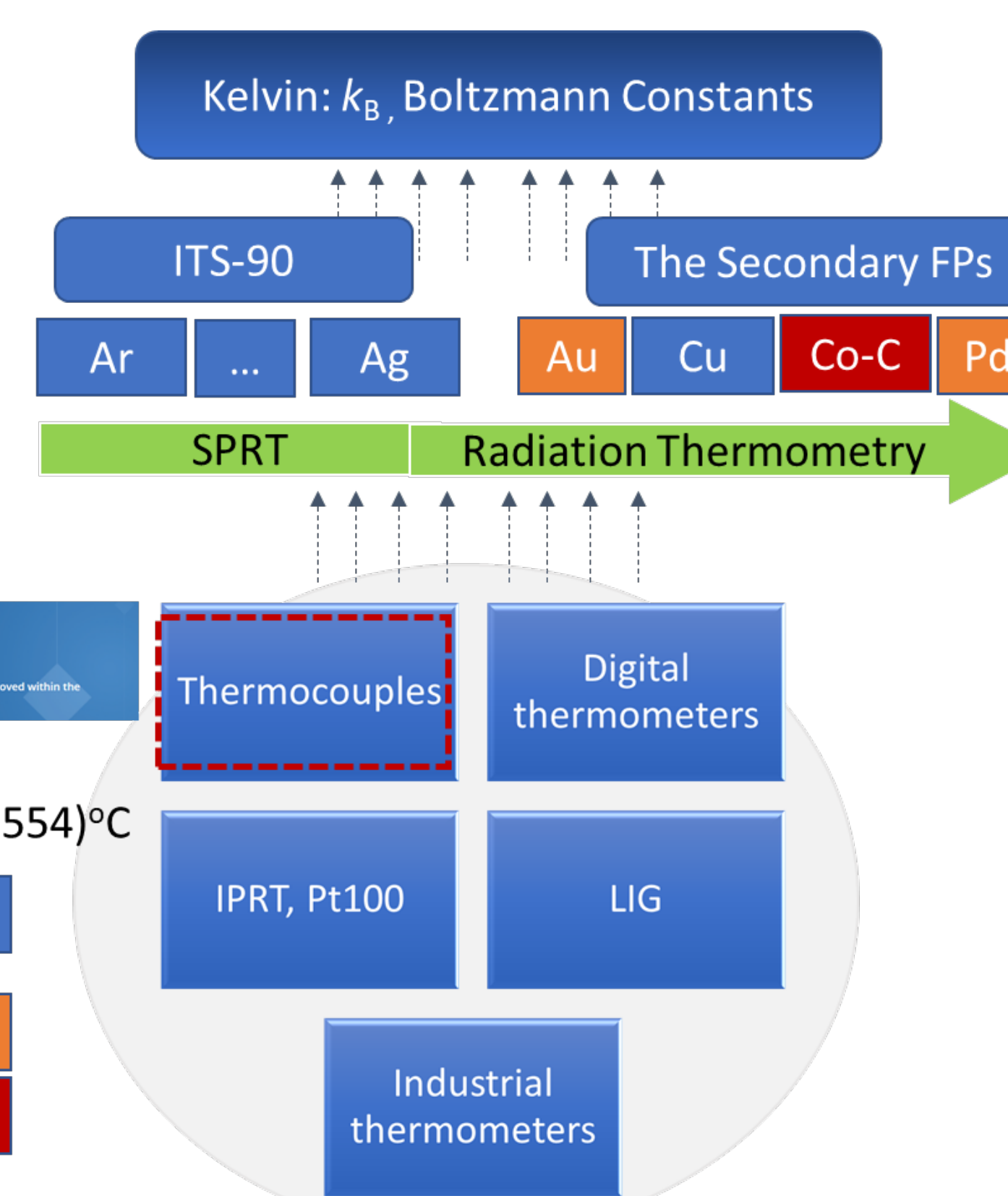
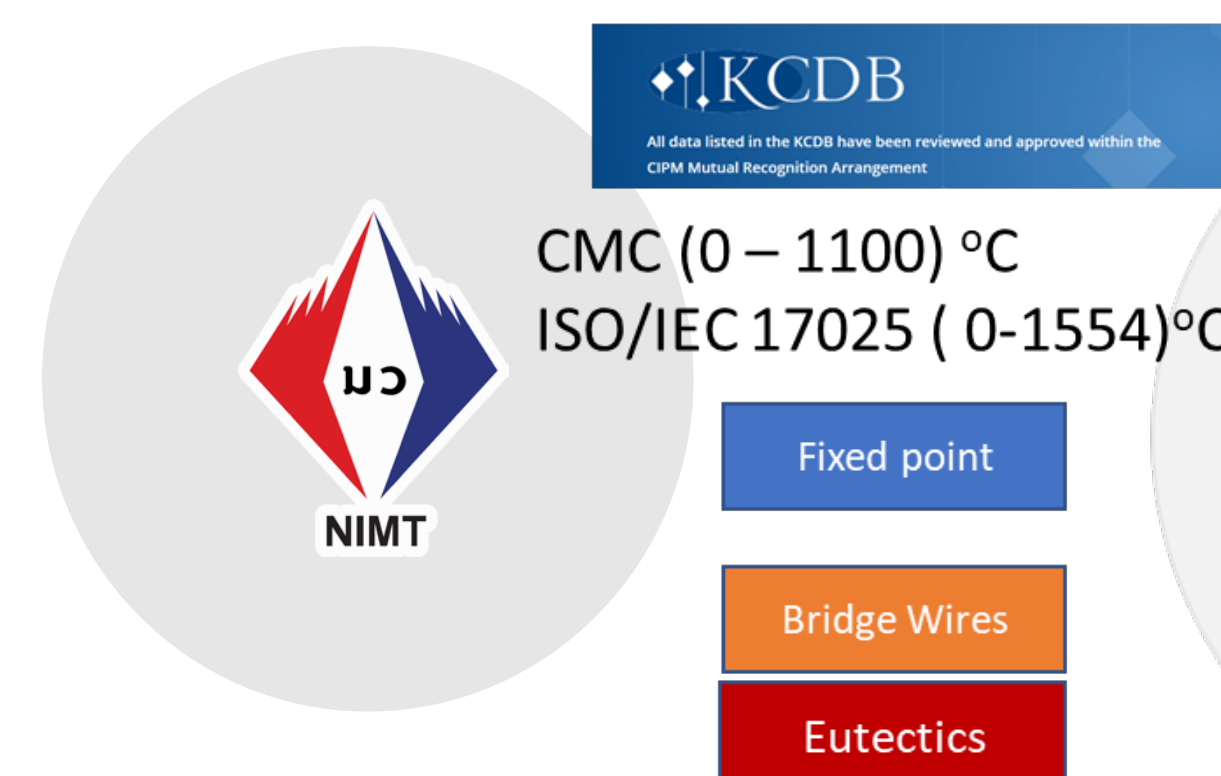
3. Thermocouple Calibration and Traceability

- NIMT supports Thailand automotive industry to ensure furnaces and temperature sensors operate within specified tolerances of CQI-9. (Temperature up to 1500 °C)
- NIMT Participating Inter-comparison (APMPT-S 16) the APMP Regional Comparison of Type R Thermocouples Calibration (Cu, Co-C & Pd point) 2017 – 2024 (Draft B) and Pt/Pd Thermocouple Hybrid Comparison between NPL, NIMT & PTB (ITS10, 2024).



NIMT calibration facilities of thermocouple calibration at cobalt-carbon eutectic cell.

NIMTs	Temperature*	Traceability
NPL	(1324.29 ± 0.44) °C	The NPL reference Co-C cell is traceable via ITS90 NPL radiation thermometry and the intercomparison [3-4].
PTB	(1323.85 ± 0.4) °C	The PTB Co-CB reference cell used is traceable through melting temperatures of more than one Co-C cells [1] and in accordance with ITS-90 extrapolation method within a bilateral comparison [5].
NIMT	(1324.06 ± 0.44) °C	The NIMT Co-C cell 2014/Co-C1 traceability is claimed via the cell calibration certificate from NPL & hybrid comparison with the NPL and PTB cells using the same Pt/Pd thermocouple.
CCT-BIPM	(1324.06 ± 0.7) °C**	Approximate ITS-90 temperature for Co-C fixed points. The temperature is assigned by radiation thermometry or using Pt/Pd thermocouples [6-7].



4. Collaborations in Metrology for CQI-9



National Institute of Metrology (NIMT) works with the Thai Heat Treating Association and over 40 heat treatment enterprises to enhance the accuracy and reliability of heat treatment processes. Supporting the productivity of the automotive and aerospace industries through temperature metrology and measurement traceability, ensuring compliance with CQI-9 standards.

- Workshops and Training:** "Metrology for CQI-9," to educate industry operators, bring together CQI-9 auditors, heat treatment experts, and calibration laboratories to provide practical measurement solutions and promote best practices.
- Capacity Building for Calibration Laboratories:** supports calibration laboratories to ensure their capabilities align with industry needs, fostering improved process reliability.

5. Conclusion

- Metrology is essential for ensuring accuracy and reliability in heat treatment processes, aligning with the CQI-9 Heat Treat System Assessment standard.
- Strengthening calibration capabilities ensures compliance with industry requirements.
- Collaboration between NIMT and the Heat Treat Society of Thailand enhances measurement traceability and industry best practices.
- Future expansion will focus on atmospheric control measurements (O₂ and gas sensors, dew point, pressure control) for improved heat treatment accuracy.

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