

EMRP SIB 52 THERMO

Metrology for thermal protection materials

MKEH In-house Designed High-Temperature
Thermal Conductivity Measurement Apparatus



Emese Turzo-Andras

Stakeholder Meeting
NPL – Nov. 2014

MKEH in-house designed HTTCMA

- Double specimen $\Phi 305$ mm
- Specimen thickness: 20 mm to 60 mm
- T: 70 °C to 850 °C
- λ : 0.02 WK⁻¹m⁻¹ to 5 WK⁻¹m⁻¹
- ΔT : 20 °C to 200 °C
- Edge guard: Insulation only
- Pressure load: 10 kPa
- Thickness measurement: measured outside the apparatus but with the same pressure

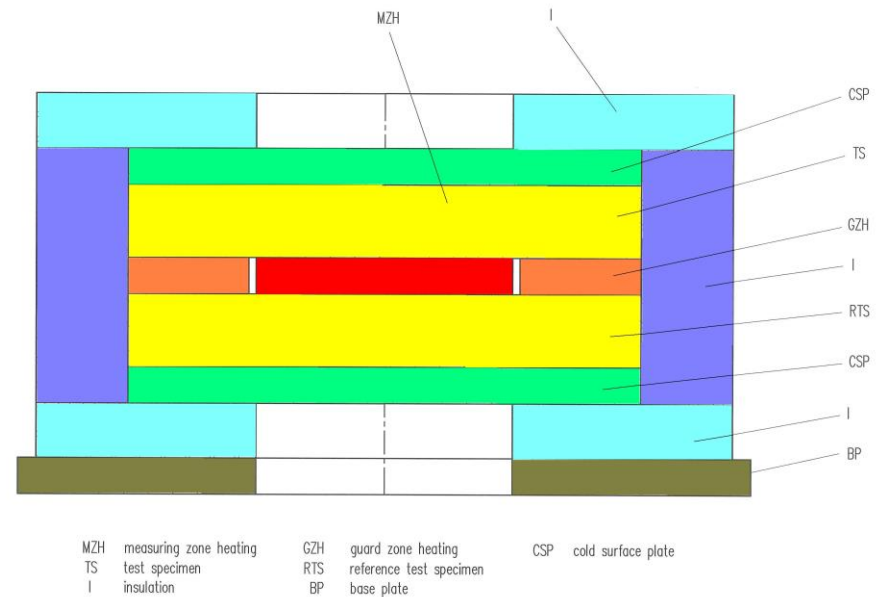


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- Dimensions:
 - Overall lateral: $\Phi 305$ mm
 - Metering area $\Phi 200$ mm
 - Centre-guard gap 2 mm, not filled
- Plates:
 - 30 mm + 2 x 15 mm thick

thermal resistant stainless steel

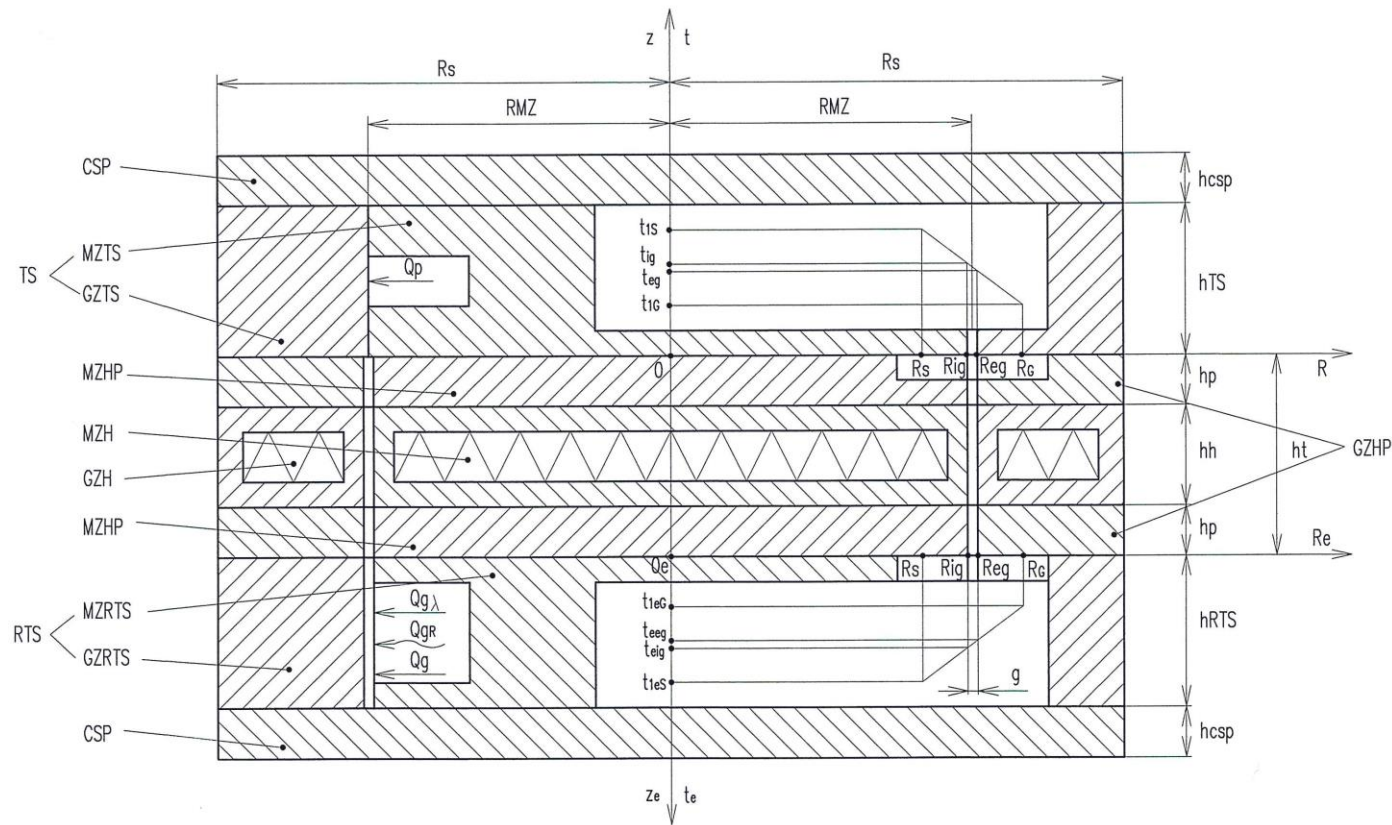
 - Heat sinks for temperature uniformity
 - No heated-cold plates



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Improvements

- Temperature sensors (16 in total):
 - Type S thermocouples, $\Phi 2$ mm
 - 12 in grooves in specimen
 - After improvements: 12 movable sensors inside the specimens, at distances of 6 mm, 18 mm and 30 mm from the upper surface
 - 2 movable sensors in grooves in heater plates
 - 2 sensors in heater plates (1 in metering zone + 1 in guard zone)
- Additional insulation at the upper and lower part of the apparatus



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Improvements

- ΔT : 10 °C to 100 °C after improvements
 - ΔT : 20 °C to 200 °C achieved for T : 70 °C to 950 °C
 - Adjustment of the guard heater
 - Additional insulation
- Position of the temperature sensors after improvements:
 - 12 movable sensors inside the specimens, at distances of 6 mm, 18 mm and 30 mm from the upper surface
 - 3 sensors at axial direction because the temperature distribution in axial direction is not linear inside the specimen
 - The sensors are placed inside the specimen in order to eliminate the effect of the thermal contact resistance, to determine experimentally the temperature distribution inside the specimen in axial direction, to determine experimentally the heat loss inside the specimen in radial direction
 - Placement of the temperature sensors causes an error of less than 1 %
 - 2 sensors inside the heater plates (metering + guard) to adjust the heating power and to protect the heating elements against overheating
 - 2 movable sensors in grooves in heater plates
 - The movable sensors in heater plates are used to determine the temperature distribution along the gap and for fine adjustment of the heating power, based on measurement results

