

Determination of the radiation effect in the temperature mapping of temperature controlled enclosures NF35

The following is applicable to all applicant and accredited calibration laboratories accredited for temperature mapping of a temperature-controlled enclosure. It also applies to testing laboratories completing internal calibration of these types of enclosures. The radiation effect as described below shall be included in estimates of measurement of uncertainty of the calibration in these cases.

Radiation effects:

When temperature controlled enclosures are used in the temperature range above room temperature, the temperature of the walls of many models can be significantly different to that of the air. Due to heat transfer through radiation, the air temperature can differ considerably to that of a thermometer or test object in the enclosure.

According to the law of radiation, the influence of this effect increases at higher temperatures. Depending on the operating principle of the enclosure, differences of several Kelvin are possible above 150 °C.

This radiation effect shall be included in estimating the measurement uncertainty for the calibration.

The radiation effect may be estimated in the following manner:

1. Use of a thermometer with a low emissivity as well as of a thermometer with a high emissivity surface; there must be a visible difference in the reflectiveness of the surfaces of both thermometers. The difference ascertained between the two thermometers is a measure of the radiation effect (if wall temperature and air temperature are not identical).
2. The air temperature can also be measured with a thermometer protected from the influence of the enclosure wall, using a radiation shield. (For example Stevenson screen) This radiation shield must be ventilated or, by its arrangement and design, allow the thermometer to be adequately exposed to the circulated air. With the radiation shield mounted, the thermometer measures the air temperature and, after removal of the radiation shield, the “radiation temperature”, i.e. the temperature under the influence of radiation. The difference ascertained between the two measurements is a measure of the radiation effect, if the wall temperature deviates from the air temperature.

In the case of 1 and 2 the temperature sensors must be of small dimensions and mounted in sheaths, the external diameter of which around the sensitive part must be less than 5 mm.^[2]

3. For temperatures from 0 °C to 150 °C, the radiation effect need not be metrologically determined and can be estimated according to the table below.^[1]

Temperature Range	Minimum Radiation effect uncertainty
Below ambient temperature	Negligible effect
Ambient temperature to 50 °C	± 0.3 °C
50 °C to 130 °C	± 1.0 °C
130 °C to 150 °C	± 1.5 °C
Above 150 °C	Effect to be determined, using methods 1 or 2

Calibration laboratories will have a choice to use options 1, 2 or 3 for temperatures up to 150 °C. Above 150 °C, options 1 or 2 shall be used.

Please contact your INAB assessment manager if you have any queries.

References:

1. Friederici S and Tegeler E 2004 Proc. of TEMPMEKO 2004, 9th Int. Symp. on Temperature and Thermal Measurements, in Industry and Science ed D Zvizdić et al (Zagreb: FSB/LPM) pp 795–800.
2. AFNOR NF X 15-140 – (2002): Mesure de l’humidité de l’air | Measurement of Air Humidity Enceintes climatiques et thermostatiques - Caractérisation et verification | Climatic and Thermostatic Chambers. Characterisation and Verification.