# Qualifying immersion depth of ø5.2 mm temperature probes – Experimental determination in different set-ups and a critical discussion about influence quantities and the test description in EN 1434 and EN IEC 60751.

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The *qualifying* immersion depth is part of the pattern approval of a temperature sensor according to EN 1434 (Clause 7.4.4.1 of EN 1434-4:2022), and described as *minimum* immersion depth, this test can also be found with subtle deviations e. g. in EN IEC 60751:2022 (Clause 6.5.9). This quantity describes how far a temperature probe shall be immersed into the medium at minimum, before a measuring error, caused by non-sufficient immersion of the temperature probe, becomes smaller than 0.1 K compared to a reference immersion under well-defined test conditions. This quantity is type-characteristic for a temperature probe and is often stated in type approval certificates and data sheets. However, typically no uncertainty is stated for this number.

Comparative investigations in the laboratories of JUMO and Kamstrup leading to different results of the qualifying immersion depth of a ø5.2 mm Pt100 temperature probe from JUMO (Type 61-63-G0-0J3-221) have revealed that the well-defined test conditions in a laboratory are still lacking an uncertainty analysis. In addition, even though it can be assumed that the terms *qualifying* immersion depth (EN 1434) and *minimum* immersion depth (EN IEC 60751) shall describe the same property of a temperature probe, subtle differences can be found in the respective test descriptions, and no clear definition of a *fully* immersed temperature probe is given.

In the presented investigations a *fully* immersed temperature probe is defined as the wet part of the temperature probe, when installed directly, and setting the reference temperature. Influence factors are investigated and their impact on the uncertainty is determined, e. g. the uncertainty in the immersion depth due to positioning errors and changes in the level of the water surface during the measurement. Furthermore, the influence of the bath is investigated, e. g. vertical temperature gradients and used materials of the cover. These influences shall be considered when the total measuring uncertainty is calculated for the qualifying immersion depth of a temperature probe.