Application Note PE014

1 GUM - DIN V ENV 13005

Measurement uncertainties are correctly determined and specified according to GUM. This is the ISO/BIPM guideline "Guide to the Expression of Uncertainty in Measurement" which can be found in the German pre-standard DIN V ENV 13005 ("Guideline for specifying uncertainty in measurement").

The measurement results are considered using statistical methods. The individual variables influencing the measurement uncertainty are examined and evaluated with regard to their distribution and their influence on the measurement result.

The aim of this method is to obtain a comprehensible picture of the measurement uncertainty that is as realistic as possible. This procedure requires appropriate knowledge and will not be explained in more detail at this point. Instead, an extremely simplified estimate is primarily intended to provide an overview of the sources and magnitudes of possible measurement uncertainties.

2 Extremely simplified error estimation

In the following, using an FM 302 with AS-NTP probe as an example, the uncertainties to be expected during the measurement and the magnitude of these are shown.
A device temperature of 33 °C and a probe temperature of 38 °C are assumed. In addition, an angular error of 2° is assumed.

A value of 1000 mT is assumed as the field.

2.1 Device linearity error

The linearity error (the proportional deviation between measured and actual value) of the device is 0.1% ± 2 digits. With a 1000 mT field, this is 1 mT ± 0.2mT ≤ 1.2 mT.

2.2 Probe linearity error

The linearity error of the probe is 0.5% ± 0.1% of the measuring range. With a 1000 mT field, this is 5 mT ± 2 mT ≤ 1,2 mT.

2.3 Temperature drift device

The device specifications refer to 23 °C. The device itself has a temperature coefficient of max. 0.01% / K and a zero point drift of max. 0.03 digits / K. With the given 10 °C temperature difference, there is a maximum temperature drift of 0.1 % and a maximum zero point drift of 3 digits. With the measured value of 1000 mT, the deviation can be a maximum of 1,3 mT.

2.4 Temperature drift probe

The probe specifications also refer to 25 °C. The probe has a temperature coefficient of max. 0.05% / K and a zero point drift of max. 0.05 mT / K. At the given 15 °C temperature difference, there is a maximum temperature drift of 0.75 % and a maximum zero point drift of 0.75 mT. With the measured value of 1000 mT, the maximum deviation can be 7.8 mT.

2.5 Angular error

From the assumed angular error of 2 °, we get

$$B_{Mess} = B_0 \cdot \cos\alpha$$

$$\Delta B = \left| B_{Mess} - B_0 \right|$$

at 1000 mT a measurement error of 0.6 mT

2.6 Total error

In the worst case, there is a total error of 16.10 mT. That is 1.610 % of the measured value. However, it is not taken into account that the errors in individual devices can be smaller or can compensate each other.

This behavior is taken into account in the GUM. For more precise calculations, please refer to the GUM and DIN V ENV 13005 regulations mentioned above.

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