

Harmonized Reference Values 2018

After the harmonization exercise of 2017, two meter packages were recalibrated by the laboratories. The result of the recalibration is an improved consistency. The laboratories have received their feedback and will implement the new reference value into their high-pressure facilities ultimately by 30 September 2018. Another development is that the EuReGa secretariat has moved from VSL to PTB on 19 September 2018.

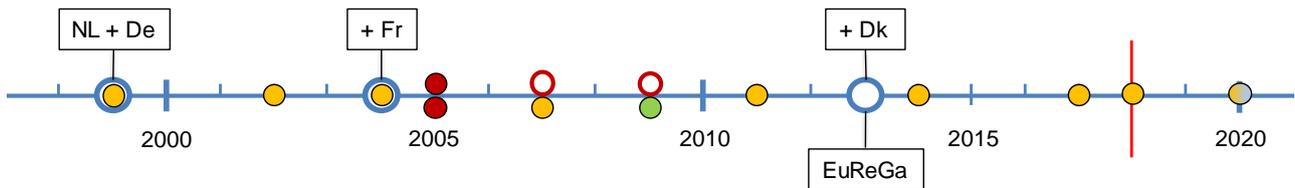


Figure 1: Timeline of intercomparisons using turbine gasmeters intended for high-pressure natural gas. The yellow dots indicate harmonization intercomparisons, the yellow-grey dots planned intercomparisons, the red dots key comparisons, the red rings subsequent bilateral comparisons and the green dot a EURAMET bilateral comparison. The white flags mark the dates at which the labs participated in the harmonization consortium. In 2013 the cooperation was renewed under the EuReGa label.

HRV

The Harmonized Reference Values (HRV) for volume and volume flowrate measurement of high-pressure natural gas are based on multiple independent traceability chains. The HRVs are the weighted averages obtained via a key comparison procedure. The laboratories change their own reference values to the HRV and benefit from a reduction of measurement uncertainties. This procedure is successful as long as the stochastic contributions to the overall measurement uncertainties are significantly smaller than the uncertainties arising from the traceability chain. The harmonization procedure is described in a paper that will be made available via open access [1].

EuReGa

Since 2013 EuReGa is the name under which National Metrology Institutes and Designated Institutes cooperate in the field of gas flow measurement in Europe. By combining their traceability chains these countries aim at a more accurate and more stable cubic metre. The results of their cooperation are graphically displayed in Figure 1.

Harmonization exercise 2018

During the 2017 intercomparison it was decided to repeat the intercomparison for the DN250 and DN400 packages [2]. The results obtained, are more consistent. The new HRV 2018 is based on the 2018 results of the DN250 and DN400 packages and the 2017 results of the DN100 and DN150 packages. The new feedback factors have been reported to the laboratories and all have agreed to have the new HRVs implemented by 30 September 2018.

Normalized deviation E_n

Figure 2 shows the E_n values with respect to the HRV level. The yellow line is warning level corresponding to $E_n = 1$. The red line is the critical level corresponding to $E_n = 1.2$.

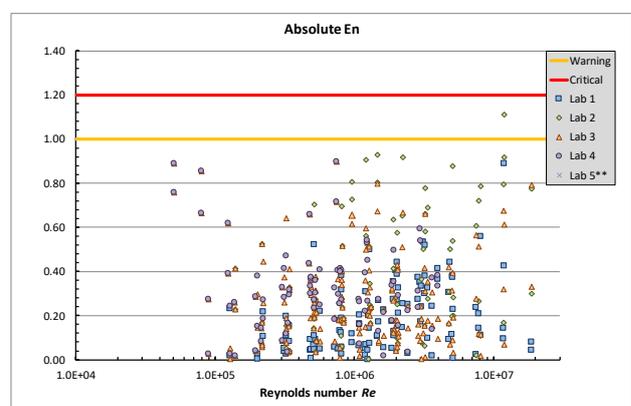


Figure 2: E_n [-] values versus Re number [-] with respect to HRV level. The yellow line is warning level corresponding to $E_n = 1$. The red line is the critical level corresponding to $E_n = 1.2$.

$E_n = 1.2$. More than 80% of the data match $E_n \leq 1/2$. Only one data point (0.2%) exceeds the warning level and there are no data points exceeding the critical level. Considering that the E_n criteria have a 95% confidence level, these results are good.

After implementation of the HRV

After the laboratories have implemented their new harmonized reference values some residues remain. These are schematically displayed in Figure 3. This figure shows that most of the residues lies with $\pm 0.1\%$. There are no residues outside $\pm 0.2\%$, which is an improvement compared to the previous exercise [2].

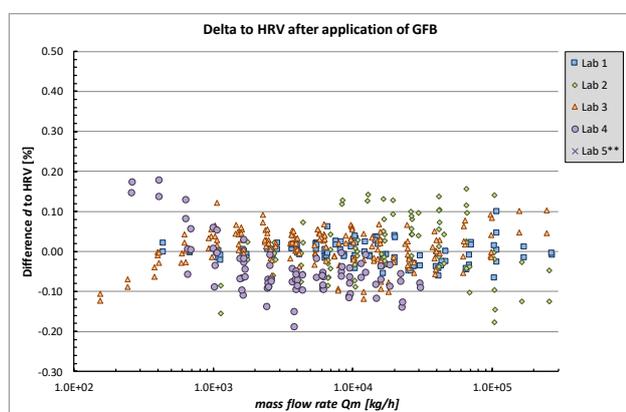


Figure 3: Residues [%] after implementation of the HRV by all laboratories.

Annex 3

Annex 3: *Methods and procedures of unification (harmonization) of reference value* is part of the MoU signed in 2013. At the last Team of Experts meeting the document has been finalized and agreed upon. From now on Annex 3 will be treated as a quality procedure. During the next intercomparison the document will be reviewed and adapted if necessary. The current contents are reflected in the open access paper [1].

Intercomparison of primary standards

The HRV intercomparison is performed at the level in the traceability chain where meters under test are calibrated that will be used in the field. The expert team thought it interesting to see if a comparison at primary level can be performed. With minor modifications to the pipework, it appears to be possible to make a direct intercomparison of the piston provers using the DN100 packages. Unfortunately, the French colleagues cannot participate as their primary PVTt system [3] operates at a variable

pressure. The French PVTt system and the German High-Pressure Piston Prover were used in an earlier primary intercomparison using sonic nozzles [4]. At this moment one laboratory needs to complete the measurements, after which the analysis can be finished.

Secretariat

As from 19 September 2018 the EuReGa secretariat has moved from VSL to PTB. Gerard Blom (VSL) has been the EuReGa contact person since the start in 2013. He will retire next year. His successor is Jos van der Grinten (PTB).

Plan 2019 and onwards

For 2019 and 2020 the following activities are scheduled:

- The new intercomparison will take place in 2020 after the laboratories have recalibrated their traceability chains. Planning of the calibrations and transportation will be completed in 2019.
- The DN100 and DN150 packages will be recalibrated in Alfortville at the end of 2018. The results will be discussed at the 2019 winter meeting. The EuReGa group is eager to learn about the results and the analysis of the observations.
- In 2019 the results of the intercomparison of the primary standards will become available.

References

- [1] Jos van der Grinten, Henri Foulon, Arnthor Gunnarsson, Bodo Mickan (2018): [Reducing measurement uncertainties of high-pressure gas flow calibrations by using reference values based on multiple independent traceability chains](#), Technisches Messen, vol 85.
- [2] EuReGa Communique (2018): Harmonized Reference Values 2017, EURAMET website: <https://tinyurl.com/yalignvr>.
- [3] EuReGa (2018): Traceability chains of EuReGa Participants for high-pressure natural gas, White Paper, EURAMET website: <https://tinyurl.com/y98xypad>.
- [4] B. Mickan, J.-P. Vallet, C. Li, J. Wright (2016): [Extended data analysis of bilateral comparisons with air and natural gas up to 5 MPa](#), 17th International Flow Measurement Conference, FLOMEKO, Sydney, 26-29 September 2016, Australia