Harmonized Reference Values 2017

The harmonization exercise 2017 has been concluded successfully. The laboratories have received their feedback and will implement the new reference into their high-pressure facilities ultimately by 30 June 2018. This communique gives a compact summary of the intercomparison results, the developments of the past period and an outlook to the next years.

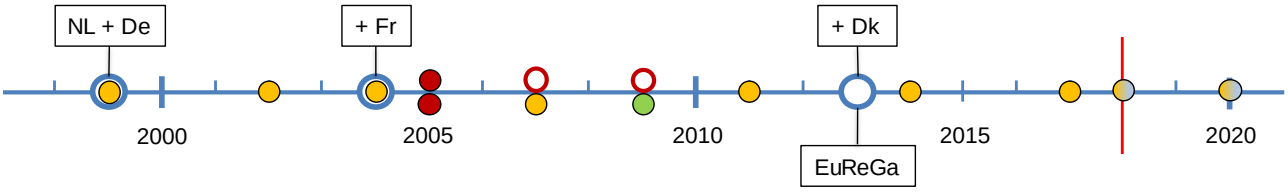

Figure 1: Timeline of intercomparisons using turbine gasmeters intended for high-pressure natural gas. The yellow dots indicate harmonization intercomparisons, the yellow-grey dots planned intercomparisons, the red dots key comparisons, the red rings subsequent bilateral comparisons and the green dot 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.

Harmonization exercise 2017

After the successful intercomparison of 2014 a new intercomparison was started in 2017. The harmonization comparisons fit in a long tradition of intercomparisons in the field of high-pressure natural gas, which is schematically depicted in the timeline plot of Figure 1. The participants are PTB using the pigsar facilities, VSL using the EuroLoop facilities, LNE-LADG operated by CESAME Exadébit, and FORCE Technology. Together these organizations form the EuReGa consortium (European References for Gas metering). The intercomparison measurements were conducted after re-calibration of the participants' facilities. Compared to the previous intercomparison the following changes took place:

- FORCE utilized a different facility for the intercomparison. In 2017 the new bigger facility was used, in 2014 the smaller facility was used.
- FORCE's traceability has been organized differently. The bigger facility is now directly traceable to the Twin Piston Prover. The traceability of the smaller facility runs via the bigger facility. In 2014 this was the other way round.
- At EuroLoop VSL's Gas Oil Piston Prover (GOPP) obtained a permanent place on the EuroLoop site. It is a stand-alone facility used to calibrate the individual rotary piston gasmeters that are part of the secondary standard, called TraSys.

PTB-Pigsar, Force Technology and LNE completed their internal re-calibration and the intercomparison measurements in 2017. VSL-EuroLoop experienced delays in the re-calibration of the EuroLoop facility, which retarded the intercomparison measurements to February 2018. The present results of the intercomparison are based on the data VSL delivered on 24 April 2018.

The results obtained in Alfortville have not been submitted as they are still under analysis by the French colleagues. However, these results are not used in the harmonization process. All in all, the entire intercomparison took more than one year. All participants agree this length of time has to be improved.

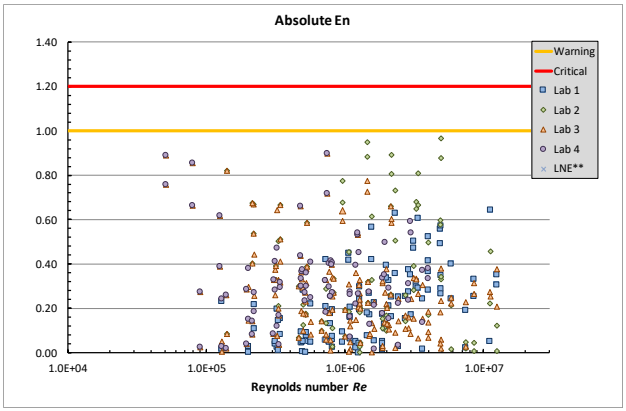

Figure 2: E_n [-] values versus Re number [-] with respect to HRV level. The yellow line is warning level corresponding to $E_n = 1$. The red line is the critical level corresponding to $E_n = 1.2$.

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 $E_n = 1.2$. More than 80% of the data match $E_n \leq ½$. Approximately 0.9% of these data exceed the warning level and only one result exceeds the critical level. Considering that the E_n criteria have a 95% confidence level, these results are acceptable.

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 ±0.1%.

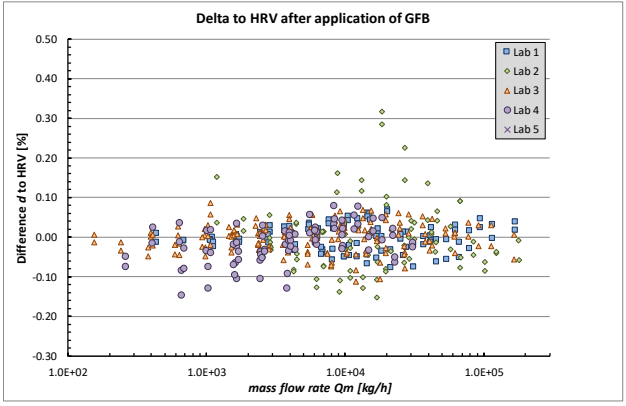

Figure 3: Residues [%] after implementation of the HRV by all laboratories.

Other work in progress

Apart from the 2017 intercomparison there are other activities, which essentially reflect the quality management of the EuReGa consortium.

Annex 3: *Methods and procedures of unification (harmonization) of reference value* is part of the MoU signed in 2013. Superseding previous drafts, a new draft was developed simultaneously with the data processing of the 2017 intercomparison. In this way the procedure could be tested thoroughly. The draft Annex 3 received a few remarks, which have been implemented in the text. After reporting the 2017 intercomparison the Annex 3 will be finalized and agreed upon.

The high-pressure gas market is interested in the details of the harmonization process. Although quite a few publications exist and presentations were made in the past on the harmonization principle and the data processing of past intercomparisons, stakeholders in the gas market are very much interested in the backgrounds of the harmonization process. EuReGa recognizes the importance of a transparent process and is prepared to explain the harmonization procedure in publications and presentations [1].

Plan 2018 and onwards

For 2018 the following activities are to be completed:

- The most urgent work for EuReGa in 2018 is the repetition of the intercomparison of the DN250 and DN400 transfer standards and reporting. The work in PTB-pigsar and Force has been completed. In June the transfer packages were shipped to EuroLoop.
- The results of the DN100 and DN150 packages obtained in Alfortville are required to check the consistency with the harmonization intercomparison. The EuReGa group is eager to learn about the results and the analysis of the observations.
- Annex 3 will be finalized. The experience of the 2017 intercomparison will be incorporated in the new Annex 3 to be agreed upon in the September meeting of the EuReGa experts.

References

[1] Jos van der Grinten (2018): How to realize a harmonized gaseous reference cubic metre?, Lecture presented at the Force Recalibration Workshop, 6-7 June 2018, Copenhagen, Denmark.