

Harmonised Reference Values 2020 – 2021

The 2020 – 2021 harmonisation exercise has been completed. This time LNE-LADG (Césame) and pignsar were pilot labs. From the 448 results only one was over $E_n = 1$. The new harmonised reference value has been implemented as from 1 September 2021. From now on harmonisation comparisons will be registered automatically as EURAMET key comparisons. The EuReGa governance has been settled according to plan.

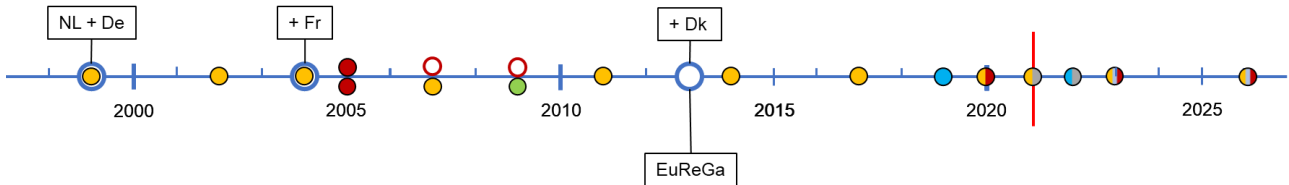


Figure 1: Updated timeline of intercomparisons using turbine gasmeters for high-pressure natural gas. The yellow dots indicate harmonisation intercomparisons, the red dots key comparisons, the yellow-red dots combined harmonisation and key comparisons, the red rings subsequent bilateral comparisons, the green dot a EURAMET bilateral comparison, and the blue dots the primary standards' intercomparison. Symbols marked with grey indicate planned intercomparisons. The white flags mark the dates at which the labs joined the harmonisation consortium. In 2013 the cooperation was renewed under the EuReGa label.

Harmonisation exercise 2020-2021

The harmonisation exercise is performed with four turbine meter twin packages that are mounted back-to-back. The meters with nominal internal diameters of DN100, DN150, DN250 and DN400, cover the operating range of 25 – 6500 m³/h at 8, 21, 50 and 65 bar pressure. The intercomparison starts with calibration of all meters by the pilot labs. Unfortunately, some labs experience technical problems, resulting in delays. The data processing method has not changed and is described in [3].

E_n values

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 $E_n \leq 1/2$.

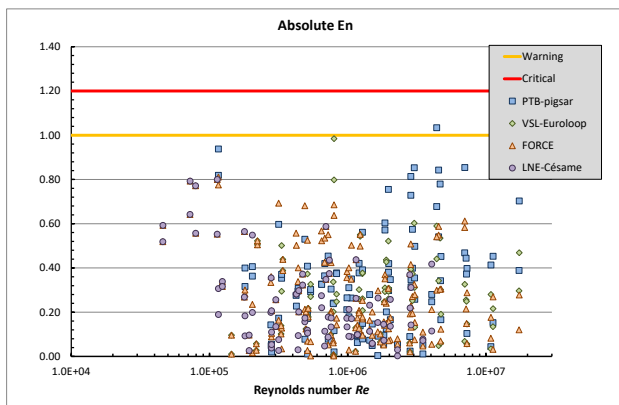


Figure 2: E_n [-] values versus Re number [-] with respect to HRV level. The yellow line is warning level corresponding to $E_n = 1$. The red line is the critical level corresponding to $E_n = 1.2$.

Only one data point out of 448 (0.2%) exceeds $E_n = 1$. Considering that the E_n criteria have a 95% confidence level, these results are excellent. This result is similar to the 2018 harmonisation results [2].

After HRV implementation

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 within $\pm 0.1\%$. There is only one residue outside $\pm 0.2\%$, which is a result similar to the previous exercise [2].

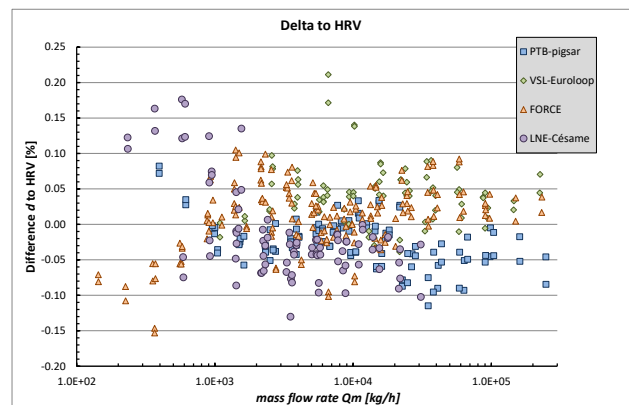


Figure 3: Residues [%] after implementation of the HRV by all laboratories.

EURAMET Key Comparison

In May 2021 both EURAMET TC Flow and CCM agreed to register the harmonisation intercomparison as a EURAMET Key Comparison (KC). The implication is that all future harmonisation intercomparisons will be also EURAMET KCs, which will be registered with BIPM. A draft protocol of this KC, describing the experimental setup and the data processing, has been approved by the participants. The next step is to include the results, which are identical to the results shown above.

Surprise

The 2019 comparison of primary references presented at the North Sea Flow Measurement Workshop, has drawn the attention of the CalLab Magazine editors. The editor's request to reprint the paper, is rapidly granted by all parties involved. Literature reference [4] refers to both the original paper and the republished version.

EuReGa Governance

Since the first of April 2021 the new EuReGa governance has come into effect. From now on there are no persons left that are simultaneously member of both the Team of Experts and the Assembly of Representatives. The latter body is intended for escalation in case the Team of Experts cannot reach an agreement. Although this never happened in the past seven years, dual functions could be obstructing the purpose of the Assembly.

The Assembly of Representatives consists of Erik Smits (VSL), Helmut Többen (PTB), Henri Foulon (LNE-LADG), Lars Hedemann Hilligsøe (FORCE Technology).

The Team of Experts consists of Bodo Mickan (PTB), Detlef Vieth (pigsar), Christophe Windenberger, Abderrahim Ouerdani (LNE-LADG), Fares Ben Rayana, (RICE/GRTgaz), Jesper Busk (FORCE Technology), Menne Schakel, Marcel Workamp (VSL), Roy van Hartingsveldt, Mijndert van der Beek (Euroloop) and Jos van der Grinten (PTB, Secretary).

Outlook

For next year the following activities have been planned, which is graphically displayed in Figure 1.

- In 2021 a bilateral comparison of the piston provers of FORCE and VSL is being performed using a dual piston rotary gasmeter. This comparison will be completed in 2022.

- The tests of the new 24" ultrasonic meter and the refurbished 24" turbine meter have started this summer and will continue in 2022.
- In 2022 a BIPM Key Comparison will start with participants from the US, China, Taiwan, Japan and Korea. PTB will be pilot lab, which means that this key comparison will be connected to the harmonised m³. The transfer package consists of two DN150 turbine gas-meters, each equipped with a fixed flow conditioner and fixed inlet and outlet spools. The package will be calibrated with both air and natural gas. The range of flows is smaller than used in the EuReGa harmonisation intercomparison where also DN400 meters are used. The PTB turbine meter model described in [4], will be used to compare the results achieved with air and natural gas at different pressures.
- In 2022 a new piston prover intercomparison is planned. Participants will be PTB, VSL and Force.
- In 2023 and 2026 the new harmonisation intercomparisons will take place following a three-year period.

Conclusion

With the successful completion of the harmonisation exercise, its upgrade to EURAMET key comparisons and the settlement of the EuReGa governance, EuReGa looks back at a successful period. In addition, EuReGa has many plans for the years to come.

References

- [1] EuReGa Communique No 4: 20th anniversary of the harmonized cubic metre, <https://tinyurl.com/EuReGa04>
- [2] EuReGa Communique No. 2 (2018): Harmonized Reference Values 2018, <https://tinyurl.com/EuReGa02>
- [3] 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(12), pp 754-763, <https://doi.org/10.1515/teme-2018-0019>
- [4] Jos G.M. van der Grinten, Arnthor Gunnarsson, Mijndert van der Beek and Bodo Mickan (2019): [An intercomparison between primary high-pressure gas flow standards with sub-permille uncertainties](#), 35th International North Sea Flow Measurement Workshop, Tønsberg, Norway, 22 - 24 October 2019, Reprinted in Cal Lab: The International Journal of Metrology, [vol 27\(4\), 2020](#), pp 28-35.