

Turbine Gas Meters High-Pressure Tests

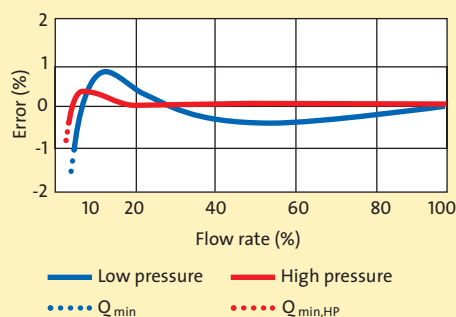
CALIBRATION SAVES MONEY

TRZ turbine gas meters are highly accurate metering devices that have been successfully used in the field of gas supply for many years now. They are normally calibrated using air under atmospheric conditions (low pressure). It is also legally permissible to use a meter that has been calibrated under these conditions at higher pressures for the purpose of calculating and billing the use of natural gas. Besides the low-pressure calibration, there is also the possibility of running a high-pressure test.

Particularly at higher pressures over 4 bar and when natural gas is the medium, it is possible that the turbine meter registers a very slight error compared with the air calibration. This is known as a high-pressure shift and is different for every individual meter. The extent of the error and in which direction it might lie cannot be accurately predicted and can only be determined by means of a measurement (Fig. 1). For this reason, the pr En 12261 (expected to come into effect in 2002) contains the following description under 5.2.1.2 Test: "For a meter type designated for measurement in a gauge pressure range extended above 4 bar the error of indication test shall be carried out with a gas in the range of the specified metering conditions." With low flow rates, the influences of boundary film and friction lead to a characteristic deviation from the linear curve. In principle, we can say that the error curve in a high-pressure test is flatter than that in a low-pressure test and, therefore, the linearity requirements are met to a more satisfactory degree. This behaviour can

be explained by the change in the flow conditions. When the gas pressure is high, there is another aspect which is important for the application of turbine meters. When the pressure rises, the forces driving the turbine wheel also increase. In practice this means a meter under the influence of a greater driving force can be operated in a lower load range. As a result, lower volumes of gas can be measured at higher pressures, i.e. the minimum flow rate " $Q_{min,HP}$ " is lower than the minimum flow rate Q_{min} at atmospheric pressure (Fig. 1). The maximum Q_{max} and minimum Q_{min} flow rates are always written on the name plate. The value Q_{max} is basically valid for all types of gas and all operating pressures. The flow rate Q_{min} is only valid for atmospheric pressure. The lower flow rate " $Q_{min,HP}$ " can be calculated for gas measurement at high pressures.

Fig. 1: Typical difference between low and high-pressure tests

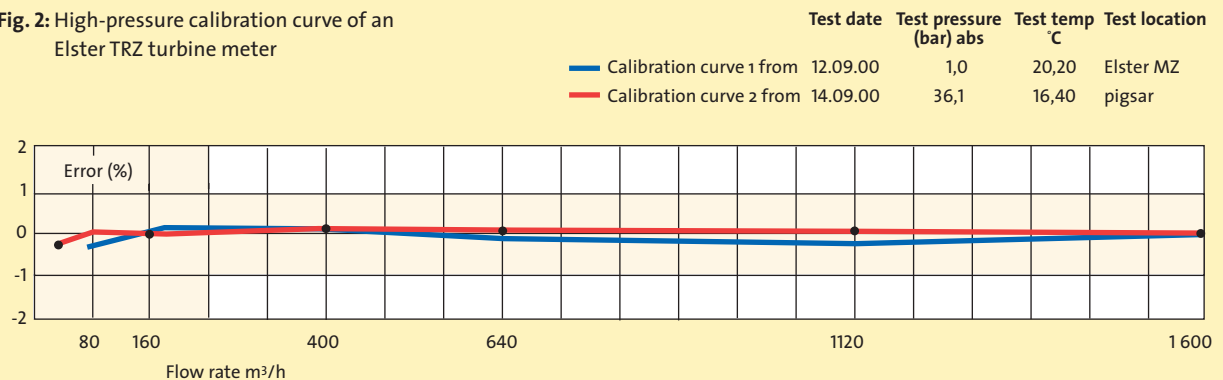


High-pressure calibration in Germany is subject to PTB TR G7. When the range is extended, following this German regulation the new measuring range is only valid up to two times the density. That means it ranges from the actual pressure during the calibration to twice the actual pressure. For example, a G 1000 turbine meter tested on the pigsar high-pressure rig at Ruhrgas in Dorsten at a pressure of 16 bar and a load range

This addition will lead to a more flexible use of the test rigs in the European Union.

When testing meters, it must first of all be determined whether the necessary flow rates in the required pressure range can actually be realised. In reality, it is possible that the pressure range is correct but the necessary loads are too small or some other condition such as nominal

Fig. 2: High-pressure calibration curve of an Elster TRZ turbine meter



extension 1:50 can be operated in the flow range “ $Q_{min,HP}$ ”=32m³/h up to Q_{max} =1600m³/h. Operating pressures higher than 32 bar require an additional calibration at the maximum operating pressure and at the flow rates “ $Q_{min,HP}$ ” and Q_{max} . When the operating pressure is lower than the 16 bar calibration pressure, the meter can only be operated in the flow range for atmospheric pressure. In preparation for an expected higher demand for high-pressure calibrations, the PTB has added supplementary conditions to the TR G7 in order to recognize high-pressure tests on other European test rigs. The additions are as follows:

diameter or the type of flange cannot be fulfilled. The pigsar high-pressure rig in Dorsten is currently trying to come to terms with the growing calibration requirements. It has been designed to handle flow rates from 8m³/h to 6500m³/h within a pressure range of 14 to 50 bar. At the moment, a refitting and modernisation is taking place.

6.2 National test rigs

The high-pressure test rigs in state-approved test centres must be based on the national master meter for high-pressure natural gas and must be approved by the Calibration Authorities.

Not only pigsar but also all test rig owners are preparing for the changing requirements – Elster is already well prepared and in a good position. We have vast experience in the development and production of high-pressure turbine meters. Tight levels of tolerance lead to good reproducibility and this is guaranteed by a high quality in the manufacturing process. The shift between low and high-pressure calibration curves has been optimised. A very fine adjustment scale helps to bring the high-pressure error curve as close to the zero line as possible. A report is then drawn up to show the results.

6.3 Metering tests in other EU member states.

The testing of high-pressure gas meters for calibration purposes may also be carried out on test rigs in other EU member states if these rigs are operated or monitored by the relevant national metering authority and if the master meters used in the tests are fully in line with the high-pressure natural gas standards set jointly by the German and Dutch authorities.

We can be proud of this result. Figure 2 shows a DN 200 meter which was tested in Mainz at atmospheric conditions and then on the pigsar high-pressure rig at a pressure of 36.1 bar.

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