Certifying a water meter

Water meters

Water meters (used at households) are actually small turbines. When the water flows through the meter it drives a rotor. The number of the performed turns by the rotor is proportional with the passed volume of the water. Thus the volume of the water flowing through the meter can be measured with a counter. By means of a magnetic clutch the shaft of the rotor and that of the counter can be synchronized without any opening in the housing of the counter so the counter can be insulated from the water. (dry running meters) In some other types the counter is not insulated from water. (wet running meters)

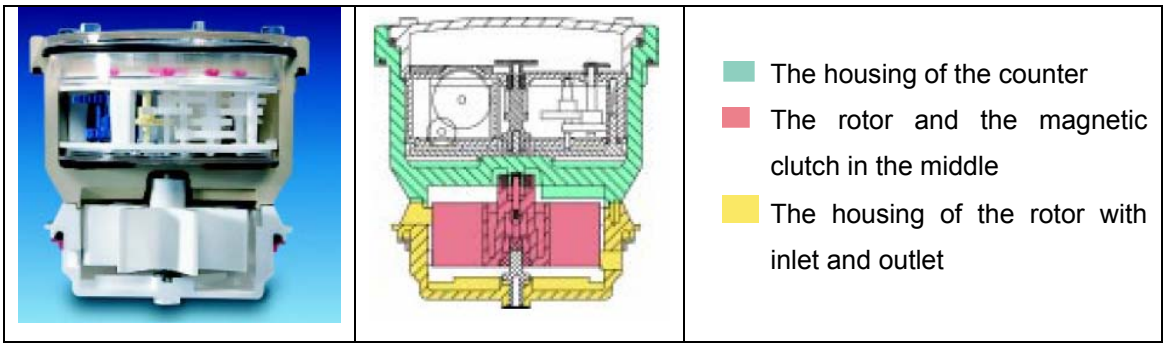


Figure 1: The framework of a water meter

Water meters can be classified as horizontally mounted meters and vertically built in meters. By their accuracy they can be labeled as class A, B and C meters. Each water meter has a nominal volume flow rate Q_{nom} $[m^3/h]$. **We shall examine here a horizontally mounted class B water meter with Q_{nom} =1.5 m^3/h.**

The ISO 4046 standard defines Q_{min}, Q_{trend} and Q_{max} levels shown in Figure 2 (bold black lines). For the class B meters:

$$Q_{\min} = 0.02 \cdot Q_{nom}$$
$$Q_{trend} = 0.12 \cdot Q_{nom}$$
$$Q_{\max} = 2 \cdot Q_{nom}$$

The abovementioned standard also determines the maximum acceptable relative measurement errors in case of stationary flow. Concerning the class B that is **±5%** between Q_{min} and Q_{trend} and **±2%** between Q_{trend} and Q_{max}. Figure 2 shows a typical error curve.

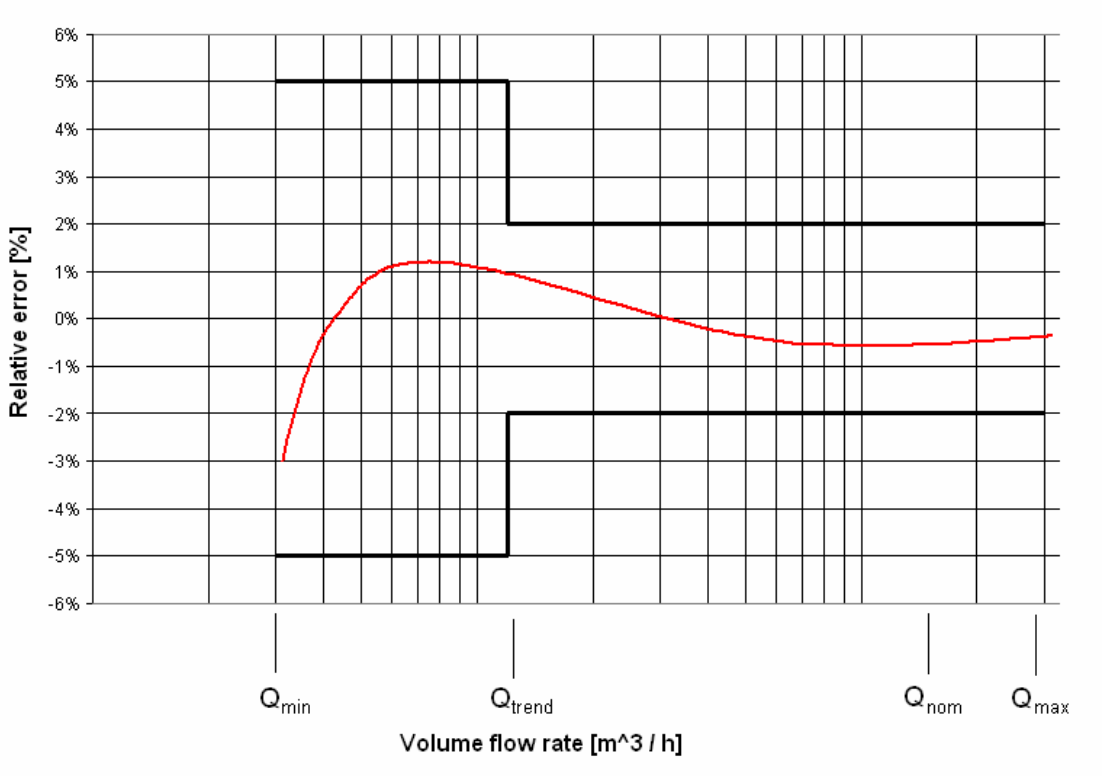


Figure 2: A typical relative error diagram of a water meter
(with a logarithmic scale at the Q axis).

The aim of the measurement

The aim of the measurement is to produce a relative error diagram of the examined water meter and based on those data the water meter should be qualified. (Weather it fulfills the requirements of the ISO 4046 standard or not.)

The measurement rig

The sketch of the measurement rig can be found at Figure 3. The water from the municipal water system flows through a latch and a valve to the water meters (denoted as VM3, VM2 and VM1) They were built in sequentially, so the same volume flows through all of them. The volume flow rate of the water can be adjusted with two valves. By means of the valve SZ1 the volume flow rate can be adjusted with in a wide range, and with SZ2 smaller volume flow rates can be fine-tuned. The metering tank consists of two reservoirs: V1 for the smaller flow rates and V2 for the larger ones. The metering tank can be emptied with the opening of the T2 tap.

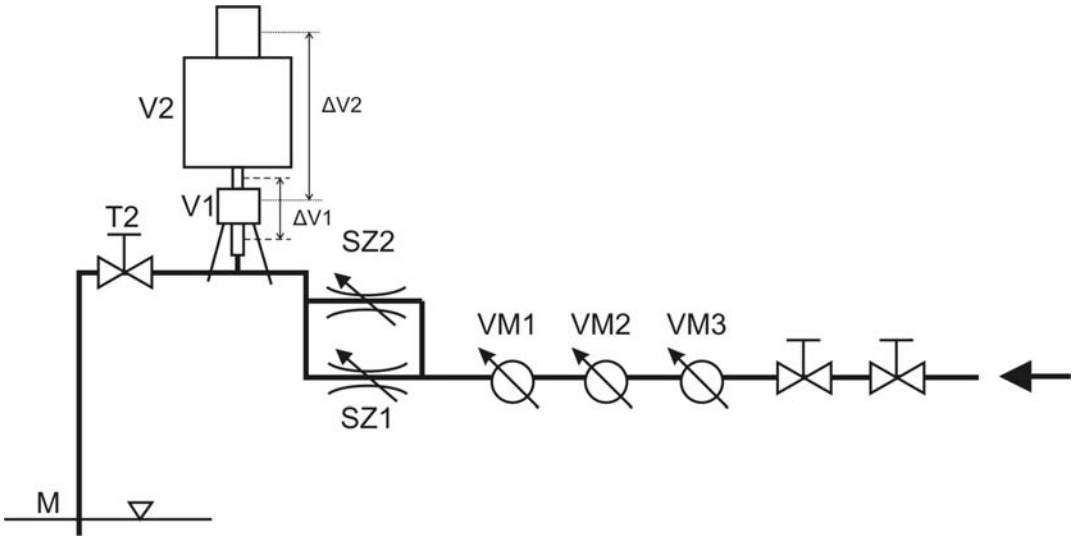


Figure 3: The sketch of the measurement rig

The measurement process

The rig is switched on by the tutor.

Measurement should taken at 8 different volume flow rates. The appropriate valve configurations are listed at the SZ1 / SZ2 column below.

Ssz.	SZ1 / SZ2	ΔV1	ΔV2	Δt_{tank}	Q_{tank}	V_{beg}	V_{after}	Δt_{wm}	Q_{wm}	Error
		L	l	s	m^3/h	m^3	m^3	s	m^3/h	%
1	SZ2 ~ 15°	2,55								
2	SZ2 ~ 30°	2,55								
3	SZ2 ~ 45°	2,55								
4	SZ1 10		22,96							
5	SZ1 20		22,96							
6	SZ1 35		22,96							
7	SZ1 60		22,96							
8	Both fully opened		22,96							

In every case the round of the duties are:

- Adjusting the valves.
- Begin to measure the time with a stopwatch when the counter of the water meter displays a whole number (in liters), and writing the value of the counter (last 3 digits) to V_{beg}
- Closing the T2 tap in order to start the filling the metering tanks.

- Begin to measure the time with a second stopwatch when the water level reaches the lower sign on the suitable reservoir (V1 or V2)
- Stopping the second stopwatch when the water level reaches the upper sign at the reservoir, and writing the elapsed time to Δt_{tank}
- Opening the T2 tap to avoid overflow.
- Stopping the first stopwatch at another whole value of the counter. Writing the value to V_{after} and the elapsed time to Δt_{wm}

Having performed the measurement at the 8 different volume flow rates, the remaining columns should be filled in using the formulas:

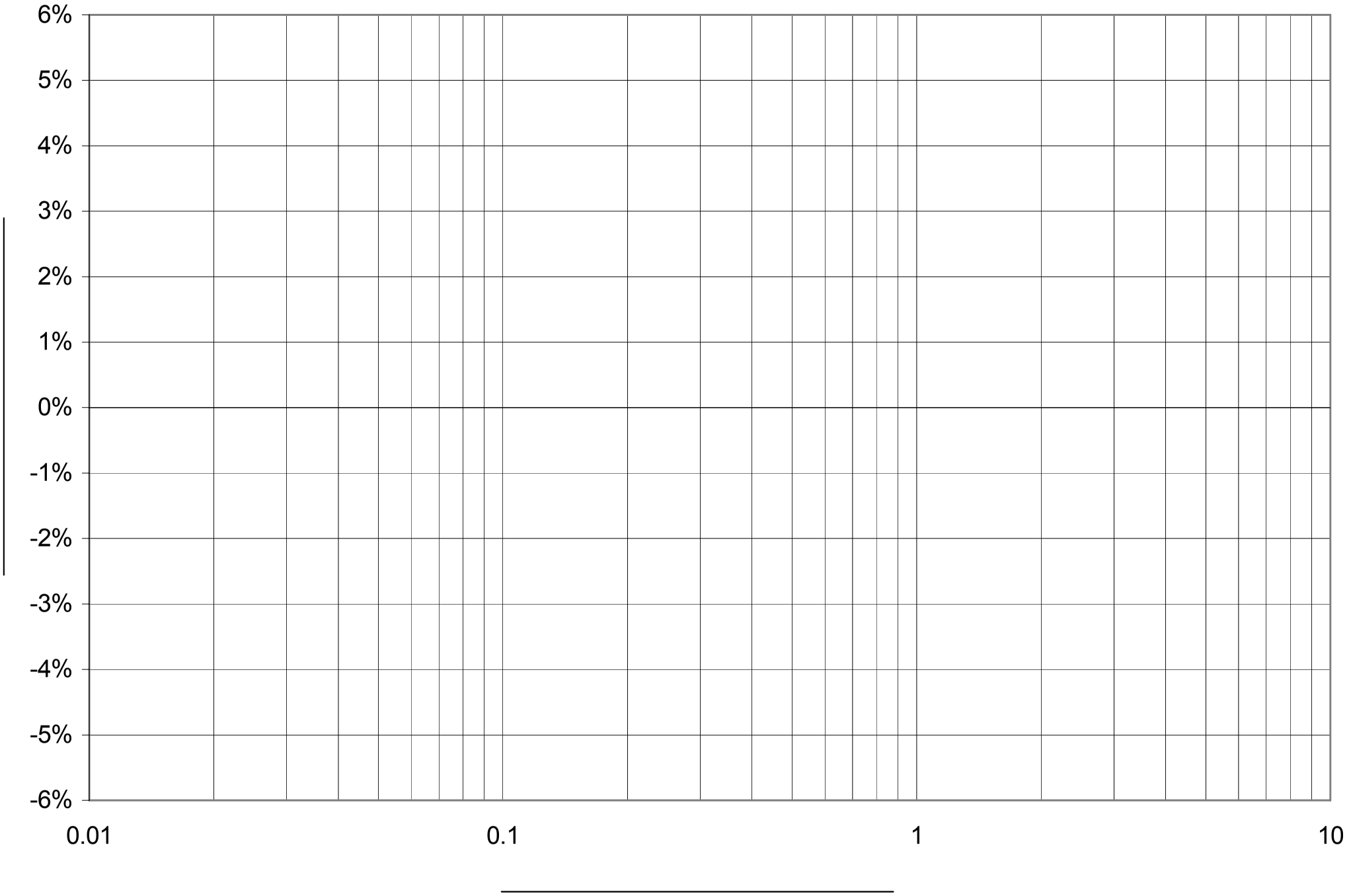
$$Q_{cube} = \frac{\Delta V1}{\Delta t_{cube}} or \frac{\Delta V2}{\Delta t_{cube}}$$

$$Q_{wm} = \frac{V_{after} - V_{bef}}{\Delta t_{wm}}$$

$$Error = \frac{Q_{wm} - Q_{cube}}{Q_{cube}}$$

The report should contain a diagram with logarithmic horizontal axis scale. (See next page.) The maximum acceptable error levels should be depicted on the diagram as preparation to the measurement session. After Q_{tank} and *Error* values are calculated, the data points and a fitted curve also should be plotted on the diagram.

Based on the diagram the water meter should be certified.
Serial numbers of the used devices need to be recorded.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