

Water Flow Meter Calibration in NMI Laboratory of Finland

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Introduction

The water flow laboratory of VTT MIKES Metrology in Kajaani is the national standard laboratory for water flow in Finland. There are three different calibration rigs in the laboratory. The gravimetric calibration rig acts also as the national standard and two other reference based calibration rigs are used in daily calibration activities. Table 1 summarises the calibration services.

D200 gravimetric standard

D200 gravimetric device, shown in figure 1, is the national standard for the water flow in Finland. It has two scales (6000 kg and 800 kg) as reference. The device is diverter operated and maximum flow rate is 720 m³/h. Meter size in meter under test (MUT) section can be up to DN200. The measurement uncertainty of the device is 0.03 % ($k = 2$).

The height difference between the water level in the upper tank and measurement section is 20 m, giving the constant 2 bar pressure. Water flow can be circulated by pumps also directly to the measurement section. The desired flow rate is regulated by electric control valves.

Data collection system

Data collection, as seen in figure 2, is based on NI's compactRIO system. A custom made Labview® software controls both the operation and the measurements during the calibration. Temperature and pressure of the water is monitored in several places in all calibration devices. Ambient conditions (air temperature, air humidity and air pressure) are also measured automatically during calibration. Both pulse output and current signal from flow meters are measured.

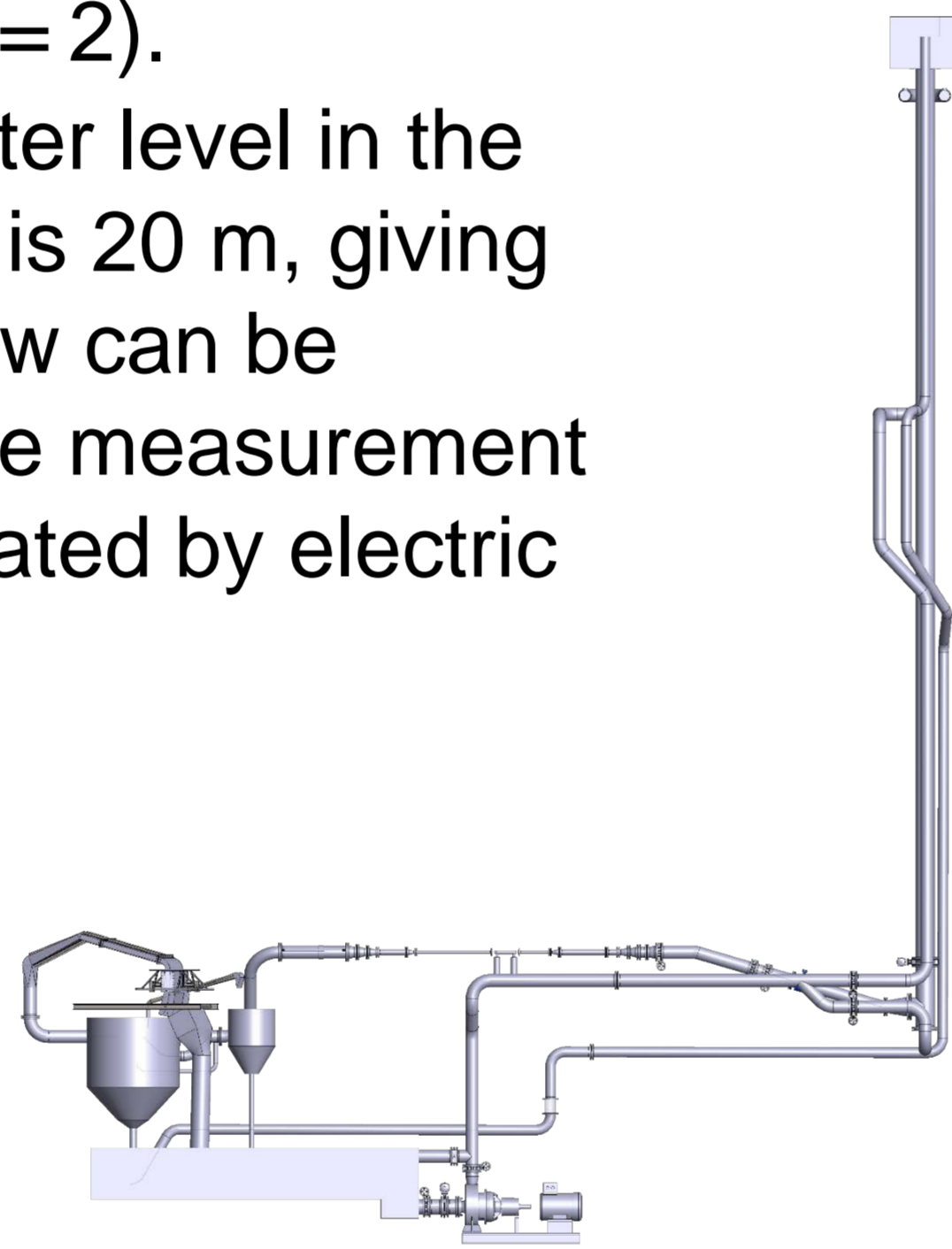


Figure 1. Picture of the gravimetric calibration device.

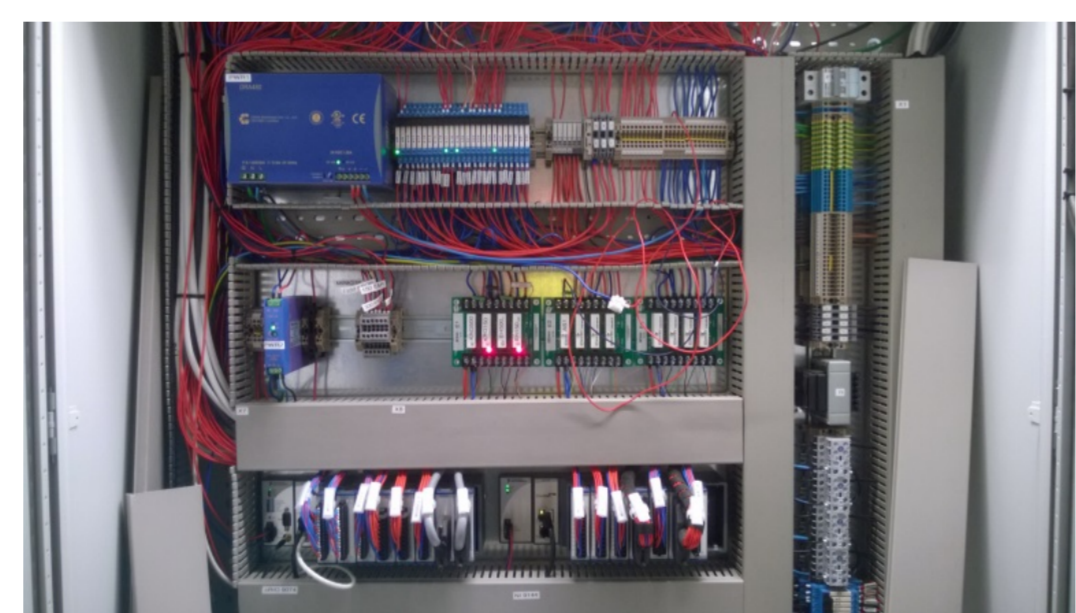


Figure 2. Data collecting instruments.

D100 calibration rig

D100 calibration rig is a closed type device with Coriolis flow meters as reference meters. Figure 3 shows the model of the device. The size of the reference meters are DN50 and DN15. The calibration device has a cooling system and a pressure stabilization system. Maximum flow rate achieved is 72 m³/h. Measurement uncertainty of the device is 0.3% ($k = 2$).

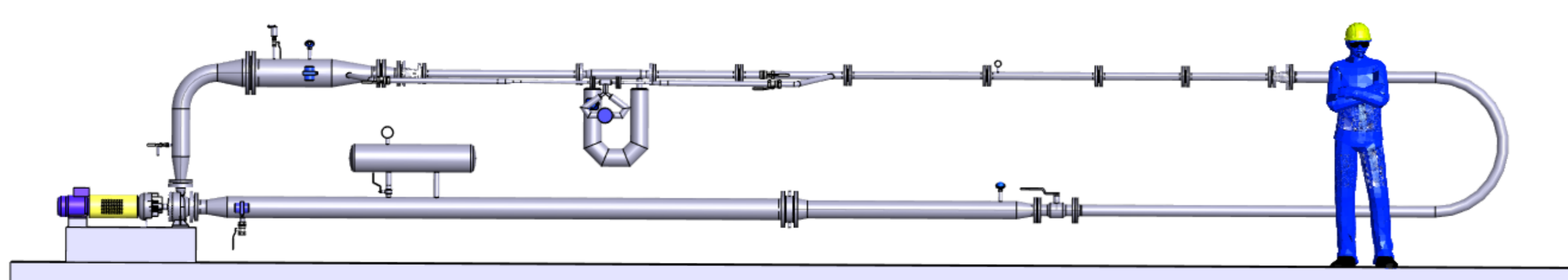


Figure 3. Picture of the D100 calibration device.

D500 calibration rig

This is the largest rig in the laboratory. It has DN500 and DN150 magnetic meters as reference meters. Maximum flow rate is 2700 m³/h, which is regulated by an inverter operated pump. Figure 4 shows part of the D500 calibration rig while in figure 5 is the model of the rig.

Flow profiles were measured by LDV in several locations of the rig. Figures 6 and 7 show the profiles at the reference meter place and at MUT place. As can be seen the flow is turbulent and similar in both locations.



Figure 4. Entrance hall of the flow laboratory.

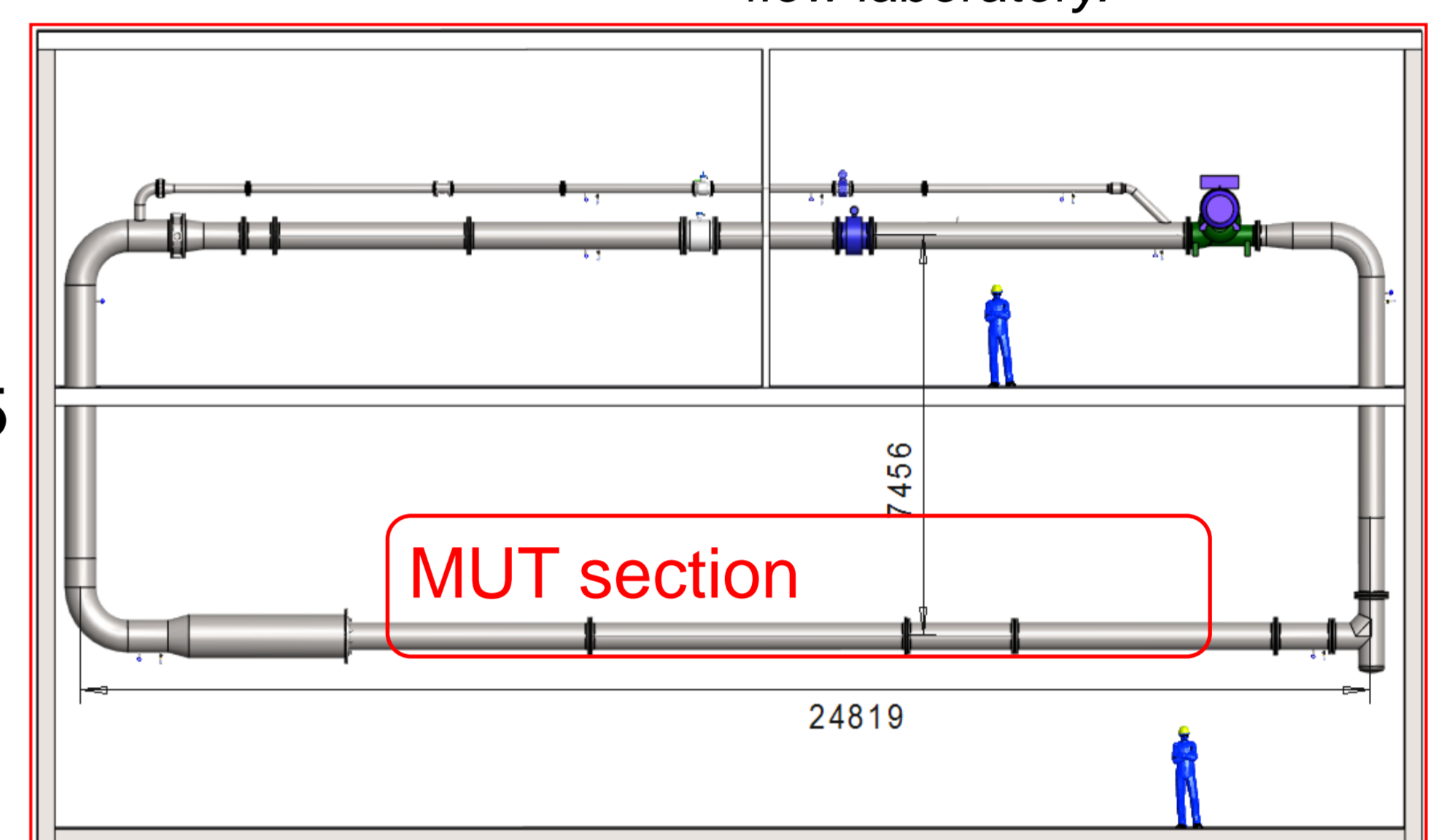


Figure 5. Picture of the D500 calibration device.

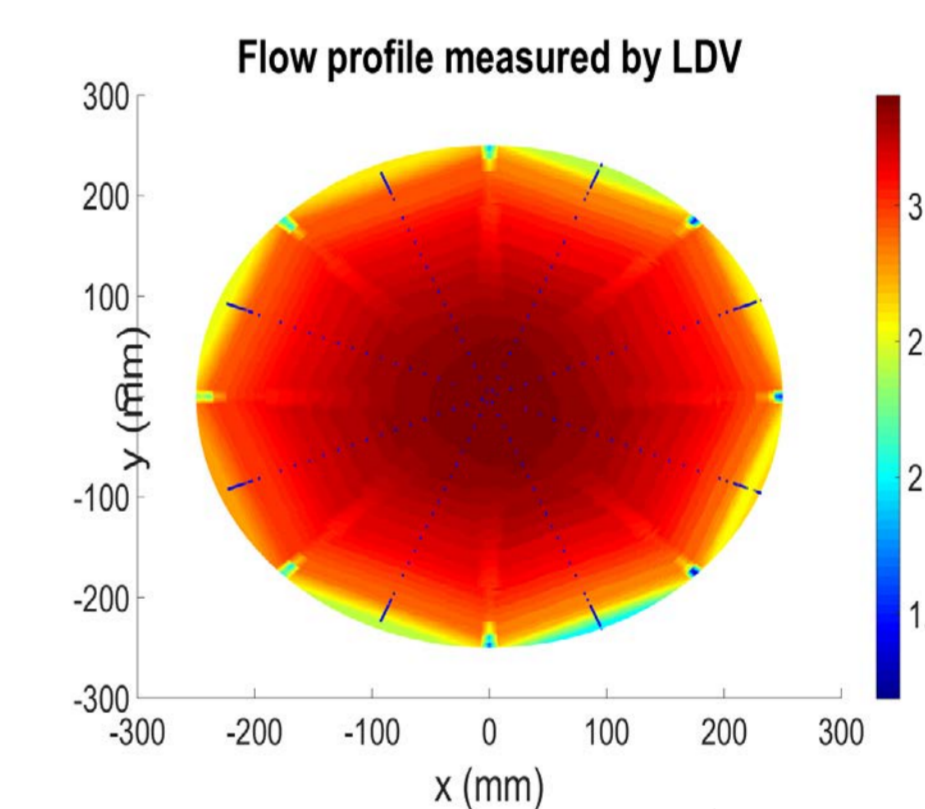


Figure 6. Flow profile at reference meter.

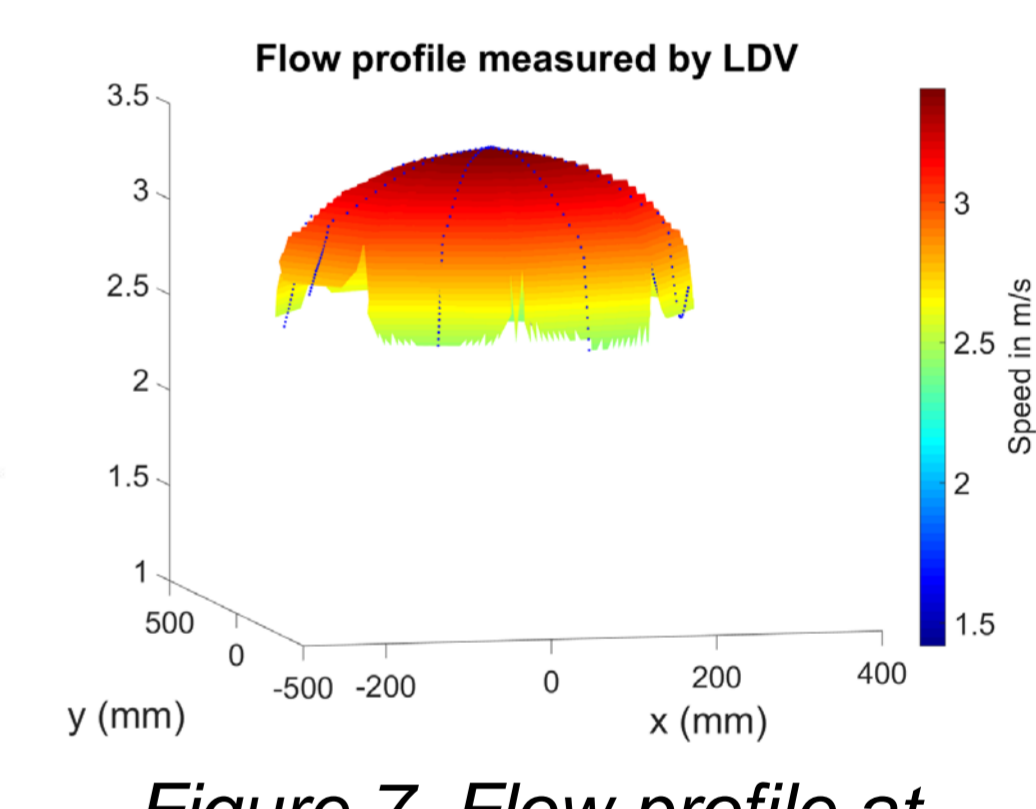


Figure 7. Flow profile at MUT section.

Table 1. Summary of the calibration devices.

Device	Operation principle	Pipe dimension	Volume flow	Pressure	Measurement uncertainty ($k = 2$)
D100	Closed	DN15 to DN50	0.36 - 72 m ³ /h	<0.7 Mpa	0.3 %
D500	Closed	DN100 to DN500	25 - 2700 m ³ /h	<0.4 Mpa	0.3 %
D200	Gravimetric	DN10 to DN200	0.3 - 720 m ³ /h	0.2 Mpa	0.03 %

Summary

VTT MIKES Metrology offers water flow meter calibration services with three different calibration rigs. D200 is the national standard for water flow and it is a diverter operating gravimetric device with scales as references. Two others, D100 and D500, are based on reference meters. Custom made software and compactRIO based control and data acquiring system controls the operations of the calibration.

Traceability to SI-system is via Finland's national standards, except DN500 reference meter, which is via Germany's national standards.

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