

## Gas meter test facility: Remote bootstrapping

Last year, a test facility ITF 6500 was supplied to one of our customers in Argentina. After installation and start-up the test facility was calibrated by means of the bootstrapping process developed by Elster-Instromet under remote supervision of the NMI Certin B.V.

As an allusion to lifting oneself up by one's own bootstraps, the term "bootstrapping" means using a special process to perform a task that one would be unable to do in general. The term is said to have come from a tale from the adventures of Baron von Münchhausen who, according to the story, escaped from a swamp by pulling himself up by the straps of his boots.

In the context of this article we understand bootstrapping as a method that provides a fast and easy way to achieve international traceability of the facility over a large flow range with low measurement uncertainty. Another innovative aspect of this method is that it can be remotely monitored and supervised by the Dutch NMI.

### The ITF product line

In the Elster-Instromet product portfolio the ITF test facilities have a somewhat special place, as they can be defined as both a system and a product. A product, because there are several well defined types, and a system, because of the complexity of the facilities.

The Elster-Instromet Test Facility (ITF) series is a series of test installations which can be used for testing rotary, turbine and ultrasonic gas meters using air under atmospheric conditions. In the early days, these facilities were built for internal use to validate the meters produced. However, many of our customers recognised the advantage of having their own test facility and therefore the ITF was launched as an official part of the product portfolio. By continuous innovation through the years the ITF has developed into a sophisticated test facility which offers the lowest measurement uncertainty in combination with a compact and flexible design. The number behind the name ITF (for example: ITF 6500) indicates the maximum capacity in  $\text{m}^3/\text{h}$ . At the moment, there are four

types available: ITF 1000, 2500, 4000 and the ITF 6500. By combining separate modules it is possible to upgrade the test facility easily.

The minimum flow rate is  $0.5 \text{ m}^3/\text{h}$ . The ITF series has been developed and is built to the highest quality standards. The units are extremely effective and reliable, and have a low measurement uncertainty or measurement error.

### ITF functions

To be able to understand the bootstrapping process it is necessary to understand the working principle and set-up of the ITF test facilities. In the following paragraphs the functions of the subsystems which the ITF comprises are described.

The first subsystem is the master meter section. This is where the reference meters are situated. The reference meters are all Elster-Instromet rotary meters. In each installation we have at least one IRM3 G650 DUO for higher flow rates and one IRM-A G16 for lower flow rates.



Fig. 2: Master meter section

The next section is the Meter Under Test section (MUT). In this section, the operator can install the meter he wants to test. The MUT module comes with several inlet and outlet pipes varying in diameter to fit different sizes of meters to be tested.

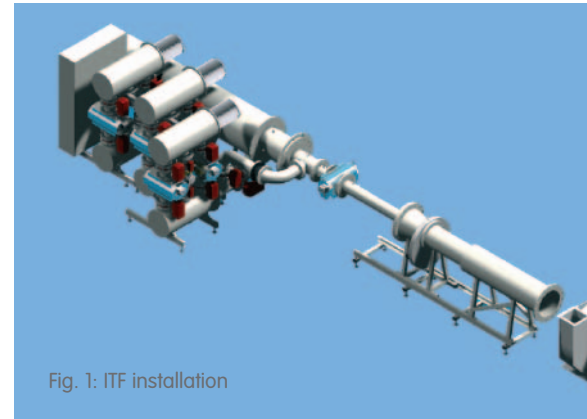


Fig. 1: ITF installation

The MUT module is followed by the flow control section. In conjunction with a blower, this section controls the flow through the MUT. The flow control section consists of



Fig. 3: MUT module

a specially designed linear proportional valve mounted on a carriage (see Fig. 4). This carriage can be moved on rails to compensate the difference in length of the meters under test. In most cases the blower is situated in a separate room.



Fig. 4: Control section

The last subsystem is the control cabinet. The control cabinet contains all the equipment needed for controlling and measuring. It is equipped with a special module for advanced time-pulse measurements to calculate the volume flow through the MUT and the reference meters. This time-pulse measurement in conjunction with the pressure and temperature measurements allows the system to calculate the actual mass flow through the MUT and reference meters. This results in a defined measurement error of the MUT at a particular flow rate.

The control cabinet is connected to a PC. All sensors and actuators, as well as a stepping motor and a frequency controller, are connected to a bus controller. This bus controller in turn is connected to the PC. All hardware is controlled using the ITF software on the PC.

Using the software, the operator can prepare a test by entering the necessary information about the meter to be tested. This can be done manually or using pre-defined templates. Then the operator notes at which flow rates, for how long, and with what reference meters he wants to conduct the tests. The software carries out all tests automatically. Besides the leakage and pre-run functions, the ITF software also has a "calibration" function. Calibration is a procedure for adjusting the error over the whole range by changing the gear ratio in the index head. To perform this calibration the software guides the operator through the process step by step.

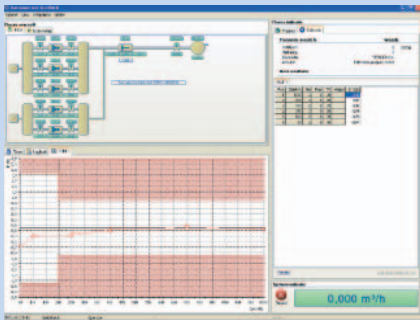


Fig. 5: PID software

After each test the operator can choose to print a user-defined or a pre-defined test report. The ITF system comes complete with a PC, modem, printer and all essential software such as Windows, remote desktop control software, Office and the ITF software.

### Bootstrapping and remote validation

Elster-Instromet can offer remote validation and verification of the ITF in cooperation with the Dutch National Metrology Institute (NMI). Just recently, in Argentina, this process of remote bootstrapping was applied on an ITF 6500 installation.

In this case, a small reference meter IRM A G040 with a low measurement uncertainty (< 0.16) was used. This uncertainty is achieved by testing the meter against a bell prover of the NMI which is directly derived from their primary standard for gas flow rates, the dynamic displacement device.

With the G040 all the standards in the installation were calibrated up to 65 m<sup>3</sup>/h. In the next step, a normal IRM3 G650 DUO meter was used as MUT and calibrated up to 400 m<sup>3</sup>/h against the reference meters in parallel. In the following step, the reference meters in the installation were calibrated up to 400 m<sup>3</sup>/h against the master meter. This action was repeated until the reference meters were calibrated up to 1200 m<sup>3</sup>/h. The complete process can be carried out with only a small increase of the total system uncertainty resulting in a total uncertainty smaller than 0.22%.

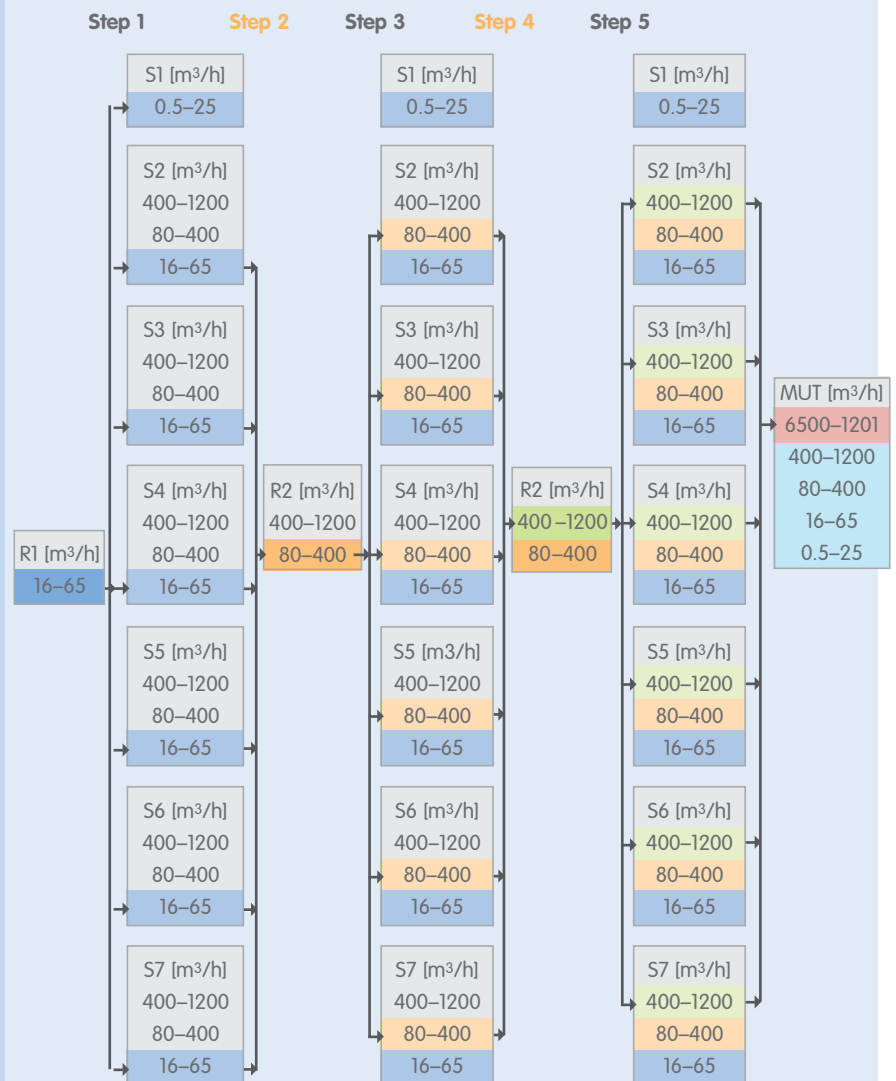
During bootstrapping, the NMI witnessed all steps that were taken using remote desktop control software. After some initial connectivity problems due to a poor

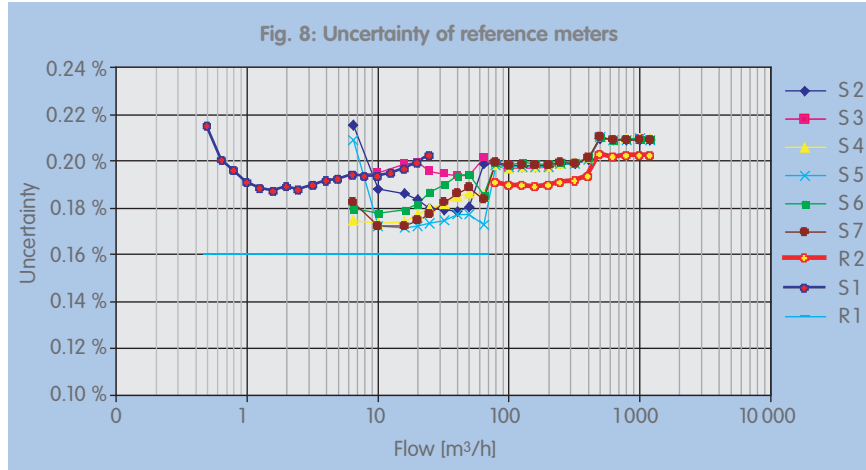
telephone line connection an improvised telephone line was installed from the tenants building to the test facility and a proper connection was established. As you can see on figure 6, the dogs on the customer site guarded the telephone line carefully. A new phenomenon was born: 'Bootstrapping watchdogs'.



Fig. 6: Bootstrapping watchdogs

Fig. 7: Calibration by bootstrapping in 5 steps





## Customer benefits

The real benefit of this remote bootstrapping function is that we can reach this low measurement uncertainty using just one small reference meter and one larger master meter. The complete bootstrapping process is fully automated and can be

completed in just one day. The traceability is transparent and the test facility can easily be validated as soon as the notified body requests it.

Meanwhile, Elster-Instromet has gathered lots of experience and has installed test

facilities all over the world: China, Switzerland, Latvia, Hungary, Spain, Argentina, Georgia and soon in Slovakia. But this does not mean we're now resting on our laurels. At the moment we are busy making the test facility suitable for high pressure gas installations. For this, we have to deal with special safety regulations and different signal processing. Currently, we are modifying our high pressure installation in Utrecht, based on this new ITF technology.

Besides the obvious benefits for the customer, such as lower calibration costs and less service time, there is one other important reason why we like to engineer these test facilities for our customers: now our customers will also be able to measure the quality of our meters.

Ron de Graaff    r.degraaff@elster-instromet.nl  
 Jos Bergervoet    j.bergervoet@elster-instromet.nl