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TriFlow Low Flow Liquid Calibrator System

The **TriFlow** TF Series Displacer Primary Liquid Flowmeter Calibration System is the ideal solution for applications where the highly accurate flowmeter calibration is required. It offers a combination of high performance, efficiency and convenience.

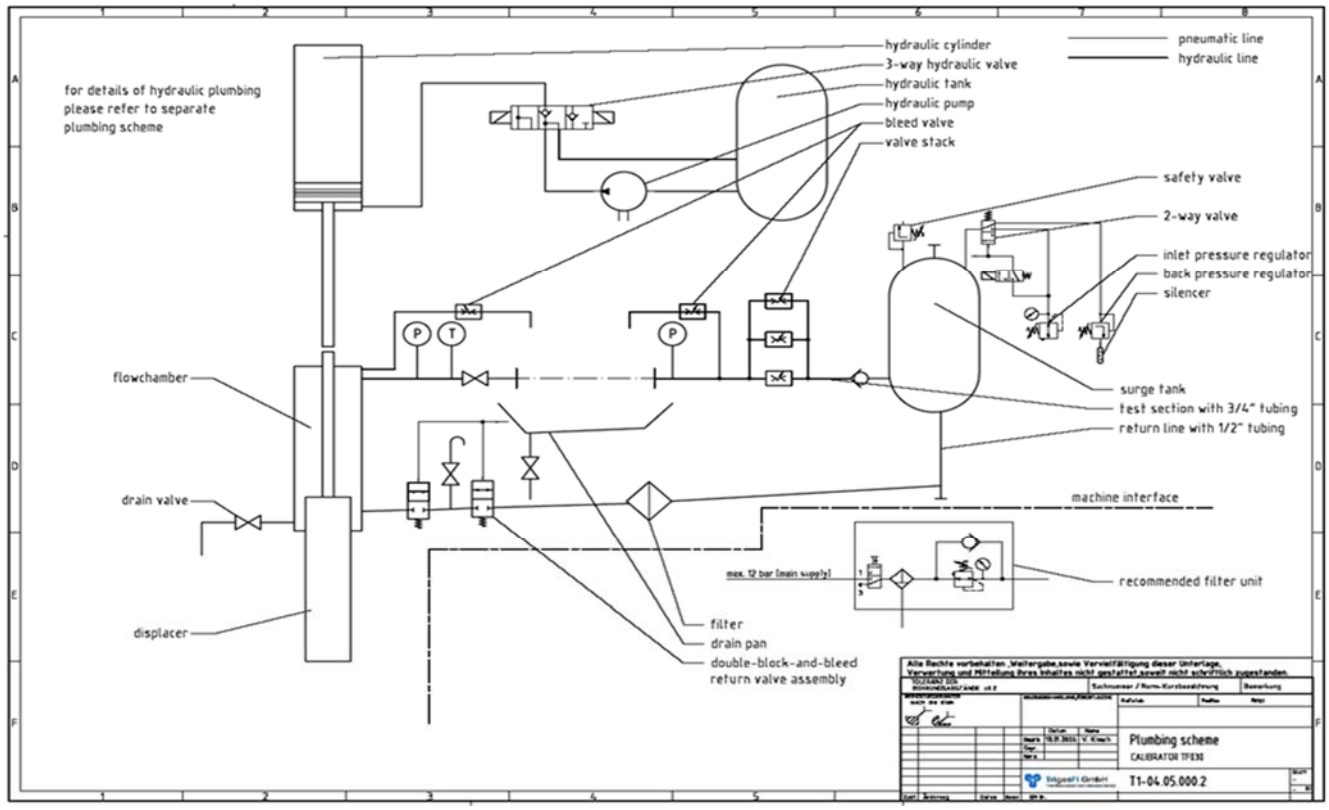
Exceptional accuracy and stability are achieved the use of a precisely honed, chrome–plated stainless steel cylinder inserted into a fluid container and displacing a precisely known volume which then becomes the reference for the calibration.

Hydraulically operated and based on positive displacement operating principle, it quickly and accurately calibrates virtually any type of flowmeter.

To overcome the low flow limitations of conventional piston flow calibrators, an innovative performance-boosting Displacer Cylinder principle has been employed. The insertion of the Cylinder inside a fluid container displaces a volume of test fluid equal to the volume of the cylinder. The movement of the Displacer Cylinder generates a continuous train of electrical pulses by use of a linear encoder/translator attached to the Cylinder guide shaft. Each pulse represents an extremely small but very precise volume of fluid.

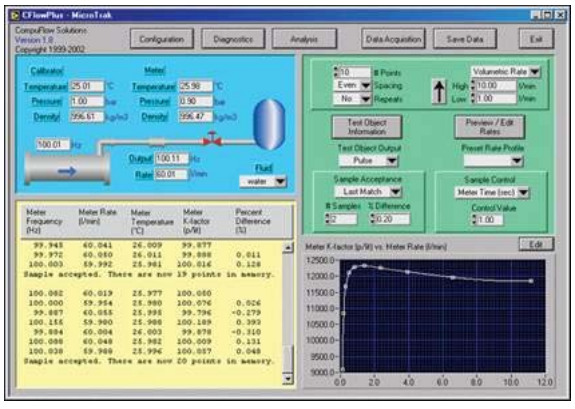
Positive Displacement Calibrators are virtually immune to the effects of test fluid viscosity, density and compressibility.

Traceability to National and International Standards (PTB, LNE, NEL, NIST, etc.) is easily achieved and maintained through the use of appropriately certified dimensional and temperature standards.



Sophisticated Data Acquisition, Data Analysis and Reporting Features

The popular ***CFlow+*** LabVIEW based data acquisition and control software ensures optimal man-machine interface and ease of operation. It is specifically designed for flow calibration activities.



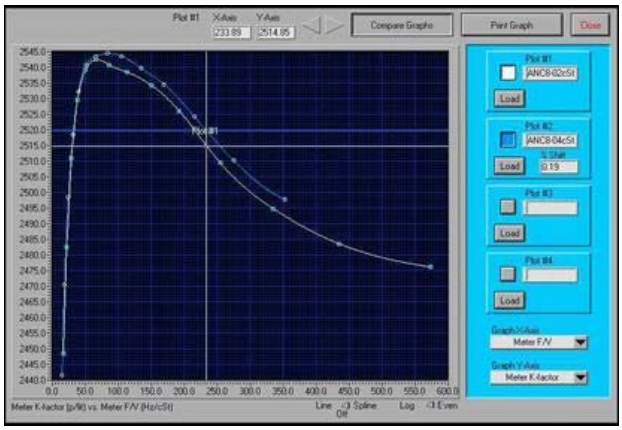
CFlow+ is currently used by hundreds of flow laboratories worldwide including several National Metrology Institutes. Ir is the Culmination of years of effort and extensive testing to ensure the accuracy of the flow calculation algorithms which operate seamlessly in the background.

Features include:

- Data Acquisition User Interface where all crucial information is readily viewable on a single screen.
- Extensive Calibration Report Generation Library
- Calibration files are stored in MS Excel format for easy customization and importation into other software programs.
- Temperature and pressure corrections to compensate for the effects of outside influences on the calibrator and Meter Under Test
- Density correction for mass flow applications.
- Cubic Spline curve-fitting to compensate for the non-linearity of pressure and temperature transducers.
- Extensive built-in diagnostics using a graphical interface make process fault identification quick and easy.
- Advanced graphical presentations of all calibration variables can easily be generated.
- Simultaneous graphing of historical data allows easy evaluation of process changes over time.

Advanced Hardware Features

The **TriFlow** Calibrator IO hardware has been designed to be accurate and robust with a standard Notebook or Desktop PC serving as control console.



- **Digital and analog (18 bit) signal processing** is performed within the hardware interface unit which communicates with the PC via serial link.
- **Double Chronometry** and **Quadrature** methods are employed to eliminate timing errors and improve overall accuracy.
- **Temperature inputs** (Ambient, Calibrator and Meter Under Test) are used for flow rate correction.
- **Pressure inputs** (Calibrator and Meter Under Test) are used for flow rate correction.
- **Automation** options offer capability to fully program the calibration process and place it under computer control.

Performance Specifications

Flow Ranges:

Model	Standard Flow Range	Minimum Achievable Flow (*)
TF200	0.1 to 200 L/min	0.004 L/min (4 ml/min)
TF100	0.05 to 100 L/min	0.002 L/min (2 ml/min)
TF030	0.015 to 30 L/min	0.0005 L/min (0.5 ml/min)
TF004	0.002 to 4 L/min	0.00005 L/min (0.05 ml/min)

* - Minimum flow is affected by lubricity and viscosity of the fluid used

Accuracy: +/- 0.03 % of Reading

Repeatability: +/- 0.02% Of Reading, depending on the type of flow meter being tested and the application conditions.

Pressure Range: Up to 12 bar (higher pressures available)

Temp. Range: 10-50 °C

Viscosity Range: Up to 10,000 centistokes

Flow Meter Inputs: Practically any type of Volumetric or Mass Flowmeter or Totalizer can be calibrated:

- o Frequency generating flowmeters: Turbines, Coriolis, Gear / Oval Gear Meters, Vortex, etc.
- o Analog generating flowmeters (0-20/4-20 mA, 0-5/0-10 VDC): Magnetic, Ultrasonic, Venturis, etc.
- o Visual output flowmeters: Variable Area Meters, Totalizers, etc.

TF Series Advantages over conventional Piston Calibrators

Accuracy of Flow Measurement

- ✓ The TF series guarantees +/-0.03% even at the lowest of flowrates because the critical dimension is the Outside Diameter of the displacer cylinder which can be manufactured to very tight tolerances.
- o Piston Calibrator accuracy is related to the precision of the Inside Diameter of the flow tube. Inside diameters are inherently much more difficult to manufacture to tight tolerances as they also are difficult to measure accurately. +/-0.03-0.05% is possible with the larger tube sizes, but becomes increasingly difficult to maintain as the diameter of the flow tube decreases.

Ease of Maintenance and Recertification

- ✓ The TF series design which allows positive leak detection and the ease by which the critical dimensions of the Displacer cylinder can be measured and monitored allows us to certify the calibrator dimensionally. This minimizes the requirements for periodic preventive maintenance. Periodic seal changes are not required and Water Draw is optional and used only as a means for extra confirmation of continuing reliable operation.
- o Piston Calibrators, because they are subject to hidden leaks require periodic time-consuming preventive seal change and Water Draw in order to ensure confidence that the calibrator is working properly.

Stability of flow

- ✓ In the TF Series the Displacer Cylinder is being pulled by the hydraulic cylinder during data acquisition resulting in smoother motion.
- o For Piston calibrators, the piston is being pushed, making them more susceptible to uneven movement.

Low Flow Capability

- ✓ Positive force from the hydraulic cylinder on the TF calibrators eliminates seal stick-slip. This enables the calibrator to be used at very low displacer velocities resulting in turndown ratios of more than 50000:1. Turndown is limited only by the practicality of measuring encoder frequency when the displacer is moving very slow.
- o In Piston calibrators the piston is pushed with compressed air which adds sponginess to the system and causes stick/slip at the low flowrates. Maximum reliable turndown range is usually not more than 2000:1, especially with non-lubricating fluids.

Leak detection

- ✓ The TF Series Displacer Calibrators come with an inherent but very important advantage: The design is such that there cannot be any hidden leaks. All potential leakage paths are exposed and can easily be inspected visually.
- o Piston Calibrators in contrast, are subject to internal leaks that cannot be visually observed. Piston seal leakage inside the flow tube can only be inferred through leak tests and Water Draw and confirmation is not possible without completely disassembling the calibrator main element.

Air elimination from the calibration fluid

- ✓ TF series: Vertical Flow element configuration allows positive air elimination. Air rises to the top and is simply bled out through a bleed valve at the highest point of the flow chamber.
- o Piston calibrators: Horizontal flow tube configuration makes air elimination difficult, normally requiring that the calibrator is raised at a slight angle to allow air to collect at the highest point before it can be eliminated.

TF Series Advantages over Gravimetric Calibrators

Size, Space Requirements

- ✓ The TF Series is very compact. Its size is primarily determined by the length of the required Test section.
- o Gravimetric Flow calibrators, also known as Catch-and-Weigh systems, require large tanks, diverter piping, weight scales, etc., which makes them much larger than Volumetric Displacer and Piston Calibrators and Provers of the same flow range capability.

Cost – Manufacturing and Maintenance

- ✓ The TF Series' minimalistic design and relative ease of manufacture of the critical components result in low costs for both production and maintenance.
- o Gravimetric equipment of comparable capability to the TF series, because of its complexity and bulk is much more costly to buy, implement and maintain.

Fluid Requirements

- ✓ The TF Calibrators inherently require small quantities of fluid to operate. For example, the displaced volume on the smallest TF series calibrator is only 0.5 lit. This results in significant cost advantages and makes fluid change fast and efficient.
- o Gravimetric equipment requires much larger volume of fluid for calibration. As a result, changing fluids can take several hours or even days.

Time required for Data Acquisition

- ✓ The TF series of calibrators can take data as fast as the operating features of of the flowmeter under test will allow. Data point speed of acquisition is only limited by the ability of the Meter Under Test to achieve and maintain stable output. Reliable flowmeters with fast response characteristics literally require only a few seconds to obtain calibration points.
- o The Gravimetric method is by contrast very time consuming because the complete sample mass must always be collected for each data point. At low flowrates, catching-and-weighing the complete sample may take several minutes or hours.

Accuracy of Flow Measurement

- ✓ The TF series of Calibrators are capable of practically instantaneous readings of flowmeters under test. The short duration of data points minimizes the risk that unstable flow conditions will affect the calibration readings.
- o The Gravimetric method calculates an average flowrate over the entire sampling period which at low flowrates may be very long (see above), consequently requiring constant flowrate over the same period of time in order to ensure measurement reliability and accuracy.


CERTIFICATE

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ISO 9001:2008