Primary Flow Elements
Ability to meet any challenge

As a family-run business acting globally, with over 7,900 highly qualified employees, the WIKA group of companies is a worldwide leader in pressure and temperature measurement. The company also sets the standard in the measurement of level and flow, and in calibration technology. Founded in 1946, WIKA is today a strong and reliable partner for all the requirements of industrial measurement technology, thanks to a broad portfolio of high-precision instruments and comprehensive services. With manufacturing locations around the globe, WIKA ensures flexibility and the highest delivery performance. Every year, over 50 million quality products, both standard and customer-specific solutions, are delivered in batches of 1 to over 10,000 units. With numerous wholly-owned subsidiaries and partners, WIKA competently and reliably supports its customers worldwide. Our experienced engineers and sales experts are your competent and dependable contacts locally.
The WIKA program covers the following product lines for various fields of application.

**Electronic pressure measurement**

WIKA offers a complete range of electronic pressure measuring instruments: pressure sensors, pressure switches, pressure transmitters and process transmitters for the measurement of gauge, absolute and differential pressure. Our pressure measuring instruments are available in the measuring ranges 0 ... 0.6 mbar to 0 ... 15,000 bar. These instruments come supplied with standardised current or voltage output signals (also intrinsically safe per ATEX or with flameproof enclosure), interfaces and protocols for various field buses. Whether ceramic thick film, metal thin film or piezo-resistive, WIKA is the leading manufacturer worldwide that develops and produces the full range of today's leading sensor technologies.

**Mechatronic pressure measurement**

As a result of the almost unlimited options for different combinations of mechanical and electrical connections, an extraordinary range of instrument variants is possible. Various digital and analogue output signals are also available for these measuring instruments.

For our measuring instruments we use latest sensors, tested in automotive applications millions of times over. They work without any kind of mechanical contact, consequently they are wear-resistant, and there's absolutely no influence on the mechanics.

**Mechanical pressure measurement**

Indicating pressure gauges for gauge, absolute and differential pressure with Bourdon tube, diaphragm or capsule pressure elements have been tested millions of times over. These instruments cover scale ranges from 0 ... 0.5 mbar to 0 ... 7,000 bar and indication accuracies of up to 0.1 %.

**Diaphragm seals**

WIKA diaphragm seals, mounted with pressure gauges, pressure transducers, pressure transmitters etc., are recognised and valued internationally for the most difficult of measuring tasks. The measuring instruments can therefore be used at extreme temperatures (-130 ... +400 °C), and with aggressive, corrosive, heterogeneous, abrasive, highly viscous or toxic media. The optimal diaphragm seal designs, materials and filling media are available for each application.

**Electrical temperature measurement**

Our range of products includes thermocouples, resistance thermometers (also with on-site display), temperature switches as well as analogue and digital temperature transmitters for all industrial applications. Measuring ranges from -200 ... +1,600 °C are covered.

**Mechatronic temperature measurement**

As a result of the integration of switch contacts and output signals into our mechanical temperature measuring instruments, we can offer a wide variety of combined instruments. With switch contacts the pointer position triggers a change-over. Electrical output signals are realised via an additional, independent sensor circuit (resistance thermometer or thermocouple).

**Mechanical temperature measurement**

The mechanical temperature measuring instruments work on the bimetal, expansion or gas actuation principle and cover scale ranges from -200 ... +700 °C. All thermometers are suited for operation in a thermowell if necessary.

**Level measurement**

WIKA has a comprehensive range of level measuring instruments available for temperatures up to 540 °C / 1000 °F, specific gravity from .35 and pressure ranges up to 5000 PSI. This includes standard instruments and customised products.

**Flow measurement**

Orifice plates, meter runs, flow nozzles, Venturi tubes and pitot tubes are part of our portfolio of primary flow elements and restriction orifices. The wide range of our products is able to cover the majority of industrial applications. Customised solutions can be developed to meet your special needs.

**Calibration technology**

WIKA offers a broad product range of calibration instruments for the physical units of measurement for pressure and temperature, and for electrical measurands. Numerous patents ensure unmatched performance from many of our calibration instruments. The range of services covers the calibration of pressure and temperature measuring instruments in our accredited DKD/DAkkS calibration laboratories and a mobile service to calibrate your instruments on site.
Orifice plates

Orifice plates are the most economical and widely utilized primary flow elements in the world. Their ease of installation and range of applications makes them an excellent option for any industry.

Main characteristics

- Maximum operating temperature up to 800 °C / 1472 °F
- Maximum working pressure up to 400 bar / 5,800 PSI
- Suitable for liquid, gas and steam flow measurement
- Accuracy of +/- 1% of actual flow rate or higher
- Repeatability of measurement 0.1%

Orifice Plate Variations

- Square edge orifice plates (standard version)
  This design is intended for general applications in clean liquids and gases.

- Quarter circle and conical entrance orifice plates
  The best choice for measurement of liquids with low Reynolds number.

- Segmental orifice plates
  For measurements with two-phase, dirty and particle-laden media.

- Eccentric orifice plates
  The application areas are similar to the segmental version. However, an eccentric orifice plate is the better solution for smaller pipe diameters.
Orifice flange unions

Orifice flanges are intended for use instead of standard pipe flanges when an orifice plate must be installed.

Pairs of pressure tappings are machined into the orifice flange, making separate orifice carriers or tappings in the pipe wall unnecessary.

Main characteristics

- Wide range of materials available
- The number and type of pressure tapping (flange or corner type) can be manufactured to customer requirements
- Special assemblies can be designed on request
- Provided with orifice flanges, standard hardware, gaskets, and orifice plate for ease of installation

Orifice chambers

Annular chambers are designed to be mounted between standard pipe flanges. Versions are available to suit all common flange standards, including DIN and ANSI B 16.5.

Main characteristics

- Standard material of construction is 316/316L Stainless Steel, but a wide range of alternative materials is available
- Gaskets are included in the scope of delivery (as standard, 1/8” thick spiral-wound gasket 316/graphite filler, unless requested otherwise)
Restriction orifices

A restriction orifice is used to achieve either a specified pressure drop or choked flow. Our engineering department will produce the correct design for the restriction orifice, depending on customer requirements and flow conditions.

In high differential pressure drops, a change in phase or sonic issues can occur. The solution in these cases is to decrease the pressure in several steps, avoiding all the issues created by these factors. This solution is called a multi-step restriction orifice assembly.

Main characteristics

- Multi-step restriction orifices reduce the pressure by more than 50% of the inlet valve
- Multi-bore option to reduce the noise level
To ensure high accuracy the primary flow element is supplied as an assembly incorporating the upstream and downstream pipe sections. This assembly is known as a 'meter run'.

**Main characteristics**

- Line size > 1/2"
- Pressure rating 300 - 2,500#
- Wide range of materials available
- Can be designed in accordance with the following standards: ISO5167-1, ASME MFC-3M, AGA3 or ASME PTC 19.5

In order to reduce upstream piping, meter runs can be provided with a flow conditioner. A calibration of the instrument can be performed if higher accuracy is required.

A honed orifice meter run is normally selected when the pipe size is 1 1/2" or smaller and the fluid is clean. Without a calibration, an accuracy of +/- 1% can be expected.
Flow nozzles

A flow nozzle consists of a convergent section with a rounded profile and cylindrical throat. This design is generally selected for steam flow at high velocity.

To reduce pressure loss an axisymmetric solution, called a Venturi nozzle, can be offered. It combines the standard features of a flow nozzle with a divergent section.

Main characteristics

- Liquid, gas and steam flow measurement
- Ideal solution for steam measurement
- Can be designed in accordance with the following standards: ISO 5167-3, ISA 1932, ASME PTC 19.5, ASME PTC 6* or ASME MFC-3M
- Special solutions to cover specific requirements possible
- Accuracy of +/- 2.0% of actual flow rate or higher

*ASME PTC 6 Flow Nozzle Test Sections are manufactured in strict accordance with the ASME PTC 6. These critical meters are used during turbine acceptance testing in power plants to measure boiler feedwater or condensate flow. Fluidic Techniques has successfully designed, manufactured and tested over 300 of these meters for the power industry.
Wedge meter

The Wedge flow meter is designed with a body and an optimized V-shaped restriction (Wedge). This wedge creates a differential pressure in proportion to the square of the volumetric flow rate. The design is suitable for almost any flow condition and is recommended for media with Reynolds number as low as 300 and as high as several million.

The Wedge flow meter is well suited for highly viscous, slurry type, contaminated or air entrained media (e.g. raw sewage, sludge, tar sands, pulp mash, cement, liquid asphalt, molten sulfur, ...). It also shows a good performance for gas or steam measurement.
A venturi tube is a reliable easily-managed and maintained instrument that can measure a wide range of clean liquids and gases.

The Venturi tube offers higher accuracy and reduces upstream and downstream straight pipe length requirements more than other differential pressure flow meters.

**Main characteristics**

- In accordance with ISO 5167-4, ASME PTC 19.5 & ASME MFC-3M standards
- Fabricated from plate or machined from bar/forgings
- Flanged or weld-in construction
- Line sizes from 2” to 48” (larger available upon request)
- Wide variety of pressure tappings available (Typically 1/2” to 1”)
- Calibration service available on request
- Accuracy of +/- 0.75% of actual flow rate or higher
HHR Flow Tube
The High Head Recovery (HHR) Flow Tube is the most efficient differential producing flow measuring device available. The HHR Flow Tube provides significant savings in recurring operation costs over any other type of primary flow element including the venturi tube. The HHR Flow Tube has the lowest permanent pressure loss available among our flow meters. Calibration reports on the HHR Flow Tube consistently show less error than in the flow calibration of any other type of differential pressure producing primary flow element. These characteristics, combined with superior fabricated construction, make the HHR Flow Tube an ideal choice for flow measurement where accuracy, long life and low operating costs are important.

HHR FlowPak
Designed from the innovative velocity profiling technology of the FTI Translineal Flow Plate and the field proven performance of the HHR Flow Tube, the HHR FlowPak consistently outperforms other flow measurement technologies in the most demanding flow environments.

Main characteristics

- Highest accuracy
- Energy efficient
- Installation versatility
- No upstream or downstream piping requirements
- Broad range of applications
Averaging pitot tubes

Averaging Pitot Tubes measure the difference between the static pressure and the dynamic pressure of the media inside the pipe. The volumetric flow is calculated from that difference using Bernoulli’s principle and the inside pipe diameter. Using four dynamic ports this instrument is able to evaluate a better velocity profile inside the pipe. This ensures a higher accuracy in the flow measurement.

**Main characteristics**

- Low installation costs
- Long-term accuracy
- Minimal unrecovered pressure loss
- Fixed and removable versions available
# Technical information

## Fluid Characteristics

Not all instruments can be used in all applications. The type of fluid (gas, liquid or steam) and its conditions must be taken into account when selecting the right instrument for your fluid condition.

The following selection chart will assist in choosing the right instrument

<table>
<thead>
<tr>
<th>Orifice plate and related assemblies (Orifice flange / Meter run / Annular chambers)</th>
<th>Flow Nozzle</th>
<th>Venturi Tube</th>
<th>Pitot Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Square edge</td>
<td>Quadrant</td>
<td>Conical entrance</td>
</tr>
<tr>
<td>Gas Clean</td>
<td>✓ ✓</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Dirty</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Clean</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Viscous</td>
<td>x</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Dirty</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Corrosive</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Steam</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
</tr>
</tbody>
</table>

✓ ✓ Preferred  ✓ Suitable  x Not Suitable

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## Reynolds Number

It is difficult to evaluate the many variables affecting the velocity profile for all flow meters and for all pipeline conditions. To combine fluid properties (density and viscosity), flow rate and geometrical aspects the Reynolds Number is used.

The table shows the smallest possible Reynolds Number that can be used with each instrument:

<table>
<thead>
<tr>
<th>Orifice plate and related assemblies (Orifice flange / Meter run / Annular chambers)</th>
<th>Dimensions</th>
<th>Reynolds Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integral</td>
<td>N</td>
<td>DN</td>
</tr>
<tr>
<td>Square edge</td>
<td>&lt; 1.5”</td>
<td>&lt; 40</td>
</tr>
<tr>
<td>Quadrant</td>
<td>&gt; 1.5”</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Conical entrance</td>
<td>&gt; 1.5”</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Eccentric</td>
<td>&gt; 4”</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Segmental</td>
<td>&gt; 4”</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Flow nozzle</td>
<td>&gt; 2”</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>Venturi tube</td>
<td>&gt; 2”</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>Pitot tube</td>
<td>&gt; 4”</td>
<td>&gt; 100</td>
</tr>
</tbody>
</table>
Quality

FTI maintains quality control at all points from receiving inspection of materials to final inspection of the finished product. Measurements of all critical dimensions are recorded and kept on file for five years or longer, as required by code or customer.

FTI maintains a full range of qualified weld procedures to ASME Section IX standards using SMAW, SAW, GTAW, GMAW and FCAW processes. FTI holds ASME Power Piping (PP) and CRN certifications. Complementing our special emphasis on welding techniques and equipment, an AWS Certified Welding Inspector is kept on staff.

FTI offers a full range of Nondestructive Examination and Testing options. In house capabilities include Gamma Radiography, Dye Penetrant Testing, Magnetic Particle, PMI & Hydrostatic Leak Testing. On staff NDE Level II & Level III personnel are certified to ASNT recommended practice SNT-TC-1A. Other nondestructive testing methods are available to FTI through 3rd party sub-contracting.

Other special services include but are not limited to Postweld Heat Treatment, Telebrinell Hardness Testing & Ferrite Testing.

FTI can manufacture our products with almost any machinable material including, but not limited to:

- Carbon steel (105, 106, LF2, 333)
- Stainless steel (304, 316, 321)
- Chrome Moly Steels (A387 Gr5, Gr9, Gr11, Gr22, Gr91)
- Duplex/Superduplex
- Hastelloy Alloys
- Inconel Alloys
- Incoloy Alloys
- Monel Alloys
Non-Destructive Testing/Evaluation

Non-Destructive Testing (NDT) and Non-Destructive Evaluation (NDE) A number of different tests can be carried out by FTI to check for defects in or on the surface of materials depending on your requirements.

Liquid Penetrant Testing (PT) is used to locate surface defects on relatively smooth and non-porous materials. This test method is normally used for welded parts to guarantee the quality of the weld surface. Typical weld defects that can be discovered are cracks, porosity, incomplete fusion and laminations.

Magnetic Particle Inspection is a non-destructive test method for the detection of surface and sub-surface discontinuities in ferrous materials. The test method involves the application of an external magnetic field to the material or applying an electric current through the material, which in turn produces a magnetic flux in the material. Simultaneously, visible ferrous particles are sprinkled or sprayed on the test surface. The presence of a surface or near-surface discontinuity in the material causes distortion in the magnetic flux which in turn causes leakage of the magnetic field at the discontinuity. The magnetic particles are attracted by the surface field in the area of the discontinuity and adhere to the edges of the discontinuity, indicating the location and shape of the discontinuity.

Radiography Testing (RT) is used extensively on the welded seams of pipes, fittings, etc. The method is based on the absorption of penetrating radiation and thus detects differences in density due to material composition, thicknesses and flaws. Defects are found internally and may be present in raw materials, castings and forgings as well as in welded joints. Radiography tests are normally used for components that must fulfill certain requirements. Irregularities or flaws that can be detected include: surface and internal cracks, voids, laminations, lack of fusion, lack of penetration, misassembly and misalignments.

Hydrostatic pressure tests are used to (statically) test assemblies, piping systems and primary flow components under pressure. The hydrostatic pressure test is conducted with water at ambient temperatures to ensure that welds are sound and do not leak.

Ultrasonic testing is used as an independent test or in conjunction with radiography testing. It is a method in which high frequency sound waves are introduced into a material. Any surface or subsurface discontinuities or flaws that are present interrupt the sound waves and reflect a portion of them. The magnitude of the reflected waves depends on the size of the discontinuity or flaw. The defects that can be detected are similar to those that can be found through radiography testing. Ultrasonic testing often replaces radiography methods when there is difficulty in positioning the radiography film or where the required distance from the radiation source cannot be maintained, which may lead to safety risks.

Positive Material Identification (PMI) A common method is spectroscopy with radiography fluorescence XRF analysis. With this method the analyzing instrument has a low-level radioactive source. The basic principle is based on the fact that each element has a different electron energy level and the instrument determines the required energy to remove an electron and thus, for example, to cause an ionization. The analyzer can only identify a limited number of elements. This testing of material composition is fast, easy and effective when determining the accuracy of material certificates, or identifying material that has lost its marking or when a large quantity of material must be checked.