Technical Data

Specifications Writer's Guide
Primary Flow Elements

Preface

The development of the "**Bullet"** shape **Verabar®** has significantly advanced the pitot technology. **Verabar®** is the alternative to orifice plates as well as other differential pressure primary flow elements, offering several important advantages.

The **MassTransmount®** and **Transmount®** fully integrated flowmeters offer the same advantages listed below, with even more cost savings due to the direct mounted electronics on the sensor. (Ref: VB-7060).

- **Long-Term Accuracy, Higher Rangeability**
  The **Verabar®** self-averaging primary flow sensor measures the critical static pressure component on both sides of the sensor with dual, multiple ports located ahead of the point at which the fluid separates from the probe. The result is a highly stable **(mathematically predictable)** discharge coefficient with an accuracy of 1% of rate, 0.1% repeatability independent of Reynolds number. The patented roughened surface creates a turbulent boundry layer allowing the **Verabar®** to measure lower flows than any other pitot tube available.

- **Non-Clog Design**
  The **Verabar®** patented dual averaging static ports are located ahead of the point at which the fluid separates from the probe, and out of the suction (low-pressure zone) where dirt and debris accumulate, resulting in the ability to operate in particulate laden fluids which will clog traditional pitot tubes.

- **Energy Savings**
  The **Verabar®** produces the lowest permanent pressure loss **(3%)**, of any differential pressure primary available to date, drastically reducing pumping/compressing cost. Total cost (purchase and installation) can be recovered in less than a year through reduced HP requirements. (Ref: ESP Energy Savings Planner).

- **Reduced Installed Cost (purchase and installation)**
  Installed cost are typically 25% to 75% lower than orifice plate, Vortex, Turbine, Venturi Tubes and Flow Nozzles, to mention just a few.

- **System Shutdown Not Required**
  Installation (hot tapping) and removal can be accomplished without system shutdown (up to and including 600# ANSI service).

- **Short Straight Run**
  Minimum straight-run applications can be accommodated with the Elbow mount configuration, allowing installation only two (2) diameters downstream of an elbow.

- **Warranty**
  The entire **Verabar®** line of primary elements is backed by a full **5-year** performance Warranty.

Table of Contents

1.0 GENERAL DESIGN SPECIFICATIONS

1.1 Flow – Differential Pressure (Gas, Liquids and Steam)

1.1.1 The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on the sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows.

1.1.2 Pipe sizes are 2" (50.8mm) and above.

1.1.3 Unrecovered pressure loss shall be equal to or less than 3% of the developed differential pressure.

1.1.4 Sensor shall be capable of installation and removal without system shut down to 600# ANSI (1440 psig @ 100 F°/99,29 bars @ 37.8 C°).

1.1.5 Where adequate straight run is **not** available, the sensor shall be capable of being installed two diameters downstream of an elbow with accuracy to be no more than 3% of flow rate.

1.1.6 Each sensing element shall be supplied with a visual and dimensional inspection report (to assure the quality and accuracy of the sensing element).

1.1.7 Each sensor shall have a **5-year performance warranty** from date of start-up.

Accuracy of the flow measuring sensors is stated in each individual sample specification and shall be verified by certified independent laboratory testing facilities.

Flow Sensor Sizes:

Model 05 – for line sizes 1/2" to 3" (spool sections)
Model 05 – for line sizes 2" to 6"
Model 10 – for line sizes 4" to 42"
Model 15 – for line sizes 8" to 144"
Model 20 – for line sizes 12" and greater

Veris, Inc. Verabar® sensors are manufactured to all ANSI specs and carry the ISO 9001 certification.

2.0 FLOW MEASUREMENT SENSORS (HOT TAP)-THREADED SINGLE ROD

2.1 GENERAL:

The contractor shall furnish and install a flow element that is of the averaging pitot type that allows installation and removal without shutdown of system (**VERABAR® Hot Tap**), as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.1.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross-section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a hot tap threaded assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.1.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated 150# or 600# ANSI depending on the application conditions and the sensor specified. The **single rod** shall utilize a stainless steel rod with **ACME™** threads and incorporate an **anti-seize orbital bearing** to assure ease of operation.

2.1.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.1.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.1.5 FLUIDS:

Liquids, gases and steam.

2.1.6 SENSOR TYPE:

The sensor type shall be a hot tap threaded, single rod assembly type in accordance with the below schedule and sizes.

VERABAR® HOT TAP Model V200S – Threaded assembly (SINGLE ROD)
05 sensors up to 600# ANSI equivalent (1440 psig @ 100 F°/99,3 bars @ 38 C°)
10 & 15 sensor up to 150# ANSI equivalent (275 psig @ 100 F°/19 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS (HOT TAP)-THREADED DUAL ROD

2.2 GENERAL:

The contractor shall furnish and install a flow element of the averaging pitot type that allows installation and removal without shutdown of system (**VERABAR® Hot Tap**), as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.2.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a hot tap threaded assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.2.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated 600# ANSI depending on the application conditions and the sensor specified. The **dual rod (SYNCRO-DRIVE)** shall utilize stainless steel rods with **ACME™** threads and incorporate **anti-seize orbital bearings** to assure ease of operation.

2.2.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.2.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.2.5 FLUIDS:

Liquids, gases and steam.

2.2.6 SENSOR TYPE:

The sensor type shall be a hot tap threaded, (SYNCRO-DRIVE) dual rod assembly type in accordance with the below schedule and sizes.

VERABAR® HOT TAP Model V200D – Threaded assembly (DUAL ROD)
10 & 15 sensors up to 600# ANSI equivalent (1440 psig @ 100 F°/99,3 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS (HOT TAP)- FLANGED SINGLE ROD

2.3 GENERAL:

The contractor shall furnish and install a flow element of the averaging pitot type that allows installation and removal without shutdown of system (**VERABAR® Hot Tap**), as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.3.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a hot tap flanged assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.3.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated 150# or 600# ANSI depending on the application conditions and the sensor specified. The **single rod** shall utilize a stainless steel rod with **ACME™** threads and incorporate an **anti-seize orbital bearing** to assure ease of operation.

2.3.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.3.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.3.5 FLUIDS:

Liquids, gases and steam.

2.3.6 SENSOR TYPE:

The sensor type shall be a hot tap flanged, single rod assembly type in accordance with the below schedule and sizes.

VERABAR® HOT TAP Model V400S – Flanged assembly (SINGLE ROD)
05 sensors up to 600# ANSI equivalent (1440 psig @ 100 F°/99,3 bars @ 38 C°)
10 & 15 sensor up to 150# ANSI equivalent (275 psig @ 100 F°/19 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS (HOT TAP)- FLANGED DUAL ROD

2.4 GENERAL:

The contractor shall furnish and install a flow element of the averaging pitot type that allows installation and removal without shutdown of system **(VERABAR® Hot Tap),** as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.4.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a hot tap flanged assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.4.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated 600# ANSI depending on the application conditions and the sensor specified. The **dual rod (SYNCRO-DRIVE)** shall utilize stainless steel rods with **ACME™** threads and incorporate **anti-seize orbital bearings** to assure ease of operation.

2.4.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.4.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.4.5 FLUIDS:

Liquids, gases and steam.

2.4.6 SENSOR TYPE:

The sensor type shall be a hot tap flanged, (SYNCRO-DRIVE) dual rod assembly type in accordance with the below schedule and sizes.

VERABAR® HOT TAP Model V400D – Flanged assembly (DUAL ROD)
10 & 15 sensors up to 600# ANSI equivalent (1440 psig @ 100 F°/99,3 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS-FLANGED

2.5 GENERAL:

The contractor shall furnish and install a flow element that is of the averaging pitot type, (**VERABAR®** Flanged), as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.5.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a flanged assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.5.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated up to 2500# ANSI depending on the application conditions and the sensor specified.

2.5.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.5.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.5.5 FLUIDS:

Liquids, gases and steam.

2.5.6 SENSOR TYPE:

The sensor type shall be a flanged assembly type in accordance with the below schedule and sizes.

VERABAR® Flange Model V500 – Flanged assembly
05, 10 & 15 sensors up to 2500# ANSI equivalent (6000 psig @ 100 F°/413,7 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS – FLANGED-SAFETY "SPRING LOCK®"

2.6 GENERAL:

The contractor shall furnish and install a flow element that is of the averaging pitot type, **(VERABAR® Spring Lock®)**, as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.6.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a flanged **(Spring Lock®)** assembly, which includes precise spring loading on the packing and on the sensor to the opposite wall of the piping to prevent leakage and eliminate the need for opposite wall support hardware. **Sealing of the packing shall be separate from the loading mechanism.** The sensor shall include instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.6.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated up to 600# ANSI depending on the application conditions and the sensor specified.

2.6.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.6.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.6.5 FLUIDS:

Liquids, gases and steam.

2.6.6 SENSOR TYPE:

The sensor type shall be a flanged safety spring lock assembly type in accordance with the below schedule and sizes.

VERABAR® Flange Model V550 – Flanged Spring Lock® assembly
05, 10 & 15 sensors up to 600# ANSI equivalent (1440 psig @ 100 F°/99,3 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS – THREADED-SAFETY "SPRING LOCK®"

2.7 GENERAL:

The contractor shall furnish and install a flow element of the averaging pitot type, **(VERABAR® Spring Lock®)**, as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.7.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a threaded **(Spring Lock®)** assembly, which includes precise spring loading on the packing and on the sensor to the opposite wall of the piping to prevent leakage and eliminate the need for opposite wall support hardware. **Sealing of the packing shall be separate from the loading mechanism.** The sensor shall include instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.7.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated up to 600 # ANSI depending on the application conditions and the sensor specified.

2.7.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(0.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.7.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.7.5 FLUIDS:

Liquids, gases and steam.

2.7.6 SENSOR TYPE:

The sensor type shall be a threaded safety spring lock assembly type in accordance with the below schedule and sizes.

VERABAR® Model V150 – Threaded Spring Lock® assembly
05, 10 & 15 sensors up to 600# ANSI equivalent (1440 psig @ 100 F°/ 99,3 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS – IN-LINE

2.8 GENERAL:

The contractor shall furnish and install a flow element of the averaging pitot type, **(VERABAR®),** as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.8.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a flanged, threaded or weld type assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.8.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The meter section shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated up to 600 # ANSI depending on the application conditions and the sensor specified.

2.8.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.8.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.8.5 FLUIDS:

Liquids, gases and steam.

2.8.6 SENSOR TYPE:

The sensor type shall be an in-line assembly type in accordance with the below schedule and sizes.

VERABAR® IN-LINE Model VNF05 – Flanged assembly
VERABAR® IN-LINE Model VNT05 – Threaded assembly
VERABAR® IN-LINE Model VNW05 – Welded assembly
Up to 600 # ANSI equivalent (1440 psig @ 100 F°/99,3 bars @ 38 C°)

2.0 FLOW MEASUREMENT SENSORS – COMPRESSION FITTING

2.9 GENERAL:

The contractor shall furnish and install a flow element of the averaging pitot type, (**VERABAR®**), as manufactured by Veris, Inc., Niwot, Colorado. The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on both sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows. The flow element shall consist of a solid one-piece welded design. The element shall have an array of sensing ports whose quantity and location are a function of line size and in accordance with the Centroid of equal area calculus.

2.9.1 CONFIGURATION:

The flow element sensing tube shall have a "BULLET" shaped cross section so that the fluid separation occurs ahead of the widest point on the body and before the low-pressure suction zone, where dirt and debris collect. This therefore allows accurate measurement independent of pressure, temperature and low side vortex shedding noise, resulting in a stable flow coefficient independent of Reynolds numbers. The flow sensor element shall be a ferrule and compression nut assembly, with instrument shut off valves and connections suitable for connecting to a transmitter/meter that is provided by the same vendor. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max allowable insertion D/P and Flow coefficient.

2.9.2 MATERIALS:

The sensing element shall be made of 316/316L stainless steel. The mounting coupling shall be made of a material that is compatible with the process pipe material. The measuring station shall be rated up to 600 # ANSI depending on the application conditions and the sensor specified.

2.9.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- 1% **(.75% if pipe I.D. measured)** of actual flow rate over a minimum flow turndown of 10:1. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.1% of actual value over the entire flow range.

2.9.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program.

2.9.5 FLUIDS:

Liquids, gases and steam.

2.9.6 SENSOR TYPE:

The sensor type shall be a ferrule and compression nut assembly type in accordance with the below schedule and sizes.

VERABAR® Model V100 – Ferrule and compression nut assembly
05 sensor 600 # ANSI (1440 psig @ 100 F°/99,3 bars @ 38 C°)
10 sensor 300 # ANSI (720 psig @ 100 F°/49,6 bars @ 38 C°)

3.0 DIRECT MOUNTED INTEGRAL METER

3.1 Transmount® Direct Mount Verabar®

3.1.1 General:

Contractor shall furnish a fully integrated and configured flow meter that inserts into the existing pipe or duct, using a single penetration in the pipe. The meter shall consist of an instrument manifold, Bullet shaped sensor with multiple sensing ports, and an integrally mounted electronic "Smart" D/P transmitter. The meter is a Transmount® as designed and manufactured by Veris, Inc. located in Niwot, Colorado.

3.1.2 Configuration and Assembly:

The flow meter shall be configured and assembled at the factory and shipped as a complete ready-to-install system.

3.1.3 Accuracy, Turndown and Repeatability:

The flow meter shall have an accuracy of +/- 1.3% of volumetric flow reading and a repeatability of +/- 0.1% of reading. Flow turndown capability shall be 10:1 or greater depending on the threshold flow available for each application.

3.1.4 Output:

4-20 maDc linear to flow, HART® Protocol

3.1.5 Fluids:

Liquids, gases and steam.

3.1.6 Pipe Sizes:

1/2" to 72" (12 to 1800mm). Larger sizes available on request, consult factory.

3.1.7 Warranty:

The flow meter shall have a **5-year** limited performance warranty.

3.2 Sensor:

The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris, Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low-pressure sensing ports shall be located on the sides of the element forward of the fluid separation point (to eliminate low-pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows.

3.3 Quality:

The flow meter shall be designed and manufactured under the control of an ISO 9001 certified program. Proof of certification shall be provided.

3.4 Optional Features:

The flow meter shall have available an integral RTD located within the sensor and an explosion-proof junction box mounted on the head.

3.5 Model Availability:

Shall be available with the following sensor models:
Regular Models – V100, V110, V150, VNT, VNW
Flanged Models – V500, V510, V550, VNF
Hot Tap Models – V200S, V200D, V400S, V400D

4.0 MASS METER

4.1 Mass Transmount® Direct Mount Verabar®

4.1.1 General:

Contractor shall furnish a fully integrated flow meter that inserts into the existing pipe or duct, using a single penetration in the pipe. The meter shall consist of an instrument manifold, integral RTD Bullet shaped sensor with multiple sensing ports, and an integrally mounted electronic "Smart" D/P transmitter. The electronics shall measure static pressure, process temperature and differential pressure directly from the inserted sensor, and calculate compensated mass flow. The meter is a Mass Transmount® as designed and manufactured by Veris Inc. located in Niwot, Colorado.

4.1.2 Configuration and Assembly:

The flow meter shall be configured and assembled at the factory and shipped as a complete ready to install system.

4.1.3 Accuracy, Turndown and Repeatability:

The flow meter shall have an accuracy of +/- 1.3% of Mass flow reading and a repeatability of +/- 0.1% of reading. Flow turndown capability shall be 10:1 or greater depending on the threshold flow available for each application.

4.1.4 Output:

4-20 maDc linear to compensated mass flow. Compensated mass flow, pressure process temperature and differential pressure signals available via HART® Protocol.

4.1.5 Fluids:

Liquids, gases and steam

4.1.6 Pipe Sizes:

1/2" to 72" (12 to 1800mm) Larger sizes available on request, consult factory.

4.1.7 Warranty:

The flow meter shall have a 5 year limited performance warrantee.

4.2 Sensor:

The sensing element shall be made from 316SS and be of a solid one-piece construction with dual chambers, as manufactured by Veris Inc. The element shall be bullet shaped and be self-averaging with multiple sensing ports on both high and low chambers. The low pressure sensing ports shall be located on the sides of the element forward of the fluid separation point (to eliminate low pressure plugging). The leading edge of the sensor shall be roughened to allow accurate measurement at low velocity flows.

4.3 Quality:

The flow meter shall be designed and manufactured under the control of an ISO 9001 certified program. Proof of certification shall be provided.

4.4 Optional Features:

The flow meter shall have available an integral RTD located within the sensor and an explosion-proof junction box mounted on the head.

4.5 Model Availability:

Shall be available with the following sensor models:
Regular Models – V100, V110, V150, VNT, VNW
Flanged Models – V500, V510, V550, VNF
Hot Tap Models – V200S, V200D, V400S, V400D

Armstrong VERIS Accelabar® Specifications

GENERAL DESIGN

5.1 GENERAL:

The contractor shall furnish and install a flow meter which utilizes a D/P technology, VERIS Accelabar®**,** as manufactured by Armstrong's Veris Flow Measurement Group, Frederick, Colorado.

5.1.1 CONFIGURATION:

The flow meter consists of a patented and unique toroidal nozzle design eliminating the need for both upstream and downstream straight run. The sensing element utilizes the advantages of the VERIS Verabar® averaging pitot tube technology. The meter body includes a welded thermowell eliminating leak paths for an optional removable RTD. A metal tag (SST) shall be permanently attached to the flow sensor showing Model No., Serial No., Pipe I.D., Tag No., Max Pressure & Temperature, Max D/P, Max Allowable Insertion D/P and Flow Coefficient.

5.1.2 MATERIALS:

The meter body (C8FM) and element (VERIS Verabar®) shall be made of 316 stainless steel for sizes 1", 2", 3", 4", 6", 8", 10" and 12" utilizing a 316 SS flow element and 304 SS mating flanges/body. Exotic Materials available including: Hastelloy C276, Inconel, etc. (List available from manufacturer). The standard meter body is rated to the 600# ANSI class depending on the application conditions and the sensor specified. It can be rated up to 2500# ANSI upon request. Each meter shall have a **5-year performance warranty** from date of shipping.

5.1.3 ACCURACY & REPEATABILITY:

The accuracy of the flow element shall be within +/- **0.5%** of actual flow rate over a MAXIMUM flow turndown of up to 65:1 (application dependent). The installation of the meter shall require **NO STRAIGHT RUN** regardless of the upstream and downstream piping configuration. Certified test data from independent flow laboratories shall be provided as verification. The repeatability of the flow element shall be +/- 0.05% of actual value over the entire flow range. The flow element has no moving parts or springs within the body itself requiring no calibration or maintenance for the life of the meter.

5.1.4 QUALITY:

The sensor shall be designed and manufactured under the control of an ISO 9001 program. All welded components will be performed by ASME Section IX code qualified welders. Available pressure testing per ASME B31.1 or ASME B31.3.

5.1.5 FLUIDS:

Liquids, gases and steam.