

SAGE THERMAL GAS MASS FLOW METER
User Manual
For Models SIA and SRA

DOCUMENT NUMBER 100-0147
REVISION 07 - SIA/SRA (SAGE CLEAR)

Make the Wise Choice.
Choose Sage Flow Meters.

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Welcome

We are pleased that you have purchased a Sage Metering Mass Flow Meter for your requirement. We hope that you are satisfied with the performance, operation and design of our highly precise, NIST traceable Thermal Gas Mass Flow Meter.

Sage Metering is your source for monitoring, measuring and controlling the gas mass flow in your industrial process, building management system or environmental application. Our high performance, NIST Traceable, Thermal Mass Flow Meters will help increase productivity, reduce energy costs, maximize product yields, and/ or help reduce environmental insult. Sage provides high quality In-Line and Insertion Thermal Mass Flow Meters for a wide variety of industrial, commercial, and environmental monitoring needs, including carbon credit verification for Greenhouse Gas reduction.

Sage Meters measure mass flow directly — there is no need for ancillary instrumentation such as temperature or pressure transmitters. Furthermore, our instruments have exceptional signal sensitivity, have no moving parts, require little if any maintenance, have negligible pressure drop and have a turndown up to 100 to 1, and resolve as much as 1000 to 1. Sage Flow Meters can measure the mass flow rate and consumption of air, oxygen, natural gas, nitrogen, digester gas, biogas, flare gas, hydrogen, argon, carbon dioxide and other gases and gas mixes.

Sage Clear is our most economical, and the latest addition to our family of high performance Thermal Mass Flow Meters. It features a bright graphical display of Flow Rate, Total and Temperature, NEMA 4 enclosure, and easy to access power and output terminals. Sage Clear features a very high contrast photo-emissive OLED display with a photocell activated Screen Saver. The terminals are easy to access and well marked for ease of customer wiring. It is powered by 24 VDC (or optionally 115/230 VAC). The power dissipation is under 2.5 watts (e.g. under 100 mA at 24 VDC for the DC version.)

Please let us know if we can assist you in any way with your Sage Meter, or if you have any questions about its installation, operation, or features. Simply phone us at 866-677-SAGE (7243), or visit our website at www.sagemetering.com to contact a factory representative in your area. This Manual is available on the website under the Knowledge Base section

Sincerely,



Robert Steinberg
President

Section

A

GETTING STARTED

Getting Started

UNPACKING YOUR SAGE METER

Your Sage flow meter is a sensitive, yet rugged, precision built electronic instrument. Upon delivery, care should be taken when opening the shipping container and removing your meter. The meter should be inspected for any damage that may have occurred during transit. If damage is found, please contact the carrier immediately to place a claim for damaged goods. The contents of the container should be checked against the packing list for any discrepancies. If there are any questions as to the contents or configuration of the equipment including calibration ranges, or, mounting hardware, contact Sage Metering as soon as possible. Please save shipping container and packaging materials (including PVC tube probe protector on Sage Insertion Flow Meters) in case the unit needs to be returned for any reason.

MAINTENANCE

Sage thermal mass flow meters essentially require little or no maintenance. While the sensing element is somewhat resistant to dirt and particulate build up, it may become necessary to clean it from time to time if mounted in extremely dirty environments. NOTE: ALWAYS REMOVE THE POWER PRIOR TO ANY CLEANING OR MAINTENANCE (or optionally turn OFF the on-board power switch). A detergent or

appropriate non-corrosive solvent for removing the buildup may be required. A soft brush can be used to gently clean the sensing element's surface, using caution to avoid damaging the sensor elements (the RTDs). If any disassembly is necessary, contact Sage Metering, Inc. for instructions. **In general, it is recommended that your Sage Thermal Mass Flow Meter be returned to the factory if cleaning, repair, or recalibration is needed. This is usually the most cost-effective and reliable alternative.**

CALIBRATION

Sage Clear has continuous diagnostics. The raw calibration milliwatts (mw) is always displayed in the upper left hand corner of the meter's display. At any time, you can check this reading at a "no flow" condition and compare the reading to the original reported "zero flow" value noted on the last few lines of your meter's Certificate of Conformance or the flow meter's data tag. This diagnostic procedure not only checks the sensor performance and the "live zero" calibration point, but it verifies that the sensor is clean. It essentially provides a means to validate the meter's performance, verifies that there is no shift or drift, and eliminates the need for annual factory calibrations. This simple field diagnostic procedure also verifies that the sensor is free from contamination, even without inspection. See "In-Situ Calibration Check" on page 46.

INSTALLATION AND MOUNTING

- Check the Certificate of Conformance included with your Sage Thermal Mass Flow Meter for system pressure, temperature, gas composition, power input, and signal output.
- It is recommended that the flow meter be inserted in a location of maximum straight run. It is suggested that there be a minimum of 15 pipe diameters of straight run upstream, and 5 diameters downstream, depending on the conditions. See **chart on page 11**. Note, obstructions such as valves, blowers, expanders and PVC and HDPE pipes will require additional straight run (contact factory for assistance).
- Check the orientation: Standard calibration flow direction is left to right when facing the flow meter. Gas flow direction is marked with an arrow on In-Line flow meters; UPSTREAM is marked on Insertion probes.
- Do not rotate probe, or errors may occur. If enclosure is facing incorrectly, rotate the enclosure 180°, but do not rotate the probe. In order to rotate the enclosure, loosen the large probe hex nut, rotate enclosure, and tighten the hex nut. The UPSTREAM mark still needs to be facing Upstream.
- Hook up the system per the wiring diagram provided with your Sage flow meter. Double check that wiring for the proper power and signal connections are correct.
- Check that all plumbing and electrical hook-ups

are in accordance with OSHA, NFPA, and all other safety requirements.

- **For Remote Style Meters (SRA) be sure the Remote Electronics is matched with the Transmitter's Junction Box and its attached Probe or Flow Body. There will be Serial Number Tags on both the Transmitter as well as the Remote Electronics enclosure. Do not mismatch the serial numbers of the Remote Electronics and the Junction Box, or calibration errors will occur.**

LOCATING PROPER WIRING DIAGRAM

- 1) Look at the sticker on your meter. The first three digits describe the basic model that you have. Refer to the appropriate page numbers below for your wiring diagram
- 2) SIA: see page 19
- 3) SRA: see pages 20-23 for input/output terminals; see page 24 (Junction Box Wiring Terminals for Remote Style Meters)

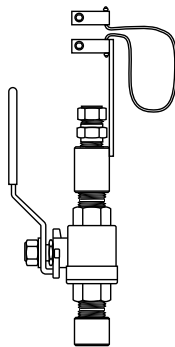
Insertion Flow Meter Application

FLOW PROFILE AND INSTALLATION CONSIDERATIONS

Insertion Flow Meters, although generally easier to install than In-Line Flow Meters, require proper installation, and a well developed flow profile, in order to perform properly. Please refer to the section on the following pages titled PROBE INSERTION GUIDELINE DRAWING (page 14) and INSTALLATION DEPTH CHART (page 15).

SAGE VALVE ASSEMBLY OPERATION

Valve assemblies (SVA05 and SVA05LP) are an optional mounting hardware for Insertion Style Flow Meters (see pages 37 and 38). They allow the removal of Insertion-style meters for service, cleaning, recalibration, relocation, etc. without the need to “shut-down” your process. The probe insertion depth is adjustable to permit sensor to be located at center to optimize measurement accuracy. (Refer to PROBE INSERTION GUIDELINE DRAWING and CHART, pages 14 & 15.) The ball valve will seal off leaks of the process gas at the point of insertion after the probe assembly has been removed. The assembly includes a valve, threadolet, compression fitting with Teflon ferrule, a cable restraint, and two collar clamps.



NOTE:
Detailed Drawings are shown on pages 37 & 38.

A threaded half coupling (3/4" FNPT) properly sized to accommodate the isolation valve retractor assembly must be fitted to the pipe/duct to which the

insertion probe will be inserted. **Avoid T-Fittings since they will disturb the flow profile, and effectively reduce the measurement area.** Direct threading together (or with necessary bushings) of the retractor assembly may be required. In other cases, the threadolet must be welded in place and a clearance hole must be drilled through the pipe/ duct to accept the probe assembly. **If the pipe/duct is under pressure during installation, a hot tap drill (not available through Sage Metering) may be required.**

FLOW CONDITIONING AND STRAIGHT RUN

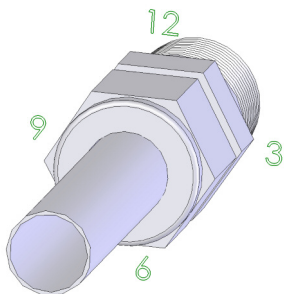
Although a minimum of 15 pipe diameters of upstream straight run is commonly recommended, to absolutely assure that the flow profile is well developed at the point of measurement, either use Flow Conditioners (standard in Sage In-Line Flow Meters, 1/2" and larger, and also available as assemblies for Insertion Flow Meters, see page 13), or consider additional straight run. The Chart below provides examples of the amount of straight run that would virtually assure that there are no flow disturbances at the point of measurement.

| IMPORTANCE OF FLOW CONDITIONING Recommended Pipe Diameters Upstream | | |
|--|---------------------------------|-------------------------------------|
| DISTURBANCE | WITHOUT FLOW CONDITIONING | WITH FLOW CONDITIONING ¹ |
| | Minimum Industry Recommendation | Sage Recommendation |
| One 90° Elbow | 15 | 3 |
| Two 90° Elbows in the same plane | 20 | 5 |
| Two 90° Elbows in different planes | At least 40 | 9 |
| 4:1 Area Reduction | 15 | 3 |
| 4:1 Area Expansion | At least 30 | 10 |
| Multiple Disturbance | To Be Determined | TBD |

¹ This column applies to In-Line Flow Meters, which come standard with built-in Flow Conditioners, as well as Insertion Meters, when provided with upstream Captive Flow Conditioners (see page 13).

COMPRESSION FITTING OPERATION

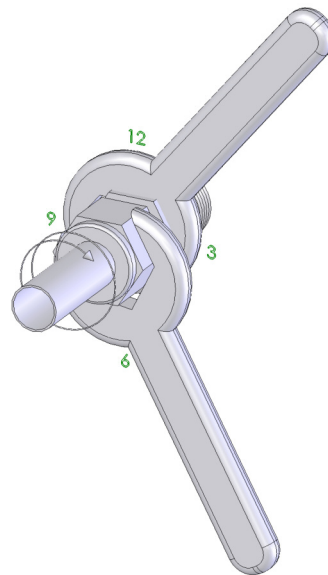
A bored through tube fitting, properly sized to accommodate an Insertion probe's particular OD, can be provided by the user or purchased as an option from Sage Metering (see page 38). Prior to installation, a clearance hole to accommodate the insertion probe assembly must be drilled in the pipe/duct. A fitting (1/2" FNPT) is then welded in place or threaded into the half-threadolet which has been welded to the pipe/duct. The probe insertion depth is adjustable to permit sensor to be located at center, to optimize measurement accuracy. (Refer to PROBE INSERTION GUIDELINE DRAWING and CHART, pages 14 & 15.)



Insert the probe shaft tubing into the compression fitting to the position indicated in the Probe Insertion guidelines.

INSTALLATION INSTRUCTIONS

1. Insert tubing into the tube fitting.
2. Make sure that the tubing is positioned properly per the PROBE INSERTION GUIDELINE DRAWING AND CHART, pages 14 & 15.
3. **Due to the variations of tubing diameters, a common starting point is desirable. Therefore, tighten the nut until the tubing will not turn by hand or move axially in the fitting.**
4. Scribe the nut at the 6 o'clock position.
5. While holding fitting body steady, tighten the nut 1¼ turns to the 9 o'clock position.

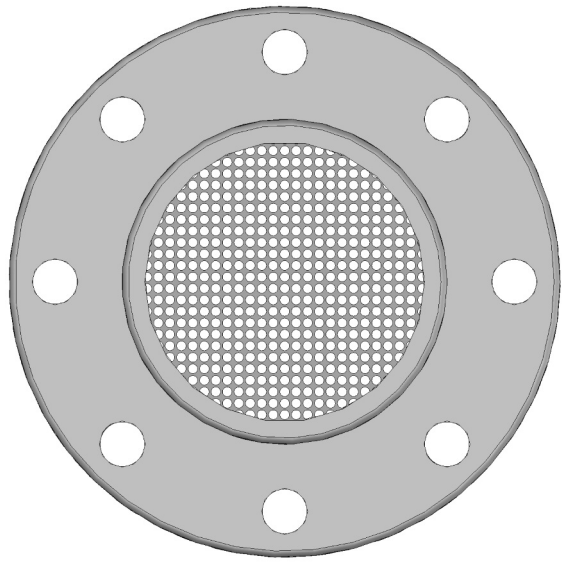
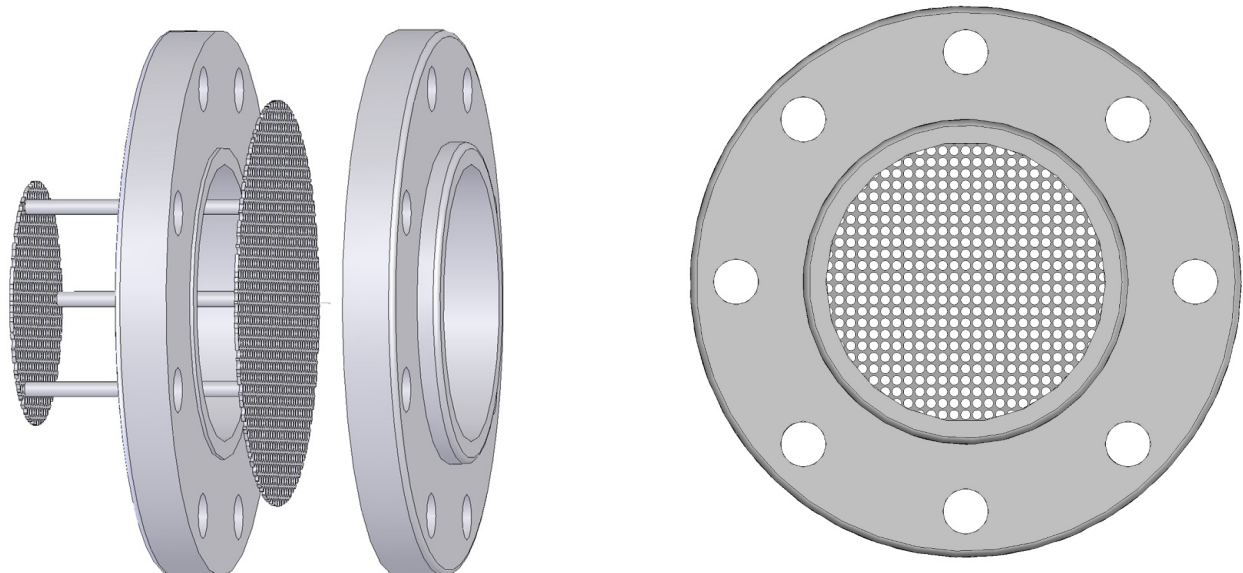


While holding the fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position.

CAPTIVE FLOW CONDITIONERS

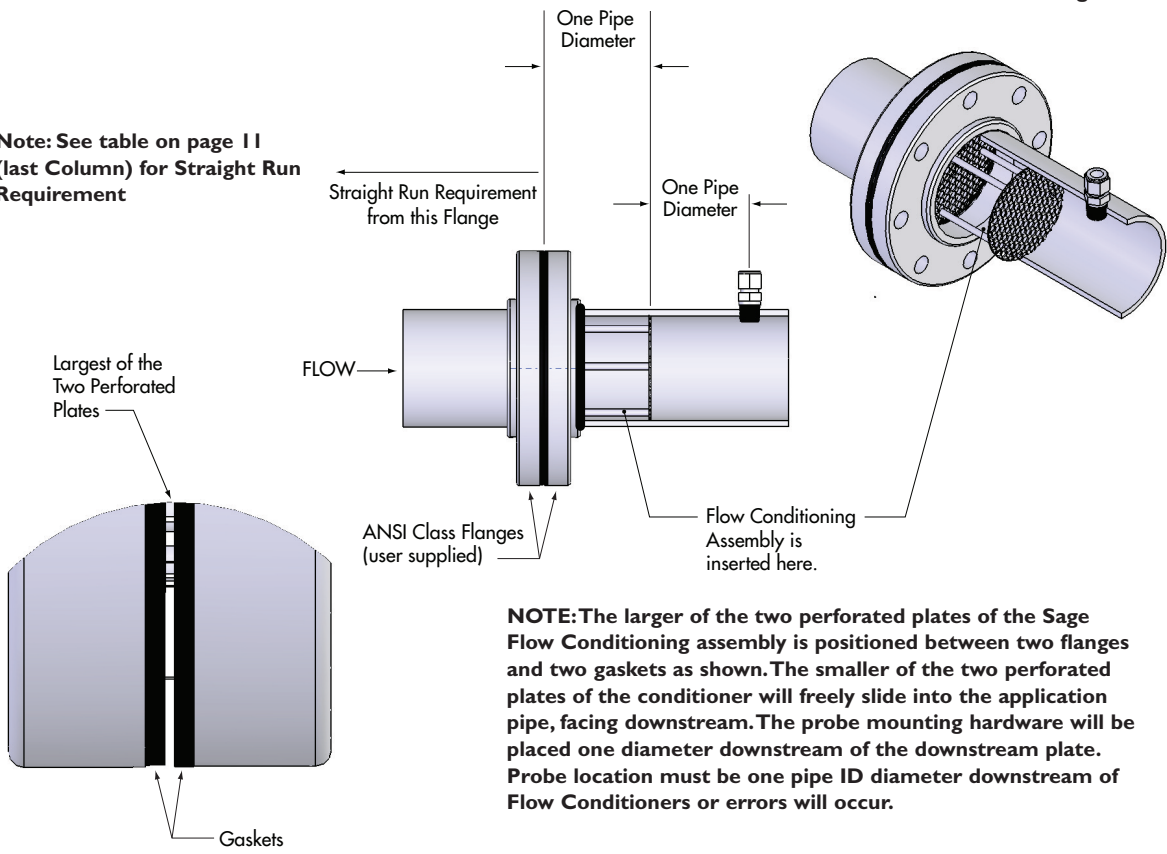
Can Be Installed in Conjunction with Insertion Style Flow Meters

IMPORTANT The location of the probe must be exactly one pipe ID diameter (i.e., 4" in a 4" pipe; 6" in a 6" pipe, etc.) downstream of the Captive Flow Conditioning assembly. The Captive Flow Conditioners are always designed to be separated by one pipe diameter. See drawing below. The probe location must be one pipe ID diameter downstream of Flow Conditioner, or errors will occur.



Front View of one of the Conditioning Plates

Note: See table on page 11 (last Column) for Straight Run Requirement

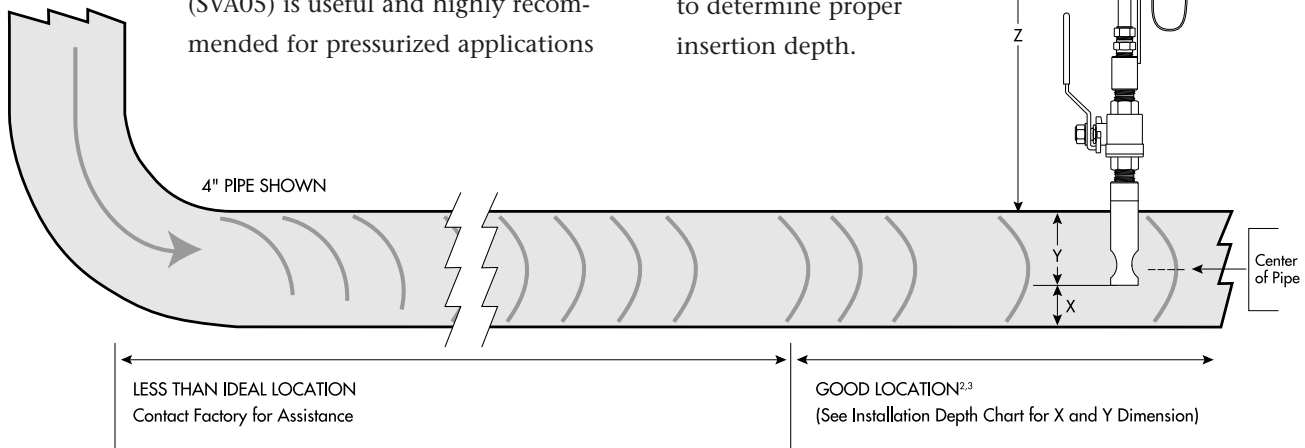


NOTE: The larger of the two perforated plates of the Sage Flow Conditioning assembly is positioned between two flanges and two gaskets as shown. The smaller of the two perforated plates of the conditioner will freely slide into the application pipe, facing downstream. The probe mounting hardware will be placed one diameter downstream of the downstream plate. Probe location must be one pipe ID diameter downstream of Flow Conditioners or errors will occur.

PROBE INSERTION GUIDELINE DRAWING¹

Choose the longest straight-run section of pipe available to allow a uniform, well-developed flow profile. Allow for a minimum of 15 pipe diameters of straight run upstream, and 5 diameters downstream, depending on the conditions. See chart on page 11. Note, obstructions such as valves, blowers expanders and PVC and HDPE pipes will require additional straight run (contact factory for assistance). Avoid, if possible, installations immediately downstream of bends, fans, nozzles, heaters and especially valves, or anything else installed in the line that may cause nonuniform flow profiles and swirls. Otherwise signal output errors could result, unless significantly more straight run is provided, or in the absence of sufficient straight run, Flow Conditioners (page 13) are installed (contact Sage for assistance if needed). Refer to page 13 to see the benefits of incorporating Flow Conditioners.

Insertion styles are available through Sage Metering, Inc. with a standard 1/2" OD probe support assembly. Standard probe lengths are 6", 12", 15", 18" and 24". A common method of mounting the probe assembly through a pipe wall or duct (if ambient air) is with a compression fitting (STCF05). A Sage valve assembly (SVA05) is useful and highly recommended for pressurized applications



or other gases, such as Natural Gas. Flange mounting is optionally available.

Sage insertion style flow meters can be assembled and calibrated for use in virtually any size pipe or duct (as small as 1"). Sage insertion flow meters include a probe assembly that supports the sensing element (a self-heated flow sensor and a temperature/reference sensor); a sensor drive circuit; micro-processor meter board, and transmitter enclosure. The probe assembly must be inserted into the correct position in the process gas flow conduit to allow the gas to flow through the sensor "window" across the sensor element. The "sensing point" or active part of the sensor (0.5" from the end of the probe) should be positioned as per the drawing below and the Installation Depth Chart on page 15.

Installation Depth

The center of the pipe (assuming a well developed turbulent flow profile) is fairly flat, and easy to locate. See "Installation Depth Chart" on next page to determine proper insertion depth.

1. SIA Industrial Meter shown in drawing. Note, probe is not bi-directional.
2. Probe should be inserted per Installation Depth Chart (see following page), so sensors are in the center of the pipe.
3. The portion of the probe that remains outside of the pipe, is simply the factory ordered probe length (i.e. "15" = 15 inches) minus the "Y" dimension.

INSTALLATION DEPTH CHART

Methods for Probe Insertion to Pipe Center

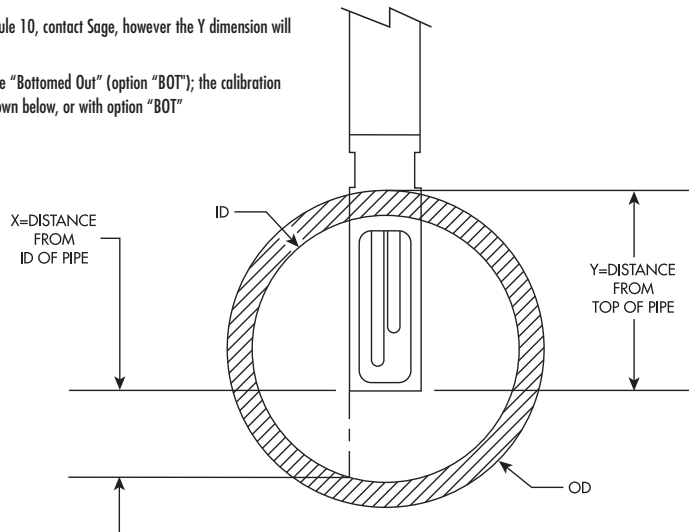
METHOD 1

Using charts below¹, select pipe size (column 1), determine X. Insert probe until the end touches the bottom of the pipe (ID), mark probe as it exits top of fitting. Lift probe distance “X” and tighten compression fitting.

METHOD 2

Using charts below¹, select pipe size (column 1), determine Y. Subtract Y from the factory supplied probe length Z. That difference (see drawing on page 14) should be outside of the pipe, and is measured from the bottom of the enclosure at the probe weld to pipe OD.

- 1 For other Pipe Schedules, such as Schedule 10, contact Sage, however the Y dimension will be the same for any Schedule Pipe
- 2 The 1" Pipe Size needs to have the Probe "Bottomed Out" (option "BOT"); the calibration method for the 1½" Pipe is either as shown below, or with option "BOT"

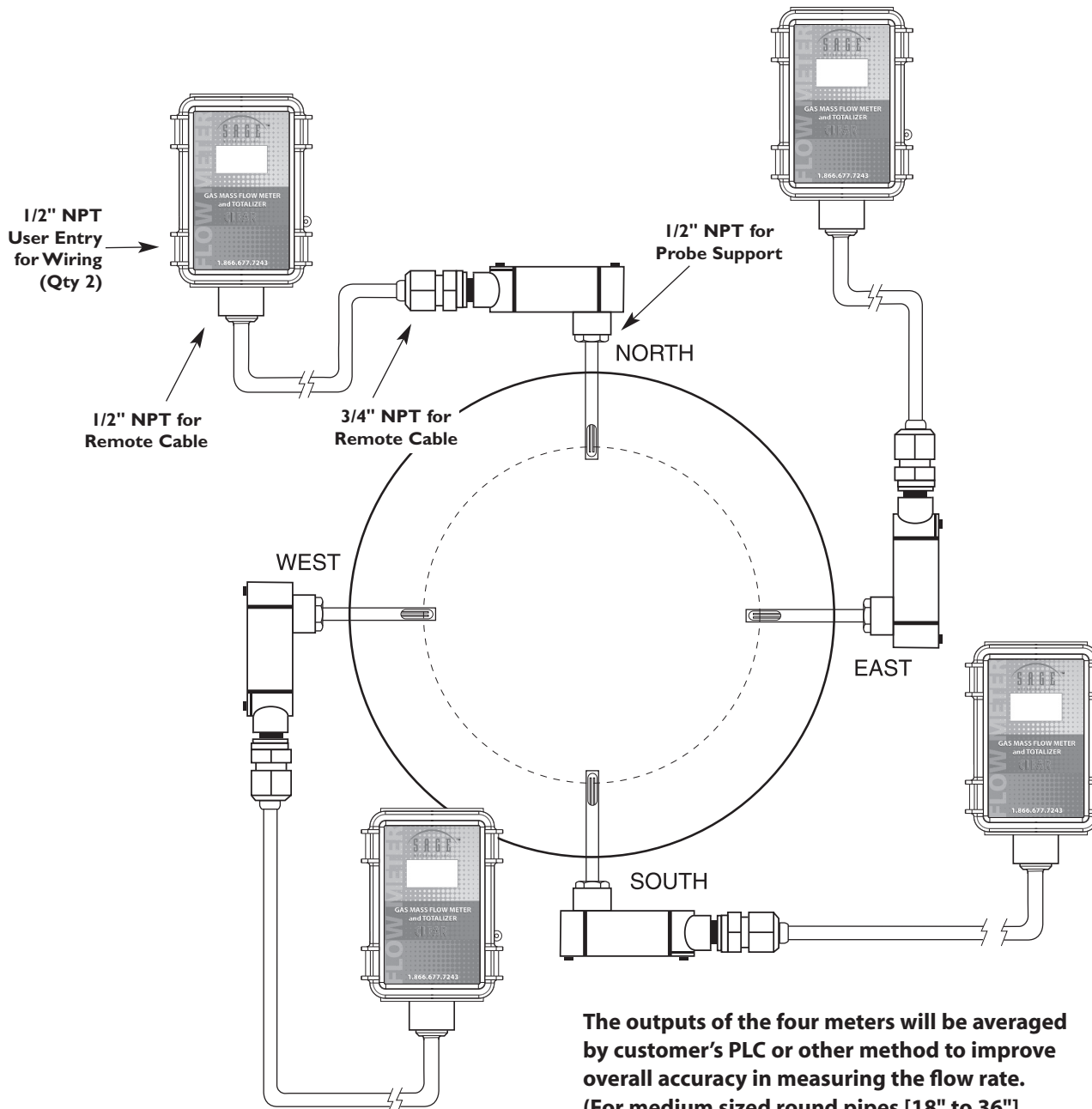


| SCHEDULE 40 PIPE ² | | | | | |
|-------------------------------|-----------------------------|--------|--------|--------|-----------|
| PIPE SIZE | OD | ID | X | Y | PIPE AREA |
| 1" | C O N S U L T F A C T O R Y | | | | |
| 1.5" | 1.900 | 1.610 | .20" | 1.56" | 0.0141 |
| 2" | 2.375 | 2.067 | .40" | 1.82" | 0.0233 |
| 2.5" | 2.875 | 2.469 | .60" | 2.07" | 0.0332 |
| 3" | 3.500 | 3.068 | .90" | 2.38" | 0.0513 |
| 4" | 4.500 | 4.026 | 1.40" | 2.86" | 0.0884 |
| 6" | 6.625 | 6.065 | 2.40" | 3.95" | 0.2006 |
| 8" | 8.625 | 7.981 | 3.40" | 4.90" | 0.3474 |
| 10" | 10.750 | 10.020 | 4.40" | 6.00" | 0.5476 |
| 12" | 12.750 | 11.938 | 5.50" | 7.00" | 0.7773 |
| 14" | 14.000 | 13.124 | 6.00" | 7.50" | 0.9394 |
| 16" | 16.000 | 15.000 | 7.00" | 8.60" | 1.2272 |
| 18" | 18.000 | 16.876 | 8.00" | 9.60" | 1.5533 |
| 24" | 24.000 | 22.625 | 10.75" | 12.60" | 2.7919 |

| SCHEDULE 80 PIPE ² | | | | | |
|-------------------------------|-----------------------------|--------|--------|--------|-----------|
| PIPE SIZE | OD | ID | X | Y | PIPE AREA |
| 1" | C O N S U L T F A C T O R Y | | | | |
| 1.5" | 1.900 | 1.500 | .15" | 1.56" | 0.0123 |
| 2" | 2.375 | 1.939 | .35" | 1.82" | 0.0205 |
| 2.5" | 2.875 | 2.323 | .55" | 2.07" | 0.0294 |
| 3" | 3.500 | 2.900 | .80" | 2.38" | 0.0459 |
| 4" | 4.500 | 3.826 | 1.30" | 2.86" | 0.0798 |
| 6" | 6.625 | 5.761 | 2.25" | 3.95" | 0.1810 |
| 8" | 8.625 | 7.625 | 3.25" | 4.90" | 0.3171 |
| 10" | 10.750 | 9.750 | 4.25" | 6.00" | 0.5185 |
| 12" | 12.750 | 11.374 | 5.13" | 7.00" | 0.7056 |
| 14" | 14.000 | 12.500 | 5.70" | 7.50" | 0.8522 |
| 16" | 16.000 | 14.312 | 6.60" | 8.60" | 1.1172 |
| 18" | 18.000 | 16.124 | 7.50" | 9.60" | 1.4180 |
| 24" | 24.000 | 21.562 | 10.25" | 12.60" | 2.5357 |

Large Stack or Duct Applications

**CONFIGURATION FOR UTILIZING FOUR (4) SAGE INSERTION MASS FLOW METERS FOR LARGE ROUND PIPES OR DUCTS LARGER THAN 36" TO MINIMIZE EFFECTS OF VARYING FLOW PROFILES
(It is recommended that Factory be contacted to assist with applications of this nature)**



The outputs of the four meters will be averaged by customer's PLC or other method to improve overall accuracy in measuring the flow rate. (For medium sized round pipes [18" to 36"], two meters, on the opposite side of the same diameter, may be sufficient [insert parallel to an upstream 90 degree bend for optimal benefit.]) Note, in this configuration, each sensor needs to be averaged.

In-Line Flow Meter Application

IN-LINE FLOW METERS

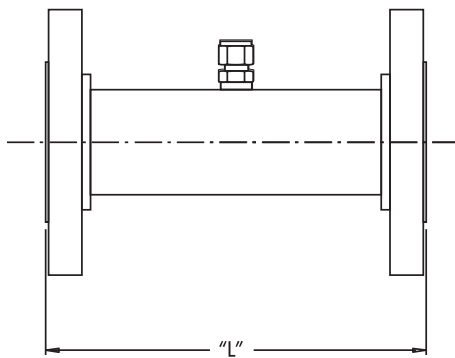
In-Line mounting styles are available through Sage Metering, Inc. in sizes from 1/4" pipe through 4" pipe. Threaded male NPT ends are standard up to 2-1/2"; ANSI 150lb flanged ends are recommended for 3" and 4" models. Contact the factory if optional end mounting styles are required. Pipe sizes in excess of 4" require the insertion style mass flow meter.

The In-Line style flow meter assembly flow section is typically specified to match the user's flow conduit and is plumbed directly in the flow line by thread-

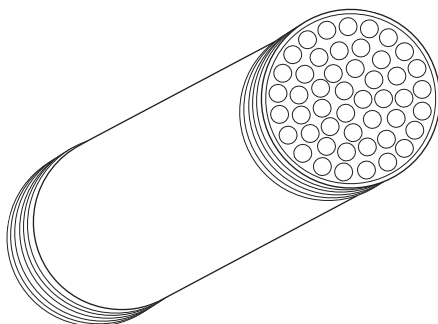
ing, flanging, welding, etc. DO NOT USE REDUCERS. It includes the sensing element (a self-heated flow sensor and a temperature/reference sensor) mounted directly in the specified flow section for exposure to the process gas; a sensor drive circuit; microprocessor meter board, and transmitter enclosure.

All In-Line Flow Meters, 1/2" and up have built-in Flow Conditioners. See Table (page 11) for Upstream Straight run requirements. **Note**, the 1/4" and 3/8" do not have Flow Conditioners and thus require more straight run.

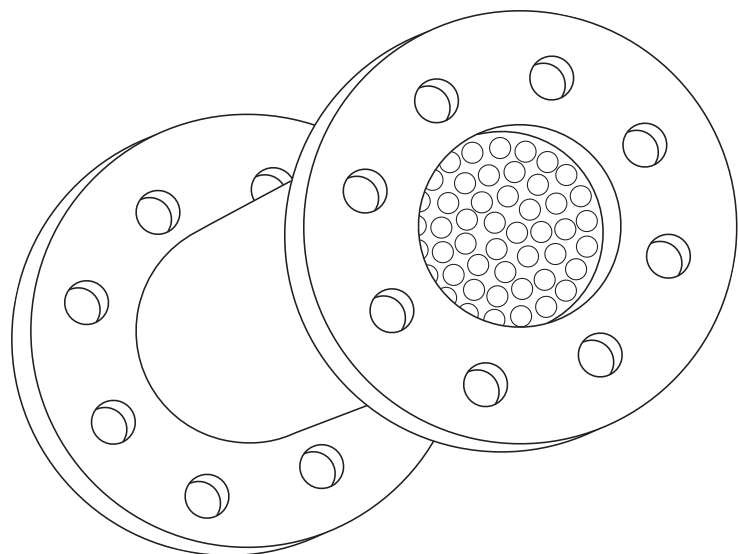
FLOW CONDITIONING SCREENS FOR IN-LINE FLOW BODIES 1/2" AND UP¹



LENGTH "L" SAME AS NON-FLANGED METER
(See table on page 35. For example, 1" x 8" flow body has an 8" length. The length will be the same whether an NPT flow body, or whether flanged. If a flanged flow body, the 8" dimension will be a Face-to-Face dimension.)



Screens shown with NPT fitting.

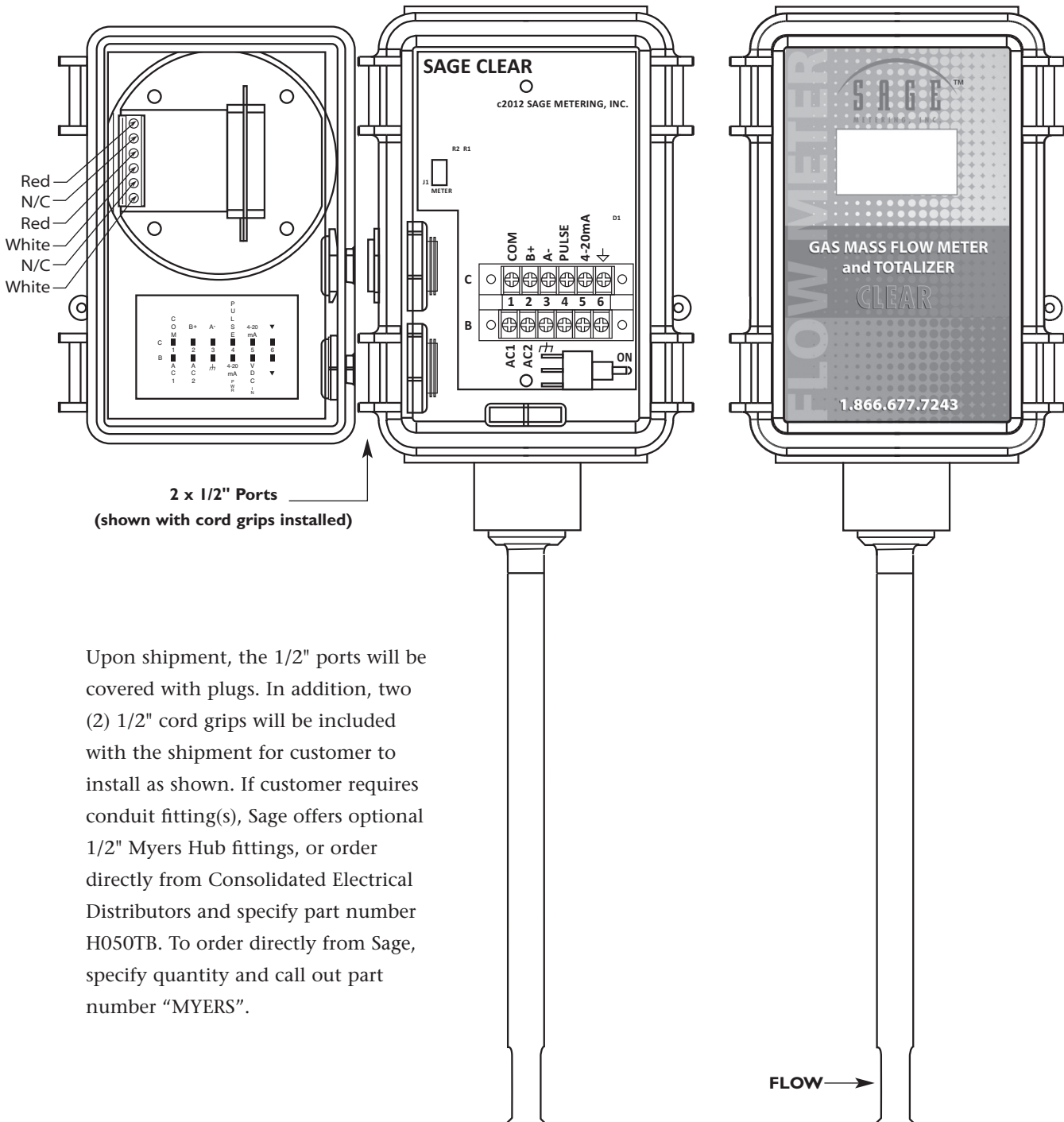


¹ Note, Flow conditioning is also available for Insertion Meter applications (see page 13)

Clear Integral (Series SIA)

TO ACCESS WIRING, SIMPLY OPEN LID;
SEE FOLLOWING PAGES FOR TERMINAL HOOKUP

FRONT VIEW



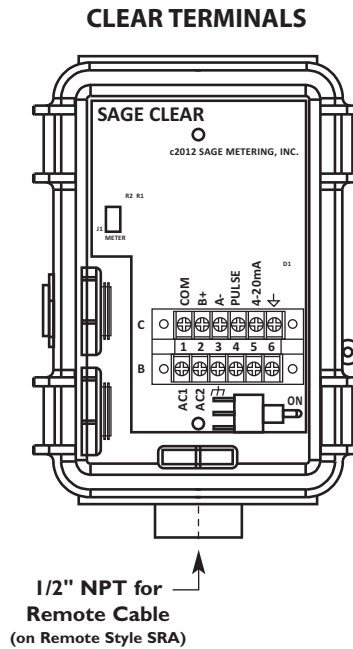
2 x 1/2" Ports
(shown with cord grips installed)


Upon shipment, the 1/2" ports will be covered with plugs. In addition, two (2) 1/2" cord grips will be included with the shipment for customer to install as shown. If customer requires conduit fitting(s), Sage offers optional 1/2" Myers Hub fittings, or order directly from Consolidated Electrical Distributors and specify part number H050TB. To order directly from Sage, specify quantity and call out part number "MYERS".

24 VDC Clear Integral Terminals (Series SIA)

- B1 – AC1
- B2 – AC2
- B3 – CHASSIS GROUND
- B4 – 4-20 mA
- B5 – VDC IN
- B6 – COMMON GROUND

- C1 – COM
- C2 – B+
- C3 – A-
- C4 – PULSE
- C5 – 4-20 mA
- C6 – COMMON GROUND



| DESCRIPTION | TERMINALS | | |
|--|---|------------------|-------------------|
| DC Input Power: 24 VDC ³ | B5 | B6 | |
| | + VDC | - VDC GND | |
| Internally Powered: 4-20 mA | C5 | C6 | |
| | 4-20 mA SIGNAL DRIVE | Return | |
| Internally Powered: Pulsed Output | C4 | C6 | |
| | 24 0  | GND | |
| ADDRESSER HOOKUP | C2 | C3 | C1 |
| | RS485(+) (D1) | RS485(-) (D0) | GROUND (REQ'D) |

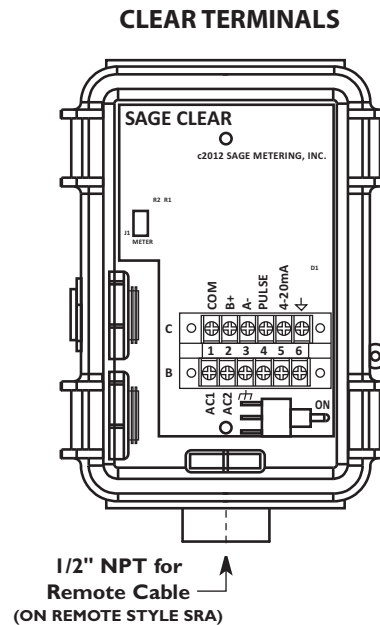
NOTE: The Sage Clear draws 2.4 watts maximum (i.e. $\approx 100\text{ma} @ 24\text{VDC}$)

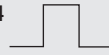
1 Pulse width 250 msec default (adjustable with Addresser software)
 2 Using Sage Addresser, a Low Flow Cutoff (LFC), commonly referred to as Min Cutoff or Zero Cutoff can be entered into the Min Flow/LFC Function. A Low Flow Cutoff (LFC) of 10 SCFM on a Meter with a Full Scale of 100 SCFM will report 0 on the Display and 4 mA on the output. The output will remain at 4 mA until the LFC is exceeded: (ie: 25 SCFM=8 mA). Thus the 4 mA will always be zero based
 3 24 VDC $\pm 10\%$

AC Powered Clear Integral Terminals (Series SIA)

B1 – AC1
B2 – AC2
B3 – CHASSIS GROUND
B4 – 4-20 MA
B5 – VDC IN
B6 – COMMON GROUND

C1 – COM
C2 – B+
C3 – A-
C4 – PULSE
C5 – 4-20 MA
C6 – COMMON GROUND



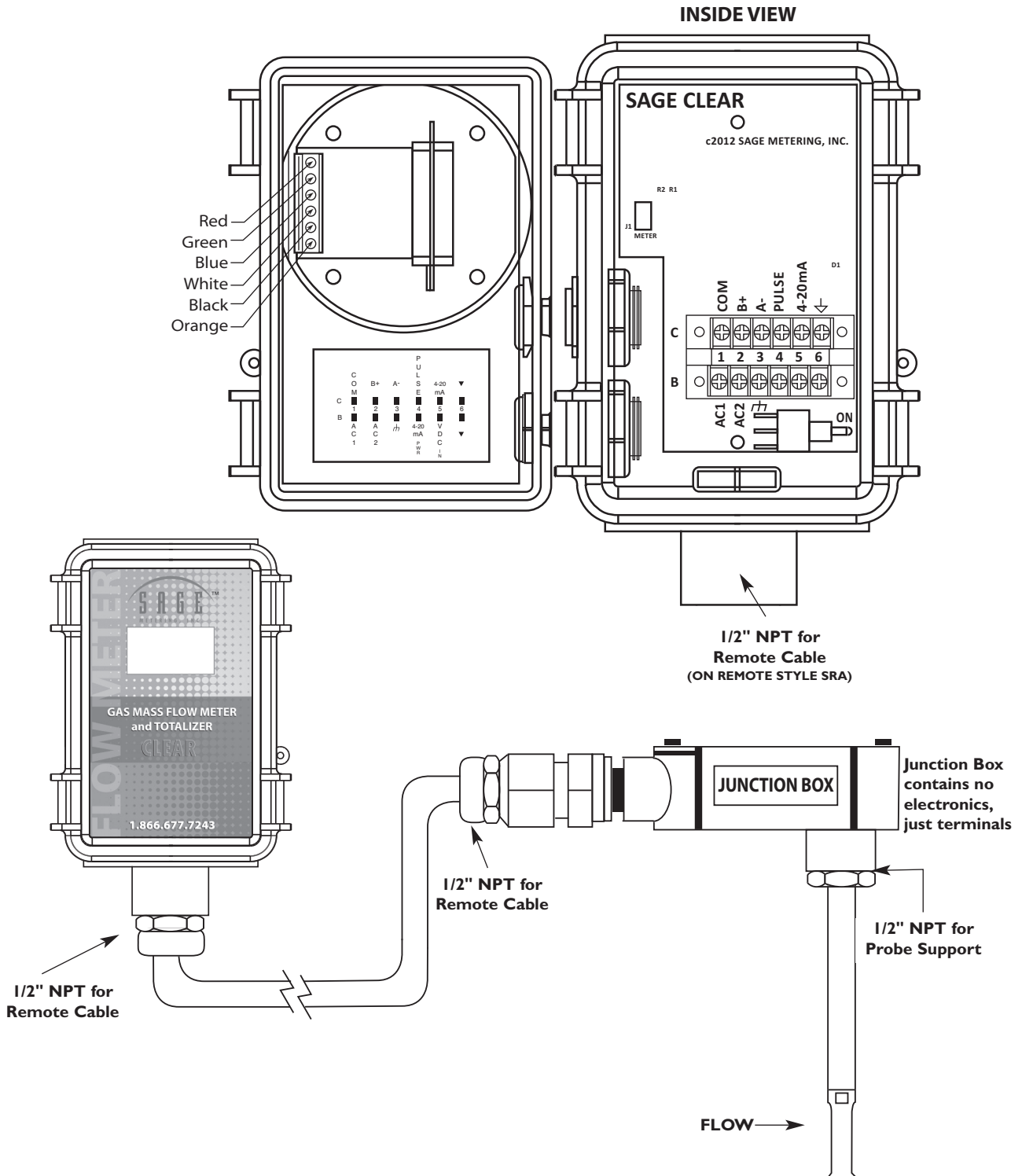
| DESCRIPTION | TERMINALS | | |
|---|---|------------------|-------------------|
| AC Input Power: 115 VAC/230 VAC | B1 | B2 | |
| | AC1 | AC2 | |
| DC Input Power: 24 VDC ^{3,4} | B5 | B6 | |
| | + VDC | – VDC GND | |
| Internally Powered: 4-20 mA | C5 | C6 | |
| | 4-20 mA SIGNAL DRIVE | Return | |
| Internally Powered: Pulsed Output | C4 | C6 | |
| | 24 0  | GND | |
| ADDRESSER HOOKUP | C2 | C3 | C1 |
| | RS485(+) (D1) | RS485(–) (D0) | GROUND (REQ'D) |

NOTE: The Sage Clear draws 2.4 watts maximum (i.e. ≈ 100ma @24VDC)

- 1 Pulse width 250 msec default (adjustable with Addresser software)
- 2 Using Sage Addresser, a Low Flow Cutoff (LFC), commonly referred to as Min Cutoff or Zero Cutoff can be entered into the Min Flow/LFC Function. A Low Flow Cutoff (LFC) of 10 SCFM on a Meter with a Full Scale of 100 SCFM will report 0 on the Display and 4 mA on the output. The output will remain at 4 mA until the LFC is exceeded: (ie: 25 SCFM=8 mA). Thus the 4 mA will always be zero based
- 3 24 VDC ±10%
- 4 On AC powered flow meters, meter can be powered by AC power or Terminals B1 and B2 or 24VDC power on Terminals B5 and B6 (but flow meter can not be powered from both at the same time)

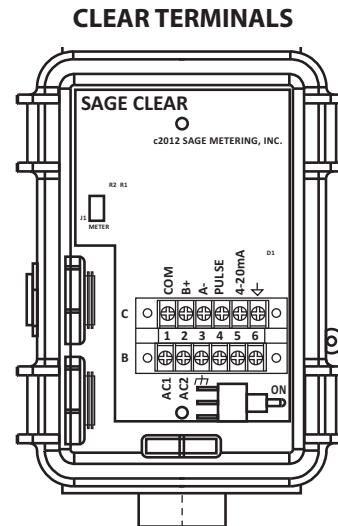
Clear Remote (Series SRA)

SEE FOLLOWING PAGES FOR TERMINAL HOOKUP




24 VDC Clear Remote Terminals (Series SRA)

- B1 – AC1**
B2 – AC2
B3 – CHASSIS GROUND
B4 – 4-20 MA
B5 – VDC IN
B6 – COMMON GROUND
- C1 – COM**
C2 – B+
C3 – A-
C4 – PULSE
C5 – 4-20 MA
C6 – COMMON GROUND



1/2" NPT for
Remote Cable
 (on Remote Style SRA)

| DESCRIPTION | TERMINALS | | |
|---|---|------------------|-------------------|
| DC Input Power: 24 VDC ³ | B5 | B6 | |
| | + VDC | – VDC GND | |
| Internally Powered: 4-20 mA | C5 | C6 | |
| | 4-20 mA SIGNAL DRIVE | Return | |
| Internally Powered: Pulsed Output | C4 | C6 | |
| | 24 0  | GND | |
| ADDRESSER HOOKUP | C2 | C3 | C1 |
| | RS485(+) (D1) | RS485(–) (D0) | GROUND (REQ'D) |
| | | | |

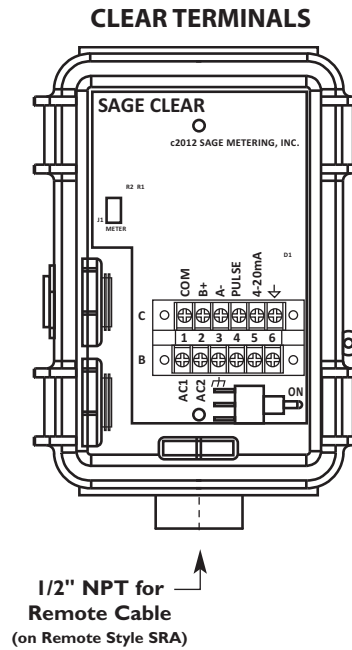
NOTE: The Sage Clear
 draws 2.4 watts maximum
 (i.e. ≈ 100ma @24VDC)


- 1 Pulse width 250 msec default (adjustable with Addresser software)
- 2 Using Sage Addresser, a Low Flow Cutoff (LFC), commonly referred to as Min Cutoff or Zero Cutoff can be entered into the Min Flow/LFC Function. A Low Flow Cutoff (LFC) of 10 SCFM on a Meter with a Full Scale of 100 SCFM will report 0 on the Display and 4 mA on the output. The output will remain at 4 mA until the LFC is exceeded: (ie: 25 SCFM=8 mA). Thus the 4 mA will always be zero based
- 3 24 VDC ±10%

AC Powered Clear Remote Terminals (Series SRA)

- B1 – AC1
- B2 – AC2
- B3 – CHASSIS GROUND
- B4 – 4-20 MA
- B5 – VDC IN
- B6 – COMMON GROUND

- C1 – COM
- C2 – B+
- C3 – A-
- C4 – PULSE
- C5 – 4-20 MA
- C6 – COMMON GROUND



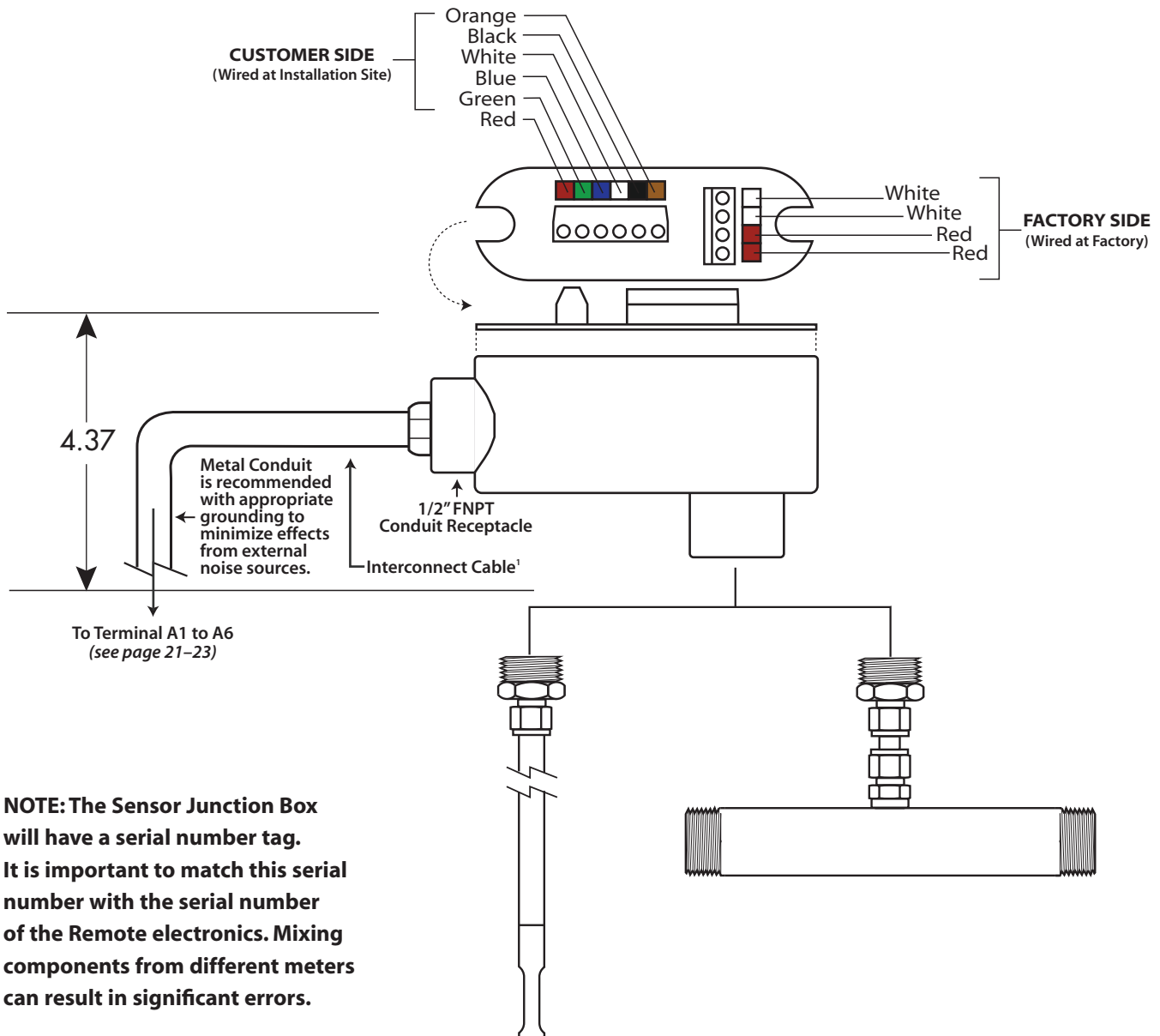
| DESCRIPTION | TERMINALS | | |
|---|--|-------------------------------|--------------------------------|
| DC Input Power: 24 VDC ^{3,4} | B5 + VDC | B6 – VDC GND | |
| Internally Powered: 4-20 mA | C5 4-20 mA SIGNAL DRIVE | C6 Return | |
| Internally Powered: Pulsed Output | C4 24 0  | C6 GND | |
| ADDRESSER HOOKUP | C2 RS485(+) (D1) | C3 RS485(-) (D0) | C1 GROUND (REQ'D) |

NOTE: The Sage Clear draws 2.4 watts maximum (i.e. ≈ 100ma @24VDC)

1 Pulse width 250 msec default (adjustable with Addresser software)
 2 Using Sage Addresser, a Low Flow Cutoff (LFC), commonly referred to as Min Cutoff or Zero Cutoff can be entered into the Min Flow/LFC Function. A Low Flow Cutoff (LFC) of 10 SCFM on a Meter with a Full Scale of 100 SCFM will report 0 on the Display and 4 mA on the output. The output will remain at 4 mA until the LFC is exceeded: (ie: 25 SCFM=8 mA). Thus the 4 mA will always be zero based
 3 24 VDC ±10%
 4 On AC powered flow meters, meter can be powered by AC power or Terminals B1 and B2 or 24VDC power on Terminals B5 and B6 (but flow meter can not be powered from both at the same time)²⁴

Junction Box Wiring Terminals for Remote Style Meters (Series SRA)

(THERE ARE NO ELECTRONICS INSIDE JUNCTION BOX)



¹ Sage supplies 25 feet of cable for the interconnect wires between the Junction Box and the Remote Enclosures: Carroll (manufacturer), Part #C0783, 20 gauge, 6 conductor, foil shielded, grey PVC jacket.

Section

B

STYLES AND FEATURES

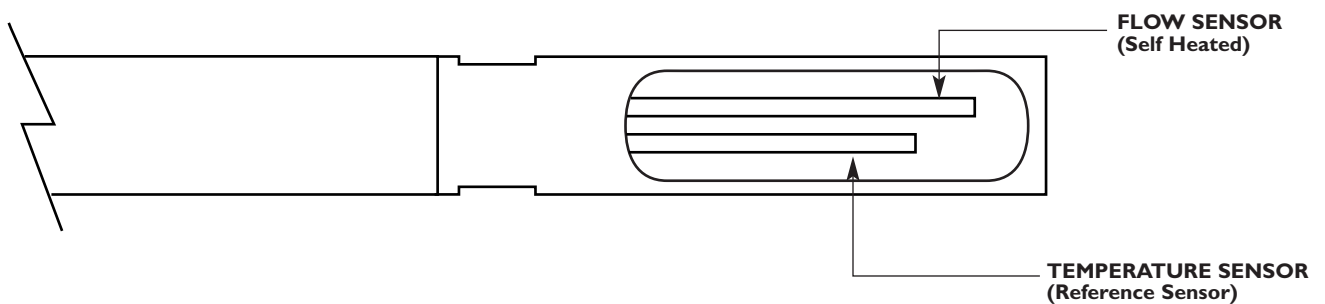
Principle of Operation of the Thermal Mass Flow Meter


Sage Thermal Mass Flow Meters have two sensors constructed of reference grade platinum windings (RTDs). The two RTDs are clad in a protective 316SS sheath and are driven by a proprietary sensor drive circuit. One of the sensors is self-heated (flow sensor), and the other sensor (temperature/reference sensor) measures the gas temperature. The pair is referred to as the sensing element, and is either installed in a probe as an Insertion style, or inserted into a pipe section as an In-Line style flow meter.

As gas flows by the flow sensor, the gas molecules carry heat away from the surface, and the sensor cools down as it loses energy. The sensor drive circuit replenishes the lost energy by heating the flow sensor until it is a constant temperature differential above the reference sensor. The electrical power required to maintain a constant temperature differential is directly proportional to the gas mass

flow rate and is linearized to be the output signal of the meter.

It is essential that this constant temperature differential be maintained, even if there are wide fluctuations in gas temperature. It is the function of the hybrid-digital proprietary sensor drive circuit to maintain the differential, whether or not the gas temperature changes, or however quickly molecules cool off the flow sensor. It is also necessary to properly calibrate the device with the actual gas (or close equivalent with certain gases), in the Sage National Institute of Standards certified (NIST) calibration facility. By accomplishing these two critical objectives, the Sage meters provide an extremely repeatable (0.2% of Full Scale) and accurate output directly proportional to the mass flow rate of the gas being measured.

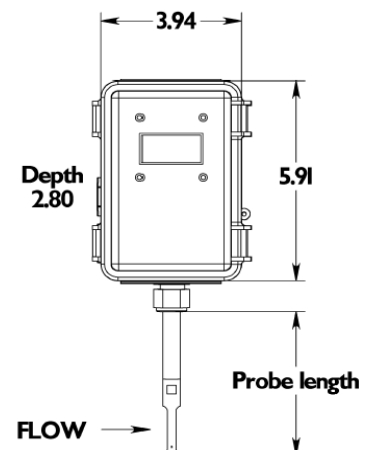
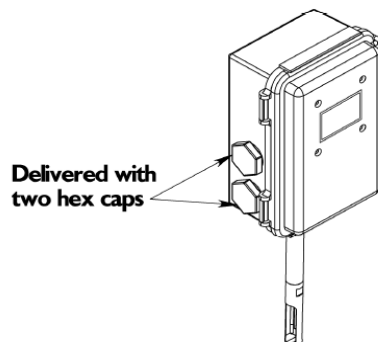
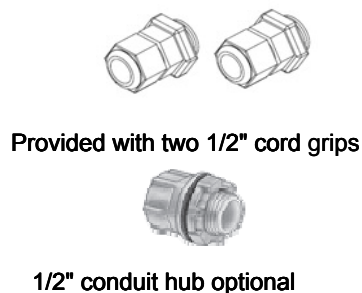



| | | |
|---|------------------------------|---|
|  | INSTRUMENT DATA SHEET | DOCUMENT NO. 100-0140 Rev. 7 |
| SAGE CLEAR THERMAL MASS FLOW METER | GAS MASS FLOW | SAGE SIA SPECIFICATIONS INTEGRAL STYLE CLEAR INSERTION MASS FLOW METER |

GENERAL INFORMATION

| | |
|---------------------------------|--|
| STYLE: | Integral Insertion Mass Flow Meter |
| SENSOR: | Two reference grade platinum RTD clad in 316SS sheath |
| MATERIAL: | Wetted metal components: 316SS |
| POWER: | 24VDC Standard (115/230VAC optional) |
| POWER DISSIPATION: | <2.5 W |
| ELECTRONICS: | Microprocessor based (Hybrid-Digital) |
| ELECTRONICS ENCLOSURE: | Integral mount, NEMA 4 enclosure |
| DISPLAY: | High contrast photo-emissive OLED graphical display (Flow Rate, Totalizer, Temperature) |
| TURNDOWN: | 100 to 1 |
| RESOLUTION: | 1000 to 1 |
| LOW END SENSITIVITY: | 5 SFPM |
| FIELD CALIBRATION CHECK: | Yes- Digital system allows raw signal validation milliwatts (In-Situ Calibration Check) |
| COMMUNICATIONS: | N/A |
| APPROVALS: | N/A |
| FIELD RECONFIGURABLE: | Optional with Sage ADDRESSER |
| FLOW ACCURACY: | +/- 0.5% of Full Scale +/- 1% of reading (Enhanced accuracy optionally available with limited turn-down) |
| FLOW REPEATABILITY: | 0.2% |
| RESPONSE TIME: | 1 second time constant |
| GAS TEMPERATURE RANGE: | -40 ° to 200 °F (93 °C) Standard (If higher temperature needed, contact Sage) |
| GAS PRESSURE: | 500 PSIG (If higher pressure needed, contact Sage) |
| FLOW OUTPUT: | 4 to 20 mA for Rate |
| TOTALIZER: | 24VDC pulse for Totalized value |
| TEMPERATURE OUTPUT: | N/A |
| AMBIENT TEMPERATURE: | -40 ° to 150 °F (65 °C) |
| PROBE STYLE / LENGTH: | 1/2" OD Probe, Lengths 6" to 24" |
| RELAYS: | N/A |
| FLOW CONDITIONING: | Captive Flow Conditioners available upon request with meter purchase |

NOTES:

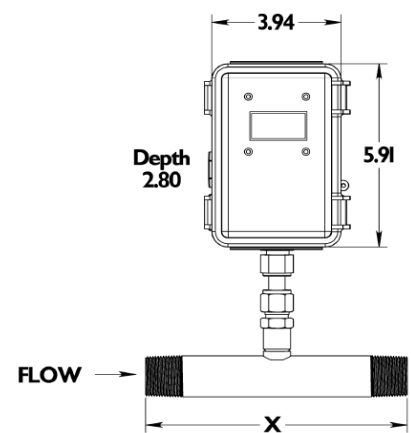
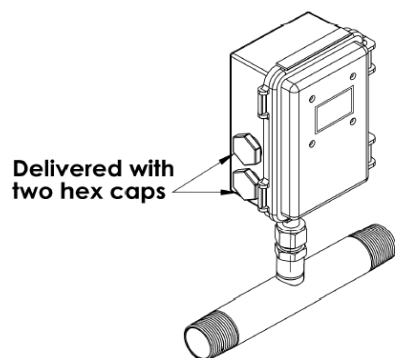
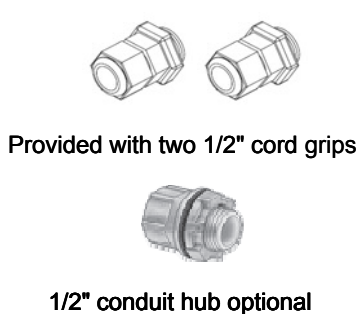



| | | |
|---|------------------------------|---|
|  | INSTRUMENT DATA SHEET | DOCUMENT NO. 100-0141 Rev. 6 |
| SAGE CLEAR THERMAL MASS FLOW METER | GAS MASS FLOW | SAGE SIA SPECIFICATIONS INTEGRAL STYLE CLEAR IN-LINE MASS FLOW METER |

GENERAL INFORMATION

| | |
|---------------------------------|--|
| STYLE: | Integral In-Line Mass Flow Meter |
| SENSOR: | Two reference grade Platinum RTD clad in 316SS sheath |
| MATERIAL: | Wetted metal components: 316SS |
| POWER: | 24VDC |
| POWER DISSIPATION: | <2.5 W |
| ELECTRONICS: | Microprocessor based (Hybrid-Digital) |
| ELECTRONICS ENCLOSURE: | Integral mount, NEMA 4 enclosure |
| DISPLAY: | High contrast photo-emissive OLED graphical display (Flow Rate, Totalizer, Temperature) |
| TURNDOWN: | 100 to 1 |
| RESOLUTION: | 1000 to 1 |
| LOW END SENSITIVITY: | 5 SFPM |
| FIELD CALIBRATION CHECK: | Yes - Digital system allows raw signal validation milliwatts (In-Situ Calibration Check) |
| COMMUNICATIONS: | N/A |
| APPROVALS: | N/A |
| FIELD RECONFIGURABLE: | Optional with Sage ADDRESSER |
| FLOW ACCURACY: | +/- 0.5% of Full Scale +/- 1% of reading (Enhanced accuracy optionally available with limited turn-down) |
| FLOW REPEATABILITY: | 0.2% |
| RESPONSE TIME: | 1 second time constant |
| GAS TEMPERATURE RANGE: | -40 ° to 200 °F (93 °C) Standard (If higher temperature needed, contact Sage) |
| GAS PRESSURE: | 500 PSIG (If higher pressure needed, contact Sage) |
| FLOW OUTPUT: | 4 to 20 mA for Rate |
| TOTALIZER: | 24VDC pulse for Totalized value |
| TEMPERATURE OUTPUT: | N/A |
| AMBIENT TEMPERATURE: | -40 ° F to 150 °F (65 °C) |
| FLOW BODY: | 316SS Schedule 40 Flow Bodies sized from 1/4" x 6" long to 4" x 12" long. Male NPT ends standard (Flanges and other options available) |
| RELAYS: | N/A |
| FLOW CONDITIONING: | Flow Conditioners are built in to In-Line Style Flow Bodies from 1/2" to 4" |

NOTES:




| | | |
|---|------------------------------|---|
|  | INSTRUMENT DATA SHEET | DOCUMENT NO. 100-0142 Rev. 7 |
| SAGE CLEAR THERMAL MASS FLOW METER | GAS MASS FLOW | SAGE SRA SPECIFICATIONS REMOTE STYLE CLEAR INSERTION MASS FLOW METER |

GENERAL INFORMATION

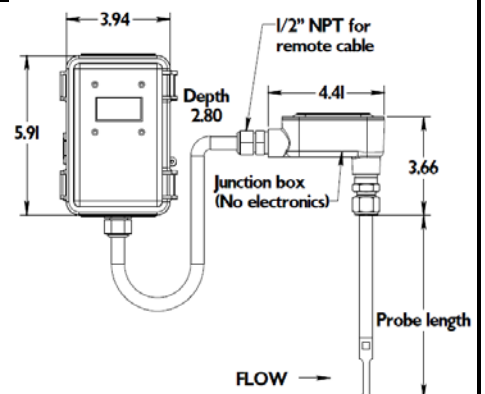
| | |
|---------------------------------|--|
| STYLE: | Remote Insertion Mass Flow Meter |
| SENSOR: | Two reference grade platinum RTD clad in 316SS sheath |
| MATERIAL: | Wetted metal components: 316SS |
| POWER: | 24VDC Standard (115/230VAC optional) |
| POWER DISSIPATION: | <2.5 W |
| ELECTRONICS: | Remote-Style Microprocessor based (Hybrid-Digital) |
| PROBE ENCLOSURE: | Junction Box is indoor/outdoor enclosure (no electronics) |
| TRANSMITTER ENCLOSURE: | Remote mount, NEMA 4 enclosure |
| DISPLAY: | High contrast photo-emissive OLED graphical display (Flow Rate, Totalizer, Temperature) |
| TURNDOWN: | 100 to 1 |
| RESOLUTION: | 1000 to 1 |
| LOW END SENSITIVITY: | 5 SFPM |
| FIELD CALIBRATION CHECK: | Yes - Digital system allows raw signal validation milliwatts (In-Situ Calibration Check) |
| COMMUNICATIONS: | N/A |
| APPROVALS: | N/A |
| FIELD RECONFIGURABLE: | Optional with Sage ADDRESSER |
| FLOW ACCURACY: | +/- 0.5% of Full Scale +/- 1% of reading (Enhanced accuracy optionally available with limited turn-down) |
| FLOW REPEATABILITY: | 0.2% |
| RESPONSE TIME: | 1 second time constant |
| GAS TEMPERATURE RANGE: | -40 ° to 200 °F (93 °C) Standard (If higher temperature needed, contact Sage) |
| GAS PRESSURE: | 500 PSIG (If higher pressure needed, contact Sage) |
| FLOW OUTPUT: | 4 to 20 mA for Rate |
| TOTALIZER: | 24VDC pulse for Totalized value |
| TEMPERATURE OUTPUT: | N/A |
| AMBIENT TEMPERATURE: | -40 ° to 150 °F (65 °C) |
| PROBE STYLE / LENGTH: | 1/2" OD Probe, Lengths 6" to 24" |
| RELAYS: | N/A |
| CABLE LENGTH: | 25' Standard (max length 1000') |
| FLOW CONDITIONING: | Captive Flow Conditioners available upon request with meter purchase |


NOTES:


Provided with two 1/2" cord grips


1/2" conduit hub optional

Delivered with two hex caps

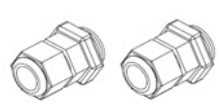


| | | |
|---|------------------------------|---|
|  | INSTRUMENT DATA SHEET | DOCUMENT NO. 100-0143 Rev. 9 |
| SAGE CLEAR THERMAL MASS FLOW METER | GAS MASS FLOW | SAGE SRA SPECIFICATIONS REMOTE STYLE CLEAR IN-LINE MASS FLOW METER |


GENERAL INFORMATION

| | |
|---------------------------------|--|
| STYLE: | Remote In-Line Mass Flow Meter |
| SENSOR: | Two reference grade platinum RTD clad in 316SS sheath |
| MATERIAL: | Wetted metal components: 316SS |
| POWER: | 24VDC Standard (115/230VAC optional) |
| POWER DISSIPATION: | <2.5 W |
| ELECTRONICS: | Remote-Style Microprocessor based (Hybrid-Digital) |
| ELECTRONICS ENCLOSURE: | Junction Box is indoor/outdoor enclosure (no electronics) |
| TRANSMITTER ENCLOSURE: | Remote mount, NEMA 4 enclosure |
| DISPLAY: | High contrast photo-emissive OLED graphical display (Flow Rate, Totalizer, Temperature) |
| TURNDOWN: | 100 to 1 |
| RESOLUTION: | 1000 to 1 |
| LOW END SENSITIVITY: | 5 SFPM |
| FIELD CALIBRATION CHECK: | Yes- Digital system allows raw signal validation milliwatts (In-Situ Calibration Check) |
| COMMUNICATIONS: | N/A |
| APPROVALS: | N/A |
| FIELD RECONFIGURABLE: | Optional with Sage ADDRESSER |
| FLOW ACCURACY: | +/- 0.5% of Full Scale +/- 1% of reading (Enhanced accuracy optionally available with limited turn-down) |
| FLOW REPEATABILITY: | 0.2% |
| RESPONSE TIME: | 1 second time constant |
| GAS TEMPERATURE RANGE: | -40 ° to 200 °F (93 °C) Standard (If higher temperature needed, contact Sage) |
| GAS PRESSURE: | 500 PSIG (If higher pressure needed, contact Sage) |
| FLOW OUTPUT: | 4 to 20 mA for Rate |
| TOTALIZER: | 24VDC pulse for Totalized value |
| TEMPERATURE OUTPUT: | N/A |
| AMBIENT TEMPERATURE: | -40 ° to 150 °F (65 °C) |
| FLOW BODY: | 316SS Schedule 40 Flow Bodies sized from 1/4" x 6" long to 4" x 12" long. Male NPT ends standard (Flanges and other options available) |
| CABLE LENGTH: | 25' Standard (max length 1000') |
| RELAYS: | N/A |
| FLOW CONDITIONING: | Flow Conditioners are built in to In-Line Style Flow Bodies from 1/2" to 4" |

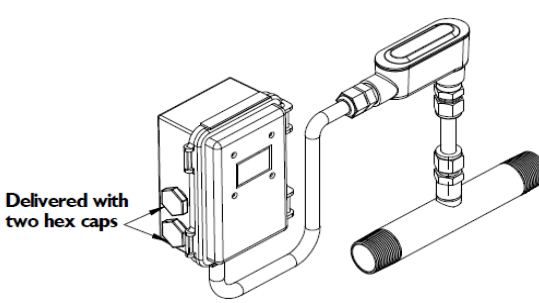
NOTES:



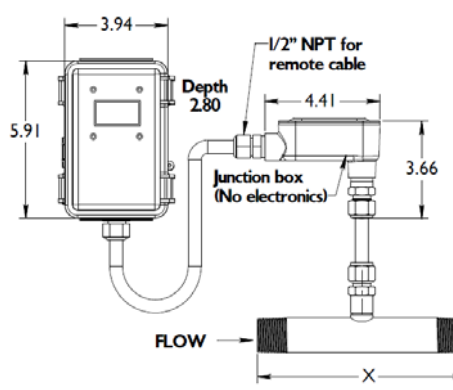
Provided with two 1/2" cord grips



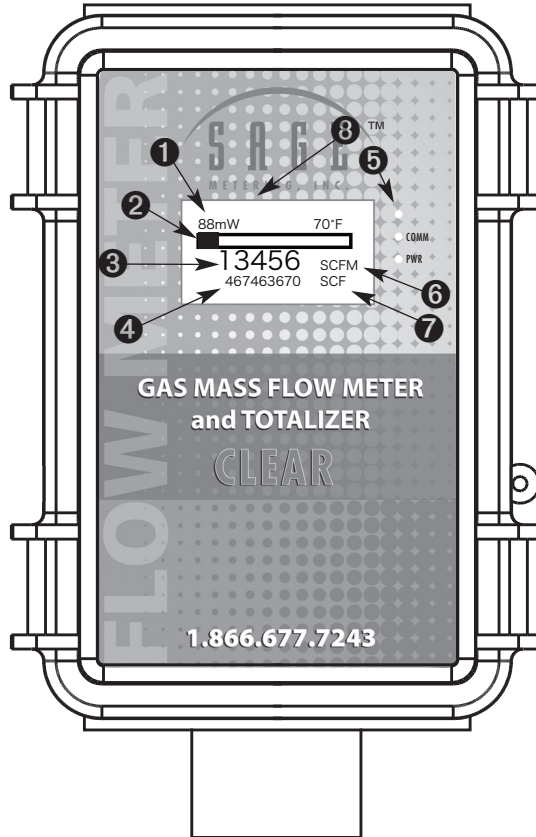
1/2" conduit hub optional



Delivered with two hex caps



Sage Clear Organic (OLED) Display^{1,2,3}



- ❶ Raw Calibration milliwatts (mw) for Diagnostics and Periodic “Zero Flow” Calibration Check
- ❷ Graphical Indication of Percentage of Full Scale Flow Rate
- ❸ Flow Rate
- ❹ Totalized Flow (Consumption)
(Value is Retained during Power Outage or Power Cycling)
- ❺ Flashes with each pulsed output of consumption
- ❻ Engineering Units of Flow Rate (the last digit can be S(seconds), M(minute), H(hour), D(day))
- ❼ Engineering Units of Consumption
- ❽ Photocell activated Screen Saver extends display life

- 1 Upon start-up, the Revision No. and Serial No. will display for a few seconds. Also the output configurations symbol is momentarily displayed
- 2 Note, a built-in photocell continuously monitors the ambient light, and adjusts the display brightness for optimum long-term life, and also senses motion which automatically switches display from Screen Saver mode to Normal mode
- 3 To view display, wave hand over display or use a flashlight. The Flow Meter displays for two minutes, then the Screen Saver resumes

Section

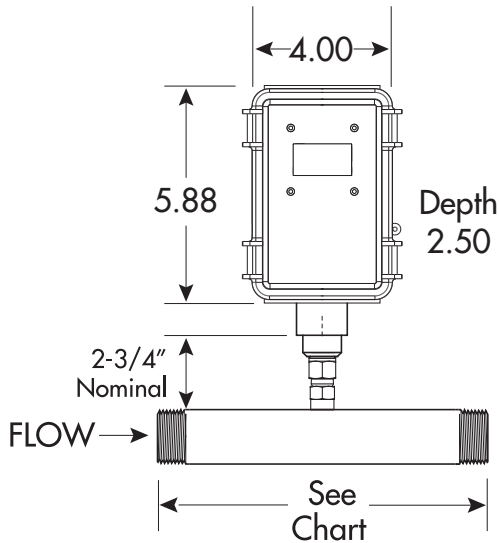
C

DRAWINGS

SIA Series Integral Style Mass Flow Meters

IN-LINE STYLE^{1,3}

150#, 300#, or 600# flanged ends are optionally available. (150# flanges recommended on 3" and 4" Flow Bodies)



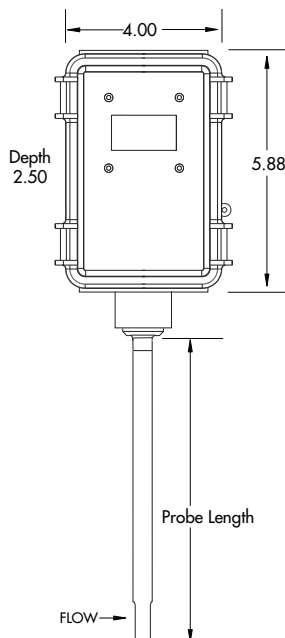
CAUTION:
Do not rotate the Enclosure of In-Line Style Meters relative to the Flow Tube, or the calibration may be effected since the sensors may become misaligned.

IN-LINE METER DIMENSIONS

| Pipe Size x Flow Body Length |
|------------------------------|
| 1/4" x 1/6" |
| 3/8" x 6" |
| 1/2" x 7" |
| 3/4" x 7" |
| 1" x 8" |
| 1-1/4" x 10" |
| 1-1/2" x 12" |
| 2" x 12" |
| 2-1/2" x 12" |
| 3" x 12" |
| 4" x 12" |

INSERTION STYLE²

150#, 300#, or 600# flanged mounting is optionally available. Available probe lengths are 6", 12", 15", 18", 24", 30", 36" or 48". Standard probe is 1/2" diameter (3/4" optional – recommended for 36" or 48")

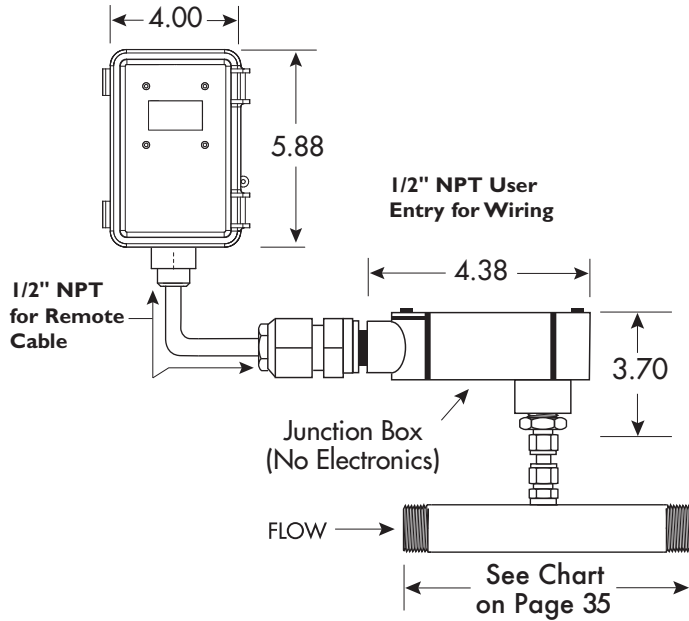


- 1 NPT Fittings standard
- 2 Flanged Mounting available (same dimensions as NPT, but Face-to-Face)
- 3 Flow Conditioning built in to Flow Meter Pipe Sizes 1/2" and up. Contact Sage for optional 1/4" tube flow body.

SRA Series Remote Style Mass Flow Meters

IN-LINE STYLE^{1,3,4}

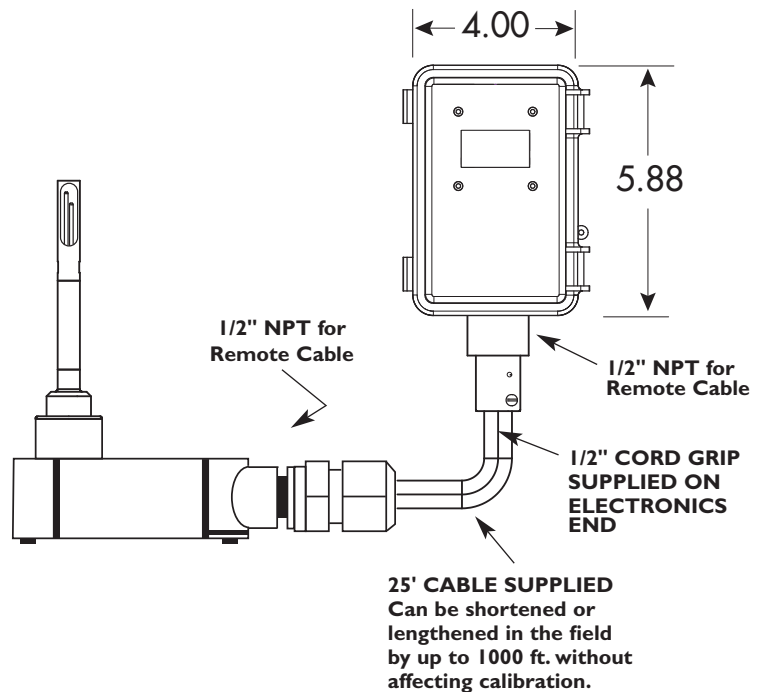
150#, 300#, or 600# flanged ends are optionally available. (150# flange recommended on 3" and 4" Flow Bodies)



CAUTION: Do not rotate the Junction Box of In-Line Style Meters relative to the Flow Tube, or the calibration may be effected since the sensors may become misaligned.

INSERTION STYLE²

150#, 300#, or 600# flanged mounting is optionally available. Available probe lengths are 6", 12", 15", 18" or 24".



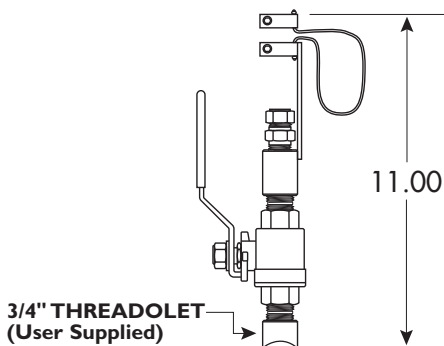
- 1 NPT Fittings standard
- 2 Flanged Mounting available (same dimensions as NPT, but Face-to-Face)
- 3 Flow Conditioning built in to Flow Meter Pipe Sizes 1/2" and up. Contact Sage for optional 1/4" tube flow body.
- 4 See Chart on page 35.
- 5 Junction Box has the following certifications: Class I, Groups B,C,D; Class II, Groups E,F,G; Class III; 4X, 7BCD, 9EFG; FM Standard 3615; UL Standard 1203; CSA Standard C22.2 No. 30; and NEMA Compliance

Mounting Hardware³

SVA05 SERIES ISOLATION VALVE ASSEMBLY FOR INSERTION METERS⁴

(for Low Pressure SVA05 see page 39)

Used for pressures to 250 psig¹ (shown for use with 1/2" diameter insertion meters). 150# or 300# flanged mounting is optionally available. Available sizes are 1/2" x 3/4" NPT (SVA05 shown), and 3/4" x 1" NPT for use with 3/4" diameter insertion meters (SVA07).

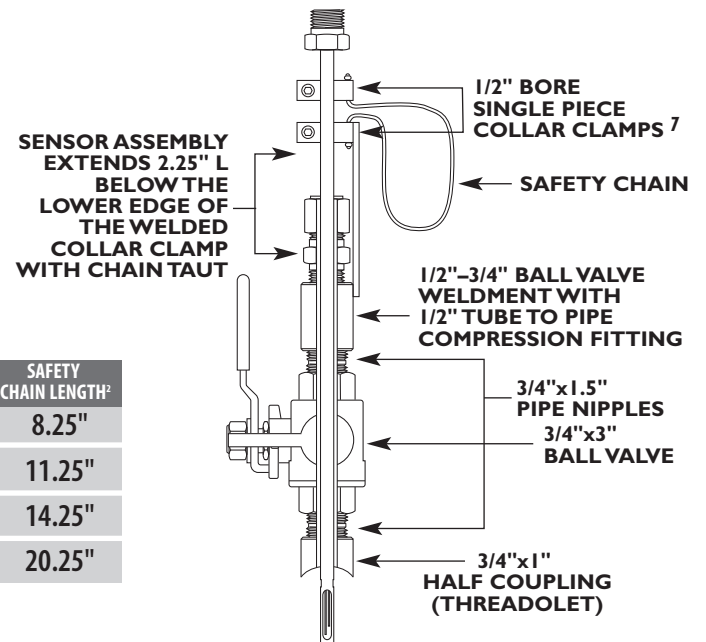


NOTE: User needs to weld a 3/4" female threadolet (of appropriate radius) to mate with existing pipe after a 3/4" hole has been drilled in pipe. The 3/4" Male Coupling of the Sage Isolation Valve Assembly will thread into the user's 3/4" threadolet.

| PROBE LENGTH (with sensor) | SAFETY CHAIN LENGTH ² |
|----------------------------|----------------------------------|
| 12" | 8.25" |
| 15" | 11.25" |
| 18" | 14.25" |
| 24" | 20.25" |

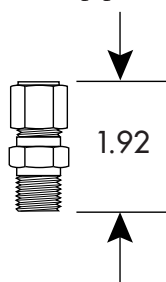
SVA05 SERIES ISOLATION VALVE ASSEMBLY DETAIL^{5,6}

Cut away view of probe inserted through isolation ball valve assembly.



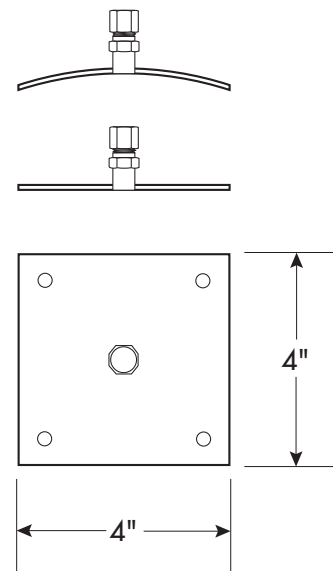
STCF SERIES TEFLON FERRULE COMPRESSION FITTING

1/2" tube x 1/2" pipe fitting (shown, not to scale), is used for low pressure insertion applications to 125 psig (Stainless Steel Ferrule optional for higher pressure applications – up to 1000 psig). Also available in 3/4" tube x 3/4" pipe size.

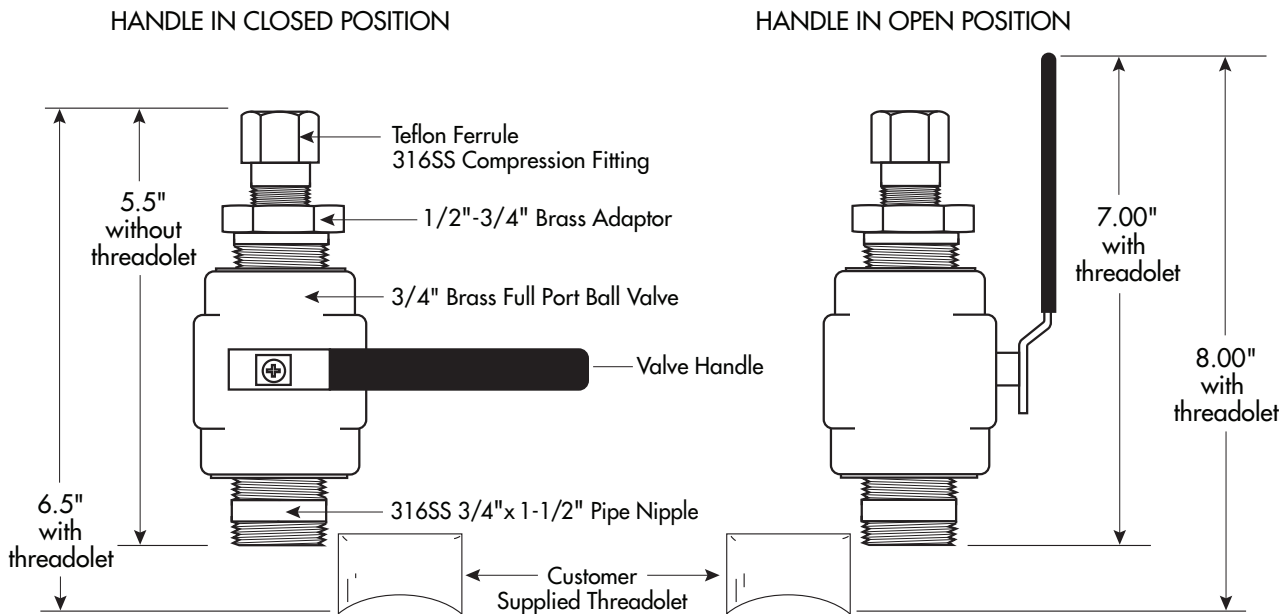


- At 250 psig, force exerted on 1/2" diameter probe is 50 lbs.
- Safety chain is designed to prevent probe from accidentally escaping from assembly during removal from pressurized pipe
- Insertion meters can have optional flanged mounting (generally used for high pressure or very hot gases). This adaptation is not shown. Consult factory for details.
- Maximum gas temperature, 200F, unless high temperature models ordered.
- Hot Tapping is feasible by removing Weldment (upper portion of assembly temporarily removed)
- See page 46. SVA05 can be utilized for Sensor Functionality and Zero Self Check.
- The Allen wrench for SVA05 is 9/64.

MOUNTING PLATE FOR THIN WALLED DUCTS (INCLUDES STCF05 COMPRESSION FITTING)



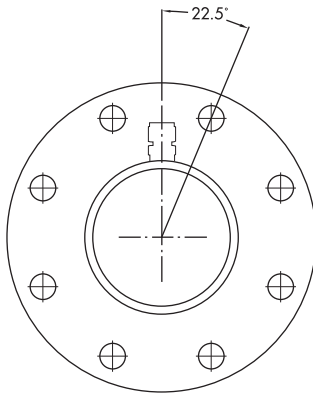
SVA05LP Low Pressure Isolation Valve Assembly



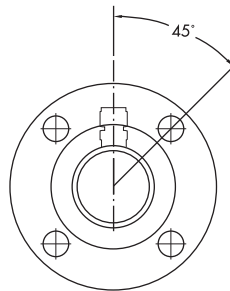
NOTES AND CAUTIONS

- Suitable for low pressure Air or Natural Gas applications (maximum 50 PSIG)
- Assumes 1/2" Insertion Probe inserted to center of a Pipe (see Sage Probe Insertion Guidelines)
- Teflon Ferrule permits ease of Probe insertion or removal
- Exercise caution when loosening Ferrule nut during insertion and removal of Probe, since this model has no Safety Chain
- Note, maximum upward force is 20% of pipe pressure (i.e., 10 Lbs with 50 PSIG)
- The Assembly will be shipped with a plastic sleeve that protects the 3/4" pipe nipple
- It is the Customer's responsibility to weld a Female Threadolet with correct diameter to pipe

Flanged Ends for In-Line Meter (OPTIONAL)

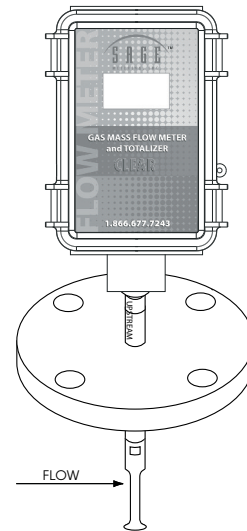


Flanges for 3½" pipe sizes and up, have 8 bolt holes



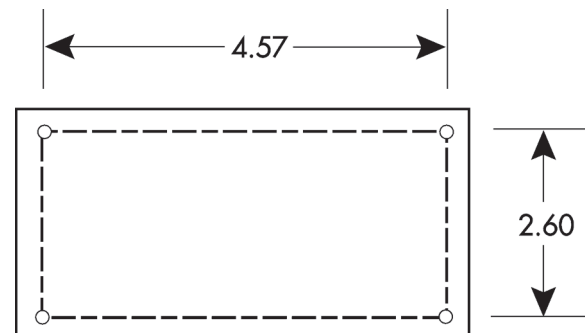
Flanges for 3" pipe sizes and smaller have 4 bolt holes

Flanged Mounting for Insertion Meter (OPTIONAL)



CLEAR Mounting Instructions

A 6-32 Pan Head Phillips machine screw is recommended for each corner of the SRA remote enclosure. The screw will have to pass through .40 inches (roughly 19/64") of overall thickness at the bottom of the enclosure mounting hole before the screw threads emerge. The thickness of the enclosure material is 1/8". The over-all length of the screw depends on the customers mounting configuration and how much depth they have to penetrate on their mounting plate that the enclosure is being fastened to.



DIMENSIONS ABOVE ARE FROM HOLE CENTER TO HOLE CENTER

Section

D

DIAGNOSTICS

Common Diagnostics

SYMPTOM: Display fading, or partially fading.

CORRECTIVE ACTION:

- a) Some fading, particularly with those characters that are lit up most frequently, is normal. The flow meter will continue to function properly, and flow meter accuracy and outputs will not be effected.
- b) Note, in early 2010, the Sage Clear features an enhancement that was added to extend the life of the display. It includes a built-in photocell that also senses motion which automatically switches display from Screen Saver mode to Normal mode.

SYMPTOM: Erratic Readings.

POSSIBLE CAUSES: If a large Motor or Generator or Variable Frequency Drive (VFD) is nearby the enclosure, it may be inducing sufficient analog noise into the circuitry to temporarily corrupt the data.

SUGGESTED CORRECTIVE ACTION:

- a) If a Power-Restart temporarily solves the problem, than it is likely that the source of the noise was the problem.
- b) To prevent subsequent problems, if a Remote Style Meter, move the enclosure as far away as possible from the source (the Motor or VFD).
- c) If an Integral Style Meter, mount the meter in a different location (further from the source) or move the source further from the meter.

SYMPTOM: Erratic Readings on a Remote Meter.

POSSIBLE CAUSE: In some cases, analog noise is induced into the Remote cable causing erratic, or climbing readings.

SUGGESTED CORRECTIVE ACTION:

- a) Be sure the remote cable is installed in metal conduit and grounded on one end (in some cases, grounding *both* ends may be required).
- b) Also, avoid coiled cable, especially if not in metal conduit.
- c) Also, if extra cable exists, move the extra cable as far away as possible from any source of analog noise, such as large motors or VFDs.

SYMPTOM: Meter reading zero continuously, or Full Scale continuously, or temperature reading is abnormally low (hundreds of degrees below zero).

POSSIBLE CAUSES/SUGGESTED CORRECTIVE ACTION:

- a) It is likely that a wire is loose. But in rare cases, a sensor could fail (i.e., if a standard sensor, HT01 or HT02 sensor exceeds a process temperature of 450°F).
- b) Check for continuity to be sure the wiring is making good contact at the terminals of the Junction Box.
- c) Also, to verify that the electronics and the sensor serial number are the same, note the following: The sensor's serial number will come up upon power up, right after Initializing on the Display. If the serial number doesn't agree with the Junction Box labels, that would affect calibration (in other words, sensors and electronics are a matched pair—mixing them up will cause false readings). Also metal Serial Number Tags are fastened to both the electronics and the Junction Box. They must have identical Serial numbers.
- d) To check if a sensor has failed on a Remote style meter, it is easy to use the Junction Box to do so. You must Power Down (shut off power, or turn Power switch OFF), but you do not need to remove the probe from the pipe. Refer to page 24.

- e) An Ohm Meter is required to check across the sensor leads of the Flow Sensor. Look at the drawing of the Junction Box on page 24. Disconnect the red wires on the Factory Side to isolate and measure the resistance. If the reading is infinity or a short, it means that sensor has failed.
- f) Now check the Temperature Sensor. Disconnect the white wires on the Factory Side to isolate and measure the resistance. If you have infinity or a short, it means that sensor is burned out. **Note:** *Normally the sensors will read approximately 110 ohms at 70° F. At higher temperatures they should read a higher resistance, but both sensors should have a similar value.*
- g) On integral style meters (SIA), there is no Junction Box. In that case, refer to the Clear Integral Terminals on page 19 and check the sensor wires. Remove the appropriate wires first (red pair for flow, then white pair for temperature). Measure their resistance. If reading infinity or short, it means that sensor has failed.
- SYMPTOM:** Meter Railing (Pegging) or Reading High
POSSIBLE CAUSES/SUGGESTED CORRECTIVE ACTION:
- a) Insufficient straight run (i.e. flow profile is disturbed, causing errors).
- b) Possible jet effect if upstream pipe is smaller than meter flow body or if valve is too close upstream to meter.
- c) Not following Probe Insertion Guideline.
- d) If sensor is inserted in reverse (“Upstream” mark is facing downstream) Meter may over-report (or under-report) by as much as 30%.
- e) If sensor is not aligned properly, with “Upstream” mark facing upstream, a rotation greater than ± 5 degrees may cause change in reading (greater than ± 5 degrees and less than ± 20 degrees causes meter to over-report; a greater rotation actually blocks the sensor, and causes meter to under-report).
- f) A downstream valve too close to the meter (flow may be reflecting back).
- g) Possibly caused by water droplets condensing out of gas stream (which generally causes output to spike; but if droplets are near continuous, output may rail).
- h) Meter is miswired, especially in Remote Style application.
- i) Possibly caused by water droplets condensing on inside of pipe wall, which roll down or hit sensor causing output to spike; but if droplets are near continuous, output may rail. **Note:** *Recommend installation 45° from vertical (see drawing on page 55).*
- j) Possibly caused by water droplets condensing out of gas stream and filling the cavity containing the sensing elements (usually due to probes mounted below horizontal in saturated pipes).
- k) Sensor may be contaminated. Remove probe, wipe off or clean with a solvent. Reinsert.
- l) Using a different gas or gas mix than the meter was specified and calibrated for.
- m) If a Remote Style Meter (SRP), be sure Serial Numbers of Junction Box and Remote Electronics are identical (if not, errors in calibration are inevitable). To confirm, verify that Junction Box Serial Number Tag has identical Serial Numbers to Tag on Remote Enclosure.
- n) Meter may appear to be reading high if user is comparing Sage flow meter readings (SCFM) to an uncorrected volumetric device (ACFM). For example, at constant volume, a decrease in gas temperature will increase the mass flow (SCFM). That is completely normal.
- SYMPTOM:** Reading Low
POSSIBLE CAUSES:
- a) Insufficient straight run (i.e. flow profile is disturbed, causing errors).
- b) Poor flow profile Upstream (insufficient upstream straight run).
- c) Not following Probe Insertion Guideline.
- d) If sensor is inserted in reverse (“Upstream” mark is facing downstream) Meter may over-report (or under-report) by as much as 30%.
- e) If sensor is not aligned properly, with “Upstream” mark facing upstream, a rotation greater than ± 5 degrees may cause change in reading (greater than ± 5 degrees and less than ± 20 degrees causes meter to over-report; a greater rotation actually blocks the sensor, and causes meter to under-report).

- f) Sensor may be contaminated. Remove probe, wipe off or clean with a solvent. Reinsert.
- g) Using a different gas or gas mix than the meter was specified and calibrated for.
- h) If a Remote Style Meter (SRP), be sure Serial Numbers of Junction Box and Remote Electronics are identical (if not, errors in calibration are inevitable). To confirm, verify that Junction Box Serial Number Tag has identical Serial Numbers to Tag on Remote Enclosure.
- i) Meter may appear to be reading low if user is comparing Sage flow meter readings (SCFM) to an uncorrected volumetric device (ACFM). For example, at constant volume, an increase in gas temperature will lower the mass flow (SCFM). That is completely normal.
- j) On most models, the Totalizer will not start counting for 10 seconds after power up so any flow data will not be accumulated during this time.
- k) Insufficient power supply—most products require minimum 100 ma.
- l) Excessive load on the 4-20 ma. (To check if problem is due to 4-20 ma output device, temporarily remove device, and observe if display reads as expected).

SYMPTOM: Totalizer can take up to 10 seconds to update its reading when flow meter is first powered up, or a channel is changed.

CORRECTIVE ACTION: None. This slight delay is completely normal.

SYMPTOM: Display does not have power

POSSIBLE CAUSE: Mis-wiring, or internal Power Switch is OFF

In-Situ Calibration Check

VERIFY SENSOR FUNCTIONALITY AND FLOW METER CALIBRATION AT A “NO FLOW” (0) CONDITION

Sage Clear has continuous diagnostics. The raw calibration milliwatts (mw) is always displayed in the upper left hand corner of the meter's display allowing the user to conduct an “in-situ” calibration. At any time, you can check this reading at a “no flow” condition and compare the reading to the original reported “zero flow” value noted on the last few lines of your meter's Certificate of Conformance or the flow meter's data tag. This diagnostic procedure not only checks the sensor performance and the “live zero” calibration point, but it verifies that the sensor is clean. It essentially provides a means to validate that the meter is operating properly, verifies that there is no shift or drift, and eliminates the need for annual factory calibrations. This simple field diagnostic procedure also verifies that the sensor is free from contamination, even without inspection.

1. Verify that meter has no gas flow¹—“In-Situ” Method. (Also see “Ex-Situ” Method in item 8.)

Close appropriate valves in the process to have a “no flow” condition so you can check the “live zero” mw output of the actual gas (it should be checked at the same pressure as noted on Certificate of Conformance).

If it is not possible to close valves in the process (e.g. natural gas supply must be kept flowing), a user with a Sage SVA05 or SVA07 Isolation Valve Assembly can check “zero” of the actual gas and pressure without shutting off the gas supply. Refer to SVA SERIES ISOLATION VALVE ASSEMBLY DETAILS ON PAGE 37.

- a) Loosen lower Collar Clamp completely
- b) Slightly loosen compression fitting until Probe can be lifted
- c) Lift Probe until Safety Chain is taut
- d) Tighten compression fitting
- e) Close Valve
- f) Check zero mw as per “2” below

Optionally, do an ambient air check by removing probe and covering up sensor by capping the sensor with a plastic bag, empty plastic water bottle or other means of preventing flow (see 8).

2. Observe the raw milliwatts (mw) on the top of the meter's display. After a few minutes of “no flow” stabilization, check the observed reading against the flow meter's data tag or last line(s) of your Meter's Certificate of Conformance.
3. A value within 5 milliwatts of the original Factory value (assuming the same gas is checked at same pressure) indicates that the meter is still

in calibration.

4. A value greater than 5 milliwatts, but less than or equal to 10 milliwatts, also indicates that the meter is still in calibration, but this reading may have been influenced by one or more of the following factors: gas composition, pressure, dirt, non-zero conditions, and sensor orientation. Any of these factors can have an effect on mWo. It is a very sensitive data point and that is why it is such a good check.
5. Note, if all of the above factors were remedied, it would be expected that the mW zero would report less than or equal to 5 milliwatts.
6. Note, in some cases, contamination of the sensor is the only cause of the additional heat transfer during the “no flow” test. Remove the probe, and clean the sensor (use an appropriate non-corrosive solvent to remove the build up). A soft brush can be used to gently clean the sensing surface, using caution to avoid damaging the sensor elements (the RTD's).
7. In summary, if a technician in the field were able to simulate Sage calibration conditions, he too would find that the mWo would be within one mW or very close to that. Since this is not always possible, we are finding that after considering all of the field variables, a mWo in the field that is within 10 mW is an acceptable value (see 9). This would allow for a check to be done in the pipe under application conditions.
8. Alternate “Ex-Situ” Method: If desired, an alternate check can be conducted, but using ambient air: This validation method requires that the sensor be removed from the pipe and inserted in a container such as an empty plastic water bottle.
9. For CAR² compliance Sage recommends a quarterly In-Situ Calibration Check per the **Landfill Project Protocol, Version 4.0, Paragraph 6.2**. As per the protocol, the maximum allowable drift is 5%. Percent drift can be determined by multiplying the mW change from factory value (see 2) by 1.0% (i.e. each mW change equals 1% drift).

¹ Sage “zeros” the meter in a horizontal pipe. If you have a vertical pipe, mW will be slightly lower at zero (also see note 4).

² CAR is the Climate Action Reserve. The Climate Action Reserve is a national offsets program working to ensure integrity, transparency and financial value in the U.S. carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of greenhouse gas (GHG) emissions reduction projects in North America. The Climate Action Reserve operates alongside its sister program, the California Climate Action Registry (California Registry), which was created by the State of California in 2001 to address climate change through voluntary calculation and public reporting of emissions.

Section

E

**WARRANTIES AND
SERVICE WORK**

Warranties and Service Work

LIMITED WARRANTY

Sage Metering's products are warranted against faulty materials or workmanship for one year from the date of shipment from the factory. Sage's obligation is limited to repair, or at its sole option, replacement of products and components which, upon verification by Sage at our factory in Monterey, California, prove to be defective. Sage shall not be liable for installation charges, for expenses of Buyer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. This warranty is extended only to Sage products properly used and properly installed for the particular application for which intended and quoted; and does not cover water damage due to improper use of cord grips or removal of protective caps; and does not cover Sage products which have been altered without Sage authorization or which have been subjected to unusual physical or electrical stress. Sage makes no other warranty, express or implied, and assumes no liability that goods sold to any purchaser are fit for any particular purpose. Transportation charges for materials shipped to the factory for warranty repair are to be paid by the shipper. Sage will return items repaired or replaced under warranty, prepaid. NOTE: No items will be returned for warranty repair without prior written authorization from Sage Metering, Inc. Sage does not warranty damage due to corrosion.

GENERAL TERMS AND CONDITIONS

Detailed General Terms and Conditions can be found on the Sage website (www.sagemetering.com) on a link "General Terms" on the Footer of any page on the website.

CANCELLATION / RETURN POLICY

Cancellation or Return: After issuance of a purchase order (by phone, mail, e-mail or fax) or a credit card order (by phone, mail, e-mail or fax), there will be a cancellation fee for any cancelled order. Cancellations must be in writing (by mail, e-mail or fax):

- 1) If credit card order or non-credit card order is cancelled within 7 days of issuance of purchase order or date order was placed (which ever is earlier), there will be a 10% cancellation fee.
- 2) If credit card order or non-credit card order is cancelled after 7 days, but prior to shipment, there will be a 20% cancellation fee. (If order is cancelled due to late delivery, the cancellation fee will be waived. Late delivery is defined as shipping a meter 7 days or later than the delivery date acknowledged by Sage Metering at time of placing order).
- 3) If a credit card customer decides to return the equipment after shipment for credit, credit will not be issued if equipment is damaged or if equipment is returned after four (4) months of shipment. If equipment is not damaged, then equipment can be returned after issuance of a Return Meter Authorization (RMA) by Sage. **Returned package must be insured by customer and must reference proper RMA# on outside of package**, or package may be rejected (i.e., package will be returned unopened). Credit Card customers will be charged a 30% re-stocking fee (70% balance will be credited back). Customer is responsible for return shipping charges and any damage if improperly packaged.

continued on next page

- 4) If a non-credit card customer decides to return the equipment after shipment for credit, credit will not be issued if equipment is damaged or if equipment is returned after 1 month of shipment, unless authorized by a representative at Sage Metering, Inc. The Sage representative will issue a Return Material Authorization (RMA) at that time and will advise of the restocking fee. **Returned package must be insured by customer and must reference proper RMA# on outside of package**, or package may be rejected (i.e., package will be returned unopened). Customer is responsible for return shipping charges and any damage if improperly packaged.

SERVICE MANUAL

In addition to the accompanying "Common Diagnostics", you can also access the online Sage Service Manual using the Login icon (top right corner) found on the home page of the Sage website: www.sagemetering.com. After logging in, select "Manuals/Downloads". Enter User name "sage" and Passcode "7243737". Then select "Click to Download Service Manual".

RETURNING YOUR SAGE METER

A Return Material Authorization Number (RMA#) must be obtained prior to returning any equipment to Sage Metering for any reason. RMA#s may be obtained by calling Sage Metering at 866-677-7243 or 831-242-2030 between 8:00 am and 5:00 pm Monday through Friday.

A Sage RMA Form (see page 52) must be filled out and included with the meter being returned to Sage Metering. RMA Form is also accessible by clicking the “Contact” tab of the Sage website (www.sagemetering.com).

Take special care when packaging your meter for return to the factory. The sensor in particular may easily be damaged if not prevented from shifting around within the package and if the sensor itself is not covered to keep it from contacting other package contents. Any damage resulting from improper packaging is the responsibility of the shipper.

A purchase order is required prior to an RMA being issued. Most repairs or recalibrations can be quoted over the phone. For equipment that must be evaluated, an Evaluation purchase order in the amount of \$150 is required. Once an evaluation is completed and a quote has been issued, you can choose to proceed with the work or have the unit returned with only the evaluation and freight fee billed.

In accordance with the “Right to Know Act” and applicable US Department of Transportation (DOT) regulations, Sage Metering will not accept delivery of equipment that has been contaminated without written evidence of decontamination, and has instituted the following Return/Repair conditions. Strict adherence to these conditions is required. Returned equipment that does not conform to the requirements listed below will not be processed. If Sage Metering finds evidence of contamination, we may, at our option,

have the unit returned at your expense. For your reference, the requirements for packaging and labeling hazardous substances are listed in DOT regulations 49 CFR 172, 178, and 179.

1. The equipment must be completely cleaned and decontaminated prior to shipment to Sage Metering. This decontamination includes the sensor, probe, electronics and enclosures internally and externally. All packaging must be clean and free from contamination.
2. A Material Safety Data Sheet (MSDS) is required for all process fluids and gases that have been in contact with the equipment. This includes fluids or gases used in cleaning the equipment. A Decontamination Statement is also required for each meter returned using a different gas or fluid. Both the MSDS and the Decontamination Statement are to be attached to the OUTSIDE of the shipping container. If both documents are not attached, you will be called, and the equipment sent back to you at your expense.
3. The decontamination Statement must include the following required information
 - A. A list of all chemicals and process fluids used in the equipment, including decontamination fluids or gases.
 - B. The model and serial number of the equipment being returned.
 - C. A company officer or other authorized person’s signature on the statement.

Return Shipping Address:

Sage Metering, Inc.
8 Harris Court, Building D1
Monterey, CA 93940

RETURN MATERIAL AUTHORIZATION

RMA # _____

Date _____

RETURN CUSTOMER INFORMATION

Customer's Name _____ Fax # _____

Customer's Contact Name _____ Phone # _____

Email Address _____

CUSTOMER'S RETURN ADDRESS

Bill to: _____ Ship to: _____

RETURN PRODUCT INFORMATION

Model No. _____ Serial No(s). _____

FLOW: MIN _____ NORMAL _____ MAX _____

TEMP: MIN _____ NORMAL _____ MAX _____

PRESSURE: MIN _____ NORMAL _____ MAX _____

GAS _____ LINE SIZE _____

REASON FOR RETURN / DESCRIPTION OF SYMPTOMS

(All non-warranty repairs could be subject to a minimum evaluation charge)

Recommended steps to be used to duplicate problem/symptoms _____

Sage Metering Technical Contact _____

Take special care when packaging your meter for return to the factory. The sensor in particular may easily be damaged if not prevented from shifting around within the package and if the sensor itself is not covered to keep it from contacting other package contents. Any damage resulting from improper packaging is the responsibility of the shipper.

SAGE METERING, INC.

8 Harris Court, Building D-1 / Monterey, California 93940

PHONE: 831-242-2030 / FAX: 831-655-4965

Section

F

APPENDIX

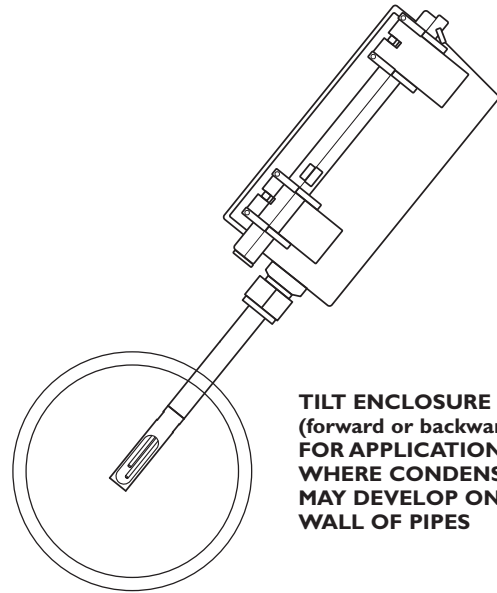
Correction Factors For Variation From Original Digester Gas Calibration

Sage can calibrate for any Digester Gas, Bio Gas or Landfill Gas Mix. However, it may be helpful to have correction factors for a typical calibration, in the event that the composition changes after delivery. The following examples assume that the initial calibration was set up for 60% CH₄ and 40% CO₂.

- a) 65% CH₄ and 35% CO₂: Multiply reading by 0.982 to correct it for new composition
 - b) 70% CH₄ and 30% CO₂: Multiply reading by 0.965 to correct it for new composition
 - c) 55% CH₄ and 45% CO₂: Multiply reading by 1.0185 to correct it for new composition
- For smaller changes, the corrections are linear in between
- d) Also, if 100% saturated with H₂O vapor (non-condensing), multiply readings by 1.042
 - e) If 50% saturated with water, multiply reading by 1.021
(Water vapor correction is linear in between)

Also, use the 45 degree mounting method in order to avoid droplets from hitting the sensor and causing spikes (see above right)

Installations Where Pipe Condensation May Develop



**TILT ENCLOSURE 45°
(forward or backward)
FOR APPLICATIONS
WHERE CONDENSATION
MAY DEVELOP ON INSIDE
WALL OF PIPES**



SAGE CLEAR THERMAL MASS FLOW METER FOR GASES PACKED WITH FEATURES – YET AFFORDABLE

SAGE CLEAR THERMAL MASS FLOW METER FOR GASES

The Sage Clear is an economical Thermal Mass Flow Meter featuring a bright, high contrast, photo-emissive OLED display of Flow Rate, Total and Temperature in a lightweight NEMA 4 indoor/outdoor enclosure. The Flow Rate is also displayed graphically in a horizontal bar graph format. The meter has large, easy-to-access, well marked terminals, for ease of customer wiring. It is powered by 24 VDC (or optionally 115/230 VAC) and includes a built-in power switch. The power dissipation is under 2.5 watts (e.g. under 100 mA at 24 VDC).

The Sage Clear Flow Meter is offered in Integral or Remote Style. The Remote Style has lead-length compensation up to 1000 feet with a NEMA 4 indoor/outdoor Junction Box (has no electronics, just terminals). Specify any standard probe length or flow body size. It has a 4-20 mA output as well as a pulsed output of Totalized Flow (solid state transistor drive).

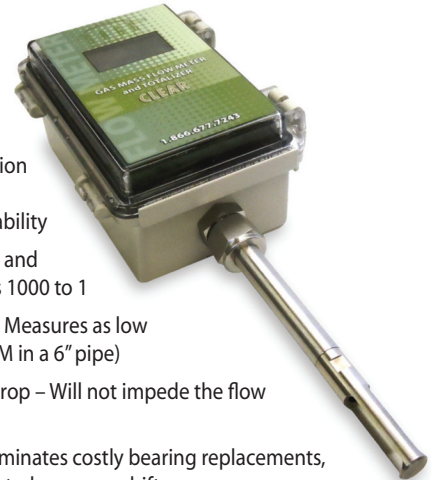
CONTINUOUS DIAGNOSTICS & FIELD CONFIGURABILITY

Sage Clear has continuous diagnostics. The raw calibration milliwatts (mw) is always displayed in the upper left hand corner of the meter's display. At any time, you can check this reading at a "No Flow" (0 SCFM) condition, and compare the reading to the original reported "No Flow" value noted on the last few lines of the meter's Certificate of Conformance or the Flow Meter's data tag. This In-Situ diagnostic procedure not only checks the sensor performance and the "Live Zero" calibration point, but it also verifies that the sensor is clean. It essentially provides a means to validate that the meter is operating properly, verifies that there is no shift or drift, and eliminates the need for annual factory calibrations. This simple field diagnostic procedure, in addition, verifies that the sensor is free from contamination, even without inspection.

Although Sage Clear is fully configured upon shipment for the pipe and process conditions requested, if field reconfigurability is required, specify the optional Addresser software.

MAJOR BENEFITS OF THERMAL MASS FLOW METERS

- Direct Mass Flow – No need for separate temperature or pressure transmitters
- High Accuracy and Repeatability – Precision measurement and extraordinary repeatability
- Turndown of 100 to 1 and resolution as much as 1000 to 1
- Low-End Sensitivity – Measures as low as 5 SFPM (e.g., 1 SCFM in a 6" pipe)
- Negligible Pressure Drop – Will not impede the flow or waste energy
- No Moving Parts – Eliminates costly bearing replacements, and prevents undetected accuracy shifts
- Dirt Insensitive – Provides sustained performance
- Low cost-of-ownership
- Ease of installation and convenient mounting hardware



SPECIFIC BENEFITS OF THE SAGE CLEAR

- Economical packaging
- High contrast photo-emissive OLED display with numerical Flow Rate, Total and Temperature, as well as Graphical Flow Indicator
- Calibration milliwatts (mw) is continuously displayed, providing for ongoing diagnostics, and In-Situ calibration check
- Photocell activated Screen Saver to extend display life
- Proprietary hybrid-digital sensor drive circuit provides enhanced signal stability; unaffected by process temperature & pressure changes
- Powerful state-of-the-art microprocessor technology for high performance mass flow measurement and low cost-of-ownership
- Remote Style has Lead-Length Compensation. Allows remote electronics up to 1000 feet from probe; Junction Box has no circuitry, just terminals (suitable for adverse environments)
- Low power dissipation, under 2.5 Watts (e.g., under 100 mA at 24 VDC)
- Field reconfigurability via optional Addresser software
- Captive Flow Conditioners for Insertion meter applications, if required

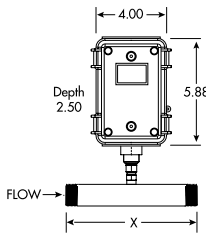
SAGE CLEAR STYLES AND SPECIFICATIONS

Sage Metering is your source for monitoring, measuring and controlling the gas mass flow in your manufacturing process, building management system or environmental application. Our high performance, NIST Traceable Thermal Mass Flow Meters will help increase productivity, reduce energy costs, maximize product yields, and/or help reduce environmental insult. Sage provides high quality In-Line and Insertion Thermal Mass Flow Meters for a wide variety of industrial, commercial, and environmental monitoring needs, including carbon credit verification for Greenhouse Gas reduction.

Our experienced application engineers, many of whom have worked in the Thermal Mass Flow marketplace since its inception, will assist you in choosing the proper gas Flow Meter for your application – and they will be pleased to offer installation guidance to assure that the meter(s) selected will perform as accurately as possible. Additionally, our Service Staff stand ready to support you with any after-sale assistance that you may require.

SIA SERIES – INTEGRAL

IN-LINE STYLE



STYLE

Integral In-Line Mass Flow Meter

SENSOR

Two reference grade Platinum RTD clad in 316SS sheath

MATERIAL

Wetted metal components: 316SS

ELECTRONICS ENCLOSURE

Integral Mount, NEMA 4 indoor/outdoor enclosure

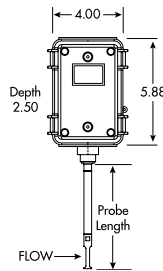
FLOW BODY

316 SS Schedule 40 Flow Bodies sized from 1/4" to 6" long to 4" x 12" long. Male NPT ends standard (Flanges and other options available)

FLOW CONDITIONING

Flow Conditioners are built in to In-Line Style Flow Bodies from 1/2" to 4"

INSERTION STYLE



STYLE

Integral Insertion Mass Flow Meter

SENSOR

Two reference grade Platinum RTD clad in 316SS sheath

MATERIAL

Wetted metal components: 316SS

ELECTRONICS ENCLOSURE

Integral Mount, NEMA 4 indoor/outdoor enclosure

PROBE STYLE/LENGTH

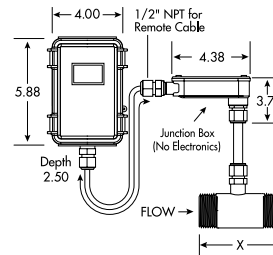
1/2" OD Probe, Lengths 6" to 24"

FLOW CONDITIONING

Captive Flow Conditioners available upon request with meter purchase

SRA SERIES – REMOTE

IN-LINE STYLE



STYLE

Remote In-Line Mass Flow Meter

SENSOR

Two reference grade Platinum RTD clad in 316SS sheath

MATERIAL

Wetted metal components: 316SS

PROBE ENCLOSURE

Junction Box is NEMA 4 indoor/outdoor enclosure (no electronics, just terminals)

TRANSMITTER ENCLOSURE

Remote mount, NEMA 4 indoor/outdoor enclosure

FLOW BODY

316 SS Schedule 40 Flow Bodies sized from 1/4" to 6" long to 4" x 12" long. Male NPT ends standard (Flanges and other options available)

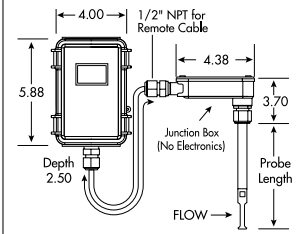
CABLE LENGTH

25' Standard (max length 1000')

FLOW CONDITIONING

Flow Conditioners are built in to In-Line Style Flow Bodies from 1/2" to 4"

INSERTION STYLE



STYLE

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PROBE STYLE/LENGTH

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FLOW CONDITIONING

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SPECIFICATIONS

POWER

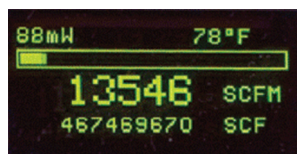
24VDC Standard (115/230VAC optional)

POWER DISSIPATION

Less than 2.5 w

DISPLAY

High contrast photo-emissive graphical display (Flow Rate, Totalizer, Temperature)



CLOSE-UP OF SAGE CLEAR DISPLAY

ELECTRONICS

Microprocessor based

TURNDOWN

100 to 1 turndown

RESOLUTION

1000 to 1 resolution

LOW END SENSITIVITY

5 SFPM

FIELD CALIBRATION CHECK

Yes – Digital system allows raw signal validation (milli-watts)

FLOW ACCURACY

± 0.5% of Full Scale ± 1% of reading

FLOW REPEATABILITY

0.2% repeatability

RESPONSE TIME

1 second time constant

GAS TEMPERATURE RANGE

-40° to 200° F Std. (if higher temperature needed, contact Sage)

GAS PRESSURE

500 PSIG (if higher pressure needed, contact Sage)

TEMPERATURE OUTPUT

Not applicable

FLOW OUTPUT

4 to 20 mA for Rate; 24VDC pulse for Totalized value

AMBIENT TEMPERATURE

-40° to 150° F

RELAYS

Not applicable

OPTIONS

Field Reconfigurability:
Specify ADDRESSER



See Sage Metering Product Brochure for additional information and product benefits, or visit us at www.sagemetering.com

What is a Thermal Mass Flow Meter?

- What is a Thermal Mass Flow Meter? It is a meter that directly measures the gas mass flow based on the principle of conductive and convective heat transfer.
- All Meters have probes (Insertion Style) or Flow Bodies (In-Line Style) that support a pair of sensors, which are in contact with the gas.
- The sensors are RTDs, which are resistance temperature detectors. They consist of highly stable reference-grade platinum windings. In fact, we use the same material that is used as Platinum Resistance Standards at the NIST.
- The RTDs are clad in a protective 316 SS sheath for industrial environments.
- One of the RTDs [See Diagram below] is self-heated by the circuitry and serves as the flow sensor. The other RTD acts as a reference sensor, and measures the gas temperature. Essentially it is used for temperature compensation.
- The Sage proprietary hybrid-digital sensor drive circuitry maintains a constant overheat between the flow sensor and the reference sensor. As gas flows by the heated sensor (flow sensor), the molecules of flowing gas carry heat away from this sensor, and the sensor cools down as it loses energy. The circuit equilibrium is disturbed, and momentarily the temperature difference between the heated sensor and the reference sensor has changed. The circuit will automatically (within 1 second) replace this lost energy by heating up the flow sensor so the overheat temperature is restored.
- The current required to maintain this overheat represents the mass flow signal. There is no need for external temperature or pressure devices.

