

# Particulate Transmitter

## BM 30T Series

# INSTALLATION & OPERATING MANUAL



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## Technical Support & Return Procedure

BinMaster provides industry leading technical support for all product lines. The technical support department is staffed with a team of engineering professionals.

Areas of assistance provided by the Technical Support department include:

- Pre-Installation Site Analysis
- Product Installation
- General Operation
- Application Specific
- Routine Calibration
- EPA Compliance
- Performance Upgrades and Add-On Features

To ensure the best and most efficient technical support please be prepared with the following information prior to contacting BinMaster. If it is determined that the component must be returned for evaluation/repair, a Return Material Authorization number will be issued. You must include the RMA number on the packing slip and mark the outside of the shipping container.

- Company Name \_\_\_\_\_
- Product Model Number \_\_\_\_\_
- Product Serial Number \_\_\_\_\_
- Date of Installation \_\_\_\_\_
- Reason for Return \_\_\_\_\_

BinMaster Technical Support may be reached by:

Phone: (800) 278-4241

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Hours of Operation: 9AM – 5PM Central Standard Time

- Any control unit or particulate sensor that was exposed to hazardous materials in a process must be properly cleaned in accordance with OSHA standards and a Material Safety Data Sheet (MSDS) completed before it is returned to the factory.
- All shipments returned to the factory must be sent by prepaid transportation.
- All shipments will be returned F.O.B. factory.
- Returns will not be accepted without a Return Material Authorization number.

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## 1. Notifications

This document contains important information necessary for proper operation of the product. It is strongly urged that all users of the product read this manual in its entirety. All instructions should be followed properly and any questions that arise should be discussed with FilterSense (A Division of Impolit Environmental Control Corp.).

Any use or distribution of this document without the express consent of FilterSense (A Division of Impolit Environmental Control Corp.) is strictly prohibited. Any reproduction is prohibited without written permission.

In no event will FilterSense (A Division of Impolit Environmental Control Corp.) be liable for any mistake, including lost profits, lost savings, or other incidental or consequential damages arising out of the use or inability to use this manual, even if advised of the possibility of such damages, or any claim by any other party.

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### WARNING



Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Warning statements help you to:

- Identify a hazard
- Avoid a hazard
- Recognize the consequences

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### IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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## 2. Safety

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**WARNING****DEVICE SUITABILITY**

- Before installing any device confirm area classification requirements. Do not install any device that is not tagged as suitable for the required area classification.
- Before installing any device, confirm ambient temperature, process temperature and process pressure requirements. Do not install any device that is not tagged as suitable for the required temperatures and pressures.

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This apparatus has been designed to comply with EN 61010, safety requirements for electrical equipment for measurement, control and laboratory use, and has been supplied in a safe condition. Before applying power, verify that the correct safety precautions have been taken (see the following warnings).

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**WARNING****GROUNDING AND FUSING**

- Before applying power to the instrument, you must connect the sensor housing and remote electronics housing (two piece configuration) to a proper earth ground. The sensor housing is connected to earth ground using the external ground screw. The remote electronics housing is connected to earth ground through the ground screw inside the housing. Grounding to the neutral conductor of a single-phase circuit is not sufficient protection.
- Only fuses with the required current, voltage and specified type should be used. Do not use repaired fuses or short-circuited fuse holders.

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**WARNING****FIELD SERVICE**

- Only appropriately licensed personnel should perform the mechanical and electrical installation.
  - This device does not contain field serviceable components. Only factory personnel should perform service on this equipment.
  - **WARNING** – To prevent ignition of flammable or combustible atmospheres and for operator safety, always disconnect power before servicing.
-

### 3. Approvals and Certifications



#### **CE Conformant**

The Electronics and Particulate Sensors conform to the appropriate country standards and governing regulations listed below:

- EN 61010 “Safety requirements for electrical equipment for measurement, control and laboratory use.”
- EN 55011 “Limits and methods of measurement of radio interference characteristics of industrial, scientific and medical equipment”. Class A: Industrial and commercial.
- EN50082-1 “Electromagnetic compatibility – Generic immunity standard”. Part 1: Residential, commercial and light industry.

## 4. Introduction

### 4.1 General

Applications for a particulate transmitter include continuous emissions monitoring, baghouse filter leak detection and process particulate flow monitoring. Types of particulate include both solid particulates (dusts, powders, granulars and pellets) and liquid particulates (mists). Various electronics and sensor configurations are offered to match the application and meet process monitoring needs.

All required operating power is derived from the 4-20mA loop. Connection to a separate power source is not required.

This model is not designed to quantify the mass concentration of particulate. For mass emissions monitoring and advanced filter leak detection consult factory on other models.

### 4.2 Principle of Operation

The principle of operation employed is a highly reliable technology based on induction. The sensor probe is mounted in an airflow stream such as a pipe, duct or stack (for small tubing an inline non-intrusive ring sensor is employed). As particulate flows near and over the sensing element, minute electrical currents are induced in the sensor. A microprocessor filters and processes the signal into a normalized, absolute output that is reasonably linear to the mass concentration of particulate.

The output units are Pico Amperes (pA). Available ranges include:

10.0pA to 5000pA (at least 10.0 to 5000mg/m<sup>3</sup> or 0.004 to 2.0gr/cf)

5.0pA to 5000pA (at least 5.0 to 5000mg/m<sup>3</sup> or 0.002 to 2.0gr/cf)

0.5pA to 5000pA (at least 0.5 to 5000mg/m<sup>3</sup> or 0.0002 to 2.0gr/cf)

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#### **IMPORTANT** MASS CORRELATION

It is important to note that the above relation between instrument units (pA) and actual mass (mg/m<sup>3</sup> or gr/cf) is just an approximate guide for selecting the appropriate model and range and for providing a general indication of the typical particulate levels monitored. For a true correlation between (pA) and actual mass (mg/m<sup>3</sup> or gr/cf), a gravimetric correlation such as an isokinetic sample must be performed for each application and a recommended model and detection level must be ordered. It is also important to note that the accuracy of such correlations is application dependent and produces the best results with consistent particulate and process conditions. The user must follow proper procedures and must understand the typical accuracy of such correlation techniques. Consult factory for details.

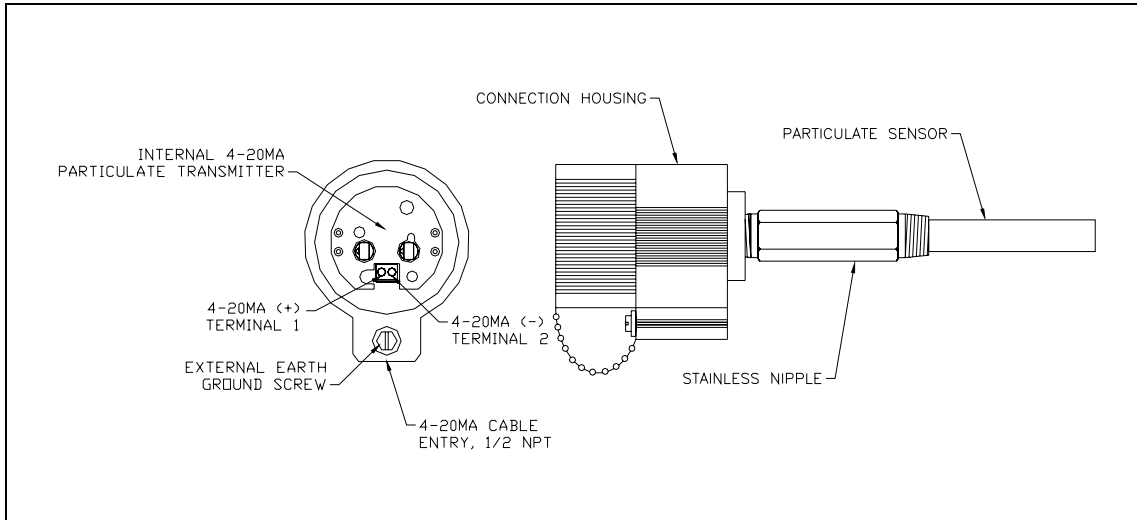
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## 5. Component Description

One and two piece versions of the particulate transmitter are available with various probe lengths and mounting configurations. The standard configuration features the smart transmitter module integrated directly into the sensor connection housing. A two-piece configuration incorporates a separate enclosure for the smart transmitter module, a remote sensor/probe and an interconnecting cable.

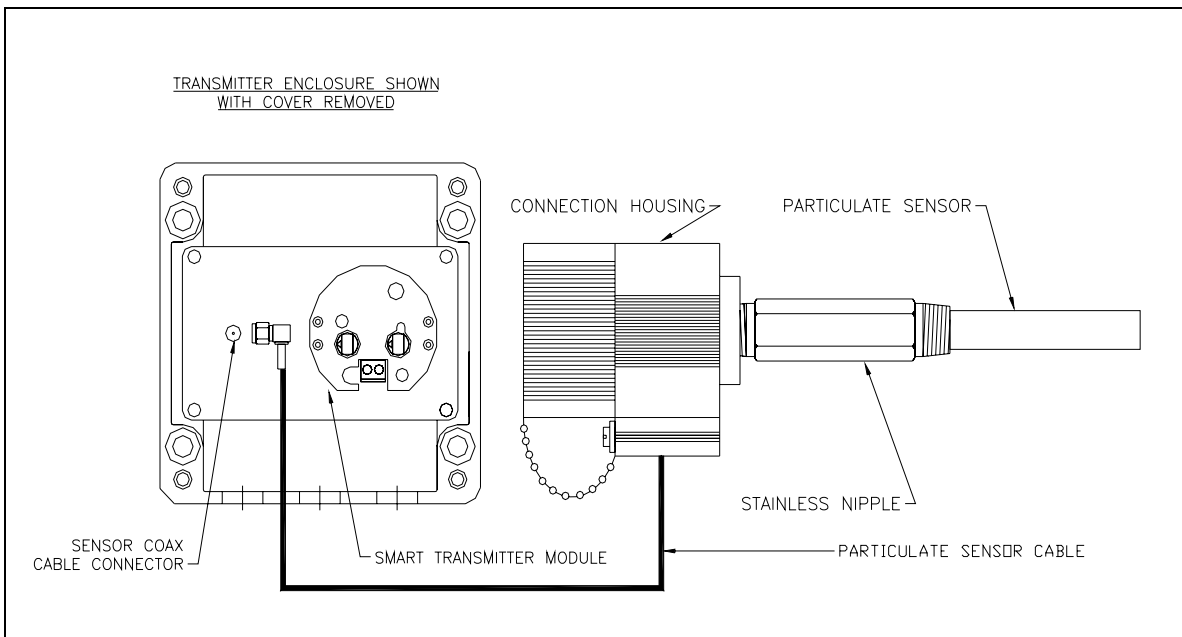
### 5.1 One-piece Configuration

(Example only, mounting and probe length variable)



### 5.2 Two-piece Configuration with Remote Electronics

(Example only, mounting and probe length variable)



### **5.3 Particulate Sensor/Probe**

The particulate sensor consists of a stainless probe with a non-conductive protective layer or coating, a stainless steel nipple/mount and the sensor housing. It is a very rugged assembly that is virtually maintenance-free. It does not require special alignment, is not affected by normal vibration and does not require cleaning.

### **5.4 Smart Transmitter Module**

The smart transmitter module processes the signals induced into the probe, quantifying and digitally filtering them into an absolute measurement of pA (pico amps). The pA reading is transmitted over a 4-20mA current loop for remote monitoring with a control system, PLC, panel meter, recorder etc. It is important that the 4-20mA signal be converted back into pA at the monitoring location to enable evaluating the instrument output readings properly. Electrical isolation is provided between the 4-20mA loop and the pA measurement circuitry. This isolation provides immunity to ground loop and power supply/plc analog input card grounding possibilities.

### **5.5 Coaxial Cable for Particulate Sensor**

The cable that connects the particulate sensor to the control unit is a high-quality coaxial cable specifically designed for the system. Maximum length is 300 ft (91m). **Do not use substitute cable.**

## 6. Installation

### 6.1 Sensor

**Location:** The following factors should be considered when determining the sensor location:

- Area Classification- Non-Hazardous areas only
- Flow conditions
- Ambient and Process Temperatures
- Process Pressure
- Electrical (Faraday) shielding
- Atmospheric shielding (in the case of ducts and stacks open to atmosphere)
- Access for installation and service

#### WARNING



#### INSTALLATION PERSONNEL

- Only appropriately licensed professionals should install this product.
- WARNING – To prevent ignition of flammable or combustible atmospheres and for operator safety, always disconnect power before servicing.

#### WARNING



#### SENSOR LOCATION

- The sensor may only be located in ordinary locations (non-hazardous safe areas)
- Before installing the sensor, confirm area classification requirements. Do not install any device that is not tagged suitable for the required area classification
- Before installing the particulate sensor, confirm ambient temperature, process temperature and process pressure requirements. Do not install any device that is not tagged as suitable for the required temperatures or pressures.

It is essential for the pipe/duct to provide an electrical (Faraday) shield for the sensor. It is therefore required that the pipe, duct or stack is metal and earth grounded (small inline tubing sensors provide their own section of metal pipe which also must be grounded). Consult the factory when insertion probe style sensors are to be installed in non-conductive pipes, ducts such as plastic or fiberglass.

The particulate sensor must be installed in a position where the flow is reasonably laminar and the particulate is evenly distributed. The ideal position is where the pipe/duct is straight and free of items such as valves, dampers or other flow obstructions for a length of 4 diameters or longer. Horizontal or vertical sections are acceptable. For basic flow/no flow detection it is not necessary to select a location with a long straight section if access has to be sacrificed dramatically. For trending and measurement the need for a straight section and laminar flow increases. The particulate sensor should be positioned with approximately two thirds of the straight section upstream of the sensor and one third downstream. The particulate sensor should be located in the center of the pipe/duct. If the pipe/ducting is square it should be located in the center of one of the sides. In either case, be sure the

position is such that the tip of the sensor reaches the midpoint or beyond. Always use good engineering sense and be sure the sensor will interact with a reasonable representation of the flow.

For emissions detection applications such as baghouses or cartridge collectors, good locations are generally found upstream of the blower. The particulate sensor can be located downstream of the blower but not too close to the stack outlet. There must be sufficient duct downstream of the sensor to provide adequate electrical and atmospheric shielding. The sensor should be located upstream of any sampling ports by at least two feet. It is not necessary that the sensor be in the same section of the duct/stack as the sampling ports. Particulate sampling ports require fully-developed laminar flow and longer straight sections.

Extreme vibration should be avoided.

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**IMPORTANT** **ATMOSPHERIC AND ELECTRICAL SHIELDING OF SENSOR**

- It is essential for the pipe/duct to provide an electrical (Faraday) shield for the sensor. The pipe/duct or stack should be metal with a high quality earth ground. Consult the factory for non-conductive pipes/ducts such as plastic or fiberglass. (Small in-line sensors for small tubing provide their own section of metal pipe, which also must be grounded).
- When the sensor is placed in a stack/duct choose a location away from atmosphere so wind driven atmospheric particulate or rain does not flow over the sensor and so external electrical noise cannot affect operation.
- Do not place the sensor where the pipe/duct is corroded or cracked which may allow water droplets to create signals as they flow by.

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**Mounting:**

The following types of process mounts are available for the standard probe style sensors:

NPT, Quick-Clamp and ANSI flange.

Inline sensors for small tubing are supplied with swage lock or other tube connections to mount inline with metal or plastic tubing.

Installation drawings of each mounting type can be found in the appendix.

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**IMPORTANT** **Sensor Grounding**

- The ground cable must remain attached when the sensor is temporarily removed from the process – do not disconnect the ground cable.
  - Leave sufficient ground cable service loop for easy removal of the sensor from the process.
-

## 6.2 Control Unit (Remote Electronics - Two Piece Configuration Only)

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**WARNING****INSTALLATION PERSONNEL**

- Only appropriately licensed professionals should install this product.
- **WARNING** – To prevent ignition of flammable or combustible atmospheres and for operator safety, always disconnect power before servicing.

**WARNING****CONTROL UNIT LOCATION**

- The control unit may only be located in ordinary locations (non-hazardous safe areas).
- Do not locate the control unit in or near sources of very high electrical noise such as a Variable Frequency Drive (VFD) or Motor Control Center. Locate the control unit at least 10 feet from these sources and if possible, power the control unit from a separate power source.

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**Location:** The control unit should be mounted in a position that is convenient for setup and operation. It should be located at eye level and at a suitable location to view and operate. The control unit should be mounted to a flat surface in a vertical orientation. Do not mount the control unit to surfaces with excessive heat or vibration.

**Mounting:** Mounting holes are integrated into the enclosure base. Mounting hardware should be capable of supporting five times the control unit weight. Refer installation drawings for dimensions.

**Wiring:** An appropriately licensed electrician must perform all electrical connections.

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**WARNING****CONTROL UNIT WIRING**

- All wiring must be rated 250V minimum. Analog 4-20mA wire should be 22 AWG stranded shielded twisted pair, Belden 8761 or equivalent.
- Analog 4-20mA cable shield should be terminated to earth ground in the PLC/ DCS/ panel meter cabinet. The shielded wire should be terminated to ground at one end only, never at both ends.
- The coaxial cable must be in conduit that is separate from all other circuits.

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Conduit openings are provided in the bottom of the enclosure to route wiring into the enclosure. Never drill new conduit openings in the side or top of the enclosure as a bad conduit seal may allow water to enter the enclosure.

**Grounding:** Proper grounding of the control unit is essential to ensure reliable operation and operator safety.

---

**WARNING****CONTROL UNIT GROUNDING**

- Before applying power to the instrument, you must connect both the sensor housing and remote electronics housing (two-piece system) to a proper earth ground. The sensor housing is connected to earth ground through the external ground screw. The remote electronics housing is connected to earth ground through an internal ground screw. Grounding to the neutral conductor of a single phase circuit is not sufficient protection.
- Only fuses with the required current, voltage and specified type should be used. Do not use repaired fuses or short-circuited fuse holders.
- The enclosure cover must be bonded to the enclosure base with the supplied ground bonding wire – do not remove.

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### 6.3 Particulate Sensor Cable (Coaxial Cable – Two piece Configuration Only)

**Connection:** Prior to making coaxial cable connections review the following routing instructions.

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**IMPORTANT****PARTICULATE SENSOR COAXIAL CABLE ROUTING**

- The sensor cable must be installed in conduit that is separate from all other wiring.
- The cable should be routed from the particulate sensor to the control unit in a path that avoids high vibration, heat over 394°F (200°C) and any strong magnetic or electrical fields.
- The cable should be located at least 18 in (46 cm) away from any power lines (conduit), motors, frequency drives and other sources of electrical interference throughout its entire path.
- The cable should be installed in metallic conduit. At the process end, use a section of shielded flex conduit that is 1 to 2 times the probe length to serve as a service loop.

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The coaxial cable is connected to the control unit by a coax connector and is connected to the sensor by two ring terminals. The connectors are normally supplied pre-assembled to the cable.

Once the cable has been routed, insert the coax connector into the control unit enclosure leaving a very small service loop as specified in the installation drawing shown in the appendix. A larger service loop should be used at the sensor end, typically 1 to 2 times the sensor length. Any small amount of extra cable length should be pulled into the nearest junction box and NOT left in the sensor housing or in the control unit enclosure. If there is a significant amount of extra cable (many feet), the cable should be shortened at the sensor end and the sensor end connectors should be re-assembled using factory-supplied connectors and instructions.

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**IMPORTANT****COAXIAL CABLE INSIDE THE CONTROL UNIT**

- A ferrite suppressor is located on the sensor coaxial cable near the coax connector and must remain inside the control unit enclosure.
- The protective shrink wrapped portion of the coax cable must extend a minimum of 6 in (15 cm) into the coax cable conduit.
- Do not leave any excess cable in the control unit or sensor housing.

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Inside the particulate sensor enclosure, attach the coax cable as indicated in the sensor drawing. When connecting the braided shield, ensure it does not touch the surge voltage protection assembly. Do not leave excess cable inside the sensor housing.

**6.4 Sensor Test Port (Customer Supplied)**

The test port is not a necessary component to operate the system, but it is recommended. It is a 1/8" NPT x 3" pipe nipple used to introduce particulate into the process to perform a natural response check. The nipple is screwed into or welded to the pipe/duct upstream of the sensor. Particles are injected into the flow stream to simulate a natural increase in particle flow. It is primarily intended for use at negative pressure locations in fabric filter outlet ducting so that when the cap is removed line suction will enable particles to be sucked into the flow. A test port is not recommended for hazardous area applications.

**Location:** The test port should be installed in a negative pressure location. It must be located upstream of the sensor so particulate can flow very near and around the sensor. It should be located at least 3 ft (1 m) upstream of the sensor and it should be located on the same side of the duct as the sensor so particles can pass very near and around the sensor. If possible locate the test port at ground level. The test port is not recommended for hazardous area applications.

**Mounting:** The test port is either screwed into a 1/8 inch NPT threaded hole, or welded in position. (Note: A foot or so of tubing can be connected to the nipple to make it easy to draw particles out of a container. Only a pinch of particulate at a time is needed for a response check.)

**IMPORTANT****TEST PORT INSTALLATION**

- Installation of the sensor test port is very helpful in checking the response to an actual increase in particulate.
  - The test port is not recommended for hazardous area applications.
-

## 7. Startup

### 7.1 4-20mA Loop Check

Upon initial installation the 4-20mA loop connection should be tested. Monitor the transmitter's mA output with a multimeter connected in series with the 4-20mA loop or monitor the PLC register or measuring device.

**Step 1:** Check the transmitter's 4mA output by setting the output range switch to the "4mA Test" position. The output should be 3.9mA – 4.1mA. If the output is not within the range specified, check the following:

Output = 0mA – check for proper termination of all wires, check for proper connection of multimeter, ensure loop power supply is on.

Output not between 3.9mA - 4.1mA - ensure loop voltage measured across the transmitter input terminals is 18 – 28VDC.

**Step 2:** Verify the reading at the recording device (PLC, etc.) is reading the equivalent of 4mA.

**Step 3:** Check the transmitter's 20mA output by setting the output range switch to the "20mA Test" position. The output should be 19.9mA – 20.1mA. If the output is not within the range specified, check the following:

Output not between 19.9mA – 20.1mA – ensure loop voltage measured across the transmitter input terminals is 18 - 28VDC. If the loop voltage is within the allowable range, ensure that the external loop impedance does not exceed that allowed for loop compliance. Calculate maximum allowable external loop impedance (Rmax) as follows:

$$R_{\max}(\Omega) = \frac{V_{\text{loop}}(\text{vdc}) - 14.0(\text{vdc})}{20.0(\text{mA})}$$

Note: If a multimeter is connected in the series current loop, its impedance will be added to that of the plc/dcs analog input impedance.

**Step 4:** Verify the reading at the recording device (PLC, etc.) is reading the equivalent of 20mA.

## 7.2 System Zero Check

The System Zero Check is used at installation to confirm proper installation and for troubleshooting.

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### WARNING



### SAFETY

- Always disconnect power to the control unit before making any wiring changes at either the control unit or sensor as well as when making any mounting changes or replacing any component.
  - Do not remove the sensor (even when power is disconnected) from a running process if it will in any way compromise personnel or plant safety.
  - Plant safety procedures must be followed at all times while performing any equipment check or maintenance.
- 

### System Zero Check

1. Shut the process off, stopping flow completely, including all airflow not just particulate flow. The slightest amount of flowing particles can create a signal. If process flow cannot be stopped, the particulate sensor can be removed from the process and installed in a grounded test pipe to create a shielded, no flow condition.
2. Let the system stabilize for 2-3 minutes.
3. Monitor the transmitter's mA output. Its scaled value should be well below its specified minimum detection level (10.0pA, 5.0pA or 0.5pA). If the system passes this check then it is assured that there are no false signals entering the system.

If the system zero check is not successful, each component of the system should be checked individually, in the following order:

1. Control Unit Zero Check
  2. Coaxial Cable Zero Check
  3. Sensor Zero Check
-

**Control Unit Zero Check**

1. Disconnect power to the control unit.
2. For a two piece configuration, open the enclosure cover and unscrew the coaxial cable connector from the control unit. Leave the connector inside the control unit enclosure. Make sure the connector does not slip down into the conduit. The one piece configuration requires only that the “Zero Button” be pressed and held after opening the enclosure cover to generate a zero test reading.
3. Close the enclosure cover.
4. Re-apply power to the control unit and allow the reading to stabilize for 1-2 minutes.
5. Monitor the transmitter’s mA output. Its scaled value should be well below its specified minimum detection level (10.0pA, 5.0pA or 0.5pA). If the control unit passes this check, there are no false signals entering the control unit. For one piece configurations the mA output should be monitored while the zero button is pressed and held.

**Pass:**

1. Disconnect power from the control unit.
2. Open the enclosure cover and re-attach the coaxial cable connector to the control unit.
3. Close the enclosure cover and proceed to the Coaxial Cable Zero Check.

**Fail:**

1. If a zero reading cannot be obtained, close the enclosure cover and contact the factory for further assistance.

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**Coaxial Cable Zero Check (Two Piece Configuration Only)**

1. Disconnect power to the control unit.
2. Open the sensor enclosure cover and disconnect the coaxial cable center conductor from the sensor probe end. Do not disconnect the coaxial cable shield. Do not remove the probe from the process. Leave the coaxial cable center conductor ring terminal hanging in free space within the sensor enclosure (do not isolate it with tape) and close the cover.
3. Re-apply power to the control unit and allow the reading to stabilize for 1-2 minutes.
4. Monitor the transmitter’s mA output. Its scaled value should be well below its specified minimum detection level (10.0pA, 5.0pA or 0.5pA). If the coaxial cable passes this check then there are no false signals entering the coaxial cable.

**Pass:**

1. Disconnect power to the control unit.
2. Open the sensor enclosure cover and re-attach the coaxial cable center conductor to the sensor probe end.
3. Close the sensor enclosure cover and proceed to the sensor zero check.

**Fail:**

1. Check cable installation and routing instructions in the Installation section of this manual for proper cable installation. Make any changes necessary.
2. Contact the factory for further assistance.

Once the control unit and coaxial cable zero have been checked, proceed to the Sensor Zero Check. To perform the sensor zero check the process flow must be stopped or a sensor test pipe (available from Factory) or length of metal pipe will be needed (4"-6" diameter pipe or larger). The pipe should be at least 3 in (8 cm) longer than the probe itself and must be grounded. The length of pipe will serve as an electrical shield for the probe while it is out of the process.

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**Sensor Zero Check**

1. Do not remove the sensor from a running process if it will in any way compromise personnel or plant safety procedures.
2. Disconnect power to the control unit.
3. Remove the sensor from the process and insert it into the grounded metal test pipe.
4. Re-apply power to the control unit and allow the reading to stabilize for 1-2 minutes.
5. Monitor the transmitter's mA output. Its scaled value should be well below its specified minimum detection level (10.0pA, 5.0pA or 0.5pA). If the sensor passes this check there are no false signals from the sensor.

**Pass:**

1. Disconnect power to the control unit.
2. Remove the sensor from the grounded test pipe and re-insert into the process.

**Fail:**

1. Contact the factory for further assistance.

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When performing a zero check, keep in mind that it may be acceptable to consider a small false signal negligible. For example if the baseline readings are 100pA and a system zero offset of 1pA was found, this is only a 1% affect on the normal readings. If using the device for basic flow/no flow detection or basic emissions detection, this would not be significant.

## 8. Interpreting Readings and Adjusting 4-20mA Range

### 8.1 Fabric Filter (Baghouse) Applications

Particulate flow is very dynamic in nature, thus the output signal is also usually very dynamic. This is more often the case with fabric filter and dust collection exhaust monitoring applications where filter emissions and filter cleaning systems can cause wide ranging variations in the particulate levels. When monitoring downstream of fabric filter, it is often possible for the difference between baseline readings and peak readings following cleaning cycles, to vary by a factor of 10 or even 100. This is the reason for the logarithmic output (linear output is also easily selected).

The logarithmic scale provides the ability to simultaneously monitor and resolve the baseline and peak readings. It is not uncommon to have baseline readings of less than 10pA while at the same time peak readings may be over a hundred or more.

Particulate levels listed below are typical for new or well maintained bag or cartridge filter dust collection system. Many factors, other than generic bag wear may contribute to high particulate levels including but not limited to: Improper filter installation, bad tube sheet seals, improper filter media for process conditions, high differential pressure or a lack of a filter cake buildup.

#### IMPORTANT

#### PARTICULATE READING GUIDE FOR FABRIC FILTERS

- The guide below is only an approximate guide for modern, highly-efficient baghouses
- With larger or older baghouses, readings can be significantly higher than the ranges shown below
- Shaker and reverse air baghouses will have higher peak readings as compared to pulse jet
- Readings tend to be higher when new filters are installed and a filter cake has yet to form
- With small cartridge filters, the readings tend to be at the lower end of the ranges
- Readings tend to also be lower with highly-efficient filter media such as Gore-Tex

#### Typical Readings and Guide for New Efficient Fabric Filters

AVERAGE BASELINE READINGS	PEAK READINGS (after cleaning cycle)	FILTER CONDITION
1 – 10 pA	Less than 50pA	No significant emissions
10 – 100 pA	Less than 500pA	Onset of emissions
100 – 1000pA	Greater than 500pA	Significant emissions present

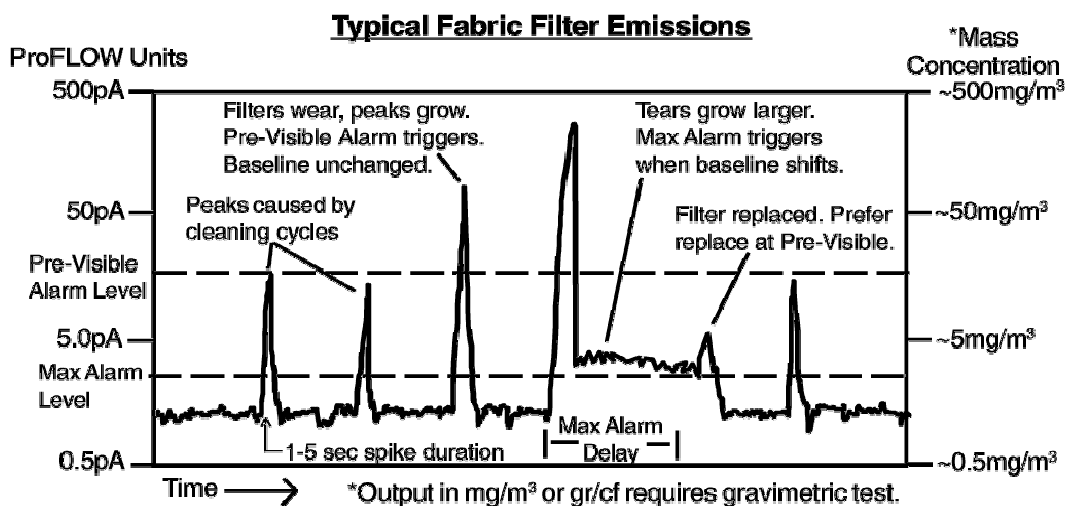
## 8.2 Alarm Levels for Fabric Filter Applications

For fabric filter applications it is recommended to set two alarm levels either using the internal alarms and or using the optional 4-20mA output signal that is sent back to a PLC or other recording system. One alarm should be set based on the average base line reading and another alarm should set based on the peak readings following cleaning cycles.

Normally, Alarm #1 is used for detecting sustained increases in the base line reading. For example a baghouse that has new, highly-efficient filters may have an average baseline reading of 10-20pA. It would then be recommend to set the baseline alarm at 30-50pA with an alarm delay time that was long enough so that cleaning cycle peaks did not activate the baseline alarm. Each application can be different (for example much higher readings are possible with larger, older baghouses) and each plant may have different operating demands in terms of how sensitive the alarms should be set. It is, therefore, recommended to initially set the alarm as low as possible and to trend and data log the readings over time before finalizing the settings. Correlations to stack test data can also be incorporated to correlate the output to actual mass concentration to set more quantitative alarms.

Normally, Alarm #2 is set to detect changes in the peak readings caused by the filter cleaning cycles. Recall that as filters just begin to tear or become porous, the momentary puffs of particulate emissions that normally occur just after a cleaning cycle will increase in peak height and duration (peak width). Essentially the cleaning cycle amplifies the existence of small tears. Thus, setting an alarm to detect changes in the peak emissions is often referred to as a Pre-Visible Alarm as it is the best, and most reliable, approach to detecting emissions before become visible. When a sustained increase in the baseline level occurs, particulate emissions will likely be visible and the filters should be changed immediately. Where as, when only the peak emissions have increased, emission will likely not be visible and there likely would be time to schedule changing the filters (i.e. early warning).

Telephone or on-site assistance is available to provide suggestions in setting alarm levels.



**IMPORTANT****ALARM LEVELS FOR EPA COMPLIANT LEAK DETECTION**

- Alarm levels for EPA compliant leak detection such as MACT regulations should initially be set as low as possible until sufficient trend data has been logged and all considerations have been made.
  - Do not increase the alarm levels without proper justification.
  - Documentation of properly determined alarm levels is recommended as well as locking out alarm set point adjustment except to authorized personnel.
  - Consult factory for alarm set point assistance and or FilterWare Visualization and EPA Compliance Software for advanced alarming and alarm record keeping.
-

### 8.3 4-20mA Output Range Adjustment

For proper selection of 4-20mA output range, both baseline and peak levels must be taken into account. The 4-20mA output range should be selected to allow accurate measurement of low baseline signals while still allowing resolution of higher peak signals that occur during pulse-jet cleaning cycles.

The 4-20mA analog output represents the linear or logarithmic equivalent of the “pA” particulate levels. Once the analog output has been transmitted to the PLC or chart recorder, it is recommended to convert the 4-20mA signal back into pA to assist in data interpretation, alarm level determination and historical data comparison. This can be of particular importance for EPA regulatory applications. The following two examples show the formulas used to convert the 4-20mA signal into pA.

**Logarithmic Scale (Recommended):** Logarithmic scaling provides a method of transmitting signals such that low-level signals are expanded for increased resolution and accuracy while high-level signals are compacted for increased signal range. Allowable ranges are 0.5-500pA and 5-5000pA. Both ranges are three decades wide. To convert the 4-20mA logarithmic signal back into pA in the remote plc/dcs, the following formula is used:

1. Scale mA input to proper log(10) argument: 
$$Y = \frac{\text{Measured}(mA) - 4.00(mA)}{5.333}$$

2. Convert log(10) argument to pA: 
$$pA = \text{MinimumRange}(pA) * 10^Y$$

Example: 0.5 – 500pA log scale with measured loop current of 9.33mA:

1. Scale mA input to proper log(10) argument: 
$$Y = \frac{9.33(mA) - 4.0(mA)}{5.333} = 1.0$$

2. Convert log(10) argument to pA: 
$$pA = 0.5(pA) * 10^{1.0} = 0.5(pA) * 10 = 5.0(pA)$$

Three decade logarithmic scale gives the following equivalent mA outputs:

4-20mA Scaling 0.5 – 500pA LOG:

$$4mA = 0.5 \text{ pA}$$

$$9.33mA = 5.0pA$$

$$14.66mA = 50pA$$

$$20mA = 500 \text{ pA}$$

4-20mA Scaling 5 – 5000pA LOG:

$$4mA = 5.0 \text{ pA}$$

$$9.33mA = 50pA$$

$$14.66mA = 500pA$$

$$20mA = 5000 \text{ pA}$$

**Linear Scale:** Linear scaling provides direct, proportional, linear change in the 4-20mA output signal over the selected pA range. Allowable ranges are 0-100pA, 0-500pA, 0-1000pA, and 0-5000pA. To convert the 4-20mA linear signal back into pA in the remote plc/dcs, the following formula is used:

$$pA = \frac{Measured(mA) - 4.0(mA)}{16.0(mA)} * Range(pA)$$

If unsure where to set the linear output range, a good generic selection for fabric filters is a range that is equal to or greater than 25 times the measured baseline signal. For example, if the baseline signal is 15pA, the linear range would be selected as 15pA \* 25 = 375pA ... choose 500pA linear range.

**Resolution:** The 4-20mA output is transmitted at a resolution of 12 bits or 4.88uA.

## 8.4 Time-constant Adjustment

The particulate transmitter contains an adjustable digital filter. Particulate flow is very erratic in nature. Filter cleaning cycles can also cause dramatic changes. Setting the filter time constant higher (in seconds) will “smooth” out the signal. Setting the filter time constant lower (in seconds) will increase the responsiveness of the signal and make it more “bouncy”. Keep in mind that setting the filter time constant too high may reduce the ability to use peak readings to determine the onset of filter wear.

The recommended filter time constant for fabric filters is 3.0 seconds. If the output signal is too bouncy with this setting, the time constant should be increased until a smoother reading is obtained. If the output signal is steady but peak readings are not seen during the activation of the filter pulse-jet cleaning cycle, the time constant should be decreased until the peak readings can be measured.

## 9. Routine Maintenance

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**WARNING****EQUIPMENT MAINTENANCE**

- Only appropriately licensed professionals should perform maintenance on this product.
  - **WARNING** – To prevent ignition of flammable or combustible atmospheres and for operator safety, always disconnect power before servicing.
- 

**Particulate Sensor:** The sensor does not normally need any cleaning and for optimal performance, routine cleaning of the sensor is not recommended.

**Transmitter Module:** The transmitter module is zeroed at the factory and normally does not require adjustment. Zero adjustment can be checked once every 6-12 months.

## 10. Troubleshooting

The most important aspects of troubleshooting are to keep in mind the instrument is monitoring small signals. The quality of cable connectors should not be overlooked. The sensor housing should be kept dry and clean. Break all troubleshooting down into the basic system components, the sensor, smart transmitter module and 4-20mA loop.

### **False High Signals (False Alarms)**

1. When an apparent false high signal is present, first check the process to be sure the particulate level has not increased. Keep in mind that the system can detect very low levels. In filtration applications the system can detect invisible particulate levels and very small emissions.
2. Check the sensor cover and conduit seal to be sure they were not left open allowing rain to enter the housing. Check the coaxial cable (two piece configuration only) connectors using a digital voltmeter and check for shorts. If nothing can be found, conduct a system zero check.

### **No Reading or Alarm (When Believed Necessary)**

1. Increase the particulate level or introduce particulate into the air stream and monitor for a response. If the system responds properly re-evaluate the selected alarm points and the process conditions.
2. If there is no response, check for electrical continuity from the sensor to the control unit end of the coax cable (two piece configuration only).
3. Contact the factory for a Field Test Unit that can generate a signal to check response and calibration (two-piece configuration only).

## 11. Spare Parts

<b>Item</b>	<b>Details</b>	<b>Manufacturer</b>	<b>Mfr Part No.</b>
Control Unit/Transmitter	Control Unit/Transmitter Family	FilterSense	Refer to Product Label
Particulate Sensor	Variable Lengths & Connections	FilterSense	Refer to Product Label
Particulate Sensor Cable	Coax, SMA x Ring Lugs	FilterSense	CCA-Feet

## 12. Specifications

ELECTRICAL			
PARAMETER	DETAIL	SPECIFICATION	NOTE
Measurement Units		Pico-ampere (pA)	$1 \times 10^{-12}$ Amp
Measurement Range	Standard	10.0pA – 5000pA	
	Optional	5.0 and 0.5pA – 5000pA	
Accuracy		± 5% of Range	Full Temp Range
Ambient Temperature Range	Operating	-15F to +160F (-25C to +70C)	
	Storage	-40F to +185F (-40C to +85C)	
Digital Filtering	Range	Ajustable 0.5 Sec – 60 Sec	
4-20mA Output	Isolation	500VDC Process to Loop	
	Output Compliance	Max. RLoad = (VSupply-18V)/0.02A (24VDC = 500Ohm RLoad Max.)	
	Scale	Linear or Logarithmic	
	pA Range	0-100, 0-500, 0-1000, 0-5000 Linear 0.5-500, 5-5000 Logarithmic	
MECHANICAL			
Mounting	Standard	½" NPT Mount	Other, consult factory
	Optional	Tri-clamp, Flange	
Materials	Sensor	Teflon over Stainless	
	Body	Stainless Steel	
Process Temperature Range	Operating	-40F to +250F (-40C to +120C)	Standard
		-40F to +450F (-40C to +232C)	Medium
Pressure Range	Operating	Full Vacuum to 10PSI	Other, consult factory
Enclosure	Type	Painted Cast Aluminum	
	Rating	NEMA 4X (IP 66)	
OPERATING and APPLICATION RANGE			
Particle Concentration (Approximate Guide)	10.0pA	At least 10.0-5000 mg/m <sup>3</sup> At least 0.004 to 2.0 gr/cf	Visible
	5.0pA	At least 5.0 – 5000 mg/m <sup>3</sup>	Barely Visible To Visible
	Optional	At least 0.002 to 2.0 gr/cf	
	0.5pA	At least 0.5 to 500 mg/m <sup>3</sup>	Barely Visible To Invisible
Optional	At least 0.0002 to 0.2 gr/cf		
Particle Velocity		300 ft/min. (91 m/min.) and Higher	
Particle Size		0.3 Micron and Higher	

## **13. Appendix**

### **Installation Drawings**

# IMPORTANT INSTALLATION INFORMATION

- HAZARDOUS AREA LOCATIONS: VERIFY REQUIRED CLASS AND DIVISION AGAINST SPECIFICATION LISTED ON THE PROCESS DEVICE TAG.
- DO NOT INSTALL ANY EQUIPMENT THAT IS NOT TAGGED SUITABLE FOR THE HAZARDOUS AREA.
- ADHERE TO NEC, CEC, NEMA, NFPA, OSHA INSTALLATION AND MAINTENANCE GUIDELINES AND ALL APPLICABLE LOCAL CODES.
- INSTALLATION AND SERVICE MUST BE PERFORMED BY QUALIFIED PERSONNEL WHILE POWER IS DISCONNECTED AND THE PROCESS IS OFF.
- AMBIENT TEMPERATURE, PROCESS TEMPERATURE AND PROCESS PRESSURE RATINGS ARE SPECIFIED ON THE DEVICE TAG.

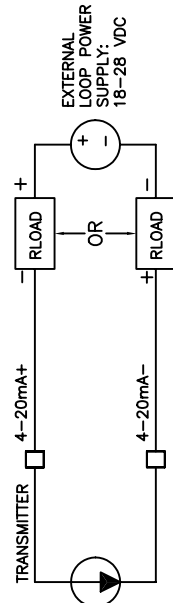
- SAFETY:**
- DISCONNECT ALL POWER TO THE CONTROL UNIT BEFORE OPENING THE ENCLOSURE.
  - ELECTRICAL (ADHERE TO THE NEC AND ALL LOCAL CODES FOR SAFETY)
  - PROPER EARTH GROUND CONNECTIONS MUST BE MADE TO THE SPECIFIED TERMINALS.
  - ALL WIRING MUST BE ENCLOSED IN GROUNDED, METAL CONDUIT.
  - ANALOG I/O AND COMMUNICATIONS WIRING MUST CROSS POWER AND CONTROL I/O WIRING AT RIGHT ANGLES.
  - WIRING AND SENSORS AWAY FROM SOURCES OF INDUCTIVE ENERGY AND INSTALL SURGE SUPPRESSION WHERE APPROPRIATE.
  - REFER TO IEEE STANDARD 518-1982 AND 1100-1992 FOR FURTHER GUIDELINES.

- MOUNTING (ADHERE TO THE NEC AND ALL LOCAL CODES FOR SAFETY)**
- MOUNTING SHOULD SUPPORT FIVE TIMES THE CONTROL UNIT WEIGHT.
  - DO NOT MOUNT THE CONTROL UNIT IN AN AREA OF HIGH VIBRATION OR OUTSIDE THE SPECIFIED TEMPERATURE RANGE.
  - TEMPERATURE RANGE: 32°F TO 140°F (0°C TO 55°C)
  - VENTILATE ALL CONDUIT FROM THE BOTTOM AND ENSURE ALL FITTINGS AND COVERS ARE PROPERLY SEALED.
- ANALOG WIRING**
- 4-20mA CABLE: 250V MINIMUM, 22AWG, STRANDED, SHIELDED TWISTED PAIR, BELDEN 8761 OR EQUIVALENT.
- PARTICULATE SENSOR COAXIAL CABLE**
- DO NOT SUBSTITUTE AND DO NOT ROUTE WITH ANY OTHER CABLE, EXCEPT OTHER PARTICULATE SENSOR COAXIAL CABLES.
  - MAINTAIN SEPARATION OF 18 INCHES (0.5 METERS) FROM OTHER CABLING AND INDUCTIVE ENERGY SOURCES. CROSS CONDUCTORS AT RIGHT ANGLES.
  - ALL CABLES MUST BE ENCLOSED IN GROUNDED, METAL CONDUIT.
  - INSTALL A SERVICE LOOP OF SHIELDED FLEX CONDUIT AT THE SENSOR-END THAT IS 1 TO 2 TIMES THE SENSOR PROBE LENGTH.

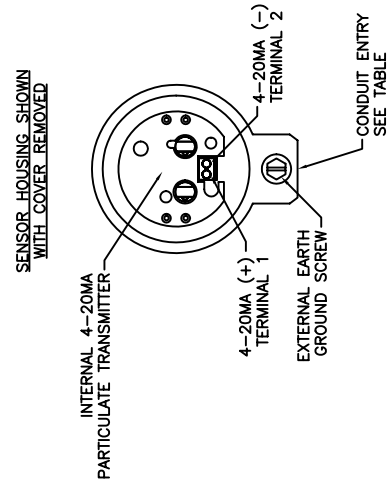
- SPECIFICATIONS**
- WIRING:
    - TERMINAL 1 = 4-20mA LOOP POSITIVE
    - TERMINAL 2 = 4-20mA LOOP NEGATIVE
  - MEASUREMENT RANGE: 0-5000PPA
  - MINIMUM DETECTION LEVEL: 10.0PPA (STD), 5.0PPA (OPT) 0.5PA (OPT)
  - OUTPUT: 4-20mA (LINEAR OR LOG SCALE)
  - POWER: SUPPLIED BY 4-20mA LOOP (18VDC MIN. LOOP VOLTAGE)
  - OPERATING TEMPERATURE:
    - ONE PIECE: -40°F TO 250°F (STD)
    - TWO PIECE: -40°F TO 450°F (OPT)
  - 4-20mA LOOP SPECIFICATIONS:
    - LOOP VOLTAGE: 18 - 28 VDC
    - LOOP EXTERNAL RESISTANCE: 300 OHMS MAX @ 24VDC

- CONDUIT ENTRY**
- 1/2" NPT
  - 3/4" NPT (OPTIONAL)
  - M18X1.5 (OPTIONAL)

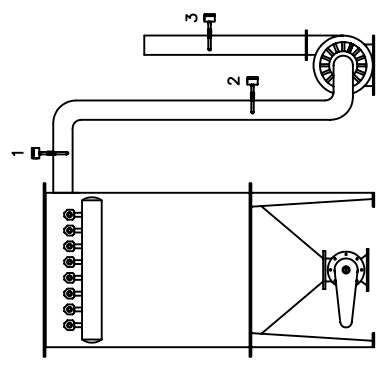
## TYPICAL WIRING EXAMPLE



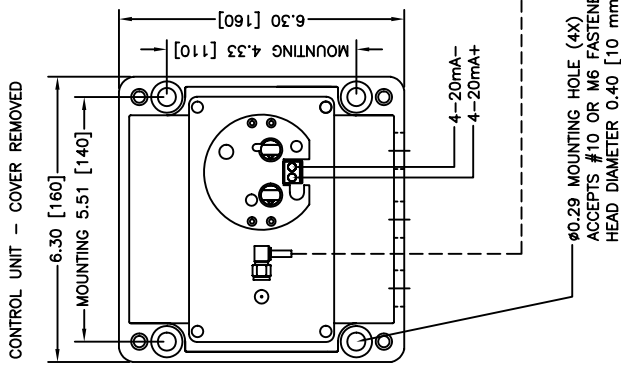
## ONE-PIECE PARTICULATE TRANSMITTER



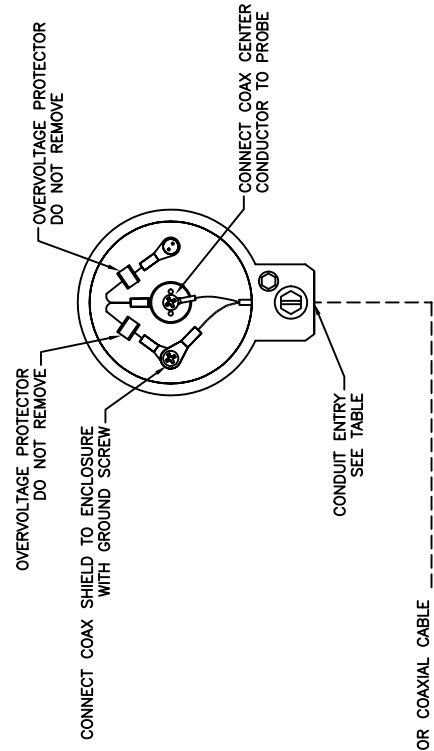
## TYPICAL PARTICULATE SENSOR MOUNTING LOCATIONS



## TWO-PIECE PARTICULATE TRANSMITTER



## ENCLOSURE SHOWN WITH COVER REMOVED



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ALL DIMENSIONS IN INCHES  
TOLERANCES UNLESS OTHERWISE SPECIFIED  
X.X = ±0.1  
X.XX = ±0.01  
X.XXX = ±0.005  
ANGLES = 1/16" UNLESS OTHERWISE SPECIFIED

SCALE: N/A  
DRAWN BY: AJD  
CHECKED BY: EC  
DATE: 1/12/06  
DRAWING NO.: 225-1032  
REV: 1 OF 2

DO NOT SCALE DRAWING

TITLE: EM\_30T, 1 & 2 PIECE UNIT  
INSTALLATION  
V2.02

REV	DESCRIPTION
A	INITIAL RELEASE
B	FLANGE AND CONDUIT UPDATES

VI.4

**IMPORTANT INSTALLATION INFORMATION**

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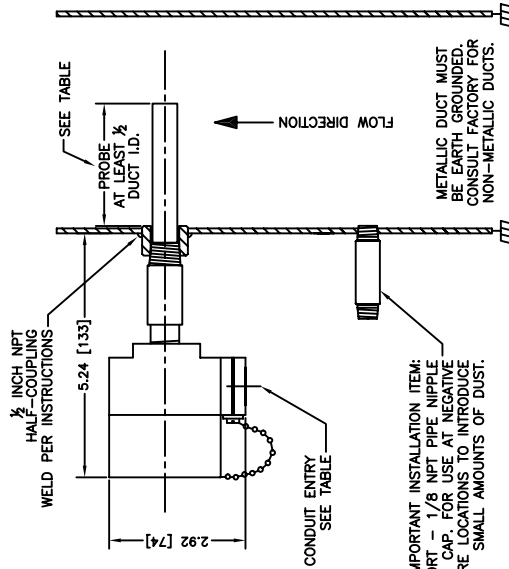
VI.4

**PARTICULATE SENSOR COAXIAL CABLE**

- DO NOT SUBSTITUTE AND DO NOT ROUTE WITH ANY OTHER CABLE, EXCEPT OTHER PARTICULATE SENSOR COAXIAL CABLES.
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- ALL CABLES MUST BE ENCLOSED IN GROUNDED METAL CONDUIT.
- INSTALL A SERVICE LOOP OF SHIELDED FLEX CONDUIT AT THE SENSOR-END THAT IS 1 TO 2 TIMES THE SENSOR PROBE LENGTH.

**NPT MOUNT**

**TYPICAL MOUNTING EXAMPLE**

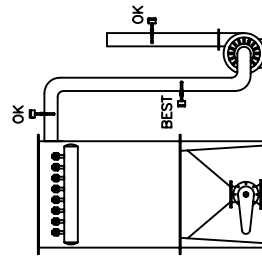


IMPORTANT INSTALLATION ITEM:  
TEST PORT - 1/8 NPT PIPE NIPPLE  
WITH CAP, FOR USE AT NEGATIVE  
PRESSURE LOCATIONS TO INTRODUCE  
SMALL AMOUNTS OF DUST.

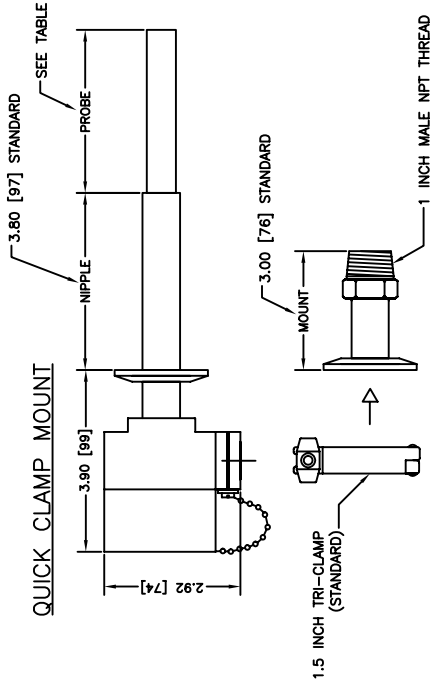
- CONDUIT ENTRY**
- 1/2" NPT (STANDARD)
  - 3/4" NPT (OPTIONAL)
  - M18X1.5 (OPTIONAL)
- FLANGE**
- 2" 150# ANSI (STANDARD)
  - DN80 PN10 (OPTIONAL)

PROBE LENGTHS	
1 PIECE	2 PIECE
INCHES	MM
3"	76
5"	127
10"	254
15"	381
20"	508
30"	762
36"	914
* DENOTES FLANGE ONLY	
	*48"
	*60"
	*72"
	*1219
	*1524
	*1828

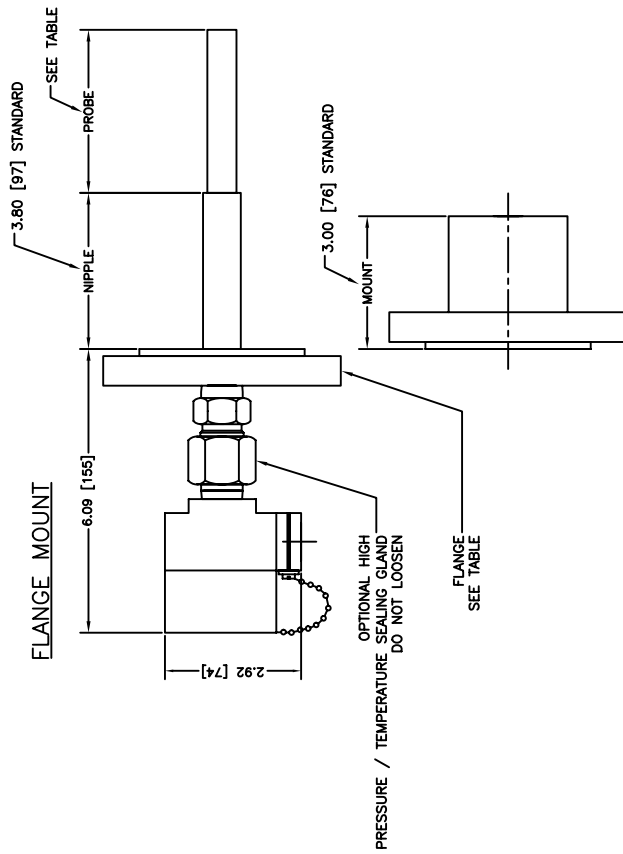
**TYPICAL PARTICULATE SENSOR MOUNTING LOCATIONS**



**QUICK CLAMP MOUNT**



**FLANGE MOUNT**



OPTIONAL HIGH PRESSURE / TEMPERATURE SEALING GLAND DO NOT LOOSEN

FLANGE SEE TABLE

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INSTALLATION  
V2.02

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ANGLES - AS SHOWN

SCALE: N/A  
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SHEET 2 OF 2  
REV: B

REV	DESCRIPTION
A	INITIAL RELEASE
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