

OPM3000

Opacity/Dust Density Monitor

Installation and Operation Manual Rev 2.0

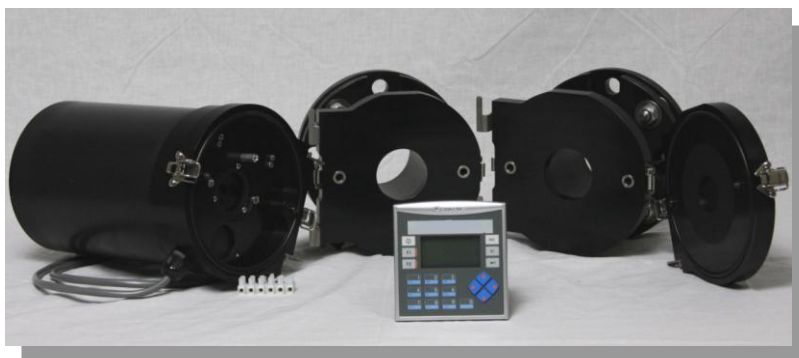


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Technical Support Hotline

For assistance with problems, please call the Customer Support Center (CSC).

Phone: 1-800-433-6076 1-440-914-1261

In addition to CSC, you may also contact Field Watch. Field Watch coordinates Emerson Process Management's field service throughout the U.S. and abroad.

Phone: 1-800-654-RMST (1-800-654-7768)

Emerson Process Management may also be reached via the Internet through e-mail and World Wide Web:

e-mail: GAS.CSC@emerson.com

World Wide Web: www.raihome.com

World Wide Web: www.raihome.com

Warnings and Safety Guidelines for user safety and equipment protection

This manual is intended to aid trained and competent personnel in the installation of this equipment. Only a technician or engineer trained in the local and national electrical standards should perform tasks associated with the electrical wiring of this device.

Warnings

- Under no circumstances will **Emerson Process Management** be liable or responsible for any consequential damage that may arise as a result of installation or use of this equipment.
- All examples and diagrams shown in the manual are intended to aid understanding. They do not guarantee operation.
- **Emerson Process Management** accepts no responsibility for actual use of this product based on these examples.
- Due to the great variety of possible applications for this equipment, the user must assess the suitability of this product for specific applications.
- Make sure to have safety procedures in place to stop any connected equipment in a safe manner if the controller should malfunction or become damaged for any reason.

- Do not replace electrical parts or try to repair this product in any way.
- Only qualified factory trained service personnel trained in its operation should open the device's housing or carry out repairs.
- The manufacturer is not responsible for problems resulting from improper or irresponsible use of this device.
- You may cause an electric shock, fire or damage the equipment if you ignore any of these safety precautions.

Section 1 - System Description and Specifications

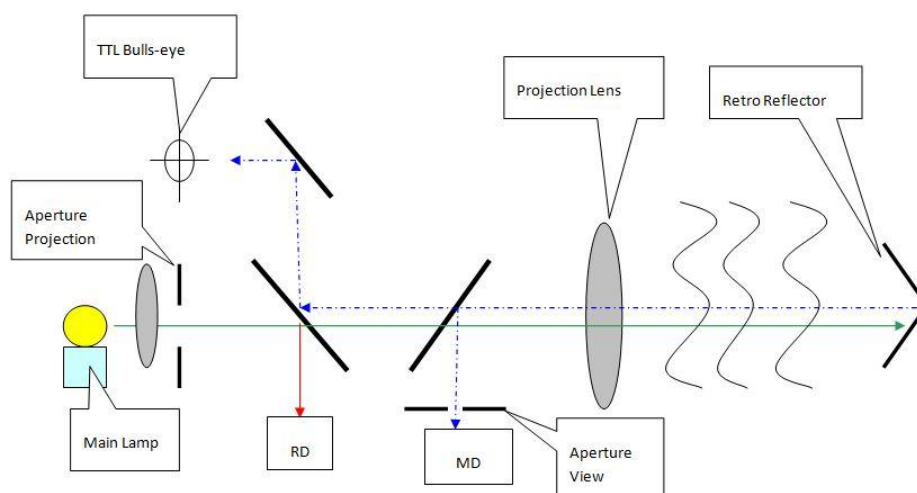
The OPM3000 Opacity Monitor provides continuous, low maintenance, precision measurement of opacity in industrial applications. It is a cost-effective instrument that serves as an aid in operating pollution and/or process control equipment.

Principal of operation

The Dual beam measurement system has a stack mounted Transmissometer sensor system consisting of an optical transceiver mounted on one side of the stack and a retro reflector mounted on the other. To avoid errors due to ambient light, the lamp is electronically modulated and projects a collimated beam of light, which is split into a reference beam, and a measurement beam by an optical Beam splitter. The reference beam is directed to the reference detector, RD. The measurement beam is projected across the stack to a Retro reflector

that returns the beam back across the stack to a beam splitter and directs the measurement beam to the measurement detector, MD.

A portion of the returning light is also sent to the TTL (Thru the Lens) bulls-eye target viewed through a window provided at the rear of the Transmissometer. The bulls-eye is used to correct changes in alignment and is unique in that no moving parts are used!



The ratio of the measurement and reference detectors is used to provide Transmittance 2 (T 2) signal. Because the same light source is used for both detectors, and a Measurement / Reference ratio is used throughout for the calculations, the monitor is insensitive to variations in light intensity. Since all measurements are made on a ratio basis, all resulting computations are independent of the absolute intensity of the light source or contamination of the optics associated with the collection and focusing of the energy from the lamp. The (T 2) signal is converted to a current format and sent to the RCU for processing. At the control unit the signal is processed to read 0-100% Opacity, provide alarms and outputs.

Transmissometer/retro reflector

The OPM3000 is a precision, double-pass, dual beam Transmissometer that consists of a transceiver (transmitter/receiver) mounted on one side of a stack or duct and a passive reflector mounted on the opposite side. The light source, photo detectors, and all measurement/reference optics used in opacity measurement are housed in the transceiver.

The function of the reflector is to return the measurement beam to the detector in the transceiver, creating a double pass across the process stream. The reflectors, optical parts and electronics will vary based on path lengths.

Optional Air Purge Weather Cover System

The transceiver and reflector may be mounted in weather covers. The weather covers are fairly compact to allow movement around them even on a three-foot walkway or platform. They protect the stack-mounted components from dirt, moisture; stack temperatures within the specified ambient temperature limits, and errant air currents around the stack.

The air purge system constantly circulates air past the optical window. The airflow is directed through the hose to an air plenum on the stack side of the optical window. The airflow in the air plenum area results in reduced pressure and increased velocity. This venturi effect tends to continually draw the air around the optical window into the purge air stream, thereby keeping the lens clean for long periods.

Alignment system

The OPM3000 includes a built-in through-the-lens alignment system. The alignment target can be viewed through a window on the transceiver. Adjustments to changes in alignment are provided by a 3-point alignment system, which is integral to the air plenum.

Cabling

The standard cabling used between the stack-mounted units and the control unit is at a minimum 2-pair, #22 AWG, twisted, shielded cable. More pairs or larger pairs than 20 AWG is acceptable.

Remote Control Unit (RCU)

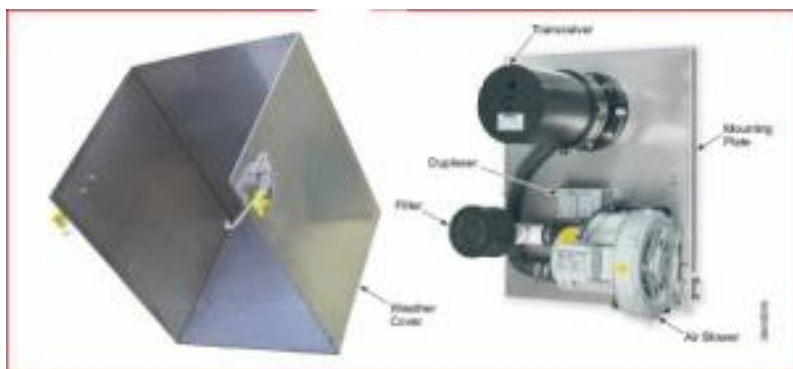
The RCU provides instrument control functions, opacity readings, alarms, analog outputs, communications, system information and more. The RCU can be DIN rail mounted or panel mounted (3.7x3.7" – 93x93mm) in a control room environment and is rated NEMA 4X/IP65 when panel mounted. Battery backup for all memory is typically 7 years.

The control unit should be mounted in a control room environment i.e., clean, temperature with max/min of +0° to +50° C (+32° to + 122° F). The OPM3000 control unit provides instrument control functions, opacity readings, alarm and fault indicators, analog outputs, and diagnostics with contact closures.



Optional Severe Air Purge Weather Cover System

The transceiver and reflector may be mounted in weather covers. The weather covers are fairly compact to allow movement around them even on a three-foot walkway or platform. They protect the stack-mounted components from dirt, moisture; stack temperatures within the specified ambient temperatures limits, and errant air currents around the stack.



The air purge system constantly circulates air past the optical window. The air flow is directed through the hose to an air plenum on the stack side of the optical window. The air flow in the air plenum area results in reduced pressure and increased velocity. This venturi effect tends to continually draw the air around the optical window into the purge air stream, thereby keeping the lens clean for long periods.

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Cabling

The standard cabling used between the stack-mounted units and the control unit is at a minimum 6-pair, #20 AWG, twisted, shielded cable separation distance approximately 1000FT. More pairs or larger than 20 AWG is acceptable.

OPM3000 Opacity Specifications

Control unit:	
Enclosure	Panel mounted IP65/NEMA4X Dimensions 96x96x64 mm (3.8"x3.8"x2.5"). Power 20.4 to 28.8VDC < 10% ripple, 400mA.
Approvals	CE and UL Listed
Digital Display	Selectable pages, LCD backlight
Ambient Temperature Range	0 to +50o C (+32 to + 122o F)
Power Requirements	24 VDC +/- 10%
Flue Gas Stack/Duct Pressure	+2" (+51mm) Water Column Ma
Alarm Time Delay & set point	6 Relays for alarms
Alarm Reset	Manual or Automatic
Analog Outputs	Two 12-bit Analog outputs 4-20mA, Ch. 1 0-100% opacity, Ch. 2 mg/m3 selectable ranges.
Maximum range	Opacity 99.9%, 2.0 O.D., 2000mg/m3
Calibration check options	Manual zero and span calibrate with dedicated zero reflector or Zero with clear stack condition.
Communications	Modbus – RS485 port
Battery Back	7 years typical

Transceiver/ Reflector:	
Enclosure	NEMA 4 watertight enclosure. Power 120/240VAC, 50/60Hz. +/- 10%, Transceiver 65va, Service Module 60va.
Path Length	3 to 40 feet, 0.6 to 4.6 meters.
Optical System	Double Pass
Reflector	Distance dependent
Light Source Aging Compensation	Automatic
Light Source Life	62,000 hours (> 7 years)
Ambient Temperature Limits	-40 to +130° F (-40 to +54° C)
Process Gas	Up to 750° F (400 ° C),
Alignment Verification	Built-in through-the-lens system standard
Mounting Flanges	3 inch IPS, 150# flange, standard
Ambient Light Immunity	Solid-state electronic light modulation
Wiring	2 pair twisted shielded cable, 22 AWG

Design and performance:	
Peak and Mean Spectral Response	Photopic; 515 to 585 nm, less than 10% of peak response outside the desired 400 to 700 nm region.
Angle of View	< 4.0 ° from optical axis
Angle of Projection	< 4.0 ° from optical axis
Calibration Error	< +2% of full scale
Response time	< 10 second
Zero Drift	< 1% (24 hours)
Calibration Drift	< 1% (24 hours)
Operational Period	6 Month

Severe Weather Cover with dual blowers:	
Material	308 Stainless Steel
Quick release pins	2 for bottom and 2 for top release.
Mounting	3 inch IPS, 150# flange. Others available.
Standard Blower	Single phase, 110/220VAC 50/60Hz
Max stack pressure	+/- 5 inch WC, with the proper installation of purge blowers.
Wind Speed	< 60 mph
Ambient temperature limits	-40°F to 130°F (-4°C to 54°C)
Protection for	Transceiver and Retro-reflector components; purge blowers.

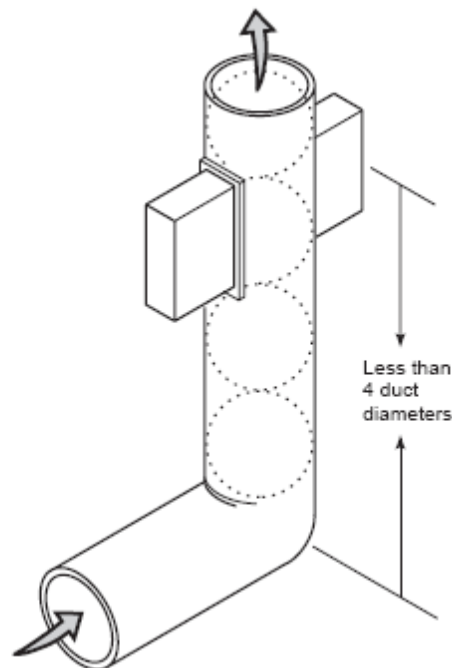
Section 2 Installation Considerations

Regulatory/Process Considerations

The EPA has established the following guidelines for choosing an opacity/dust density monitor installation site:

- 1) Locate the transmitter across a section of a duct or stack that will provide a particulate matter flow through the path of the transmitter beam representative of the duct or stack flow.
- 2) Ensure the transmitter location is down-stream from all particulate control equipment.
- 3) Locate the transmitter as far from bends and obstructions as practical.
- 4) If a transmitter is to be located less than 4 duct diameters downstream from a bend, install the transmitter in the plane defined by the bend, as shown in the figure below.
- 5) Ideally, locate the transmitter eight to ten stack diameters upstream from the stack exit and three to five diameters downstream from any bends, junctions, or other constrictions in the stack or duct.

For best results, mount the transceiver and retro reflector modules so the light beam is exactly perpendicular to the stack or duct and the beam goes through the center. Do not install the transmitter downstream of a wet scrubber. The water droplets introduced to the gas stream by such equipment will interfere with the opacity readings. For an accurate measurement under these conditions, choose a location upstream from a wet scrubber or a location downstream from the scrubber where the water droplets are vaporized by the reheating of the gas. The stack exit correlation is especially important to verify. If possible all dimensions should be verified by actual measurements. Measure and record inside stack dimensions at the measuring point and at the stack exit, and compute the Optical Path Length Ratio (O.P.L.R.). Check that the calculated and the O.P.L.R. found in the Factory OPLR Check step found further in this section are within $\pm 2\%$.



Stack Exit Correlation Computations

NOTE: The stack exit correlation is especially important to verify. If possible, all dimensions should be verified by actual measurements. Using the instructions below verify that the values are correct as displayed in the about page.

Lx/Lt is the ratio of the inside diameter at the top of the stack to the inside diameter of the stack where the instrument is located. If the ratio is greater than 1.0, the exit opacity will be greater than the opacity at the instrument location. The OPM3000 uses this correction factor to calculate the stack exit opacity. It is not practical to have an Lx/Lt factor much greater than 2.0 because the error of the instrument increases as Lx/Lt becomes greater.

Lx = inside stack diameter at stack exit.

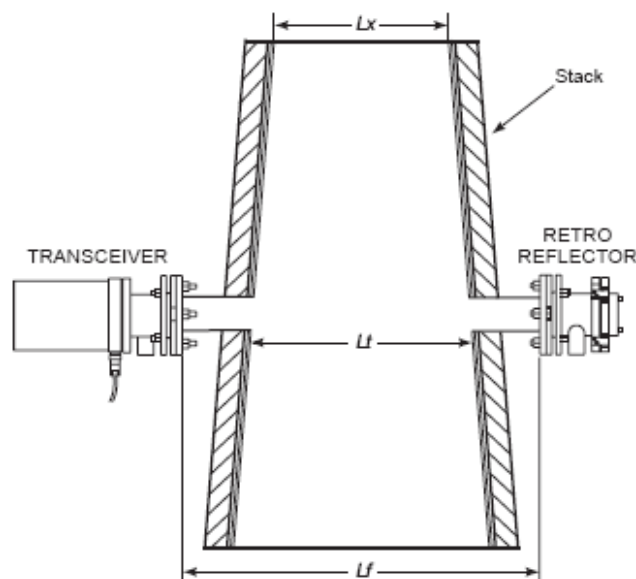
Lt = inside stack diameter at the transmitter location.

Lf = flange to flange distance between the transceiver and retro reflector unit.

- 1) Measure and record Lx and Lt and compute the Optical Path Length Ratio (OPLR).
- 2) Check that the calculated value and the OPLR found in the 2nd about page are within $\pm 2\%$.
- 3) Example: A stack with a 120 in. (3048 mm) stack exit ID and a 120 in. (3048 m) path length.
- 4) Enter the exit diameter (Lx) and measured diameter (Lt) in the control unit. Refer to Section 3 for entering the values in the control unit.

$$OPLR = \frac{Lx}{2 * Lt}$$

$$OPLR = \frac{120}{2 * 120} = 0.50$$



Choose an installation site

The primary considerations for choosing a site for the OPM3000 are accessibility, ambient environmental conditions, and locating the unit to obtain a representative sample of the process. Review the excerpt from the *Federal Register* in appendix for suggestions before selecting an installation site. The following general guidelines should also be considered.

Sensors height from Platforms, walk way/ decks, etc, A platform or walkway must be available for access to the weather covers. The optimum condition would have the mounting flanges and weather covers approximately 5 feet up from the floor. Railings and other obstructions should allow the weather cover to swing clear as shown in the installation drawings.

Locate the stack-mounted units in an area with ambient temperatures between -4° to $+130^{\circ}$ F. (Consult the factory for other temperature ranges.) Areas that are clean and dry are desirable. Avoid areas with condensation.

Maintenance intervals are directly related to the installation environment. Intervals can vary from 2 to 3 months in fairly clean environments, to twice a month in dirty environments. Lens cleaning is a function of the ambient conditions and cleanliness of the purge air.

Locate the instrument to avoid excessive vibration or shock.

Locate the control unit in an easily accessible area with temperatures between $+32^{\circ}$ to 122° F. To permit the operator to read and/or change controls, the unit should not be mounted higher than five feet from floor level.



Stack exit, Locate the transceiver more than two stack diameters down from the stack exit is recommended.

Installation – Mechanical

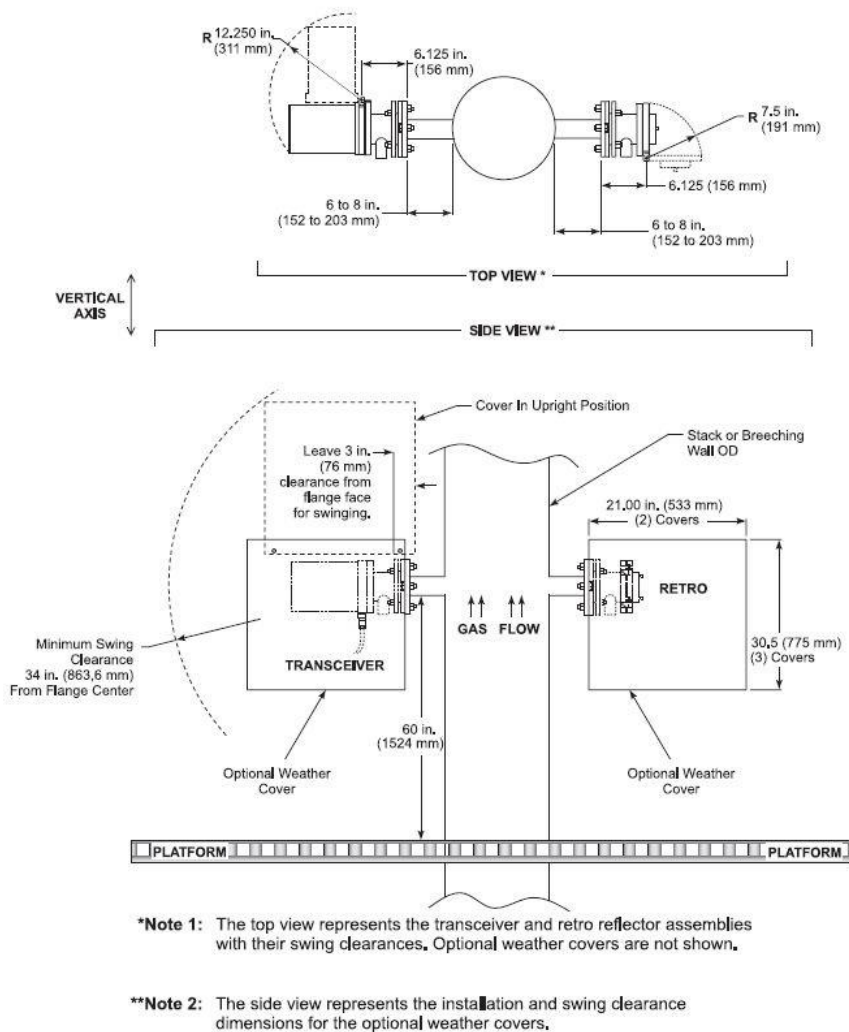
A review of the drawings and procedures provided will help to produce an error free installation. However, there are important additional points that must be observed. The beam of the instrument must be kept in the horizontal plane; the transceiver cannot be rotated more than $\pm 10^\circ$ from vertical. The weather covers must be installed vertically plumb.

Installation and wiring diagrams are found at the end of this manual. Please review all drawings prior to starting installation or wiring. If you have any questions please contact our Customer Support Center (CSC) Phone: 1-800-433-6076 or 1-440-914-1261

E-mail: GAS.CSC@emerson.com

Installation procedure - stack flanges

For an opacity monitor, the customer is required to supply and install two 3" I.P.S. flanges at eye level directly across from each other. The flange faces, mounted on pipe stubs, should be approximately 6" to 8" from the stack or insulation. On completion of the installation, the flanges must be aligned so that the total deviation of the light source flange relative to a common centerline, does not exceed $\pm 1^\circ$ and the retro reflector flange does not exceed $\pm 3^\circ$.



Flanges should be mounted approximately 5 feet up from the deck of platforms, roof or walk way.

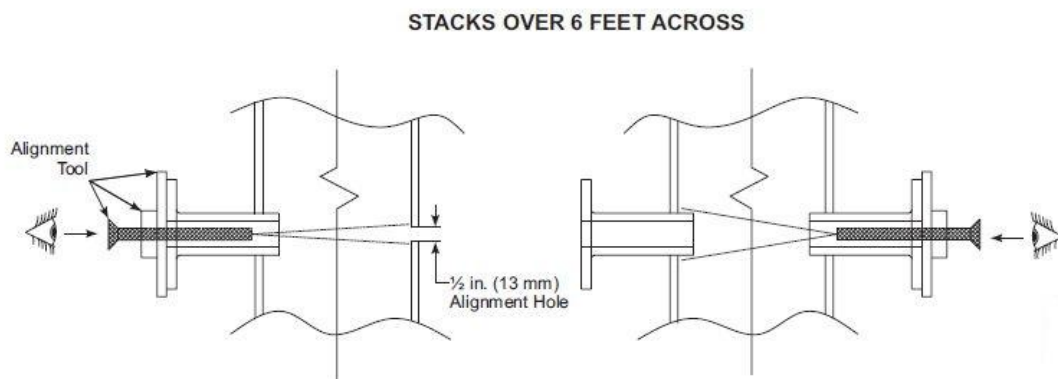
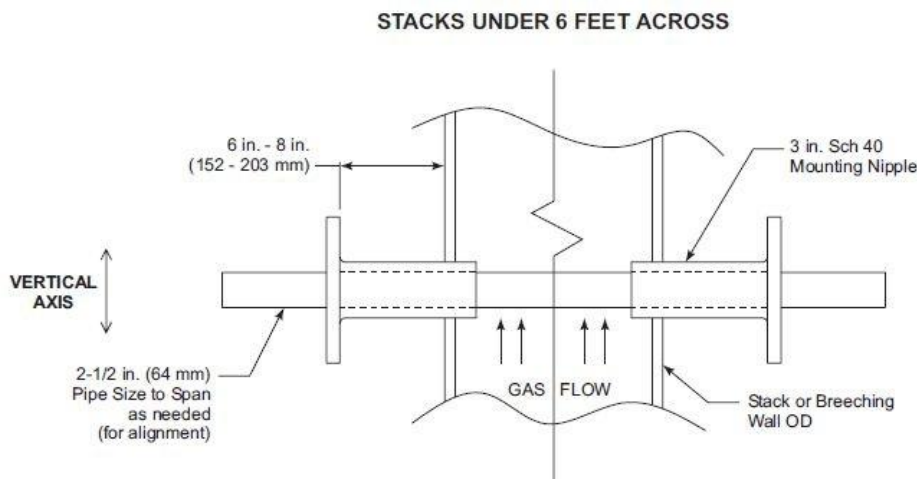
At installations where conditions permit, this may be accomplished by using a piece of 2 1/2" pipe suspended across the stack protruding far enough to allow slipping the 3" flange pipe assemblies over each end and welding in place as shown on the following page.

Any deviation up to the previously specified limits can be adjusted out during the installation and alignment of the light source and retro reflector with the system's alignment adjustments.

Where installations do not permit the use of the aforementioned method, the following procedure will accomplish the same results. An alignment tool can be purchased from the factory to insure accurate alignment.

Accurately locate one 3 1/2" diameter hole (large enough to accept the 3" pipe) and the other hole approximately 1/2" diameter, directly across from each other. Attach the alignment tool to the flange/pipe assembly and insert the pipe into the 3 1/2" hole in the stack wall. Align the assembly with the 1/2" diameter hole on the opposite side by viewing through the alignment tool and weld the pipe in place. Care must be exercised when welding to maintain alignment.

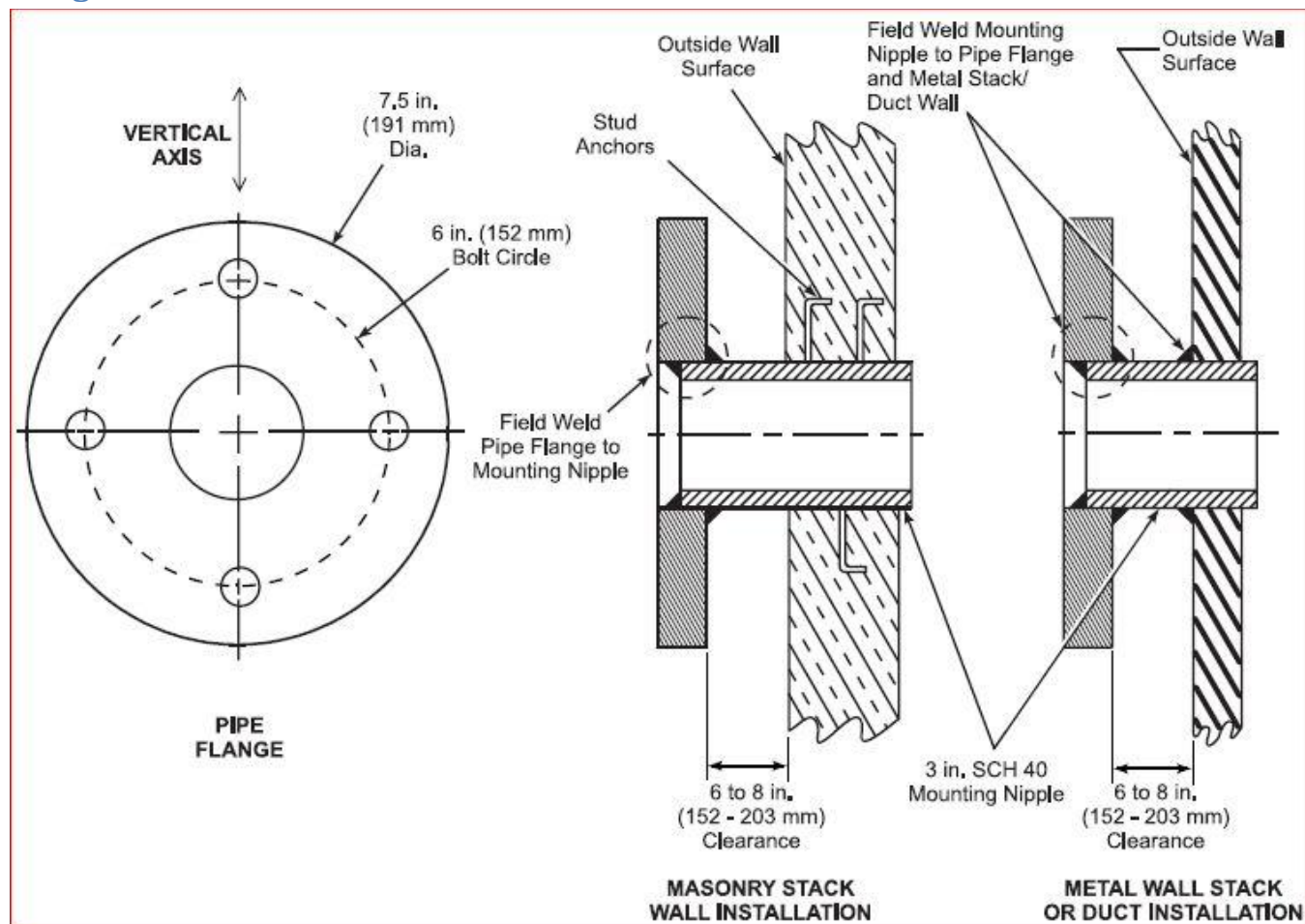
The 1/2" diameter hole should now be enlarged approximately 3 1/2" to accept the other flange/pipe assembly. Proceed in the same manner, installing the assembly with the alignment tool attached, and weld in place maintaining concentric alignment with the 3" pipe previously installed on the opposite wall.



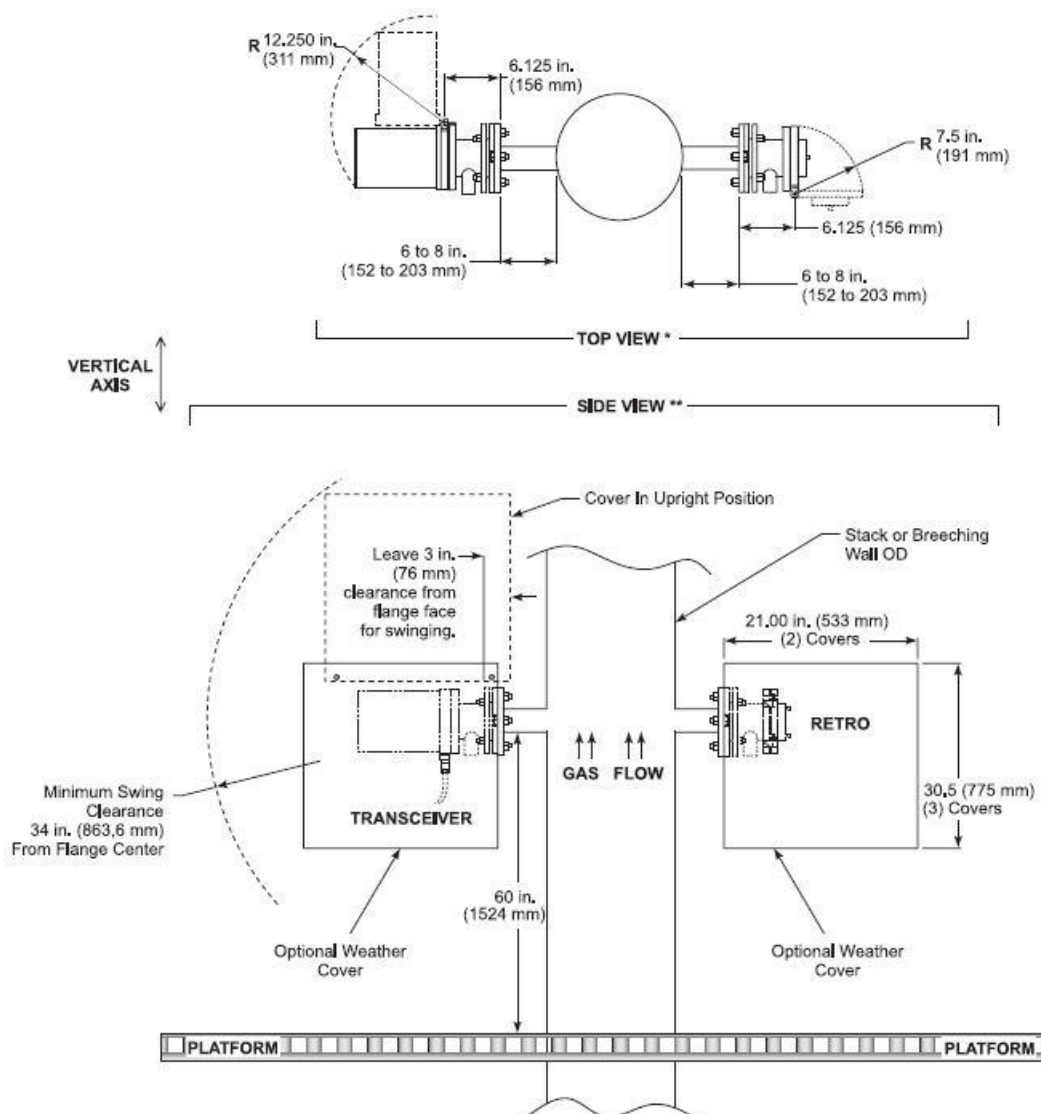
NOTE

If installed path length is not within 10% of the factory set path length, return the unit to the factory so the path length can be reset.

Flange to stack installation



Air purge/Weather cover mechanical Installation



***Note 1:** The top view represents the transceiver and retro reflector assemblies with their swing clearances. Optional weather covers are not shown.

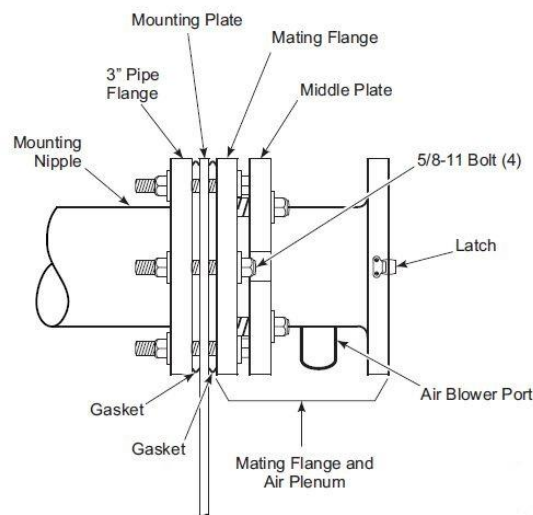
****Note 2:** The side view represents the installation and swing clearance dimensions for the optional weather covers.

Mounting the air plenum and weather covers

WARNING! Control unit, Transceiver & Retro serial numbers must match.

After the installation site has been selected and the platform requirements have been met, the mounting flanges should be installed and aligned as described on the previous pages. Flanges should be installed with the mounting faces on the vertical plane.

- 1) Before installing the Transceiver, Retro reflector or any type of weather cover remove the air plenum from both the Transceiver and retro reflector. Removal will make the installation easier and less chance of damage while mechanical attachment of the air plenums and optional weather covers when provided.
- 2) If the transceiver and retro reflector have been shipped from the factory with the air plenum attached, un-clip both hold down latches, swing open and lift up & off the hinge pins. Place the Transceiver and retro in a safe place.



- 3) The air plenum is attached to the customer supplied 3" pipe flange by four 2 1/2" long 5/8-11 bolts. Working from the 3" flange the correct assembly is; gasket then air plenum.
- 4) If you have weather covers remove the two (2)-weather cover hood hinge pins located on the upper right and left hand corner of the hood. The air plenum and weather cover are attached to the 3" pipe flange by four (4) 2 1/2" long 5/8-11 bolts. Working from the 3" flange the correct assembly is; gasket, weather cover mounting plate, gasket, mating flange & air plenum. Place the 5/8-11 bolt through the top hole of the middle plate. Place a flat washer between the middle plate and mating flange and pass the bolt through. Slip a split lock washer over the bolt and secure with a nut. Repeat for the remaining three mounting bolts.
- 5) Any wiring or air hoses can be connected now.

Transceiver and retro reflector assembly

- 6) Attach the Transceiver and Retro reflector to the air plenum assembly by placing them on the hinge pins.
- 7) Close transceiver & retro and secure in place with the two hold down latches.
- 8) The air-purge blowers should be powered up at this time to prevent stack particulate from accumulating in the nipple and air-purge housing.

Caution: If installed location has a positive pressure the air-purge system must be used continuously during installation to prevent process gases from contaminating optical surfaces or over heating instrument electronics. If the system is shut off for more than momentary interruptions, the instrument may be damaged. Failure to provide continuous air-purge may void the warranty.



All wiring from the control unit to the transceiver should be completed at this time.

NOTE: THE AIR PLENUM ASSEMBLY FOR BOTH TRANSCEIVER AND RETRO MUST BE INSTALLED AS ABOVE, I.E. THE PINS ON THE LEFT SIDE POINTING UP!

Section 3 Control Unit (RCU) Operation Page Description

RCU unit buttons

About page

When power is first applied press ESC to display the Main page.

The left, right, up, down arrows are used to move display arrows or move to other pages.



The ESC button is used to move back from the page you are on to the previous page.



The enter or return button is used when entering variable. Press it and the variable will change from steady to blinking, enter the new value and follow screen tip at the bottom to complete the operation.



The info button is used for setting the PLC functions. This is not used during normal operation. When required the use of the functions will be explained in this manual.



The key pad is used to enter values.



The +/- is used when (–) sign for values are required.




These buttons are not used on this model.



Main page - By pushing UP or the DOWN arrow



you can select the OPM3000 Display, Setup or About pages. Use the return/enter button  to enter the page (screen) you desire.

To get to the About page scroll down to About and press the right arrow button to enter the 1st page of the about page.



Press the down arrow to get to the 2nd page.

Note: Press "ESC" to go back on any page.



Process Opacity



Password protected parameters

Password 1234 - From any screen press ESC until the OPM3000 Display, setup and about screen is visible. Scroll to Setup and press the return/enter button. The password is 1234.




Auto/Manual setup – Press return/enter button to enter. Choose between 1-auto or 2- manual.

Auto means when the high opacity alarm has been activated and when the level of smoke drops below the alarm point the alarm contacts 02 & 04 and icon will reset automatically.


Manual reset means when the high opacity alarm has been activated, pushing the return/enter button 04 contact will de-energize but 02 will remain energized. When the level of smoke drops below the alarm point the return/enter button is pushed and both 02 & 04 will be de-energized.



Alarm set point – Use the return/enter button  to enter the page (screen). Press the return/enter button to set the alarm set point from 0-99% with the key pad. Esc = exit.



Alarm delay – In seconds

Use the return/enter button  to enter the page (screen). Press the return/enter button to set the delay from 0-360 with the key pad. Esc = exit.



Early warning setup – Press return/enter button and set the Early Warning alarm set point to any value below the Alarm set point.

No delay for Early Warning.



Section 4 Modbus

Modbus Setup

MODBUS I.D. – Press return/enter button to enter and key in the node number (1 to 32) desired press Press return/enter button to to set then ESC to exit.



Modbus Poll

To read the register number use the register number plus 40,001.

To read relay use the coil number.

Register type	Register #	Name	Read register	Coil
MI	35	Opacity full value	40036	
MI	65	OPLR	40066	
MB	20	High Alarm 02,04,06 0=off, 1=on		20
MB	22	E.W. Alarm 03,05 0=off, 1=on		22
MB	23	Air flow alarm 07 0=off, 1=on		23

RS/485 Communications and connection

Port 2, 6-pin R J25 connector. Pin 1 (+), Pin 6 (-). RS-485 cabling may be up to 2000 feet in length. Belden P/N 3106A cable is recommended. **Note: Cable drawing and pin out at the end of drawing section.**

If not specified in the original order default is as follows. NOTE: The following communication parameters cannot be changed in the field contact the factory.

Baud Rate 9600

Data Bits 8

Parity None

Flow Ctrl None

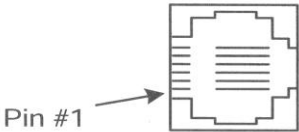
Timeout 0.2 seconds.

RS485: Pin out

Use RS485 to create a multi-drop network containing up to 32 devices.

Note: port #1 is set to RS485

- Note that the ports are not isolated. If controller is used with a non-isolated external device, avoid potential voltage that exceeds +/- 10V. To avoid damaging the system, all non-isolating device ports should relate to the same ground signal.

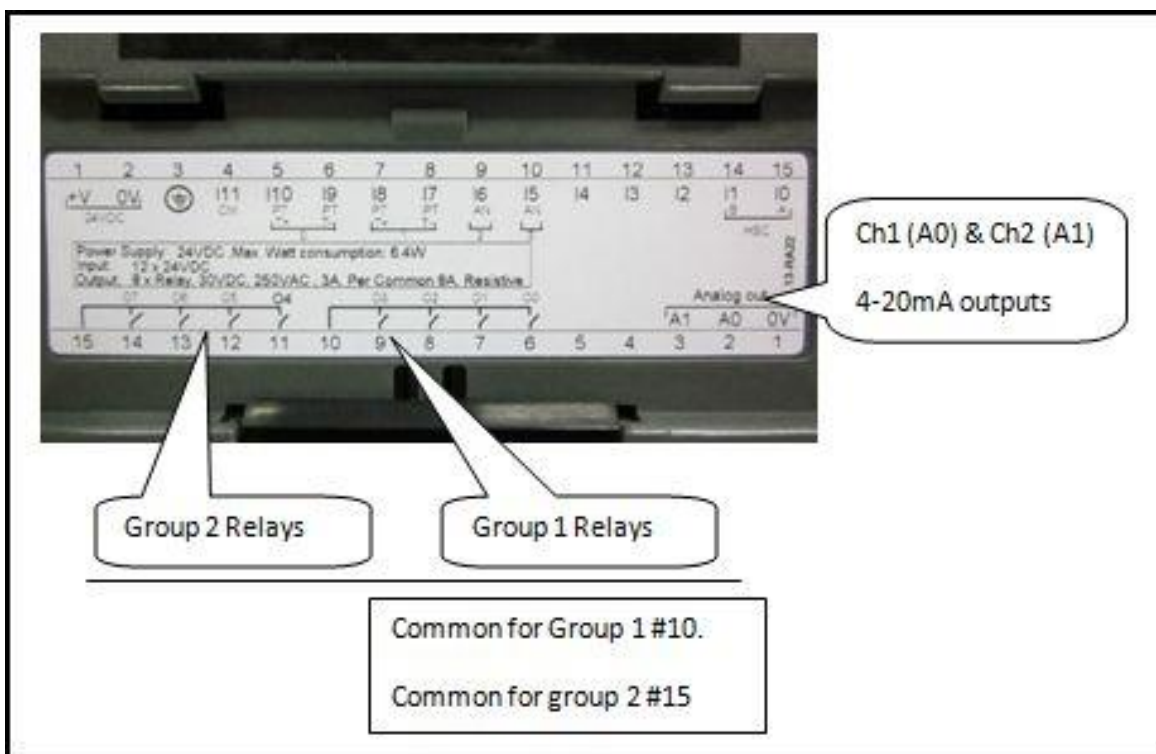
Diagram	Pin Number	Function
	1	A signal (+)
	2	(RS232 signal)
	3	(RS232 signal)
	4	(RS232 signal)
	5	(RS232 signal)
	6	B signal (-)

- Use shielded, twisted pair cables.
- Minimize the stub (drop) length leading from each device to the bus.
- Ideally, the main cable should be run in and out of the network device.
- Do not cross positive (A) and negative (B) signals. Positive terminals must be wired to positive and negative terminals to negative.

Section 5 - Output Connections and F.S. Setup

Channel #1 and 2 Full Scale setup

Multiply desired FS by 10 and enter it. For example; 100% enter 999, for 50% enter 500. (Maximum 500 ohm device load) Connect the (-) minus wire from your device to the bottom connector terminal 0V and the (+) plus wire from your device to the terminal AO for channel 1 and AI for channel 2.



Alarm output Connections

Alarm outputs are SPST relays. There are 2 groups each group has common Relays are rated at: 250Vac/30Vdc, 3Amp max per relay and 8Amp max per common.

Group 1 Relays

High opacity and Boiler shut off alarm – Relay O2 and O4, Set point and delay are chosen in the setup page. Choose Auto or manual mode in the setup page. For O2 and O4 to be utilized as a boiler shut down you must select “Manual” in the alarm set up page.

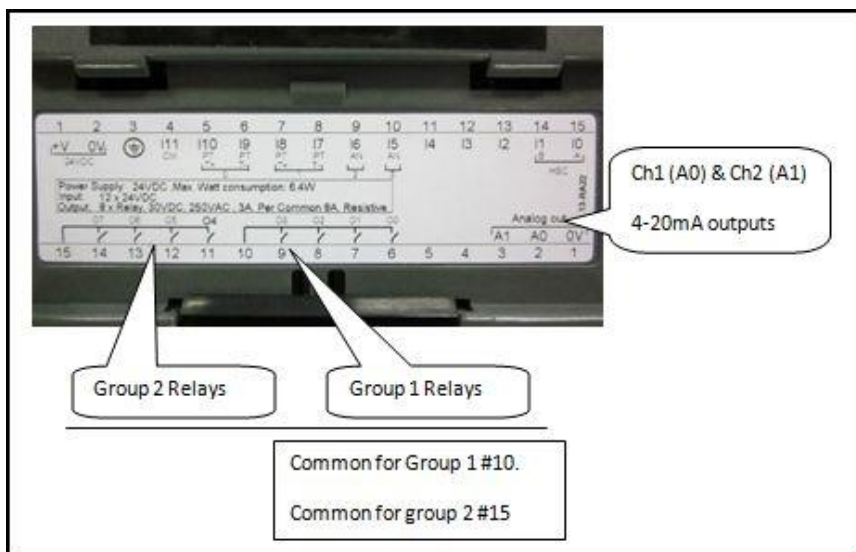
Early warning – Relay O3, Set point is chosen in the setup page.

Group 2 Relays

Early warning – Relay O5, Set point is chosen in the setup page.

High opacity Audible alarm – Relay O6 may be used for audible alarm and can be reset (acknowledged) even if the opacity is still above the set point.

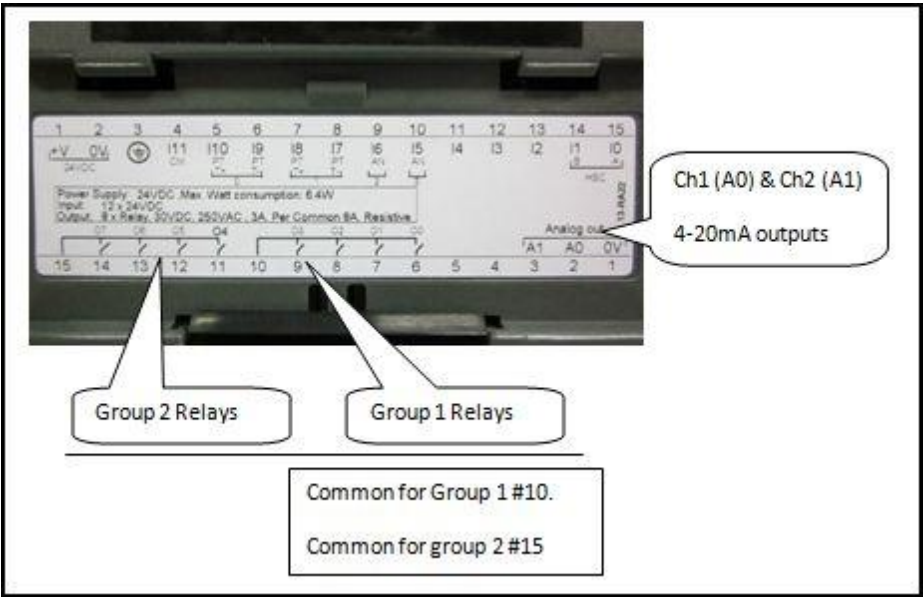
Air purge alarm – Relay O7, When the airflow switch is utilized, remove the jumper supplied with the controller and connect it to the I2 input. With sufficient airflow the relay will be open, if insufficient airflow the relay O7 will energize (contact will close) and the flashing airflow icon will appear on the main display.



Analog outputs 4-20ma

The OPM3000 comes with two 4-20mA output channels. The ranges are set during final test to the information supplied by the customers. Field changes can be made in the set up page. Maximum output Loop compliance is 500 Ohms.

OPM3000 Analog output wiring list	
Bottom Connector	
Common for mA outputs - 0V	<div> 4-20mA Outputs </div>
Positive 4-20mA output CH1 - A0	
Positive 4-20mA output CH2 - A1	



Section 6 – Beam Alignment and Clear path adjustments

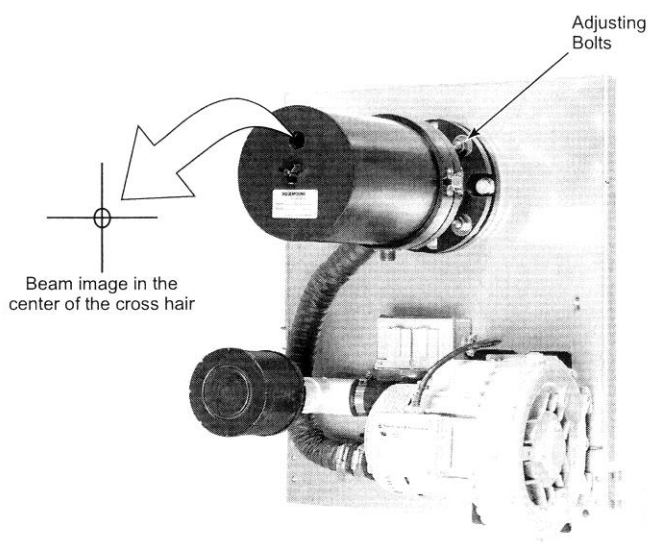
First time adjustment & calibration procedures

Beam alignment procedure

Note: Alignment cannot be done unless the power is applied to the stack mounted transceiver. The control unit does not have to be connected or powered. For alignment accuracy, the stack should be at normal temperature.

Note: Alignment should be completed before instrument calibration.

1. If not already on, turn on the power to transceiver and air purge systems.
2. Align the Reflector mating flange so it is plumb and parallel to the 3" 150# mounting flange. Use the 3 adjusting nuts on the air purge plenum flange until this is accomplished. The adjusting nuts have nylon locking inserts to prevent loosening by vibration.
3. Move to the Transceiver, and determine monitor alignment by looking through the viewing port located on the rear of the transceiver and observing whether the beam image is in the center of the cross hair (bulls-eye). Use the 3 adjusting nuts on the air purge plenum flange until this is accomplished. The adjusting nuts have nylon locking inserts to prevent loosening by vibration.



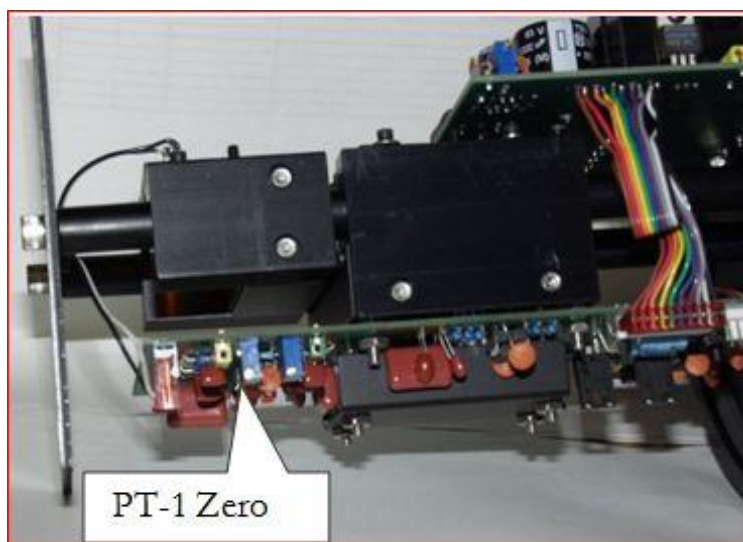
Clear path zero adjustment

The instrument has been calibrated at the factory to specifications received with the order and if the actual dimensions of the flange to flange are exactly as received the calibration adjustments required will be minimal or none at all. The following adjustments are for the first time the instrument is installed. To calibrate or adjust the OPM3000, use the following steps. **NOTE:** Calibration must be performed with the boiler or process shut down to produce a clear stack condition. If a clear conditions is not possible go to “Off stack zero calibration” procedure later in this manual.

Before proceeding clean both transceiver and retro reflector lens.

Remove the transceiver cover (Always disconnect power when removing or replacing the transceiver cover) by removing the screw below the target viewing window and pulling the cover straight back until it clears the Optical plate.

1. Connect an accurate meter to measure the 4-20 mA signal from the transceiver to the control unit at terminal 8 (+) & 9 (-) in the J box, Electrical Installation drawing OPM-6126. The meter should be placed in series with wiring or remove both wires and place the meter across 8 (+) & 9 (-). Note: Allow readings to stabilize before proceeding to the next step. Wait one minute for maximum accuracy.
2. With the cover adjust PT-1 (zero) on the Signal Processor PCB 222-1667 (see drawing) slowly CW several turns until you decrease to about 10mA, then slowly turn the PT-1 CCW until you have 20mA. (Zero % opacity). If the signal is over 20mA it will be negative opacity. In some cases setting the current a small amount less than 20mA like 19.5mA will give a small positive opacity reading.



Clear path span adjustment

1. Install the optional Micro-turn on-line reflector by, swinging open the Transceiver and attach the Micro-turn by placing it on the alignment pins and with the thumbs screw secure it to the transceiver. With the large knurled adjustment knob adjust the Micro-turn to equal the across stack zero condition previously set, 20mA zero % opacity, and then lock it in place. Insert the span filter that came with the kit in the slot provided in the Micro-turn and adjust PT-3 (span) on the Signal Processor PCB 222-1667 until the mA meter reads the calculated mA of the span filter value using the formula:

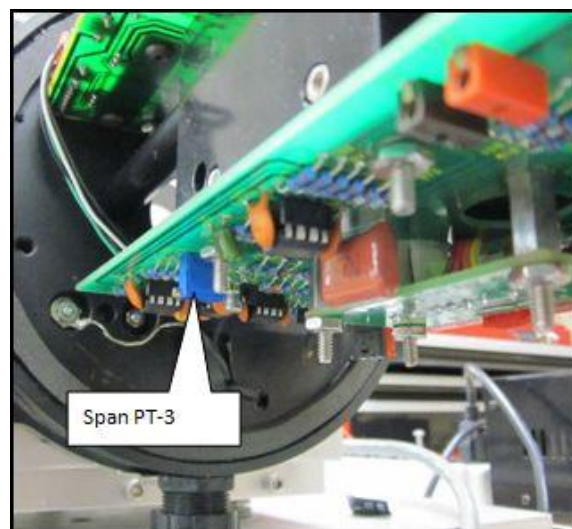
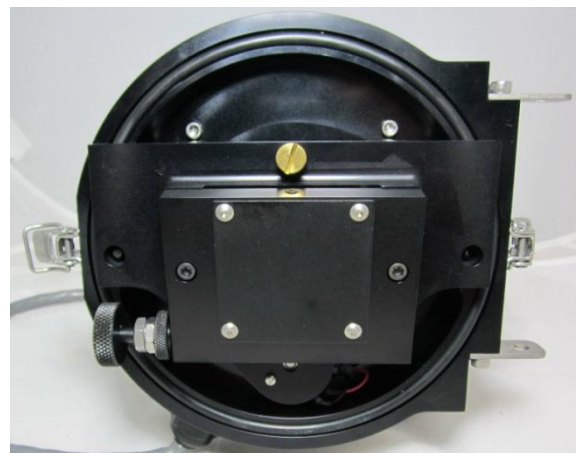
$$[(1 - \%opacity/100) 2 \times 16] + 4 = mA$$

If no Micro-turn is available you can place a black cloth over the transceiver and adjust PT-3 for 4.0ma

Repeat adjustments until they are within +/- .04mA

Remove the on line reflector and place in a safe place. Because the on line reflector was set during initial calibration it can be used to reestablish the instruments across stack zero even if the source is running. . If at any time you need to check the clear across stack zero install the on line reflector.

Calibration is complete. Connect the wires as before and replace the cover. Close the transceiver and clamp it securely in place.



Off stack zero calibration

This procedure may be used if: A clear stack condition is not possible and the zero appears to be incorrect or if the flange to flange distance on site are different than the original factory set up.

1. Remove the transceiver and retro reflector from the hinge pins, remove the service module and install the system on portable off stack test stands and at the correct flange to flange distance plus 11 inches. The additional 11 inches compensates for air plenum spacing, as the air plenums are not used for the off stack zero calibration.
2. Clean transceiver and retro windows.
3. Connect the control unit with the control to service module test cable kit (p/n 1469) and apply power to the system.
4. The retro reflector must be level.
5. Follow instruction for "Clear on stack zero and span calibration".



Section 7 Micro-turn audit kit

Using the on line zero reflector (option)

The "Micro-turn" 200 on - line test and audit system may be used for:

- Opacity audit
- Linearity checks and adjustments
- System accuracy verification
- Service on line or off stack

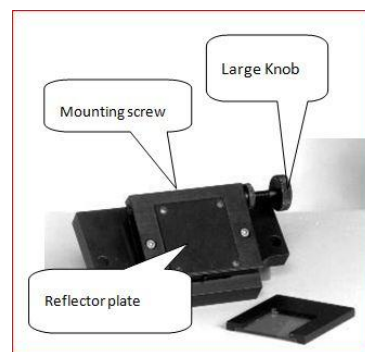


The "Micro-turn" 200 on - line test and audit system 6A00188G07 contains a test reflector, three neutral density filters, filter certification certificates and carrying case. The Micro-turn 200 on-line test reflector is inserted over the transceiver lens.

Procedure

The Micro-turn 200 on-line test reflector is inserted over the transceiver lens. The filters provided are marked in single-pass opacity, this is the same as double-pass with a correlation factor (OPLR) of "0.50" for other correlation factors turn to CHANGING OPLR section for instructions.

1. Hold the Micro-turn in a position so as to see the reflector. Turn the fine adjustment (large knob) in a direction, which will open the iris to expose more of the reflector. This direction will cause the monitor to lower opacity and by turning in the opposite direction, closing the iris, will raise the opacity.
2. Loosen clamps on the transceiver and swing it open and clean the lens, use alcohol with a clean lint free paper and leave no film on the lens.
3. Place the Micro-Turn 200 with the reflector facing toward the Transmissometer (away from the stack) on the two alignment pins and screw the device to the transceiver with the mounting screw.
4. Using the fine adjustment (large knob) start by raising the opacity level above zero, and then slowly turn the knob in the opposite direction to just reach "ZERO". If you cannot reach zero or you cannot come above zero see "course" adjustment section of this manual.
5. Place the Neutral Density Slides in the slot provided on the top of the device just behind the mounting screw. The system should read the same value written on the label +/- 2% or better.



Course adjustments

1. *Opacity is below zero* and you cannot reach zero after you have turned the adjustment knob as far as it will go into the Micro-turn housing perform the following procedure:
2. Hold the Micro-turn in your hand so you can see the iris and retro reflector. Turn the fine adjustment knob so that the iris is closed as far as it will go. CAUTION: do not force the knob at the first sign of binding STOP.
3. Next loosen the course adjustment set screw.
4. Turn the fine adjustment knob in the opposite direction as far as it will go than tighten Allen set screw located on the bottom of the COM block. Be sure not to tighten more than 1/16 of a turn to prevent damage to the iris ring.
5. After the setscrew is tight again try to reach zero, repeat if necessary.
6. *Opacity is above zero* and you cannot bring it up after you have turned the adjustment knob as far as it will go into the Micro-turn housing perform the following procedure:
7. Hold the Micro-turn in your hand so you can see the iris and retro reflector. Turn the adjustment knob so that the iris is open as far as it will go. CAUTION: do not force the knob at the first sign of binding STOP.
8. Next loosen the course adjustment set screw.
9. Turn the fine adjustment knob in the opposite direction as far as it will go than tighten Allen set screw located on the bottom of the COM block. Be sure not to tighten more than 1/16 of a turn to prevent damage to the iris ring.
10. After the setscrew is tight again try to reach zero, repeat if necessary.
11. You have tried above and you cannot reach zero or zero is unstable, contact the factory for assistance.

Filter correction formula

If you have an OPLR (correlation factor) other than 0.5 your slides will read differently. To calculate what the slide will read with another OPLR use the formula:

$$\left(1 - \left(1 - \frac{Op1}{100} \right)^{\frac{M2}{0.5}} \right) * 100 = OP2$$

Where:

OP1 = Standard filter Value in %

M2 = OPLR for your instrument

OP2 = Standard Filter value at your OPLR in %

Example:

Standard filter value is 23.1% what will it read at OPLR of 1.5?

$$\left(1 - \left(1 - \frac{23.1}{100} \right)^{\frac{1.5}{0.5}} \right) * 100 = 54.5\%$$

Neutral Density Filter certification and standard values

Filter certification is available from Emerson Process Management. Filters are tested per USA Code of Federal Regulations 40CFR60 Appx. B, Performance Specification 1, Section 7.1.3 Attenuation Calibration.

QA/QC testing by Emerson Process Management of the filters at an interval of not more than 6 months is recommended. Filter certification, replacement, or additional neutral density filters are available from Emerson Process Management.

Emerson's Rosemount Analytical neutral density filters for the zero jig are calibrated on a Perkin-Elmer Lambda Series 6 / PECSS Spectrophotometer per Federal Environmental Protection Agency specifications. These specifications are contained in the Code of Federal Regulations 40 CFR 60, Appendix B, Performance Specification 1, Attenuator Calibration. The filters are scanned over the visible region from 380 to 780 nanometers in one nanometer steps and the resulting transmittances of the filter are weighted to the Source C Human Eye Response by multiplying each value by its associated response factor. The corrected values of transmittance are converted to % Opacity and the value is recorded on the filter and associated chart.

Density (O.D.)	% Opacity
0.02	Special contact the factory for details, 3-5%
0.04	8.8
0.1	20.57
0.2	36.9
0.3	49.88
0.4	60.19
0.5	68.38
0.6	74.88
0.7	80.05
0.8	84.15
0.9	87.41

Section 8 - Preventive/corrective maintenance/spare parts

Preventive/corrective maintenance schedule

<u>ITEM TO CHECK</u>	<u>FREQUENCY</u>	<u>PROCEDURE</u>
Projection lens and Reflector	As required	Clean with optical cloth and lens cleaning fluid
Beam alignment	As required	Check and adjust as necessary
Linearity check	3 months	Adjust as necessary
Air filters	3 months	Clean or replace as necessary
Air hoses	3 months	Replace as necessary
Hose clamps	3 months	Inspect and tighten
Mounting hardware	3 months	Check bolts for tightness
Weather cover	3 months	Clean as required
Cables and connectors	6 months	Check, clean, replace as necessary.
Flange	6 months	Push build-up into stack to clear flange
Clear stack or off stack zero	Yearly	Calibrate if necessary
Transceiver & Retro	3-5 years (site dependent)	Return to the factory for internal optical alignment and cleaning.

Trouble Shooting

Problem	Possible Cause	Remedy
Control unit reads high opacity	1- Smoke 2- Alignment is out 3- Transceiver and/or retro window is dirty	1- Correct process 2- Adjust alignment until centered on target. 3- Clean windows.
Control unit reads 100%	Transceiver current loop to the control unit is open	Check wiring for open from Terminal 0V & I6 on control unit to wire 9 & 8 at J-box location.
Alignment is good but control unit reads high opacity.	1- Reference voltage TP-2 on signal processor 1667 is lower than 9.3V 2- Main lamp out	1- Adjust lamp drive PT-2 on the power modulator 1668 until Reference voltage TP-2 on signal processor 1667 is 10.0 Volts +/- .3v. 2- Replace main lamp assembly
Control unit reads High, lens clean, alignment is good.	Dirt built up in flanges	Swing open transceiver & Retro. Clean flanges with push rod.

Spare parts

Contact an Emerson Process Management sales department with the system serial number of your system and they will make recommendations based on your OPM3000 LED source system.

For assistance with problems, please call the Customer Support Center (CSC). The CSC is staffed 24 hours a day, 7 days a week.

Phone: 1-800-433-6076 1-440-914-1261

In addition to CSC, you may also contact Field Watch. Field Watch coordinates Emerson Process Management's field service throughout the U.S. and abroad.

Phone: 1-800-654-RMST (1-800-654-7768)

Emerson Process Management may also be reached via the Internet through e-mail and World Wide Web:

e-mail: GAS.CSC@emerson.com

World Wide Web: www.raihome.com

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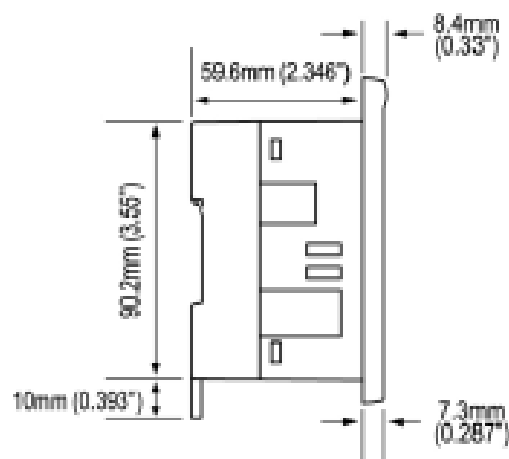
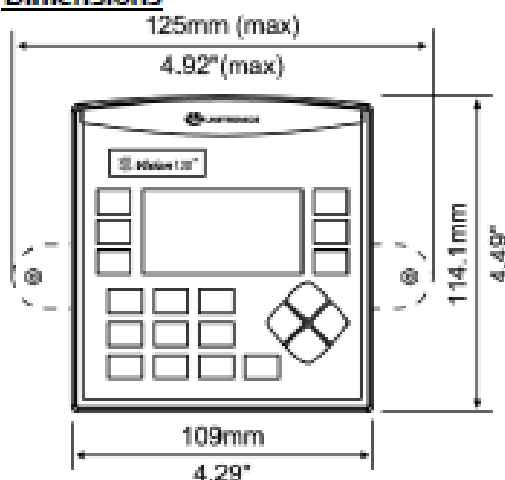
<http://www.raihome.com>


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Section 9 - Drawings

Mounting

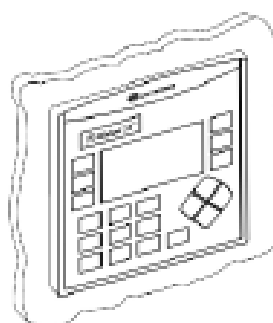
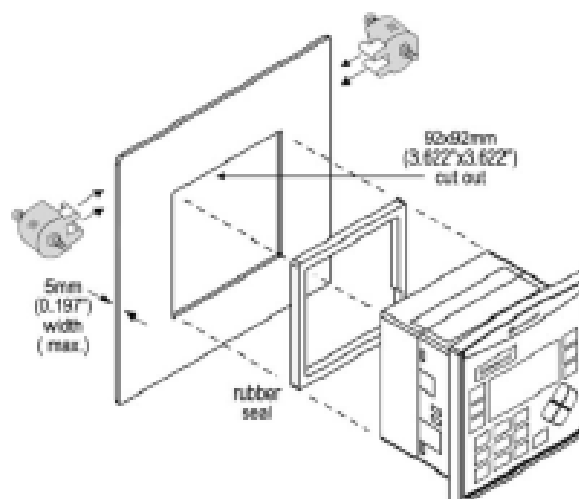
Dimensions



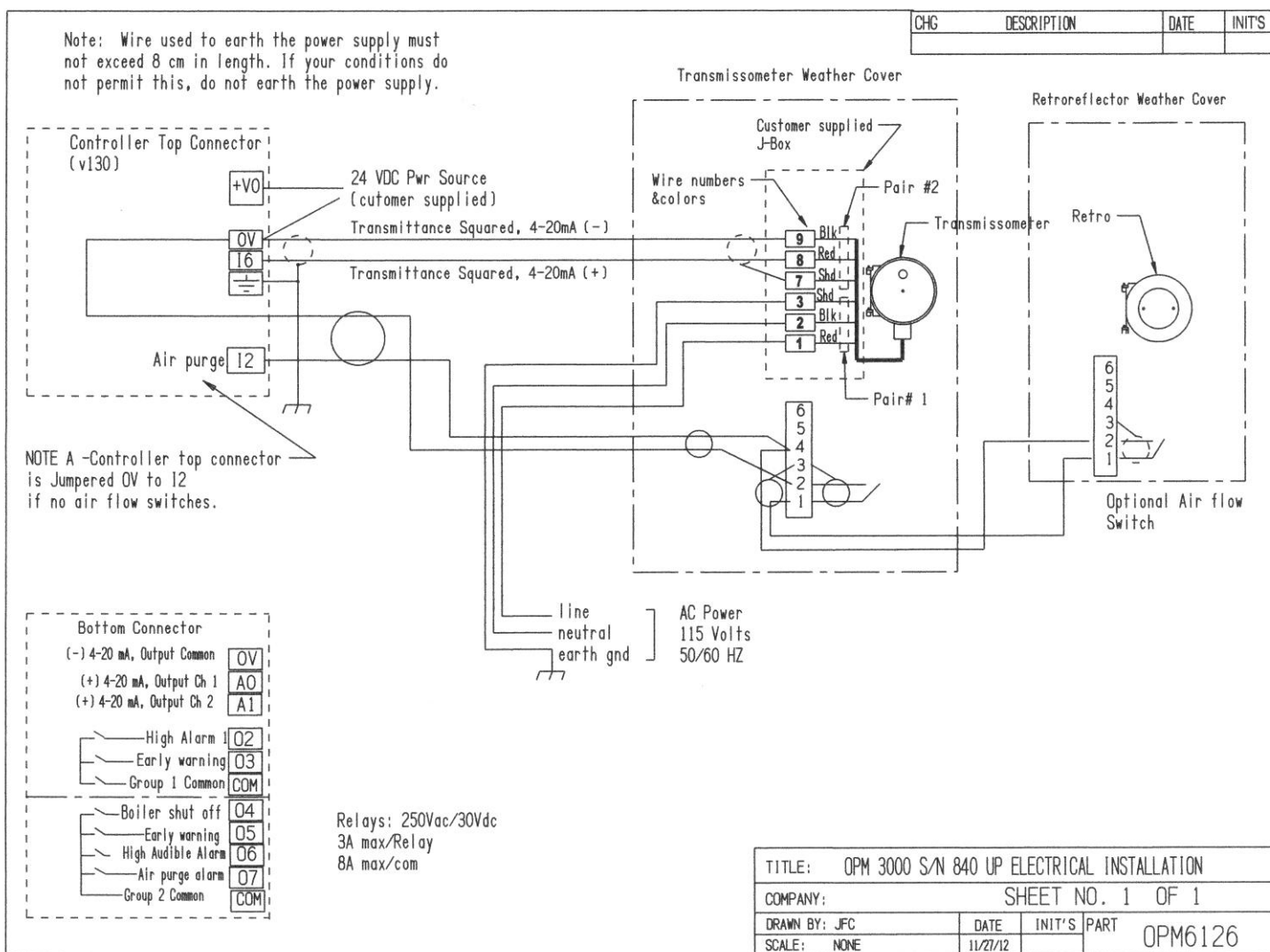
Panel Mounting

Before you begin, note that the mounting panel cannot be more than 5 mm thick.

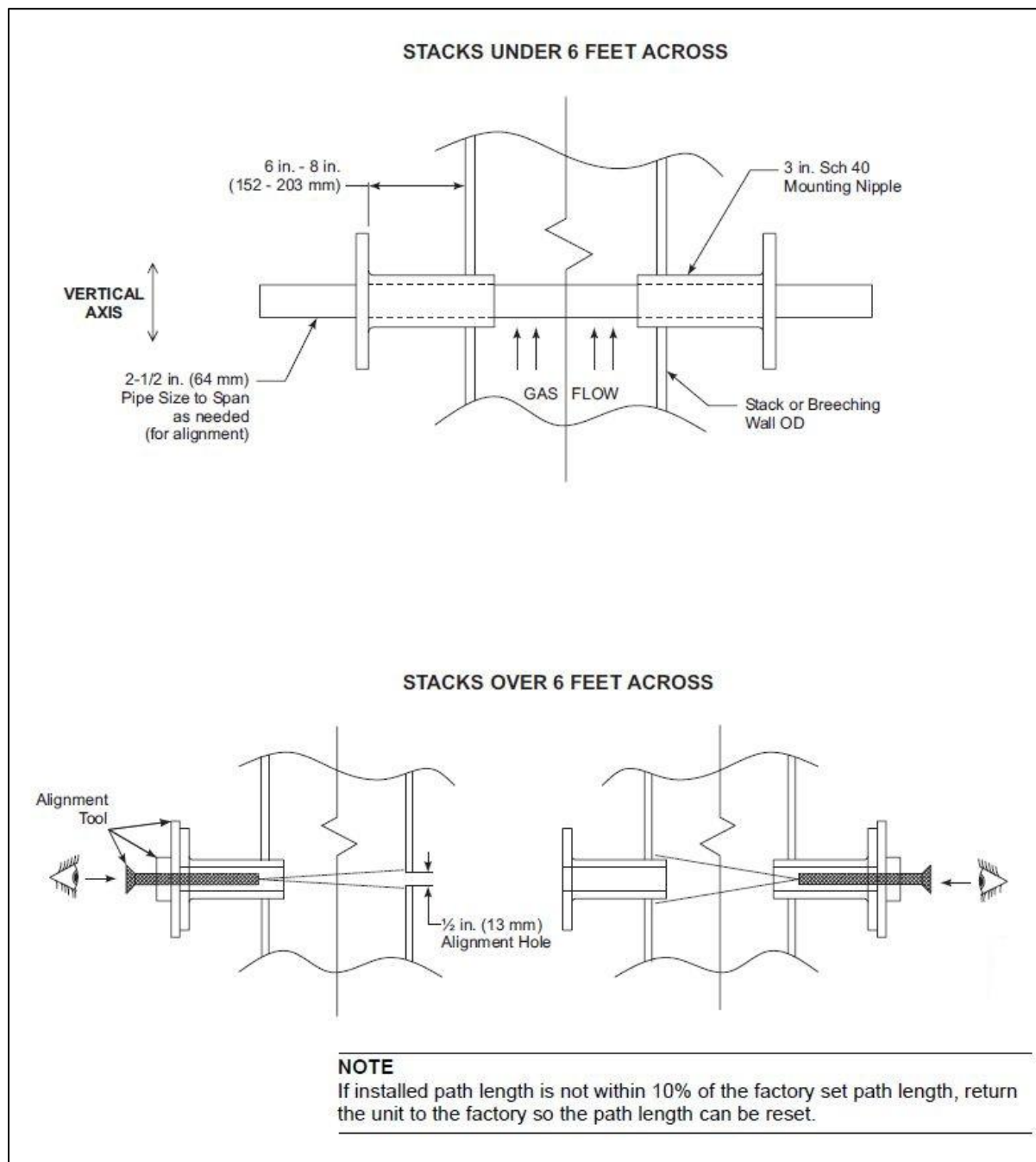
1. Make a panel cut-out measuring 92x92 mm (3.622"x3.622").
2. Slide the controller into the cut-out, ensuring that the rubber seal is in place.
3. Push the 2 mounting brackets into their slots on the sides of the controller as shown in the figure to the right.
4. Tighten the bracket screws against the panel. Hold the bracket securely against the unit while tightening the screw.
5. When properly mounted, the controller is squarely situated in the panel cut-out as shown in the figure to the right.



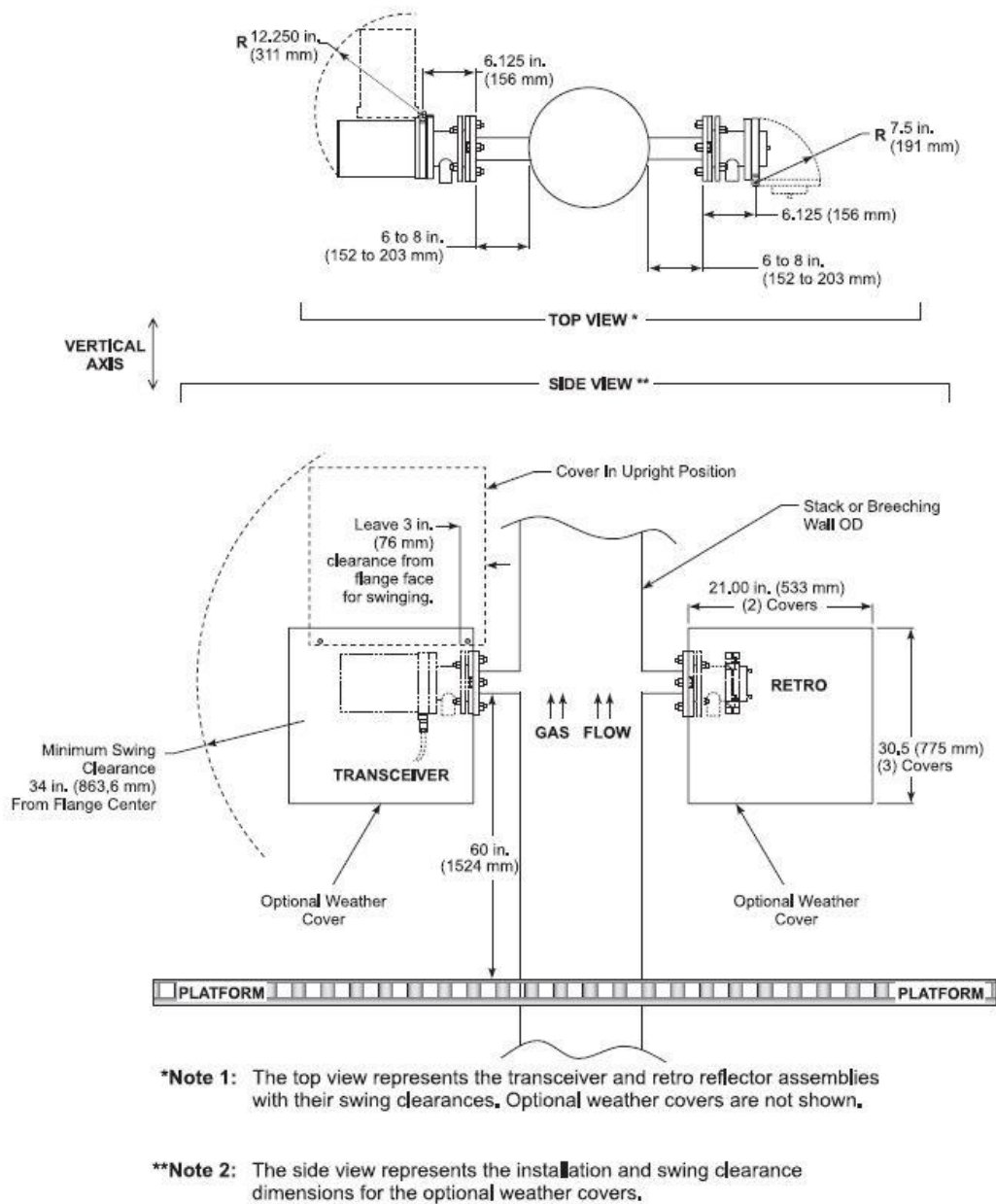
Electrical wiring OPM6126



Mounting stack flanges 38440018



Sensor mounting with or without weather covers 38440021

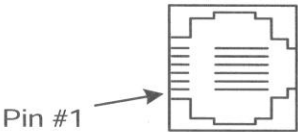


RS485: Pin out

Use RS485 to create a multi-drop network containing up to 32 devices.

Note: port #1 is set to RS485

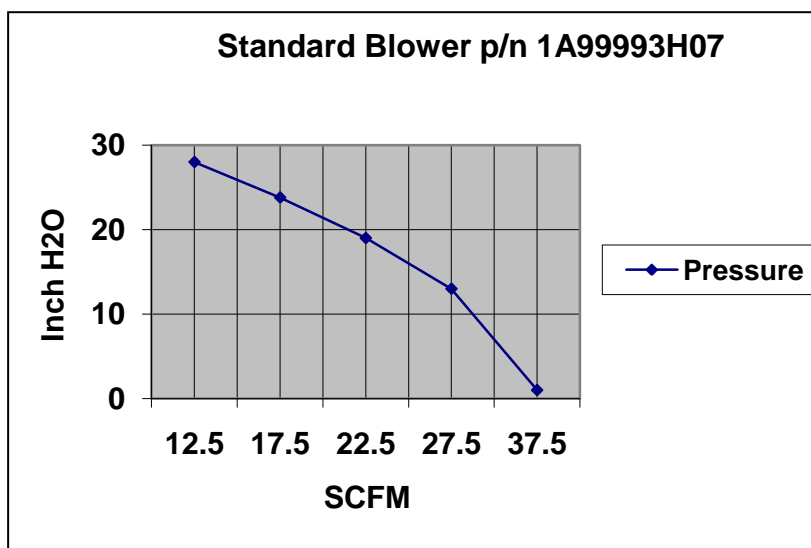
- Note that the ports are not isolated. If controller is used with a non-isolated external device, avoid potential voltage that exceeds +/- 10V. To avoid damaging the system, all non-isolating device ports should relate to the same ground signal.

Diagram	Pin Number	Function
	1	A signal (+)
	2	(RS232 signal)
	3	(RS232 signal)
	4	(RS232 signal)
	5	(RS232 signal)
	6	B signal (-)

- Use shielded, twisted pair cables.
- Minimize the stub (drop) length leading from each device to the bus.
- Ideally, the main cable should be run in and out of the network device.
- Do not cross positive (A) and negative (B) signals. Positive terminals must be wired to positive and negative terminals to negative.

Purge blower electrical and pressure information

Single Phase	110VAC 50/60Hz	220VAC 50/60Hz
Run Amps	3.4	1.7
H.P.	0.25	0.25



Appendix A

Appendix B to Part 60—Performance Specifications

(2) You must install the opacity monitor at a location where the opacity measurements are representative of the total emissions from the affected facility. You must meet this requirement by choosing a measurement location and a light beam path as follows:

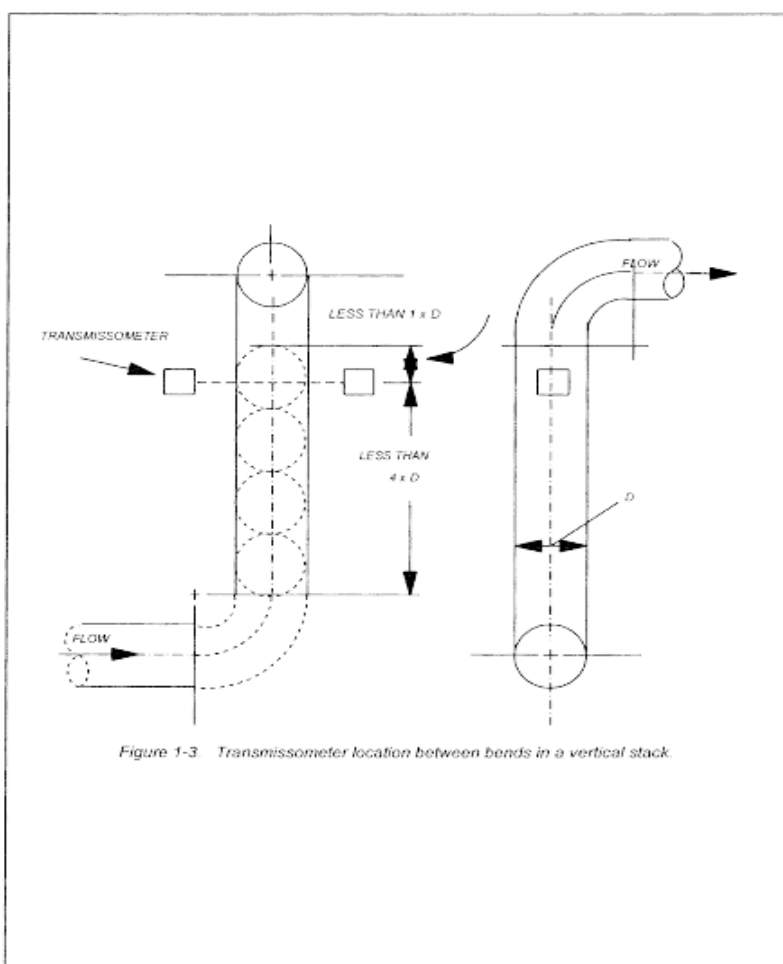
(i) *Measurement Location.* Select a measurement location that is (1) at least 4 duct diameters downstream from all particulate control equipment or flow disturbance, (2) at least 2 duct diameters upstream of a flow disturbance, (3) where condensed water vapor is not present, and (4) accessible in order to permit maintenance.

(ii) *Light Beam Path.* Select a light beam path that passes through the centroidal area of the stack or duct. Also, you must follow these additional requirements or modifications for these measurement locations:

If your measurement location is in a:	And is:	Then use a light beam path that is:
1. Straight vertical section of stack or duct	Less than 4 equivalent diameters downstream from a bend	In the plane defined by the upstream bend (see figure 1–1).
2. Straight vertical section of stack or duct	Less than 4 equivalent diameters upstream from a bend	In the plane defined by the downstream bend (see figure 1–2).
3. Straight vertical section of stack or duct	Less than 4 equivalent diameters downstream and is also less than 1 diameter upstream from a bend	In the plane defined by the upstream bend (see figure 1–3).
4. Horizontal section of stack or duct	At least 4 equivalent diameters downstream from a vertical bend	In the horizontal plane that is between 1/3 and 1/2 the distance up the vertical axis from the bottom of the duct (see figure 1–4).
5. Horizontal section of duct	Less than 4 equivalent diameters downstream from	In the horizontal plane that is between 1/2 and 2/3 the distance up the vertical axis from the bottom of the duct for upward flow in the vertical section, and is between 1/3 and

	a vertical bend	1/2 the distance up the vertical axis from the bottom of the duct for downward flow (figure 1–5).
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(iii) *Alternative Locations and Light Beam Paths.* You may select locations and light beam paths, other than those cited above, if you demonstrate, to the satisfaction of the Administrator or delegated agent, that the average opacity measured at the alternative location or path is equivalent to the opacity as measured at a location meeting the criteria of sections 8.1(2)(i) and 8.1(2)(ii). The opacity at the alternative location is considered equivalent if (1) the average opacity value measured at the alternative location is within ± 10 percent of the average opacity value measured at the location meeting the installation criteria, and (2) the difference between any two average opacity values is less than 2 percent opacity (absolute). You use the following procedure to conduct this demonstration: simultaneously measure the opacities at the two locations or paths for a minimum period of time (e.g., 180-minutes) covering the range of normal operating conditions and compare the results. The opacities of the two locations or paths may be measured at different times, but must represent the same process operating conditions. You may use alternative procedures for determining acceptable locations if those procedures are approved by the Administrator.



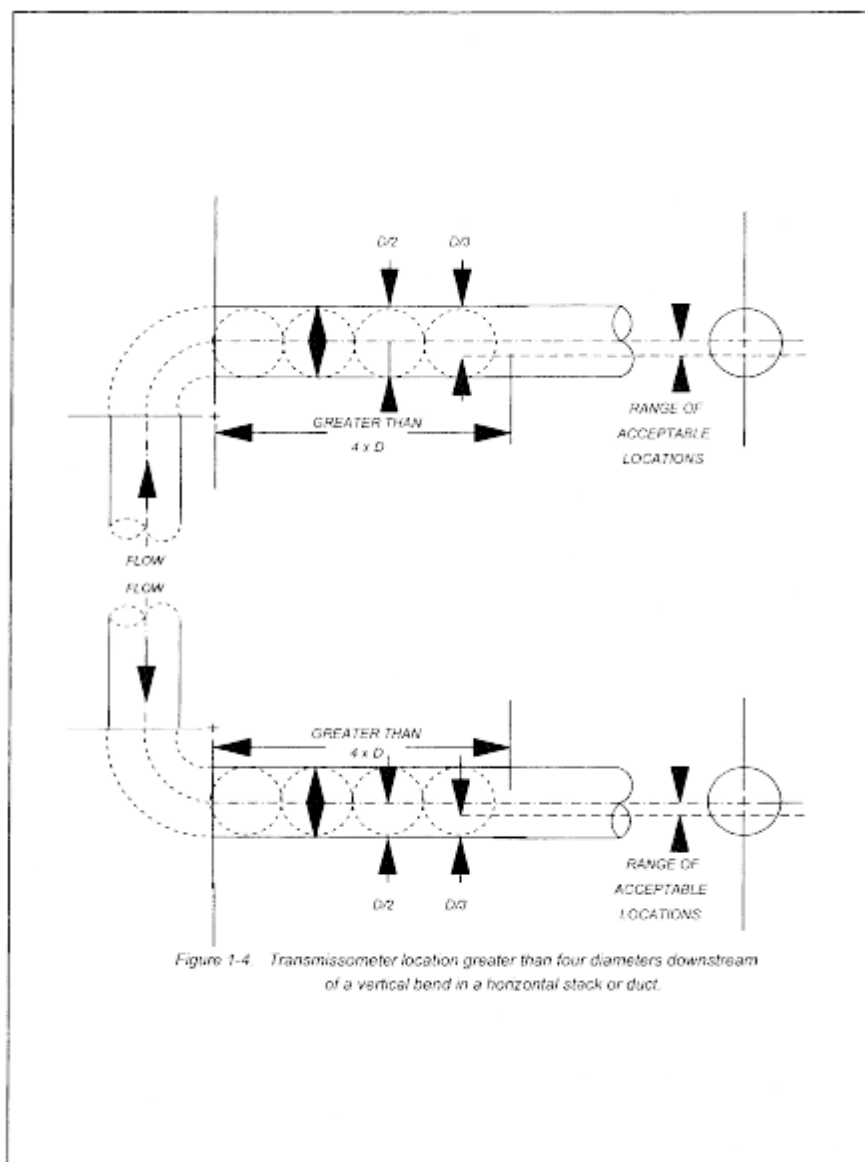


Figure 1-4 Transmissometer location greater than four diameters downstream of a vertical bend in a horizontal stack or duct.

