tyco / Flow Control / Environmental Systems

USER MANUAL v1.5

EMP5, EMP5N, BBD5 Emission Monitor

Safety

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Appendix D

Document Ems5Um15, Issued 30 October 2000. Reference Products: AUD1 Author: A M Roe.

SAFETY

Electrical

These products can operate from AC mains power supplies, and the included output relays can switch dangerous voltages. To minimise the risk of injury or damage to equipment, wiring should be carried out only by competent, qualified personnel. Do not open case unless the proper isolations have been performed.

Process

These products may be connected to plant which operates at high temperatures or pressures, or with harmful materials. Before any installation or maintenance work is carried out, please ensure that the proper isolations have been performed.

INTRODUCTION

This manual contains information relevant to the installation, commissioning and operation of Triboelectric Emission Monitors EMP5N, EMP5 and BBD5. Those and all associated products and this manual are subject to continuous development, and it is acknowledged that the manual may contain errors and/or omissions. For the most up-to-date information, including applications information, the user should always refer to the supplier, or to the latest issue of CONNECT, whose HELP system will also include this Manual.

General Description

These Triboelectric Emission Monitors are designed to detect and report solid particulate matter in motion, and consist of:

- a rectangular control unit,
- a separate cylindrical active head and
- a probe (a sensing rod, wire or other element screwed to the active head).

When the active head is mounted through the side of a duct carrying moving particles, the probe is exposed to the particles. The particles are usually suspended in a gas stream which is exhausted to atmosphere, but the particles may alternatively be conveyed by other means, even gravity-fed. The products differ as follows:

- BBD5 includes manual range selection, delayed alarm relay and LED bargraph indication.
- EMP5 adds fine gain control, 0-10V output and 4-20mA output.
- EMP5N adds AUD1 for numeric display, averaging, isokinetic calibration, alarms and networking.

SPECIFICATIONS

Certifications

Certifications	Directives 89/336/EEC, 93/68/EEC
Standards	EN55011, EN50082, IEC1000-4, IEC1010, AS/NZS 2064.1/2, IEC 1010-1:1990 (1:1992 & 2:1995)
CE	This symbol indicates compliance with the EMC directive and the Low Voltage directive (LVD).
C-tick	This symbol indicates compliance with Australian / New Zealand C-tick EMC standards for emission.

Operational Limits

Ambient Temperature	-20C to 60C (for electronics).
Vibration	1G (10m/s2) RMS max continuous, any direction, any frequency (with standard wire rope probe).
Environment	IP66/NEMA4, non-corrosive. Active head: Powder-coated Aluminium alloy body, stainless steel boss and coat shield, M8 brass core, PTFE/epoxy/Delrin insulation. Control unit: Plastic Composite.
Insertion (gas) Pressure	100kPa (15 PSI) max.
Insertion (gas) Temperature	-20C to 80C or 200C max (kits also available for higher temperatures).
Purge Air Pressure	400kPa (60 PSI) max.

Standard Conditions

Duct Gas Velocity	5m/s to 30m/s (virtually unlimited with appropriate probe installation).
Particle Size	0.1um to 1000um (still functional outside nominal range with slightly different characteristics).
Duct Size	50mm to 10m diameter (using the appropriate probe options).
Humidity	0 to 80% non-condensing.
Magnetic Field	60A/m max at 50Hz (= 50Ampere-Turns in a 1m X 1m square coil).

Mechanical

Purge Air	RC 1/8 inch purge air connection point is provided. Periodically pulsed dry purge air is useful to prevent particulate buildup.
Probe	Removable, M8 thread fitting. 300mm x 5mm stainless steel stranded wire rope is standard, any other length or type on request to suit installation requirements.
Probe Options	Solid rod, tubular, extendable, PTFE coated, tubular ceramic, wear-resistant alloys, any length, multiple supports.
Dimensions	80 degree C Active Head: 73 dia X 95 (+18 thread, +53 probe mount). 200 degree C Active Head: 73 dia X 137 (+18 thread, +53 probe mount). Control Unit: 183 wide X 181 high X 90 deep.
Mounting	Active Head: 1 inch male BSPT requires 1 inch female pipe fitting on duct (optional quick disconnect). Control Unit: 4 holes on 167 wide X 165 high centres.

Electrical

Power supply	Active Head: Powered from Control Unit via 4 core screened data cable (50m recommended, 200m max for Belden 9534 cable). AC Control Unit: 100-240VAC +/-10% 50/60Hz (use 2A slow-blow fuse for wiring protection). DC Control Unit: 20-30VDC regulated +/-10% (use 500mA slow-blow fuse for wiring protection).
Alarm output	Form C relay, 8A resistive / 1A inductive load @ 250VAC or 30VDC.
Control Unit Connections	Power supply input (AC or DC), Active head (4 core + drain wire), Alarm output (form C changeover), 0-10V (EMP5 and EMP5N only, for high impedance load), 4-20mA (EMP5 and EMP5N only, for 0-470 ohm load).
Bargraph	0-100% over 20 segments (5% per segment; the first segment acts as a power-on indicator).
Numeric Display	AUD1: included in EMP5N, or added to EMP5, with 4 digits, averaging, isokinetic calibration, networking, additional alarms, etc.

Emission Signal

Resolution	Typical, at max gain. BBD5, EMP5: 0.2mg/m3 (bargraph). EMP5N or EMP5 via 4-20mA: 0.01mg/m3.
Noise Immunity	All 50Hz or 60Hz and harmonics are effectively removed from the signal before detection. However proper grounding and shielding techniques must be used to avoid mains frequency interference overloading the first amplifier.
Gain Switch	9 positions; depending on material, velocity, geometry, 0-3/6/12/25/50/100/200/400/800 mg/m3.
Gain Fine	Fine adjustment 0X to 2X (EMP5, EMP5N only)
Zero Drift	Better than 1% of range per year Better than 1% of range over specified Temperature range
Gain Drift	Better than 1% of range per year Better than 1% of range over specified Temperature range
Circuit Linearity	Better than 1% of range
Circuit Stability	Only high stability components are used (no trimpots)
Self-Test	After power-up or grounding of test input, relay toggles for 1 second.

FEATURES

Easy Probe Mounting

Probes mount onto monitors via a standard M8 thread, and so can be replaced easily if damaged, or to adjust coverage.

Hostile Environments

Robust machined alloy housing with purge air facility to clear particulate buildup from the probe and insulators in hostile environments.

Low Noise

Electronics right at the probe connection, avoiding the inevitable noise, signal loss and microphonics of a passive probe with separate electronics.

Wide Sensitivity Adjustment Range

Output is adjustable over a range of more than 250:1, to cover virtually any real situation.

Universal Power Supply

Universal power supply inputs (either 100-240VAC or 18-32VDC); no need to adjust for different supply standards.

Clear Bargraph Display

The big, clear 20 segment LED bargraph can be read easily from a distance to get a quick, easy view of the current emission levels.

Flexible Alarms

The alarm has adjustable trip point and time delay, LED indication, relay output and High/Low selection control. On EMP5N, the AUD1 Numeric Display also includes two additional relays with similar specifications.

Long Service Life

Design service life exceeding 20 years. Our earliest triboelectric emission monitors have been in continuous operation since 1992.

EMP5N Additional Features

EMP5N includes the AUD1 Numeric Display, which provides a range of additional features including averaging, easy isokinetic calibration, additional alarm relays and networking. Please refer to the AUD1 user manual. for more detail.

OPTIONS

Active Head/Probe Options

Standard probes are 5mm dia stranded stainless steel wire rope, but many variants are available to suit different applications, including various lengths of solid rod and telescopic tube, plus special coatings including PTFE, custom wire rope arrays and custom probe materials such as Tungsten Carbide.

Active Heads are available to suit insertion temperatures of 80C max and 200C max.

Passive Heads are also available with intrinsically safe barriers for hazardous areas.

AUD1 Numeric Display

AUD1 is included as part of EMP5N, but may also be purchased separately for use with EMP5, effectively upgrading that product to EMP5N. AUD1 can also be used to display, average, calibrate and network a wide range of other process signals. Note that BBD5 has no 4-20mA output signal, so it cannot be connected to AUD1.

Connect Access

AXD1 or AUD1 may also be purchased separately for use with EMP5, effectively adding network connectivity.

Complete Family

These products are part of a complete family of products for the clean air industry from monitors to control computer systems and turnkey projects.

INSTALLATION

General

Wiring may only be undertaken by a qualified and licensed practitioner, and must be performed in full accordance with all local regulations. The Front Panel must remain fitted at all times while the unit is connected to a power source. After all connections are made, ensure that all electrical glands are tight to maintain IP ratings. Please refer to the diagram below to locate all controls and connectors referred to in the text.

Power Supply

After checking that the local power supply conforms to the unit's label specifications, connect the supply to connector (15) through the recommended fuse. If the control unit is to be hard-wired to a mains supply, a disconnect device must be fitted near the control unit, easily accessible by the operator.

This symbol indicates that hazardous voltages are present. Access only after disconnecting the power, and only by qualified Electrical personnel.

This symbol indicates a connection point which must be connected to mains earth (ground).

DC Model — Connector (15): Red to (+), Black to (-) (system common and earth). Use 1mm2 wire.

AC Model — Connector (15): Brown to Line/Active, Blue to Neutral, Green/Yellow to system Earth (ground). Use 1mm2 wire.

Active Head

For installation of the Active Head please refer to Appendix D: Emission Monitor Deployment. Wire the ground terminal on the Active Head to ductwork/supports/local earth. Wire the active head via a 4 core screened data cable to connector (4) of the control unit, ensuring that only like pin numbers are joined. For Belden 9534, use this convention:

Pin	1	2	3	4	5
Name	Signal -	Signal +	Drainwire	+3V	-3V
Colour Code	Green	White	None	Red	Black

Alarm

If an external alarm system or PLC is to be driven, make connections to relay connector (13). Set the mode switch (11), which is only read at power-up or after the Test input on connector (14) is activated. In Normal Mode, the alarm relay is de-energised when the unit is fully powered up and is energised when the alarm is tripped. In Failsafe Mode, the alarm relay is energised when the unit is fully powered up and is de-energised when the alarm is tripped, thus also generating an alarm condition when the unit loses power.

Normally Open	Contact Use the COM-NO contact to switch a normal alarm lamp, bell, siren or PLC.
Normally Closed	Contact Use the COM-NC contact as an alternative to FailSafe mode. Both methods generate an alarm on wiring faults, but FailSafe mode also generates an alarm if the unit loses power, while the COM-NC contact does not.

Analog Outputs

EMP5 and EMP5N (not BBD5) include both 0-10V and 4-20mA analog outputs which can be used to drive a chart recorder, data logger, Distributed Control System (DCS), Programmable Logic Controller (PLC), Supervisory Control And Data Acquisition (SCADA) system, AUD1 Numeric Display or a CONNECT Emission Control System. Both these signals have the same range as the bargraph display (1). The 0-10V signal is preferred for short distances (up to 10m), while the 4-20mA signal is preferred for longer distances (up to 4000m to AUD1 using Belden 9534 data cable). If either signal is required, make the connections via screened cable to connector (14).

4-20mA	4-20mA terminal to Load (+), RETURN to Load (-), cable screen to DRAIN. The 4-20mA load should be isolated 50-470 Ohms, eg AUD1. If the load is located with a DC power supply (as in AUD1), a 4 core screened cable may be used for both this function and the DC power supply function.
0-10V	0-10V terminal to load (+), RETURN to Load (-), cable screen to DRAIN; the load should be isolated, high impedance.
Test	Connect a normally open pushbutton from TEST to RETURN

SETTING UP

Please refer to the diagram below to locate all controls and connectors referred to in the text.

Probe Overload

If the Probe Overload LED (3) illuminates during operation, reduce the probe's sensitivity by using a thinner and/or shorter probe), and repeat the setup procedure.

Setting the Gain

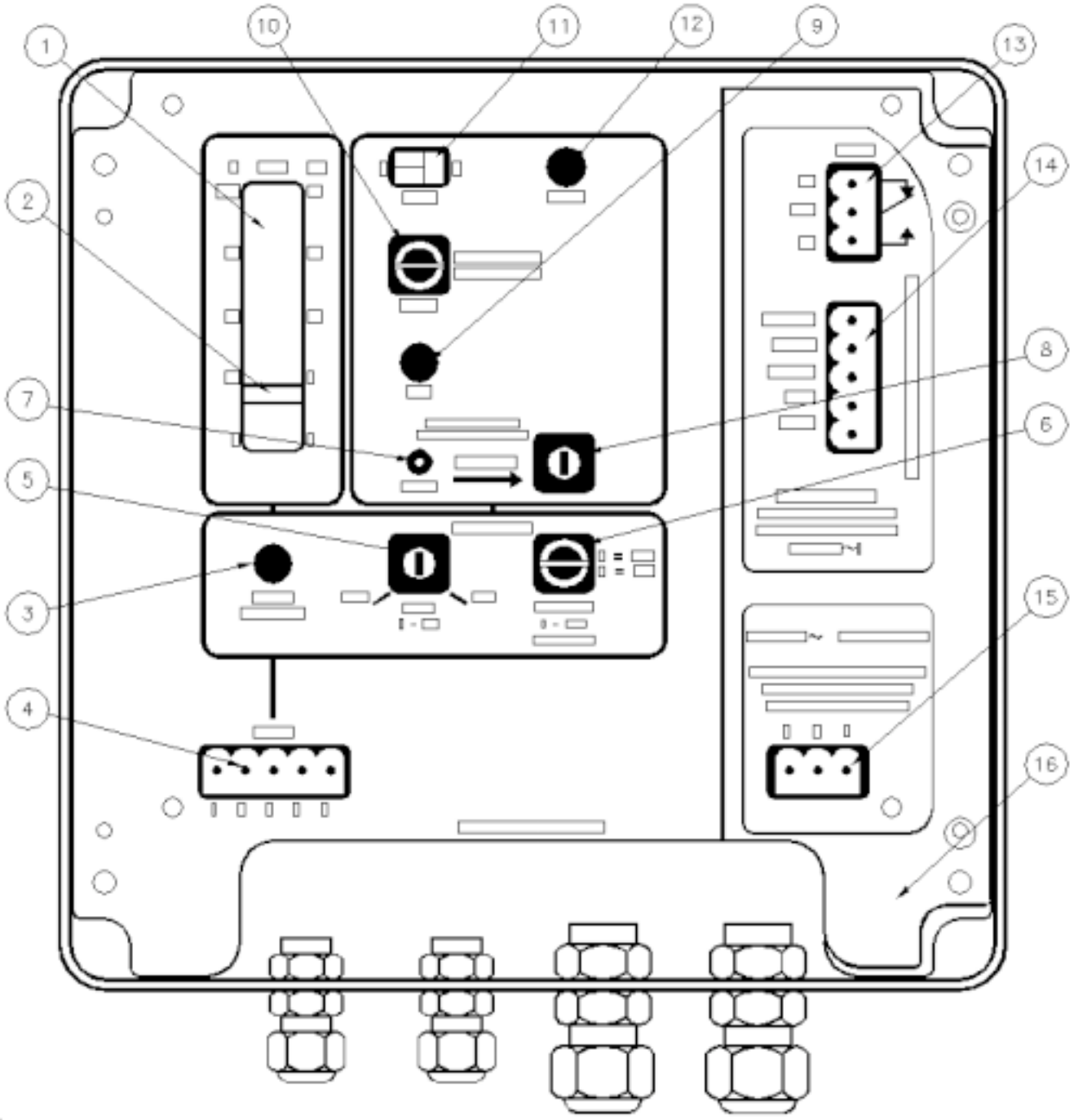
With the plant operating normally, set the fine sensitivity (5) to MAX, adjust the coarse sensitivity switch (6) so the display reads 15-20% for BBD5 or if the bargraph is used alone in EMP5, or 5-10% if the 0-10V, 4-20mA or Numeric Display is used (EMP5 or EMP5N). Note that clockwise rotation will increase range and DECREASE sensitivity. If after a period it is found that some emission peaks reach 100%, reduce the sensitivity further (and therefore the normal signal level).

Setting the Alarm

Hold Button (7) down to show the alarm level (2), then use control (8) to adjust that level. If the alarm level is below the current emission level, the LED (9) will illuminate immediately, then the relay LED (12) and the output relay contacts (13) will trip after a time delay. Set the alarm level either to a simulated alarm condition (eg, run the plant with one filter bag removed), else about 4 times the normal operating emission level. Set the time delay switch (10) so that the brief peaks (eg during bag cleaning) do not trip the relay (12 and 13), eg 10 to 16 seconds.

Calibration

If the 0-10V or 4-20mA outputs are used to drive a PLC, SCADA or Numeric Display, then those devices will normally allow for fine calibration. Otherwise, EMP5 and EMP5N (not BBD5) include a fine control. For further detail, see Appendix C: Emission Monitor Calibration.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Appendix D
Emission Monitor Deployment

Introduction

Preparation

Illustrations

Wiring

Alarms

Purging and Cleaning

INTRODUCTION

This document details the recommended steps in installing a Triboelectric Emission Monitor to ensure that it performs well. This document and the product manuals are all subject to continuous development, and it is acknowledged that they may contain errors and/or omissions. For the most up-to-date information, including further applications information and case studies, the user should always refer to the supplier, or to the latest issue of CONNECT, whose HELP system will also include this document.

PREPARATION

Mounting Positions

Choose a mounting position which satisfies these criteria:

- in a straight section of metal duct,
- at least 5 diameters after or 2 diameters before any bend or screen,
- about 2 diameters before any isokinetic sampling point, at right angles,
- even further from dampers, electrostatic precipitators, wet scrubbers, fans,
- away from high vibration, ambient temperature or direct radiation,
- with probe axis perpendicular to the gas flow,
- with probe axis perpendicular to the plane of the nearest bend (if close).

Control Units, Juction Boxes and Numeric Displays (eg EMP5, ANJ1 and AUD1) should be mounted in a safe position which provides easy access and operability, but close to their connected Emission Monitor or Active Head.

Grounding Of The Duct Material

If possible, replace any insulating material (particularly plastic) which comes into contact with the gas flow, with grounded metal.

Ensure that every part of the duct and all metal exposed to the gas flow (eg inspection covers, fan and damper blades, isokinetic probes) are grounded.

If there remain any ungrounded metal or insulating material in contact with the gas stream, ensure that it is electrically screened from the probe (eg, by an intermediate grounded welded mesh screen). For any unusual conditions, consult the supplier.

Probe Options

The Emission Monitor is widely adjustable, however probe length also has a significant effect on sensitivity, so choose the probe length according to these recommendations:

- Below 1mg/m3: 0.8 duct diameters
- Above 100mg/m3: 0.1 duct diameters
- Otherwise: 0.5 duct diameters

Probes are traditionally formed from solid stainless steel rod. However stainless steel wire rope is standard for new models, and is available on request for all other models. Wire rope has a number of advantages over solid rod:

- The surface texture and small diameter minimise downstream gas flow disturbances to flow transmitters, isokinetic sampling probes, etc,
- The high internal damping eliminates resonance effects which can damage probes and Emission Monitors,
- The inherent sagging minimises the probability of a probe unscrewing itself in operation.
- The wire strands slide slightly against each other with normal movement of the probe in the gas stream, which tends to dislodge accumulated matter.

Standard wire rope probes are commonly fitted in one of these forms:

- Cantilevered probe 0-800mm: use a simple wire rope probe alone.
- Probe 800-2000mm total: supported on opposite side by P2-60230 support head.
- Probe above 2000: string the probe across the duct with egg insulators in line at both ends, and strong supports. Add another short section of stainless steel wire to connect the Emission Monitor to the probe.

Since emission monitors are rated for an insertion temperature of 200C max, elevated temperatures require the use of extension tube mounting kit such as P2-60205 (300mm, up to 500C) or P2-60210 (450mm, up to 600C). Provided the gas path is at negative pressure and non-toxic (the usual case for a stack), and the emission monitor body is protected from rain or other contaminants, improved cooling for the emission monitor may be provided by drilling several holes around the outermost end of the mounting tube, thus allowing ambient air to coat the emission monitor's nose and part of the probe.

Alternatively, consult the supplier to discuss other probe options including:

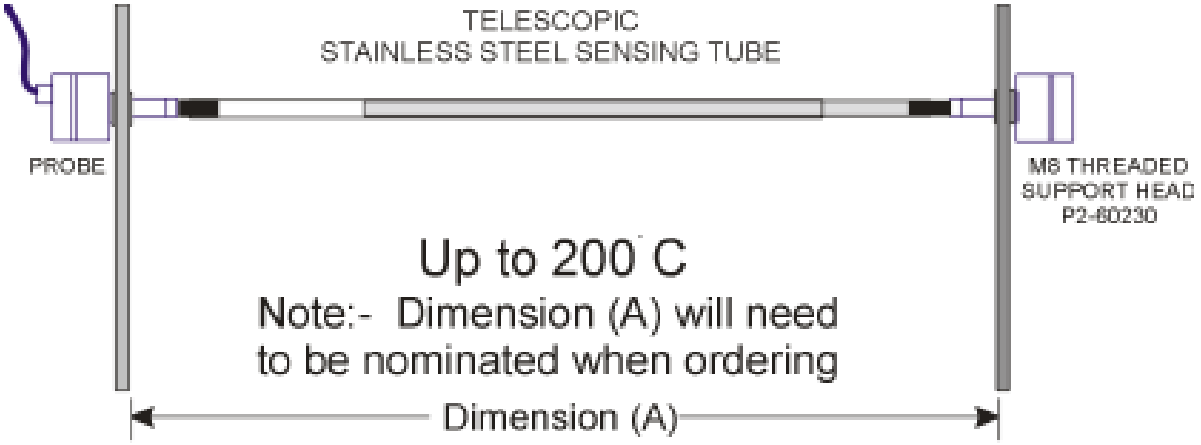
- rigid rod,
- PTFE coated rod,
- rod or rope in wear-resistant material,
- telescopic tubes, as follows:
  - Probe 800-1100mm: use P2-90600 telescopic + P2-60230 support head.
  - Probe 1100-1700mm: use P2-90610 telescopic + P2-60230 support head.
  - Probe 1700-2500mm: use P2-90620 telescopic + P2-60230 support head.

Other Options

If the insertion temperature is over 80C, check with the supplier to ensure that the equipment, accessories and mounting arrangement are suitably rated.

If a quick-release tapping point is required, use either the Bolt-on Mount Kit (P/No. P2-60203, fig 1) or the Weld-on Mount Kit (P/No. P2-60202, fig 2 and fig 4).

ILLUSTRATIONS



AVAILABLE LENGTHS AND PART NUMBERS

P2-90600 Dimension (A) from 700 - 1100mm
P2-90610 Dimension (A) from 1100 - 1700mm
P2-90620 Dimension (A) from 1700 - 2500mm

Installation

Cut a 30mm hole in the duct, and either:

- Weld on a plain 1 inch BSPT female bush, or
- Weld on the Weld-on Mount Kit (P/No. P2-60202, fig 2 and fig 4), or
- Weld on a flange to suit Bolt-on Mount Kit (P/No. P2-60203, fig 1).

If a mount kit is used, screw the Emission Monitor or active head firmly into the thread insert with chamfer outwards (fig 3), insert the assembly through the mounting flange, apply thread sealant to the grub screws and tighten them (fig 5). Otherwise, install the Emission Monitor (firmly hand-tighten) directly in the BSPT bush on the duct.

Figure 1

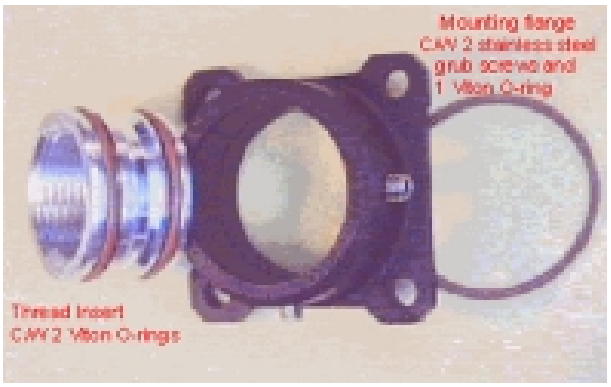


Figure 2

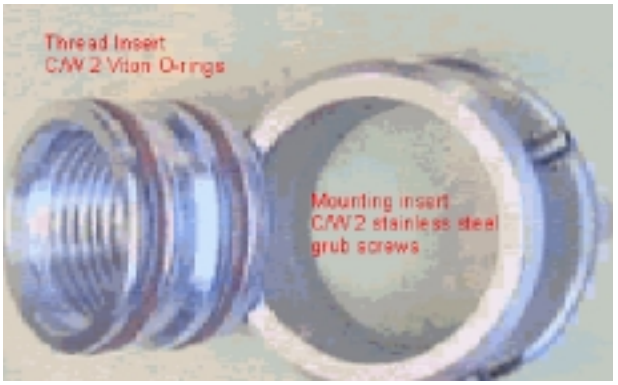


Figure 3

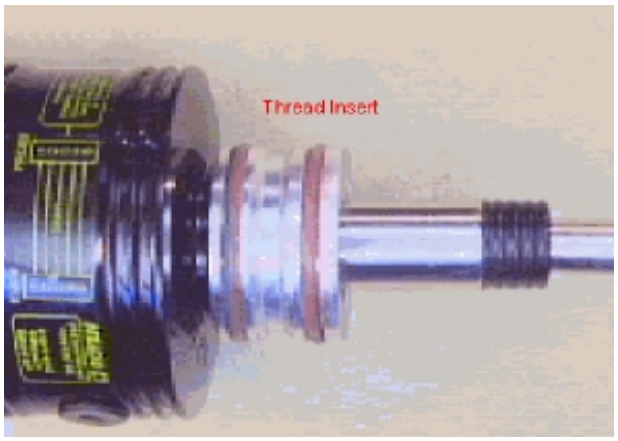
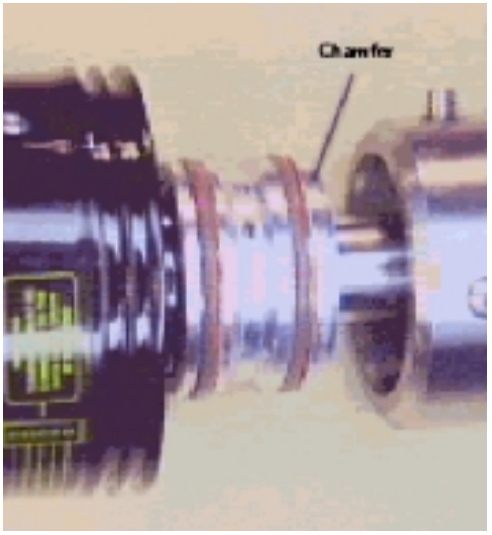


Figure 4

Figure 5



WIRING

Wiring may only be undertaken by a qualified and licensed practitioner, and must be performed in full accordance with all local regulations. After all connections are made, ensure that the electrical gland is tight to maintain IP ratings.

Remove the lid of the Emission Monitor or Active Head and feed the screened data cable through the lid gland. Clamp the gland onto the cable, lock the outer screen (drain) wire under the lid's internal earth screw if fitted, terminate all cores to the pluggable terminal strip, plug in the terminal strip and replace the lid.

The standard wiring colour code for Networked Emission Monitors and Active Heads is:

Product	Terminal 1	Terminal 2	Terminal 3	Terminal 4	Terminal 5
Networked Emission Monitor	White	Green	Screen	Black	Red
Active Head	Green	White	Screen	Red	Black

ALARMS

High Alarms

A basic emision monitoring system will include at least one alarm to indicate that emissions have increased to an unacceptable level. If only one alarm is available, it should be set to about 2 to 3 times the normal running level, or as decreed by the EPA. The alarm delay should be set to at least as long as any normal system disturbances (eg, cleaning pulses from a bag filter), so that the alarm only responds to genuine high emission levels.

Low Alarms

The emission signal can drop below normal because of an obstructed filter or because of particulate buildup across the insulators on the emission monitor. If a Low Alarm is available, it may be set up safely below normal emission levels to warn of these conditions, so that corrective action can be taken.

Software Alarms

Software alarms should be directed to the appropriate output device so that the operator is aware of the alarm condition (in the CONNECT software, the alarm is displayed on-screen, and it is usual also to direct each alarm to an external relay and/or an internal computer-generated audible signal). For bag filter installations there are also a number of options for Row Leak Discrimination.

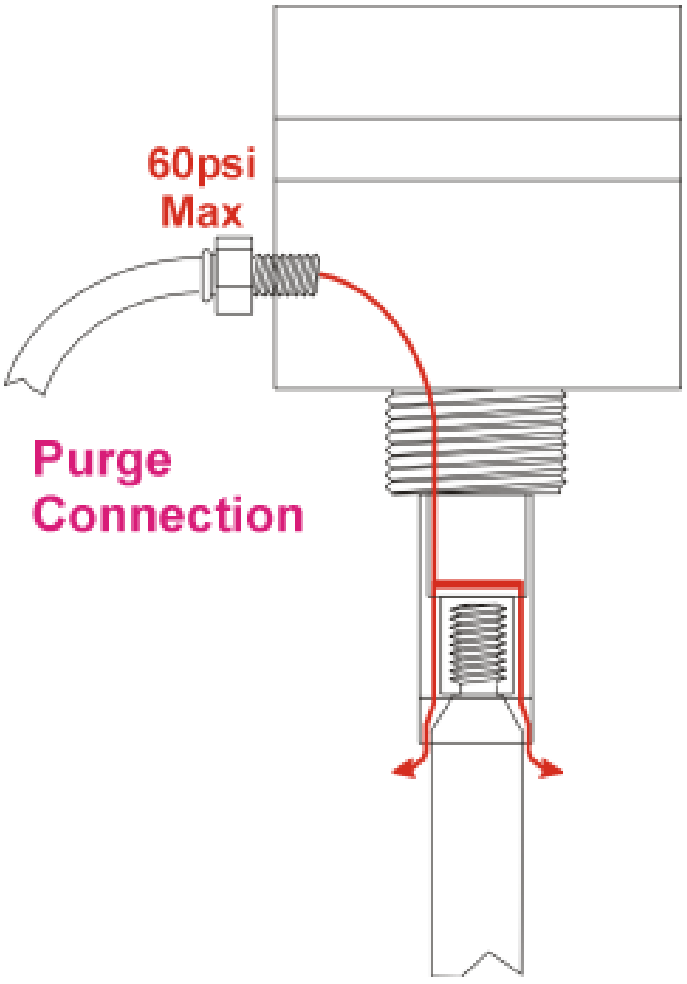
PURGING AND CLEANING

Particulate Buildup

Particulate buildup on the probe itself can be minimised by the use of PTFE coated probes (consult the supplier), however buildup on the probe will not cause errors in any case. Buildup across the insulation barrier from the probe to the earthed metalware will, however, progressively attenuate the emission signal, so it should be avoided where possible. A low level alarm can be configured to detect this condition.

Connecting The Purge Air

The purge air port may be connected to a source of clean dry instrument air. If particulate buildup is considered to be a potential problem, then a periodic pulse of purge air (not a continuous bleed) will dislodge recently deposited particles. NEVER exceed the rated pressure of the purge port, or overtighten the air fitting. If not using this facility, the original sealing plug and O-ring must be fitted at all times.



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NEVER exceed the rated pressure of the purge port, or overtighten the air fitting. If not using this facility, the original sealing plug and O-ring must be fitted at all times.

Corrosive Gases

If the gas is corrosive, it should not be allowed to enter the body of the Emission Monitor; normally the purge air path is sealed off in these circumstances by a plug inserted before the probe is screwed in (see the supplier). This is the recommended method. If, however, purge air is required with a corrosive gas, then the purge path cannot be sealed, and a small amount of continuous purge air should be allowed to flow in addition to the pulsed purge air, to prevent the corrosive gas entering the housing.

Periodic Cleaning

Normally, no periodic maintenance is required. If purge air is not used, or in extreme cases even when it is used, it may be desirable to periodically remove, inspect and clean the inserted parts of the Emission Monitor, and also any other insulators if used to support the probe. The period of this maintenance may vary from weekly to annually, depending on the material characteristics.