tyco / Flow Control / Environmental Systems

USER MANUAL v1.6

EMP7, EMP7N Emission Monitor

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SAFETY

Electrical

EMP7 operates from low voltage DC power supplies which pose no danger or health risk.

EMP7N includes an AUD1 Numeric Display which is available in two versions, for use with low voltage DC power supplies or AC main power supplies (which are potentially lethal). In either case, the output relays included in the AUD1 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

This equipment 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 the EMP7 and EMP7N Emission Monitors. EMP7, EMP7N 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.

Description

General

Triboelectric Emission Monitors are designed to detect and report solid particulate matter in motion. These products include a cylindrical Emission Monitor with detachable probe (sensing rod or wire); when mounted through the side of a duct, stack or other conduit carrying moving particles suspended in the gas stream, the probe is exposed to the particles. The products differ as follows:

- EMP7 is a single unit with wide range logarithmic 4-20mA output only.
- EMP7N adds a separate AUD1 Numeric Display for logarithmic conversion, numeric output display, averaging, isokinetic calibration, alarms and networking.

Interconnection

EMP7 requires only one connection, a screened 2 wire cable for the 4-20mA output. EMP7N also includes the AUD1 Numeric Display, with many possible connection options.

SPECIFICATIONS

Certifications

Certifications	EN55011:1992, EN5082-2:1995, IEC801-4, IEC1000-4-3, IEC1000-4-2, IEC100-4-4.
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 or frequency (with short or separately supported wire rope probe).
Environment	IP66/NEMA4, non-corrosive (Aluminium alloy body, stainless steel inserted parts).
Duct Gas Pressure	100kPa (15 PSI) max.
Duct Gas Temperature	-20C to 80C or 200C max (standard models; higher temp to order).
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 (wider with some changed 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 purge air may reduce particulate buildup.
Probe	Removable, M8 thread fitting. 300 x 5mm stainless steel stranded wire rope is standard. Probe length and type in accordance with installation requirements.

Mechanical (continued)

Probe Options	Solid rod, tubular, extendable, PTFE coated, tubular ceramic, wear-resistant alloys, multiple supports, any length.
Dimensions	88 dia X 125 long (+18 cable gland, +70 probe mount nose).
Mounting	1 inch male BSPT requires 1 inch female pipe fitting on duct (optional quick disconnect).

Electrical

Power supply	4-20mA 2-wire 10-32VDC +/-15% after cable and load voltage drops.
Max Distance To AUD1	AUD1 supplies 24VDC, 50 ohm input, so max external resistance = 15.5V/20mA - 50ohms = 725 ohms = 8000m of Belden 9534 data cable.

Emission Signal

Processing Method	Impulse Signature Extraction (ISE)
Output Signal Type	4-20mA Logarithmic.
Resolution	Typically 0.1% of output range (2% of emission level).
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.
Accuracy	(per year and over specified Temperature range) 4-20mA Output Signal (electronics): - Zero 0.6% max. - Range 0.6% max. - Linearity 0.6% max. After conversion to linear (electronics): - Zero not applicable. - Range 10% max. - Linearity (over 10:1 range) 10% max.
Accuracy (cont)	Overall (typical, including plant): - Zero not applicable. - Range 20%. - Linearity over 10:1 signal range 20% untrimmed, 5% trimmed. All components are high stability, rated for -40C to +85C industrial temperature range (no trimpots).

Diagnostics

Statistical History	Diagnostic history maintained internally from production onwards, to check for drift or other anomaly.
Run-Time Diagnostics	RTD runs continuously, testing all possible functions against internal absolute references. Statistical analysis reveals any impending problems. RTD shuts down output signal if it is suspect, or emits optional output "blip" if attention is needed. Output blip is 4.0mA for 2s every minute, or to order.
Power-Up Diagnostics	PUD performs RTD plus a full multipoint internal calibration sequence. PUD sends a total result code as a 4-20mA output level. Standard PUD result code is 4, 5,...20mA for 4s; others to order.

FEATURES

Easy Probe Mounting

Probes mount onto Emission 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. Inserted metal parts are all stainless steel to resist many hostile materials.

Low Noise

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

Impulse Signature Extraction (ISE)

This model-based signal processing system extracts the fundamental attributes of the many individual particles which contribute to the noisy signal from the probe. EMP7 uses 32-bit signal processing throughout to achieve the precision necessary for ISE. ISE also has all the well known advantages of conventional AC coupled Emission Monitors, plus many unique features.

True Mass Density Output

In this simplest application of ISE, the result is a true mass density output, independent of velocity over a wide range. This complements the existing range of Mass Flow Rate Emission Monitors, and contrasts with competitive models which only approximate a mass density characteristic.

Wide Switch-Free Signal Range

The single output range covers an unprecedented dynamic range of over 160dB without range switching of any kind (auto or manual). With appropriate choice of probe, it covers every application without any setup, adjustment or unwanted glitches in the output signal from 0.01mg/m3 right up to pneumatic conveyor loads of 1kg/m3.

Absolute calibration

Built-in test/calibration circuitry is enabled every time the unit is powered up, ensuring that all units are completely interchangable in the field without adjustment (note that calibration may still be required to account for process conditions).

Simple 4-20mA 2-wire connection

The foolproof intuitive wiring interface minimises wiring errors and other installation problems. In addition, the polarity-proof power circuit ensures that no damage will be done even if an error is made.

Full Internal Isolation

The 4-20mA interface is isolated from the (grounded) probe circuit (500V DC or AC peak), eliminating problems due to ground loops or unusual power supply arrangements.

Intrinsically Safe Design

When used with a suitable external galvanic barrier or +/-12V zener barrier and associated equipment, operation is permitted in hazardous areas. For Emission Monitors, the Intrinsically Safe method is more reliable than the use of a DIP (Dust-Ignition-Proof) enclosure, since the enclosure must be penetrated during manufacture for the probe connection, rendering a DIP rating ineffective.

Industry's best immunity to insulator bridging

A novel input preamplifier provides the industry's best performance in immunity from both insulator bridging and severe overloads. Although purge air facilities are provided as standard, they are seldom needed.

Logarithmic Output

The 4-20mA output signal is proportional to the logarithm of the emission level.

For applications that do not require absolute calibration (simple alarm or indicator applications like plant condition monitor, broken bag detector), no special processing is needed.

Where the signal is processed by AUD1 (included in EMP7N), or by the CONNECT software, log-to-linear conversion is included, which defaults to suit EMP7.

Where absolute calibration is required, and AUD1 or CONNECT is not available (eg a third-party PLC or SCADA system), then use the formula

LIN = B X 10^(LOG/L), where

- LIN = desired linear emission signal,
- B = base value (eg 0.01mg/m3, adjust to calibrate unit to plant),
- LOG = Logarithmic input signal from EMP7/EMP7N, as read by ADC.
- L = Log Law (= 0.13 of the maximum possible value of LOG (eg if the max value of LOG is 4095, then L = 0.13x4095 = 532; adjust to trim linearity if needed).

High Resolution Even At Low Levels

The log output is able to resolve very small changes even at very low levels, eg from 0.010mg/m3 to 0.011mg/m3.

Extensive Automatic Diagnostics

EMP7's extensive continuous diagnostics at startup and continuously during operation guarantee the validity of the output, and a number of different mechanisms are included to signal potential problems to the plant control system.

Upgradable Flash Memory

All programmable code and data in the Emission is field-upgradable in case of factory revisions or even custom applications. This also produces the side benefit that each manufactured unit can track it's own progress through manufacture, and log the results to a central database before it's final programming. Should service ever be required in the future, this process provides an excellent historical base record.

Long Service Life

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

Additional Features

EMP7N includes the AUD1 Numeric Display, which provides a range of additional features including log conversion, averaging, easy isokinetic calibration, alarm relays and networking. Please refer to the AUD1 user manual. for more detail.

OPTIONS

Probe Options

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

Temperature Options

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

AUD1 Numeric Display

AUD1 is included as part of EMP7N, but may also be purchased separately for use with EMP7, effectively upgrading that product to EMP7N. AUD1 can also be used to display, average, calibrate and network a wide range of other process signals.

Complete Family

EMP7, EMP7N and AUD1 are part of a complete family of products for the clean air industry from monitors to control computer systems and turnkey projects.

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:

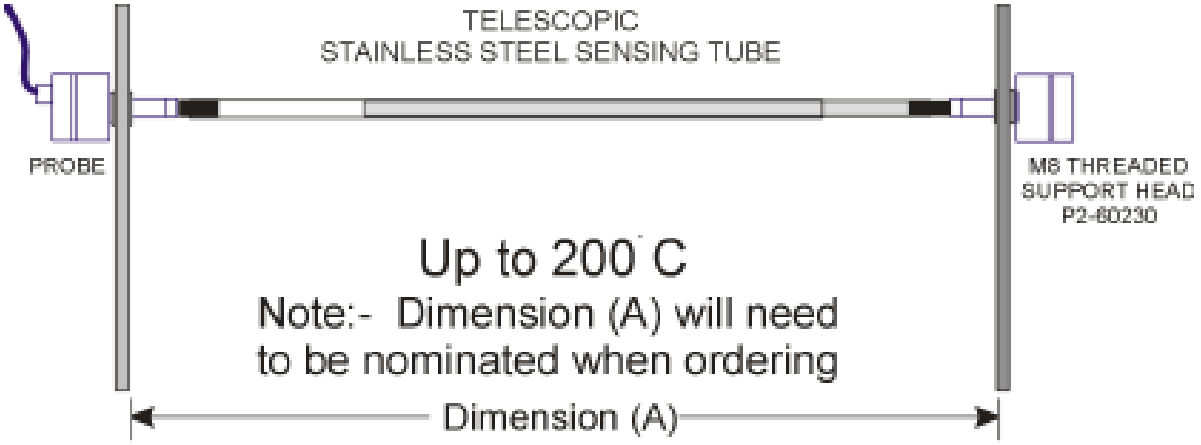
- rigid rod,
- PTFE coated rod,
- rod or rope in wear-resistant material,
- telescopic tubes, as follows:
  - Probe 800-1100mm: use P2-90600 telescopic + P2-60230 support head.
  - Probe 1100-1700mm: use P2-90610 telescopic + P2-60230 support head.
  - Probe 1700-2500mm: use P2-90620 telescopic + P2-60230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

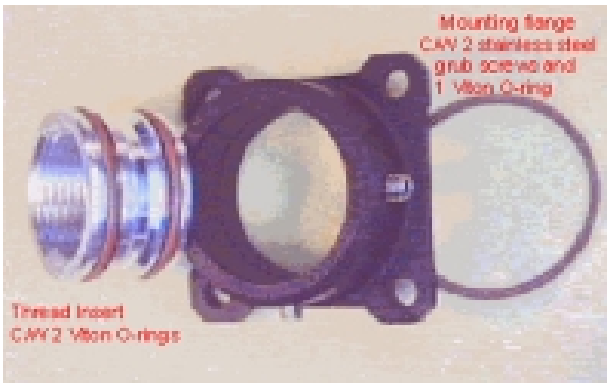


Figure 2

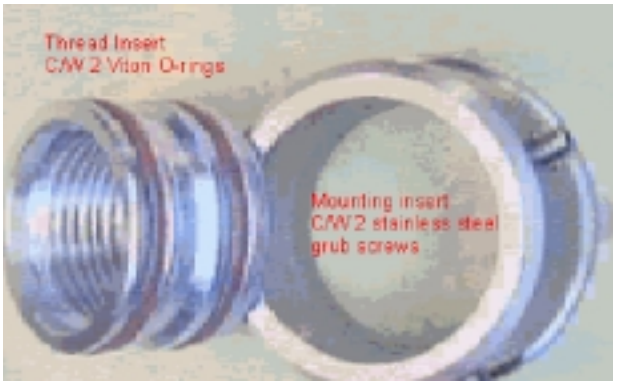


Figure 3

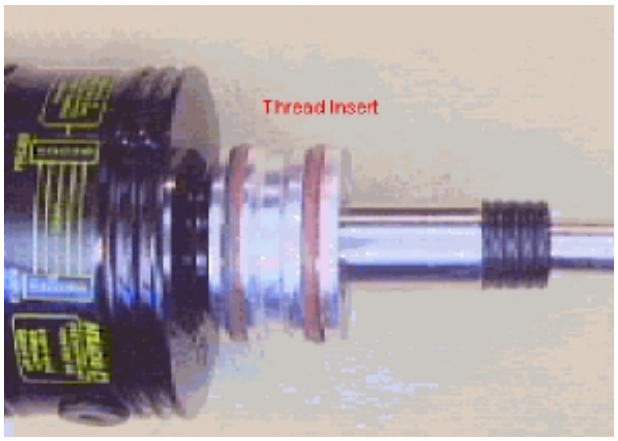
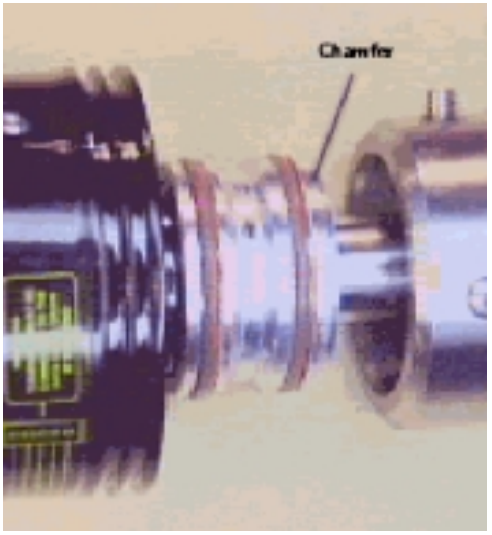


Figure 4

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.

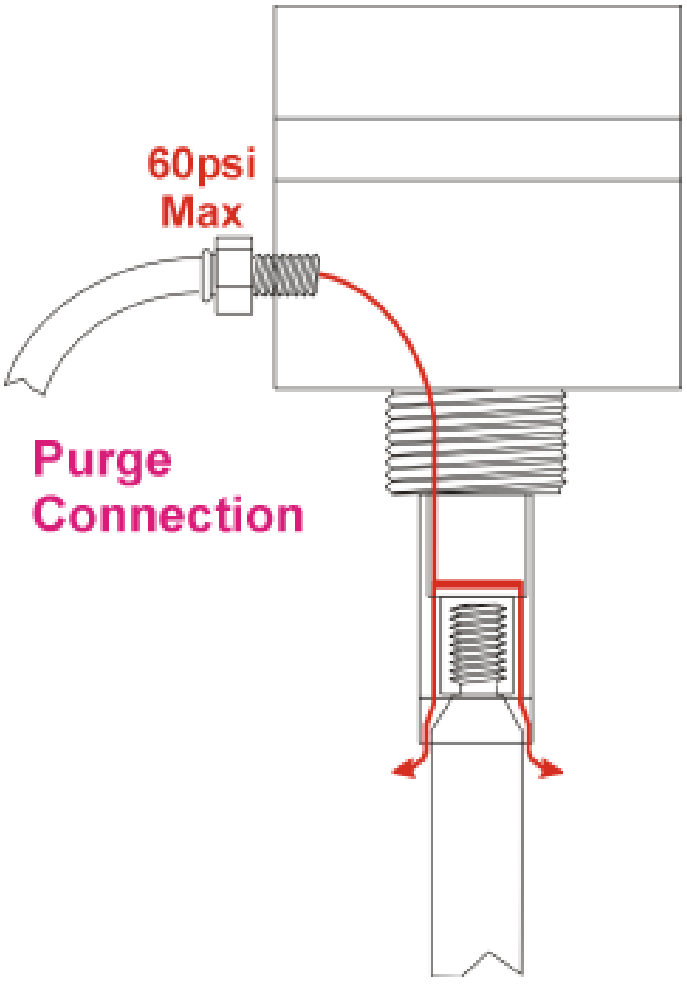
PURGING AND CLEANING

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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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.