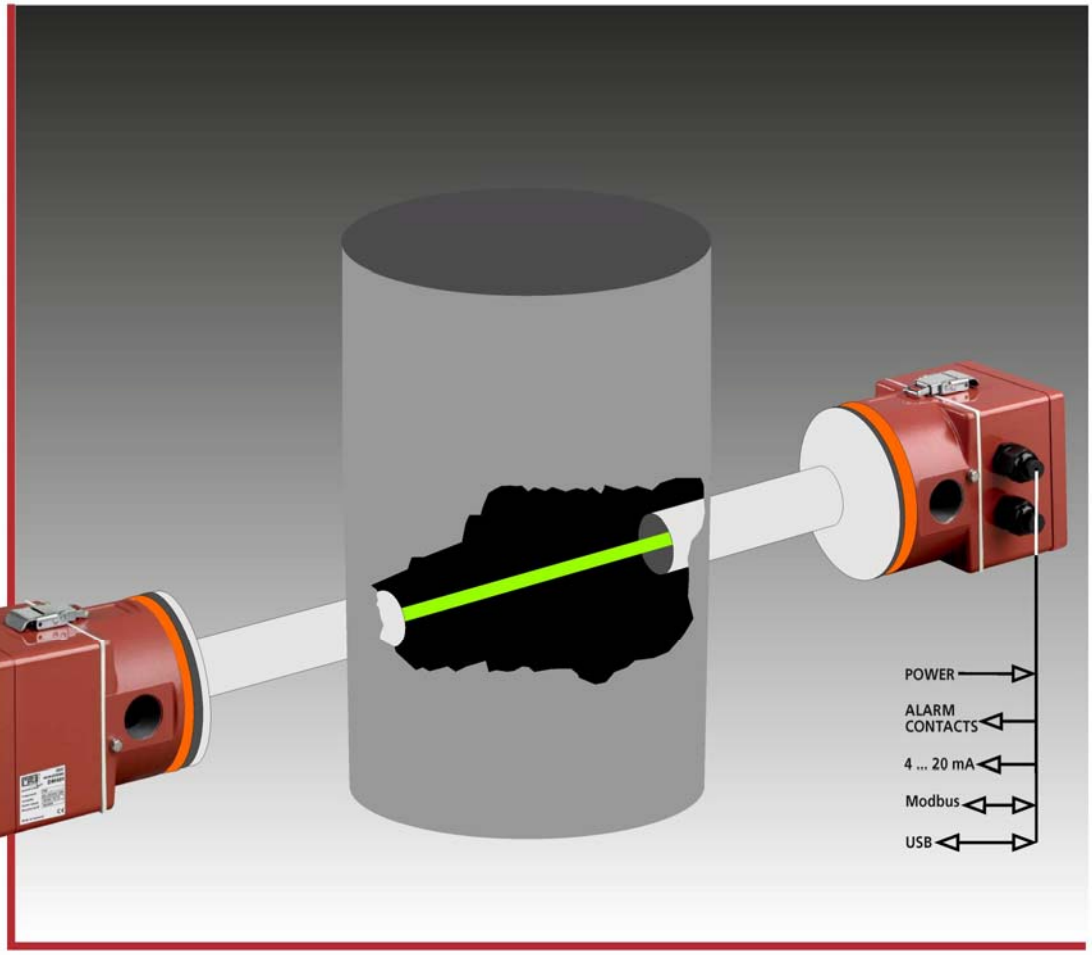
EMISSION MONITORING SYSTEMS

We *care* about the environment

INSTALLATION MANUAL DUST MONITOR



MRU AIR fair since 1984 ®

EMISSION MONITORING SYSTEMS

DM 401

62785GB

1 CONTENT

Inspect Shipment for Damage

Carefully inspect the entire shipment for damage in the presence of the shipper's agent, removing packaging material if necessary. Note any damage to packaging and/or goods on Packing List and have it signed by the shipper's agent prior to accepting the shipment. Submit damage claim to MRU immediately.

NOTE: Damage claims not received by MRU within 3 days of receipt of shipment will not be accepted.

Save the original box and the packing material for use if the analyzer must be shipped in the future.

The products described in this manual are subject to continuous development and improvement and it is therefore acknowledged that this manual may contain errors or omissions. MRU encourages customer feedback and welcomes any comments or suggestions relating to the product or documentation.

Please forward all comments or suggestions to the Customer Feedback Department at the following address:

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This manual is intended solely as a guide to the use of the product.

MRU shall not be liable for any loss or damage whatsoever arising from content errors or misinterpretation of information's from this manual or any mis-use resulting from the use of this manual.

2 INTRODUCTION

2.1 The company MRU GmbH

Your analyzer is produced by the MRU GmbH in Neckarsulm Germany (founded in 1984), a medium sized company that specializes in developing, producing and marketing high quality emission monitoring analyzers. MRU GmbH produces a wide range of instruments, from standard analyzers up to tailor made industrial analyzers. MRU GmbH contact details are listed on the previous page.

Factory 1 (service department, development division, administration)

Factory 2 (Product division)

3 RETURNED GOODS

Packing regulation of 12.07.1991

If your local waste facility does not except MRU packing materials for disposal, you may return it to MRU or our local sales representative. Packing materials returned to MRU must be returned prepaid.

3.1 Return of analyzer according to ElektroG

MRU GmbH is required to accept the return, for proper disposal, of all analyzers delivered after 13th of August 2005. Analyzers must be returned to MRU prepaid.

4 Product Overview

The DM 401 Double Pass Particulate Monitor measures open path light transmission using a transceiver (TRX) and reflector system. It is typically installed on a duct, stack, chimney or flue for the purpose of monitoring increases in particulate (mg/m³) caused by suspended particles (dust and smoke) passing through the light path.

The Reflector and TRX are mounted opposite each other across the stack so that the light beam generated in the TRX passes across the centre of the duct (through the gas stream) and falls directly onto the Reflector on the other side. The Reflector then returns the light to the TRX. The initial intensity of the light is memorised, and any reductions in that intensity (caused by smoke and particulate suspended in the gas stream) are measured as particulate.

A number of checks and measures are employed to maintain continued accuracy of the instrument, including direct monitoring and compensation for the light source intensity, and also monitoring and compensation of the internal instrument temperature.

The DM 401 can be supplied for "stand alone" configuration (i.e. TRX/Reflector heads only – no control unit), in which case command and control of the instrument is performed using either the Utility software provided (for use on a laptop PC), or by ModBus serial comms connected to the TRX. In the stand alone configuration the TRX head has a range of interface outputs including 4-20mA, level/service alarm contacts, ModBus, and USB, allowing the head pair to slot into standard industrial monitoring systems.

Calibration involves performing an instrument zero under clear path conditions, and an upscale calibration adjustment based on comparison between instrument readings and independent gravimetric sample measurements.

Both TRX and Reflector heads are supplied with cast aluminium air-purge heads, which not only provide the physical mounting point for the instrument, but also allow users to connect a high volume, low pressure air supply to help keep the optics clean and prolong service intervals. By default the instrument is a 24VDC powered device, but it can be optionally supplied with universal input 90-265VAC PSU for AC operation.

5 Physical Installation of the Heads

5.1 Warnings

Warning: All aspects of installation, whether electrical or mechanical, should be carried out by suitably qualified engineers.

Warning: The DM 401 contains sensitive optics and electronics, and must be protected from physical shock, vibration and exposure to moisture at all times. Always handle with care, replace lids and covers when not in use, and always protect from water ingress.

The TRX is particularly vulnerable during transportation and manual handling. Always transport the instrument in its original packaging and handle with utmost care.

It's very important that the installation of your DM 401 is planned out carefully in advance. Please study this section carefully and ensure that you have taken proper advice on local and national regulatory requirements before starting your installation. Proper planning will avoid the need for modification to your installation at a later date.

5.2 Choosing a location and general considerations

When choosing a location for the Reflector and TRX heads, please consider the follow:

5.2.1 Legislation

- Legislation (local or national) covering the installation may specify or make specific requirements on, the positioning of the sensor heads. If legislation does affect the head position, priority must be given to this legislation, but do not disregard other considerations discussed here.

5.2.2 Accessibility

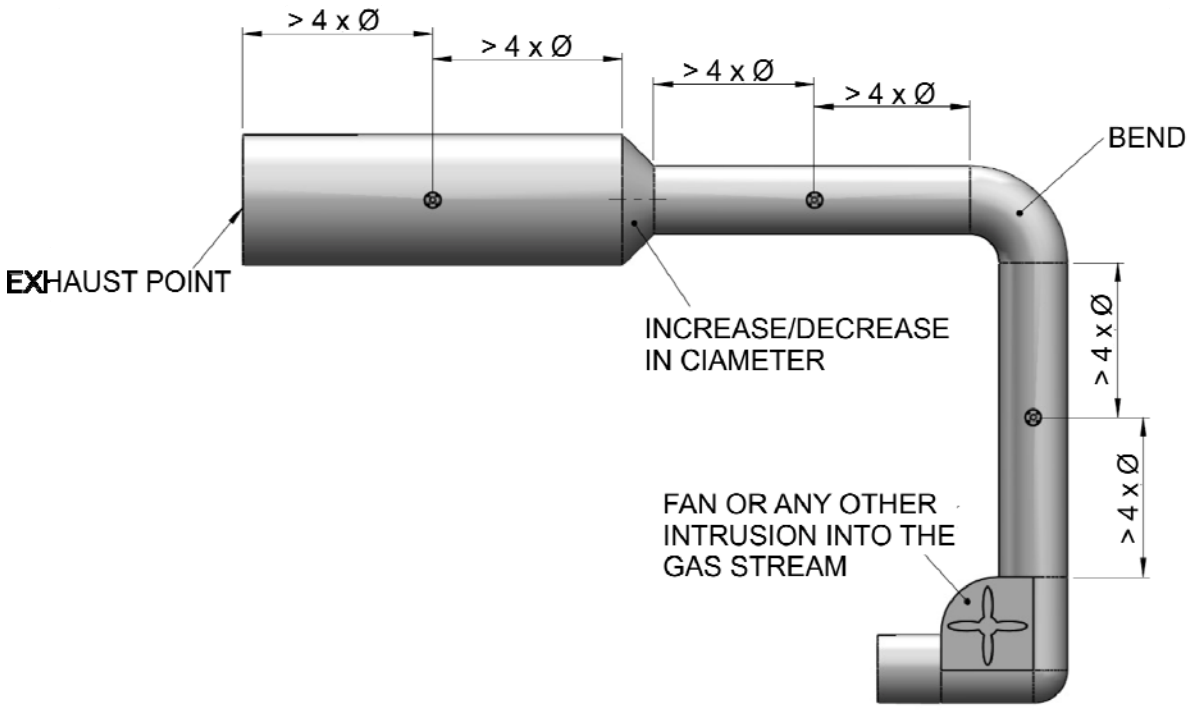
- Accessibility is very important for maintenance. Access to the back of both heads should be easily available, so positioning at the level of a gantry or platform is preferable.

5.2.3 Vibration and angular movement

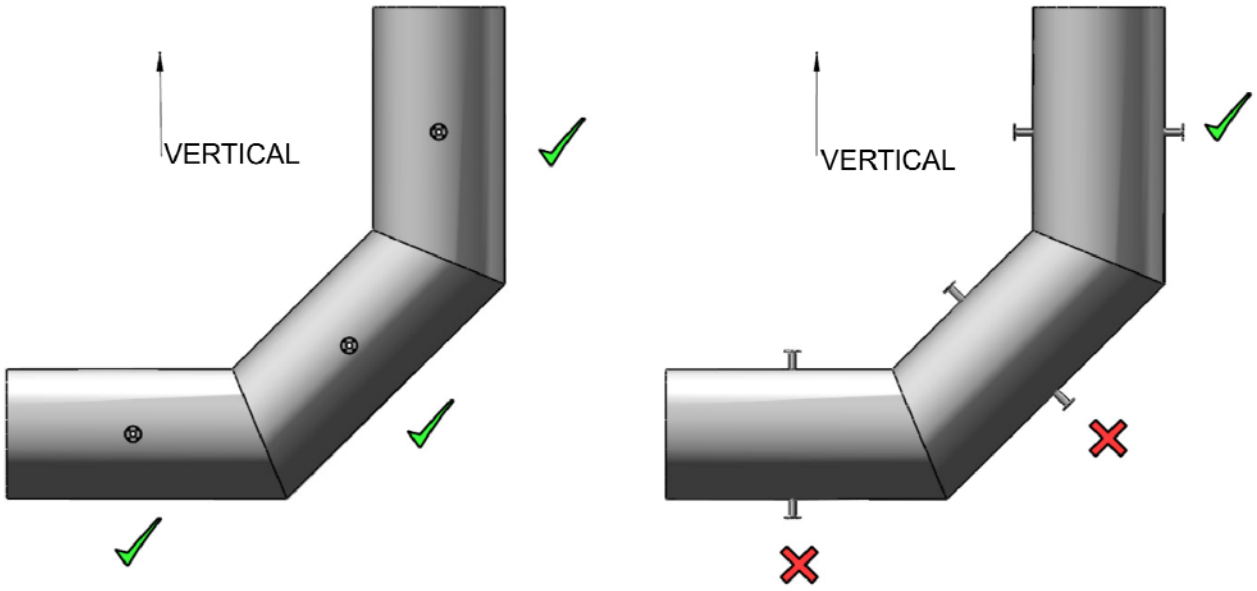
- Vibration and angular movement will cause the light beam to move and may result in an unstable particulate measurement. Therefore the heads must be mounted securely on a sturdy section of the duct or stack that will not be prone to high levels of vibration. If the duct wall is thin and flexible, it should be reinforced at the mounting position, or a frame should be constructed to hold both heads stable in relation to one another. You must ensure that the angular relationship between the Reflector and TRX heads remains constant in all conditions. Pay particular consideration to the possibility of vibration, and also expansion and contraction of local structures with temperature.

5.2.4 Gas flow characteristics in the stack

- Gas flow characteristics in the stack at the measurement point should be considered carefully when locating the heads. Ideally the heads should be positioned on a straight section of duct with no increases/decreases in diameter, no bends, no inlets/outlets, and no intrusions/protrusions, within 4 duct diameters of the heads, particularly if the interference is upstream.



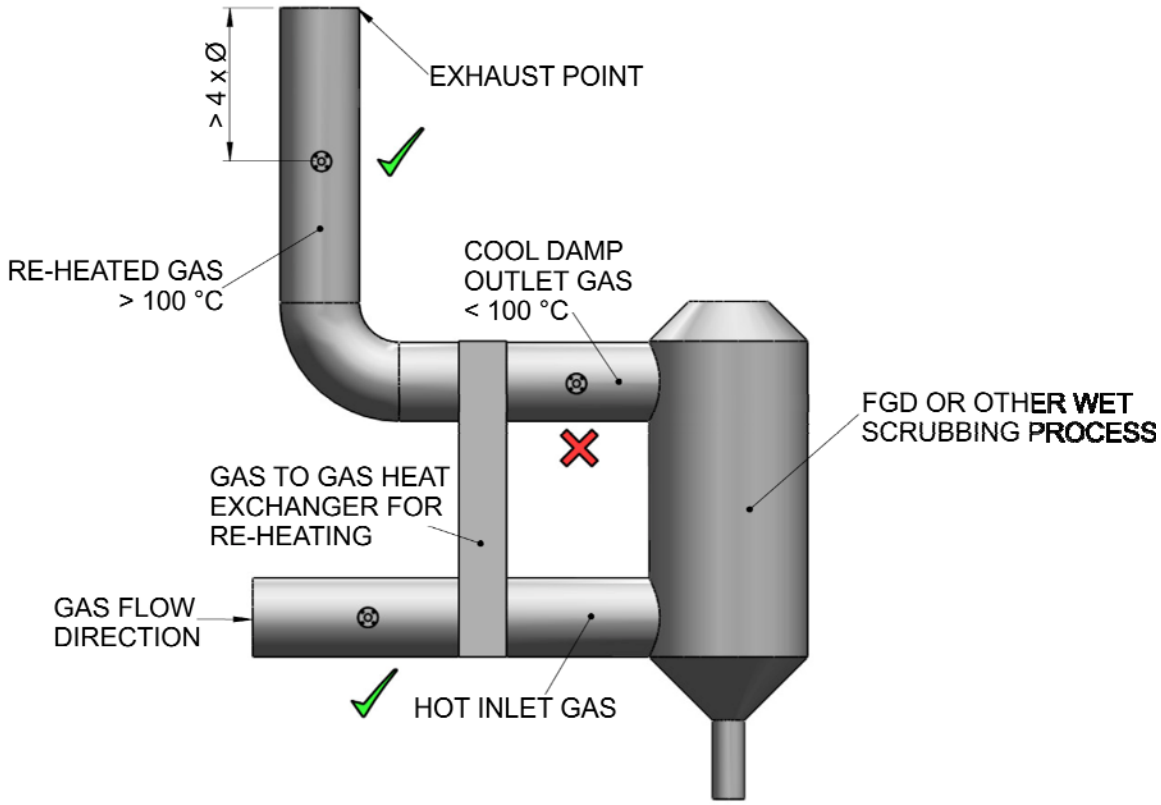
The heads should never be positioned top and bottom of a horizontal duct or angled duct, as particle matter will fall under gravity into the bottom head and cause the optics to dirty more quickly.



5.2.5 Mist, spray, droplets, and condensing liquids

- Mist, spray, droplets, and condensing liquids will be seen by the instrument in the same way as suspended particulate matter, and will therefore generate an additional particulate reading. In most installations it is undesirable to measure particulate caused by liquids and therefore a mounting location for the Reflector and TRX heads should be chosen where there is no possibility of such contaminates being present in the gas stream.

As a general rule, the heads should be located at least 4 stack diameters upstream of the exhaust point, at a point where the exhaust gas is consistently in excess of 100°C, and upstream of any wet scrubber or other process which may introduce liquid mist or spray (unless fitted with an re-heater or demister).



When mounted on vertical stack sections near to the exhaust point, the possibility of heavier droplets (from rain or condensing steam) falling back down into the stack should be considered.

Knowledge of the process gas conditions, engineering logic, and common sense should be employed to choose a location for the heads that will not be affected by mist, spray, droplets, or condensing liquids.

5.2.6 Temperature

- Temperature considerations include:

Stack gas temperature

Mounting flange temperature

Ambient air temperature around the heads

Radiated heat

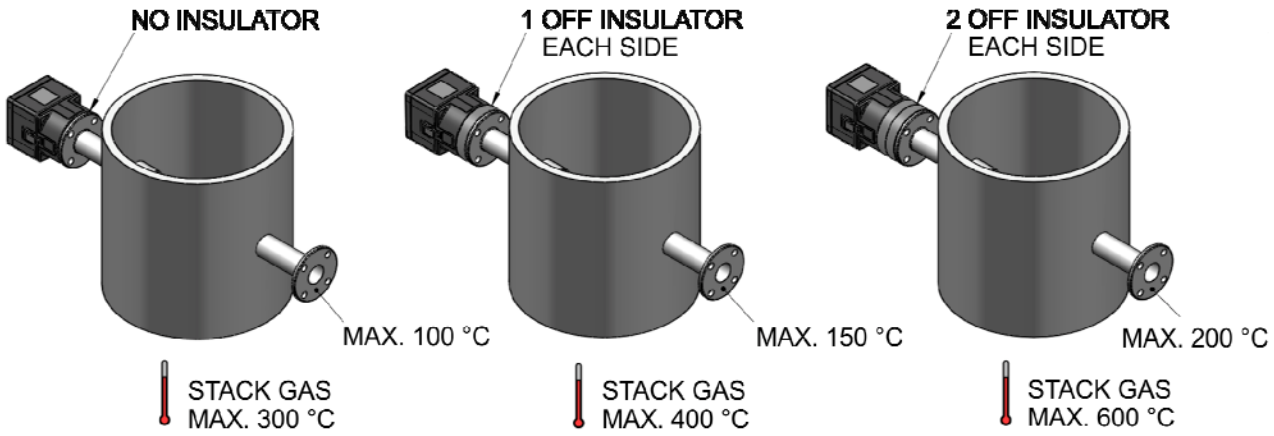
Direct sunlight

The maximum stack gas temperature should not exceed 600°C, and the mounting flange face temperature must not exceed 200°C.

Where the gas temperature exceeds 150°C it is recommended that an air-purge system is properly installed to provide an additional cooling effect. On all installations Teflon washers with a minimum thickness of 5mm must be used to thermally insulate the mounting bolts from the hot mounting flange.

Where the stack gas temperature exceeds 300°C, or the mounting flange surface temperature exceeds 100°C, a heat insulating gasket (available from MRU GmbH) must be fitted between the stack flange and the air-purge head on both sides of the stack (i.e. both Reflector and TRX) to prevent excess heat being conducted into the heads.

Where the stack gas temperature exceeds 400°C, or the mounting flange surface temperature exceeds 200°C, 2 heat insulating gaskets (available from MRU GmbH) must be fitted between the stack flange and the air-purge head on both sides of the stack (Reflector and TRX) to prevent excess heat being conducted into the heads.



The ambient air temperature around the heads should be >-20°C / <50°C.

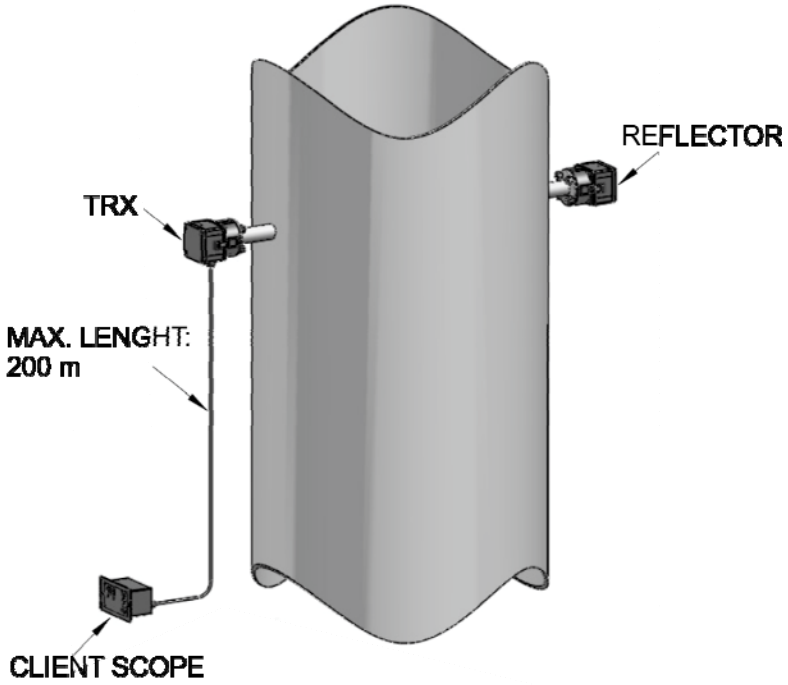
If the ambient air temperature around the head is being affected by radiated heat from the duct, the use of rock wool lagging on the duct, or a heat shield in front of the heads, may be necessary.

Where the heads are mounted externally they should be shielded from direct sunlight at all times. The heads may be mounted under a canopy or shelter, or alternatively an optional weather cover is available from MRU GmbH.

Temperature is one of the most important considerations in choosing the correct location for the heads.

5.2.7 Cable lengths

- Cable lengths should be kept as short as possible to reduce voltage loss and to reduce the possibility of interference pickup.



The cable *route* should also be considered. Avoid laying the DM 401 cables over, or alongside anything which may emit electromagnetic or RF signals, such as heavy power cables or switch gear cabling. Tight bends, pinching, clamping, and the possibility of wear or abrasion must also be avoided.

Note: use of ferrite bead at both ends of cable is mandatory!

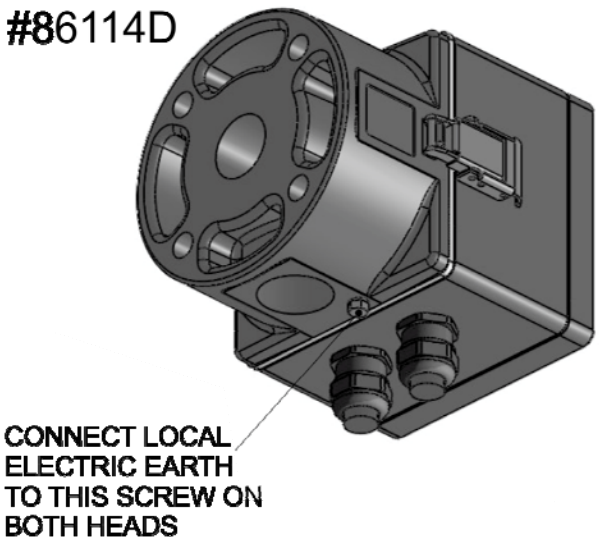
5.2.8 Earth connections

- Earth connections on both the metal air-purge heads are essential to protect the electronic circuit boards inside the Reflector and TRX heads from the effects of Electro Static Discharge (ESD) and high voltage surges.

If the metal air-purge bodies are not directly earthed, any local ESD or high voltage surge is likely find a path to earth through the sensitive circuit boards inside the heads. However, if the air-purge heads are properly earthed that same ESD or surge would find its way back to earth through the proper electrical earth connection instead of through the heads.

In practical terms this means that properly earthed heads are more likely to survive nearby lightning strikes (which generate high voltage surges throughout the plant infrastructure), and less likely to be damaged by any electro-static charge generated by friction with low level cloud on equipment sited at height (i.e. on tall stacks).

A heavy duty earth wire, or braid, should be connected between the M5 screw (located alongside the air inlet) on each air-purge body, and a proper electrical earth point. It is not acceptable to rely on the stack or the mounting flanges as an earth point.



Failure to make a proper earth connection to the air-purge bodies will leave the instrument vulnerable to damage from ESD and high voltage surges.

5.2.9 Summary

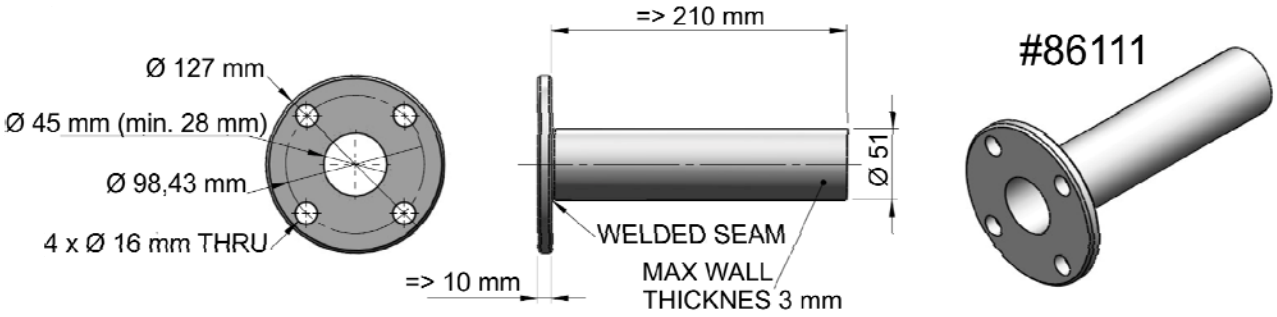
- **Summary:** Taking all the above points into consideration a considered decision should be made on where to locate the Reflector and TRX. If it is impossible to satisfy all the recommended criteria please make a sensible compromise rather than disregard one point altogether.

Having chosen a suitable location, you should now prepare the mounting flanges and install them at the chosen location.

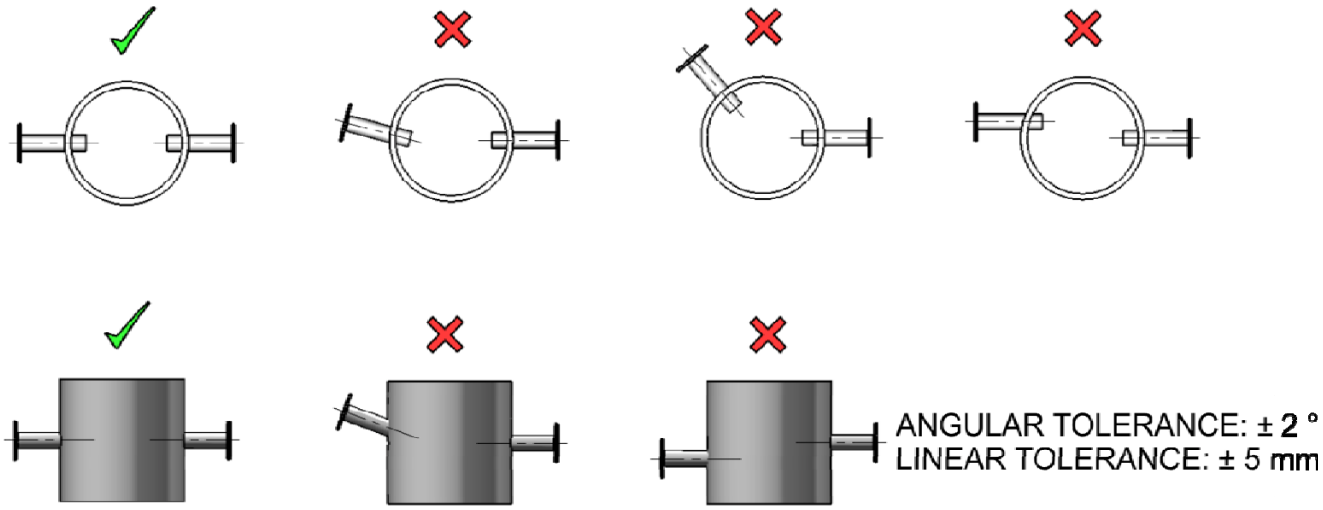
5.3 Mounting the heads

The Reflector and TRX heads must be mounted directly opposite each other across the stack or duct, so that light from the TRX passes through the centre of the duct and falls directly onto the Reflector.

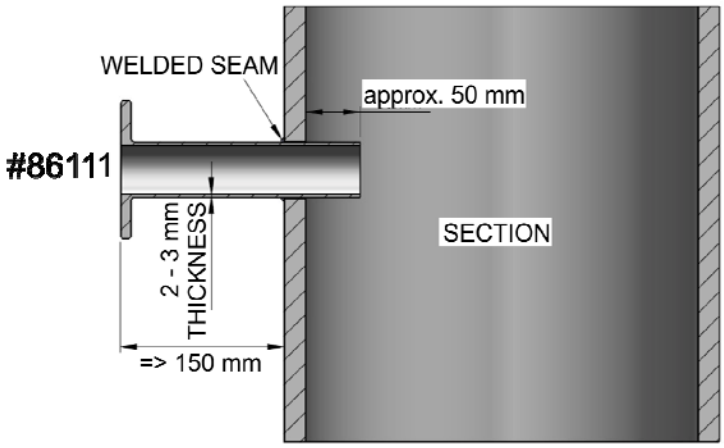
Each head should be bolted to a suitable mounting flange (1.5" ANSI 150) extension on the stack. See below for the suggested construction details of a suitable mounting flange extension. Alternatively, mounting flange extensions can be purchased from MRU GmbH.



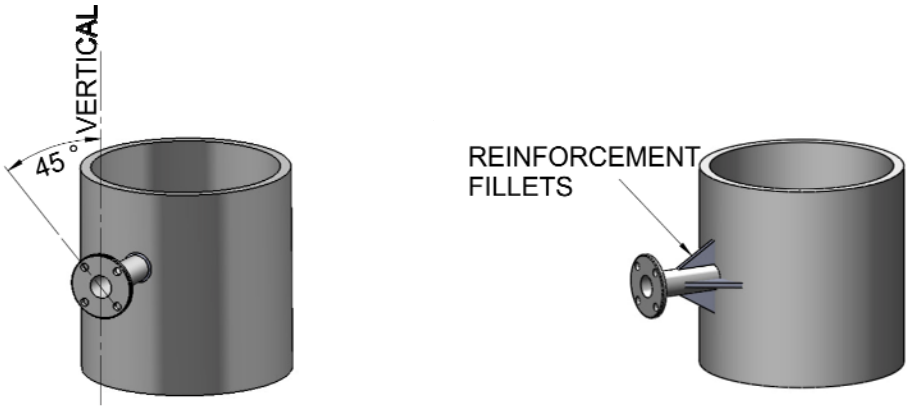
The mounting flange extensions should be fitted on opposite sides of the stack such that the bore of both extension tubes are concentric and co-linear, with a maximum angular alignment tolerance of +/-2° and a maximum liner alignment tolerance of +/-5mm (see below).



The flange extension tube should pass through the wall of the stack and protrude slightly (~50mm) into the duct. The purpose of the intrusion is to prevent any dirt or slime build-up on the inner wall of the duct falling down the wall and passing through the light path – instead it will fall around the protrusion. Keep the flange extension tube as short as possible whilst maintaining the minimum flange/stack distance shown below.



The flange extensions should be installed with the bolt holes at 45° to the vertical, as shown below.



The mounting flange extensions must be installed on a sturdy section of duct where there is no danger of movement or vibration. The mounting flanges must maintain angular alignment at all times during operation. Relative movement between the TRX and Reflector will cause errors in the reading. Thin wall stacks should be reinforced at the head location, or alternatively a sturdy support frame should be made up to support the heads.

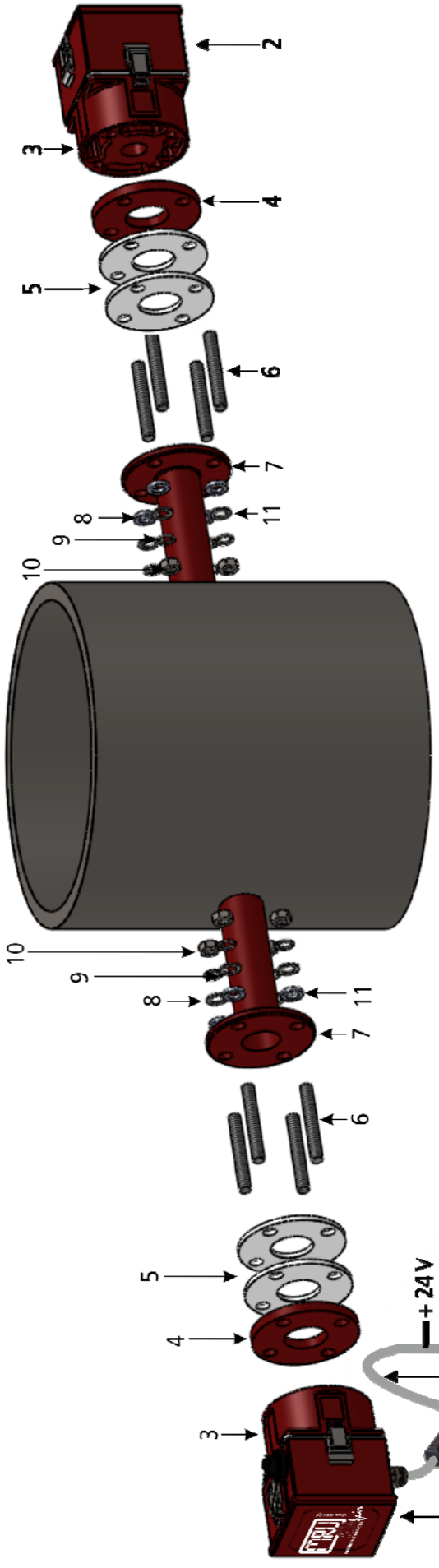
The DM 401 air-purge heads have 4 threaded (M14) holes on a PCD to match the mounting flange. The heads can be installed on the mounting flange either by inserting a bolt from the stack side of the flange, or by fitting short lengths of threaded stud into the air-purge head and securing them from the stack side of the flange with matching nuts.

Select bolts and studs of a suitable length, and remember to allow for the additional thickness of the rubber flange gaskets and any heat insulating flanges and washers or weather shield that may be fitted as part of the installation.

If heat insulator gaskets are required, they must be fitted between the mounting flange and the rubber alignment gasket, so that the insulator is the only part in contact with the hot mounting flange. The rubber alignment gaskets must not come into contact with any surface that has a temperature in excess of 100°C.

Where heat insulating gaskets are used, Teflon washers with a minimum thickness of 5mm must be used to thermally insulate the fixing nuts/bolts from the hot mounting flange.

It is essential that the rubber alignment gaskets are fitted in all installations, as they allow for small changes to be made in the angular alignment of the heads (by applying uneven torque on the flange bolts). This enables operators to adjust the angular alignment of the head for optimum signal strength during the commissioning process.



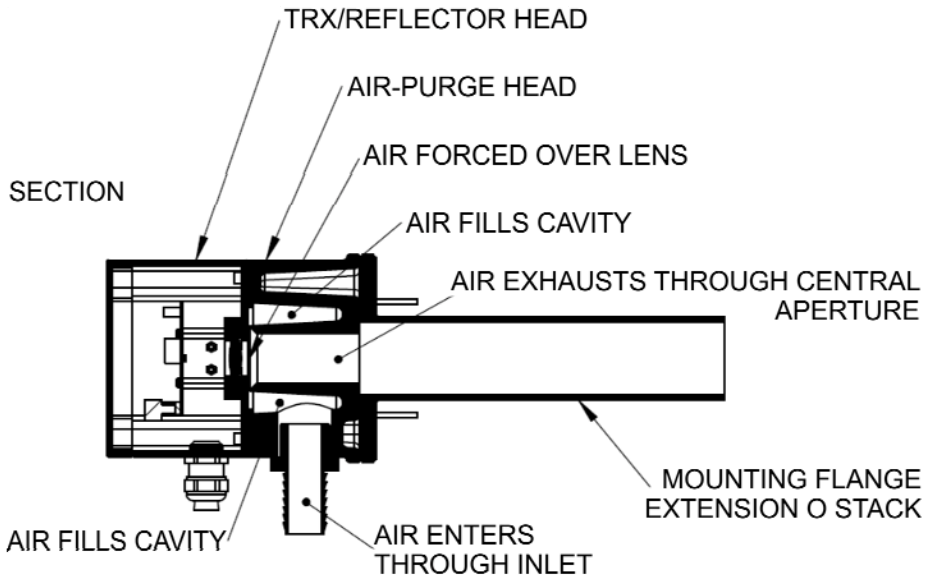
Pos.	#	Qt.	Description	Comments
1	#86114C	1	TXR HEAD	Transceiver with electronics
2	#86114A	1	REFLECTOR HEAD	For short optical path (0,5 – 4m)
2	#86114B	1	REFLECTOR HEAD	For long optical path (3 – 10m)
3	#86114D	2	PURGE HEAD	To connect the purging air for keep the optics free of dust
4	#86114E	2	RUBBER ALIGNMENT GASKET	Supplied with instrument for alignment of optics
5	#86114E	4	HEAT INSULATING GASKETS	Supplied with instrument ; use 2 sets in case of high stack tempe-rature
6	#86112	8	M14 x 100 mm THREADED STUDS	
7	#86111	2	1,5" AINSI FLANGE	Supplied with instrument
8	#86112	8	FLAT WASHERS	
9	#86112	8	SPRING WASHERS	
10	#86112	8	M14 NUTS	Tool: 22mm wrench used for alignment
11	#86114F	8	TEFLON WASHERS	Required for high stack temperature
12	#86114F	2	FERRITE	To prevent EMI influence on TRX head
13		1	CABLE	2x 2wire shielded (user scope)

5.4 Installing an air purge system

The main purpose of an air purge system is to keep the optical surfaces clean and free from dirt.

The air-purge system achieves this by passing air directly over the optical surfaces (thereby preventing dirt from settling), and also by producing a pressurised stream of laminar air-flow moving out of the head and into the stack. This laminar air-flow provides a clean air barrier between the optics and the stack gas.

The sectioned diagram below shows how the air-purge head works. Clean air enters via the inlet, filling the cavity around the central aperture, and is then forced out through a narrow gap adjacent to the surface of the lens, before exhausting out through the central aperture in the air-purge head, and down the flange extension tube to the stack.



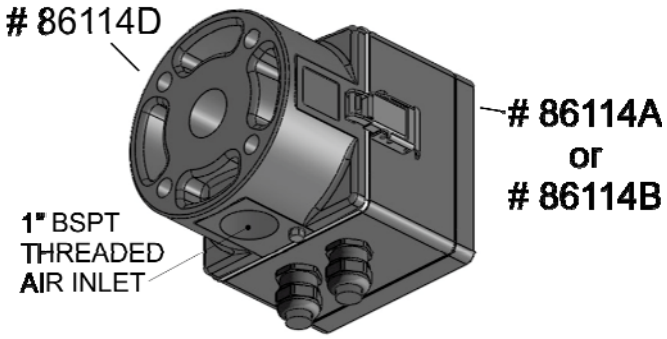
Both air-purge heads have a 1" BSPT threaded inlet port to provide a large bore entry for high volume supply of clean dry air.

The air supply must be clean, dry, and free from oil, so the inlet air must be drawn from a clean source and must be properly filtered before entering the air-purge heads.

The air supply should have a flow rate in the range 5 to 60m³/h, and the pressure must be sufficient to defeat the maximum pressure expected in the stack, but must not exceed 500mbar (7psi).

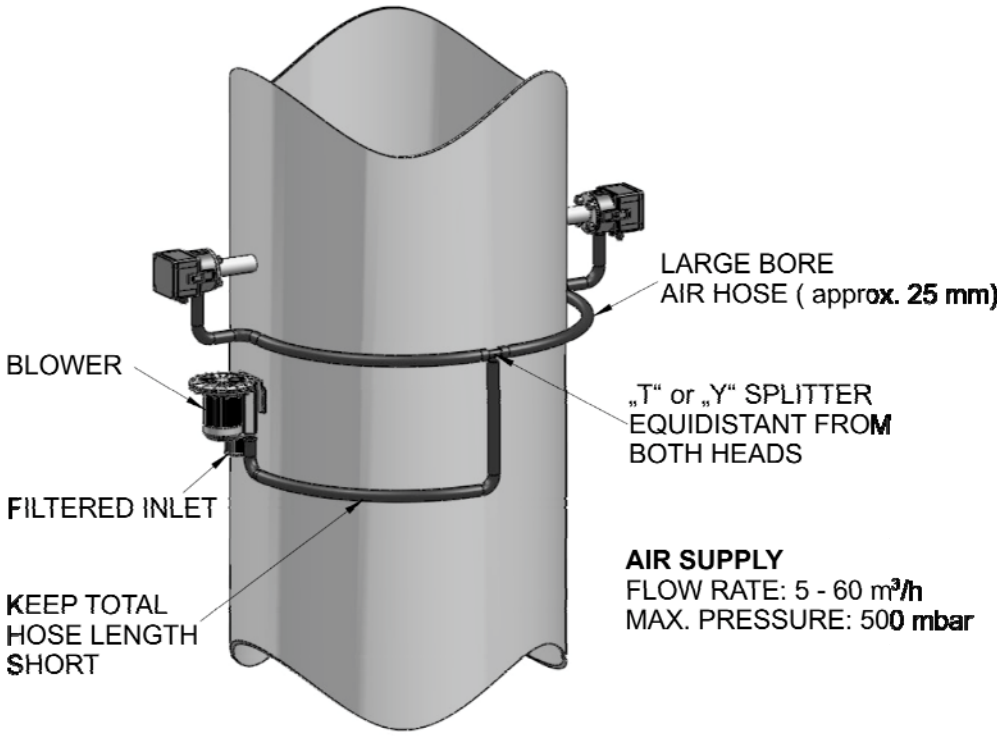
Most stacks are negative pressure and will have a natural "draft" drawing air into the stack, but some stacks can be positive pressure, or may have periods of positive pressure during certain conditions. In these circumstances the pressure of the air purge system should be sufficient to defeat the maximum possible positive pressure that may be experienced in the stack.

The best way to provide a suitable air supply is to use a local blower fan. Blowers produce excellent flow rates, but are usually only relatively low pressure (in the order of 50mbar (0.7psi).



Ideally the blower should be installed locally to the heads, and should have short, large bore (~25mm) hose connections. The blower intake must be filtered and the filter must be sheltered so that the blower only draws in clean dry air.

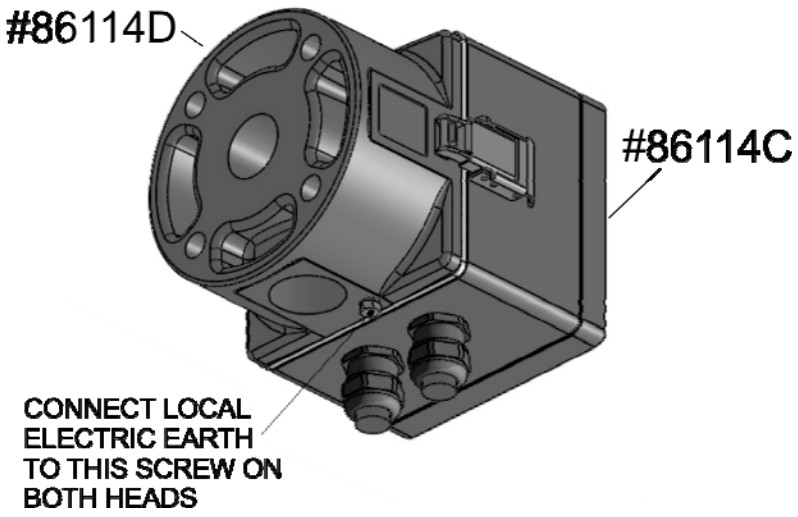
Where a single blower is used to supply both Reflector and TRX heads a "T" or "Y" piece splitter should be used to separate the air supply. This splitter should be installed so that the hose between splitter and TRX is the same length as the hose from splitter to Reflector. Maintaining equal hose lengths between the splitter and the heads will ensure that both heads receive equal pressure and flow rates from the blower.



5.5 Earth connection

A heavy duty earth wire, or braid, should be connected between the M5 screw (located alongside the air inlet) on each air-purge body, and a proper electrical earth point.

It is not acceptable to rely on the stack or the mounting flange as an earth point.



Failure to make a proper earth connection to the air-purge bodies will leave the instrument vulnerable to damage from ESD and high voltage surges.

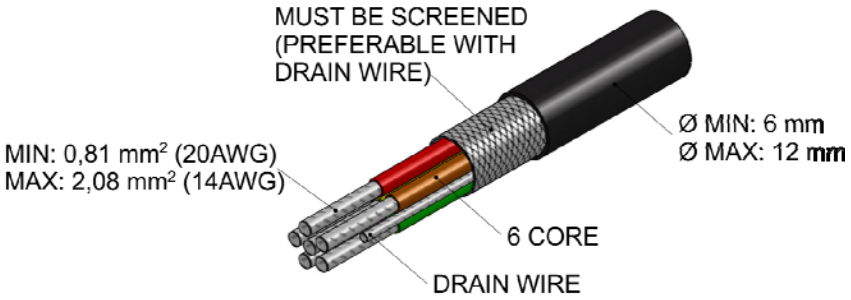
6 Physical Installation of the Cable

Because of the potentially long and variable lengths of cable required to connect up the DM 401, this instrument is not supplied with any interconnecting cable and suitable cable must be sourced locally or purchased separately from MRU GmbH.

All cables should have an individual core size of between 0.81mm² (20AWG) and 2.08mm² (14AWG).

All cables should be screened, and should preferably have a drain wire to assist termination of the screen inside the heads.

The overall diameter of the cable should be between 6 and 12mm.

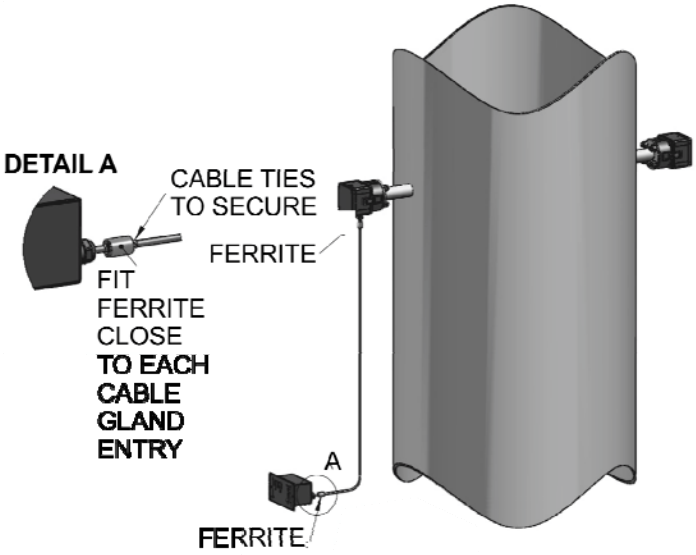


Ideally we recommend the use of a cable with individually screened twisted pairs, such as Belden 9874 (6 core, screened pair, 20AWG).

The DM 401 cables carry sensitive electronic signals which can be affected by RFI and EMI, so care should be taken to run the cables away from high voltage power cables, high frequency signal cables, or switch gear cabling.

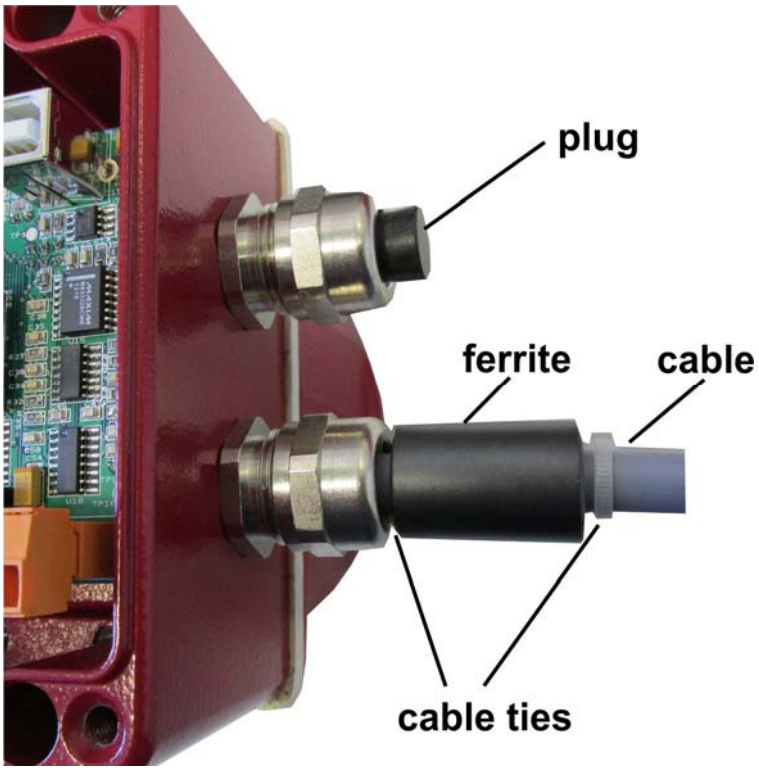
Ideally any cables connecting to the instrument, or between instrument components, will follow an independent route and will not be installed in bundles or cable trays with other cabling.

The supplied ferrite tubes should be fitted on the cables where the cables enter the TRX enclosures. The ferrites should be secured in place so that they remain fixed adjacent to the cable gland entry.



All cables entering the TRX must do so through the cable glands provided. All cable glands must be tightened onto the cable to maintain the enclosures environmental rating.

Any unused cable gland entries should be sealed using the rubber bungs supplied. Tighten the gland onto the rubber bung to ensure protection.



Wiring details are covered in the electrical installation section.

7 Electrical Wiring Details

Warnings

Warning: All aspects of installation, whether electrical or mechanical, should be carried out by suitably qualified engineers.

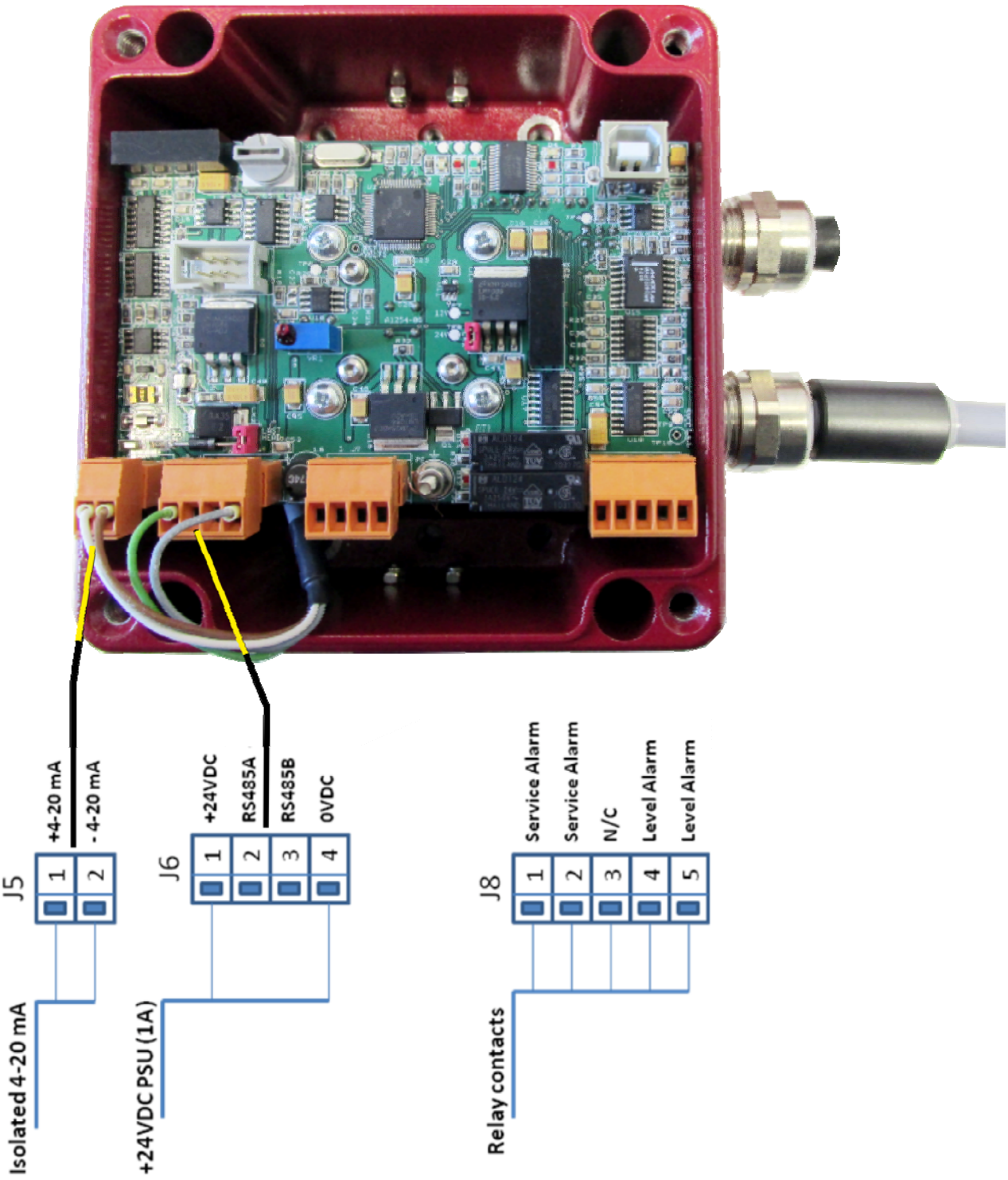
Warning: All electrical work must be carried out with the power to the instrument OFF i.e. it must be isolated from any source of voltage.

Warning: Do not make or break connections whilst power is connected to the instrument. In particular do not separate/mate the two part terminals on the inside the TRX or OI. "Hot plugging" may damage the electronics and require a circuit board to be replaced.

Warning: Avoid opening the head enclosures (i.e. remove the top cover) whilst power is connected to the instrument.

Warning: Take all necessary precautions to prevent moisture from entering the Reflector, TRX or OI enclosures.

Cable specification and physical cable installation are discussed in an earlier section.


J5
1
2
+4-20 mA
- 4-20 mA
Isolated 4-20 mA
J6
1
2
3
4
+24VDC
RS485A
RS485B
0VDC
+24VDC PSU (1A)
J8
1
2
3
4
5
Service Alarm
Service Alarm
N/C
Level Alarm
Level Alarm
Relay contacts

8 Declaration of confirmity

EG-Konformitätserklärung

Declaration of confirmity

CE

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Person authorized to compile the technical documents

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Land / *country:*	Deutschland / *Germany*

Produkt/Product

Bezeichnung /*designation:*	Staub- und Trübungsüberwachung *Dust and opacity monitor*
Produktname / *name:*	DM 401
Funktion / *function:*	Siehe / see Bezeichnung /*designation*

Hiermit erklären wir, dass das oben beschriebene Produkt allen einschlägigen Bestimmungen entspricht, es erfüllt die Anforderungen der nachfolgend genannten Richtlinien und Normen:

We declare the conformity of the product with the applicable regulations listed below:

- EMV-Richtlinie / *EMV-directive* 2004/108/EG
- Niederspannungsrichtlinie / *low voltage directive* 2006/95/EG
- RoHS-Richtlinie / *RoHS directive* 2011/65/EU (RoHS II)

Neckarsulm, 22.11.2013

Erwin Hintz, Geschäftsführer / *Managing Director*

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All technical details and specifications are subject to change without notice

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