

MAS 2600

Tank Contents Transmitter



The content of this publication are presented for information purposes only, and while effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, expressed or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available upon request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice. Damcos A/S and Rosemount Tank Radar AB accepts no responsibility for any errors that may appear in this publication.

As each system may be configured for each delivery, the content and illustrations in this manual may differ from your system.

Table of Contents

Description and Technical Data	3
Description and Operation	5
Technical Specification.....	6
Ordering Information	9
MAS 2600 Ordering Information	11
Type	12
Measuring Ranges	13
Temperature Sensor.....	16
Cable.....	17
Mounting Methods.....	18
Amplifier Box.....	25
Amplifier PCB	26
Intrinsically Safe Installation	27
Intrinsic Safety	29
Intrinsically Safe Installation.....	30
Installation	33
Handling	35
Installation.....	36
Testing and Recalibration	39
Testing	41
Recalibrating Gauge Transmitter Using Pressure on the Transducer	42
Recalibrating Gauge Transmitter using Vacuum (for gauge transmitters only)	43
Recalibrating the Absolute Transmitter Using Pressure on the Transducer .	44
Maintenance and Troubleshooting	45
Maintenance	47
Trouble Shooting	48
MAS 2600 Test Sheet	49
Index	51

Description and Technical Data

Description and Operation

MAS 2600 Tank Contents Transmitter

The MAS 2600 is a 2-wire 4-20 mA level transmitter consisting of a transducer, an amplifier and an interconnecting cable.

Transducer

The transducer is a pressure sensitive silicon micro strain gauge sensor mounted in a glass to metal seal. The sensor is protected by an isolation diaphragm, welded to the transducer housing, with an oil filling between the sensor and the diaphragm. Pressure changes on the front of the diaphragm will bring a resistance change in the Wheatstone bridge of the transducer. This change in the Wheatstone bridge will be transmitted to the amplifier as a change in the electrical signal.

The transducer is fully welded, housed in titanium with a titanium diaphragm.

All transducer types are submersible (IP68).

The transducer is available in two versions:

- Gauge version
- Absolute version

As optional the transducer is available with a built-in Pt100 temperature sensor.

Cable

The cable is available as a standard version and as a high temperature version.

Amplifier

The amplifier is available in the following options:

- Programmable version: Calibration is made by dip switches and potentiometers
- Differential version: For measuring of both pressure and vacuum

The amplifier is housed in a sea water resistant polyester casing (IP56).

Application

The MAS 2600 has been developed for level measuring in ballast, oil, service and fresh water tanks as well as tanks containing media which are not hostile to titanium.

Intrinsically Safe in Hazardous Areas

The MAS 2600 is certified for use with standard transmitter safety barriers or Ex isolation amplifiers and is Ex ia [ia Ga] IIC T4 Gb compliant in accordance with IEC/EN 60079-0 and IEC/EN 60079-11.

Type Approvals

DNV, GL, LRS, MRS, BV, RINA, KRS, ABS, PRS.

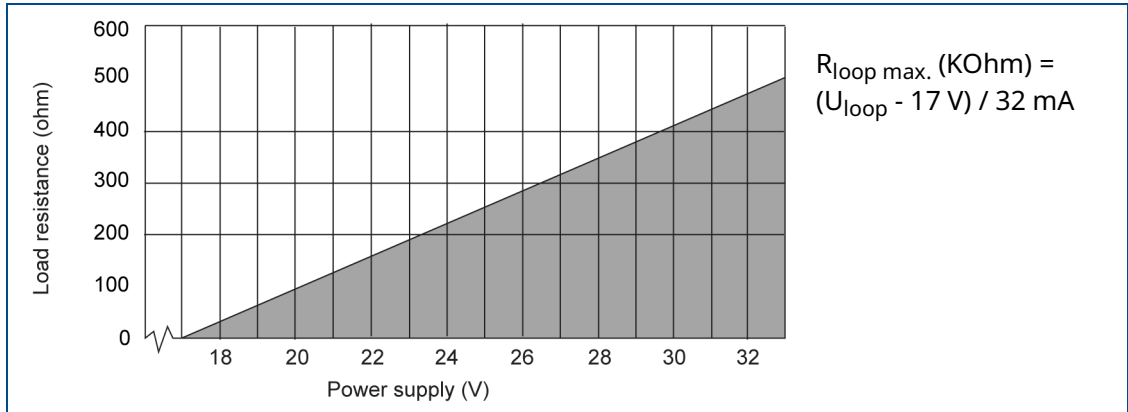
CE marked in accordance with EU directive.

Technical Specification

Transducer Ranges	Gauge	0 - 3.5 / 0 - 7 / 0 - 16 / 0 - 35 m H ₂ O	
	Absolute	0 - 20.394 / 0 - 35.690 m H ₂ O	
Accuracy	± 0.25% F.S. at 20°C		
Stability	Max. ± 0.1% / Year		
TEB (Total Error Band)	± 0.4% F.S. at ±0 to +50°C ± 2.0% F.S. at -20 to +80°C		
Overload Capability	Minimum 4 x transducer range with no changes in calibration. 6 x transducer range burst pressure.		
Built-in Temperature Sensor Pt100	Optional (for safe area only)		
Output Current	4-20 mA DC, loop powered 2-wire system		
Current Limiting	Typical: 25 mA Maximum: 32 mA		
Sensor Materials	Housing	Titanium Grade 2	
	Diaphragm	Titanium Grade 4	
Transducer cable	Safe area	Maximum 300 m	
	Intrinsically safe in hazardous area	Standard cable: 44m High temperature cable: 34 m	
Operating Temperature Ranges	Safe Area	Transducer	-20° to +125°C
		Standard cable	-20° to + 80°C
		High temperature cable	-20° to +125°C
		Amplifier	-20° to + 80°C
	Intrinsically safe in Hazardous Area	Transducer	-20° to +80°C
		Standard cable	-20° to + 80°C
		High temperature cable	-20° to + 80°C
		Amplifier	-20° to + 80°C
Ingress Protection	Transducer	IP 68	
	Amplifier	IP 56	
Intrinsic Safety (IS)	Ex ia [ia Ga] IIC T4 Gb compliant.		

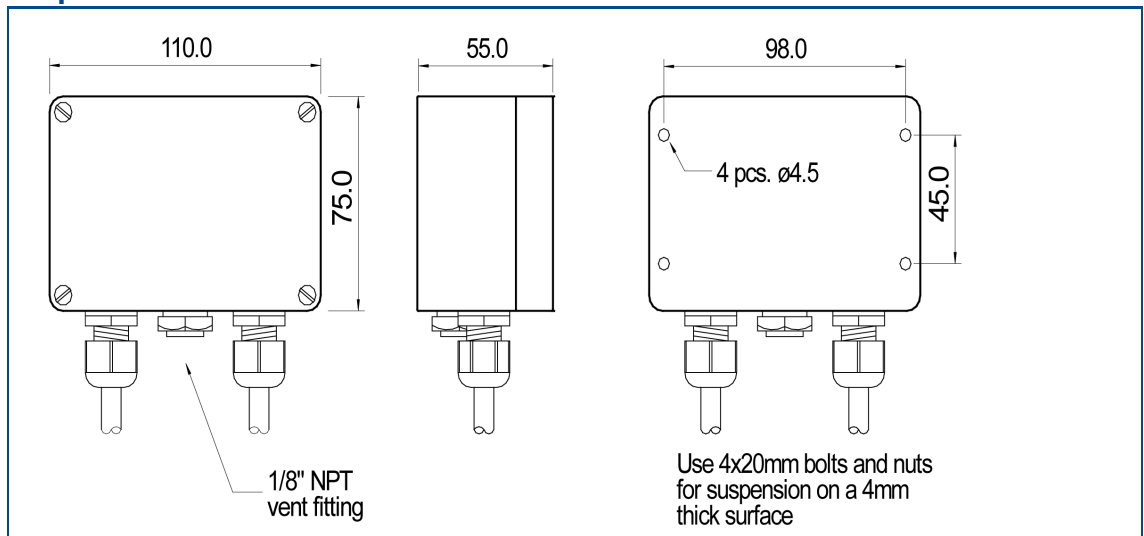
Power Supply

The Power Supply can vary from 17-33 VDC. Permissible load resistance is shown graphically below.

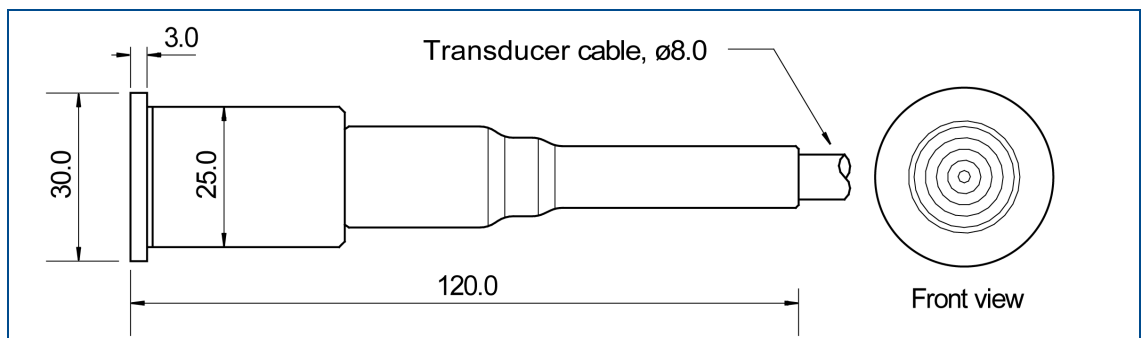


Transmitter Dimensions

Amplifier Box



Transducer



Ordering Information

MAS 2600 Ordering Information

Type						
A	Absolute Transducer					
G	Gauge Transducer					
H	High Temperature Gauge Transducer					
	Transducer Ranges					
	1	3,5 mH ₂ O gauge				
	2	7,0 mH ₂ O gauge				
	3	16,0 mH ₂ O gauge				
	4	35,0 mH ₂ O gauge or 0,8 to 3,5 bar absolute				
	7	0,8 to 2,0 bar absolute				
	Temperature Sensor					
	0	without				
	1	Built-in Pt 100 (not available for IS installations)				
	Cable (length in meters)					
	XX	Standard cable (-20° to 80° C) Maximum length: Hazardous area 44 m, Safe area 300 m				
	XX	High temperature cable (-20° to 125° C) (-20° to 80° C for IS installation) Maximum length: Hazardous area 34 m, Safe area 300 m				
	Mounting					
	0	without fittings				
	1	brackets for internal mounting				
	2	pole mounting				
	3	1" pipe end mounting				
	4	flange mounting DN 25				
	5	flange mounting DN 40				
	6	flange mounting DN 50				
	9	flexible rubber tube mounting (add length in mm)				
	P	flexible PTFE tube mounting (add length in mm)				
	V	DN 25 flange with 1" ball valve mounting				
	A - M	replacement				
	Amplifier Box					
	0	not supplied				
	1	standard box with PG 11 / PG 11				
	2	standard box with PG 11 / PG 13,5				
	3	standard box with PG 11 / PG 16				
	5	standard box with PG 13,5 / PG 13,5				
	Amplifier PCB					
	0	not supplied				
	P	programmable output range gauge				
	D	differential output range gauge				
X	X	X -	XX -	X /	X	X

Type

MAS 2600 -XXX-XX-X/XX

Type		
A	Absolute Transducer	The absolute transducer has no breather pipe, because it refers to absolute vacuum. An atmospheric pressure sensor is used to compensate for the atmospheric pressure. The absolute transducer is especially suitable for open deck applications, where the amplifier box may be exposed to flooding.
G	Gauge Transducer	The gauge transducer is fitted with a breather pipe at the back of the diaphragm to compensate for the atmospheric pressure. The breather pipe is connected to a vent plug in the amplifier box. The gauge transducer is suitable for most applications.
H	High Temperature Gauge Transducer	The transducer is mounted with a special high temperature cable and designed for heated tanks e.g. HFO tanks, and other applications with high tank media temperatures.

Selecting the Transducer Type

Gauge and High Temperature Gauge Transducers

The Gauge Transmitter is normally used on dry and pressure neutral locations.

The Gauge Transmitter is available in 4 ranges:

- 0 - 3.5 mH₂O.
- 0 - 7.0 H₂O.
- 0 - 16.0 mH₂O.
- 0 - 35.0 mH₂O.

Absolute Transducers

The Absolute Transmitter is typically used if the amplifier is exposed to water, e.g. on open deck.

The Absolute Transmitter is available in 2 ranges: 0 - 20 and 0 - 35 mH₂O. In practice this means

10 mH₂O less than the nominal range because of the atmospheric pressure which must be taken into consideration when choosing the transducer.

A transducer with an effective range larger than the tank height should be selected.

Measuring Ranges

MAS 2600 -XXX-XX-X/XX

Gauge Transmitter

The MAS 2600 Gauge Transmitter is supplied in 4 ranges. In the programmable amplifier the measuring range is divided into 8 sub-ranges and operated by means of the range select switch.

The transmitter output signal can be adjusted to 20 mA within the sub-ranges as of the table below.

Range no.	Transducer Type			
	Type 1: 0 - 3.5 mH ₂ O	Type 2: 0 - 7.0 mH ₂ O	Type 3: 0 - 16.0 mH ₂ O	Type 4: 0 - 35.0 mH ₂ O
1	0.20 - 0.37 mH ₂ O	0.20 - 0.30 mH ₂ O	0.50 - 0.75 mH ₂ O	1.00 - 1.90 mH ₂ O
2	0.37 - 0.54 mH ₂ O	0.30 - 0.50 mH ₂ O	0.75 - 1.00 mH ₂ O	1.90 - 2.80 mH ₂ O
3	0.54 - 0.73 mH ₂ O	0.50 - 0.70 mH ₂ O	1.00 - 1.50 mH ₂ O	2.80 - 3.90 mH ₂ O
4	0.73 - 1.10 mH ₂ O	0.70 - 1.10 mH ₂ O	1.50 - 2.50 mH ₂ O	3.90 - 5.80 mH ₂ O
5	1.10 - 1.92 mH ₂ O	1.10 - 1.80 mH ₂ O	2.50 - 4.00 mH ₂ O	5.80 - 9.90 mH ₂ O
6	1.92 - 3.10 mH ₂ O	1.80 - 3.00 mH ₂ O	4.00 - 6.00 mH ₂ O	9.90 - 15.30 mH ₂ O
7	3.10 - 3.50 mH ₂ O	3.00 - 4.80 mH ₂ O	6.00 - 10.00 mH ₂ O	15.30 - 25.10 mH ₂ O
8	Not Applicable	4.80 - 7.10 mH ₂ O	10.00 - 16.00 mH ₂ O	25.10 - 35.60 mH ₂ O

Absolute Transmitter

The MAS 2600 Absolute Transmitter is available in two ranges.

The output signals are calibrated as follows:

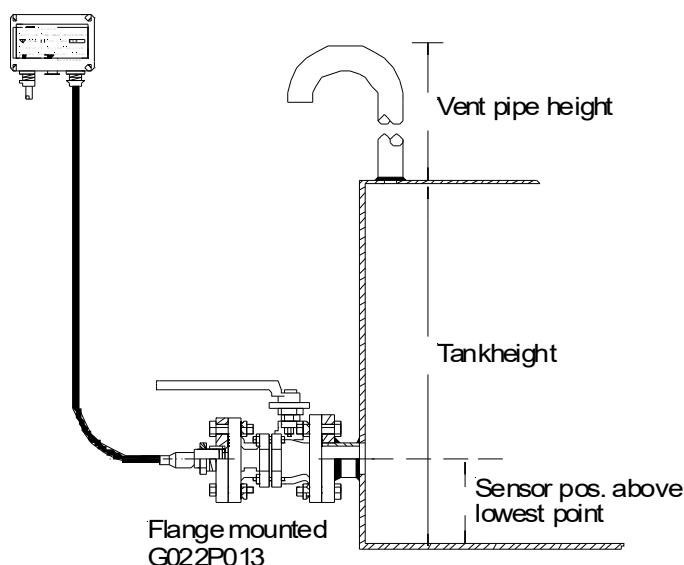
Transducer Type	
4	0.8 - 3.5 bar abs
7	0.8 - 2.0 bar abs

Selecting the Measuring Range

When selecting the measuring range it is important to consider the tank height, vent pipe height, the tank type and the specific gravity (SG) of the tank contents.

The transducer measures the height of the fluid from the transducer diaphragm to the surface of the fluid, including the fluid in the vent pipe.

MAS 2600 Amplifier box



To ensure measuring accuracy a transducer type within the range no. 4, 5, 6, 7 and 8 is recommended.

Guidelines for selection of transducer measuring ranges are set out in the following.

Basic Rules

1. The selected measuring range must be larger than the tank height.
2. The selected measuring range must be larger than: $(\text{tank height} + \text{vent pipe height}) / 2$

Example:

Tank height = 6 m

Vent pipe height = 14 m

1. The selected measuring range must be larger than 6 m due to the height of the tank.
2. The selected measuring range must be larger than $(6 + 14) / 2 = 10$ m due to the total height of the tank and the vent pipe combined.

Select a transducer with a measuring range of 16 mH₂O as this is the next measuring range larger than 10 m.

Turn the range select switch on the amplifier to range No. 7.

Normally the selection of transducer, range select and calibration are done by Marine Tank Management.

Special consideration applies to e.g. forepeak tanks and draft measuring when selecting the measuring range of the transducer.

If the transducer is installed in tanks which may have excessive dynamic stresses such as e.g. high pump pressure, long bottomed tanks with a risk of sloshing etc., contact Marine Tank Management.

Forepeak Tank

If transducer measuring range > tank height: Select the next measuring range.

Example:

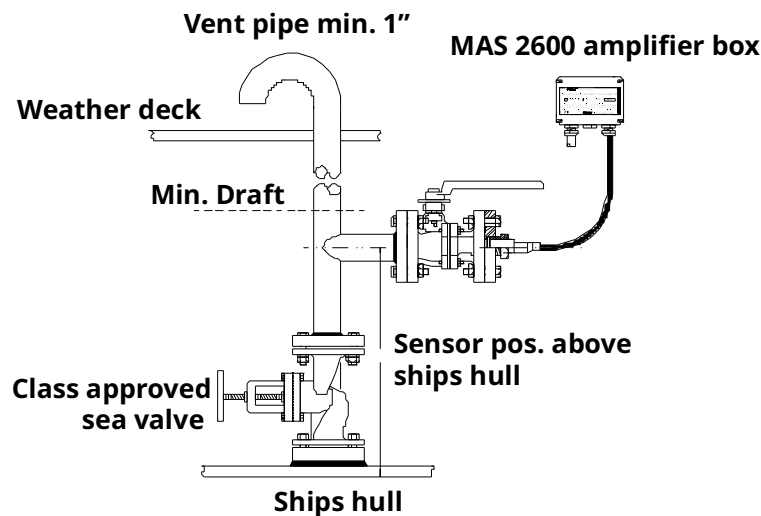
Tank height 12 m.

Based on the tank height a transducer with a measuring range of 16 mH₂O should be selected.

However, due to the dynamic conditions in the forepeak tank, a transducer with a measuring range of 35 mH₂O, i.e. the next in line, should be selected.

Turn amplifier range select switch to range No. 6.

Draft



Transducer measuring range > max. draft minus sensor position.

This rule applies provided the transducer is mounted in accordance with the installation drawing for draft transmitters (vent pipe min. 1"). The sensor may be mounted directly on the sea valve with an air release valve depending on ship type and environment, always consult Marine Tank Management for proper installation guidance.

Temperature Sensor

MAS 2600 -XX^X-XX-X/XX

The transducer can be supplied with a built-in Pt100 temperature sensor. The temperature sensor will only give a proper reading, if the transducer is an internally mounted type.

Temperature Sensor	
0	Without temperature sensor.
1	With temperature sensor.

Cable

MAS 2600 -XXX-**XX**-X/XX

Two types of transducer cables are available. The standard cable for applications with temperatures up to 80°C, and high temperature cable for applications with temperatures up to 125°C. The transducer cable is delivered in whole meters.

To make the MAS 2600 transmitter easy to install, and for later service purposes, the transducer cable should be as short as possible, though considering the position of the transducer and amplifier box.

Note! **Maximum cable length:**

Safe area

Standard cable 300 m

High temperature cable 300 m

Hazardous area

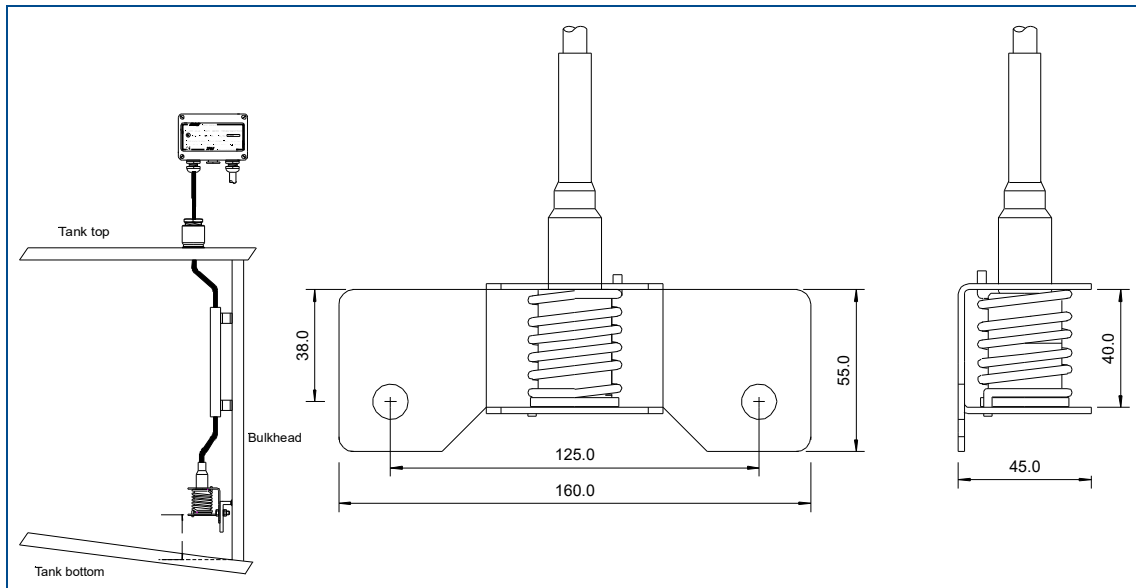
Standard cable 44 m

High temperature cable 34 m

Mounting Methods

MAS 2600 -XXX-XX-X/XX

Brackets for Internal Mounting (dwg no. P022P010)



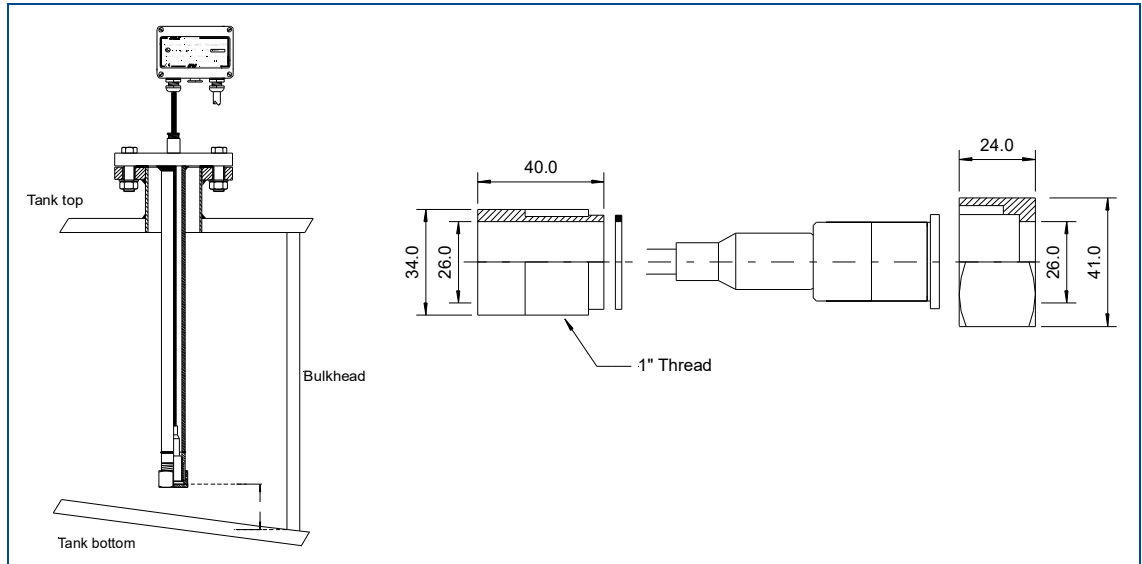
The brackets are U-shaped and manufactured of 2 mm ASTM 316L plated steel. Diameter of mounting holes: 11.5 mm. The transducer is secured by means of a spring fitted into two holes in the “U” shape, and can be mounted/dismounted without the use of tools.

When installing in hazardous areas the cable must be protected by a steel pipe welded to the tank.

Also consider not to install to close the pump inlets.

Note! Internal mounting in service tanks is not recommended due to limited possibilities to perform service and maintenance.

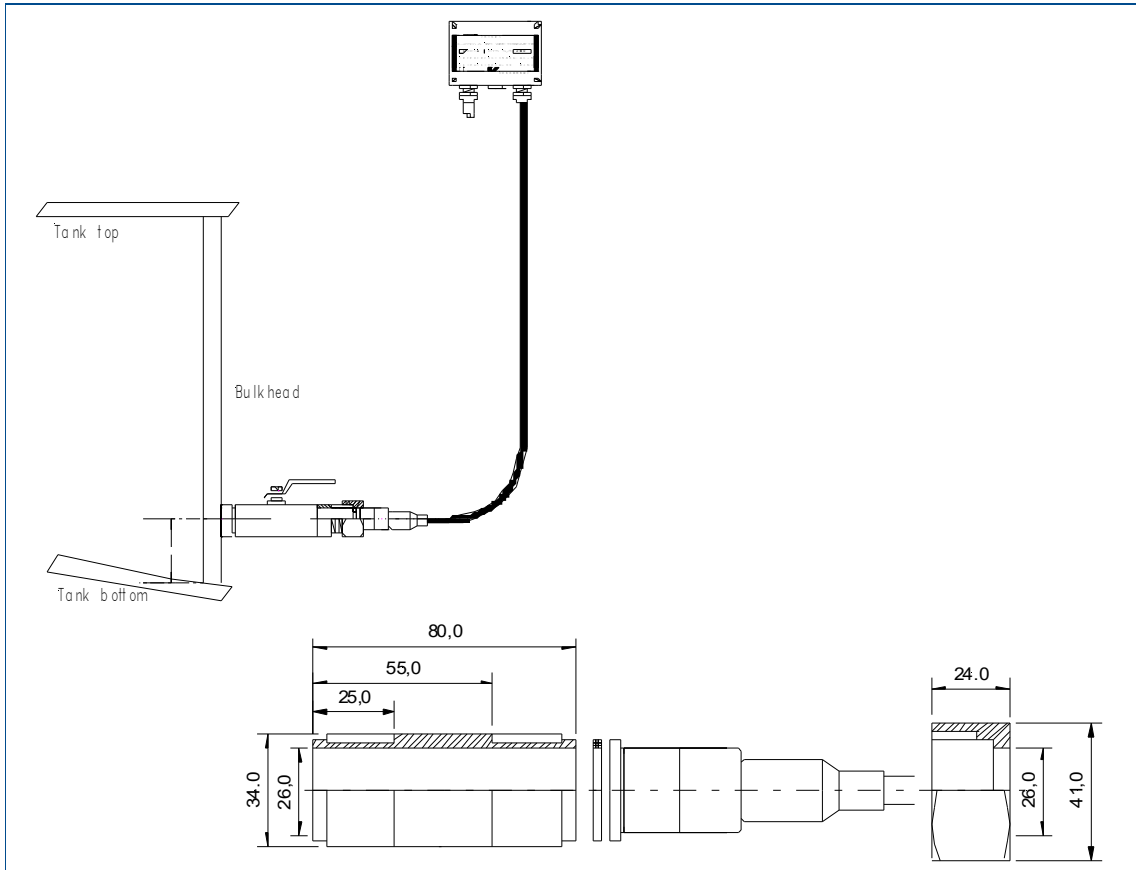
Pole Mounting (dwg no. P022P011)



The weldable collar and the nut are manufactured of ASTM 316L steel. The gaskets are made of nitrile rubber.

Note! Max torque 20 Nm (slightly tighten by the hand + 1/8-1/4 turn).
Remember the gasket.

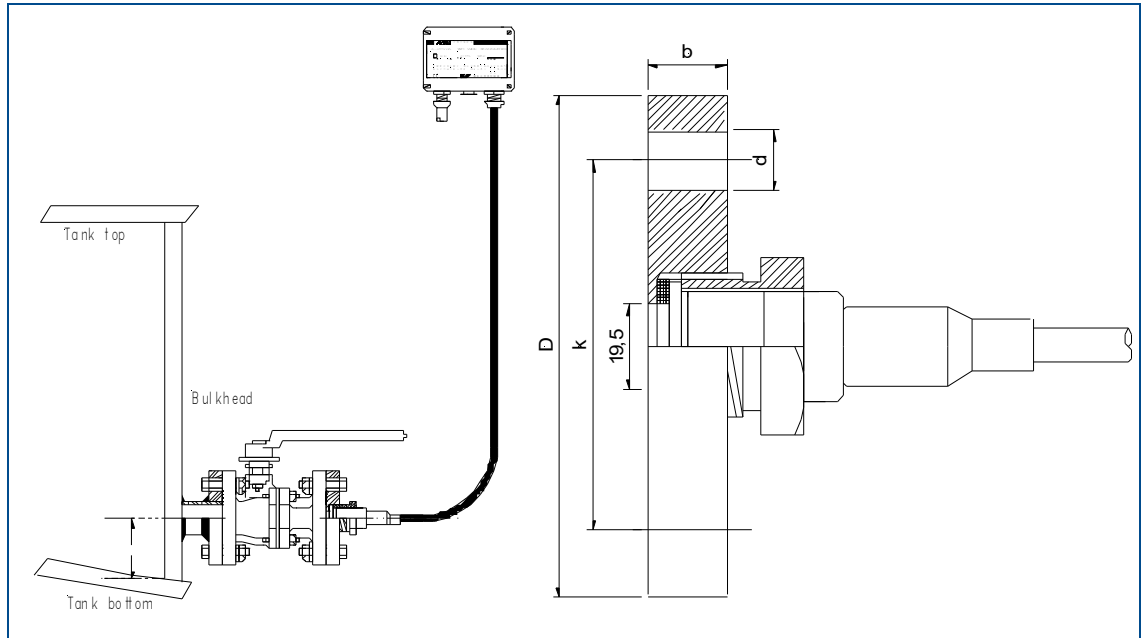
1" Pipe End Mounting (dwg no. P022P015)



The thread collar and the nut are manufactured of SS 316L steel. The gaskets are made of nitrile rubber.

Note! Max torque 20 Nm (slightly tighten by the hand + 1/8 to 1/4 turn).
Remember the gasket.

Flange Mounting (dwg no. P022P013)

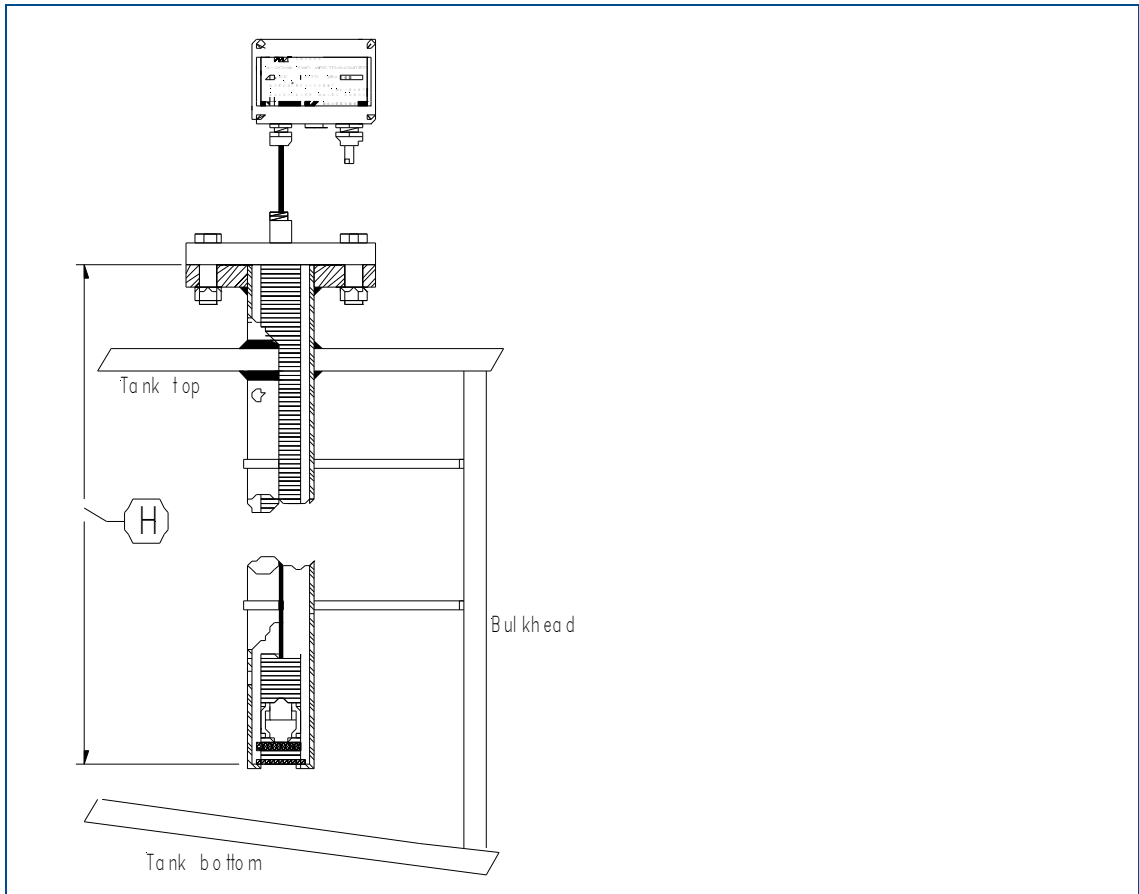


The standard transducer is supplied with DN25, DN40 or DN50 PN16 DIN2527 flange manufactured of ASTM 316L steel.

DN	Flange			Bolts		
	D mm	B mm	K mm	No. of bolts	Thread diameter	d mm
25	115	16	85	4	M12	14
40	150	16	110	4	M16	18
50	165	18	125	4	M16	18

Note! Maximum torque 20 Nm (slightly tighten by the hand + 1/8 to 1/4 turn).
Remember the gasket.

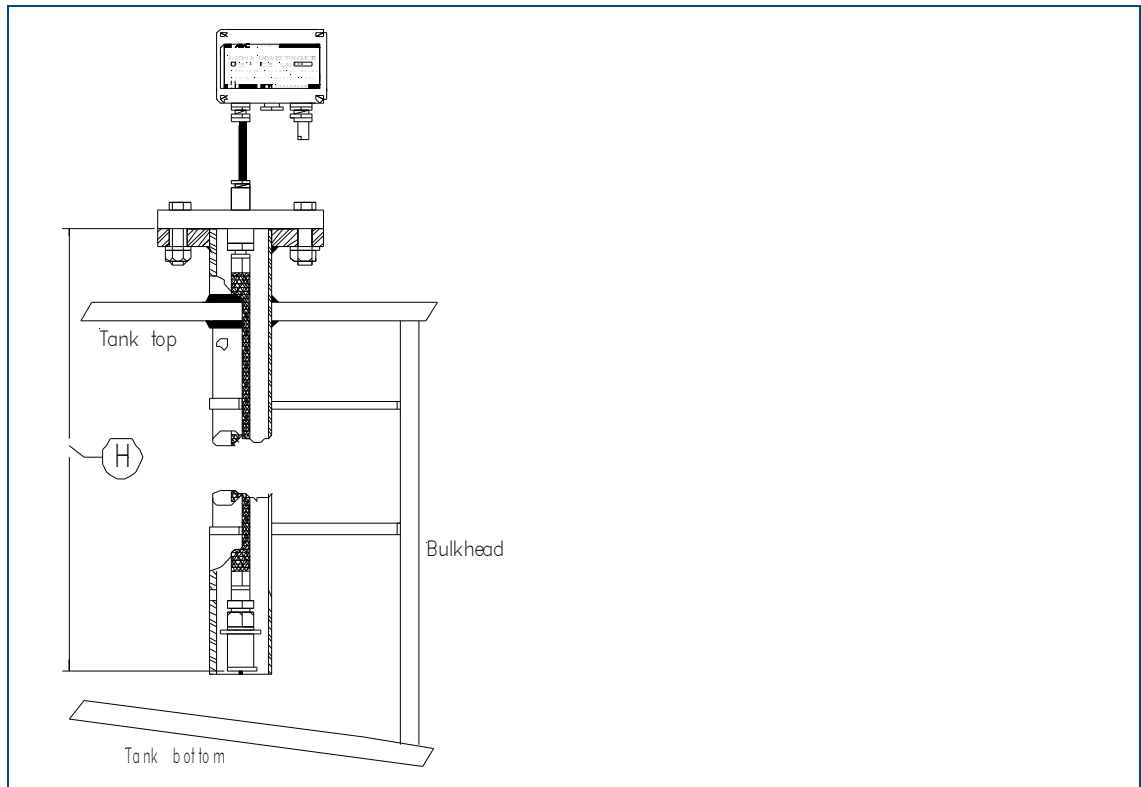
Flexible Rubber Tube Mounting (dwg no. P022P001)



A top flange made of ASTM 316L connected to rubber tube by a tightening clip using a special tool. The opposite hose end covers the transducer body and is fixed by a tightening clip.

Note! When ordering this mounting type always specify the length for the measurement of H (see picture above).

Flexible PTFE Tube Mounting (dwg no. P022P021)

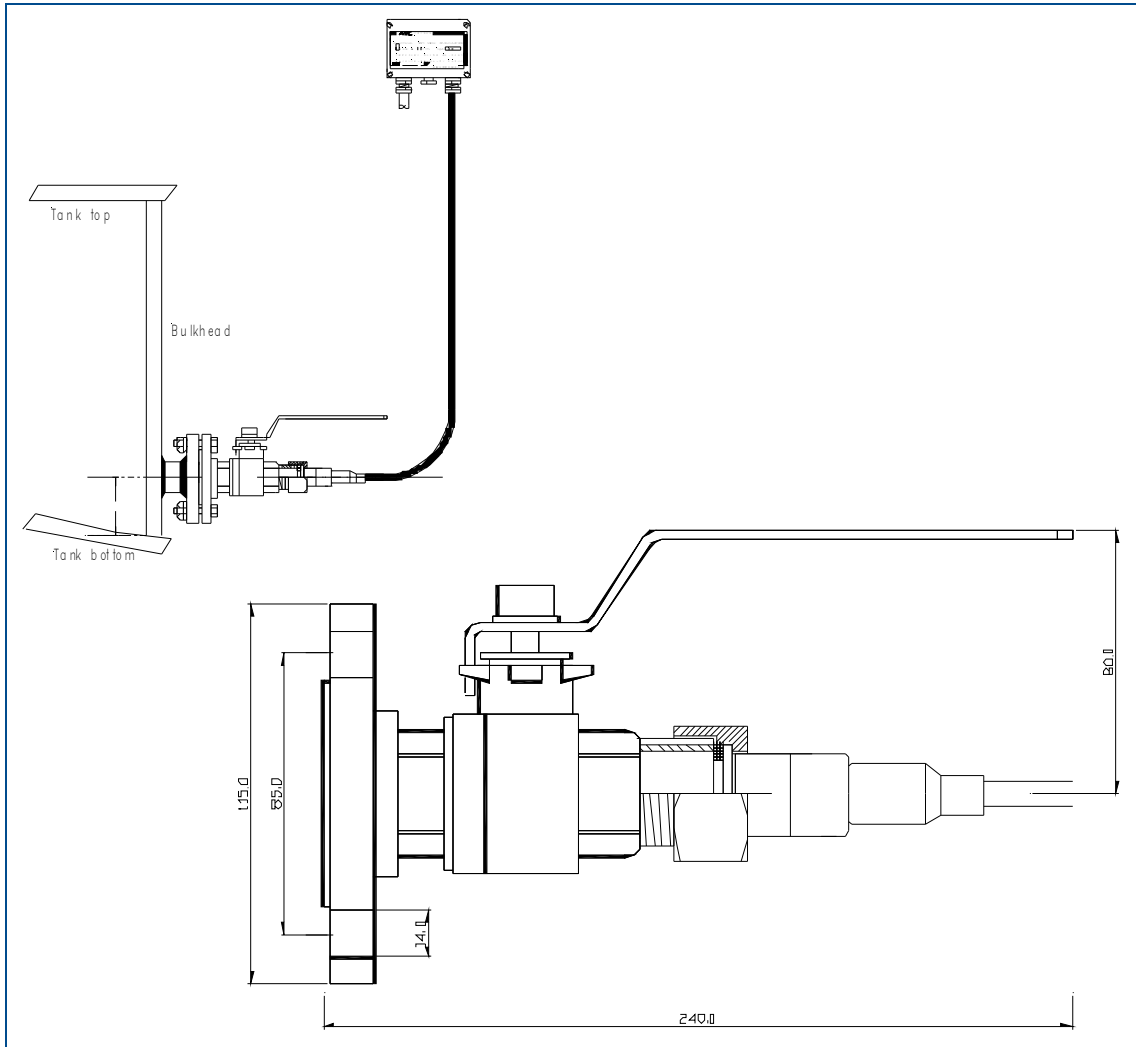


A top flange made of ASTM 316L connected to a Stainless Steel braided PTFE tube by fittings fixed to the tube by using special tools. A fitting in the opposite tube end is fixed to the transducer by means of nut and ferrules. Minimum hose bending radius is 130 mm.

Note! When ordering this mounting type always specify the length for the measurement of H (see picture above).

Note! This mounting type can only be assembled by Marine Tank Management because it requires special tools. The customer can exchange the MAS 2600 transmitter by ordering a G022B085 and a G022B082 together with the new MAS 2600 transducer. It must clearly be specified that it is a replacement for an MAS 2600 XXX-XX-P/XX.

DN25 flange with 1" ball valve (dwg no. P022P019)



Flange, valve and nut are manufactured of ASTM 316L steel. The gaskets are made of nitrile rubber.

Note! Max torque 20 Nm (slightly tighten by the hand + 1/8 to 1/4 turn).
Remember the gasket.

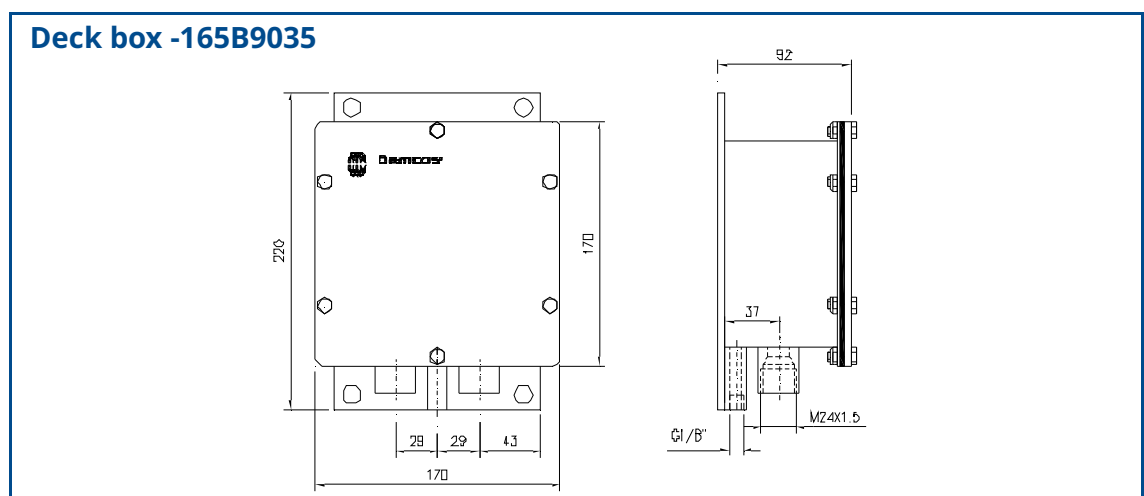
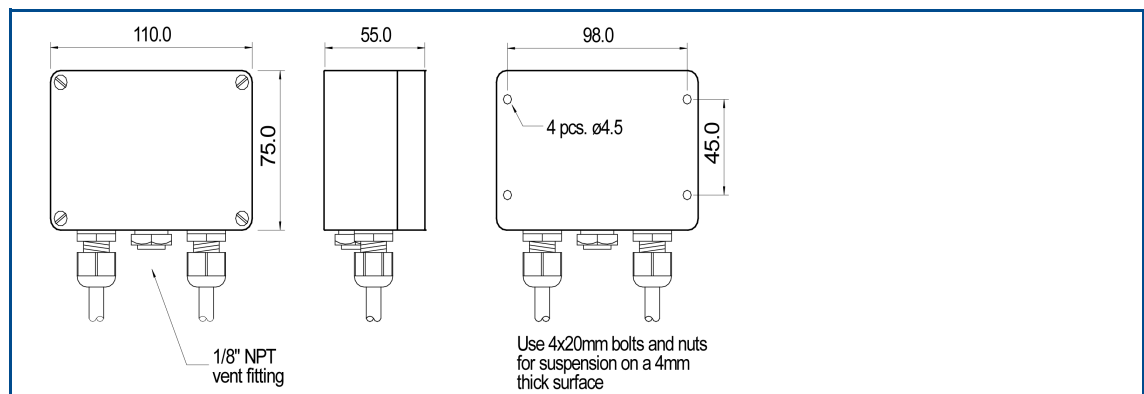
Amplifier Box

MAS 2600 -XXX-XX-X/XX

The MAS 2600 amplifier box is manufactured of polyester, which has the strength and stability of aluminium, insulation and resistance properties of plastics. Color code RAL 7000. The amplifier box is protected to the level of IP 56 and must be mounted outside the tank, e.g. in the engine room or other dry areas.

When the amplifier box is mounted on open deck with the risk of being drenched it is strongly recommended to mount the amplifier box inside the deck box 165B9035. To further reduce the exposure of water place the amplifier box to the center of the vessel.

Amplifier Box	
0	Without amplifier box.
1	Standard box with PG 11/PG 11 cable glands. For cable diameter 5 -10 mm
2	Standard box with PG 11/PG 13.5 cable glands. For cable diameter 6-12 mm.
3	Standard box with PG 11/PG 16 cable glands. For cable diameter 10-14 mm.
5	Standard box with PG 13.5/PG 13.5 cable glands. For cable diameter 6-12 mm.



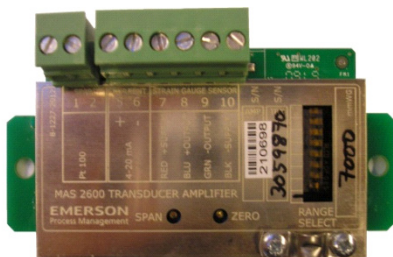
Amplifier PCB

MAS 2600 -XXX-XX-X/XX

The PCB is available in different types for the different transducers.

Amplifier PCB	
O	Without amplifier PCB.
P	Programmable output range. The amplifier can be calibrated to 4-20 mA output in whatever range wanted within the transducer range. Calibration is made by means of dip switches and potentiometers.
D	Differential output range. The output can be adjusted to 12 mA output with no pressure applied. With pressure or vacuum, the output goes against 20 mA and 4 mA respectively. Full-scale and zero point calibration by means of software, e.g. tank monitoring software.

Amplifier PCB



Intrinsically Safe Installation

Description of the Ex safety information and
Intrinsically Safe Installation


MAS 2600

Intrinsic Safety

When connecting equipment in hazardous areas, certain requirements must be fulfilled to comply to the equipment safety certification and cable installation. There are requirements both for the equipment in the hazardous area on deck and for the associated apparatus in the nonhazardous area.

Safety Certifications

The MAS 2600 Level Transmitter is intrinsically safe and meets the requirements of all the major classification societies. The MAS 2600 has the following safety Ex-certifications:

- ATEX:  II 2(1) G Ex ia [ia Ga] IIC T4 Gb
- IECEx: Ex ia [ia Ga] IIC T4 Gb

The MAS 2600 is certified by UL international Demko A/S (certificate DEMKO 11 ATEX 146506X and IECEx Certificate of Conformity no IECEx ULD 10.0013X).

Intrinsic Safety Principle

Intrinsic safety is based on the principle of restricting electrical energy available in hazardous-area circuits, so that any sparks or hot surfaces, that may occur as a result of electrical faults in components, have too low energy content to cause ignition.

An intrinsic safe environment allows the crew or the service personnel to safely maintain the equipment while the ship is in operation.

Precautions are necessary to maintain in safe environment. Precautions related to installation and special considerations for safe use are to be found on page 31.

Intrinsically Safe Installation

The MAS 2600 is designed for use in an approved intrinsically safe installation. The amplifier is fitted with a label describing the IS category:



Item	Explanation
S/N	Serial number - production year
⊕	Ex identification according to guideline 2014/34/EU
II	Equipment group II
2(1)	Sensor mounted in zone 0 and amplifier in zone 1
Ex ia	Denotes the type of protection intrinsic safety, i.e. the system is incapable of causing ignition in normal operation or with any combination of up to two faults applied. This category will be adequate for use in zone 0, 1 and 2.
IIC	Denotes the group of gases
T4	Denotes the maximum surface temperature classification specified (T4: 135 C)
Tamb	Denotes the minimum and maximum ambient temperature. When calculating ambient temperature the effect from external source of heating shall be included.

Relevant intrinsic safety certificates to be supplied with the system units.

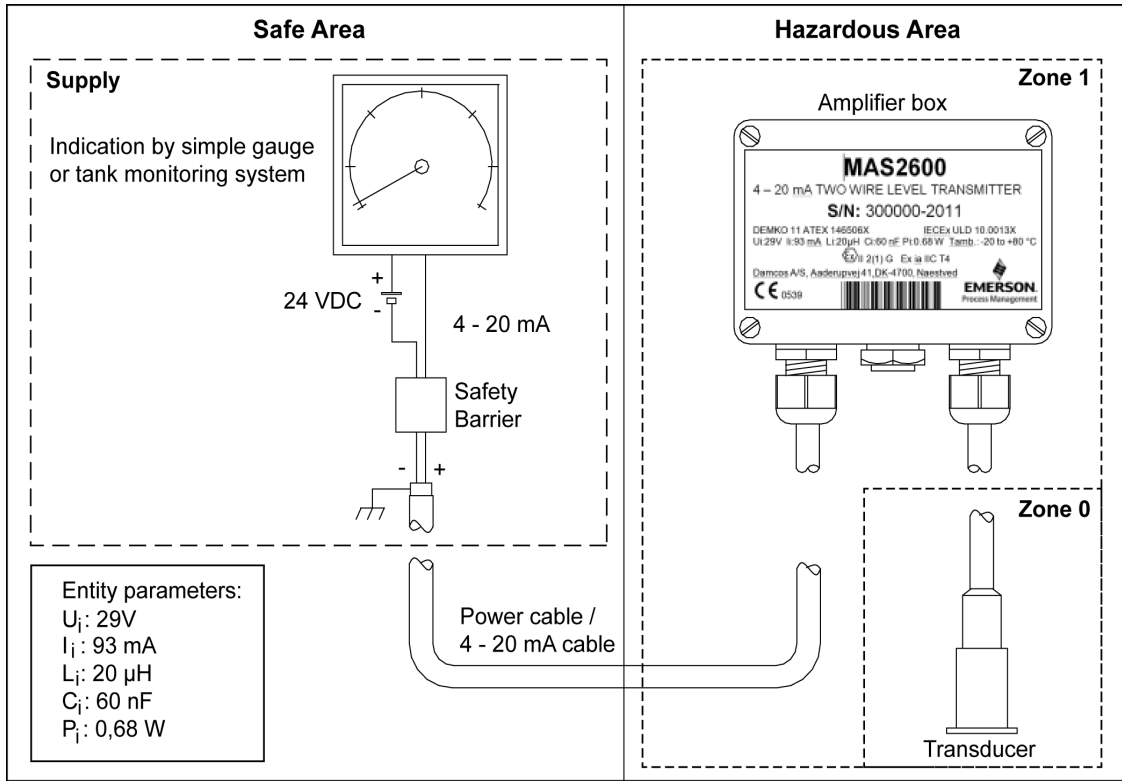
The certification of electric apparatus as intrinsically safe requires the apparatus to be designed and tested in accordance with approved drawings and the apparatus to be installed in accordance with approved block schematic diagrams.

Installation and Special Considerations for Safe Use

Before installing intrinsically safe units within an approved installation, it is essential to ensure that there are no deviations from the conditions of the order or the requirements of the approved block schematic diagram and the following related instructions:

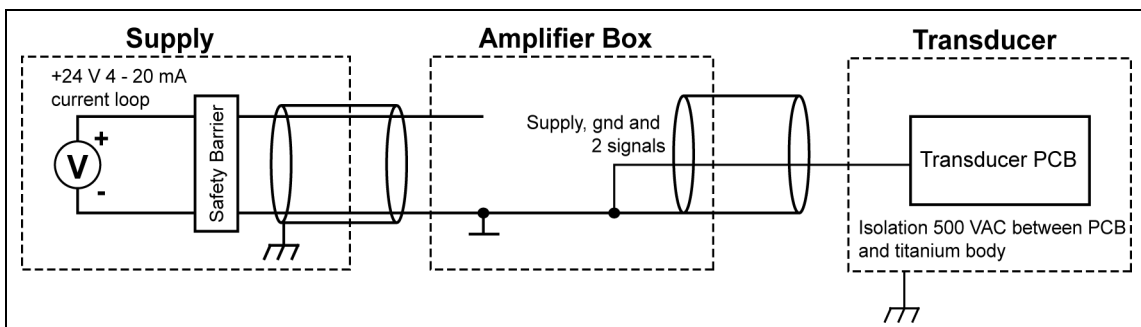
- 1.** No circuits other than those shown on the drawing are permitted. There must be no interconnection to any other circuits.
- 2.** The intrinsically safe cabling must not be connected to non-intrinsically safe circuits, through any plug, socket or other form of electric connector containing the cable.
- 3.** Adequate precautions must be taken to prevent danger arising from the charging of the intrinsically safe circuit by the contact leakage or inductance from any other circuit. To prevent static electricity do not rub cables or amplifier housing with a dry piece of cloth.
- 4.** The intrinsically safe circuit must be adequately insulated from earth in the hazardous area and the insulation of all cabling must be at least 500 V r.m.s.
- 5.** The safety barrier must be placed in a safe area and be mounted within a protective enclosure with a protection degree, at least equal to IP 20.
- 6.** The cable between the safety barrier and the amplifier should be provided with a cable shield which is connected to earth at the safety barrier. The impedance between the safety barrier earth rail and a secure bond to the hull must not exceed 1 ohm.
- 7.** Safe area apparatus must not be supplied from, nor contain, a source of potential with respect to earth under normal or abnormal conditions exceeding 250V r.m.s. or 250 V DC.
- 8.** The inductance/resistance ratio, total inductance and total capacitance, of the cable and the amplifier must not exceed the values stated by the manufacturer of the approved safety barriers.
- 9.** Prevent impacts on the sensor housing to avoid sparks. Do not mount or dismount the sensor when there is a hazardous condition in the tank. Be sure the tank is vented and gas free.
- 10.** Be sure that the amplifier box is dry and clean before the lid is mounted. The four screws in the lid should be tightened fully.
- 11.** Be sure to order and use sensor cable with the right temperature specification. Check that the ambient temperature for the entire cable run do not exceed the max limit for the cable.
- 12.** MAS 2600 contain no repairable parts. Repairing or fixing the circuit or replacing components may impact the intrinsic safety.
- 13.** The sensor cable shall remain in one piece from sensor to amplifier box.

Reference is made to manufacturer instructions of safety barriers and to the rules in force at the time in question concerning intrinsically safe area installation.



The entity concept allows inter-connections of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved values of maximum open circuit voltage and maximum short circuit current and maximum output power, for the associated apparatus must be less than or equal to the maximum safe input voltage (U_i), maximum safe input current (I_i), and maximum safe input power (P_i) of the intrinsically safe apparatus. In addition, the approved maximum allowable connected capacitance of the associated apparatus must be greater than the sum of the inter-connecting cable capacitance and the unprotected internal capacitance (C_i) of the intrinsically safe apparatus, and the approved maximum allowable connected inductance of the associated apparatus must be greater than the sum of the inter-connecting cable inductance and the unprotected internal inductance (L_i) of the intrinsically safe apparatus.

Grounding



Installation

Installation and Handling the MAS 2600

Handling

The MAS 2600 transducer is a highly sensitive electronic piece of equipment and proper handling is most important.

To avoid damaging the transducers:

- NEVER lift by the cable if transducer is mounted with fittings.
- NEVER remove the protection cap in front of the diaphragm before installation.
- NEVER knock the transducer.
- NEVER apply pressure to the diaphragm in any way whatsoever, whether using fingers, tools or sharp objects.
- NEVER use sharp objects when cleaning the diaphragm.
- NEVER submerge the cable so that the breather tube is under water.
- NEVER bend the cable in a radius of less than 90 mm.

Installation

As part of the installation please check that:

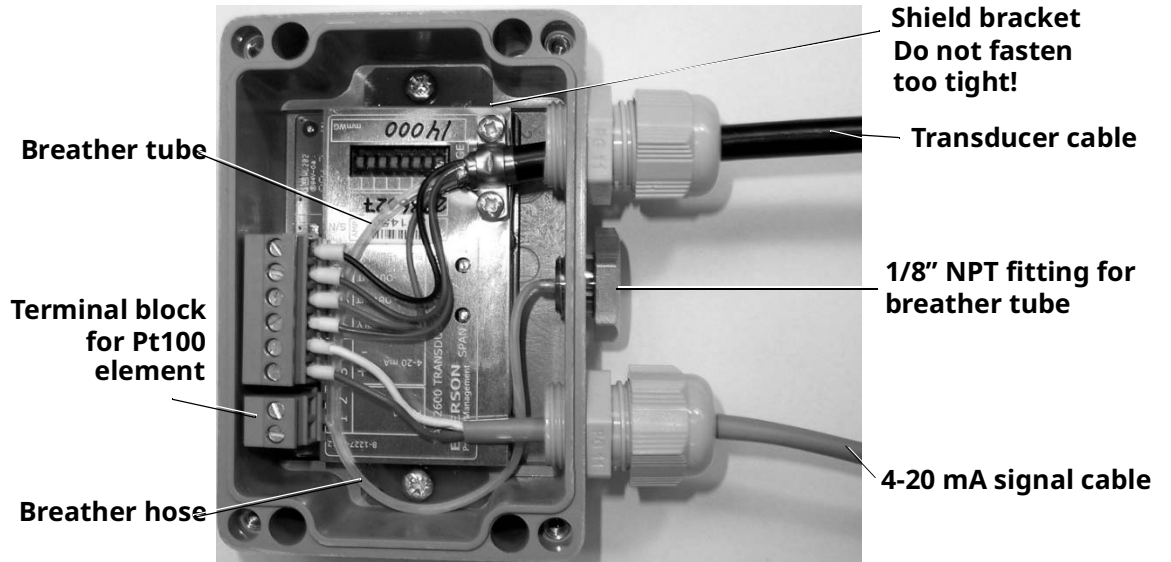
- the serial numbers on the transducer, amplifier and lid of amplifier box complies. The serial numbers are found on the S/N on the amplifier box at the bottom line and on the transducer S/N on the range label.
- the transducer is fitted in the correct tank.
- the transducer is correctly connected to the amplifier.
- all cable glands are properly secured to the amplifier box. Use torque of 6 Nm.
- the amplifier box is mounted in such a way that the breather tube cannot be flooded.
- the cable is fastened with cable clips with a distance of max. 50 cm.
- the cable isolation is not damaged (cracks, weld spatter, burns etc.).
- shut-off valves can be either ball valves or other valves not generating over pressure exceeding 4 x the transducer range between valve seat and transducer when the valve is closed.

Note! The white and brown wires in the transducer cable are only used when a Pt100 sensor is built into the transducer.

As for flange mounted applications it is recommended that a ball valve is fitted in the front of the transducer to facilitate testing and calibration of the transmitter.

The power cable / 4 - 20 mA signal cable shall be a cable with solid insulation; the minimum wire insulation must be 0.25 mm for each wire. Using a shielded cable for the 4-20 mA signal, the shield shall be connected at the earth terminal of the I/O system (e.g. simple gauge or tank monitoring system) and not in the amplifier box. Using a shielded cable ensures maximum protection against electrical noise.

If the amplifier box is installed in an area with over pressure or negative pressure in relation to the atmospheric pressure in the tank, the breather tube must be directed to an area with atmospheric pressure equal to the pressure inside the tank. This applies to gauge transmitters only. For absolute transmitters this has no affect, due to the reference to absolute vacuum and not atmospheric pressure. This is also the reason why no breather tube is necessary.



Testing and Recalibration

Testing and Recalibration of the MAS 2600

Testing

Caution! Please observe that testing and recalibration of transmitters mounted in hazardous areas shall be carried out by Ex qualified personnel.

Before dispatch, the MAS2600 transmitter is calibrated in accordance with the requirements specified in the order.

The transducer and the amplifier are calibrated together and must, therefore, always be used together.

A programmable measuring range transmitter will in conditions of no pressure (empty tank) give an output signal of 4 mA, and in conditions of maximum pressure an output signal of 20 mA.

The transmitter should be tested by applying to the transducer a known pressure from a calibrator and reading the equivalent milliamp signal on a milliamp meter.

The above-mentioned applies to the gauge transmitter only. For absolute transmitters the output signal will be higher than 4 mA, because it is calibrated for 4 mA at 0.8 bar abs. The output signal will typically be 5-7.5 mA in atmospheric pressure, depending on the transducer range and the actual atmospheric pressure. Maximum output signal 20 mA, will be at the transducers absolute range.

Recalibrating Gauge Transmitter Using Pressure on the Transducer

Caution! Please observe that testing and recalibration of transmitters mounted in hazardous areas shall be carried out by Ex qualified personnel.

When recalibrating the MAS2600 Gauge Transmitter a pressure calibrator with a range of -1 to 3.5 bar should be used. It should have an accuracy of 0.05% FS or better, as well as a 4½ digit milliamp meter.

1. Set the calibrator to pressure mode.
2. Connect the pressure calibrator to the transducer via MAS2600 Test Cup, type G022S100 (DPI610 and DPI603) or type G022S103 (DPI802P CAL KIT).
3. Check that the range select switch on the amplifier is correctly set.
4. In conditions of no pressure (atmospheric pressure) the output signal should be adjusted to 4.00 mA on the zero potentiometer.
5. Increase the pressure to maximum and adjust the output signal to 20.00 mA on the span potentiometer.
6. Remove the pressure and check the zero point
7. Check the linearity at 0-25-50-75 and 100% of the measuring range.
8. If necessary, repeat the steps 4 to 7.

Recalibrating Gauge Transmitter using Vacuum (for gauge transmitters only)

Caution! Please observe that testing and recalibration of transmitters mounted in hazardous areas shall be carried out by Ex qualified personnel.

An internally mounted transducer can also be recalibrated by using vacuum.

1. Check that the tank is empty.
 2. Check that the range select switch on the amplifier is correctly set.
 3. Set the calibrator to vacuum mode.
 4. Connect the hose from the calibrator to the breather tube from the transducer cable.
 5. In conditions of no pressure the output signal should be adjusted to 4.00 mA on the zero potentiometer.
 6. Increase the vacuum equal to the maximum height of the fluid (water gauge) and adjust the output signal to 20.00 mA on the span potentiometer.
 7. Remove the vacuum and check the zero point.
 8. Check the linearity at 0-25-50-75 and 100% of the measuring range.
 9. If necessary, repeat the steps 5 to 8.
-

Note! If the calibrated maximum water gauge is greater than the maximum water gauge that can be generated by the vacuum calibrator, the proportional mA output signal equal to the maximum vacuum signal should be calculated.

Example:

If the full-scale of the transmitter is 15 mH₂O, and the maximum capacity of the vacuum calibrator is 7.5 mH₂O, the mA output signal at 7.5 mH₂O is calculated as:

$$15 \text{ mH}_2\text{O} = 20 \text{ mA and } 0 \text{ mH}_2\text{O} = 4 \text{ mA}$$

$$7.5 \text{ mH}_2\text{O} = 4 + ((20 - 4) * 7.5) / 15 = 12 \text{ mA}$$

The span potentiometer is adjusted so that the output signal shows 12 mA at 7.5 mH₂O.

Recalibrating the Absolute Transmitter Using Pressure on the Transducer

Caution! Please observe that testing and recalibration of transmitters mounted in hazardous areas shall be carried out by Ex qualified personnel.

When recalibrating the MAS2600 Absolute Transmitter a pressure calibrator with a range of -1 to 3.5 bar should be used. It should have an accuracy of 0.05% FS or better, as well as a 4½ digit milliampmeter. If a calibrator without reference transmitter is used, the atmospheric pressure must be known to calculate the correction.

Atmospheric pressure and Transducer range to be entered into the formulas as mbar.

1. The calibrator with the output selector switch set to pressure mode is connected to the MAS2600 transmitter via MAS2600 Test Cup, type G022S100 (DPI610 and DPI603) or type G022S103 (DPI802P CAL KIT).
2. Check the transducer range. The transducer range is indicated on the amplifier inside the box.
3. Calculate output signal in conditions of no pressure (atmospheric pressure), using below formula. The output signal should be adjusted to the calculated value on the zero potentiometer.
$$\text{mA at Atmospheric pressure} = 4 + (16 * (\text{Atm. press} - 800) / (\text{Trd. range} - 800))$$
4. Calculate the pressure for maximum output signal, using the following formula.
$$\text{mbarg at 20 mA} = \text{Trd. range} - \text{Atm. press}$$

Increase the pressure to calculated pressure and adjust the output signal to 20.00 mA on the span potentiometer.
5. Remove the pressure and check the zero point.
6. Check the linearity at 0-25-50-75 and 100% of the measuring range.
Output signal at different pressures P can be calculated, using the following formula.
$$\text{mA at P mbarg} = 4 + (16 * (\text{Atm. press} - 800 + P) / (\text{Trd. range} - 800))$$
7. If necessary, repeat the steps 3 to 6.

Example:

If the range of the transducer is 3.5 bar abs and the atmospheric pressure is 1005 mbar.

Calculated output at atmospheric pressure:

$$\text{mA at Atm.press} = 4 + (16 * (1005 - 800) / (3500 - 800)) = 5.215 \text{ mA}$$

Calculated applied pressure for maximum output:

$$\text{mbarg at 20 mA} = 3500 - 1005 = 2495 \text{ mbarg}$$

Calculated pressure at 50% of the transducer range:

$$\text{mA at P mbarg} = 4 + (16 * (1005 - 800 + 1750) / (3500 - 800)) = 15.585 \text{ mA}$$

Maintenance and Troubleshooting

Maintenance

Caution! Please observe that testing and recalibration of transmitters mounted in hazardous areas shall be carried out by Ex qualified personnel.

Marine Tank Management recommends that the following to be checked annually:

1. Visual inspection of the cable, transducer and amplifier.
2. Compare signal with e.g. manual readings, and if necessary perform a zero and full-scale calibration.

Trouble Shooting

Caution! Please observe that testing and recalibration of transmitters mounted in hazardous areas shall be carried out by Ex qualified personnel.

If the MAS 2600 transmitter is not functioning in accordance with Marine Tank Management instructions, check that:

1. the 24 VDC power supply has been correctly connected, and is between 17-33 VDC.
2. the 4 - 20 mA output signal is functioning (compared with e.g. hand sounding).
3. the transducer cable has been correctly fitted and the shield connected to the shield terminal in the amplifier box.
4. the diaphragm has not been damaged.

If this does not succeed, fill in the test sheet on page 49 and submit this to our Service department at Marine Tank Management.

When contacting our Service department please specify the serial numbers of transducer, amplifier and box.

The test sheet will be examined to see whether it can be established that the transmitter is broken or not.

When returning a defective MAS 2600 transmitter, please ensure that:

- The transducer diaphragm is protected against mechanical damage.
- Both the transducer and the amplifier are returned.
- A detailed description of the fault is enclosed.

MAS 2600 Test Sheet

Name		ATT. Emerson Marine Solutions Damcos A/S, Service Department FAX.: +45 5578 7272
Ship name	Yard	NB no.

MAS 2600 Transducer serial no.		MAS 2600 Amplifier serial no.		
Tank name				
Liquid in tank	HFO	DO	Ballast	Other
The tank is	Full	Empty	Other	

	Step	Result	Unit	Limits
1	Measure voltage between terminal 5 and 6.		V DC	Voltage should be in the range 17 to 22 V DC. Check power supply.
2	Measure nipple voltage between terminal 5 and 6.		V AC	Voltage must not exceed 2 V AC. Check power supply.
3	Measure sensor excitation voltage between terminal 7 and 10.		V DC	Voltage should be in the range 3.0 and 6.2 V DC.
4	Measure sensor excitation voltage between terminal 8 and 9.		mV DC	Voltage should be in the range -15 to 100 mV DC.
5	Measure current in supply lead to terminal 5.		mA DC	Current should be in the range 4 to 20 mA and the same value as measured in point 6. if not the amplifier may be defect.
6	Measure current in supply lead to terminal 6.		mA DC	Current should be in the range 4 to 20 mA and the same value as measured in point 5. if not the amplifier may be defect.
7	Measure sensor resistance with sensor cable unconnected between:			If the measured resistance is less than 1 M Ohm the sensor is considered defect.
	Terminal 7 to cable shield.		M Ohm	
	Terminal 8 to cable shield.		M Ohm	
	Terminal 9 to cable shield.		M Ohm	
	Terminal 10 to cable shield.		M Ohm	

	Step	Result	Unit	Limits
8	Measure sensor bridge resistance with sensor cable unconnected between: Terminal 7 to terminal 8. Terminal 7 to terminal 9. Terminal 7 to terminal 10. Terminal 8 to terminal 9. Terminal 8 to terminal 10. Terminal 9 to terminal 10.		K Ohm K Ohm K Ohm K Ohm K Ohm K Ohm	If the measured resistance is less than 1 K Ohm or greater than 50 K Ohm the sensor is considered defect.
9	Visual inspect the transmitter for: - Damages on the cable - Sharp bends on the cable - Moisture/liquids in the breather tube - Damages on the diaphragm			
10	Comments			

Index

Numerics

1" Pipe End Mounting..... 20

A

Absolute Transducers..... 12
Absolute Transmitter..... 13
Amplifier 5
Amplifier Box..... 25
Amplifier PCB 26
Application..... 5
ATEX 29

B

Brackets for Internal Mounting..... 18

C

Cable 17

D

Description 5
DN25 flange with 1" ball valve..... 24

F

Flange Mounting..... 21
Flexible PTFE tube mounting 125°C 23
Flexible rubber tube mounting 80 °C..... 22

G

Gauge 12
Gauge Transmitter 13

H

Handling 35
High Temperature Gauge Transducers 12

I

Installation 36
 Intrinsically safe 30
Intrinsic Safety 29
Intrinsically Safe..... 5
Intrinsically Safe Installation 30

M

Maintenance 47
Measuring Ranges..... 13

Mounting Methods 18

O

Operation..... 5
Ordering Information..... 11

P

Pole Mounting 19
Power Supply..... 7

R

Recalibrating Gauge Transmitter using Test Cup
type G022S100 42
Recalibrating Gauge Transmitter using Vacuum
43
Recalibrating the Absolute Transmitter using
Test Cup type G022S100..... 44

S

Safety Approvals 29
Selecting Measuring Range 14
Selecting Transducer Type..... 12

T

Technical Specification 6
Temperature Sensor 16
Test Sheet 49
Testing 41
Transducer..... 5
Transducer Type..... 12
Transmitter Dimensions..... 7
Transmitter is not functioning 48
Trouble Shooting 48
Type Approvals..... 5

About Emerson's Marine Solutions

Emerson is a world-leading provider of marine solutions with engineering excellence, decades of industry experience and global presence supporting any ship anywhere. All marine systems and solutions are designed especially for the harsh marine environments, engineered and manufactured in-house by our skilled teams of marine engineers. Emerson is well-known in the industry and has more than 50 years' experience with a large installed base and covers well-known marine brands such as Rosemount, MicroMotion and Damcos. Supporting marine customers from a global network of sales and service hubs along the maritime highway.

To learn more about Emerson's marine solutions, visit [Emerson.com/marine](https://emerson.com/marine)

To contact Emerson's marine experts, visit [Emerson.com/marinecontacts](https://emerson.com/marinecontacts)

The Emerson logo is trademark and service mark of Emerson Electric Co.
The Rosemount, MicroMotion and Damcos logotypes are registered trademarks of one of the Emerson family of companies. All other marks are the property of their respective owners.
All other marks are the property of their respective owners.

©2023 Emerson. All rights reserved.

