Note: This manual is the Transducer Replacement Procedure for the old style MPU Series B (6 Long Transducers)

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1. INTRODUCTION

This manual describes mounting and dismounting of the transducers for the MPU ultrasonic gas flow meter delivered by FMC Kongsberg Metering. If further information is needed, please do not hesitate to contact our service department.

We reserve the right to make changes to the construction and/or configuration at any time, this manual is based on the latest information, and may be subject to changes.

1.1. Contact Address if Assistance is Required

	Publisher	Customer Support
Contact Address:	FMC Kongsberg Metering AS P.O. Box 1012 NO-3601 Kongsberg Norway	FMC Kongsberg Metering AS P.O. Box 1012 NO-3601 Kongsberg Norway
Telephone No.:	(47) 32 28 67 00	(47) 32 28 79 21
Telefax No.:	(47) 32 28 67 50	(47) 32 28 79 10
E-Mail:	meteringservice@fkm.fmcti.com	meteringservice@fkm.fmcti.com
Internet:	www.fmcmeasurementsolutions.com	

1.2. Copyright

All technical and technological information contained in this manual, including any drawings and technical specifications shall remain the property of FMC Kongsberg Metering a.s. and may not be used (other than for the operation of this product), copied, multiplied, passed on or communicated to a third party without the prior written permission of FMC Kongsberg Metering a.s.

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Kongsberg, Norway

FMC Kongsberg Metering a.s. is an FMC Technologies Inc. subsidiary.

1.3. Trademarks

Products listed are trademarks of their respective manufacturers. Company names listed are trade names of their respective companies.

1.4. Equipment Required

- Adjustable wrench
- Hexagonal key 4, 6 and 8 mm
- Oilstone or fine file
- Seeger ring pliers
- Transducer Removal Wrench ►
- Torque wrench

1.5. Consumables

- O-rings.
- Back-up rings.
- Copper Grease (Copaslip or equivalent)
- Silicone grease (Gleitmo 750 or equivalent)
- Loctite 577 or equivalent

1.6. Reference Documents

	Document No.	Title
1	USM-0000020565	MPU User Manual, Series B
2	PRD-0000021266	MPU Transducer Replacement Procedure using Retraction Tool

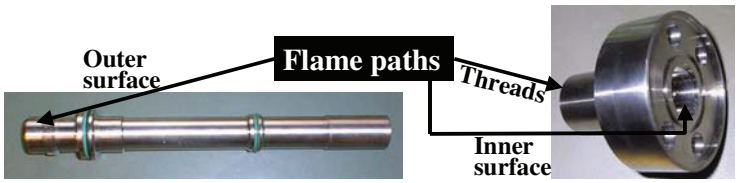
1.7. Warnings

Warning: Always make absolutely sure that there is no pressure in the pipe, before removing the Transducer End Cover.

Do not use metal tools or similar that can damage the inner surface of the Nozzle when dismounting the Transducers. The Nozzle has a very fine O-ring surface to make it possible to use the Transducer Retraction Tool.

Caution: Spesial attention is required to avoid damages to flame paths, see Picture 1**.**

If the flame paths are damaged, the parts must be replaced and NOT repared.



Picture 1 Flame Paths

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2. DISMOUNTING PROCEDURE

This procedure describes how to remove and mount a Transducer with **NO PRESSURE** in the pipeline. This can only be done before the spool piece is installed in the pipeline, or if the operational pressure is atmospheric and the pipeline is drained of any lethal or flammable gases.

If it is necessary to remove a transducer from the MPU without shutting down the line, this is possible by using the Transducer Retraction Tool. This tool may be ordered as an option, and will be delivered with its own operational manual. Alternatively, this can be done by the supplier's service engineer, bringing the suppliers own Transducer Retraction Tool.

If the transducer is replaced by a new, remember to update the acoustic path length and the zero calibration data in the database. See USM-0000020565 "User Manual, MPU Series B" [1] for details.

Unless otherwise stated, nuts and screws are removed by turning counter-clockwise, and tightened by turning clockwise.

Make sure the workplace is suitable for this operation, protected from rain- or sea water, dirt or oil spill. Cover the MPU with a protection hood if necessary.

2.1. Dismounting, Short Form

A. Remove the mechanical protection for the transducers (if any).

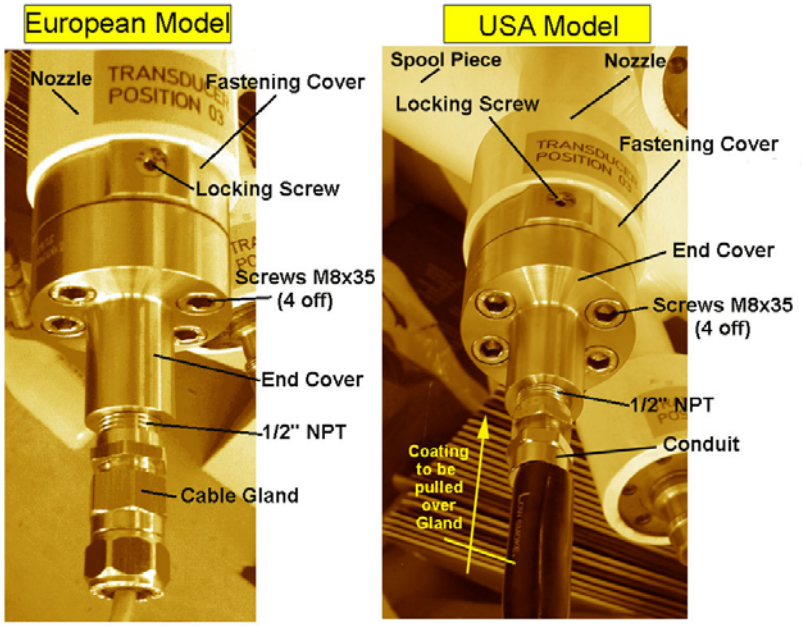
B. Make sure there is no pressure in the pipe.

C. Unscrew the 4 screws on the End Cover and remove it (ref. section 2.3).

D. Disconnect the Transducer Cable Connector.

E. Check that the Locking Screws are set to outer position or remove the Fastening Cover (ref. section 2.4).

F. Remove the Transducer by carefully pulling it straight out (ref. section 2.5).



Picture 2 Transducer mounting parts

2.2. Dismounting Cable Gland From End Cover

2.2.1. Dismounting (European Model)

NOTE: It is not necessary to dismount the Cable Gland from the End Cover to remove a Transducer.

A. Dismount part C of the Cable Gland. See Figure 1 below.

B. Dismount part B of the Cable Gland.

C. Part A of the Cable Gland is connected to the End Cover with Locktite, and shall not be dismounted unless the complete Cable Gland must be changed.

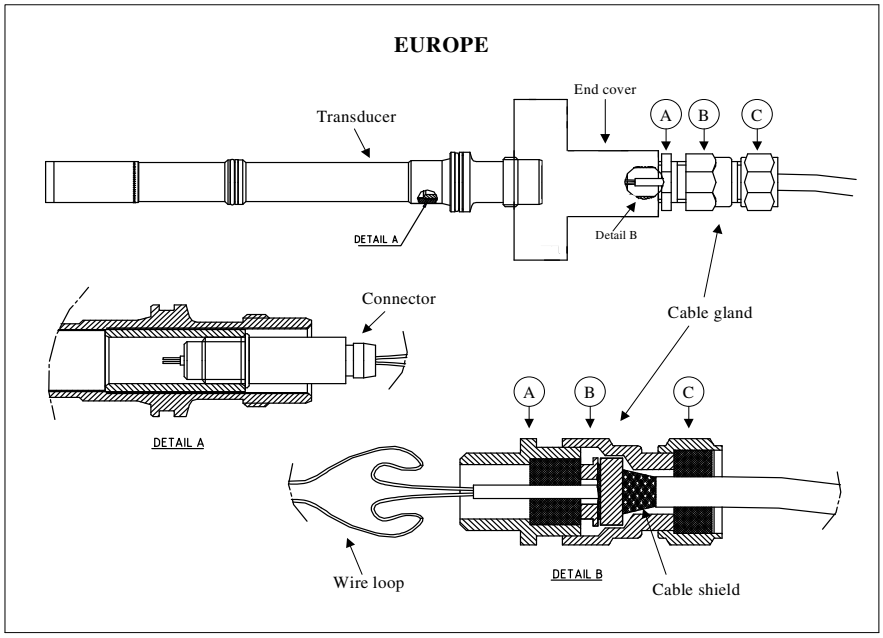


Figure 1 Cable Gland and End Cover (European Model)

2.2.2. Dismounting (USA Model)

NOTE: It may not be necessary to dismount the Conduit from the End Cover to remove a Transducer. However, it may ease the operation as the Conduit is not very bendable.

A. Pull back the coating over the Conduit Gland.

B. Dismount part B of the Conduit. See Figure 2 below.

C. Part A of the Conduit is connected to the End Cover with Locktite, and shall not be dismounted unless the complete Cable Gland must be changed.

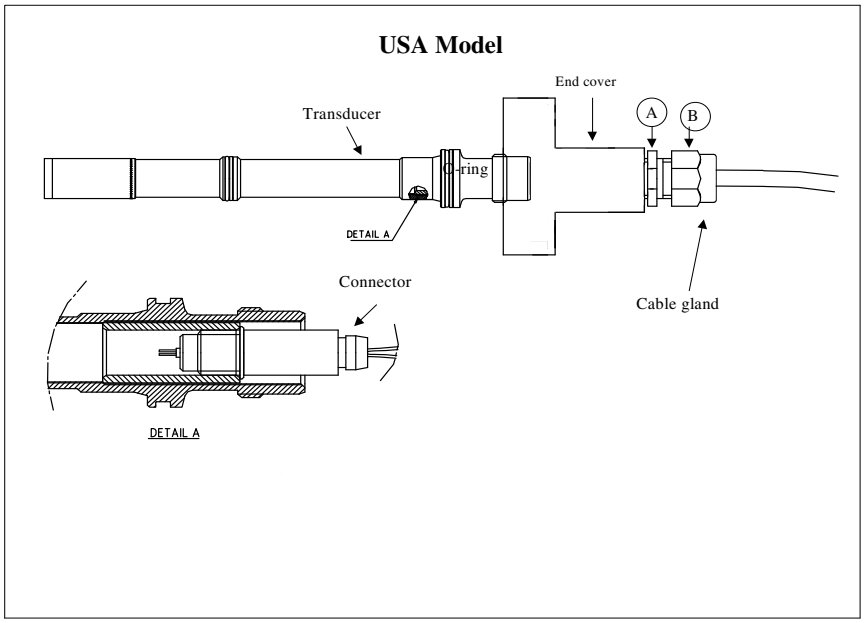


Figure 2 Conduit and End Cover (USA Model)

2.3. Dismounting End Cover

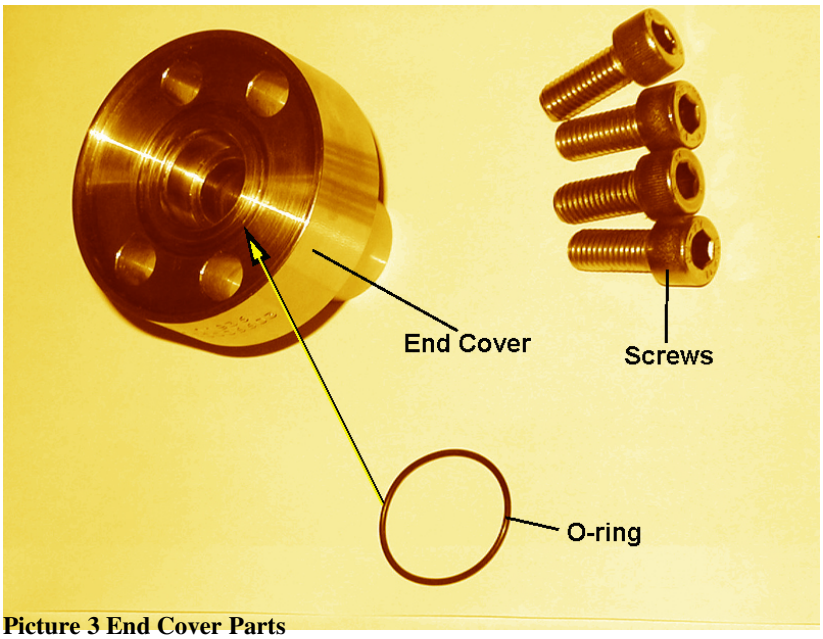
Before removing the End Cover, make absolutely sure that there is no pressure in the pipe!

A. Remove the 4 screws (see picture below) located on the End Cover (quantity may vary on 6" units).

B. Remove the End Cover.

C. Disconnect the Transducer Cable Connector.

D. Make sure neither the End Cover nor the Transducer Connector is subjected to water ingress or mechanical damage while dismounted. Do not leave the End Cover hanging by the Transducer Cable.



Picture 3 End Cover Parts

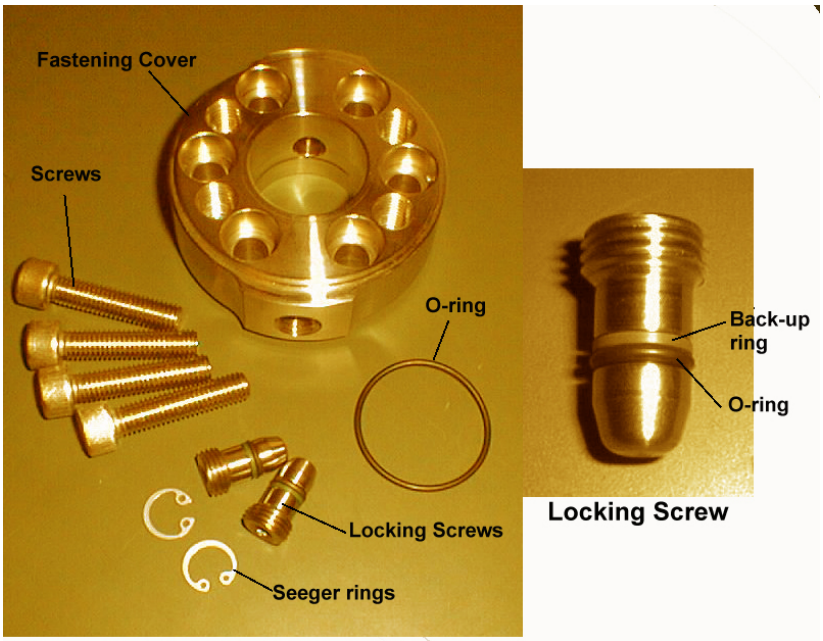
2.4. Dismounting Fastening Cover

NOTE: It is not necessary to remove the Fastening Cover to change the Transducer. If the Fastening Cover is left mounted, the Locking Screws (if any) must be put to their outer position before pulling the transducer out. See Figure 3 below.

A. Remove the screws.

B. Remove the Fastening Cover by pulling it straight out. In case the Fastening Cover is stuck to the spool piece, knock gently with a plastic hammer on the sides while pulling out. Be aware of the temperature effects on metal.

C. Make sure that the Fastening Cover is not subjected to water ingress or mechanical damage while dismounted.



Picture 4 Fastening Cover Parts

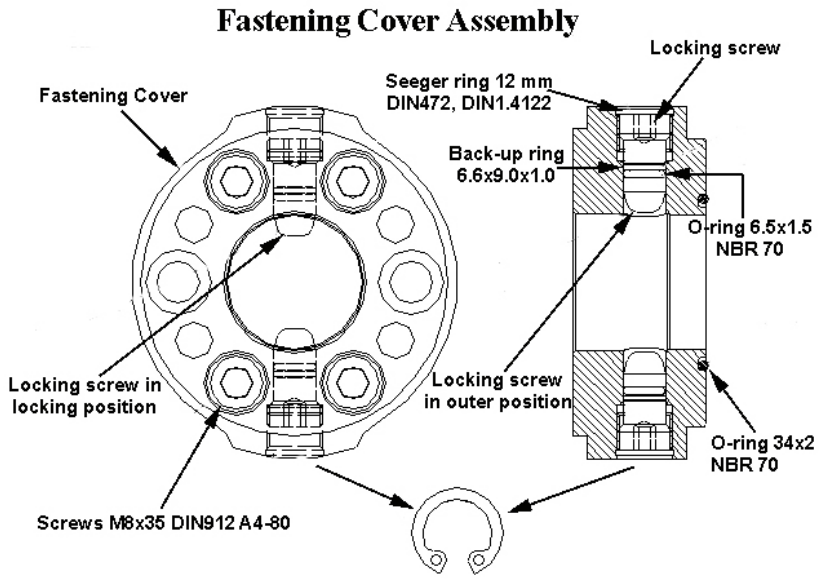


Figure 3 Fastening Cover Assembly Mounted

2.5. Dismounting the Transducer

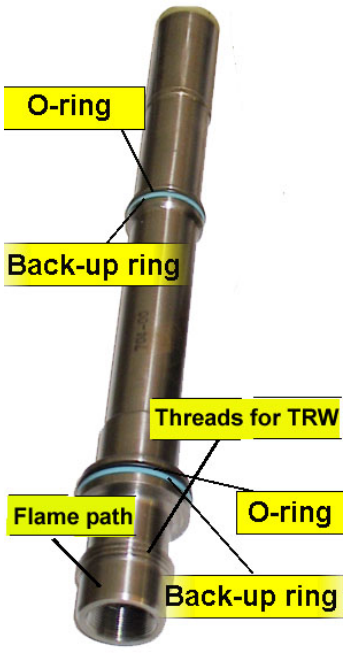
A. If the Fastening Cover is removed or the Locking Screws are in outer position, see Figure 3, the Transducer can be removed. Enter the Transducer Removal Wrench (TRW) to the threads of the Transducer and turn clockwise two to three turns. Then pull the Transducer carefully straight out using the TRW.

CAUTION: Do not use any kind of tools, which may damage the Transducer while dismounting. Pay special attention to the transducer front and the flame path section.

B. Make sure that the Transducer is not subjected to water ingress or mechanical damage while dismounted.

C. While the Transducer is removed, one must inspect the inside of the nozzle for damages, grease or pollution from the process. Pollutions must be removed using suitable tools and liquids, preferably isopropanol.

CAUTION: If any damage is discovered to the nozzle, this Transducer Nozzle must be clearly marked such that the Transducer Retraction Tool is NOT used on this specific nozzle. This must also be reported to the one responsible for the MPU.



Picture 5 Transducer with O-rings and Back-up rings mounted

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3. MOUNTING PROCEDURE

3.1. Pre-mounting Procedure

Before starting the mounting procedure, the following procedure must be performed:

3.1.1. Cleaning

Pollutions must be removed using suitable tools and liquids, preferably isopropanol.

3.1.2. Visual Inspection

- Inspect the inside of the nozzle for damages, grease or pollution from the process.
- Transducers with O-rings and Back-up rings.
- Tolerances for Fastening Cover mounting.

3.1.3. Assumptions

It is assumed that the Transducers are zero calibrated.

3.2. Mounting, Short Form

CAUTION: Make sure the Transducers are mounted in correct position according to the calibration certificate.

A. Replace o-rings and back-up rings. Use silicon grease on O-rings and copper grease (e.g. Copaslip) on the screws.

B. Check the nozzle internals, clean it before mounting.

C. Mount the Fastening Cover to the Spool Piece.

CAUTION: Make sure that the flamepaths (see Figure 4, pos. no. 15, 16, 17) do not have any damage. If so, the part must be replaced.

D. Carefully insert the Transducer into the Nozzle.

E. Mount the Cable Gland (EU) or Conduit (US) into the End Cover.

F. Connect the Transducer Cable Connector.

G. Mount the End Cover onto the Fastening Cover.

H. Change Transducer nameplate if the Transducer has been replaced.

I. Mount the optional mechanical protection.

J. Update the database if transducers are replaced.

CAUTION: The screws must be of required quality, the threads must be lubricated and correct torque must be used (ref section 3.3 and 3.6).

CAUTION: Make sure to measure the ohm resistance between Transducer Cables and bonding if transducers are replaced.

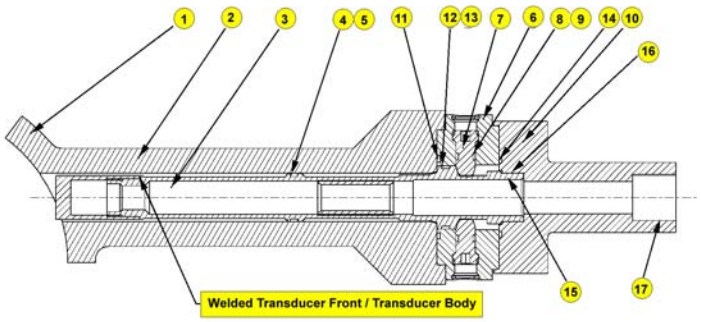


Figure 4 Transducer Mounting

ITEM	NAME, TYPE, DIMENSION
1	Spool Piece
2	Nozzle
3	Transducer Assy.
4	O-ring 18.77x1.78
5	Back-up ring 19.4x22x1.2
6	Fastening Cover
7	Locking Screw
8	O-ring 6.5x1.5
9	Back-up ring 6.6x9x1
10	End Cover
11	O-ring 34x2
12	O-ring 25.12x1.78
13	Back-up ring 26.2x29x1.4
14	O-ring 22x2
15	Flamepath Transducer
16	Flamepath End Cover
17	Flamepath threads for Eex d Gland

3.3. Mounting the Fastening Cover

A. Remove the old O-rings.

B. Make sure that the mating faces are clean. When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks with an oilstone or fine file.

C. Replace the O-ring on the Fastening Cover. Put silicon grease on the new O-ring.

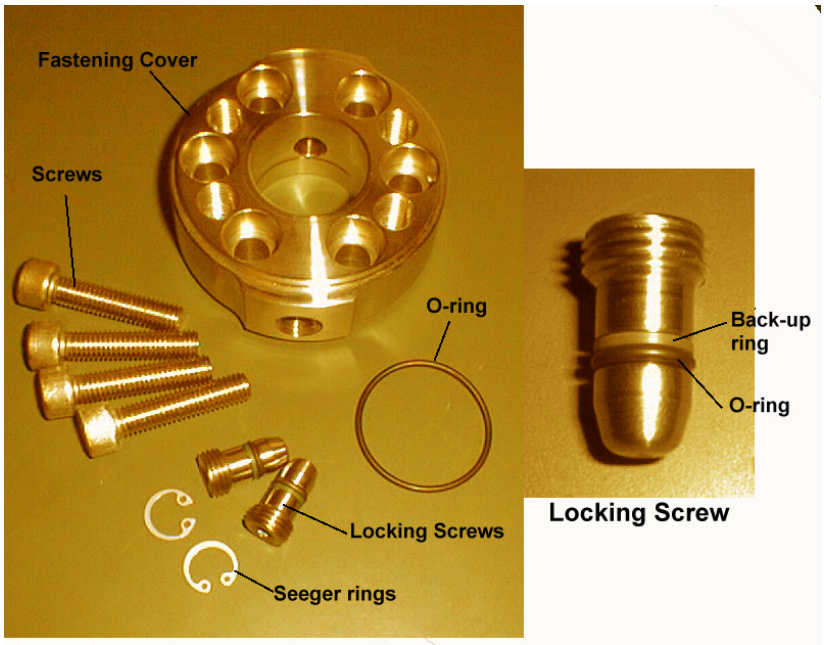
D. Remove the Seeger rings on the Fastening Cover. Remove the Locking Screws and replace the O-rings and the Back-up rings. Put silicon grease (Gleitmo 750 or equivalent) on the new O-rings.

E. Mount the Locking Screws and the Seeger rings.

Mount the Fastening Cover and fasten the bolts. Use copper grease (e.g. Copaslip) on the bolt threads.

CAUTION: Required torque is 22 Nm!

F. Put the Locking Screws in their outer position if the Transducer is not mounted.



Picture 6 Fastening Cover Parts

3.4. Mounting Transducer

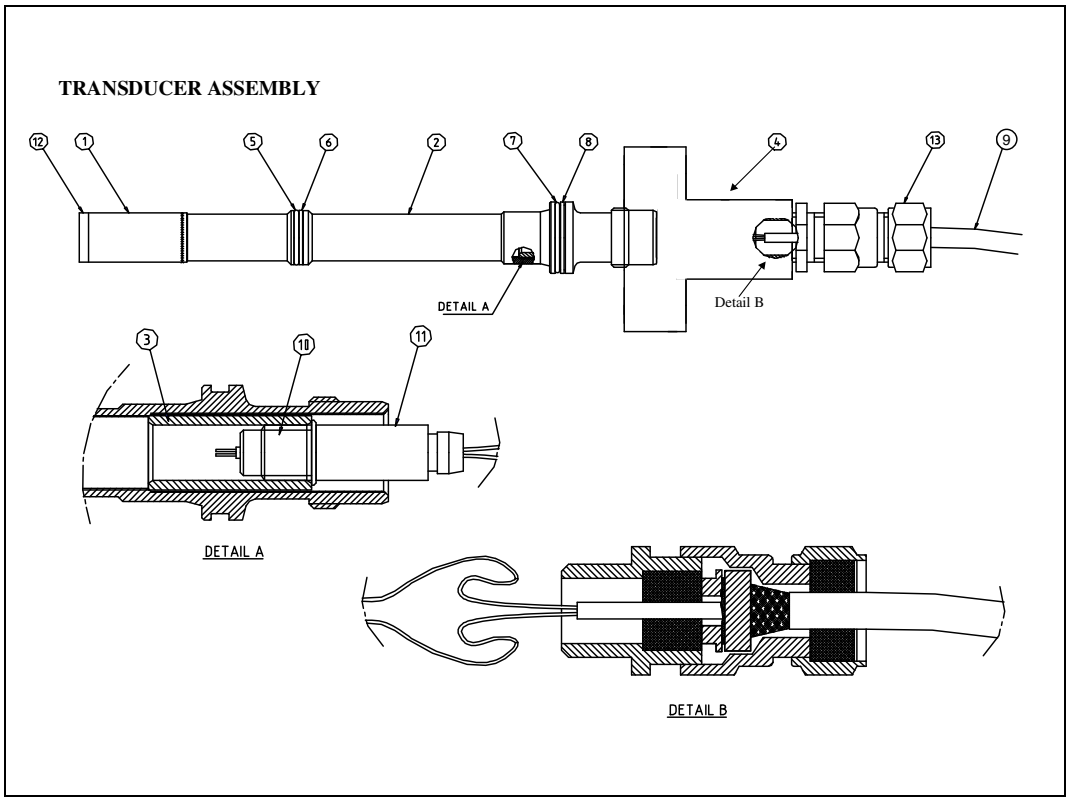


Figure 5 Transducer Assembly

ITEM	NAME, TYPE, DIMENSION
1	Transducer Front
2	Transducer Body
3	Transducer Insertprobe
4	Transducer Body Elongation
5	O-ring 18.77x1.78 V70
6	Back-up ring 19.4x22.0x1.2
7	O-ring 25.12x1.78 V70
8	Back-up ring 26.2x29.0x1.4
9	Cable 2x0.5 mm² Ølflex-FD 855 CP
10	Socket ERA 1S 302CLL
11	Connector LEMO FFA 1S 302CLAC42
12	Coupling layer 3.5 mm TYPICAL
13	Cable gland D705 1CX/ ½" NPT Eex d

CAUTION: Make sure the Transducers are mounted in correct position according to the calibration certificate.

A. Remove the old O-rings and Back-up rings.

B. Make sure that the mating faces are clean and dry. When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks with an oilstone or fine file.

CAUTION: Make sure that the flamepaths (see Figure 4, pos. no. 15, 16, 17) do not have any damage. If so, the part must be replaced.

C. Replace the O-rings and the Back-up rings on the Transducer (see **Figure 5**). Put silicon grease (Gleitmo 750 or equivalent) on the new O-rings. Do not use too much silicon grease on these O-rings, wipe off superfluous grease before mounting. The silicon grease can make an acoustic contact between the Transducer and the Spool Piece, which will disturb the ultrasonic signals.

D. Make sure that the Transducer Nozzle is clean and undamaged.

E. Take note of the complete serial number for the Transducer.

F. Insert the Transducer gently into the Transducer Nozzle.

G. If the Transducer is a replacement, remember to change the Transducer nameplate.

3.5. Mounting Cable Gland to End Cover

3.5.1. Mounting (European Model)

A. If removed, mount part A of the Cable Gland to the End Cover, see Figure 6 below. Use Locktite 577 or equivalent on the threads.

B. Mount the part B of the Cable Gland to part A of the Cable Gland. The cable shield shall be mounted to the Cable Gland. Make sure that the shield connection is not damaged while tightening the gland.

C. Mount part C of the Cable Gland to part B of the Cable Gland.

D. Make a loop of the Transducer cable wires between the connector and the Cable Gland and place it inside the End Cover.

E. Bring the Connector through the End Cover and connect it to the Transducer.

F. Mount the End Cover to the Fastening Cover as described in section 3.6. Take care not to squeeze the Transducer cable wires.

G. Measure the ohm resistance between Transducer Cables and bonding.

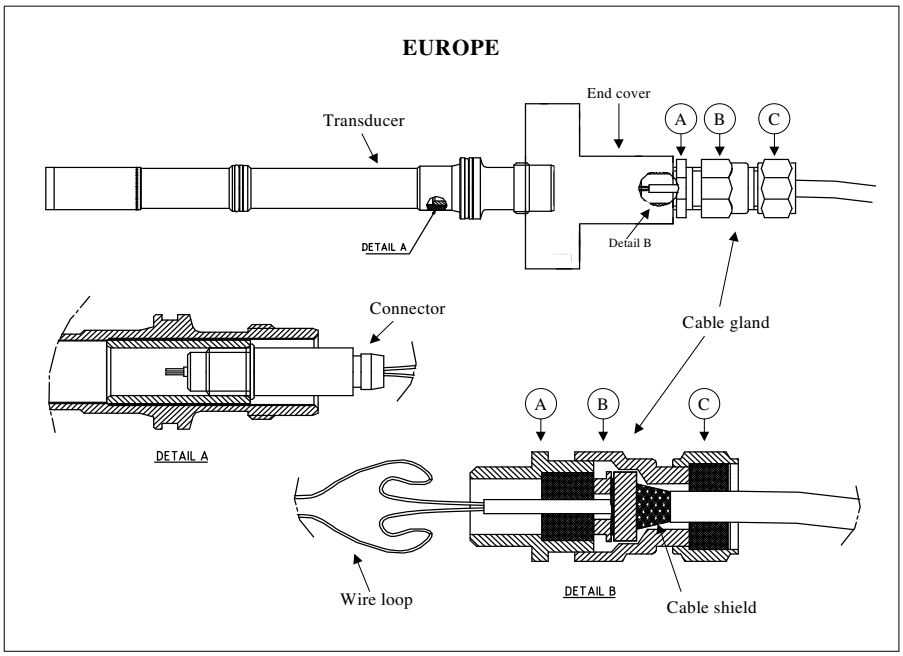


Figure 6 Cable Gland and End Cover (European Model)

3.5.2. Mounting (USA Model)

A. If removed, mount part A of the cable gland to the End Cover, see Figure 7 below. Use Locktite 577 or equivalent on the threads.

B. Mount the part B of the Cable Gland to part A of the Cable Gland.

C. Make a loop of the Transducer Conduit wires between the Connector and the Cable Gland and place it inside the End Cover.

D. Bring the Connector through the End Cover and connect it to the Transducer.

E. Mount the End Cover to the Fastening Cover Cover as described in section 3.6. Take care not to squeeze the Transducer cable wires.

F. Measure the ohm resistance between Transducer Cables and bonding.

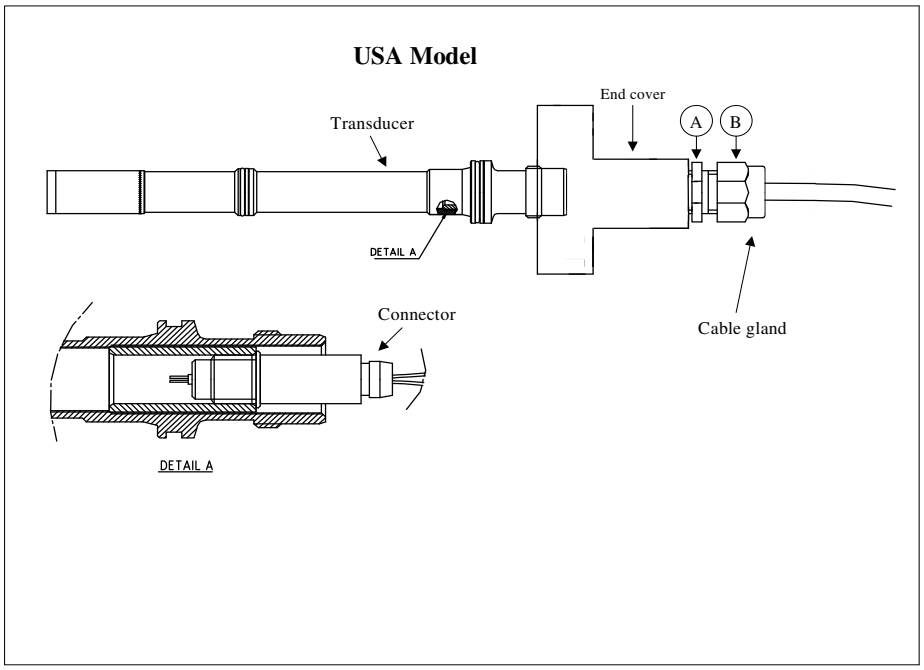


Figure 7 Cable Gland and End Cover (USA)

3.6. Mounting the End Cover

A. Remove the old O-rings.

Make sure that the mating faces are clean. When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks with an oilstone or fine file.

CAUTION: Make sure that the flamepaths (see Figure 4, pos. no. 15, 16, 17) do not have any damage. If so, the part must be replaced.

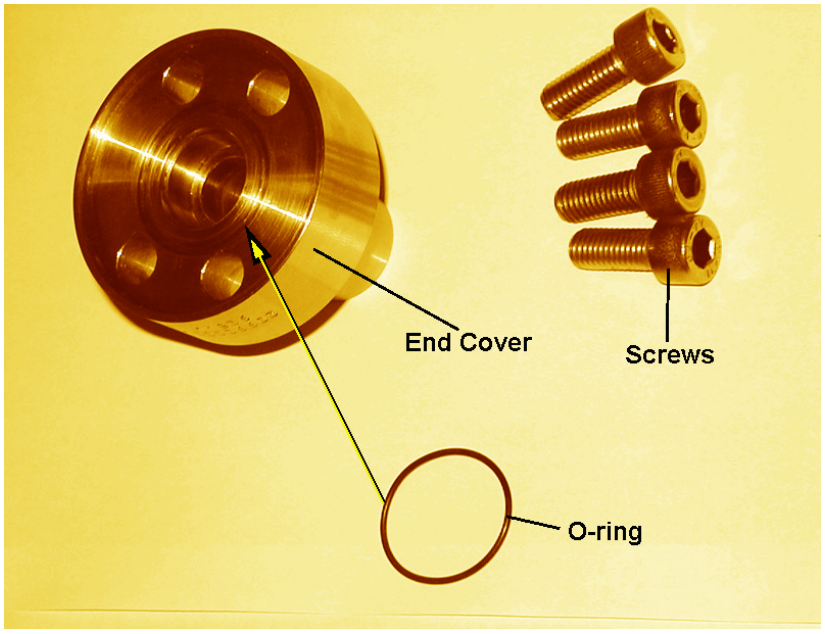
B. Replace the O-rings. Put silicon grease (Gleitmo 750 or equivalent) on the new O-rings.

C. Make sure the Transducer Cable Connector is connected to the Transducer and that the wires have been put into the End Cover in a loop.

G. Mount the End Cover to the Fastening Cover. Use copper grease (e.g. Copaslip) on the screw threads. Take care not to squeeze the Transducer cable wires.

CAUTION: Required torque is 44 Nm!

H. For USA model, pull the coating over the Conduit Gland.



Picture 7 End Cover Parts

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4. PARAMETER CONFIGURATION

4.1. General

It is necessary to update the database if transducers have been replaced. During first time assembly database configuration will be a part of the process, and this chapter will be irrelevant.

Updating the database requires knowledge of how to manouvre in the MPU 1200 database, and shall be performed by trained personnel.

Spare transducers are delivered in pairs, with a calibration certificate for each temperature and pressure combination with corresponding signal frequency, and measurement certificate of the length of each transducer. The spare transducer pair is calibrated in an arbitrary position. They can be mounted in any position, but it is important that the transducers are kept within the same pairs.

A “Calibration Node” is defined as a combination of pressure and temperature.

Definition of transducer pairs:

Position Group A	Position Group B
1A	1B
2A	2B
3A	3B
4A	4B
5A	5B
6A	6B

Table 1 Transducer pair definition

4.2. Calibration certificate

The relevant data in the calibration certificate is stated in the header and the 4 first rows of the table (see Figure 8 below).

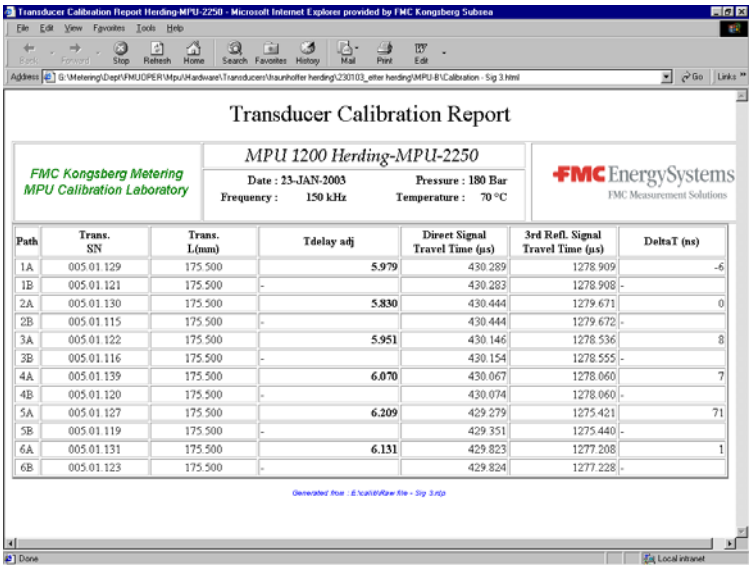
The header shows:

- Date
- Pressure
- Temperature
- Signal frequency

The table shows:

- Path 1 to 6, referring to position 1A/1B to 6A/6B
- Transducer serial number (S/N), which is stamped on the transducer
- Transducer length (L), listed in millimeters (mm)
- Tdelay adj, referring to Transducer delays in microseconds (µs) to be inserted into the database

The rest of the table is for information and diagnostic purposes only.



Transducer Calibration Report

MPU 1200 Herding-MPU-2250

FMC Kongsberg Metering
MPU Calibration Laboratory

Date : 23-JAN-2003 Pressure : 180 Bar
Frequency : 150 kHz Temperature : 70 °C

FMC EnergySystems
FMC Measurement Solutions

Path	Trans. SN	Trans. L(mm)	Tdelay adj	Direct Signal Travel Time (µs)	3rd Refl. Signal Travel Time (µs)	DeltaT (ns)
1A	005.01.129	175.500	5.979	430.289	1278.909	-6
1B	005.01.121	175.500	-	430.283	1278.908	-
2A	005.01.130	175.500	5.830	430.444	1279.671	0
2B	005.01.115	175.500	-	430.444	1279.672	-
3A	005.01.122	175.500	5.951	430.146	1278.536	8
3B	005.01.116	175.500	-	430.154	1278.555	-
4A	005.01.139	175.500	6.070	430.067	1278.060	7
4B	005.01.120	175.500	-	430.074	1278.060	-
5A	005.01.127	175.500	6.209	429.279	1275.421	71
5B	005.01.119	175.500	-	429.351	1275.440	-
6A	005.01.131	175.500	6.131	429.823	1277.208	1
6B	005.01.123	175.500	-	429.824	1277.228	-

Figure 8 Transducer Calibration Report

4.3. Transducer delays

The transducers are calibrated in pairs. The transducer delays and delta T for spare transducer pairs are found in the supplied calibration certificates, one certificate for each calibration node. These must be entered for the respective Calibration Nodes. Make sure that the calibration data is inserted for the correct pressure and temperature combination. The data can be entered using the MPU WinScreen program. Instructions can be found in USM-0000020565, “WinScreen User Manual, MPU Series B” [1].

The database object number for the respective Calibration Nodes are shown in the table below.

	Database Object Number					
Description	**Node 1**	**Node 2**	**Node 3**	**Node 4**	**Node 5**	**Node 6**
Cal. Node x Pressure	500	509	518	527	536	545
Cal. Node x Temperature	501	510	519	528	537	546
Cal. Node x Signal Type	502	511	520	529	538	547
Cal. Node x Tr. Delay 1	503	512	521	530	539	548
Cal. Node x Tr. Delay 2	504	513	522	531	540	549
Cal. Node x Tr. Delay 3	505	514	523	532	541	550
Cal. Node x Tr. Delay 4	506	515	524	533	542	551
Cal. Node x Tr. Delay 5	507	516	525	534	543	552
Cal. Node x Tr. Delay 6	508	517	526	535	544	553

Table 2 Database object numbers for zero calibration nodes

4.4. Update path lengths

Due to minor variations of the length of the transducers, new data for the acoustic path length has to be entered when transducers are changed. The measured transducer lengths for the original transducers are stated in the Calibration Report for the meter. The measured transducer lengths for the new transducers are stated in the supplied measurement certificate. The acoustic path length is given by:

$$\mathbf{PathL_{new} = PathL_{original} + (L_{Original\ transd\ A} - L_{New\ transd\ A}) + (L_{Original\ transd\ B} - L_{New\ transd\ B})}$$

$PathL_{new}$	= New acoustic path length
$PathL_{original}$	= Original acoustic path length
$L_{Original\ transd\ A}$	= Length of original transducer position A
$L_{Original\ transd\ B}$	= Length of original transducer position B
$L_{New\ transd\ A}$	= Length of new transducer position A
$L_{New\ transd\ B}$	= Length of new transducer position B

The new acoustic path length $PathL_{new}$ must be calculated according to the above formula and then entered into the database. The corresponding database numbers are shown in the table below:

Description	Database Object Number
Transducer Pair 1 Length	401
Transducer Pair 2 Length	402
Transducer Pair 3 Length	403
Transducer Pair 4 Length	404
Transducer Pair 5 Length	405
Transducer Pair 6 Length	406

Table 3 Database object numbers for path lengths

4.5. Documentation

It is important that relevant documentation is updated if transducers are replaced. A new printout of the database should be performed, or at least the recently entered data must be noted in the log book.

4.6. Example

Imagine the following situation:
1. A fault is detected at transducer number 5A.
2. Spare transducers are calibrated at pair 1.
3. The system has 3 nodes.

What to do:
1. Replace transducer 5A with spare transducer 1A (position Group A).
2. Replace transducer 5B with spare transducer 1B (position Group B).
3. Check the pressure and temperature combination for the 3 nodes by reading the database (see Table 2).
4. Then locate the 3 correct calibration certificates according to the right combination of pressure, temperature and frequency.
5. Enter the new transducer delay for the 3 nodes into the database, data for spare transducer 1A at position 5A and data for spare transducer 1B at position 5B.
6. Calculate new path length according to the formula in section 4.4.
7. Enter the new calculated path length for path 5A-5B into the database (see Table 3)
8. Update documentation.

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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