



OPTIFLUX Handbook

- OPTIFLUX 2300 C / 4300 C / 5300 C / 6300 C
- OPTIFLUX 2000 F / 4000 F / 5000 F / 6000 F
- IFC 300 F



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1.1 Safety instructions from the manufacturer

1.1.1 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect, incidental, punitive and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.1.2 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.1.3 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.1.4 Display conventions

The following symbols are used to help you navigate this documentation more easily:



DANGER!

This symbol designates safety advice on handling electricity.



WARNING!

These warning signs must be observed without fail. Even only partial disregarding such warnings can result in serious health damage, damage to the device itself or to parts of the operator's plant.



CAUTION!

These warnings must be observed without fail. Even only partial disregarding such warnings can lead to improper functioning of the device.



LEGAL NOTICE!

This symbol designates information on statutory directives and standards.



INFORMATION!

This symbol designates important information for the handling of the device.



• **HANDLING**

This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.



• **CONSEQUENCE**

This symbol designates all important consequences of the previous actions.

1.1.5 Manufacturer

This instrument is developed and manufactured by:

KROHNE Altometer
Kerkeplaat 12
3313 LC Dordrecht
The Netherlands

For information, maintenance or service please contact your nearest local KROHNE representative.

1.2 Safety instructions for the operator



WARNING!

- *Do not change the device. Unauthorized changes affect the explosion safety of the devices.*
- *The prescriptions and regulations as well as the electrical data described in the EC type examination certificate must be obeyed.*
- *Beside the instructions for electrical installations in non-hazardous locations according to the applicable national standard (equivalent to HD 384 or IEC 364, e.g. VDE 0100), especially the regulations in EN 60079-14 "Electrical installations in hazardous locations", equivalent national standard (e.g. DIN VDE 0165 Part 1) or dust hazardous areas such as EN 61241-14 must be complied with!*
- *Installation, establishment, utilization and maintenance are only allowed to be executed by personnel with an education in explosion safety!*

These additional instructions are an extension to the handbook. All technical information as described in the handbook is applicable, when not specifically excluded, completed or replaced by the instructions in these additional instructions.

1.3 Approvals

The flowmeter system consists of a flow sensor and a signal converter. The approval numbers are:

compact versions:

- OPTIFLUX 2300 C (= OPTIFLUX 2000 + IFC 300):
KEMA 04 ATEX 2077 X
- OPTIFLUX 4300 C (= OPTIFLUX 4000 + IFC 300):
KEMA 04 ATEX 2077 X
- OPTIFLUX 5300 C (= OPTIFLUX 5000 + IFC 300):
KEMA 04 ATEX 2127 X
- OPTIFLUX 6300 C (= OPTIFLUX 6000 + IFC 300):
KEMA 04 ATEX 2214

field versions:

- OPTIFLUX 2000 F + IFC 300 F:
KEMA 04 ATEX 2125 X + KEMA 04 ATEX 2166
- OPTIFLUX 4000 F + IFC 300 F:
KEMA 04 ATEX 2125 X + KEMA 04 ATEX 2166
- OPTIFLUX 5000 F + IFC 300 F:
KEMA 04 ATEX 2126 X + KEMA 04 ATEX 2166
- OPTIFLUX 6000 F + IFC 300 F:
KEMA 07 ATEX 0020 X + KEMA 04 ATEX 2166



INFORMATION!

All type examination certificates can be downloaded from the website.

1.4 OPTIFLUX 2000 / 4000

1.4.1 Compact versions

OPTIFLUX 2300 C / 4300 C is certified as a group II, category 2 GD equipment, if fitted with an IFC 300 signal converter without Ex ia signal in/outputs or as a group II, category 2 (1) GD equipment, if fitted with a signal converter with Ex ia signal in/outputs.

It is therefore suitable for installation in gas hazardous areas zone 1 or 2, gas group IIC, temperature class T6 (or T5)...T3 and dust hazardous areas zone 21 or zone 22, surface temperature T85...150°C. Additionally, the Ex ia signal inputs/outputs of the signal converter may run or originate from a Zone 0 Gas hazardous area.

Converter housing, connection compartment: with power supply (terminals L, N / L+, L-) and I/O connections (terminals A, A+, A-, B, B-, C, C-, D and D-):

Ex e (Increased safety), optionally: Ex d (Flameproof Enclosure). For certain versions of the signal converter the terminals A, A+, A-, B, B-, C, C-, D and D- are additionally Ex ia (Intrinsic safety). Consult the table with the CG numbers for more details.

Converter housing, electronics compartment: Ex d (Flameproof enclosure).

EEx marking OPTIFLUX 2300 C / 4300 C:

Nominal diameter	EEx e connection compartment, II 2 GD or II 2(1) GD	EEx d connection compartment, II 2 GD or II 2(1) GD
10...20 ("me")	EEx dme [ia] IIC T6...T3 T85...150°C	EEx dme [ia] IIC T6...T3 T85...150°C
25...150 ("d")	EEx de [ia] IIC T6...T3 T85...150°C	EEx d [ia] IIC T6...T3 T85...150°C
200...300 ("qe")	EEx dqe [ia] IIC T6...T3 T85...150°C	EEx dqe [ia] IIC T6...T3 T85...150°C
350...3000 ("e")	EEx de [ia] IIC T6...T3 T85...150°C	EEx de [ia] IIC T6...T3 T85...150°C
Optional:		
25...150 ("qe")	EEx dqe [ia] IIC T5...T3 T85...150°C	EEx dqe [ia] IIC T5...T3 T85...150°C

1.4.2 Field versions

OPTIFLUX 2000 F / 4000 F is certified as group II, category 2 GD equipment for gas hazardous areas zone 1 and 2, gas group IIC, temperature classes T6 (or T5) ... T3 and dust hazardous areas zone 21 and 22, surface temperature T85...150/160/180°C.

The connection box contains terminals for the connection of the field current and electrode circuits:

Field current circuit, in type of protection "Increased safety" (Ex e), terminals 7,8 and 9:
U < 40 V (switched DC voltage, alternately +40 and -40 V), I = 125 mA (injected square wave current),

Electrode terminals, in type of protection "Intrinsic safety" (Ex ia), terminals 1, 2, 3, and 4:
U_i = 20 V, I_i = 175 mA, C_i ≈ 0 nF, L_i ≈ 0 mH.

The before mentioned intrinsically safe circuits shall, from the safety point of view, be considered to be connected to ground.

The **cable gland** for the electrode circuit is - as intrinsic safe circuit - marked with a blue O-ring.

EEx marking OPTIFLUX 2000 F / 4000 F:

Nominal diameter	II 2 GD
10...20 ("me")	EEx me ia IIC T6...T3 T85...150°C
25...150 ("d")	EEx de ia IIC T6...T3 T85...180°C
200...300 ("qe")	EEx qe ia IIC T6...T3 T85...150°C
350...3000 ("e")	EEx e ia IIC T6...T3 T85...160°C
Optional:	
25...150 ("qe")	EEx qe ia IIC T5...T3 T85...180°C

1.5 OPTIFLUX 5000

1.5.1 Compact versions

OPTIFLUX 5300 C is certified as group II, category 2 GD equipment if fitted with an IFC 300 signal converter without Ex ia signal in/outputs or as a group II, category 2 (1) GD equipment, if fitted with a signal converter with Ex ia signal in/outputs. It is therefore suitable for installation in gas hazardous areas zone 1 and 2, gas group IIC, temperature class T6...T3 and dust hazardous areas zone 21 or zone 22, surface temperature T85...180°C. Additionally, the Ex ia signal in/outputs of the signal converter may run or originate from a Zone 0 gas hazardous area. The sensor is available in "sandwich" and in "flange" version.

Converter housing, connection compartment:

with power supply (terminals L, N / L+, L-) and I/O connections (terminals A, A+, A-, B, B-, C, C-, D and D-): Ex e (increased safety), optionally: Ex d (Flameproof enclosure). For certain versions of the signal converter the terminals A, A+, A-, B, B-, C, C-, D and D- are additionally Ex ia (Intrinsic safety). Consult the table with CG numbers for details.

Converter housing, electronics compartment:

Ex d (Flameproof enclosure).

EEx marking OPTIFLUX 5300 C "sandwich":

Nominal diameter	EEx e connection compartment, II 2 GD or II 2(1) GD	EEx d connection compartment, II 2 GD or II 2(1) GD
2,5...15	EEx dme [ia] IIC T6...T3 T85...150°C	EEx dme [ia] IIC T6...T3 T85...150°C
25...100	EEx de [ia] IIC T6...T3 T85...150°C	EEx d [ia] IIC T6...T3 T85...150°C

EEx marking OPTIFLUX 5300 C "flange":

Nominal diameter	EEx e or EEx d connection compartment, II 2 GD or II 2(1) GD
15...100	EEx d e [ia] mb IIC T6...T3 T85...150°C

1.5.2 Field versions

OPTIFLUX 5000 F is certified as group II, category 2 GD equipment for gas hazardous areas zone 1 and 2, gas group IIC, temperature classes T6...T3 and dust hazardous areas zone 21 and 22, surface temperature T85...180°C.

The connection box contains terminals for the connection of the field current and electrode circuits:

Field current circuit, in type of protection "Increased safety" (Ex e), terminals 7,8 and 9:

U < 40 V (switched DC voltage, alternately +40 and -40 V), I = 125 mA (injected square wave current),

Electrode circuit, in type of protection "Intrinsic safety" (Ex ia), terminals 1, 2, 3, and 4:
 $U_i = 20 \text{ V}$, $I_i = 175 \text{ mA}$, $C_i \approx 0 \text{ nF}$, $L_i \approx 0 \text{ mH}$.

The before mentioned intrinsically safe circuits shall, from the safety point of view, be considered to be connected to ground.

The cable gland for the electrode circuit is - as intrinsic safe circuit - marked with a blue O-ring.

The connection box contains terminals for the connection of the field current and electrode circuits:

Field current terminals, in type of protection "Increased safety" (Ex e), terminals 7, 8 and 9:
 $U < 40 \text{ V}$ (switched DC voltage, alternately +40 and -40 V), $I = 125 \text{ mA}$ (injected square wave current).

Electrode terminals, in type of protection "Intrinsic safety" (Ex ia), terminals 1, 2, 3 and 4:
 $U_i = 20 \text{ V}$, $I_i = 175 \text{ mA}$, $C_i \approx 0 \text{ nF}$, $L_i \approx 0 \text{ mH}$.

The before mentioned intrinsically safe circuits shall, from the safety point of view, be considered to be connected to ground.

The cable gland for the electrode circuit is - as intrinsic safe circuit - marked with a blue O-ring.

EEx marking OPTIFLUX 5000 F "sandwich":

Nominal diameter	
2,5...15	II 2 GD EEx me ia IIC T6...T3 T85...180°C
25...100	II 2 GD EEx de ia IIC T6...T3 T85...180°C

1.6 OPTIFLUX 6000

1.6.1 Compact versions

OPTIFLUX 6300 C is certified as group II, category 2 GD equipment, if fitted with an IFC 300 signal converter without Ex ia signal in/outputs or as a group II, category 2 (1) GD equipment, if fitted with a signal converter with Ex ia signal in/outputs. It is therefore suitable for installation in gas hazardous areas zone 1 and 2, gas group IIC, temperature classes T6...T3 and dust hazardous areas zone 21 and 22, surface temperature T150°C. Additionally, the Ex ia signal in/outputs of the signal converter may run or originate from a Zone 0 gas hazardous area.

Converter housing, connection compartment: with power supply (terminals L, N / L+, L-) and I/O connections (terminals A, A+, A-, B, B-, C, C-, D and D-):

Ex e (Increased safety), optionally: EEx d (Flameproof Enclosure).

For certain versions of the signal converter, the terminals A, A+, A-, B, B-, C, C-, D and D- are additionally Ex ia (Intrinsic safety). Consult the tables with CG numbers for details.

Converter housing, electronics compartment: Ex d (Flameproof Enclosure)

EEx marking OPTIFLUX 6300 C:

Nominal diameter	EEx e connection compartment, II 2 GD or II 2 (1) GD	EEx d connection compartment, II 2 GD or II 2 (1) GD
25...80	II 2 GD Ex e ia mb IIC T6...T3 T180°C	

1.6.2 Field versions

OPTIFLUX 6000 F is certified as group II, category 2 GD equipment for gas hazardous areas zone 1 and 2, gas group IIC, temperature classes T6...T3 and dust hazardous areas zone 21 and 22, surface temperature T180°C.

The connection box contains terminals for the connection of the field current and electrode circuits:

Field current circuit, in type of protection "Increased safety" (Ex e), terminals 7,8 and 9:
U < 50 V (switched DC voltage, alternately +40 and -40 V), I = 125 mA (injected square wave current),

Electrode circuit, in type of protection "Intrinsic safety" (Ex ia), terminals 1, 2, 3, and 4:
U_i = 20 V, I_i = 175 mA, C_i ≈ 0 nF, L_i ≈ 0 mH.

The before mentioned intrinsically safe circuits shall, from the safety point of view, be considered to be connected to ground.

The cable gland for the electrode circuit is - as intrinsic safe circuit - marked with a blue O-ring.

Ex marking OPTIFLUX 6000 F:

Nominal diameter	
25...80	II 2 GD Ex e ia mb IIC T6...T3 T180°C

1.7 IFC 300

The IFC 300 is certified as a group II, category 2 GD equipment, if fitted without Ex ia signal in/outputs or as a group II, category 2 (1) GD equipment, if fitted with Ex ia signal inputs/outputs. It is therefore suitable for installation in gas hazardous areas zone 1 or 2, gas group IIC, temperature class T6 and dust hazardous areas zone 21 or 22, surface temperature T85°C. Additionally, The Ex ia signal in/outputs of the converter may run or originate from a zone 0 gas hazardous area.

In the IFC 300 signal converter the following types of protections are used:

Converter housing, connection compartment: with power supply (terminals L, N / L+, L-) and I/O connections (terminals A, A+, A-, B, B-, C, C-, D and D-): Ex e (Increased safety). Optionally compact flowmeters have Ex d (Flameproof Enclosure). For certain versions of the signal converter the terminals A, A+, A-, B, B-, C, C-, D and D- are additionally Ex ia (Intrinsic safety). Consult the table with CG numbers for details.

Converter housing, electronics compartment: Ex d (Flameproof enclosure)

Field current circuit, in type of protection "Increased safety" (Ex e), terminals 7,8 and 9: $U < 40\text{ V}$ (switched DC voltage, alternately +40 and -40 V), $I = 125\text{ mA}$ (injected square wave current). The field current source is protected by 2 TR5 fuses, rated value 160 mA. The maximum prospective short circuit current is restricted to 35 A.

Electrode terminals, in type of protection "Intrinsic safety" (Ex ia), terminals 1, 2, 20, 3, 30, 4 and 40:

$U_o = 14\text{ V}$, $I_o = 70\text{ mA}$, $P_o = 300\text{ mW}$ (linear), $C_o = 430\text{ nF}$, $L_o = 2\text{ mH}$.

The Ex marking is II 2 GD EEx de [ia] IIC T6 T85°C for converters with non Ex ia signal in/outputs or II 2 (1) GD EEx de [ia] IIC T6 T85°C for converters with Ex ia signal in/outputs.

1.8 Marking labels

The data sticker on the connection box of the separate flow sensor typically contains the following information.

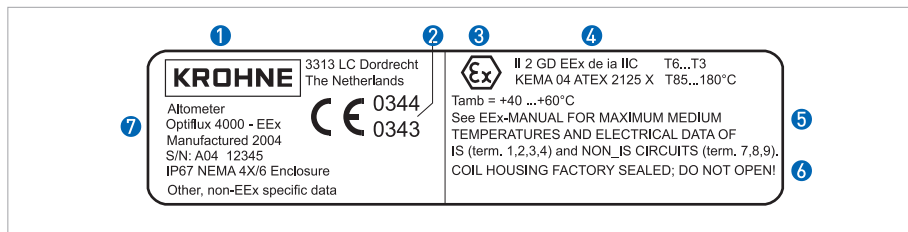


Figure 1-1: Data sticker on sensor

- ① Name and address of the manufacturer
- ② CE sign with number(s) of notified body / bodies
- ③ Specific sign for explosion protection
- ④ Number of EC type examination certificate
- ⑤ General EEx notes and warnings
- ⑥ Specific EEx notes and warnings
- ⑦ Type designation of the flowmeter

The data sticker on the converter typically contains the following information.

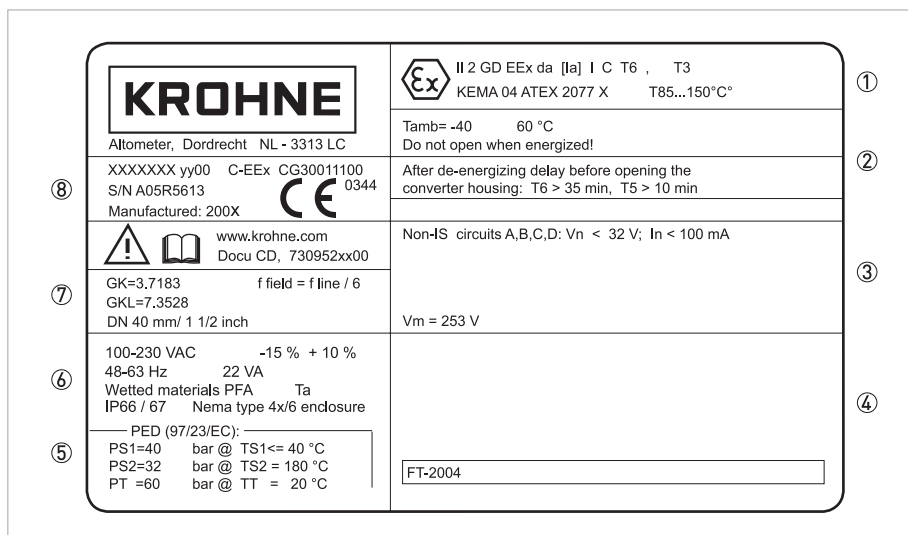


Figure 1-2: Example of a nameplate for compact version

- ① Approvals-related information: Ex approval, EC type test certificate, hygienic approvals, etc.
- ② Approvals-related thresholds
- ③ Approvals-related connection data of the inputs/outputs; V_m = max. power
- ④ Approvals-related data (e.g. accuracy class, measuring range, temperature threshold, pressure threshold and viscosity threshold)
- ⑤ Approvals-related pressure and temperature thresholds
- ⑥ Power; protection category; materials of parts in contact with media
- ⑦ GK/GKL values (measuring sensor constants); size (mm / inches); field frequency
- ⑧ Product designation, serial number and date of manufacture

The temperature limits apply under the following conditions:

- The instrument is installed and operated in accordance with the installation directions given in the installation and operating instructions.
- The instrument is not heated up by any additional heat radiation (direct solar radiation, heat from adjacent plant parts) so causing it to operate above the permissible ambient temperature range.
- Insulation is not hindering free ventilation of the signal converter housing.

2.1 OPTIFLUX 2000 / 4000

2.1.1 Compact versions

- The OPTIFLUX 2300 C / 4300 C is suitable for an ambient temperature range of -40...+60°C.
- For dust hazardous areas, the maximum surface temperature is equal to the process temperature with a minimum of 85°C.
- The minimum process temperature for all DN sizes is -40°C.
- The maximum process temperature is determined by the temperature class T6/T5...T3 of the gas hazardous area of concern, the maximum ambient temperature (T_a), and the nominal diameter. The temperature range is often limited further by the liner type used (refer to the Quick Start).

DN10...20 ("me")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	70	60	-
T5	95	85	60
T4	130	130	60
T3	150	150 ①	60

① 140°C for versions with stainless steel converter housing

DN25...150 ("d")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	80	80	80 ①
T5	95	95	80 ①
T4	130	130	80 ①
T3	150	150 ②	80 ①

① 60°C for versions with stainless steel converter housing

② 140°C for versions with stainless steel converter housing

DN25...150 ("qe")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T5	50	-	-
T4	100	95	80 ①
T3	150	150 ②	80 ①

① 60°C for versions with stainless steel converter housing

② 140°C for versions with stainless steel converter housing

DN200...300 ("qe") and DN350...3000 ("e")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	80	80	75 ①
T5	95	95	80 ①
T4	130	130	80 ①
T3	150	150 ②	80 ①
T3 ③	130	130	80 ①

① 60°C for versions with stainless steel converter housing

② 140°C for versions with stainless steel converter housing

③ For some versions the process temperature is restricted to 130 °C. This version is identified by extra text (/RT) on the data sticker

2.1.2 Field versions

- In general the OPTIFLUX 2000 F / 4000 F flow sensors are suitable for an ambient temperature range of $-40\dots+60^\circ\text{C}$.
- For dust hazardous areas the maximum surface temperature is equal to the process temperature T_p with a minimum of 85°C .
- The minimum process temperature is -40°C .
- The maximum process temperature T_p is dependent on the required temperature class T6/T5...T3, the diameter and the maximum ambient temperature T_a . The temperature range is often limited further by the liner type used (refer to the Quick Start).

DN10...20 ("me")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	75	70	70
T5	95	90	75
T4	130	115	75
T3	150	115	75

DN25...150 ("d")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	70	70	70
T5	85	85	85
T4	120	120	120
T3	180	180	180
Use heat resistant cables for T_p above: ❶	Not needed	155	105

❶ Cables must withstand a continuous operating temperature of 85°C.

DN200...300 ("qe")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	75	70	70
T5	95	90	75
T4	130	115	75
T3	150	115	75

DN350...3000 ("e")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	60	60	60
T5	80	75	75
T4	115	115	115
T3 ❶	160	150	140
Use heat resistant cables for T_p above: ❷	Not needed	145	110

❶ For some versions the process temperature for T3 is restricted to 130°C. This version is identified by extra text (/RT) on the data sticker.

❷ Cables must withstand a continuous operating temperature of 85°C.

DN25...150 ("qe")

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T5	60	55	-
T4	110	105	100
T3	180	180	180
Use heat resistant cables for T_p above: ❶	Not needed	155	105

❶ Cables must withstand a continuous operating temperature of 85°C.

2.2 OPTIFLUX 5000

The maximum process temperature T_p is dependent on the required temperature class T6...T3 and the maximum ambient temperature T_a .

2.2.1 Compact versions

Sandwich versions

- For dust hazardous areas, the maximum surface temperature is equal to the process temperature with a minimum of 85 °C.
- The OPTIFLUX 5300 C "sandwich" is suitable for an ambient temperature range of -20...60°C (DN2,5...15) or -40...+60°C (DN25...100).
- The minimum process temperature is -20°C (DN2,5...15) or -40°C (DN25...100).

Temperature class	Max. process temperature T_p [°C]		
	$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	60	55	-
T5	75	75	70
T4	115	115	75
T3	150	135	75

Flange versions

- The OPTIFLUX 5300 C "flange" is suitable for an ambient temperature range of -40...+60°C.
- The minimum process temperature is -40°C.

Temperature class	Max. surface temperature for dust [°C]	Max. process temperature T_p [°C]		
		$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 60^\circ\text{C}$
T6	85	80	80	60
T5	100	95	95	60
T4	135	135	130	60
T3	150	150	145	60

2.2.2 Field versions

Sandwich versions

- The flow sensor is suitable for an ambient temperature range of -20...65°C (DN2,5...15) or -40...+65°C (DN25...100).
- The minimum process temperature is -20°C (DN2,5...15) or -40°C (DN25...100).

Temperature class (for gasses)	Maximum surface temperature for dust [°C]	Max. process temperature T_p [°C]		
		$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 65^\circ\text{C}$
T6	85	65	65	60
T5	95	85	85	75
T4	130	125	125	115
T3	180	180	165	140
Use heat resistance cable for T_p above: ①		165	130	100

① Cables must withstand a continuous operating temperature of 85 °C.

Flange versions

- The flow sensor is suitable for an ambient temperature range of -40...65°C (DN15...100).
- The minimum process temperature is -40°C.

Temperature class (for gasses)	Maximum surface temperature for dust [°C]	Max. process temperature T_p [°C]		
		$T_a \leq 40^\circ\text{C}$	$40 < T_a \leq 50^\circ\text{C}$	$50 < T_a \leq 65^\circ\text{C}$
T6	85	80	80	75
T5	95	95	95	95
T4	130	130	130	130
T3	180	180	180	145
Use heat resistance cable for T_p above: ①		never	165	90

① Cables must withstand a continuous operating temperature of 85 °C.

2.3 OPTIFLUX 6000

2.3.1 Compact versions

- The flow sensor is suitable for an ambient temperature range of $-40\dots+60^{\circ}\text{C}$.
- The minimum process temperature is -40°C .
- For dust hazardous areas the maximum surface temperature is 150°C at an ambient temperature $T_a \leq 60^{\circ}\text{C}$.
- The maximum process temperature T_p depends on the required temperature class T6...T3 and the maximum ambient temperature T_a .

Temperature class	Max. process temperature T_p [$^{\circ}\text{C}$]		
	$T_a \leq 40^{\circ}\text{C}$	$40 < T_a \leq 50^{\circ}\text{C}$	$50 < T_a \leq 60^{\circ}\text{C}$
T6	75	70	65
T5	95	95	85
T4	130	130	85
T3	150	150	85
Use heat resistant cables for T_p above: ❶	Not needed	150	110

❶ Cables must withstand a continuous operating temperature of 85°C .

2.3.2 Field versions

- The flow sensor is suitable for an ambient temperature range of $-40\dots+60^{\circ}\text{C}$ (DN25...80).
- For dust hazardous areas the maximum surface temperature is 180°C at an ambient temperature $T_a \leq 60^{\circ}\text{C}$.
- The minimum process temperature is -40°C .
- The maximum process temperature T_p depends on the required temperature class T6...T3 and the maximum ambient temperature T_a .

Temperature class	Max. process temperature T_p [$^{\circ}\text{C}$]		
	$T_a \leq 40^{\circ}\text{C}$	$40 < T_a \leq 50^{\circ}\text{C}$	$50 < T_a \leq 60^{\circ}\text{C}$
T6	75	70	65
T5	95	90	85
T4	130	130	130
T3	180	180	170
Use heat resistant cables for T_p above: ❶	Not needed	150	110

❶ Cables must withstand a continuous operating temperature of 85°C .

2.4 IFC 300 F

The signal converter IFC 300 F is suitable for an ambient temperature range of -40...+65°C.

In the case of field versions, the electrical connection between the sensor and the signal converter is established via a signal cable and a field current cable.

The **field current cable** is no part of the supply and must be supplied by the user. It must be according EN 60079-14 clause 9.3 and 11.3 (Increased safety).

The **signal cable** is part of the supply.

3.1 Signal cable A

The signal cable A is a double screen shielding cable, according to EN 60079-14 clause 12.2 (Intrinsic safety).

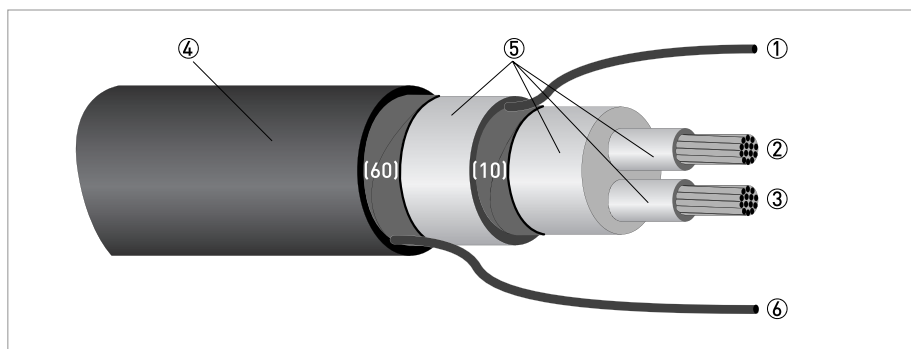


Figure 3-1: Construction of signal cable A

- ① Stranded drain wire (1) for the inner shield (10), 1.0 mm² Cu / AWG 17 (not insulated, bare)
- ② Insulated wire (2), 0.5 mm² Cu / AWG 20
- ③ Insulated wire (3), 0.5 mm² Cu / AWG 20
- ④ Outer sheath
- ⑤ Insulation layers
- ⑥ Stranded drain wire (6) for the outer shield (60)

3.2 Signal cable B

The signal cable B is a triple screen shielding cable, according to EN 60079-14 clause 12.2 (Intrinsic safety).

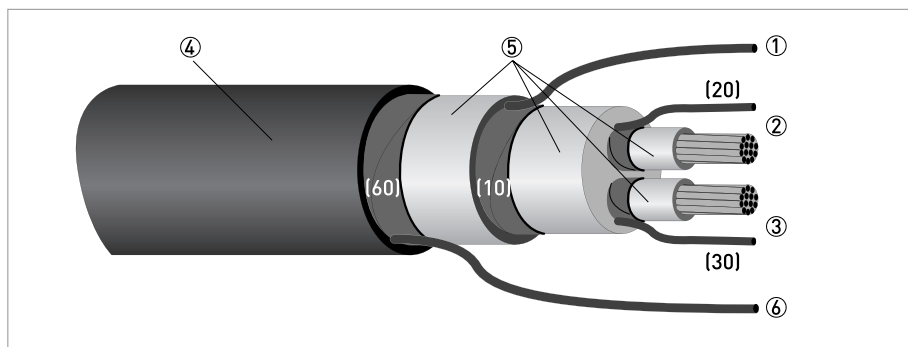


Figure 3-2: Construction of signal cable B

- ① Stranded drain wire for the inner shield (10), 1.0 mm² Cu / AWG 17 (not insulated, bare)
- ② Insulated conductor (2), 0.5 mm² Cu / AWG 20 with stranded drain wire (20) of the shield
- ③ Insulated conductor (3), 0.5 mm² Cu / AWG 20 with stranded drain wire (30) of the shield
- ④ Outer sheath
- ⑤ Insulation layers
- ⑥ Stranded drain wire (6) for the outer shield (60), 0.5 mm² Cu / AWG 20 (not insulated, bare)

3.3 Equipotential bonding

- As the Ex ia electrode circuits of the flow sensors are effectively grounded through the conductive liquid in the measuring tube, an equipotential bonding system must exist over the whole area in which the electrode circuits, including their wiring, are installed, conform EN 60 079-14 clause 12.2.4.
- The flowmeters OPTIFLUX 2000, 4000, 5000 and 6000, the electrode cable and the IFC 300 F signal converter must all be included in the equipotential bonding system of the hazardous area. If a single separate conductor is used for equipotential bonding, than this conductor must have a cross section of at least 4 mm² copper.
- The separate equipotential bonding conductor between flowmeter and converter can be left out, if by other means (e.g. over bonding conductors over the metal piping system) a high level of assurance that potential equalization exists between flowmeter and converter is reached.

3.4 Signal cable connections

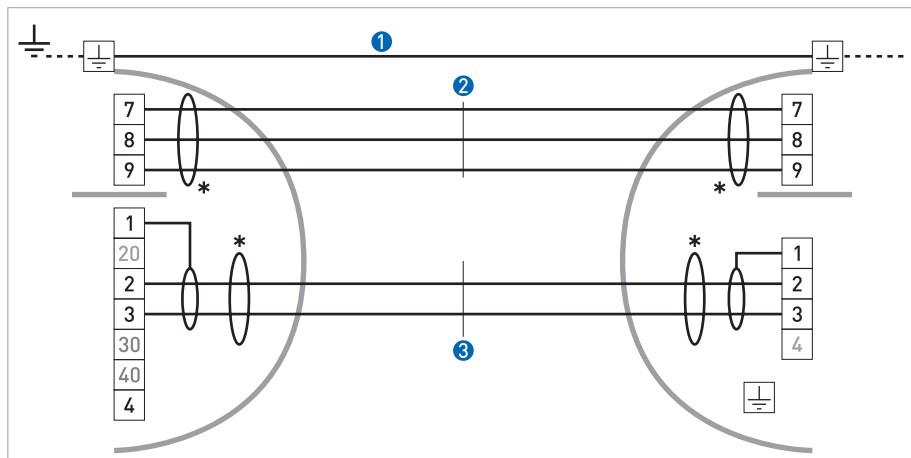


Figure 3-3: Connecting with signal cable A

- ① Equipotential bonding, conductor $\geq 4 \text{ mm}^2$
- ② Field current cable acc. EN 60079-14 clause 9.3 and 11.3 (Increased safety)
- ③ Signal cable A acc. EN 60079-14 clause 12.2 (Intrinsic safety)

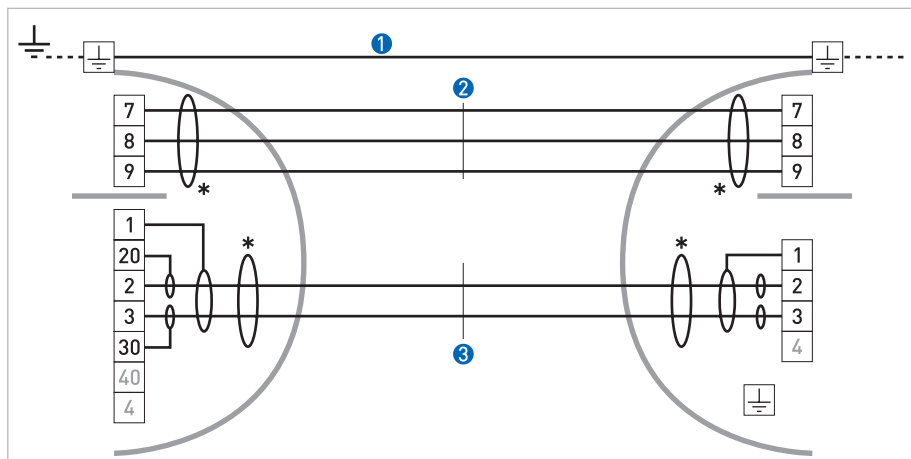


Figure 3-4: Connecting with signal cable B

- ① Equipotential bonding, conductor $\geq 4 \text{ mm}^2$
- ② Field current cable acc. EN 60079-14 clause 9.3 and 11.3 (Increased safety)
- ③ Signal cable B acc. EN 60079-14 clause 12.2 (Intrinsic safety)

4.1 Installation instructions

For IFC 300 F, OPTIFLUX 2000 F / 4000 F / 5000 F, OPTIFLUX 2300 C / 4300 C / 5300 C / 6300 C:

When used in a potentially explosive atmosphere, requiring the use of apparatus of equipment category 2G, certified cable entry devices must be used that are suitable for the application and correctly installed.

When used in a potentially explosive atmosphere, requiring the use of apparatus of equipment category 2D, certified cable entry devices with a degree of ingress protection of at least IP6x according to EN 60 529 must be used that are suitable for the application and correctly installed.

Unused openings must be closed with suitable certified closing elements.

With the use of conduits, a suitable certified sealing device such as a stopping box with setting compound must be provided immediately at the entrance to the flameproof enclosure.

For IFC 300 F, OPTIFLUX 4300 C / 5300 C:

To avoid voltage and current addition, the intrinsically safe circuits must be separated and wired to EN 60 079-14.

For OPTIFLUX 6000 F:

The cable glands and blanking elements must be in type of protection increases safety "e", suitable for the conditions of use and correctly installed. The devices must provide a degree of protection of at least IP64 according to EN 60 529.

Additionally for OPTIFLUX 2000 F / 4000 F / 5000 F / 6000 F:

The field coils in type of explosion protection "q" and "m" must be protected by a 160 mA fuse. The breaking capacity of the fuse must be in accordance with the prospective short circuit current of the supply. This concerns:

OPTIFLUX 2000 F / 4000 F	DN10...20 ("me")
	DN200...300 ("qe")
	DN25...150 ("qe") (optional)
OPTIFLUX 5000 F "sandwich"	DN2,5...15 ("me")
OPTIFLUX 5000 F "flange"	DN15...100 ("mb")
OPTIFLUX 6000 F	DN25...80 ("mb")

**INFORMATION!**

- *The internal field coil fuses of an IFC 300 electronic unit fulfill the above mentioned requirement with respect to breaking capacity*
- *The IFC 300 signal converter is delivered with two Ex e certified M20x1,5 cable glands and one Ex e certified M20x1,5 stopping plug in the connection compartment for power supply etc. and with two Ex e certified M20x1,5 cable glands in the connection box for the field current / electrode cables.*
- *The OPTIFLUX 2000 F / 4000 F / 5000 F / 6000 F flow sensors are normally delivered with two Ex e certified M20x1,5 cable glands, clamping range Ø 6...12 mm*
- *The OPTIFLUX 2300 C / 4300 C / 5300 C / 6300 C: flow meters are normally (connection compartment in type of Ex protection Ex e) delivered with two Ex e certified M20x1,5 cable glands, clamping range Ø 6...12 mm, and one Ex e certified M20x1,5 stopping plug. The optional OPTIFLUX 2300 C / 4300 C / 5300 C / 6300 C flow meters with connection compartment in type of Ex protection Ex d (flameproof enclosure) are normally delivered with one Ex d certified M20x1,5 stopping plug and two temporarily non-Ex certified simple plastic plugs. The purpose of these two plugs is only to keep the connection compartment free of dust and moisture during transport and storage.*

4.2 Connection of IFC 300

The flow sensors and the signal converter in field version must be incorporated in the equipotential bonding system of the installation. This can be established internally by connection of the protective earth (PE) conductor of the mains supply system to the internal PE clamp, or externally, by connecting a separate equipotential bonding conductor to the external U-clamp terminal (size M5) at respectively the flange of the mounting support (in case of compact instruments) or at the wall-mounting device (for signal converters in field version). A separate bonding conductor must have a cross-sectional area of at least 4 mm².

The display cover seals the electronics compartment of the converter housing and provides type of protection “flameproof enclosure”. The terminal compartment is default in type of protection “increased safety” and can optionally be performed as flameproof enclosure. The threaded joints formed by the covers and housing are a tight fit due to the requirements for type of protection “flameproof enclosure”. Screw the covers on and off with care and never use excessive force !

Keep the screw-threads free of dirt and well-greased (e.g. with PTFE grease). The grease will help to prevent the threads from locking due to corrosion.

To unscrew the covers, first release the interlocking devices (one at each cover). Therefore unscrew the M4 head screw with internal hexagon socket set using a No. 3 Allen key until the interlocking device can be turned. After the covers are screwed back onto the housing, make sure that the interlocking devices are properly refitted.



WARNING!

Allow the electronics to de-energize before opening the electronics compartment of the flow converter housing. Wait at least 35 minutes for T6 and 10 minutes for T5 before opening.

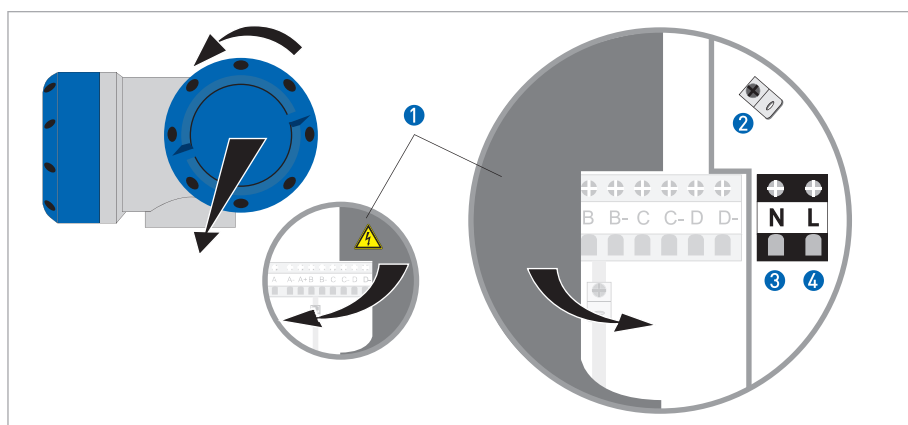


Figure 4-1: Electrical connections

- ① protection cover
- ② PE grounding clamp
- ③ N (or L-) terminal
- ④ L (or L+) terminal

Terminals	Function, electrical data
L, N L+, L-	Connections for mains supply, always non-Ex i 100...230 V AC, +10%/-15%, 22 VA 12...24 V DC, +30%/-25%, 12 W 24 V AC, +10%/-15%, 22 VA 24 V DC, +30%/-25%, 12 W $U_m = 253 \text{ V}$
A, A-, A+ B, B- C, C- D, D-	Connections for signal I/Os (PELV circuits), non-“Ex i” or “Ex i”, are dependent on the specific version of the signal converter ordered. Consult the tables with CG numbers for details.

The exact I/O-configuration for circuits A, B, C and D is order-specific and can be determined by the CG number shown on the converter. Therefore check the data on the back of electronics unit of the signal converter. The CG number contains 10 characters of which the last three characters (XYZ) determine the configuration of the I/O circuits:

CGxx	*	*	*	X	Y	Z
Pos 1...4	5	6	7	8	9	10
				determine I/O circuits		

The wiring of instruments has to be in accordance with the requirements as specified in the relevant national or international standard for electrical installations in hazardous areas, e.g. EN 60079-14. Section 9 (wiring systems) of this standard applies to all types of protection. Section 10 (additional requirements for type of protection “d” - flameproof enclosures), section 11 (additional requirements for type of protection “e” - increased safety) and section 12 (additional requirements for type of protection “i” - intrinsic safety) apply to respectively “Ex d”, “Ex e” and “Ex i” performed connection (terminal) compartments.

4.3 Input/output connections

The following non-intrinsically safe signal I/O (inputs/outputs) are available:

I/O PCB	Input/output functions, $U_n < 32 \text{ V DC}$, $I_n < 100 \text{ mA}$, $U_m = 253 \text{ V}$
Basic I/O	Current Output, active or passive, with HART Status Output / Control Input Status Output Pulse / Status Output
Modular I/O	Current Output, active or passive, with HART Pulse / Status Output, active or passive, highC or Namur
Modular carrier with 1 or 2 I/O modules	Each module: 1 out of following 3 in-/output functions: Current Output, active or passive Pulse / Status Output, active or passive, highC or Namur Control Input, active or passive, highC or Namur
Profibus DP I/O	Profibus-DP, active
Fieldbus I/O	Profibus-PA or Foundation Fieldbus
RS 485 Modbus	Modbus

Notes:

- The options separated by “/” are software selectable (can be changed by the user).
- The options separated by “or” are hardware versions (must be ordered as suchs).
- All outputs are passive unless otherwise indicated.
- HighC means High Current input/output, Namur means that the in-/outputs are according to the NAMUR recommendations.

The following signal I/O connections are available as intrinsically safe:

I/O PCB	CG nr. (XYZ)	I/O functions	
Ex i I/O	300, 310, 320	Current output 4...20 mA with HART passive (C and C-)	EEx ia IIC $U_i = 30 \text{ V}$, $I_i = 100 \text{ mA}$, $P_i = 1,0 \text{ W}$ $C_i = 10 \text{ nF}$, $L_i = \text{negligibly low}$
	200, 210, 220, 300, 310, 320	Pulse/status output (D and D-)	
	200, 210, 220	Current output 4...20 mA with HART active (C and C-)	EEx ia IIC $U_o = 21 \text{ V}$, $I_o = 90 \text{ mA}$, $P_o = 0,5 \text{ W}$ Linear characteristics $C_o = 90 \text{ nF}$, $L_o = 2,0 \text{ mH}$ $C_o = 110 \text{ nF}$, $L_o = 0,5 \text{ mH}$
Ex i Option	220, 320	Current output 4...20 mA passive (A and A-)	EEx ia IIC $U_i = 30 \text{ V}$, $I_i = 100 \text{ mA}$, $P_i = 1,0 \text{ W}$ $C_i = 10 \text{ nF}$, $L_i = \text{negligibly low}$
	210, 220, 310, 320, D10, D20, E10, E20	Pulse/status output / control input (B and B-)	
	210, 310, D10, E10	Current output 4...20 mA active (A and A-)	EEx ia IIC $U_o = 21 \text{ V}$, $I_o = 90 \text{ mA}$, $P_o = 0,5 \text{ W}$ Linear characteristics $C_o = 90 \text{ nF}$, $L_o = 2,0 \text{ mH}$ $C_o = 110 \text{ nF}$, $L_o = 0,5 \text{ mH}$
Fieldbus I/O	D00, D10, D20	Profibus-PA (C and C-, D and D-)	EEx ia IIC $U_i = 24 \text{ V}$, $I_i = 380 \text{ mA}$, $P_i = 5,32 \text{ W}$ $C_i = 5 \text{ nF}$, $L_i = 10 \mu\text{H}$ Suitable for connection to an intrinsically safe fieldbus in accordance with the FISCO model.
	E00, E10, E20	Foundation Fieldbus (C and C-, D and D-)	

The I/O circuits titled “Ex i I/O” and “Ex i Option” are always provided with type of protection Intrinsic Safety (Ex ia). The I/O-circuits “Fieldbus I/O Profibus-PA” as well as “Fieldbus I/O Foundation Fieldbus” can be provided with type of protection Intrinsic Safety.

Up to a maximum of 4 intrinsically safe (Ex ia) in-/outputs are possible. All intrinsically safe circuits are galvanically insulated with respect to earth and each other. To avoid summation of voltages and current, the wiring of these “Ex ia”-circuits must be sufficiently separated, e.g. in accordance with the requirements of standard EN 60079-14, clause 12.2.

The “Ex ia” signal in-/outputs may only be connected to other “Ex ia” or “Ex ib” approved devices (e.g. intrinsically safe isolation amplifiers), even if such devices are installed in a non-hazardous location !

Connection to non-“Ex i” devices cancels the “Ex ia” properties of the flowmeter.

Terminals L and N (or L+ and L-) for connection of the mains supply are not available with type of protection “intrinsic safety”. To achieve the necessary separation distances according to EN 60079-11 between the non-“Ex i” and “Ex i” circuits, the mains terminals are provided with a semi-circular protection cover with a “snap-in” lock. This cover MUST be closed before establishing the power supply to the converter.

**INFORMATION!**

For converters with an “Ex e” terminal compartment, the compartment can be opened in an energized state for short periods of time, to access the intrinsically safe terminals for possible checks. However, the semi-circular insulation cover over the non-intrinsically safe mains supply terminals L and N (or L+ and L-) MUST be kept closed.

**INFORMATION!**

More detailed information about the connections can be found in the handbook of the converter.

5.1 Maintenance

The flowmeters are maintenance free with respect to the flowmetering properties. Within the scope of periodic inspections required for electrical equipment installed in hazardous areas it is recommended to check the flameproof converter housing and covers for signs of damage or corrosion.

5.2 Before and after opening

**WARNING!**

the following instructions must always be carefully followed, if the housing of the signal converter has to be opened respectively closed again.

Before opening:

- Make absolutely sure that there is no explosion hazard!
- Gas-free certificate!
- Make sure that all connecting cables are safely isolated from all external sources!
- Allow the electronics to de-energize before opening the electronics compartment of the converter housing. Wait at least 35 minutes for T6 and 10 minutes for T5 before opening.

When the instructions above are strictly followed, the display cover (includes glass window) of the electronics compartment may be removed. First unscrew the head screw with internal hexagon socket set (size M4) of the interlocking device by a No. 3 Allen key, until the cover can rotate freely.

After opening:

- Before the cover is screwed back onto the housing, the screw-thread must be clean and well-greased with an acid and resin-free grease, e.g. PTFE grease.
- Screw the cover as tight as possible into the housing by hand, until it cannot be opened by hand anymore. Fixate the screw of the interlocking device tight with the No. 3 Allen key.

5.3 Replacement of mains fuse

**WARNING!**

Before commencing the work, refer to Before and after opening on page 33.



- Pull the display unit of the mounting frame using the two metal levers left and right and turn display unit carefully aside.
- Unscrew the two screws size M4 that hold the mounting frame with the electronics unit.

- Carefully pull the mounting frame with electronics unit almost completely out of the housing, disconnect the long rectangular (14-pole) blue connector at the back-end of the electronics unit. Now carefully remove the unit from the housing.
- The mains fuse is located in a fuse holder at the back-end of the electronics unit. The specifications must be as follows:

Fuse type: 5 x 20 mm (H) according to IEC 60127	
Power supply	Electrical data
12...24 V DC	250 V / 2 A
24 V AC/DC	250 V / 2 A
100...230 V AC	250 V / 1,6 A

**WARNING!**

Before reassembling the unit, refer to Before and after opening on page 33.



- Reassemble the unit in reverse order.

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