

Electromagnetic Flowmeters



Variable area flowmeters

Vortex flowmeters

Flow controllers

Electromagnetic flowmeters

Ultrasonic flowmeters

Mass flowmeters

Level measuring instruments

Communications technology

Engineering systems & solutions

Switches, counters, displays and recorders

Heat metering

Pressure and temperature



Electromagnetic flowmeters from KROHNE are designed to measure the volumetric flowrate of liquids (with and without solids contents), pulps, pastes and slurries in practically all industrial sectors.

The only requirement is that the process product should have a defined minimum electrical conductivity.

KROHNE is of course your competent partner in other sectors of instrumentation and control.

Ultra-modern electronic equipment and state-of-the-art production processes, combined with an efficient quality management system, ensure consistently high precision and quality in variable-area flowmeters, CORIMASS mass flow meters, level measuring devices, as well as engineering solutions & systems and communications engineering.

Electromagnetic flowmeters

The principle of electromagnetic flowmetering has various special advantages over other methods of measurement:

- Measurement largely independent of pressure, density, temperature, viscosity and flow profile
- Short inlet and outlet runs
- Unimpeded tube cross-section
- No additional pressure drop
- No moving parts
- Any installation position
- Turn-down ratio 100:1



Application

KROHNE electromagnetic flowmeters are to be found in many industrial sectors and applications.

Just a small selection:

- Chemical industry
- Water and wastewater
- Hydraulic transport, liquid products with up to 50% solids content
- Paper and woodpulp production
- Pharmaceutical
- Food and beverages
- Filling and dispensing processes
- Highly abrasive slurries
- High-pressure industrial processes
- Partially filled pipelines

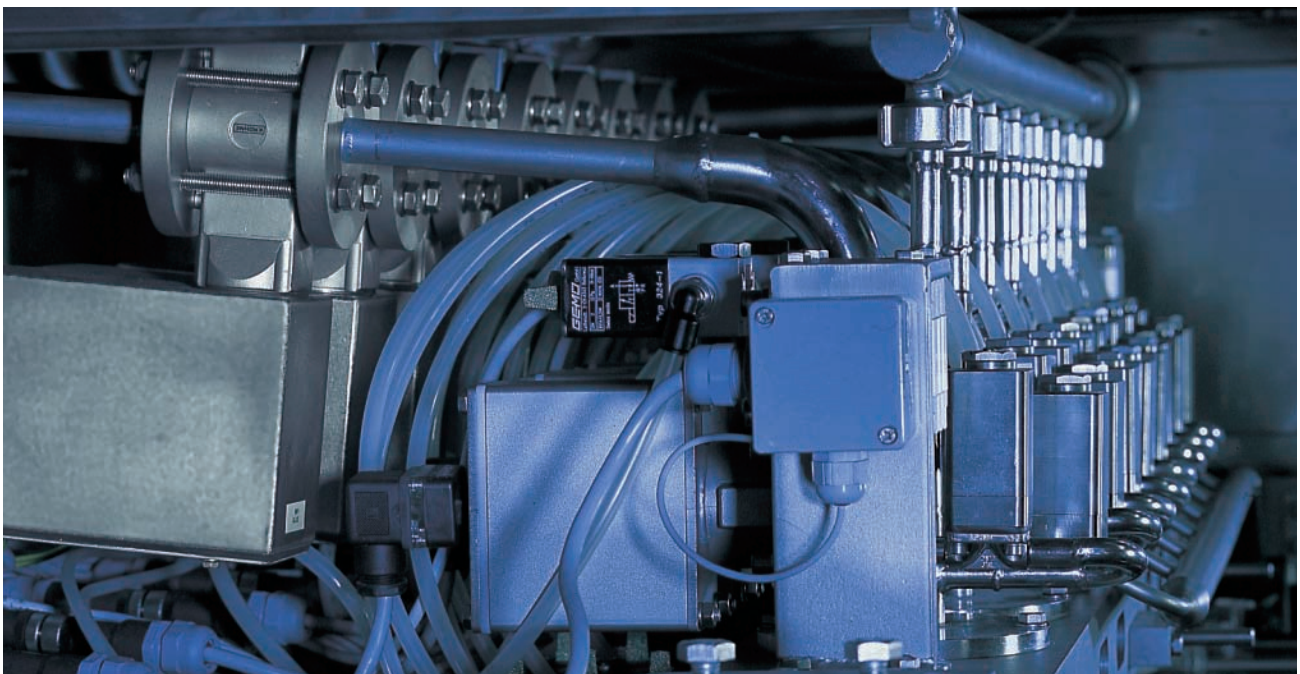
and many, many other applications in other industries



FIT and FORGET !

All electromagnetic flowmeters are delivered ready for operation.

Install the flowmeter in the pipeline,
make the electrical connection, that's it.

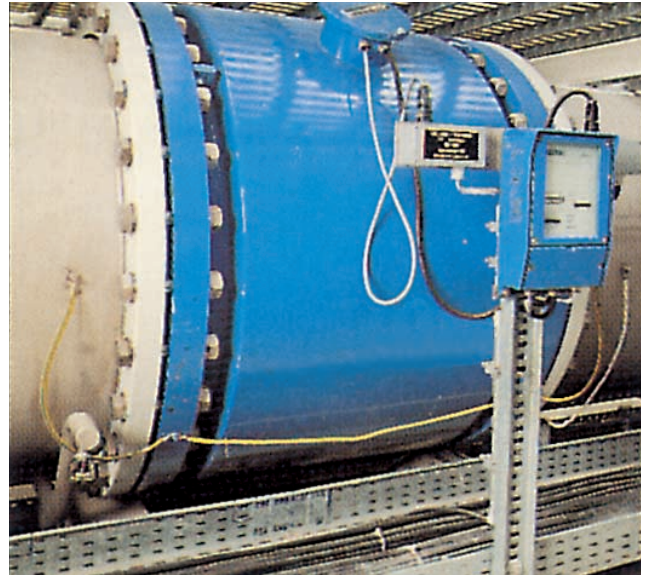


Always one step ahead with KROHNE

This highly accurate measurement technology is available with integrally or remote mounted converter, some with measuring errors of less than 0.2% of the measured value.

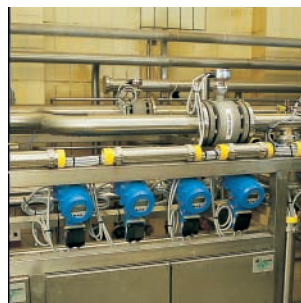
The primary head is installed in the pipeline, while the signal converter for signal processing is remote mounted in a field housing or 19" plug-in unit.

In the integral system, the signal converter is mounted in a housing with high protection category directly on the primary head.



With meter sizes of DN2.5 - 3000 / $\frac{1}{4}$ " - 120", measurements can be carried out from 2 l/h to 300 000 m³/h and more.

Most of the devices are approved for use in hazardous locations. Various materials are available for the measuring tube, liner and electrodes of the flowmeters for most applications.



Production and calibration

All electromagnetic flowmeters from KROHNE meet the requirements of CE directives and EMC guidelines. Fabrication and production shops are certified to ISO 9001.



At KROHNE, all electromagnetic flowmeters are calibrated by direct comparison of volumes, the most accurate calibration method of all. The KROHNE calibration rigs are the world's biggest and most accurate, and are accredited to EN17 025. Measurement uncertainty is less than 0.013% of the measured value for meter sizes up to DN 3000 / 120" and above.



Device selection

The following tables will help you to find the right device for your particular application.

Pages 6 and 7 comprise the various flowmeters (primary heads) and the associated signal converters.

Selection table of electromagnetic flowmeters

	Combined with signal converter											Approvals	Product temperature range								Operation pressure													
	IFC 010 K, F / ≤ ± 0.5 % of MW	IFC 020 K / ≤ ± 0.3 % of MW	IFC 020 F, E / ≤ ± 0.3 % of MW	IFC 040 K / ≤ ± 0.5 % of MW	IFC 090 K / ≤ ± 0.3 % of MW	IFC 110 F / ≤ ± 0.3 % of MW	IFC 210 E / ≤ ± 0.3 % of MW	SC 150 F / ≤ ± 0.3 % of MW	IFC 090 K-CAP / ≤ ± 0.4 % of MW	IFC 110 PF / ≤ ± 0.1 - 0.4 % of MW	IFC 210 E-PF / ≤ ± 1.0 % of MW		Hazardous duty version (ATEX)	FM Factory Mutual	FML Weihenstephan	> +180°C / > +356°F on request	+180°C / +356°F max. separate	+140°C / +284°F max. compact	+130°C / +266°F	+120°C / +248°F					+100°C / +212°F	+90°C / +194°F	+60°C / +140°F	+0°C / +32°F	-5°C / +23°F	-20°C / -4°F	-25°C / -13°F	-60°C / -75°F	≤ 1 500 bar / ≤ 20 000 psig	≤ 40 bar / ≤ 580 psig
AQUAFLUX	●	●	●	●	●	●	●														●	●	●	●					●	●	●			
ECOFLUX 1000	●	●	●	●	●	●	●														●	●	●	●	●	●	●			●	●			
ALTOFLUX 2000			●		●	●	●	●													●	●	●	●	●	●	●	●			●	●		
ALTOFLUX 4000	●	●	●	●	●	●	●	●				●	●								●	●	●	●	●	●	●			●	●	●		
PROFLUX 5000	●	●	●	●	●	●	●					●	●								●	●	●	●	●	●	●			●	●	●		
VARIFLUX 6000	●	●	●	●	●	●	●					●	●	●	●						●	●	●	●	●	●	●			●	●	●		
ALTOFLUX 2W 2 wire			●									●									●	●	●	●	●	●	●			●	●	●		
BATCHFLUX							●														●	●	●	●	●	●	●			●	●	●		
CAPAFLUX								●				●	●									●	●	●	●	●	●			●	●	●		
TIDALFLUX partially filled										●	●											●	●	●						●				
ALTOFLUX IFS 2005 F							●														●	●	●	●	●	●	●	●			●	●		
ALTOFLUX IFS 4005 F					●	●	●														●	●	●	●	●	●	●			●	●	●		
ALTOFLUX M 900		●		●	●	●	●					●	●								●	●	●	●	●	●	●	●			●	●	●	

Signal converter

	Outputs	Control inputs	Forward / reverse flow	Limit contact	Loop test function	Galvanically isolated	Overvoltage protection	Automatic range change	External totalizer reset	Magnet pin (option)	Empty pipe indication	Intrinsically safe EEx version	FM Factory Mutual	Hazardous duty version (ATEX)	0/4 - 20 mA	4 - 20 mA / 2 and 2 x 2-wire connection	0 - 100 Hz for full-scale, adjustable	0 - 100 Hz for full-scale, adjustable	0 - 10 000 Hz for full-scale, adjustable	0 - 1 000 Hz for full-scale, adjustable	0 - 10 Pulse/s (selectable)	1 x	max. 2 x	max. 4 x	max. 2 x, for e.g. totalizer reset, hold outputs
IFC 010 K, F	●	●	●	●	●	●				●					●		●	●	●	●					
IFC 020 K, F, E	●	●	●	●	●	●		●							●	●	●	●	●	●					
IFC 040 K 2 wire	●	●	●	●	●	●				●					●		●	●	●	●					
IFC 090 K, F IFC 090 K-CAP	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	
IFC 110 F IFC 110 PF	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	
IFC 210 E IFC 210 E-PF	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	
SC 150 F	●	●	●	●	●	●				●					●	●	●	●	●	●					
BATCHFLUX IFC 012 K	●	●	●		●	●											●	●	●						

<

- K** kompakt
F separate / field housing
E separate / 19" plug-in unit
PF partially filled pipes
CAP capacitive signal pickup, non-contact measurement

Standard equipment

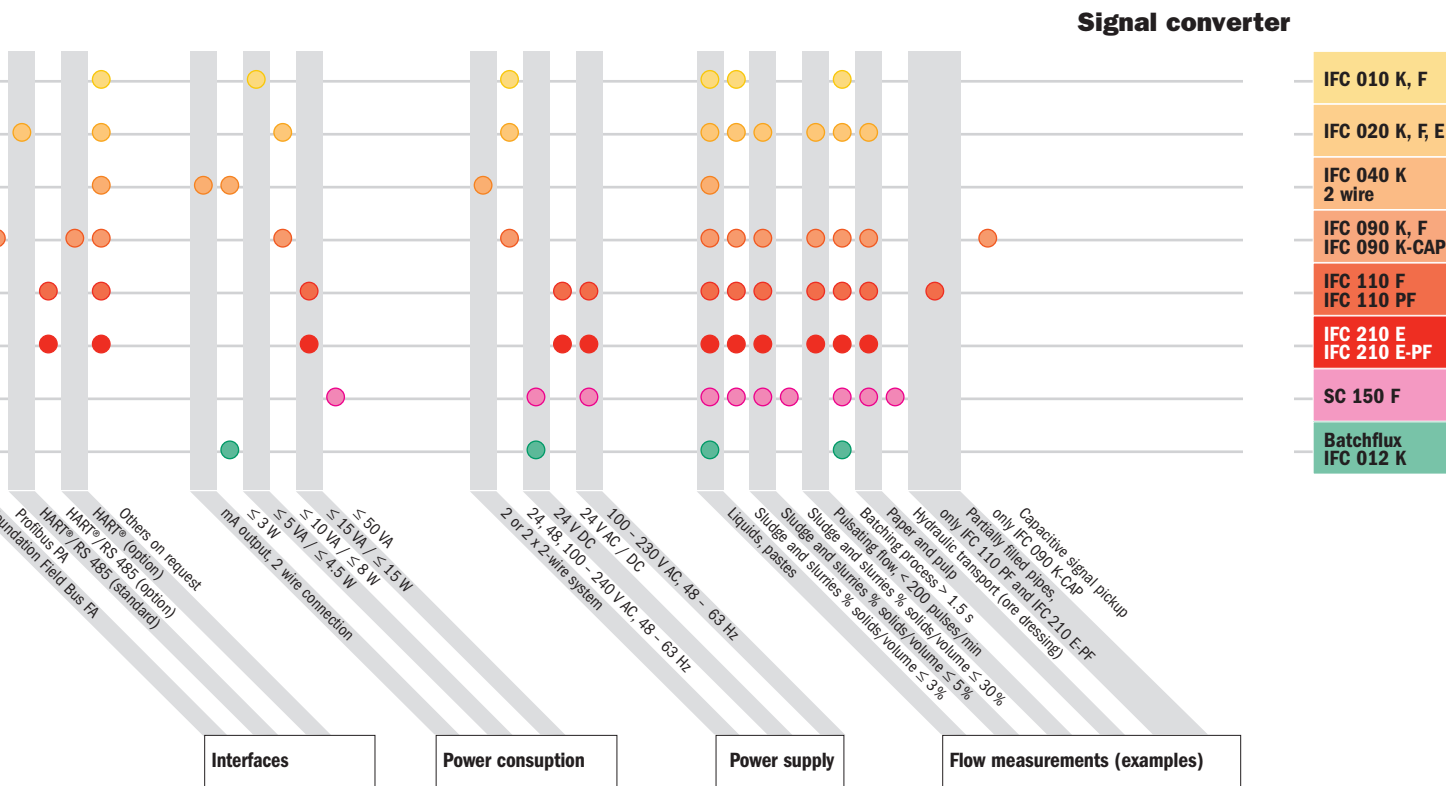
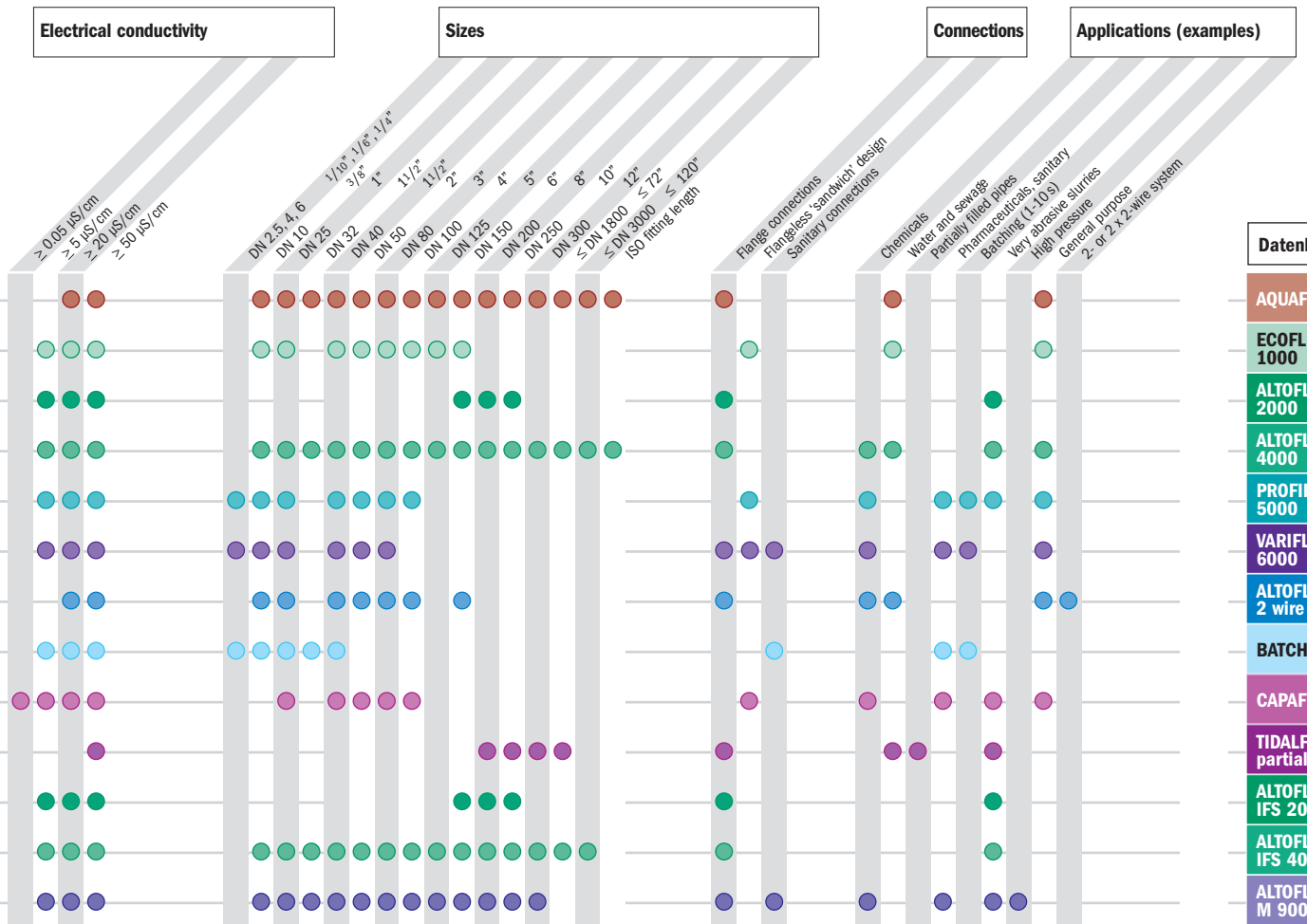
Approvals

Current output

Pulse output

Status output

Control input



Integral systems of electromagnetic flowmeters

ECOFLUX
IFM 1010 K
IFM 1020 K
IFM 1080 K



AQUAFLUX
010 K
020 K
080 K



ALTOFLUX
IFM 4010 K
IFM 4020 K
IFM 4080 K



ALTOFLUX 2W
IFM 4042 K
2 wire

Characterization	- Flangeless version - Rugged measuring tube with stainless steel reinforced Teflon® PFA liner - Particularly economical - Wide field of application	- Flanged connections - Steel housing - µP-signal converter in plastics housing - Available with or without indicator - Particularly economical - Liner of Polypropylene, NSF-approved Polyurethane liner and KTW approved hard rubber quality	- Flanged connections - Steel housing - Teflon® PFA liner, reinforced with stainless steel mesh, for high chemical, vacuum and abrasion resistance ALTOFLUX 2W 2 wire unit DN 10-150 / 3/8"-6" hybrid connection technology (IFC 040 K signal converter)
Signal converter , see page 12	IFC 010 K, IFC 020 K or IFC 090 K	IFC 010 K, IFC 020 K or IFC 090 K	IFC 010 K, IFC 020 K or IFC 090 K
Electrical conductivity	≥ 5 µS/cm (water ≥ 20 µS/cm)	≥ 20 µS/cm	≥ 5 µS/cm (water ≥ 20 µS/cm)
Full scale range	85 liter/h - 760 m³/h 0.3 - 3 360 US Gal/min	85 liter/h - 87 000 m³/h 0.3 - 388 000 US Gal/min	85 liter/h - 87 000 m³/h 0.3 - 388 000 US Gal/min
Meter size	DN10 - 150 and 3/8" - 6"	DN10 - 1600 and 3/8" - 64"	DN10 - 1600 and 3/8" - 64"
Pressure rating	up to 16 bar/230 psig	up to 40 bar/580 psig	up to 40 bar/580 psig
Product temperature	- 25 to + 120°C/- 13 to + 248°F	- 5 to + 90°C/+ 23 to + 194°F	- 60 to + 140°C/- 75 to + 284°F
Protection category (IEC 529/EN 60 529)	IP 67, equivalent to NEMA 6	IP 67, equivalent to NEMA 6	IP 67, equivalent to NEMA 6
Materials measuring section/liner	Teflon® PFA	≥ DN25 / ≥ 1" Polypropylene, hard rubber ≤ DN20 / ≤ 3/4" Teflon® PTFE	Teflon® PFA, Teflon® PTFE, ETFE (Tefzel), (others on request)
electrodes	Hastelloy C4	Hastelloy C4	Hastelloy C4, platinum, titanium, stainless steel 1.4571/316 Ti.
Hazardous duty versions ATEX Ex II 2 GD FM-Factory Mutual	no Class I, II, III, Div 2	no no	yes (also with "EEx ia" outputs) Class I, II, III, Div 1, 2
Fields of application <u>Industry</u>	environmental engineering, water and sewage, agriculture, batching of fertilizers and liquids feeds	environmental engineering, water and sewage	the "workhorse" for water, sewage and waste water, chemicals, paper, cellulose, ore dressing
<u>Abrasion resistance</u>	very good	higher than required for the applications in question	dependent on liner material, very high with Teflon® PFA
<u>Chemical resistance of liner</u> ... with alkalis, e. g. NaOH	NaOH up to 70% at 20°C/68°F	NaOH up to 50% at 20°C/68°F	all concentrations with Teflon® PFA or PTFE liners
... with acids, e. g. HNO ₃	HNO ₃ up to 65% at 20°C/68°F	HNO ₃ up to 5% at 20°C/68°F	all concentrations with Teflon® PFA or PTFE liners
	(limited by electrode material)		(select materials for grounding rings and gaskets for process compatibility)

PROFILUX
IFM 5010 K
IFM 5020 K
IFM 5080 K



- Flangeless version
- Stainless steel housing
- The only precision flowmeter with flow profile-optimizing measuring tube
- Influence on measuring accuracy from temperature, viscosity, pressure and flow profile is extremely slight

IFC 010 K, IFC 020 K or IFC 090 K
 $\geq 5 \mu\text{S}/\text{cm}$ (water $\geq 20 \mu\text{S}/\text{cm}$)
 6 liter/h - 340 m³/h
 0.02 - 1 500 US Gal/min 0.75 - 54 ft/s
 DN 2.5 - 100 and 1/10" - 4"
 up to 40 bar/580 psig
 - 60 to + 140°C/- 75 to + 284°F
 IP 67, equivalent to NEMA 6
 fused aluminium oxide, 99.7% Al₂O₃
 Cermet, platinum
 yes (also with „EEx ia“ outputs)
 Class I, II, III, Div 2**

all applications requiring extremely high measuring stability under arduous operating conditions.
 extremely high
 NaOH up to 50% at 50°C/122°F
 HNO₃ up to 99% at 90°C/194°F, HF (hydrofluoric acid), all concentr. up to 50°C/122°F
 (select materials for grounding rings and gaskets for process compatibility)

VARIFLUX
IFM 6010 K
IFM 6020 K
IFM 6080 K



- Various sanitary/flanged connections
- Stainless steel housing
- FDA approved Teflon® PFA liner, vacuum resistant, CIP and SIP cleaning facilitated by unique metal reinforcement of the PFA
- Largest assortment of sanitary connections

IFC 010 K, IFC 020 K or IFC 090 K
 $\geq 5 \mu\text{S}/\text{cm}$ (water $\geq 20 \mu\text{S}/\text{cm}$)
 6 liter/h - 220 m³/h
 0.3 - 950 US Gal/min
 DN 2.5 - 80 and 1/10" - 3"
 up to 40 bar/580 psig
 - 60 to + 140°C/- 75 to + 284°F
 IP 67, equivalent to NEMA 6
 Teflon® PFA
 Hastelloy C4, platinum, titanium
 stainless steel 1.4571/316 Ti
 yes (also with „EEx ia“ outputs)
 Class I, II, III, Div 1, 2**

food and beverage, pharmaceutical, cosmetics, chemical
 high
 all concentrations
 all concentrations
 (select materials for grounding rings and gaskets for process compatibility)

CAPAFLUX
IFM 5080 K-CAP



- Precision flowmeter
- With capacitive signal pickup (electrodes not in contact with the product)
- Minimum required electrical conductivity only 0.05 μS/cm (water: 1 μS/cm)
- No need for selection of electrode material, liner has high chemical resistance
- No electrochemical effects at the electrodes, also suitable for the most difficult chemical processes
- Not affected by electrically insulating deposits
- Abrasion resistant, suitable for products with high solids contents
- No crevices, no blind spots: sanitary
- With flow profile-optimizing measuring tube

IFC 090 K-CAP (similar to IFC 090 K)
 $\geq 0.05 \mu\text{S}/\text{cm}$ (water $\geq 1 \mu\text{S}/\text{cm}$)
 530 liter/h - 340 m³/h
 2.3 - 1 500 US Gal/min
 DN 25 - 100 and 1" - 4"
 up to 40 bar/580 psig
 - 20 to + 100°C/- 4 to + 212°F
 IP 67, equivalent to NEMA 6
 fused aluminium oxide, 99.7% Al₂O₃
 capacitive electrodes, not wetted
 yes (also with „EEx ia“ outputs)
 yes, in preparation

all sectors where what counts are leak-tight and crevice-free tubes for flow-metering the most difficult products, including low-conductivity and deposit-forming products
 extremely high
 NaOH up to 50% at 50°C/122°F
 HNO₃ up to 99% at 90°C/194°F, HF (hydro-fluoric acid), all concentr. up to 50°C/122°F

BATCHFLUX



- Excellent measuring accuracy and repeatability
- Dimensionally stable Al₂O₃ measuring tube, suitable for SIP and CIP cleaning
- Crevice-free CERMET electrodes
- Specially developed for use on filling machines
- Fast and accurate volumetric filling processes for even the smallest amounts
- Batching times > 1s
- Low power consumption, < 3W

IFC 011 K (similar to IFC 010 K)
 $\geq 5 \mu\text{S}/\text{cm}$ (water $\geq 20 \mu\text{S}/\text{cm}$)
 6 liter/h - 50 m³/h
 0.02 - 220 US Gal/min
 DN 2.5 - 40 and 1/10" - 1 1/2"
 up to 10 bar/150 psig
 - 25 to + 140°C/- 13 to + 284°F
 IP 67, equivalent to NEMA 6
 fused aluminium oxide, 99.7% Al₂O₃
 Cermet, platinum
 no
 no

batching of fertilizers and liquid feeds
 extremely high
 NaOH up to 50% at 50°C/122°F
 HNO₃ up to 99% at 90°C/194°F
 (select materials for grounding rings and electrodes for process compatibility)

Primary heads of electromagnetic flowmeters

ECOFLUX
IFS 1000 F



AQUAFLUX
F



ALTOFLUX
IFS 4000 F
IFS 4005 F



Characterization

- Flangeless version
- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Particularly economical
- Wide field of application

- Flanged connections
- Steel housing
- Liner of Polypropylene, NSF-approved Polyurethane liner and KTW approved hard rubber quality
- Particularly economical

- Flanged connections
- Steel housing
- Teflon® PFA liner, reinforced with stainless steel mesh, for high chemical, vacuum and abrasion resistance
- **IFS 4000 F** for largely homogeneous liquids, slurries, pastes
- **IFS 4005 F** for liquids with high solids content

Magnetic system

pulsed DC field

pulsed DC field

pulsed DC field

Electrical conductivity

≥ 5 μS/cm (water ≥ 20 μS/cm)

≥ 20 μS/cm

≥ 5 μS/cm (water ≥ 20 μS/cm)

Full scale range

0.3 - 12 m/s / 1 - 40 ft/s

85 liter/h - 760 m³/h

0.3 - 3 360 US Gal/min

85 liter/h - 305 000 m³/h

0.3 - 1 400 000 US Gal/min

85 liter/h - 305 000 m³/h

0.3 - 1 400 000 US Gal/min

Meter size

DN10 - 150 and 3/8" - 6"

DN10 - 3000 and 3/8" - 120"

DN 10 - 3000 and 3/8" - 120"

Pressure rating

up to 16 bar/230 psig

up to 40 bar/580 psig

up to 40 bar/580 psig (higher on request)

Product temperature

- 25 to + 120°C/- 13 to + 248°F

- 5 to + 90°C/+ 23 to + 194°F

- 60 to + 180°C/- 76 to + 356°F

Protection category (IEC 529/EN 60 529)

IP 67, equivalent to NEMA 4/4X

IP 67, equivalent to NEMA 6

IP 67, equivalent to NEMA 6

Materials

measuring section/liner

Teflon® PFA

≥ DN25 / ≥ 1" Polypropylene, hard rubber
≤ DN20 / ≤ 3/4" Teflon® PTFE

Teflon® PFA, Teflon® PTFE, ETFE (Tefzel)

electrodes

Hastelloy C4

Hastelloy C4

Hastelloy C4, platinum, titanium, stainless steel 1.4571/316 Ti.

Approvals/Tests

Hazardous duty version: ATEX Ex II 2 GD
FM-Factory Mutual

Food and beverage

no
pending Div 2
no

no
no
no

yes
Class I, II, III, Div 1, 2
no

Combined with signal converter (see Pages 12 and 13)

IFC 010 F / IFC 020 F, E
IFC 090 F
IFC 110 F / IFC 210 E

IFC 010 F / IFC 020 F, E
IFC 090 F
IFC 110 F / IFC 210 E

IFS 4000 F: IFC 010 F / IFC 020 F, E
IFC 090 F
IFC 110 F / IFC 210 E
IFS 4005 F: SC 150 F

Fields of application

Industry

environmental engineering water and sewage, agriculture, batching of fertilizers and liquids feeds

environmental engineering, water and sewage

the "workhorse" for water, sewage and waste water, chemicals, paper, cellulose, ore dressing

Abrasion resistance

high

higher than required for the applications in question

dependent on liner material, very high with ETFE, Irtthane, hardrubber

Chemical resistance of liner

... with alkalis, e. g. NaOH, KOH

NaOH up to 70% at 20°C/68°F

NaOH up to 50% at 20°C/68°F

all concentrations with Teflon® PFA or PTFE liners

... with acids, e. g. HNO₃

HNO₃ up to 65% at 20°C/68°F

HNO₃ up to 5% at 20°C/68°F

all concentrations with Teflon® PFA or PTFE liners

(limited by electrode material)

(select materials for grounding rings and gaskets for process compatibility)

PROFILUX
IFS 5000 K



- Flangeless (sandwich) design
- Stainless steel housing
- The only precision flowmeter with flow profile-optimizing measuring tube
- Influence on measuring accuracy from temperature, viscosity, pressure and flow profile is extremely slight

ALTOFLUX
IFS 2000 F
IFS 2005 F



- Flanged connections
- Steel housing
- Measuring tube made of Al2O3 almost as hard as diamonds
- High measurement and long-term stability, even with highly abrasive products
- **IFS 2000 F:** for largely homogeneous liquids, slurries, pastes
- **IFS 2005 F:** for liquids with high (and coarse-grained) solids content

VARIFLUX
IFS 6000 F



- Various sanitary/flanged connections, stainless steel housing
- FDA approved Teflon® PFA liner, vacuum resistant, CIP and SIP cleaning facilitated by unique metal reinforcement of the PFA
- Largest selection of sanitary connections

TIDALFLUX
IFS 4000 PF



- Designed for partially filled pipelines
- Excellent measuring accuracy, also for low levels, through the integrated capacitive level measuring system
- Saves installation and maintenance of sluice underpasses

pulsed DC field

≥ 5 μS/cm (water ≥ 20 μS/cm)

6 liter/h - 340 m³/h

0.02 - 1 500 US Gal/min

DN 2.5 - 100 and 1/10" - 4"

up to 40 bar/580 psig

- 60 to + 180 °C/- 76 to + 356 °F

IP 67, equivalent to NEMA 6

pulsed DC field

≥ 5 μS/cm (water ≥ 20 μS/cm)

19 liter/h - 2100 m³/h

84 - 930 US Gal/min

DN 150 - 250 and 6" - 10"

up to 16 bar/230 psig

- 60 to + 120 °C/- 76 to + 248 °F

IP 65, equivalent to NEMA 4/4X

pulsed DC field

≥ 5 μS/cm (water ≥ 20 μS/cm)

6 liter/h - 220 m³/h

0.02 - 950 US Gal/min

DN 2.5 - 80 and 1/10" - 3"

up to 40 bar/580 psig

- 60 to + 180 °C/- 76 to + 356 °F

IP 67, equivalent to NEMA 6

pulsed DC field

≥ 50 μS/cm

2 - 100 000 m³/h

8.8 - 500 000 US Gal/min

DN 200 - 1800 and 8" - 24"

up to 10 bar/150 psig

- 5 to + 60 °C/+ 23 to + 140 °F

IP 67, equivalent to NEMA 6

fused aluminium oxide, 99.7% Al₂O₃

Cermet, platinum

fused aluminium oxide, 99.7 % Al₂O₃

Hastelloy C4, platinum
stainless steel 1.4571/316 Ti

Teflon®-PFA

FDA approved

Hastelloy C4, platinum, titanium,
stainless steel 1.4571/316 Ti

Irathane, 12 mm/0.47"

Hastelloy C4

yes

Class I, II, III, Div 2

yes

no

Class I, II, III, Div. 2

no

yes

Class I, II, III, Div. 1, 2

Dairy and Research Center

Weihenstephan, A3

Ex N, Zone 2 (option)

in preparation

no

IFS 010 F / IFC 020 F, E

IFS 090 F

IFS 110 F / IFC 210 E

IFS 2000 F: IFC 020 F, E

IFS 090 F

IFS 110 F / IFC 210 E

IFS 2005 F: SC 150 F

IFS 010 F / IFC 020 F, E

IFS 090 F

IFS 110 F / IFC 210 E

IFS 110 PF

IFS 210 E-PF

all applications requiring
extremely high measuring stability
under arduous operating conditions.

extremely high

NaOH up to 50% at 50 °C/122 °F

HNO₃ up to 99% at 90 °C/194 °F, HF
(hydrofluoric acid), all concentr. up to
50 °C/122 °F

(select materials for grounding rings
and gaskets for process compatibility)

aluminium, ore mining,
heat measurement

extremely high

NaOH up to 50% at 50 °C/122 °F

HNO₃ up to 99 % at 90 °C/194 °F

(select materials for grounding rings,
electrodes and gaskets for process
compatibility)

food and beverage, pharmaceutical,
cosmetics, chemical

high

all concentrations

all concentrations

(select materials for connections and
electrodes for process compatibility)

sewage in partially filled
pipelines

very high

NaOH up to 10% at 30 °C/86 °F

HNO₃ up to 5% at 20 °C/68 °F

Signal converters for electromagnetic flowmeters

IFC 010 K IFC 020 K
IFC 010 F IFC 020 F
IFC 020 E



IFC 090 K IFC 040 K
IFC 090 F (2 wire)



Characterization	● IFC 010 K/IFC 020 K of integral design ● IFC 010 F/IFC 020 F in field housing ● IFC 020 E 19" plug-in version. ● Signal processing by microprocessor, good dynamic response. Basic version with display/totalizing and control unit with plain-text operator prompting, all functions/data can be set. ● IFC 020: display/totalizing, HART®/RS 485 interface, higher field current,	● IFC 090 K of integral design ● IFC 090 F in field housing ● Signal processing by microprocessor, very good dynamic response. ● Basic version with display/totalizing and control unit with clear-text operator prompting, all functions/data can be set (also with magnetic sensors without opening the housing) ● IFC 040 K, equivalent to IFC 090 K, but 2 wire technology
Application	For liquids, pastes, sludges and slurries with up to 3% solids content, IFC 020 for pulsating flows with up to approx. 200 pump lifts/min, and batching processes.	Liquids, pastes, sludges and slurries with solids content up to 5%, also for pulsating flows up to approx. 200 pump lifts/min, and batching processes, also with intrinsic safety (i) outputs
Special features	Identical electronic module for remote-system and compact flowmeters = simplified stocking of spares. Modular electronic unit easily upgradable, easily adaptable to meet additional requirements	Outstanding repeatability and dynamic response through higher field frequency and field current. Modular electronic unit, easily upgradable, easily adaptable to meet additional requirements.
Magnetic field excitation	Bidirectional pulsed DC field.	Bidirectional pulsed DC field.
Full-scale range	0.3 – 12m/s, 1 – 40ft/s configurable in user-definable flow units	0.3 – 12m/s, 1 – 40ft/s configurable in user-definable flow units
Outputs	Current Pulse Status 0/4 – 20 mA 0 – 10 pulses/s (scalable), 0 – 100 Hz 0 – 1000 Hz for full-scale range Binary output, e.g. for flow direction error indication	0/4 – 20 mA, etc. 0 – 1000 pulses/s (scalable) for full-scale range Binary output, e.g. for direction of flow error indication, range selection
Control input	–	Binary outputs switch-selectable to the control input, e.g. set outputs and totalizer to zero, external range change, etc.
Interfaces (option)	HART®, RS 485	HART®, Profibus PA, Fieldbus Foundation FF
Power supply	24, 48, 100 – 240V AC, 48 – 63Hz and 24 V DC	24, 48, 100 – 240V AC, 48 – 63Hz and 24V DC
Power consumption	5VA / 4W	10VA / 8W
Error limits overall system	± 0.5% of measured value (0.3% IFC 020)	± 0.3% of measured value
Standard equipment	Low-flow cutoff Forward/reverse flow measurement Limit contact Test function for converter and receiver instruments Galvanic isolation Overvoltage protector (supply power and all outputs)	Low-flow cutoff, Forward/reverse flow measurement, Automatic range change Limit contacts, External range selector, External totalizer reset Test function for converter and receiver instruments, Galvanic isolation Overvoltage protector (supply power and all inputs and outputs)
Other versions <u>Hazardous-duty version</u> ATEX Ex II 2 GD FM (Factory Mutual) <u>For custody transfer</u>	– – –	IFC 090 F: yes, installation in Ex area IFC 090 F: class I, II, III, Div. 2 in preparation

IFC 110 F IFC 110 PF



- Signal converter in field housing
- Signal processing by microprocessor, outstanding interference rejection, very good dynamic response
- Basic version without display or control unit
- **Option:** display/totalizing and control unit with plain-text operator prompting, all functions/data can be set.
- **IFC 110 PF** for TIDALFLUX IFS 4000 PF

SC 150 F



- Signal converter in field housing for wall mounting
- Signal processing by microprocessor, outstanding interference rejection, through high field frequency and field current, very good measuring stability despite high frequency.
- **Option:** magnetic sensors for setting all data without opening the housing

IFC 210 E IFC 210 E-PF



- Signal converter in 19" plug-in unit to DIN 41495, Part 5
- Signal processing by microprocessor, excellent noise rejection, very good dynamic response
- Digital signal processing and sequence control
- Active and passive outputs and inputs
- Large graphic LCD display
- **IFC 210 E-PF** for TIDALFLUX IFS 4000 PF

Liquids, pastes, slurries and slurries with solids contents up to 5%, also for pulsating flows up to approx. 200 pump lifts/min, and batching processes

Liquids, pastes, slurries, slurries with solids contents in excess of 30%, e.g. paper and pulp industry, hydraulic conveyance (ore dressing), dredging industry

Liquids, pastes, slurries and slurries with solids contents up to 5%, also for pulsating flows up to approx. 200 pulses/min, and batching processes

3 status indication outputs and 2 control inputs allow easy, flexible system integration. Modular electronic unit, easily upgradable, with unassigned slots for add-on board
Bidirectional pulsed DC field, field.

Heavy-duty electronic module, Excellent measuring signals, Outstanding repeatability through high field current, Designed for toughest process conditions
Bidirectional, pulsed high-power DC field.

HART® interface, excellent noise rejection

0.3 - 12m/s, 1 - 40ft/s configurable in user-definable flow units
0/4 - 20mA, etc.
0 - 10 000 pulses/s (scalable)

0.3 - 12m/s, 1 - 40ft/s configurable in user-definable flow units
0/4 - 20mA, etc.
0 - 10 000 pulses/s (scalable)

0.3 - 12m/s, 1 - 40ft/s configurable in user-definable flow units
0/4 - 20mA, etc.
0 - 10 000 pulses/s (scalable)

4 binary outputs, e.g. for flow direction, error indication, automatic range change
2, e.g. totalizer reset, hold outputs, set outputs to zero, test

Binary output, e.g. for direction of flow, error indication

Automatic range change, flow direction, error indication, limit contacts
e.g. automatic range change, reset of totalizer and errors, set outputs to min values, hold actual values

HART®, RS 485

-

HART® interface (optionally RS 485)

85 - 264V AC, 48 - 63 Hz and 24V DC/AC

100 - 240V AC, 48 - 63Hz

85 - 264V AC, 48 - 63 Hz and 18-32 V DC/AC

15VA / 15W

approx. 50VA

11 VA / 11 W (typical)

± 0.3% of measured value (option: 0.2%)

± 0.4% of measured value

± 0.3% of measured value (option: 0.2%)

Low-flow cutoff, Forward/reverse flow measurement, Automatic range change, Limit contacts, External range selection, External totalizer reset, Function test of converter and receiver instruments, Galvanic isolation Overvoltage protector (supply power and all inputs and outputs)

Low-flow cutoff, Forward/reverse flow measurement, Automatic range change, Limit contacts, Galvanic isolation

Low-flow cutoff, Forward/reverse flow measurement, Automatic range change, Limit contacts, External range selection, External totalizer reset, Function test of converter and receiver instruments, Galvanic isolation

yes, installation outside of Ex area
in preparation

-

yes, installation outside of Ex area

in preparation

-

-

Precision

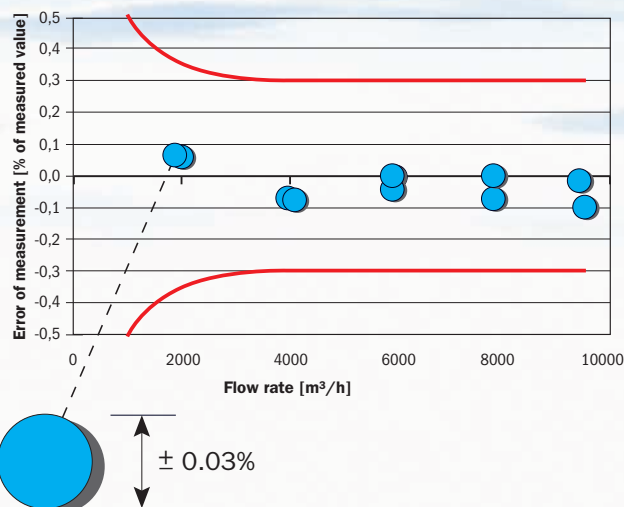
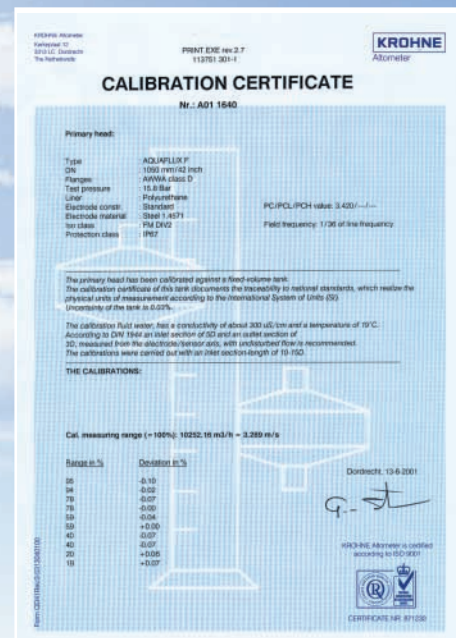
Tower height 43 m equivalent to 141 ft / net volume 350 000 litres equivalent to 95 000 US Gal

28 precision level switches control the flow volume and various computer-aided volume totalizers

Inlet run $\geq 10 \times \text{DN}$ (DN = meter size)

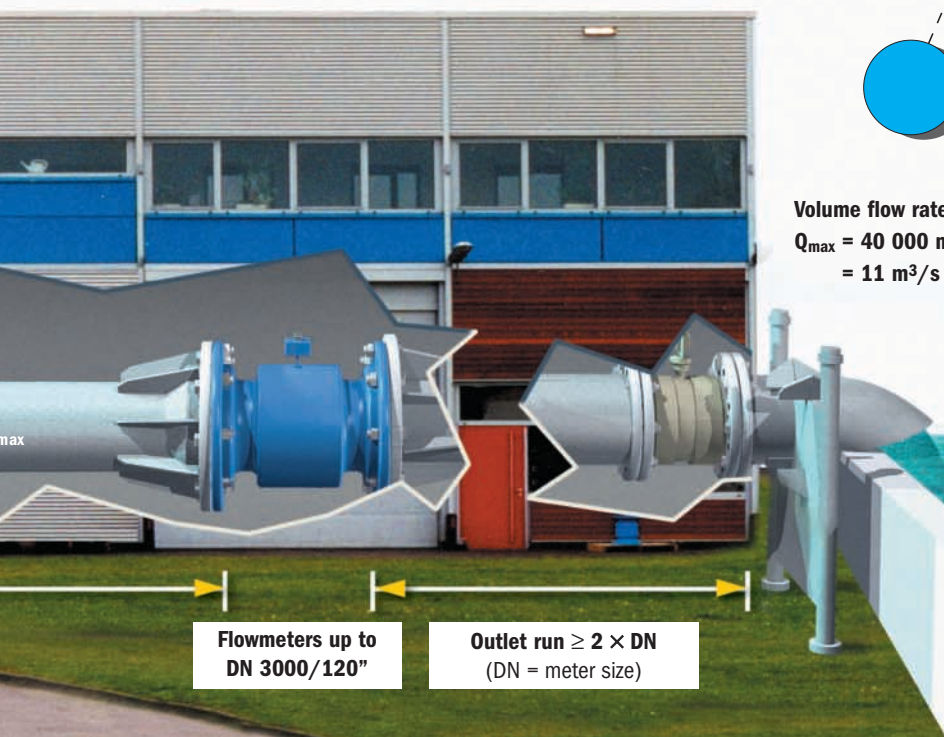
creates the KROHNE standard

- The world's largest and most accurate calibration rig
- Calibration of flowmeters up to DN 3000 / 120"
- Calibration by direct comparison of volumes, altogether the most accurate method
- Comparison measurements with so-called master meters are much less accurate and cannot be verified
- The volume measurement standards of KROHNE calibration rigs have been calibrated by NMI, the Netherlands Standards Institute. Measurement uncertainty is less than 0.013% of the measured value.
- KROHNE Altometer calibration rigs are accredited in conformity with EN 17 025.
- Calibration accuracy is better than 99.97% of the measured value.
- The error of measurement of the calibration rigs is better by a factor of 10 than the accuracy data of the flowmeter being tested.
- All flowmeters are calibrated under reference conditions, similar to EN 29 104.
- All calibration data are genuine and verifiable; documented in writing in the calibration reports, which are supplied together with each KROHNE flowmeter. An example is shown on the right.



Volume flow rate
 $Q_{\max} = 40\,000 \text{ m}^3/\text{h}$
 $= 11 \text{ m}^3/\text{s}$

At this flowrate, a typical public swimming-pool can be filled in less than 1 minute. Inaccuracy is less than 0.013% in terms of volume and less than 0.26 mm in terms of filling level (equal to the thickness of a single hair), based on an average pool depth of 2 metres.



**Flowmeters up to
DN 3000/120"**

Outlet run $\geq 2 \times \text{DN}$
(DN = meter size)

Measuring Principle 3.1

Electromagnetic flowmeters measure the volume flow of electrically conductive liquids and slurries.

Measuring principle

An electric conductor, in this case the electrically conductive medium, passes through a magnetic field. The voltage U induced in this medium is directly proportional to the mean flow velocity v . Magnetic induction B (magnetic field strength) and the distance between electrodes D (nominal pipe diameter) are constant.

$$U = K \times B \times \bar{v} \times D \quad (1)$$

K instrument constant

B magnetic field strength

v mean flow velocity

D electrode spacing

The volumetric flow rate q_v can be calculated according to

$$q_v = \bar{v} \times D^2 \times \frac{\pi}{4} \quad (2)$$

It follows from equation 1 that

$$\bar{v} = \frac{U}{K \times B \times D} \quad (3)$$

Therefore:

$$q_v = \frac{U}{K \times B} \times D \times \frac{\pi}{4} \quad (4)$$

The induced voltage signal is picked up either by two measuring electrodes in conductive contact with the medium or indirectly by capacitive coupling. A signal converter amplifies the signal and converts it into a standard analog signal (e.g. 4 to 20 mA) and a frequency signal (e.g. 1 pulse for every US gallon or cubic metre of medium flowing through the measuring tube).

To ensure that the voltage is not short-circuited by the pipe wall, the measuring tube is made of an electrically insulating material or fitted with an insulating liner.

Measurement is largely independent of the flow profile and other properties of the medium, such as pressure, temperature, viscosity, density, consistency, electrical conductivity, and electrode contamination.

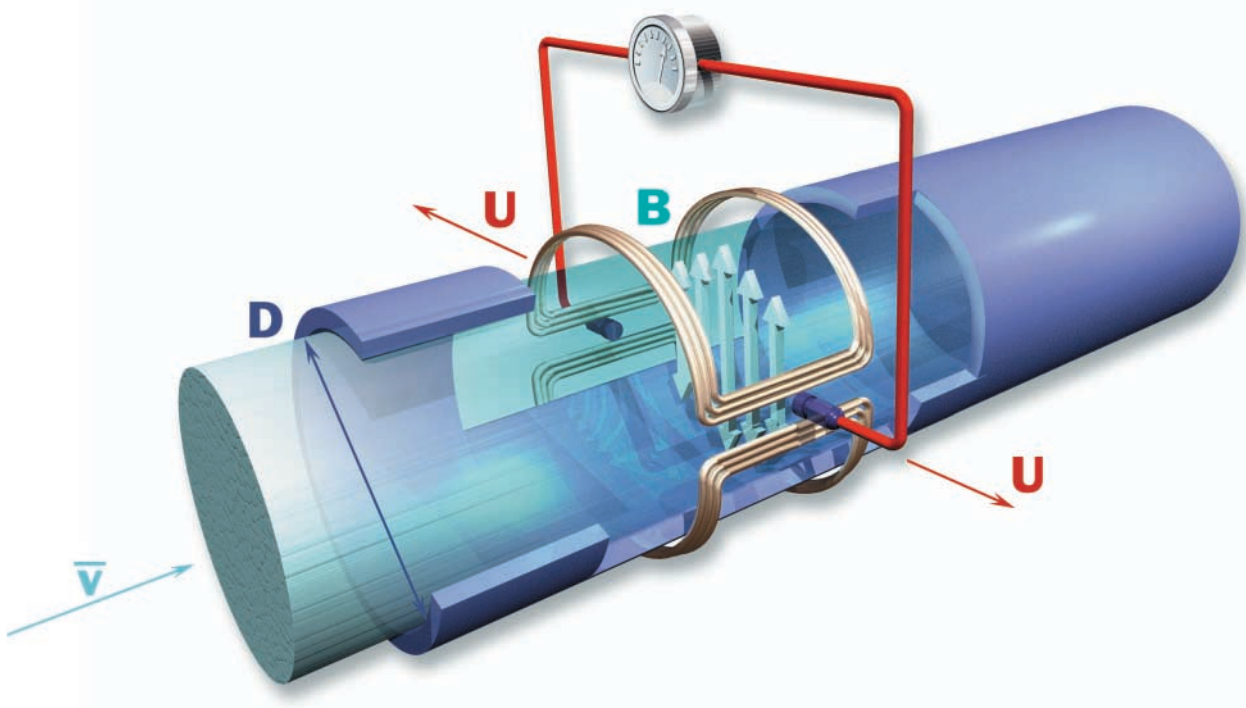
Measuring systems

The electromagnetic flowmeter consists of a primary head, that is installed in the pipeline, and a signal converter.

The compact design has the signal converter mounted directly on the primary head.

For systems with pulsed d.c. field the primary head field coils which generate the magnetic field are energized by a pulsed direct current from the signal converter.

The measuring signal is a squarewave voltage of the same frequency. These systems feature extremely small measuring errors.



Pressure Loss Calculation

A primary head with a smaller meter size may prove to be more economical for pipe runs with a low flow velocity. The pressure loss resulting from pipe reduction/expansion and from the greater velocity in the primary head can be calculated as follows:

ζ_1, ζ_3 nondimensional quantities as a function of the Reynolds number (see diagrams)

ζ_2 nondimensional quantity: 0.02 for KROHNE flowmeters

ρ density in kg/m³

d_1, d_2 pipe I.D. in metres and inches

v_1, v_2 flow velocity in m/s and ft/s

l_2 length of flowmeter (primary head)

Pressure loss in mbar

- (1) Pressure loss, reducing section

$$\Delta p_1 = \frac{\rho}{2} \times \zeta_1 \times v_2^2$$

- (2) Pressure loss, primary head

$$\Delta p_2 = \frac{\rho}{2} \times \zeta_2 \times v_2^2 \times \frac{l_2}{d_2}$$

- (3) Pressure loss, expanding section

$$\Delta p_3 = \frac{\rho}{2} \times \zeta_3 \times v_1^2$$

Total pressure loss is:

$$\Delta p_{\text{tot.}} = (\Delta p_1 + \Delta p_2 + \Delta p_3) \times 0.01 \text{ [mbar]}$$

Pressure loss in inches w.c. (water column)

- (1) Pressure loss, reducing section

$$\Delta p_1 = \frac{\rho}{2} \times \zeta_1 \times v_2^2 \times 3.654 \times 10^{-4}$$

- (2) Pressure loss, primary head

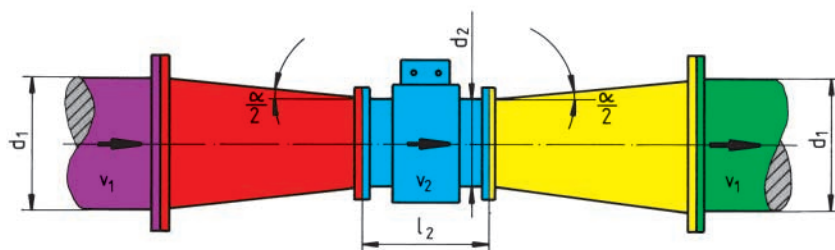
$$\Delta p_2 = \frac{\rho}{2} \times \zeta_2 \times v_2^2 \times 3.654 \times 10^{-4} \times \frac{l_2}{d_2}$$

- (3) Pressure loss, expanding section

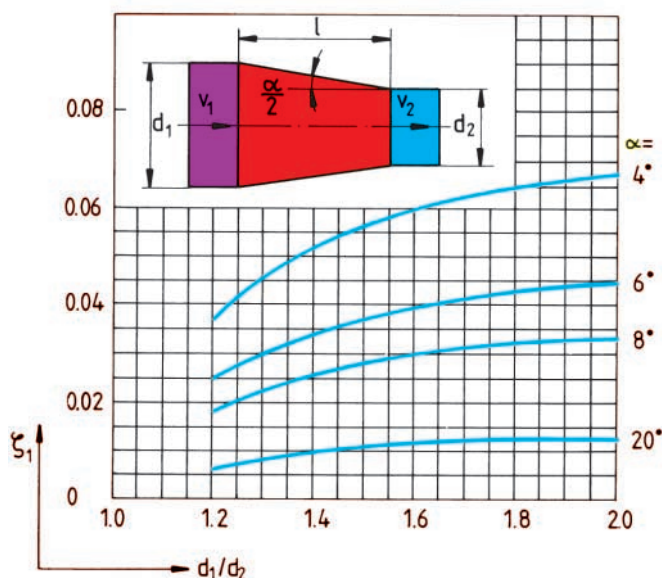
$$\Delta p_3 = \frac{\rho}{2} \times \zeta_3 \times v_1^2 \times 3.654 \times 10^{-4}$$

Total pressure loss is:

$$\Delta p_{\text{tot.}} = (\Delta p_1 + \Delta p_2 + \Delta p_3) \text{ [inches w.c.]}$$

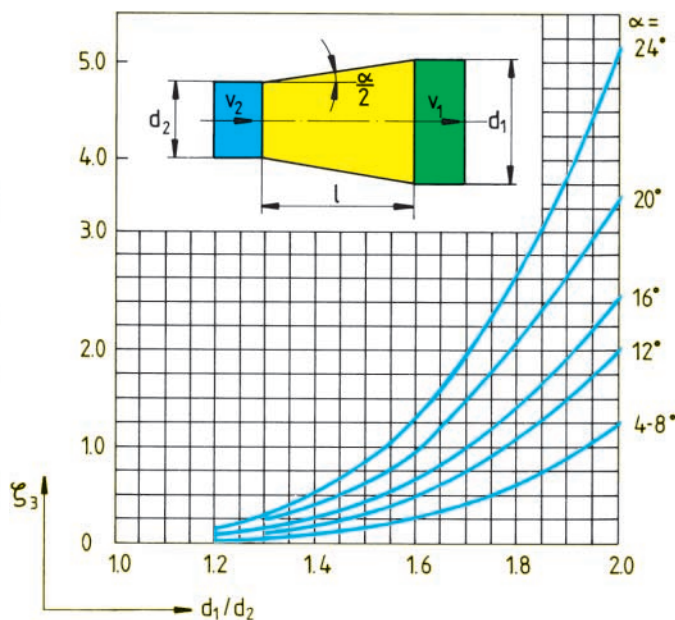


Reducing section



The reducing angle (α) should not exceed 8° (equivalent to $\alpha/2 = 4^\circ$), otherwise measuring accuracy may be affected. If the reducing angle is greater, a straight inlet section must be fitted between reducing socket and primary head.

Expanding section



For the expanding section, the optimum angle of expansion is $\alpha = 8^\circ$.

ζ at $\alpha = 8^\circ$

d_1/d_2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
ζ_1	0.018	0.023	0.0255	0.028	0.03	0.0308	0.0315	0.0323	0.0332
ζ_3	0.01	0.02	0.07	0.15	0.26	0.43	0.64	0.9	1.25

Recommendations for installation

Selection of meter size

The size of primary head should if possible be selected to provide a velocity of 2 to 3 m/s or 6 to 9 ft/sec. for the full-scale range. Minimum full-scale range is 0.5 m/s or 1.5 ft/sec., maximum is 10 or 11 m/s or 30 or 33 ft/sec., depending on flowmeter type.

For fluids with a solids content, the velocity should be between 3 and 5 m/s or 9 and 15 ft/s to prevent deposits and minimize abrasion.

Exact determination of flow velocity

For range setting purposes, the exact flow velocity can be determined using the flow table for each nominal pipe width.

Example: v in m/s

Nominal pipe diameter	DN 150
Desired measuring range	200 m ³ /h

From the table we obtain for the flow velocity of 1 m/s a flow rate of 63.617 m³/h at DN 150; for 200 m³/h the flow velocity v is:

$$v = \frac{200 \text{ m}^3/\text{h}}{63.617 \text{ m}^3/\text{h}} \times 1 \text{ m/s}$$

$$v = 3.144 \text{ m/s}$$

Example: v in ft/s

Nominal pipe diameter	6"
Desired measuring range	1000 US GPM

From the table we obtain for the flow velocity of 1 ft/s a flow rate of 88.128 US GPM at 6" meter size; for 1000 US GPM the flow velocity v is:

$$v = \frac{1000 \text{ US GPM}}{88.128 \text{ US GPM}} \times 1 \text{ ft/s}$$

$$v = 11.35 \text{ ft/s}$$

Flow tables

v = 1 m/s

Meter size DN mm	Flow rate m ³ /h	Meter size DN mm	Flow rate m ³ /h
2.5	0.017671	250	176.71
4	0.045239	300	254.47
6	0.10179	350	346.36
10	0.28274	400	452.39
15	0.63617	500	706.86
20	1.1310	600	1017.9
25	1.7671	700	1385.4
32	2.8953	800	1809.6
40	4.5239	900	2209.2
50	7.0686	1000	2827.4
65	11.946	1200	4071.5
80	18.096	1400	5541.8
100	28.274	1600	7238.2
125	44.179	1800	9160.9
150	63.617	2000	11310
200	113.10		

v = 1 ft/s

Meter size inch	Flow rate US GPM	Meter size inch	Flow rate US GPM
1/10	0.024480	10	244.80
1/8	0.038250	12	352.51
1/4	0.15300	14	479.81
3/8	0.34425	16	626.69
1/2	0.61200	20	979.21
3/4	1.3770	24	1410.1
1	2.4480	28	1919.2
1 1/4	3.8250	32	2506.8
1 1/2	5.5080	36	3172.6
2	9.7921	40	3916.8
2 1/2	15.300	48	5640.2
3	22.032	56	7677.0
4	39.168	64	10027
5	61.200	72	12691
6	88.128	80	15667
8	156.67		

Protection classes

to IEC 529/EN 60529

IP 20 , equivalent to NEMA 1	Protection against accidental large-area hand contact	Protection against foreign bodies of > 12 mm or 1/2" diameter	No protection against water
IP 65 , equivalent to NEMA 4 and 4X	Protection against contact with means of any kind	Total protection against ingress of dust (dust-proof enclosure)	Protection against jets of water from any direction (hose-proof)
IP 66 , equivalent to NEMA 4 and 4X	Protection against contact with means of any kind	Total protection against ingress of dust (dust-proof enclosure)	Protection against jets of water and heavy seas
IP 67	Protection against contact with means of any kind	Total protection against ingress of dust (dust-proof enclosure)	Protection against immersion in water
IP 68 equivalent to NEMA 6	Protection against contact with means of any kind	Total protection against ingress of dust (dust-proof enclosure)	Protection against ingress of water under pressure (water-tight)

