Electromagnetic Flowmeters
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 / 1/10" - 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

<table>
<thead>
<tr>
<th>Model</th>
<th>Function</th>
<th>Feature</th>
<th>Approvals</th>
<th>Outputs Control inputs</th>
<th>Status Output</th>
<th>Pulse Output</th>
<th>Current Output</th>
<th>Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTOFLUX 2W</td>
<td>2-wire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>CAPAFLUX</td>
<td>partially filled</td>
<td></td>
<td></td>
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<tr>
<td>TIDALFLUX</td>
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<td></td>
</tr>
<tr>
<td>IFC 010 K, F</td>
<td>compact / field</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IFC 020 K, F</td>
<td>separate / field</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFC 040 K</td>
<td>separate / 19&quot;</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>IFC 090 K-CAP</td>
<td>capacitive signal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SC 150 F</td>
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</tr>
<tr>
<td>IFC 012 K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Other Features**
- Hazardous duty version (ATEX)
- Intrinsically safe EEx version
- FM Factory Mutual
- 3A FML Weihenstephan
- Pressure: ≤ 1 500 bar / ≤ 20 000 psig
- ≤ 40 bar / ≤ 580 psig
- ≤ 16 bar / ≤ 230 psig
- ≤ 10 bar / ≤ 150 psig
- Temperature: +100°C / +212°F
- +90°C / +194°F
- +60°C / +140°F
- +0°C / +32°F
- –5°C / +23°F
- –20°C / –4°F
- –60°C / –75°F
- –25°C / –13°F

**Approval Standards**
- Standard equipment
- Combined with signal converter

**Notes**
- Review page for additional information.
### Electrical conductivity

<table>
<thead>
<tr>
<th>Sizes</th>
<th>Connections</th>
<th>Applications (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 2.5, 4, 6</td>
<td>1/10&quot;, 1/6&quot;, 1/4&quot;</td>
<td>Chemicals, Water and sewage, Partly filled pipes, Pharmaceuticals, sanitary, Batch (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 10</td>
<td>3/8&quot;</td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 32</td>
<td>1/2&quot;</td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 50 1&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 80 3&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 100 4&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 125 5&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 150 6&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 200 8&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 250 10&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 300 12&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 350 14&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 400 16&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 500 20&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 600 24&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 700 28&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 800 32&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 900 36&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 1000 40&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 1200 48&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 1500 60&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 1800 72&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 2000 80&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 2500 100&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
<tr>
<td>DN 3000 120&quot;</td>
<td></td>
<td>Chemicals, Water and sewage, Partially filled pipes, Pharmaceuticals, sanitary, Batching (1-10 s), Very abrasive slurries, High pressure</td>
</tr>
</tbody>
</table>

### Flow measurements (examples)

- **Signal converter**
  - **Interfaces**: 2 or 2 x 2-wire system
  - **Power consumption**: ≤ 3 W, ≤ 5 VA, ≤ 4.5 W, ≤ 10 VA, ≤ 8 W, ≤ 15 VA, ≤ 15 W, ≤ 50 VA
  - **Power supply**: 24, 48, 100 – 240 V AC, 48 – 63 Hz, 24 V DC, 24 V AC / DC, 100 – 230 V AC, 48 – 63 Hz
  - **Flow measurements (examples)**: Liquids, pastes, Sludge and slurries, % solids/volume, ≤ 3%, ≤ 5%, ≤ 30%

###סיסスターグランフィーユャルックス

- **DN 2.5, 4, 6**
- **DN 10**
- **DN 32**
- **DN 50**
- **DN 80**
- **DN 100**
- **DN 125**
- **DN 150**
- **DN 200**
- **DN 250**
- **DN 300**
- **DN 350**
- **DN 400**
- **DN 500**
- **DN 600**
- **DN 700**
- **DN 800**
- **DN 900**
- **DN 1000**
- **DN 1200**
- **DN 1500**
- **DN 1800**
- **DN 2000**
- **DN 2500**
- **DN 3000**
## Integral systems of electromagnetic flowmeters

<table>
<thead>
<tr>
<th>Characterization</th>
<th>ECOFLUX</th>
<th>AQUAFLUX</th>
<th>ALTOFLUX</th>
<th>ALTOFLUX 2W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IFM 1010 K</td>
<td>010 K</td>
<td>IFM 4010 K</td>
<td>IFM 4042 K</td>
</tr>
<tr>
<td></td>
<td>IFM 1020 K</td>
<td>020 K</td>
<td>IFM 4020 K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IFM 1080 K</td>
<td>080 K</td>
<td>IFM 4080 K</td>
<td>2 wire</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Full scale range</th>
<th>≥ 5µS/cm (water ≥ 20µS/cm)</th>
<th>≥ 20µS/cm</th>
<th>≥ 5µS/cm (water ≥ 20µS/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 - 12m/s / 1 - 40ft/s</td>
<td>85liter/h - 760m³/h</td>
<td>85liter/h - 87 000m³/h</td>
<td>85liter/h - 87 000m³/h</td>
</tr>
<tr>
<td>0.3 - 3 360US Gal/min</td>
<td>0.3 - 3 360US Gal/min</td>
<td>0.3 - 3 360US Gal/min</td>
<td>0.3 - 3 360US Gal/min</td>
</tr>
</tbody>
</table>

### Meter size

<table>
<thead>
<tr>
<th>DN10 - 150 and ¾&quot; - 6&quot;</th>
<th>DN10 - 1600 and ¾&quot; - 64&quot;</th>
</tr>
</thead>
</table>

### Pressure rating

- up to 16bar/230psig, up to 40bar/580psig, up to 40bar/580psig

### 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

- measurement section/liner
- Teflon® PFA, Hastelloy C4
- DN 25/ ≥ 1" Polypropylene, hard rubber
- ≤ DN 20/ ≤ ¾" Teflon® PTFE, Hastelloy C4
- DN 20/ ≤ ¾" Teflon® PTFE, Hastelloy C4
- Teflon® PFA, Teflon® PTFE, ETFE (Tefzel), others on request
- Hastelloy C4, Platinum, Titanium, Stainless steel 1.4571/316 Ti.

### Hazardous duty versions

- ATEX Ex II 2 GD
- FM-Factory Mutual
- no
- no
- yes (also with "Ex ia" outputs)
- Class I, II, III, Div 2
- no
- no
- Class I, II, III, Div 1, 2

### Fields of application

- Industry
- Environmental engineering, waste water, sewage, agriculture, paper, cellulose, ore dressing
- Environmental engineering, water and sewage, agriculture, batching of fertilizers and liquids feeds
- the "workhorse" for water, sewage and waste water, chemicals, paper, cellulose, ore dressing
- Environmentally dependent on liner material, very high with Teflon® PFA

### Abrasion resistance

- Very good
- Higher than required for the applications in question
- Higher than required for the applications in question
- Higher than required for the applications in question

### Chemical resistance of liner

- ... 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
- (limited by electrode material)
- All concentrations with Teflon® PFA or PTFE liners
- All concentrations with Teflon® PFA or PTFE liners

---

**ECOFLUX**

- Flangeless version
- Steel housing
- Flanged connections
- Relatively economical
- Particularly economical
- ATEX Ex II 2 GD
- Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

**AQUAFLUX**

- Wide field of application
- Available with or without indicator
- Particularly economical
- ATEX Ex II 2 GD
- Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

**ALTOFLUX**

- Wide field of application
- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Wide field of application
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

**ALTOFLUX 2W**

- Wide field of application
- Two wire unit
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**AQUAFLUX**

- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Wide field of application
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**ALTOFLUX**

- Wide field of application
- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Wide field of application
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**ALTOFLUX 2W**

- Wide field of application
- Two wire unit
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**AQUAFLUX**

- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Wide field of application
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**ALTOFLUX**

- Wide field of application
- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Wide field of application
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**ALTOFLUX 2W**

- Wide field of application
- Two wire unit
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA

---

**AQUAFLUX**

- Rugged measuring tube with stainless steel reinforced Teflon® PFA liner
- Wide field of application
- ATEX Ex II 2 GD
- No Class I, II, III, Div 2
- Environmentally dependent on liner material, very high with Teflon® PFA
### PROFIFLUX
- **IFM 5010 K**
- **IFM 5020 K**
- **IFM 5080 K**

**Features:**
- Flangeless version
- Stainless steel housing
- Influence on measuring accuracy from temperature, viscosity, pressure and flow profile is extremely slight

**Applications:**
- High conductivity media
- All applications requiring extremely high measuring stability under arduous operating conditions

**Materials:**
- **Cermet:** platinum, fused aluminum oxide, 99.7% Al₂O₃
- **Capacitive electrodes:** not wetted

**Conditions:**
- **NaOH** up to 50% at 50°C/122°F
- **HNO₃** up to 99% at 90°C/194°F

**Range:**
- 6 liter/h - 340 m³/h
- 0.02 - 1,500 US Gal/min
- 0.75 – 54 ft/s

**Dimensions:**
- DN 2.5 - 100 and 1/10" - 4"
- Up to 40 bar/580 psig
- – 60 to + 140°C/– 75 to + 284°F

**Approval:**
- IP 67, equivalent to NEMA 6

**Additional Features:**
- Ceramic, platinum electrodes
- Fused aluminum oxide, 99.7% Al₂O₃

### VARIFLUX
- **IFM 6010 K**
- **IFM 6020 K**
- **IFM 6080 K**

**Features:**
- 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

**Applications:**
- Food and beverage, pharmaceutical, cosmetics, chemical

**Materials:**
- **Cermet:** platinum, titanium stainless steel 1.4571/316 Ti
- **Capacitive electrodes:** not wetted

**Conditions:**
- **NaOH** up to 50% at 50°C/122°F
- **HNO₃** up to 99% at 90°C/194°F

**Range:**
- 6 liter/h - 220 m³/h
- 0.3 - 950 US Gal/min

**Dimensions:**
- DN 2.5 - 80 and 1/10" - 3"
- Up to 40 bar/580 psig
- – 20 to + 140°C/– 4 to + 212°F

**Approval:**
- IP 67, equivalent to NEMA 6

### CAPAFLUX
- **IFM 5080 K-CAP**

**Features:**
- 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

**Applications:**
- Batching of fertilizers and liquid feeds
- 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
- All concentrations

**Range:**
- 530 liter/h - 340 m³/h
- 2.3 - 1,500 US Gal/min

**Dimensions:**
- DN 25 - 100 and 1" - 4"
- Up to 10 bar/150 psig
- – 20 to + 100°C/– 4 to + 212°F

**Approval:**
- IP 67, equivalent to NEMA 6

### BATCHFLUX
- **IFC 011 K (similar to IFC 010 K)**

**Features:**
- 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 > 1 s
- Low power consumption, < 3 W

**Applications:**
- Batchflux of fertilizers and liquid feeds
- 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
- All concentrations

**Range:**
- 6 liter/h - 50 m³/h
- 0.02 - 220 US Gal/min

**Dimensions:**
- DN 2.5 - 40 and 1/10" - 1 1/2"
- Up to 10 bar/150 psig
- – 25 to + 140°C/– 13 to + 284°F

**Approval:**
- IP 67, equivalent to NEMA 6
### Primary heads of electromagnetic flowmeters

<table>
<thead>
<tr>
<th>Characterization</th>
<th>ECOFLUX IFS 1000 F</th>
<th>AQUAFLUX F</th>
<th>ALTOFLUX IFS 4000 F IFS 4005 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flangeless version</td>
<td>Rugged measuring tube with stainless steel reinforced Teflon® PFA liner</td>
<td>Flanged connections Steel housing Liner of Polypropylene, NSF- approved Polyurethane liner and KTW approved hard rubber quality Particularly economical</td>
<td>Flanged connections Steel housing Teflon® PFA liner, reinforced with stainless steel mesh, for high chemical, vacuum and abrasion resistance IFS 4000F for largely homogeneous liquids, slurries, pastes IFS 4005F for liquids with high solids content</td>
</tr>
<tr>
<td>Magnetic system</td>
<td>pulsed DC field</td>
<td>pulsed DC field</td>
<td>pulsed DC field</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>≥ 5 µS/cm (water ≥ 20 µS/cm)</td>
<td>≥ 20 µS/cm</td>
<td>≥ 5 µS/cm (water ≥ 20 µS/cm)</td>
</tr>
<tr>
<td>Full scale range</td>
<td>85 liter/h - 760 m³/h</td>
<td>85 liter/h - 3 600 US gal/min</td>
<td>85 liter/h - 305 000 US gal/min</td>
</tr>
<tr>
<td>0.3 - 12 m/s / 1 - 40 ft/s</td>
<td>0.3 - 1 400 000 US gal/min</td>
<td>0.3 - 1 400 000 US gal/min</td>
<td></td>
</tr>
<tr>
<td>Meter size</td>
<td>DN10 - 150 and 1 1/2&quot; - 6&quot;</td>
<td>DN10 - 3000 and 1 1/2&quot; - 120&quot;</td>
<td>DN 10 - 3000 and 1/2&quot; - 120&quot;</td>
</tr>
<tr>
<td>Pressure rating</td>
<td>up to 16 bar/230 psig</td>
<td>up to 40 bar/580 psig</td>
<td>up to 40 bar/580 psig (higher on request)</td>
</tr>
<tr>
<td>Product temperature</td>
<td>-25 to + 120°C/- 13 to + 248°F</td>
<td>-5 to + 90°C/- 23 to + 194°F</td>
<td>-60 to + 180°C/- 76 to + 356°F</td>
</tr>
<tr>
<td>Protection category (IEC 529/EN 60 529)</td>
<td>IP 67, equivalent to NEMA 4/4X</td>
<td>IP 67, equivalent to NEMA 6</td>
<td>IP 67, equivalent to NEMA 6</td>
</tr>
<tr>
<td>Materials</td>
<td>measuring section/liner Teflon® PFA</td>
<td>electrodes Hastelloy C4</td>
<td>materials Teflon® PFA, Teflon® PTFE, ETFE (Tefzel) Hastelloy C4, platinum, titanium, stainless steel 1.4571/316Ti.</td>
</tr>
<tr>
<td>Approvals/Tests</td>
<td>Hazardous duty version: ATEX Ex II 2 GD PM-Factory Mutual</td>
<td>Food and beverage pending Div 2</td>
<td>yes Class I, II, III, Div 1, 2</td>
</tr>
<tr>
<td>Combined with signal converter</td>
<td>(see Pages 12 and 13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field of application</td>
<td>environmental engineering water and sewage, agriculture, batching of fertilizers and liquids feeds</td>
<td>environmental engineering, water and sewage</td>
<td>the ’workhorse’ for water, sewage and waste water, chemicals, paper, cellulose, ore dressing</td>
</tr>
<tr>
<td>Abrasion resistance</td>
<td>high</td>
<td>higher than required for the applications in question</td>
<td>dependent on liner material, very high with ETFE, Irathane, hardrubber</td>
</tr>
<tr>
<td>Chemical resistance of liner</td>
<td>... with alkalis, e. g. NaOH, KOH NaOH up to 70% at 20°C/68°F</td>
<td>NaOH up to 50% at 20°C/68°F</td>
<td>all concentrations with Teflon® PFA or PTFE liners</td>
</tr>
<tr>
<td>... with acids, e. g. HNO₃ HNO₃ up to 65% at 20°C/68°F</td>
<td>HNO₃ up to 5% at 20°C/68°F</td>
<td></td>
<td>all concentrations with Teflon® PFA or PTFE liners</td>
</tr>
<tr>
<td>(limited by electrode material)</td>
<td>(select materials for grounding rings and gaskets for process compatibility)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**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
- 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

**ALTOFLUX**
IFS 2000 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

### Parameters

<table>
<thead>
<tr>
<th>PROFILUX</th>
<th>ALTOFLUX</th>
<th>VARIFLUX</th>
<th>TIDALFLUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanged connections</td>
<td>Flanged connections</td>
<td>Various sanitary/flanged connections</td>
<td>Designed for partially filled pipelines</td>
</tr>
<tr>
<td>Stainless steel housing</td>
<td>Steel housing</td>
<td>Stainless steel housing</td>
<td>Excellent measuring accuracy, also for low levels, through the integrated capacitive level measuring system</td>
</tr>
<tr>
<td>The only precision flowmeter with flow profile-optimizing measuring tube</td>
<td>Measuring tube made of Al2O3 almost as hard as diamonds</td>
<td>FDA approved Teflon® PFA liner, vacuum resistant, CIP and SIP cleaning facilitated by unique metal reinforcement of the PFA</td>
<td>Saves installation and maintenance of sluice underpasses</td>
</tr>
<tr>
<td>Influence on measuring accuracy from temperature, viscosity, pressure and flow profile is extremely slight</td>
<td>High measurement and long-term stability, even with highly abrasive products</td>
<td>Largest selection of sanitary connections</td>
<td></td>
</tr>
</tbody>
</table>

### Flowmeter Specifications

<table>
<thead>
<tr>
<th>PROFILUX</th>
<th>ALTOFLUX</th>
<th>VARIFLUX</th>
<th>TIDALFLUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>pulsed DC field</td>
<td>pulsed DC field</td>
<td>pulsed DC field</td>
<td>pulsed DC field</td>
</tr>
<tr>
<td>≥ 5 µS/cm (water ≥ 20 µS/cm)</td>
<td>≥ 5 µS/cm (water ≥ 20 µS/cm)</td>
<td>≥ 50 µS/cm</td>
<td>≥ 50 µS/cm</td>
</tr>
<tr>
<td>6–100 and 1/8” - 4”</td>
<td>19 liter/h - 2100 m³/h</td>
<td>6–100 and 1/8” - 4”</td>
<td>19 liter/h - 2100 m³/h</td>
</tr>
<tr>
<td>up to 10bar/580psig</td>
<td>up to 16bar/230 psig</td>
<td>up to 20bar/150 psig</td>
<td>up to 10bar/150 psig</td>
</tr>
<tr>
<td>- 60 to + 180°C/- 76 to + 356°F</td>
<td>- 60 to + 120°C/- 76 to + 248°F</td>
<td>- 5 to + 60°C/+ 23 to + 140°F</td>
<td></td>
</tr>
</tbody>
</table>

### Materials

<table>
<thead>
<tr>
<th>PROFILUX</th>
<th>ALTOFLUX</th>
<th>VARIFLUX</th>
<th>TIDALFLUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fused aluminium oxide, 99.7% Al₂O₃</td>
<td>Fused aluminium oxide, 99.7% Al₂O₃</td>
<td>Teflon®-PFA</td>
<td>Irathan, 12mm/0.47”</td>
</tr>
<tr>
<td>Cermet, platinum</td>
<td>Hastelloy C4, platinum, stainless steel 1.4571/316 Ti</td>
<td>FDA approved, Hastelloy C4, titanium, stainless steel 1.4571/316 Ti</td>
<td>Ex N, Zone 2 (option)</td>
</tr>
</tbody>
</table>

### Applications

<table>
<thead>
<tr>
<th>PROFILUX</th>
<th>ALTOFLUX</th>
<th>VARIFLUX</th>
<th>TIDALFLUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>All applications requiring extremely high measuring stability under arduous operating conditions.</td>
<td>All applications requiring extremely high measuring stability under arduous operating conditions.</td>
<td>Food and beverage, pharmaceutical, cosmetics, chemical</td>
<td>Sewage in partially filled pipelines</td>
</tr>
<tr>
<td>Extrememly high</td>
<td>Extrememly high</td>
<td>High</td>
<td>Very high</td>
</tr>
<tr>
<td>NaOH up to 50% at 50°C/122°F</td>
<td>NaOH up to 50% at 50°C/122°F</td>
<td>All concentrations</td>
<td>NaOH up to 10% at 30°C/86°F</td>
</tr>
<tr>
<td>HNO₃ up to 99% at 90°C/194°F; HF (hydrofluoric acid), all concentr. up to 50°C/122°F</td>
<td>HNO₃ up to 99% at 90°C/194°F</td>
<td>All concentrations</td>
<td>HNO₃ up to 5% at 20°C/68°F</td>
</tr>
<tr>
<td>(select materials for grounding rings and gaskets for process compatibility)</td>
<td>(select materials for grounding rings and gaskets for process compatibility)</td>
<td>(select materials for connections and electrodes for process compatibility)</td>
<td></td>
</tr>
</tbody>
</table>

---

*Electromagnetic flowmeters*
Signal converters for electromagnetic flowmeters

**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,

**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.

**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.

**Magnetic field excitation**
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: 0/4 – 20 mA
- Pulse: 0 – 10 pulses/s (scalable), 0 – 100 Hz
- Status: 0 – 1000 Hz for full-scale range
- Binary output, e.g. for flow direction error indication

**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 24 V DC

**Power consumption**
- 5VA / 4W
- 10VA / 8W

**Error limits**
- Overall system: ± 0.5% of measured value (0.3% IFC 020)
- Overall system: ± 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**
- Hazardous-duty version
  - 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

- ATEX Ex II 2 GD
- FM (Factory Mutual)

- For custody transfer
### 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

#### Applications
- 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

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

### SC 150 F
- Signal converter in field housing
- 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

#### Applications
- Heavy-duty electronic module, Excellent measuring signals, Outstanding repeatability through high field current,
  Designed for toughest process conditions
- Bidirectional pulsed DC field.
  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 direction of flow, error indication

### 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

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

#### Specifications
- HART® interface, excellent noise rejection
- Auto ranging
- 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
- 85 – 264V AC, 48 – 63 Hz and 18-32 V DC/AC

---

### Notes
- Yes, installation outside of Ex area in preparation
- ± 0.3% of measured value (option: 0.2%)
- ± 0.4% of measured value (option: 0.2%)

---

**Electromagnetic flowmeters**
Electromagnetic flowmeters

- Tower height: 43 m equivalent to 141 ft
- Net volume: 350,000 litres equivalent to 95,000 US Gal

Precision

- 28 precision level switches control the flow volume and various computer-aided volume totalizers
- Inlet run ≥ 10 × DN (DN = meter size)
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.

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.
**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.

$$U = K \times B \times v \times D$$  \hspace{1cm} (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

$$q_v = \frac{\pi}{4} D^2 v$$  \hspace{1cm} (2)

It follows from equation 1 that

$$v = \frac{U}{K \times B \times D}$$  \hspace{1cm} (3)

Therefore:

$$q_v = \frac{U}{K \times B} \times D \times \frac{\pi}{4}$$  \hspace{1cm} (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:

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

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

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

Total pressure loss is:

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

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

\[ \zeta_1, \zeta_3 \] nondimensional quantities as a function of the Reynolds number (see diagrams)

\[ \zeta_2 \] nondimensional quantity: 0.02 for KROHNE flowmeters

\[ \rho \] 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)

Reducing section

Expanding section

The reducing angle (\( \alpha \)) should not exceed 8° (equivalent to \( \alpha/2 = 4° \)), 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.

For the expanding section, the optimum angle of expansion is \( \alpha = 8° \).

\[ \zeta_1 \] at \( \alpha = 8° \)

<table>
<thead>
<tr>
<th>( d_1/d_2 )</th>
<th>1.2</th>
<th>1.3</th>
<th>1.4</th>
<th>1.5</th>
<th>1.6</th>
<th>1.7</th>
<th>1.8</th>
<th>1.9</th>
<th>2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \zeta_1 )</td>
<td>0.018</td>
<td>0.023</td>
<td>0.0255</td>
<td>0.028</td>
<td>0.03</td>
<td>0.0308</td>
<td>0.0315</td>
<td>0.0323</td>
<td>0.0332</td>
</tr>
<tr>
<td>( \zeta_3 )</td>
<td>0.01</td>
<td>0.02</td>
<td>0.07</td>
<td>0.15</td>
<td>0.26</td>
<td>0.43</td>
<td>0.64</td>
<td>0.9</td>
<td>1.25</td>
</tr>
</tbody>
</table>
**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.

**Flow tables**

- **Flow rate (m³/h)**
  - DN mm
  - Flow rate m³/h
  - 2.5 0.017671
  - 4 0.045239
  - 6 0.10179
  - 10 0.28274
  - 15 0.63617
  - 20 1.310
  - 25 1.7671
  - 32 2.8953
  - 40 4.5239
  - 50 7.0686
  - 65 11.946
  - 80 18.096
  - 100 28.274
  - 125 44.179
  - 150 63.617
  - 200 113.10

- **Flow rate (US GPM)**
  - inch
  - Flow rate US GPM
  - 1/10 0.024480
  - 1/8 0.038250
  - 1/4 0.15300
  - 3/8 0.34425
  - 1/2 0.61200
  - 3/4 1.3770
  - 1 2.4480
  - 1 1/4 3.8250
  - 1 1/2 5.5080
  - 2 9.7921
  - 2 1/2 15.300
  - 3 22.032
  - 4 39.168
  - 5 61.200
  - 6 88.128
  - 8 156.67

**Example: v in m/s**

Nominal pipe diameter DN150

Desired measuring range 200 m³/h

From the table we obtain for the flow velocity of 1 m/s a flow rate of 63.617 m³/h at DN150; 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:

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

\[ v = 11.35 \text{ ft/s} \]
### Protection classes

to IEC 529/EN 60529

<table>
<thead>
<tr>
<th>Protection Class</th>
<th>Protection Against</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP 20</strong>, equivalent to <strong>NEMA 1</strong></td>
<td>Protection against accidental large-area hand contact</td>
</tr>
<tr>
<td><strong>IP 65</strong>, equivalent to <strong>NEMA 4 and 4X</strong></td>
<td>Protection against contact with means of any kind</td>
</tr>
<tr>
<td><strong>IP 66</strong>, equivalent to <strong>NEMA 4 and 4X</strong></td>
<td>Protection against contact with means of any kind</td>
</tr>
<tr>
<td><strong>IP 67</strong></td>
<td>Protection against contact with means of any kind</td>
</tr>
<tr>
<td><strong>IP 68</strong>, equivalent to <strong>NEMA 6</strong></td>
<td>Protection against contact with means of any kind</td>
</tr>
</tbody>
</table>