Operating Instructions

Radiation-based sensor for mass flow detection

WEIGHTRAC 31

Foundation Fieldbus
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Safety instructions for Ex areas
Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

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1 About this document

1.1 Function
This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group
This operating instructions manual is directed to trained specialist personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used
- Information, tip, note
  This symbol indicates helpful additional information.
- Caution: If this warning is ignored, faults or malfunctions can result.
- Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
- Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.
- Ex applications
  This symbol indicates special instructions for Ex applications.
- List
  The dot set in front indicates a list with no implied sequence.
- Action
  This arrow indicates a single action.
- Sequence of actions
  Numbers set in front indicate successive steps in a procedure.
- Battery disposal
  This symbol indicates special information about the disposal of batteries and accumulators.
2 For your safety

2.1 Authorised personnel
All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use
WEIGHTRAC 31 is a sensor for continuous mass flow detection on conveyor belts as well as screw or chain conveyors.

You can find detailed information on the application range in chapter "Product description".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use
Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions
This is a state-of-the-art instrument complying with all prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.

This measuring system uses gamma rays. Therefore take note of the instructions for radiation protection in chapter "Product description". Any work on the source container may only be carried out under the supervision of a qualified radiation protection officer.
2.5 CE conformity

The device fulfills the legal requirements of the applicable EC guidelines. By affixing the CE marking, VEGA confirms successful testing of the product.

Only with class A instruments:
The device is a class A instrument designed for use in an industrial environment. When used in a different environment, e.g., in a living area, the electromagnetic compatibility must be ensured by the user. If necessary, suitable screening measures against conducted and emitted disturbances must be taken.

You can find the conformity certificate in the download section under www.vega.com.

2.6 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfills the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for malfunction information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 – Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.7 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfill this obligation by observing the environmental instructions in this manual:

- Chapter "Packaging, transport and storage"
- Chapter "Disposal"
3 Product description

3.1 Configuration

The nameplate contains the most important data for identification and use of the instrument:

![Nameplate Diagram]

Fig. 1: Layout of the type label (example)

1. Instrument type
2. Product code
3. Electronics
4. Protection rating
5. Ambient temperature
6. Measurement width
7. Hardware and software version
8. Order number
9. Serial number of the instrument
10. ID numbers, instrument documentation

Serial number

The type label contains the serial number of the instrument. With it you can find the following data on our homepage:

- Product code of the instrument (HTML)
- Delivery date (HTML)
- Order-specific instrument features (HTML)
- Operating instructions at the time of shipment (PDF)
- Order-specific sensor data for an electronics exchange (XML)
- Test certificate pressure transmitters (PDF)

Go to www.vega.com, "VEGA Tools" and "Serial number search".

As an alternative, you can find the data via your Smartphone:

- Download the smartphone app "VEGA Tools" from the "Apple App Store" or the "Google Play Store"
- Scan the Data Matrix code on the type label of the instrument or
- Enter the serial number manually in the app

Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.5
- Software from 1.6.0
• Modification status, electronics as of -01

Electronics versions
The instrument is available in different electronics versions. Each version can be identified via the product code on the type label:
• Standard electronics type PT30E-XX

Scope of delivery
The scope of delivery encompasses:
• Radiation-based sensor
• Measuring frame (optional)
• Mounting accessories
• Documentation
  – this operating instructions manual
  – Operating instructions manual "Display and adjustment module" (optional)
  – Ex-specific "Safety instructions" (with Ex versions)
  – if necessary, further certificates

Fig. 2: WEIGHTRAC 31
1 Source container (e.g. SHLD-1)
2 WEIGHTRAC 31
3 Support stand
4 Crossbeam
5 Clamp collars

Note:
The appropriate source container (e.g. SHLD-1) must be ordered separately.
3.2 Principle of operation

The instrument is suitable for bulk solid applications on conveyor belts and screw conveyors. There are application possibilities in nearly all areas of industry.

In radiation-based measurement, a Caesium-137 or Cobalt-60 isotope emits focussed gamma rays that are attenuated when penetrating the conveyor belt and the medium. The PVT detector on the lower side of the conveyor belt receives the radiation, whose strength is proportional to the density. The measuring principle has proven to be very reliable in conjunction with extreme process conditions because it measures contactlessly from outside through the conveyor belt. The measuring system ensures maximum safety, reliability and plant availability, independently of the medium and its properties.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "Supplement - Technical data - Ambient conditions"
- Relative humidity 20 … 85 %

Application area

Functional principle

Packaging

Transport

Transport inspection

Storage

Storage and transport temperature
3.4 Accessories and replacement parts

Indicating module
The display module PLICSCOM is used for measured value indication and diagnosis. It can be inserted into the sensor and removed at any time.

VEGACONNECT
The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC. For parameter adjustment of these instruments, the adjustment software PACTware with VEGA-DTM is required.

You can find further information in the operating instructions "Interface adapter VEGACONNECT" (Document-ID 32628).

External display and adjustment unit
VEGADIS 61 is an external display unit for sensors with single chamber housing and Ex-d double chamber housing.

It is suitable for measured value indication and is connected to the sensor with a four-wire standard cable up to 50 m long.

You can find further information in the operating instructions "VEGADIS 61" (Document-ID 27720).

Electronics module
The electronics module PT30E.XX is a replacement part for radiation-based sensors WEIGHTRAC 31.

The electronics module can only be exchanged by VEGA service technician.

Basic mounting set
If you have ordered WEIGHTRAC 31 without a measuring frame, a basic mounting set is enclosed with the instrument. It includes everything needed to fasten the measuring tube reliably.

Measuring frame for mounting
The corresponding measuring frame and mounting accessories can be ordered optionally.

Tachometer
Use a tachometer for detection of the belt speed. The tachometer can be connected to the input of the WEIGHTRAC 31.

3.5 Corresponding source container

An isotope in a suitable source container (e.g. SHLD-1) is the prerequisite for a radiation-based measurement setup.

The handling of radioactive substances is regulated by law. The radiation protection rules of the country in which the system is operated apply first and foremost.

In Germany, for example, the current radiation protection ordinance (StrlSchV) based on the Atomic Energy Law (AtG) applies.

The following points are important for measurement with radiation-based methods:

Handling permit
A handling permit is required for operation of a system using gamma rays. This permit is issued by the respective government office or the responsible authority (in Germany, for example, offices for environmental protection, trade supervisory boards, etc.)
General instructions for radiation protection

When handling radioactive substances, unnecessary radiation exposure must be avoided. An unavoidable radiation exposure must be kept as low as possible. Take note of the following three important measures:

1. **Shielding** - Provide good shielding between the radioactive source and yourself as well as all other persons. Special source containers (SHLD-1) as well as all materials with high density (e.g. lead, iron, concrete, etc.) provide effective shielding.

2. **Time** - Stay as short a time as possible in radiation exposed areas.

3. **Distance** - Your distance to the source should be as large as possible. The local dose rate of the radiation decreases in proportion to the inverse square of the distance to the radiation source.

Radiation safety officer

The plant operator must appoint a radiation safety officer with the necessary expert knowledge. He is responsible that the radiation protection ordinance is maintained and that all radiation protection measures are implemented.

Control area

Control areas are areas in which the local dose rate exceeds a certain value. Only persons who undergo official dose monitoring are allowed into these control areas. You can find the respectively valid limit values for control areas in the guideline of the respective authority (in Germany, for example, the radiation protection ordinance).

We are at your disposal for further information concerning radiation protection and regulations in other countries.
4 Mounting

4.1 General instructions

The source container is part of the measuring system. In case the source container is already equipped with an active isotope, the source container must be locked before mounting.

![Danger:]
Before mounting; make sure that the source is securely closed. Use a padlock to secure the source container in the closed condition and prevent it from being inadvertently opened.

Protection against moisture

Protect your instrument against moisture penetration through the following measures:

- Use the recommended cable (see chapter "Connecting to power supply")
- Tighten the cable gland
- Turn the housing in such a way that the cable gland points downward
- Loop the connection cable downward in front of the cable gland

This applies particularly to:

- Outdoor mounting
- Installations in areas where high humidity is expected (e.g. through cleaning processes)
- Installations on cooled or heated vessels

Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions are particularly:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

You can find the specifications of the process conditions in chapter "Technical data" as well as on the type label.

Protective caps

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The openings for the cable glands are therefore covered with red protective caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs. The suitable cable glands and blind plugs come with the instrument.
4.2 Mounting instructions

Note:
During planning, our specialists will analyse the conditions of the measuring point to dimension the radiation source (isotope) accordingly.

You get a "Source Sizing" document specifying the required source activity and containing all relevant mounting information for your measuring point.

You must follow the instructions of this "Source Sizing" document in addition to the following mounting instructions.

The following mounting information is applicable as long as there is nothing else specified in the "Source Sizing" document.

You can position and mount WEIGHTRAC 31 in the measuring frame from both sides.

Direct the exit angle of the source container to the WEIGHTRAC 31.

Mount the source container at the specified distance to the conveyor belt. Secure the area with a safety fence and protective grating so that no one can reach into the dangerous area.

You can find information on protective barriers and the mounting of the source container in the operating instructions manual of the source container.

Basic mounting set

If you have ordered WEIGHTRAC 31 without measuring frame, a basic mounting set is enclosed with the instrument.

Determine the mounting position of the sensor in advance.

1. Fasten the mounting bracket (6) to your conveyor belt.
   You can either weld the mounting bracket (6) to your system or fasten it with screws through the two ø9 mm (0.35 in) holes.

2. Place two clamp collars (4) onto the premounted mounting brackets (6).
3. Move the sensor (5) laterally beneath the conveyor belt and place the sensor in the two clamp collars (4).

   Position the measuring width of the sensor below the conveyor belt as close as possible to the center. Make sure that there is sufficient distance between sensor and conveyor belt when the belt is loaded.

4. Place the other two clamp collars (4) according to the illustration above the clamp collars that are already in place (4).

5. Place a metallic cover plate (3) according to the illustration on each upper clamp collar (4).

6. Insert the screws (1), each with one wedge lock washer (2), through the clamp collars (4).

7. Place a wedge lock washer (2) from below on each screw (1) and screw one nut (7) onto each screw.
8. Align the clamp collars (4) and tighten the nuts (7) evenly with 8 Nm (5.9 lb ft).

9. Check if the sensor (5) is fastened correctly.

- **Conveyor belts**
  Mount the measuring frame in such a way that the measurement tube of WEIGHTRAC 31 is below the conveyor belt (tight span).
  Keep a distance of at least 10 mm (0.4 in) between the conveyor belt and the measurement tube of WEIGHTRAC 31.

- **Screw conveyors**
  Mount the measuring frame at a position on the spiral conveyor where the product is transported steadily. Avoid places where the product accumulates or falls back over the worm shaft.

- **Chain conveyors**
  When mounting the WEIGHTRAC 31 on a chain conveyor, the installation angle is very important for optimal irradiation.
  Follow the instructions in the "Source Sizing" document.

**Mounting of the measuring frame (optional)**
The measuring frame with mounting accessories can be selected as an option. If you have ordered WEIGHTRAC 31 with measuring frame, then proceed as follows.

**Mounting - Crossbeam**
Before fastening the support stands, we recommend premounting the measuring frame. By doing this you can easily lay out the holes for fastening the unit to the conveyor belt.

To mount the measuring frame you need a torque wrench (45 Nm or 8 Nm) and two socket wrenches of size 16 and 10.

1. Place the crossbeam (4) on the upper holding fixtures of the two support stands (6).
   Make sure that the crossbeam (4) has an excess length of approx. 30 mm on both sides.
Fig. 5: Mounting the crossbeam

1. Screws M10 x 40 (12 pcs.)
2. Wedge lock washer M10 Nordlock (24 pcs.)
3. Crossbeam (1 pce.)
4. Toe clamps (4 pcs.)
5. Nut M10 (12 pcs.)
6. Support stand (2 pcs.)

2. Place the four clamping claws (4) with the corrugation downwards into the crossbeam (3).

3. Insert the screws (1) with one wedge lock washer (2) through the clamping claws (4).

4. Place a wedge lock washer (2) from below on each screw (1) and screw one nut (5) onto each screw.

5. Align the crossbeam (3) with the upper holding fixtures of the support stands (6) and tighten the nuts (5) evenly with 45 Nm (33.2 lb ft).

Mounting - Support stand

1. Place the premounted measuring frame above the conveyor belt and determine a suitable position for mounting the support stands (6).

Mount the measuring frame as well centered as possible and at an angle of 90° above the conveyor belt. Keep enough lateral distance to the conveyor belt.
2. Drill the through-holes for the support stands (6) according to the following drilling plan. The through-holes in the support stands (6 in each) are suitable for screws of size M10. The screws (14) and the washers (15) for fastening on the conveyor belt are not included in the scope of delivery.

![Drilling plan for support stands](image)

3. Use suitable washers (15) for mounting the support stands (6).
Fig. 7: Mounting the support stands
14 Screw M10 (24 pcs.) - provided by the customer
15 Washer M10 (24 pcs.) - provided by the customer

4. Tighten the screws (14) evenly with 45 Nm (33.2 lb ft).

Mounting - Sensor
1. Place two of the clamp collars (11) on the fastening brackets of the support stands (6).
Fig. 8: Mounting the sensor in the measuring frame

8 Screws M6 x 120 (4 pcs.)
9 Wedge lock washer M6 Nordlock (8 pcs.)
10 Cover plate (2 pcs.)
11 Clamp collar (4 pcs.)
12 Nut M6 (4 pcs.)
13 Sensor

2. Insert the sensor (13) laterally into the measuring frame beneath the conveyor belt and place the sensor in the two clamp collars (11).

   Position the measuring width of the sensor below the conveyor belt as close as possible to the center. Make sure that there is sufficient distance between sensor and conveyor belt when the belt is loaded.

3. Place the other two clamp collars (11) according to the illustration above the clamp collars that are already in place (11).

4. Place a metallic cover plate (10) according to the illustration on each upper clamp collar (11).
5. Insert the screws (8), each with one wedge lock washer (9), through the clamp collars (11).
6. Place a wedge lock washer (9) from below on each screw (8) and screw one nut (12) on each of the screws.
7. Align the clamp collars (11) and tighten the nuts (12) evenly with 8 Nm (5.9 lb ft).
8. Check if the sensor (13) is fastened correctly.

**Mounting - Source container**

![Fig. 9: Mounting the source container on the measuring frame](image)

1. Screws M10 x 40 (4 pcs.)
2. Wedge lock washer M10 Nordlock (8 pcs.)
3. Nut M10 (4 pcs.)
4. Source container (SHLD-1)

1. Place the closed and locked source container (7) from above onto the measuring frame.
   The source container is very heavy. Therefore use a suitable lifting device. For this purpose the source container is equipped with a suitable eye-bolt for a lifting hook, etc.
2. Align the source container (7) with the holes.
   Make sure that the source container is placed in the correct direction on the crossbeam.
3. Insert the screws (1) with one wedge lock washer (2) through the flange of the source container (7).
4. Place a wedge lock washer (2) from below on each screw (1) and screw one nut (5) onto each screw.
5. Align the source container (7) and tighten the nuts (5) evenly with 45 Nm (33.2 lb ft).
The mounting of the measuring frame is finished.

**Strain the measuring frame**

Large measuring frames can deflect when subjected to strong vibration or strong winds.

Therefore, measuring frames used on conveyor belts with widths over 1600 mm (63 in) should be strained with steel cables.

For this there are two fastening straps on the side of the support stand of the measuring frame.

Determine the fastening points on your conveyor belt according to the local conditions.

Provide the straining screws (1) for each cable to ensure reliable straining of the measuring frame.

Make sure that the measuring frame is perfectly vertical after straining.

![Fig. 10: Straining the measuring frame](image)

1 Straining screw

**Protection against heat**

If the max. ambient temperature is exceeded, you must take suitable measures to protect the instrument against overheating.

You can protect the instrument by providing a suitable insulation against the heat or mounting the instrument further away from the heat source.

Make sure these measures are taken into account already in the planning stage. If you want to carry out such measures later on, contact our specialists to ensure that the accuracy of the application is not impaired.

If these measures are not sufficient to maintain the max. ambient temperature, you could consider using the water cooling system we offer for WEIGHTRAC 31.
The water cooling must also be included in the calculations for the measuring point. Contact our specialists regarding the dimensioning of the water cooling.
5 Connecting to power supply

5.1 Preparing the connection

Safety instructions
Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, overvoltage arresters should be installed

Voltage supply
Power supply and digital bus cable via separate two-wire connection cables. Power is supplied via the H1 voltage supply.

Connection cable
Connection is carried out with screened cable according to Fieldbus specification.
Use cable with round cross-section. A cable outer diameter of 5...9 mm (0.2...0.35 in) ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.
Make sure that the entire installation is carried out according to the Fieldbus specification. In particular, make sure that the bus is terminated with suitable terminating resistors.

Cable entry
Replace all unused cable entries with suitable blind plugs. The thin foam rubber washers in the cable glands only serve as a dust cover during transport.

Cable gland ½ NPT
In the case of instrument housings with self-sealing NPT threads, it is generally not possible to have the cable glands screwed in at the factory. The openings for the cable glands are therefore covered with red protective caps as transport protection.
Before setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs. Unused cable glands do not provide sufficient protection against moisture and must be replaced with blind plugs.
The suitable cable glands and blind plugs come with the instrument.

Cable screening and grounding
Make sure that the cable screening and ground is executed according to the Fieldbus specification. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, we recommend to connect the cable screen on both ends to ground potential.
In systems with potential equalisation, connect the cable screen directly to ground potential at the power supply unit, in the connection box and at the sensor. The screen in the sensor must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation (low impedance).
In systems without potential equalisation with cable screening on both sides, connect the cable screen directly to ground potential at the power supply unit and at the sensor. In the connection box or
T-distributor, the screen of the short stub to the sensor must not be connected to ground potential or to another cable screen. The cable screens to the power supply unit and to the next distributor must be connected to each other and also connected to ground potential via a ceramic capacitor (e.g. 1 nF, 1500 V). Low-frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

**Connection technology**

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

The connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

**Connection procedure**

Proceed as follows:

The procedure applies to instruments without explosion protection.

1. Unscrew the big housing cover
2. Loosen compression nut of the cable entry gland
3. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
4. Insert the cable into the sensor through the cable entry

Fig. 11: Connection steps 4 and 5

1 Locking of the terminal blocks

5. Insert a small slotted screwdriver firmly into the rectangular lock openings of the respective connection terminal
6. Insert the wire ends into the round openings of the terminals according to the wiring plan

**Information:**
Solid cores as well as flexible cores with cable end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the rectangular lock opening with a small screwdriver; the terminal opening is freed. When the screwdriver is released, the terminal opening closes again.

7. Check the hold of the wires in the terminals by lightly pulling on them

To loosen a line, insert a small slotted screwdriver firmly into the rectangular lock opening according to the illustration

8. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation

9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable

10. Screw the housing cover back on

The electrical connection is finished.

**Information:**
The terminal blocks are pluggable and can be detached from the electronics. To do this, loosen the two lateral locking levers of the terminal block with a small screwdriver. When loosening the locking, the terminal block is automatically squeezed out. It must snap in place when re-inserted.
5.2 Connection - Mass flow detection

Non-Ex instruments and instruments with non-intrinsically safe current output

Fig. 12: Electronics and terminal compartment with non-Ex instruments and instruments with non-intrinsically safe current output

1 Voltage supply
2 Relay output
3 Signal output FF bus
4 Signal input 4 ... 20 mA (active sensor)
5 Switching input for NPN transistor
6 Switching input floating
7 Transistor output
8 Interface for sensor-sensor communication (MGC)
9 Simulation switch (1 = simulation on)
10 Setting the bus address for sensor-sensor communication (MGC)

Fig. 13: Adjustment and connection compartment with non-Ex instruments and instruments with non-intrinsically safe current output

1 Terminals for the external display and adjustment unit
2 Contact pins for the display and adjustment module or interface adapter

Instruments with intrinsically safe current output

You can find detailed information on the explosion-protected versions (Ex-ia, Ex-d) in the Ex-specific safety instructions. These safety

1) MGC = Multi Gauge Communication
Electronic and terminal compartment - Instruments with intrinsically safe current output

![Diagram of Electronics and terminal compartment](image)

Fig. 14: Electronics and terminal compartment (Ex-d) with instruments with intrinsically safe current output

1. Voltage supply
2. Relay output
3. Signal input 4…20 mA (active sensor)
4. Switching input for NPN transistor
5. Switching input floating
6. Transistor output
7. Interface for sensor-sensor communication (MGC)
8. Simulation switch (1 = simulation on)
9. Setting the bus address for sensor-sensor communication (MGC)

Adjustment and connection compartment - Instruments with intrinsically safe current output

![Diagram of Adjustment and connection compartment](image)

Fig. 15: Adjustment and connection compartment (Ex-ia) with instruments with intrinsically safe current output

1. Terminals for intrinsically safe signal output FF bus
2. Contact pins for the display and adjustment module or interface adapter
3. Terminals for the external display and adjustment unit
4. Ground terminal

2) MGC = Multi Gauge Communication
5.3 Connection - Summation

Several instruments can be cascaded to measure also broad conveyor belts. The measuring ranges of the instruments must overlap. Cascading means that two or several instruments are connected which can together cover a longer measuring range.

The instrument acts as Master and all other instruments operate as Slaves.

The pulse rates of all instruments are summed in the Master instrument and converted into a common signal.

The Master instrument must have the function "Mass flow detection". For this purpose, select under the menu item "Setup/Application" the function "Mass flow detection".

Set the address setting (MGC) on the Master instrument to "0 - 0".

For this purpose, the Slave instruments must be defined as "Slave". Select under the menu item "Setup/Application" the function "Summation Slave".

The address setting (MGC) on the Slave instruments can be freely selected. Only the address "0 - 0" is reserved for the Master instrument.

Connect the instruments according to the following wiring plan:
Fig. 16: Electronics and terminal compartment with cascading of several instruments.

1 Conveyor belt
M Master instrument
S Slave instrument

Information:
For example, a radial connection would be also possible as an alternative. Take note of the polarity.
The selection of the two terminal pairs is individual.
5.4 Connection - Tachometer

The speed of the conveyor belt, the chain conveyor or the feed screw are absolutely necessary for mass flow determination.

There are three different possibilities:

- Entering a constant speed
- Accepting a speed value from the plant control system (e.g. PLC)
- Connecting a tachometer (analogue or digital)

**Constant belt speed**

If a constant speed is entered, fluctuations in the speed are not taken into account. This can cause measurement errors. We recommend using a real value from the plant control system or the optional tachometer.

See "Parameter adjustment - Mass flow detection".

If you have entered a constant belt speed, we recommend using a belt stop signal.

If the belt stops, measurement is also halted for this period. Without a belt stop signal, WEIGHTRAC 31 would continue summing the delivery rate.

You can implement the belt stop signal with a switching relay or a signal from the plant control system (PLC).

Connect a switching relay to terminals 14 and 16.

Connect the digital output signal (open collector) from the plant control system (PLC) to terminals 14 and 15.

**Belt speed (PLC), tachometer (analogue)**

**Belt speed - PLC**

The shown diode should have a blocking voltage of > 50 V, any type of diode can be used.

If the output of the PLC is an "open collector", then the diode is not required.

**Tachometer - analogue**

Connect the analogue tachometer according to the following illustration.
Fig. 17: Belt speed - plant control system (PLC) or tachometer (analogue)

A  Output
1  Plant control system (PLC)
2  Tachometer (analogue)
3  Diode (blocking voltage > 50 V)\(^3\)

Tachometer (digital)

Fig. 18: Digital tachometer (TACHO.A1A4M)

\(^3\) Not required with output "open collector"
The digital tachometer is powered by WEIGHTRAC 31. When using the digital tachometer, you must power WEIGHTRAC 31 with max. 24 V.

The following cable colors are valid if the tachometer is ordered with cable.

**Fig. 19: Belt speed - plant control system (PLC) or tachometer (analogue)**

A Tachometer (digital)
1 Voltage supply - cable colour brown
2 Voltage supply - cable colour white
15 Digital input - cable colour green
16 Digital input - cable colour yellow
6 Adjustment with the display and adjustment module

6.1 Insert display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the small housing cover
2. Place the display and adjustment module in the desired position on the electronics (you can choose any one of four different positions - each displaced by 90°)
3. Press the display and adjustment module onto the electronics and turn it to the right until it snaps in.
4. Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.

Note:
If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.

Fig. 20: Insert display and adjustment module
6.2 Adjustment system

The device is adjusted via the four keys of the display and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with [OK] will not be saved.

6.3 Display and adjustment module - Indication of system parameters

Note: During the first setup or after an instrument reset the instrument starts with an error message (F025 - Invalid linearization table). This is quite normal because the sensor doesn't yet have any reference points.
for correct operation. Push the button “OK” to acknowledge the error message. Carry out the adjustment with PACTware.

With the display and adjustment module you can only read out the parameters of the WEIGHTRAC 31. Carry out the parameter adjustment of the instrument with the adjustment software PACTware.

You can find the parameter adjustment in the next chapter.

**Setup**

**Setup/Application**

In this menu item you can read out the set application.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weigh scales</td>
</tr>
</tbody>
</table>

**Display**

**Display - Language**

With this parameter you can change the display language.

This parameter is described in the operating instructions manual "Display and adjustment module".

**Display - Displayed value**

With this parameter you can change the indication of the display.

You can choose for example if the display should show the actual pulse rate, the electronics temperature or the percentage value.

**Diagnostics**

**Diagnostics - Device status**

In this menu item, you can enquire the status of your sensor. In normal operation, the sensor displays the message "OK". In case of fault, you will find the corresponding fault code here.

This parameter is described in the operating instructions manual "Display and adjustment module".

**Diagnosis - Peak value**

The peak value function holds the max. and min. values during operation.

This parameter is described in the operating instructions manual "Display and adjustment module".

**Diagnosis - Adjustment data**

Here you can retrieve the adjustment value of the sensor. This is the percentage value of the difference of the min. and max. adjustment points (Delta I). The value is an indication for the reliability and reproducibility of the measurement.

The higher the difference between the two adjustment points, the higher the differential value (Delta I) and the more reliable the measurement. A Delta I value below 10 % is an indication for a critical measurement.
To increase the Delta I value, you have to increase the distance of the min. and max. adjustment points in the linearization.

**Adjustment data**

| Delta I | 90.00 % |

**Diagnosis - Simulation**

In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.

**Note:**

To carry out a simulation with the display and adjustment module, you have to switch on the simulation switch on the electronics module (switch position 1).

You can find the rotary switch on the electronics module in the electronics and connection department (large cover).

You can simulate different values:

- **Pulse rate of the sensor**
  - Simulation running
    - Count rate
    - 124 ct/s

- **Process value**
  - Simulation running
    - Process value
    - 0.00 m

- **Switching function of the relay**
  - Simulation running
    - Relay
    - Closed

**Information:**

10 minutes after the key was pressed for the last time, the simulation is interrupted automatically. You can also interrupt the simulation with the switch on the electronics module.

**Info**

In this menu you will find the following menu items:

- Instrument name - shows instrument name and serial number
- Instrument version - shows hardware and software version of the instrument
6.4 Saving the parameter adjustment data

We recommended noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If the instrument is equipped with a display and adjustment module, the data in the sensor can be saved in the display and adjustment module. The procedure is described in the operating instructions manual "Display and adjustment module" in the menu item "Copy sensor data". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "Setup" and "Display"
- In the menu "Additional adjustments" the items "Sensor-specific units, temperature unit and linearization"
- The values of the user programmable linearization curve

The function can also be used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, the display and adjustment module is inserted into the replacement instrument and the data are likewise written into the sensor via the menu item "Copy sensor data".
7 Setup with PACTware

7.1 Connect the PC

Fig. 22: Connection of the PC directly to the sensor via the interface adapter

1 USB cable to the PC
2 Interface adapter VEGACONNECT 4
3 "Sensor

Information:
The interface adapter VEGACONNECT 3 is not suitable for connection to the sensor.

7.2 Parameter adjustment with PACTware

For parameter adjustment of the sensor via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The up-to-date PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated into other frame applications according to FDT standard.

Note:
To ensure that all instrument functions are supported, you should always use the latest DTM Collection (from DTM Collection 06/2012). Furthermore, not all described functions are included in older firmware versions. You can download the latest instrument software from our homepage. A description of the update procedure is also available in the Internet.

Further setup steps are described in the operating instructions manual "DTM Collection/PACTware" attached to each DTM Collection and
which can also be downloaded from the Internet. Detailed descriptions are available in the online help of PACTware and the DTMs.

**Standard/Full version**

All device DTMs are available as a free-of-charge standard version and as a full version that must be purchased. In the standard version, all functions for complete setup are already included. An assistant for simple project configuration simplifies the adjustment considerably. Saving/printing the project as well as import/export functions are also part of the standard version.

In the full version there is also an extended print function for complete project documentation as well as a save function for measured value and echo curves. In addition, there is a tank calculation program as well as a multiviewer for display and analysis of the saved measured value and echo curves.

The standard version is available as a download under [www.vega.com/downloads](http://www.vega.com/downloads) and "Software". The full version is available on CD from the agency serving you.

### 7.3 Parameter adjustment - Mass flow detection

The parameter adjustment adapts the instrument to the application conditions.

**Note:**

During the first setup or after an instrument reset the instrument starts with an error message (F025 - Invalid linearization table). This is quite normal because the sensor doesn't yet have any reference points for correct operation. Push the button "OK" to acknowledge the error message.

Carry out a setup in the sequence described in the following.

**Presets**

Check if the correct language is already set for the software. If not, you can change the language in the menu item "Extras/Options".

In this menu you can assign an unambiguous name to the sensor or the measurement loop.

**Start screen**

After starting PACTware, you can choose if you want to carry out the extended adjustment with the DTM (Device Type Manager) or work with the setup assistant.
In this menu item you can first of all adjust the WEIGHTRAC 31 to the integrated isotope in the source container.

For this purpose, check which isotope is integrated in the source container. You can find this information on the type label of the source container.

Through this selection, the sensitivity of the sensor is adapted perfectly to the isotope. The normal reduction of the emitter activity is hence considered through the radioactive decay.

The WEIGHTRAC 31 requires this information of the automatic decay compensation. This ensures an interference-free measurement over the complete life time of the gamma emitter - an annual recalibration is not necessary.

**Isotope**

**Setup assistant**

**Setup**

Start the setup assistant by clicking the respective button.

Work as far as possible according to the sequence of the setup assistant.

**Selection of the application (step 1)**

This menu item enables adaptation of the sensor to the requested application. You can choose between the following applications: "Mass flow (belt/spiral)" or "Mass flow summation slave".
Mass flow (belt/spiral)
The application "Mass flow (belt/spiral)" is for the detection of the mass flow of bulk solids on a conveyor belt or a conveyor spiral.

Mass flow summation slave
The application "Mass flow summation slave" is for the detection of the mass flow of bulk solids, for example on a broader conveyor belt with several instrument whereby the concerned instrument works as a slave.

When you have selected this function, you can activate the slave outputs via a selection field. When you activate this field, then the current output of WEIGHTRAC 31 functions.

When the output is activated, the instrument remains in its function as a Slave, but the 4 … 20 mA output can be also used als single instrument. The instrument provides the complete range of functions when the output is active.

Information:
If you want to operate your instrument as master of a mass flow summation, select application "Mass flow (belt/spiral)".

Select inputs (step 2)
In this window you can carry out the settings for the inputs of WEIGHTRAC 31.
Fig. 25: Select inputs

**Summation**
If you want to use several instruments, for example on a broad conveyor belt, activate the function "Summation".
The instrument then operates as master of a cascading group.

**X-ray alarm**
Radiation from external sources can influence the measuring result of the sensor.
Possible external radiation sources can be, for example, a weld joint test on a neighbouring facility or other radiation-based instruments.
For this you need an additional sensor (X-ray alarm sensor) for detection of the external radiation.
The X-ray alarm is only outputted for the period of increased external radiation. Then the X-ray alarm is automatically reset.
In this menu item you can determine the behaviour of the sensor when external radiation sources appear. You can also select the switching threshold as needed in case of external radiation.
You can choose whether the sensor should output modulated current (dithering) or the set fault current in case external radiation appears.
In the case of modulated measuring current (dithering), the last valid current value is maintained and the current output modulates a square-wave voltage ±1 mA around this value.

**Information:**
If you have activated the X-ray alarm, you have to enter in the next step the type and the data of the connected X-ray alarm sensor.
Process speed
The speed of the conveyor belt is important for the measuring result of the sensor.

This function is selected as a standard feature. Hence the input can be used for an external tachometer or a speed value from the control room.

Process speed (step 3)
In this window you can carry out the settings for the speed of the conveyor belt or the spiral conveyor.

Input
If you have neither a tachometer on the conveyor belt nor the actual belt speed from the plant control system, you should deactivate the input of the process speed by selecting "No belt/spiral stop signal". In such case you have to enter a fixed conveyor belt speed.

You can transmit the conveyor belt speed via an "Analogue input (4 ... 20 mA)" or a "Digital input (frequency input)". Tachometers are designed mainly for digital input.

Here you have the possibility to process only one "Belt stop signal". In this case you have to enter a fixed belt speed.

Scaling min./max.
If you have selected one of the inputs for the process speed, you can determine here the min. and max. values for the input. Specify mA for analogue input and Hz for digital input.

Unit - Belt/screw speed
Here you can select the unit of the conveyor belt speed (e.g. m/s, ft/ min etc.)
Setup with PACTware

CHEAP TRAC 31 • Foundation Fieldbus

**Belt/screw speed min./max.**
Here you can enter the min. and max. speed of the conveyor belt.

**Check inputs (step 4)**
In this window you are asked to check the inputs of the instrument.

**Accept application (step 5)**
In this window you can accept the modifications previously made.
The data are written into the instrument.

**Setup - Background radiation (step 6)**

![Setup: Step 6](image)

Background radiation (Compensation of the natural background radiation)

![Background radiation](image)

It is recommended to enter the actual value for the background radiation before carrying out the adjustment.
The source holder must be closed for the measurement of the background radiation.

**Fig. 27: Fade out background radiation**

The natural radiation on earth influences the accuracy of the measurement.

With this menu item the natural background radiation can be faded out.

For this purpose, the WEIGHTRAC 31 measures the natural background radiation and sets the pulse rate to zero.

In the future, the pulse rate from this background radiation will be automatically deducted from the total pulse rate. This means: only the component of the pulse rate originating from the source will be displayed.

**Caution:**
For this setting, the source container must be closed and the sensor already in operation for five minutes.

**Note:**
If you want to use an already existing source container, we recommend measuring the background radiation without connected source container. A source container with a Cs-137 source should have a distance of at least 3 m (10 ft) to the sensor for measurement of the...
background radiation. A source container with a Co-60 source should have a distance at least 5 m (17 ft).
This ensures that the measured pulse rate really originates from the source used.

Setup - Adjustment (step 7)

Fig. 28: Adjustment

In this menu item you can enter the measuring range (min. and max. process value) of the sensor.
These settings influence the process value and hence also the digital output of the sensor.
Enter in the menu window "Max. process value" the max. level (full), e.g. in "t/h".
Enter in the menu window "Min. process value" the min. level (empty), e.g. in "t/h".
In this menu item you can adjust the damping of the sensor with filter selection "Manual". With it you can suppress fluctuations in the measured value indication, caused e.g. by an agitated product surface. This time can be between 1 and 1200 seconds. Keep in mind that the reaction time will increase and the instrument will react to quick level changes with a delay. Generally, a time setting of approximately 60 seconds is sufficient to smooth the measured value indication.

With the setting "Automatic", the instrument itself calculates a suitable damping on the basis of the adjustment and the measured value changes. This setting is particularly suitable for application where fast and slow level changes occur.
Fig. 30: Relay output

In this menu item you can activate the relay output and determine its function as well as the switching points.

When the output of the process values is set, you can choose between overfill and dry run protection.

The relay outputs of the sensor react accordingly.

You can choose "no" reference value. In this case, the relay output operates as fail safe relay.

- None - Relay operates as fail safe relay
- Electronics temperature
- Process value

"No" reference value means that the relay output operates as fail safe relay.

Caution:
Independent of the selected reference value, the relay will deenergize in case of failure.
Fig. 31: Set up totalizer

With this function you can activate the totalizer. As a default setting, the totalizer is deactivated. You can set material quantity that causes a counting pulse to be outputted via the digital output (NPN transistor). The leak volume suppression determines which degree of filling (in percent) activates the totalizer. With this you can avoid a continued summation of contamination or slight buildup on an otherwise empty conveyor belt.

Complete

In a last step, complete the adjustment with the setup assistant. After terminating the assistant, the program jumps back to the usual DTM program environment.

Information: After a successful run of the setup assistant, you have to adjust two points in the DTM.
Adjustment

To increase accuracy, you have to carry out the zero rate determination with an empty conveyor belt. During the zero rate determination make sure that no material is transported and that no residues fall onto the conveyor belt. In such case, you have to repeat the procedure.

The conveyor belt should make several circulations to compensate for irregularities of the conveyor belt or the conveyor system. The more often the conveyor belt circulates during the zero rate determination, the more precise the zero rate determination will be.

**Tip:**
To check the zero rate determination (taring), you can carry out a test measurement after the adjustment with empty belt over a period of 5 to 10 minutes. If no or only a negligible feed rate sums up during the measurement, the zero rate determination has been carried out correctly.

1. Start empty conveyor belt and let it run idle
   - Tip: Mark the conveyor belt with coloured adhesive tape
2. Set the source container to "ON"
3. Click the button "Determine zero rate"
4. Let the conveyor belt run for two to three belt lengths
5. Terminate the zero rate determination
6. Stop conveyor belt

The determined value of the zero rate is transferred to the sensor

**Note:**
In case of heavy belt wear, this zero rate determination should be carried out regularly to keep the accuracy constant.

If you exchange the belt, you have to carry out the zero rate determination again.

**Adjustment - Linearization (DTM)**

In this menu item you can carry out the adjustment of the sensor. During linearization, a corresponding total weight of conveyed material is assigned to a particular pulse rate.
It is therefore important to detect the weight of the conveyed material correctly. This means that you have to use a precise, possibly also calibrated, scale.

Make sure that no material is lost from the belt or the transport and that no foreign material is added. If you carry out the measurement with a truck, make sure that you have comparable measuring conditions (always measure with or without driver, use the same vehicle or compensate for differences, make sure there is no residue buildup on the loading platform of the vehicle, etc.).

Make sure that the density of the material during the linearization corresponds to the original material measured later on.

Due to the measuring principle, there is no linear relationship between pulse rate and level. Hence, this adjustment (i.e. linearisation) must in any case be carried out.

For very precise measuring results, you should carry out this adjustment with different filling heights (flow rates) on the conveyor belt. The bigger the difference in flow rates, the more precise the linearization.

The way you measure the total quantity of the conveyed material depends on the options you have on site.

You can collect the total quantity of conveyed material on a truck and determine the weight with a truck scale. But you can also weigh the material before the measurement and keep it ready for the linearization. Another possibility would be to transfer the conveyed material to a container sitting on load cells.

You can carry out the linearization with two different principles:

- Dynamically - with running conveyor belt
- Statically - with stationary conveyor belt

**Dynamic linearization**

During dynamic linearization you simulate the actual operation of the conveyor belt with the known material quantity. For a dynamic linearization you need at least 20 % of the max. process value. If the measuring range is e.g. 0 ... 200 t, then at least 40 t of material should be available for linearization.
As with zero point determination, the linearization will be more precise the longer the linearization runs and the larger the filling height differences are. Hence, linearizations are often carried out with the max. conveyed quantity, in our example with 200 t.

**Tip:**
During linearization many technical and process-related factors can cause a faulty measurement. Therefore, have enough material ready for the linearization so that, if necessary, you can repeat the measurement.

- You have a known quantity of material that is continuously loaded onto the conveyor belt.
- If possible, load the conveyor belt to maximum (100 %).

1. Load the conveyor belt continuously with a known quantity of material.
   - Measure the material quantity with a belt weigher or weigh the material with a truck scale.
   - Make sure that the material used corresponds to the material that is measured later on.
2. Start the conveyor belt.
3. Click to "Start measurement", as soon as the first material passes by the measuring point.
4. The run should last several minutes.
5. Click to "Stop measurement", as soon as the last material passes the measuring point.
6. The measured count rate is stated in ct/s. This is the number of counts per second, i.e. the measured radioactive radiation dose actually reaching the sensor.
7. Now enter the corresponding material quantity (e.g. kg, t, lb). In this case, this is the total quantity of material that has passed by during the measurement.
   - This assigns a corresponding material quantity to the current pulse rate.
8. Click to "Complete".
   - Accept the value pair with "Accept".

Carry out such a linearization with several different loading heights. We recommend two to three measurements.

The measurement will be more reliable if you enter several linearization points with different loading heights.

**Static linearization**
During static linearization you simulate a typical loading of the conveyor belt with a known quantity of material on a defined belt length.

Enter the adjustment points in kg/m.

**Tip:**
To ensure that the material is loaded onto the belt continuously and without loss, we recommend the use of a ready-made wooden frame.
• You have a known quantity of material lying in typical way and at a typical height on a short section of the conveyor belt.
• You know the later, continuous belt speed or can measure it.
• The conveyor belt is loaded as completely as possible (100%).
• You can slowly move the conveyor belt manually.

If you do not have the option of moving the conveyor belt slowly by hand and the materials are light weight, place the material on a long piece of foil that you slowly pull through the measuring frame. In case the weight of the foil is not negligible, you should add the weight of the foil to the total weight later on.

Make sure that you do not reach into the control area of the measuring plant. Cut the foil to an appropriate length.

1. Make sure that the source container is closed and locked (operating position: Off)
2. Load the conveyor belt evenly with a known quantity of material, for example 60 kg over a length of 1 m.
   Make sure that the material type and loading height corresponds to the material that is measured later on.
3. Move the stretch of material into the measuring frame of WEIGHTRAC 31.
4. Switch on the source container.
5. Click to "Start measurement".
6. Slowly move the belt manually or move the material slowly by pulling on the foil. This process should take 5 to 10 minutes.
7. Click to "Stop measurement".
8. The measured count rate is stated in ct/s. This is the number of counts per second, i.e. the measured radioactive radiation dose actually reaching the sensor.
9. Now enter the corresponding material quantity (e.g. kg, t, lb). In this case, this is the total material quantity lying on the conveyor belt during the measurement.
   Enter the length of the portion of belt used (e.g. 1 m).
   This assigns a corresponding material quantity to the actual pulse rate (e.g. 60 kg/m).
10. Click to "Complete".
    Accept the value pair with "Accept".
11. Repeat this procedure with a larger quantity of material (e.g. 120 kg) until you have reached the max. loading height of the conveyor belt.

Further settings in PACTware
You can select further options in PACTware.
A detailed description of the functions is available in the PACTware online help.

Additional adjustments - Reset
When a reset is carried out, all settings (with only a few exceptions) are reset. The exceptions are: PIN, language and HART mode.
The following reset functions are available:
**Basic settings:** Restores the parameter settings at the time of shipment Ex factory including the order-specific settings. The measured value memory is deleted.

**Factory settings:** Resets parameter settings including special parameters to the default values of the respective instrument. The measured value memory and the order-specific settings are deleted.

**Peak values:** Resets the parameter settings in the menu item "Setup" to the default values of the respective instrument. Order-specific settings remain but are not taken over into the current parameters. The measured value memory as well as the event memory remain unaffected.

The following table shows the default values of the instrument. The values apply for the application "Mass flow". The application must be selected first.

Depending on the instrument version, not all menu items may be available or they may be differently assigned:

**Setup - Mass flow determination**

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Default value</th>
<th>Modified value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement loop name</td>
<td>Sensor</td>
<td></td>
</tr>
<tr>
<td>Isotope</td>
<td>Cs-137</td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>Mass flow</td>
<td></td>
</tr>
<tr>
<td>Input - Process speed</td>
<td>Non belt/screw stop signal</td>
<td></td>
</tr>
<tr>
<td>Unit - Belt/screw speed</td>
<td>m/s</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>1 m/s</td>
<td></td>
</tr>
<tr>
<td>Background radiation</td>
<td>0 ct/s</td>
<td></td>
</tr>
<tr>
<td>Unit of the process value</td>
<td>t/h</td>
<td></td>
</tr>
<tr>
<td>Adjustment max.</td>
<td>Max. process value: 999 t/h</td>
<td></td>
</tr>
<tr>
<td>Adjustment min.</td>
<td>Min. process value: 0 t/h</td>
<td></td>
</tr>
<tr>
<td>Actual zero rate</td>
<td>90000</td>
<td></td>
</tr>
<tr>
<td>Linearization</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Damping</td>
<td>60 s</td>
<td></td>
</tr>
<tr>
<td>Reference value - Relay</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Totalizer</td>
<td>Deactivated</td>
<td></td>
</tr>
<tr>
<td>Block adjustment</td>
<td>Released</td>
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</table>

**Display**

<table>
<thead>
<tr>
<th>Menu item</th>
<th>Default value</th>
<th>Modified value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>Selected language</td>
<td></td>
</tr>
<tr>
<td>Displayed value</td>
<td>Pulse rate</td>
<td></td>
</tr>
<tr>
<td>Temperature unit</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>
7.4 Saving the parameter adjustment data
We recommend documenting or saving the parameter adjustment data via PACTware. That way the data are available for multiple use or service purposes.
8 Set up with other systems

8.1 DD adjustment programs
Device descriptions as Enhanced Device Description (EDD) are available for DD adjustment programs such as, for example, AMS™ and PDM.

The files can be downloaded at www.vega.com/downloads under "Software".

8.2 Field Communicator 375, 475
Device descriptions for the instrument are available as EDD for parameter adjustment with the Field Communicator 375 or 475.

For the integration of the EDD in the Field Communicator 375 or 475, the software "Easy Upgrade Utility" is required which is available from the manufacturer. This software is updated via the Internet and new EDDs are automatically taken over into the device catalogue of this software after they are released by the manufacturer. They can then be transferred to a Field Communicator.
9 Diagnostics and service

9.1 Maintenance
If the device is used correctly, no maintenance is required in normal operation.
The corresponding source container must be checked in regular intervals. You can find further information in the operating instructions manual of the source container.

9.2 Status messages
The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables there are more detailed error messages available under the menu item "Diagnostics" via the display and adjustment module and PACTware/DTM.

Status messages

The status messages are divided into the following categories:

- Failure
- Function check
- Out of specification
- Maintenance requirement

and explained by pictographs:

Fig. 34: Pictographs of the status messages

1  Failure - red
2  Out of specification - yellow
3  Function check - orange
4  Maintenance - blue

Failure: Due to a malfunction in the instrument, a failure message is outputted.
This status message is always active. It cannot be deactivated by the user.

Function check: The instrument is in operation, the measured value is temporarily invalid (for example during simulation).
This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Out of specification: The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature).
This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.
Maintenance: Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Failure

The following table shows the error codes and text messages in the status message "Failure" and provides information on causes as well as corrective measures.

Example for a failure message

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>F008</td>
<td>Error multisensor communication</td>
<td>Additional sensors not switched on</td>
<td>Check wiring between the sensors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMC influences</td>
<td>Connect the sensors correctly and make them ready for operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No other sensor available</td>
<td></td>
</tr>
<tr>
<td>F013</td>
<td>Sensor signals a fault</td>
<td>Error on the current input</td>
<td>Check current input</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No valid measured value</td>
<td>Check connected instruments (Slaves)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connected instruments without function</td>
<td></td>
</tr>
<tr>
<td>F016</td>
<td>Adjustment data exchanged</td>
<td>Values of the min. and max. adjustment exchanged</td>
<td>Correct adjustment data</td>
</tr>
<tr>
<td>F017</td>
<td>Adjustment span too small</td>
<td>The values of the min. and max. adjustment are too close together</td>
<td>Correct adjustment data</td>
</tr>
<tr>
<td>F025</td>
<td>Invalid linearization table</td>
<td>Empty linearization table</td>
<td>Create linearization table</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong value in the linearization table</td>
<td>Correct linearization table</td>
</tr>
<tr>
<td>F030</td>
<td>Process value out of limits</td>
<td>Process values are not within the adjusted measuring range</td>
<td>Repeat adjustment</td>
</tr>
<tr>
<td>F034</td>
<td>EPROM hardware error</td>
<td>Electronics defective</td>
<td>Restart instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exchanging the electronics</td>
</tr>
<tr>
<td>F035</td>
<td>EPROM data error</td>
<td>Error in the internal instrument communication</td>
<td>Carry out a reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exchanging the electronics</td>
</tr>
<tr>
<td>Code</td>
<td>Text message</td>
<td>Cause</td>
<td>Rectification</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------</td>
<td>------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>F036</td>
<td>Faulty program memory</td>
<td>– Error during software update</td>
<td>– Repeat software update</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Exchanging the electronics</td>
</tr>
<tr>
<td>F037</td>
<td>RAM hardware error</td>
<td>– Error in RAM</td>
<td>– Restart instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Exchanging the electronics</td>
</tr>
<tr>
<td>F038</td>
<td>Slave signals failure</td>
<td>– Connection cable to the Slave instrument</td>
<td>– Check the connection cable to the Slave instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Define instrument as Slave</td>
</tr>
<tr>
<td>F040</td>
<td>Hardware error</td>
<td>– Sensor defective</td>
<td>– Restart instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Exchanging the electronics</td>
</tr>
<tr>
<td>F041</td>
<td>Photomultiplier error</td>
<td>– Error in the measured value recording</td>
<td>– Restart instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Exchanging the electronics</td>
</tr>
<tr>
<td>F052</td>
<td>Faulty configuration</td>
<td>– Invalid parameter adjustment</td>
<td>– Carry out a reset</td>
</tr>
<tr>
<td>F053</td>
<td>Adjustment data input not correct</td>
<td>– Adjustment of the input not correct</td>
<td>– Correct adjustment of the input</td>
</tr>
<tr>
<td>F066</td>
<td>Faulty adjustment</td>
<td>– Adjustment not yet carried out</td>
<td>– Carrying out adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Error during adjustment or when entering the linearization table</td>
<td>– Carry out linearization</td>
</tr>
<tr>
<td>F068</td>
<td>Count rate too high</td>
<td>– Faulty instrument settings</td>
<td>– Carry out a reset</td>
</tr>
<tr>
<td>F072</td>
<td>Limit exceeded</td>
<td>– Faulty instrument settings</td>
<td>– Carry out a reset</td>
</tr>
<tr>
<td>F080</td>
<td>System error</td>
<td>– Instrument error</td>
<td>– Restart instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Call our service</td>
</tr>
<tr>
<td>F086</td>
<td>Communication error</td>
<td>– Error in the Fieldbus communication</td>
<td>– Restart instrument</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Call our service</td>
</tr>
<tr>
<td>F114</td>
<td>Error real time clock</td>
<td>– Discharge accumulator</td>
<td>– Readjust real time clock</td>
</tr>
</tbody>
</table>
### Code Text message

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>F120</td>
<td>Filter time error</td>
<td>Faulty or missing instrument adjustment</td>
<td>Carrying out adjustment</td>
</tr>
<tr>
<td>F121</td>
<td>Slave instruments not found</td>
<td>Check Slave instruments</td>
<td>Check Slave list in Master instrument</td>
</tr>
<tr>
<td></td>
<td>Faulty participant list on the multisensor</td>
<td>Slave instrument with wrong address</td>
<td></td>
</tr>
<tr>
<td></td>
<td>communication bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F122</td>
<td>Instrument addresses was assigned several times</td>
<td>Change instrument addresses</td>
<td></td>
</tr>
<tr>
<td>F123</td>
<td>X-ray alarm</td>
<td>External instruments cause radiation</td>
<td>Determine reason for X-ray alarm</td>
</tr>
<tr>
<td></td>
<td>Increase radiation</td>
<td></td>
<td>In case of brief X-ray radiation: Monitor switching outputs for this time manually</td>
</tr>
<tr>
<td>F124</td>
<td>Alarm due to radiation</td>
<td>Radiation dose too high</td>
<td>Determine reason for increased radiation</td>
</tr>
<tr>
<td>F125</td>
<td>Ambient temperature too high</td>
<td>Ambient temperature on the housing outside the specification</td>
<td>Cool the instrument or protect it with isolating material against radiation heat</td>
</tr>
</tbody>
</table>

### Function check

The following table shows the error codes and text messages in the status message "Function check" and provides information on causes as well as corrective measures.

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>C029</td>
<td>Simulation</td>
<td>Simulation active</td>
<td>Finish simulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wait for the automatic end after 60 mins.</td>
</tr>
</tbody>
</table>

### Out of specification

The following table shows the error codes and text messages in the status message "Out of specification" and provides information on causes as well as corrective measures.
### Maintenance

The instrument has no status messages to the section "Maintenance".

### 9.3 Rectify faults

The operator of the system is responsible for taking suitable measures to rectify faults.

#### Procedure for fault rectification

The first measures are:

- Evaluation of fault messages, for example via the display and adjustment module
- Checking the output signal
- Treatment of measurement errors

Further comprehensive diagnostics options are available with a PC with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified.

#### Check output signal (mass flow determination)

The following table describes possible errors with the output signal and helps to remove them:

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal not stable</td>
<td>Loading fluctuations</td>
<td>Adjust damping via PACTware/DTM</td>
</tr>
<tr>
<td></td>
<td>Conveyor belt was changed</td>
<td>Carry out a zero rate determination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Text message</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>S017</td>
<td>Accuracy outside the specification</td>
<td>-- Accuracy outside the specification</td>
<td>-- Correct adjustment data</td>
</tr>
<tr>
<td>S025</td>
<td>Bad linearization table</td>
<td>-- Bad linearization table</td>
<td>-- Carry out linearization</td>
</tr>
<tr>
<td>S038</td>
<td>Slave outside the specification</td>
<td>-- Slave outside the specification</td>
<td>-- Check Slave</td>
</tr>
<tr>
<td>S125</td>
<td>Ambient temperature too high/too low</td>
<td>-- Ambient temperature too high/too low</td>
<td>-- Protect instrument with isolating material against extreme temperatures</td>
</tr>
</tbody>
</table>
### Additional interferences

The following table describes possible faults that may not generate an error message:

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal missing</td>
<td>Electrical connection faulty</td>
<td>Check connection according to chapter &quot;Connection steps&quot; and if necessary, correct according to chapter &quot;Wiring plan&quot;</td>
</tr>
<tr>
<td>Voltage supply missing</td>
<td>Check cables for breaks; repair if necessary</td>
<td></td>
</tr>
<tr>
<td>Operating voltage too low</td>
<td>Check, adapt if necessary</td>
<td></td>
</tr>
</tbody>
</table>

### Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "Setup" must be carried out again or must be checked for plausibility and completeness.

### 24 hour service hotline

Should these measures not be successful, please call in urgent cases the VEGA service hotline under the phone no. **+49 1805 858550**.

The hotline is also available outside normal working hours, seven days a week around the clock.

Since we offer this service worldwide, the support is provided in English. The service itself is free of charge, the only costs involved are the normal call charges.

### 9.4 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

If there is no electronics module available on site, the electronics module can be ordered through the agency serving you. The electronics modules are adapted to the respective sensor and differ in signal output or voltage supply.

The new electronics module must be loaded with the default settings of the sensor. These are the options:
9.5 Software update

The following components are required to update the sensor software:

- Sensor
- Voltage supply
- Interface adapter VEGACONNECT
- PC with PACTware
- Current sensor software as file

You can find the actual sensor software as well as detailed information of the procedure under "www.vega.com/downloads" and "Software".

You can find information about the installation in the download file.

Caution:

- Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval remains effective with a software update.

You can find detailed information on www.vega.com/downloads and "Approvals".

9.6 How to proceed in case of repair

The following procedure refers only to the sensor. Should a repair of the source container be necessary, you can find the respective instructions in the operating instructions manual of the source container.

You can find a repair form as well as detailed information on how to proceed under www.vega.com/downloads and "Forms and certificates".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

If a repair is necessary, please proceed as follows:

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please contact the agency serving you to get the address for the return shipment. You can find the agency on our home page www.vega.com.
10 Dismounting

10.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.
Take note of chapters "Mounting" and "Connecting to power supply" and carry out the listed steps in reverse order.

10.2 Disposal
The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the parts to be easily separable.
Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.
Materials: see chapter "Technical data"
If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.
11 Supplement

11.1 Technical data

General data

316L corresponds to 1.4404 or 1.4435

Materials, non-wetted parts

- Detector tube 316L
- Scintillation material PVT (Polyvinyltoluene)
- Aluminium die-casting housing Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
- Stainless steel housing 316L
- Seal between housing and housing cover NBR (stainless steel housing, investment casting), silicone (Aluminium housing)
- Inspection window in housing cover (optional) Polycarbonate
- Ground terminal 316L
- Measuring frame (optional) Galvanized steel, stainless steel
- Clamp collar (DIN 3015, part 1) PA (Polyamide)

Process fittings

- Fastening lugs ø 9 mm (0.35 in), hole centre distance 119 mm (4.69 in)

Weight

- Aluminium housing, with electronics 3.4 kg (7.5 lbs) + measurement tube
- Stainless steel housing, with electronics 8.36 kg (18.43 lbs) + measurement tube
- Measurement tube 7.1 kg/m (4.77 lbs/ft)
- Measuring frame (optional) 29 ... 66 kg (64 ... 146 lbs)

Conveyor belt width (see table) 500 ... 1600 mm (19.7 ... 63 in)

Max. torque, mounting screws - fastening lugs on the sensor housing 50 Nm (36.88 lbf ft)

Max. torque for NPT cable glands and Conduit tubes

- Aluminium/Stainless steel housing 50 Nm (36.88 lbf ft)

Input variable

Measured variable The measured variable is the intensity of the gamma radiation of an isotope. In case the radiation intensity decreases, for example due to rising loading volume of the conveyor belt, the measured value of WEIGHTRAC 31 changes in proportion to the loading volume.
Fig. 35: Data of the input variable

A  Maximum conveyor belt width
B  Total width - Crossbeam
C  Clear width (internal dimension) - measuring frame
D  Total height - measuring frame
E  Clear height (internal dimension) - measuring frame
L  Length of the detector (instrument length)

Dimensions/measuring frame (optional)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 mm</td>
<td>19.68 in</td>
<td>880 mm (34.65 in)</td>
<td>635 mm (25 in)</td>
<td>500 mm (19.68 in)</td>
<td>435 mm (17.13 in)</td>
<td>610 mm (24 in)</td>
</tr>
<tr>
<td>800 mm</td>
<td>31.5 in</td>
<td>1175 mm (46.26 in)</td>
<td>948 mm (37.32 in)</td>
<td>770 mm (30.32 in)</td>
<td>705 mm (27.76 in)</td>
<td>1000 mm (39.37 in)</td>
</tr>
<tr>
<td>1000 mm</td>
<td>39.37 in</td>
<td>1370 mm (53.94 in)</td>
<td>1143 mm (45 in)</td>
<td>1000 mm (39.37 in)</td>
<td>935 mm (36.81 in)</td>
<td>1219 mm (48 in)</td>
</tr>
<tr>
<td>1200 mm</td>
<td>47.24 in</td>
<td>1570 mm (61.81 in)</td>
<td>1343 mm (52.87 in)</td>
<td>1180 mm (46.46 in)</td>
<td>1115 mm (43.9 in)</td>
<td>1500 mm (59.06 in)</td>
</tr>
<tr>
<td>1600 mm</td>
<td>63 in</td>
<td>1960 mm (77.17 in)</td>
<td>1733 mm (68.23 in)</td>
<td>1550 mm (61.02 in)</td>
<td>1485 mm (58.46 in)</td>
<td>1829 mm (72 in)</td>
</tr>
</tbody>
</table>

Measuring width (L)  610 … 1829 mm (24 … 72 in)
Analogue input
- Input type  4 … 20 mA, passive
- Internal load: 250 Ω

Switching input:
- Type of input - Open Collector: 10 mA
- Type of input - Relay contact: 100 mA

Output variable - Mass flow rate measurement:

Output:
- Signal: digital output signal, Foundation Fieldbus protocol
- Physical layer: according to IEC 61158-2

Damping (63 % of the input variable): 0 … 999 s, adjustable

Channel Numbers:
- Channel 1: Process value (mass flow rate)
- Channel 8: Electronics temperature
- Channel 9: Pulse rate

Transmission rate: 31.25 Kbit/s

Current value: 10 mA, ±0.5 mA

Resolution, digital: > 0.1 mm (0.004 in)

Relay output:

Output: Relay output (SPDT), floating spdt

Switching voltage:
- Min.: 10 mV
- Max.: 253 V AC, 253 V DC

Switching current:
- Min.: 10 µA
- Max.: 3 A AC, 1 A DC

Breaking capacity:
- Min.: 50 mW
- Max.: 750 VA AC, 40 W DC

If inductive loads or stronger currents are switched through, the gold plating on the relay contact surface will be permanently damaged. The contact is then no longer suitable for switching low-level signal circuits.

Contact material (relay contacts): AgNi or AgSnO and Au plated

Transistor output:

Output: Floating transistor output, permanently shortcircuit-proof

Load current: < 400 mA

Voltage loss: < 1 V

Switching voltage: < 55 V DC

Blocking current: < 10 µA
### Accuracy (according to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1

- **Temperature**: +18 ... +30 °C (+64 ... +86 °F)
- **Relative humidity**: 45 ... 75 %
- **Air pressure**: 860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig)

Repeatability

1 % of the measuring range end value

Deviation with bulk solids

The values depend on the quality of the linearization

Deviation under EMC influence

≤ 1 %

### Characteristics and performance data

**Step response time**

≤ 5 s (with damping 1 s)

### Ambient conditions

Ambient, storage and transport temperature

-40 ... +60 °C (-40 ... +140 °F)

### Process conditions

For the process conditions, please also note the specifications on the type label. The lower value always applies.

- **Process pressure**: Unpressurized
- **Process temperature (measured on the detector tube)**: -40 ... +60 °C (-40 ... +140 °F)

Vibration resistance

- **- sensor**
  
  mechanical vibrations up to 1 g in the frequency range 5 ... 200 Hz

- **- mounted in the measuring frame**
  
  mechanical vibrations up to 1 g in the frequency range 5 ... 200 Hz

### Electromechanical data - version IP 66/IP 67

**Cable entry**

- **M20 x 1.5**

  2 x cable gland M20 x 1.5 (cable: ø 6 ... 12 mm), 4 x blind plug M20 x 1.5

  Included: 1 x cable gland M20 x 1.5

- **½ NPT**

  5 x closing cap (red) ½ NPT

  Included: 3 x cable gland ½ NPT (cable: ø 6 ... 12 mm), 4 x blind plug ½ NPT

Spring-loaded terminals for wire cross-section

- **Massive wire, cord**

  0.2 ... 2.5 mm² (AWG 24 ... 14)

- **Stranded wire with end sleeve**

  0.2 ... 1.5 mm² (AWG 24 ... 16)

### Display and adjustment module

**Display element**

Display with backlight

**Measured value indication**

4) Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

5) Tested according to the guidelines of German Lloyd, GL directive 2.
### Supplementary information Foundation Fieldbus

The following table gives you an overview of the instrument versions and the corresponding device descriptions, the electrical characteristics of the bus system as well as the applied function blocks.

---

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of digits</td>
<td>5</td>
</tr>
<tr>
<td>Size of digits</td>
<td>W x H = 7 x 13 mm</td>
</tr>
<tr>
<td>Adjustment elements</td>
<td>4 keys</td>
</tr>
<tr>
<td>Protection rating</td>
<td></td>
</tr>
<tr>
<td>- unassembled</td>
<td>IP 20</td>
</tr>
<tr>
<td>- mounted into the housing without cover</td>
<td>IP 40</td>
</tr>
<tr>
<td>Materials</td>
<td></td>
</tr>
<tr>
<td>- Housing</td>
<td>ABS</td>
</tr>
<tr>
<td>- Inspection window</td>
<td>Polyester foil</td>
</tr>
</tbody>
</table>

#### Integrated clock

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date format</td>
<td>Day.Month.Year</td>
</tr>
<tr>
<td>Time format</td>
<td>12 h/24 h</td>
</tr>
<tr>
<td>Time zone Ex factory</td>
<td>CET</td>
</tr>
<tr>
<td>Rate deviation max.</td>
<td>10.5 min/year</td>
</tr>
</tbody>
</table>

#### Measurement electronics temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>1 °C (1.8 °F)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±1 °C (1.8 °F)</td>
</tr>
</tbody>
</table>

#### Voltage supply

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating voltage</td>
<td></td>
</tr>
<tr>
<td>- Sensor power supply</td>
<td>20 … 72 V DC or 20 … 253 V AC, 50/60 Hz</td>
</tr>
<tr>
<td>- FF bus</td>
<td>9 … 32 V DC</td>
</tr>
</tbody>
</table>

#### Electrical protective measures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection, depending on housing version</td>
<td>IP 66/IP 67&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td>Overvoltage category</td>
<td>III</td>
</tr>
<tr>
<td>Protection class</td>
<td>I</td>
</tr>
</tbody>
</table>

#### Approvals

Instruments with approvals can have different technical data depending on the version. For that reason the associated approval documents of these instruments must be carefully noted. They are part of the delivery or can be downloaded under [www.vega.com](http://www.vega.com) and "VEGA Tools" as well as under "Downloads" and "Approvals".

---

<sup>6</sup> A suitable cable is the prerequisite for maintaining the protection rating.
<table>
<thead>
<tr>
<th><strong>Revisions Data</strong></th>
<th><strong>DD-Revision</strong></th>
<th><strong>Rev_01</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CFF-File</td>
<td>010101.cff</td>
<td></td>
</tr>
<tr>
<td>Device Revision</td>
<td>0101.ffo</td>
<td>0101.sym</td>
</tr>
<tr>
<td>Cff-Revision</td>
<td>xx xx 01</td>
<td></td>
</tr>
<tr>
<td>Device software revision</td>
<td>&gt; 1.5.0</td>
<td></td>
</tr>
<tr>
<td>ITK (Interoperability Test Kit) Number</td>
<td>6.0.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Electricial Characteristics</strong></th>
<th><strong>Physical Layer Type</strong></th>
<th><strong>Low-power signaling, bus-powered, FISCO I.S.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Impedance</td>
<td>&gt; 3000 Ohms between 7.8 KHz - 39 KHz</td>
<td></td>
</tr>
<tr>
<td>Unbalanced Capacitance</td>
<td>&lt; 250 pF to ground from either input terminal</td>
<td></td>
</tr>
<tr>
<td>Output Amplitude</td>
<td>0.8 V P-P</td>
<td></td>
</tr>
<tr>
<td>Electrical Connection</td>
<td>4 Wire</td>
<td></td>
</tr>
<tr>
<td>Polarity Insensitive</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Max. Current Load</td>
<td>10 mA</td>
<td></td>
</tr>
<tr>
<td>Device minimum operating voltage</td>
<td>9 V</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Transmitter Function Blocks</strong></th>
<th><strong>Resource Block (RB)</strong></th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducer Block (TB)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Standard Block (AI)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Execution Time</td>
<td>30 ms</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Diagnostics</strong></th>
<th><strong>Standard</strong></th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Function Blocks Instantiable</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>General Information</strong></th>
<th><strong>LAS (Link Active Scheduler)</strong></th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Capable</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Number of VCRs (Virtual Communication Relationships)</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

**Function block Analog Input (AI)**

The function block "Analog Input (AI)" takes the original measured value selected by a Channel Number and makes it available to additional function blocks on its output.
Fig. 36: Schematic presentation function block Analog Input (AI)

**Parameter list**
The following table gives you an overview of the parameters used.

<table>
<thead>
<tr>
<th>FF descriptor</th>
<th>Rel. Index</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRIMARY_VALUE</td>
<td>13</td>
<td>PRIMARY_VALUE (Linearized value). This is the process value after min/max adjustment and Linearization with the status of the transducer block. The unit is defined in &quot;PRIMARY_VALUE_UNIT&quot;</td>
<td>FF_PRIMARY_VALUE_UNIT</td>
</tr>
<tr>
<td>FF_PRIMARY_VALUE_UNIT</td>
<td>14</td>
<td>Selected unit code for &quot;PRIMARY_VALUE&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_VAPOR_DENSITY</td>
<td>15</td>
<td>Density with Temperature correction</td>
<td>FF_VAPOR_DENSITY_UNIT</td>
</tr>
<tr>
<td>FF_VAPOR_DENSITY_UNIT</td>
<td>16</td>
<td>Selected unit code for &quot;FF_VAPOR_DENSITY&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_PROCESS_TEMPERATURE</td>
<td>17</td>
<td>Process temperature</td>
<td>FF_PROCESS_TEMPERATURE_UNIT</td>
</tr>
<tr>
<td>FF_PROCESS_TEMPERATURE_UNIT</td>
<td>18</td>
<td>Selected unit code for &quot;FF_PROCESS_TEMPERATURE&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_DENSITY</td>
<td>19</td>
<td>Density</td>
<td>FF_DENSITY_UNIT</td>
</tr>
<tr>
<td>FF_DENSITY_UNIT</td>
<td>20</td>
<td>Selected unit code for &quot;FF_DENSITY&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_VOLUMETRIC_FLOW</td>
<td>21</td>
<td>Volumetric flow</td>
<td>FF_VOLUMETRIC_FLOW_UNIT</td>
</tr>
<tr>
<td>FF_VOLUMETRIC_FLOW_UNIT</td>
<td>22</td>
<td>Selected unit code for &quot;FF_VOLUMETRIC_FLOW&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_WEIGHT</td>
<td>23</td>
<td>Weight on belt</td>
<td>FF_WEIGHT_UNIT</td>
</tr>
<tr>
<td>FF_WEIGHT_UNIT</td>
<td>24</td>
<td>Selected unit code for &quot;FF_WEIGHT&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_BELT_SPEED</td>
<td>25</td>
<td>Belt speed</td>
<td>FF_BELT_SPEED_UNIT</td>
</tr>
<tr>
<td>FF_BELT_SPEED_UNIT</td>
<td>26</td>
<td>Selected unit code for &quot;FF_BELT_SPEED&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF descriptor</td>
<td>Rel. Index</td>
<td>Description</td>
<td>Unit</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------</td>
<td>--------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>FF_ELECTRONIC_TEMPERATURE</td>
<td>27</td>
<td>Electronics temperature</td>
<td>FF_ELECTRONIC_TEMPERATURE_UNIT</td>
</tr>
<tr>
<td>FF_ELECTRONIC_TEMPERATURE_UNIT</td>
<td>28</td>
<td>Selected unit code for &quot;FF_ELECTRONIC_TEMPERATURE&quot;</td>
<td>-</td>
</tr>
<tr>
<td>FF_COUNT_RATE</td>
<td>29</td>
<td>Count rate</td>
<td>FF_COUNT_RATE_UNIT</td>
</tr>
<tr>
<td>FF_COUNT_RATE_UNIT</td>
<td>30</td>
<td>Selected unit code for &quot;FF_COUNT_RATE&quot;</td>
<td>-</td>
</tr>
<tr>
<td>DEVICE_TAG</td>
<td>31</td>
<td>Tagname</td>
<td>-</td>
</tr>
<tr>
<td>DEVICE_NAME</td>
<td>32</td>
<td>Device type</td>
<td>-</td>
</tr>
<tr>
<td>DEVICE_STATE</td>
<td>33</td>
<td>Error code</td>
<td>-</td>
</tr>
<tr>
<td>PEAK_MEAS_VAL_MIN</td>
<td>34</td>
<td>Pulse rate (min.)</td>
<td>-</td>
</tr>
<tr>
<td>PEAK_MEAS_VAL_MAX</td>
<td>35</td>
<td>Pulse rate (max.)</td>
<td>-</td>
</tr>
<tr>
<td>PEAK_TEMP_VAL_MIN</td>
<td>36</td>
<td>Electronics temperature (min.)</td>
<td>-</td>
</tr>
<tr>
<td>PEAK_TEMP_VAL_MAX</td>
<td>37</td>
<td>Electronics temperature (max.)</td>
<td>-</td>
</tr>
<tr>
<td>APPLICATION_TYPE_SEL</td>
<td>38</td>
<td>Selected application</td>
<td>-</td>
</tr>
<tr>
<td>TEMP_COMP_UNIT</td>
<td>39</td>
<td>Selected unit code for process temperature</td>
<td>-</td>
</tr>
<tr>
<td>DELTA_I</td>
<td>40</td>
<td>Calculated percent delta I</td>
<td>-</td>
</tr>
<tr>
<td>GAUGE_TEMPERATURE</td>
<td>41</td>
<td>Electronics temperature</td>
<td>-</td>
</tr>
<tr>
<td>DECAY_COMPENSATION_FACTOR</td>
<td>42</td>
<td>Factor for the decay compensation</td>
<td>-</td>
</tr>
<tr>
<td>PMT_VOLTAGE_CALIBRATION</td>
<td>43</td>
<td>Photomultiplier voltage on delivery</td>
<td>-</td>
</tr>
<tr>
<td>CORRELATION_COEFF</td>
<td>44</td>
<td>Correlation coefficient for linearizer table</td>
<td>-</td>
</tr>
<tr>
<td>ERROR_TEXT</td>
<td>45</td>
<td>Error text</td>
<td>-</td>
</tr>
<tr>
<td>PMT_VOLTAGE_ACTUAL</td>
<td>46</td>
<td>Current photomultiplier voltage</td>
<td>-</td>
</tr>
<tr>
<td>STANDARDIZATION_FACTOR</td>
<td>47</td>
<td>Factor for the real value correction</td>
<td>-</td>
</tr>
<tr>
<td>SERIALNUMBER</td>
<td>48</td>
<td>Serial number</td>
<td>-</td>
</tr>
<tr>
<td>NAMUR_STATE</td>
<td>49</td>
<td>NAMUR state</td>
<td>-</td>
</tr>
<tr>
<td>NULL_COUNT_RATE</td>
<td>50</td>
<td>Zero count rate</td>
<td>-</td>
</tr>
<tr>
<td>COUNT_RATE_PMT</td>
<td>51</td>
<td>Pulse rate photomultiplier (raw values)</td>
<td>-</td>
</tr>
<tr>
<td>ADJ_DENSITY_ABS_COEFF</td>
<td>52</td>
<td>Process absorption coefficient</td>
<td>-</td>
</tr>
<tr>
<td>DEV_SW_VER.ASCII</td>
<td>53</td>
<td>Software version</td>
<td>-</td>
</tr>
</tbody>
</table>
### FF descriptor

<table>
<thead>
<tr>
<th>FF descriptor</th>
<th>Rel. Index</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>POINT_LEVEL_ADJUST_MODE</td>
<td>54</td>
<td>Point level adjustment mode</td>
<td>-</td>
</tr>
<tr>
<td>RELAY_VALUE_SEL</td>
<td>55</td>
<td>Relay basic value</td>
<td>-</td>
</tr>
<tr>
<td>DIGITAL_IN</td>
<td>56</td>
<td>Frequency of digital input</td>
<td>-</td>
</tr>
<tr>
<td>DIGITAL_IN_BOOL</td>
<td>57</td>
<td>State of digital input</td>
<td>-</td>
</tr>
<tr>
<td>ANALOG_IN</td>
<td>58</td>
<td>Current on analog input</td>
<td>-</td>
</tr>
<tr>
<td>FF_CHANNEL_AVAILABLE</td>
<td>59</td>
<td>Available channels</td>
<td>-</td>
</tr>
<tr>
<td>FF_CHANNEL_USED</td>
<td>60</td>
<td>Used channels</td>
<td>-</td>
</tr>
</tbody>
</table>

### Mapping of Process Value Status

<table>
<thead>
<tr>
<th>Hex</th>
<th>Quality</th>
<th>Sub-Status</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00</td>
<td>Bad</td>
<td>Non-specific</td>
<td>Unexpected error</td>
</tr>
</tbody>
</table>
| 0x01 | Bad     | Configuration Error | It was tried to set a wrong unit with FF interface  
On user error codes: 16, 17, 25, 52, 57, 66, 72, 117, 120 |
| 0x0C | Bad     | Device Failure   | Five or more internal communications have failed while "Process Data Update". Last usable value is displayed  
On user error codes: 8, 34, 35, 36, 37, 38, 73, 80, 86, 121, 122, 141 |
| 0x10 | Bad     | Sensor Failure   | On user error codes: 40, 41, 53, 68, 123, 124, 125                                                  |
| 0x1C | Bad     | Out of Service   | Transducer block is in mode "Out of Service"  
Channel is not assigned to an AIFB  
Channel is not available in running application |
| 0x20 | Bad     | Transducer in MAN | Transducer block is in mode "Manual" |
| 0x44 | Uncertain | Last Usable Value | Three or more internal communications have failed while "Process Data Update". Last usable value is displayed |
| 0x48 | Uncertain | Substitute       | On user error codes: 29                                                                            |
| 0x4C | Uncertain | Initial Value    | After startup of device or channel assignment in AIFB was changed. The channel unit may be unknown until next "Process Data Update"  
On user error codes: 13 |
| 0x80 | Good (NC) | Non-specific     | No errors concerning to channel handling  
On user error codes: 0, 33, 45, 71, 126, 127 |

### Mapping of User Error Codes to FF Field Diagnostics

<table>
<thead>
<tr>
<th>Priority</th>
<th>Description</th>
<th>User Error Codes</th>
<th>NE-107 Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Hardware failure</td>
<td>40, 41</td>
<td>FAILURE</td>
</tr>
<tr>
<td>30</td>
<td>Memory failure</td>
<td>34, 35, 36, 37</td>
<td>FAILURE</td>
</tr>
<tr>
<td>Priority</td>
<td>Description</td>
<td>User Error Codes</td>
<td>NE-107 Status</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------------------</td>
<td>-----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>29</td>
<td>Software failure</td>
<td>80</td>
<td>FAILURE</td>
</tr>
<tr>
<td>28</td>
<td>Paramererization corrupt</td>
<td>72</td>
<td>FAILURE</td>
</tr>
<tr>
<td>27</td>
<td>Undefined 27</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>26</td>
<td>Undefined 26</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>Paramererization error</td>
<td>16, 17, 25, 52, 53, 57, 66, 117, 120</td>
<td>FAILURE</td>
</tr>
<tr>
<td>24</td>
<td>Conflict in MGC</td>
<td>121, 122, 141</td>
<td>FAILURE</td>
</tr>
<tr>
<td>23</td>
<td>Communication error in MGC</td>
<td>8</td>
<td>FAILURE</td>
</tr>
<tr>
<td>22</td>
<td>MGC slave reports error</td>
<td>38</td>
<td>FAILURE</td>
</tr>
<tr>
<td>21</td>
<td>Undefined 21</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>Undefined 20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>Undefined 19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>Detector temperature critical</td>
<td>125</td>
<td>OUT_OF_SPEC</td>
</tr>
<tr>
<td>17</td>
<td>Error while auto-standardization</td>
<td>73</td>
<td>FAILURE</td>
</tr>
<tr>
<td>16</td>
<td>Excessive radiation</td>
<td>123, 124</td>
<td>FAILURE</td>
</tr>
<tr>
<td>15</td>
<td>Input out of bounds</td>
<td>13</td>
<td>OUT_OF_SPEC</td>
</tr>
<tr>
<td>14</td>
<td>Error while signal processing</td>
<td>68</td>
<td>FAILURE</td>
</tr>
<tr>
<td>13</td>
<td>Undefined 13</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Undefined 12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>Undefined 11</td>
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</tr>
<tr>
<td>10</td>
<td>Undefined 10</td>
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</tr>
<tr>
<td>9</td>
<td>Undefined 9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Undefined 8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>AITB simulated</td>
<td>29</td>
<td>FUNCTION_CHECK</td>
</tr>
<tr>
<td>6</td>
<td>Undefined 6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Undefined 5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Undefined 4</td>
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<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Undefined 3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Undefined 2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>Error while trend recording</td>
<td>126, 127</td>
<td>GOOD</td>
</tr>
<tr>
<td>0</td>
<td>Reserved</td>
<td>-</td>
<td>Reserved</td>
</tr>
<tr>
<td></td>
<td>Not displayed</td>
<td>33, 45, 71, 86</td>
<td>-</td>
</tr>
</tbody>
</table>

### 11.3 Dimensions

The following dimensional drawings represent only an extract of all possible versions. Detailed dimensional drawings can be downloaded at [www.vega.com/downloads](http://www.vega.com/downloads) under "Drawings".
Aluminium and stainless steel housing

Fig. 37: Aluminium housing or stainless steel housing - Precision casting
**Fig. 38: WEIGHTRAC 31**

**L** Measurement width
WEIGHTRAC 31 mounted in the measuring frame (optionally)

Fig. 39: WEIGHTRAC 31 in the measuring frame with source container SHLD-1 (can be ordered separately)

A Maximum conveyor belt width
B Total width - Crossbeam
C Clear width (internal dimension) - measuring frame
D Total height - measuring frame
E Clear height (internal dimension) - measuring frame
L Measuring width (length of the detector)

Dimensions/measuring frame (optional)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 mm (19.68 in)</td>
<td>880 mm (34.65 in)</td>
<td>635 mm (25 in)</td>
<td>500 mm (19.68 in)</td>
<td>435 mm (17.13 in)</td>
<td>610 mm (24 in)</td>
</tr>
<tr>
<td>800 mm (31.5 in)</td>
<td>1175 mm (46.26 in)</td>
<td>948 mm (37.32 in)</td>
<td>770 mm (30.32 in)</td>
<td>705 mm (27.76 in)</td>
<td>1000 mm (39.37 in)</td>
</tr>
<tr>
<td>1000 mm (39.37 in)</td>
<td>1370 mm (53.94 in)</td>
<td>1143 mm (45 in)</td>
<td>1000 mm (39.37 in)</td>
<td>935 mm (36.81 in)</td>
<td>1219 mm (48 in)</td>
</tr>
<tr>
<td>1200 mm (47.24 in)</td>
<td>1570 mm (61.81 in)</td>
<td>1343 mm (52.87 in)</td>
<td>1180 mm (46.46 in)</td>
<td>1115 mm (43.9 in)</td>
<td>1500 mm (59.06 in)</td>
</tr>
<tr>
<td>1600 mm (63 in)</td>
<td>1960 mm (77.17 in)</td>
<td>1733 mm (68.23 in)</td>
<td>1550 mm (61.02 in)</td>
<td>1485 mm (58.46 in)</td>
<td>1829 mm (72 in)</td>
</tr>
<tr>
<td>2000 mm (78.74 in)</td>
<td>2450 mm (96.46 in)</td>
<td>2223 mm (87.52 in)</td>
<td>1970 mm (77.56 in)</td>
<td>1905 mm (75 in)</td>
<td>2500 mm (98.43 in)</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>L</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
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<tr>
<td>2400 mm</td>
<td>2826 mm</td>
<td>2599 mm</td>
<td>2357 mm</td>
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</tr>
<tr>
<td>(94.49 in)</td>
<td>(111.26 in)</td>
<td>(102.32 in)</td>
<td>(92.8 in)</td>
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<td>(107.99 in)</td>
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<tr>
<td>2800 mm</td>
<td>3198 mm</td>
<td>2971 mm</td>
<td>2775 mm</td>
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<td>3000 mm</td>
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<tr>
<td>(110.24 in)</td>
<td>(125.91 in)</td>
<td>(116.97 in)</td>
<td>(109.25 in)</td>
<td>(106.69 in)</td>
<td>(118.11 in)</td>
</tr>
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11.4 Industrial property rights

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