

The sensor series SONOFLOW CO.56 – designed as clamp-on-sensors – measures the flow rate of liquids and detects bubbles in plastic tubes of different diameters or materials within a few milliseconds.

The flow-bubble sensors have no contact to the medium or product and are suitable for applications in fields with strict hygienic standards e.g. the medical industry. The ultrasonic sensors with complete built-in electronics can be easily integrated into machines or apparatuses.

In addition to our standard sensors, we also manufacture customer-specific solutions regarding housing materials, colors, mechanical dimensions, output specifications and parameter settings.

Overview sensors

Specification SONOFLOW	Order-No.	Max. Flow Range	Measuring channel (□ CH = CW)	Dimensions (L × W × H)	Weight
CO.56/035	200 04 0009	3 000 ml/min	3.5 mm	44 × 44 × 28 mm	120 g
CO.56/044	200 04 0010	5 000 ml/min	4.4 mm	44 × 44 × 30 mm	125 g
CO.56/060	200 04 0011	6 000 ml/min	6.0 mm	44 × 44 × 32 mm	130 g
CO.56/080	200 04 0012	8 000 ml/min	8.0 mm	44 × 44 × 34 mm	135 g
CO.56/120	200 04 0013	12 000 ml/min	12.0 mm	44 × 44 × 36 mm	140 g
CO.56/140	200 04 0014	14 000 ml/min	14.0 mm	44 × 44 × 38 mm	145 g

Tubing properties

The selection of the right sensor depends on tubing dimensions as well as on tubing properties. If possible, please provide us with a tubing sample (minimum length of 50 cm).

Specification SONOFLOW	Tubing OD	Tubing ID	Factory Calibration Tubing
CO.56/035	4.0 mm	3.0 mm	PVC, 3500304 ¹
CO.56/044	5.0 mm	3.0 mm	PVC, 702101031099 ²
CO.56/060	7.0 mm	5.0 mm	PVC, 702101051099 ²
CO.56/080	9.0 mm	6.0 mm	PVC, 702101061599 ²
CO.56/120	14.0 mm	10.0 mm	PVC, 702101102050 ²
CO.56/140	16.0 mm	12.0 mm	PVC, 702101122050 ²

Manufacturer: 1 Deutsch & Neumann GmbH, 10585 Berlin (Germany) | 2 ESSKA.de GmbH, 20537 Hamburg (Germany)

Flow accuracy / repeatability

Specification SONOFLOW	Flow measurement accuracy after 30 min sensor warm-up, no thermal gradients, trained staff for removing / insertion of tubing. Flow measurement repeatability at constant conditions, after 30 min warm-up, no thermal gradients, lid remains closed, no removing / inserting of tubing, no movements of sensor or tubing.	
CO.56/035	< 300 ml/min: ± 15 ml/min ± 6 ml/min	≥ 300 ml/min: $\pm 5\%$ ³ $\pm 2\%$ ³
CO.56/044	< 500 ml/min: ± 25 ml/min ± 10 ml/min	≥ 500 ml/min: $\pm 5\%$ ³ $\pm 2\%$ ³
CO.56/060	< 600 ml/min: ± 30 ml/min ± 12 ml/min	≥ 600 ml/min: $\pm 5\%$ ³ $\pm 2\%$ ³
CO.56/080	< 800 ml/min: ± 40 ml/min ± 16 ml/min	≥ 800 ml/min: $\pm 5\%$ ³ $\pm 2\%$ ³
CO.56/120	< 1 200 ml/min: ± 60 ml/min ± 24 ml/min	$\geq 1 200$ ml/min: $\pm 5\%$ ³ $\pm 2\%$ ³
CO.56/140	< 1 400 ml/min: ± 70 ml/min ± 28 ml/min	$\geq 1 400$ ml/min: $\pm 5\%$ ³ $\pm 2\%$ ³

³ of reading

Zero point stability: Flow measurement drifts less than 0.02 l/min in 24 h at zero flow.

Calibration and conditions of use

<p>Calibration</p>	<p>Sensors are factory calibrated under the following conditions:</p> <ul style="list-style-type: none"> ▪ PVC tubing as listed in table above (Tubing properties) ▪ Water at 23 °C ± 2 °C ▪ Warm up: at least 30 min (to compensate thermal effects) ▪ Zero calibration just before measurement procedure ▪ Normal pressure <p>Calibration to customer tubing, fluid, flow range, temperature, etc. on request.</p>
<p>Media</p>	<p>Water, saline, human blood or other acoustically transparent liquids</p> <p>⚠ NOTE: SONOTEC does not operate with human blood within the company premises.</p> <p>With respect to calibration, the difference between water and saline solution is negligible. For applications with blood (hemoglobin: Hb = 9 ± 2 g/dl) some special factors/settings can be modified after calibration (→ observe the instruction in the next chapter.)</p> <p>⚠ CAUTION:</p> <p>If the sensor is applied to measure the flow of sensitive liquids, like human blood, the maximum flow velocity of fluid inside the tubing and inside the measuring channel shall be considered carefully. The blood cells could be harmed or damaged if transported at high velocities. It is the responsibility of the manufacturer of medical device to assess if there is a potential risk.</p>
<p>Conditions of use</p>	<p>⚠ CAUTION:</p> <p>The sensors need to be adjusted individually to special operating conditions</p> <ul style="list-style-type: none"> ▪ in case of operation with tubing that is not listed in the table 'Tubing properties', since the accuracy of flow measurement and bubble detection can be affected and ▪ if the sensor is intended to measure with human blood at 37 °C and hemoglobin between 6 g/dl to 12 g/dl. <p>Please contact us for details!</p> <p>⚠ NOTE:</p> <p>Generally, the sensors are able to measure liquids in an extended operating temperature range of +1 to +50 °C and to measure blood within the ranges of Hb = 0 to 6 g/dl or Hb = 12 to 18.5 g/dl, but with limited accuracy only.</p>

Accuracy depends on tubing, temperature, fluid properties and other conditions. Absolute accuracy is influenced by zero stability, resolution and zero offset effects. For details see next chapter.

Bubble detection and sensitivity

If bubbles with a size larger than the threshold are detected, the bubble alarm is set. The threshold depends on the sensor type. The sensitivity depends on the diameter of the tube and the mounting position.

Bubble sensitivity	Bubbles larger than the alarm threshold are detected. Larger amounts of foam in the liquid will be detected as air.	
	Specification SONOFLOW	Threshold alarm
	CO.56/035	2.0 mm ⁴
	CO.56/044	2.0 mm ⁴
	CO.56/060	3.5 mm
	CO.56/080	6.5 mm
	CO.56/120	9.0 mm
	CO.56/140	10.0 mm
Reaction time	Internal evaluation of bubbles within intervals of max. 1.6 ms	
Response time	< 10 ms; faster response time possible if needed	

⁴ Values valid in limited flow range of max. 900 ml/min, values for higher flow rate on request.

Technical data

SONOFLOW CO.56

Flow-Bubble Sensor for liquids

Measuring method	Ultrasonic transit time difference measurement in transmission with two redundant measurement paths, dry coupling, no couplant required
Mounting	Fixed installation: 4 fixing holes M4, 8 mm deep
Tube insertion	<ul style="list-style-type: none"> ▪ Tube must be put in manually without tools. Lid must be closed. ▪ No couplant (e.g. gel) permitted. ▪ Prevent excessive bending or tube compressing close to sensor (10 × inner tube diameter before and 5 × inner tube diameter behind the sensor)
Sensor materials	Measuring channel: PMMA black Housing: aluminum, anodized grey/red Hinge: stainless steel 1.4301 Potting compound (not accessible after mounting): PUR (blue)
Labelling (laser engraving)	<ul style="list-style-type: none"> ▪ Arrow on lid indicating flow direction ▪ On side of housing (sensor type, hardware version, serial number, manufacturer with address)

<p>Operating voltage</p>	<p>5 VDC +0.5/-0.1 VDC</p> <p>Internal suppressor diode to protect the sensor: Type: SMBJ5.0A nom. 5 V 600 W peak pulse power dissipation Inverse-polarity protection: In case of inverse polarity, the sensor is protected by the diode. A high short-circuit current flows.</p>
<p>Current consumption</p>	<p>< 150 mA</p> <p>⚠ ATTENTION: Current must be limited externally to max. 250 mA (e.g. fuse) to minimize the risk of heating / fire as a consequence of a short-circuit.</p>
<p>RS-485 interface (SONOTEC protocol)</p>	<p>Half-duplex operation / 115.200 baud / no parity / 1 stop bit / no handshaking</p> <p>Dialog mode (on demand): Machine is intended to ask results cyclically, sensor does not have an own alarm equipment) Query cycle: 20 ... 200 ms (typically)</p> <p>⚠ NOTE: Description of the serial protocol for details upon request.</p> <div> </div> <p>Recommended electrical connection of the RS-485 interface</p>
<p>RS-485 bus operation</p>	<p>Bus operation supported up to 12 subscribers, default address is #01 (can be changed with the help of SONOFLOW Monitor, permitted are addresses from #01 ... #12)</p>
<p>Maintenance</p>	<p>Maintenance-free</p>
<p>Ambient temperature</p>	<p>+10 ... +50 °C (see also chapter 'Calibration and conditions of use')</p>
<p>Media temperature</p>	<p>+10 ... +50 °C, other temperatures available on request</p>
<p>Storage & transportation temperature</p>	<p>-20 ... + 70 °C</p>
<p>Humidity</p>	<p>10 ... 95 % relative. humidity (not condensing)</p>
<p>Atmospheric pressure</p>	<p>620 hPa ... 1060 hPa</p>
<p>Degree of protection</p>	<p>IP67</p>

Scope of supply	<ul style="list-style-type: none"> ▪ SONOFLOW CO.56/xxx flow-bubble sensor according to specification ▪ User documentation
Optional accessories	<p>Calibration report</p> <hr/> <p>SONOFLOW Monitor Software for setting parameters, recording measurements and update of sensor software consisting of</p> <ul style="list-style-type: none"> ▪ USB Data Converter (type 012), for the connection to a computer ▪ USB cable, type A-B, length 2 m ▪ CD with Software SONOFLOW Monitor and driver for Windows

Directives and standards

Medical safety	Medical safety: IEC 60601-1 3 rd edition
Electrical safety	<p>For MEANS OF PATIENT PROTECTION (MOPP) according to IEC 60601-1: The protection from SECONDARY CIRCUITS requires an installation of a SELV (Safety Extra-Low Voltage) converter prior to connecting the sensor onto the medical device. This ensures that no higher voltage than 60 V can occur at the sensor under any circumstances.</p> <p>Internal insulation of inner electronic to metallic housing with > 1000 VAC. It applies 2 × MOPP, secondary circuit, according to IEC 60601-1, Table 6.</p> <p>The classification as Applied Part “CF” in combination with the medical device and tubing is possible, depending on the application.</p>
Electromagnetic compatibility	<p>EMC tests must be performed by manufacturer of medical device after built-in. Precondition for EMC is the safe, functional grounding of housing by means of screws or connection line. Pretests have been performed by SONOTEC acc. IEC 60601-1-2, 4th edition.</p> <ul style="list-style-type: none"> ▪ IEC 61000-4-3 (electromagnetic immunity) 10 V/m 80 MHz to 2.7 GHz 80 % AM at 1 kHz ▪ IEC 61000-4-3 (electromagnetic immunity, wireless frequencies) Section 8.10 ▪ IEC 61000-4-8 (magnetic fields) 30 A/m 50 Hz und 60 Hz ▪ IEC 55011 class B / CISPR 11 (electromagnetic emission), tests according to IEC 55016: 30 ... 1000 MHz 30 dBµV @ 10 m ▪ IEC 61000-4-2 (electrostatic discharges) ± 8 kV direct and indirect contact ± 15 kV air ▪ IEC 61000-4-4/ IEC 61000-4-5/ IEC 61000-4-6: not applicable Rationale: Sensor doesn't provide a patient-coupled line and the cable length is below 3 m.
Further standards	<ul style="list-style-type: none"> ▪ Software development: DIN EN 62304, class C ▪ RoHS: 011/65/EU, exception: III 7cI/ IV 15, RoHS (EU) 2015/863 ▪ Acoustic emission: IEC 61157, suitable for use on human blood

Use in medical devices and safety

The manufacturer of the medical device is responsible for the medical approval. SONOTEC as a component supplier supports the approval process and shares documents with a notified body (3rd party).

Medical safety	<ul style="list-style-type: none"> ▪ PESS (Programmable Electrical Sub System) according to the IEC 60601. ▪ One-channel architecture / Fail Safe ▪ Cyclical self-tests of safe functionality of all essential components ▪ Output secured by watchdog: in case of major errors (for example software crashes), the output will be blocked ▪ After power on or software reset: initial test procedure (check of output circuit, watchdog functionality and locking of output)
Self-test	<p>FTT: 0.7 s (cycle time of self-test),</p> <p>MFTT: 24 h (tests after power on or restart only; sensor must be restarted within the defined period)</p>
Settings	<p>Each sensor is factory calibrated. Each sensor has individual settings regarding zero adjustment and characteristics of flow and the sensor specific identification character (e.g. serial number of the sensor, type codes).</p>
Use in medical applications	<p>⚠ CAUTION:</p> <p>Sensors are normally delivered in a state that is NOT FOR CLINICAL USE, since the settings are not protected against any changes.</p> <p>Proper settings of the sensor are essential for medical safety. All settings must be adjusted and verified carefully according to the medical application.</p> <p>The settings must be protected against unintentional changes. Hence, the appropriate self-test routines <u>must be enabled</u>.</p> <p>Please contact us to ensure a delivery of sensors with specified, verified settings!</p>
Special applications	<p>⚠ ATTENTION:</p> <p>The sensors are not suitable to be applied in immediate proximity to operating surgical devices using high energized pulses e.g. electrosurgical knives (radio frequency cautery). The sensors might be destroyed, the values of flow could be affected or the sensor could raise false bubble alarm due to the strong radiation along the tubing. Customized sensors with additional protection are available.</p>

Type HW V1.0

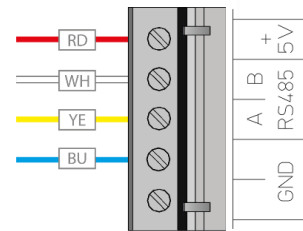
Electrical connection

Type 4 × wire, LiY / 0.14 mm²

Length 1.0 m ± 0.1 m

Connector WECO terminal block

Assignment	Color	Connection	WECO Terminal
	Red	+5 V	1
	White	RS-485 B	2
	Yellow	RS-485 A	3
	Blue	GND	4
			5



Grounding ⚠ **NOTE:** The metallic part of the housing of sensor must be connected to ground of machine by means of mounting or by shielded connection line!
Metallic front of machine: Grounding by mounting screws. If the panel is not conductive, an additional grounding line has to be fixed on one of the four screws.

Type HW V1.1

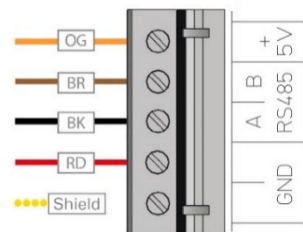
Electrical connection

Type UL-LifYDY / 5 × 0.08 mm² / shielded / Ø 3.5 ± 0.1 mm

Length 2.5 m ± 10 cm

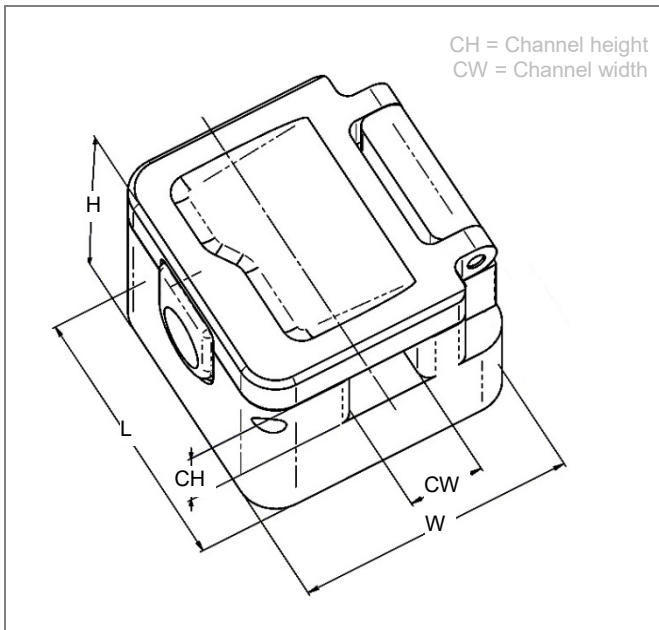
Connector WECO terminal block

Assignment	Color	Connection	WECO Terminal
	Orange	VCC	1
	Brown	RS-485 B	2
	Black	RS-485 A	3
	Red	GND	4
	Shield / Yellow	Housing of sensor	5

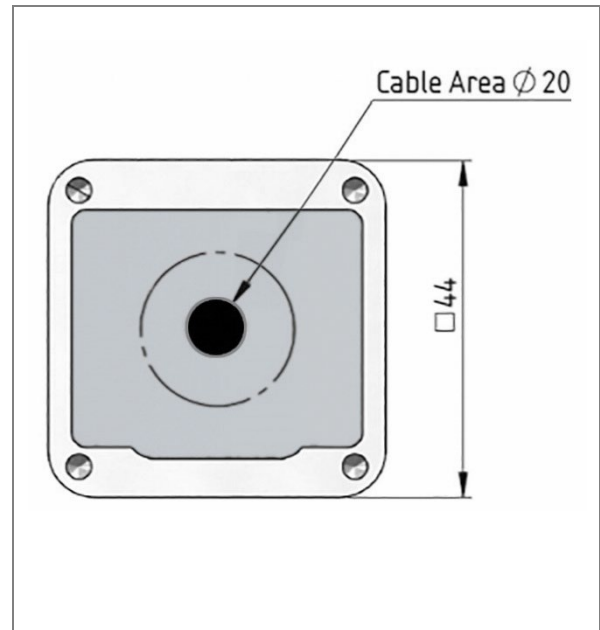


Grounding ⚠ **NOTE:** The metallic part of the housing of sensor must be connected to ground of machine by means of mounting or by shielded connection line!
Metallic front of machine: Grounding by mounting screws | Plastic front of machine: Grounding by connecting the shield of connection line to ground.

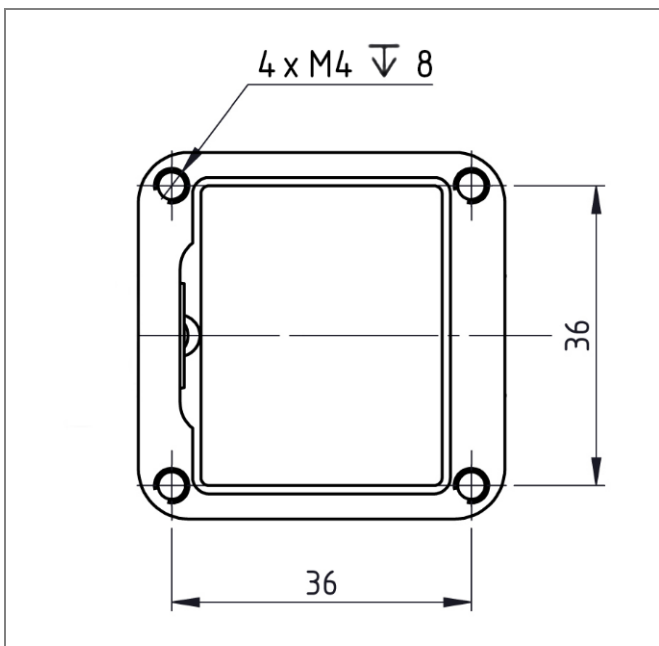
Technical drawings



Dimensions SONOFLOW CO.56



Rear side of sensor



Dimensions of drill holes for mounting

Drawings are not to scale. Dimensions in mm, unless otherwise specified. Information is subject to change without notice!

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