SIEMENS



SITRANS F

Ultrasonic flowmeters

SITRANS F US SONO 3100

Operating Instructions

Edition 03/2013

Answers for industry.

SIEMENS

SITRANS F

Ultrasonic Flowmeters SITRANS F US SONO 3100 sensor

Operating Instructions

Introduction 1

Safety notes 2

Description 3

Installing/Mounting 4

Electrical connection 5

Maintenance and repair 6

Technical data 7

Appendix A A

Safety note for installation in hazardous area B

Sensor type SONO 3100 DN 100 ... DN 1200 for use with transmitter type FUS060

03/2013

A5E00814513-008

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Table of contents

1 Introduction 5

1.1 Items supplied 5

1.2 History 5

1.3 Further Information 6

1.4 Notes on warranty 6

2 Safety notes 7

2.1 Laws and directives 7

2.2 Installation in hazardous area 8

2.3 Certificates 10

3 Description 11

3.1 System components 11

3.2 Design 11

3.3 Theory of operation 13

4 Installing/Mounting 15

4.1 Installation safety precautions 15

4.2 Determining a location 16

4.3 Orienting the sensor 18

4.4 Mounting the sensor 20

5 Electrical connection 21

5.1 Step 1: Transducer wiring 22

5.2 Step 2: Wiring transducer and transmitter 23

6 Maintenance and repair 25

6.1 Maintenance 25

6.2 Recalibration 25

6.3 Unit repair 25

6.4 Technical support 26

6.5 Application-specific data 27

6.6 Return procedures 28

6.7 Disposal 28

7 Technical data 29
7.1 Coaxial cable specifications 31
7.2 Pressure and temperature rating 32
7.3 Reference conditions 34
7.4 Dimensions and weight 35
A Appendix A 39
A.1 Sizing table (DN 100 to DN 1200) 39
A.2 Ordering 40
B Safety note for installation in hazardous area 41
Index 45

Introduction

1

These instructions contain all the information you need for using the device.

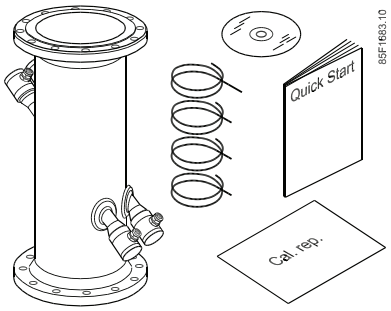
The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it as well as service and maintenance engineers.

Note

It is the responsibility of the customer that the instructions and directions provided in the operating instructions are read, understood and followed by the relevant personnel before installing the device.

1.1 Items supplied

- SITRANS F US SONO 3100
- SITRANS F US / F X literature CD
- Quick Start guide
- Calibration report
- Transducer coaxial cable (4 pcs)
- Transmitter type FUS060 (not shown)



Note

Scope of delivery may vary, depending on version and add-ons.

Note

Handle with care!

Impact and shock can damage the piezeoelectric crystal located in the transducers.

1.2 History

The contents of these instructions are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

The following table shows the most important changes in the documentation compared to each previous edition.

Edition	Remarks
12/2007	SITRANS F US Ultrasonic flowmeter Sensor type SONO 3100 DN 100 ... DN 1200 for use with transmitter type FUS060 (Operating manual, revision 3.)
06/2010	Contents restructured.
03/2011	Updates regarding compliance to PED directive.
03/2013	Update regarding ATEX approvals

Note

A flowmeter system consists of a sensor (SONO 3100) and a transmitter (FUS060).

These Operating Instructions only cover the sensor part of the system. The transmitter FUS060 has a separate manual, which is available on the SITRANS F US / F X literature CD-ROM and on the flow documentation homepage (http://www.siemens.com/flowdocumentation)

1.3 Further Information

Product information on the Internet

The Operating Instructions are available on the CD-ROM shipped with the device, and on the Internet on the Siemens homepage, where further information on the range of SITRANS F flowmeters may also be found:

Product information on the internet (http://www.siemens.com/flow)

Worldwide contact person

If you need more information or have particular problems not covered sufficiently by these Operating Instructions, get in touch with your contact person. You can find contact information for your local contact person on the Internet:

Local contact person (http://www.automation.siemens.com/partner)

1.4 Notes on warranty

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The sales contract contains all obligations on the part of Siemens as well as the complete and solely applicable warranty conditions. Any statements regarding device versions described in the manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of publishing. Siemens reserves the right to make technical changes in the course of further development.

Safety notes 2

⚠ CAUTION
Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance. Only qualified personnel should install or operate this instrument.

Note

Alterations to the product, including opening or improper modifications of the product, are not permitted.

If this requirement is not observed, the CE mark and the manufacturer's warranty will expire.

2.1 Laws and directives

General requirements

Installation of the equipment must comply with national regulations. For example EN 60079-14 for installation in hazardous location in the European Community.

Instrument safety standards

The device has been tested at the factory, based on the safety requirements. In order to maintain this condition over the expected life of the device the requirements described in these Operating Instructions must be observed.

NOTICE
Material compatibility The meters have been designed according to EN 13480 with an additional corrosion layer of up to 200 µm for steel sensors. Stainless steel transducer parts do not have an additional layer. It is the responsibility of the customer to ensure that the medium is compatible with the sensor construction material. The full responsibility for the selection rests with the customer and Siemens Flow Instruments can take no responsibility for any failure due to material incompatibility.

CE-marked equipment

Depending on device version, the CE mark symbolizes the compliance of the device with the following directives:

- EMC directive 2004/108/EC
- Low voltage directive (LVD) 2006/95/EC
- Pressure equipment directive (PED) 97/23/EC
- ATEX Directive 94/9/EC

⚠ WARNING

SONO 3100 weld-in version

SONO 3100 in the weld-in version, without flanges, are not pressure-tested and are not CE marked to PED. All installation activities (welding, pressure test, etc) are the responsibility of the customer.

2.2 Installation in hazardous area

⚠ WARNING

Ex-approved equipment

Equipment used in hazardous areas must be Ex-approved and marked accordingly. It is required that the special conditions for safe use provided in the manual and in the Ex certificate are followed!

Hazardous area approvals

This flowmeter (SONO 3100 with FUS060) is approved for use in hazardous area and has the following approvals (see Safety note for installation in hazardous area (Page 41)).

- Transmitter (FUS060): II 2G Ex dem [ia/ib] IIC T6/T4/T3 (Only approved for use with SONO 3100 Ex i)
- Sensor (SONO 3100 Ex i approved version): II 2G Ex ib IIC T6/T4/T3 (Only approved for use with FUS060 Ex version)
- Sensor (SONO 3100 Ex d approved version): II 2G Ex d IIC T3-T6 (Only approved for use with FUS060 non Ex version installed in safe zone)

⚠ WARNING

Approval scope

Make sure the hazardous area approval is suitable for the environment in which the device will be installed.

Temperature specifications for use in hazardous area

Table 2- 1 Hazardous area temperature specifications for SONO 3100 Ex i approved versions (with transducers type SONO 3200 Ex i)

Temperature class	Max. surface temperature	Process media temperature	Ambient temperature
T3	+200°C	-10 ... 200°C	-20 ... +60°C
T4	+135°C	-10 ... 135°C	-20 ... +60°C
T5	+100°C	-10 ... 100°C	-20 ... +60°C
T6	+85°C	-10 ... 85°C	-20 ... +60°C

Table 2- 2 Hazardous area temperature specifications for SONO 3100 Ex d approved versions (with transducers type SONO 3200 Ex d)

Temperature class	Max. surface temperature	Process media temperature	Ambient temperature
T3	+200°C	-20 ... 200°C	-20 ... +180°C
T4	+135°C	-20 ... 135°C	-20 ... +125°C
T5	+100°C	-20 ... 100°C	-20 ... +90°C
T6	+85°C	-20 ... 85°C	-20 ... +75°C

⚠ WARNING

Process media temperature specifications

Make sure that process media temperature specifications indicated on the device nameplate / label will not be exceeded.

⚠ WARNING

Hazardous area safety requirements

It is required that:

- Electrical connections are in accordance with EN60079-14 (Installing Electrical Systems in Explosion Hazardous Areas).
- Appropriate cable connectors are used for the output circuits:
  - Intrinsically safe: blue and / or metal (nickle-plated brass)
  - Non-intrinsically safe: gray or black
- Protective earth terminals (PE) on both sensor and transmitter are connected (min. 4 mm^2).

2.3 Certificates

Certificates are posted on the Internet and on the documentation CD-ROM shipped with the device.

See also

Certificates (http://www.siemens.com/processinstrumentation/certificates)

Description

3

SITRANS F US ultrasonic flowmeters measure flow in standard volumetric units. Measurement is independent of changes in liquid temperature, density, pressure and conductivity. A time of flight flowmeter is designed for use on single phase liquids.

They are designed for measurement of:

- Volume flow rate
- Limit monitoring
- Total volume
- Sound velocity in the media

3.1 System components

Table 3- 1 System components, SONO 3100 with FUS060

Sensor	Transmitter	Outputs	Measurement
SONO 3100 DN 100 - DN 1200 (40" - 480")	FUS060	FUS060 with HART: • Analog with HART • Frequency / pulse • Relay FUS060 with Profibus PA: • Profibus PA • Frequency / pulse	• Volume flowrate • Total volume • Mass flowrate • Total mass • Sound velocity • Error indication • Limit monitoring • Ultrasonic amplitude

3.2 Design

SITRANS F US SONO 3100 with FUS060 is designed for measuring the flow velocity of liquids in full pipes. Satisfactory function of the ultrasonic flowmeter depends on a low sound attenuation of the process media and a well-defined and stable flow profile.

The sensor SONO 3100 with transmitter FUS060 remote mounted measures with a high accuracy (better than ±0.5% of reading over a wide measuring range).

The sensor is equipped with four transducers of the type SONO 3200, SONO 3200 Ex i, or SONO 3200 Ex d.



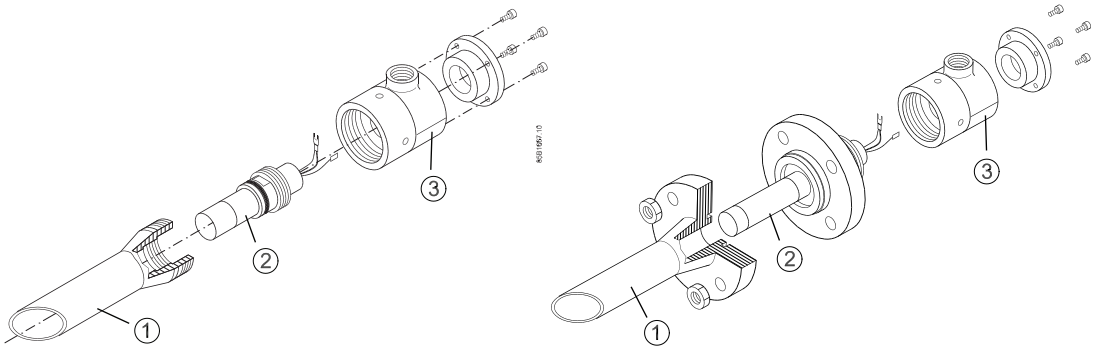
Figure 3-1 SITRANS F US SONO 3100 sensor

Transducer SONO 3200

All three SONO 3200 (standard non-Ex or Ex i, or Ex d) transducer types are available in two variants:

- Flange type:
  The transducer has a DIN flange with a groove for fitting to a corresponding flange welded onto the pipe.
- O-ring type:
  The transducer has a screwed union connection for fitting in a counterflange welded onto the pipe. The union and pipe are sealed with an O-ring.

Transducers are constructed in three parts:



① Transducer holder

② Transducer element (standard non-Ex, Ex i, or Ex d version)

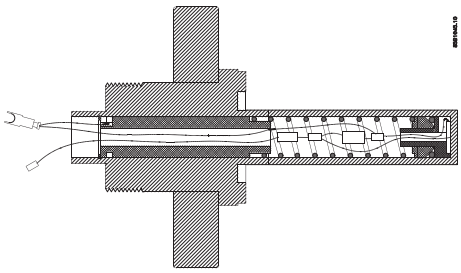
③ Terminal housing (standard non-Ex, Ex i, or Ex d version)

SONO 3200 exploded views

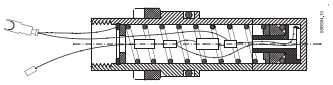
Further information on SONO 3200 Ex d

For safety notes related to the installation and assembly of SONO 3200 Ex d, see Safety note for installation in hazardous area (Page 41).

Transducer element



Flange type



O-ring type

The terminal box, transducer element and insert are identical in both versions.

The insert, consisting of a spring and piezoelectric crystal, can be removed from the transducer element during operation. No draining is necessary as the transducer element remains in the pipe. When exchanging the transducer insert everything must be kept extremely clean to avoid dirt between piezo and window.

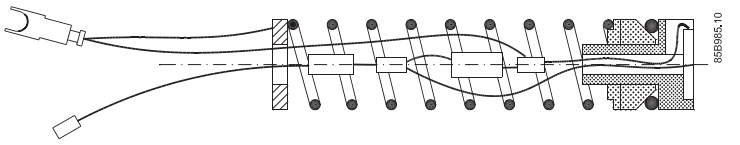


Figure 3-2 Transducer element insert

3.3 Theory of operation

Physical principle

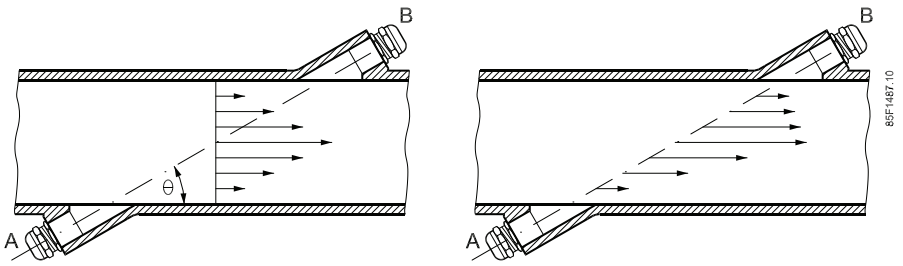


Figure 3-3 Velocity distribution along sound path

A sound wave travelling in the same direction as the liquid flow arrives at point B from point A in a shorter time than the sound wave travelling against the direction of flow (from point B to A).

The difference in sound transit time indicates the flow velocity in the pipe.

Since delay time is measured at short intervals both in and against flow direction, temperature has no influence on measurement accuracy.

SITRANS F US flowmeters

In SITRANS F US flowmeters the ultrasonic transducers are placed at an angle θ in relation to the pipe axis. The transducers function as transmitters and receivers of the ultrasonic signals. Measurement is performed by determining the time the ultrasonic signal takes to travel with and against the flow. The principle can be expressed as follows:

$v = K \times (t_{B,A} - t_{A,B}) / (t_{A,B} \times t_{B,A}) = K \times \Delta t/t^2$

v = Average flow velocity

t = Transit time

K = Proportional flow factor

This measuring principle offers the advantage that it is independent of variations in the actual sound velocity of the liquid, i.e. independent of the temperature.

The Proportional factor K is determined by wet calibration or calculated by "Auto" in case of manual programming of mechanical geometrical pipe data (SONOKIT only). The transducer angle (Θ), distance between sensors (L) and pipe dimension (Di) are shown in the figure below.

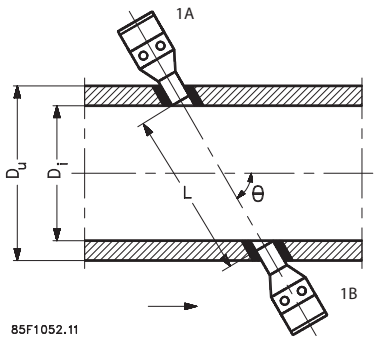


Figure 3-4 Measuring principle

The ultrasonic signal is sent directly between the transducers. The advantage gained sending signals from point to point is an extremely good signal strength.

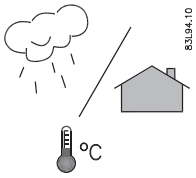
Installing/Mounting

4

The installation of the sensor has 3 steps:

1. Determining a location (Page 16)
2. Orienting the sensor (Page 18)
3. Mounting the sensor (Page 20)

Ambient conditions



SITRANS F flowmeters with minimum IP67 / NEMA 4X/6 enclosure rating are suitable for indoor and outdoor installations.

NOTICE
Make sure that pressure and temperature specifications indicated on the device nameplate / label will not be exceeded.

Note

In case of large temperature differences between medium and environment, the sensor must be isolated to avoid 2-phase flow which will result in inaccurate measuring results

⚠ WARNING
Installation in hazardous location Special requirements apply to the location and interconnection of sensor and transmitter. See "Installation in hazardous area" (Page 8)

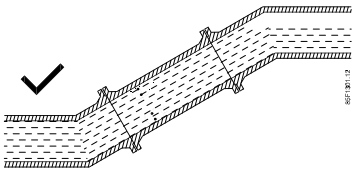
4.1 Installation safety precautions

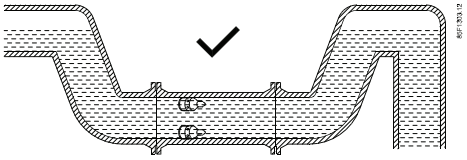
⚠ WARNING
High pressure hazard In applications with working pressures/media that can be dangerous to people, surroundings, equipment or others in case of pipe fracture, we recommend that special precautions such as special placement, shielding or installation of a pressure guard or a safety valve are taken when the sensor is mounted.

4.2 Determining a location

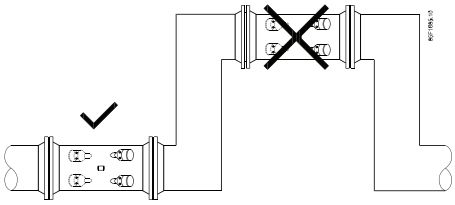
NOTICE
The sensor must always be completely filled with liquid.

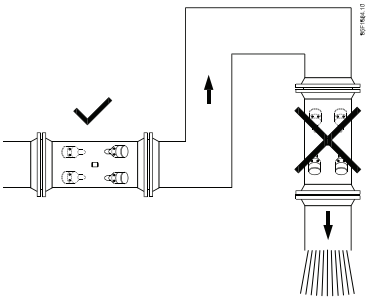
- Locate the flowmeter in U-shaped pipes if pipes are only partially filled or have free outlet.





- Avoid the following installations:
  - Installation at the highest point of the pipe system
  - Installation in vertical pipes with free outlet





Inlet / outlet conditions

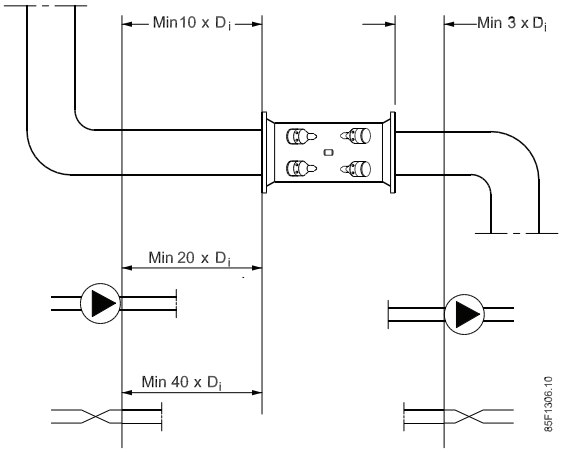


Figure 4-1 Inlet / outlet conditions

- Ensure that inlet and outlet are straight
- Ensure sufficient distance between meter and bends, pump and valves (see the table below).
- Install valves influencing the flow profile after the flowmeter. The only exception is installation of the sensor in a vertical pipe (upwards flow direction). In installations in a vertical pipe a valve below the sensor is required to allow zero-point adjustment

Note

Select a valve not altering flow when fully opened.

Table 4- 1 Recommended inlet / outlet conditions

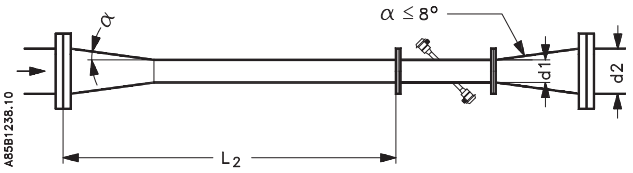
Conditions	Recommended inlet / outlet
90° bend	Min. 10 x D_i
Fully opened valve	Min. 10 x D_i
Partially opened valve	Min. 40 x D_i
2 x 90° bends in same plane	Min. 15 x D_i
2 x 90° bends in two planes	Min. 20 x D_i
Outlet	3 x D_i

Note

By more than one bend, the optimal inlet is min. 40 × pipe diameter.

Installation with pipe reducers

The flowmeter can be installed between two reducers.



L_2 10 x D_i

Figure 4-2 Installation in large pipes

At 8° the following pressure drop curves apply. The curves are applicable to water.

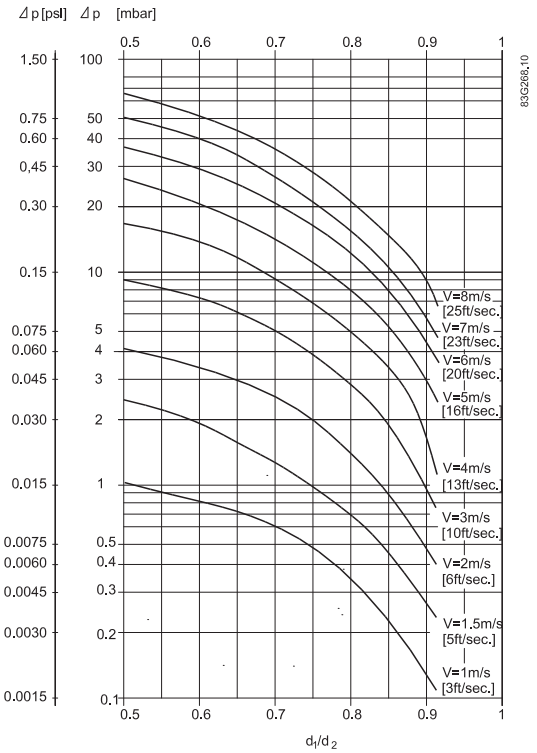


Figure 4-3 Pressure loss by use of pipe reducers

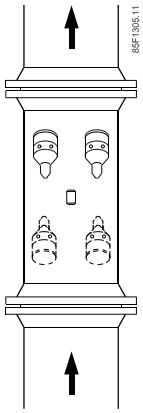
4.3 Orienting the sensorFlow direction

The flow direction is indicated with the "+" on the double arrow on the sensor.

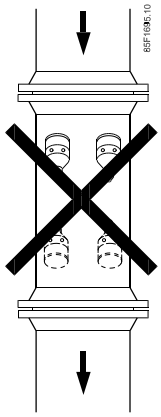
Orienting the sensor

SITRANS F US SONO 3100 operates in any orientation, but Siemens Flow Instruments recommends orienting the sensor as follows:

1. Vertical orientation with an upwards flow in order to minimize the effect of gas / air bubbles in the media

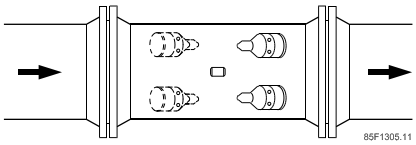


Vertical installation, upwards flow

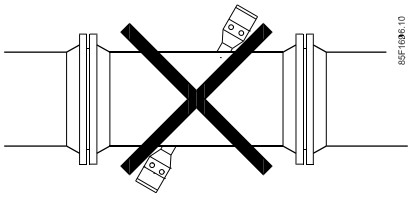


Vertical installation, downwards flow

1. Horizontal orientation with transducers installed horizontally



Horizontal installation, transducers oriented horizontally



Horizontal installation, transducers oriented vertically

CAUTION

Measurement of liquids containing abrasive or other particles

In order to minimize wear, install the flowmeter vertically with an upwards flow.

4.4 Mounting the sensor

- Install the sensor in rigid pipelines in order to support the weight of the meter.
- Centre the connecting pipelines axially in order to assure a stress-free installation.
- Centre the flowmeter in relation to pipe flanges and gaskets.
- Install two supports or hangers symmetrically and stress-free in close proximity to the process connections.

⚠ CAUTION
Gas / air bubbles in the liquid Avoid the accumulation of large quantities of air in the sensor as these will affect measurement. When air is present, installation of an air separator upstream of the meter is recommended.

Electrical connection

5

The following contains a short description of how to connect the sensor for operation with the transmitter SITRANS FUS060. For more information, refer to the relevant Operating Instructions of the transmitter.

⚠ WARNING

Only qualified personnel may carry out work on the electrical connections.

⚠ WARNING

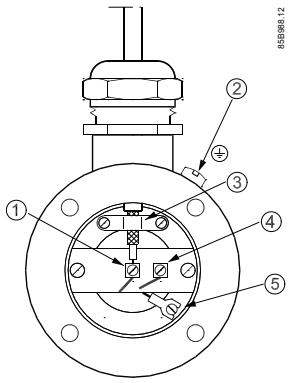
Use in hazardous areas

Before opening the terminal box check that:

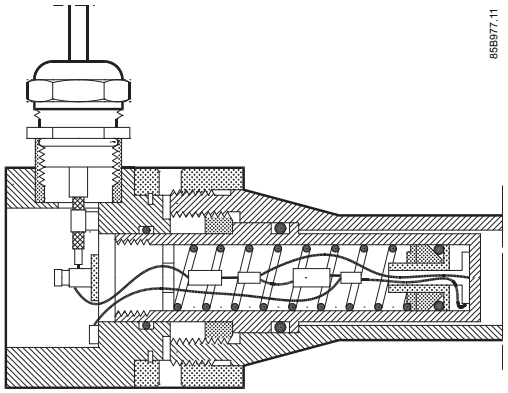
- No explosion hazard exists
- A fire department permission certificate has been issued
- All connection leads are potential free

Special requirements apply to the location and interconnection of sensor and transmitter.
See "Installation in hazardous area" (Page 8)

5.1 Step 1: Transducer wiring



Electrical connection of transducer



Transducer cut-away

1. Remove the lid of the terminal housing.
2. Connect the wire without a spade terminal to ④.
3. Connect the wire with a spade terminal to ⑤ (the transducer housing).
4. Connect the wire of the transducer coax cable to ①.
5. Fix the shield of the coax cable with ③ (the cable clip).
6. Remount the lid.
7. For stainless steel terminal housing connect the PE terminal ②. On the polyamide terminal housing there is no PE terminal. It is recommended to ensure a suitable grounding of the sensor. A direct ground connection of sensor and transmitter is recommended.

⚠ WARNING

Potential equalization

Ex version: According to the Ex requirements, the PE terminals on FUS060 and on sensors (PE terminals of the SONO 3200 Ex d/i transducer terminal housings) must be potentially equalized (min. 4 mm^2). A direct ground connection of sensor and transmitter is recommended.

⚠ CAUTION

Protect connection wires

Avoid stress on the connection wires when passing them through the terminal box.

Disassembling the terminal box

- Loosen the wires from the connection board. It is not necessary to remove the transducer cable.
- Support the terminal box while loosening the union. Then remove the terminal box from the transducer holder.

⚠ CAUTION

Unsuitable turning of terminal box

Risk of device malfunction due to damaged wires inside the terminal box

- Do not turn the terminal box

5.2 Step 2: Wiring transducer and transmitter

Wire transducer cables and transmitter as follows:

1. Connect the 4 transducer cables at the FUS060 transmitter as shown below (terminal plug 1B, 1A, 2B and 2A):
   Push the SMB-plug cable ends carefully through the cable glands, plug them in and fix them by using the glands.

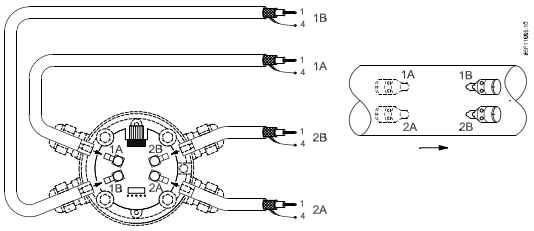


Figure 5-1 Electrical connection of SONO 3100 and FUS060

2. Ensure that transducer cables are not overbent. Minimum cable bend radius is 50 mm

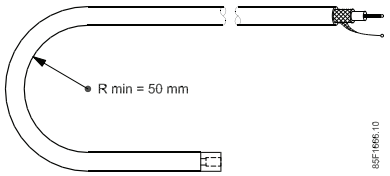
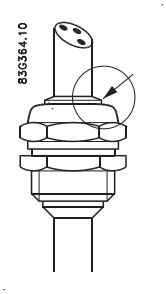
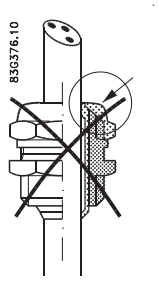


Figure 5-2 Minimum cable bend radius

3. Tighten the cable glands to obtain optimum sealing. The gaskets must protrude along the cable



Cable sealing, correct



Cable sealing, incorrect

1. Ground transmitter and sensor for optimal performance.

⚠ CAUTION
Grounding A direct ground connection of transmitter and sensor is recommended.

⚠ WARNING
Use in hazardous area Connect protective earth terminals (PE) on both sensor and transmitter (min. 4mm^2)

Maintenance and repair

6

6.1 Maintenance

The device is maintenance-free, however, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

6.2 Recalibration

Siemens Flow Instruments offers to recalibrate the system. The following calibrations are offered as standard:

- Standard matched pair calibration
- Accredited matched pair calibration

Note

For recalibration the transmitter must always be returned with the sensor

6.3 Unit repair

NOTICE
Repair and service must be carried out by Siemens authorized personnel only.

Note

Siemens defines flow sensors as non-repairable products.

WARNING

Impermissible repair of explosion protected devices

Danger of explosion in areas subject to explosion hazard.

- Repair must be carried out by Siemens authorized personnel only.

6.4 Technical support

If you have any technical questions about the device described in these Operating Instructions and do not find the right answers, you can contact Customer Support:

- Via the Internet using the **Support Request:**
  Support request (http://www.siemens.com/automation/support-request)
- Via Phone:
  - Europe: +49 (0)911 895 7222
  - America: +1 423 262 5710
  - Asia-Pacific: +86 10 6475 7575

Further information about our technical support is available on the Internet at Technical support (http://support.automation.siemens.com/WW/view/en/16604318)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

Service and support (http://www.siemens.com/automation/service&support)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter, providing you with the latest information about your products.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- You can find your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have additional questions about the device

Find your contact partner at:

Local contact person (http://www.automation.siemens.com/partner)

6.5 Application-specific data

In case the device needs service, the factory will typically request information about application and flowmeter.

The following tables can be used as a preparation guide before taking contact to Siemens.

Note

Sketch

It is recommended to prepare a sketch of the installation / application.

Table 6- 1 Application data

Liquid	Chemical formula
	Name of liquid
	Concentration
	Density
	Viscosity at 20°C [cSt]
	Viscosity at process temperature [cSt]
Measurement range	
Nominal size [mm]	
Process temperature [°C]	
Ambient temperature (transmitter) [°C]	
Pressure [PN]	
Gas/solid content [%]	
Explosion protection	

Table 6- 2 Sensor data

Serial-No. (See system label)	
Order.No. (See system label)	
Flow (Menu 1.2)	
Sound velocity [600 [m/s] ≤ Medium ≤ 2000 [m/s]] (Menu 1.5)	
Ultrasonic amplitude [%](Menu 1.6)	
Frequency output [Hz] (Menu 1.7)	
Device status, error message, frequency, ... (Menu 2.1)	
Upper range value for flow (Menu 3.1.2)	
Low flow cut-off [%] (Menu 3.1.6)	
Software version (Menu 5.2.3)	
Gain (Menu 6.5.1)	
Amplitude (Menu 6.5.2)	
Trigger level [0....128] (Menu 6.5.3)	
Error count [0....100%] (Menu 6.5.4)	
Time of flight up [ns] (Menu 6.5.5)	
Time of flight down [ns] (Menu 6.5.6)	
Delta TOF (Menu 6.5.7)	

6.6 Return procedures

Enclose the delivery note, the cover note for return delivery and the declaration of decontamination form on the outside of the package in a well-fastened clear document pouch.

Required forms

- **Delivery Note**
- **Cover Note for Return Delivery** with the following information

  Cover note (http://support.automation.siemens.com/WW/view/en/16604370)

  – product (ordering number)

  – number of devices or spare parts returned

  – reason for the return
- **Declaration of Decontamination**

  Declaration of Decontamination (http://pia.khe.siemens.com/efiles/feldg/files/Service/declaration_of_decontamination_en.pdf)

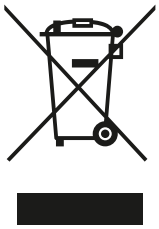
  With this declaration you certify *that the returned products/spare parts have been carefully cleaned and are free from any residues.*

  If the device has been operated together with toxic, caustic, flammable or water-damaging products, clean the device before return by rinsing or neutralizing. Ensure that all cavities are free from dangerous substances. Then, double-check the device to ensure the cleaning is completed.

  We shall not service a device or spare part unless the declaration of decontamination confirms proper decontamination of the device or spare part. Shipments without a declaration of decontamination shall be cleaned professionally at your expense before further proceeding.

You can find the forms on the Internet and on the CD delivered with the device.

6.7 Disposal



Devices identified by this symbol may not be disposed of in the municipal waste disposal services under observance of the Directive 2002/96/EC on waste electronic and electrical equipment (WEEE).

They can be returned to the supplier within the EC or to a locally approved disposal service. Observe the specific regulations valid in your country.

Technical data

7

Technical data SONO 3100	
Description	2-track sensor with four SONO 3200 transducers
Designated use	Measurement of process media: • Fluid group 1 (dangerous) • Aggregate state: Liquid
Measurement accuracy at reference conditions	v > 0.5 ... 10 m/s, < ±0.5 % of flowrate (v = flow velocity)
Max. flow velocity	10 m/s (32 ft/s)
Nominal size	DN 100 ... 1200 (4" ... 48")
Process media / Device surface temperature	• Stainless steel: −20 ... +200 °C (-4 ... +392 °F) • PA: -20 ... +100 °C (-4 ... +212 °F) • ATEX Ex d version: −20 ... +190 °C (-4 ... +374 °F) • ATEX Ex i version: −10 ... +190 °C (14 ... 374 °F) • Specials: −200 (-328 °F) or up to 250 °C (482 °F)
Ambient temperature (sensor)	• Stainless steel: −20 ... +200 °C (-4 ... +392 °F) • PA: -20 ... +100 °C (-4 ... +212 °F) • ATEX Ex d version: −20 ... +180 °C (-4 ... +356 °F) • ATEX Ex i version: −20 ... +60 °C (-4 ... +140 °F) • Storage: − 40 ... +85 °C (-40 ... +185 °F)
Degree of protection	• IP67 (NEMA 4X / 6)
Transducer SONO 3200	O-rings or flanges

Table 7- 1 Process connections

Designation	Pipe material	
PN designated EN 1092-1	Carbon steel	• PN 10: DN 200 ... DN 1200 (8" ... 48") • PN 16: DN 100 ... DN 1200 (4" ... 48") • PN 25: DN 200 ... 1000 (8" ... 40") • PN 40: DN 100 ... DN 500 (4" ... 20")
	Stainless steel	• PN 10 and PN 25: DN 200 ... DN 300 (8" ... 12") • PN 16 and PN 40: DN 100 ... DN 300 (4" ... 12")
Class designated EN 1759-1	Carbon steel	• ANSI Class 150: DN 100 ... DN 600 (4" ... 24") • ANSI Class 300: DN 100 ... DN 300 (4" ... 12")
	Stainless steel	• ANSI Class 150 and 300: DN 100 ... DN 300 (4" ... 12")
Without flanges (weld-in version)	Carbon steel	• PN 16: DN 100 ... DN 1200 (4" ... 48") • PN 25: DN 200 ... 1000 (8" ... 40") • PN 40: DN 100 ... DN 500 (4" ... 20")

Materials	
Pipe	• Carbon steel EN 1.0345, painted • Stainless steel EN 1.4404 (AISI 316)
Flange (PN)	• Carbon steel EN 1.0038 • Stainless steel EN 1.4404 (AISI 316)
Flange (Class)	• ASTM A105 • ASTM F316L
Transducer body	• Stainless steel: EN 1.4404 (AISI 316) or similar
Transducer terminal house	• Stainless steel: EN 1.4404 (AISI 316) • Polyamide: PA 6.6

Certificates and approvals	
Declaration of conformity	CE declaration available on the internet and on the Sitrans F US / F X literature CD (supplied with the device).
Material certificate	Material certificate according to EN 10204-3.1 is available as option.
NDT examination report	Non Destructive Test (e.g. ultrasonic or penetrant test) available as option.
Pressure certificate	Pressure test according to EN 1024-2.3 is available as option.
Calibration report	• A standard calibration report is supplied with the sensor. • An extended accredited ISO/IEC 17025 calibration is available as option.
Approvals for use in hazardous area	• Transmitter (FUS060): II 2G Ex dem [ia/ib] IIC T6/T4/T3 (Only approved for use with SONO 3100 Ex i) • Sensor (SONO 3100 Ex i approved version): II 2G Ex ib IIC T6/T4/T3 (Only approved for use with FUS060 Ex version) • Sensor (SONO 3100 Ex d approved version): II 2G Ex d IIC T3-T6 (Only approved for use with FUS060 non Ex version installed in safe zone)

7.1 Coaxial cable specifications

Technical data, Standard coaxial cable	
Standard Coaxial cable (75 Ω)	Coaxial cable with SMB straight plug on one end for the FUS060 connector
Outside diameter	Ø 5.8 mm (0.29")
Length	3, 15, 30, 60, 90, 120 m (9.84, 49.21, 98.43, 196.85, 295.28, 393.70 ft) between sensor and transmitter.
Material (outside jacket)	Black PE
Ambient temperature	-10 ... +70 °C (14 ... 158 °F)

Technical data, Standard coaxial cable	
High temperature Coaxial cable (75 Ω)	Coaxial cable with SMB straight plug on one end for the FUS060 connector
Outside diameter	• Ø 5.13 mm (0.2") (first 0.3 m (0.98 ft) of cable) • Ø 5.8 mm (0.29") (remaining cable) - with plug hot melt junction on the end) Between the two parts a mounted black hot melt junction Ø 16 mm (length 70 mm)
Length	3, 15, 30 m (9.84, 49.21, 98.43 ft) between sensor and transmitter
Material (outside jacket)	• Brown PTFE (first 0.3 m (0.98 ft) of cable) • Black PE (remaining cable)
Ambient temperature	• -200 ... +200 °C (-328 ... +392 °F) (first 0.3 m (0.98 ft)) • -10 ... +70 °C (14 ... 158 °F) (remaining cable)

7.2 Pressure and temperature rating

The maximum permissible pressure and temperature for Siemens Flow Instruments ultrasonic flowmeters are indicated on the sensor label.

Note

The pressure / temperature curves shown below only assist in the selection of a system. No responsibility is taken for the correctness of the information. For exact data, refer to the PED requirements.

Flanges according to EN 1092

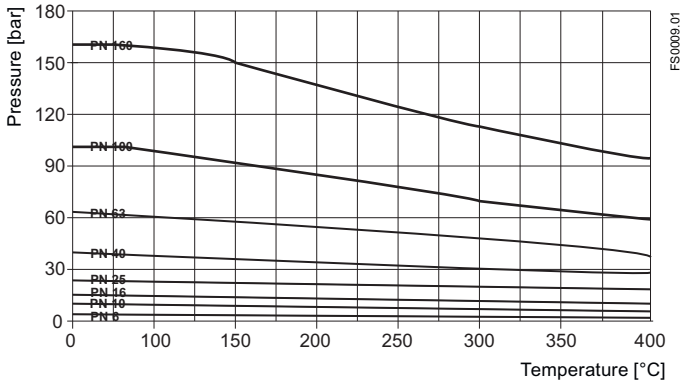


Figure 7-1 Pressure/temperature curve for carbon steel flanges according to EN 1092

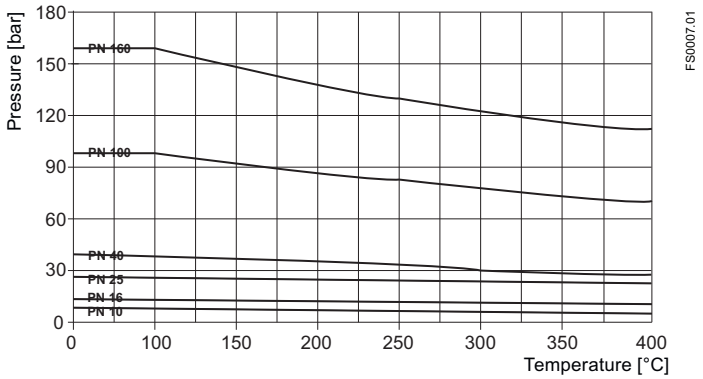


Figure 7-2 Pressure/temperature curve for stainless steel flanges according to EN 1092

Flanges and joints as well as related pressure / temperature (p/t) classification are described in EN 1092.

- For carbon steel group 1E1 (A105): Table 15
- For stainless steel material group 13E0 (A240 Gr.316L): Table 17

No flange bolts or gaskets are supplied for EN flange version. Bolts shall comply with EN 1515-2 and gaskets with EN 1591-1.

Flanges according to ANSI Class

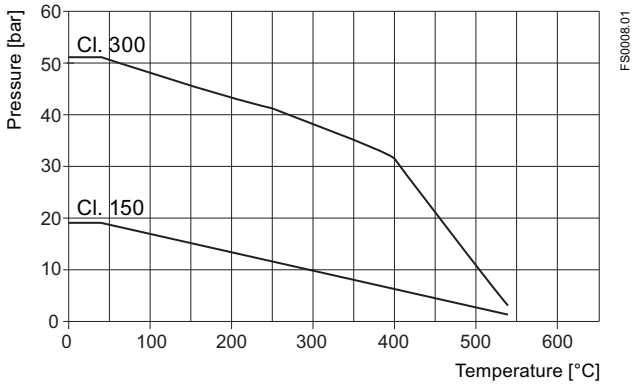


Figure 7-3 Pressure/temperature curve for carbon steel flanges according to ANSI B16.5

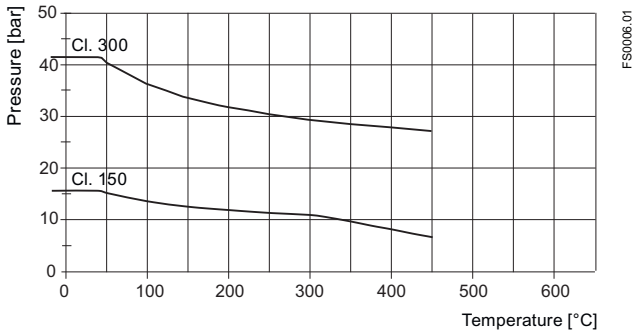


Figure 7-4 Pressure/temperature curve for stainless steel flanges according to ANSI B16.5

Flanges and joints as well as related pressure / temperature (p/t) classification are described in EN 1759-1.

- For carbon steel group 1.1 ASTM A105, class 150: Table 16
- For carbon steel group 1.1 ASTM A105, class 300: Table 17

No flange bolts or gaskets are supplied for ANSI flanges versions.

⚠ WARNING

Exposing the sensors to pressures or temperatures above the limits stated may cause damage.

The sensor construction does not allow external action other than what is normal during common mounting in the pipeline. Make allowance for earthquakes, action of the air etc.

7.3 Reference conditions

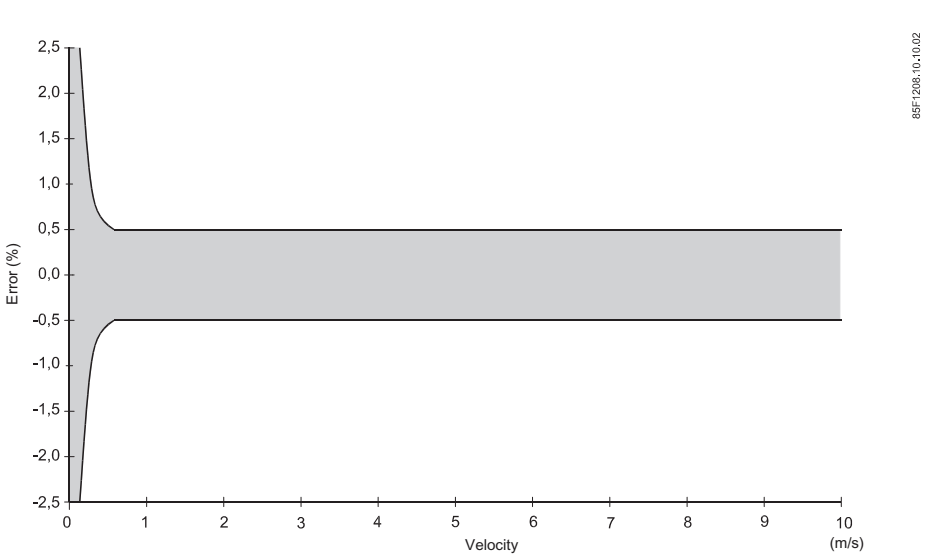


Figure 7-5 System accuracy

Standard calibration better than:
v ≥ 0.5 m/s (1.6 ft/s) → E: 0.5 % of measured value
v > 0.5 m/s (1.6 ft/s) → E: (0.25/v) % of measured value

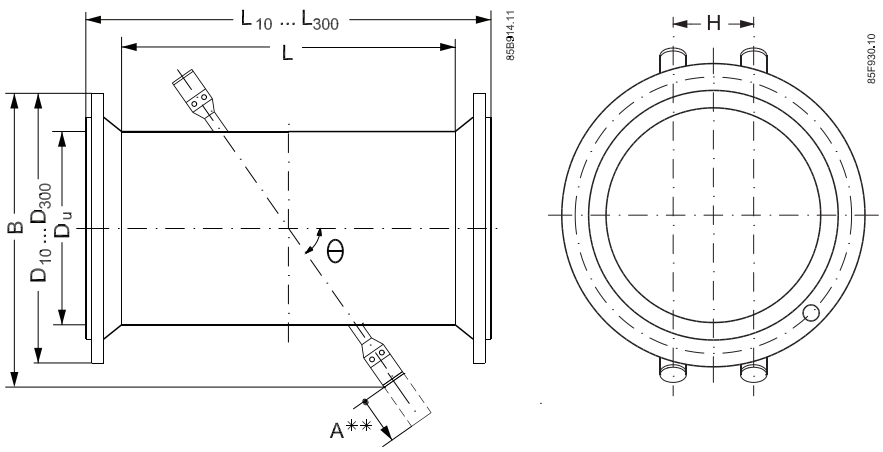
Table 7- 2 Reference conditions

Parameter	Condition
Fluid	Water
Fluid temperature	22 °C ± 5 °K (71.6 °F ± 9 °F)
Ambient temperature	22 °C ± 5 °K (71.6 °F ± 9 °F)
Supply voltage (FUS060)	• 115/230 V AC +10 % ... -15 % • 24 V DC +25 % ... -15 % • 24 V AC 15 %
Straight inlet length	30 x D_i
Outlet	3 x D_i
Rangeability	0-1 m/s to 0-10 m/s
Repeatabilty	Better than 0.25 % in the range from 0.5 m/s to 10 m/s
Linearity (for water) • 1000 < Re < 5000 • Re > 5000	 Better than 1 % Better than 0.5 %

Table 7- 3 Additional effects of deviations from reference conditions

Parameter	Effect
Current output	As pulse/frequency output plus ± 0.1% ± 20 µ A
Ambient temperature	
• Frequency/pulse output	< 0.005 % SPAN/K
• Current output	< 0.0075 % SPAN/K
Supply voltage	0.005% of measuring value at 1% change

7.4 Dimensions and weight



A**) Space required for replacement of transducer min. 230 mm (9,1 inch).

Table 7- 4 SONO 3100 with EN norm

PN	DN	Du (mm)	L (mm)	B (mm)	θ [°]	H (mm)	W[2)] (mm)	$D_{10...300}$ (mm)	$L_{10...300}$[1)] (mm)	Weight** (kg)
10	200	219.1	668	430	45*	102.1	6.3	340	790	59
	250	273.0	714	480	45*	127.6	6.3	395	850	73
	300	323.9	607	525	45*	151.8	7.1	445	740	83
	350	355.6	639	550	45*	166.4	8.0	405	770	98
	400	406.4	703	600	45*	191.3	8.0	565	850	119
	500	508.0	797	690	45*	241.1	7.1	670	950	153
	600	610.0	912	705	60	294.8	7.1	780	1075	193
	700	711.0	937	895	60	340.6	8.0	895	1100	262
	800	813.0	967	985	60	390.4	8.0	1015	1150	329
	900	914.0	1007	1070	60	445.9	10.0	1115	1200	428
	1000	1016.0	1060	1160	60	490.0	10.0	1230	1250	500

PN	DN	Du (mm)	L (mm)	B (mm)	θ [°]	H (mm)	W[2] (mm)	$D_{10...300}$ (mm)	$L_{10...300}$[1] (mm)	Weight** (kg)
	1200	1220.0	1100	1350	60	588.0	8.0	1340	1280	680
16	100	114.3	860	305	45*	42.8	3.6	220	960	32
	125	139.7	862	325	45*	64.5	4.0	250	970	38
	150	168.3	862	350	45*	78.1	4.5	285	970	45
	200	219.1	668	430	45*	102.1	6.3	340	790	58
	250	273.0	714	480	45*	127.6	6.3	405	850	75
	300	323.9	607	525	45*	151.8	7.1	460	760	92
	350	355.6	639	550	45*	166.4	8.0	520	800	113
	400	406.4	703	600	45*	191.3	8.0	580	875	141
	500	508.0	797	690	45*	241.1	8.0	715	980	207
	600	610.0	912	705	60	294.8	8.8	840	1105	276
	700	711.0	937	895	60	340.6	8.8	910	1140	303
	800	813.0	967	985	60	390.4	10.0	1025	1180	400
	900	914.0	1007	1070	60	445.9	10.0	1125	1230	475
	1000	1016.0	1060	1160	60	490.0	10.0	1255	1300	594
	1200	1220.0	1100	1350	60	588.0	11.0	1455	1360	860
25	200	219.1	668	430	45*	102.1	6.3	360	820	70
	250	273.0	714	480	45*	127.6	7.1	425	890	96
	300	323.9	607	525	45*	151.8	8.0	485	790	114
	350	355.6	639	550	45*	166.4	8.0	555	840	145
	400	406.4	703	600	45*	191.3	8.8	620	925	191
	500	508.0	797	690	45*	241.1	10.0	730	1050	284
	600	610.0	912	705	60	294.8	11.0	845	1165	363
	700	711.0	937	895	60	340.6	12.5	960	1190	480
	800	813.0	967	985	60	390.4	14.2	1085	1240	650
	900	914.0	1007	1070	60	445.9	16.0	1185	1300	835
	1000	1016.0	1060	1160	60	490.0	17.5	1320	1370	1078
40	100	114.3	860	305	45*	42.8	3.6	235	990	35
	125	139.7	862	325	45*	64.5	4.0	270	990	44
	150	168.3	862	350	45*	78.1	4.5	300	1010	52
	200	219.1	668	430	45*	102.1	6.3	375	840	79
	250	273.0	714	480	45*	127.6	7.1	450	920	117
	300	323.9	607	525	45*	151.8	8.0	515	830	151
	350	355.6	639	550	45*	166.4	8.8	580	880	191
	400	406.4	703	600	45*	191.3	11.1	660	975	275
	500	508.0	797	690	45*	241.1	14.2	755	1080	379

1) Length tolerance (mm): DN 100: +2/-3, DN 125 to DN 200: +3/-4, DN 250 to DN 400: +4/-5, DN 500 to DN 1200: +5/-6.

2) W = Min. wall thickness for pressure rates PN10 to PN40.

* For all sensors with flange transducers the track angle is 60°.

**Weight of system incl. process flanges and standard o-ring transducers. For sensors with flange transducers, add appr. 10 kg (22 lbs). For stainless steel terminal housings instead of the standard PA housing add appr. 5 kg (11 lbs).

Table 7- 5 SONO 3100 with ANSI norm

Class	DN (inch)	Du (inch)	L (inch)	B (mm)	θ [˚]	H (inch)	W[2)] (mm)	$D_{10...300}$ (mm)	$L_{10...300}$[1)] (mm)	Weight** (lbs)
150	4	4.5	33.86	12.01	45*	1.69	0.14	9.00	39.86	70.5
	5	5.5	33.94	12.80	45*	2.54	0.15	10.00	40.94	83.8
	6	6.63	33.94	13.78	45*	3.07	0.16	11.00	40.94	99.2
	8	8.63	26.30	16.93	45*	4.02	0.16	13.50	34.30	127.9
	10	10.75	28.11	18.90	45*	5.02	0.18	16.00	36.11	165.3
	12	12.75	23.90	20.67	45*	5.98	0.20	19.00	32.90	202.8
	14	14.00	25.16	21.65	45*	6.55	0.21	21.00	35.16	249.1
	16	16.00	27.68	23.62	45*	7.53	0.22	23.50	33.74	310.9
	20	20.00	31.38	27.17	45*	9.49	0.26	27.50	42.76	456.4
	24	24.00	35.91	27.76	60	11.61	0.30	32.00	47.91	608.5
300	4	4.5	33.86	12.01	45*	1.69	0.25	10.00	40.62	77.2
	5	5.5	33.94	12.80	45*	2.54	0.27	11.00	41.70	97.0
	6	6.63	33.94	13.78	45*	3.07	0.30	12.50	41.70	114.6
	8	8.63	26.30	16.93	45*	4.02	0.29	15.00	35.06	174.2
	10	10.75	28.11	18.90	45*	5.02	0.34	17.50	37.35	257.9
	12	12.75	23.90	20.67	45*	5.98	0.39	20.50	34.14	332.9

1) Length tolerance: 4" (DN 100): +0,08"/-0,12" (+2/-3 mm), 5"to 8" (DN 125 ... DN 200): +0,12"/-0,16" (+3/-4 mm) , 10" to 16"(DN 250 ...DN 400) +0,16"/-0,20" (+4/-5 mm), 20" to 24" (DN 500 ... DN 600) +0,20"/-0,24" (+5/-6 mm)

2) Minimum wall thickness for pressure rates CL 150 or CL 300.

* For all sensors with flange transducers track angle are 60º

**Weight of system incl. process flanges and standard o-ring transducers. For sensors with flange transducers please add appr. 10 kg (22 lbs). For SS terminal housings instead of the standard PA housing add appr. 5 kg (11 lbs).

Appendix A

A

A.1 Sizing table (DN 100 to DN 1200)

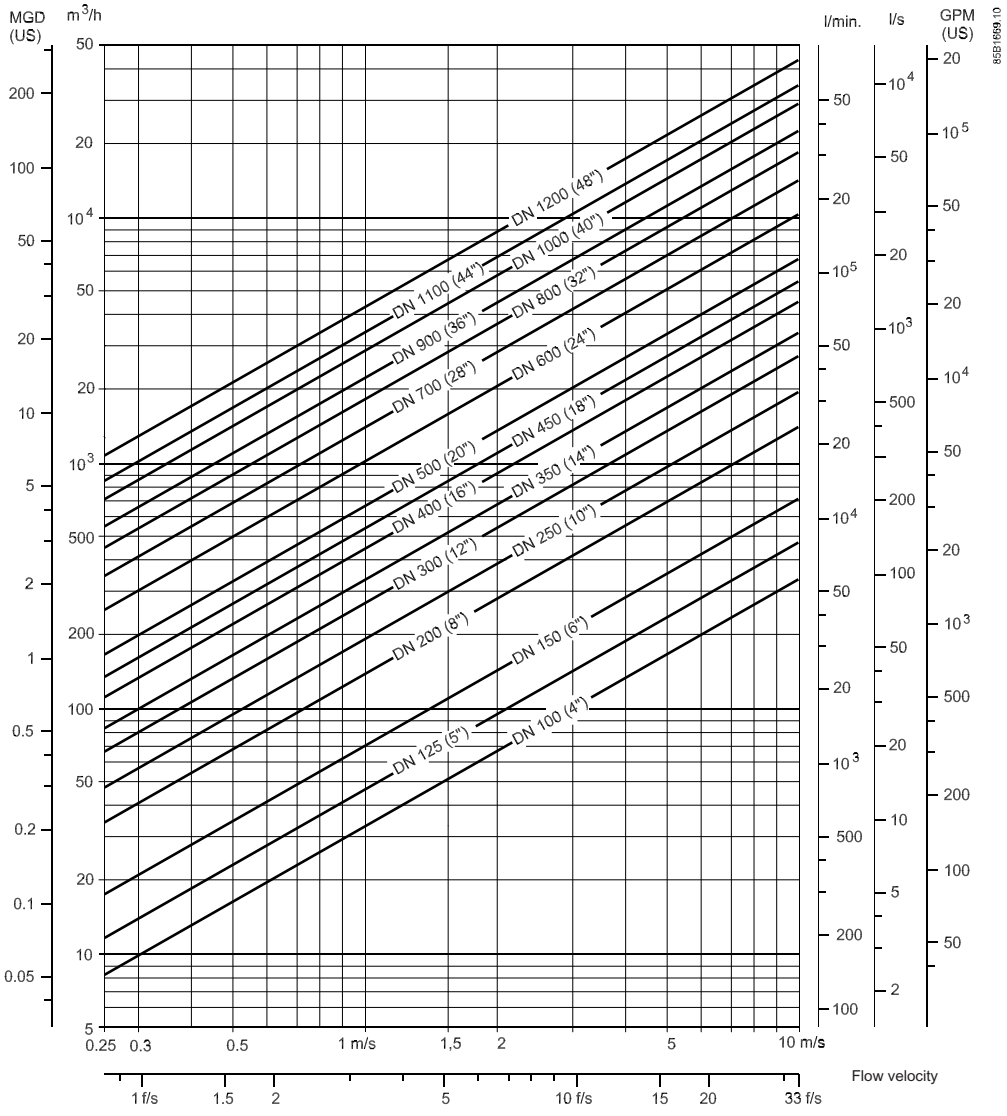


Figure A-1 Relationship between flow velocity V, flow quantity Q and sensor dimension DN.

Guidelines for sensor selection

- Min. measuring range: 0-1 m/s
- Max. measuring range: 0-10 m/s

Normally the sensor is selected so that V lies within the measuring range 1-3 m/s.

Flow velocity calculation formula

$$V = \frac{1273.24 \times Q\ [l/s]}{Di^2[mm]}\ [m/s] \text{ or } V = \frac{353.68 \times Q\ [m^3/h]}{Di^2[mm]}\ [m/s]$$

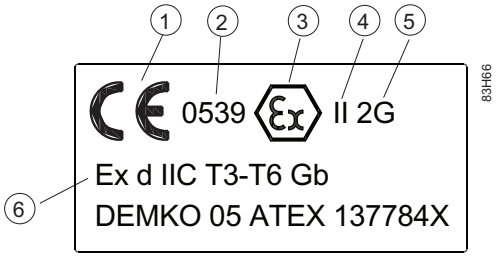
A.2 Ordering

In order to ensure that the ordering data you are using is not outdated, the latest ordering data is always available on the Internet: Process instrumentation catalog (http://www.siemens.com/processinstrumentation/catalogs)

Safety note for installation in hazardous area

B

Safety note for ultrasonic transducer type SITRANS FUS SONO 3200 Ex d: ATEX certificate DEMKO 05 ATEX 137784X



①	CE	CE mark
②	0539	Identification number of Notified Body: UL Demko, Product Quality Assurance
③	Ex	Explosive atmosphere symbol
④	II	Equiment group II (other groups than mining)
⑤	2G	Equipment category 2 Gas (for use in Zone 1 gas explosive environment)
⑥	Ex d IIC T3-T6 Gb	Ex protection type d: flameproof enclosure Gas group IIC (hydrogen, acetylene) Temperature class T3-T6 (temperature class depends on media/ambient temperature, see table below) Equipment Protection Level: Gas zone 1

ATEX harmonized standards

The device complies with ATEX harmonized standards EN 60079-0:2009 and EN 60079-1:2007.

Temperature range

The relation between ambient temperature and the assigned temperature class is as follows:

Ambient temperature range	Temperature class
-20 °C ... +75 °C	T6
-20 °C ... +90 °C	T5
-20 °C ... +125 °C	T4
-20 °C ... +180 °C	T3

Electrical data

0.5 A; 0.5 W

Installation

All cable entry devices and blanking elements must be certified according to type of explosion protection flameproof enclosure "d", suitable for the conditions of use and correctly installed.

For ambient temperatures below -10 °C and above +60 °C, use field wiring suitable for both minimum and maximum ambient temperatures.

⚠ CAUTION

Special conditions for safe use

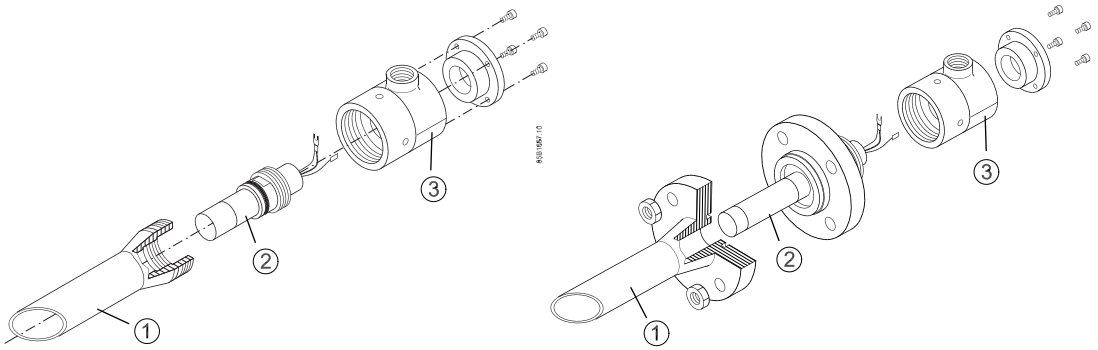
- The equipment must be installed with cables with suitable temperature ratings.

NOTICE

Installation requirement

The ultrasonic transducer type SITRANS F US SONO 3200 Ex d must be connected to the potential equalizing system.

Assembly



① Transducer holder

② Transducer element (Ex d version)

③ Terminal housing

Special care when assembling:

- Only use original screw for the lid assembly: M4x0.7 6g ST A2-70, ISO 965-1/-3, thread ISO 262 & ISO 4762 with a minimum yield stress of 450 MPa, 12 mm, full thread.
- Secure correct assembly of transducer element (2). Be aware that the flamepath stays intact.
- Secure correct assembly of terminal housing (3). Be aware that the flamepath to the transducer element and the lid stays intact.
- Only use M20 x 1.5 Ex d certified cable glands, suitable for temperature and cable diameter.

⚠ WARNING

SONO 3200 Ex d

Do not open or disassemble SONO 3200 Ex d when energized.

Index

C

Compliance, 9
Connection
  Electrical, (See Electrical connection)
Contact person, 6
Customer Support Hotline, 32

D

Decontamination, 34
Description, 13
Design, 13
Document history, 5

E

Electrical connection
  Basic requirements, 25
  Transmitter wiring, 28

F

Flow direction, 22
Flow factor, 16
Flow velocity, 16

H

Hazardous area
  Approvals, 11
  Safety requirements, 12
  Temperature specifications, 11
Hotline, 32

I

Inlet / outlet conditions, 21
Installation
  Ambient conditions, 19
  Free outlet, 20
  Horizontal pipes, 23
  Large pipes, 22
  Location, 20
  Mounting of sensor, 24
  Orientation, 23
  Safety instructions, 19
  U-shaped pipes, 20
  Vertical pipes, 23
Internet
  Contact person, 6, 32
  Flowdocumentation, 6
  Support, 32
Introduction, 5
Items supplied, 5

L

Laws and directives, 9
Liquid
  Abrasive, 23
  Containing particles, 23
  Gas / air bubbles, 24

M

Maintenance, 31
Material compatibility, 9
Measuring principle, 16

P

Pipe reducers, 22
Pressure
  Safety instructions, 19
Pressure classification, 40

R

Recalibration, 31
Reference conditions, 43
Repair, 31
Return procedures, 34

S

Safety, 9
  Instrument safety standards, 9
  Sensor installation, 19

Sensor location, 20
Sensor orientation, 23
Service, 31, 32
    Application information, 33
SONO 3200, 14
Support, 32
System accuracy, 43
System components, 13

T

Technical data
    SONO 3200, 14
    Transducer, 14
Temperature classification, 40
Temperature specifications, 11
Transit time, 16

W

Wiring, (See Electrical connection)

For more information

www.siemens.com/flow

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