

SunOpta

Omak, Washington

Waste Water System Operation and Maintenance Manual

Operation and Maintenance Manual

SunOpta

1124 5th Avenue East

Omak, Washington 98841

Bus: (509) 826-5471 Fax: (509) 826-1508

State of Washington Department of Ecology

State Waste Discharge Permit Number ST0009253

SunOpta Contacts:

Name	Title	Phone Number
Terry Llewellyn	Plant Director	(952) 243-1530
Rob Gilbertson	Maintenance Contractor	(805) 331-5578

The process of wastewater system operation and maintenance at the SunOpta facility in Omak, Washington will be handled in the following manner.

Description of System

Process wastewater is collected throughout the facility by means of a floor gutter and drain system. The drain system flows to one of two collection points; a sump and pump located in the Main Line process area(also known as BCH / Mac), or a sump and pump system located by the steam generator area(water collected from Pilot line and sanitation room). The Main Line sump discharges to the sump and pump by the steam generator where this pump transfers the wastewater directly into the lift station holding tank.

Process areas are defined as BCH, Mac, and Pilot. The bar line was removed from the production floor. All process areas use a small section of trench drain that gravity feeds under the concrete to a sump pump location. Underground piping is PVC and ABS.

The sanitary sewer from the facility restrooms and wash facilities are discharged to the lift station holding tank. The sanitary sewer mixes with process wastewater in the lift station holding tank. In the lift station all wastewater is ran through two grinder pumps and then transferred through a magnetic flow meter to the City of Omak POTW.

Wastewater sampling is done at the lift station via a refrigerated sampler. The City of Omak handles all testing from the sampler.

The SunOpta wastewater system is designed to grind all wastewater, ensuring all solids are ground before sending it to the City of Omak POTW for any necessary treatment.

PH Sampling is taken from a PH meter installed on the main discharge line after the flowmeter.

See drawing for a depiction of flow and system components.

Operational Objectives

The waste system is designed to grind all solids from the process waste stream before it is transferred to the City of Omak POTW. No provisions are in place to change pH, lower BOD or

TSS. By nature of the product that is produced at the SunOpta Omak plant pH adjustment is not necessary in order to fall within the established permit limits for ph. When reading PH, the pump or pumps need to be running, in some cases out of range PH is caused by taking a reading without water flow. Out of range PH can also be caused when the facility is down for long periods of time and sampling is done at or before start up. The only control for solids is for the facility to not dump products down the drains, currently there is no way for the facility to control BOD and TSS loads.

Detailed Operation

Sump pumps. The sump pumps located in the Main Line and steam generator areas are operated off of level floats. A failure of one or both of these pumps will not impact the discharge quality of wastewater going to the City of Omak. Any failure will be evident by excess water being present in the facility process waste floor gutter system.

Lift Station. The lift station holding tank collects all sanitary sewer and all process water from the facility. The lift station pumps are controlled via a float system located in the lift station holding tank. The check valves on the discharge of the pumps are changed once per year to insure proper operation of pump system. A failure of the pump system will not impact the quality of wastewater going to the City of Omak.

Sampler. A refrigerated wastewater sampler is located at the lift station. This sampler is programmed to pull a sample every hour for a 24 hour period. The City of Omak will initiate the sample sequence and pull the sample bottle after the sample sequence has ended. The City of Omak runs the appropriate tests on the waste water per the permit specifications. The sampler pump tube is replaced according to the manufacturer's recommendations.

Testing. SunOpta does not test any wastewater samples. All testing is done through the sampler in the lift station, all samples taken from sampler are tested by the City of Omak. Ph calibration is done onsite by SunOpta's quality department.

Magnetic Flow Meter. The magnetic flow meter located on the discharge pipe of the lift station has the calibration checked once per year according to the permit requirements.

Startup, Shutdown, Emergency Procedures

The system pumps and equipment are normally left operational since all pumps function only when necessary via floats. During a power failure no additional actions are necessary for the wastewater system; if a part of the system is non-functioning after restoration of power it will be evident due to accumulation of process waste water inside the plant. Reference the SunOpta Spill Control Plan for actions to take if a spill has occurred within the plant. In the event the lift station becomes nonfunctional, it would be necessary to call a pumper truck to remove water from the lift station.

Waste Water Sampling

All necessary sample analysis required by the permit is handled by the City of Omak. Waste water flow (from magnetic flow meter) and pH is taken once per day during production operations. All readings for flow and pH are recorded on the DMR form and submitted monthly to Department of Ecology.

Maintenance Schedule

Due to the benign nature of any equipment failure (other than that dictated by the permit or other regulatory requirements) pumps, floats, piping, etc. are replaced/repaired as needed.

Safety

All work performed on the wastewater system conforms to the requirements of applicable regulatory requirements. Some of the requirements include Lock Out Tag Out, Hot Work, etc. PPEs are required before handling any waste pump, waste hose or waste line.

PPEs

All employees must wear face shields, gloves, Tyvek hooded suit, and Tyvek boot guards while working on any component touching wastewater in the lift station.

All PPEs in lift station are one time use and must be thrown away immediately after use. All lift station PPEs are stored in the lift station.

When handling process pump components employees are required to wear gloves and safety glasses.

Spare Parts

A spare pump and floats are maintained onsite in case of failure. The spare lift station grinder pump and lift station spare parts are stored in the lift station. The spare pump and parts for the plant pumps are stored in the spare parts room. All lift station parts and pumps are not allowed in the facility due to company Food Safety Policies. Replacement equipment is purchased from applicable suppliers as the need arises.

For pump information contact Rob Gilbertson @ (805) 331-5578 or pump distributor any local Fergusons Plumbing supply

For flow meter information contact Cameron Bachman (509) 703-2835

Contacts

Emergencies, over limits	Terry Llellyn	(952) 243-1530
Emergencies, over limits	Rob Gilbertson	(805) 331-5578
Over limits	Lorre Riehart	(509) 740-2927
Emergency Pump truck	Morgan and Sons	(509) 422-3621

RESOLUTION No, 25-2011

**A RESOLUTION OF THE CITY COUNCIL OF THE
CITY OF OMAK, APPROVING REVISIONS TO THE
INDUSTRIAL WASTEWATER USER CONTRACT
WITH SUNOPTA FRUIT GROUP,
FORMERLY KETTLE VALLEY DRIED FRUIT COMPANY**

WHEREAS, on January 19, 2010, Omak City Council approved Resolution 05-2010, revising a contract between Kettle Valley Dried Fruit Company and the City of Omak, to accept increased industrial effluent discharge from Kettle Valley's fruit processing facility, so they can increase their plant capacity; and

WHEREAS, since that time, Kettle Valley Dried Fruit Company has changed the name of their operation to SunOpta Fruit Group, which is reflected in this contract; and

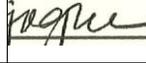
WHEREAS, further changes in the contract have been initiated regarding Section 2.3, ownership, operation and maintenance of the industrial wastewater facility; and

WHEREAS, another aspect of the new contract in Section 3.2, refers to the current City Fee Schedule for the cost to SunOpta for this service, rather than quoting an actual cost in the contract.

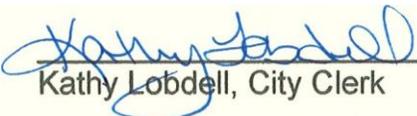
NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Omak that the wastewater discharge contract agreed to between SunOpta Fruit Group, a private corporation, and the City of Omak, attached to this Resolution as Exhibit "A", is hereby approved. The Mayor is hereby authorized and directed to execute the same for and on behalf of the City, and the City Clerk is authorized and directed to attest her signature.

INTRODUCED AND APPROVED by the City Council of the City of Omak this day of May, 2011.

APPROVED:

	
Cindy Ga	ay

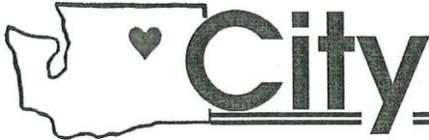
ATTEST:


Kathy Lobdell, City Clerk

APPROVED AS TO FORM:



Michael D. Howe, City Attorney



2 North Ash of Omak P.O. Box 72
(509) 826-1 170

Omak, WA 98841
Fax: (509) 826-6531

In the Heart of the Okanogan email: kathyl@omakcity.com
State of Washington

May 17, 2011

SunOpta Fruit Group
Shaun Jones
1124 — 5th Avenue East
Omak, WA 98841

RE: Revisions to Kettle Valley Dried Fruit Company Contract

Dear Mr. Jones;

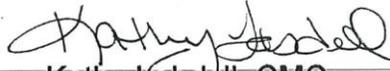
Omak City Council, in regular session May 16, 2011, passed Resolution 282011, approving revisions to the current contract with Kettle Valley.

The revisions are as follows:

- Acknowledge the name change from Kettle Valley Dried Fruit Company to SunOpta Fruit Group
- ◆ Revise Section 2.3 defining ownership, operation, and maintenance of the wastewater monitoring facility as that of SunOpta, to the satisfaction of the City.
- + Revise Section 3.2, deleting the referenced 2009 charges and leaving the section that defined rates as those that are specified in the City's current Fee Schedule.

Enclosed you will find a copy of the Resolution and two City-executed original contract documents. Please execute both originals and return one to me for our records.

Sincerely,



Kathy Lobdell, CMC

KathyL

City Clerk
City of Omak

Encls.

cc: Todd McDaniel, Jesus Arciniega

CITY OF OMAK

INDUSTRIAL WASTEWATER USER CONTRACT

SunOpta Fruit Group

May 16, 2011

1. Parties:

1.1. City of Omak, a Washington municipal corporation, hereinafter referred to as "the City."

1.2. SunOpta Fruit Group, a private corporation, hereinafter referred to as "SunOpta."

2. Industrial Wastewater Terms Conditions:

2.1. This Contract shall commence upon the signing of this Contract, and shall continue until terminated by SunOpta as provided herein.

2.2. SunOpta may terminate this Contract by providing the City with written notice at least six months prior to the date of Contract termination.

2.3. Monitoring of the industrial wastewater discharges shall be conducted by the City. SunOpta will be required to pay for and install the wastewater monitoring facilities. SunOpta will own, operate, and maintain the industrial wastewater facilities to the satisfaction of the City of Omak, as determined by the Public Works Director. Access will be provided by SunOpta to the City of Omak during regular working hours and within 1 hour during non-regular working hours.

2.4. The City shall gather and handle all samples in accordance with recognized standards and requirements and will use only certified laboratories for testing of the samples.

2.5. SunOpta may request that duplicate samples be taken at any time during the period of the Contract. The City will make duplicate samples available to SunOpta, for SunOpta's own testing, at the time the City retrieves their samples from the sampling device.

2.6. It is understood that, due to differences in handling and testing procedures, no direct comparison between the City's testing results and SunOpta's testing results can be made.

2.7. Testing results of the City shall be used to determine the characteristics of the wastewater for the purpose of establishing industrial wastewater billings.

2.8. Unauthorized discharge of industrial wastewater, which has not passed through the industrial monitoring facility by SunOpta to the City's wastewater system, shall be considered a violation of this Contract. The fine for such a violation shall be \$1,000 per day for every day on which such unauthorized discharge occurs. SunOpta may appeal any such fines to the Omak City Council.

- 2.9 Discharges of industrial wastewater to the City's wastewater treatment system shall, in volume and strength, not exceed the amounts listed in Schedule A attached hereto. The listed values are the monthly average values measured at Sun Opta's discharge, and represent the combined total of all SunOpta discharges to the City's wastewater treatment system.

3. Rates and Charges:

- 3.1 Monthly charges for the discharge of industrial wastewater shall be based on the volume and strength of wastewater discharged. Monthly charges will be based on the total volume of wastewater discharged during the month as measured by the flow meter at the monitoring facility, and the average strength of the wastewater, expressed as pounds of BOD per month, and pounds of TSS per month, as determined through testing of the wastewater by the City.
- 3.2 Rates for volume and strength of industrial wastewater discharged shall be as specified in the current rate and fee schedule as adopted by the City of Omak.
- 3.3 Rates and charges shall be subject to review by the City Council and may be adjusted as required to meet the revenue needs of the City's sewer fund.
- 3.4 If components of SunOpta's industrial wastewater discharges exceed the allowable quantities set forth in Condition 2.9 of this Contract, the rates for that portion in excess of that set forth in Condition 2.9 shall be 1.25 times the rate listed in Condition 3.2.

4. Prohibited Discharges:

- 4.1 SunOpta shall not cause or permit the release or discharge of the following pollutants to the City's wastewater system:
- A. Pollutants that create a fire or explosion hazard in the City's wastewater system, including, but not limited to, discharges with a closed cup flashpoint of less than 140 ° Fahrenheit or 60 ° Centigrade using the test method specified in 40 CFR 261.21 ;
 - B. Pollutants which will cause corrosive structural damage to the wastewater system, but in no cases discharges with a pH lower than 5.0 or greater than 11.0;
 - c. Solid or viscous pollutants in amounts that obstruct the flow in the wastewater system;
 - D. Any discharge at a flow rate and/or concentration that will cause interference with wastewater treatment;
 - E. Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference with wastewater treatment or will pass through the wastewater system untreated;
 - F. Pollutants that result in the presence of toxic gases, vapors, or fumes within the wastewater system in a quantity that may cause acute worker health and safety problems or will pass through the wastewater system untreated; and

- G. Heat in amounts which will inhibit biological activity or which would cause wastewater entering the treatment plant to exceed 40 ° Centigrade.

5. Billing Procedure:

- 5.1 Monthly billings by the City and payments by SunOpta shall be in accordance with City standard billing and payment procedures.

6. Remedies if SunOpta Fails to Perform:

- 6.1 . If SunOpta fails to make any payment or perform any obligation required of SunOpta under the terms of this Contract, the City shall be entitled to exercise all rights and remedies allowed by law or equity including, without limitation, the following remedies, which may be cumulative:
 - A. Collection Action: The City may commence an action for the collection of past due payments or obligations.
 - B. Damages, Fines, and Penalties: In the event the SunOpta fails to perform this Contract including, without limitation, prohibited discharges, SunOpta shall be responsible for any damages to the City, including without limitation:
 - 1 . Costs incurred in connection with removal of debris or obstructions from pipelines, pumping stations, and other wastewater collection or treatment system components;
 - 2 Costs of repairs to the City facilities and equipment;
 - 3 Any environmental cleanup costs;
 - 4 Any damages, costs, fines, penalties, or expenses for which the City may be obligated as a result of Kettle Valley's failure to perform this Contract.
- 6.2 If the City fails to perform any obligation required of the City under the terms of this Contract, SunOpta shall be entitled to all rights and remedies allowed by law or equity.

7. Indemnification:

- 7.1 SunOpta will at all times indemnify and hold harmless and defend the City, its elected officials, officers, employees, agents, and representatives from and against any and all losses, damages, costs, charges, expenses, judgments, and liabilities, including attorney's fees (including attorney's fees in establishing indemnification of whatsoever nature), collectively referred to herein as "losses," directly or indirectly resulting from, arising out of, or related to one or more claims, as hereinafter defined, unless such losses or claims, or both, directly or indirectly result from, arise out of or relate to, or are asserted to have resulted from, arisen out of or related to, in whole or in part, one or more negligent acts

or omissions of the City or its elected officials, officers, agents, representatives, employees, or any other party acting for or on behalf of the City.

- 7.2 The term "claims" as used herein shall mean all claims, lawsuits, causes of action, and other legal actions and proceedings of whatsoever nature, that arise out of SunOpta's breach of any of its obligations under this contract, including but not limited to claims, lawsuits, causes of action, and other legal actions and proceedings involving bodily or personal injury or death of any person or damage to any property (including but not limited to persons employed by the City, SunOpta, or any other person and all property owned or claimed by the City, SunOpta, and any affiliate of SunOpta, or any other person).
- 7.3 The obligations of SunOpta hereunder shall apply to all losses or claims, or both, that result from, arise out of, or are related to any event, occurrence, condition or relationship, whether such losses or claims, or both, are asserted. The City will not be liable to SunOpta for, and SunOpta hereby releases the City from, all liability for any injuries, damages, or destruction to all or any part or parts of any property owned or claimed by SunOpta that directly or indirectly result from, arise out of, or relate to SunOpta's use of the City's wastewater facilities or under this Contract or any part thereof, unless such injuries, damages, or destruction directly or indirectly result from, arise out of, or relate to, in whole or in part, one or more negligent acts or omissions of the City or its elected officials, directors, employees, agents, representatives, or any other party acting for or on behalf of the City.
- 7.4 In case any action shall be brought against the City in respect of which indemnity may be sought against SunOpta, the City shall promptly notify SunOpta in writing and SunOpta shall have the right to assume the investigation and defense thereof including the employment of counsel and the payment of all expenses. The City shall have the right to employ separate counsel in any such action and participate in the investigation and defense thereof, but the fees and expenses of such counsel shall be paid by the City unless the employment of such counsel has been authorized by SunOpta and SunOpta shall control the defense of claims against which it is providing indemnity hereunder.
- 7.5 Should a court of competent jurisdiction determine that this Contract is subject to RCW 4.24.115, then, in the event of liability for damages arising out of bodily injury to persons or damages to property caused by or resulting from the officers, employees, and agents of the City, SunOpta's liability hereunder shall be only to the extent of SunOpta's negligence.
- 7.6 It is further specifically and expressly understood that the indemnification provided herein constitutes SunOpta's waiver of immunity under industrial insurance, Title 51 RCW, solely for the purpose of this indemnification. This Waiver has been mutually negotiated by the parties.
- 

(initial) Initial)
- 7.7 The provisions of this indemnification section shall survive the expiration or termination of this Contract.

IN WITNESS WHEREOF the parties hereto have executed this Contract as of this 16th of May, 2011.

CITY OF OMAK

Cindy Gagne
CINDY GAGNE, MAYOR

ATTEST:

Kathy Lobdell
KATHY LOBDELL, CITY CLERK

SunOpta Fruit Group

Abraham M. Jones
DULY AUTHORIZED REPRESENTATIVE

704C.U
Sharon M. Jones

PRINT NAME

Facility Manager
TITLE

CITY OF OMAK

INDUSTRIAL WASTEWATER USER CONTRACT
SUNOPTA FRUIT GROUP

January 19, 2010

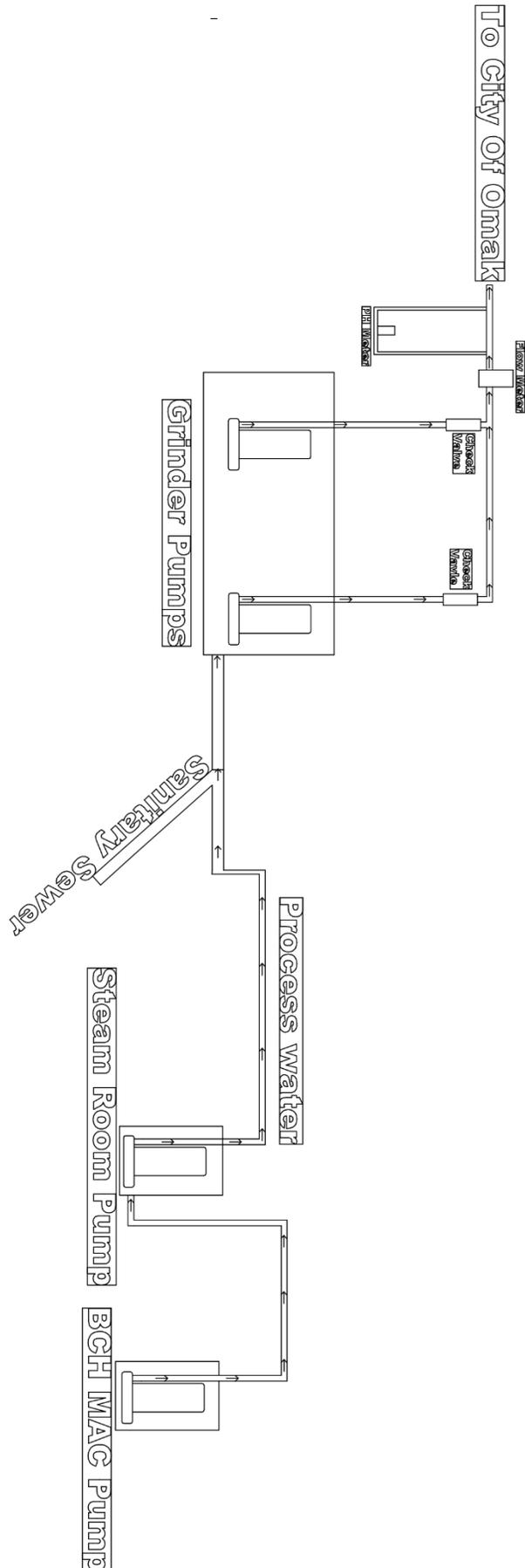
SCHEDULE A
ALLOWABLE WASTEWATER DISCHARGES

Month	Average Daily Flow (gallons per day)	Average Daily BOD Loading (pounds per day)	Average Daily TSS Loading (pounds per day)
January	50,000	350	50
February	50,000	350	50
March	50,000	350	50
April	50,000	350	50

Proline Promag W 400

May	50,000	350	50
June	50,000	350	50
July	50,000	350	50
August	50,000	350	50
September	50,000	350	50
October	50,000	350	50
November	50,000	350	50
December	50,000	350	50

2.



NOTICE TO INSTALLER: Instructions must remain with installation.

FM2168

Trusted. Tested. Tough.®0624



Supersedes
0424

Register your Zoeller Pump Company Product on
our website: <http://reg.zoellerpumps.com/>



MAIL TO: P.O. BOX 16347 • Louisville, KY 40256-0347
3649 Cane Run Road • Louisville, KY 40211-1961
(502) 778-2731 • 1 (800) 928-PUMP

Visit our website:
zoellerpumps.com

SHIP TO:
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Product
factory



information presented here reflects conditions at time of publication.
regarding discrepancies or inconsistencies.

OWNER'S MANUAL CSA 22.2 No. 108 Standards



Consult



Certified to ANSI/UL 778 and

MODELS 840 & 841 SUBMERSIBLE GRINDER UNITS

Congratulations on the purchase of a Zoeller® submersible in the pump. Since 1939, the name Zoeller® has represented the Please read submersible dewatering and sewage pumps. The same Follow the workmanship and easy maintenance design has been contained incorporated into this line of heavy-duty submersible grinder pumps. This Zoeller® pump will provide years of trouble-free service when installed according to the manufacturer's recommendations. for model incorporates the installation, operation, necessary please call our instructions into one document to aid 928-PUMP (7867).

ownership of a Zoeller® submersible wastewater product. grinder and review this manual before installing the product. standard for steps in this manual for a proper start-up. Many items high quality within, when followed correctly, will not only ensure a long and problem-free life for the pump, but also save time and money during installation. Reference FM1308 for model 840 and FM2180 841 replacement parts. Should further assistance be This manual Technical Service Department at 1-800maintenance, and service

Manufacturer warrants, to the purchaser and subsequent owner warranties the warranty period, every new product to be free from any representative or other and workmanship under normal use and liability in connection with our products. and maintained, for a period from date of original manufacture of the product, Contact whichever comes first. Parts that fail within the warranty period any needed inspection determines defect in material or workmanship information pertaining to replaced or remanufactured at the the manufacturer will not be obligated to replace the entire entire mechanism or the complete unit. No allowance will be made **SPECIAL**, shipping charges, damages, labor or other charges that may **OF EXPRESSED** to product failure, repair or replacement. **OR IMPLIED A PARTICULAR PURPOSE AND OF MERCHANTABILITY SHALL BE** warranty for any **TO THE DURATION OF THE EXPRESSED WARRANTY.** approval of

Manufacturer, subjected to misuse, misapplication, neglect, alteration, warranty, accident or act of nature; that has not been installed, states do not allow maintained in accordance with Manufacturer's consequential damages, so that has been exposed to outside exclusion may not apply to you.

the following: sand, gravel, cement, mud, tar, hydrocarbons, abrasive or corrosive This warranty gives you specific legal rights and products, etc. in all other rights which vary from state to state.

applications other than in raw sewage pumping applications. The

during warranty set out in the paragraph above is in lieu of all other defects in material expressed or implied; and we do not authorize service, when properly used person to assume for us any other of one year from date of purchase by the end user, or 18 months Manufacturer at, 3649 Cane Run Road, Louisville, Kentucky whereas 40211, Attention: Customer Service Department to obtain will be repaired, repair or replacement of part(s) or additional manufacturer's option. However, our warranty.

assembly,
for **MANUFACTURER EXPRESSLY DISCLAIMS LIABILITY FOR** occur due **CONSEQUENTIAL OR INCIDENTAL DAMAGES OR BREACH WARRANTY; AND ANY IMPLIED WARRANTY OF FITNESS FOR LIMITED** This warranty does not apply to and there shall be no material or product that has been disassembled without prior

Some states do not allow limitations on the duration of an implied operated or so the above limitation may not apply to you. Some installation instructions; the exclusion or limitation of incidental or substances including but not limited to the above limitation or

hydrocarbon derivatives (oil, gasoline, solvents, etc.), or other you may also have substances, wash towels or feminine sanitary

In instances where property damages are incurred as a result of an alleged product failure, the property owner must retain possession of the product for investigation purpose.

APPLICATIONS

1. Zoeller Grinder Pumps are designed for grinding and pumping 3. installed in a prepackaged job ready sanitary sewage from pump is intended system or may be used in a field assembled basin to grind and pump reasonable quantities of items normally found sanitary sewage applications. displacement pump installations.
2. Zoeller Grinder Pumps can be installed in new applications or as a grinder application of like size and capacity. Some rail system

- Zoeller Grinder Pumps can be submersible lift stations. The package.
4. Zoeller Grinder Pumps can be retrofitted to existing positive in direct replacement for any retrofit kits are available.

Preinstallation Checklist

1. **Inspect your grinder pump.** If the unit has been damaged in shipment, 2. **Carefully read all literature** to familiarize yourself with details regarding contact your dealer before installing. **Do Not** remove the test plug in installation and use. Retain materials for future reference. the cover nor the motor housing.

CAUTION

SEE BELOW FOR LIST OF WARNINGS

SEE BELOW FOR LIST OF CAUTIONS

1. **Make sure pump connection contains a ground terminal.** The power cord 1. **Make sure the power source** is capable of handling the electrical on all Zoeller Grinder Pumps contains a green conductor for grounding requirements of the grinder pump, as indicated on the nameplate. to help protect you against the possibility of electric shock. 2. **A disconnect switch should be installed ahead of the pump.**
2. **Make certain the electrical service is within reach of the power supply cord.** 3. The Grinder pumps are operated by control panels with variable level

Proline Promag W 400

3. **Make sure any panels and branch circuits are equipped** with proper size fuses float control switches. It is the responsibility of the installing party to and circuit breakers. An independent power circuit is recommended, see that float control switches will not hang up on the grinder pump sized according to the National Electrical Code, for the current shown or other pit peculiarities and are secured so that the grinder pump on the grinder pump nameplate. will shut off. It is recommended to use rigid pipe and fittings and 4. **For your protection, always disconnect the power source to the grinder the pit be 24" in diameter for simplex systems and 36" in diameter for pump before handling.** All grinder pumps must be properly grounded duplex systems or larger. and wired in accordance with the "National Electrical Codes" and all 4. Grinder installations should be checked yearly for debris and/or build local codes and ordinances. up which may interfere with the "ON" or "OFF" positions of variable
5. Installation of electrical hardware and checking of control panels level float control switches. Repair and service, other than cutter and circuits should be performed by a qualified licensed electrician. assembly maintenance, should be performed by Zoeller authorized 6. Risk of electrical shock - These pumps have not been investigated for service stations only.

use in swimming pool areas. 5. Maximum operating temperature must not exceed 130 °F, 7. Prop65 Warning for California residents (P65 W).



: Cancer and Reproductive Harm- 6. **Pump and float switch electrical connections must be permanently installed, operational and protected from submergence.**



7. **Junction box conduit must be installed with watertight connection. Zoeller junction boxes include a UL Listed potting kit for sealing the conduit. Failure to properly install this sealant material could void warranty.**

Do not attempt to turn star cutter located on bottom of the unit with fingers. Use a wrench when checking or removing star cutter.

Electrical Data

Model	HP	RPM	Voltage	Phase	Hertz	Amps				KVA Code	Winding Resistance Line-to-Line
						Full Load	In Air	Shut Off	Locked Rotor		
I840	2	3450	200	1	60	20.0	6.6	12.1	60	H	1.0 / 1.5
E840	2	3450	230	1	60	17.2	4.0	10.9	56	F	1.3 / 4.0
J840	2	3450	200	3	60	12.3	3.7	7.7	54	L	1.9
F840	2	3450	230	3	60	10.8	3.3	6.9	42	K	2.4
G840	2	3450	460	3	60	5.5	1.6	3.5	21	K	9.7
I841	2	3450	200	1	60	20.0	6.6	15.5	60	H	1.0 / 1.5
E841	2	3450	230	1	60	17.2	4.0	10.9	56	F	1.3 / 4.0
J841	2	3450	200	3	60	12.3	3.7	7.7	54	L	1.9
F841	2	3450	230	3	60	10.8	3.3	6.9	42	K	2.4
G841	2	3450	460	3	60	5.5	1.6	3.5	21	K	9.7

General Information

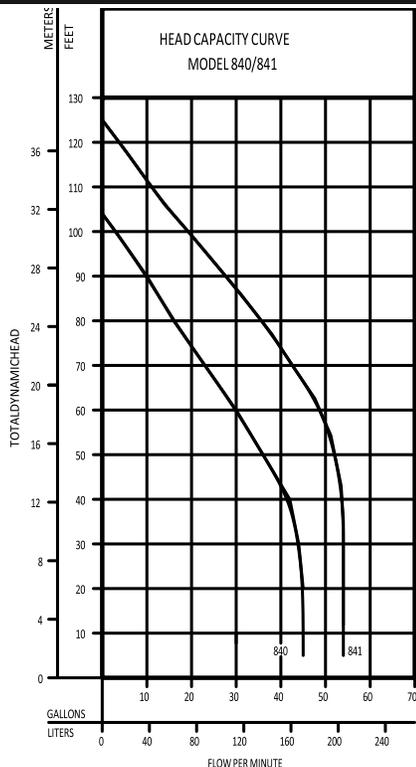
GRINDER PUMP DESCRIPTION

1. Pumps are constructed of cast iron protected with powder coated control epoxy for long life when pumping sewage in submersible being retrofitted. The cutter assembly is comprised of stainless steel cutter and a precision ground flat be required. Consult hardened to a value of 55-60 on the model of rail system being used.
2. Refer to the appropriate Indoor/Outdoor prepackaged with the rotation of the star cutter at 3450 RPM against the cutter plate (see page 11).
3. All electrical connections including pump to control box and 2. The cutter mechanism on the model 840 is bidirectional, enabling it cut in either direction. A control panel with the reversing feature alternate the pump's rotational direction with each duty cycle. cutter mechanism on the model 841 is single directional. seal. should be made by a qualified licensed electrician. A UL Listed Pump motors are available in single and three phase design.
4. A properly sized disconnect switch, supplied by others, shall panel installed on the service side of the pump and control panel.
5. When installing a pump with a check valve, or a rail system 4. The 840 Grinder Pumps are dual seal and have seal leak probes. a phase units have an internal thermal overload. Three phase prevent air a thermal sensor. case has an air vent located behind the discharge. must be cleaned before each reinstall. An extra air vent hole (3/16") in the control panel. in discharge pipe below the check valve to help reinstall. After the
6. A Grinder Pump is an intermittent duty pump designed for pumping sanitary sewage. It is not a dewatering or trash pump. is filled

ASSEMBLED INSTALLATION

1. Installation and piping instructions are included with the applications. panel, rail system and basin instructions. If pump is steel components to an existing rail system, accessory parts may the factory and advise make and Rockwell C scale; a star shaped disk. Cutting action takes place instructions stationary on pages 6-9 for more information on system installation.
- power supply to control panels must comply with the "National to Electrical Code" and applicable local codes. Conduit and will panel enclosure openings must have a gas and watertight The Installation of electrical panels, conduit and connections potting kit, P/N 10-2350, is available from Zoeller Company. 3. phase motors require a Zoeller approved starting relay, starting be capacitor and a run capacitor, which are mounted in a control (ref. page 8).
- with check valve, you must give the pump case time to fill to help Single lock when lowering the unit into the liquid. The pump pumps have This air vent is across the pump housing mounting surface and may be drilled 5. Three phase pumps require overload protection prevent air lock. This drilled hole must be cleaned before each pump is installed, run the unit submerged to assure the pump case (Water should come out of 3/16" diameter hole).

FIGURE



1. TOTAL DYNAMIC HEAD/FLOW PER MINUTE
SEWAGE

MODEL		840		841	
Feet	Meters	Gal.	Liters	Gal.	Liters
5	1.5	45	170	54	204
10	3.0	45	170	54	204
20	6.1	45	170	54	204
30	9.1	44	167	54	204
40	12.2	42	159	54	204
50	15.2	36	136	52	197
60	18.3	30	114	49	185
70	21.3	23	87	43	163
80	24.4	16	61	36	136
90	27.4	10	38	28	106
100	30.5	3	11	19	72
110	33.5	--	--	11	42
120	36.6	--	--	4	15
Shut-off Head:		104 ft (31.7 m)		125 ft (38.1 m)	

016532

Pump Wiring Instructions



WARNING

FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER SOURCE BEFORE HANDLING.

WARNING

All electrical connections must be wired and grounded in accordance with the National Electrical Code and all applicable local codes and ordinances.



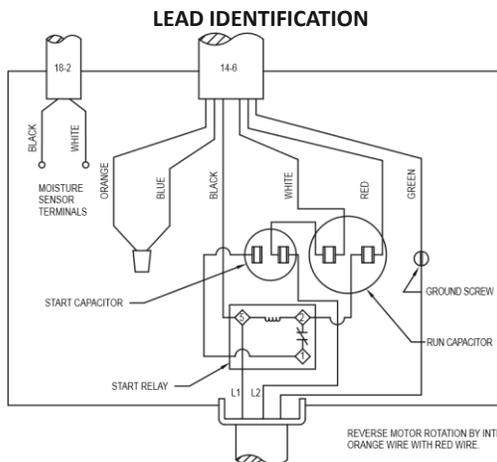
WARNING

“Risk of electrical shock” Do not remove the power supply cord and strain relief or connect conduit directly to pump.

WARNING

Installation and checking of electrical circuits and hardware should be performed by a qualified licensed electrician.

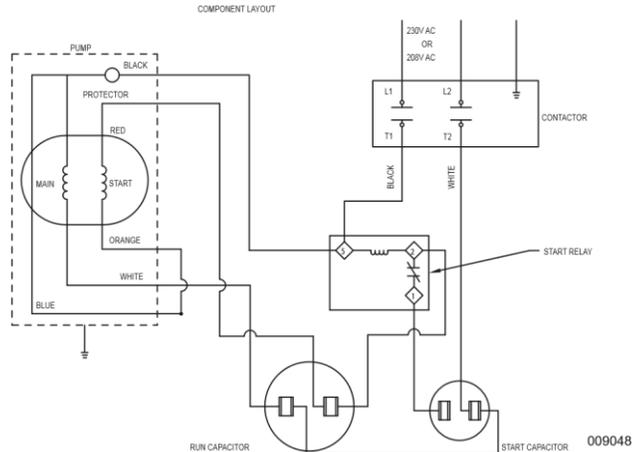
FIGURE 2.



SK1367

SE-2HP
. 840

WIRING DIAGRAM



009048

FIGURE 3.

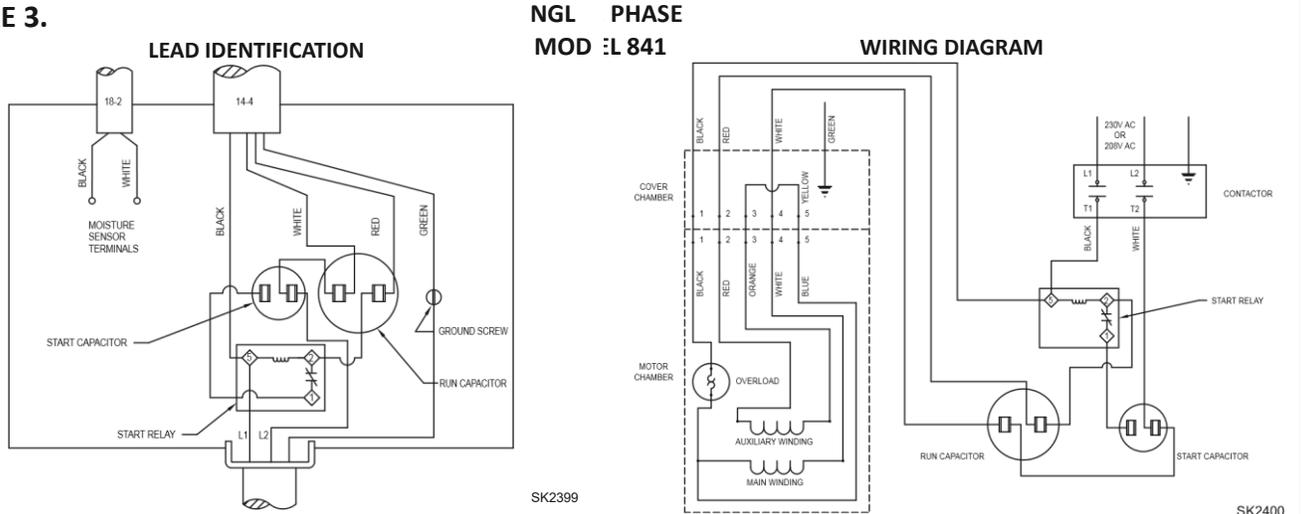
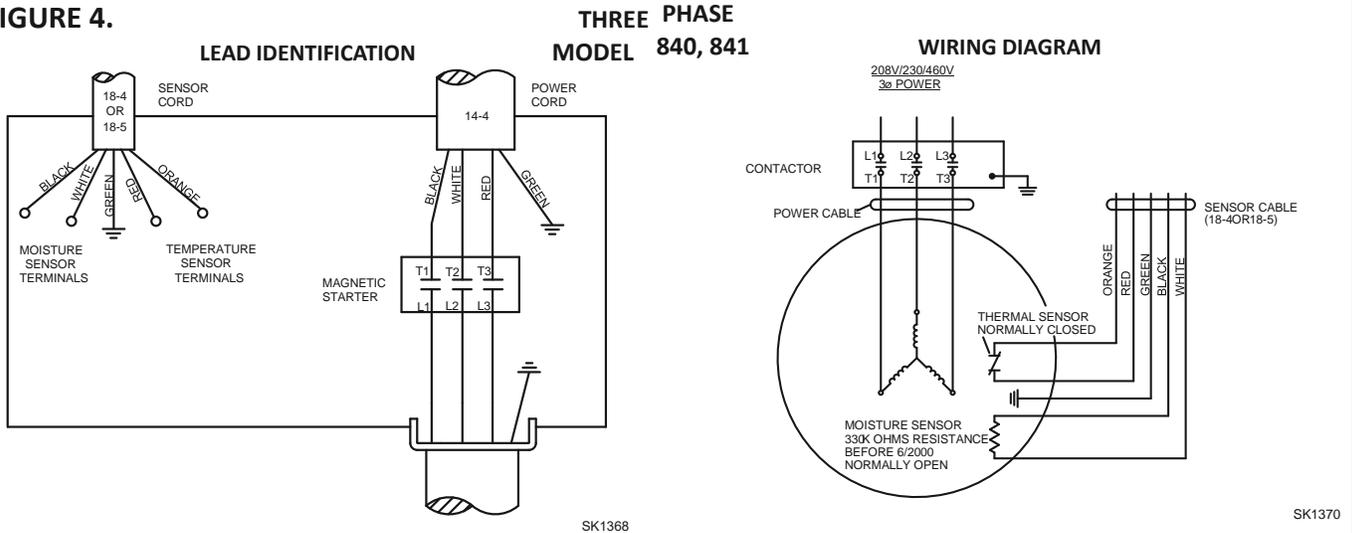
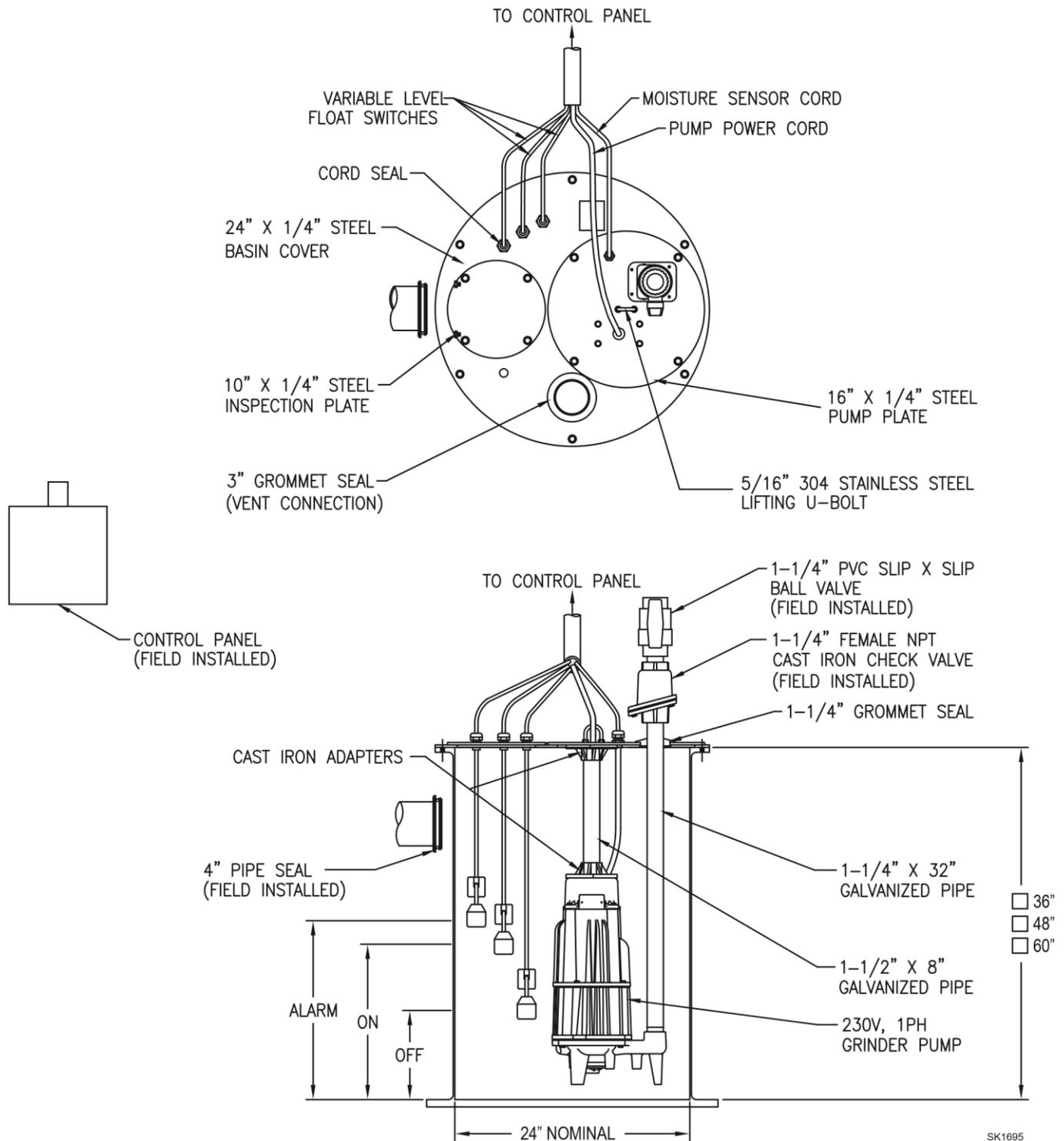


FIGURE 4.



Indoor Prepackaged System

FIGURE 5.



All installations must comply with all applicable electrical and plumbing codes, including but not limited to the National Electrical Code, local, regional and/or state plumbing codes, etc.

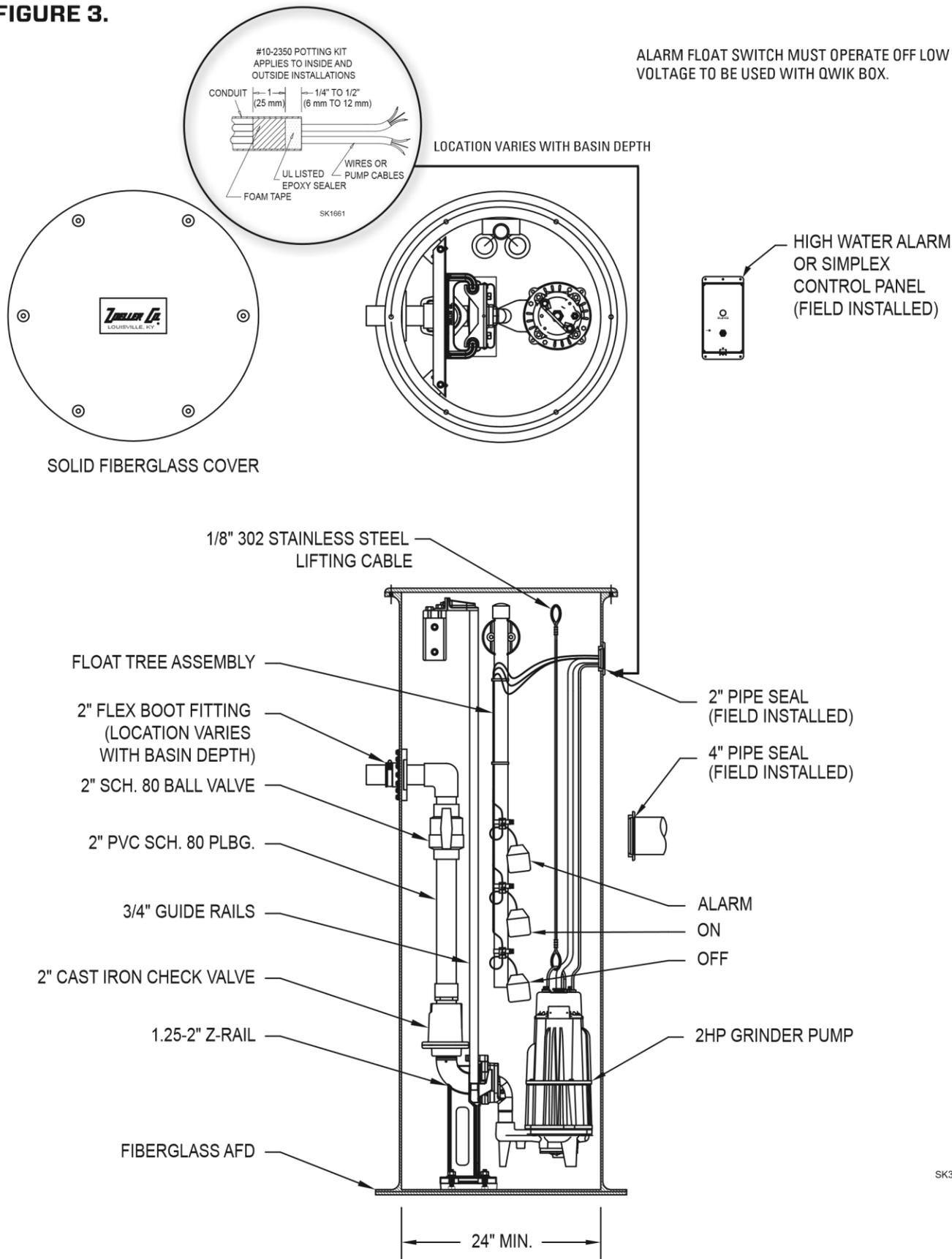
Indoor Prepackaged System Installation Instructions

▲ NOTICE This set of instructions is for factory prepackaged indoor systems only. If your system is a field assembled indoor system, use these instructions as a guideline. If your system is an outdoor system then go to the next section in this manual that covers outdoor systems.

1. Indoor grinder pump systems are for installing at grade in an indoor basin application only. If you will be installing this system outside 10 inches the residence then you will need an outdoor system. DO the location of THE INDOOR SYSTEM OUTDOORS.the inlet hub based upon your
2. Review the drawing in Fig. 5 on page 6 and the actual system to side familiar with the components in the grinder pump system. supplied where the unit will be installed. Determine where the power fitting inlet pipe, discharge pipe and vent will be located.hole saw at a and connect the 4" inlet pipe to the inlet hub
3. Remove the unit from the packing. Indoor prepackaged systems are preassembled at the Zoeller Company and require a minimum leave field assembly work. All work inside the basin can be be poured in the inspection port. There should be no reason to from the basin. Pump and float switches are already set inside basin. 8. Connect the discharge applicable National, State and Local plumbing codes. 4. Remove for proper operation from the factory. Verify that where the 9. Mount switches are set will work for your application. Verifying that the float switches are set properly and will not hang up inside the basin 10. Clean any debris out of the basin. Fill the basin with water and check the system for proper operation. float switch bulb or the unit will not operate properly.
11. Record system start-up data for future reference. 5. Dig a hole for within 15' of the power disconnect. The hole should be at 12. Seal and in diameter than the basin in order to leave 4" of backfill bolts and around the perimeter. A minimum of 4" of compacted be completed. subbase is also required. Backfill and subbase should be 1/8" to 3/4" pea gravel or 1/8" to 1/2" crushed stone. Also reference the basin installation instructions included with the unit.
6. The 4" inlet hub should be located between the top lip of the next to and the alarm float "on" level with a minimum distance of NOT INSTALL between the floor of the basin and hub. Determine inlet pipe arrangement. The inlet hub must be used with 4" pipe. It is best to install the inlet on the of the basin opposite the float switches. Most systems are become with a field installed 4" pipe seal inlet fitting. This inlet Review is installed in the basin's side-wall in a 5" hole drilled with a feed, location lining up with the inlet pipe.
7. Set the basin in the hole using the rubber insert. Backfill around the basin with specified of media. Care should be taken not to damage components or performed via voids when backfilling. Finish grade of floor should remove the cover place around the top 6" of the basin assembly. the pipe, valves and vent according to all the inspection plate from the cover. All floats are set and tethered the control panel on the wall within 15' of the system. float Connect the float switch and pump cords. is the responsibility of the installing contractor. Float switches are tied in place for shipping purposes. Cut the cable tie around each the basin. The basin should be located in a very low traffic area secure the inspection plate to the lid using the proper least 8" larger sealant. Pouring concrete around the system can now all the way

Typical Outdoor Grinder Pumping System Installation

FIGURE 3.



SK3110

All installations must comply with all applicable electrical and plumbing codes, including but not limited to the National Electrical Code, local, regional and/or state plumbing codes, etc.

Outdoor Prepackaged System Installation Instructions

▲ NOTICE This set of instructions is for factory prepackaged outdoor grinder systems only. If this is a field assembled outdoor system you can use these instructions as a guideline. If this is an indoor system then go back to pages 6-7 in this manual that covers indoor systems.

1. Review the drawing in Fig. 3 on page 8 and the actual system to familiar with the components in the packaged grinder pump. Review where the unit will be installed. Determine where power feed, inlet pipe, and discharge pipe will be located. or 1/8" –1/2" crushed stone. (Reference basin installation
2. Remove the unit from packing. Prepackaged outdoor systems are preassembled at the Zoeller Company and require a minimum of inlet hub. field assembly work. Float switches are set and tethered for proper operation from the Factory. Systems using an automatic unit, WD 7. Pouring a concrete anchor around system can now be completed. or WH series, have an integral "on/off" float switch. See Fig. 4 Basin should be filled with water when pouring concrete to minimize on page 5 for adjustment instructions. The alarm switch should movement of the system. Backfill around basin with specified media. be located 3" above the pump "on" level. Three float systems Care should be used to avoid damaging components or leaving voids used with a control panel are placed at 27", 24", and 15" from the when back filling. Refer to Basin installation reference guide on bottom of the basin. Four float systems used with a control panel more specific requirements.
- are placed at 33", 27", 24", and 15" from the bottom of the basin. 8. PVC or HDPE discharge piping is connected to the 2" threaded If the invert location is at or below the level of the float switches, fitting located in the basin sidewall. Support discharge piping with contact the factory. sufficient backfill.
3. Float switches are tied in place for shipping purposes on all model 9. Connect lift cable to top of pump. Lower the pump into basin ensuring prepackaged systems. Cut the cable tie around each float switch the discharge pipe bracket slides into the disconnect fitting.
- bulb or the unit will not operate properly. Verify that where the float switches are set will work for your application. **Verifying 10. Note: The grinder basin is a sewage holding tank. Vent connection should that the float switches are set properly and will not hang up be installed in accordance with all national, state and local plumbing inside the basin is the responsibility of the installing contractor. codes.**
4. Dig a hole for the basin. The hole should be at least 24" larger in 11. Dig a trench for the electrical conduit. The conduit should be located diameter than the basin diameter to provide 12" of backfill all around below the frost line. Follow all applicable electrical codes.
- and deep enough to provide either 12" of compacted backfill or 6" 12. If using a junction box, connect the electrical conduit and wiring when a concrete pad is required. **Note: Care must be taken when according to instructions included in this manual and wiring diagram excavating in order to avoid underground utilities and disturbance of in box. If a potting kit is provided with the junction box, follow the existing structure foundations. The hole should be located at least ten instructions for sealing the conduit connection to the junction box. feet from adjacent structures. Additional distance may be required to If a potting kit is not provided, the conduit connection to the junction sufficiently locate the basin outside of the loading area of the adjacent box must be sealed.**
- structures.**
5. Determine the location of the inlet hub based upon your inlet pipe 13. Mount the control panel within sight of the system. Connect arrangement. The inlet hub must be used with 4" pipe. It is best to float switches and pump cords according to the "Pump Wiring install the inlet on the side of the basin opposite the float switches. Instructions" found later in this manual and located inside the panel enclosure.
- basin. Using clean water, check the Most systems are supplied with a field installed 4" pipe seal inlet system for proper operation. fitting. This inlet fitting is installed in the basin's side-wall in a 5"
- proper bolts and sealant when hole drilled with a hole saw at a location lining up with the inlet using a lid without a formed gasket. pipe.
14. Remove any debris from the
15. Seal and secure the lid using the
16. Test system for leaks and proper
17. Record system start up data for
17. Record system start up data for future reference.

Operation

GENERAL • Conduit connections to panel and junction box are Zoeller pumps are lubricated and tested at the factory prior to with adequate and require minimum pre-start-up the unit using manual controls. If flow is appreciably less than rated Maximum operating temperature of pump liquid for grinder pumps several not exceed 130 °F (54 °C).times, using the manual controls.

- Have a qualified electrician take voltage and current measurements
- These units are designed for intermittent duty sanitary sewage with applications. If pump is used to dewater areas or pump liquids with in future heavy or abrasive materials, the warranty will be

NAMEPLATE DATAADJUSTMENT PROCEDURE

The nameplate, located on the side of the pump, indicates specific construction of the pump. The model number Floats: Refer to the information should be recorded on the front page in the for the desired “Owner’s Information” section of this manual.Valves: Discharge valves operated for extended periods of time **SHORT TERM** damaging

Do not install pump until electrical power is available and system is valve. When not in use, the pump should be stored and the following

SHUTDOWN

- Store pump inside whenever possible or cover with some type of following is covering.recommended:
- Tape or seal in plastic bag the terminal ends of wire leads.
- Spray coat unpainted surfaces with rust inhibiting oil.Pumps: If pit
- The impeller should be rotated every six months in order to keep minutes seals lubricated and not develop a permanent set.once be removed and stored as noted above.

If panel is to be stored, the following is advised:

Panels: The panel should have all openings sealed to prevent

- Store the panel inside whenever possible and leave in the shipping box.the panel should be inspected for presence of moisture and
- All openings shall be sealed.loose connections.
- Store in an upright position.
- Do not stack anything on top of panel.Valves: Consult the components.

START-UP PROCEDURE

Before placing the equipment into operation the following should be checked:

- Clean pit.
- Pump, float switches, electrical cables and junction box are dry and
- Electrical boxes dry, sealed and securely installed.
- Floats positioned properly.
- Discharge valves open.
- 3/16" vent hole drilled in pipe between check valve and pump.

properly sealed. shipment • After installing the pump into the containment area, maintenance.submergence, open the discharge valve fully. Start performance, must pump may be air locked. To expel trapped air, jog the unit the pump running. Record these readings in the space provided the “Owner’s Information” section on page 1 of this manual for voided.reference.

Pumps: No adjustments are required. information about the system drawing or to the panel wiring schematic and date code location of each float switch setting.

should be placed in the fully open position. Systems should not be **STORAGE**with the discharge valves partially closed due to

operational. the is advised:

PROCEDURES

protective If a system is shutdown for more than six months, the

is to remain dry, then the pump can remain in the pit. the With the pump in the pit, it should be operated for five every three months. If the pit is to remain wet, the pump should

moisture and dust from entering the enclosure. Prior to restarting system, any

valve/actuator supplier for information concerning these systems

properly installed.

Once the above has been verified proceed with the following checks:

- Pump power cables and control floats properly installed and voltage verified.

Cutter Maintenance

1. **All power circuits must be disconnected and locked out before service parts or are made at servicing.** The star cutter and disc accomplished by surface sharpened by grinding the cutting faces. micro finish. Do not attempt must be removed from the pump. a qualified machine shop for accomplished in the field by shims are a matched set. Keep positioning horizontally to access before and after resurfacing with or other repairs are required, measurements. and serviced in a shop by a qualified pump disc and star cutter must be flat within 0.001".

If the disc has been surface ground, it will be necessary to remove

2. Remove the three countersunk screws on the plastic guard ring and remove the ring.starting point, remove shims of the same above). Final running clearance 3. Thoroughly clean the star 0.008". Be sure pump is in vertical back to the vertical position removed before measuring.
been removed. Check and record the clearance between the cutter and disc with a feeler gage. The correct running clearance is between 0.004" and 0.008".retainer screws. Torque to 63-67 and torque hex head bolt to 71-75

4. With pump in horizontal position, heat the hex head bolt in the threads of the star cutter with a propane torch. The bolt must pump in vertical 350 °F to soften the thread lock sealer on the must be between 0.004" and Remove the bolt by turning in a when pump is put back in service.

be necessary to use a wood block to prevent the star cutter from from the shaft and 9. Replace plastic guard ring and its three remove the spacer shims located behind the star cutter.

5. Remove the three cap screws holding the disc and remove disc 10. Check the oil in the motor housing before reinstalling. Contact the from the pump.factory if the oil has a milky appearance or burnt smell. The level should be even with the fill plug when pump is in the upright position.

any attempts 6. The disc and star cutter can be replaced with new can be removed and resurfaced by grinding. Resurfacing is Both star cutter and disc grinding both disc and star cutter to a 32 Removal of these parts can be grinding in the field. Send parts to removing pump from the sump and repair. The disc, star cutter and the intake of the pump. If seals parts together. Measure disc the pump must be totally removed micrometer and record technician or authorized service center.7. After resurfacing, the

shims to compensate for the material removed from the disc. As a thickness as the amount machined from the cutter disc (step 6 cutter and disc assembly. Tilt pump must be between 0.004" and to make certain the end play has position and all end play has been

star
8. Clean bottom of pump where disc is located and replace disc and in-lbs. Replace star cutter with the correct shims. Install washer

center in-lbs. apply Loctite 262 thread-lock sealant or equal to bolt be heated to prior to insertion. Check running clearance with bolt for ease of removal. position to remove end play. Clearance counterclockwise rotation. It will 0.008" to obtain efficient grinding

turning while removing the bolt. Pull star cutter screws.

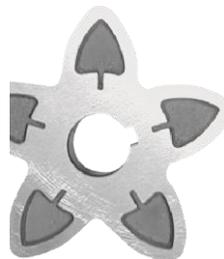
Add oil if required. Use insulating oil supplied by the factory.

FIGURE 7.

To remove star cutter: Remove guard ring then heat the center bolt to 350 °F to loosen Loctite® thread sealant.



840 components shown)



Grind the Star Cutter and Disc seen here to a 32 microfinish. Surfaces must be flat to within 0.001" T.I.R. Gap must be between 0.004" and 0.008" on these parts.

General Maintenance

NOTICE Repair and service should be performed by a Zoeller Pump Company Authorized Service Station only.

No lubrication is required.

SAFETY PROCEDURES If pumps are to be stored for more than six months, refer to short term storage For your protection, always disconnect pump and panel procedure in the Operation section.



WARNING from its power source before handling.

PREVENTIVE MAINTENANCE



WARNING Never enter the basin until it has been properly vented. Preventive maintenance is recommended to ensure a long service life from the product. Provided is a suggested maintenance schedule. the

and tested. Any person entering a basin should be wearing a harness with safety rope extending to the surface so that they can be pulled out in case of asphyxiation. Sewage water gives off methane and hydrogen sulfide gases, both of which can be highly poisonous. • Inspect and test system for proper operation.

Installation and checking of electrical circuits and hardware should be performed by a qualified electrician. • Listen for proper check valve operation.

Pump is never to be lifted by power cord. **Every 5 years or 10,000 hours**



WARNING Unit must be cleaned and disinfected, inside the chamber and all exterior surfaces, prior to servicing. • Flush and

operation. • Check for proper and unobstructed float operation.

DOUBLE SEAL PUMPS

GENERAL SYSTEM INSPECTION

Double seal pumps offer extra protection when these pumps are supplied with optional moisture sensors, check the control panel's seal failure light for a warning.

Before the system is placed into operation, it should be inspected by a qualified technician. Whenever the seal leak is activated, it's indicating that moisture is present, and Wiring and grounding must be in accordance with the the pump should be removed and serviced in order to avoid damage to the motor. National Electrical Code and all applicable local codes and ordinances.



WARNING

LUBRICATION PROCEDURES

operation.

MAINTENANCE

operation.

operation.

operation.

operation.

operation.

of operation:

operation. • Remove pump, inspect and service using a Zoeller rebuild kit. clean basin.

Service Checklist



WARNING

Precautions. Before servicing a grinder pump, always shut off the main power circuit. Make sure you are wearing insulated protective sole shoes and not standing in water. Under flooded conditions, contact your local electric company or a qualified licensed electrician for disconnecting electrical service to the pump prior to removal.



WARNING

Grinder pumps contain oil which becomes pressurized and hot under operating conditions. Allow 2-1/2 hours after shut down before servicing pump.

Condition	Common Causes
A. Pump will not start or run.	Blown panel or circuit breaker fuse, low voltage, thermal overload open, defective capacitor circuit, cutter or impeller clogged, float switch held down or defective, incorrect wiring in control panel, water in cap assembly.
B. Motor overheats and trips on overload.	Incorrect voltage, impeller or cutter blocked, negative head (discharge lower than intake of pump). Defective "off" float. Pump runs continuously at low water level. Low oil level in motor shell.
C. Pump will not shut off.	Air lock, debris under float assembly, defective switch, incoming sewage exceeds capacity of pump.
D. Pump operates but delivers little or no water.	Intake clogged with grease or sludge, pump air locked (clear vent hole), low or incorrect voltage, clogged discharge line, operating near shut-off head.
E. Pump starts and stops too often.	Check valve stuck open or defective. Sump pit too small to handle incoming sewage. Level control out of adjustment. Thermal overload tripping.
F. Large red flashing light comes on at control box.	High water in pit. Check pump for clogging, or overload trip. On single phase pumps, check the start capacitor in the control panel. See "A" and "D" above.
G. Grease and solids accumulate in pit around pump.	Break up solids and run pump with water running into the pit. Allow level to lower to the pump intake. Continue until solids are cleared from the pit. Do not drain kitchen grease down the sink.

If the above checklist does not uncover the problem, consult the factory. Do not attempt to service or otherwise disassemble pump. Service must be performed by Zoeller Authorized Service Stations. Go to www.zoellerpumps.com to find the Authorized Service Station in your area.

Technical Information

Proline Promag W 400

Electromagnetic flowmeter



Application

- The bidirectional measuring principle is virtually independent of pressure, density, temperature and viscosity
- Ideal for water measurement, e.g. drinking water, utility water and industrial/municipal wastewater

Device properties

- International drinking water approvals
- Degree of protection IP68 (Type 6P enclosure)
- Approved for custody transfer to MI-001/OIML R49
- Transmitter housing made of durable polycarbonate or aluminum
- WLAN access
- Integrated data logger: measured values monitoring

Your benefits

- Reliable measurement at constant accuracy with 0 x DN run without pressure loss
- Flexible engineering – sensors with fixed flanges or lap joint flanges
- Application suitability – corrosion protection according to EN ISO 12944 for buried or underwater installations
- Improved plant availability – sensor compliant with industry-specific requirements
- Safe operation – no need to open device
- Time-saving local operation without additional software and hardware – integrated web server
- Built-in verification and build-up detection – Heartbeat Technology

Versatile standard flowmeter for the water and wastewater industry

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Proline Promag W 400

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About this document

Symbols

Electrical symbols

Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current
	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Protective Earth (PE) A terminal which must be connected to ground prior to establishing any other connections. The ground terminals are situated inside and outside the device: <ul style="list-style-type: none"> • Inner ground terminal: Connects the protective earth to the mains supply. • Outer ground terminal: Connects the device to the plant grounding system.

Communication symbols

Symbol	Meaning
	Wireless Local Area Network (WLAN) Communication via a wireless, local network.
	Bluetooth Wireless data transmission between devices over a short distance.
	LED Light emitting diode is off.
	LED Light emitting diode is on.
	LED Light emitting diode is flashing.

Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Visual inspection

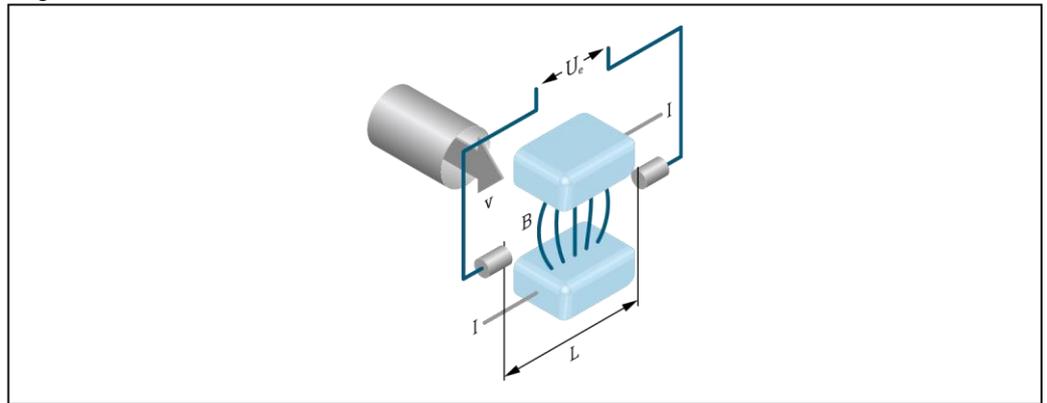
Symbols in graphics

Symbol	Meaning
1, 2, 3, ...	Item numbers
1., 2., 3., ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections
-	Hazardous area
.	Safe area (non-hazardous area)
⇒	Flow direction

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.



- U_e Induced voltage
- B Magnetic induction (magnetic field)
- L Electrode spacing
- I Current
- v Flow velocity

In the electromagnetic measuring principle, the flowing medium is the moving conductor. The voltage induced (U_e) is proportional to the flow velocity (v) and is supplied to the amplifier by means of two measuring electrodes. The flow volume (Q) is calculated via the pipe cross-section (A). The DC magnetic field is created through a switched direct current of alternating polarity.

Formulae for calculation

- Induced voltage $U_e = B \cdot L \cdot v$
- Volume flow $Q = A \cdot v$

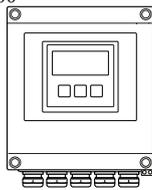
The device consists of a transmitter and a sensor.

Two device versions are available:

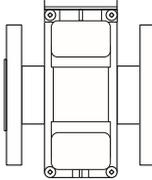
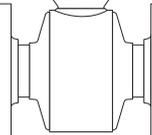
- Compact version - transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.

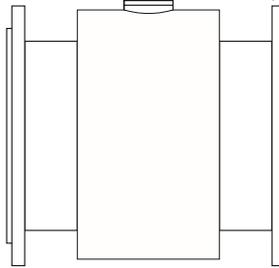
Transmitter

Measuring system

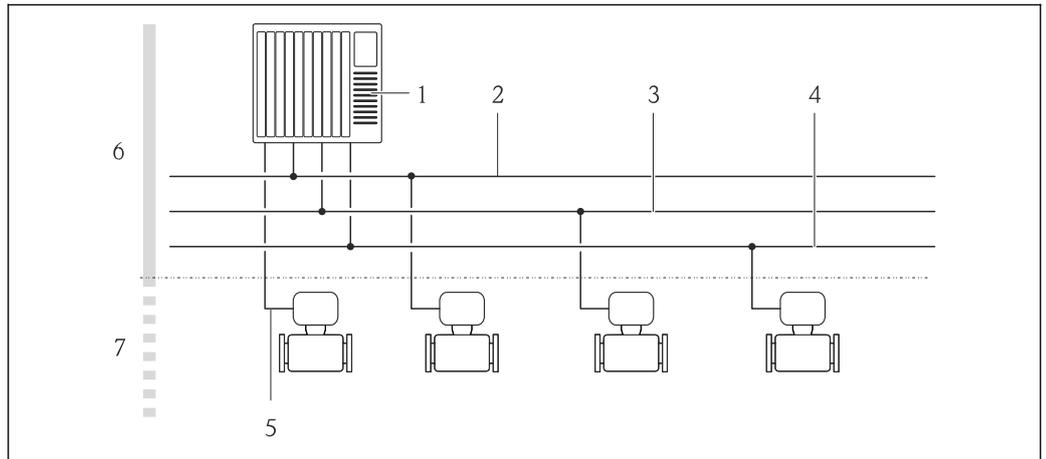
<p>Proline 400</p>  <p>A0045222</p>	<p>Device versions and materials:</p> <ul style="list-style-type: none"> • Compact version: compact housing • Polycarbonate plastic • Aluminum, AlSi10Mg, coated • Remote version: wall-mount housing • Polycarbonate plastic • Aluminum, AlSi10Mg, coated <p>Configuration:</p> <ul style="list-style-type: none"> • External operation via four-line, illuminated local display with touchcontrol and guided menus ("Make-it-run" wizards) for applications • Via operating tools (e.g. FieldCare) • Via Web browser (e.g. Microsoft Internet Explorer) • Also for device version with EtherNet/IP output: • Via Add-on Profile Level 3 for automation system from RockwellAutomation • Via Electronic Data Sheet (EDS) • Also for device version with PROFIBUS DP output: • Via PDM driver for Siemens automation system
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Sensor

<p>Promag W</p> <p><i>Lap joint flange, lap joint flange, stamped plate or fixed flange with aluminum half-shell housing: DN 25 to 300 mm (1 to 12 in)</i></p>  <p>A0017040</p>	<ul style="list-style-type: none"> • Nominal diameter range: DN 25 to 3 000 mm (1 to 120 in) • Materials → □ 91
<p><i>Fixed flange with fully welded housing made of carbon steel: DN 25 to 300 mm (1 to 12 in)</i></p>  <p>A0022673</p>	

<p><i>Fixed flange with fully welded housing made of carbon steel: DN 350 to 3 000 mm (14 to 120 in)</i></p>  <p>A0017041</p>	
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Equipment architecture



A0037833

□ 1 Possibilities for integrating measuring devices into a system

- 1 Control system (e.g. PLC)
- 2 EtherNet/IP
- 3 PROFIBUS DP
- 4 Modbus RS485
- 5 4 to 20 mA HART, pulse/frequency/switch output
- 6 Non-hazardous area
- 7 Non-hazardous area and Zone 2/Div. 2

Safety

IT security

Our warranty is valid only if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the device and associated data transfer, must be implemented by the operators themselves in line with their security standards.

Device-specific IT security

The device offers a range of specific functions to support protective measures on the operator's side. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. An overview of the most important functions is provided in the following section.

Protecting access via a password

Different passwords are available to protect write access to the device parameters or access to the device via the WLAN interface.

- User-specific access code
Protect write access to the device parameters via the local display, Web browser or operating tool (e.g. FieldCare, DeviceCare). Access authorization is clearly regulated through the use of a userspecific access code.
- WLAN passphrase
The network key protects a connection between an operating unit (e.g. notebook or tablet) and the device via the WLAN interface which can be ordered as an option.

User-specific access code

Write access to the device parameters via the local display or operating tool (e.g. FieldCare, DeviceCare) can be protected by the modifiable, user-specific access code.

WLAN passphrase: Operation as WLAN access point

A connection between an operating unit (e.g. notebook or tablet) and the device via the WLAN interface, which can be ordered as an optional extra, is protected by the network key. The WLAN authentication of the network key complies with the IEEE 802.11 standard.

When the device is delivered, the network key is pre-defined depending on the device. It can be changed via the WLAN settings submenu in the WLAN passphrase parameter.

General notes on the use of passwords

- The access code and network key supplied with the device should be changed during commissioning.
- Follow the general rules for generating a secure password when defining and managing the access code or network key.
- The user is responsible for the management and careful handling of the access code and network key.

Access via Web server

The device can be operated and configured via a Web browser with the integrated Web server. The connection is via the service interface (CDI-RJ45) or the WLAN interface. For device versions with the EtherNet/IP and PROFINET communication protocols, the connection can also be established via the terminal connection for signal transmission with EtherNet/IP or PROFINET (RJ45 plug).

The Web server is enabled when the device is delivered. The Web server can be disabled if necessary (e.g. after commissioning) via the Web server functionality parameter.

The device and status information can be hidden on the login page. This prevents unauthorized access to the information.



For detailed information on device parameters, see:

The "Description of Device Parameters" document → □ 106

Input

Measured variable

Direct measured variables

- Volume flow (proportional to induced voltage)
- Electrical conductivity

Electrical conductivity: $\geq 5 \mu\text{S/cm}$ for liquids in general



In custody transfer: only volume flow

Flow characteristic values in SI units: DN 25 to 125 mm (1 to 4 in)

Calculated measured variables

Mass flow

Measuring range

Typically $v = 0.01$ to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value ($v \sim 0.3 \dots 10 \text{ m/s}$)	Full scale value current output ($v \sim 2.5 \text{ m/s}$)	Pulse value ($\sim 2 \text{ Pulse/s}$ at $v \sim 2.5 \text{ m/s}$)	Low flow cut off ($v \sim 0.04 \text{ m/s}$)
[mm]	[in]	[dm ³ /min]	[dm ³ /min]	[dm ³]	[dm ³ /min]
25	1	9 to 300	75	0.5	1
32	–	15 to 500	125	1	2

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value ($v \sim 0.3 \dots 10 \text{ m/s}$)	Full scale value current output ($v \sim 2.5 \text{ m/s}$)	Pulse value ($\sim 2 \text{ Pulse/s}$ at $v \sim 2.5 \text{ m/s}$)	Low flow cut off ($v \sim 0.04 \text{ m/s}$)
[mm]	[in]	[dm ³ /min]	[dm ³ /min]	[dm ³]	[dm ³ /min]
40	1 ½	25 to 700	200	1.5	3
50	2	35 to 1 100	300	2.5	5
65	–	60 to 2 000	500	5	8
80	3	90 to 3 000	750	5	12

100	4	145 to 4700	1200	10	20
125	–	220 to 7500	1850	15	30

Flow characteristic values in SI units: DN 150 to 3 000 mm (6 to 120 in)

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3...10 m/s)	Factory settings:		
[mm]	[in]		Full scale value current output (v ~ 2.5 m/s) [m³/h]	Pulse value (~ 2 Pulse/s at v ~ 2.5 m/s) [m³]	Low flow cut off (v ~ 0.04 m/s) [m³/h]
150	6	20 to 600	150	0.025	2.5
200	8	35 to 1100	300	0.05	5
250	10	55 to 1700	500	0.05	7.5
300	12	80 to 2400	750	0.1	10
350	14	110 to 3300	1000	0.1	15
375	15	140 to 4200	1200	0.15	20
400	16	140 to 4200	1200	0.15	20
450	18	180 to 5400	1500	0.25	25
500	20	220 to 6600	2000	0.25	30
600	24	310 to 9600	2500	0.3	40
700	28	420 to 13500	3500	0.5	50
750	30	480 to 15000	4000	0.5	60
800	32	550 to 18000	4500	0.75	75
900	36	690 to 22500	6000	0.75	100
1000	40	850 to 28000	7000	1	125
–	42	950 to 30000	8000	1	125
1200	48	1250 to 40000	10000	1.5	150
–	54	1550 to 50000	13000	1.5	200
1400	–	1700 to 55000	14000	2	225
–	60	1950 to 60000	16000	2	250
1600	–	2200 to 70000	18000	2.5	300
–	66	2500 to 80000	20500	2.5	325
1800	72	2800 to 90000	23000	3	350
–	78	3300 to 100000	28500	3.5	450
2000	–	3400 to 110000	28500	3.5	450

Nominal diameter	Recommended flow	Factory settings
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Nominal diameter		Recommended flow	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.04 m/s)
[mm]	[in]	[m ³ /h]	[m ³ /h]	[m ³]	[m ³ /h]
–	84	3 700 to 125 000	31 000	4.5	500
2200	–	4 100 to 136 000	34 000	4.5	540
–	90	4 300 to 143 000	36 000	5	570
2400	–	4 800 to 162 000	40 000	5.5	650
–	96	5 000 to 168 000	42 000	6	675
–	102	5 700 to 190 000	47 500	7	750
2600	–	5 700 to 191 000	48 000	7	775
–	108	6 500 to 210 000	55 000	7	850
2800	–	6 700 to 222 000	55 500	8	875
–	114	7 100 to 237 000	59 500	8	950
3000	–	7 600 to 254 000	63 500	9	1 025
–	120	7 900 to 263 000	65 500	9	1 050

Flow characteristic values in SI units: DN 50 to 200 mm (2 to 8 in) for order code for "Design", option C "Fixed flange, constricted measuring tube, 0 x DN inlet/outlet runs"

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.12...5 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 4 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.01 m/s)
[mm]	[in]	[dm ³ /min]	[dm ³ /min]	[dm ³]	[dm ³ /min]
50	2	15 to 600	300	1.25	1.25
65	–	25 to 1 000	500	2	2
80	3	35 to 1 500	750	3	3.25
100	4	60 to 2 400	1 200	5	4.75
125	–	90 to 3 700	1 850	8	7.5
150	6	145 to 5 400	2 500	10	11
200	8	220 to 9 400	5 000	20	19

Flow characteristic values in SI units: DN 250 to 300 mm (10 to 12 in) for order code for "Design", option C "Fixed flange, constricted measuring tube, 0 x DN inlet/outlet runs"

Nominal diameter		Recommended flow	Factory settings		
		min./max. full scale value (v ~ 0.12...5 m/s)	Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 4 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.01 m/s)
[mm]	[in]	[m ³ /h]	[m ³ /h]	[m ³]	[m ³ /h]
250	10	20 to 850	500	0.03	1.75

300	12	35 to 1300	750	0.05	2.75
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Flow characteristic values in US units: DN 1 to 48 in (25 to 1200 mm)

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3...10 m/s)	Factory settings		
[in]	[mm]		Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.04 m/s)
		[gal/min]	[gal/min]	[gal]	[gal/min]
1	25	2.5 to 80	18	0.2	0.25
–	32	4 to 130	30	0.2	0.5
1 ½	40	7 to 185	50	0.5	0.75
2	50	10 to 300	75	0.5	1.25
–	65	16 to 500	130	1	2
3	80	24 to 800	200	2	2.5
4	100	40 to 1 250	300	2	4
–	125	60 to 1 950	450	5	7
6	150	90 to 2 650	600	5	12
8	200	155 to 4 850	1 200	10	15
10	250	250 to 7 500	1 500	15	30
12	300	350 to 10 600	2 400	25	45
14	350	500 to 15 000	3 600	30	60
15	375	600 to 19 000	4 800	50	60
16	400	600 to 19 000	4 800	50	60
18	450	800 to 24 000	6 000	50	90
20	500	1 000 to 30 000	7 500	75	120
24	600	1 400 to 44 000	10 500	100	180
28	700	1 900 to 60 000	13 500	125	210
30	750	2 150 to 67 000	16 500	150	270
32	800	2 450 to 80 000	19 500	200	300
36	900	3 100 to 100 000	24 000	225	360
40	1000	3 800 to 125 000	30 000	250	480
42	–	4 200 to 135 000	33 000	250	600
48	1200	5 500 to 175 000	42 000	400	600

Flow characteristic values in US units: DN 54 to 120 in (1400 to 3000 mm)

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3...10 m/s)	Factory settings		
			Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.04 m/s)

[in]	[mm]	[Mgal/d]	[Mgal/d]	[Mgal]	[Mgal/d]
54	–	9 to 300	75	0.0005	1.3
–	1400	10 to 340	85	0.0005	1.3
60	–	12 to 380	95	0.0005	1.3
–	1600	13 to 450	110	0.0008	1.7
66	–	14 to 500	120	0.0008	2.2
72	1800	16 to 570	140	0.0008	2.6

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.3...10 m/s)	Factory settings		
[in]	[mm]		Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 2 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.04 m/s)
[in]	[mm]	[Mgal/d]	[Mgal/d]	[Mgal]	[Mgal/d]
78	–	18 to 650	175	0.0010	3.0
–	2000	20 to 700	175	0.0010	2.9
84	–	24 to 800	190	0.0011	3.2
–	2200	26 to 870	210	0.0012	3.4
90	–	27 to 910	220	0.0013	3.6
–	2400	31 to 1030	245	0.0014	4.0
96	–	32 to 1066	265	0.0015	4.0
102	–	34 to 1203	300	0.0017	5.0
–	2600	34 to 1212	305	0.0018	5.0
108	–	35 to 1300	340	0.0020	5.0
–	2800	42 to 1405	350	0.0020	6.0
114	–	45 to 1503	375	0.0022	6.0
–	3000	48 to 1613	405	0.0023	6.0
120	–	50 to 1665	415	0.0024	7.0

Flow characteristic values in US units: DN 2 to 12 in (50 to 300 mm) for order code for "Design", option C "Fixed flange, constricted measuring tube, 0 x DN inlet/outlet runs"

Nominal diameter		Recommended flow min./max. full scale value (v ~ 0.12...5 m/s)	Factory settings		
[in]	[mm]		Full scale value current output (v ~ 2.5 m/s)	Pulse value (~ 4 Pulse/s at v ~ 2.5 m/s)	Low flow cut off (v ~ 0.01 m/s)
[in]	[mm]	[gal/min]	[gal/min]	[gal]	[gal/min]
2	50	4 to 160	75	0.3	0.35
–	65	7 to 260	130	0.5	0.6
3	80	10 to 400	200	0.8	0.8
4	100	16 to 650	300	1.2	1.25

–	125	24 to 1 000	450	1.8	2
6	150	40 to 1 400	600	2.5	3
8	200	60 to 2 500	1 200	5	5
10	250	90 to 3 700	1 500	6	8
12	300	155 to 5 700	2 400	9	12

Recommended measuring range

 Flow limit → □ 52

 For custody transfer, the applicable approval determines the permitted measuring range, the pulse value and the low flow cut off.

Operable flow range

Over 1000 : 1

 For custody transfer, the operable flow range is 100 : 1 to 630 : 1, depending on the nominal diameter. Further details are specified by the applicable approval.

Input signal

External measured values

 Various pressure transmitters and temperature measuring devices can be ordered from Endress +Hauser: see "Accessories" section → □ 105

It is recommended to read in external measured values to calculate the following measured variables:
Mass flow

HART protocol

The measured values are written from the automation system to the measuring device via the HART protocol. The pressure transmitter must support the following protocol-specific functions:

- HART protocol
- Burst mode

Digital communication

The measured values can be written from the automation system to the measuring via:

- PROFIBUS DP
- Modbus RS485
- EtherNet/IP

Status input

Output

Output signal

Current output

Maximum input values	<ul style="list-style-type: none"> • DC 30 V • 6 mA
Response time	Configurable: 5 to 200 ms

Input signal level	<ul style="list-style-type: none"> • Low signal (low): DC -3 to +5 V • High signal (high): DC 12 to 30 V
Assignable functions	<ul style="list-style-type: none"> • Off • Reset totalizers 1-3 separately • Reset all totalizers • Flow override
Current output	Can be set as: <ul style="list-style-type: none"> • 4 to 20 mA NAMUR • 4 to 20 mA US • 4 to 20 mA HART • 0 to 20 mA
Maximum output values	<ul style="list-style-type: none"> • DC 24 V (no flow) • 22.5 mA
Load	0 to 700 Ω
Resolution	0.5 μ A

Damping	Configurable: 0.07 to 999 s
Assignable measured variables	<ul style="list-style-type: none"> • Volume flow • Mass flow • Corrected volume flow • Flow velocity • Conductivity ¹⁾ • Corrected conductivity ¹⁾ • Temperature ¹⁾ • Electronics temperature • Reference electrode potential ¹⁾ • Coil current rise time ¹⁾ • Noise ¹⁾ • Build-up measured value ¹⁾ • Test points 1-3

1) Visible depending on order options or device settings

Pulse/frequency/switch output

Function	<ul style="list-style-type: none"> • With the order code for "Output; Input", option H: output 2 can be set as a pulse or frequency output • With the order code for "Output; Input", option I: output 2 and 3 can be set as a pulse, frequency or switch output • With the order code for "Output; Input", option J: output 2 firmly assigned as certified pulse output
Version	Passive, open collector
Maximum input values	<ul style="list-style-type: none"> • DC 30 V • 250 mA
Voltage drop	At 25 mA: \leq DC 2 V
Pulse output	
Pulse width	Configurable: 0.05 to 2000 ms
Maximum pulse rate	10000 Impulse/s
Pulse value	Configurable
Assignable measured variables	<ul style="list-style-type: none"> • Volume flow • Mass flow • Corrected volume flow
Frequency output	

Output frequency	Configurable: 0 to 12 500 Hz
Damping	Configurable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	<ul style="list-style-type: none"> • Volume flow • Mass flow • Corrected volume flow • Flow velocity • Conductivity¹⁾ • Corrected conductivity¹⁾ • Temperature¹⁾ • Electronics temperature • Noise¹⁾ • Coil current rise time¹⁾ • Reference electrode potential¹⁾ • Build-up measured value¹⁾ • Test points 1-3
Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s

Number of switching cycles	Unlimited
Assignable functions	<ul style="list-style-type: none"> • Off • On • Diagnostic behavior • Limit value: • Off • Volume flow • Corrected volume flow • Mass flow • Flow velocity • Conductivity¹⁾ • Corrected conductivity¹⁾ • Totalizer 1-3 • Temperature¹⁾ • Electronics temperature • Flow direction monitoring • Status: • Empty pipe detection • Low flow cut off • Build-up limit value¹⁾

1) Visible depending on order options or device settings

PROFIBUS DP

Signal encoding	NRZ code
Data transmission	9.6 kBaud...12 MBaud

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	Integrated, can be activated via DIP switch on the transmitter electronics module

EtherNet/IP

Standards	In accordance with IEEE 802.3
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Signal on alarm

Depending on the interface, failure information is displayed as follows:

Current output 4 to 20 mA

4 to 20 mA

Failure mode	Choose from: <ul style="list-style-type: none"> • 4 to 20 mA in accordance with NAMUR recommendation NE 43 • 4 to 20 mA in accordance with US • Min. value: 3.59 mA • Max. value: 22.5 mA • Freely definable value between: 3.59 to 22.5 mA • Actual value • Last valid value
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0 to 20 mA

Failure mode	Choose from: <ul style="list-style-type: none"> • Maximum alarm: 22 mA • Freely definable value between: 0 to 22.5 mA
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HART current output

Device diagnostics	Device condition can be read out via HART Command 48
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Pulse/frequency/switch output

Pulse output	
Failure mode	Choose from: <ul style="list-style-type: none"> • Actual value • No pulses
Frequency output	
Failure mode	Choose from: <ul style="list-style-type: none"> • Actual value • 0 Hz • Defined value: 0 to 12 500 Hz
Switch output	
Failure mode	Choose from: <ul style="list-style-type: none"> • Current status • Open • Closed

PROFIBUS DP

Status and alarm messages	Diagnostics in accordance with PROFIBUS PA Profile 3.02
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Modbus RS485

Failure mode	Choose from: <ul style="list-style-type: none"> • NaN value instead of current value • Last valid value
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EtherNet/IP

Device diagnostics	Device condition can be read out in Input Assembly
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Local display

Plain text display	With information on cause and remedial measures
Backlight	Red backlighting indicates a device error.

 Status signal as per NAMUR recommendation NE 107

Interface/protocol

- Via digital communication:
 - HART protocol
 - PROFIBUS DP
 - Modbus RS485
 - EtherNet/IP
- Via service interface
 - CDI-RJ45 service interface
 - WLAN interface

Plain text display	With information on cause and remedial measures
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 Additional information on remote operation → □ 95

Web browser

Plain text display	With information on cause and remedial measures
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Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: <ul style="list-style-type: none"> • Supply voltage active • Data transmission active • Device alarm/error has occurred • EtherNet/IP network available • EtherNet/IP connection established
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Low flow cut off The switch points for low flow cut off are user-selectable.

Galvanic isolation The following connections are galvanically isolated from each other:

- Inputs
- Outputs
- Power supply

Protocol-specific data

HART

Manufacturer ID	0x11
Device type ID	0x1169
HART protocol revision	7
Device description files (DTM, DD)	Information and files under: www.endress.com
HART load	Min. 250 Ω

Dynamic variables PV, SV, TV, QV	<ul style="list-style-type: none"> • Read out the dynamic variables via HART command 3 • The measured variables can be freely assigned to the dynamic variables
Device variables	<ul style="list-style-type: none"> • Read out the device variables via HART command 9 • The measured variables can be freely assigned • A maximum of 8 device variables can be transmitted
System integration	Operating Instructions for the device → □ 106

PROFIBUS DP

Manufacturer ID	0x11
Ident number	0x1562
Profile version	3.02
Device description files (GSD, DTM, DD)	Information and files under: <ul style="list-style-type: none"> • www.endress.com • www.profibus.org
Output values	Output values (from the measuring device to the automation system) <ul style="list-style-type: none"> • 4 Analog input • 2 Digital input • 3 Totalizer

Input values	Input values (from the automation system to the measuring device) <ul style="list-style-type: none"> • 2 Analog output (fixed assignment) • 2 Digital output (fixed assignment) • 3 Totalizer
Device address configuration options	Configuration of the device address <ul style="list-style-type: none"> • Hardware: DIP switches on the I/O electronics module • Software: Via operating tools (e.g. FieldCare)
Supported functions	<ul style="list-style-type: none"> • Identification & Maintenance: Simplest device identification on the part of the control system and nameplate • PROFIBUS upload/download: Reading and writing parameters is up to ten times faster with PROFIBUS upload/download • Condensed status: Simplest and self-explanatory diagnostic information by categorizing diagnostic messages that occur
System integration	Operating Instructions for the device → □ 106

Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	<ul style="list-style-type: none"> • 03: Read holding register • 04: Read input register • 06: Write single registers • 08: Diagnostics • 16: Write multiple registers • 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: <ul style="list-style-type: none"> • 06: Write single registers • 16: Write multiple registers • 23: Read/write multiple registers

Supported baud rate	<ul style="list-style-type: none"> • 1 200 BAUD • 2 400 BAUD • 4 800 BAUD • 9 600 BAUD • 19 200 BAUD • 38 400 BAUD • 57 600 BAUD • 115 200 BAUD
Modbus data transmission	<ul style="list-style-type: none"> • ASCII • RTU
Data access	<p>Each device parameter can be accessed via Modbus RS485.</p> <p><input type="checkbox"/> see the Description of Device Parameters → <input type="checkbox"/> 106 For detailed information on the "Modbus RS485 register information",</p>
System integration	Operating Instructions for the device → <input type="checkbox"/> 106

EtherNet/IP

Protocol	<ul style="list-style-type: none"> • The CIP Networks Library Volume 1: Common Industrial Protocol • The CIP Networks Library Volume 2: EtherNet/IP Adaptation of CIP
Communication type	<ul style="list-style-type: none"> • 10Base-T • 100Base-TX
Device profile	Generic device (product type: 0x2B)
Manufacturer ID	0x49E

Device type ID	0x1069
Baud rates	Automatic 10/100 Mbit with half-duplex and full-duplex detection
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs
Supported CIP connections	Max. 3 connections
Explicit connections	Max. 5 connections
I/O connections	Max. 6 connections (scanner)
Configuration options for measuring device	<p>Configuration options for measuring device</p> <ul style="list-style-type: none"> • DIP switches on the electronics module for IP addressing • Manufacturer-specific software (FieldCare) • Custom Add-on Profile for Rockwell Automation control systems • Web browser • Electronic Data Sheet (EDS) integrated in the measuring device
EtherNet interface configuration options	<p>Configuration of the EtherNet interface</p> <ul style="list-style-type: none"> • Speed: 10 MBit, 100 MBit, auto (factory setting) • Duplex: half-duplex, full-duplex, auto (factory setting)
Device address configuration options	<p>Configuration of the device address</p> <ul style="list-style-type: none"> • DIP switches on the electronics module for IP addressing (last octet) • DHCP • Manufacturer-specific software (FieldCare) • Custom Add-on Profile for Rockwell Automation control systems • Web browser • EtherNet/IP tools, e.g. RSLinx (Rockwell Automation)
Device Level Ring (DLR)	No

Assembly	<ul style="list-style-type: none"> • Legacy Input Assembly Fix (Assem 100) • Legacy Input Assembly Configurable (Assem 101) • Legacy Output Assembly Fix (Assem 102) • Legacy Configuration Assembly (Assem 104) • Input Assembly Fix (Assem 120) • Input Assembly Configurable (Assem 121) • Output Assembly Fix (Assem 122) • Configuration Assembly (Assem 124) • Volume Flow Extended Fix Input (Assem 126) • Volume Flow Universal Fix Input (Assem 127) • Dummy Output Assembly Fix (Assem 199)
Requested Packet Interval (RPI)	5 ms to 10 s (factory setting: 20 ms)
System integration	Operating Instructions for the device → □ 106

Power supply

Terminal assignment

Transmitter: 0 to 20 mA/4 to 20 mA HART

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	<ul style="list-style-type: none"> • Option A: coupling M20x1 • Option B: thread M20x1 • Option C: thread G ½" • Option D: thread NPT ½"

Supply voltage

Order code "Power supply"	Terminal numbers	terminal voltage		Frequency range
Option L (wide range power unit)	1 (L+/L), 2 (L-/N)	DC 24 V	±25%	–
		AC 24 V	±25%	50/60 Hz, ±4 Hz
		AC 100 to 240 V	–15 to +10%	50/60 Hz, ±4 Hz

Signal transmission with current output 0 to 20 mA/4 to 20 mA HART and other outputs and inputs

Order code for "Output" and "Input"	Terminal							
	Output 1		Output 2		Output 3		Input	
	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)
Option H	Current output • 4 to 20 mA HART (active) • 0 to 20 mA (active)		Pulse/frequency output (passive)		Switch output (passive)		-	
Option I	Current output • 4 to 20 mA HART (active) • 0 to 20 mA (active)		Pulse/frequency/switch output (passive)		Pulse/frequency/switch output (passive)		Status input	
Option J	Current output • 4 to 20 mA HART (active) • 0 to 20 mA (active)		Fixed assignment: Certified pulse output (passive)		Switch output		Status input	

Transmitter: PROFIBUS DP

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	<ul style="list-style-type: none"> Option A: coupling M20x1 Option B: thread M20x1 • Option C: thread G ½" Option D: thread NPT ½"

Supply voltage

Order code "Power supply"	Terminal numbers	terminal voltage		Frequency range
Option L (wide range power unit)	1 (L+/L), 2 (L-/N)	DC 24 V	±25%	–
		AC 24 V	±25%	50/60 Hz, ±4 Hz
		AC 100 to 240 V	–15 to +10%	50/60 Hz, ±4 Hz

PROFIBUS DP signal transmission

Order code for "Output" and "Input"	Terminal numbers 26 (Rx/D/TxD-P)	
	27 (Rx/D/TxD-N)	
Option L	B	A
Order code for "Output": Option L: PROFIBUS DP, for use in non-hazardous areas and Zone 2/Div. 2		

Transmitter: Modbus RS485

The sensor can be ordered with terminals.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
Terminals	Terminals	<ul style="list-style-type: none"> Option A: coupling M20x1 Option B: thread M20x1 • Option C: thread G ½" Option D: thread NPT ½"

Supply voltage

Order code "Power supply"	Terminal numbers	terminal voltage		Frequency range
Option L (wide range power unit)	1 (L+/L), 2 (L-/N)	DC 24 V	±25%	–
		AC 24 V	±25%	50/60 Hz, ±4 Hz
		AC 100 to 240 V	–15 to +10%	50/60 Hz, ±4 Hz

Signal transmission with Modbus RS485 and other outputs

Order code for "Output" and "Input"	Terminal r						
	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+) 21 (-)
Option M	Modbus		-	-	-		
	B	A					
Option O	Current output 4 to 20 mA (active)		Pulse/frequency/ switch output (passive)	Pulse/frequency/ switch output (passive)	Mo Ibus		
					B	A	

Option P	Current output 4 to 20 mA (active)	Pulse output certified (passive)	Pulse/frequency/ switch output (passive)	Moibus B A
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Transmitter: EtherNet/IP

The transmitter can be ordered with terminals or a device plug.

Connection methods available		Possible options for order code "Electrical connection"
Outputs	Power supply	
EtherNet/IP (RJ45 plug)	Terminals	Option D: thread NPT 1/2"
Device plug → □ 22	Terminals	<ul style="list-style-type: none"> Option L: plug M12x1 + thread NPT 1/2" Option N: plug M12x1 + coupling M20 Option P: plug M12x1 + thread G 1/2" Option U: plug M12x1 + thread M20

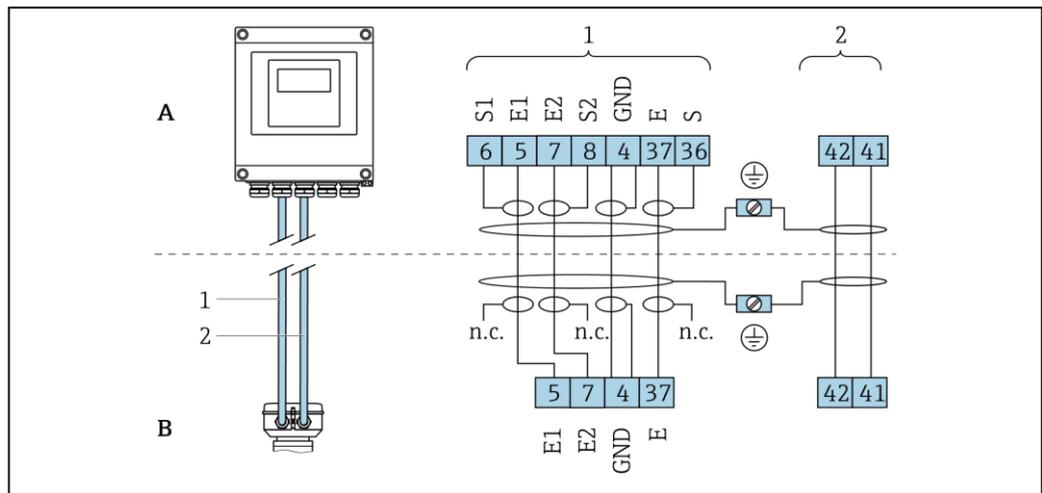
Supply voltage

Order code "Power supply"	Terminal numbers	terminal voltage		Frequency range
Option L (wide range power unit)	1 (L+/L), 2 (L-/N)	DC 24 V	±25%	–
		AC 24 V	±25%	50/60 Hz, ±4 Hz
		AC 100 to 240 V	–15 to +10%	50/60 Hz, ±4 Hz

EtherNet/IP signal transmission

Order code for "Output"	Connection via
Option N	EtherNet/IP: RJ45 or M12 plug

Remote version



A0032059

□ 2 Remote version terminal assignment

A Transmitter wall-mount housing

B Sensor connection housing

1 Electrode cable

2 Coil current cable

n.c. Not connected, insulated cable shields

Terminal No. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Pin assignment, device plug



Order codes for the M12x1 plugs, see the "Order code for electrical connection" column:
EtherNet/IP → □ 21

EtherNet/IP

Device plug for signal transmission (device side)

	Pin	Assignment		Coding	Plug/socket
	1	+	Tx	D	Socket
	2	+	Rx		
	3	-	Tx		
	4	-	Rx		

Recommended plug:

- Binder, series 763, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q
- The device plug is not permitted in the hazardous area, Class I Division 2. The device plug may only be used in the non-hazardous area (General Purpose).

Supply Transmitter voltage

Order code for "Power supply"	terminal voltage		Frequency range
Option L	DC 24 V	±25%	—
	AC 24 V	±25%	50/60 Hz, ±4 Hz
	AC 100 to 240 V	-15 to +10%	50/60 Hz, ±4 Hz

Power consumption

Order code for "Output"	Maximum power consumption
Option H: 4-20mA HART, pulse/frequency output, switch output	30 VA/8 W
Option I: 4-20mA HART, 2 x pulse/frequency/switch output, status input	30 VA/8 W
Option J: 4-20mA HART, certified pulse output, switch output, status input	30 VA/8 W
Option L: PROFIBUS DP	30 VA/8 W
Option M: Modbus RS485	30 VA/8 W
Option O: Modbus RS485, 4-20mA, 2 x pulse/frequency/switch output	30 VA/8 W
Option P: Modbus RS485, 4-20mA, certified pulse output, pulse/frequency/switch output	30 VA/8 W
Option N: EtherNet/IP	30 VA/8 W

Current Transmitter consumption

Order code for "Power supply"	Maximum Current consumption	Maximum switch-on current
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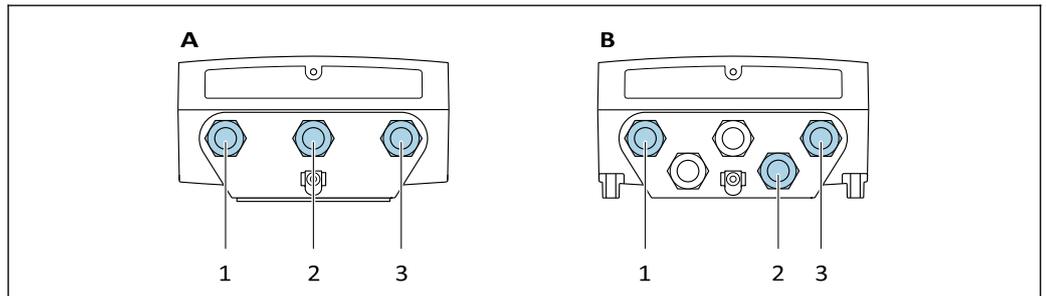
Option L: AC 100 to 240 V	145 mA	25 A (< 5 ms)
Option L: AC/DC 24 V	350 mA	27 A (< 5 ms)

Power supply failure

- Totalizers stop at the last value measured.
- Depending on the device version, the configuration is retained in the device memory or in the pluggable data memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

Electrical connection

Connecting the transmitter

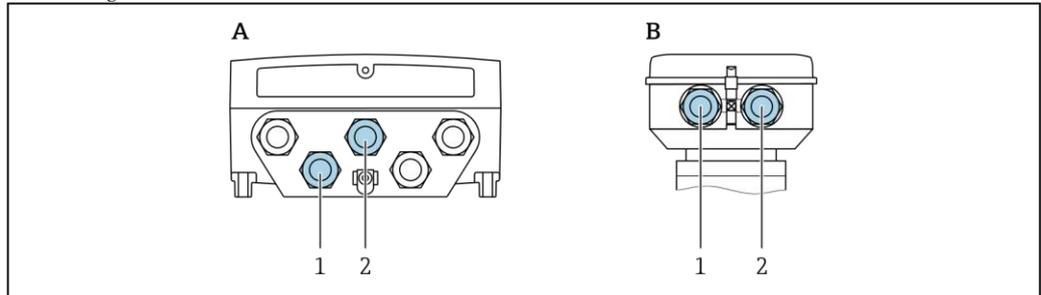


□ 3 Supply voltage and signal transmission connection

- A Compact version
- B Remote version wall-mount housing
- 1 Cable entry for supply voltage
- 2 Cable entry for signal transmission
- 3 Cable entry for signal transmission

Remote version connection

Connecting cable



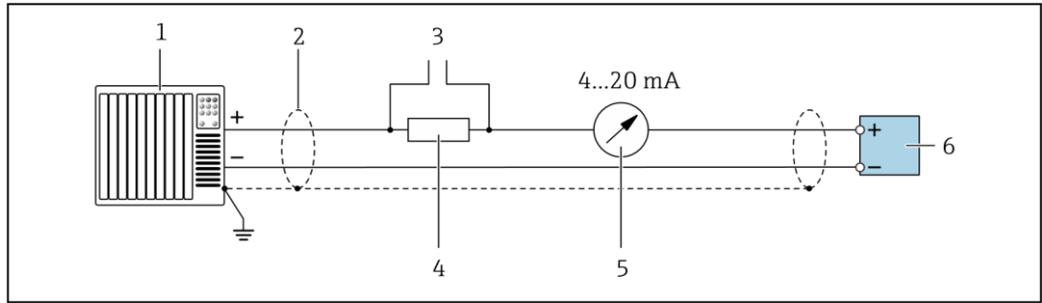
□ 4 Connecting cable connection: electrode and coil current cable

- A Transmitter wall-mount housing
- B Sensor connection housing
- 1 Electrode cable
- 2 Coil current cable

- Fix the cable run or route it in an armored conduit.
Cable movements can influence the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between the sensor and transmitter → □ 27.

Connection examples

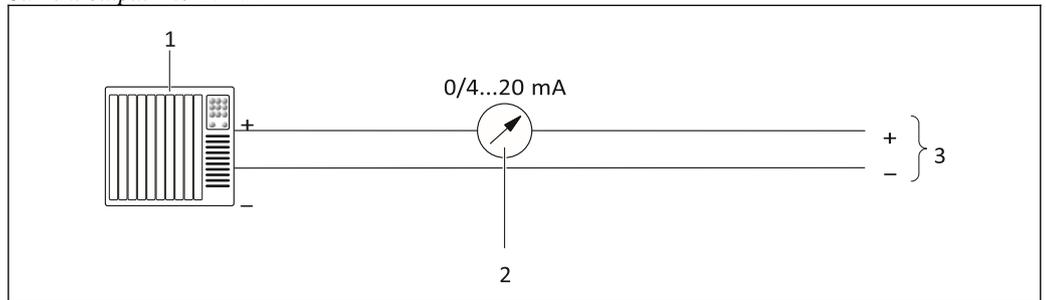
Current output 4 to 20 mA HART



A0029055

- 5 Connection example for 4 to 20 mA HART current output (active)
- 1 Automation system with current input (e.g. PLC)
- 2 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications → □ 31
- 3 Connection for HART operating devices → □ 95
- 4 Resistor for HART communication ($\geq 250 \Omega$): observe maximum load → □ 13
- 5 Analog display unit: observe maximum load → □ 13
- 6 Transmitter

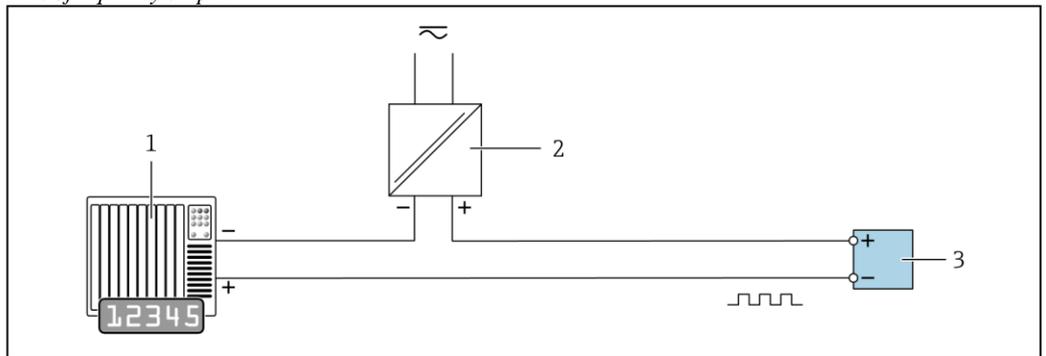
Current output 4 to 20 mA



A0017162

- 6 Connection example for 0 to 20 mA (active) and 4 to 20 mA (active) current output
- 1 Automation system with current input (e.g. PLC)
- 2 Analog display unit: observe maximum load 3 Transmitter

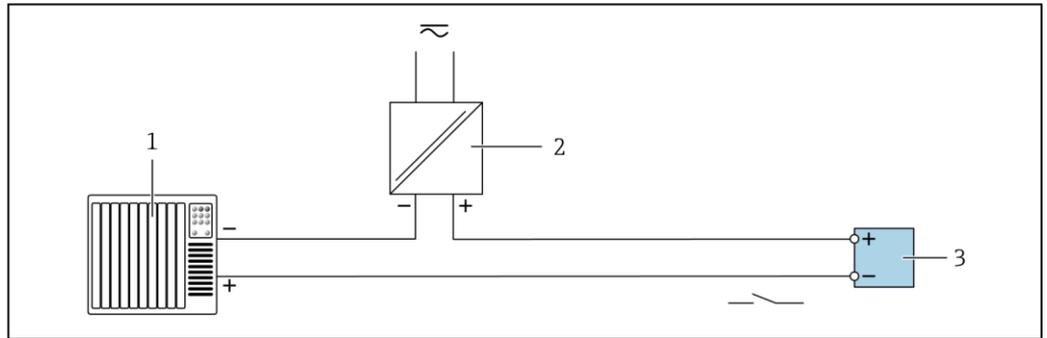
Pulse/frequency output



A0028761

- 7 Connection example for pulse/frequency output (passive)
- 1 Automation system with pulse/frequency input (e.g. PLC)
- 2 Power supply
- 3 Transmitter: Observe input values → □ 14

Switch output

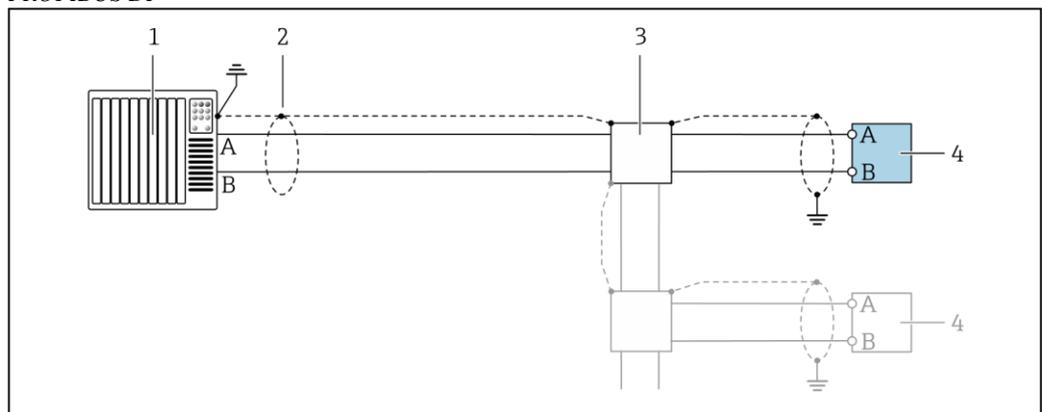


A0028760

□ 8 Connection example for switch output (passive)

- 1 Automation system with switch input (e.g. PLC)
- 2 Power supply
- 3 Transmitter: Observe input values → □ 14

PROFIBUS DP



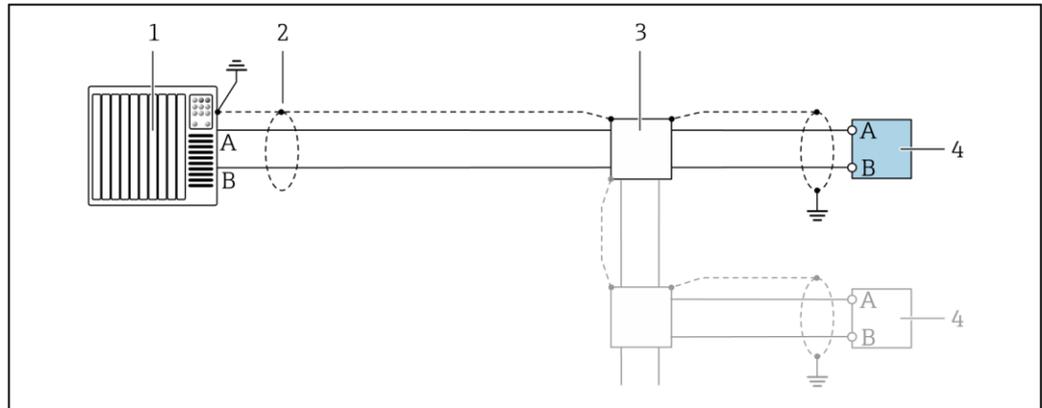
A0028765

□ 9 Connection example for PROFIBUS DP, non-hazardous area and Zone 2/Div. 2

- 1 Control system (e.g. PLC)
- 2 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications
- 3 Distribution box
- 4 Transmitter

i If baud rates > 1.5 Mbaud an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

Modbus RS485



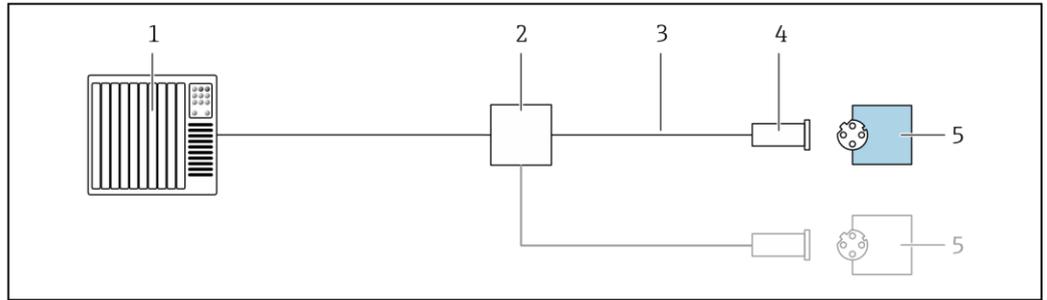
A0028765

□ 10 Connection example for Modbus RS485, non-hazardous area and Zone 2/Div. 2

- 1 Control system (e.g. PLC)

- 2 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications
- 3 Distribution box
- 4 Transmitter

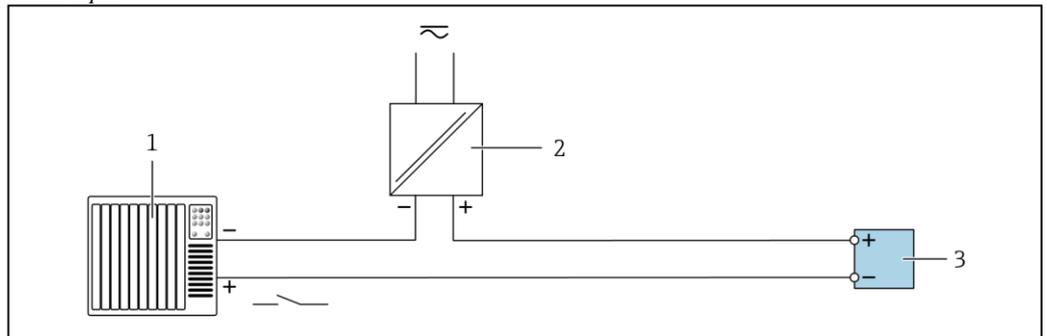
EtherNet/IP



□ 11 Connection example for EtherNet/IP

- 1 Control system (e.g. PLC)
- 2 Ethernet switch
- 3 Observe cable specifications
- 4 Device plug
- 5 Transmitter

Status input



□ 12 Connection example for status input

- 1 Automation system with status output (e.g. PLC)
- 2 Power supply
- 3 Transmitter

Potential equalization

Introduction

Correct potential equalization (equipotential bonding) is a prerequisite for stable and reliable flow measurement. Inadequate or incorrect potential equalization can result in device failure and present a safety hazard.

The following requirements must be observed to ensure correct, trouble-free measurement:

- The principle that the medium, the sensor and the transmitter must be at the same electrical potential applies.
- Take in-company grounding guidelines, materials and the grounding conditions and potential conditions of the pipe into consideration.
- Any necessary potential equalization connections must be established by ground cables with a minimum cross-section of 6 mm² (0.0093 in²).
- For remote device versions, the ground terminal in the example always refers to the sensor and not to the transmitter.



You can order accessories like ground cables and ground disks from Endress+Hauser → □ 103



For devices intended for use in hazardous locations, observe the instructions in the Ex documentation (XA).

Abbreviations used

- PE (Protective Earth): potential at the protective earth terminals of the device
- P_P (Potential Pipe): potential of the pipe, measured at the flanges
- P_M (Potential Medium): potential of the medium

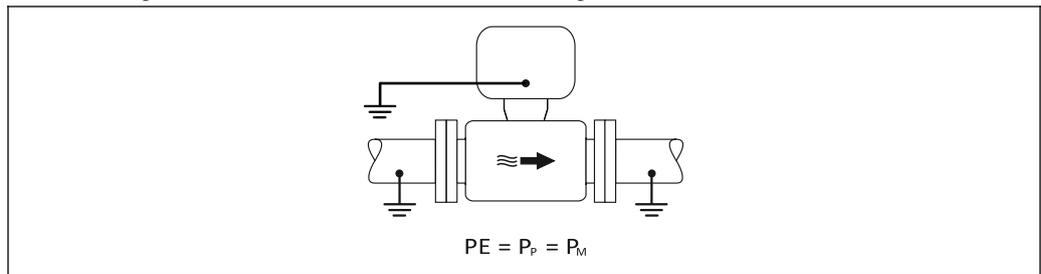
Connection examples for standard situations

Unlined and grounded metal pipe

- Potential equalization is via the measuring pipe.
- The medium is set to ground potential.

Starting conditions:

- Pipes are correctly grounded on both sides.
- Pipes are conductive and at the same electrical potential as the medium



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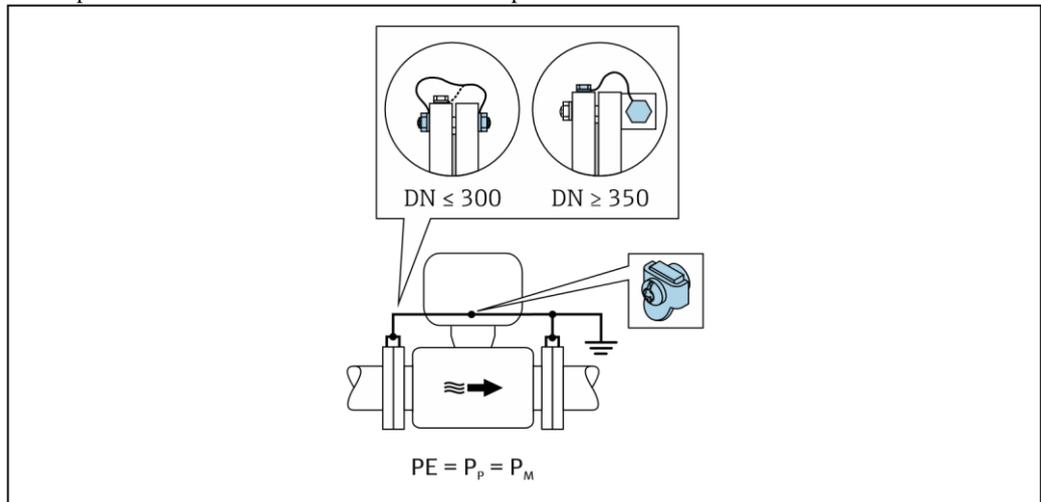
- Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for this purpose.

Unlined metal pipe

- Potential equalization is via the ground terminal and pipe flanges.
- The medium is set to ground potential.

Starting conditions:

- Pipes are not sufficiently grounded.
- Pipes are conductive and at the same electrical potential as the medium



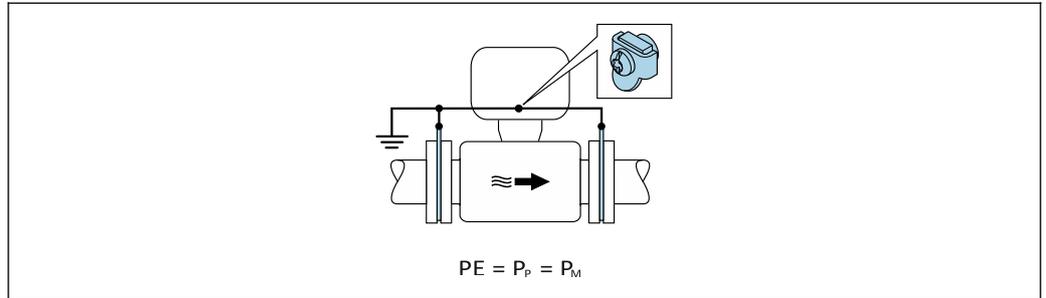
A0042089

1. Connect both sensor flanges to the pipe flange via a ground cable and ground them.
2. Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for this purpose.

- i** • For DN ≤ 300 (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.
- For DN ≥ 350 (14"): Mount the ground cable directly on the metal transport bracket. Observe screw tightening torques: see the Brief Operating Instructions for the sensor.

Plastic pipe or pipe with insulating liner

- Potential equalization is via the ground terminal and ground disks.
- The medium is set to ground potential.
Starting conditions:
- The pipe has an insulating effect.
- Low-impedance medium grounding close to the sensor is not guaranteed.
- Equalizing currents through the medium cannot be ruled out.



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1. Connect the ground disks to the ground terminal of the connection housing of the transmitter or sensor via the ground cable.
2. Connect the connection to ground potential.

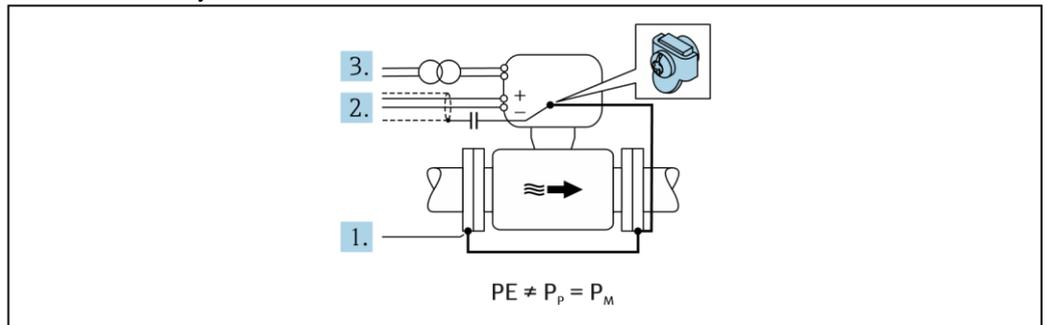
Connection example with the potential of the medium not equal to the protective ground In these cases, the medium potential can differ from the potential of the device.

Metal, ungrounded pipe

The sensor and transmitter are installed in a way that provides electrical insulation from PE, e.g. applications for electrolytic processes or systems with cathodic protection.

Starting conditions:

- Unlined metal pipe
- Pipes with an electrically conductive liner



A0042253

1. Connect the pipe flanges and transmitter via the ground cable.
2. Route the shielding of the signal lines via a capacitor (recommended value 1.5µF/50V).
3. Device connected to power supply such that it is floating in relation to the protective earth (isolation transformer). This measure is not required in the case of 24V DC supply voltage without PE (= SELV power unit).

Connection examples with the potential of medium not equal to protective earth with the "Measurement isolated from ground" option

In these cases, the medium potential can differ from the potential of the device.

Introduction

The "Measurement isolated from ground" option enables the galvanic isolation of the measuring system from the device potential. This minimizes harmful equalizing currents caused by differences in potential between the medium and the device. The "Measurement isolated from ground" option is optionally

available: order code for "Sensor option", option CV

Operating conditions for the use of the "Measurement isolated from ground" option

Device version	Compact version and remote version (length of connecting cable ≤ 10 m)
Differences in voltage between medium potential and device potential	As small as possible, usually in the mV range
Alternating voltage frequencies in the medium or at ground potential (PE)	Below typical power line frequency in the country

i To achieve the specified conductivity measuring accuracy, a conductivity calibration is recommended when the device is installed.

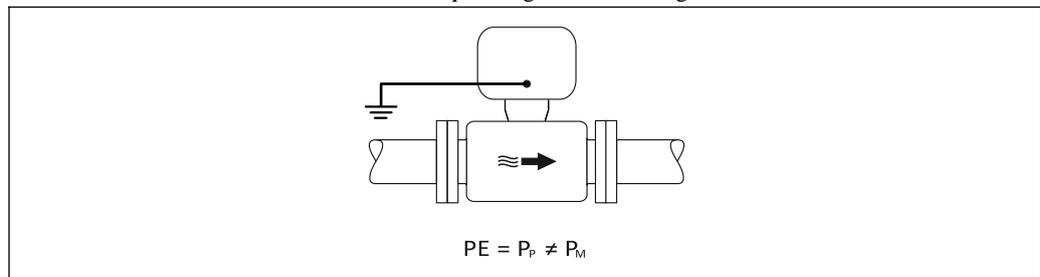
A full pipe adjustment is recommended when the device is installed.

Plastic pipe

Sensor and transmitter are correctly grounded. A difference in potential can occur between the medium and protective earth. Potential equalization between P_M and PE via the reference electrode is minimized with the "Measurement isolated from ground" option.

Starting conditions:

- The pipe has an insulating effect.
- Equalizing currents through the medium cannot be ruled out.



A0044855

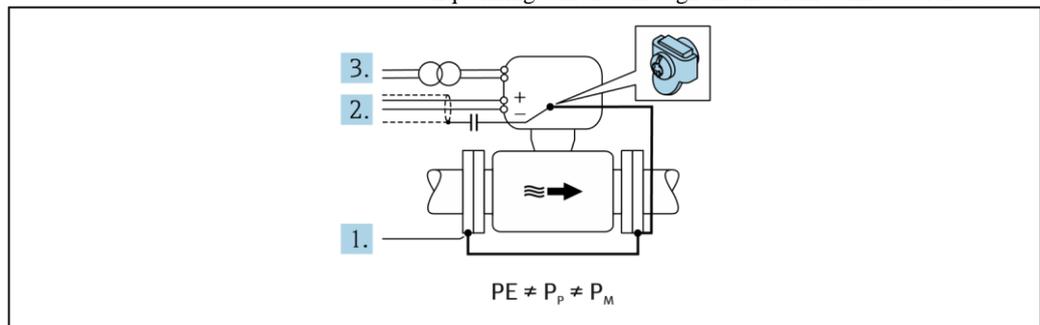
1. Use the "Measurement isolated from ground" option, while observing the operating conditions for measurement isolated from ground.
2. Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for this purpose.

Metal, ungrounded pipe with insulating liner

The sensor and transmitter are installed in a way that provides electrical insulation from PE. The medium and pipe have different potentials. The "Measurement isolated from ground" option minimizes harmful equalizing currents between P_M and P_P via the reference electrode.

Starting conditions:

- Metal pipe with insulating liner
- Equalizing currents through the medium cannot be ruled out.



A0044857

1. Connect the pipe flanges and transmitter via the ground cable.
2. Route the shielding of the signal cables via a capacitor (recommended value $1.5\mu F/50V$).

3. Device connected to power supply such that it is floating in relation to the protective earth (isolation transformer). This measure is not required in the case of 24V DC supply voltage without PE (= SELV power unit).
4. Use the "Measurement isolated from ground" option, while observing the operating conditions for measurement isolated from ground.

Terminals	<p>Transmitter</p> <ul style="list-style-type: none"> • Supply voltage cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG) • Signal cable: plug-in spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG) • Electrode cable: spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG) • Coil current cable: spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG) <p>Sensor connection housing</p> <p>Spring terminals for wire cross-sections 0.5 to 2.5 mm² (20 to 14 AWG)</p>
Cable entries	<p>Cable entry thread</p> <ul style="list-style-type: none"> • M20 x 1.5 • Via adapter: • NPT 1/2" • G 1/2"

- Cable gland
- For standard cable: M20 × 1.5 with cable □ 6 to 12 mm (0.24 to 0.47 in)
 - For armored cable: M20 × 1.5 with cable □ 9.5 to 16 mm (0.37 to 0.63 in)



If metal cable entries are used, use a grounding plate.

Cable specification

- Permitted temperature range
- installation must be observed.
- The installation guidelines that apply in the country of
 - The cables must be suitable for the minimum and maximum temperatures to be expected.

Power supply cable (incl. conductor for the inner ground terminal) Standard installation cable is sufficient.

Signal cable

Current output 0/4 to 20 mA

Standard installation cable is sufficient.

Current output 4 to 20 mA HART

A shielded cable is recommended. Observe grounding concept of the plant.

Pulse/frequency/switch output

Standard installation cable is sufficient.

Status input

Standard installation cable is sufficient.

PROFIBUS DP

The IEC 61158 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz

Cable capacitance	< 30 pF/m
Wire cross-section	> 0.34 mm ² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shield	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.



For further information on planning and installing PROFIBUS networks see:
 Operating Instructions "PROFIBUS DP/PA: Guidelines for planning and commissioning"
 (BA00034S)

Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	< 30 pF/m
Wire cross-section	> 0.34 mm ² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shield	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

EtherNet/IP

The standard ANSI/TIA/EIA-568-B.2 Annex specifies CAT 5 as the minimum category for a cable used for EtherNet/IP. CAT 5e and CAT 6 are recommended.



For more information on planning and installing EtherNet/IP networks, please refer to the "Media Planning and Installation Manual. EtherNet/IP" of ODVA Organization

Connecting cable for remote version

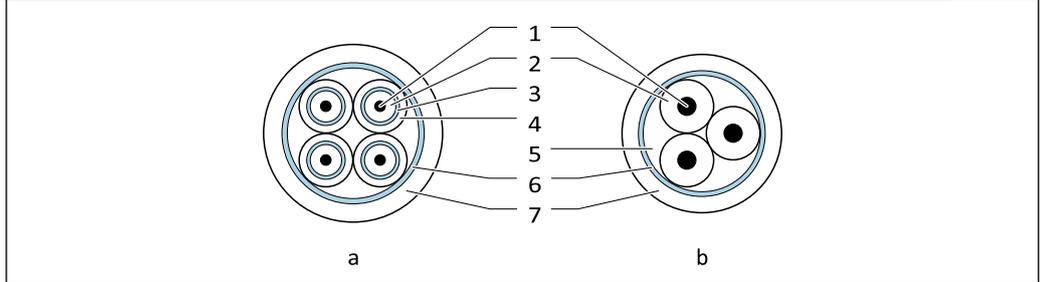
Electrode cable

Standard cable	3 × 0.38 mm ² (20 AWG) with common, braided copper shield (□ ~9.5 mm (0.37 in)) and individual shielded cores
Cable for empty pipe detection (EPD)	4 × 0.38 mm ² (20 AWG) with common, braided copper shield (□ ~9.5 mm (0.37 in)) and individual shielded cores
Conductor resistance	≤50 Ω/km (0.015 Ω/ft)
Capacitance: core/shield	≤420 pF/m (128 pF/ft)
Operating temperature	-20 to +80 °C (-4 to +176 °F)

Coil current cable

Standard cable	3 × 0.75 mm ² (18 AWG) with common, braided copper shield (□ ~9 mm (0.35 in))
Conductor resistance	≤37 Ω/km (0.011 Ω/ft)

Capacitance: core/core, shield grounded	≤120 pF/m (37 pF/ft)
Operating temperature	-20 to +80 °C (-4 to +176 °F)
Test voltage for cable insulation	≤ AC 1433 V rms 50/60 Hz or ≥ DC 2026 V



A0029151

□ 13 Cable cross-section a

Electrode cable

b Coil current cable

- 1 Core
- 2 Core insulation
- 3 Core shield 4 Core jacket
- 5 Core reinforcement
- 6 Cable shield
- 7 Outer jacket



A connecting cable can be ordered from Endress+Hauser for IP68:

- Pre-terminated cables that are already connected to the sensor
- Pre-terminated cables, where the cables are connected by the customer onsite (incl. tools for sealing the connection compartment)

Armored connecting cable

Armored connecting cables with an additional, reinforcing metal braid should be used:

- When laying the cable directly in the ground
- Where there is a risk of damage from rodents
- Use as per IP68 degree of protection



Armored connecting cables with an additional, reinforcing metal braid can be ordered from Endress+Hauser → □ 103.

Operation in environments with strong electrical interference

The measuring system meets the general safety requirements → □ 102 and EMC specifications → □ 48.

Grounding is by means of the ground terminal provided for the purpose inside the connection housing. The stripped and twisted lengths of cable shield to the ground terminal must be as short as possible.

Performance characteristics

Reference operating conditions

- Error limits following DIN EN 29104, in future ISO 20456
- Water, typically +15 to +45 °C (+59 to +113 °F); 0.5 to 7 bar (73 to 101 psi)
- Data as indicated in the calibration protocol
- Accuracy based on accredited calibration rigs according to ISO 17025

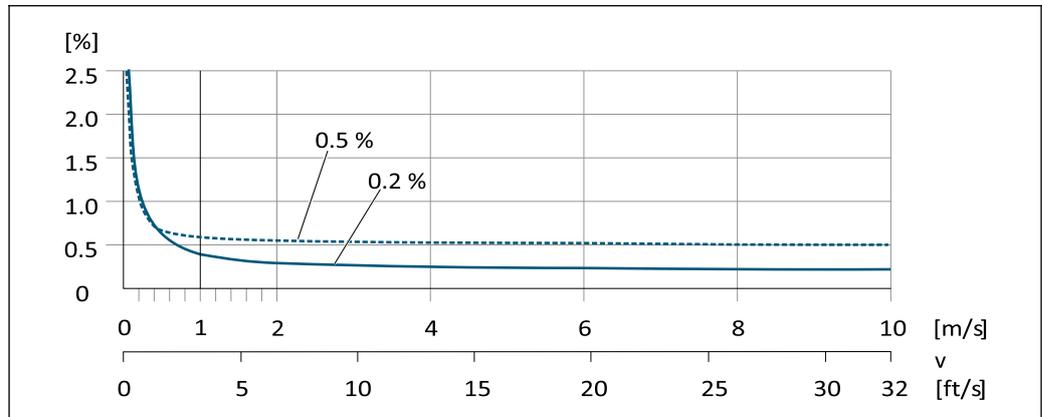
Maximum measured error

Error limits under reference operating conditions

Volume flow

- $\pm 0.5\%$ o.r. ± 1 mm/s (0.04 in/s)
- Optional: $\pm 0.2\%$ o.r. ± 2 mm/s (0.08 in/s)

i Fluctuations in the supply voltage do not have any effect within the specified range.

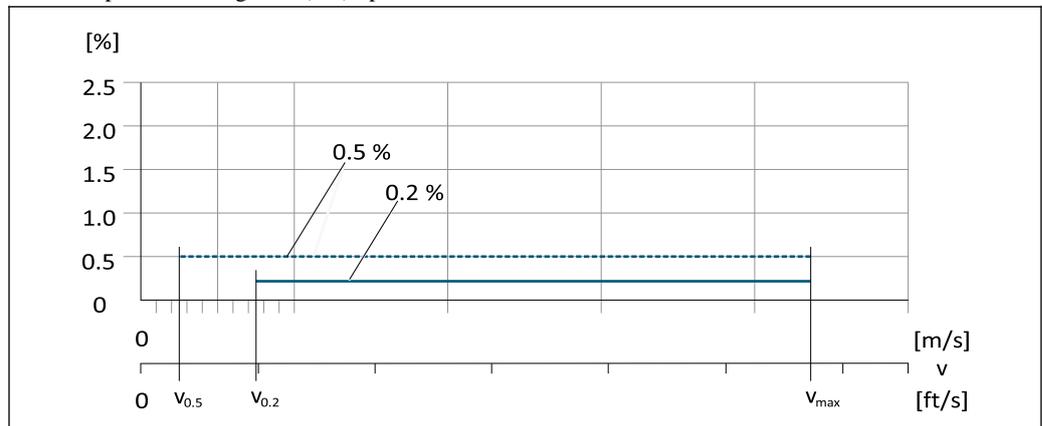


A0028974

□ 14 Maximum measured error in % o.r.

Flat Spec

For Flat Spec in the range $v_{0.5}$ ($v_{0.2}$) up to v_{max} the measured error is constant.



A0017051

□ 15 Flat Spec in % o.r.

Flat Spec flow values 0.5 %

Nominal diameter		v _{0.5}		V _{max}	
[mm]	[in]	[m/s]	[ft/s]	[m/s]	[ft/s]
25 to 600	1 to 24	0.5	1.64	10	32
50 to 300 ¹⁾	2 to 12	0.25	0.82	5	16

1) Order code for "Design", option C

Flat Spec flow values 0.2 %

Nominal diameter		v _{0.2}		V _{max}	
[mm]	[in]	[m/s]	[ft/s]	[m/s]	[ft/s]
25 to 600	1 to 24	1.5	4.92	10	32
50 to 300 ¹⁾	2 to 12	0.6	1.97	4	13

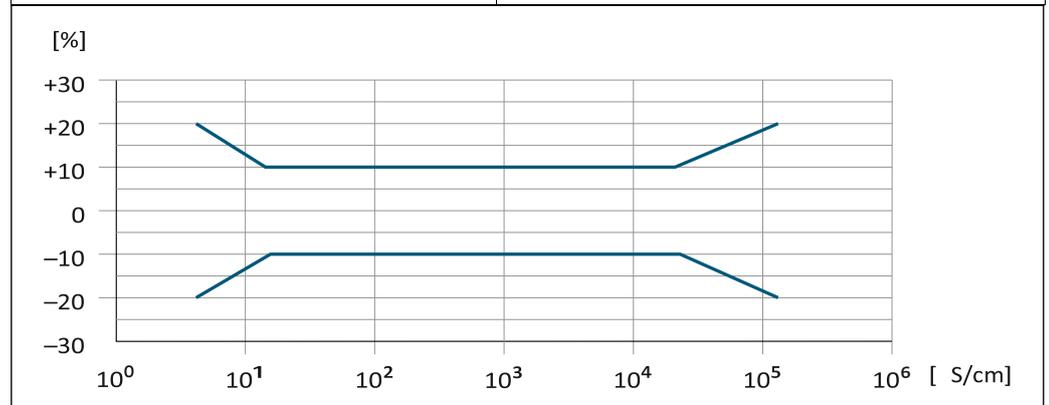
1) Order code for "Design", option C

Electrical conductivity

The values apply for:

- Measurements at a reference temperature of 25 °C (77 °F)
At different temperatures, attention must be paid to the temperature coefficient of the medium (typically 2.1 %/K)
- Device version: compact version - transmitter and sensor form a mechanical unit
- Devices installed in a metal pipe or in a non-metal pipe with ground disks
- Devices whose potential equalization was performed according to the instructions in the associated Operating Instructions

Conductivity [$\mu\text{S/cm}$]	Measured error [%] o. r.
5 to 20	$\pm 20\%$
20 to 20 000	$\pm 10\%$
20 000 to 100 000	$\pm 20\%$



A0042279

□ 16 *Measured error*

Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	Max. $\pm 5 \mu\text{A}$
----------	--------------------------

Pulse/frequency output

o.r. = of reading

Accuracy	Max. $\pm 50 \text{ ppm o.r.}$ (over the entire ambient temperature range)
----------	--

Repeatability

o.r. = of reading

Volume flow

max. $\pm 0.1 \%$ o.r. $\pm 0.5 \text{ mm/s}$ (0.02 in/s)

Electrical conductivity Max.
±5 % o.r.

Influence of ambient temperature Current output
o.r. = of reading

Temperature coefficient	Max. ±0.005 % o.r./°C
-------------------------	-----------------------

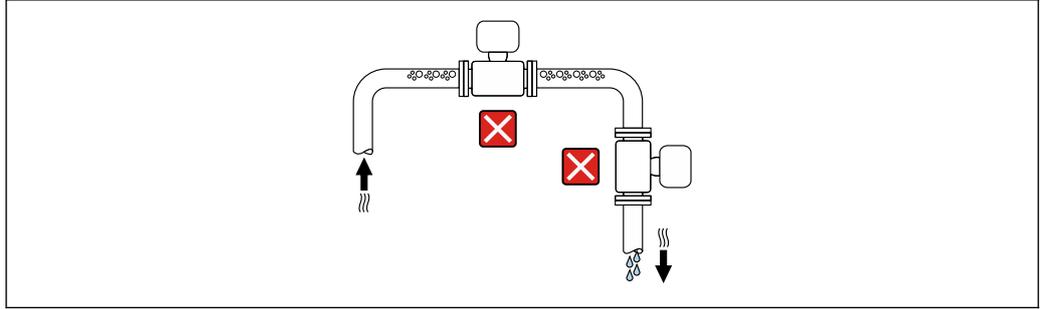
Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.
-------------------------	---

Installation

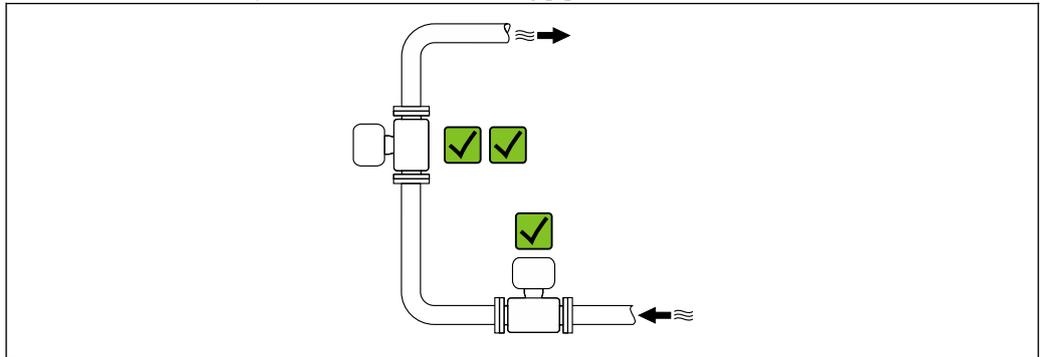
Mounting location

- Do not install the device at the highest point of the pipe.
- Do not install the device upstream from a free pipe outlet in a down pipe.



A0042131

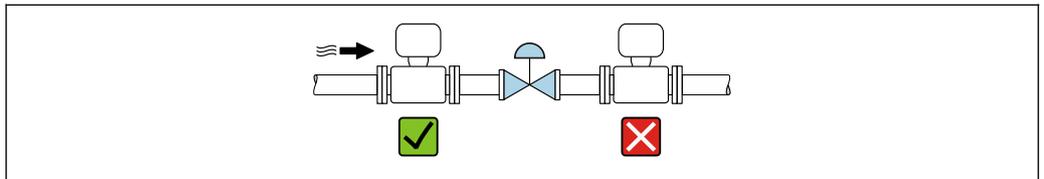
The device should ideally be installed in an ascending pipe.



A0042317

Installation near valves

Install the device in the direction of flow upstream from the valve.



A0041091

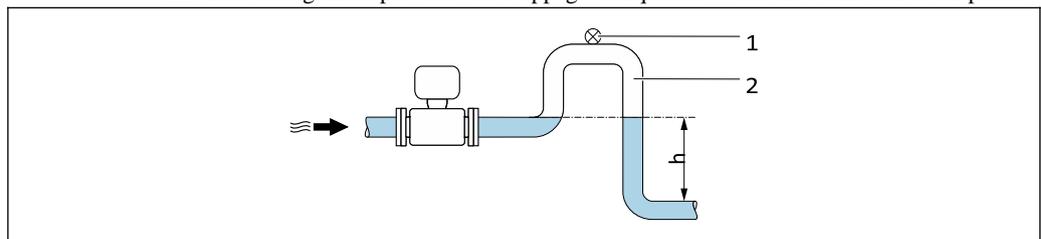
Installation upstream from a down pipe

NOTICE Negative pressure in the measuring pipe can damage the liner!

- If installing upstream from down pipes with a length $h \geq 5$ m (16.4 ft), install a siphon with a vent valve downstream from the device.



This arrangement prevents the stoppage of liquid flow and the formation of air pockets.

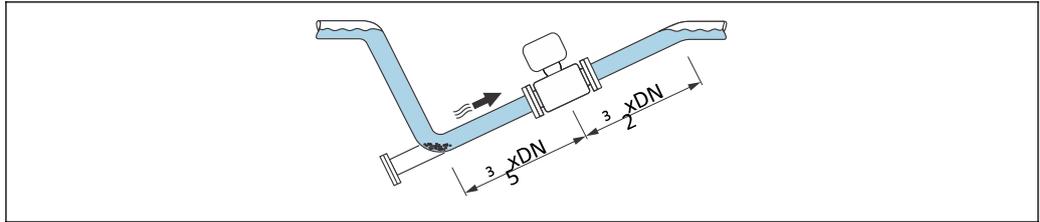


A0028981

- 1 Vent valve
2 Pipe siphon
 h Length of down pipe

Installation with partially filled pipes

- Partially filled pipes with a gradient require a drain-type configuration.
- The installation of a cleaning valve is recommended.



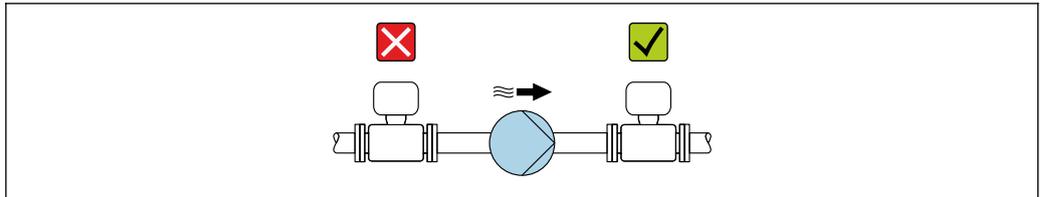
A0041088

i No inlet and outlet runs for devices with the order code for "Design": Option C, H, I, J or K.

Installation near pumps

NOTICE Negative pressure in the measuring pipe can damage the liner!

- In order to maintain the system pressure, install the device in the flow direction downstream from the pump.
- Install pulsation dampers if reciprocating, diaphragm or peristaltic pumps are used.



A0041083



- Information on the liner's resistance to partial vacuum → □ 51
- Information on the measuring system's resistance to vibration and shock → □ 47

Installation of very heavy devices

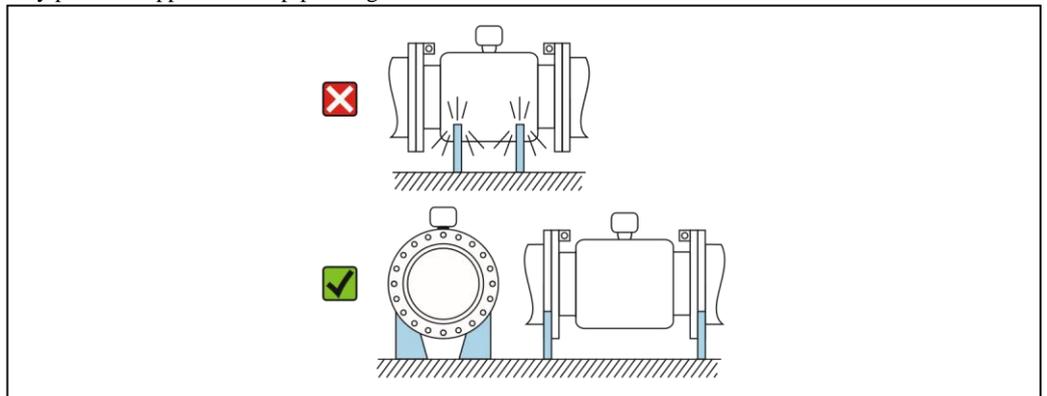
Support required for nominal diameters of $DN \geq 350$ mm (14 in).

NOTICE

Damage to the device!

If incorrect support is provided, the sensor housing could buckle and the internal magnetic coils could be damaged.

- Only provide supports at the pipe flanges.



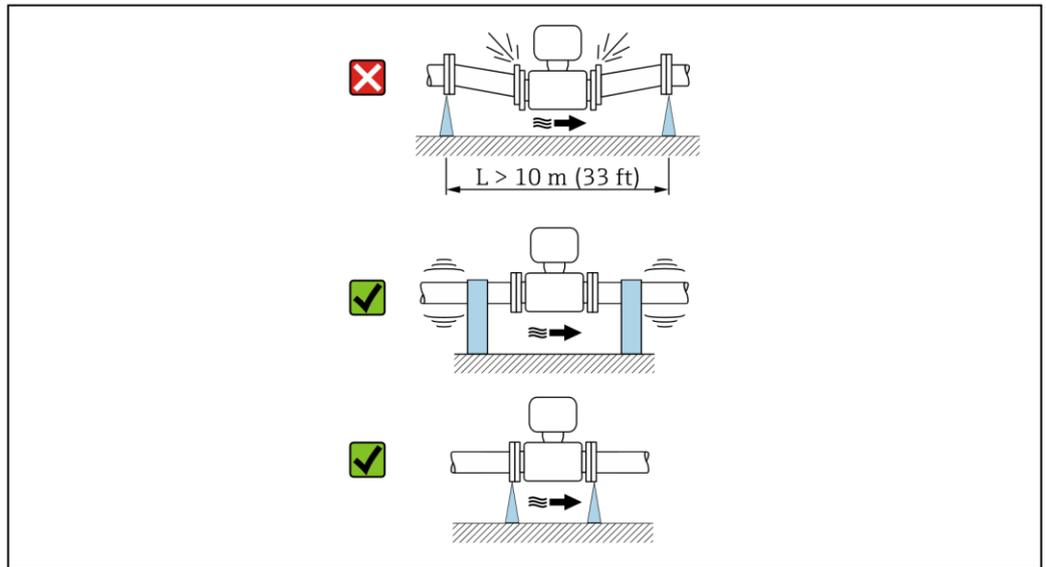
A0041087

Installation in event of pipe vibrations

A remote version is recommended in the event of strong pipe vibrations.

NOTICE Pipe vibrations can damage the device!

- ▶ Do not expose the device to strong vibrations.
- ▶ Support the pipe and fix it in place.
- ▶ Support the device and fix it in place.
 - ▶ Mount the sensor and transmitter separately.

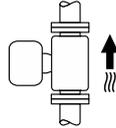
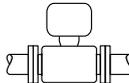
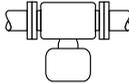


A0041092

 Information on the measuring system's resistance to vibration and shock →  47

Orientation

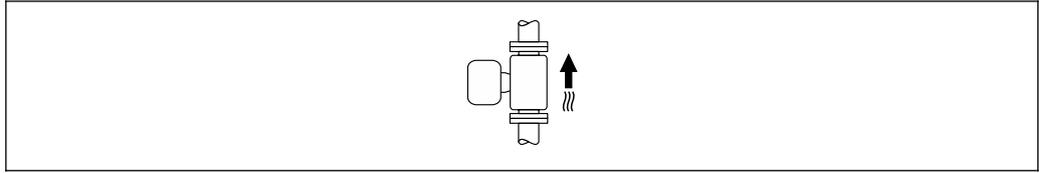
The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

Orientation		Recommendation
Vertical orientation	 <p style="text-align: right; font-size: small;">A0015591</p>	
Horizontal orientation, transmitter at top	 <p style="text-align: right; font-size: small;">A0015589</p>	 1)
Horizontal orientation, transmitter at bottom	 <p style="text-align: right; font-size: small;">A0015590</p>	 2) 3)  4)
Horizontal orientation, transmitter at side	 <p style="text-align: right; font-size: small;">A0015592</p>	

- 1) Applications with low process temperatures may decrease the ambient temperature. To maintain the minimum ambient temperature for the transmitter, this orientation is recommended.
- 2) Applications with high process temperatures may increase the ambient temperature. To maintain the maximum ambient temperature for the transmitter, this orientation is recommended.
- 3) To prevent the electronics module from overheating in the case of a sharp rise in temperature (e.g. CIP or SIP processes), install the device with the transmitter component pointing downwards.
- 4) With the empty pipe detection function switched on: empty pipe detection only works if the transmitter housing is pointing upwards.

Vertical

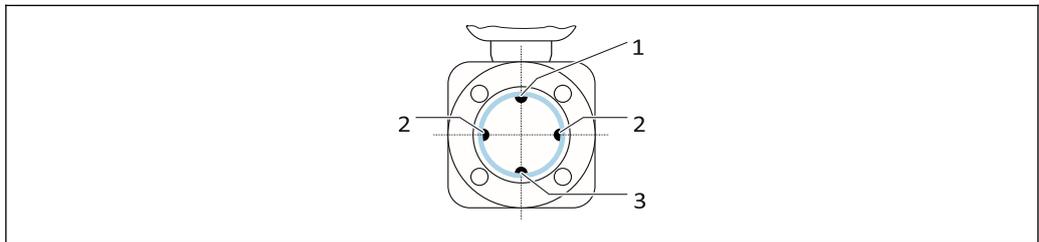
Optimum for self-emptying pipe systems and for use in conjunction with empty pipe detection.



A0015591

Horizontal

- Ideally, the measuring electrode plane should be horizontal. This prevents brief insulation of the measuring electrodes by entrained air bubbles.
- Empty pipe detection only works if the transmitter housing is pointing upwards as otherwise there is no guarantee that the empty pipe detection function will actually respond to a partially filled or empty measuring tube.



A0029344

- 1 EPD electrode for empty pipe detection
- 2 Measuring electrodes for signal detection
- 3 Reference electrode for potential equalization

Inlet and outlet runs

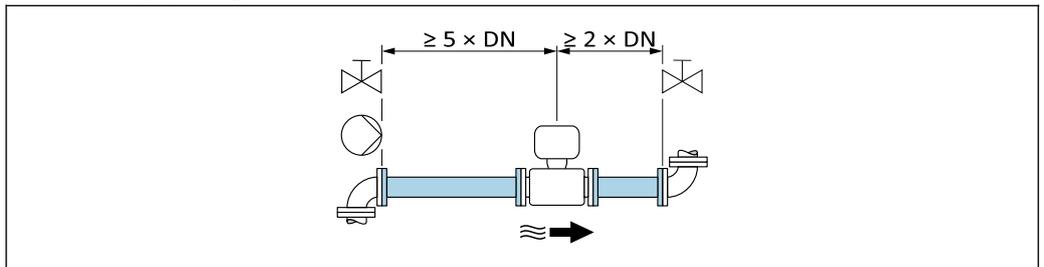
Installation with inlet and outlet runs

Installation requires inlet and outlet runs: devices with the order code for "Design", option D, E, F and G.

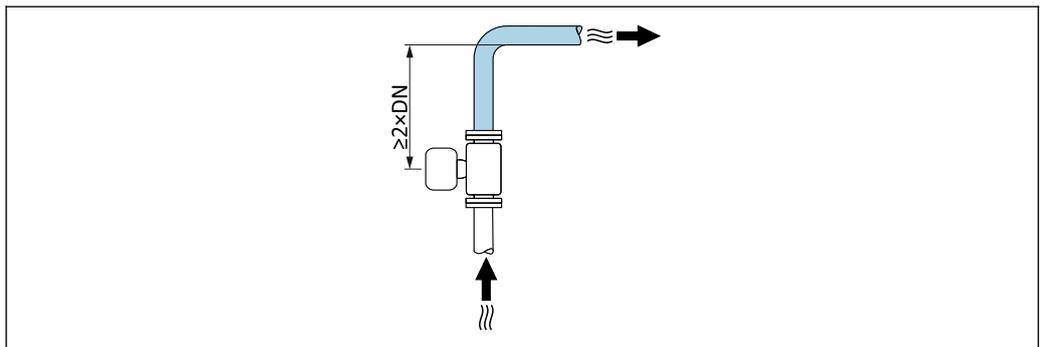
Installation with elbows, pumps or valves

To avoid a vacuum and to maintain the specified level of accuracy, install the device upstream from assemblies that produce turbulence (e.g. valves, T-sections) and downstream from pumps, wherever possible.

Maintain straight, unimpeded inlet and outlet runs.



A0028997



A0042132

Installation without inlet and outlet runs

Depending on the device design and installation location, the inlet and outlet runs can be reduced or omitted entirely.

i Maximum measured error

When the device is installed with the inlet and outlet runs described, a maximum measured error of $\pm 0.5\%$ of the reading ± 1 mm/s (0.04 in/s) can be guaranteed.

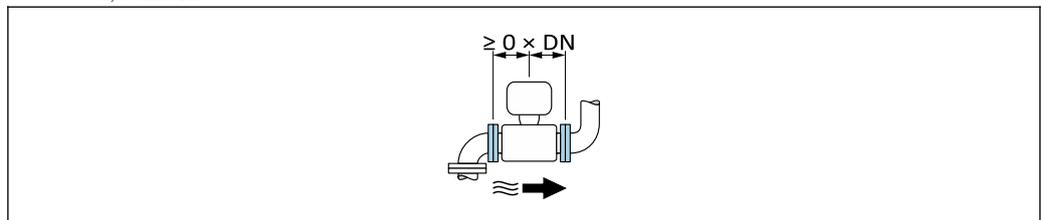
Devices and possible order options

Order code for "Design"		
Option	Description	Design
C	Fixed flange, constricted measuring tube, 0 x DN inlet/outlet runs	Constricted measuring tube ¹⁾
H	Lap joint flange, 0 x DN inlet/outlet runs	Full Bore ²⁾
I	Fixed flange, 0 x DN inlet/outlet runs	
J	Fixed flange, short installed length, 0 x DN inlet/outlet runs	
K	Fixed flange, long installed length, 0 x DN inlet/outlet runs	

- 1) "Constricted measuring tube" stands for a reduction of the internal diameter of the measuring tube. The reduced internal diameter causes a higher flow velocity inside the measuring tube.
- 2) "Full Bore" stands for the full diameter of the measuring tube. There is no pressure loss with a full diameter.

Installation before or after bends

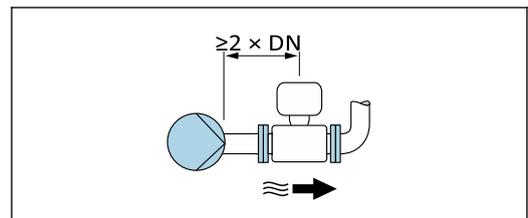
Installation without inlet and outlet runs is possible: devices with the order code for "Design", option C, H, I, J and K.



Installation downstream of pumps

Installation without inlet and outlet runs is possible: devices with the order code for "Design", option C, H and I.

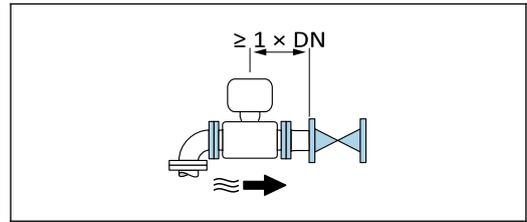
i In the case of devices with the order code for "Design", option J and K, an inlet run of only ≥ 2 x DN must be taken into consideration.



Installation upstream of valves

Installation without inlet and outlet runs is possible: devices with the order code for "Design", option C, H and I.

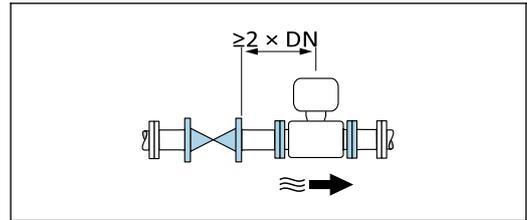
i In the case of devices with the order code for "Design", option J and K, an outlet run of only $\geq 1 \times DN$ must be taken into consideration.



Installation downstream of valves

Installation without inlet and outlet runs is possible if the valve is 100% open during operation: devices with the order code for "Design", option C, H and I.

i In the case of devices with the order code for "Design", option J and K, an inlet run of only $\geq 2 \times DN$ must be taken into consideration if the valve is 100% open during operation.



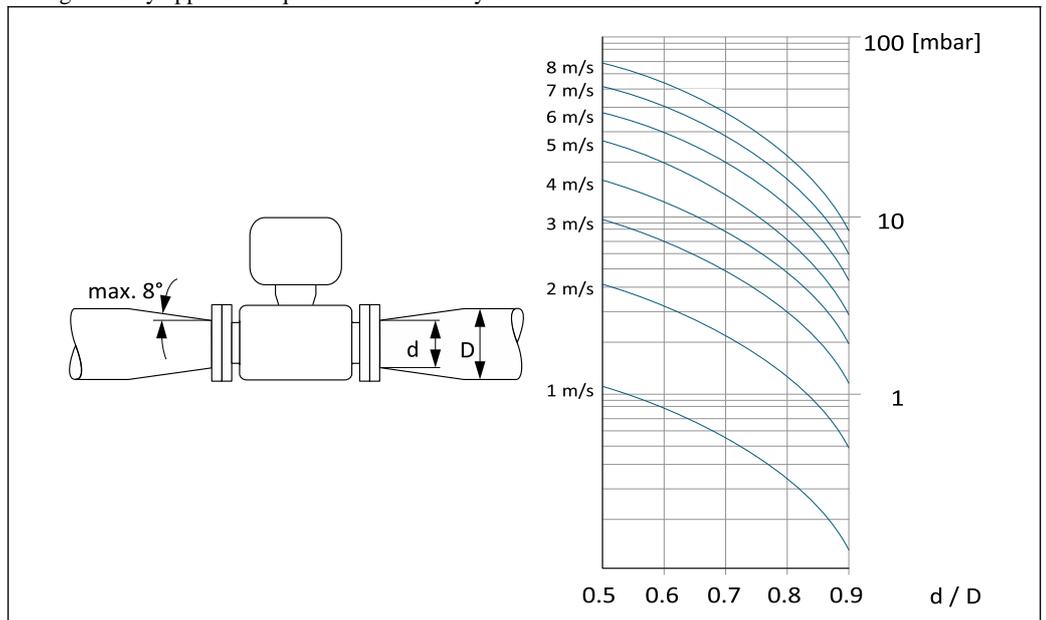
Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders:

- Calculate the ratio of the diameters d/D .
- From the nomogram read off the pressure loss as a function of flow velocity (downstream from the reduction) and the d/D ratio.

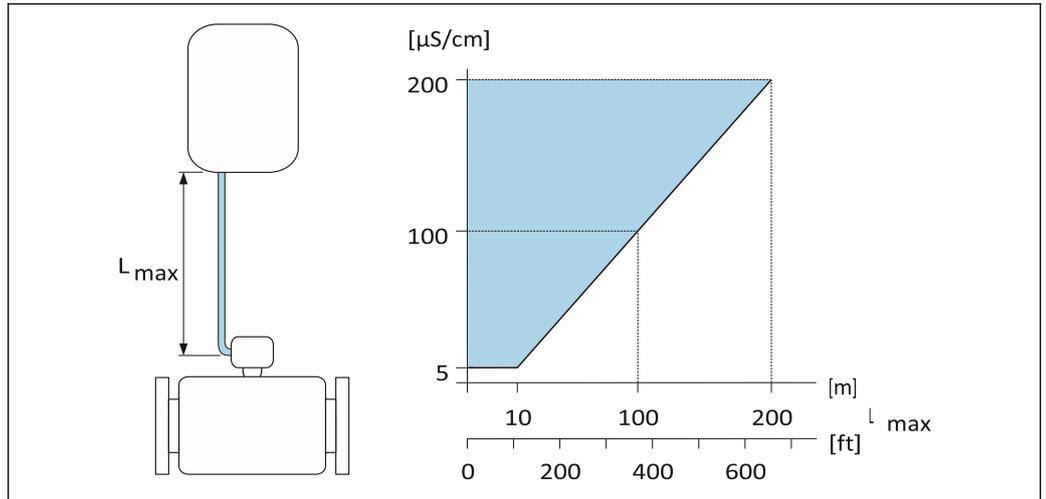
i The nomogram only applies to liquids with a viscosity similar to that of water.



A0029002

Length of connecting cable

To obtain correct measurement results, observe the permitted connecting cable length of L_{max} . This length is determined by the conductivity of the fluid. If measuring liquids in general: $5 \mu S/cm$



A0016539

□ 17 Permitted length of connecting cable

Colored area = permitted range

L_{max} = length of connecting cable in [m] ([ft])

[$\mu\text{S/cm}$] = fluid conductivity

Special mounting Display guard instructions

To ensure that the optional display guard can be easily opened, maintain the following minimum head clearance: 350 mm (13.8 in)

Immersion in water



- Only the remote version of the device with IP68 protection, Type 6P is suitable for underwater use: order code for "Sensor option", options CB, CC, CD, CE and CQ.
- Pay attention to regional installation instructions.

NOTICE If the maximum water depth and operating duration is exceeded, this can damage the device!

- Observe the maximum water depth and operating duration.

Order code for "Sensor option", options CB, CC

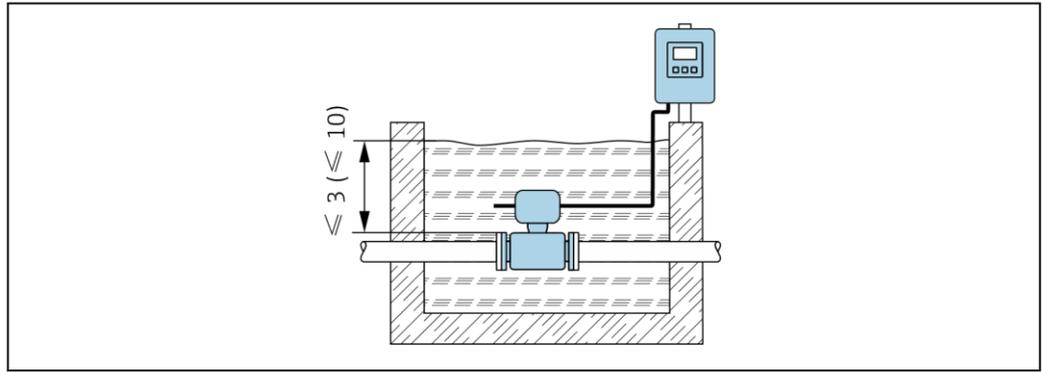
- For the operation of the device under water • Operating duration at a maximum depth of:
- 3 m (10 ft): permanent use
- 10 m (30 ft): maximum 48 hours

Order code for "Sensor option", option CQ "Temporarily water-proof"

- For the temporary operation of the device under non-corrosive water
- Operating duration at a maximum depth of:
- 3 m (10 ft): maximum 168 hours

Order code for "Sensor option", options CD, CE

- For the operation of the device under water and in saline water
- Operating duration at a maximum depth of:
- 3 m (10 ft): permanent use
- 10 m (30 ft): maximum 48 hours

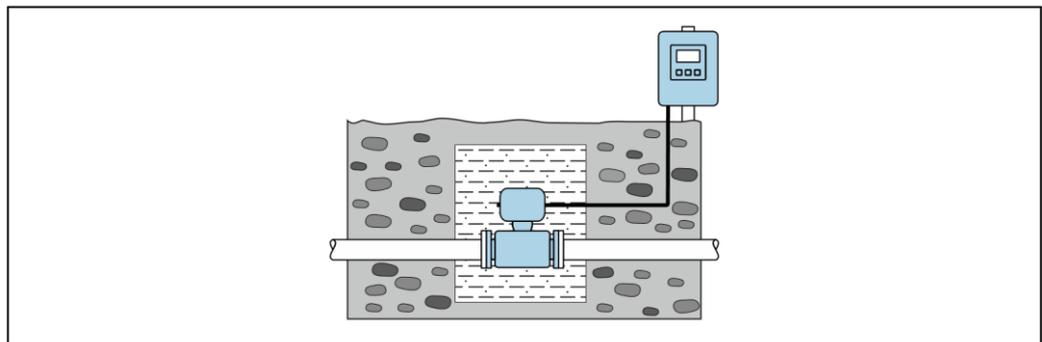


A0042412

Use in buried applications

-  Only the remote version of the device with IP68 protection is suitable for use in buried applications: order code for "Sensor option", options CD and CE.
- Pay attention to regional installation instructions.

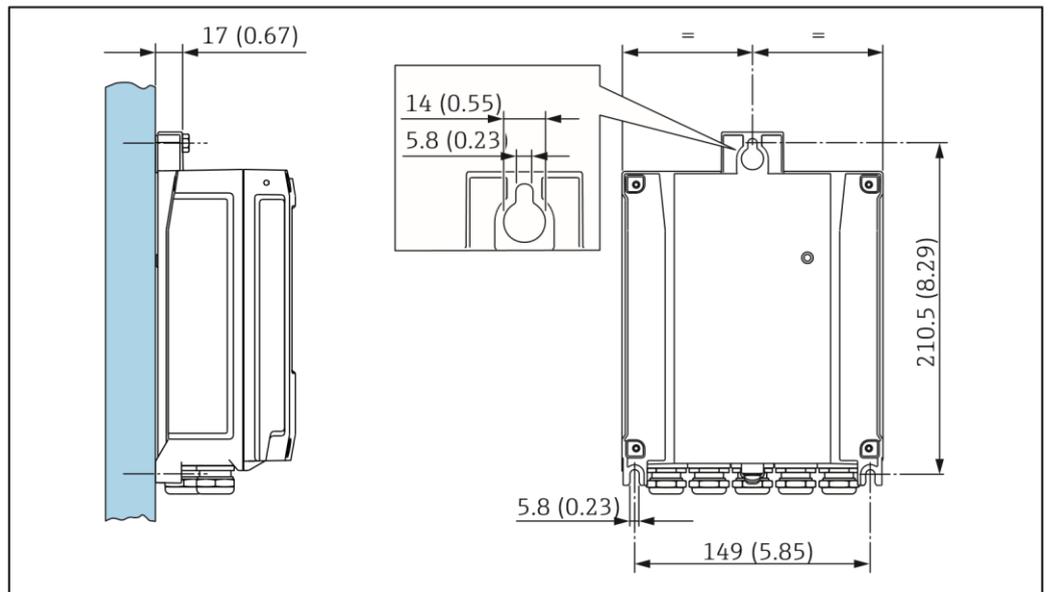
Order code for "Sensor option", options CD, CE
For the use of the device in buried applications.



A0042646

Mounting the transmitter housing

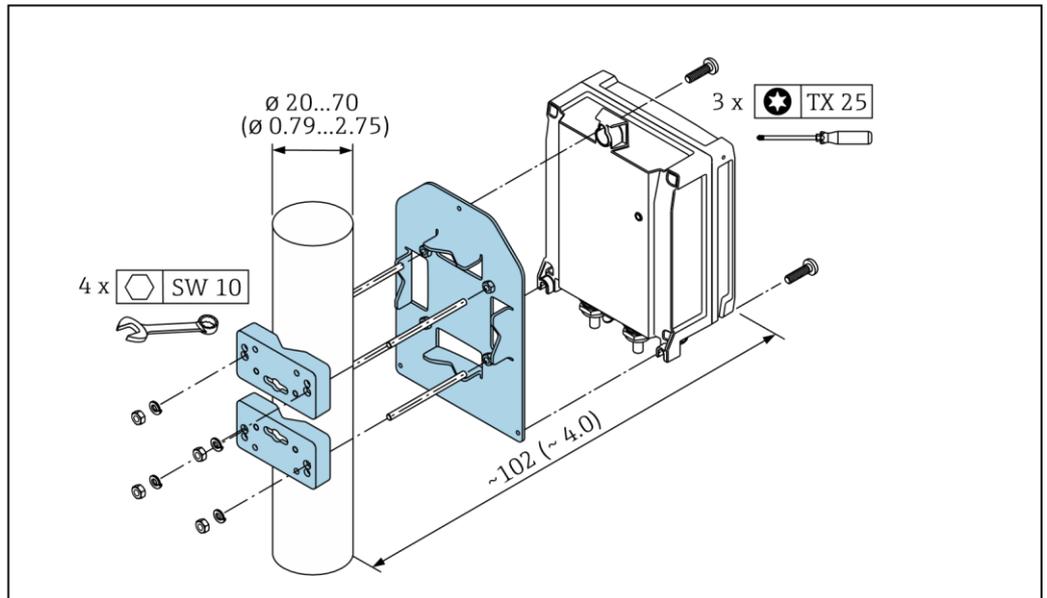
Wall mounting



A0020523

 18 Engineering unit mm (in)

Post mounting



A0029051

□ 19 Engineering unit mm (in)

Environment

Ambient temperature range	Transmitter	-40 to +60 °C (-40 to +140 °F)
	Local display	-20 to +60 °C (-4 to +140 °F), the legibility of the local display may be impaired at temperatures outside the temperature range.
Sensor	<ul style="list-style-type: none"> • Process connection material, carbon steel: -10 to +60 °C (+14 to +140 °F) • Process connection material, stainless steel: -40 to +60 °C (-40 to +140 °F) <p>If both the ambient and the medium temperatures are high, mount the sensor separately from the transmitter.</p>	
Liner	Do not exceed or fall below the permitted temperature range of the liner → □ 48.	

If operating outdoors:

- Install the measuring device in a shady location.
- Avoid direct sunlight, particularly in warm climatic regions.
- Avoid direct exposure to weather conditions.
- If the compact version of the device is insulated at low temperatures, the insulation must also include the device neck.
- Protect the display against impact.
- Protect the display from abrasion, e.g. caused by sand in desert areas.

 Display guard available as an accessory → □ 103.

Temperature tables

Observe the interdependencies between the permitted ambient and fluid temperatures when operating the device in hazardous areas.



For detailed information on the temperature tables, see the separate document entitled "Safety Instructions" (XA) for the device.

Storage temperature

The storage temperature corresponds to the operating temperature range of the transmitter and the sensor
→ □ 45.

- Protect the measuring device against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Select a storage location where moisture cannot collect in the measuring device as fungus or bacteria infestation can damage the liner.
- If protection caps or protective covers are mounted these should never be removed before installing the measuring device.

Atmosphere

If a plastic transmitter housing is permanently exposed to certain steam and air mixtures, this can damage the housing.



In cases of doubt, please contact the Sales Center.

Degree of protection

Transmitter

- IP66/67, type 4X enclosure
- When housing is open: IP20, type 1 enclosure
- Display module: IP20, type 1 enclosure

Sensor

Compact and remote version

IP66/67, type 4X enclosure

Optionally available for compact and remote version:

Order code for "Sensor option", option CA, C3

- IP66/67, type 4X enclosure
- Fully welded, with protective coating as per EN ISO 12944 C5-M
- For the operation of the device in corrosive environments

Optionally available for remote version:

Order code for "Sensor option", option CB, CC

- IP68, type 6P enclosure
- Fully welded, with protective coating as per EN ISO 12944 C5-M/Im1 and EN 60529
- For the operation of the device under water • Operating duration at a maximum depth of:
- 3 m (10 ft): permanent use
- 10 m (30 ft): maximum 48 hours

Order code for "Sensor option", option CQ

- IP68, type 6P, temporarily waterproof
- Sensor with aluminum half-shell housing
- For the temporary operation of the device under non-corrosive water
- Operating duration at a maximum depth of:
 - 3 m (10 ft): maximum 168 hours

Order code for "Sensor option", option CD, CE

- IP68, type 6P enclosure
- Fully welded, with protective coating as per EN ISO 12944 Im2/Im3 and EN 60529
- For the operation of the device in buried applications
- For the operation of the device under water and in saline water
- Operating duration at a maximum depth of:
 - 3 m (10 ft): permanent use
 - 10 m (30 ft): maximum 48 hours

Vibration- and shockresistance

Sinusoidal vibration according to IEC 60068-2-6

Compact version; order code for "Housing", option A "Compact, aluminum, coated"

- 2 to 8.4 Hz, 3.5 mm peak
- 8.4 to 2000 Hz, 1 g peak

Compact version; order code for "Housing", option M "Compact, polycarbonate"

- 2 to 8.4 Hz, 7.5 mm peak
- 8.4 to 2000 Hz, 2 g peak

Remote version; order code for "Housing", option N "Remote, polycarbonate" and option P "Remote, aluminum, coated" • 2 to 8.4 Hz, 7.5 mm peak

- 8.4 to 2000 Hz, 2 g peak

Vibration broad-band random, according to IEC 60068-2-64

Compact version; order code for "Housing", option A "Compact, aluminum, coated"

- 10 to 200 Hz, 0.003 g²/Hz
- 200 to 2000 Hz, 0.001 g²/Hz
- Total: 1.54 g rms

Compact version; order code for "Housing", option M "Compact, polycarbonate"

- 10 to 200 Hz, 0.01 g²/Hz
- 200 to 2000 Hz, 0.003 g²/Hz
- Total: 2.70 g rms

Remote version; order code for "Housing", option N "Remote, polycarbonate" and option P "Remote, aluminum, coated" • 10 to 200 Hz, 0.01 g²/Hz

- 200 to 2000 Hz, 0.003 g²/Hz
- Total: 2.70 g rms

Shock half-sine, according to IEC 60068-2-27

- Compact version; order code for "Housing", option A "Compact, aluminum, coated" 6 ms 30 g
- Compact version; order code for "Housing", option M "Compact, polycarbonate" 6 ms 50 g
- Remote version; order code for "Housing", option N "Remote, polycarbonate" and option P "Remote, aluminum, coated" 6 ms 50 g

Rough handling shocks according to IEC 60068-2-31

Mechanical load

- Protect the transmitter housing against mechanical effects, such as shock or impact; the use of the remote version is sometimes preferable.
- Never use the transmitter housing as a ladder or climbing aid.

Electromagnetic • As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21) compatibility (EMC) • Complies

with emission limits for industry as per EN 55011 (Class A)

- Device version with PROFIBUS DP: Complies with emission limits for industry as per EN 50170 Volume 2, IEC 61784



The following applies for PROFIBUS DP: If baud rates > 1.5 Mbaud, an EMC cable entry must be used and the cable shield must continue as far as the terminal wherever possible.

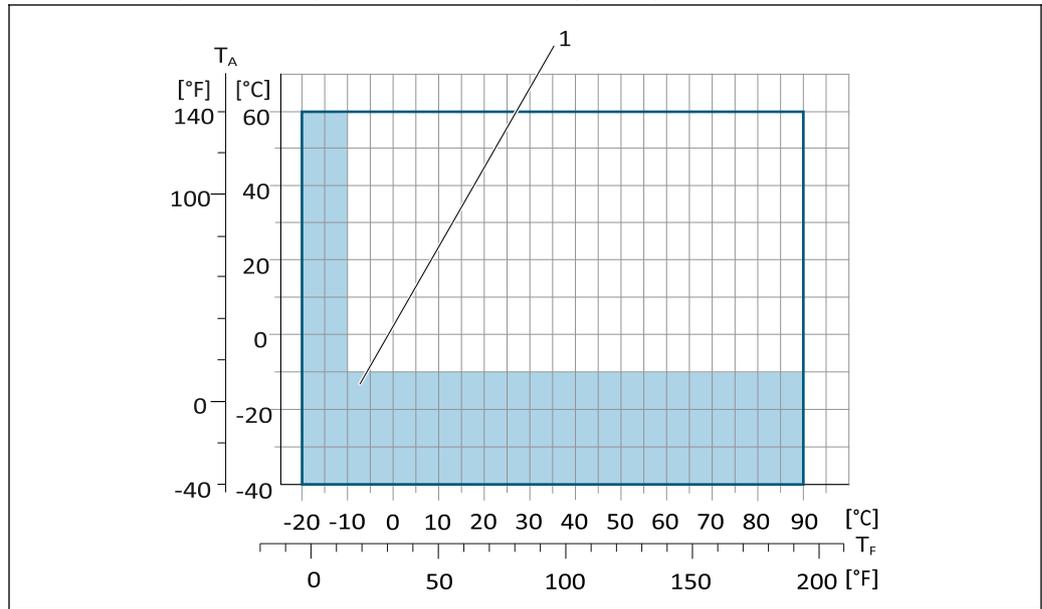


Details are provided in the Declaration of Conformity.

Process

Medium temperature range

- 0 to +80 °C (+32 to +176 °F) for hard rubber, DN 50 to 3000 (2 to 120")
- -20 to +50 °C (-4 to +122 °F) for polyurethane, DN 25 to 1200 (1 to 48")
- -20 to +90 °C (-4 to +194 °F) for PTFE, DN 25 to 300 (1 to 12")



A0038130

T_A Ambient temperature T_F
Medium temperature

1 Colored area: The ambient temperature range of -10 to -40 °C (+14 to -40 °F) and the medium temperature range of -10 to -20 °C (+14 to -4 °F) only apply for stainless flanges



The permitted fluid temperature in custody transfer is 0 to +50 °C (+32 to +122 °F).

Conductivity

≥5 μS/cm for liquids in general.

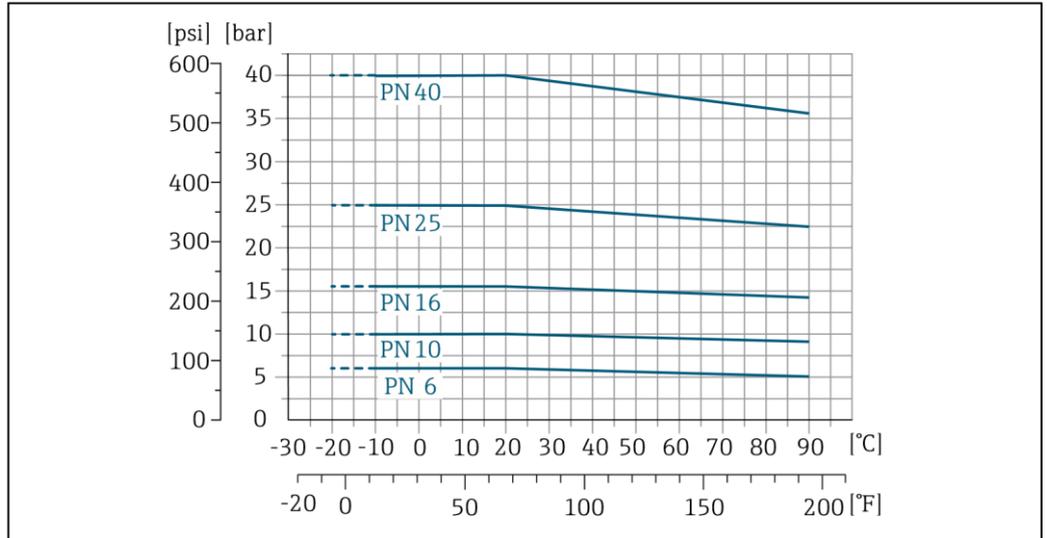


- Note that in the case of the remote version, the requisite minimum conductivity additionally depends on the length of the connecting cable → □ 43.
- Maximum measured error for electrical conductivity → □ 35.

Pressure/temperature

The following pressure/temperature diagrams apply to all pressure-bearing parts of the device and ratings not just the process connection. The diagrams show the maximum permissible medium pressure depending on the specific medium temperature.

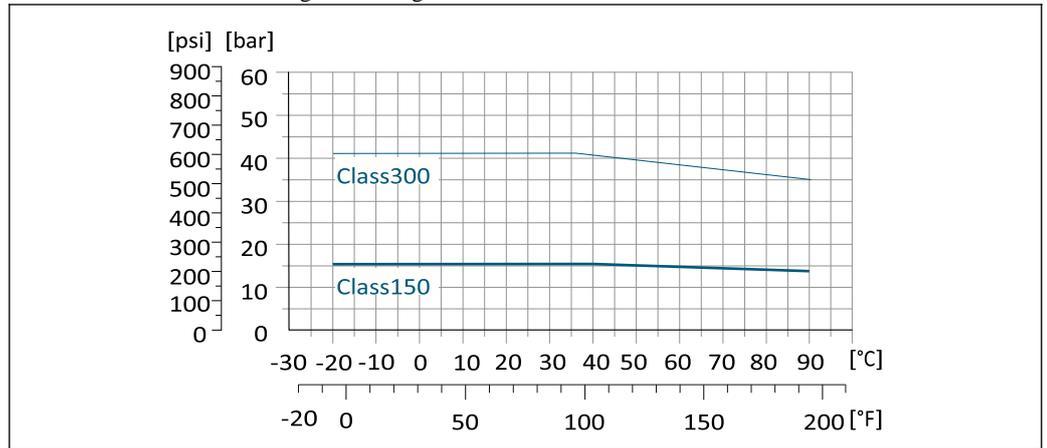
Process connection: fixed flange according to EN 1092-1 (DIN 2501)



A0038122-EN

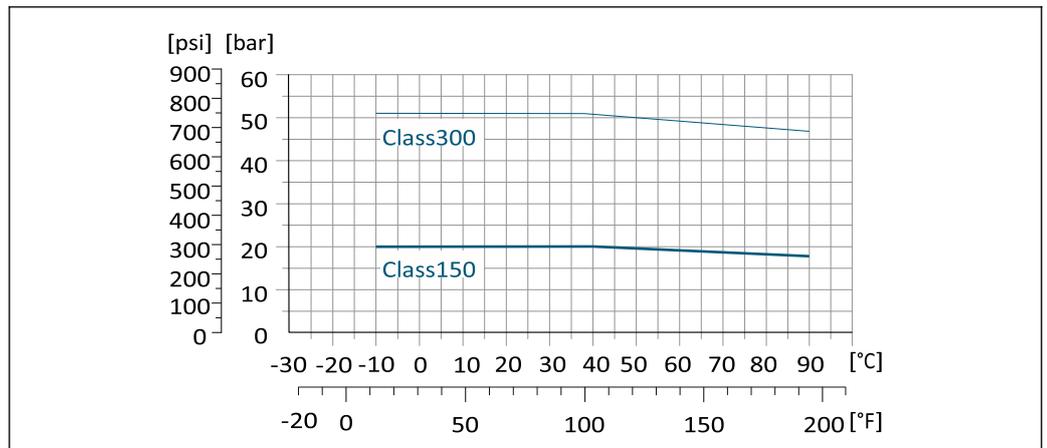
□ 20 Process connection material: stainless steel (-20 °C (-4 °F)); carbon steel (-10 °C (14 °F))

Process connection: fixed flange according to ASME B16.5



A0038122-EN

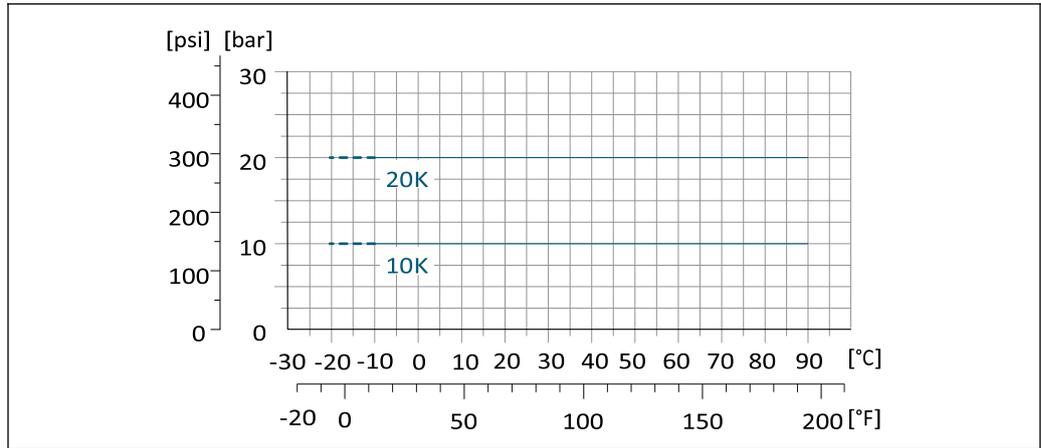
□ 21 Process connection material: stainless steel



A0038121-EN

□ 22 Process connection material: carbon steel

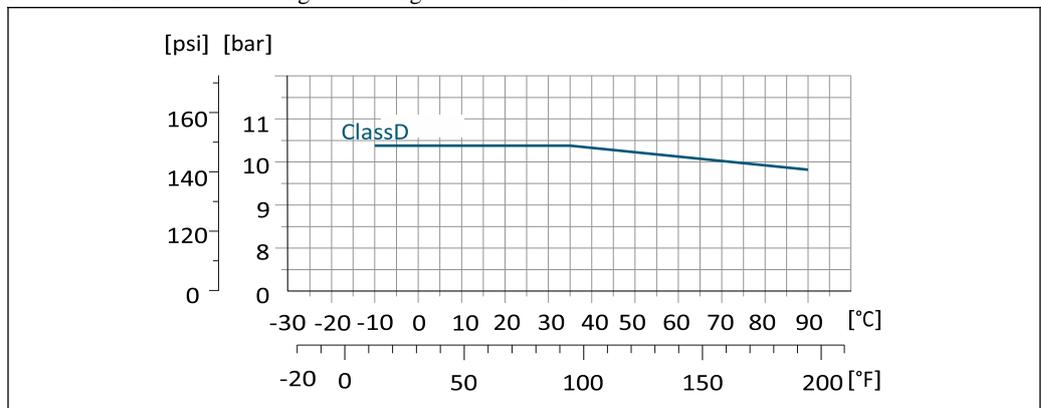
Process connection: fixed flange according to JIS B2220



A0038124-EN

- 23 Process connection material: stainless steel (-20 °C (-4 °F)); carbon steel (-10 °C (14 °F))

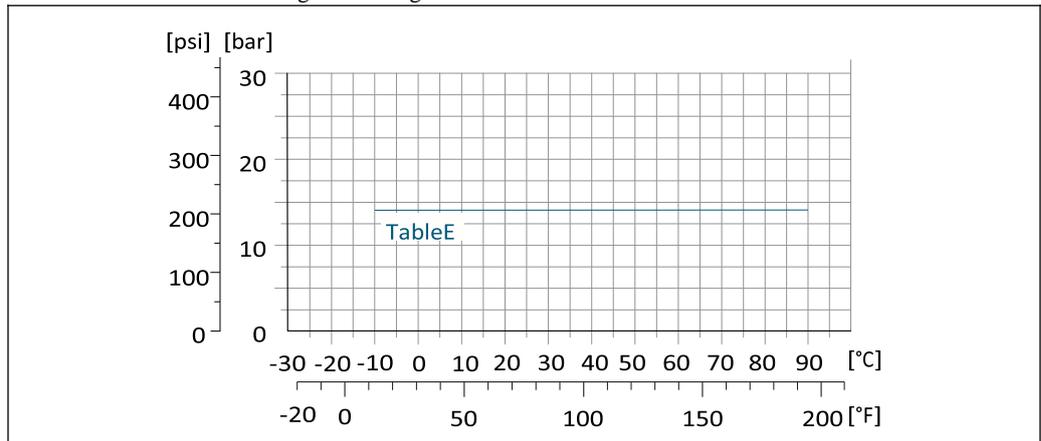
Process connection: fixed flange according to AWWA C207



A0038126-EN

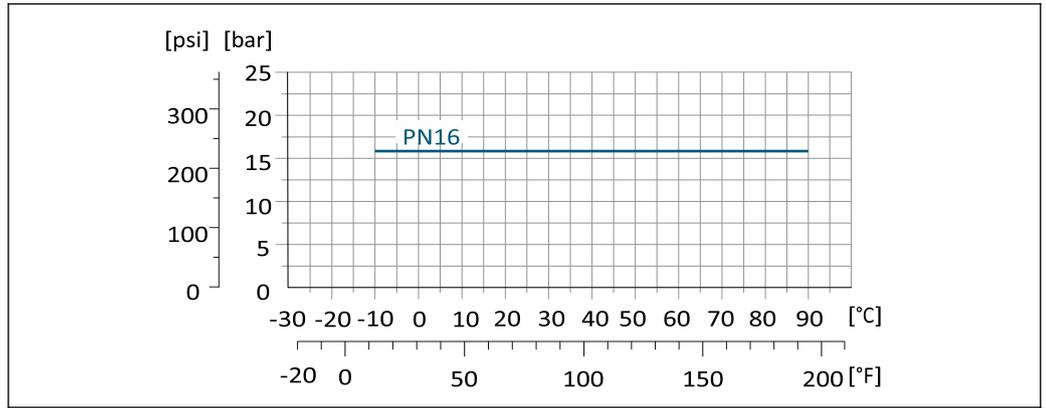
- 24 Process connection material: carbon steel

Process connection: fixed flange according to AS 2129



A0038127-EN

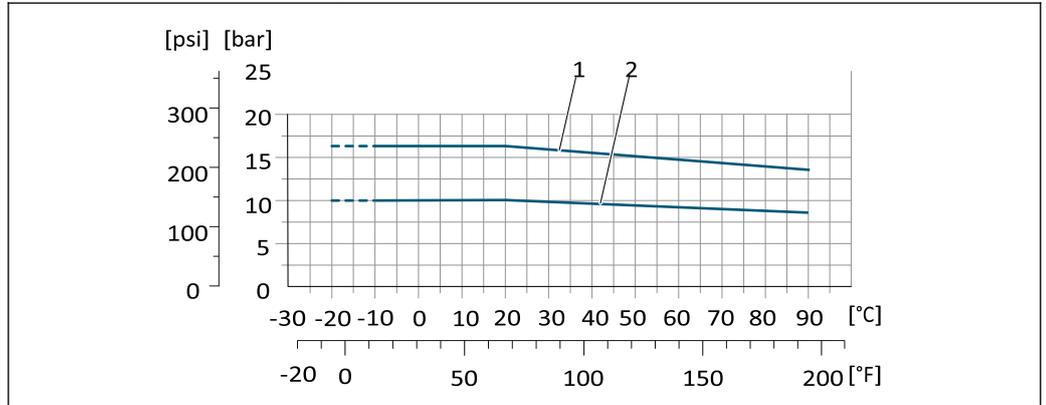
- 25 Process connection material: carbon steel
Process connection: fixed flange according to AS 4087



A0038128-EN

□ 26 Process connection material: carbon steel

Process connection: lap joint flange/lap joint flange, stamped plate according to EN 1092-1 (DIN 2501) and ASME B16.5; DN 25 to 300 (1 to 12")



A0038129-EN

□ 27 Process connection material: stainless steel (-20 °C (-4 °F)); carbon steel (-10 °C (14 °F))

- 1 Lap joint flange PN16/ Class150
- 2 Lap joint flange, stamped plate PN10, lap joint flange PN10

Pressure tightness

Liner: hard rubber

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for medium temperatures:		
[mm]	[in]	+25 °C (+77 °F)	+50 °C (+122 °F)	+80 °C (+176 °F)
50 ... 3000	2 ... 120	0 (0)	0 (0)	0 (0)

Liner: polyurethane

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for medium temperatures:	
[mm]	[in]	+25 °C (+77 °F)	+50 °C (+122 °F)
25 ... 1200	1 ... 48	0 (0)	0 (0)

Liner: PTFE

Nominal diameter		Limit values for absolute pressure in [mbar] ([psi]) for medium temperatures:	
[mm]	[in]	+25 °C (+77 °F)	+90 °C (+194 °F)
25	1	0 (0)	0 (0)
40	2	0 (0)	0 (0)

[mm]	[in]	+25 °C (+77 °F)	+90 °C (+194 °F)
50	2	0 (0)	0 (0)
65	2 ½	0 (0)	40 (0.58)
80	3	0 (0)	40 (0.58)
100	4	0 (0)	135 (2.0)
125	5	135 (2.0)	240 (3.5)
150	6	135 (2.0)	240 (3.5)
200	8	200 (2.9)	290 (4.2)
250	10	330 (4.8)	400 (5.8)
300	12	400 (5.8)	500 (7.3)

Flow limit

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 to 3 m/s (6.56 to 9.84 ft/s). Also match the velocity of flow (v) to the physical properties of the medium:

- v < 2 m/s (6.56 ft/s): for abrasive media (e.g. potter's clay, lime milk, ore slurry)
- v > 2 m/s (6.56 ft/s): for media producing buildup (e.g. wastewater sludge)



diameter.



For an overview of the full scale values for the measuring range, see the "Measuring range" section → □ 8

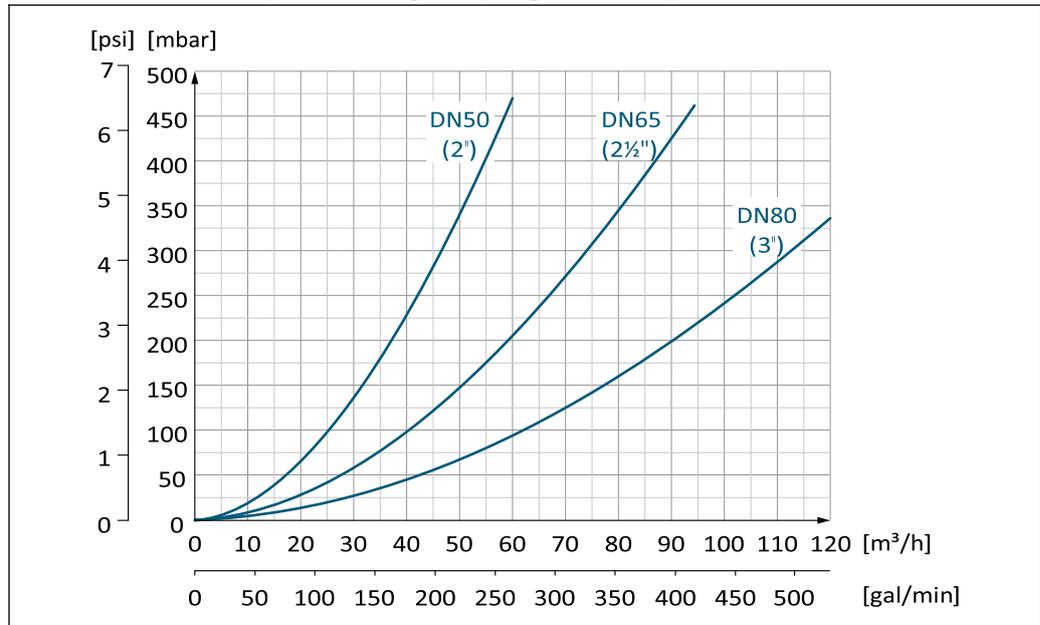


For custody transfer, the applicable approval determines the permitted measuring range.

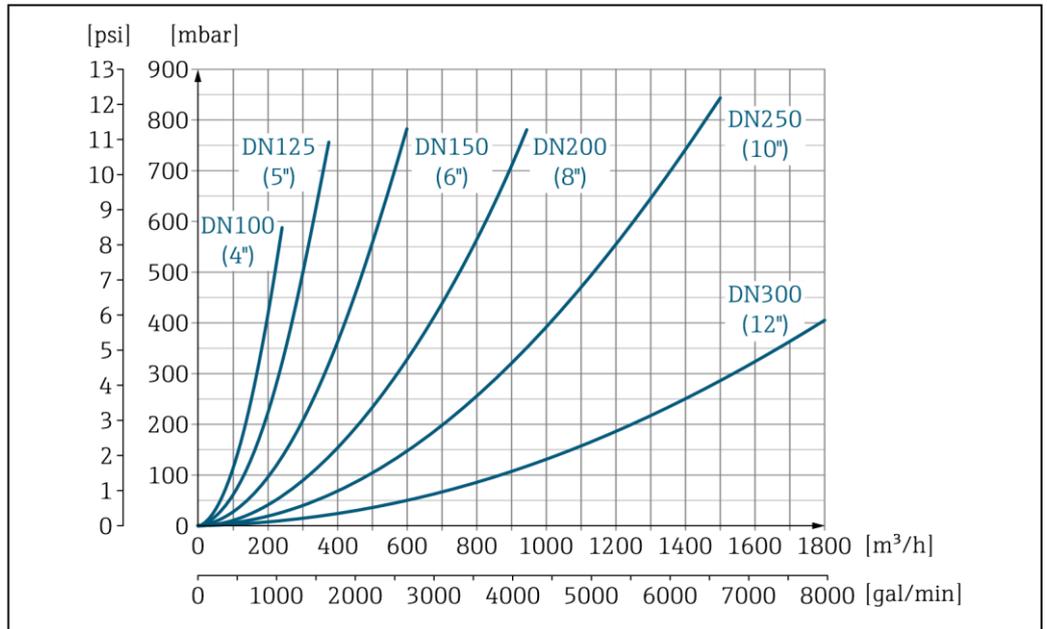
A necessary increase in the flow velocity can be achieved by reducing the sensor nominal

Pressure loss

- No pressure loss occurs if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → □ 42



□ 28 Pressure loss DN 50 to 80 (2 to 3") for order code for "Design", option C "Fixed flange, constricted measuring tube", 0 x DN inlet/outlet runs"



A0032668-EN

- 29 *Pressure loss DN 100 to 300 (4 to 12") for order code for "Design", option C "Fixed flange, constricted measuring tube", 0 x DN inlet/outlet runs"*

System pressure

Installation near pumps → 38

Vibrations

Installation in event of pipe vibrations → 39

Custody transfer mode

The measuring device is optionally tested in accordance with OIML R49 and has an EU type examination certificate according to Measuring Instruments Directive 2014/32/EU for service subject to legal metrological control ("custody transfer") for cold water (Annex III). The permitted medium temperature in these applications is 0 to +50 °C (+32 to +122 °F).

The device is used with a legally controlled totalizer on the local display and optionally with legally controlled outputs.

Measuring devices subject to legal metrological control totalize in both directions, i.e. all the outputs consider flow components in the positive (forward) and negative (reverse) flow direction.

Generally a measuring device subject to legal metrological control is secured against tampering by seals on the transmitter or sensor. These seals may normally only be opened by a representative of the competent authority for legal metrology controls.

After putting the device into circulation or after sealing the device, operation is only possible to a limited extent.

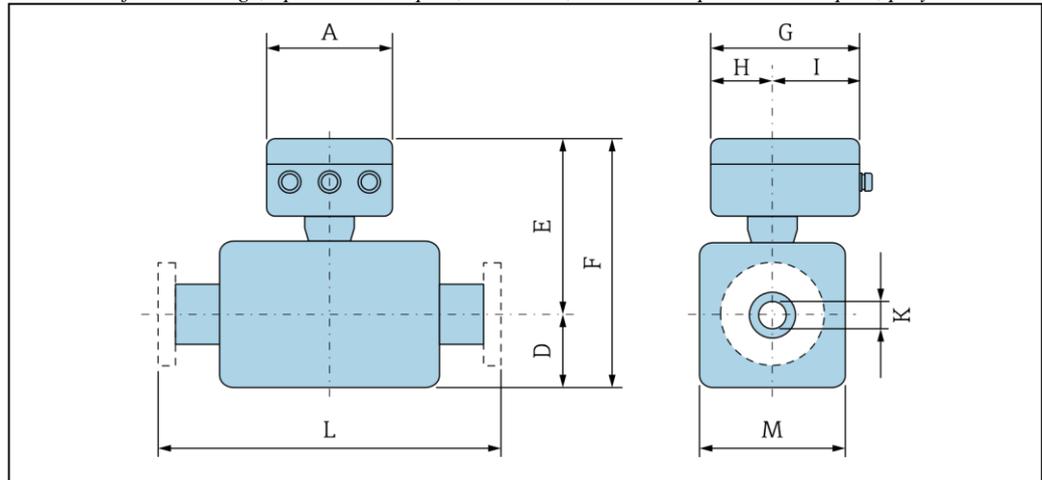
Detailed ordering information is available from your local Endress+Hauser sales center for national approvals (outside Europe) as cold water meters based on OIML R49.

Mechanical construction

Dimensions in SI units

Compact version

Order code for "Housing", option A "Compact, aluminum, coated" or option M "Compact, polycarbonate"



A0033790

A	G ¹⁾	H	I ¹⁾
[mm]	[mm]	[mm]	[mm]
167	193	90	103

1) Depending on the cable gland used: values up to + 30 mm

DN 25 to 300 mm (1 to 12 in): Sensor with aluminum half-shell housing

DN		Order code for "Design"									K	L
		Options D, E, H, I				Option C						
[mm]	[in]	D ¹⁾	E ¹⁾	F ¹⁾	M ¹⁾	D ¹⁾	E ¹⁾	F ¹⁾	M ¹⁾	[mm]	[mm]	
25	1	84	201	285	120	–	–	–	–	²⁾	200	
32	–	84	201	285	120	–	–	–	–	²⁾	200	
40	1 ½	84	201	285	120	–	–	–	–	²⁾	200	

50	2	84	201	285	120	84	201	285	120	2)	200
65	–	109	226	335	180	84	201	285	120	2)	200
80	3	109	226	335	180	84	201	285	120	2)	200
100	4	109	226	335	180	109	226	335	180	2)	250
125	–	150	266	416	260	109	226	335	180	2)	250
150	6	150	266	416	260	109	226	335	180	2)	300
200	8	180	291	471	324	150	266	416	260	2)	350
250	10	205	316	521	400	150	266	416	260	2)	450
300	12	230	341	571	460	180	291	471	324	2)	500

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90

DN 350 to 400 mm (14 to 16 in)

DN		Order code for "Design"					K	L
		Options E, I						
[mm]	[in]	D ₁₎	E ₁₎	F ₁₎	M ₁₎	[mm]		
350	14	282	379	679	564	2)	550	
375	15	308	423	731	616	2)	600	
400	16	308	423	731	616	2)	600	

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90 *DN 450 to 900 mm (18 to 36 in)*

DN		Order code for "Design"								K	L	
		Options F, J				Options G, K						
[mm]	[in]	D ₁₎	E ₁₎	F ₁₎	M ₁₎	D ₁₎	E ₁₎	F ₁₎	M ₁₎		[mm]	[mm]
450	18	290	405	695	580	333	448	781	666	2)	600 ₃₎	650 ₄₎
500	20	315	430	745	630	359	474	833	717	2)	600 ₃₎	650 ₄₎
600	24	365	480	845	730	411	526	937	821	2)	600 ₃₎	780 ₄₎
700	28	426	541	967	851	512	627	1139	1024	2)	700 ₃₎	910 ₄₎
750	30	463	578	1041	926	512	627	1139	1024	2)	750 ₃₎	975 ₄₎

DN		Order code for "Design"								K	L	
		Options F, J				Options G, K						
[mm]	[in]	D ₁₎	E ₁₎	F ₁₎	M ₁₎	D ₁₎	E ₁₎	F ₁₎	M ₁₎		[mm]	[mm]
800	32	482	597	1079	964	534	649	1183	1065	2)	800 ₃₎	1040 ₄₎
900	36	532	647	1179	1064	610	725	1335	1218	2)	900 ₃₎	1170 ₄₎

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90
- 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"

- 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 1000 to 2000 mm (40 to 78 in)

DN		Order code for "Design"					K	L	
		Options F, G, J, K							
[mm]	[in]	D ₁₎ [mm]	E ₁₎ [mm]	F ₁₎ [mm]	M ₁₎ [mm]	[mm]	[mm]		
1000	40	582	697	1 279	1 164	2)	1 000 ³⁾	1 300 ⁴⁾	
–	42	618	733	1 351	1 236	2)	1 050 ³⁾	1 365 ⁴⁾	
1200	48	696	811	1 507	1 392	2)	1 200 ³⁾	1 560 ⁴⁾	
–	54	809	924	1 733	1 617	2)	1 350 ³⁾	1 755 ⁴⁾	
1400	–	809	924	1 733	1 617	2)	1 400 ³⁾	1 820 ⁴⁾	
–	60	909	1 024	1 933	1 817	2)	1 500 ³⁾	1 950 ⁴⁾	
1600	–	909	1 024	1 933	1 817	2)	1 600 ³⁾	2 080 ⁴⁾	
–	66	960	1 075	2 035	1 919	2)	1 650 ³⁾	2 145 ⁴⁾	
1800	72	1 016	1 131	2 147	2 032	2)	1 800 ³⁾	2 340 ⁴⁾	
–	78	1 127	1 242	2 369	2 254	2)	2 000 ³⁾	2 600 ⁴⁾	
2000	–	1 127	1 242	2 369	2 254	2)	2 000 ³⁾	2 600 ⁴⁾	

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90
 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 2200 to 3000 mm (84 to 120 in)

DN		Order code for "Design"					K	L
		Option F, J						
[mm]	[in]	D ₁₎ [mm]	E ₁₎ [mm]	F ₁₎ [mm]	M ₁₎ [mm]	[mm]	[mm]	
–	84	1 227	1 342	2 569	2 454	2)	2 200	
2200	–	1 227	1 342	2 569	2 454	2)	2 200	
–	90	1 332	1 447	2 779	2 664	2)	2 400	
2400	–	1 332	1 447	2 783	2 664	2)	2 400	
–	96	1 431	1 546	2 977	2 861	2)	2 450	

DN		Order code for "Design"					K	L
		Option F, J						
[mm]	[in]	D ₁₎ [mm]	E ₁₎ [mm]	F ₁₎ [mm]	M ₁₎ [mm]	[mm]	[mm]	
–	102	1 516	1 631	3 147	3 032	2)	2 600	
2600	–	1 442	1 557	2 999	2 883	2)	2 600	

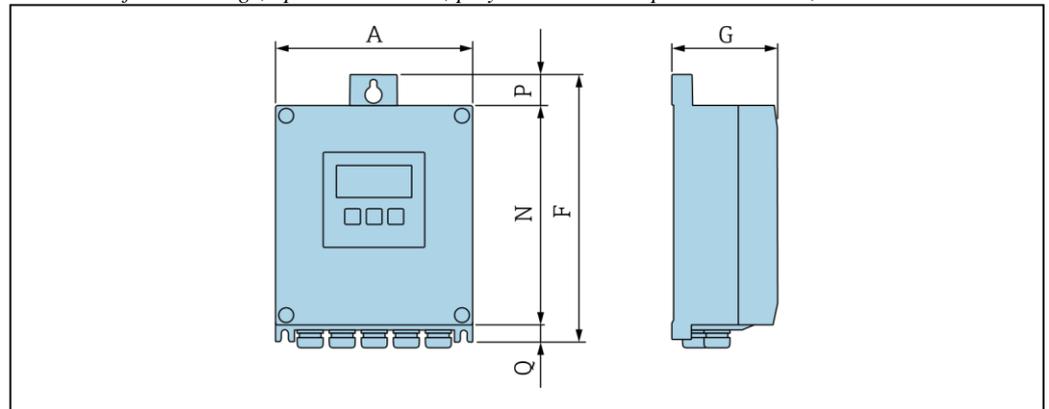
–	108	1602	1718	3320	3204	2)	2750
2800	–	1547	1662	3209	3093	2)	2800
–	114	1688	1803	3491	3375	2)	2900
3000	–	1647	1762	3409	3293	2)	3000
–	120	1774	1889	3663	3547	2)	3050

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90

Remote version

Transmitter remote version

Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



A0033789

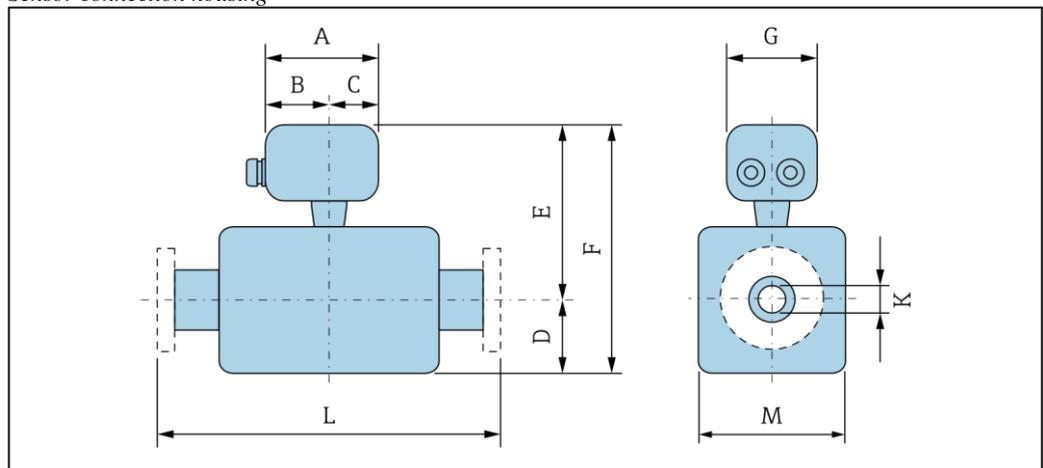
Order code for "Transmitter housing", option P "Remote, aluminum, coated"

A [mm]	F [mm]	G [mm]	N [mm]	P [mm]	Q [mm]
167	232	80	187	24	21

Order code for "Transmitter housing", option N "Remote, polycarbonate"

A [mm]	F [mm]	G [mm]	N [mm]	P [mm]	Q [mm]
177	234	90	197	17	22

Sensor connection housing



A0033784

Aluminum, coated

A	B	C	G
[mm]	[mm]	[mm]	[mm]
148	94	54	136

Polycarbonate (only in conjunction with order code for "Sensor option", options CA...CE)

A	B	C	G
[mm]	[mm]	[mm]	[mm]
113	62	51	112

DN 25 to 300 mm (1 to 12 in): Sensor with aluminum half-shell housing

DN		Order code for "Design"									
		Options D, E, H, I				Option C				K	L
[mm]	[in]	D ₁	E ₁	F ₁	M ₁	D ₁	E ₁	F ₁	M ₁	[mm]	[mm]
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1	84	200	284	120	–	–	–	–	2)	200
32	–	84	200	284	120	–	–	–	–	2)	200
40	1 ½	84	200	284	120	–	–	–	–	2)	200
50	2	84	200	284	120	84	200	284	120	2)	200
65	–	109	225	334	180	84	200	284	120	2)	200
80	3	109	225	334	180	84	200	284	120	2)	200
100	4	109	225	334	180	109	225	334	180	2)	250
125	–	150	265	415	260	109	225	334	180	2)	250
150	6	150	265	415	260	109	225	334	180	2)	300
200	8	180	290	470	324	150	265	415	260	2)	350
250	10	205	315	520	400	150	265	415	260	2)	450
300	12	230	340	570	460	180	290	470	324	2)	500

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90

DN 25 to 300 mm (1 to 12 in): Sensor with fully welded carbon steel housing

DN		Order code for "Design"									
		Option E				Option C				K	L
[mm]	[in]	D ₁	E ₁	F ₁	M ₁	D ₁	E ₁	F ₁	M ₁	[mm]	[mm]
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1	70	200	270	140	–	–	–	–	2)	200
32	–	70	200	270	140	–	–	–	–	2)	200
40	1 ½	70	200	270	140	–	–	–	–	2)	200
50	2	70	200	270	140	70	200	270	140	2)	200
65	–	82	225	307	165	70	200	270	140	2)	200
80	3	87	225	312	175	70	200	270	140	2)	200
100	4	100	225	325	200	82	225	307	165	2)	250
125	–	113	265	378	226	87	225	312	175	2)	250

150	6	134	265	399	269	100	225	325	200	2)	300
200	8	160	290	450	320	113	265	378	226	2)	350
250	10	193	315	508	387	134	265	399	269	2)	450
300	12	218	340	558	437	160	290	450	320	2)	500

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90

DN 350 to 400 mm (14 to 16 in)

DN		Order code for "Design"						K	L
		Options E, I				K	L		
		D ₁₎	E ₁₎	F ₁₎	M ₁₎				
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		
350	14	282	379	679	564	2)	550		
375	15	308	423	731	616	2)	550		
400	16	308	423	731	616	2)	600		

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90 *DN 450 to 900 mm (18 to 36 in)*

DN		Order code for "Design"								K	L	
		Options F, J				Options G, K						
		D ₁₎	E ₁₎	F ₁₎	M ₁₎	D ₁₎	E ₁₎	F ₁₎	M ₁₎			
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	
450	18	290	405	695	580	333	448	781	666	2)	600 ₃₎	650 ₄₎
500	20	315	430	745	630	359	474	833	717	2)	600 ₃₎	650 ₄₎
600	24	365	480	845	730	411	526	937	821	2)	600 ₃₎	780 ₄₎
700	28	426	541	967	851	512	627	1139	1024	2)	700 ₃₎	910 ₄₎
750	30	463	578	1041	926	512	627	1139	1024	2)	750 ₃₎	975 ₄₎

DN		Order code for "Design"								K	L	
		Options F, J				Options G, K						
		D ₁₎	E ₁₎	F ₁₎	M ₁₎	D ₁₎	E ₁₎	F ₁₎	M ₁₎			
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	
800	32	482	597	1079	964	534	649	1183	1065	2)	800 ₃₎	1040 ₄₎
900	36	532	647	1179	1064	610	725	1335	1218	2)	900 ₃₎	1170 ₄₎

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90
 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 1000 to 2000 mm (40 to 78 in)

DN		Order code for "Design"								K	L	
		Options F, G, J, K										

DN		D ₁₎	E ₁₎	F ₁₎	M ₁₎	K	L	
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	
1000	40	582	697	1 279	1 164	2)	1 000 ³⁾	1 300 ⁴⁾
–	42	618	733	1 351	1 236	2)	1 050 ³⁾	1 365 ⁴⁾
1200	48	696	811	1 507	1 392	2)	1 200 ³⁾	1 560 ⁴⁾
–	54	809	924	1 733	1 617	2)	1 350 ³⁾	1 755 ⁴⁾
1400	–	809	924	1 733	1 617	2)	1 400 ³⁾	1 820 ⁴⁾
–	60	909	1 024	1 933	1 817	2)	1 500 ³⁾	1 950 ⁴⁾
1600	–	909	1 024	1 933	1 817	2)	1 600 ³⁾	2 080 ⁴⁾
–	66	960	1 075	2 035	1 919	2)	1 650 ³⁾	2 145 ⁴⁾
1800	72	1 016	1 131	2 147	2 032	2)	1 800 ³⁾	2 340 ⁴⁾
–	78	1 127	1 242	2 369	2 254	2)	2 000 ³⁾	2 600 ⁴⁾
2000	–	1 127	1 242	2 369	2 254	2)	2 000 ³⁾	2 600 ⁴⁾

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Internal diameter depends on the liner, see the measuring tube specification → □ 90
- 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
- 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 2200 to 3000 mm (84 to 120 in)

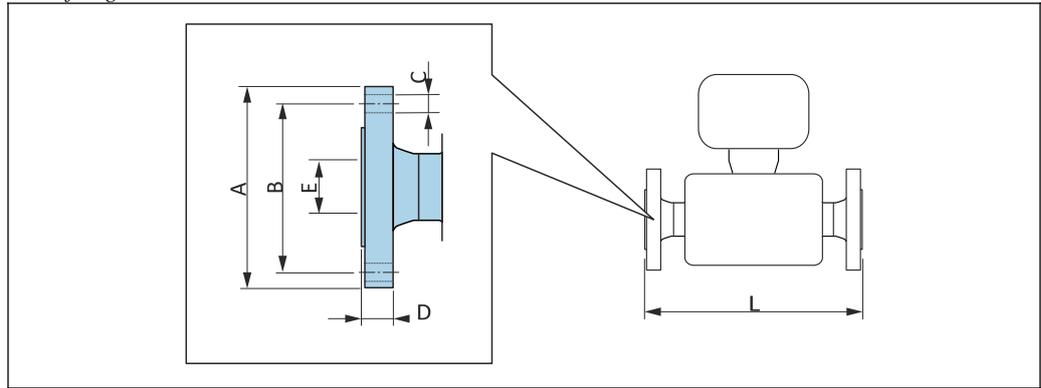
DN		Order code for "Design"					
		Option F, J					
[mm]	[in]	D ₁₎	E ₁₎	F ₁₎	M ₁₎	K	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
–	84	1 227	1 342	2 569	2 454	2)	2 200
2200	–	1 227	1 342	2 569	2 454	2)	2 200
–	90	1 332	1 447	2 779	2 664	2)	2 400
2400	–	1 332	1 447	2 783	2 664	2)	2 400
–	96	1 431	1 546	2 977	2 861	2)	2 450

DN		Order code for "Design"					
		Option F, J					
[mm]	[in]	D ₁₎	E ₁₎	F ₁₎	M ₁₎	K	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
–	102	1 516	1 631	3 147	3 032	2)	2 600
2600	–	1 442	1 557	2 999	2 883	2)	2 600
–	108	1 602	1 718	3 320	3 204	2)	2 750
2800	–	1 547	1 662	3 209	3 093	2)	2 800
–	114	1 688	1 803	3 491	3 375	2)	2 900
3000	–	1 647	1 762	3 409	3 293	2)	3 000
–	120	1 774	1 889	3 663	3 547	2)	3 050

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Internal diameter depends on the liner, see the measuring tube specification → □ 90

Flange connections

Fixed flange



A0015621

Flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 6
 Carbon steel: order code for "Process connection", option D1K
 Stainless steel: order code for "Process connection", option D1S

DN	A	B	C	D	E	L
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
350	490	445	12 × Ø22	22	1)	2)
400	540	495	16 × Ø22	22		
450	595	565	20 × Ø26	26		
500	645	600	20 × Ø22	24		
600	755	705	20 × Ø26	30		
700	860	810	24 × Ø26	30		
800	975	920	24 × Ø30	30		
900	1 075	1 020	24 × Ø30	34		
1000	1 175	1 120	28 × Ø30	38		
1200	1 405	1 340	32 × Ø33	42		
1400	1 630	1 560	36 × Ø36	56		
1600	1 830	1 760	40 × Ø36	63		
1800	2 045	1 970	44 × Ø39	69		
2000	2 265	2 180	48 × Ø42	74		
2200	2 475	2 390	52 × Ø42	81		
2400	2 685	2 600	56 × Ø42	87		
2600	2 905	2 810	60 × Ø48	91		
2800	3 115	3 020	64 × Ø48	101		
3000	3 315	3 220	68 × Ø48	102		

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 µm

- 1) Depends on the liner → 90
- 2) Total installed length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 10
 Carbon steel: *order code for "Process connection", option D2K*
 Stainless steel: *order code for "Process connection", option D2S*

DN	A	B	C	D	E	L
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
200	340	295	8 × Ø22	26	1)	2)
250	395	350	12 × Ø22	28		
300	445	400	12 × Ø22	28		
350	505	460	16 × Ø22	26		
400	565	515	16 × Ø26	26		
450	615	565	20 × Ø26	26		
500	670	620	20 × Ø26	28		
600	780	725	20 × Ø30	30		
700	895	840	24 × Ø30	35		
800	1015	950	24 × Ø33	38		
900	1115	1050	28 × Ø33	38		
1000	1230	1160	28 × Ø36	44		
1200	1455	1380	32 × Ø39	55		
1400	1675	1590	36 × Ø42	65		
1600	1915	1820	40 × Ø48	75		
1800	2115	2020	44 × Ø48	85		
2000	2325	2230	48 × Ø48	90		
2200	2550	2440	52 × Ø56	100		
2400	2760	2650	56 × Ø56	110		
2600	2960	2850	60 × Ø56	110		
2800	3180	3070	64 × Ø56	124		
3000	3405	3290	68 × Ø62	132		

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 µm

- 1) Depends on the liner → 90
- 2) Total installed length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 16 Carbon steel: <i>order code for "Process connection", option D3K</i> Stainless steel: <i>order code for "Process connection", option D3S</i>						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
65	185	145	8 × Ø18	20	1)	2)
80	200	160	8 × Ø18	20		
100	220	180	8 × Ø18	22		
125	250	210	8 × Ø18	24		
150	285	240	8 × Ø22	24		
200	340	295	12 × Ø22	26		
250	405	355	12 × Ø26	32		
300	460	410	12 × Ø26	32		

Flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 16 Carbon steel: <i>order code for "Process connection", option D3K</i> Stainless steel: <i>order code for "Process connection", option D3S</i>						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
350	520	470	16 × Ø26	30		
400	580	525	16 × Ø30	32		
450	640	585	20 × Ø30	34		
500	715	650	20 × Ø33	36		
600	840	770	20 × Ø36	40		
700	910	840	24 × Ø36	40		
800	1025	950	24 × Ø39	41		
900	1125	1050	28 × Ø39	48		
1000	1255	1170	28 × Ø42	59		
1200	1485	1390	32 × Ø48	78		
1400	1685	1590	36 × Ø48	84		
1600	1930	1820	40 × Ø56	102		
1800	2130	2020	44 × Ø56	110		
2000	2345	2230	48 × Ø62	124		

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 µm

- 1) Depends on the liner → 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 25
 Carbon steel: *order code for "Process connection", option D4K*
 Stainless steel: *order code for "Process connection", option D4S*

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
200	360	310	12 × Ø26	32	1)	2)
250	425	370	12 × Ø30	36		
300	485	430	16 × Ø30	40		
350	555	490	16 × Ø33	38		
400	620	550	16 × Ø36	40		
450	670	600	20 × Ø36	46		
500	730	660	20 × Ø36	48		
600	845	770	20 × Ø39	48		
700	960	875	24 × Ø42	50		
800	1 085	990	24 × Ø48	53		
900	1 185	1 090	28 × Ø48	57		
1000	1 320	1 210	28 × Ø56	63		

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 µm

- 1) Depends on the liner → □ 90
 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 40
 Carbon steel: *order code for "Process connection", option D5K*
 Stainless steel: *order code for "Process connection", option D5S*

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
25	115	85	4 × Ø14	16	1)	2)
32	140	100	4 × Ø18	18		
40	150	110	4 × Ø18	18		
50	165	125	4 × Ø18	20		
65	185	145	8 × Ø18	24		
80	200	160	8 × Ø18	26		
100	235	190	8 × Ø22	26		
125	270	220	8 × Ø26	28		
150	300	250	8 × Ø26	30		

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 µm

- 1) Depends on the liner → □ 90

- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Flange according to ASME B16.5, Class 150
 Carbon steel: *order code for "Process connection", option A1K*
 Stainless steel: *order code for "Process connection", option A1S*

DN		A	B	C	D	E	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1	108	79.2	4 × Ø16	12.6	1)	2)
40	1 ½	127	98.6	4 × Ø16	15.9		
50	2	152.4	120.7	4 × Ø19.1	17.5		
80	3	190.5	152.4	4 × Ø19.1	22.3		
100	4	228.6	190.5	8 × Ø19.1	22.3		
150	6	279.4	241.3	8 × Ø22.4	23.8		
200	8	342.9	298.5	8 × Ø22.4	26.8		
250	10	406.4	362	12 × Ø25.4	29.6		
300	12	482.6	431.8	12 × Ø25.4	30.2		
350	14	535	476.3	12 × Ø28.6	35.4		
400	16	595	539.8	16 × Ø28.6	37		
450	18	635	577.9	16 × Ø31.8	40.1		
500	20	700	635	20 × Ø31.8	43.3		
600	24	815	749.3	20 × Ø34.9	48.1		

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → 90
 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Flange according to ASME B16.5, Class 300
 Carbon steel: *order code for "Process connection", option A2K*
 Stainless steel: *order code for "Process connection", option A2S*

DN		A	B	C	D	E	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1	123.9	88.9	4 × Ø19.1	15.9	1)	2)
40	1 ½	155.4	114.3	4 × Ø22.4	19		
50	2	165.1	127	8 × Ø19.1	20.8		
80	3	209.6	168.1	8 × Ø22.4	26.8		
100	4	254	200.2	8 × Ø22.4	30.2		
150	6	317.5	269.7	12 × Ø22.4	35		

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Flange according to JIS B2220, 10K
 Carbon steel: *order code for "Process connection", option N3K*
 Stainless steel: *order code for "Process connection", option N3S*

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
50	155	120	4 × Ø19	16	1)	2)
65	175	140	4 × Ø19	18		
80	185	150	8 × Ø19	18		
100	210	175	8 × Ø19	18		
125	250	210	8 × Ø23	20		
150	280	240	8 × Ø23	22		
200	330	290	12 × Ø23	22		
250	400	355	12 × Ø25	24		
300	445	400	16 × Ø25	24		

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Flange according to JIS B2220, 20K
 Carbon steel: *order code for "Process connection", option N4K*
 Stainless steel: *order code for "Process connection", option N4S*

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
25	125	90	4 × Ø19	16	1)	2)
32	135	100	4 × Ø19	18		
40	140	105	4 × Ø19	18		
50	155	120	8 × Ø19	18		
65	175	140	8 × Ø19	20		
80	200	160	8 × Ø23	22		
100	225	185	8 × Ø23	24		

Flange according to JIS B2220, 20K
 Carbon steel: *order code for "Process connection", option N4K*
 Stainless steel: *order code for "Process connection", option N4S*

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
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125	270	225	8 × Ø25	26		
150	305	260	12 × Ø25	28		
200	350	305	12 × Ø25	30		
250	430	380	12 × Ø27	34		
300	480	430	16 × Ø27	36		
Surface roughness (flange): Ra 6.3 to 12.5 µm						

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Flange according to AWWA, Class D Order code for "Process connection", option W1K							
DN		A	B	C	D	E	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
700	28	927	863.6	28 × Ø35	33.4	1)	2)
750	30	984	914.4	28 × Ø35	35.0		
800	32	1060	977.9	28 × Ø42	38.1		
900	36	1168	1085.9	32 × Ø42	41.3		
1000	40	1289	1200.2	36 × Ø42	41.3		
–	42	1346	1257.3	36 × Ø42	44.5		
1200	48	1511	1422.4	44 × Ø42	47.7		
–	54	1683	1593.9	44 × Ø48	54.0		
–	60	1855	1759.0	52 × Ø48	57.2		
–	66	2032	1930.4	52 × Ø48	63.5		
1800	72	2197	2095.5	60 × Ø48	66.7		
–	78	2362	2260.6	64 × Ø54	69.9		
–	84	2535	2425.7	64 × Ø54	73.1		
–	90	2705	2717.8	68 × Ø60	76.2		
–	96	2877	2755.9	68 × Ø60.3	82.55		
–	102	3048	2908.3	68 × Ø66.7	82.55		
–	108	3219	3067.0	68 × Ø66.7	85.73		
–	114	3391	3219.5	68 × Ø73	88.90		
–	120	3562	3371.8	68 × Ø73	88.90		
Surface roughness (flange): Ra 6.3 to 12.5 µm							

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Installed length according to DVGW → □ 54 (compact version) → □ 58 (remote version)

Flange according to AS 2129, Tab. E Order code for "Process connection", option M _{2K}						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
80	185	146	4 × Ø18	12	1)	2)
100	215	178	8 × Ø18	13		
150	280	235	8 × Ø22	17		
200	335	292	8 × Ø22	19		
250	405	356	12 × Ø22	22		
300	455	406	12 × Ø26	25		
350	525	470	12 × Ø26	30		
400	580	521	12 × Ø26	32		
450	640	584	16 × Ø26	35		
500	705	641	16 × Ø26	38		
600	825	756	16 × Ø33	48		
700	910	845	20 × Ø33	51		
750	995	927	20 × Ø36	54		
800	1060	984	20 × Ø36	54		
900	1175	1092	24 × Ø36	64		
1000	1255	1175	24 × Ø39	67		
1200	1490	1410	32 × Ø39	79		
Surface roughness (flange): Ra 6.3 to 12.5 μ _n						

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Flange according to AS 4087, PN 16 Order code for "Process connection", option M3K						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
80	185	146	4 × Ø18	12	1)	2)
100	215	178	4 × Ø18	13		
150	280	235	8 × Ø18	13		
200	335	292	8 × Ø18	19		
250	405	356	8 × Ø22	19		
300	455	406	12 × Ø22	23		

350	525	470	12 × Ø26	30
375	550	495	12 × Ø26	30
400	580	521	12 × Ø26	32
450	640	584	12 × Ø26	30
500	705	641	16 × Ø26	38
600	825	756	16 × Ø30	48
700	910	845	20 × Ø30	56
750	995	927	20 × Ø33	56
800	1060	984	20 × Ø36	56

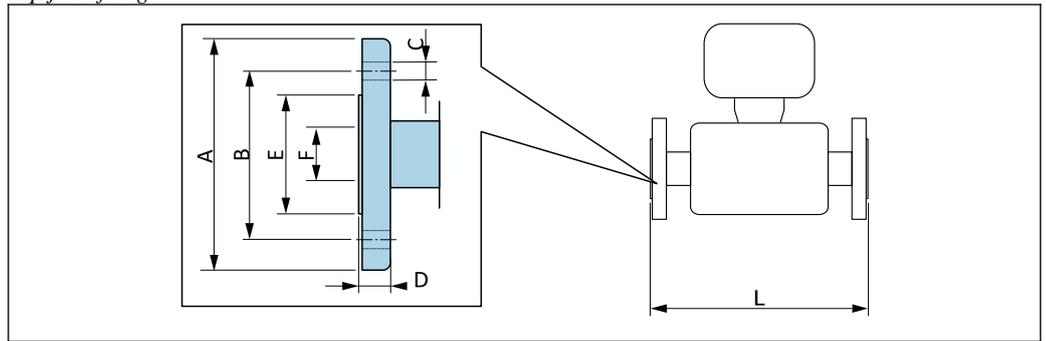
Flange according to AS 4087, PN 16
 Order code for "Process connection", option M 3K

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
900	1175	1092	24 × Ø36	66		
1000	1255	1175	24 × Ø36	66		
1200	1490	1410	32 × Ø36	76		

Surface roughness (flange): Ra 6.3 to 12.5 µn

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Lap joint flange



A0037862

Lap joint flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 10
 Carbon steel: order code for "Process connection", option D22
 Stainless steel: order code for "Process connection", option D24

DN	A	B	C	D	E	F	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
200	8	340	295	8 × Ø22	24	264	1) 2)
250	10	395	350	12 × Ø22	26	317	
300	12	445	400	12 × Ø22	26	367	

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Lap joint flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 16
 Carbon steel: *order code for "Process connection", option D32*
 Stainless steel: *order code for "Process connection", option D34*

DN		A	B	C	D	E	F	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1	115	85	4 × Ø14	16	49	1)	2)
32	-	140	100	4 × Ø18	18	65		
40	1 ½	150	110	4 × Ø18	18	71		
50	2	165	125	4 × Ø18	20	88		
65	-	185	145	8 × Ø18	20	103		
80	3	200	160	8 × Ø18	20	120		

Lap joint flange in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 16
 Carbon steel: *order code for "Process connection", option D32*
 Stainless steel: *order code for "Process connection", option D34*

DN		A	B	C	D	E	F	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
100	4	220	180	8 × Ø18	22	148		
125	-	250	210	8 × Ø18	22	177		
150	6	285	240	8 × Ø22	24	209		
200	8	340	295	12 × Ø22	26	264		
250	10	405	355	12 × Ø26	29	317		
300	12	460	410	12 × Ø26	32	367		

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 54 (compact version) → 58 (remote version)

Lap joint flange according to ASME B16.5, Class 150
 Carbon steel: *order code for "Process connection", option A12*
 Stainless steel: *order code for "Process connection", option A*

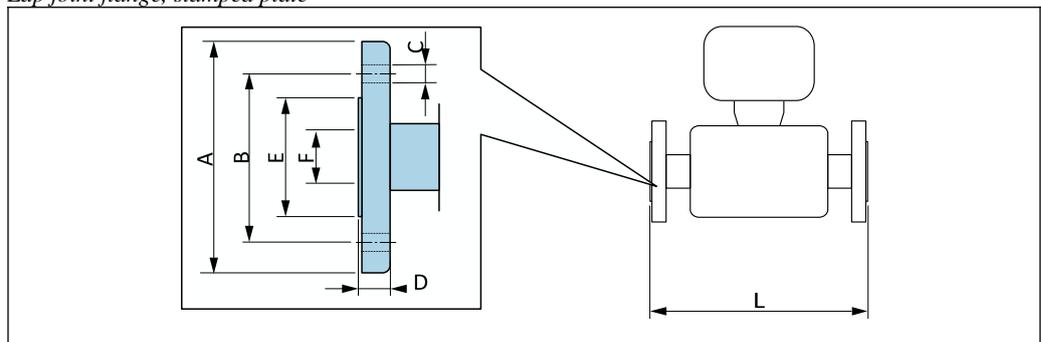
DN		A	B	C	D	E	F	L
[mm]	[in]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	1	110	80	4 × Ø16	14	49	1)	2)

40	1 ½	125	98	4 × Ø16	17.5	71
50	2	150	121	4 × Ø19	19	88
80	3	190	152	4 × Ø19	24	120
100	4	230	190	8 × Ø19	24	148
150	6	280	241	8 × Ø23	25	209
200	8	345	298	8 × Ø23	29	264
250	10	405	362	12 × Ø25	30	317
300	12	485	432	12 × Ø25	32	378

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Lap joint flange, stamped plate



Lap joint flange, stamped plate in accordance with EN 1092-1 (DIN 2501 / DIN 2512N): PN 10
 Carbon steel: order code for "Process connection", option D21
 Stainless steel: order code for "Process connection", option D23

DN	A	B	C	D	E	F	L
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
25	115	85	4 x Ø13.5	16.5	49	1)	2)
32	140	100	4 x Ø17.5	17	65		
40	150	110	4 x Ø17.5	16.5	71		
50	165	125	4 x Ø17.5	18.5	88		
65	185	145	4 x Ø17.5	20	103		
80	200	160	8 x Ø17.5	23.5	120		
100	220	180	8 x Ø17.5	24.5	148		
125	250	210	8 x Ø17.5	24	177		
150	285	240	8 x Ø21.5	25	209		
200	340	295	8 x Ø21.5	27.5	264		

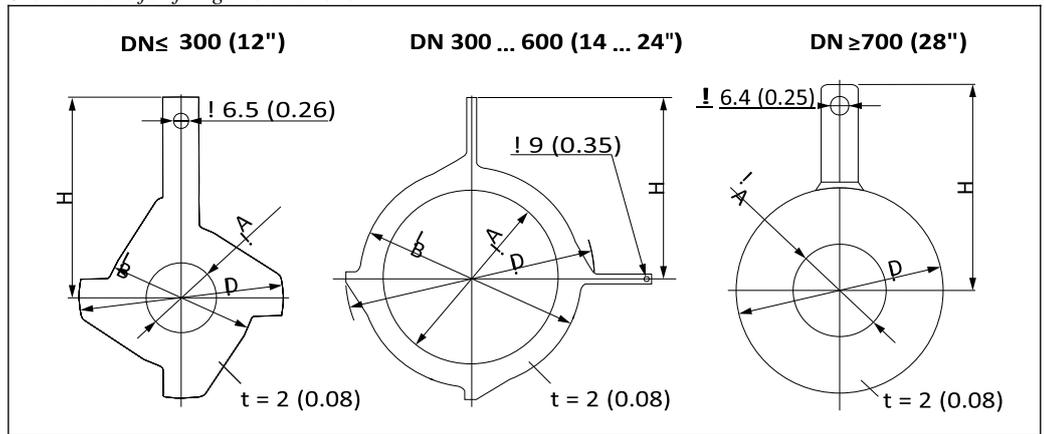
250	405	350	12 x Ø21.5	30.5	317
300	445	400	12 x Ø21.5	34.5	367

Surface roughness (flange): Ra 6.3 to 12.5 µm

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 54 (compact version) → □ 58 (remote version)

Accessories

Ground disks for flange connections



A0015442

DN		Pressure rating	A		B		D		H	
[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
25	1"	1)	26	1.02	62	2.44	77.5	3.05	87.5	3.44
32	1 ¼"	1)	35	1.38	80	3.15	87.5	3.44	94.5	3.72
40	1 ½"	1)	41	1.61	82	3.23	101	3.98	103	4.06
50	2"	1)	52	2.05	101	3.98	115.5	4.55	108	4.25
65	2 ½"	1)	68	2.68	121	4.76	131.5	5.18	118	4.65
80	3"	1)	80	3.15	131	5.16	154.5	6.08	135	5.31

DN		Pressure rating	A		B		D		H	
[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
100	4"	1)	104	4.09	156	6.14	186.5	7.34	153	6.02
125	5"	1)	130	5.12	187	7.36	206.5	8.13	160	6.30
150	6"	1)	158	6.22	217	8.54	256	10.08	184	7.24
200	8"	1)	206	8.11	267	10.51	288	11.34	205	8.07
250	10"	1)	260	10.2	328	12.91	359	14.13	240	9.45
300	12"	PN 10 PN 16 Cl. 150	312	12.3	375	14.76	413	16.26	273	10.75

		PN 25 JIS 10K JIS 20K	310	12.2	375	14.76	404	15.91	268	10.55
350	14"	PN 6	420	16.5	420	16.54	479	18.86	365	14.37
		PN 10								
		PN 16								
375	15"	PN 16	461	18.2	461	18.2	523	20.6	395	15.6
400	16"	PN 6	470	18.5	470	18.50	542	21.34	395	15.55
		PN 10								
		PN 16								
450	18"	PN 6	525	20.7	525	20.67	583	22.95	417	16.42
		PN 10								
		PN 16								
500	20"	PN 6	575	22.6	575	22.64	650	25.59	460	18.11
		PN 10								
		PN 16								
600	24"	PN 6	676	26.6	676	26.61	766	30.16	522	20.55
		PN 10								
		PN 16								
700	28"	PN 6	697	27.4	–	–	786	30.94	460	18.11
		PN10	693	27.3	–	–	813	32.01	480	18.9
		PN16	687	27.1	–	–	807	31.77	490	19.29
		Cl, D	693	27.3	–	–	832	32.76	494	19.45
750	30"	Cl, D	743	29.3	–	–	833	32.8	523	20.59
800	32"	PN 6	799	31.5	–	–	893	35.16	520	20.47
		PN 10	795	31.3	–	–	920	36.22	540	21.26
		PN 16	789	31.1	–	–	914	35.98	550	21.65
		Cl, D	795	31.3	–	–	940	37.01	561	22.09
900	36"	PN 6	897	35.3	–	–	993	39.09	570	22.44
		PN 10	893	35.2	–	–	1020	40.16	590	23.23
		PN 16	886	34.9	–	–	1014	39.92	595	23.43
		Cl, D	893	35.2	–	–	1048	41.26	615	24.21
1000	40"	PN 6	999	39.3	–	–	1093	43.03	620	24.41
		PN 10	995	39.2	–	–	1127	44.37	650	25.59
		PN 16	988	38.9	–	–	1131	44.53	660	25.98

DN		Pressure rating	A		B		D		H	
[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
		Cl, D	995	39.2	–	–	1163	45.79	675	26.57

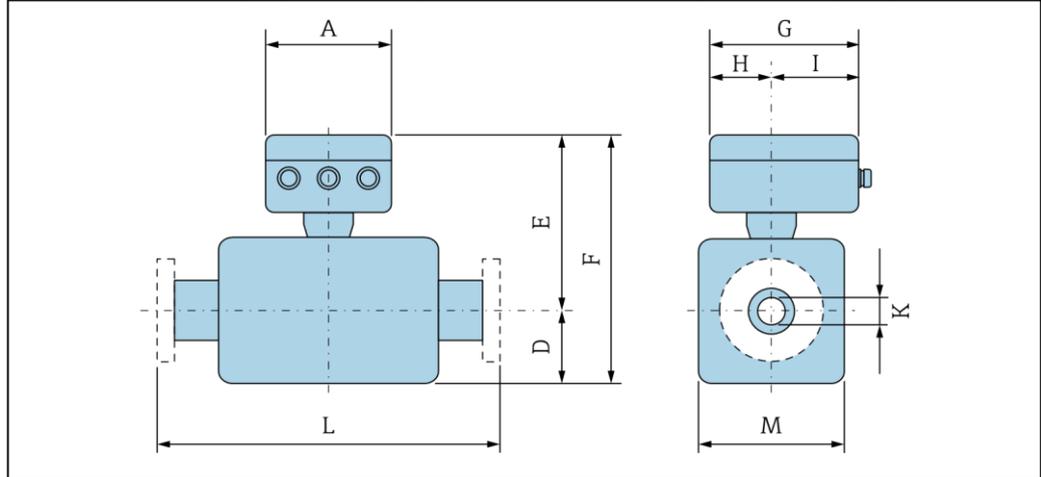
-	42"	PN 6	1044	41.1	-	-	1220	48.03	704	27.72
1200	48"	PN 6	1203	47.4	-	-	1310	51.57	733	28.86
		PN 10	1196	47.1	-	-	1344	52.91	760	29.92
		PN 16	1196	47.1	-	-	1385	54.53	786	30.94
		Cl, D	1188	46.8	-	-	1345	52.95	775	30.51

- 1) In the case of DN 25 to 250, ground disks can be used for all the flange standards/pressure ratings which can be supplied in the standard version

Dimensions in US units

Compact version

Order code for "Housing", option A "Compact, aluminum, coated" or option M "Compact, polycarbonate"



A0033790

A	G ¹⁾	H	I ¹⁾
[in]	[in]	[in]	[in]
6.57	7.60	3.54	4.06

1) Depending on the cable gland used: values up to + 1.18 in

DN 1 to 12 in (25 to 300 mm): Sensor with aluminum half-shell housing

DN		Order code for "Design"									
		Options D, E, H, I					Option C				
[mm]	[in]	D ¹⁾	E ¹⁾	F ¹⁾	M ¹⁾	D ¹⁾	E ¹⁾	F ¹⁾	M ¹⁾	K	L
		[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
25	1	3.31	7.91	11.22	4.72	–	–	–	–	2)	7.87
32	–	3.31	7.91	11.22	4.72	–	–	–	–	2)	7.87
40	1 ½	3.31	7.91	11.22	4.72	–	–	–	–	2)	7.87
50	2	3.31	7.91	11.22	4.72	3.31	7.91	11.22	4.72	2)	7.87
65	–	4.29	8.9	13.19	7.09	3.31	7.91	11.22	4.72	2)	7.87
80	3	4.29	8.9	13.19	7.09	3.31	7.91	11.22	4.72	2)	7.87
100	4	4.29	8.9	13.19	7.09	4.29	8.9	13.19	7.09	2)	9.84
125	–	5.91	10.47	16.38	10.24	4.29	8.9	13.19	7.09	2)	9.84
150	6	5.91	10.47	16.38	10.24	4.29	8.9	13.19	7.09	2)	11.81
200	8	7.09	11.46	18.54	12.76	5.91	10.47	16.38	10.24	2)	13.78
250	10	8.07	12.44	20.51	15.75	5.91	10.47	16.38	10.24	2)	17.72
300	12	9.06	13.43	22.48	18.11	7.09	11.46	18.54	12.76	2)	19.69

1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.

2) Depends on the liner → □ 90

DN 14 to 16 in (350 to 400 mm)

Order code for "Design"			
Options E, I			

DN		D ₁₎	E ₁₎	F ₁₎	M ₁₎	K	L
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
350	14	11.10	15.63	26.73	22.20	2) ²⁾	21.65
375	15	12.13	16.65	28.78	24.25	2) ²⁾	23.62
400	16	12.13	16.65	28.78	24.25	2) ²⁾	23.62

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90

DN 18 to 36 in (450 to 900 mm)

DN		Order code for "Design"								K	L	
		Options F, J				Options G, K						
[mm]	[in]	D ₁₎	E ₁₎	F ₁₎	M ₁₎	D ₁₎	E ₁₎	F ₁₎	M ₁₎	[in]	[in]	[in]
450	18	11.42	15.94	27.36	22.83	13.11	17.64	30.75	26.22	2) ²⁾	23.62 ³⁾	25.59 ⁴⁾
500	20	12.40	16.93	29.33	24.80	14.13	18.66	32.80	28.23	2) ²⁾	23.62 ²⁾	25.59 ⁴⁾
600	24	14.37	18.90	33.27	28.74	16.18	20.71	36.89	32.32	2) ²⁾	23.62 ²⁾	30.71 ⁴⁾
700	28	16.77	21.30	38.07	33.50	20.16	24.69	44.84	40.31	2) ²⁾	27.56 ²⁾	35.83 ⁴⁾
750	30	18.23	22.76	40.98	36.46	20.16	24.69	44.84	40.31	2) ²⁾	29.53 ²⁾	38.39 ⁴⁾
800	32	18.98	23.50	42.48	37.95	21.02	25.55	46.57	41.93	2) ²⁾	31.5 ²⁾	40.94 ⁴⁾
900	36	20.94	25.47	46.42	41.89	24.02	28.54	52.56	47.95	2) ²⁾	35.43 ²⁾	46.06 ⁴⁾

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90
- 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
- 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 40 to 78 in (1000 to 2000 mm)

DN		Order code for "Design"				K	L	
		D ₁₎	E ₁₎	F ₁₎	M ₁₎			
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
1000	40	22.91	27.44	50.35	45.83	2) ²⁾	39.37 ³⁾	51.18 ⁴⁾
–	42	24.33	28.86	53.19	48.66	2) ²⁾	41.34 ³⁾	53.74 ⁴⁾
1200	48	27.40	31.93	59.33	54.80	2) ²⁾	47.24 ³⁾	61.42 ⁴⁾
–	54	31.85	36.38	68.23	63.66	2) ²⁾	53.15 ³⁾	69.09 ⁴⁾
1400	–	31.85	36.38	68.23	63.66	2) ²⁾	55.12 ³⁾	71.65 ⁴⁾
–	60	35.79	40.31	76.10	71.54	2) ²⁾	59.06 ³⁾	76.77 ⁴⁾
1600	–	35.79	40.31	76.10	71.54	2) ²⁾	62.99 ³⁾	81.89 ⁴⁾
–	66	37.80	42.32	80.12	75.55	2) ²⁾	64.96 ³⁾	84.45 ⁴⁾
1800	72	40.00	44.53	84.53	80.00	2) ²⁾	70.87 ³⁾	92.13 ⁴⁾

DN		Order code for "Design"					L	
		D ₁₎	E ₁₎	F ₁₎	M ₁₎	K		
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	
–	78	44.37	48.90	93.27	88.74	2)	78.74 ³⁾	102.36 ⁴⁾
2000	–	44.37	48.90	93.27	88.74	2)	78.74 ³⁾	102.36 ⁴⁾

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90
- 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
- 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 84 to 120 in (2200 to 3000 mm)

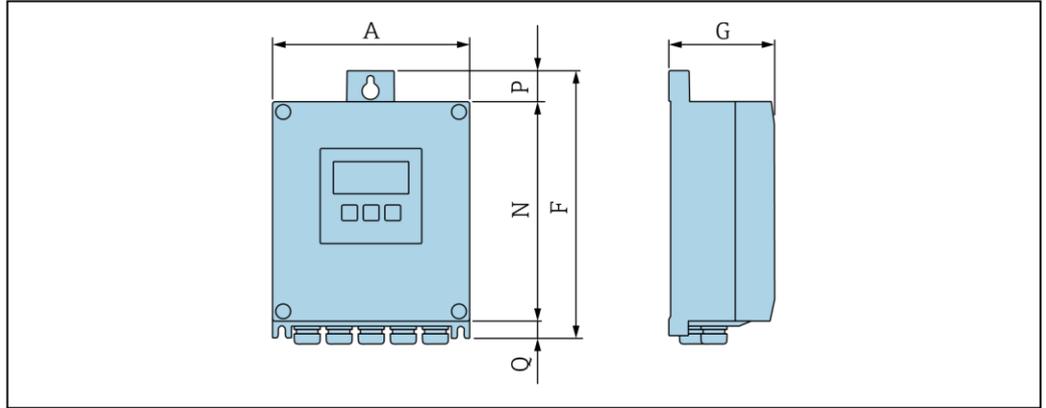
DN		Order code for "Design"					L	
		D ₁₎	E ₁₎	F ₁₎	M ₁₎	K		
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	
–	84	48.31	52.83	101.14	96.61	2)	86.61	
2200	–	48.31	52.83	101.14	96.61	2)	86.61	
–	90	52.44	56.97	109.41	104.88	2)	94.49	
2400	–	52.44	56.97	109.57	104.88	2)	94.49	
–	96	56.34	60.87	117.20	112.64	2)	96.46	
–	102	59.69	64.21	123.90	119.37	2)	102.36	
2600	–	56.77	61.30	118.07	113.50	2)	102.36	
–	108	63.07	67.64	130.71	126.14	2)	108.27	
2800	–	60.91	65.43	126.34	121.77	2)	110.24	
–	114	66.46	70.98	137.44	132.87	2)	114.17	
3000	–	64.84	69.37	134.21	129.65	2)	118.11	
–	120	69.84	74.37	144.21	139.65	2)	120.08	

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Depends on the liner → □ 90

Remote version

Transmitter remote version

Order code for "Housing", option N "Remote, polycarbonate" or option P "Remote, aluminum coated"



A0033789

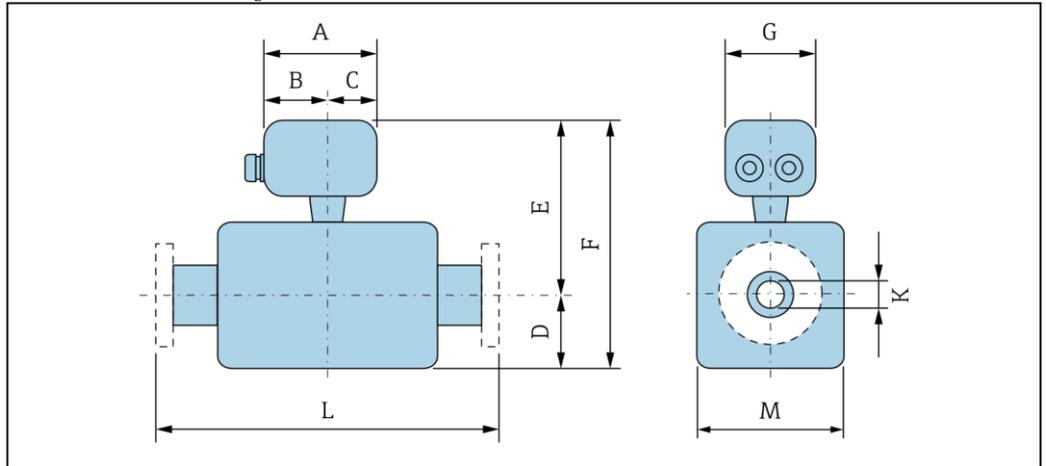
Order code for "Transmitter housing", option P "Remote, aluminum, coated"

A [in]	F [in]	G [in]	N [in]	P [in]	Q [in]
6.57	9.13	3.15	7.36	0.94	0.83

Order code for "Transmitter housing", option N "Remote, polycarbonate"

A [in]	F [in]	G [in]	N [in]	P [in]	Q [in]
6.97	9.21	3.54	7.76	0.67	0.87

Sensor connection housing



A0033784

Aluminum, coated

A [in]	B [in]	C [in]	G [in]
5.83	3.7	2.13	5.35

Polycarbonate (only in conjunction with order code for "Sensor option", options CA...CE)

A [in]	B [in]	C [in]	G [in]
4.45	2.44	2.01	4.41

DN 1 to 12 in (25 to 300 mm): Sensor with aluminum half-shell housing

DN	Order code for "Design"	
	Options D, E, H, I	Option C

DN		D ₁	E ₁	F ₁	M ₁	D ₁	E ₁	F ₁	M ₁	K	L
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
25	1	3.31	7.87	11.18	4.72	–	–	–	–	2)	7.87
32	–	3.31	7.87	11.18	4.72	–	–	–	–	2)	7.87
40	1 ½	3.31	7.87	11.18	4.72	–	–	–	–	2)	7.87
50	2	3.31	7.87	11.18	4.72	3.31	7.87	11.18	4.72	2)	7.87
65	–	4.29	8.86	13.15	7.09	3.31	7.87	11.18	4.72	2)	7.87
80	3	4.29	8.86	13.15	7.09	3.31	7.87	11.18	4.72	2)	7.87
100	4	4.29	8.86	13.15	7.09	4.29	8.86	13.15	7.09	2)	9.84
125	–	5.91	10.43	16.34	10.24	4.29	8.86	13.15	7.09	2)	9.84
150	6	5.91	10.43	16.34	10.24	4.29	8.86	13.15	7.09	2)	11.81
200	8	7.09	11.42	18.5	12.76	5.91	10.43	16.34	10.24	2)	13.78
250	10	8.07	12.4	20.47	15.75	5.91	10.43	16.34	10.24	2)	17.72
300	12	9.06	13.39	22.44	18.11	7.09	11.42	18.5	12.76	2)	19.69

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90

DN 1 to 12 in (25 to 300 mm): Sensor with fully welded carbon steel housing

DN		Order code for "Design"									
		Option E				Option C				K	L
[mm]	[in]	D ₁	E ₁	F ₁	M ₁	D ₁	E ₁	F ₁	M ₁	[in]	[in]
25	1	2.76	7.87	10.63	5.51	–	–	–	–	2)	7.87
32	–	2.76	7.87	10.63	5.51	–	–	–	–	2)	7.87
40	1 ½	2.76	7.87	10.63	5.51	–	–	–	–	2)	7.87
50	2	2.76	7.87	10.63	5.51	2.76	7.87	10.63	5.51	2)	7.87
65	–	3.23	8.86	12.09	6.5	2.76	7.87	10.63	5.51	2)	7.87
80	3	3.43	8.86	12.28	6.89	2.76	7.87	10.63	5.51	2)	7.87
100	4	3.94	8.86	12.8	7.87	3.23	8.86	12.09	6.5	2)	9.84
125	–	4.45	10.43	14.88	8.9	3.43	8.86	12.28	6.89	2)	9.84
150	6	5.28	10.43	15.71	10.59	3.94	8.86	12.8	7.87	2)	11.81
200	8	6.3	11.42	17.72	12.6	4.45	10.43	14.88	8.9	2)	13.78

DN		Order code for "Design"									
		Option E				Option C				K	L
[mm]	[in]	D ₁	E ₁	F ₁	M ₁	D ₁	E ₁	F ₁	M ₁	[in]	[in]
250	10	7.6	12.4	20	15.24	5.28	10.43	15.71	10.59	2)	17.72
300	12	8.58	13.39	21.97	17.2	6.3	11.42	17.72	12.6	2)	19.69

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90

DN 14 to 16 in (350 to 400 mm)

DN		Order code for "Design"					
		Options E, I					
		D ₁₎	E ₁₎	F ₁₎	M ₁₎	K	L
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	
350	14	11.10	15.63	26.73	22.20	2) ⁾	21.65
375	15	12.13	16.65	28.78	24.25	2) ⁾	23.62
400	16	12.13	16.65	28.78	24.25	2) ⁾	23.62

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90

DN 18 to 36 in (450 to 900 mm)

DN		Order code for "Design"								K	L	
		Options F, J				Options G, K						
		D ₁₎	E ₁₎	F ₁₎	M ₁₎	D ₁₎	E ₁₎	F ₁₎	M ₁₎			
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	
450	18	11.42	15.94	27.36	22.83	13.11	17.64	30.75	26.22	2) ⁾	23.62 ³⁾	25.59 ⁴⁾
500	20	12.40	16.93	29.33	24.80	14.13	18.66	32.80	28.23	2) ⁾	23.62 ³⁾	25.59 ⁴⁾
600	24	14.37	18.90	33.27	28.74	16.18	20.71	36.89	32.32	2) ⁾	23.62 ³⁾	30.71 ⁴⁾
700	28	16.77	21.30	38.07	33.50	20.16	24.69	44.84	40.31	2) ⁾	27.56 ³⁾	35.83 ⁴⁾
750	30	18.23	22.76	40.98	36.46	20.16	24.69	44.84	40.31	2) ⁾	29.53 ³⁾	38.39 ⁴⁾
800	32	18.98	23.50	42.48	37.95	21.02	25.55	46.57	41.93	2) ⁾	31.5 ³⁾	40.94 ⁴⁾
900	36	20.94	25.47	46.42	41.89	24.02	28.54	52.56	47.95	2) ⁾	35.43 ³⁾	46.06 ⁴⁾

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
 2) Depends on the liner → □ 90
 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

DN 40 to 78 in (1000 to 2000 mm)

DN		Order code for "Design"					K	L	
		Options F, G, J, K							
		D ₁₎	E ₁₎	F ₁₎	M ₁₎				
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]		
1000	40	22.91	27.44	50.35	45.83	2) ⁾	39.37 ³⁾	51.18 ⁴⁾	
–	42	24.33	28.86	53.19	48.66	2) ⁾	41.34 ³⁾	53.74 ⁴⁾	
1200	48	27.40	31.93	59.33	54.80	2) ⁾	47.24 ³⁾	61.42 ⁴⁾	
–	54	31.85	36.38	68.23	63.66	2) ⁾	53.15 ³⁾	69.09 ⁴⁾	
1400	–	31.85	36.38	68.23	63.66	2) ⁾	55.12 ³⁾	71.65 ⁴⁾	
–	60	35.79	40.31	76.10	71.54	2) ⁾	59.06 ³⁾	76.77 ⁴⁾	
1600	–	35.79	40.31	76.10	71.54	2) ⁾	62.99 ³⁾	81.89 ⁴⁾	
–	66	37.80	42.32	80.12	75.55	2) ⁾	64.96 ³⁾	84.45 ⁴⁾	

1800	72	40.00	44.53	84.53	80.00	2)	70.87 ³⁾	92.13 ⁴⁾
–	78	44.37	48.90	93.27	88.74	2)	78.74 ³⁾	102.36 ⁴⁾
2000	–	44.37	48.90	93.27	88.74	2)	78.74 ³⁾	102.36 ⁴⁾

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Internal diameter depends on the liner, see the measuring tube specification → □ 90
- 3) Order code for "Design", option F "Fixed flange, short installed length" and option J "Fixed flange, short installed length, 0 x DN inlet/outlet runs"
- 4) Order code for "Design", option G "Fixed flange, long installed length" and option K "Fixed flange, long installed length 0 x DN inlet/outlet runs"

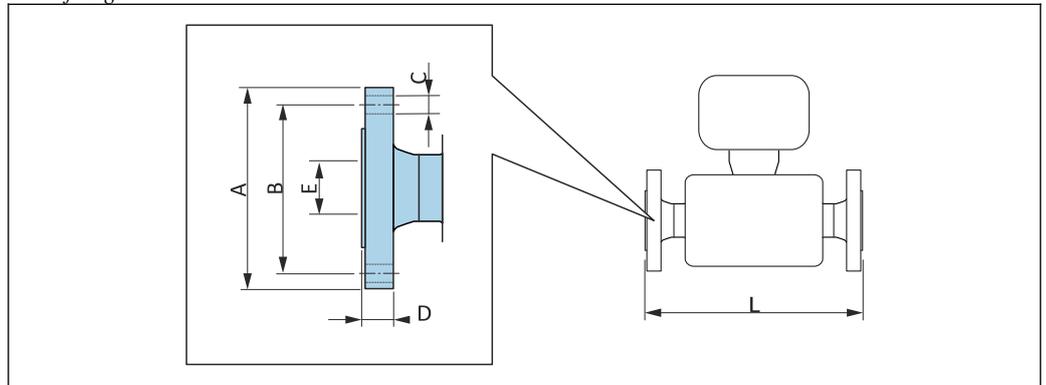
DN 84 to 120 in (2200 to 3000 mm)

DN		Order code for "Design"					
		Option F, J					
[mm]	[in]	D ₁₎ [in]	E ₁₎ [in]	F ₁₎ [in]	M ₁₎ [in]	K [in]	L [in]
–	84	48.31	52.83	101.14	96.61	2)	86.61
2200	–	48.31	52.83	101.14	96.61	2)	86.61
–	90	52.44	56.97	109.41	104.88	2)	94.49
2400	–	52.44	56.97	109.57	104.88	2)	94.49
–	96	56.34	60.87	117.20	112.64	2)	96.46
–	102	59.69	64.21	123.90	119.37	2)	102.36
2600	–	56.77	61.30	118.07	113.50	2)	102.36
–	108	63.07	67.64	130.71	126.14	2)	108.27
2800	–	60.91	65.43	126.34	121.77	2)	110.24
–	114	66.46	70.98	137.44	132.87	2)	114.17
3000	–	64.84	69.37	134.21	129.65	2)	118.11
–	120	69.84	74.37	144.21	139.65	2)	120.08

- 1) The dimensions are reference values. They may vary depending on the pressure rating, design and order option.
- 2) Internal diameter depends on the liner, see the measuring tube specification → □ 90

Flange connections

Fixed flange



A0015621

Flange according to ASME B16.5, Class 150
 Carbon steel: *order code for "Process connection", option A1K*
 Stainless steel: *order code for "Process connection", option A1S*

DN		A	B	C	D	E	L
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
25	1	4.25	3.12	4 × Ø0.63	0.5	1)	2)
40	1 ½	5	3.88	4 × Ø0.63	0.63		
50	2	6	4.75	4 × Ø0.75	0.69		
80	3	7.5	6	4 × Ø0.75	0.88		
100	4	9	7.5	8 × Ø0.75	0.88		
150	6	11	9.5	8 × Ø0.88	0.94		
200	8	13.5	11.75	8 × Ø0.88	1.06		
250	10	16	14.25	12 × Ø1	1.17		
300	12	19	17	12 × Ø1	1.19		
350	14	21.06	18.75	12 × Ø1.13	1.39		
400	16	23.43	21.25	16 × Ø1.13	1.46		
450	18	25	22.75	16 × Ø1.25	1.58		
500	20	27.56	25	20 × Ø1.25	1.7		
600	24	32.09	29.5	20 × Ø1.37	1.89		

Surface roughness (flange): Ra 250 to 492 µm

- 1) Depends on the liner → □ 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → □ 74 (compact version) → □ 77 (remote version)

Flange according to ASME B16.5, Class 300
 Carbon steel: *order code for "Process connection", option A2K*
 Stainless steel: *order code for "Process connection", option A2S*

DN		A	B	C	D	E	L
[in]	[mm]	[in]	[in]	[in]	[in]	[in]	[in]
1	25	4.88	3.5	4 × Ø0.75	0.63	1)	2)
1 ½	40	6.12	4.5	4 × Ø0.88	0.75		
2	50	6.5	5	8 × Ø0.75	0.82		

Flange according to ASME B16.5, Class 300
 Carbon steel: *order code for "Process connection", option A2K*
 Stainless steel: *order code for "Process connection", option A2S*

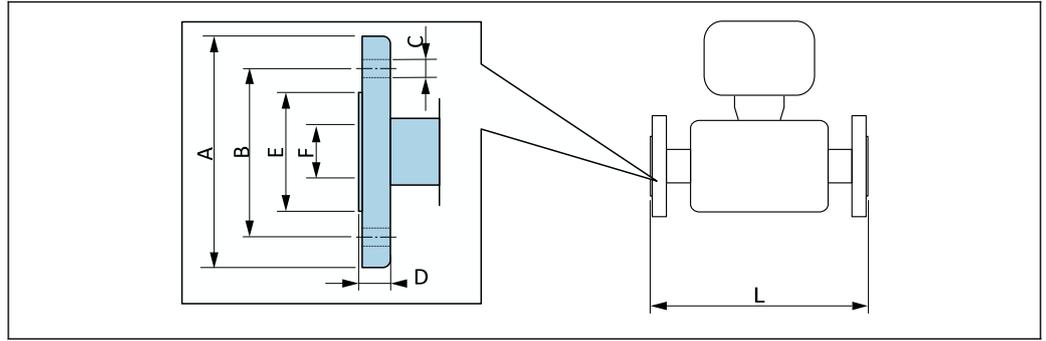
DN		A	B	C	D	E	L
[in]	[mm]	[in]	[in]	[in]	[in]	[in]	[in]

3	80	8.25	6.62	8 × Ø0.88	1.06		
4	100	10	7.88	8 × Ø0.88	1.19		
6	150	12.5	10.62	12 × Ø0.88	1.38		
Surface roughness (flange): Ra 250 to 492 µm							

- 1) Depends on the liner → 90
- 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 74 (compact version) → 77 (remote version)

Flange according to AWWA, Cl. D Order code for "Process connection", option W1K							
DN		A	B	C	D	E	L
[in]	[mm]	[in]	[in]	[in]	[in]	[in]	[in]
28	700	36.50	34.00	28 × Ø1.38	1.31	1)	2)
30	–	38.74	36.00	28 × Ø1.38	1.38		
32	800	41.73	38.50	28 × Ø1.65	1.50		
36	900	45.98	42.75	32 × Ø1.65	1.63		
40	1000	50.75	47.25	36 × Ø1.65	1.63		
42	–	52.99	49.50	36 × Ø1.65	1.75		
48	1200	59.49	56.00	44 × Ø1.65	1.88		
54	–	66.26	62.75	44 × Ø1.89	2.13		
60	–	73.03	69.25	52 × Ø1.89	2.25		
66	–	80.00	76.00	52 × Ø1.89	2.50		
72	1800	86.50	82.50	60 × Ø1.89	2.63		
78	–	92.99	89.00	64 × Ø2.13	2.75		
84	–	99.80	95.50	64 × Ø2.13	2.88		
90	–	106.50	107.00	68 × Ø2.36	3.00		
96	–	113.27	108.50	68 × Ø2.37	3.25		
102	–	120.00	114.50	68 × Ø2.63	3.25		
108	–	126.73	120.75	68 × Ø2.63	3.38		
114	–	133.50	126.75	68 × Ø2.87	3.50		
120	–	140.24	132.75	68 × Ø2.87	3.50		
Surface roughness (flange): Ra 250 to 492 µm							

- 1) Depends on the liner → 90
- 2) Total length is independent of the process connections. Installed length according to DVGW → 74 (compact version) → 77 (remote version)
Lap joint flange



A0037862

Lap joint flange according to ASME B16.5, Class 150
 Carbon steel: order code for "Process connection", option A12
 Stainless steel: order code for "Process connection", option A

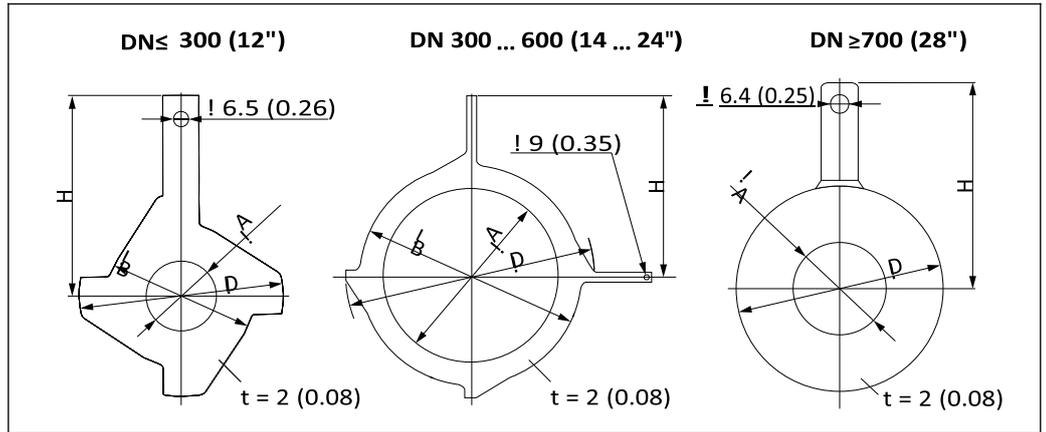
DN		A	B	C	D	E	F	L
[mm]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]
25	1	4.33	3.15	4 × Ø0.63	0.55	1.93	1)	2)
40	1 ½	4.92	3.86	4 × Ø0.63	0.69	2.8		
50	2	5.91	4.76	4 × Ø0.75	0.75	3.46		
80	3	7.48	5.98	4 × Ø0.75	0.94	4.72		
100	4	9.06	7.48	8 × Ø0.75	0.94	5.83		
150	6	11.02	9.49	8 × Ø0.91	0.98	8.23		
200	8	13.58	11.73	8 × Ø0.91	1.14	10.39		
250	10	15.94	14.25	12 × Ø0.98	1.18	12.48		
300	12	19.09	17.01	12 × Ø0.98	1.26	14.88		

Surface roughness (flange): Ra 248 to 492 µin

- 1) Depends on the liner → 90
 2) Total length is independent of the process connections. Length according to DVGW (German Technical and Scientific Association for Gas and Water) → 74 (compact version) → 77 (remote version)

Accessories

Ground disks for flange connections



A0015442

DN		Pressure rating	A		B		D		H	
[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
25	1"	1)	26	1.02	62	2.44	77.5	3.05	87.5	3.44
32	1 ¼"	1)	35	1.38	80	3.15	87.5	3.44	94.5	3.72
40	1 ½"	1)	41	1.61	82	3.23	101	3.98	103	4.06
50	2"	1)	52	2.05	101	3.98	115.5	4.55	108	4.25
65	2 ½"	1)	68	2.68	121	4.76	131.5	5.18	118	4.65
80	3"	1)	80	3.15	131	5.16	154.5	6.08	135	5.31
100	4"	1)	104	4.09	156	6.14	186.5	7.34	153	6.02
125	5"	1)	130	5.12	187	7.36	206.5	8.13	160	6.30
150	6"	1)	158	6.22	217	8.54	256	10.08	184	7.24
200	8"	1)	206	8.11	267	10.51	288	11.34	205	8.07
250	10"	1)	260	10.2	328	12.91	359	14.13	240	9.45
300	12"	PN 10 PN 16 Cl. 150	312	12.3	375	14.76	413	16.26	273	10.75
		PN 25 JIS 10K JIS 20K	310	12.2	375	14.76	404	15.91	268	10.55
350	14"	PN 6	420	16.5	420	16.54	479	18.86	365	14.37
		PN 10								
		PN 16								
375	15"	PN 16	461	18.2	461	18.2	523	20.6	395	15.6
400	16"	PN 6	470	18.5	470	18.50	542	21.34	395	15.55
		PN 10								
		PN 16								
450	18"	PN 6	525	20.7	525	20.67	583	22.95	417	16.42
		PN 10								
		PN 16								

500	20"	PN 6	575	22.6	575	22.64	650	25.59	460	18.11
		PN 10								
		PN 16								
600	24"	PN 6	676	26.6	676	26.61	766	30.16	522	20.55
		PN 10								
		PN 16								
700	28"	PN 6	697	27.4	–	–	786	30.94	460	18.11
		PN10	693	27.3	–	–	813	32.01	480	18.9
		PN16	687	27.1	–	–	807	31.77	490	19.29
		Cl, D	693	27.3	–	–	832	32.76	494	19.45
750	30"	Cl, D	743	29.3	–	–	833	32.8	523	20.59
800	32"	PN 6	799	31.5	–	–	893	35.16	520	20.47
		PN 10	795	31.3	–	–	920	36.22	540	21.26
		PN 16	789	31.1	–	–	914	35.98	550	21.65
		Cl, D	795	31.3	–	–	940	37.01	561	22.09
900	36"	PN 6	897	35.3	–	–	993	39.09	570	22.44

DN		Pressure rating	A		B		D		H	
[mm]	[inch]		[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
		PN 10	893	35.2	–	–	1020	40.16	590	23.23
		PN 16	886	34.9	–	–	1014	39.92	595	23.43
		Cl, D	893	35.2	–	–	1048	41.26	615	24.21
1000	40"	PN 6	999	39.3	–	–	1093	43.03	620	24.41
		PN 10	995	39.2	–	–	1127	44.37	650	25.59
		PN 16	988	38.9	–	–	1131	44.53	660	25.98
		Cl, D	995	39.2	–	–	1163	45.79	675	26.57
–	42"	PN 6	1044	41.1	–	–	1220	48.03	704	27.72
1200	48"	PN 6	1203	47.4	–	–	1310	51.57	733	28.86
		PN 10	1196	47.1	–	–	1344	52.91	760	29.92
		PN 16	1196	47.1	–	–	1385	54.53	786	30.94
		Cl, D	1188	46.8	–	–	1345	52.95	775	30.51

1) In the case of DN 25 to 250, ground disks can be used for all the flange standards/pressure ratings which can be supplied in the standard version

Weight

All values (weight exclusive of packaging material) refer to devices with flanges of the standard pressure rating.

The weight may be lower than indicated depending on the pressure rating and design.

Weight in SI units

, D, E, H, I : DN 25 to 400 mm (1 to 16 in)			
Nominal diameter		Reference values EN (DIN), AS, JIS	
[mm]	[in]	Pressure rating	[kg]
25	1	PN 40	10
32	–	PN 40	11
40	1 ½	PN 40	12
50	2	PN 40	13
65	–	PN 16	13
80	3	PN 16	15
100	4	PN 16	18
125	–	PN 16	25
150	6	PN 16	31
200	8	PN 10	52
250	10	PN 10	81
300	12	PN 10	95
350	14	PN 6	106
375	15	PN 6	121
400	16	PN 6	121
Order code for "Design", option F, J: D 000 mm (18 to 78 in)			
Nominal diameter		Reference values EN (DIN) (PN16) AS (PN 16)	
[mm]	[in]	[kg]	[kg]
450	18	142	138
500	20	182	186
600	24	227	266
700	28	291	369
–	30	–	447
800	32	353	524
900	36	444	704
1000	40	566	785
–	42	–	–
1200	48	843	1 229

-	54	-	-
1400	-	1 204	-
-	60	-	-
1600	-	1 845	-
-	66	-	-

Order code for "Design", option F, J		000 mm (18 to 78 in)	
Nominal diameter		Reference values	
		EN (DIN) (PN16)	
[mm]	[in]	[kg]	AS (PN 16) [kg]
1800	72	2 357	-
-	78	2 929	-
2000	-	2 929	-
Order code for "Design", option F, J:		200 to 3 000 mm (84 to 120 in)	
Nominal diameter		Reference values	
		EN (DIN) (PN6)	
[mm]	[in]	[kg]	
-	84	-	
2200	-	3 422	
-	90	-	
2400	-	4 094	
-	96	-	
-	102	-	
2600	-	7 601.5	
-	108	-	
2800	-	9 466.5	
-	114	-	
3000	-	11 911	
-	120	-	
Order code for "Design", option G, K		000 mm (18 to 78 in)	
Nominal diameter		Reference values	
		EN (DIN) (PN 6)	
[mm]	[in]	[kg]	
450	18	161	
500	20	156	
600	24	208	
700	28	304	

–	30	–
800	32	357
900	36	485
1000	40	589
–	42	–
1200	48	850
–	54	850
1400	–	1 300
–	60	–
1600	–	1 845

Order code for "Design", option G, 2			000 mm (18 to 78 in)
Nominal diameter			Reference values
			EN (DIN) (PN 6)
[mm]	[in]	[kg]	
–	66	–	
1800	72	2 357	
–	78	2 929	
2000	–	2 929	

Weight in US units

D, E, H, I: DN 1 to 16 in (25 to 400 mm)		
Nominal diameter		Reference values
[mm]	[in]	ASME (Class 150)
		[lb]
25	1	11
32	–	–
40	1 ½	15
50	2	20
65	–	–
80	3	31
100	4	42
125	–	–
150	6	73
200	8	115
250	10	198
300	12	284
350	14	379

375	15	–
400	16	448
Order code for "Design", option F, J: D1		000 mm)
Nominal diameter		Reference values ASME (Class 150), AWWA (Class D)
[mm]	[in]	[lb]
450	18	421
500	20	503
600	24	666
700	28	587
–	30	701
800	32	845
900	36	1036
1000	40	1294
–	42	1477
1200	48	1987

Order code for "Design", option F, J		000 mm)
Nominal diameter		Reference values ASME (Class 150), AWWA (Class D)
[mm]	[in]	[lb]
–	54	2807
1400	–	–
–	60	3515
1600	–	–
–	66	4699
1800	72	5662
–	78	6864
2000	–	6864
–	84	8280
2200	–	–
–	90	10577
2400	–	–
–	96	15574.6
–	102	18023.9
2600	–	–
–	108	20783.0

2800	-	-
-	114	24 060.2
3000	-	-
-	120	27 724.3
Order code for "Design", option G, 000 mm)		
Reference values ASME (Class 150), AWWA (Class D)		
Nominal diameter		
[mm]	[in]	[lb]
450	18	562
500	20	628
600	24	893
700	28	882
-	30	1 014
800	32	1 213
900	36	1 764
1000	40	1 984
-	42	2 426
1200	48	3 087
-	54	4 851
1400	-	-
-	60	5 954
1600	-	-
-	66	8 158

Order code for "Design", option G, 000 mm)		
Reference values ASME (Class 150), AWWA (Class D)		
Nominal diameter		
[mm]	[in]	[lb]
1800	72	9 040
-	78	10 143
2000	-	-

Measuring tube specification



The values are reference values and can vary depending on the pressure rating, design and order option.

Nominal diameter		Pressure rating				Measuring tube internal diameter					
[mm]	[in]	EN (DIN)	ASME	AS 2129	JIS	Hard rubber		Polyurethane		PTFE	
			AWWA	AS 4087		[mm]	[in]	[mm]	[in]	[mm]	[in]

25	1	PN 40	Class 150	–	20K	–	–	24	0.93	25	1.00
32	–	PN 40	–	–	20K	–	–	32	1.28	34	1.34
40	1 ½	PN 40	Class 150	–	20K	–	–	38	1.51	40	1.57
50	2	PN 40	Class 150	Table E, PN 16	10K	50	1.98	50	1.98	52	2.04
50 1)	2	PN 40	Class 150	Table E, PN 16	10K	32	1.26	–	–	–	–
65	–	PN 16	–	–	10K	66	2.60	66	2.60	68	2.67
65 1)	–	PN 16	–	–	10K	38	1.50	–	–	–	–
80	3	PN 16	Class 150	Table E, PN 16	10K	79	3.11	79	3.11	80	3.15
80 1)	3	PN 16	Class 150	Table E, PN 16	10K	50	1.97	–	–	–	–
100	4	PN 16	Class 150	Table E, PN 16	10K	101	3.99	104	4.11	104	4.09
100 1)	4	PN 16	Class 150	Table E, PN 16	10K	66	2.60	–	–	–	–
125	–	PN 16	–	–	10K	127	4.99	130	5.11	129	5.08
125 1)	–	PN 16	–	–	10K	79	3.11	–	–	–	–
150	6	PN 16	Class 150	Table E, PN 16	10K	155	6.11	158	6.23	156	6.15
150 1)	6	PN 16	Class 150	Table E, PN 16	10K	102	4.02	–	–	–	–
200	8	PN 10	Class 150	Table E, PN 16	10K	204	8.02	207	8.14	202	7.96
200 1)	8	PN 16	Class 150	Table E, PN 16	10K	127	5.00	–	–	–	–
250	10	PN 10	Class 150	Table E, PN 16	10K	258	10.14	261	10.26	256	10.09
250 1)	10	PN 16	Class 150	Table E, PN 16	10K	156	6.14	–	–	–	–
300	12	PN 10	Class 150	Table E, PN 16	10K	309	12.15	312	12.26	306	12.03
300 1)	12	PN 16	Class 150	Table E, PN 16	10K	204	8.03	–	–	–	–
350	14	PN 10	Class 150	Table E, PN 16	10K	337	13.3	340	13.4	–	–
375	15	–	–	PN 16	10K	389	15.3	392	15.4	–	–
400	16	PN 10	Class 150	Table E, PN 16	10K	387	15.2	390	15.4	–	–
450	18	PN 10	Class 150	–	10K	436	17.2	439	17.3	–	–
500	20	PN 10	Class 150	Table E, PN 16	10K	487	19.2	490	19.3	–	–
600	24	PN 10	Class 150	Table E, PN 16	10K	585	23.0	588	23.1	–	–
700	28	PN 10	Class D	Table E, PN 16	10K	694	27.3	697	27.4	–	–
750	30	–	Class D	Table E, PN 16	10K	743	29.3	746	29.4	–	–
800	32	PN 10	Class D	Table E, PN 16	–	794	31.3	797	31.4	–	–

Nominal diameter	Pressure rating				Measuring tube internal diameter		
	EN (DIN)	ASME	AS 2129	JIS	Hard rubber	Polyurethane	PTFE
		AWWA	AS 4087				

[mm]	[in]					[mm]	[in]	[mm]	[in]	[mm]	[in]
900	36	PN 10	Class D	Table E, PN 16	-	895	35.2	898	35.4	-	-
1000	40	PN 6	Class D	Table E, PN 16	-	991	39.0	994	39.1	-	-
-	42	-	Class D	-	-	1043	41.1	1043	41.1	-	-
1200	48	PN 6	Class D	Table E, PN 16	-	1191	46.9	1197	47.1	-	-
-	54	-	Class D	-	-	1339	52.7	-	-	-	-
1400	-	PN 6	-	-	-	1402	55.2	-	-	-	-
-	60	-	Class D	-	-	1492	58.7	-	-	-	-
1600	-	PN 6	-	-	-	1600	63.0	-	-	-	-
-	66	-	Class D	-	-	1638	64.5	-	-	-	-
1800	72	PN 6	-	-	-	1786	70.3	-	-	-	-
-	78	-	Class D	-	-	1989	78.3	-	-	-	-
2000	-	PN 6	-	-	-	1989	78.3	-	-	-	-
-	84	-	Class D	-	-	2099	84.0	-	-	-	-
2200	-	PN 6	-	-	-	2194	87.8	-	-	-	-
-	90	-	Class D	-	-	2246	89.8	-	-	-	-
2400	-	PN 6	-	-	-	2391	94.1	-	-	-	-
-	96	-	Class D	-	-	2382	93.8	-	-	-	-
-	102	-	Class D	-	-	2533	99.7	-	-	-	-
2600	-	PN 6	-	-	-	2580	101.6	-	-	-	-
-	108	-	Class D	-	-	2683	105.6	-	-	-	-
2800	-	PN 6	-	-	-	2780	109.5	-	-	-	-
-	114	-	Class D	-	-	2832	111.5	-	-	-	-
3000	-	PN 6	-	-	-	2976	117.2	-	-	-	-
-	120	-	Class D	-	-	2980	117.3	-	-	-	-

1) Order code for "Design", option C

Materials

Transmitter housing

Compact version

- Order code for "Housing", option A "Compact, alu, coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option M: polycarbonate plastic • Window material:
- For order code for "Housing", option A: glass
- For order code for "Housing", option M: plastic

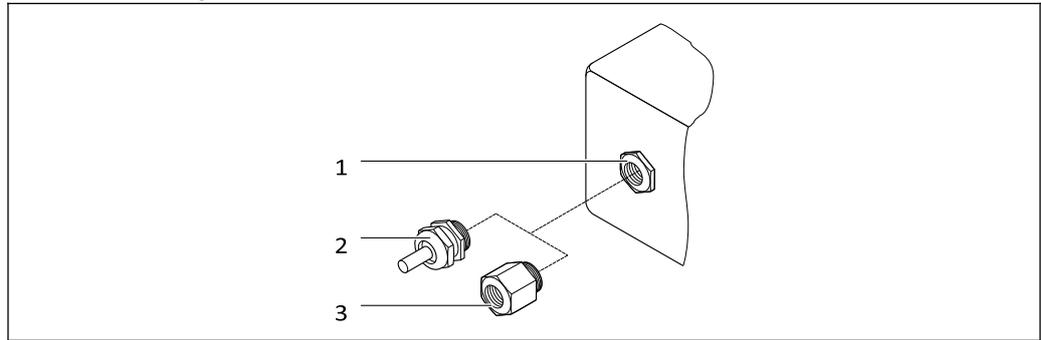
Remote version (wall-mount housing)

- Order code for "Housing", option P "Remote, alu, coated": Aluminum, AlSi10Mg, coated
- Order code for "Housing", option N: polycarbonate plastic • Window material:
- For order code for "Housing", option P: glass
- For order code for "Housing", option N: plastic

Sensor connection housing

- Aluminum, AlSi10Mg, coated
- Polycarbonate plastic (only in conjunction with order code for "Sensor option", options CA, C3, CB,CC, CD, CD)

Cable entries/cable glands



A0020640

□ 30 Possible cable entries/cable glands

- 1 Female thread M20 × 1.5
- 2 Cable gland M20 × 1.5
- 3 Adapter for cable entry with female thread G ½" or NPT ½"

Compact and remote versions and sensor connection housing

Cable entry/cable gland	Material
Cable gland M20 × 1.5	<ul style="list-style-type: none"> • Plastic • Nickel-plated brass
Remote version: cable gland M20 × 1.5 Option of armored connecting cable	<ul style="list-style-type: none"> • Sensor connection housing: Nickel-plated brass • Transmitter wall-mount housing: Plastic
Adapter for cable entry with female thread G ½" or NPT ½"	Nickel-plated brass

Device plug

Electrical connection	Material
Plug M12x1	<ul style="list-style-type: none"> • Socket: Stainless steel, 1.4404 (316L) • Contact housing: Polyamide • Contacts: Gold-plated brass

Remote version connecting cable

i UV rays can impair the cable outer sheath. Protect the cable from exposure to sun as much as possible.

Electrode and coil current cable:

- Standard cable: PVC cable with copper shield
- Armored cable: PVC cable with copper shield and additional steel wire braided jacket

Sensor housing

- DN 25 to 300 (1 to 12")
- Aluminum half-shell housing, aluminum, AlSi10Mg, coated
- Fully welded carbon steel housing with protective varnish
- DN 350 to 3000 (14 to 120")

Fully welded carbon steel housing with protective varnish

Measuring tubes

- DN 25 to 600 (1 to 24")
Stainless steel: 1.4301, 1.4306, 304, 304L
- DN 700 to 3000 (28 to 120")Stainless steel: 1.4301, 304

Liner

- DN 25 to 300 (1 to 12"): PTFE
- DN 25 to 1200 (1 to 48"): polyurethane
- DN 50 to 3000 (2 to 120"): hard rubber

Electrodes

- Stainless steel, 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

Process connections



For flanges made of carbon steel:

- DN \leq 300 (12"): with Al/Zn protective coating or protective varnish
- DN \geq 350 (14"): protective varnish



All carbon steel lap joint flanges are supplied with a hot-dip galvanized finish.

EN 1092-1 (DIN 2501)

Fixed flange •

Carbon steel:

- DN \leq 300: S235JRG2, S235JR+N, P245GH, A105, E250C
- DN 350 to 3000: P245GH, S235JRG2, A105, E250C • Stainless steel:
- DN \leq 300: 1.4404, 1.4571, F316L
- DN 350 to 600: 1.4571, F316L, 1.4404
- DN 700 to 1000: 1.4404, F316L

Lap joint flange

- Carbon steel DN \leq 300: S235JRG2, A105, E250C
- Stainless steel DN \leq 300: 1.4306, 1.4404, 1.4571, F316L

Lap joint flange, stamped plate

- Carbon steel DN \leq 300: S235JRG2 similar to S235JR+AR or 1.0038
- Stainless steel DN \leq 300: 1.4301 similar to 304

ASME B16.5

Fixed flange, lap joint flange

- Carbon steel: A105
- Stainless steel: F316L

JIS B2220

- Carbon steel: A105, A350 LF2
- Stainless steel: F316L

AWWA C207

Carbon steel: A105, P265GH, A181 Class 70, E250C, S275JR

AS 2129

Carbon steel: A105, E250C, P235GH, P265GH, S235JRG2

AS 4087

Carbon steel: A105, P265GH, S275JR

Seals

As per DIN EN 1514-1, form IBC

Accessories

Display guard

Stainless steel, 1.4301 (304L)

Ground disks

- Stainless steel, 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022) • Tantalum

Fitted electrodes

Measurement, reference and empty pipe detection electrodes available as standard with:

- 1.4435 (316L)
- Alloy C22, 2.4602 (UNS N06022)
- Tantalum

Process connections

- EN 1092-1 (DIN 2501)
- ASME B16.5
- JIS B2220
- AS 2129 Table E
- AS 4087 PN 16
- AWWA C207 Class D



For information on the different materials used in the process connections → □ 93

Surface roughness

Electrodes with 1.4435 (316L); Alloy C22, 2.4602 (UNS N06022); tantalum: < 0.5 µm (19.7 µin) (All data relate to parts in contact with medium)

Human interface

Operating concept

Operator-oriented menu structure for user-specific tasks

- Commissioning
- Operation
- Diagnostics
- Expert level

Fast and safe commissioning

- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief descriptions of the individual parameter functions
- Access to the device via Web server
- WLAN access to the device via mobile handheld terminal, tablet or smart phone

Reliable operation

- Operation in local language
- Uniform operating philosophy applied to device and operating tools
- If replacing electronic modules, transfer the device configuration via the integrated memory (HistoROM backup) which contains the process and measuring device data and the event logbook. No need to reconfigure.

Efficient diagnostic behavior increases measurement availability

- Troubleshooting measures can be called up via the device and in the operating tools
- Diverse simulation options, logbook for events that occur and optional line recorder functions

Languages

Can be operated in the following languages:

- Via local operation:
 - English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech, Swedish
- Via "FieldCare", "DeviceCare" operating tool:
 - English, German, French, Spanish, Italian, Chinese, Japanese
- Via Web browser (only available for device versions with HART, PROFIBUS DP and EtherNet/IP):
 - English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Bahasa (Indonesian), Vietnamese, Czech, Swedish

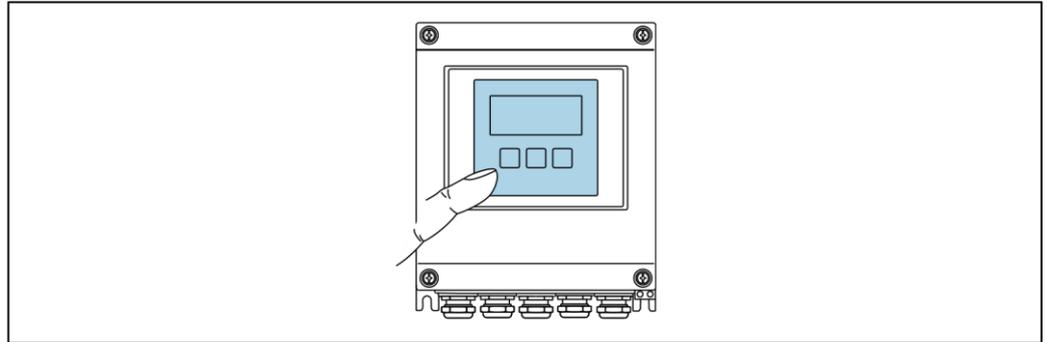
Local operation

Via display module

Equipment:

- Standard features 4-line, illuminated, graphic display; touch control
- Order code for "Display; operation", option BA "WLAN" offers standard equipment features in addition to access via Web browser

 Information about WLAN interface →  98



 31 Operation with touch control

Display elements

- 4-line, illuminated, graphic display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: -20 to $+60$ °C (-4 to $+140$ °F)
The readability of the display may be impaired at temperatures outside the temperature range.

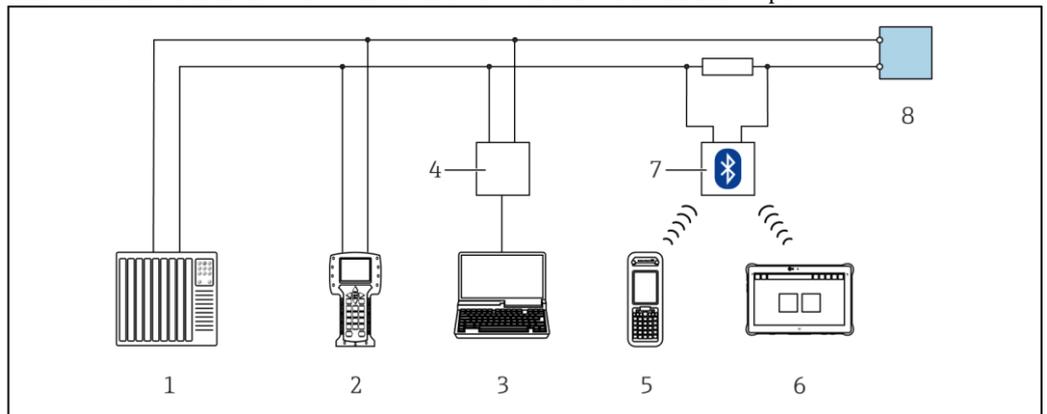
Operating elements

- External operation via touch control (3 optical keys) without opening the housing: , ,
- Operating elements also accessible in the various zones of the hazardous area

Remote operation

Via HART protocol

This communication interface is available in device versions with a HART output.

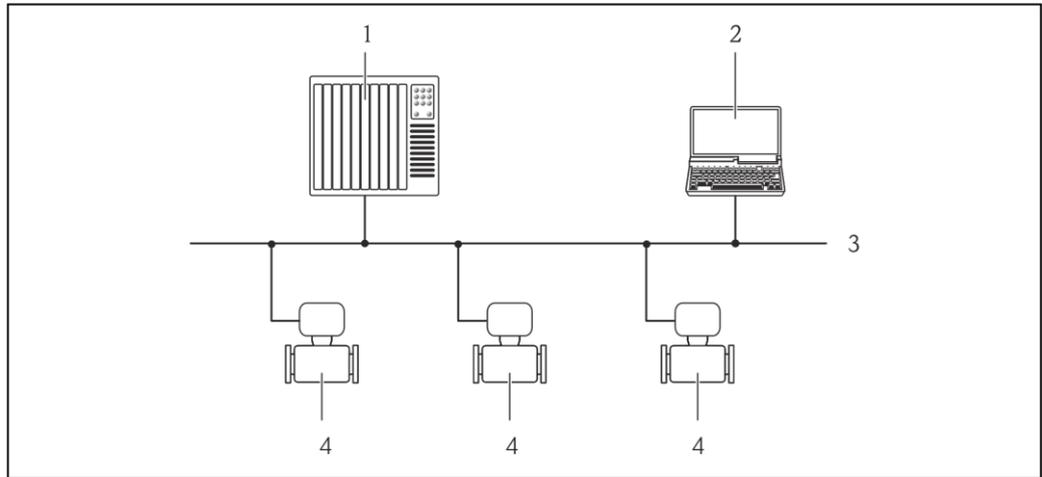


32 Options for remote operation via HART protocol

- 1 Control system (e.g. PLC)
- 2 Field Communicator 475
- 3 Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)
- 4 Commubox FXA195 (USB)
- 5 Field Xpert SFX350 or SFX370
- 6 Field Xpert SMT70
- 7 VIATOR Bluetooth modem with connecting cable
- 8 Transmitter

Via PROFIBUS DP network

This communication interface is available in device versions with PROFIBUS DP.



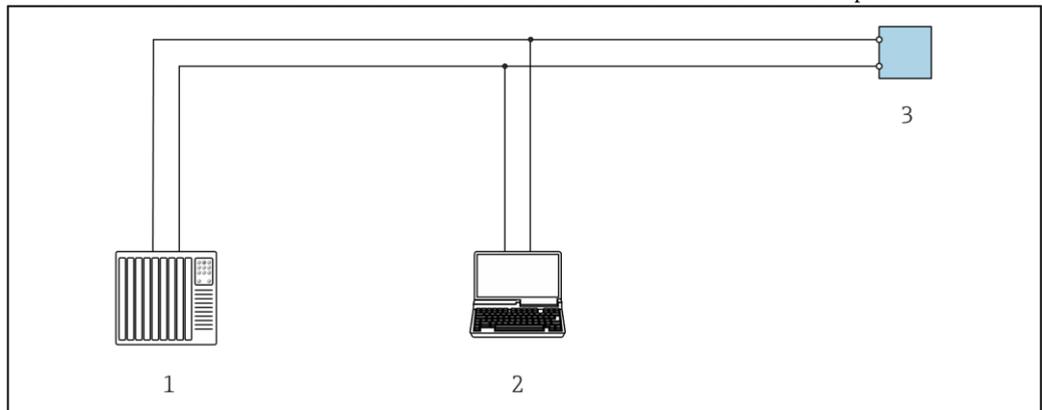
A002903

□ 33 Options for remote operation via PROFIBUS DP network

- 1 Automation system
- 2 Computer with PROFIBUS network card
- 3 PROFIBUS DP network
- 4 Measuring device

Via Modbus RS485 protocol

This communication interface is available in device versions with a Modbus-RS485 output.



A0029437

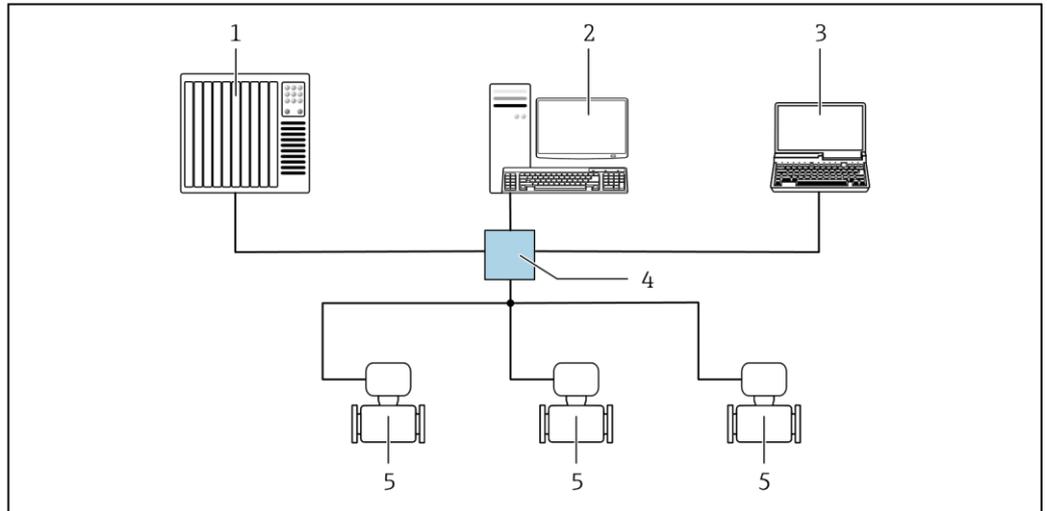
□ 34 Options for remote operation via Modbus-RS485 protocol (active)

- 1 Control system (e.g. PLC)
- 2 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or with operating tool (e.g. FieldCare, DeviceCare) with COM DTM "CDI Communication TCP/IP" or Modbus DTM
- 3 Transmitter

Via EtherNet/IP network

This communication interface is available in device versions with EtherNet/IP.

Star topology



A0032078

□ 35 Options for remote operation via EtherNet/IP network: star topology

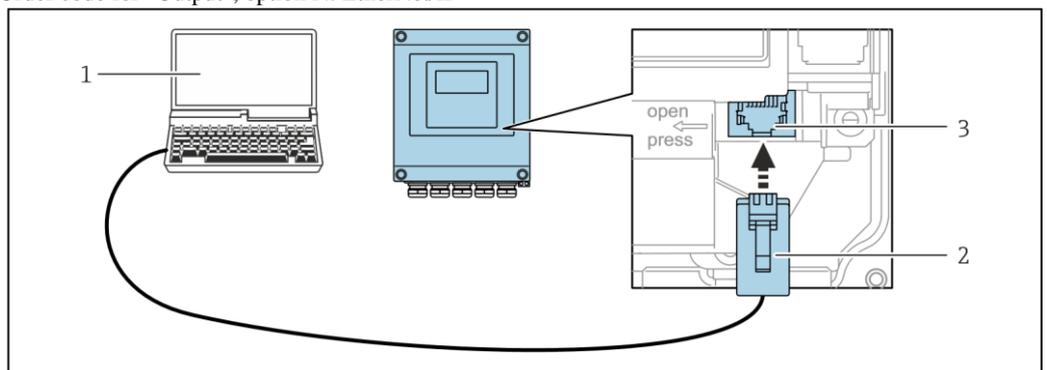
- 1 Automation system, e.g. "RSLogix" (Rockwell Automation)
- 2 Workstation for measuring device operation: with Custom Add-On Profile for "RSLogix 5000" (Rockwell Automation) or with Electronic Data Sheet (EDS)
- 3 Computer with Web browser (e.g. Internet Explorer) for accessing the integrated device Web server or computer with operating tool (e.g. FieldCare, DeviceCare) with COM DTM "CDI Communication TCP/IP"
- 4 Ethernet switch
- 5 Measuring device

Service interface

Via service interface (CDI-RJ45)

This communication interface is present in the following device version:

- Order code for "Output", option H: 4 to 20 mA HART, pulse/frequency output, switch output
- Order code for "Output", option I: 4 to 20 mA HART, 2 x pulse/frequency/switch output, status input
- Order code for "Output", option J: 4 to 20 mA HART, certified pulse output, switch output; status input
- Order code for "Output", option L: PROFIBUS DP
- Order code for "Output", option M: Modbus RS485
- Order code for "Output", option O: Modbus RS485, 4 to 20 mA, 2 x pulse/frequency/switch output
- Order code for "Output", option P: Modbus RS485, 4 to 20 mA, certified pulse output, pulse/frequency/switch output
- Order code for "Output", option N: EtherNet/IP



A0029163

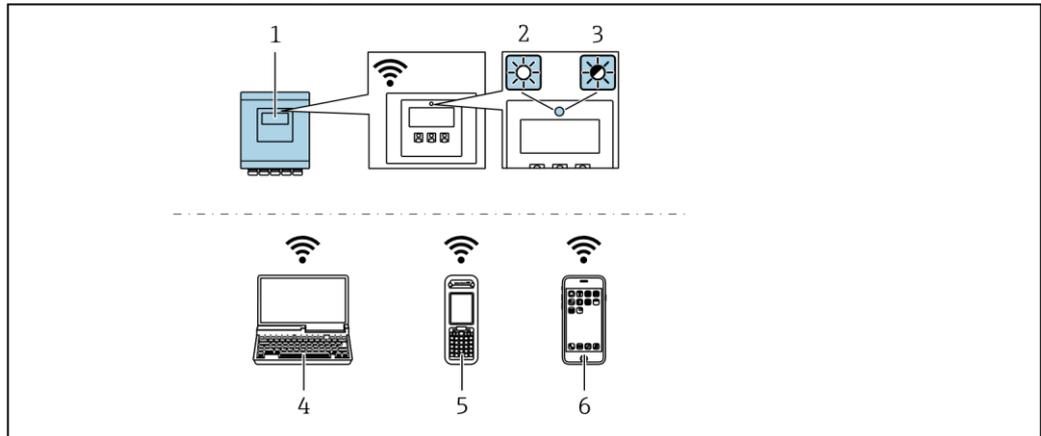
□ 36 Connection via service interface (CDI-RJ45)

- 1 Computer with Web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device Web server or with "FieldCare", "DeviceCare" operating tool with COM DTM "CDI Communication TCP/IP" or Modbus DTM
- 2 Standard Ethernet connecting cable with RJ45 plug
- 3 Service interface (CDI-RJ45) of the measuring device with access to the integrated Web server

Via WLAN interface

The optional WLAN interface is available on the following device version:

Order code for "Display", option BA "WLAN":
 4-line, illuminated, graphic display; touch control + WLAN



A0043149

- 1 Transmitter with integrated WLAN antenna
- 2 LED lit constantly: WLAN reception is enabled on measuring device
- 3 LED flashing: WLAN connection established between operating unit and measuring device
- 4 Computer with WLAN interface and Web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device Web server or with operating tool (e.g. FieldCare, DeviceCare)
- 5 Mobile handheld terminal with WLAN interface and Web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device Web server or operating tool (e.g. FieldCare, DeviceCare)
- 6 Smart phone or tablet (e.g. Field Xpert SMT70)

Function	WLAN: IEEE 802.11 b/g (2.4 GHz) <ul style="list-style-type: none"> • Access point with DHCP server (default setting) • Network
Encryption	WPA2-PSK AES-128 (in accordance with IEEE 802.11i)
Configurable WLAN channels	1 to 11
Degree of protection	IP67
Available antenna	Internal antenna
Range	Typically 10 m (32 ft)

Supported operating tools

Different operating tools can be used for local or remote access to the measuring device. Depending on the operating tool used, access is possible with different operating units and via a variety of interfaces.

Supported operating tools	Operating unit	Interface	Additional information
Web browser	Notebook, PC or tablet with Web browser	<ul style="list-style-type: none"> • CDI-RJ45 serviceinterface • WLAN interface • Ethernet-basedfieldbus (EtherNet/IP) 	Special Documentation for the device
DeviceCare SFE100	Notebook, PC or tablet with Microsoft Windows system	<ul style="list-style-type: none"> • CDI-RJ45 serviceinterface • WLAN interface • Fieldbus protocol 	→ □ 105
Supported operating tools	Operating unit	Interface	Additional information
FieldCare SFE500	Notebook, PC or tablet with Microsoft Windows system	<ul style="list-style-type: none"> • CDI-RJ45 serviceinterface • WLAN interface • Fieldbus protocol 	→ □ 105

Device Xpert	Field Xpert SFX 100/350/370	Fieldbus protocol HART	Operating Instructions BA01202S Device description files: Use update function of handheld terminal
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Other operating tools based on FDT technology with a device driver such as DTM/iDTM or DD/EDD can be used for device operation. These operating tools are available from the individual manufacturers. Integration into the following operating tools, among others, is supported:

- FactoryTalk AssetCentre (FTAC) from Rockwell Automation → www.rockwellautomation.com
- Process Device Manager (PDM) from Siemens → www.siemens.com
- Asset Management Solutions (AMS) from Emerson → www.emersonprocess.com
- FieldCommunicator 375/475 from Emerson → www.emersonprocess.com
- Field Device Manager (FDM) from Honeywell → www.honeywellprocess.com
- FieldMate from Yokogawa → www.yokogawa.com
- PACTWare → www.pactware.com

The related device description files are available: www.endress.com → Downloads

Web server

Thanks to the integrated Web server, the device can be operated and configured via a Web browser and via a service interface (CDI-RJ45) or via a WLAN interface. The structure of the operating menu is the same as for the local display. In addition to the measured values, device status information is also displayed, allowing users to monitor the status of the device. Furthermore the device data can be managed and the network parameters can be configured.

A device that has a WLAN interface (can be ordered optionally) is required for the WLAN connection: order code for "Display", option BA "WLAN". The device acts as an Access Point and enables communication by computer or a mobile handheld terminal.

Supported functions

Data exchange between the operating unit (such as a notebook for example) and the measuring device:

- Upload the configuration from the measuring device (XML format, configuration backup)
- Save the configuration to the measuring device (XML format, restore configuration)
- Export event list (.csv file)
- Export parameter settings (.csv file or PDF file, document the measuring point configuration)
- Export the Heartbeat verification log (PDF file, only available with the "Heartbeat Verification" application package)
- Flash firmware version for device firmware upgrade, for instance
- Download driver for system integration
- Visualize up to 1000 saved measured values (only available with the Extended HistoROM application package → □ 103)



Web server special documentation → □ 106

HistoROM data management

The measuring device features HistoROM data management. HistoROM data management comprises both the storage and import/export of key device and process data, making operation and servicing far more reliable, secure and efficient.

Additional information on the data storage concept

There are different types of data storage units in which device data are stored and used by the device:

	HistoROM backup	T-DAT	S-DAT
Available data	<ul style="list-style-type: none"> • Event logbook such as diagnostic events foreexample • Device firmware package • Driver for system integration for exporting via Web server, e.g: • GSD for PROFIBUS DP • EDS for EtherNet/IP 	<ul style="list-style-type: none"> • Measured value logging ("ExtendedHistoROM" order option) • Current parameter data record (used by firmware at run time) • Peakhold indicator (min/max values) • Totalizer values 	<ul style="list-style-type: none"> • Sensor data: nominal diameter etc. • Serial number • Calibration data • Device configuration (e.g. SW options, fixed I/O or multi I/O)
Storage location	Fixed on the user interface board in the connection compartment	Attachable to the user interface board in the connection compartment	In the sensor plug in the transmitter neck part

Data backup

Automatic

- The most important device data (sensor and transmitter) are automatically saved in the DATmodules
- If the transmitter or measuring device is replaced: once the T-DAT containing the previous devicedata has been exchanged, the new measuring device is ready for operation again immediately without any errors
- If the sensor is replaced: once the sensor has been replaced, new sensor data are transferred from the S-DAT in the measuring device and the measuring device is ready for operation again immediately without any errors

Data transmission

Manual

- Transfer of a device configuration to another device using the export function of the specific operating tool, e.g. with FieldCare, DeviceCare or Web server: to duplicate the configuration or to store in an archive (e.g. for backup purposes)
- Transmission of the drivers for system integration via Web server, e.g.:
- GSD for PROFIBUS DP
- EDS for EtherNet/IP

Event list

Automatic

- Chronological display of up to 20 event messages in the events list
- If the Extended HistoROM application package (order option) is enabled: up to 100 event messages are displayed in the events list along with a time stamp, plain text description and remedial measures
- The events list can be exported and displayed via a variety of interfaces and operating tools e.g. DeviceCare, FieldCare or Web server

Data logging

Manual

If the Extended HistoROM application package (order option) is enabled:

- Record up to 1 000 measured values via 1 to 4 channels
- User configurable recording interval
- Record up to 250 measured values via each of the 4 memory channels
- Export the measured value log via a variety of interfaces and operating tools e.g. FieldCare, DeviceCare or web server

Certificates and approvals

Current certificates and approvals for the product are available via the Product Configurator at www.endress.com.

1. Select the product using the filters and search field.
2. Open the product page.
The Configuration button opens the Product Configurator.

CE mark

The device meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

UKCA marking	<p>The device meets the legal requirements of the applicable UK regulations (Statutory Instruments). These are listed in the UKCA Declaration of Conformity along with the designated standards. By selecting the order option for UKCA marking, Endress+Hauser confirms a successful evaluation and testing of the device by affixing the UKCA mark.</p> <p>Contact address Endress+Hauser UK: Endress+Hauser Ltd. Floats Road Manchester M23 9NF United Kingdom www.uk.endress.com</p>
RCM mark	<p>The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".</p>
Ex approval	<p>The devices are certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Control Drawing" document. Reference is made to this document on the nameplate.</p>
Drinking water approval	<ul style="list-style-type: none"> • ACS • KTW/W270 • NSF 61 • WRAS BS 6920
HART certification	<p>HART interface</p> <p>The measuring device is certified and registered by the FieldComm Group. The measuring system meets all the requirements of the following specifications:</p> <ul style="list-style-type: none"> • Certified according to HART 7 • The device can also be operated with certified devices of other manufacturers (interoperability)
PROFIBUS conformity	<p>PROFIBUS interface</p> <p>The measuring device is registered with PI (PROFIBUS and PROFINET International). It meets all the requirements of PROFIBUS PA Profile 3.02 specifications and can also be operated with certified devices of other manufacturers (interoperability).</p>
Modbus RS485 certification	<p>The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out.</p>
EtherNet/IP certification	<p>The measuring device is certified and registered by the ODVA (Open Device Vendor Association). The measuring system meets all the requirements of the following specifications:</p> <ul style="list-style-type: none"> • Certified in accordance with the ODVA Conformance Test • EtherNet/IP Performance Test • EtherNet/IP PlugFest compliance • The device can also be operated with certified devices of other manufacturers (interoperability)
Radio approval	<p>The measuring device has radio approval.</p> <p> For detailed information regarding radio approval, see the Special Documentation → □ 106</p>
Measuring instrument	<p>The measuring device is (optionally) approved as a cold water meter (MI-001) for volume approval measurement in service subject to legal metrological control in accordance with the European Measuring Instruments Directive 2014/32/EU (MID). The measuring device is qualified to OIML R49: 2013.</p>

Other standards and guidelines

- EN 60529
Degrees of protection provided by enclosures (IP code)
- EN 61010-1
Safety requirements for electrical equipment for measurement, control and laboratory use general requirements
- IEC/EN 61326-3-2
Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements).
- ANSI/ISA-61010-1 (82.02.01)
Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- CAN/CSA-C22.2 No. 61010-1-12
Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1 General Requirements
- NAMUR NE 21
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 32
Data retention in the event of a power failure in field and control instruments with microprocessors
- NAMUR NE 43
Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 105
Specifications for integrating fieldbus devices in engineering tools for field devices
- NAMUR NE 107
Self-monitoring and diagnosis of field devices
- NAMUR NE 131
Requirements for field devices for standard applications

Ordering information

Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Product Configurator under www.endress.com :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field Open the
5. product page

The Configuration button to the right of the product image opens the Product Configurator.



Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Application packages

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Package	Description
Electrode cleaning circuit (ECC)	The electrode cleaning circuit (ECC) function has been developed to have a solution for applications where magnetite (Fe ₃ O ₄) deposits frequently occur (e.g. hot water). Since magnetite is highly conductive this build up leads to measuring errors and ultimately to the loss of signal. The application package is designed to avoid build-up of very conductive matter and thin layers (typical of magnetite).

Package	Description
Extended HistoROM	Comprises extended functions concerning the event log and the activation of the measured value memory. Event log: Memory volume is extended from 20 message entries (standard version) to up to 100 entries. Data logging (line recorder): <ul style="list-style-type: none"> • Memory capacity for up to 1000 measured values is activated. • 250 measured values can be output via each of the 4 memory channels. Therecording interval can be defined and configured by the user. • Measured value logs can be accessed via the local display or operating tool e.g. FieldCare, DeviceCare or Web server.

Package	Description
Heartbeat Verification +Monitoring	<p>Heartbeat Verification Meets the requirement for traceable verification to DIN ISO 9001:2008 Chapter 7.6 a) "Control of monitoring and measuring equipment".</p> <ul style="list-style-type: none"> • Functional testing in the installed state without interrupting the process. • Traceable verification results on request, including a report. • Simple testing process via local operation or other operating interfaces. • Clear measuring point assessment (pass/fail) with high test coverage within the framework of manufacturer specifications. • Extension of calibration intervals according to operator's risk assessment. <p>Heartbeat Monitoring Continuously supplies data, which are characteristic of the measuring principle, to an external condition monitoring system for the purpose of preventive maintenance or process analysis. These data enable the operator to:</p> <ul style="list-style-type: none"> • Draw conclusions - using these data and other information - about the impact process influences (such as corrosion, abrasion, buildup etc.) have on the measuring performance over time. • Schedule servicing in time. • Monitor the process or product quality, e.g. gas pockets.

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Accessories	Description
Promag 400 transmitter	Transmitter for replacement or storage. Use the order code to define the following specifications: <ul style="list-style-type: none"> • Approvals • Output/input • Display/operation • Housing • Software <p><input type="checkbox"/> For details, see Installation Instructions EA00104D</p>

Display guard	Is used to protect the display against impact or scoring, for example from sand in desert areas. <input type="checkbox"/> Order number: 71228792 <input type="checkbox"/> Installation Instructions EA01093D
Connecting cable for remote version	Coil current and electrode cables, various lengths, reinforced cables available on request.
Ground cable	Set, consisting of two ground cables for potential equalization.
Post mounting kit	Post mounting kit for transmitter.
Compact → Remote conversion kit	For converting a compact device version to a remote device version.
Conversion kit Promag 50/53 → Promag 400	For converting a Promag with transmitter 50/53 to a Promag 400.

For the sensor

Accessory	Description
Ground disks	Are used to ground the medium in lined measuring tubes to ensure proper measurement. <input type="checkbox"/> For details, see Installation Instructions EA00070D

Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. <input type="checkbox"/> Technical Information TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. <input type="checkbox"/> Technical Information TI405C/07
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. <input type="checkbox"/> • Technical Information TI00429F • Operating Instructions BA00371F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. <input type="checkbox"/> Operating Instructions BA00061S
Fieldgate FXA42	Is used to transmit the measured values of connected 4 to 20 mA analog measuring devices, as well as digital measuring devices <input type="checkbox"/> • Technical Information TI01297S • Operating Instructions BA01778S • Product page: www.endress.com/fxa42

Field Xpert SMT70	<p>The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress.</p> <p>This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle. <input type="checkbox"/> • Technical Information TI01342S</p> <ul style="list-style-type: none"> • Operating Instructions BA01709S • Product page: www.endress.com/smt70
Field Xpert SMT77	<p>The Field Xpert SMT77 tablet PC for device configuration enables mobile plant asset management in areas categorized as Ex Zone 1.</p> <p><input type="checkbox"/> • Technical Information TI01418S</p> <ul style="list-style-type: none"> • Operating Instructions BA01923S • Product page: www.endress.com/smt77

Service-specific accessories

Accessory	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> • Choice of measuring devices with industrial requirements • Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy. • Graphic illustration of the calculation results • Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. <p>Applicator is available:</p> <ul style="list-style-type: none"> • Via the Internet: https://portal.endress.com/webapp/applicator • As a downloadable DVD for local PC installation.
W@M	<p>W@M Life Cycle Management</p> <p>Improved productivity with information at your fingertips. Data relevant to a plant and its components is generated from the first stages of planning and during the asset's complete life cycle.</p> <p>W@M Life Cycle Management is an open and flexible information platform with online and on-site tools. Instant access for your staff to current, in-depth data shortens your plant's engineering time, speeds up procurement processes and increases plant uptime.</p> <p>Combined with the right services, W@M Life Cycle Management boosts productivity in every phase. For more information, see: www.endress.com/lifecyclemanagement</p>
FieldCare	<p>FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.</p> <p><input type="checkbox"/> Operating Instructions BA00027S and BA00059S</p>
DeviceCare	<p>Tool for connecting and configuring Endress+Hauser field devices. <input type="checkbox"/></p> <p>Innovation brochure IN01047S</p>
Commubox FXA291	<p>Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.</p> <p><input type="checkbox"/> Technical Information TI00405C</p>

System components

Accessories	Description
Memograph M graphic data manager	<p>The Memograph M graphic data manager provides information on all the relevant measured variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick.</p> <p><input type="checkbox"/> • Technical Information TI00133R • Operating Instructions BA00247R</p>

Supplementary documentation



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the matrix code on the nameplate

Standard documentation

Brief Operating Instructions

Brief Operating Instructions for the sensor

Measuring device	Documentation code
Proline Promag W	KA01266D

Transmitter Brief Operating Instructions

Measuring device	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Proline 400	KA01263D	KA01420D	KA01419D	KA01418D

Operating Instructions

Measuring device	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Promag W 400	BA01063D	BA01234D	BA01231D	BA01214D

Description of device parameters

Measuring device	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Promag 400	GP01043D	GP01044D	GP01045D	GP01046D

Supplementary device-dependent documentation

Special Documentation

Content	Documentation code			
Display modules A309/A310	SD01793D			
Information on Custody Transfer Measurement	SD02038D			
Information on Custody Transfer Measurement	SD02561D			
Content	Documentation code			
	HART	PROFIBUS DP	Modbus RS485	EtherNet/IP
Web server	SD01811D	SD01813D	SD01812D	SD01814D

Heartbeat Verification + Monitoring	SD01847D	SD02569D	SD02568D	SD02570D
---	----------	----------	----------	----------

Installation Instructions

Content	Comment
Installation instructions for spare part sets and accessories	Documentation code: specified for each individual accessory → □ 103.

Registered trademarks

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Registered trademark of the FieldComm Group, Austin, USA

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Modbus®

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Proline Promag W 400

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FEATURES

Impeller:Cast iron, enclosed, non-clog, dynamically balanced with 10 out vanes for mechanical seal protection.

Casing:Cast iron flanged volute type for maximum efficiency. Design for easy installation on A10-20 slide rail or base elbow rail systems.

Mechanical Seal: SILICON CARBIDE VS. SILICON CARBIDE for superior abrasive resistance, stainless steel metal parts, BUNA-N elastomers.

Shaft:Corrosion-resistant, 300 series stainless steel. Threaded design Locknut on all models to guard against component damage on accidental reverse rotation.

Fasteners:300 series stainless steel.

Capable of running dry without damage to components.

Designed for continuous operation when fully submerged.

EXTENDED WARRANTY AVAILABLE FOR RESIDENTIAL APPLICATIONS

WS_BHF Series

Model 3887BHF

SUBMERSIBLE SEWAGE PUMP

APPLICATIONS

Specifically designed for the following uses:

- Homes
 - Water transfer
 - Sewage systems
 - Light industrial
 - Dewatering/Effluent
 - Commercial applications
- Anywhere waste or drainage must be disposed of quickly, quietly and efficiently.

SPECIFICATIONS

Pump

- Solids handling capabilities: 2" maximum
- Capacities: up to 220 GPM
- Total heads: up to 81 feet TDH
- Discharge size: 2" NPT threaded companion flange as standard. 3" option available but must be ordered separately. (Order no. A1-3)
- Temperature: 104°F (40°C) continuous
140°F (60°C) intermittent.

MOTORS

- Fully submerged in high grade turbine oil for lubrication and efficient heat transfer. All ratings are within the working limits of the motor.

Class B insulation on 1/3-1 1/2 HP models.

Class F insulation on 2 HP models.

Single phase (60 Hz):

- Capacitor start motors for maximum starting torque.
- Built-in overload with automatic reset.
- SJTOW or STOW severe duty oil and water resistant power cords.
- 1/3 – 1 HP models have NEMA three prong grounding plugs.
- 1 1/2 HP and larger units have bare lead cord ends.

Three phase (60 Hz):

- Class 10 overload protection must be provided in separately ordered starter unit.
- STOW power cords all have bare lead cord ends.
- Bearings: Upper and lower heavy duty ball bearing construction.
- Designed for Continuous Operation: Pump ratings are within the motor manufacturer's recommended working limits, can be operated

continuously without damage when fully submerged.

- Power Cable: Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. Standard cord is 20'. Optional lengths are available.
- Motor Cover O-ring: Assures positive sealing against contaminants and oil leakage.

AGENCY LISTINGS MOTOR AND MODEL INFORMATION

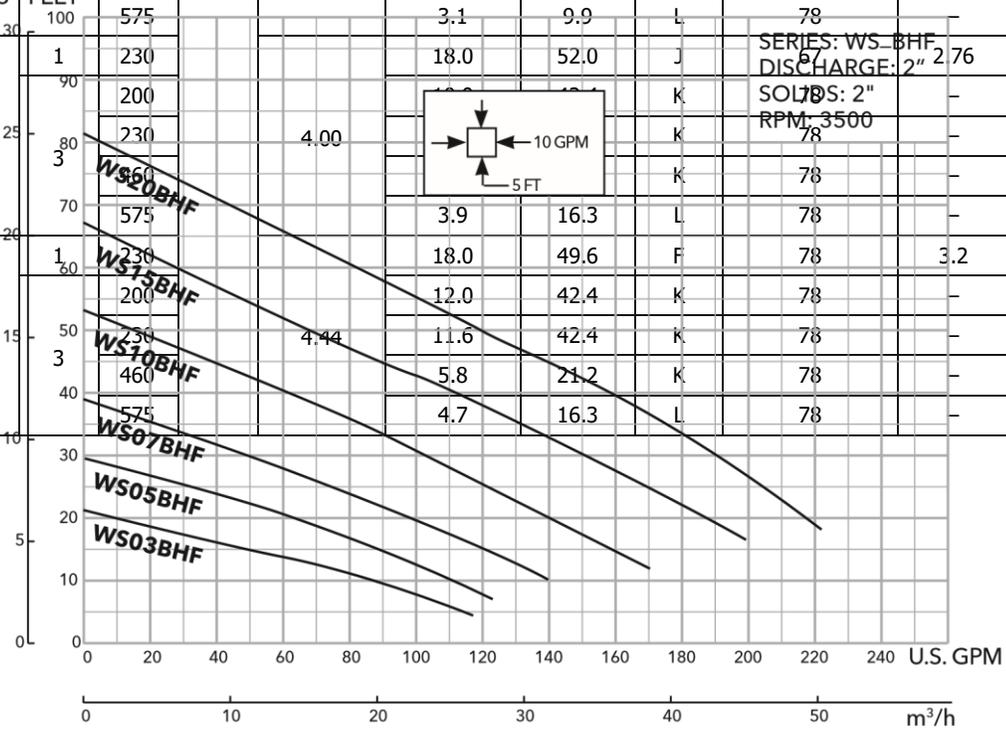
DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)

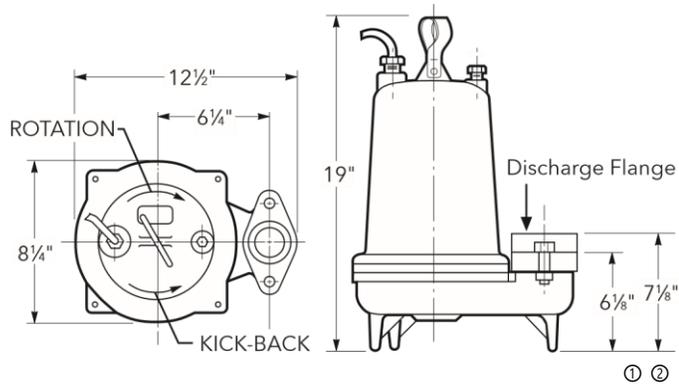
Order Number	HP	Phase	Volts	RPM	Impeller Diameter (in.)	Maximum Amps	Locked Rotor Amps	KVA Code	Full Load Motor Efficiency %	Resistance		
										Start	Line-Line	
WS0311BHF	0.33	1	115	3500	2.94	12.4	46.0	M	54	7.5	1.0	
WS0318BHF			208			6.8	31.0	K	68	9.7	2.4	
WS0312BHF			230			6.2	34.5	M	53	9.6	4.0	
WS0511BHF	0.5	1	115		3.19	14.5	46.0	M	54	7.5	1.0	
WS0518BHF			208			8.4	31.0	K	68	9.7	2.4	
WS0512BHF			230			7.6	34.5	M	53	9.6	4.0	
WS0538BHF		3	200			4.9	22.6	R	68	-	3.8	
WS0532BHF			230			3.6	18.8	R	70	-	5.8	
WS0534BHF			460			1.8	9.4	R	70	-	23.2	
WS0537BHF	575	1.5	7.5		R	62	-	35.3				
WS0718BHF	0.75	1	208		3.44	3.44	11.0	31.0	K	68	9.7	2.4
WS0712BHF			230				10.0	27.5	J	65	12.2	2.7
WS0738BHF		3	200				6.2	20.6	L	64	-	5.7
WS0732BHF			230				5.4	15.7	K	68	-	8.6
WS0734BHF			460				2.7	7.9	K	68	-	34.2
WS0737BHF			575	2.2			9.9	L	78	-	26.5	
WS1018BHF	1	1	208	3.75	3.75	14.5	59.0	K	68	9.3	1.1	
WS1012BHF			230			13.0	36.2	J	69	10.3	2.1	
WS1038BHF		3	200			8.6	27.6	M	77	22.7	108	2.7
WS1032BHF			230			7.5	24.1	By Canadian Standards Association	79	-	4.1	
WS1034BHF			460			3.8	12.1	L	79	-	16.2	
WS1037BHF			575			3.1	9.9	L	78	-	26.5	
WS1512BHF	1.5	1	230	4.00	4.00	18.0	52.0	J	67	2.76	0.53	
WS1538BHF			200			10.0	31.0	K	78	-	1.7	
WS1532BHF			230			9.0	31.0	K	78	-	1.7	
WS1534BHF		3	575			3.9	16.3	L	78	-	6.6	
WS1537BHF			230			18.0	49.6	F	78	3.2	1.1	
WS2012BHF			200			12.0	42.4	K	78	-	1.7	
WS2038BHF	2	3	230	4.44	4.44	11.6	42.4	K	78	-	1.7	
WS2032BHF			460			5.8	21.2	K	78	-	6.6	
WS2034BHF			575			4.7	16.3	L	78	-	10.5	
WS2037BHF	2	3	230	4.44	4.44	11.6	42.4	K	78	-	1.7	
WS2032BHF			460			5.8	21.2	K	78	-	6.6	
WS2034BHF			575			4.7	16.3	L	78	-	10.5	
WS07BHF	0.33	1	115	2.94	2.94	12.4	46.0	M	54	7.5	1.0	
WS05BHF			208			8.4	31.0	K	68	9.7	2.4	
WS03BHF			230			6.2	34.5	M	53	9.6	4.0	

METERS FEET

TOTAL DYNAMIC HEAD



Tested to UL 778 and CSA 22.2 108 Standards
By Canadian Standards Association
File #LR38549



Discharge Flange:

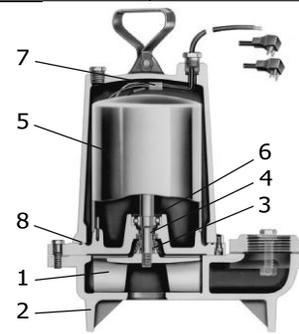
- ① 2" NPT standard
- ② 3" NPT optional (order an A1-3)

PERFORMANCE RATINGS (gallons per minute)

COMPONENTS (for reference only)

Order No.	WS03BHF	WS05BHF	WS07BHF	WS10BHF	WS15BHF	WS20BHF	
TotalHeadFeetofWater	HP	1/3	1/2	3/4	1	1 1/2	2
	RPM	3500	3500	3500	3500	3500	3500
	10	86	110	140	-	-	-
	15	48	88	120	158	-	-
	20	-	62	98	139	186	217
	25	-	32	74	120	170	204
	30	-	-	49	101	150	190
	35	-	-	21	82	130	175
	40	-	-	-	60	110	159
	45	-	-	-	38	88	140
	50	-	-	-	-	67	120
	55	-	-	-	-	47	100
	60	-	-	-	-	29	80
	65	-	-	-	-	-	62
	70	-	-	-	-	-	43
	75	-	-	-	-	-	23

Item No.	Description
1	Impeller
2	Casing
3	Mechanical Seal
4	Motor Shaft
5	Motor
6	Ball Bearings
7	Power Cable
8	Casing O-Ring



** For repair parts, reference repair parts book.*



Xylem, Inc.
2881 East Bayard Street Ext., Suite A
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TX100 - pH/mV

2-Wire Loop-Powered
Transmitter





ISO9001:2008

European Declaration of Conformity

Manufacturer: Sensorex Corp.

11751 Markon Drive

Garden Grove, CA 92841

Telephone: 714-895-4344

FAX: 714-894-4839

Product: 4-20mA Loop Powered Transmitter

Model No. TX100

Serial Number:0207xxxxx-1214xxxxx

The undersigned hereby declares, on behalf of Sensorex Corp. of Garden Grove, CA that the above-referenced product, to which this declaration relates, is in conformity with the provisions of the Directive of Electromagnetic Compatibility (EMC) 2004/108/EC

- **European Standards EN 61326-1**

The Technical Construction File required by this Directive is maintained at the corporate headquarters of Sensorex Corp, 11751 Markon Drive, Garden Grove, CA 92841.

A handwritten signature in black ink, appearing to read "Mack Reed".

Mack Reed

Director of Quality

Signed June 22, 2011 Garden Grove, CA

TX100 pH/MV Transmitter ESSENTIAL INSTRUCTIONS

READ THIS BEFORE USING YOUR TX100 pH/mV TRANSMITTER!

Thank you for choosing the TX100 pH/mV transmitter. This transmitter is a user-friendly microprocessor based transmitter for pH and mV measurement. As with all electronic instruments, it is essential to follow all directions for optimal performance. In particular, you must properly install, use and maintain the TX100 to ensure that it will continue to operate within its specifications.

- Follow all warnings, cautions and instructions marked on and supplied with the transmitter. Please contact your supplier with any product questions or concerns.
- Install the transmitter as specified in this manual, following all applicable local and national codes.
- Do not attempt to repair your TX100 transmitter or use any replacement parts from any other supplier.
- If you find any errors in this manual, please report them to Sensorex by fax 714-894-4839 or via e-mail at TECHNICAL AT SENSOREX.COM
- Please complete the WARRANTY REGISTRATION located at the back of this manual and fax to Sensorex at 714-894-4839 or scan and e-mail to TECHNICAL AT SENSOREX.COM

About This Document

This manual contains instructions for the installation, operation and care of the TX100 pH/mV transmitter. The following list provides notes concerning revisions of this document.

Rev Level	Date	Notes
A	8/2007	1st revision of manual. Removed lightning protection graphic on pg. 15 and "DO NOT REMOVE NOTE"
B	10/2007	Added "Essential Instructions". Fixed drawing in "Quick Start Guide". Added bold text to "Cord Grip installation" section. Fixed Figure references Section 8.1 and 8.2. Fixed drawing Figure 11-1. Fixed drawing Figure 11-3. Added bold text to Section 9.7. Added EMI/RFI specs in TX100 Specifications. Revised Figure 10-1. Re-numbered all pages.
C	12/2007	Fixed Figure 11-3 and 11-4 (removed top and bottom holes from mounting plate)
D	3/2009	Corrected ORP range specification from +/-1999mV to +/- 1000mV revised Figure 2-1 to used flathead screwdriver at edge of knockouts.
E	4/28/10	Clarified NEMA, IP ratings
F	6/23/11	Added European Declaration of Conformity Certificate to inside cover
G	10/12/11	Correct ORP Range in Specifications
H	01/2013	Updated product photo on cover.

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Part 1 Introduction

1.1 General

The Model TX100 is a microprocessor-based, loop-powered monitoring system, designed for the continuous measurement of pH, mV (ORP) and temperature. The full scale operating range of the transmitter may be user adjusted to any value between 0-14 pH or -1999 to + 1999mV. All transmitter features are selectable via the silicone keypad. Please read this manual thoroughly before operating the transmitter. For quick use, please read the “Quick Start” Instructions supplied with your transmitter.

1.2 Features

- The TX100 is designed to be a fully isolated, loop powered pH/mV instrument for two-wire DC applications.
- Can be user-adjusted for specific application span from 0-14pH or -1999mV to + 1999mV.
- Automatic temperature compensation via Pt1000 RTD.
- Instrument supplied in rugged NEMA 4X (IP65) enclosure.
- Built-in programmable sensor cleaning reminder.
- Probe select menu allows user to scale in pH or mV units.
- Calibration Offset menu allows user to calibrate transmitter to match another reference pH meter.
- Several preprogrammed pH buffer selections available for calibration.

1.3 TX100 Specifications

Measuring Range (pH)	0.00 to 14.00pH, 0.01 pH resolution, +/- 0.01 accuracy											
Measuring Range (ORP/mV)	-1999mV to 1999mV, 1mV resolution, +/- 2mV accuracy											
Measuring Temperature Range	-20 degC to 110 degC /-4 degF to 230degF, 0.1degC/F resolution											
Current Output Range	2.00mA to 24mA (4-20mA galvanically isolated) , 0.01mA resolution,+/-0.005mA accuracy											
Enclosure	NEMA 4X, IP65, ABS case with silicone keypad HWD: 3.8" (96.52 mm) x 3.8" (96.52 mm) x 2.8" (71.5mm)											
Weight	approx. 1lb (.45kg)											
Mounting Options	Wall mount, panel mount, pipe mount and DIN rail (rail not included)											
Conduit Openings	Standard: 2 - 3/8" openings cordgrips included.											
Ambient Temperature	Transmitter Service, 0 degC to 60 degC / 32 degF to 140 degF Sensor Service – Refer to Sensor specifications											
Ambient Humidity	0 to 95% (non-condensing)											
Location	Designed for non-hazardous areas											
Temperature Input	2-wire Pt1000 RTD with automatic compensation											
Max. Sensor-to-Transmitter Distance	30 feet (9.1 meters)											
Power	12-24 V .DC, 8 amp maximum current											
	<table border="1"> <thead> <tr> <th>Supply Voltage (V DC)</th> <th>Max Resistance Load (Ohms)</th> </tr> </thead> <tbody> <tr> <td>12</td> <td>150</td> </tr> <tr> <td>16</td> <td>350</td> </tr> <tr> <td>20</td> <td>550</td> </tr> <tr> <td>24</td> <td>750</td> </tr> </tbody> </table>		Supply Voltage (V DC)	Max Resistance Load (Ohms)	12	150	16	350	20	550	24	750
Supply Voltage (V DC)	Max Resistance Load (Ohms)											
12	150											
16	350											
20	550											
24	750											

EMI/RF

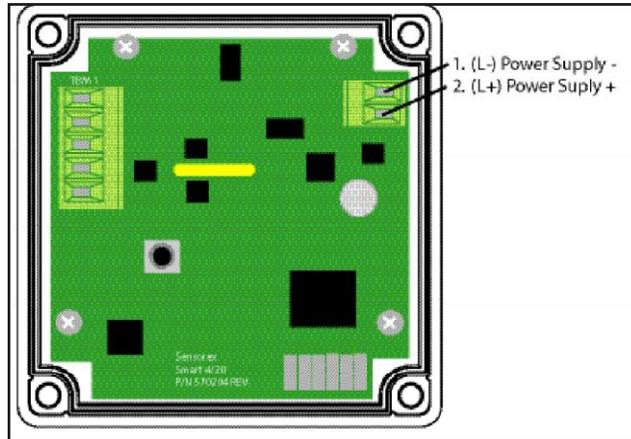
EN 61326-1



1.4 TX100 pH/MV Transmitter - QUICK START GUIDE

a. Refer to Section 2 for installation instructions.

b. Connect electrode to transmitter as shown below.



c. Remove front cover from transmitter case by unscrewing four screws in rear corners of transmitter. Connect a 12-24V DC, 8 amp maximum power supply as shown above. See page 6 for resistance load vs. voltage.

d. Transmitter Programming/Setup

The TX100 is supplied with the following preset programming:

Factory Calibrated Values

pH Manual Offset = 0

mV Manual Offset = 0

Temperature Manual Offset = 0

Without TC, Default 25°C or 77°F

Range Mode [-] OFF

Range Mode Lo mV reset to -999 mV

Range Mode Hi mV reset to 999 mV

Range Mode Lo pH reset to 0.00

Range Mode Hi pH reset to 13.99

Hold Mode HLd Lr

Limit Mode O.r. OFF

Clean Probe Timer C.P. OFF

To change any of these parameters, please refer to the specific section in this manual (See Table of Contents).

- e. If installed electrode is pH, move to step f.
If ORP/mV electrode is installed see Section 9.1 for Probe Selection programming.
- f. Temperature Calibration is done at the factory before shipping. For temperature recalibration follow steps shown in Section 9.8.
- g. Factory preset temperature units are oC. To change to oF, follow instructions in Section 9.9.
- h. For pH, perform Two-Point pH calibration as outlined in Section 8.2.
First buffer is pH 7.00 or 6.86 (NIST), second buffer choices are 4.01, 10.00 or 9.18 (NIST). A two-point calibration must be performed. Three-point calibration is not necessary with the TX100.

Part 2 Transmitter Mounting

2.1 Cord Grip Installation

Turn transmitter upside down with display facing you. Punch out either one or two conduit knockouts with a small hammer and punch as shown below for cord grip mounting. Ensure back cover is installed to provide mechanical support for the enclosure walls. **BE CAREFUL NOT TO DAMAGE THE INTERNAL ELECTRONICS OR CRACK THE TRANSMITTER CASE** while performing this action.

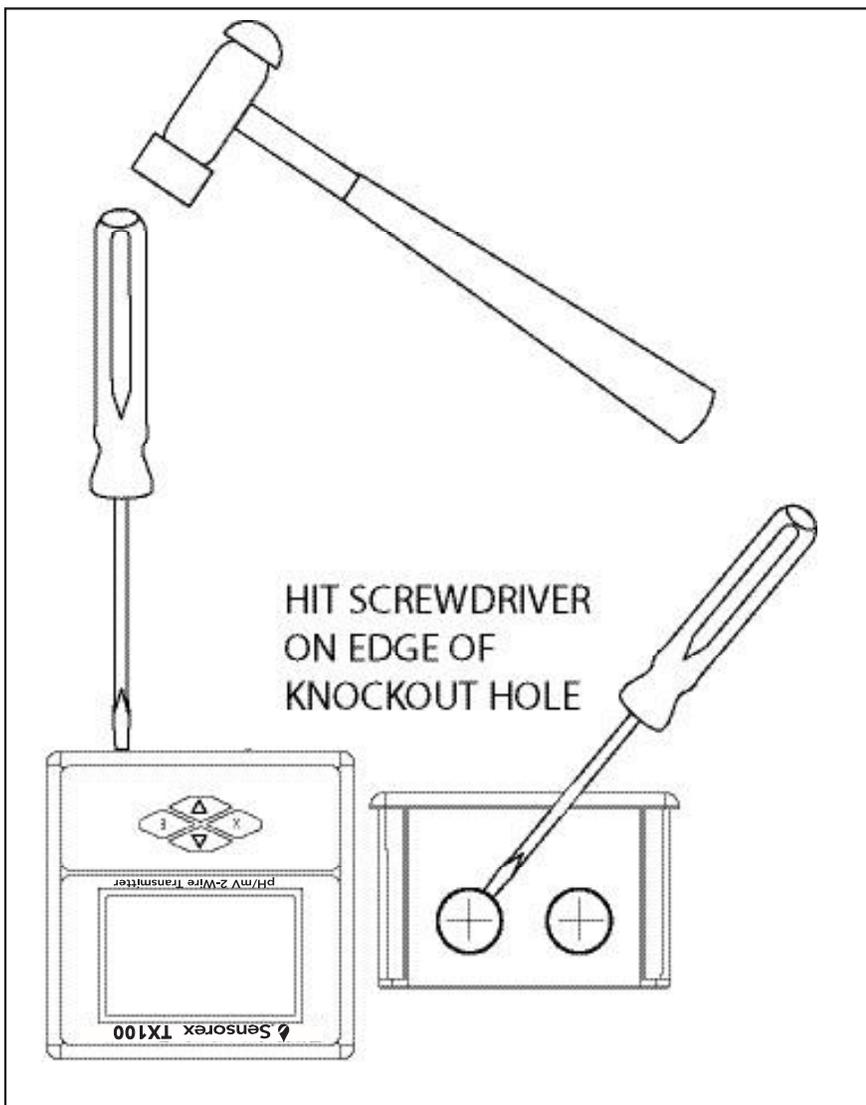


Figure 2.1

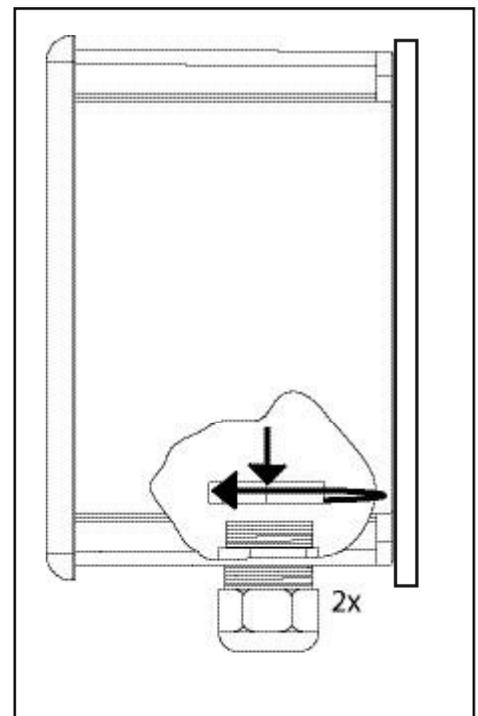


Figure 2.2

2.2 Wall Mounting

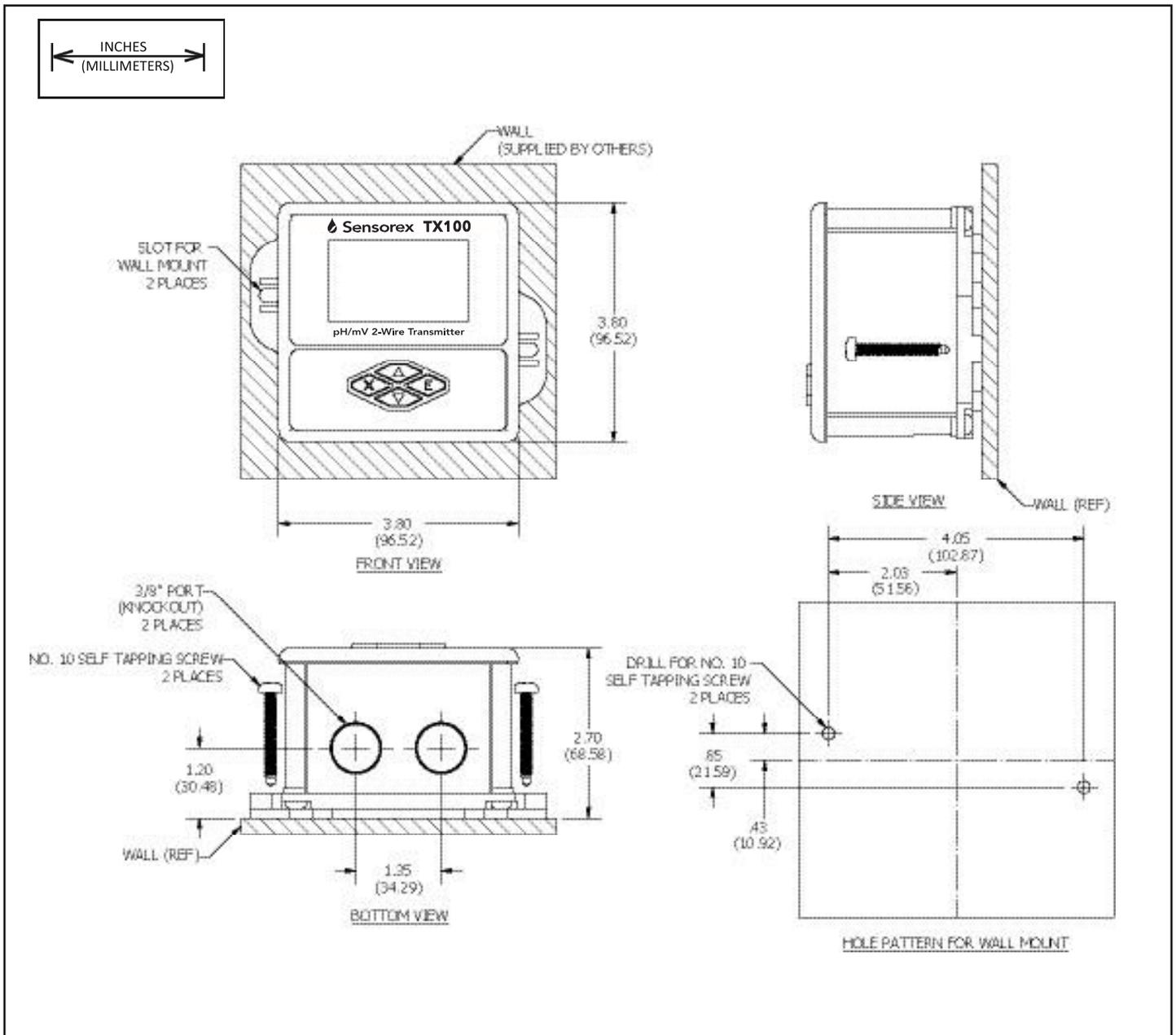


Figure 2.3

2.3 Panel Mounting

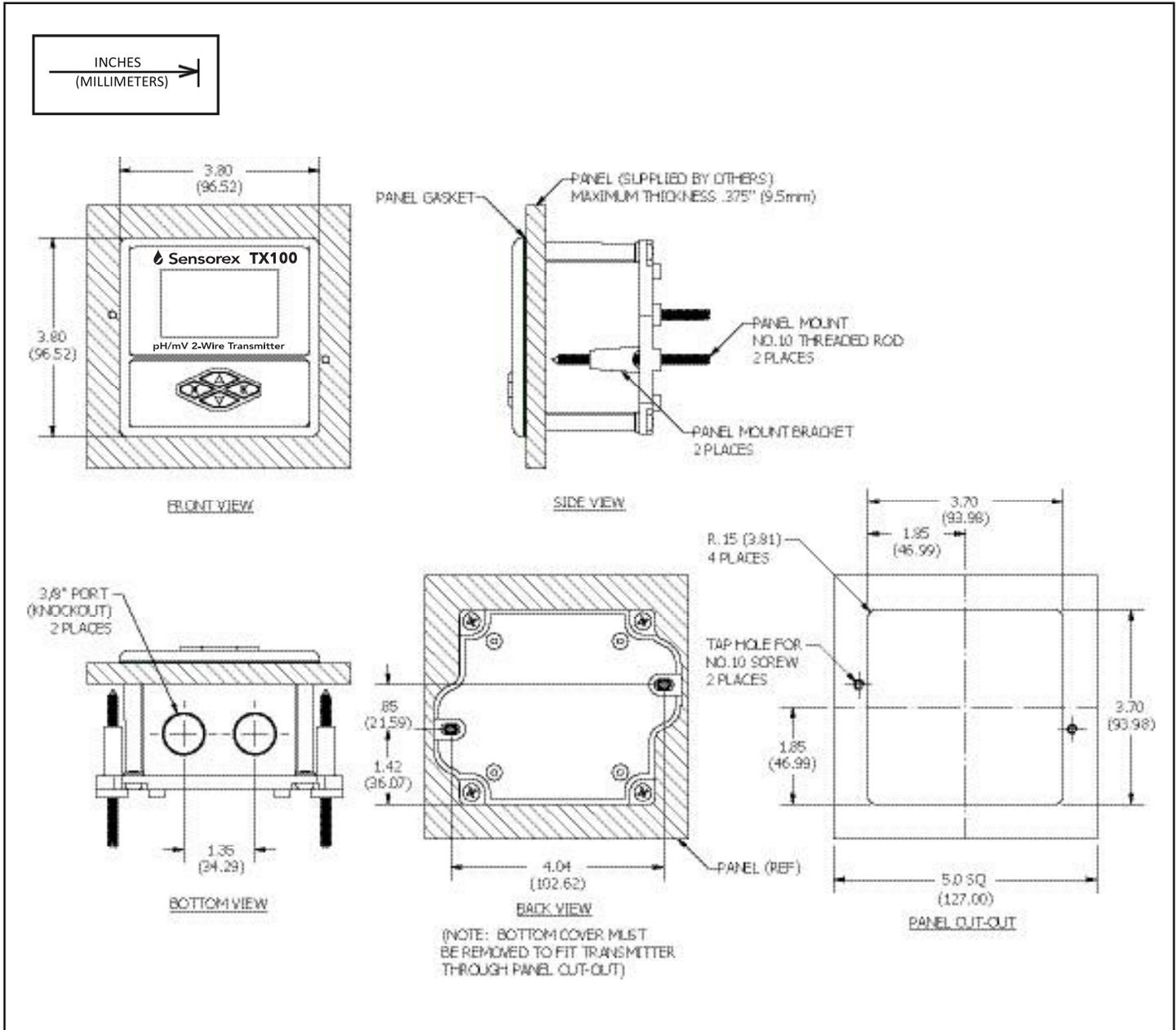


Figure 2.4

2.4 DIN Rail Mounting

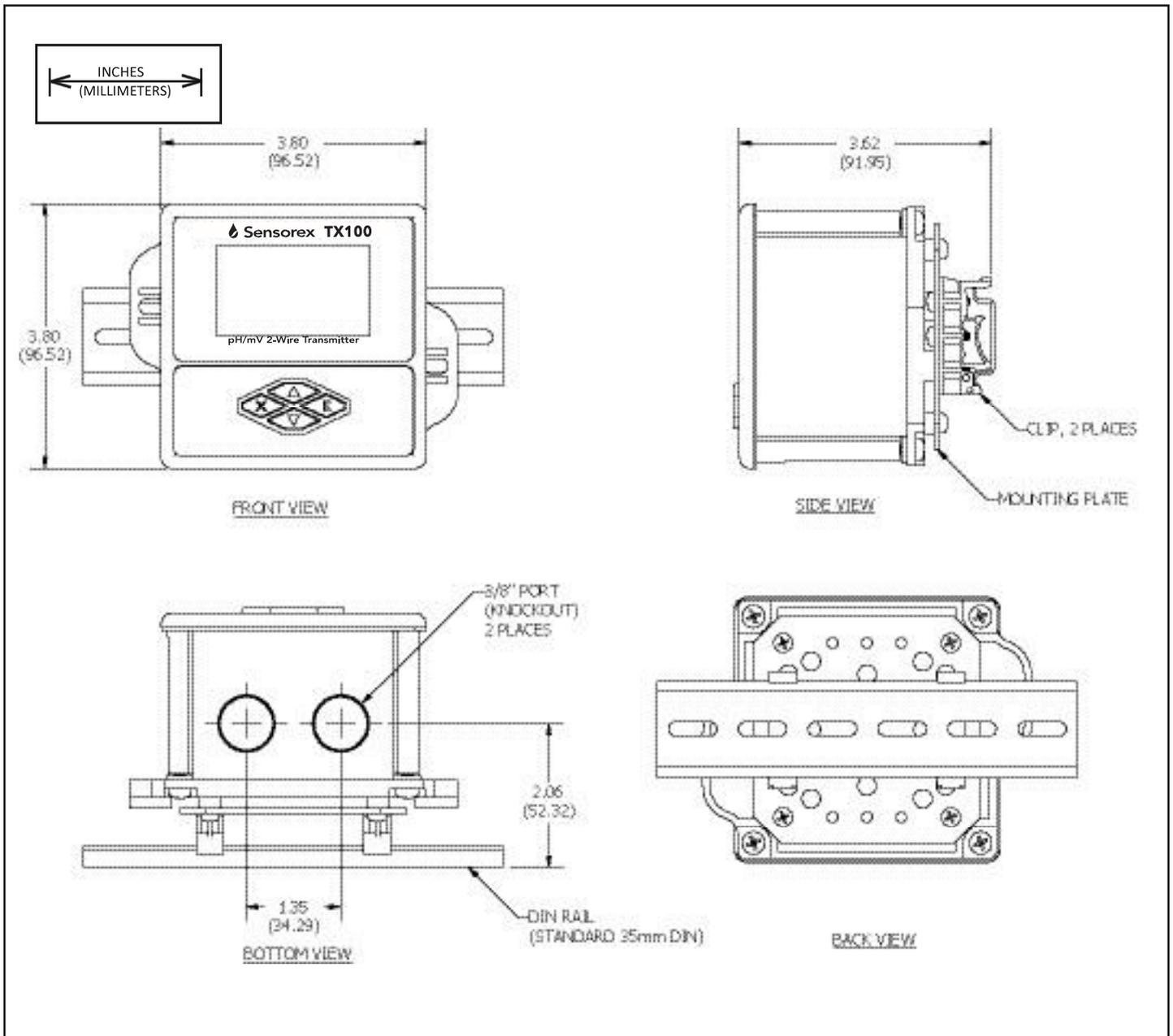


Figure 2.5

2.5 Pipe Mounting

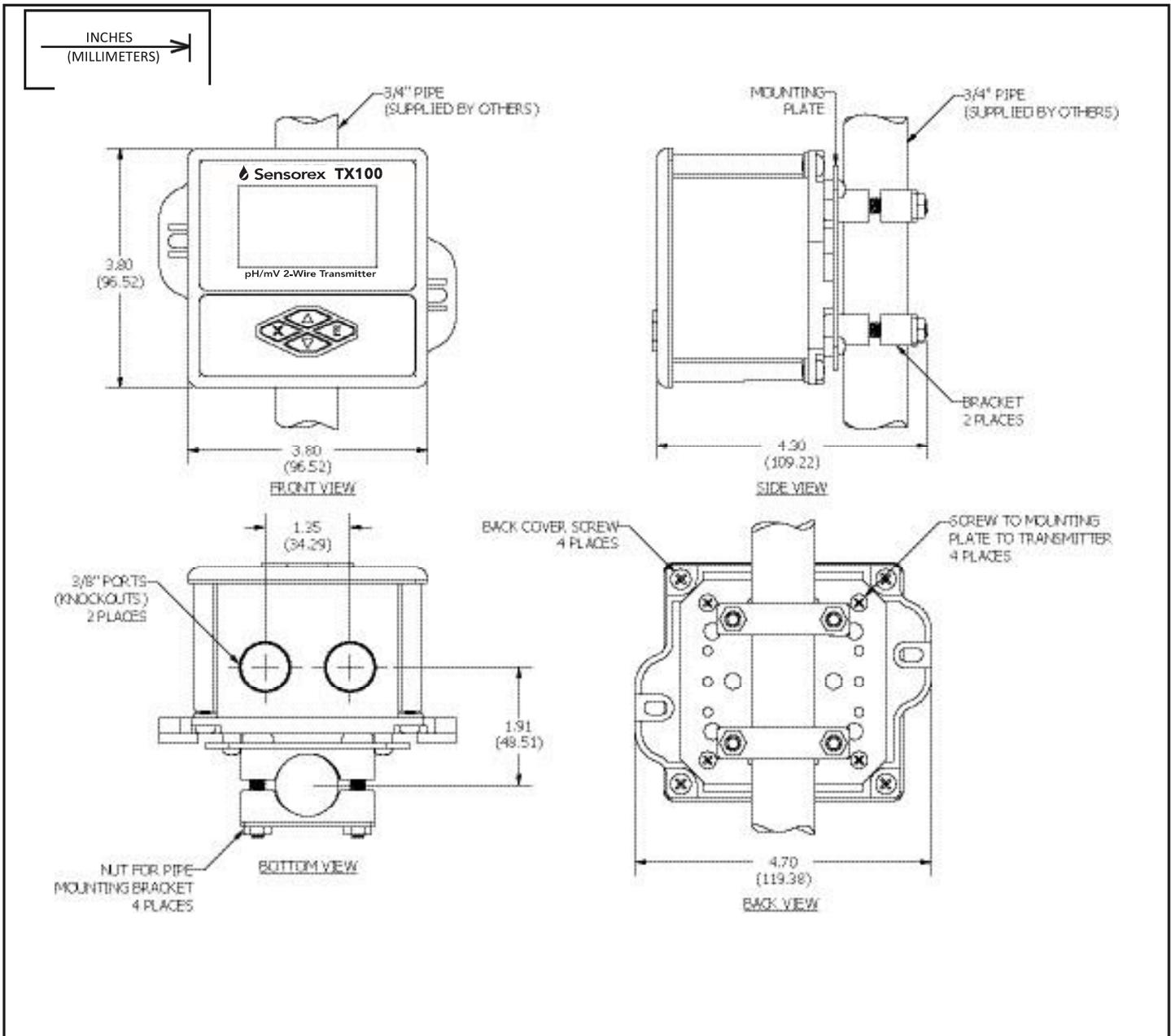


Figure 2.6

Part 3 Sensor Mounting

3.1 General

Select a location within the maximum sensor cable length (30 ft) for mounting of the sensor flow cell. If there is more than 30 ft distance from the electrode to the transmitter, you should purchase a battery-powered preamplifier model PHAMP-1, or use an amplified pH or ORP electrode. Locate sensor away from pumps,

adjustable frequency drive systems, or other sources of high frequency EMI if possible. Refer to the installation manual for your electrode for mounting requirements.

Part 4 Transmitter Electrical Installation

4.1 General

The TX100 loop-powered instrument is a 12-24 VDC loop-powered pH/mV transmitter.

WARNING: Do not connect AC line power to the 2-wire module. Severe damage will result.

Important Notes:

1. Use wiring practices that conform to all national, state, and local electrical codes.
2. DO NOT run sensor cables or instrument 4-20 mA output wiring in the same conduit that contains AC power wiring. AC power wiring should be run in a dedicated conduit to prevent electrical noise from coupling with the instrumentation signals.
3. DO NOT remove dessicant pack from inside transmitter case. This is necessary to control moisture.

4.2 Power

A 12-24VDC power supply, eight amp maximum current must be used to power the instrument. See chart below for Maximum load. The exact connection of this power supply is dependent on the control system into which the instrument will connect. See Figure 4.1 for further details. Any twisted pair shielded cable can be used for connection of the instrument to the power supply. Route signal cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run sensor or signal cables in conduit that contains AC power lines or motor leads. The TX100 is supplied with a lightning protective component.

Note: Terminal block labels for power, electrode and temperature sensor connections are marked on the PCB next to their respective terminal.

Supply Voltage(V DC)	Max Resistance Load (Ohms)
12	150
16	350
20	550
24	750

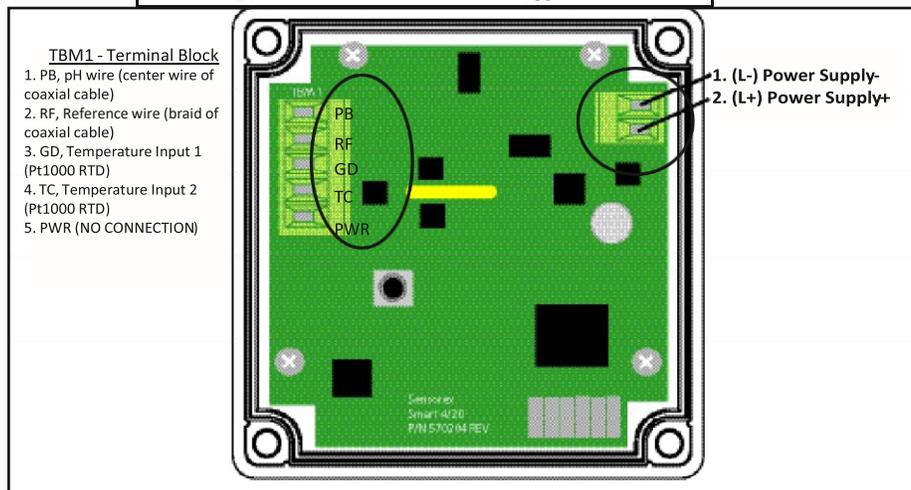


Figure 4.1

Part 4 Transmitter Electrical Installation

4.3 4-20mA loop connection to PLC or other 4-20mA load device

Install loop wiring as shown below in diagram 4.1A, paying particular attention to maximum resistance load shown in the chart. Note that PLC or 4-20mA device and power supply are customer supplied components.

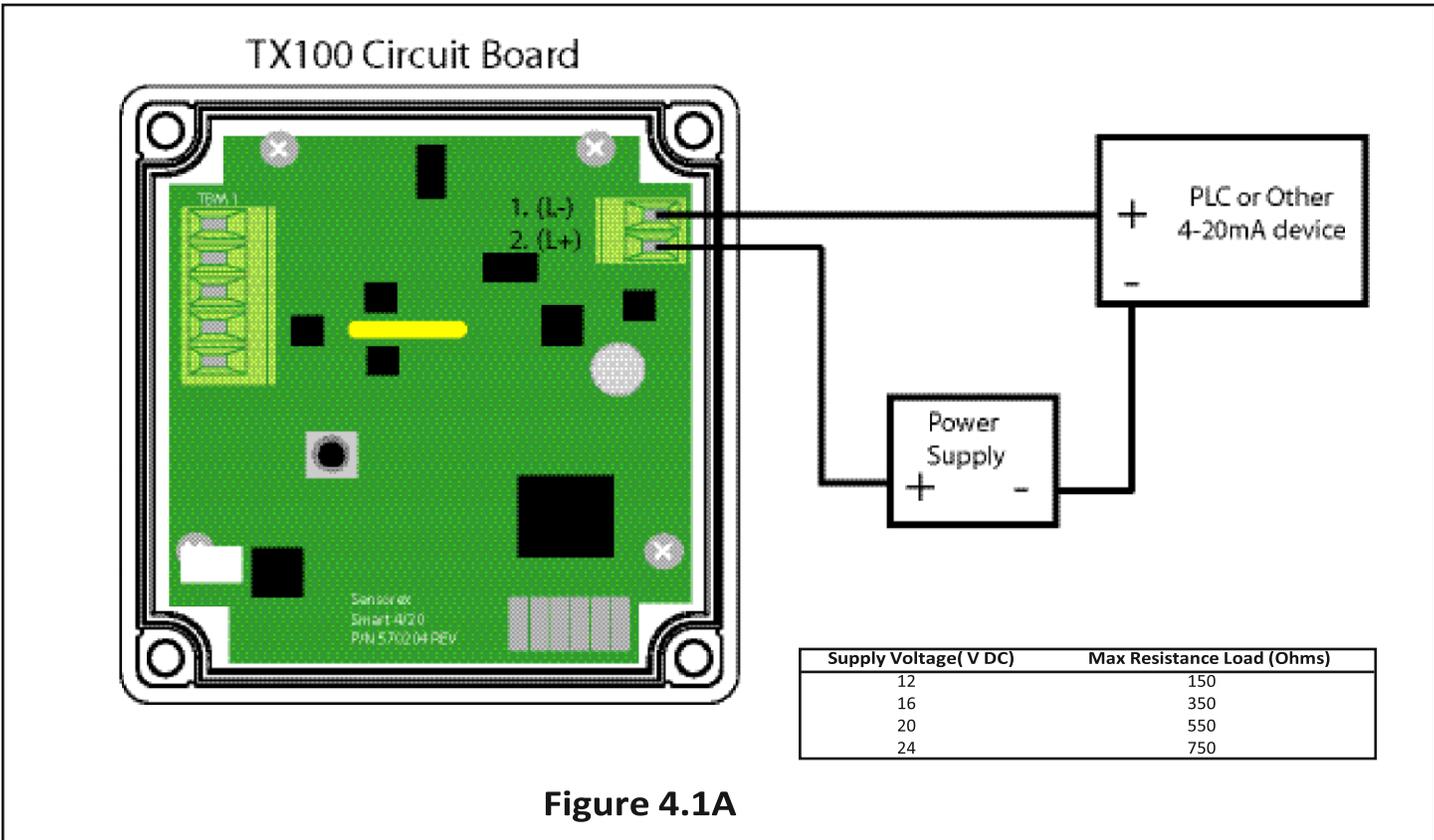


Figure 4.1A

Part 5 Electrode Electrical Connection

5.1 General

The electrode cable can be quickly connected to the TX100's terminal strip by matching the wire colors on the cable conductors. Route signal cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run sensor or signal cables in conduit that contains AC power lines or motor leads.

5.2 Direct Sensor Connection

The sensor cable can be routed into the enclosure through one of the provided cord-grip retainers, or through a properly sized conduit connection. Connect electrode wires as shown below.

If the cord-grip devices are used for sealing the cable, ensure the cord-grips are snugly tightened after electrical connections have been made to prevent moisture incursion.

Note: Terminal block labels for power, electrode and temperature sensor connections are marked on the PCB next to their respective terminal.

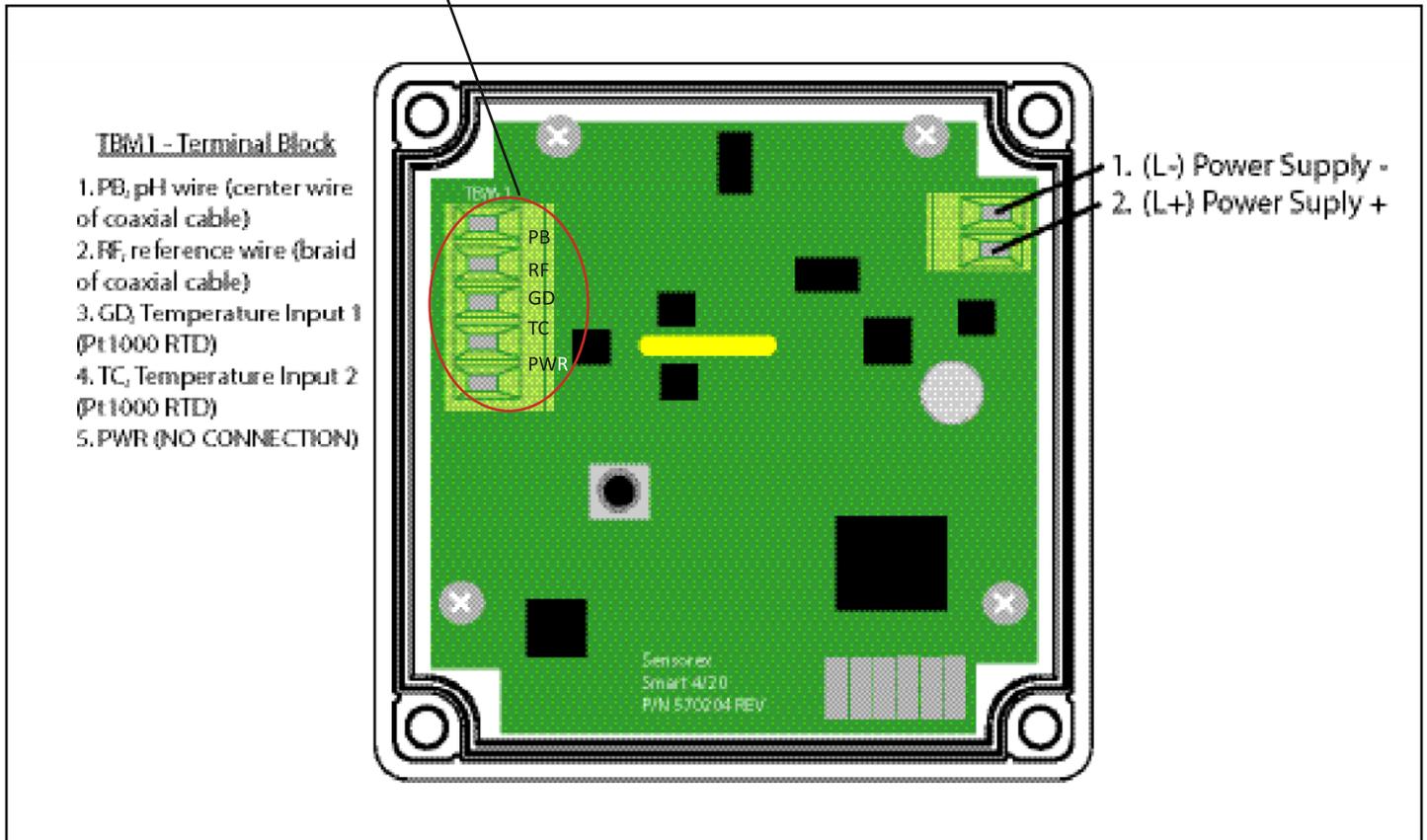


Figure 5.1

Part 6 Keypad Function and LCD

6.1 Keypad

The TX100 keypad is designed for ease-of-use. See graphic below for keypad function.

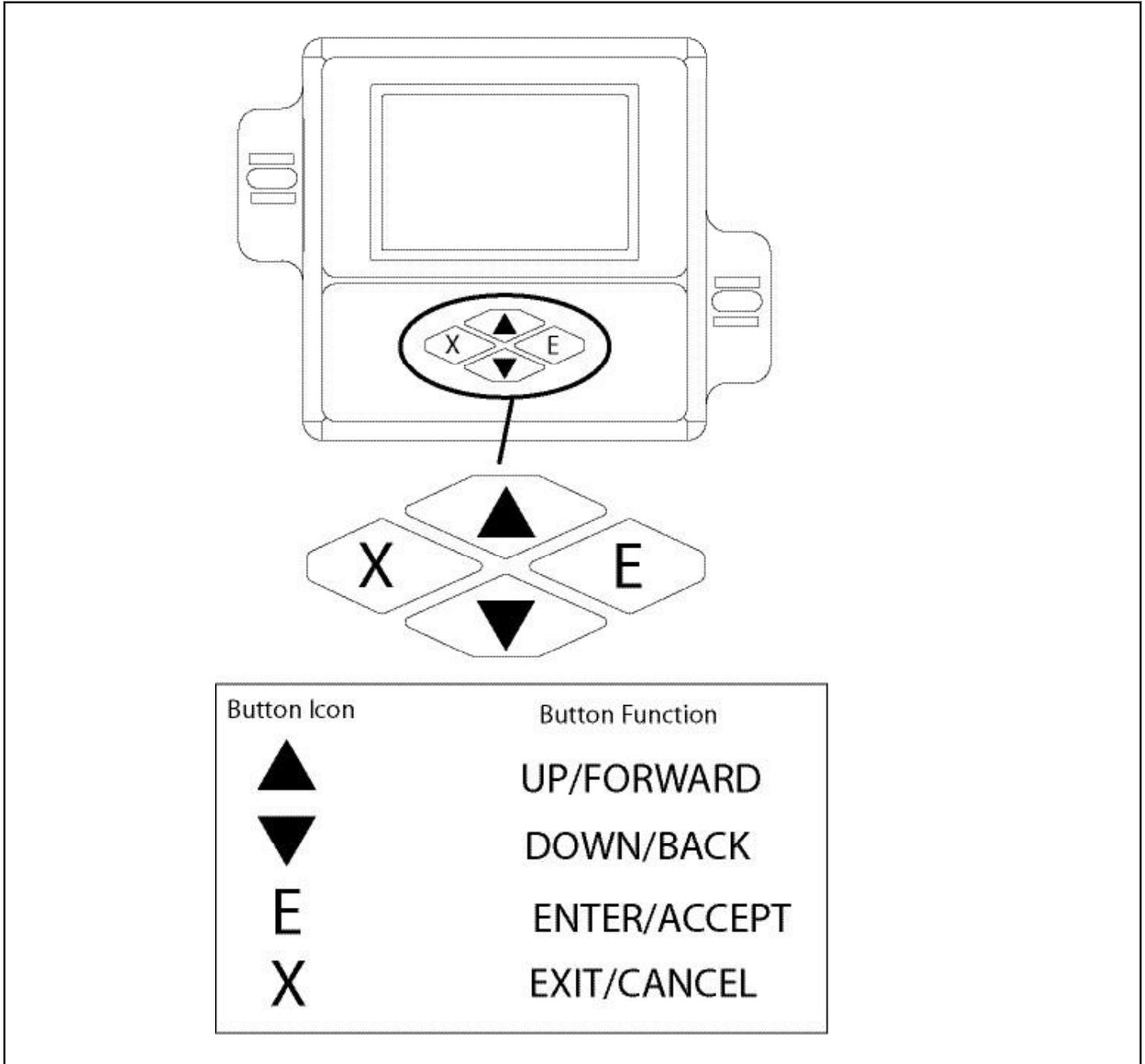


Figure 6.1

6.2 LCD Screen

The TX100's LCD display contains a number of useful indicators which let the user know which mode is active. In addition, all values to be changed will flash. The silicone keypad is designed for ease-of-use. See graphic below for display features.

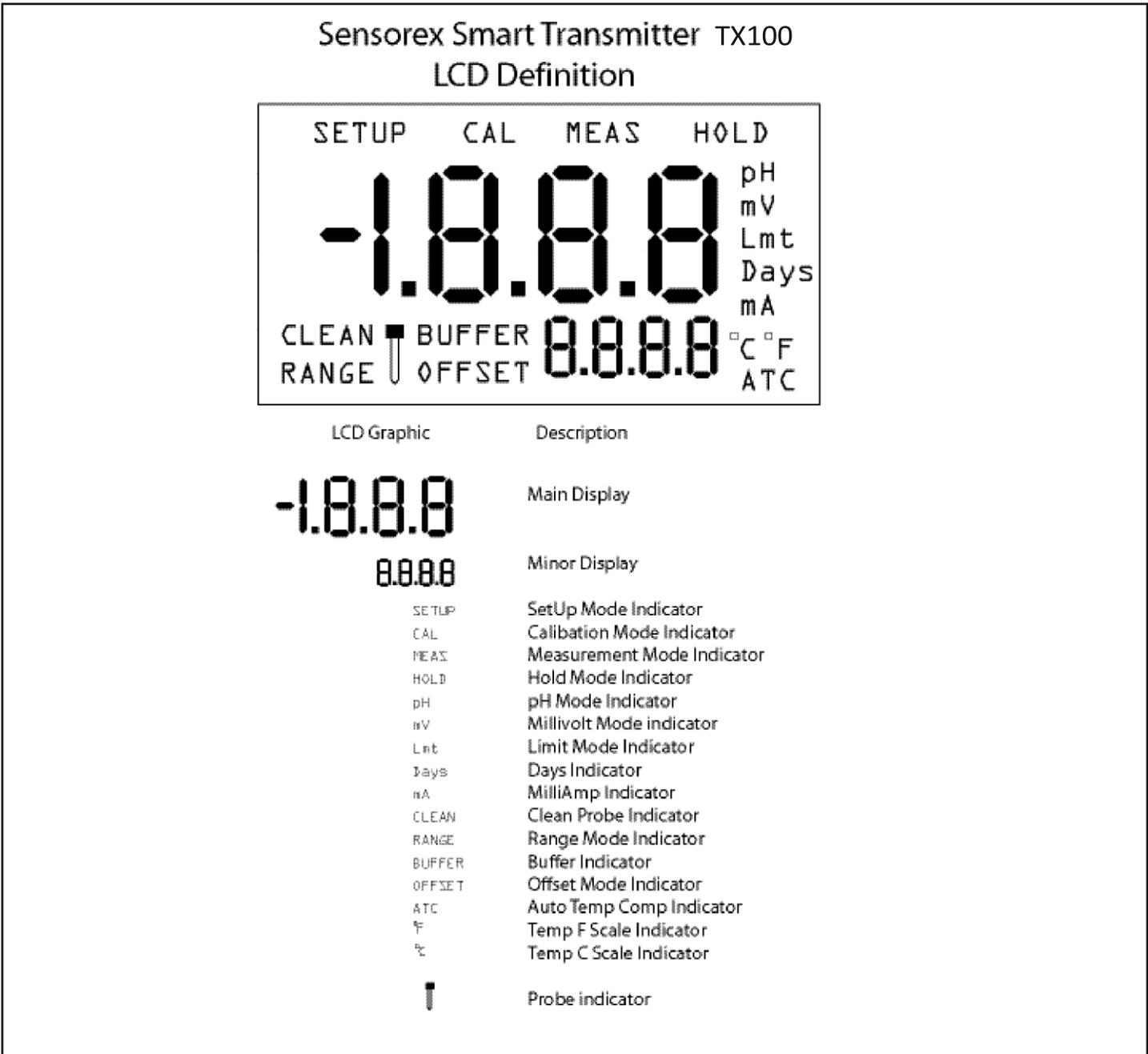


Figure 6.2

Part 7 Programming Menu

7.1 Menu

The TX100 pH/ORP transmitter menu flow chart below shows a quick view of navigation basics. For detailed submenu programming, please refer to the appropriate menu subsection.

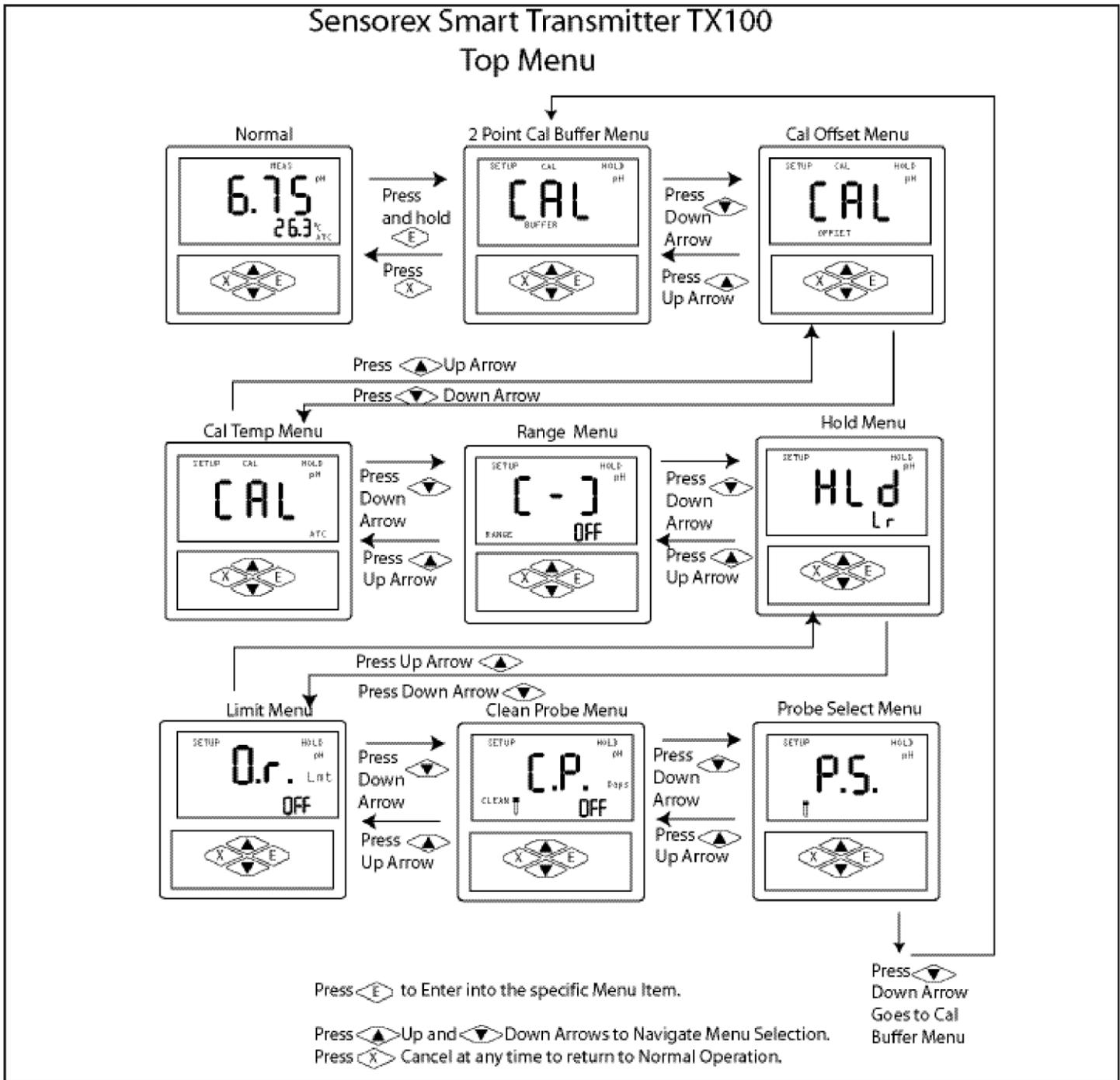


Figure 6.3

Part 8 Calibration

8.1 Getting Started

Before pH and temperature calibration is possible, some preparation is necessary. First, make sure you are in the proper measurement mode. The measurement mode is shown on the display in the upper right corner “pH” for pH and “mV” for ORP or other mV sensors.

Ensure the sensor is connected to the transmitter as shown in Part 5.1.

Always use fresh buffer solutions when calibrating. Check expiration date on buffer package.

If possible, use deionized water to rinse electrode before calibration and between buffers.

For temperature calibration, make sure the temperature sensor wires are connected as shown in FIG 5.1. If no temperature sensor is connected, the transmitter will default to read 25.0 degrees C or 77.0 degrees F.

8.2 2-Point pH Calibration

The TX100 performs two-point calibrations using preprogrammed buffer choices. No mV calibration is required. See Figure 8.1 for calibration programming.

Sensorex Smart Transmitter TX100 2 Point Calibration Sub Menu

Description: Performs 2 point calibration on Transmitter

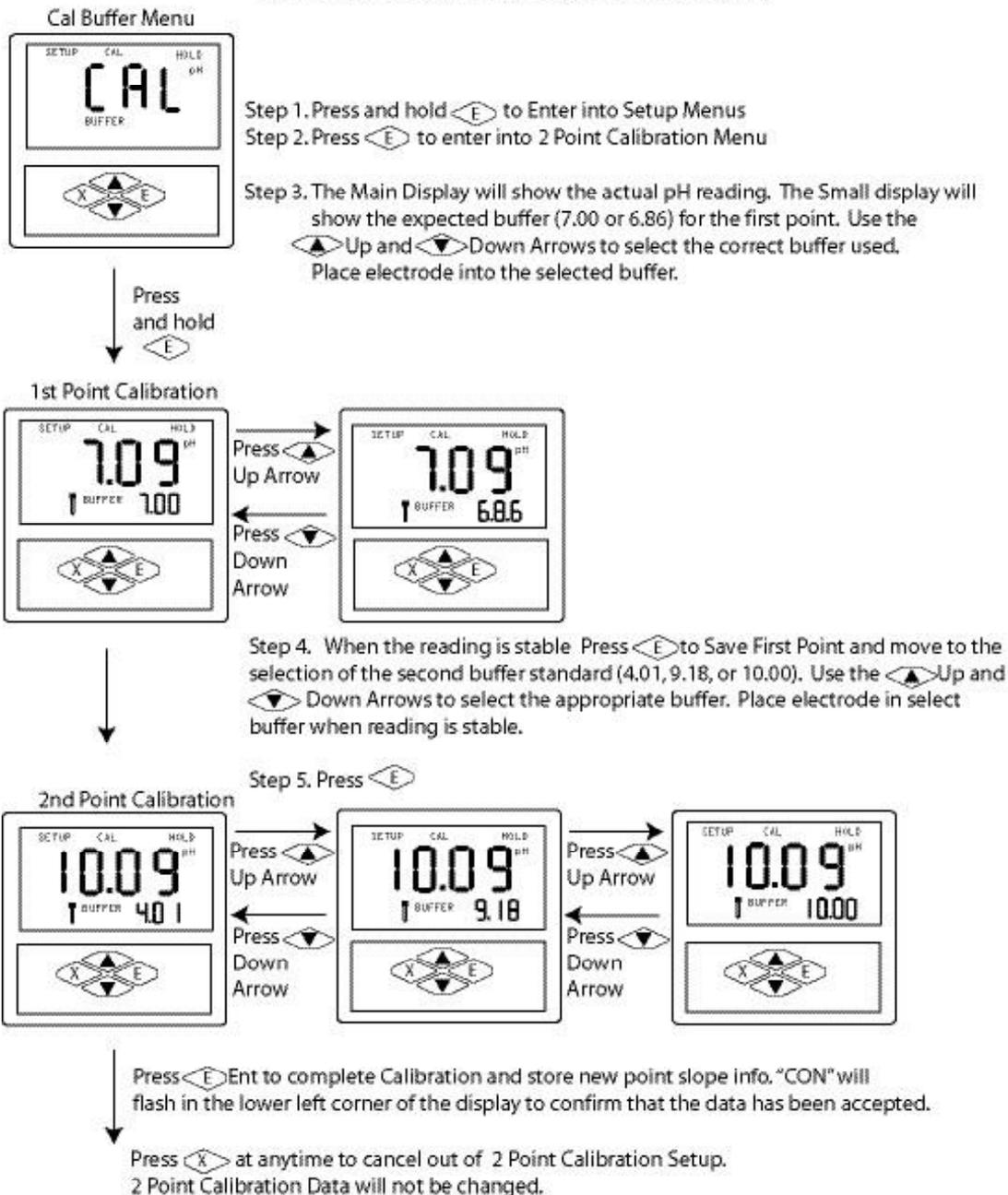


Figure 8.1

8.3 Temperature Calibration

This menu allows the user to select temperature units of measure and to calibrate the temperature displayed

on the T100's screen to match another sensor or thermometer. This menu is only available in pH mode (See Probe Select menu for details)

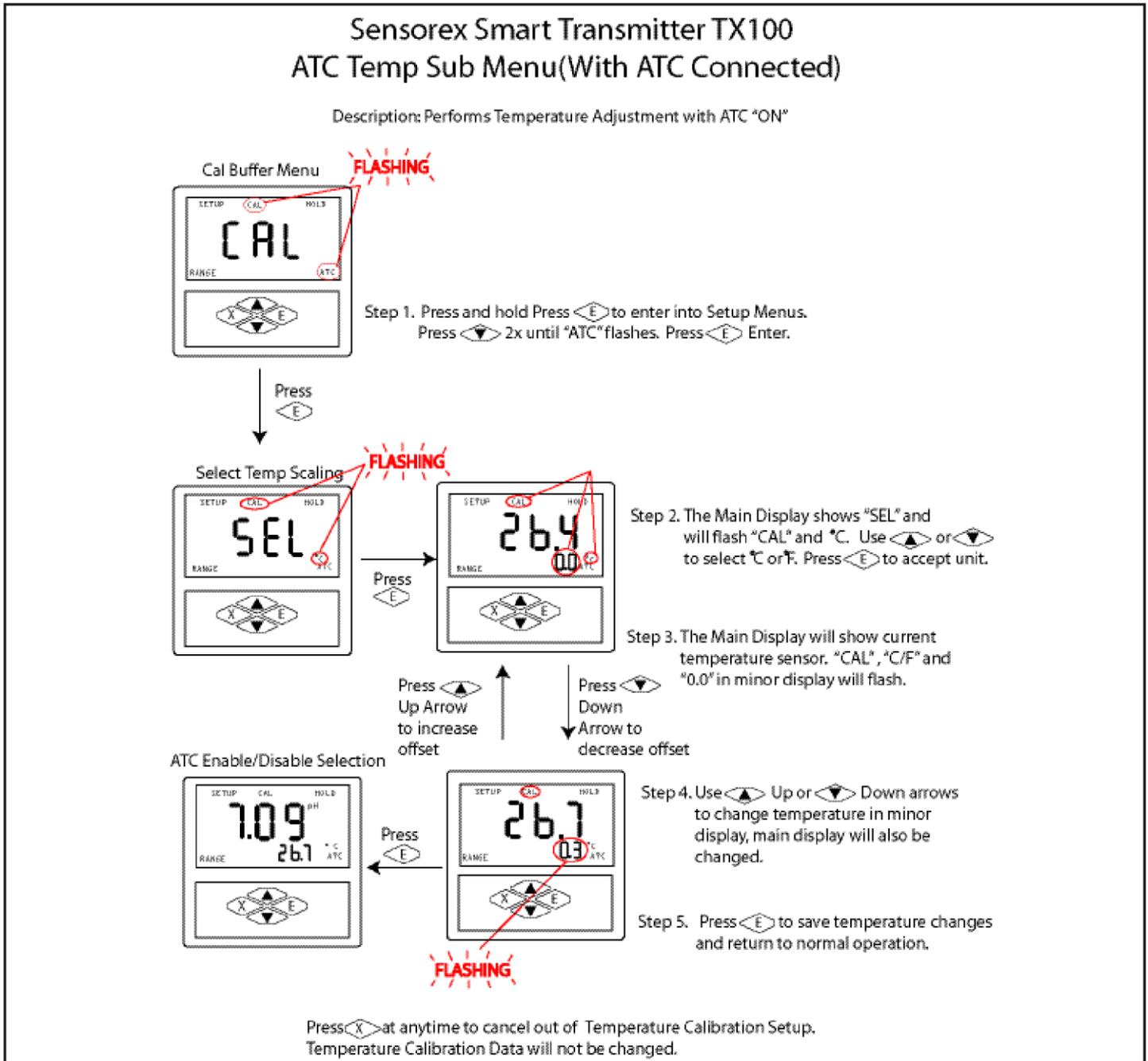


Figure 8.2

9.1 Probe Select Menu

Allows for selection of pH or ORP (mV) sensor. Menu is preset to "pH" from factory.

Sensorex Smart Transmitter TX100 Probe Select Sub Menu

Description: Selects pH or mV operation of Transmitter

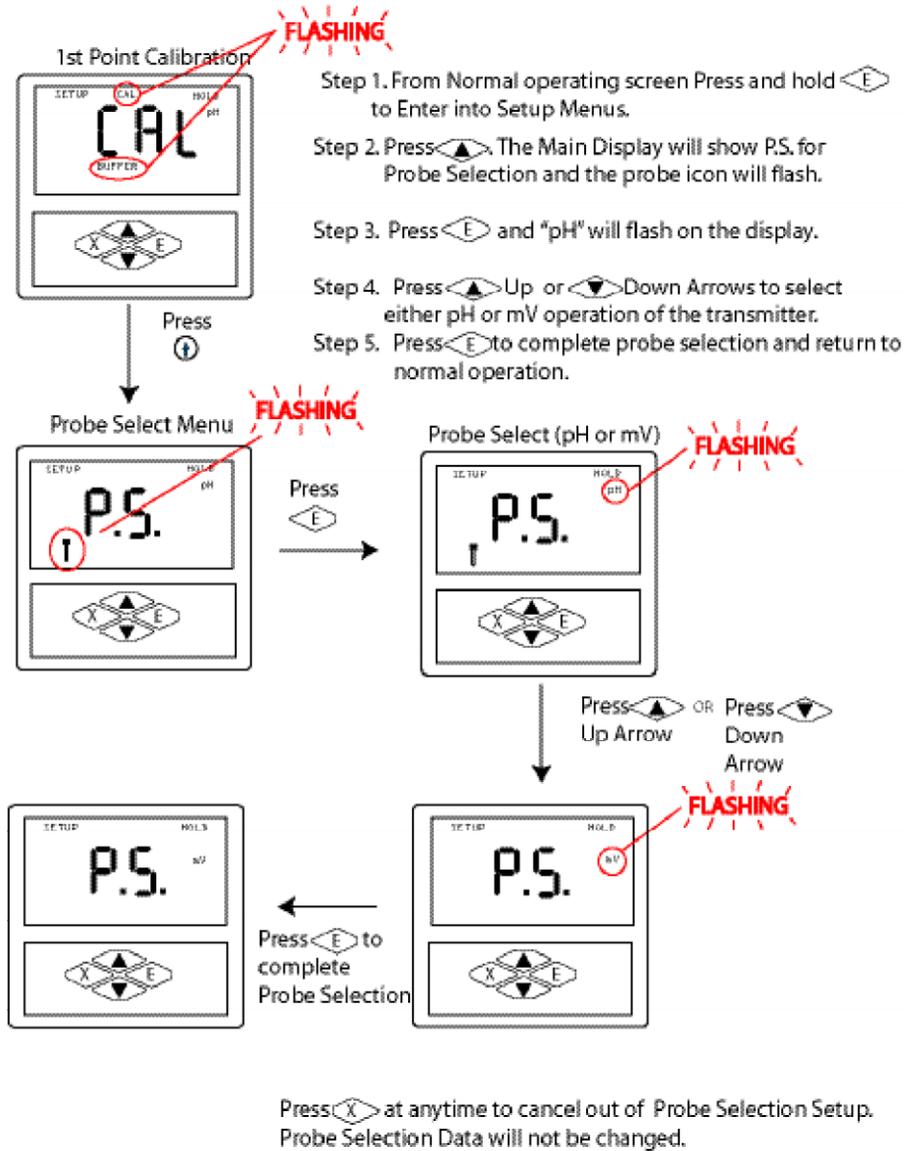


Figure 9.1

9.2 Calibration Offset

This mode allows the user to offset the current calibration by up to 2.00 pH units to make it equal to the calibration/reading of another meter.

Sensorex Smart Transmitter TX100 Offset Calibration Sub Menu

Description: Performs 1 point Offset calibration on Transmitter

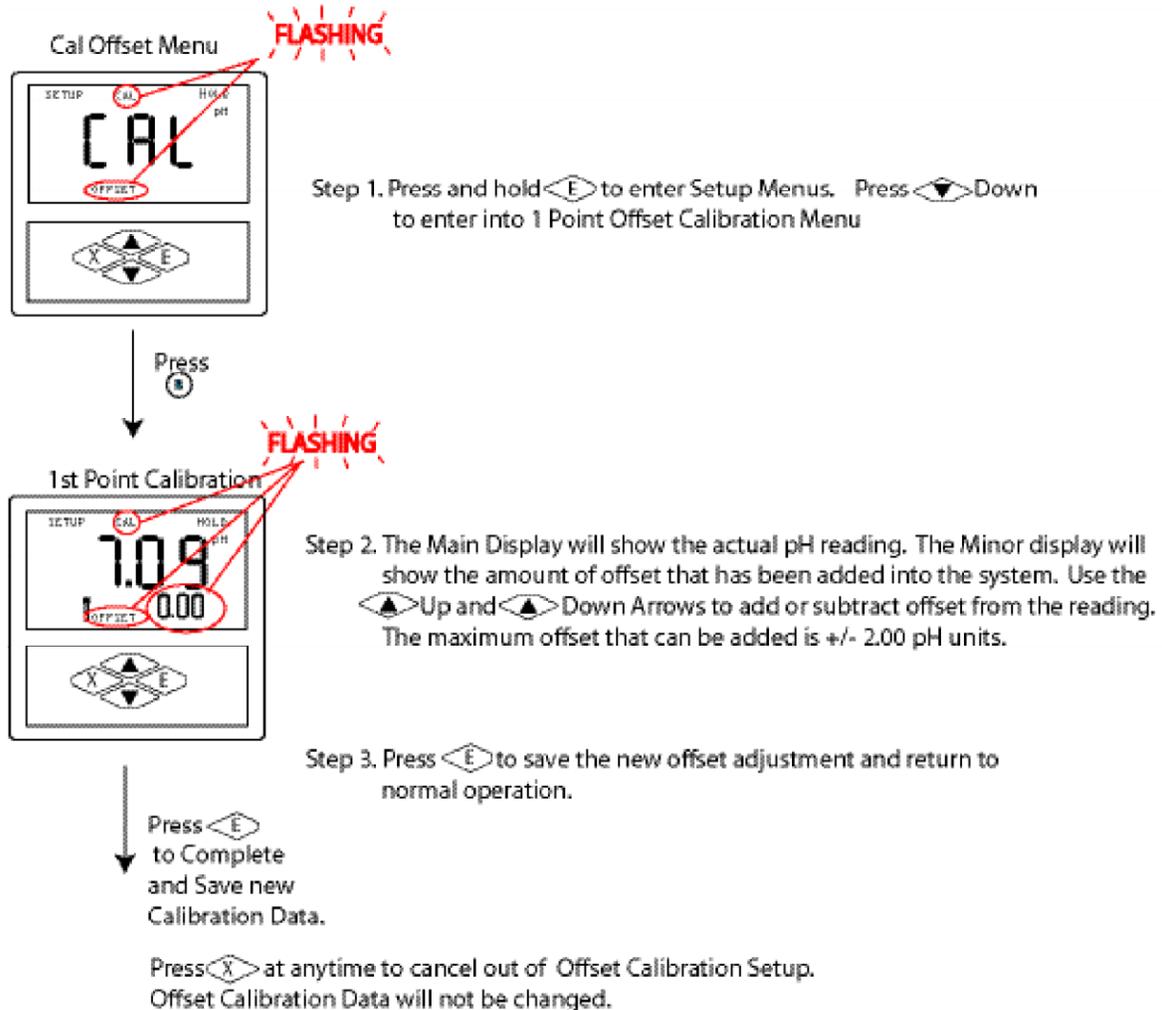


Figure 9.2

9.3 Range Menu

This calibration mode allows the user to define the pH values equal to 4.0 and 20.0mA. The factory preset Values are 0.0 pH for 4.0mA and 14.0pH for 20mA.

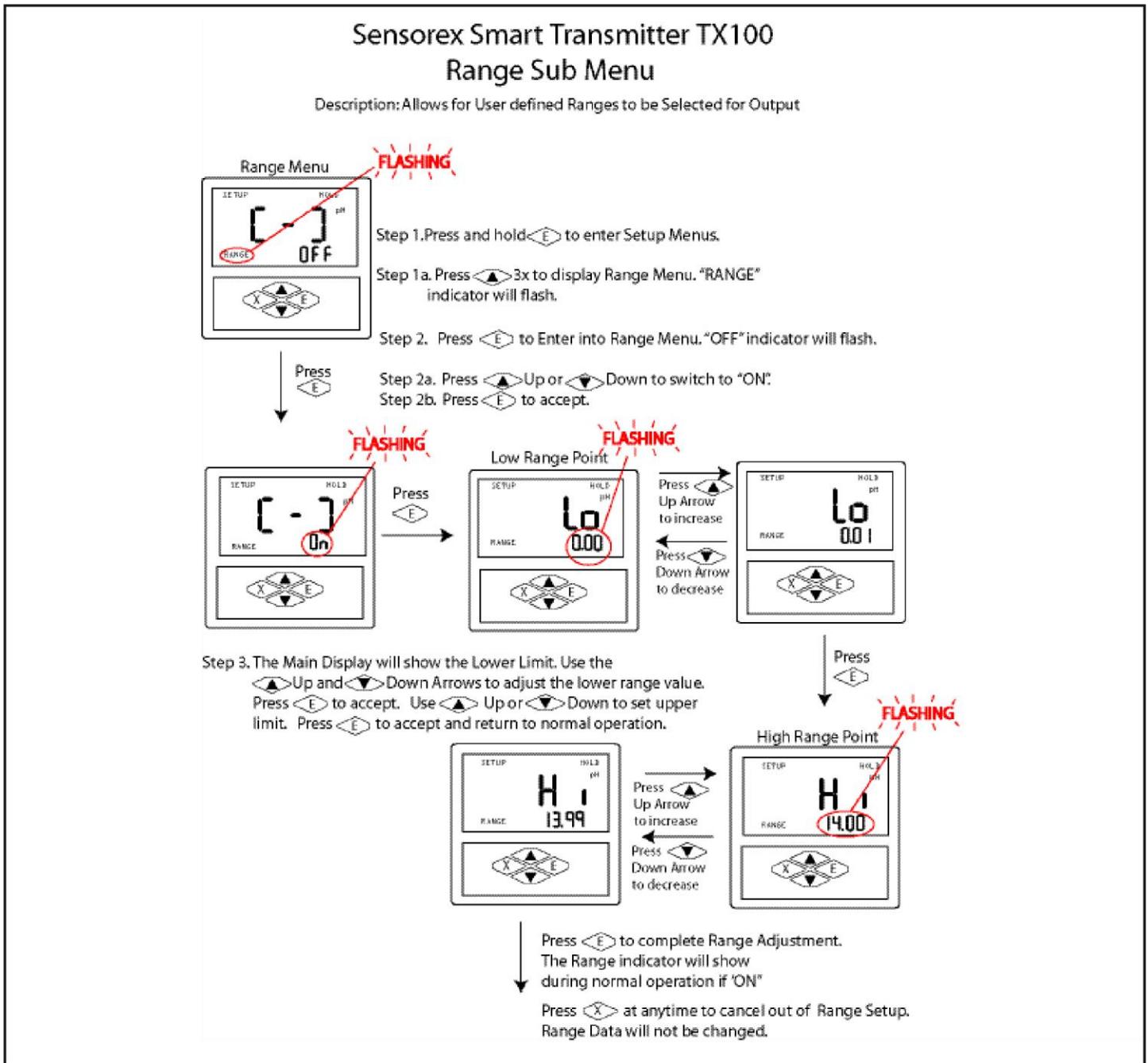


Figure 9.3

9.4 Limit Menu

This calibration mode allows the user to turn off or on the current output limit.

Sensorex Smart Transmitter TX100 Limit Menu

Description: Controls Output during Over and Under range conditions

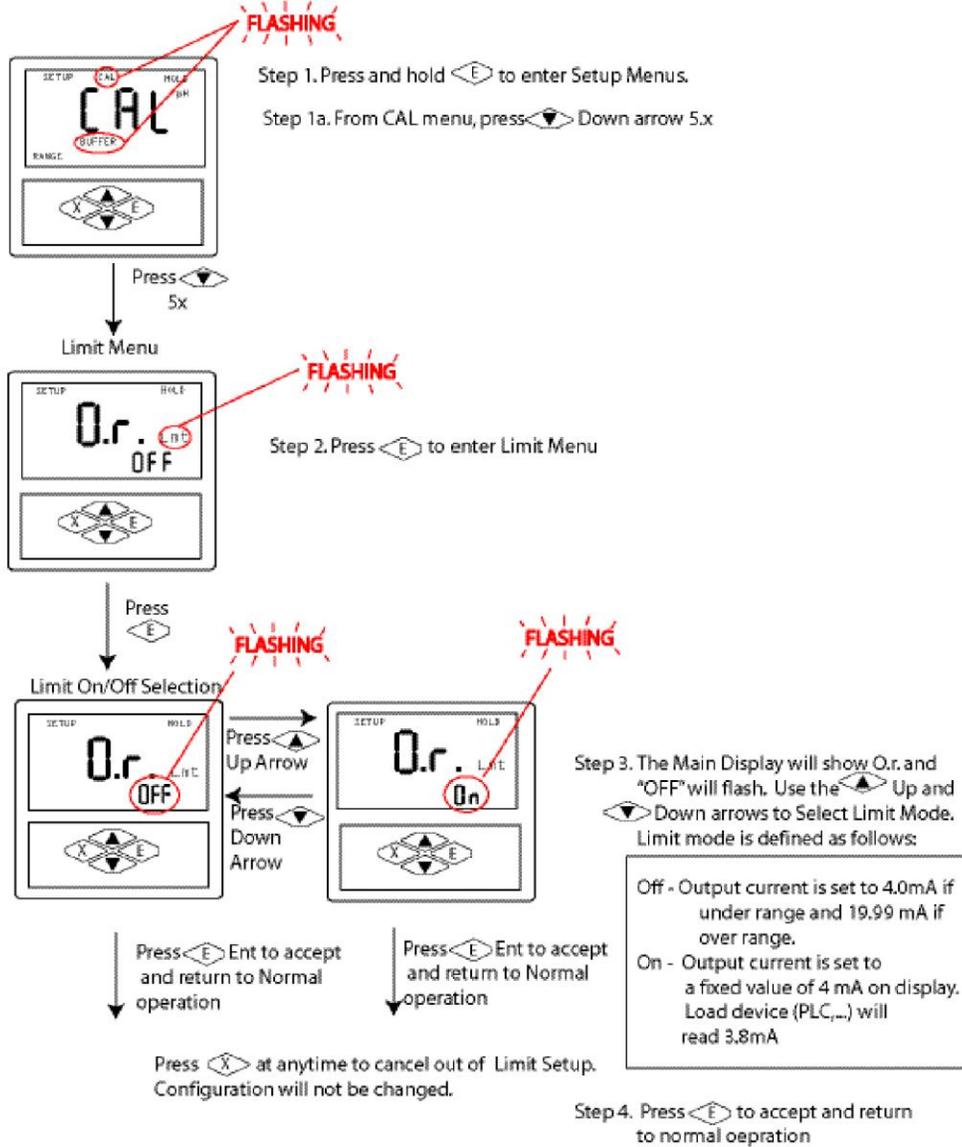


Figure 9.4

9.5 Hold Menu

Controls output during transmitter setup.

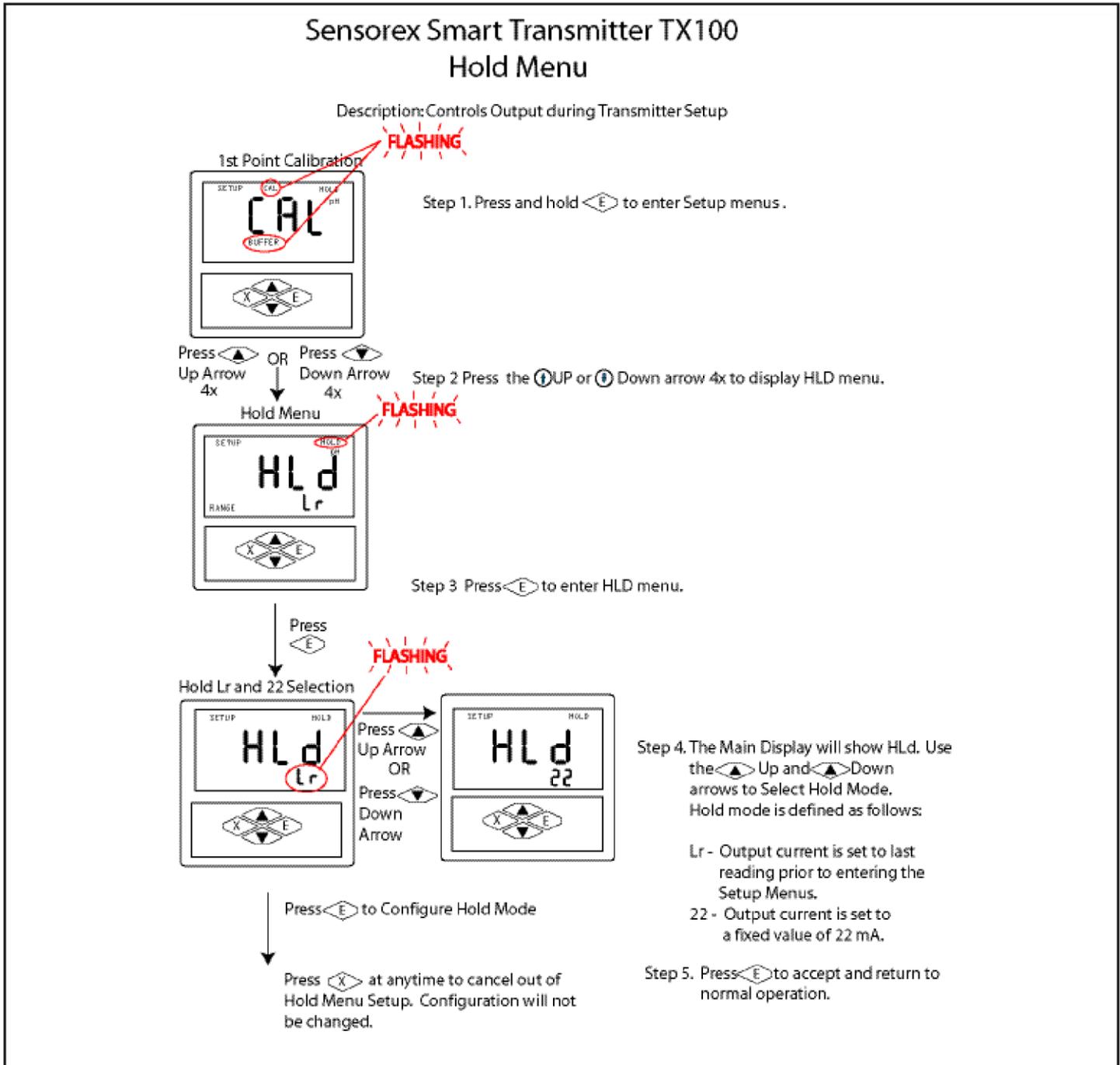


Figure 9.5

9.6 Clean Probe Menu

This menu allows the user to set a visual reminder to clean the probe. The reminder can be set to within 1-250

days. Once the timer has expired the clean probe icon will flash on the screen. Flashing probe icon is disabled by setting clean probe menu OFF.

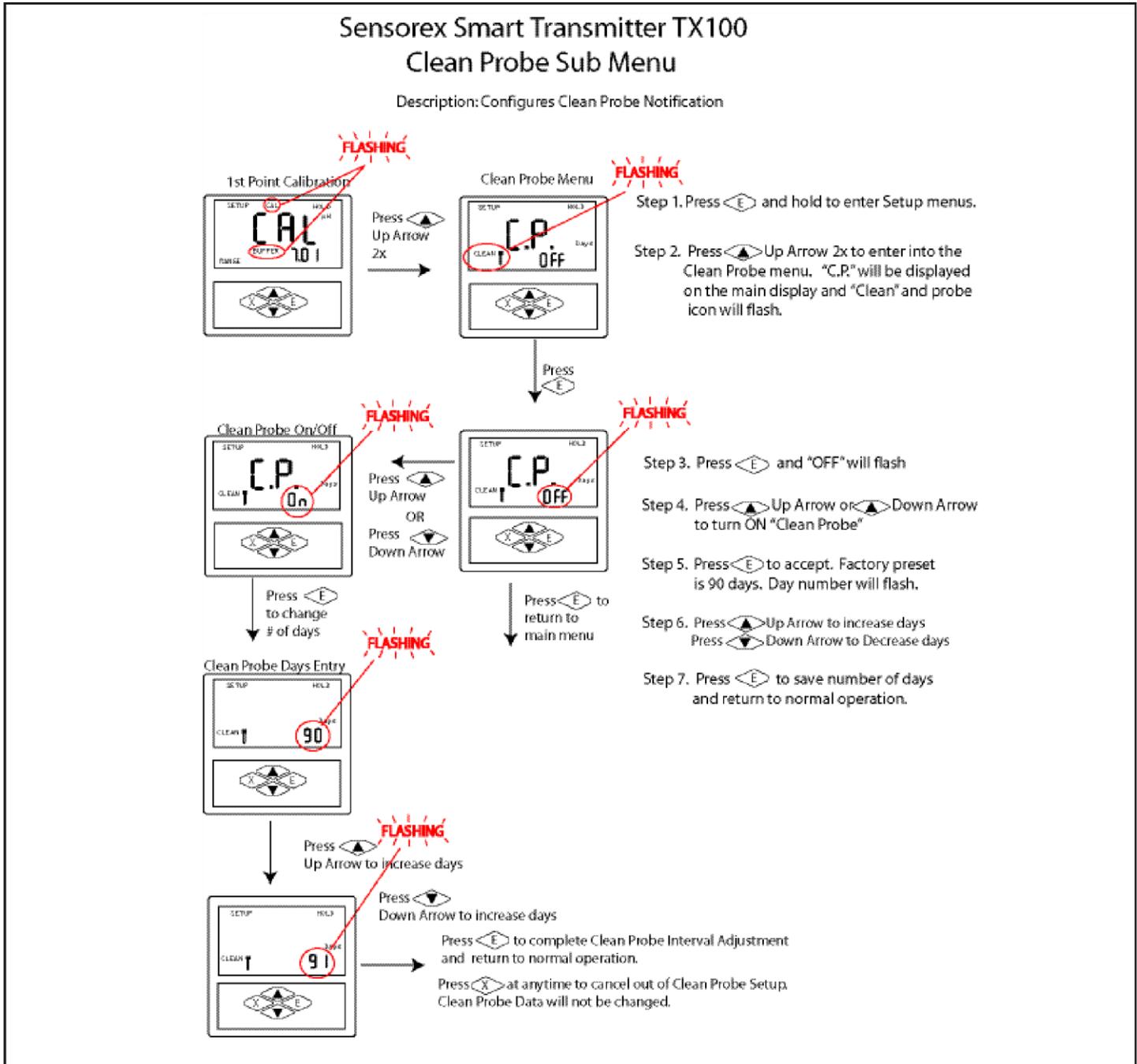


Figure 9.6

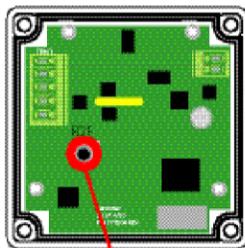
9.7 Factory Reset Menu

This menu allows the user to reset all programmed settings back to the factory defaults.

Factory Reset Values	
pH Slope and Offset values reset to Ideal mV Slope and Offset values reset to Factory Calibrated Values pH Manual Offset reset to 0 mV Manual Offset reset to 0 Temperature Manual Offset reset to 0 Without TC, Default 25oC or 77oF	Range Mode [-] OFF Range Mode Lo mV reset to -999 mV Range Mode Hi mV reset to 999 mV Range Mode Lo pH reset to 0.00 Range Mode Hi pH reset to 13.99 Hold Mode HLd Lr Limit Mode O.r. OFF Clean Probe Timer C.P. OFF

Sensorex Smart Transmitter TX100 Factory Reset Sub Menu

Description: Performs Factory reset of all parameter to factory settings



Factory Reset Button

- Step 1. Disconnect power. Press and hold "R2F" button on circuit board.
- Step 2. Reconnect power and continue holding "R2F" button on circuit board.
- Step 3. Release "R2F" button. Main display reads "r2F" and minor display flashes "OFF".
- Step 4. Press Up or Down arrow to turn ON factory reset. Minor display flashes "ON".
- Step 5. Press to accept reset to "ON". Screen will show 4 dashes from left to right then return to normal operation.

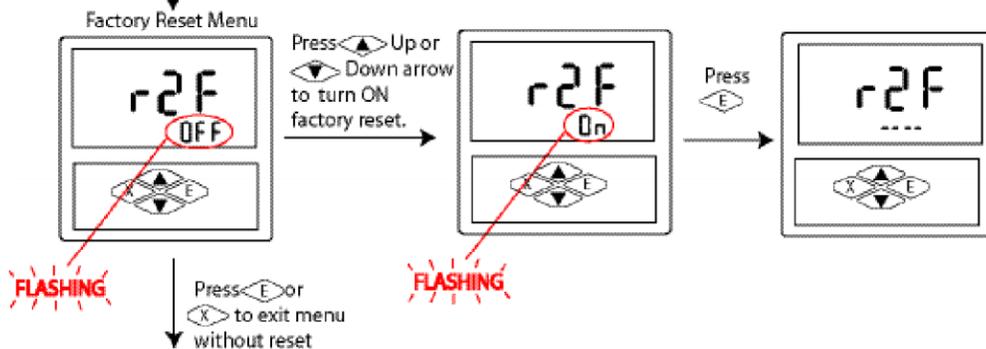


Figure 9.7

9.8 Manual Temperature Compensation

This menu allows the user to set the temperature displayed on the screen (when a temperature sensor is not attached) for temperature compensation.

Sensorex Smart Transmitter TX100 ATC Temp Sub Menu(With NO ATC Connected)

Description: Performs Temperature Adjustment with ATC "ON"

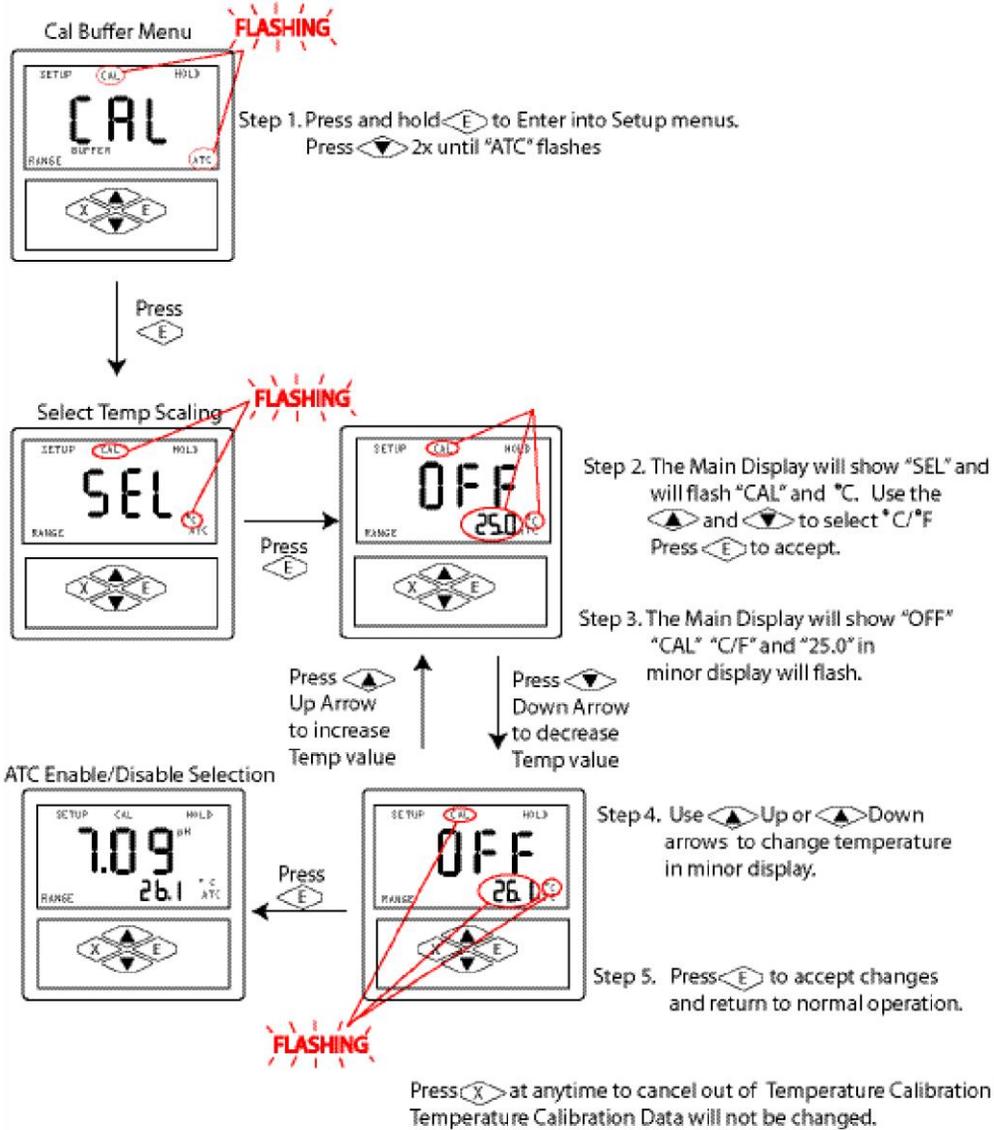


Figure 9.8

the system. During any troubleshooting process, it will save time if the operator can first determine if the problem is related to the transmitter, electrode, or some external source. Therefore, this section is organized from the approach of excluding any likely external sources, isolating the transmitter, and finally isolating the electrode. If these procedures still do not resolve the operational problems, any results noted here will be very helpful when discussing the problem with the factory technical support group.

10.2 Troubleshooting Guidelines

To begin this process, review the connections of the system to all external connections:

1. Verify the proper power input is present (12-24V DC, 8 amp maximum). Ensure the loads on the 4-20 mA outputs do not exceed the limit (See Section 4.2) .
2. Do not run sensor cables or analog output wiring in the same conduits as power wiring. If low voltage signal cables must come near power wiring, cross them at 90° to minimize coupling.
3. Check for possible ground loops. High frequency sources of electrical noise may still cause erratic behavior in extreme conditions. If readings are very erratic after wiring has been checked, check for a possible AC ground loop by temporarily moving the sensor to a sample of solution in a beaker or other container.

10.3 Troubleshooting Chart TX100

Symptom/Problem	Possible Cause(s)	Solution
Display Not Working	1) Power not connected 2) Power connections loose 3) Power connections reversed (reverse polarity)	1) Connect Power (see Section 4.2) 2) Tighten connections. Press removeable power terminal block tightly into receptacle. 3) Reconnect power supply in correct polarity (see Section 4.2)
"Buffer Err" displayed	1) Wrong buffer used 2) Buffer value is more than 1.5 pH units away from calibration buffer value. 3) Input voltage (mV mode) is out of +/- 2000mV range	1) Make sure to calibrate in order, 7.00 or 6.86 first, then the 2nd buffer next (4.01 or 9.18 or 10.00). 2) Check to make sure correct buffer is used. If correct, electrode may be defective. Refer to electrode instructions for assistance. 3) Possible electrode problem. Replace electrode and check again. Return transmitter to Factory Settings. Refer to Section 9.7.
"--" displayed	Various	Return transmitter to Factory Settings (RTF) Refer to Section 9.7

Part 11 Maintenance

11.1 Overview

The TX100 pH/mV transmitter needs little routine maintenance. The calibration of the transmitter should be

checked periodically. To recalibrate the TX100 and electrode, see Part 8.

11.2 Replacement Parts

Replacement parts for the TX100 are available as a kit. This is the same kit that is in the TX100 box. For individual parts, please contact the factory.

11.2.1 Wall Mount Parts

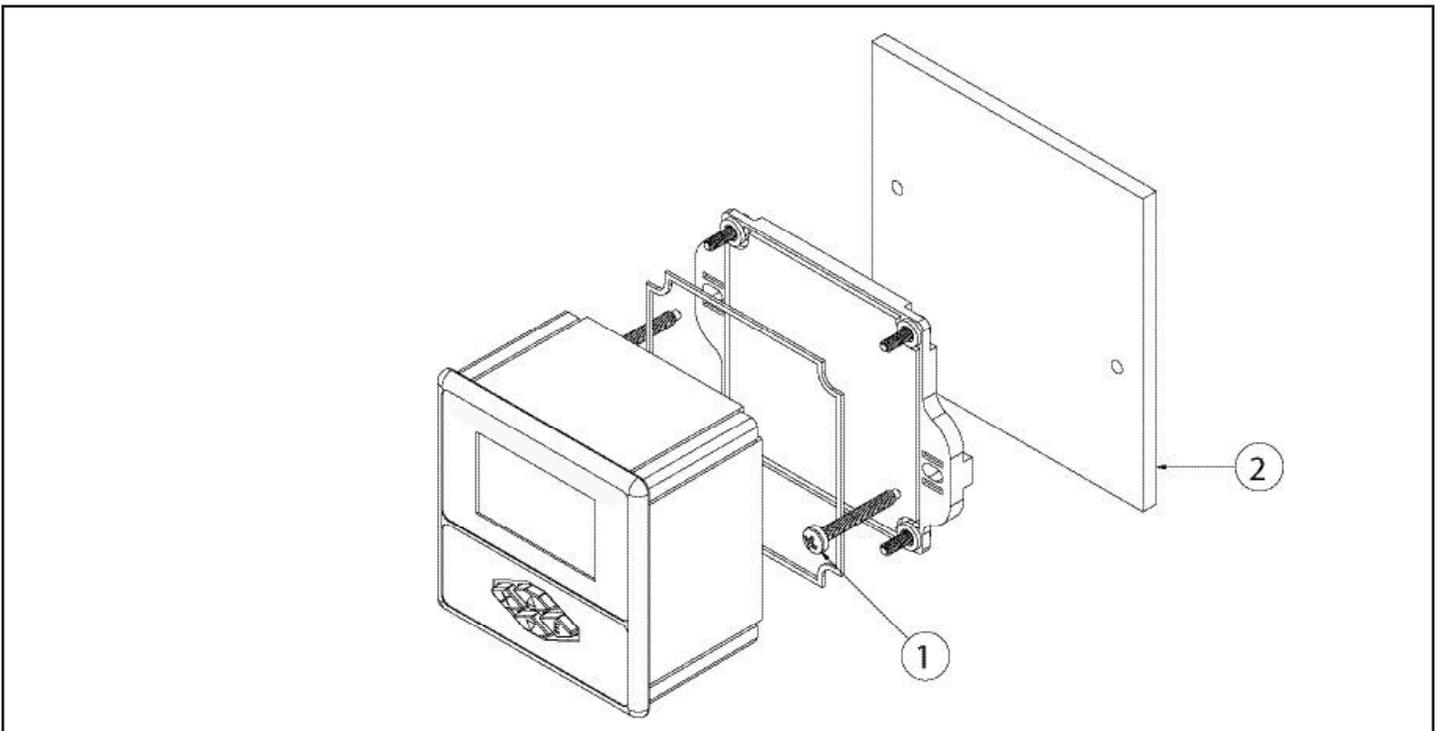


Figure 11.1

WALL MOUNT PARTS

Location in Fig 11.1	Qty in kit	Part Number	Description
1	0		No. 10 Self-tapping screw, 2 inches(customer supplied)
2	0		Wall (customer supplied)

11.2.2 Panel Mount Parts

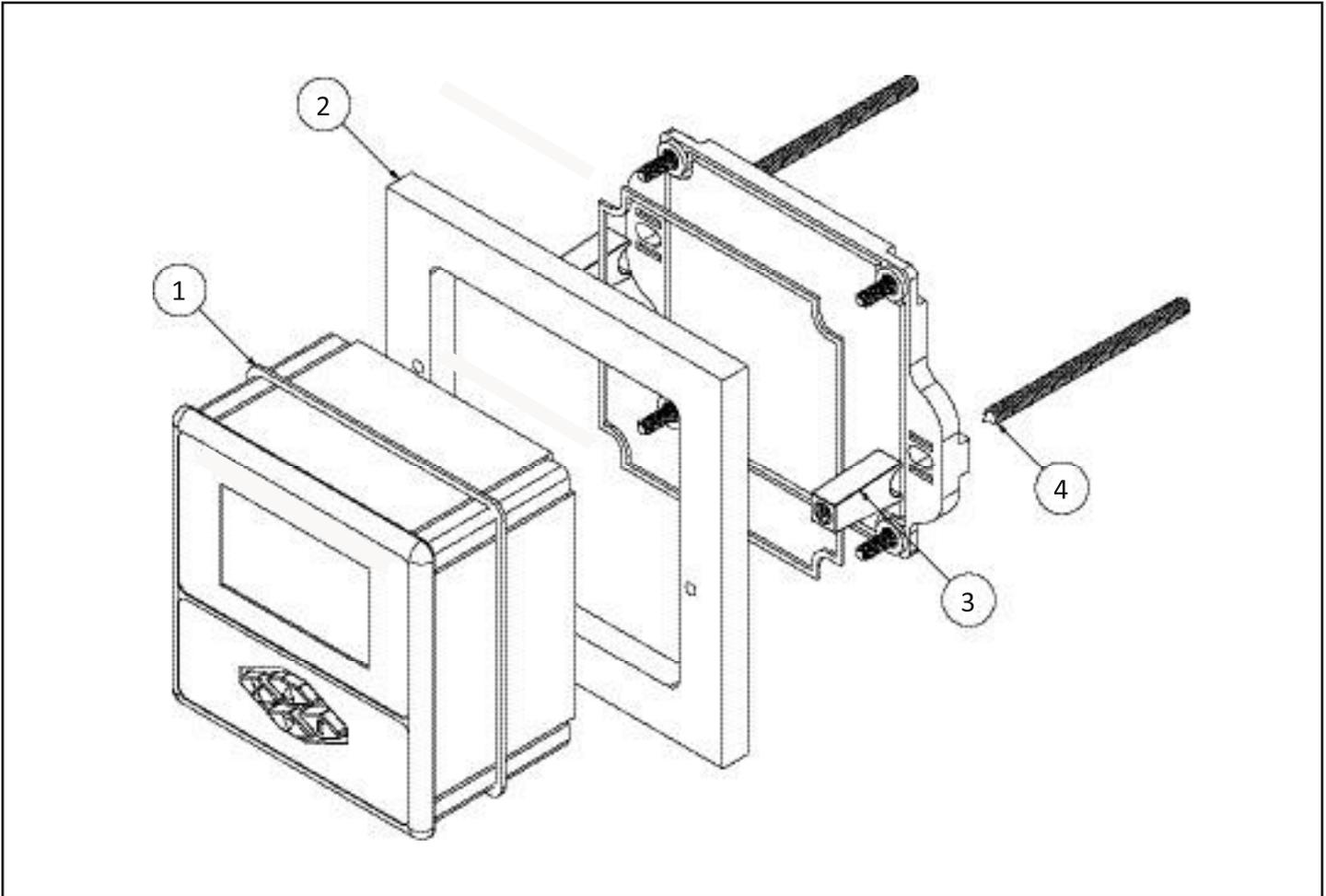


Figure 11.2

PANEL MOUNT PARTS

Location in Fig 11.1	Qty in kit	Part Number	Description
1	1	171121	gasket, panel seal
2	0	N/A	panel cut out (customer supplied)
3	2	171094	Panel mount bracket, plastic blue
4	2	271064	Threaded rod for panel mount

11.2.3 DIN Rail Mount Parts

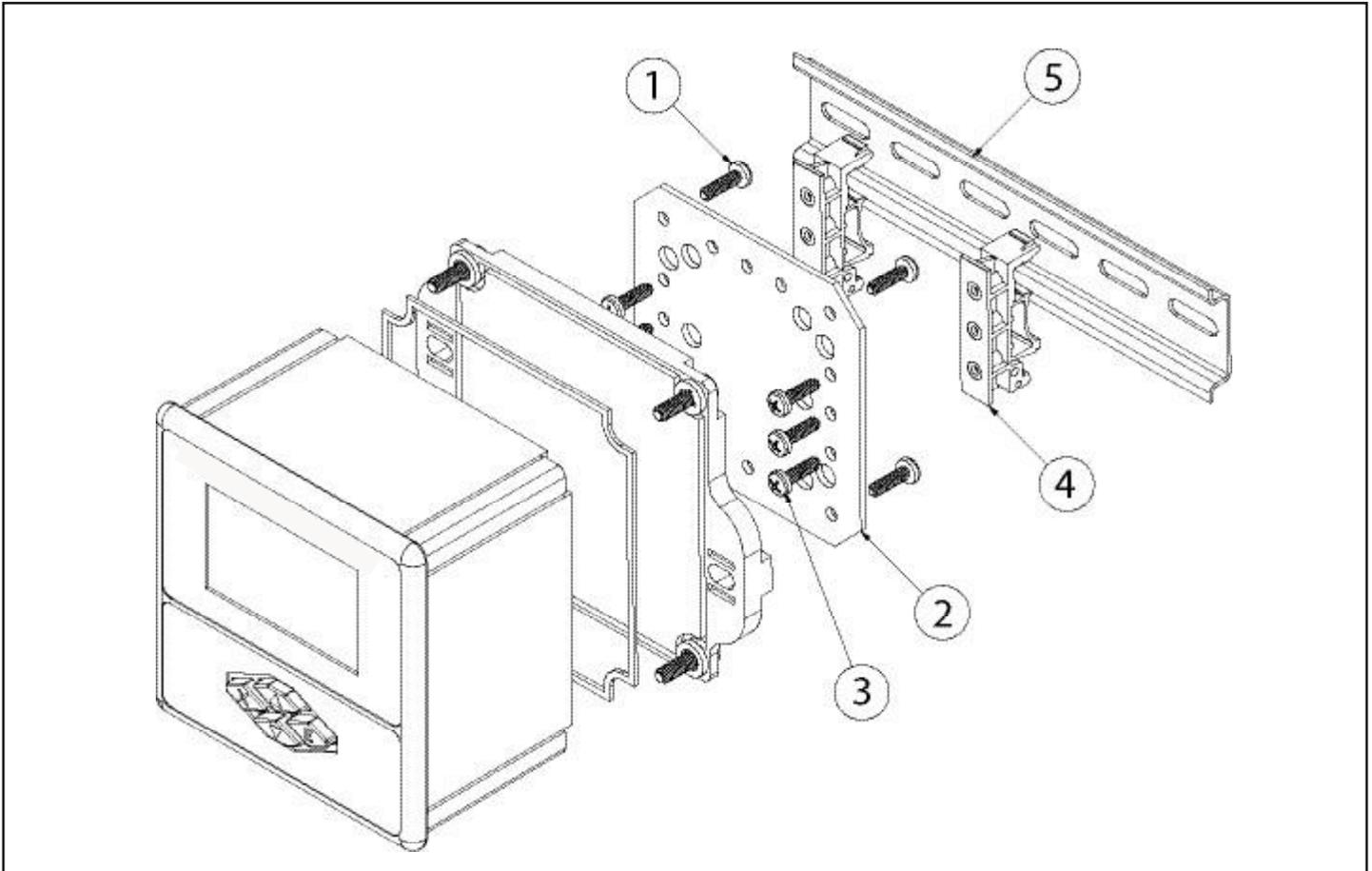


Figure 11.3

DIN Rail MOUNT PARTS

Location in Fig 11.1	Qty in kit	Part Number	Description
1	4	271067	Screws for mounting plate
2	1	171090	Mounting plate
3	6	271067	Screws for DIN rail clamp mounting
4	2	271073	DIN-rail clamp
5	0	N/A	DIN-rail (customer supplied)

11.2.4 Pipe Mount Parts

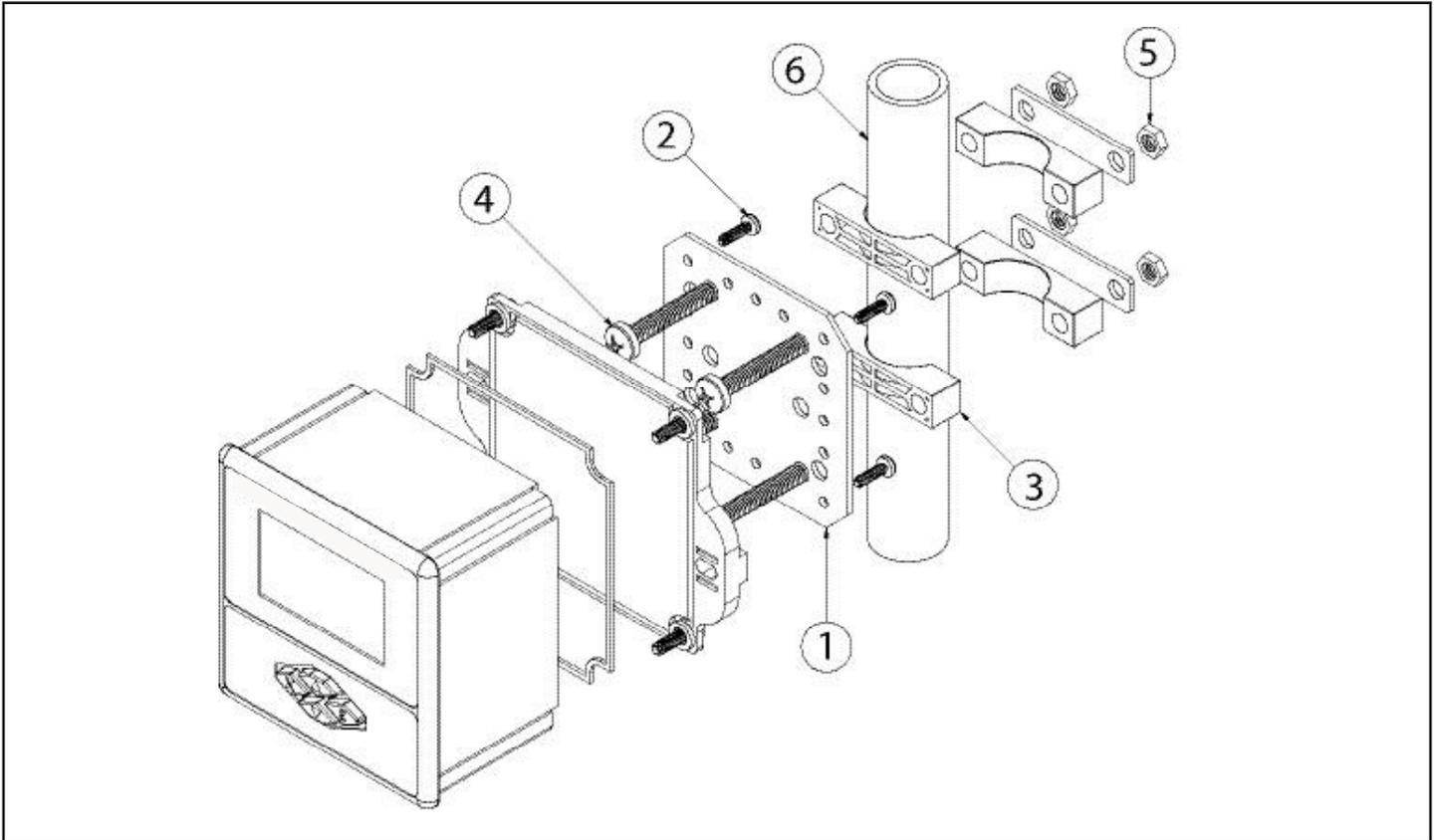


Figure 11.4

PIPE MOUNT PARTS

Location in Fig 11.1	Qty in kit	Part Number	Description
1	1	171090	Mounting plate
2	4	271067	Screws for mounting plate
3	4	171095	3/4" Pipe mount brackets, blue plastic
4	4	271068	Philips head bolt for mounting brackets
5	4	271071	Nut for mounting bracket bolt
6	0	N/A	3/4" pipe (customer supplied)
7	2	171091	3/4" pipe mounting plate/backing

Part 12 Warranty and Product Returns

12.1 Warranty

The TX100 pH/mV transmitter is supplied with a one-year warranty for material and workmanship from date marked on the product. However, SENSOREX offers no warranty, either expressed or implied, as to the useful

life of the product. There are no implied warranties of merchantability or fitness for a particular purpose given in connection with the sale of any goods. In no event shall SENSOREX be liable for consequential, incidental or special damages. The buyer's sole and exclusive remedy and the limit of SENSOREX's liability for any loss whatsoever shall not exceed the purchase price paid by the purchaser for the product to which claim is made. A warranty card is included with this TX100 pH/MV transmitter instruction manual. Please complete it and mail or fax to Sensorex.

Sensorex Corporation
Attn: Warranty/ Returns Department
11751 Markon Drive
Garden Grove, CA. 92841 USA
fax: 714-895-4344

12.2 Return of Items

If repair is necessary and is not the result of misuse, contact Sensorex for a Return Goods Authorization Number (RGA#). No product returns will be accepted without prior authorization. You will be asked for the serial number of the transmitter and a description of the failure. Customers are responsible for incoming freight charges on returned products. Sensorex will pay all outgoing freight charges on warranted returns. If, after evaluation, the product is deemed damaged due to misuse, you will be contacted regarding repair charges.

Warranty Registration



www.sensorex.com

Product / Model No. : _____

Serial No. : (located on label on side of

--	--	--	--	--	--	--	--

transmitter)

Date of Purchase. :

--	--	--	--	--	--	--	--

DDMMYYYY

SOLD
BY:

Title: _____ First Name: _____ Last Name/Surname: _____

Address: _____

City: _____ State: _____ Zip/Postal Code: _____ Country: _____

Telephone: _____ Fax: _____ E-mail: _____

Warranty Terms and Conditions

1. Please complete the warranty card and fax to 714-894-4839 within 30 days of purchase.
2. The Warranty shall become void if any unauthorized repair, tampering or alteration is done on to the product.
3. Do not remove or alter the serial number on the product. This will again void the warranty.
4. The owner of the product must present a copy of this warranty card to request RGA service.
5. The Warranty does not cover:
 - a) Accessories, consumable items, wear and tear parts, corrosion, rusting or stains
 - b) Incoming shipping cost when sending product in for repair
 - c) Use of wrong electrical supply/voltage
 - d) Dropping or other impact
 - e) Use not in accordance with product manual
6. SENSOREX warrants all products to be free of defects in materials and workmanship for one year from date marked on the product or based on the serial number. However, SENSOREX offers no warranty, either expressed or implied, as to the useful life of these products. There are no implied warranties of merchantability of fitness for a particular purpose given in connection with the sale of any goods. In no event shall SENSOREX be liable for consequential, incidental or special damages. All responsibilities for items not provided in this box (software, monitors, electrodes or power supplies) are not the responsibility of Sensorex. The buyer's sole and exclusive remedy and the limit of SENSOREX's liability for any loss whatsoever shall not exceed the purchase price paid by the purchaser for the product to which claim is made.

NOTES:

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E-mail: info@sensorex.comwww.sensorex.com

Form: INSTRTX100-RevG

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