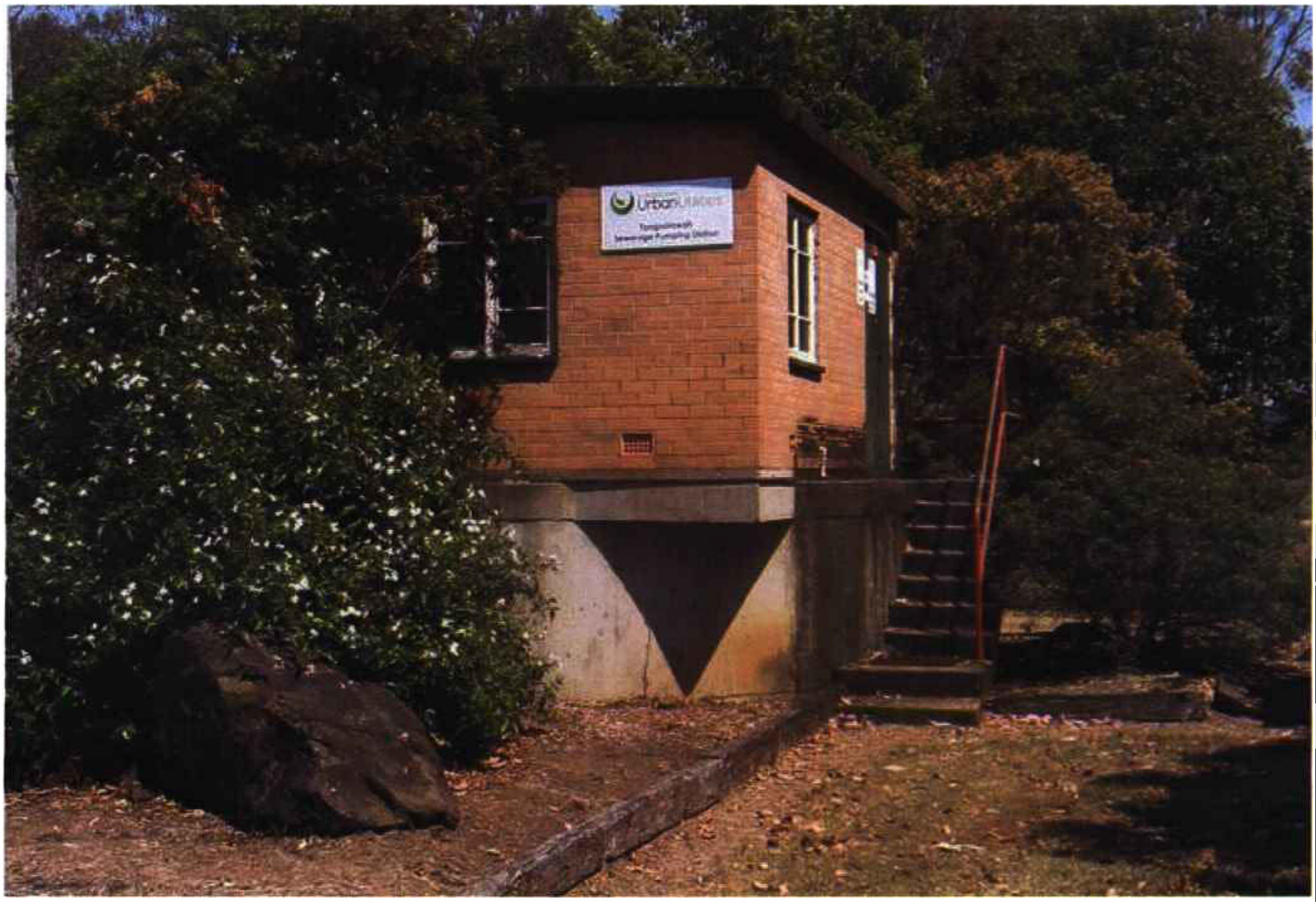
QUEENSLAND UrbanUtilities

Toogoolawah Brisbane Valley Highway Pump Station SP385



Pump & Flow Meter Manual

Client: Aquatec-Maxcon

Attention: Mr Matthew Xiu

Your Reference: Purchase Order No. - 060294

Date: 28th March 2013

REPORT NO: 4212-1473_Q_REV5

WET WELL - TOOGOOLAWAH PUMP STATION

DETERMIANTION OF DURABILITY CHARACTERISTICS OF THE REINFORCED CONCRETE WALL ELEMENTS TO THE WET WELL OF THE TOOGOOLAWAH PUMP STATION

Robert Bell
Principal Civil Engineer

Corporate Signatory

Arthur Austin
Principal Scientist

Assisting: Arthur Austin
Principal Scientist

Supervising Consultant: Robert Bell
Principal Civil Engineer

Revision schedule					
Rev no	Date	Description	Prepared by	Reviewed by	Approved by
1	18/1/2013	4212-1473_Q_Rev1	RB	RB	
2	1/2/2013	4212-1473_Q_Rev2	RB	RB	
3	5/2/2013	4212-1473_Q_Rev3	RB	RB	
4	22/2/2012	4212-1473_Q_Rev4	RB	RB	
5	28/3/2013	4212-1473_Q_Rev5	RB	RB	

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INTRODUCTION

This report addresses the durability aspects of the reinforced concrete sewer sump structure about the "wet well" of Toogoolawah pump station. This study follows discussions between the writer and Mr Matthew Xui and the instructions on site.

ALS Industrial (ALSI) was appointed on the 14th December 2012 in terms of the scope of works agreed on that day between the writer and Mr Matthew Xui (representing Aquatec-Maxcon).

ALS was appointed to undertake an investigation into selected the durability characteristics of the concrete elements of the "wet well", specifically the structural wall. The testing was to include:

- Compression strength on a single core.
- Carbonation assessment of the concrete in three cores taken.
- Determination of the chloride contamination profile into the concrete from a single core.
- Determination of the sulphate contamination profile into the concrete from a single core.
- Survey of the cover characteristics of the concrete over reinforcing.
- Determination of the concrete thickness of the outer wall element.

The site is located in the town of Toogoolawah in Queensland. The works on site was undertaken on the 17th December 2012.

CONCLUSIONS

The testing conducted on the "wet well" of the Toogoolawah pump station focused on the specific areas of:

- Assessment of the durability status of the reinforced concrete structural wall.

An assessment into the durability characteristics of the reinforced wall element was undertaken by using the following techniques:

- Removal of core samples (extracted by others).
- Compression testing on a single core sample to determine the concrete strength.
- Undertaking concrete cover to reinforcement surveys to assess the protective layer to the bar as well as assess the influence of contaminant ingress with specific reference to chlorides and carbonation.
- Chemical analysis of the concrete samples to determine the chloride and sulphate contaminants at incremental depths into the concrete.
- Assessment of the ingress of carbonation into the concrete via phenolphthalein testing.
- Assessment of the thickness of the wall element via impact echo techniques.

The testing undertaken and the conclusions of this study reveal the following:

- The strength of the concrete in the wall element is considered to be high with a value in the region of 57MPa.
- There is no carbonation evident and the concrete is considered to be dense, well compacted and of good quality.
- The contaminant levels by way of chlorides and sulphate is low and well below levels that would present durability concerns.
- The cover to rebar is held to be good with no bar assessed as being within 40mm from the surface.
- The thickness of the element is generally in excess of 270mm with some locations indicating readings in the region of 300mm.
- There is an amount of erosion of the cement paste about the internal surfaces of the well that is visually obvious. Although this is not part of the investigation brief, it is noted that this loss is limited to the initial approximate 5mm with no observable loss of main aggregate.

TEST PROGRAMME

The test programme for the diagnostic investigations involved:

1. Durability assessments of the reinforced concrete suspended slab.

With regard to the investigation into the durability of the reinforced concrete wall element of the "wet well", the testing included:

- Core sample extraction
- Carbonation measurements of the extracted cores
- UCS (Unconfined compressive stress) on a single core samples.
- Chemical analysis of the concrete matrix to identify chloride and sulphate contamination.
- Impact echo assessment of the wall element thickness.
- Concrete cover over reinforcement survey.

TEST SET-UP

The test locations was within the "wet well" in the region of half way down. The access ladder platform was used to allow for access to the specified test location of the wall.

- The concrete testing required the initial mapping of reinforcement in the wall to avoid severing the bar in the coring operation where required. In one location it was required that a bar be severed for inspection purposes.
- Three cores were removed from the well internally for the purposes of further inspection and analysis.
- Cores were sliced into segments to isolate depth increments into the wall and conduct chemical analysis tests. This was to determine the levels of chlorides and sulphates.
- The remainder of the concrete testing procedures were non-destructive. Carbonation test were undertaken on the extracted cores by applying a phenolphthalein indicator solution onto the freshly broken concrete and measuring the thickness of the carbonated band.
- The unconfined compressive strength tests were obtained from the extracted cores.
- The element thickness was determined by non-destructive impact-echo techniques.
- The concrete cover survey was undertaken by data-logging the bar spacing and cover with a ferroscan eddy current instrument.

TEST PROCEDURE

The testing procedure commenced with the scanning of the wall surfaces with a Ferroscan (eddy current instrument) to identify the location of imbedded reinforcement. This was for the purposes of avoiding severing the bar in the subsequent coring works where required.

Coring was undertaken in the selected 3 locations by setting up a standard Hilti coring rig on the vertical surfaces and cutting cores to an approximate 150mm depth from the surface.

The carbonation was measured on the cores extracted. This was done by applying a phenolphthalein indicator onto the freshly cut surface to determine the depth to which acidic gasses (typically carbon dioxide) had migrated into the concrete. The indicator will register a crimson colour where the concrete matrix is alkaline. The loss of concrete alkalinity renders the imbedded reinforcement susceptible to corrosive degradation.

The element thickness was determined by non-destructively with an impact-echo instrument.

UCS (Unconfined compression strength) was determined by testing an extracted core in a press. This was conducted after the site works at an independent laboratory.

Chemical analysis on the depth increments into the concrete was achieved by cutting the core samples into 15mm thick slices. This was then pulverised and tested in the ALS Minerals laboratory for the presence of total chloride contaminants via the "volhard" acid digestion method as well as sulphates. The results were graphed from the increments tested at 0 to 15mm, 15 to 30mm and 45 to 60mm.

The concrete cover over reinforcement was assessed with the use of a ferroscan eddy current meter. This is able to identify the depth of the bar in the concrete and record the distance between bars. The scanning unit is wheeled across the surface in a series of lines to determine the cover characteristics of the bars. The readings are data logged and then transferred into a survey software package to allow for analysis. The presence of chloride contamination and carbonation can then be superimposed onto the plots to determine the imbedded bar that is located in compromised concrete.

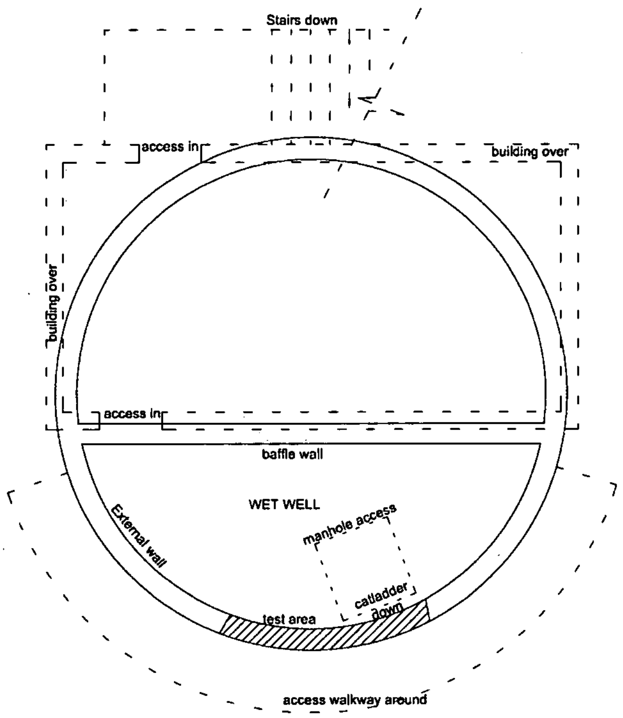
TEST RESULTS AND DISCUSSION

The results from the analysis are presented in the appendices that follow. In summary the following may be noted.

- A visual assessment of the structure was undertaken and the following conclusions were made:
    - There was a notable degree of surface erosion of the cement paste and fines about the main aggregate on the <u>internal</u> concrete surfaces within the wet well. There was variability in the degree of erosion; one may review figure 4 and 7 to visually note areas on the wall and soffit of the suspended slab where the exposed aggregate is not readily visible, and other areas where it is obvious. It was generally concluded that approximately 50% of the area was surface eroded in the region of 5 to 10mm.
    - There was no erosion on the external surfaces which displayed marginal surface friability. Refer to figure 1.
    - The visual assessment classified all elements (outer wall, central baffle wall, suspended slab over the well) as being in comparable condition. It must be noted that the floor elements were not able to be inspected. It was thus held

that the data gleaned from the testing undertaken would equally apply across the structure generally.

- The area selected for testing purposes is indicated in the sketch below .



- The location and number of cores were taken as per instructions on site.
  - A total of 3 cores were taken.
  - All cores were taken from within the Wet Well. The coring and the repairing of the core holes on completion was done by others.
  - The location of the cores was on the curved outer wall section as accessed from the cat ladder platform.

    The core locations may best be described as 3 meters down from the manhole access into the wet well on the southern side.

- The concrete to reinforcement cover is presented in Appendix A by way of a surface contour plot. This identifies reinforcement within 30mm of the surface which is coloured "red" to indicate poor cover. The reinforcement that is located between 30 & 40mm is coloured "orange" to signify marginal to acceptable cover. Finally the reinforcement that is greater than 40mm from the surface is coloured "green" to signify acceptable. In addition the depth of carbonation is superimposed on the contour plots to allow for a visual appreciation of the reinforcement that is in carbonated concrete.

- It may be noted that the reinforcement is primarily in good cover. Refer to the surface plot contained in Appendix A. This is in excess of 40mm. Generally one would expect to find reinforcement at some location in any structure that is in poor cover (i.e. within 30mm from the surface). This may be the case in locations outside of the areas surveyed. It is however assumed that there is generally good protective cover over the reinforcing in the "wet well".

- Reviewing the data the minimum readings was found to be 56mm cover, the maximum was 104mm. The average bar cover was found to be 71mm.

- The bars read were the vertical reinforcement

- In reviewing the drawings to hand it is noted that the horizontal bars are placed outside (closer to the concrete surface). The horizontal bars are thus 12mm cover variation form the vertical bars measured, i.e. ranging from 44 to 92mm with an average of 59mm. This is held to be within good cover parameters.

- There was no ingress of carbonation detected and consequently there is no indication of this on the contour plot presented in the Appendix A.

• The size of the reinforcing was determined by physical examination of the extracted core samples where a bar was intentionally cut.

  - Refer to figure 11 in the appendix to view the reinforcement.

  - The bars were marked up on the wall by ALS and the coring undertaken by others on the instruction of Aquatec Maxcon

  - The bar within the core was found to be a 12mm in diameter round bar. This is assumed to be a link or distribution bar (i.e. horizontal bar). This finding confirms the drawing which notes 12 mm bars in both horizontal and vertical orientations.

• The spacing of the reinforcing was determined via datalogging the readings from the ferroscan instrument. This is able to record the concrete cover to the bar and the centres between bars.

  - The reinforcement spacing was found to be very erratic and it is difficult to state the bar centres. The scan was undertaken on the vertical bars.

  - On average the vertical bars were at 120mm centres. The drawing noted the bars were to be at 250mm centres. It is thus taken that the bars, although erratically placed, are generally better than required by the specification.

  - The minimum bar spacing of the vertical bars was found to be 60mm and the maximum was found to be 285mm.

  - The bars seen in the core in figure 11 are likely to be lapped bars rather than implying bar centres. This core was taken internally.

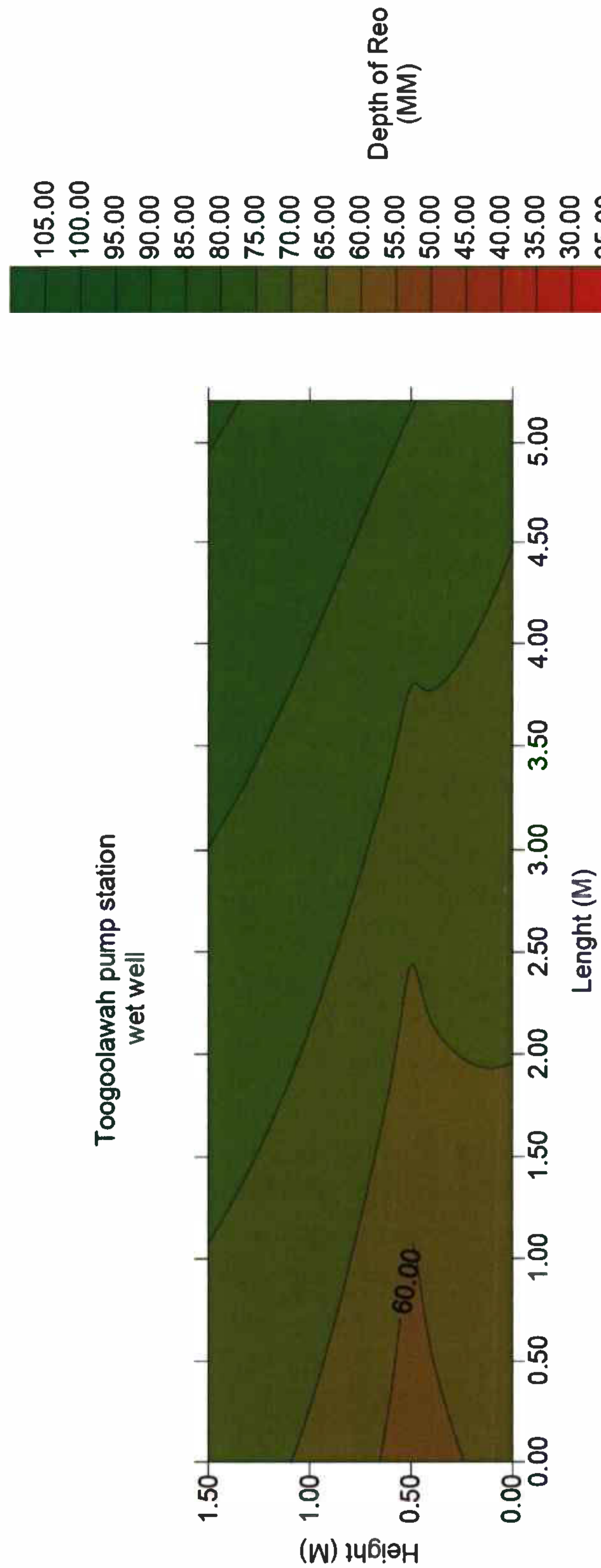
- The chloride and sulphate contamination analysis results are contained in Appendix B. This is graphically presented in by way of a profile into the concrete from the surface. This allows for an appreciation of the contamination concentration at incremental depths into the concrete. Associated with the chloride contamination profile is a corrosion threshold line on the graph to indicate the corrosive stability of the area.
    - The results of the chemical analysis identifying the chloride contamination is low and significantly below the known corrosion threshold.
    - The sulphate levels are not considered to present concerns. This was found to be in the region 0.2% about the surface and marginally less than 0.15% consistently at deeper increments into the concrete (0.12% at about 30mm and 0.13% about 60mm). There is an amount of sulphate reducing bacteria type attack of the cement paste that is expected in this environment. Visual indications would confirm this to have occurred to a limited degree as there is a marginal loss of cement paste and fines about the surface. This is however considered to be confined to the surface and not to compromise the internal reinforcement.
- The concrete strength were assessed and the results are contained in Appendix C. This is presented by way of a table indicating the corrected unconfined compression strength (UCS).
    - The results of the UCS show the concrete strength to be reasonably high with a recorded value of 57 MPa.
- The wall element thickness was assessed as being in excess of 270mm. It is expected that there would be a degree of variability as a result of site controls in setting the formwork. It was found that the thickness did increase to approximately 300mm in areas.
    - The process of determining the element thickness via impact-echo is to take multiple readings at each location over a number of sites. In the region of 22 sites were prepared and approximately two to three readings taken at each site. The results were assessed and averaged to arrive at the above conclusions

APPENDICES

APPENDIX - A

Concrete Cover to Reinforcing

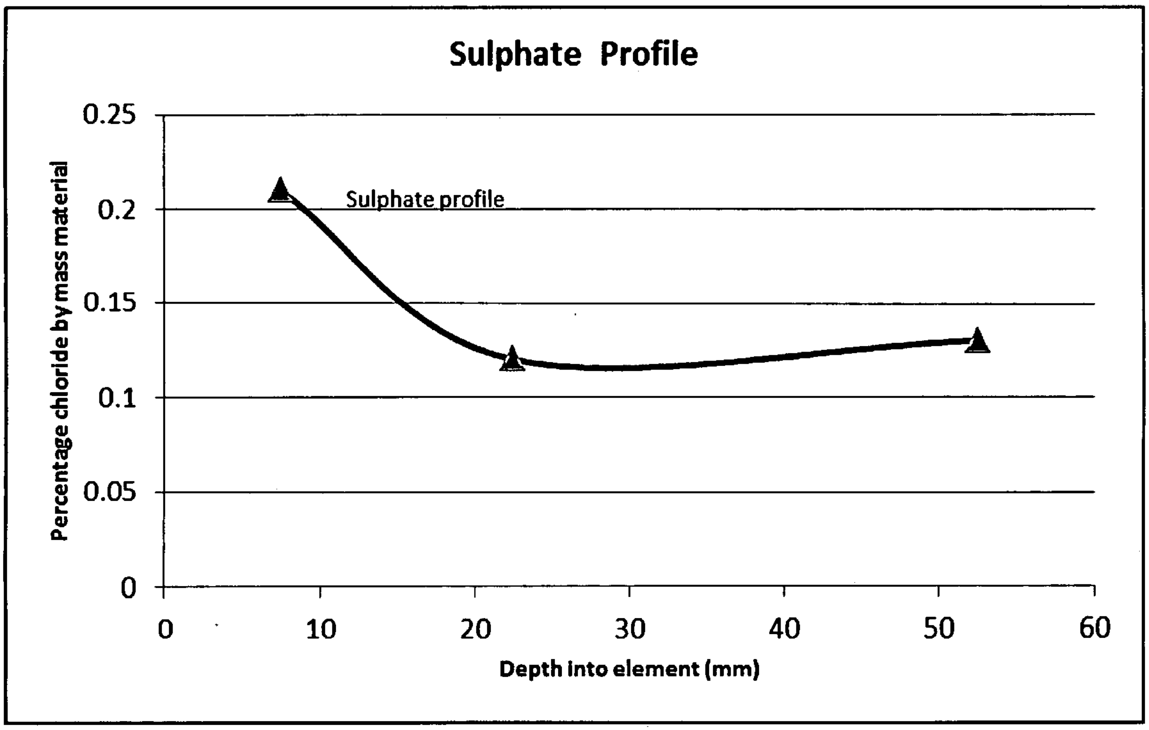
Report No.:4212-1473_R4

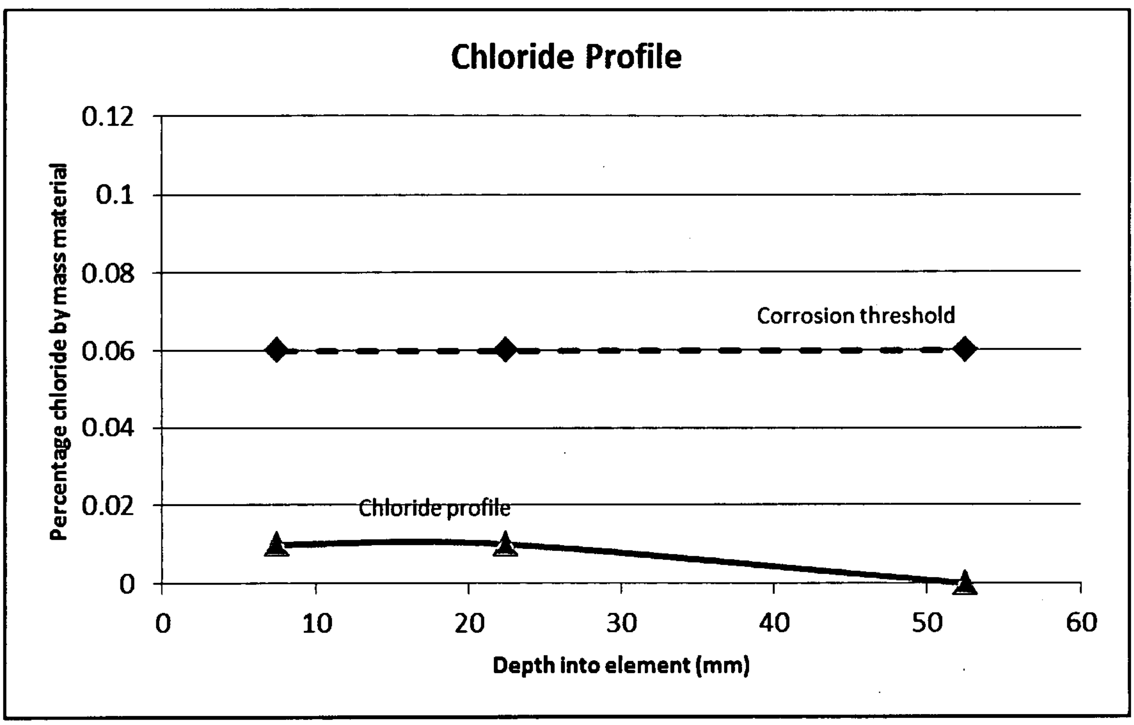


APPENDIX - B

Chloride & Sulphate Analysis

Depth into concrete	Chlorides %	Sulphate %
0 to 15mm	0.01	0.21
15 to 30mm	0.01	0.12
45 to 60mm	<0.01	0.13





Report No.:4212-1473_R4

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Page: 1
Finalized Date: 9-JAN-2013
Account: ETRS

CERTIFICATE BR12295343

Project: 4212-1473
P.O. No.: TBA
This report is for 3 Concrete samples submitted to our lab in Brisbane, QLD, Australia on 20-DEC-2012.
The following have access to data associated with this certificate:
ROBERT BELL

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
LEV-01	Waste Disposal Levy
LOG-22	Sample login - Rcd w/o BarCode
WEI-21	Received Sample Weight
CRU-21	Crush entire sample > 70% - 6 mm
PUL-31	Pulverize split to 85% <75 um
TRA-21	Transfer sample

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
Cl-VOL66	Cl - Volumetric	
S-ICP16	Sulphate S by ICPAES	ICP-AES
ME-OG62	Ore Grade Elements - Four Acid	ICP-AES

To: ALS INDUSTRIAL
ATTN: ROBERT BELL
PO BOX 303
CAROLE PARK QLD 4300

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

Signature:
Shaun Kenny, Brisbane Laboratory Manager

Report No.:4212-1473_R4

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Page: 2 - A
Total # Pages: 2 (A)
Finalized Date: 9- JAN- 2013
Account: ETRS

Project: 4212- 1473

CERTIFICATE OF ANALYSIS BR12295343

Sample Description	Method Analyte Units LOR	Cl- VOL66 Cl % 0.01	ME- OG62 Mg % 0.01	WEI- 21 Recvd Wt. kg 0.02	S- ICP16 Sulphate % 0.01
4212- 1473_2- 15		0.01	0.48	0.12	0.21
4212- 1473_2- 30		0.01	0.42	0.15	0.12
4212- 1473_2- 60		<0.01	0.46	0.13	0.13

APPENDIX - C

Unconfined Compression Stress Tests on Concrete

Report No.:4212-1473_R4

CONCRETE CORE CERTIFICATE

Interim

Prior Reports: None

Certificate Number: CERT130044
Issued: 14, January 2013
Laboratory Sample ID: 13010181 **Mix Code:** IC_130095

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA Accredited Laboratory Number 187

Client:
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Carole Park QLD 4300

Cement Australia
PO Box 1034
Sumner Park QLD 4074
Australia
Telephone: +61 7 3375 0501
Fax: +61 7 3375 0473

The following test results were obtained by the Darra Laboratory for concrete specimens supplied by the client on: 09-Jan-2013

Client Identification: Toogoolawah Pit Sample 3
Date Sampled: Not Provided
Client Report ID: 42121473
Preconditioning: Wet

Notes:
1. Density AS1012.12.1
2. Cap Type Key:
   R - Rubber, G - Grinding, P - Cement paste
3. Compressive Strength to AS1012 Pt 9
4. Indirect Tensile AS 1012 Pt 10
5. Comments added by exception

If the concrete specimens were not sampled by the Darra laboratory, only data relevent to Notes 1 to 5 are covered by this NATA accreditation.

Test Results

Specimen ID	Dimensions Dia.	Height	Density	Conditioning Time	Cap Type	Test Date	Age	Uncorrected Strength	Correction Factor	Corrected Strength	Comments
	mm	*mm*	*kg/m3*	*days*	*Note 2*		*days*	*MPa*		*MPa*	*Note 6*
Toogoolawah Pit Core 3	75	120	2400	3	G	14-Jan-13	n/a	59.4	0.96	57.0	

13 0 0 9 5

C E R T 1 3 0 0 4 4

Approved Signatory

G Polistchuk

Construction Materials Testing

DA-SF-021

APPENDIX - D

Photographs

Report No.:4212-1473_R4

Figure 1: View of the pump station

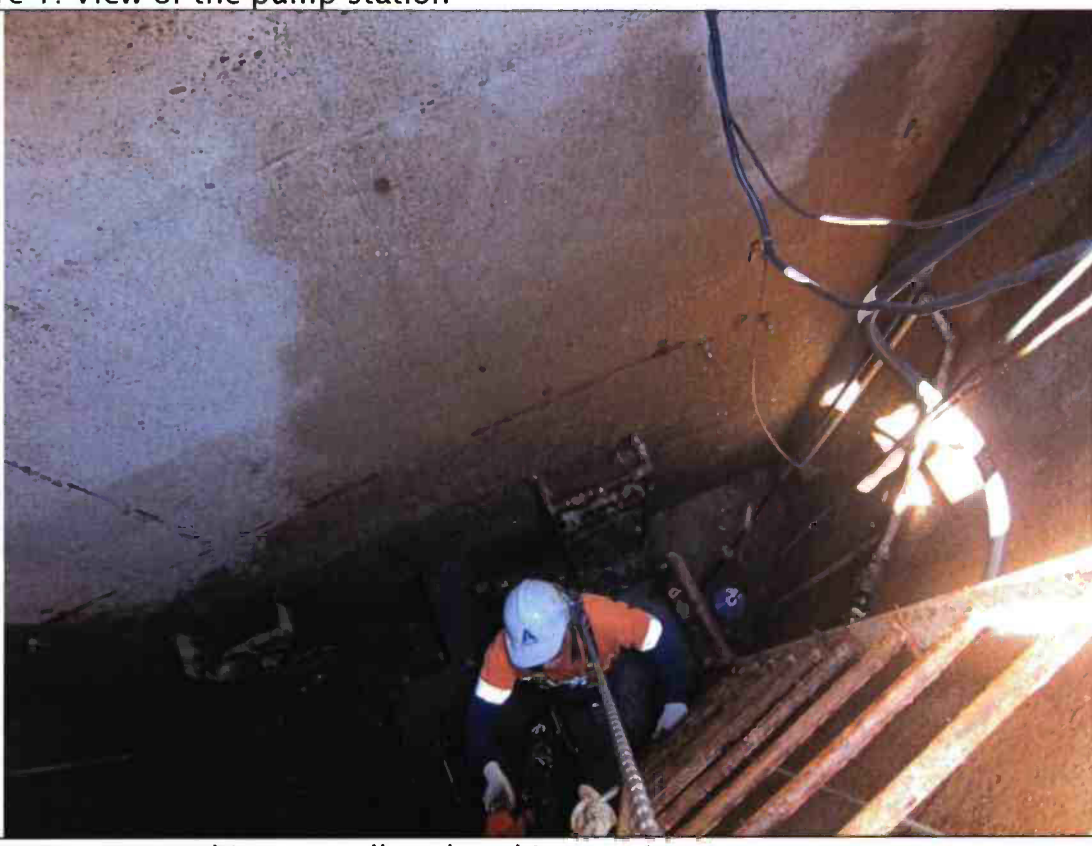


Figure 2: Personnel in wet well undertaking testing

Figure 3: Further view of staff member undertaking cover analysis

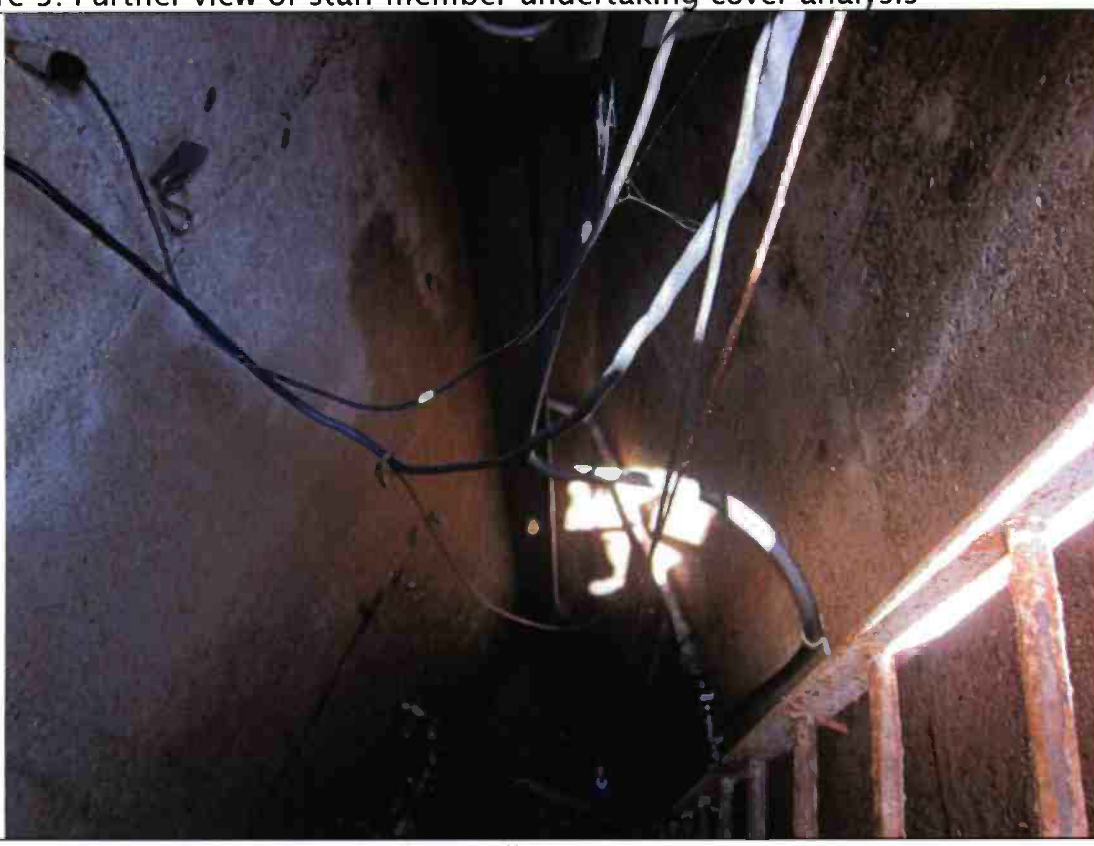


Figure 4: General view into the wet well

Figure 5: Closer view of the surface showing erosion of surface fines

Figure 6: further view of surface from additional perspective, general erosion


Figure 7: Areas of the soffit are eroded as shown


Figure 8: Closer view of the surface where cores were extracted

Figure 9: Further view of the surface where cores were taken

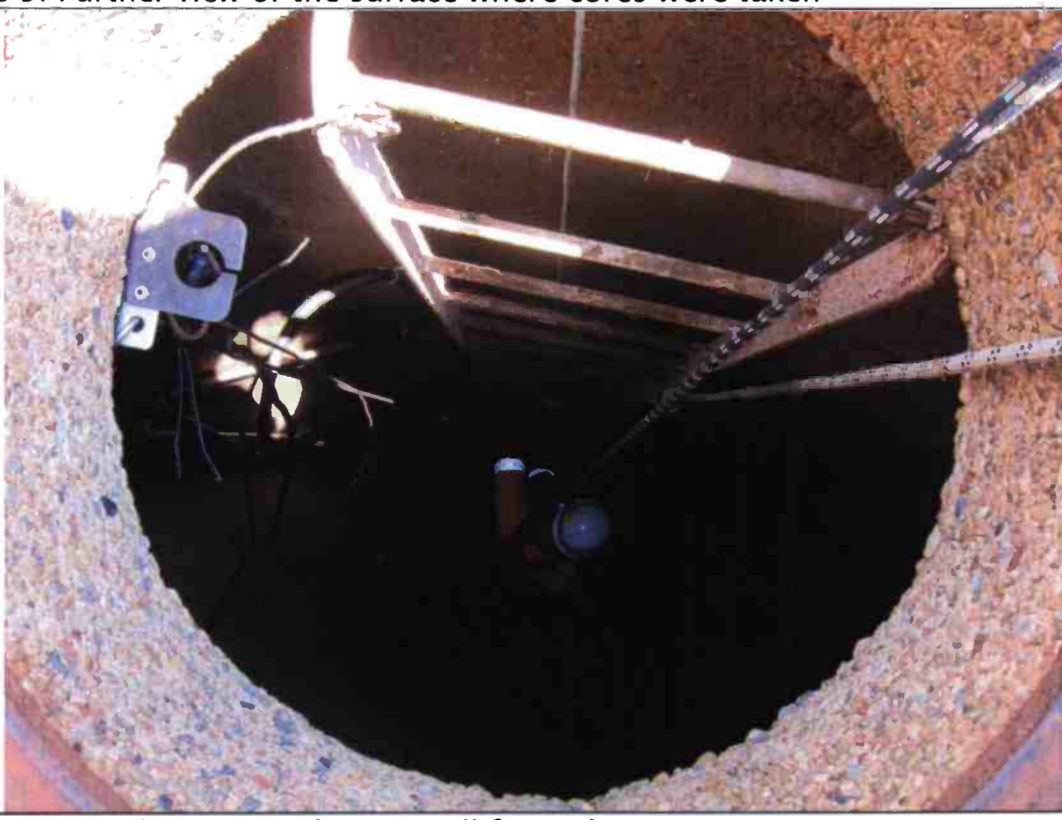


Figure 10: Final view into the wet well from above

Figure 11: Evidence of the reinforcement in the wall eelment

Figure 12: Internal concrete matrix

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Additional documentation for software version 2.01.00

Proline Promag 50/51/53

Scope of validity:
Description of Device Functions Promag 50: BA059D (HART); BA056D (PROFIBUS-DP/-PA)
Description of Device Functions Promag 51: BA081D (HART)
Description of Device Functions Promag 53: BA048D (HART); BA054D (PROFIBUS-DP/-PA); BA051D (FOUNDATION Fieldbus); BA118D (MODBUS)

This document describes the changes and additions that come into effect with the software version V 2.01.00 and replace or supplement the specifications in the documentation concerned.

Function, valid for Promag 53 (HART/PB/FF/MODBUS)	
UNIT DENSITY (0420)	21 = **g/l** is a new option that can be selected for the unit of density (metric).

Function, valid for Promag 53 (HART/MODBUS)	
ASSIGN STATUS INPUT (5000)	In the extended options with the optional BATCHING software package, the following has been added: 27 = **RESET TOTALIZER 3 & START BATCHING** (reset of totalizer 3, followed by start)

Function, valid for Promag 50 (HART/PB) **Function, valid for Promag 51 (HART)** **Function, valid for Promag 53 (HART/PB/FF/MODBUS)**	
EMPTY PIPE DETECTION (6420)	A nominal diameter restriction has been added to the 1 = ON SPECIAL **(for DN <400 only)** Switching on the Empty Pipe Detection (EPD) for remote versions of the device. option.

Function, valid for Promag 50 (HART/PB) **Function, valid for Promag 53 (HART/PB/FF/MODBUS)**	
The following function has been added to the SUPERVISION group (Promag 50) or the SUPERVISION Block (Promag 53):	
PERMANENT STRORAGE (8007)	This function indicates whether permanent storage of all parameters in the EEPROM has been switched on or off. **Display:** 0 = OFF 1 = ON **Factory setting:** ON
The following also for Modbus devices:	
MODBUS register: 6807 Data type: Float Access: Integer read	Caution! ▪ The options in this function can only be changed by the Endress+Hauser service organization. ▪ If the "OFF" option is selected, all the subsequent parameter changes are not stored permanently to the EEPROM. This means, in particular, that these changes are not available after a power failure. The device then starts with the last parameter configuration saved in the EEPROM.
The following also for FOUNDATION Fieldbus devices:	
	Transducer Block "Flow"/ Basisindex 1400
	Parameter: Sys. - Permanent Storage
	Write access with operating mode (MODE_BLK) read only

SD116D/06/a2/11.06
71035085

Valid as of version:
V 2.01.00 (Device software)

Endress+Hauser
People for Process Automation

Füllstand | Druck | Durchfluss | Temperatur | Flüssigkeitsanalyse | Registrierung | Systeme Komponenten | Services | Solutions

Zusatzdokumentation zur Software-Version 2.01.00

Proline Promag 50/51/53

Gültigkeitsbereich:
Gerätefunktionen Promag 50: BA059D (HART); BA056D (PROFIBUS-DP/-PA)
Gerätefunktionen Promag 51: BA081D (HART)
Gerätefunktionen Promag 53: BA048D (HART); BA054D (PROFIBUS-DP/-PA); BA051D (FOUNDATION Fieldbus); BA118D (MODBUS)

Dieses Dokument beschreibt Änderungen und Ergänzungen, die mit der Software-Version V 2.01.00 zum Tragen kommen und ersetzt bzw. ergänzt die Angaben in den betroffenen Dokumentationen.

Funktion gültig für Promag 53 (HART/PB/FF/MODBUS)	
EINHEIT DICHTE (0420)	Bei den Auswahlmöglichkeiten für die Einheit der Dichte (Metrisch) ist neu 21 = **g/l** hinzugekommen.

Funktion gültig für Promag 53 (HART/MODBUS)	
ZUORDNUNG STATUS-EINGANG (5000)	In der erweiterten Auswahl mit dem optionalen Softwarepaket ABFÜLLEN ist neu 27 = **RESET SUMMENZÄHLER 3 & START ABFÜLLEN** (Reset von Summenzähler 3, gefolgt von Start Abfüllen) hinzugekommen.

Funktion gültig für Promag 50 (HART/PB) **Funktion gültig für Promag 51 (HART)** **Funktion gültig für Promag 53 (HART/PB/FF/MODBUS)**	
MSÜ (6420)	Unter dem Auswahlpunkt EIN SPEZIAL ist neu eine Nennweitenbeschränkung 1 = EIN SPEZIAL **(nur für DN <400)** Einschalten der Messstoffüberwachung (MSÜ) für Messgeräte in Getrenntausführung hinzugekommen.

Funktion gültig für Promag 50 (HART/PB) **Funktion gültig für Promag 53 (HART/PB/FF/MODBUS)**	
In der Gruppe ÜBERWACHUNG (Promag 50) bzw. Block ÜBERWACHUNG (Promag 53) ist die folgende Funktion neu hinzugekommen:	
DAUERHAFT SPEICHERN (8007)	Diese Funktion zeigt an, ob das dauerhafte Speichern aller Parameter im EEPROM ein oder ausgeschaltet ist **Anzeige:** 0 = AUS 1 = EIN **Werkeinstellung:** EIN
bei Modbusgeräten zusätzlich:	
MODBUS Register: 6807 Datentyp: Float Zugriff: Integer read	Achtung! ▪ Die Auswahl in dieser Funktion kann nur von der Endress+Hauser Serviceorganisation verändert werden. ▪ Bei der Auswahl "AUS" werden alle nachfolgenden Parameteränderungen nicht dauerhaft im EEPROM gespeichert. Dies bedeutet insbesondere, dass diese Änderungen nach einem Netzausfall nicht zur Verfügung stehen. Das Gerät startet dann mit der zuletzt im EEPROM gespeicherten Parameterkonfiguration auf.
bei FOUNDATION Fieldbus-Geräten zusätzlich:	
	Transducer Block "Flow"/ Basisindex 1400
	Parameter: Sys. - Permanent Storage
	Schreibzugriff bei Betriebsart (MODE_BLK) nur lesbar

SD116D/06/a2/11.06
71035085

gültig ab Version:
V 2.01.00 (Gerätesoftware)

Endress+Hauser
People for Process Automation

Endress+Hauser
People for Process Automation

Flow Calibration with Adjustment
Etalonnage du débit avec ajustement

20477685-1774831

52708650
Purchase order number · Référence de commande

AU-428286-10 / Endress+Hauser Flowtec AG
Order N°/Manufacturer · N° d'ordre/Fabricant

50W1H-S90A1AK4AAAD
Order code · N° commande

PROMAG 50 W DN100
Transmitter/Sensor · Transmetteur/Capteur

980FCB19000
Serial N° · N° de série

-, PRV046-F231
Tag N° · N° de Tag

FCP-7.1.2
Calibration rig · Banc d'étalonnage

39.2699 l/s (≙ 100%)
Calibrated full scale · Valeur finale d'étalonnage

Calibration Interface
Calibrated output · Signal de sortie étalonné

1.2619
Calibration factor · Facteur d'étalonnage

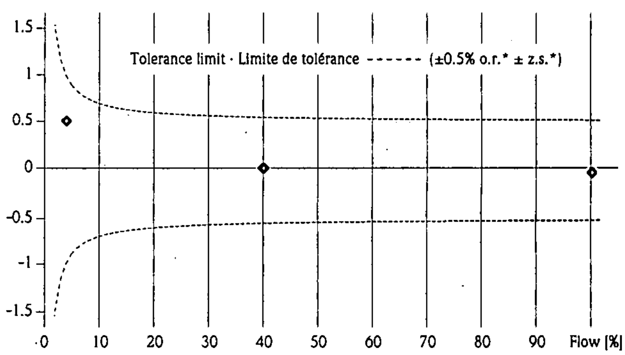
4
Zero point · Point zéro

25.5 °C
Water temperature · Temperature de l'eau

Flow Débit [%]	Flow Débit [l/s]	Duration Durée [sec]	V target V doit [l]	V meas. V mesure [l]	Δ o.r.* Δ d.m.* [%]	Outp.** Sortie** [mA]
4.0	1.59	30.1	47.678	47.921	0.51	4.65
40.0	15.7	30.1	472.653	472.665	0.00	10.40
40.1	15.8	30.1	474.035	474.036	0.00	10.42
100.3	39.4	30.1	1184.93	1184.38	-0.05	20.03
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

*o.r. · d.m.: of rate · de la mesure
**Calculated value · Valeur calculée (4 - 20 mA)

Measured error % o.r.
Déviation de mesure % d.m.



*z.s.: Zero stability · Stabilité du zéro

For detailed data concerning output specifications of the unit under test, see technical informations (TI), chapter Performance characteristics.
Pour les données détaillées sur les spécifications des sorties signal de l'appareil à étalonner, se reporter aux informations techniques (TI), chap. Précision de mesure.

Traceability to the national standard for all test instruments used for the calibration is guaranteed.
Nous garantissons que les instruments de mesure utilisés sur nos bancs d'étalonnage sont raccordés aux étalons nationaux.

Endress+Hauser Flowtec operates ISO/IEC 17025 accredited calibration facilities in Reinach (CH), Cernay (FR), Greenwood (USA) and Aurangabad (IN).
Endress+Hauser Flowtec exploite des bancs d'étalonnage accrédités selon ISO/CEI 17025 sur ses sites de Reinach (CH), Cernay (FR), Greenwood (USA) et Aurangabad (IN).

17.10.2007
Date of calibration · Date d'étalonnage

M. Weinzorn
Operator · Opérateur

Endress+Hauser Flowtec AG
Rue de l'Europe 35 / Kägenstrasse 7
F-68700 Cernay / CH-4153 Reinach

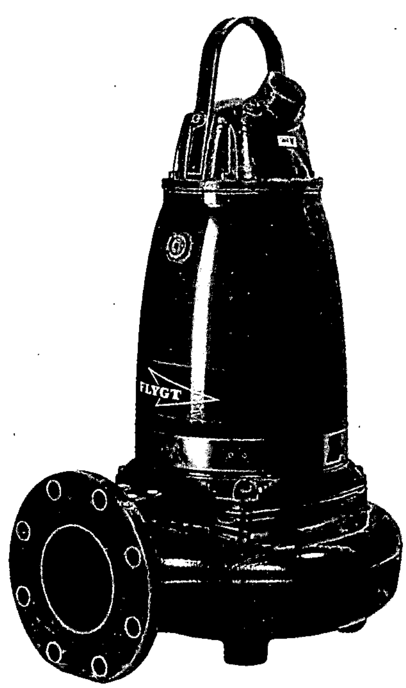
Certified acc. to · Certifié selon
ISO 9001

ITT

Water & Wastewater

Installation, Operation, and Maintenance Manual

Flygt 3153



FLYGT

Engineered for life

Table of Contents

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Introduction and Safety

Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
- Do not change the service application without the approval of an authorized ITT representative.
- Never operate the pump without safety devices installed.
- Never operate the pump with the discharge valve closed.

NOTICE:

For information about how to transport and store the pump, see Transportation and Storage in the Installation, Operation and Maintenance manual.

Safety message levels

Definitions

Safety message level	Indication
DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
Electrical Hazard:	The possibility of electrical risks if instructions are not followed in a proper manner
NOTICE:	• A potential situation which, if not avoided, could result in an undesirable result or state • A practice not related to personal injury

User health and safety

General precautions

The product is designed for use in liquids that can be hazardous to health. Observe these rules when working with the product:

- Make sure that all personnel who work with sewage systems are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.

Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Helmet
- Safety goggles (with side shields)
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection

NOTICE:

The noise level of the product is lower than 70 dB. However, the noise level of 70 dB may be exceeded in some installations and at certain operating points on the performance curve. Make sure that you understand the noise level requirements in the environment where the pump is installed. Failure to do so may result in hearing loss or violation of local laws.

The work area

Observe these regulations and warnings in the work area:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.

Product and product positioning requirements

Observe these requirements for the product and the product positioning:

- Vent the tank of a sewage station in accordance with local plumbing codes.
- Never operate a pump unless safety devices are installed.

Electrical connections regulations

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations.

Observe these guidelines and warnings for electrical connections:

- Make sure that the product is isolated from the power supply and cannot be energized by mistake. This guideline also applies to the control circuit.
- Make sure that the thermal contacts are connected to a protection circuit according to the product approvals, and that they are in use.
- Make sure that the cable and the cable entry have not been damaged during shipping.
- Use only the screened cable when using a variable-frequency drive (VFD). The screened cable is necessary to fulfill European CE requirements. Contact your ITT representative and ask your VFD supplier for electrical limitations. See also VFD recommendation in article no. 893472.

Earthing (grounding)

Observe the following regulations for earthing (grounding) connections.

Earthing (grounding) regulation	Comment
All electric equipment must be earthed (grounded).	This rule applies to pumps and mixers as well as monitoring equipment.

Earthing (grounding) regulation	Comment
The earthing (grounding) conductors must be correctly connected.	Failure to follow this rule could result in a fatal accident.
The earthing (grounding) conductors should always be longer than the phase conductor/conductors.	If the motor cable is disconnected by mistake, the earthing (grounding) conductor needs to be disconnected last from its terminal. This rule applies to both ends of the cable.
Risk of electrical shock or burn. You must connect an additional earth- (ground-) fault protection device to the earthed (grounded) connectors if persons are likely to come into physical contact with the pump or pumped liquids.	—

Precautions before work

Observe these safety precautions before you work with the product or are in connection with the product:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Allow all system and pump components to cool before you handle them.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.
- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- Check the explosion risk before you weld or use electric hand tools.

Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Never lift the product by its motor cable or hose.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

Clean chemicals from the eyes

1. Hold your eyelids apart forcibly with your fingers.
2. Rinse the eyes for at least 15 minutes.

   Use an eyewash or running water.
3. Seek medical attention.

Clean chemicals from the body

1. Remove contaminated clothing.
2. Wash the skin with soap and water for at least one minute.
3. Seek medical attention, if required.

Safety regulations for Ex-approved products in potentially explosive atmospheres

General guidelines

ATEX compliance is only fulfilled when the pump is operated within its intended use, for example within its intended hydraulic range. The conditions of the service must not be changed without approval of an authorized ITT representative. When installing or maintaining ATEX-compliant pumps, follow these guidelines:

- Always install ATEX-approved equipment in compliance with the directive and applicable standards (IEC/EN 60079–14).
- Always install FM-approved products according to ANSI/NFPA 70-2005.

WARNING:

Installation, Operation, and Maintenance manuals clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.

If there are any questions regarding these requirements, the intended use, or if the equipment requires modification, contact an ITT representative before you proceed.

Personnel requirements

ITT disclaims all responsibility for work done by untrained and unauthorized personnel.

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas and/or vapor present in hazardous areas.
- The maintenance operation for Ex-approved products must be made in conformity to the international or national standards (IEC/EN 60079-17).

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data stated on the nameplates.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- See the dimensional drawings of the product for the minimum permitted water level according to the ATEX approval. Level-sensing equipment must be installed if the product can be operated at less than the minimum submersion depth.
- Before you start working with the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that have been provided by an authorized ITT representative.

Equipment for monitoring

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

- Level indicators
- Temperature detectors

Environmental safety

The work area

Always keep the pump station clean to avoid and/or discover emissions.

Recycling guidelines

Always recycle according to these guidelines:

1. If the unit or parts are accepted by an authorized recycling company, then follow local recycling laws and regulations.
2. If the unit or parts are not accepted by an authorized recycling company, then return them to the nearest ITT representative.

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Dispose appropriately of all waste.
- Handle and dispose of the pumped fluid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

Reference for electrical installation

For electrical installation requirements, consult your local electric utility.

Product warranty

Coverage

ITT undertakes to remedy faults in products from ITT under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to an ITT representative within the warranty period.
- The product is used only under the conditions described in this manual.
- The monitoring equipment incorporated in the product is correctly connected and in use.
- All service and repair work is done by ITT-authorized personnel.
- Genuine ITT parts are used.
- Only Ex-approved spare parts and accessories authorized by ITT are used in Ex-approved products.

Limitations

The warranty does not cover faults caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation made without consulting ITT
- Incorrectly executed repair work
- Normal wear and tear

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

ITT products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your ITT representative.

Spare parts

ITT guarantees that spare parts will be available for 15 years after the manufacture of this product has been discontinued.

Transportation and Storage

Inspect the unit upon delivery

Receive the unit

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.

Unpack the unit

1. Remove packing materials from the unit.
   Dispose of all packing materials in accordance with local regulations.
2. Inspect the unit to determine if any parts have been damaged or are missing.
3. Contact your ITT representative if anything is out of order.

Lifting guidelines

General

The following are general guidelines for lifting the unit:

- Always use lifting equipment when handling the unit.
- When you use a lifting eyebolt or shackle for lifting the unit, make sure that the eyebolt or shackle is fastened firmly before lifting.
- The unit can be transported either horizontally or vertically.

Precautions

WARNING:

- The unit might get stuck if it hangs at any angle when lifting or lowering along guide bars. Make sure the unit hangs straight up and down from the lifting hook.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- Do not attach sling ropes to shaft ends.
- Stay clear of suspended loads.
- Always lift the unit by its lifting handle. Never lift the unit by the motor cable or by the hose.

Lifting equipment

The lifting equipment must fulfill the following requirements:

- The minimum height between the lifting hook and the floor must be sufficient to lift the unit out of the sump. Contact ITT for information.
- The lifting equipment must be able to hoist the unit straight up and down in the sump, preferably without the need for resetting the lifting hook.
- The lifting equipment must be securely anchored and in good condition.
- The lifting equipment must support the entire assembly and must only be used by authorized personnel.
- Two sets of lifting equipment must be used to lift the unit for repair work.
- The lifting equipment must be dimensioned to lift the unit with any remaining pumped media (liquid) in it.
- The lifting equipment must not be oversized.

NOTICE:

Oversized lifting equipment could cause damage if the unit should stick when being lifted.

Store the unit

1. After raising the unit, allow it to run for a short time to discharge all remaining pumped media (liquid).
   The unit is frost-proof while operating or immersed in liquid, but the impeller and the shaft seal may freeze if the unit is raised in a temperature below freezing.
2. Store the unit in a covered and dry location free from heat, dirt, and vibrations.
3. If the unit is stored more than 6 months, rotate the shaft every other month to prevent the seals from sticking together.
4. Before operating the unit after storage:

If...	Then...
the unit has been stored more than 6 months	inspect the unit with special attention to the seals and the cable entry.
the impeller is frozen	thaw the impeller by immersing the unit in liquid. **NOTICE:** Never use a naked flame to thaw the unit.

Product Description

Pump design

The pump is submersible, and driven by an electric motor.

Intended use

WARNING:
Only use Ex- or MSHA-approved pumps in an explosive or flammable environment.

NOTICE:
Do NOT use the pump in highly corrosive liquids.

For information about pH, see *Application limits* (page 58).

Spare parts

- Modifications to the unit or installation should only be carried out after consulting with ITT.
- Original spare parts and accessories authorized by ITT are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation. For more information contact your ITT representative.

Pressure class

LT	Low head
MT	Medium head
HT	High head
SH	Super high head

Parts

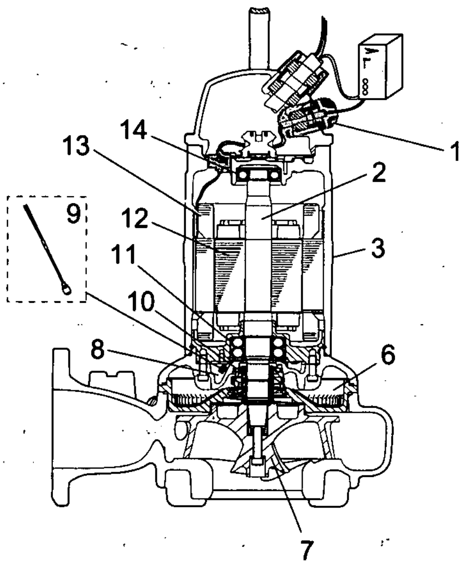


Figure 1: Without cooling jacket

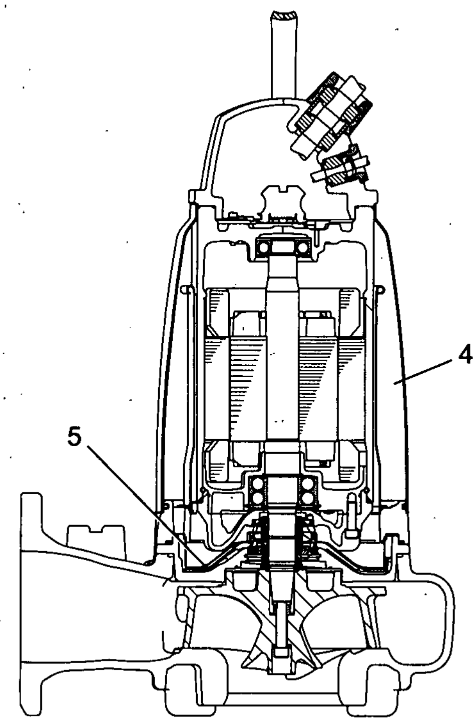


Figure 2: With cooling jacket

Position	Part	Description
1	Monitoring sensor	Optional sensor. For information about sensors, see *Monitoring equipment* (page 13).
2	Shaft	Stainless steel, with an integrated rotor
3	Cooling without jacket	The pump is cooled by the ambient liquid.
4	Cooling with jacket	The motor is cooled by a closed loop system. An integrated coolant pump circulates the coolant whenever the pump is operated.
5	Flow diffuser	Provides heat transfer from the coolant to the pumped media (liquid)
6	Seal housing	Includes a coolant that lubricates and cools the seals; the housing acts as a buffer between the pumped media (liquid) and the electric motor
7	Impeller	N-impeller, a semi-open, two-vane impeller
8	Inspection chamber	Equipped with an FLS10 leakage sensor to prevent damages to the motor
9	FLS10	For information about FLS10, see *Monitoring equipment* (page 13).
10	Mechanical seals	Made of one of the following alternatives: • Alternative 1 • Inner seal: corrosion-resistant cemented carbide WCCR/WCCR • Outer seal: corrosion-resistant cemented carbide WCCR/WCCR • Alternative 2 • Inner seal: corrosion-resistant cemented carbide/Aluminum oxide WCCR/ Al_2O_3 • Outer seal: silicon carbide RSiC/RSiC
11	Main bearings	Consisting of a two-row angular contact ball bearing
12	Motor	For information about the motor, see *Motor data* (page 58).

Position	Part	Description
13	Thermal contact/ Thermistors	For information about the thermal contact and thermistors, see *Monitoring equipment* (page 13).
14	Support bearing	Consisting of a two-row ball bearing

Monitoring equipment

The following applies to the monitoring equipment of the pump:

- Normally the stator incorporates thermal contacts connected in series that activates the alarm at overtemperature.
- The thermal contacts open at 140°C (285°F).
- Ex-approved pumps must have thermal contacts connected to the control panel.
- The sensors must be connected to either the MiniCAS II monitoring unit or an equivalent unit.
- The monitoring equipment must be of a design that makes automatic restart impossible.
- The pump is supplied with an inspection sensor FLS10 for sensing the presence of any liquid in the inspection chamber.
- The label in the junction box shows if the pump is equipped with optional sensors.

Optional sensors

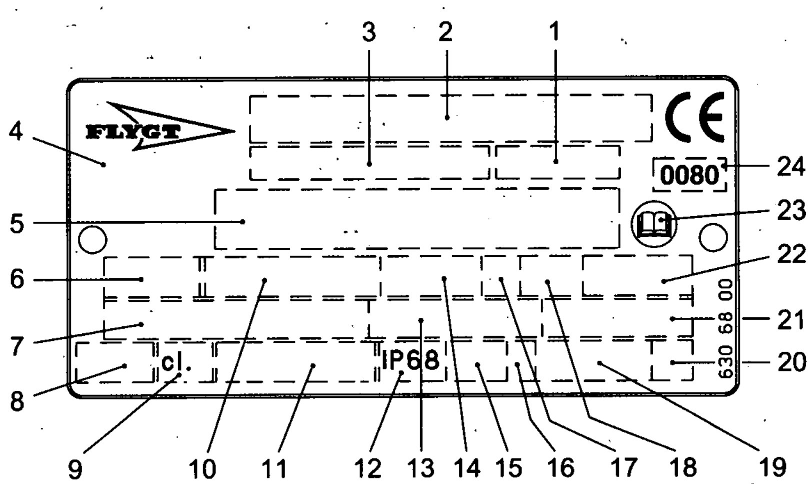
Thermistor Thermistors are optional sensors for measuring the temperature. They are connected in series in the stator and activate the alarm at overtemperature. The sensors are only optional for standard pumps.

NOTICE:

Thermistor must never be exposed to voltages higher than 2.5 V. If the voltage exceeds this value, for example when the control circuit is tested, the thermistors will be destroyed.

The data plate

The data plate is a metal label located on the main body of the pump. The data plate lists key product specifications. Explosion-proof products also have an approval plate. Both are described below.



1. Curve code/Propeller code
2. Serial number, see *Product denomination* (page 15)
3. Product number
4. Country of origin
5. Additional information
6. Phase; type of current; frequency
7. Rated voltage
8. Thermal protection

9. Thermal class
10. Rated shaft power
11. International standard
12. Degree of protection
13. Rated current
14. Rated speed
15. Maximum submergence
16. Direction of rotation: L=left, R=right
17. Duty class
18. Duty factor
19. Product weight
20. Locked rotor code letter
21. Power factor
22. Maximum ambient temperature
23. Read installation manual
24. Notified body/only for EN-approved Ex-products

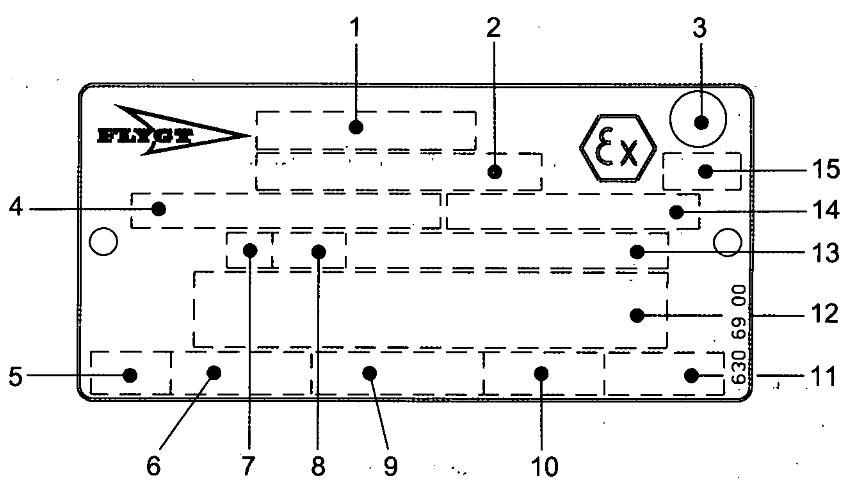
Figure 3: The data plate

Approvals

This section describes the EN and FM approvals that explosion-proof products have. For more information, please contact your ITT representative. In addition to the data plate, explosion-proof products also have either an EN or a FM approval plate.

EN

- European Norm
- ATEX Directive
- EN 50014, EN 50018, EN 1127-1
- Ⓔx II 2 G EEx d IIB T3



1. Approval
2. Approval authority + approval number
3. Approval for Class I
4. Approved drive unit
5. Stall time
6. Starting current/Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Controller
12. Additional information
13. Maximum ambient temperature
14. Serial number
15. ATEX marking

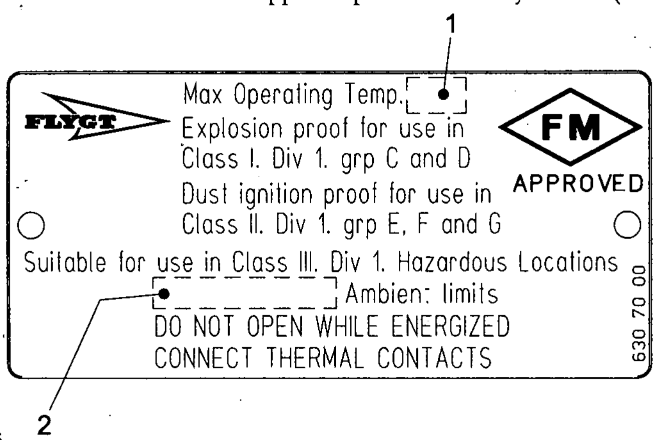
Figure 4: EN approval plate

EN approval for cable entry:

- Certificate number: INERIS 02ATEX9008 U
- ⟨Ex⟩ II 2 G or IM2 EEx d IIC or EEx dI

FM

This illustration describes the approval plate for Factory Mutual (FM) and the information contained in its fields.



1. Temperature class
2. Maximum ambient temperature

Figure 5: FM approval plate

Product denomination

Sales denomination

The sales denomination consists of the four-digit sales code and two letters that indicate the hydraulic end and type of installation.

This is an example of a sales denomination, and an explanation of its parts.

NP 3085

1 2 3

1. Hydraulic part
2. Installation type
3. Sales code

Product code

The product code consists of nine characters divided into two parts.

This is an example of a product code, and an explanation of its parts.

NP 3085.183

1 2

1. Sales denomination
2. Version

Serial number

The serial number is used for identification of an individual product, and is divided into four parts.

This is an example of a serial number, and an explanation of its parts.

Product Description (Continued)

NP 3085.183 - 951 0163

1 2 3 4

1. Product code
2. Production year
3. Production cycle
4. Running number

Installation

Install the pump

These requirements apply:

- Use the pump dimensional drawing in order to ensure proper installation.
- In S-, T-, and Z-installations the pump must be equipped with cooling jacket
- Provide a suitable barrier around the work area, for example, a guard rail.
- Check the explosion risk before you weld or use electric hand tools.
- Remove all debris from the inlet piping system before you install the pump.

WARNING:

- Before installing the pump, check that the cable and cable entry have not been damaged during transportation.
- Note that special rules apply to installation in explosive atmospheres.
- Make sure that the pump cannot roll or fall over and injure people or damage property.
- Do not install CSA-approved products in locations that are classified as hazardous in the national electric code, ANSI/NFPA 70-2005.

NOTICE:

- Do not run the pump dry.
- Never force piping to make a connection with a pump.

Install with P-installation

In the P-installation, the pump is installed on a stationary discharge connection, and operates either completely or partially submerged in the pumped liquid. These requirements and instructions only apply when the installation is made according to the dimensional drawing.

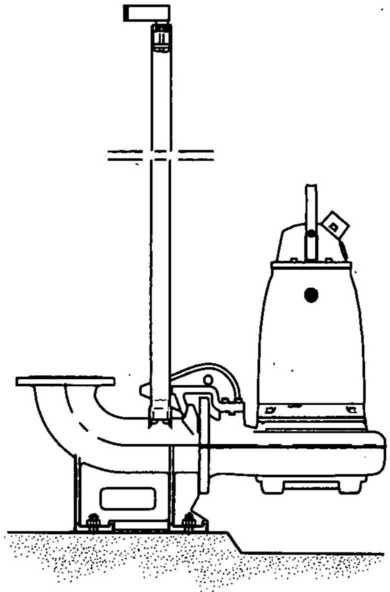


Figure 6: P-installation

These items are required:

- Guide bars
- Guide bar bracket for attaching the guide equipment to the access frame or to the upper part of the sump
- Level regulators or other control equipment for start, stop, and alarm
- Cable holder for holding the cable and regulating the height of the level regulators
- Access frame (with covers) to which the upper guide bar bracket and cable holder can be attached
- Discharge connection for connecting the pump to the discharge line

  The discharge connection has a flange which fits the pump casing flange and a bracket for attaching the guide equipment.
- Fasteners for the discharge connection
- Anchor bolts

1. Run a cable between the sump and the stator and monitoring equipment.

   Make sure that the cable is neither sharply bent, nor pinched.
2. Install the access frame:
   a) Place the access frame in position and align it horizontally.
   b) Grout the frame in place.
3. Grout the anchor bolts in place.

   Be careful when you align and position the discharge connection in relation to the access frame.
4. Place the discharge connection in position, and tighten the nuts.
5. Install the guide bars:
   a) Secure the guide bars in the bracket.
   b) Check that the guide bars are placed vertically. Use a level or a plumb line.
6. Connect the discharge pipe to the discharge connection.
7. Prepare for the level regulator:
   a) Bolt the cable holder to the access frame.
   b) Thread the level regulator cable through the holes in the cable holder, and adjust the height of the level regulators.
   c) Protect bolts and nuts with a corrosion-preventive compound.
8. Lower the pump along the guide bars.
9. Secure the motor cable:
   a) Fasten the permanent lifting device to the pump and to the access frame. For example, you can use a stainless-steel lifting chain with shackles.
   b) Fasten the cable to the cable holder.

      Make sure that the cable cannot be sucked into the pump inlet or that it is neither sharply bent, or pinched. Support straps are required for deep installations.
   c) Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

      Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* (page 29).

Clean all debris from the sump before starting the pump.

Install with S-installation

In the S-installation, the pump is transportable and intended to operate either completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe and stands on a base stand.

These requirements and instructions only apply when the installation is made according to the dimensional drawing. For more detailed information about the different installation types, see the Parts List document.

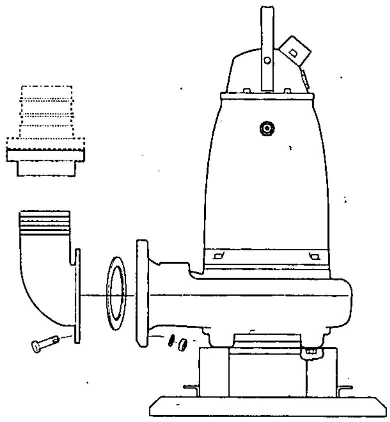


Figure 7: S-installation

1. Run the cable so that it has no sharp bends, is not pinched, and cannot be sucked into the pump inlet.
2. Connect the discharge line.
3. Lower the pump into the sump.
4. Place the pump on the base and make sure it cannot fall over or sink.

   Alternatively, the pump can be suspended with a lifting chain just above the sump bottom. Make sure that the pump cannot rotate at startup or during operation.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* (page 29).

Install with T/Z-installation

- In the T-installation, the pump is installed in a vertical position in a dry well next to the wet sump. These requirements and instructions only apply when the installation is made according to the dimensional drawing.
- In the Z-installation, the pump is installed in a horizontal position on a support stand in a dry well next to the wet sump, and a bell-mouth is connected to the inlet pipe. These requirements and instructions are for Z-installations that comply to the dimensional drawing.

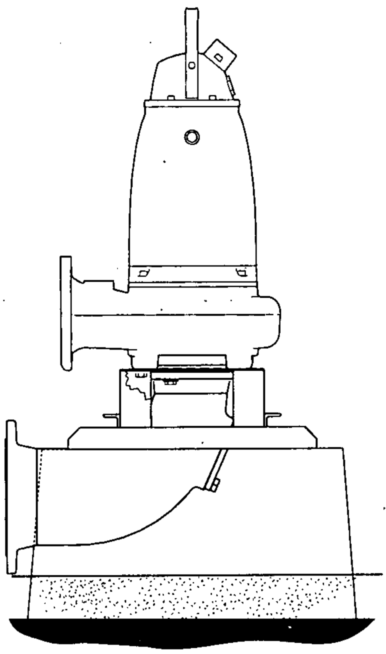


Figure 8: T-installation

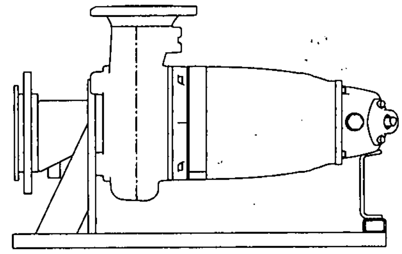


Figure 9: Z-installation

These items are required:

- Support stand and anchor bolts for anchoring the pump to a base
- Inlet elbow for connecting the suction line and discharge line
- Shut-off valves that allow you to remove the pump from service
- Air vent on the discharge side between the pump and the check valve
- Level regulators or other control equipment for start, stop, and alarm

NOTICE:

The risk of freezing is particularly high in T- or Z-installations.

1. Fasten the pump:
   a) Use the anchor bolts to bolt the support stand to the concrete base.
   b) Bolt the pump to the support stand and the suction connection.
2. Make sure that the pump is vertical for the T-installation or horizontal for the Z-installation.
3. Connect the suction line and discharge line.
4. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* (page 29).
5. Make sure that the weight of the pump does not put strain on the piping.

Make the electrical connections

General precautions

Electrical Hazard:

- A certified electrician must supervise all electrical work. Comply with all local codes and regulations.
- Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well. If the pump is equipped with automatic level control, there is a risk of sudden restart.
- Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable above the liquid level.
- Make sure that all the conductors that are not used are insulated.
- There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out or if there is fault or damage on the product.

Requirements

These general requirements apply for electrical installation:

- The supply authority must be notified before installing the pump if it will be connected to the public mains. When the pump is connected to the public power supply, it may cause flickering of incandescent lamps when started.
- The mains voltage and frequency must agree with the specifications on the data plate. If the pump can be connected to different voltages, the connected voltage is specified by a yellow sticker close to the cable entry.
- The fuses, short-circuit, and circuit breakers must have the proper rating, and the pump overload protection (motor protection breaker) must be connected and set to the rated power according to the data plate. The starting current in direct-on-line starting can be up to six times higher than the rated current.
- The fuse rating and the cables must be in accordance with the local rules and regulations.
- If intermittent operation is prescribed, the pump must be provided with monitoring equipment supporting such operation.
- The motor is convertible between different voltages, as stated on the data plate. This conversion is done on the terminal board.

Cables

These are the requirements to follow when you install cables:

- The cables must be in good condition, not have any sharp bends, and not be pinched.
- The sheathing must not be damaged and must not have indentations or be embossed (with markings, etc.) at the cable entry.
- The cable entry seal sleeve and washers must conform to the outside diameter of the cable.
- The minimum bending radius must not be below the accepted value.
- If using a cable which has been used before, a short piece must be peeled off when refitting it so that the cable entry seal sleeve does not close around the cable at the same point again. If the outer sheath of the cable is damaged, then replace the cable (contact an ITT service shop).
- The voltage drop in long cables must be taken into account. The drive unit's rated voltage is the voltage measured at the terminal board in the upper part of the pump.
- The screened cable must be used according to the European CE requirements if a Variable Frequency Drive (VFD) is used. For more information, contact your ITT representative (VFD-supplier).

Earthing (Grounding)

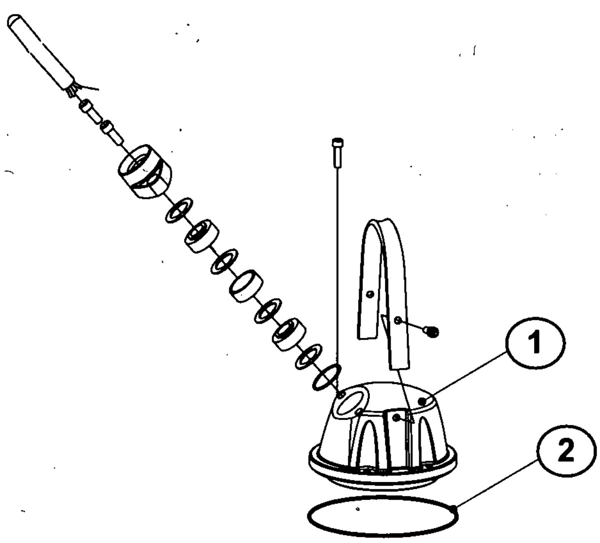
Electrical Hazard:

- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.
- If the motor cable is jerked loose by mistake, the earth (ground) conductor should be the last conductor to come loose from its terminal. Make sure that the earth (ground) conductor is longer than the phase conductors. This applies to both ends of the motor cable.
- Risk of electrical shock or burn. You must connect an additional earth- (ground-) fault protection device to the earthed (grounded) connectors if persons are likely to come into physical contact with the pump or pumped liquids.

Connect the motor cable to the pump

CAUTION:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable above the liquid level.



1. Entrance cover
2. O-ring

1.

   This provides access to the terminal board.
2. Check the data plate to see which connections are required for the power supply:
   - Y
   - D
   - Y serial
   - Y parallel
   - Y/D
3. Arrange the connections on the terminal board in accordance with the required power supply.

   Links (jumper strips) are not used with the Y/D start.
4. Connect the motor conductors (U1, V1, W1, and earth (ground)) to the terminal board.

   The earth (ground) conductor must be 100 mm (4.0 in.) longer than the phase conductors in the junction box of the unit.
5.
6.
7.

8.

Connect the motor cable to the starter and monitoring equipment

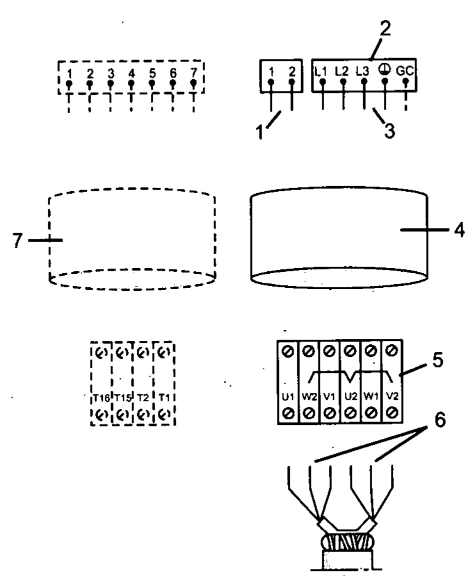
WARNING:
Do not install the starter equipment in an explosive zone or in the sump.

NOTICE:
- Either thermal contacts or thermistors are incorporated in the pump.
- Thermal contacts must never be exposed to voltages higher than 250 V, breaking current maximum 4 A. It is recommended that they are connected to 24 V over separate fuses to protect other automatic equipment.

1. If thermal contacts are included in the pump installation, connect the T1 and T2 control conductors to the MiniCAS II monitoring equipment.
2. If thermistors are included in the pump installation, and screened or auxiliary cable is used, then connect T1(1) and T2(2) to thermistor relay or MAS 711, and T3(3) and T4 (4) to MiniCAS II or MAS 711.
3. Connect the mains leads (L1, L2, L3, and earth [ground]) to the starter equipment.
   For the color codes of the leads, see *Cable charts* (page 23).
4. Check the functionality of the monitoring equipment:
   a) Check that the signals and the tripping function work properly.
   b) Check that the relays, lamps, fuses, and connections are intact.
   Replace any defective equipment.

Cable charts

Connection locations



1. Control leads
2. Starter equipment
3. Mains leads
4. Motor cable
5. Terminal blocks on pump
6. Stator leads
7. Control cable

Colors and marking of the mains leads

Mains	SUBCAB 7GX	SUBCAB 4GX	SUBCAB AWG	SUBCAB (screened) and NSSHÖU ../3E +st
L1	Black 1	Brown	Red	Brown
L2	Black 2	Black	Black	Black
L3	Black 3	Grey	White	Grey
L1	Black 4	-	-	-
L2	Black 5	-	-	-
L3	Black 6	-	-	-
⏚	Yellow/Green	Yellow/Green	Yellow/Green	Screen from leads
Groundcheck (GC)	-	-	Yellow	-

Color and marking of the control leads

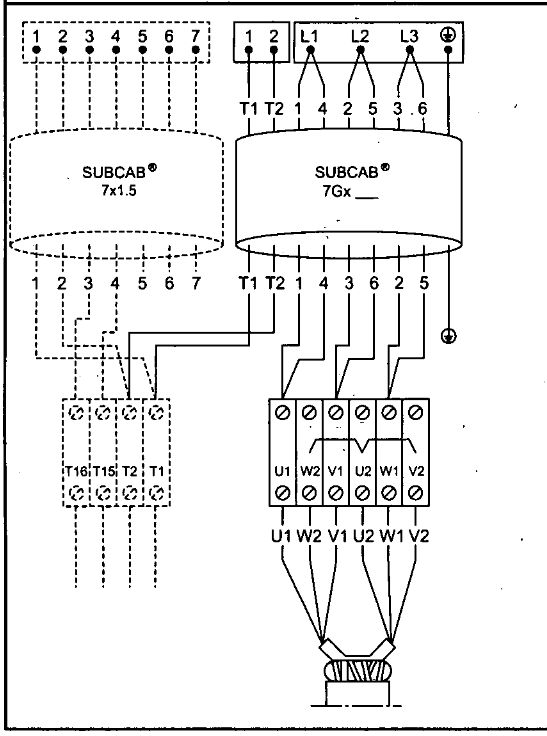
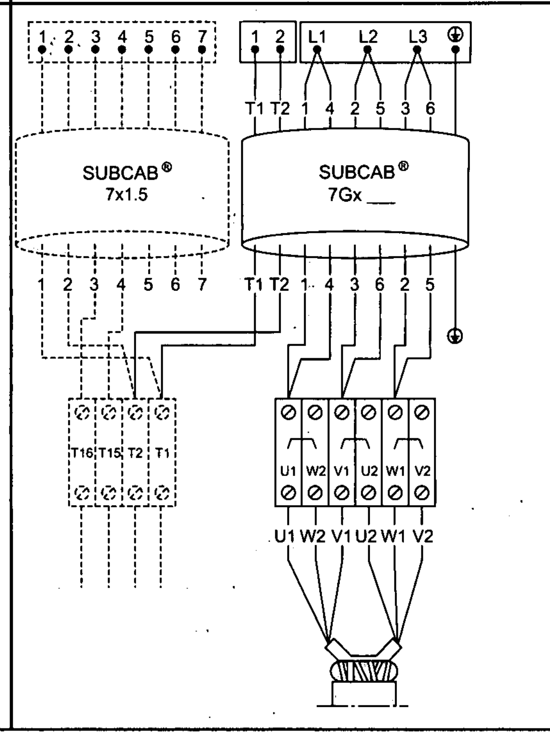
Control	SUBCAB 7GX and SUBCAB 4GX	SUBCAB AWG	SUBCAB screened	NSSHÖU ../3E +st
T1	White T1	Orange	White T1	Black
T2	White T2	Blue	White T2	Brown
T3	-	-	White T3	Grey (Unused)
T4	-	-	White T4	-

Colors of the stator leads

Stator connection	Lead color
U1	Red
U2	Green
U5	Red
V1	Brown
V2	Blue
V5	Brown
W1	Yellow
W2	Black
W5	Yellow

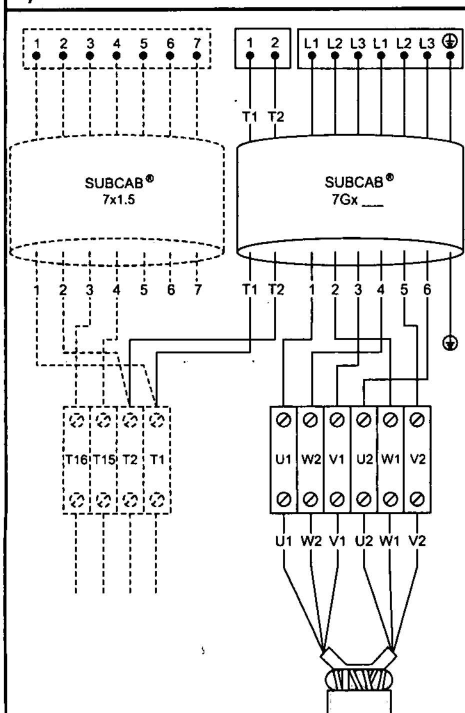
SUBCAB 7GX, 6 stator leads, Y and D connections

This table shows the connection diagrams for the SUBCAB 7GX (3-phase power cables), with Y and D connections.

Y connection	D connection
	

SUBCAB 7GX, 6 stator leads, Y/D connection

This table shows the connection diagrams for the SUBCAB 7GX (3-phase power cables), with Y/D connection.

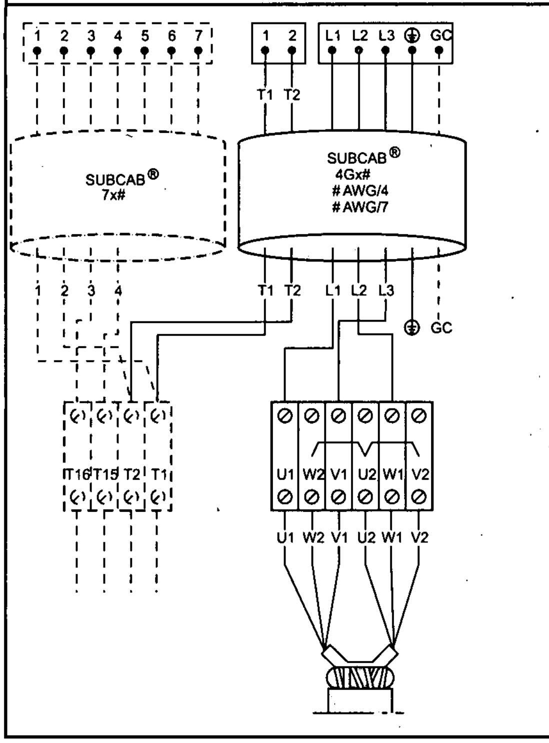
Y/D connection


SUBCAB 4GX/SUBCAB AWG, 6 stator leads, Y and D connections

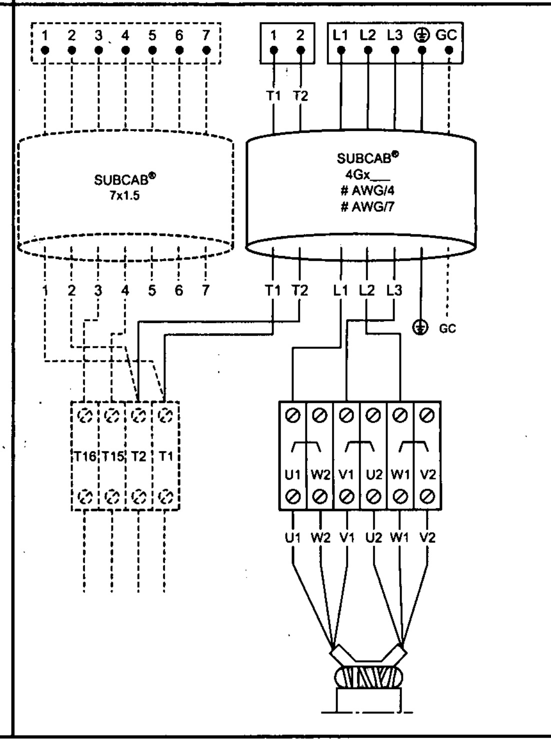
This table shows the connection diagrams for the SUBCAB 4GX/SUBCAB AWG (3-phase power cables), with Y and D connections.

Installation (Continued)

Y connection



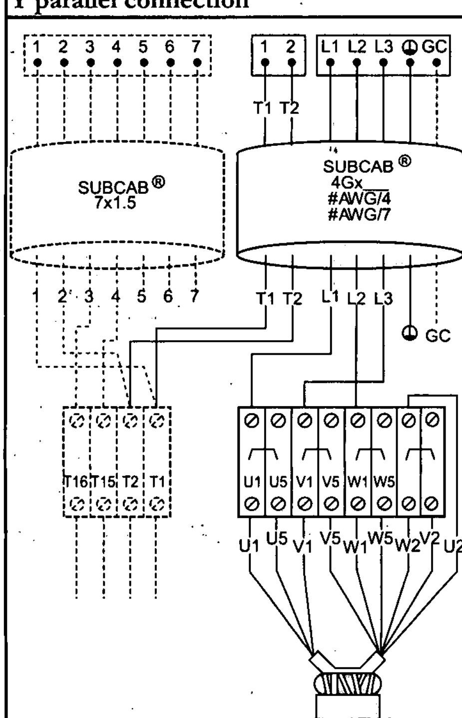
D connection



SUBCAB 4GX/SUBCAB AWG, 9 stator leads, 230V

This table shows the connection diagrams for the SUBCAB 4GX/SUBCAB AWG (3-phase power cable), with Y parallel connection (60 Hz only).

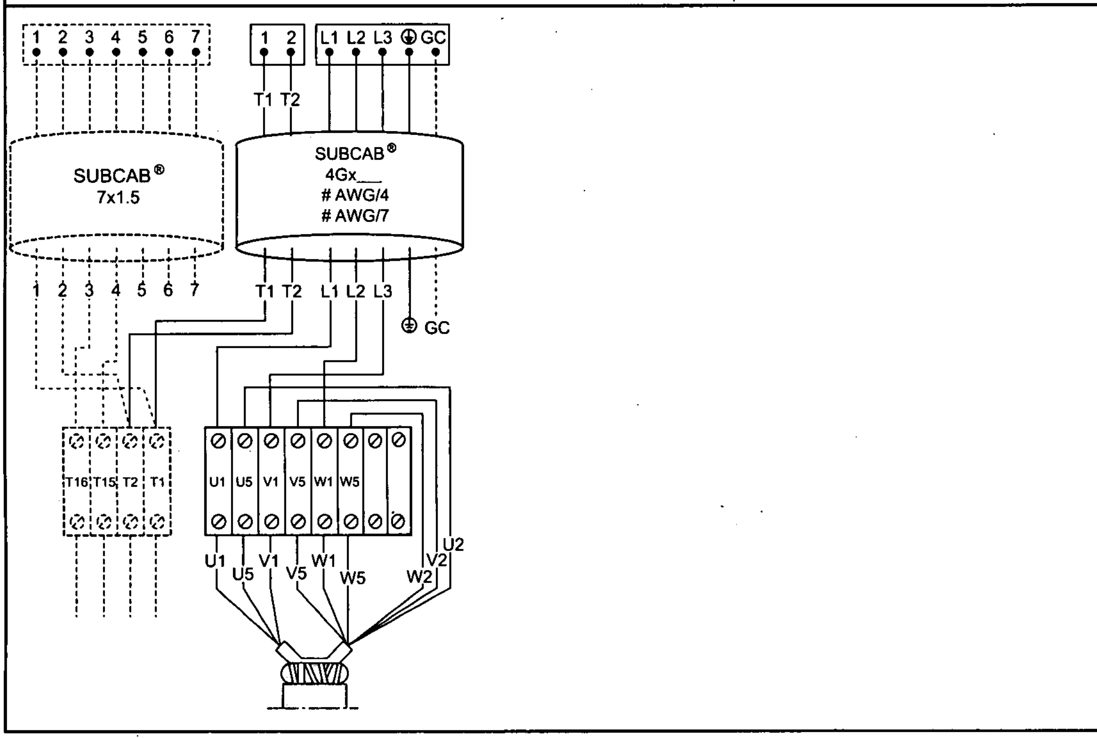
Y parallel connection



SUBCAB 4GX/SUBCAB AWG, 9 stator leads, 460V

This table shows the connection diagram for the SUBCAB 4GX/SUBCAB AWG (3-phase power cable), with Y serial connection (60 Hz only).

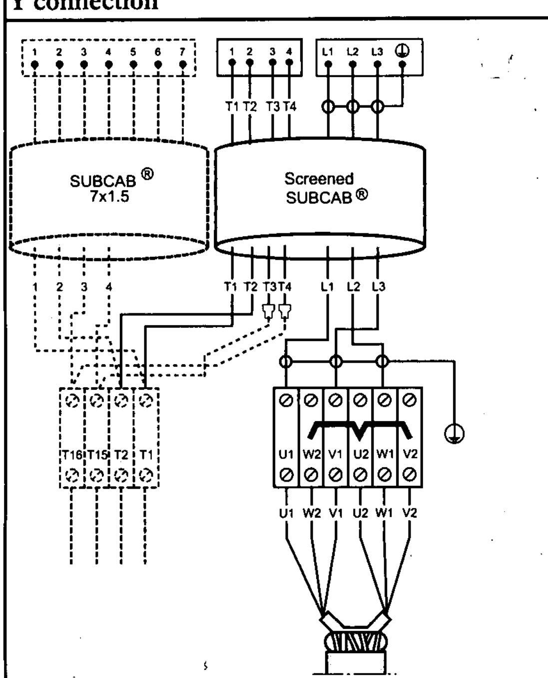
Y serial connection



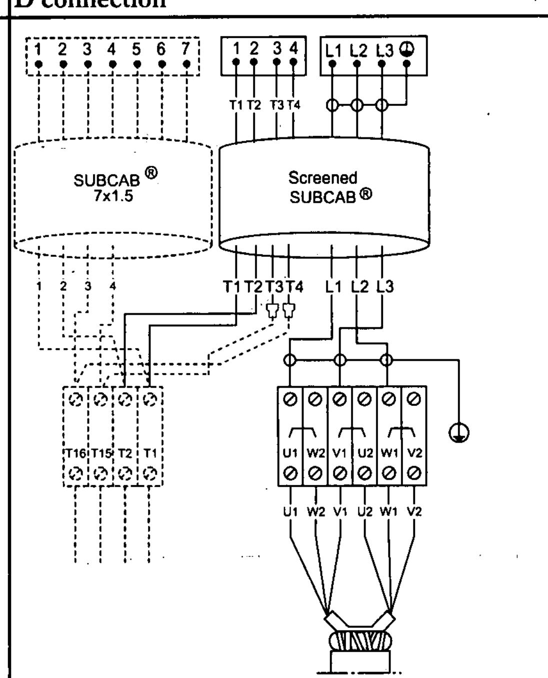
SUBCAB, screened, 6 stator leads, Y and D connections

This table shows the connection diagrams for the screened SUBCAB 4GX/SUBCAB AWG (3-phase power cables), with Y and D connections.

Y connection



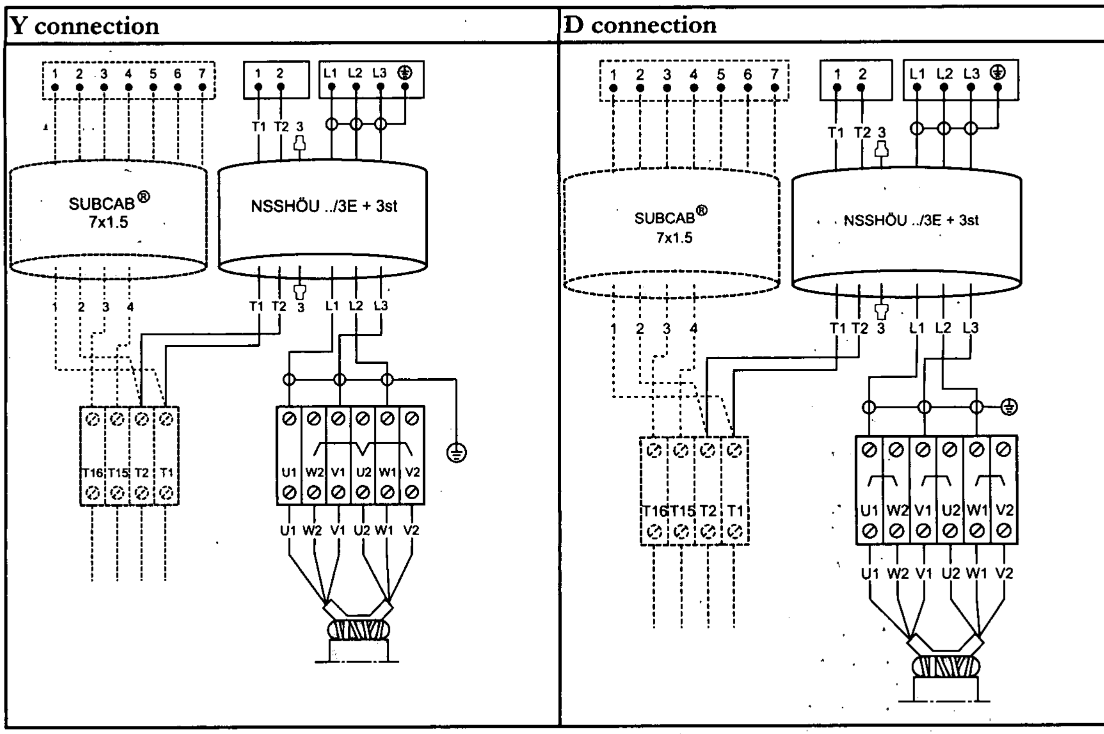
D connection



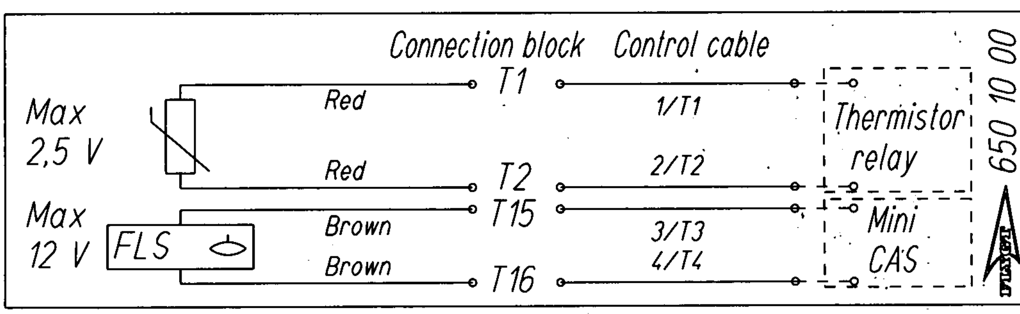
NSSHÖU ../3e + st, 6 stator leads, Y and D connections

This table shows the connection diagrams for the screened NSSHÖU ../3e + st (3-phase power cables), with Y and D connections.

Installation (Continued)



Sensor-connection

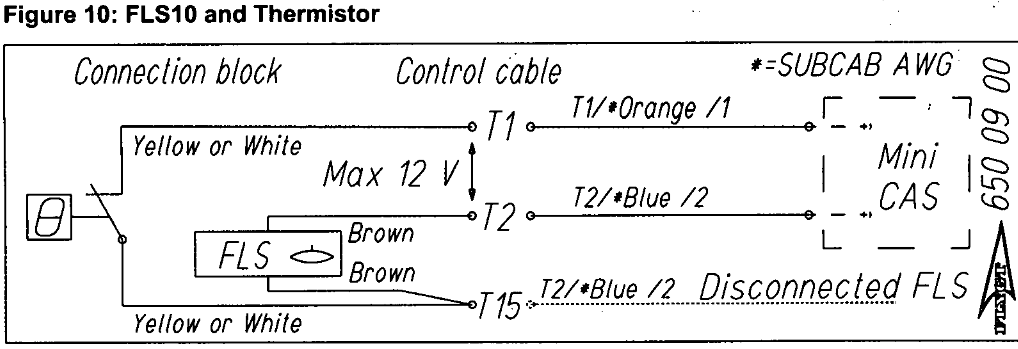


T=25°C (77°F) R ≤ 100 Ohm

T=135°C (275°F) (T_{REF}-5°C (9°F)) R ≤ 550 Ohm

T=145°C (293°F) (T_{REF}+5°C (9°F)) R ≤ 1330 Ohm

Figure 10: FLS10 and Thermistor



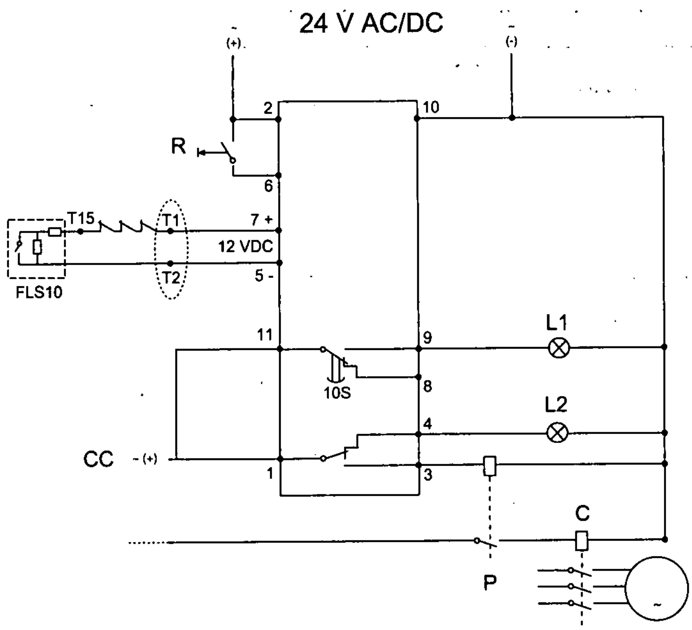
0 mA Overtemperature

10 mA OK

28 mA Leakage

The values have a 10 % tolerance

Figure 11: FLS10 and Thermal contact



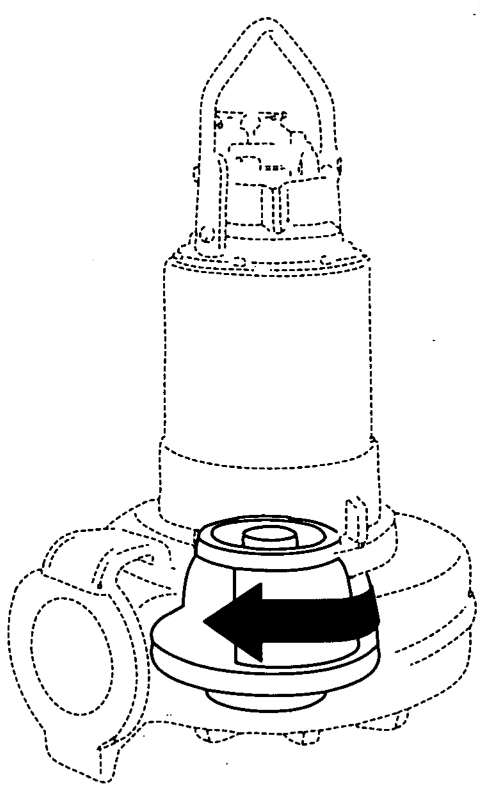
C Pump contactor
CC Control circuit
L1 Caution light (leakage)
L2 Caution light (stator over-temperature)
P Pump main supply
R Reset switch

Figure 12: MiniCAS II

Check the impeller rotation

WARNING:
The starting jerk can be powerful.

1. Start the motor.
2. Stop the motor.
3. Check that the impeller rotates according to this illustration.



Installation (Continued)

The correct direction of impeller rotation is clockwise when you look at the pump from above.

4. If the impeller rotates in the wrong direction, transpose two phase leads (3-phase) and do this procedure again.

Operation

Distance to wet areas

Electrical Hazard:

Risk of electrical shock when pumping or mixing near a lake, jetties, beaches, ponds, fountains, or similar. There must be a safety distance of at least 20 m (65 ft.) between the person and the product if the person is in contact with the pumped or mixed liquid.

Start the pump

WARNING:

- If you need to work on the pump, make sure that it is isolated from the power supply and cannot be energized.
- Make sure that the pump cannot roll or fall over and injure people or damage property.
- In some installations, the pump and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.
- Make sure nobody is close to the pump when it is started. The pump will jerk in the opposite direction of the impeller rotation.

NOTICE:

Make sure that the rotation of the impeller is correct. For more information, see Check the impeller rotation.

1. Remove the fuses or open the circuit breaker, and check that the impeller can be rotated freely.
2. Conduct insulation test phase to ground. To pass, the value must exceed 5 megohms.
3. Check that the monitoring equipment works.
4. Start the pump.

Maintenance

Maintenance guidelines

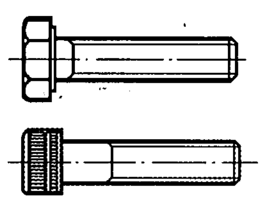
During maintenance and before reassembly, always remember to perform these tasks:

- Clean all parts thoroughly, particularly O-ring grooves.
- Change all O-rings, gaskets, and seal washers.
- Lubricate all springs, screws, and O-rings with grease.

During reassembly, always make sure that existing index markings are in line.

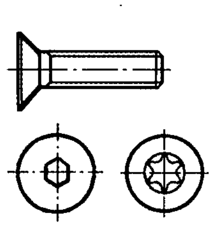
Torque values

Screw and nuts



Stainless steel, A2 and A4											
	Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
Torque, Nm (ft-lbs)	70 +80[1]	2.7 (2)	5.4 (4)	9.3 (6.9)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
Carbon steel and alloyed steel											
Torque, Nm (ft-lbs)	8.8	2.9 (2.1)	5.7 (4.2)	9.8 (7.2)	24 (18)	47 (35)	81(60)	194 (143)	385 (285)	665 (490)	1310 (966)
	10.9	4.0 (2.9)	8.1 (6)	14 (10.3)	33 (24.3)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
	12.9	4.9 (3.6)	9.7 (7.2)	17 (12.5)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825)	2210 (1630)

Screws with countersunk heads



Stainless steel, A2 and A4										
	Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24
Torque, Nm (ft-lbs)	70 +80[1]	1.2 (0.9)	2.7 (2)	5.4 (4)	9.3 (6.9)	22 (16)	44 (32)	76 (56)	120 (88)	187 (138)
Carbon steel and alloyed steel										

[1] Property class 70 is torque tightened as class 80.

Torque, Nm (ft-lbs)	8.8	2.3 (1.7)	4.6 (3.4)	7.8 (5.8)	19 (14)	38 (28)	65 (48)	158 (116)	308 (228)	532 (392)
	10.9	3.2 (2.4)	6.5 (4.8)	11(8)	26 (19)	52 (38)	91 (67)	222 (164)	433 (320)	748 (552)
	12.9	3.9 (2.9)	7.8 (5.8)	14 (10.3)	32 (23.6)	63 (46)	109 (80)	266 (196)	519 (383)	896 (661)

Change the coolant

This image shows the plugs that are used to change the coolant.

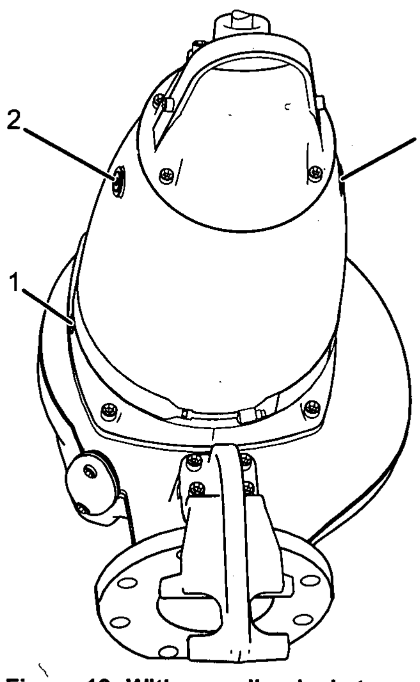


Figure 13: With a cooling jacket

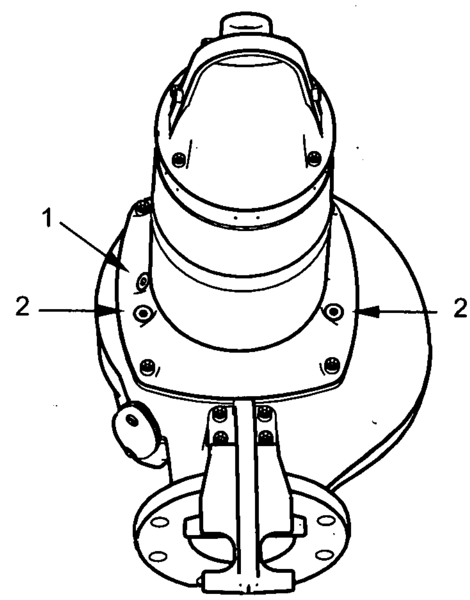


Figure 14: Without a cooling jacket

1. Inspection plug
2. Coolant plugs

Empty the coolant

WARNING:

The seal housing may be pressurized. Hold a rag over the inspection/ filling plugs to prevent splatter.

1. Empty the coolant in the inspection chamber:
   a) Remove the inspection plug.

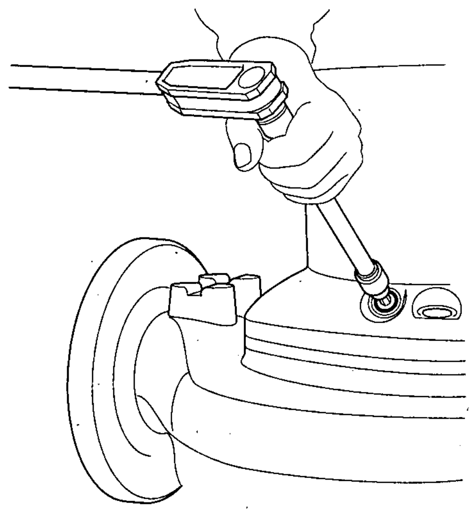


Figure 15: Without a cooling jacket

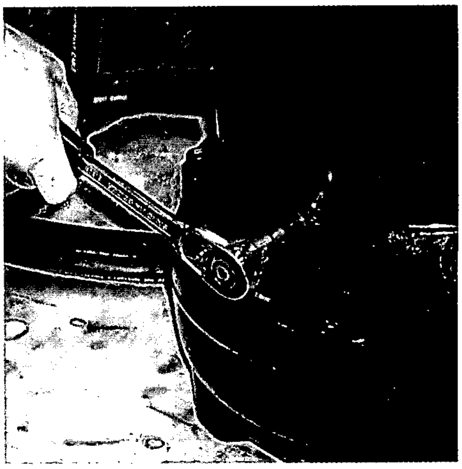
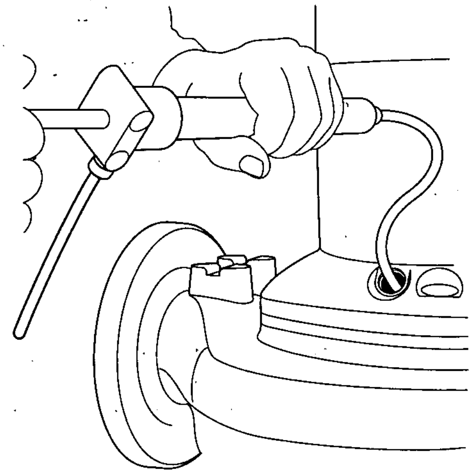


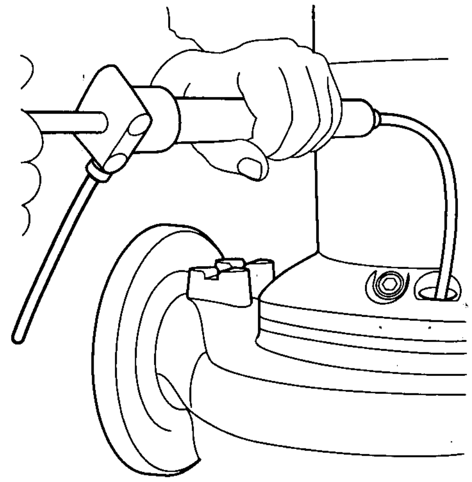
Figure 16: With a cooling jacket

b) Pump out any coolant from the inspection chamber, as shown here.



c) Replace the inspection plug and O-ring and tighten.
   Tightening torque: 44 Nm (33 ft-lbs)

2. Empty the coolant:
   a) Place the pump in a horizontal position, or leave it upright to use a pump to empty the coolant.



   b) If the pump is laid in a horizontal position, place a container under the pump.
   c) Remove the coolant plugs and empty the coolant.

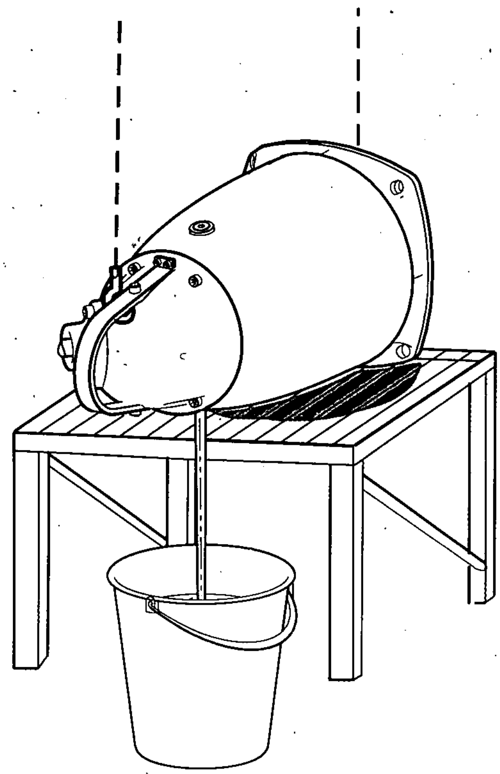


Figure 17: With a cooling jacket

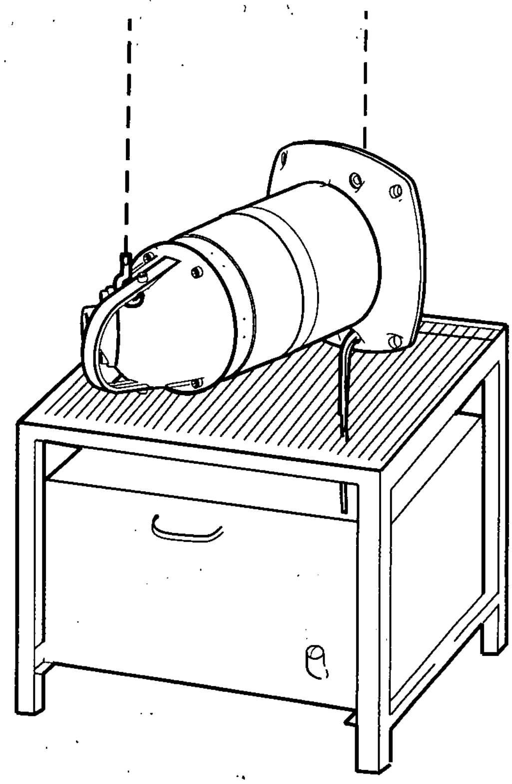


Figure 18: Without a cooling jacket

Fill with coolant

Use a coolant that has a mixture of 70% water and 30% monopropylene glycol. The coolant should prevent corrosion and be nonpoisonous (generally recognized as safe by the FDA as food additives under part 184 and 182).

NOTICE:

Clean water with an anti-corrosive is an acceptable coolant when there is no risk of freezing.

1. Fill with coolant until it overflows through the opposite hole, as shown here.

   Quantity: approximately

   - 2.2 liters (2.3 US quarts) without cooling jacket
   - 10.5 liters (11.2 US quarts) with cooling jacket

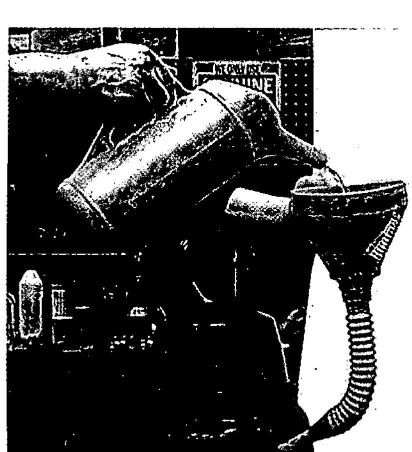


Figure 19: With a cooling jacket

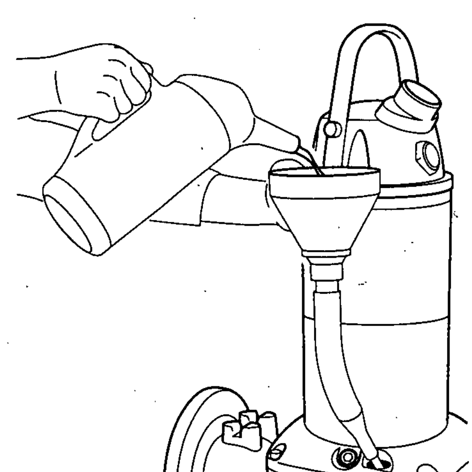


Figure 20: Without a cooling jacket

2. Replace the O-rings.
3. Tighten the coolant plugs.
   Tightening torque: 44 Nm (33 ft-lbs)

Replace the impeller

The following items are needed for these procedures:

- 12 mm hexagon-bit adaptor with an extension of at least a 100 mm (4 in.)
- Rod (wood or plastic) for locking the impeller in place.

WARNING:

- If you fail with the impeller installation, you must redo the installation procedure from the beginning.
- A worn impeller and/or pump housing can have very sharp edges. Wear protective gloves.
- When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

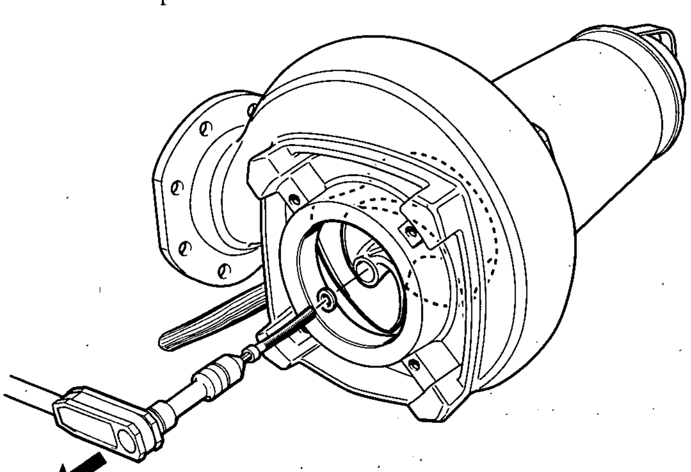
Replace the impeller for wet installation

Remove the impeller for wet installation

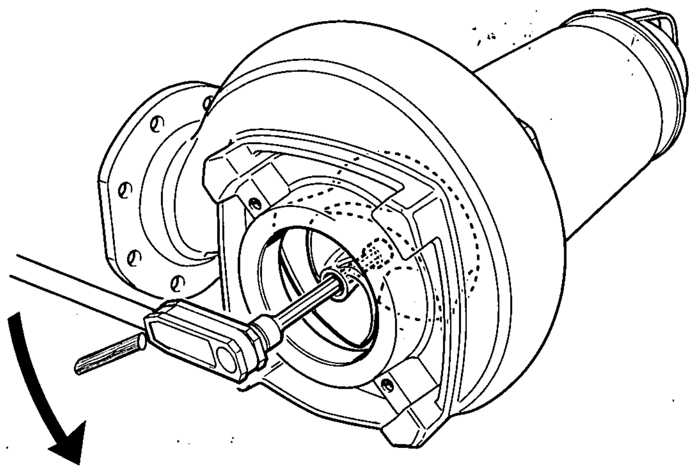
CAUTION:

Wear heavy work gloves when you handle impellers. The sharp edges can cause physical injury.

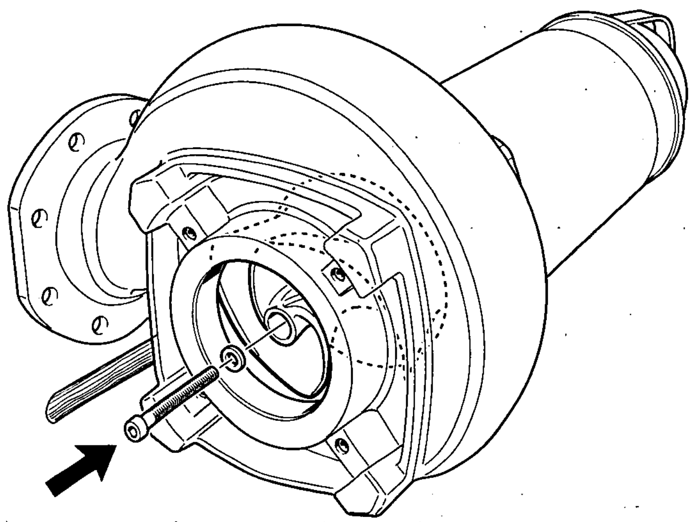
1. Place the pump in a horizontal position.
2. Loosen the impeller:
   a) Remove the flush valve cover and its O-ring.
   b) Lock the impeller in place by inserting a rod through the hole.
   c) Remove the impeller screw.



   d) Turn the adjustment screw counterclockwise until the impeller breaks free from the shaft.

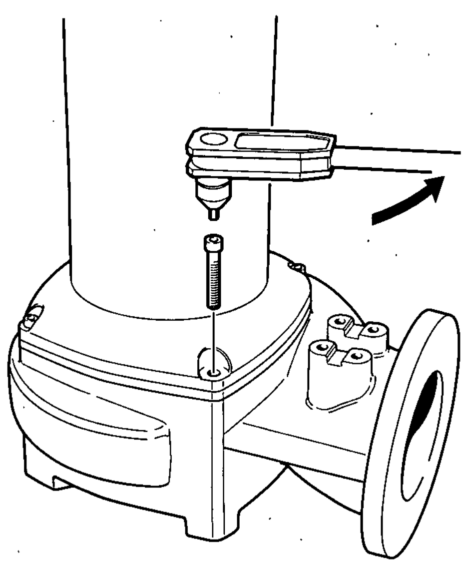


e) Hand-tighten the impeller screw to prevent it from falling off.

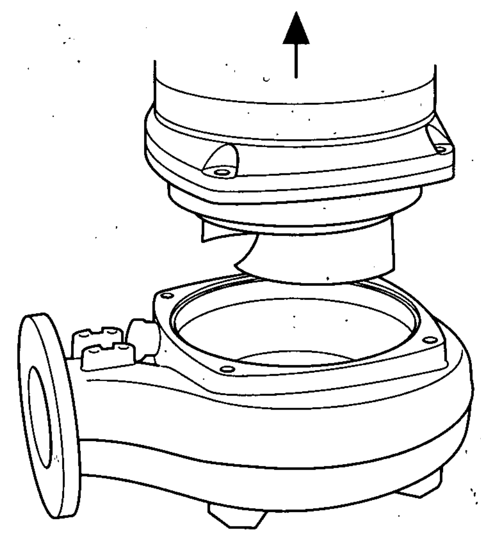


f) Remove the rod.

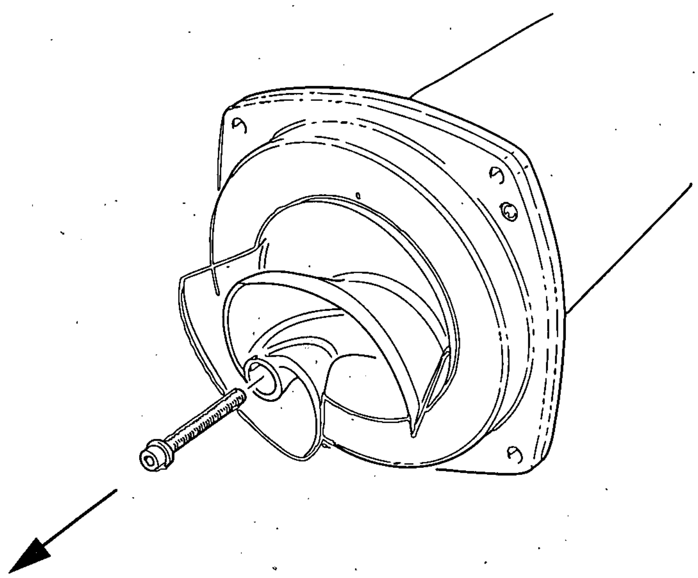
3. Raise the pump.
4. Remove the drive unit from the pump housing:
   a) Remove the pump housing screws.



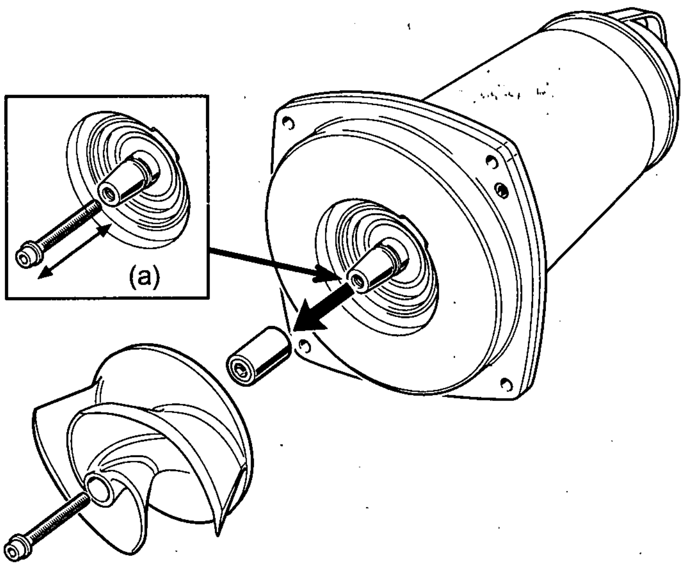
   b) Remove the drive unit from the pump housing.



5. Remove the impeller:
   a) Place the drive unit horizontally.
   b) Remove the impeller screw.



   c) Remove the impeller and the conical sleeve.

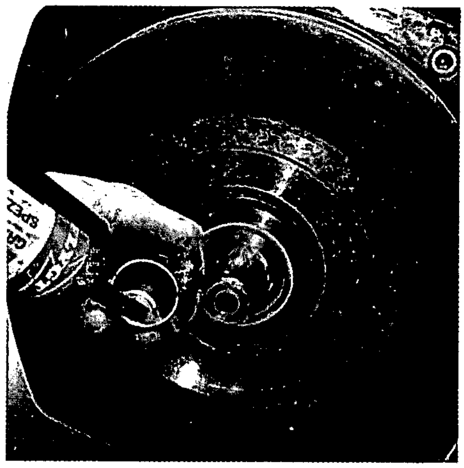


Install the impeller for wet installation

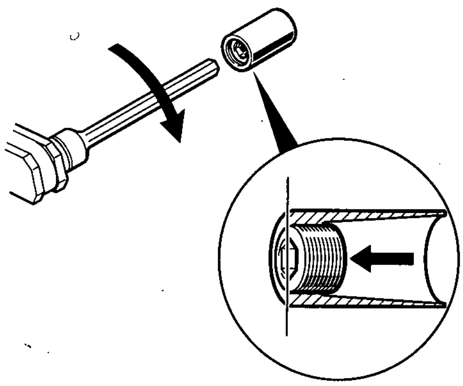
1. Fit the impeller:
   a) Make sure that the end of the shaft is free from burrs.
      Polish off any flaws with a fine emery cloth.
   b) Grease the shaft end.

NOTICE:
The impeller can become loose. Remove any surplus grease from conical and cylindrical surfaces of shafts and sleeves.

   c) Grease the conical sleeve, the threads of the adjustment screw, the washer, and the impeller screw.



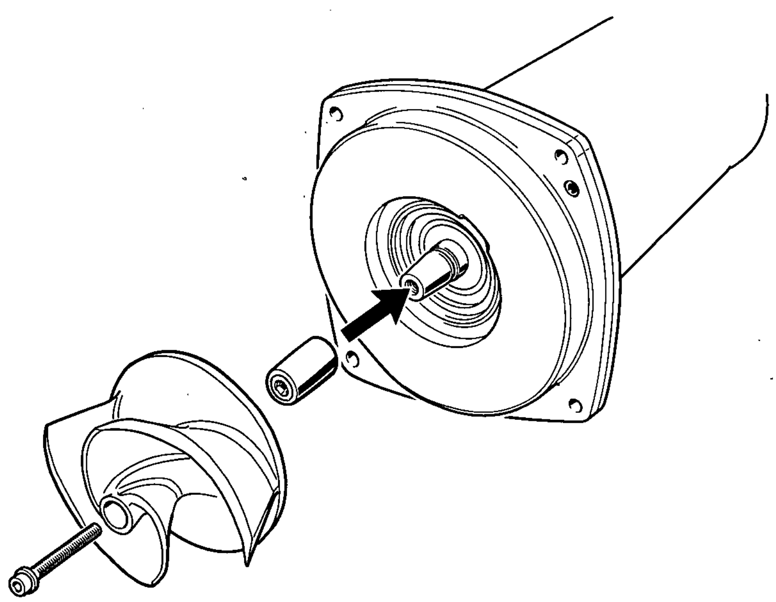
d) Adjust the adjustment screw so that it is flush with the sleeve.



e) Fit the sleeve and impeller to the shaft.

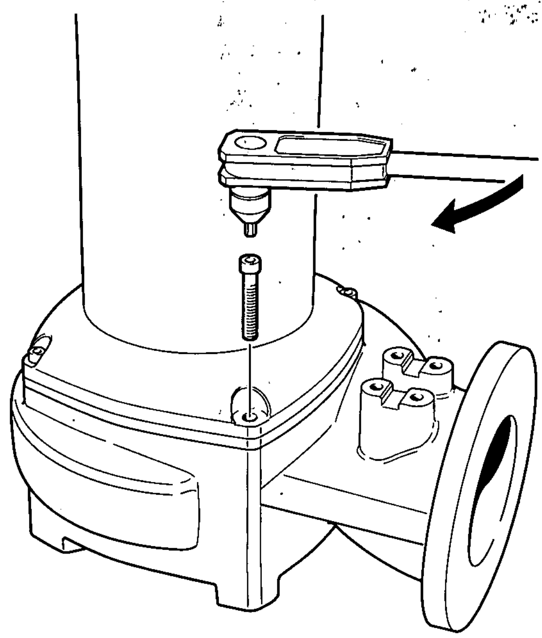
f) Hand-tighten the impeller screw to prevent it from falling off.

If the impeller screw is not clean and easily screwed back into the shaft, then replace the screw.

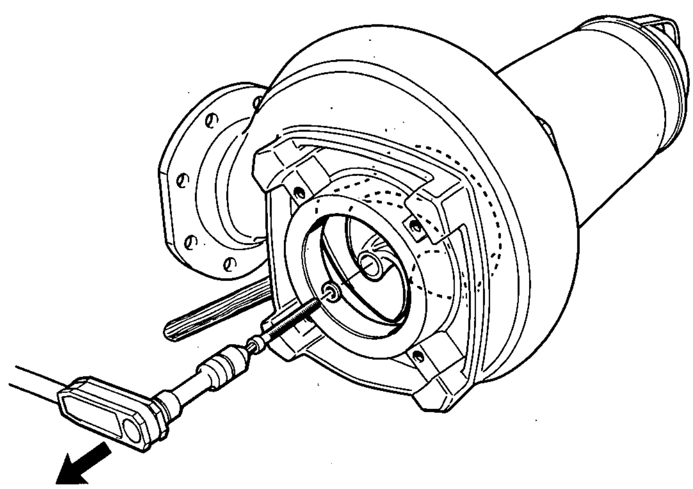


2. Fit the pump housing:
   a) Fit a new and greased O-ring on the seal housing cover.
   b) Grease the pump housing screws.
   c) Raise the drive unit.
   d) Place the drive unit into the pump housing.

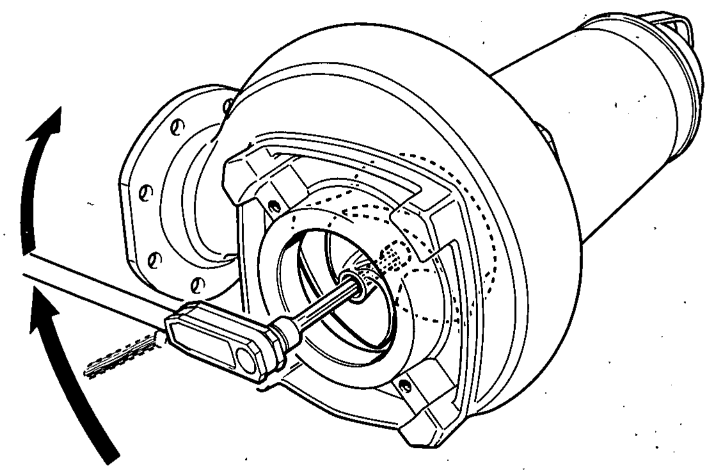
e) Adjust its position so that the inspection hole is on the same side as the flush valve.
f) Tighten the screws in diagonal sequence.



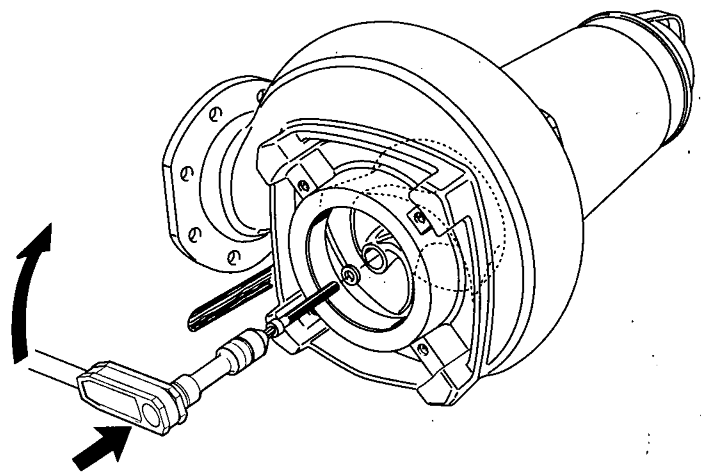
3. Remove the impeller screw:
   a) Place the pump horizontally.
   b) Lock the impeller in place by inserting a rod through the hole.
   c) Remove the impeller screw and the washer.



4. Adjust the impeller:
   a) Using a hexagon-bit adapter, turn the adjustment screw clockwise until the impeller makes contact with the pump housing.
   b) Tighten it a further 1/8 turn (45°).



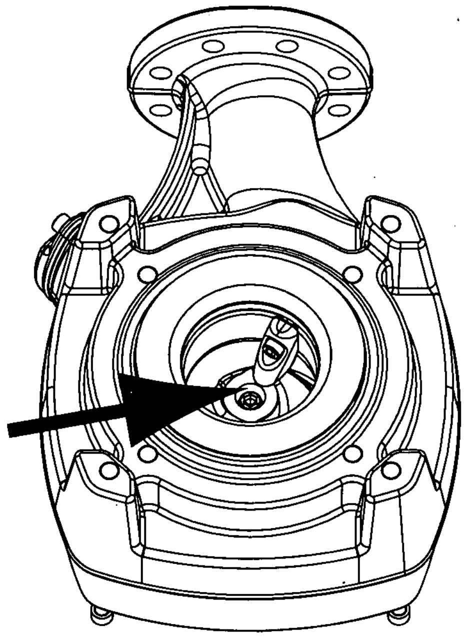
5. Fasten the impeller:
   a) Fit the greased washer and impeller screw.
   b) Tighten the impeller screw.
   c) Tighten it a further 1/8 turn (45°).



   d) Remove the rod used to lock the impeller.
   e) Fit the O-ring and flush valve cover and fasten it with screws.
   f) Check that the impeller can rotate freely.

CAUTION:
Beware of the pinch point hazard between the rotating impeller and the guide pin.

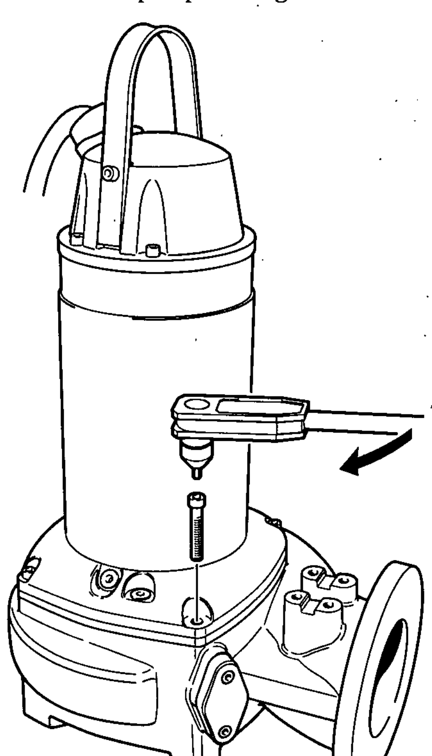
6. Adjust clearance to 0.2–0.8 mm (0.008–0.32 in.) between the guide pin and the impeller.



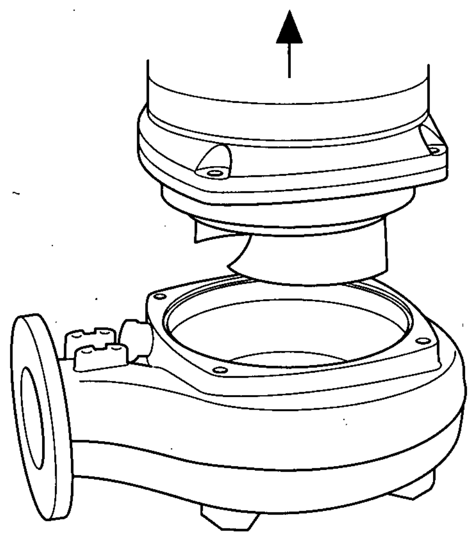
Replace the impeller for dry installation

Remove the impeller for dry installation

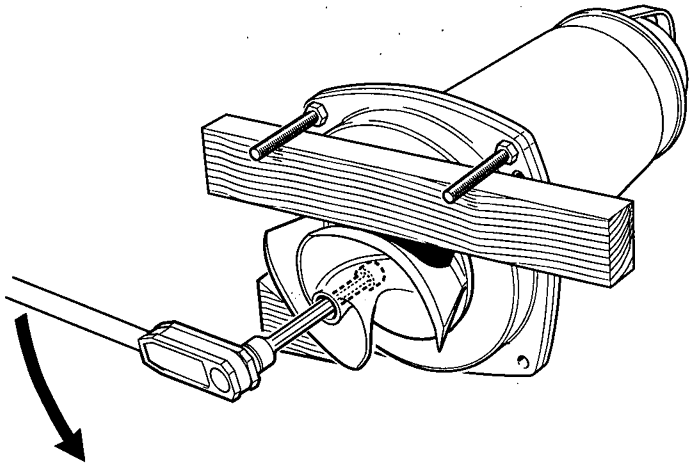
1. Remove the drive unit from the pump housing:
   a) Remove the pump housing screws.



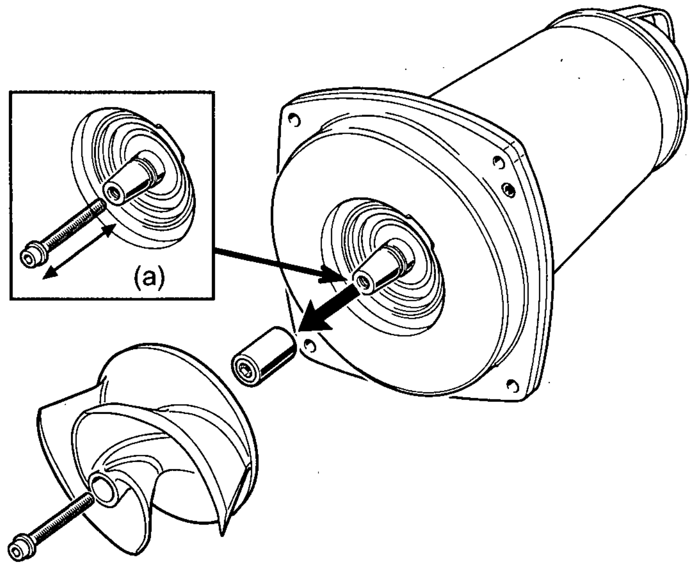
   b) Remove the drive unit from the pump housing.



2. Remove the impeller:
   a) Place the drive unit horizontally.
   b) Lock the impeller as shown in the figure.
   c) Remove the impeller screw.



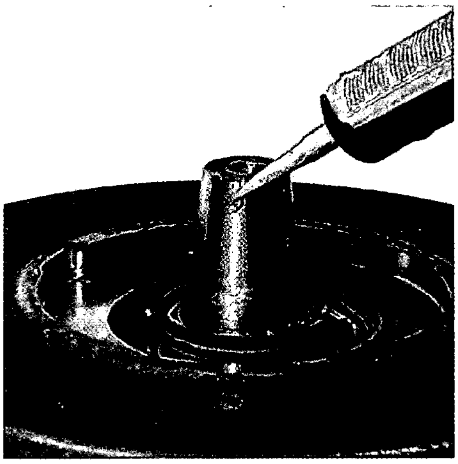
   d) Turn the adjustment screw counter-clockwise until the impeller breaks free from the shaft.
   e) Remove the impeller and the conical sleeve.



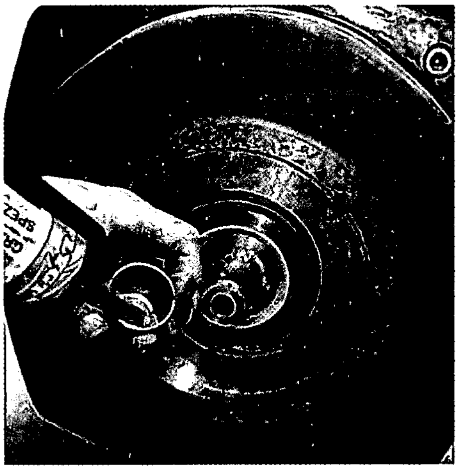
Install the impeller for dry installation

1. Prepare the sleeve:
   a) Make sure that the end of the shaft is free from burrs.
   Polish off any flaws with a fine emery cloth.
   b) Grease the shaft end.

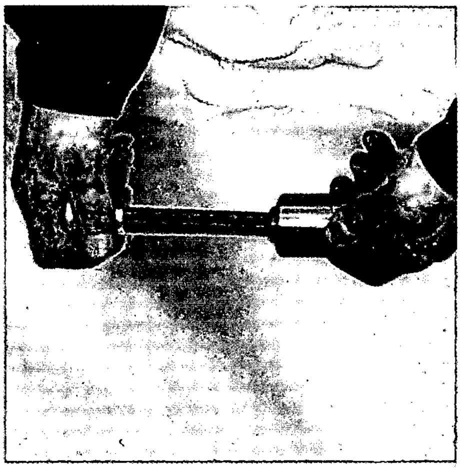
   NOTICE:
   The impeller can become loose. Remove any surplus grease from conical and cylindrical surfaces of shafts and sleeves.



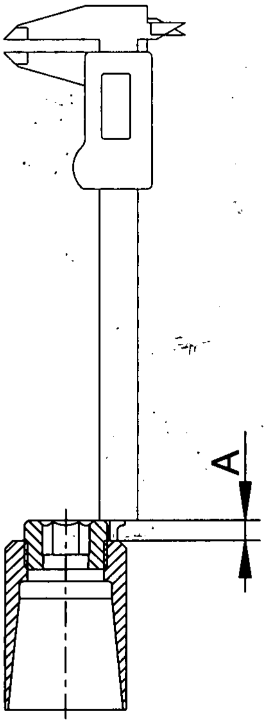
   c) Grease the conical sleeve, the threads of the adjustment screw, the washer, and the impeller screw.



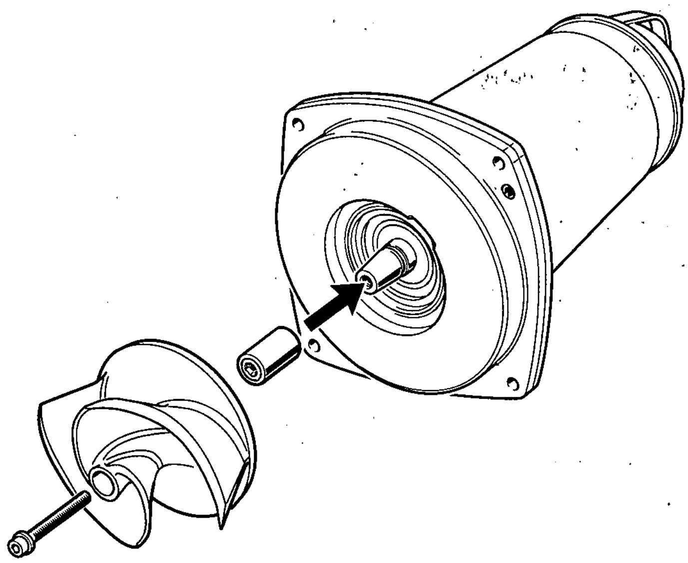
   d) Unscrew the adjustment screw approximately 5 mm (0.2 in.).



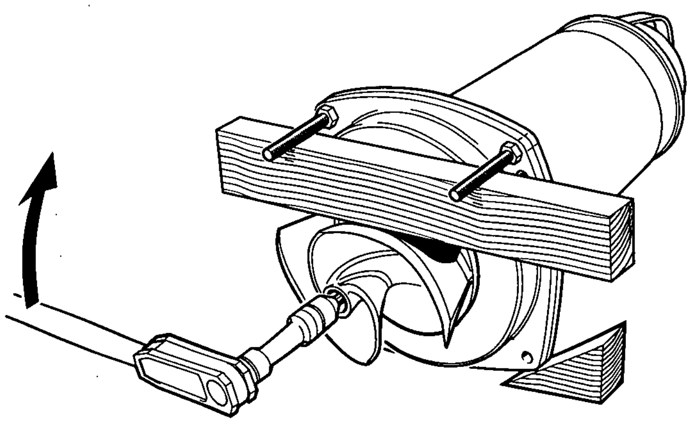
e) Measure and note the distance A.



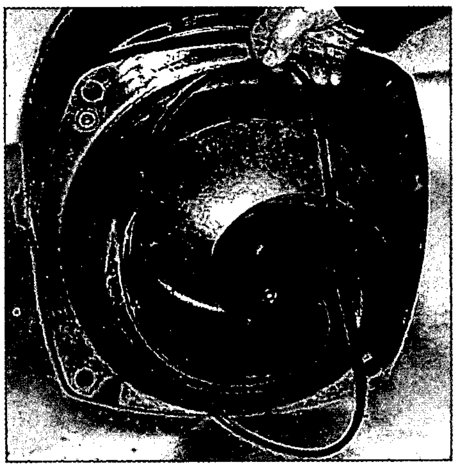
2. Fit the impeller:
   a) Fit the sleeve and the impeller to the shaft.



b) Fit the impeller screw and washer and tighten.

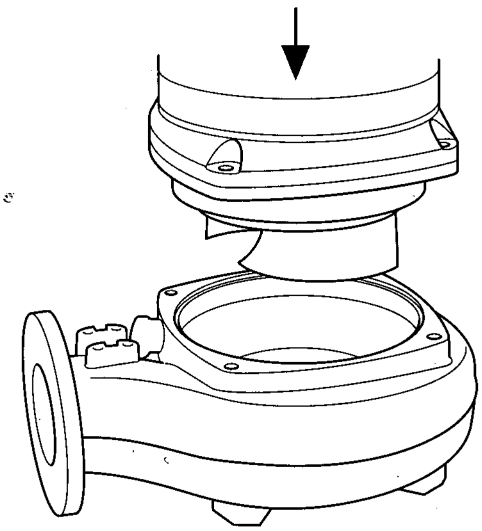


3. Make sure that the O-ring is removed from the seal housing cover.

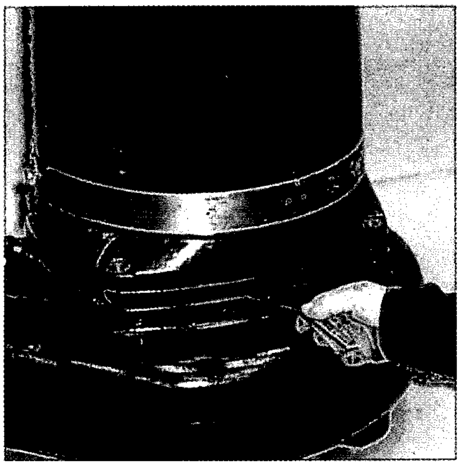


4. Measure the trim distance:

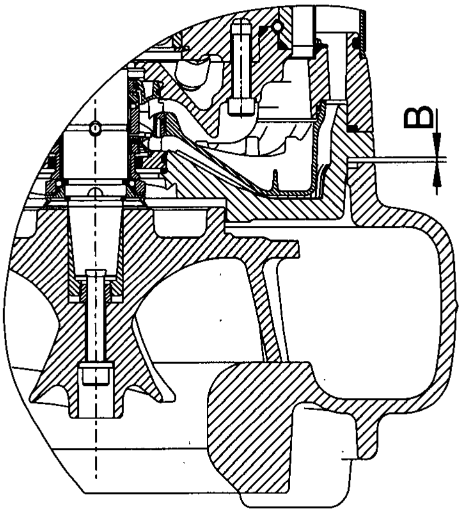
a) Place the drive unit in the pump housing.



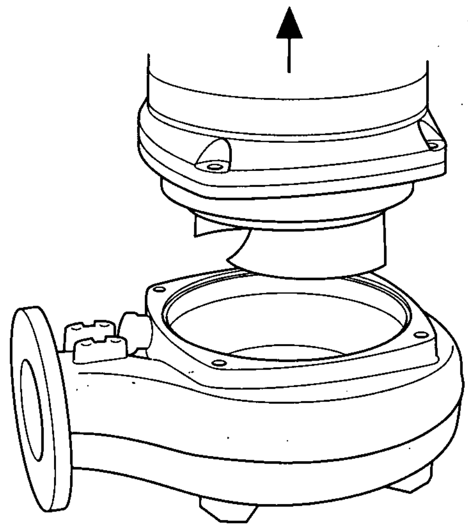
b) Check the distance between the seal housing cover and the pump housing with a feeler gauge. Check diagonally at four points.



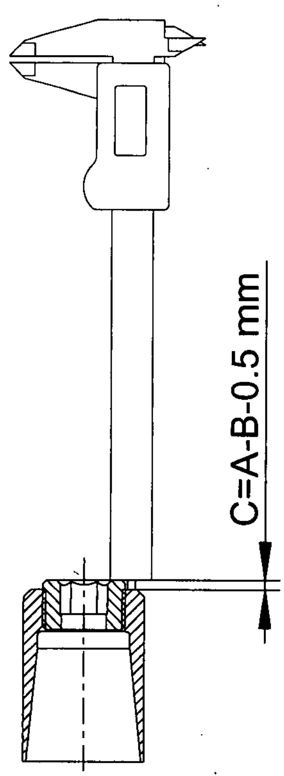
c) Note the largest distance B.



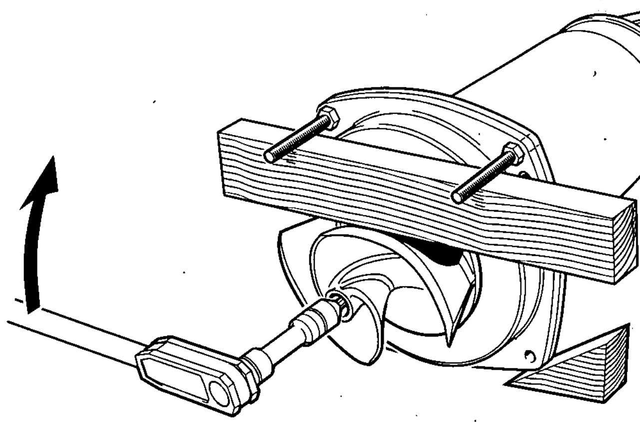
d) Lift the drive unit out of the pump housing and remove the impeller and conical sleeve.



5. Trim to the correct distance:
   a) Calculate the measure C according to the formula shown in the image.

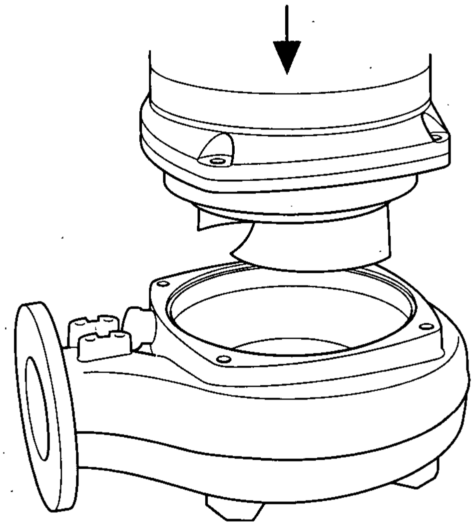


   b) Unscrew the adjustment screw until C is reached.
6. Fasten the impeller:
   a) Fit the sleeve, impeller, greased washer with a greased impeller screw.
   b) Tighten the impeller screw.
      Tighten it further 1/8 turn (45°).

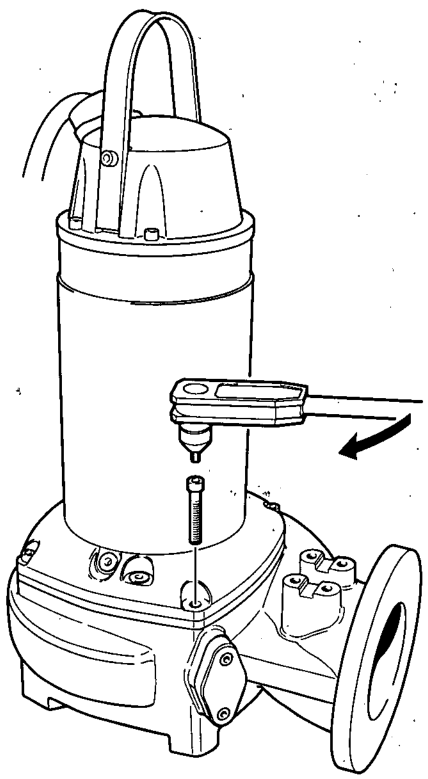


7. Install the drive unit in the pump housing:
   a) Fit a new and greased O-ring to the seal housing cover.

   b) Place the drive unit in the pump housing.

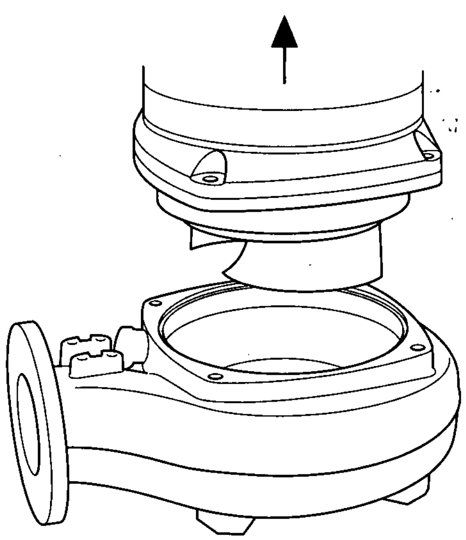


   c) Adjust the position of the drive unit so that the inspection hole is on the same side as the flush valve. Tighten the screws diagonally.

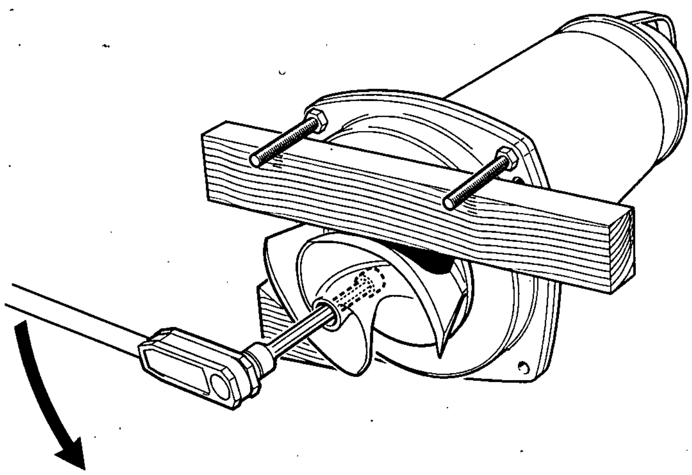


Adjust the impeller

1. Remove the drive unit from the pump housing.



2. Remove the impeller and the conical sleeve.
   a) Turn the screw counter-clockwise until the impeller is free from the shaft.
   Use a 12 mm hexagon bit adapter with a minimum length of 100 mm (3.94 in.).



3. To complete adjusting the impeller, continue with the steps in *Install the impeller for dry installation* (page 45).

Service the pump

Regular inspection and service of the pump ensures more reliable operation.

Type of service	Inspection interval
Intermediate service	Every 2 years /8000 hours (For standard sewage applications with FLS10 in use and a pumped liquid temperature of 40°C (104°F) or less.)
Major service in an authorized service shop	Every 20,000 hours (May vary considerably depending on operating conditions.)

Intermediate service

Service of the...	Action
Cable	1. If the outer jacket is damaged, replace the cable. 2. Check that the cables do not have any sharp bends and are not pinched.
Connection to power	Check that the connections are properly tightened.
Electrical cabinets	Check that they are clean and dry.
Impeller	1. Check the impeller clearance. 2. Adjust the impeller, if necessary.
Inspection chamber	1. Drain all liquid, if any. 2. Check the resistance of the leakage sensor. Normal value approx.1200 ohms, alarm approx. 430 ohms.
Insulation	1. Check that the resistance between the earth (ground) and phase lead is more than 5 megohms. 2. Conduct a phase-to-phase resistance check.
Junction box	Check that it is clean and dry.
Level regulators	Check the condition and functionality.
Lifting device	Check that local safety regulations are followed.
Lifting handle	1. Check the screws. 2. Check the condition of the lifting handle. 3. Replace if necessary.

Service of the...	Action
O-rings	1. Replace the oil plug O-rings 2. Replace the O-rings at the entrance or junction cover. 3. Grease the new O-rings.
Overload protection and other protections	Check the correct settings.
Personnel safety devices	Check the guard rails, covers, and other protections.
Rotation direction	Check the impeller rotation.
Seal housing	1. Fill with new coolant, if necessary. 2. Check that the freezing point is lower than -13°C (9°F).
Terminal board	Check that the connections are properly tightened.
Thermal contacts	Check the resistance of the leakage sensor. Normally closed circuit; interval 0–1 ohm.
Thermistor	Check the resistance is between 20–250 ohms and the measured voltage is maximum 2 V DC.
Voltage and amperage	Check the running values.

Major service

For a major service, take this action, in addition to the tasks listed under intermediate service.

Service of the...	Action
Support and main bearing	Replace the bearings with new bearings.
Mechanical seal	Replace with new seal units.

Service in case of alarm

Alarm source	Action
FLS10	1. Drain the fluid in the inspection chamber. Fill with new coolant if necessary. 2. Check the freezing point (lower than -13°C or 9°F). Check the inspection chamber again after one week of operation. If leakage has occurred: 1. Drain the fluid. 2. Change the mechanical seal unit. 3. Replace with new coolant.
The thermistor/Thermal contact	1. Check the coolant level (pump with cooling jacket). 2. Check the start and stop levels.
The overload protection	Check that the impeller can rotate freely.

Troubleshooting

Introduction

Follow these guidelines when troubleshooting the pump:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the pump when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

The pump does not start

WARNING:
Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Cause	Remedy
An alarm signal has been triggered on the control panel.	Check that: • The impeller rotates freely. • If the sensor indicator indicates an alarm. • The overload protection is not tripped. If the problem still persists: Contact the local ITT service shop.
The pump does not start automatically, but can be started manually.	Check that: • The start level regulator is functioning. Clean or replace if necessary. • The thermal contacts have not opened. • All connections are intact. • The relay and contactor coils are intact. • The control switch (Man/Auto) makes contact in both positions.
The installation is not receiving voltage.	Check that: • The main power switch is on. • There is control voltage to the start equipment. • The fuses are intact. • There is voltage in all phases of the supply line. • All fuses have power and that they are securely fastened to the fuse holders. • The overload protection is not tripped. • The motor cable is not damaged.
The impeller is stuck.	Clean: • The impeller • The sump in order to prevent the impeller from clogging again.

If the problem persists, refer to the Flygt Service Guide on the web or contact the local ITT service shop. Always state the serial number of your pump when you contact ITT, see *Product Description* (page 11).

The pump does not stop when a level sensor is used

WARNING:

Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Cause	Remedy
The pump is unable to empty the sump to the stop level.	Check that: • There are no leaks from the piping and/or discharge connection. • The impeller is not clogged. • The non-return valve(s) are functioning properly. • The pump has adequate capacity. For information: Contact the local ITT service shop.
There is a malfunction in the level-sensing equipment.	• Clean the level regulators. • Check the functioning of the level sensors. • Check the contactor and the control circuit. • Replace all defective items.
The stop level is set too low.	Raise the stop level.

If the problem persists, refer to the Flygt Service Guide on the web or contact the local ITT service shop. Always state the serial number of your pump when you contact ITT, see *Product Description* (page 11).

The pump starts-stops-starts in rapid sequence

Cause	Remedy
The pump starts due to back-flow which fills the sump to the start level again.	Check that: • The distance between the start and stop levels is not too small. • The non-return valve(s) work(s) properly. • The riser is not too long without a non-return valve.
The self-holding function of the contactor malfunctions.	Check: • The contactor connections. • The voltage in the control circuit in relation to the rated voltages on the coil. • The functioning of the stop-level regulator. • Whether the voltage drop in the line at the starting surge causes the contactor's self-holding malfunction.

If the problem persists, refer to the Flygt Service Guide on the web or contact the local ITT service shop. Always state the serial number of your pump when you contact ITT, see *Product Description* (page 11).

The pump runs but the motor protection trips

WARNING:

Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Cause	Remedy
The motor protection is set too low.	Set the motor protection according to the data plate.

Cause	Remedy
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The drive unit is not receiving full voltage on all three phases.	• Check the fuses. Replace fuses that have tripped. • If the fuses are intact, notify a certified electrician.
The phase currents vary, or they are too high.	Contact the local ITT service shop.
The insulation between the phases and ground in the stator is defective.	1. Use an insulation tester. With a 1000 V DC megger, check that the insulation between the phases and between any phase and ground is > 5 megohms. 2. If the insulation is less: Contact the local ITT service shop.
The density of the pumped fluid is too high.	Make sure that the maximum density is 1100 kg/m^3 (9.2 lb/US gal) • Change the impeller or to a more suitable pump. • Contact the local ITT service shop.
There is a malfunction in the overload protection.	Replace the overload protection.

If the problem persists, refer to the Flygt Service Guide on the web or contact the local ITT service shop. Always state the serial number of your pump when you contact ITT, see *Product Description* (page 11).

The pump delivers too little or no water

WARNING:

Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The impeller rotates in the wrong direction.	• If it is a 3-phase pump, transpose two leads. • If it is a 1-phase pump: Contact the local ITT service shop.
One or more of the valves are set in the wrong positions.	• Reset the valves that are set in the wrong position. • Replace the valves, if necessary. • Check that all valves are correctly installed according to media flow. • Check that all valves open correctly.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The pipes are obstructed.	Clean out the pipes to ensure a free flow.
The pipes and joints leak.	Find the leaks and seal them.
There are signs of wear on the impeller, pump, and casing.	Replace the worn parts.
The liquid level is too low.	• Check that the level sensor is set correctly. • Depending on the installation type, add a means for priming the pump, such as a foot valve.

If the problem persists, refer to the Flygt Service Guide on the web or contact the local ITT service shop. Always state the serial number of your pump when you contact ITT, see *Product Description* (page 11).

Technical reference

Application limits

Data	Description
Liquid temperature	40°C (104°F) maximum Warm-liquid version (only with cooling jacket): 70°C (158°F) maximum Ex-approved pumps: 40°C (104°F) maximum
Liquid density	1100 kg/m³ (9.2 lb per US gal) maximum
pH of the pumped media (liquid)	5.5–14
Depth of immersion	20 m (65 ft) maximum
Other	For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump.

Motor data

Feature	Description
Motor type	Squirrel-cage induction motor
Frequency	50 or 60 Hz
Supply	3-phase
Starting method	• Direct on-line • Star-delta
Maximum starts per hour	30 evenly spaced starts per hour
Code compliance	IEC 60034-1
Rated output variation	±10%
Voltage variation without overheating	±10%, provided that it does not run continuously at full load.
Voltage imbalance tolerance	2%
Stator insulation class	H (180°C [360°F]).

ITT

What can ITT Water & Wastewater do for you?

Integrated solutions for fluid handling are offered by ITT Water &Wastewater as a world leader in transport and treatment of wastewater. We provide a complete range of water, wastewater and drainage pumps, equipment for monitoring and control, units for primary and secondary biological treatment, products for filtration and disinfection, and related services. ITT Water & Wastewater, headquartered in Sweden, operates in some 140 countries across the world, with own plants in Europe, China and North and South America. The company is wholly owned by the ITT Corporation of White Plains, New York, supplier of advanced technology products and services.

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 895381_10.0_en.US_2010-01_IOM.3153.091/.095/.181/.185/.350/.390

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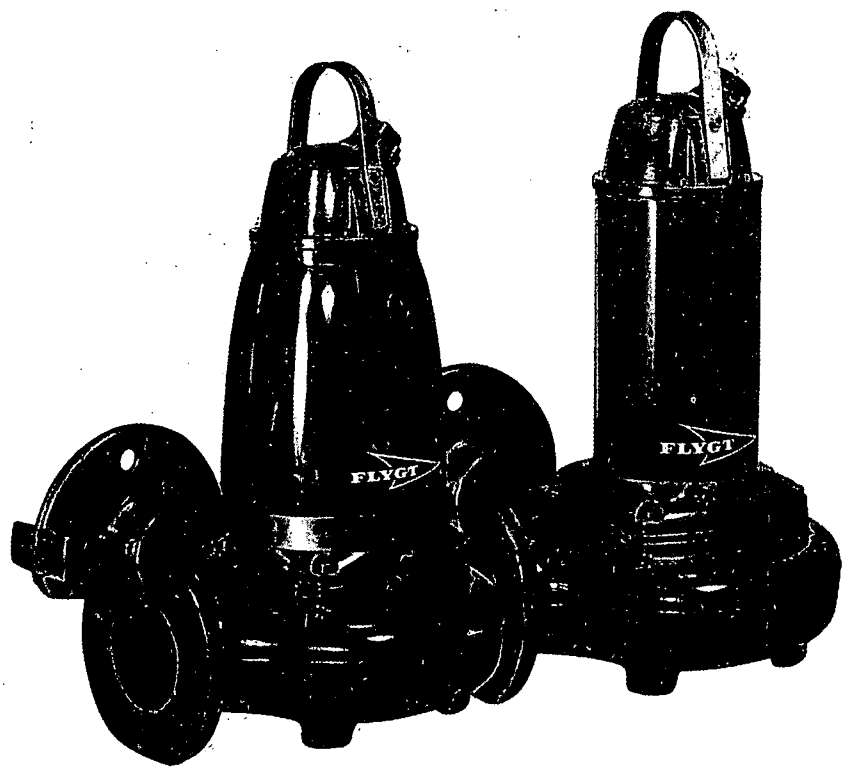
Water & Wastewater

Parts List

Flygt 3153.091/095/181/185



FLYGT

Engineered for life

Parts List

Flygt 3153.091/095/181/185

Overview

Table of Contents

This publication contains the following topics:

Topic

Preface

Purpose

The purpose of this manual is to give the reader information about available spare parts and accessories for the product.

Recipient

The manual is principally intended for ITT

- customers
- service personnel *and*
- sales personnel.

Contact

Please contact ITT if any information in this publication is

- incorrect
- missing
- difficult to find *or*
- irrelevant.

Reference

More information about the product is available in the following documents:

- Installation
- Service and Maintenance
- Accessories. Please see Mechanical Accessories at ITT intranet, GPI for list of Stationary Discharge Connections.

Practical Information

Overview

Table of Contents

This chapter contains the following topics:

Topic

Data Plate Interpretation

Introduction

The ITT product is always provided with data plates:

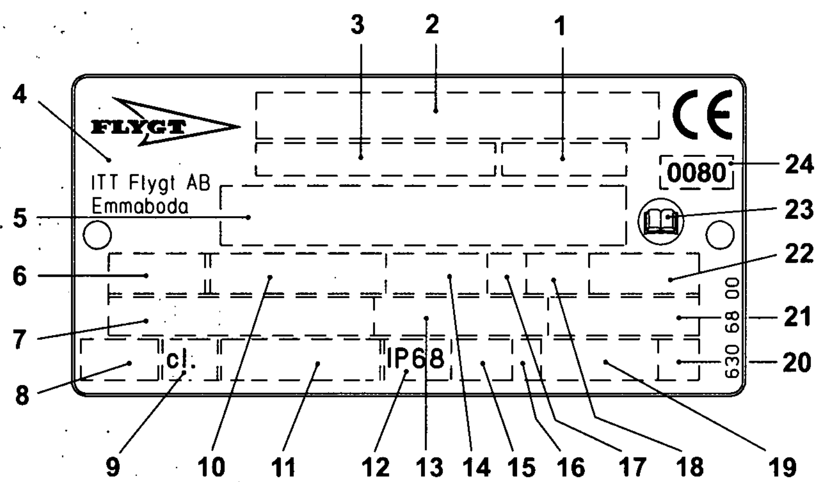
- The general data plate is used on all products.
- The approval plate is added to all explosion proof products.

Data Plate

The product may only be operated within the parameters stated on the data plate.

Illustration

This is an illustration of a general data plate.



Field description

This table shows the fields on the general data plate, and which information each field contains.

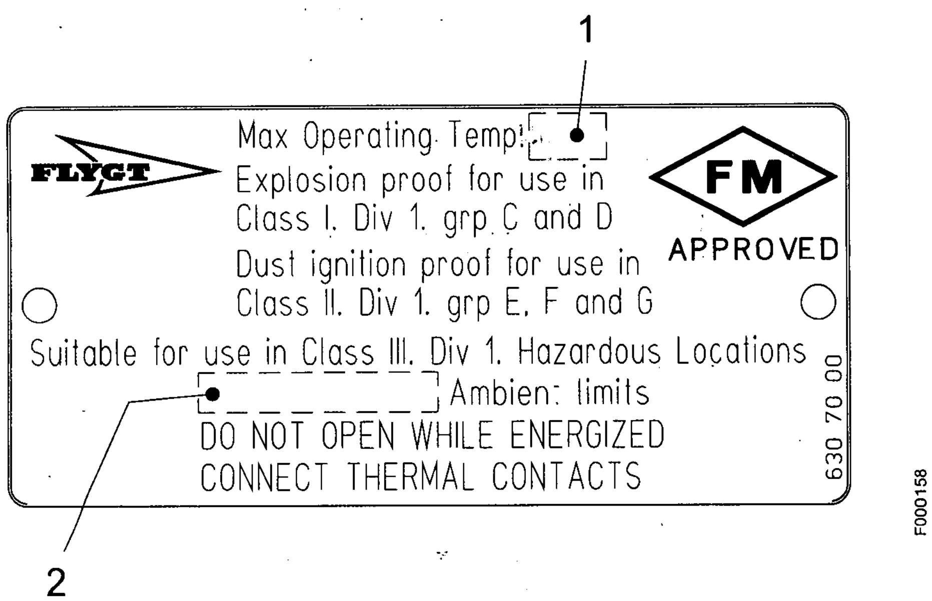
Field	Description	Field	Description
1	Curve code/Propeller code	13	Rated current
2	Serial number	14	Rated speed
3	Product number	15	Maximal submersion
4	Country of origin	16	Direction of rotation: • L = Left • R = Right
5	Additional information	17	Duty class
6	Phase; type of current, frequency	18	Duty factor
7	Rated voltage	19	Product weight
8	Thermal protection	20	Locked rotor code letter
9	Thermal class	21	Power factor
10	Rated shaft power	22	Maximal ambient temperature

Field	Description	Field	Description
11	International standard	23	Read Installation Manual
12	Degree of protection	24	Notified body (only for EN-approved Ex-products)

Approval Plate – FM approved version

Illustration

This is an illustration of an approval plate for the FM approved product version.



Field description

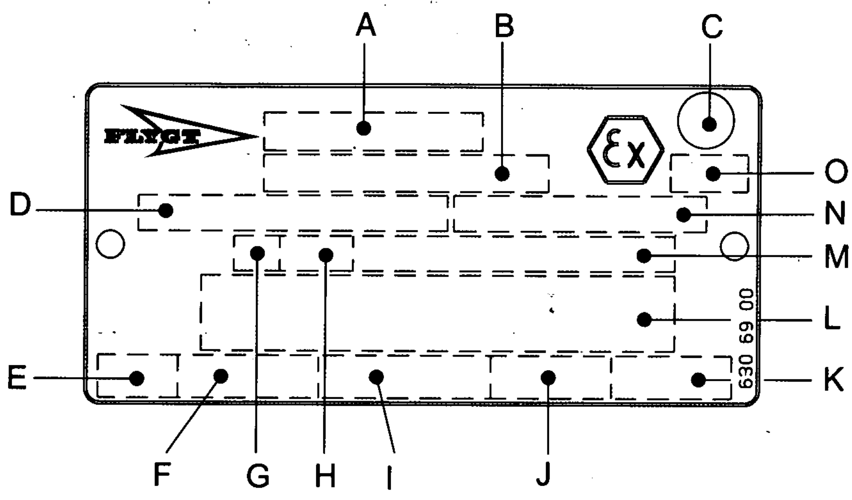
This table shows the fields on the approval plate, and which information each field contains.

Field	Description
1	Temperature class
2	Maximum ambient temperature

Approval Plate – EN approved version

Illustration

This is an illustration of an approval plate for the EN approved product version.



Field description

This table shows the fields on the approval plate.

Field	Description	Field	Description
A	Approval	I	Input power
B	Approval authority + Approval Number	J	Rated speed
C	Approval for Class 1	K	Controller
D	Approved drive unit	L	Additional information
E	Stall time	M	Max. ambient temperature
F	Starting current / Rated current	N	Serial number
G	Duty class	O	ATEX marking
H	Duty factor	—	—

Approval

The approval for the European version according to ATEX Directive 94/9/EC is shown on the Approval Plate with one of the following information:

⟨Ex⟩ IM2 EEx de I

⟨Ex⟩ IM2 EEx dI

⟨Ex⟩ II2G EEx de IIB T3

⟨Ex⟩ II2G EEx d IIB T3

⟨Ex⟩ II2G EEx d IIB T4

Cable entry: The approval for the cable entry has the following certificate number:

INERIS 02ATEX 9008 U

⟨Ex⟩ II 2 G or IM2 EEx dIIC or EEx dI

Product Identity

Sales denomination

The product's identity is built up of the Sales Code (four digit) and two letters indicating hydraulic end and type of installation.

This is an example of a sales denomination.

NP 3085

1 2 3

Table: This table explains what the letters and the numbers in the sales code stand for.

Code Position	Gives information about the...
1	hydraulic part
2	installation mode
3	sales code

Product code

In each range the product´s identity, Product Code, is made up of seven digits.

This is an example of a product code.

NP 3085.183

1 2

Table: This table explains what the product code is made up of:

Code position	Gives information about the ...
1	sales denomination
2	version

Serial number

The serial number is used for identification of an individual pump/mixer.

This is an example of a serial number.

NP 3085.183 - 951 0163

1 2 3 4

Table: This table explains what the serial number is made up of:

Product code position	Gives information about the ...
1	product code
2	production year
3	production cycle
4	running number

Order parts

Order

When ordering spare parts, state serial number of the product, spare part number and quantity.

Requirements

Genuine ITT parts must always be used for repairs if the product is to fulfill requirements and obtain official approval.

Qualification of personnel

Only ITT or ITT-authorized service personnel may undertake repair work on Ex-approved products.

Specially Approved Products

Spare parts marked with (EX) after the part number are subject to dimensional accuracy inspection.

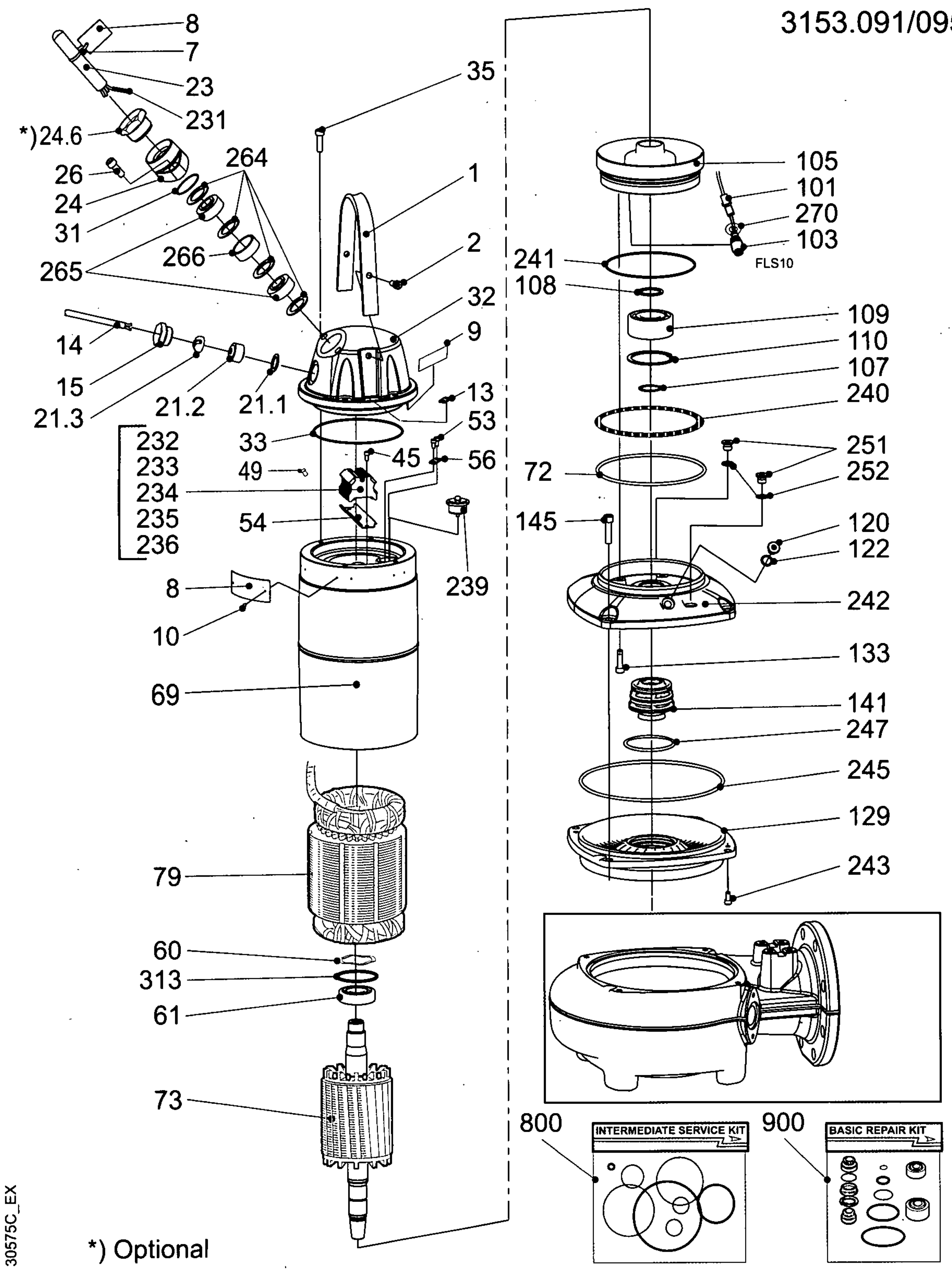
Motor Parts

Overview

Table of Contents

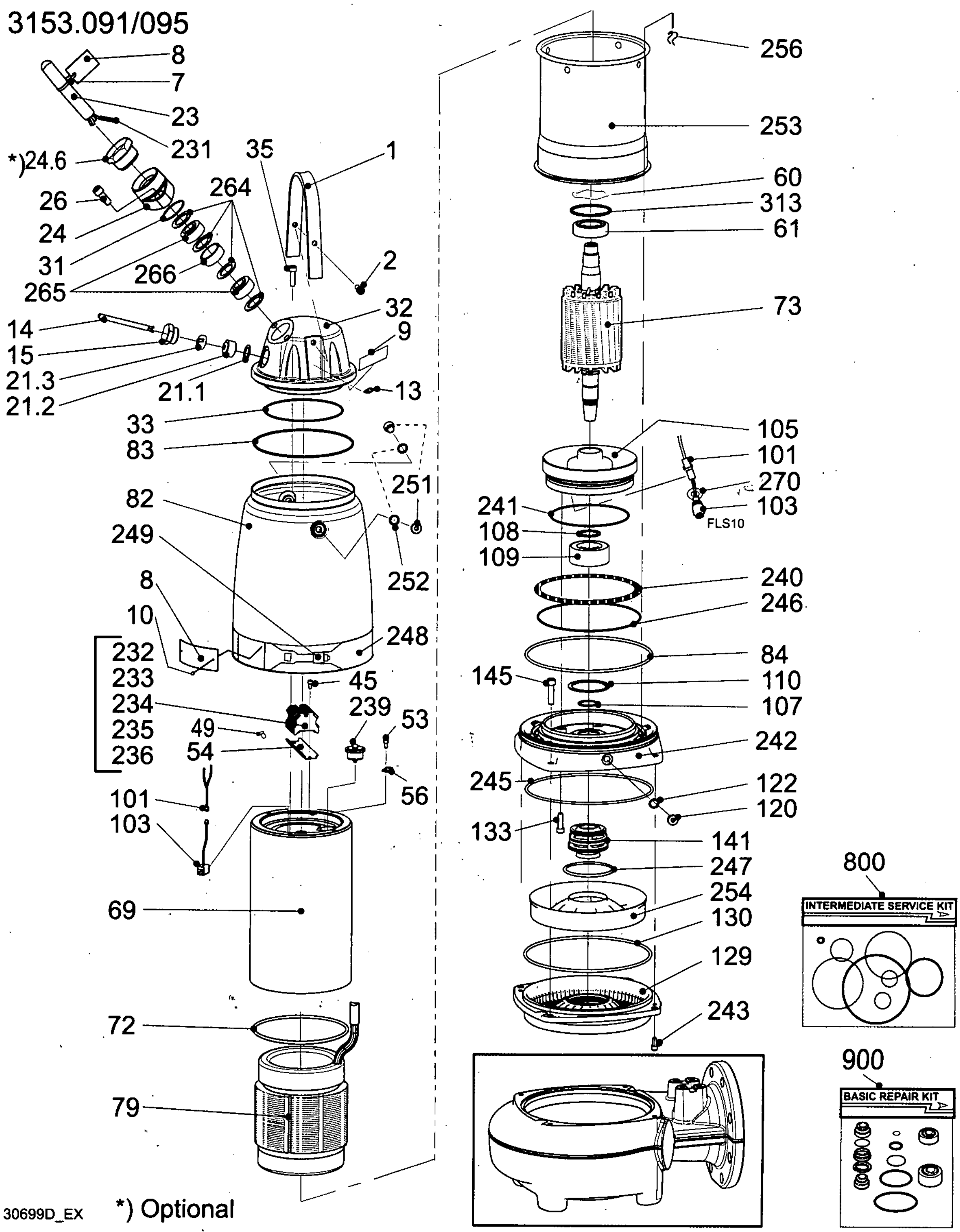
This chapter contains the following topics:

Exploded view: Motor Parts, Explosion proof version without Cooling jacket



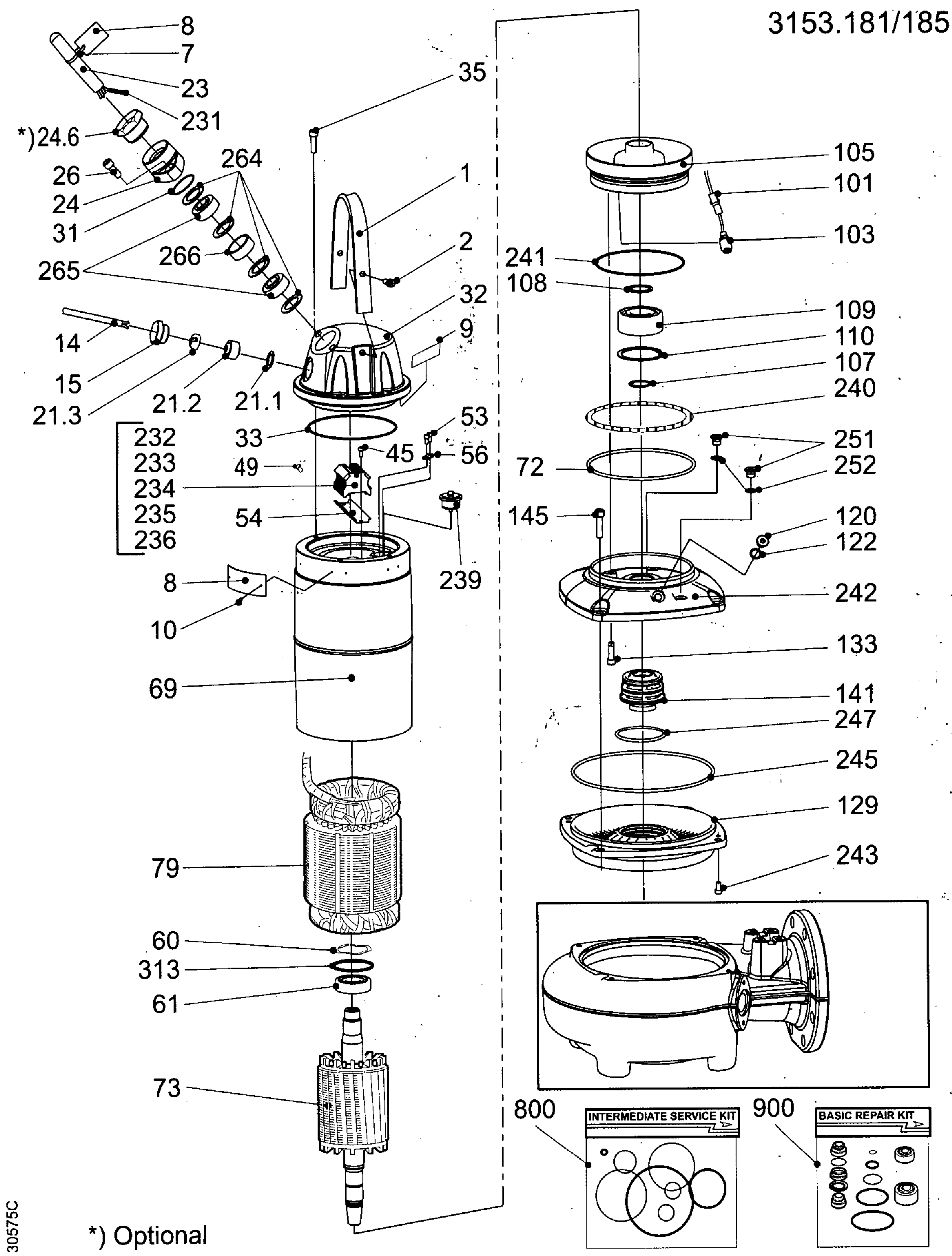
*) Optional

Exploded view: Motor Parts, Explosion proof version with Cooling jacket

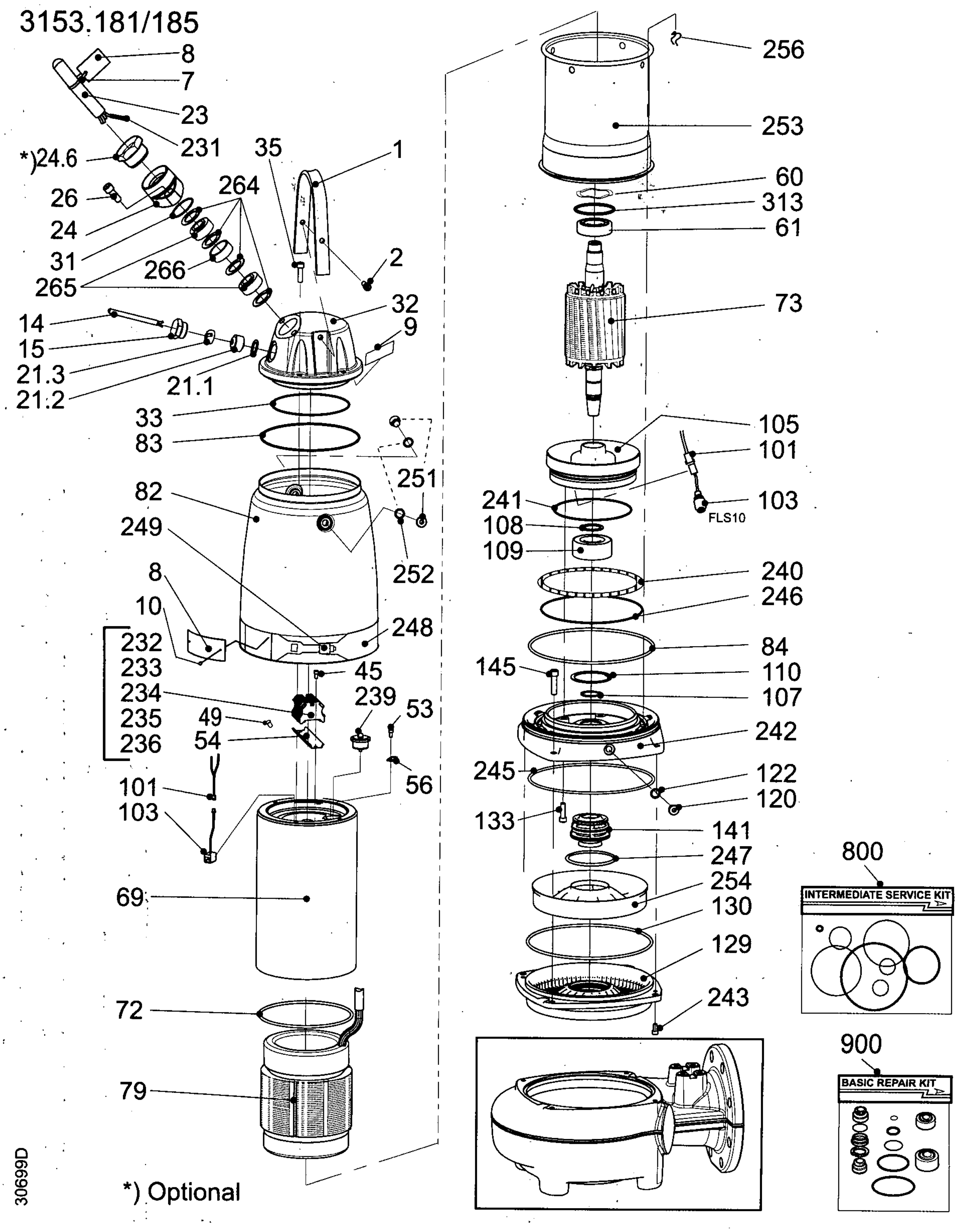


30699D_EX *) Optional

Exploded view: Motor Parts, Standard version without Cooling jacket



Exploded view: Motor Parts, Standard version with Cooling jacket



List of Motor Parts

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
1	642 15 00	Lifting handle		1	1	1	1
2	83 04 56	Hex.socket hd screw M10X35-A4-80		2	2	2	2
7	83 45 52	Cable tie 292X3.5;NYLON;+125 C		1	1	1	1
7	83 45 59	Cable tie 200X2.4 PA 6/6 -55+105		1	1	1	1
8	630 68 00	Data plate USE 6306801 AS SPARE PART		2	2	2	2
8	630 69 00	Certificate plate EX		1	2		
8	630 70 00	Certificate plate FM APPROVED		1	1		
8	630 76 00	Plate HOT WATER PRODUCT				1	1
9	83 93 50	Marking strip 5-GW(T1;T2;T15;T16)		1	1	1	1
9	83 93 51	Marking strip W5;V5;U5;V2;W1;U2;V1;W2;U		1	1	1	1
9	650 09 00	Connection plate	FLS10/thermal contact	1	1	1	1
9	650 10 00	Connection plate	FLS/thermistor			1	1
9	657 79 00	Connection plate SCREENED SUBCAB		1	1	1	1
9	681 58 00	Plate		1	1	1	1
9	698 94 00	Connection plate		1	1	1	1
9	698 95 00	Connection plate		1	1	1	1
10	82 20 88	Drive screw 4X5-A2-70		6	6	4	4
13	642 16 00	Earthing plate		1	1		
14	94 19 22	Control cable SUBCAB 7X1.5MM2 OD=15-17		*	*	*	*
14	94 19 30	Control cable 25X1.5	25x1.5 mm2	1	1	1	1
15	397 81 00 (EX)	Gland screw FOR CABLE ENTRY		1	1	1	1
21.1	82 40 61	Plain washer (10)-22MM		1	1	1	1
21.2	84 17 90	Seal sleeve (10)-12MM		1	1	1	1
21.2	84 17 92	Seal sleeve (14)-16MM		1	1	1	1
21.3	678 58 12	Cable clip (10)-12MM		1	1	1	1
21.3	678 58 16	Cable clip (14)-16MM		1	1	1	1
23	94 17 81	Motor cable SUBCAB S3X2,5+3X2,5/3+4X1	SUBCAB S3X2,5+3X2,5/3+4X1,5, Max 70°C (158°F)(18.7) -20 mm. Screened	*	*	*	*
23	94 17 82	Motor cable SUBCAB S3X6+3X6/3+4X1,5	Max 70°C (158°F)(20) -23 mm. Screened	*	*	*	*
23	94 17 84	Motor cable SUBCAB S3X16+3X16/3+4X1,5	Max 70°C (158°F)(29) -32 mm. Screened	*	*	*	*

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
23	94 20 56	Motor cable SUBC 4G6+2X1.5MM2 23-25	Max 70°C (158°F)(23) -25 mm	*	*	*	*
23	94 20 57	Motor cable SUBC 4G10+2X1.5MM2 26-28	Max 70°C (158°F)(26) -28 mm	*	*	*	*
23	94 20 59	Motor cable SUBC 4G2,5+2X1.5MM2 17-18	Max 70°C (158°F)(17) -18 mm	*	*	*	*
23	94 20 60	Motor cable SUBC 4G4+2X1.5MM2 20-22	Max 70°C (158°F)(17) -18 mm	*	*	*	*
23	94 20 80	Motor cable SUBC 7G4+2X1.5MM2 22-26	Max 70°C (158°F)(22) -26 mm	*	*	*	*
23	94 20 81	Motor cable SUBC 7G6+2X1.5MM2 24-28	Max 70°C (158°F)(24.3) -28.3 mm	*	*	*	*
23	94 20 82	Motor cable SUBC 7G2,5+2X1.5MM2 20-23	Max 70°C (158°F)(20) -23 mm	*	*	*	*
23	94 21 02	Motor cable SUBCAB 14AWG/7	Subcab 14AWG/7 2.08mm² (18-20mm).	*	*	*	*
23	94 21 04	Motor cable SUBCAB 12AWG/7	Subcab 12AWG/7 3.31mm² (20-22mm).	*	*	*	*
23	94 21 06	Motor cable SUBC 10AWG/3-2-1-GC 20-22	Subcab 10AWG/3-2-1-GC 5.26mm² (20.3-22.3mm).	*	*	*	*
23	94 21 08	Motor cable SUBC 8AWG/3-2-1-GC 27-29	Max 70°C (158°F)(27.2) -29.2 mm	*	*	*	*
23	94 21 09	Motor cable SUBC 6AWG/3-2-1-GC 30-32	Max 70°C (158°F)(30) -32 mm	*	*	*	*
23	94 21 10	Motor cable SUBC 4AWG/3-2-1-GC 33-35	Max 70°C (158°F)(33) -35 mm	*	*	*	*
24	597 87 01 (EX)	Entrance flange SS	ISO228/1-G1 1/4	1	1	1	1
24	597 87 04 (EX)	Entrance flange ISO 228/1-G2		1	1	1	1
24	597 87 08 (EX)	Entrance flange 2-11.5 NPT		1	1	1	1
24	597 87 11 (EX)	Entrance flange 1 1/2-11.5 NPT		1	1	1	1
24	642 17 01 (EX)	Entrance flange	Cast iron	1	1	1	1
24.6	633 11 01	Gland screw 1 1/4" ISO.FOR METALHOSE		1	1	1	1
24.6	633 11 04	Gland screw 1 1/2" NPT.FOR METALHOSE		1	1	1	1
25	84 41 09	Plate		1	1	1	1
26	83 04 53	Hex.socket hd screw M12X45-A4-80		2	2	2	2
30	429 24 00	Metal hose ISO 7/1 RP 1 1/4"	ISO 7/1 Rp 1 1/4, ISO 7/1 R1 1/4	1	1	1	1
30	517 38 00	Metal hose ISO 7/1 RP 2"	ISO 7/1 Rp 2, ISO 7/1 R2	1	1	1	1
31	82 74 63	O-ring 49.5X3 NBR		1	1	1	1

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
31	82 81 03	O-ring 49.5X3 FPM		1	1	1	1
32	642 14 00	Entrance cover	Intended for only motorcable			1	1
32	642 14 01 (EX)	Entrance cover	Intended for only motorcable	1	1		
32	642 14 04	Entrance cover	Intended for motorcable and aux.cable			1	1
32	642 14 05 (EX)	Entrance cover	Intended for motorcable and aux.cable	1	1		
33	82 71 33	O-ring 175X3.0 FPM		1	1	1	1
33	82 78 35	O-ring 175.0X3.0 NBR		1	1	1	1
35	83 04 56	Hex.socket hd screw M10X35-A4-80		4	4	4	4
45	82 00 11	Hex.socket hd screw EXT. GROUND SCREW M6X12		2	2	2	2
49	83 42 48	End sleeve H16/24		3	3	3	3
49	83 42 49	End sleeve H25/30		3	3	3	3
53	82 00 11	Hex.socket hd screw EXT. GROUND SCREW M6X12		6	6	4	4
54	642 08 00	Rail		1	1	1	1
56	642 16 00	Earthing plate		2	2	2	2
60	82 56 25	Spring washer 71.5X59.0X0.55		1	1	1	1
61	83 30 16	Ball bearing 3306A-2Z/C3VT113		1	1	1	1
69	642 09 00	Stator housing				1	1
69	642 09 01 (EX)	Stator housing		1	1		
72	82 74 94	O-ring 209.3X5.7 NBR		1	1	1	1
72	82 80 83	O-ring 209.3X5.7 FPM		1	1	1	1
73	641 91 03	Shaft unit	For motor 21-18-2	1	1	1	1
73	641 98 05 (EX)	Shaft unit	For motor 21-15-4	1	1	1	1
73	641 98 06 (EX)	Shaft unit	For motor 21-18-4	1	1	1	1
73	648 61 01 (EX)	Shaft unit	For motor 21-18-6	1	1	1	1
79	641 93 01 (EX)	Stator 21-18-4a	3-phase, 50 Hz, 400VD/690VY. 3-phase, 60 Hz, 460V D.	1	1	1	1
79	641 93 02 (EX)	Stator 21-18-4a	3-phase, 50 Hz, 400VY/230VD.	1	1	1	1
79	641 93 03 (EX)	Stator 21-18-4a	3-phase, 50 Hz, 415 - 440V D.	1	1	1	1
79	641 93 04 (EX)	Stator 21-18-4a	3-phase, 60 Hz, 200 - 208V D.	1	1	1	1
79	641 93 05 (EX)	Stator 21-18-4a	3-phase, 60 Hz, 460VY SER/230VY //.	1	1	1	1

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
79	641 93 06 (EX)	Stator 21-18-4a	3-phase, 60 Hz, 380V D.	1	1	1	1
79	641 93 07 (EX)	Stator 21-18-4a	3-phase, 60 Hz, 380V Y.	1	1	1	1
79	641 93 08 (EX)	Stator 21-18-4a	3-phase, 50 Hz, 500V D. 3-phase, 60 Hz, 575 - 600V D.	1	1	1	1
79	641 93 09 (EX)	Stator 21-18-4a	3-phase, 50 Hz, 380V D/660V Y. 3-phase, 60 Hz, 440V D	1	1	1	1
79	641 94 01 (EX)	Stator 21-15-4a	3-phase, 50 Hz, 690VY/400VD. 3-phase, 60 Hz, 460V D.	1	1	1	1
79	641 94 02 (EX)	Stator 21-15-4a	3-phase, 50 Hz, 400VY/230VD.	1	1	1	1
79	641 94 03 (EX)	Stator 21-15-4a	3-phase, 50 Hz, 415 - 440VD.	1	1	1	1
79	641 94 04 (EX)	Stator 21-15-4a	3-phase, 60 Hz, 200 - 208V D.	1	1	1	1
79	641 94 05 (EX)	Stator 21-15-4a	3-phase, 60 Hz, 460VYSER/230VY//.	1	1	1	1
79	641 94 06 (EX)	Stator 21-15-4a	3-phase, 60 Hz, 380V D.	1	1	1	1
79	641 94 07 (EX)	Stator 21-15-4a	3-phase, 60 Hz, 380V Y	1	1	1	1
79	641 94 08 (EX)	Stator 21-15-4a	3-phase, 50 Hz, 500VD. 3-phase, 60 Hz, 575 - 600V D	1	1	1	1
79	641 94 09 (EX)	Stator 21-15-4a	3-phase, 50 Hz, 660VY/380VD. 3-phase, 60 Hz, 440V D.	1	1	1	1
79	647 27 01 (EX)	Stator 21-18-6	3-phase, 50 Hz, 690VY/400VD. 3-phase, 60 Hz, 460V D.	1	1	1	1
79	647 27 02 (EX)	Stator 21-18-6	3-phase, 50 Hz, 400VY/230VD.	1	1	1	1
79	647 27 03 (EX)	Stator 21-18-6	3-phase, 50 Hz, 415 - 440V D.	1	1	1	1
79	647 27 04 (EX)	Stator 21-18-6	3-phase, 60 Hz, 200 - 208V D.	1	1	1	1
79	647 27 05 (EX)	Stator 21-18-6	3-phase, 60 Hz, 460VY SER/230VY //.	1	1	1	1
79	647 27 06 (EX)	Stator 21-18-6	3-phase, 60 Hz, 380V D.	1	1	1	1
79	647 27 07 (EX)	Stator 21-18-6	3-phase, 60 Hz, 380V Y.	1	1	1	1
79	647 27 08 (EX)	Stator 21-18-6	3-phase, 50 Hz, 500VD. 3-phase, 60 Hz, 575 - 600VD.	1	1	1	1
79	647 27 09 (EX)	Stator 21-18-6	3-phase, 50 Hz, 660VY/380VD. 3-phase, 60 Hz, 440V D.	1	1	1	1
79	654 95 03	Stator 21-18-4a	3-phase, 50 Hz, 415 - 440VD.			1	1
79	654 96 03	Stator 21-15-4a	3-phase, 50 Hz, 415 - 440VD.			1	1

Pos. No	Part. No	Denomination		Qty/Version			
				091	095	181	185
79	659 48 03	Stator 21-18-6	3-phase, 50 Hz, 415 - 440V D.			1	1
79	661 39 01 (EX)	Stator 21-18-2b	3-phase, 50 Hz, 400 - 440VD/690VY. 3-phase, 60 Hz, 460V D.	1	1	1	1
79	661 39 02 (EX)	Stator 21-18-2b	3-phase, 50 Hz, 400VY/230VD.	1	1	1	1
79	661 39 03 (EX)	Stator 21-18-2b	3-phase, 50 Hz, 500VD. 3-phase, 60 Hz, 575 - 600V D	1	1	1	1
79	661 39 04 (EX)	Stator 21-18-2b	3-phase, 60 Hz, 440 - 460VY SER/220 - 230VY //	1	1	1	1
79	661 39 07 (EX)	Stator 21-18-2b	3-phase, 50 Hz, 660VY/380VD. 3-phase, 60 Hz, 440V D.	1	1	1	1
79	661 39 08 (EX)	Stator 21-18-2b	3-phase, 60 Hz, 200 - 208V D	1	1	1	1
79	689 07 01	Stator 21-18-2b	3-phase, 50 Hz, 400 - 440VD/690VY. With thermistor.			1	1
79	702 44 01	Stator 21-18-2f	3-phase, 50 Hz, 660 - 690VY/380 - 400VD. 3-phase, 60 Hz, 440 - 460V D.	1	1	1	1
79	702 44 02	Stator 21-18-2f	3-phase, 50 Hz, 400VY/230VD.	1	1	1	1
79	702 44 03	Stator 21-18-2f	3-phase, 50 Hz, 500VD. 3-phase, 60 Hz, 575 - 600V D.	1	1	1	1
79	702 44 04	Stator 21-18-2f	3-phase, 60 Hz, 440 - 460VY SER/220 - 230VY //	1	1	1	1
79	702 44 07	Stator 21-18-2f	3-phase, 50 Hz, 415 - 440VD.	1	1	1	1
79	702 44 08	Stator 21-18-2f	3-phase, 60 Hz, 200 - 208V D	1	1	1	1
79	702 45 07	Stator 21-18-2f	3-phase, 50 Hz, 415 - 440VD. With thermistor.			1	1
82	608 12 00	Cooling jacket OUTER	Standard	1	1	1	1
82	608 12 01	Cooling jacket OUTER	Stainless Steel	1	1	1	1
83	82 71 70	O-ring 221.84X3.53 FPM		1	1	1	1
83	82 78 49	O-ring 221.84X3.53 NBR		1	1	1	1
84	82 75 01	O-ring 279.3X5.7 NBR		1	1	1	1
84	82 75 22	O-ring 279.3X5.7 FPM		1	1	1	1
101	650 51 00	Cable unit FLS10	Intended for FLS 10	1	1	1	1
103	663 04 00 (EX)	Level sensor FLS10	FLS 10	1	1	1	1
105	642 10 00	Bearing holder				1	1
105	642 10 01 (EX)	Bearing holder		1	1		
107	82 59 06	Retaining ring SGA 40		1	1	1	1
108	82 44 15	Supporting washer 40X50X2.5-SPRING STEEL		1	1	1	1
109	83 30 18	Ball bearing 3308A-2Z/C3VT113	Lower bearing	1	1	1	1

Pos. No	Part. No	Denomination		Qty/Version			
				091	095	181	185
110	83 07 62	Retaining ring JB 90		1	1	1	1
120	642 13 00	Inspection screw		1	1	1	1
122	82 76 85	O-ring 17X3 NBR		1	1	1	1
122	82 79 15	O-ring 17X3 FPM		1	1	1	1
129	642 12 00	Seal housing cover		1	1	1	1
130	82 78 39	O-ring 230X3 NBR		1	1	1	1
133	83 04 56	Hex.socket hd screw M10X35-A4-80		6	6	6	6
141	641 50 30	Mechanical seal DIAM.35	WCCR/WCCR	1	1	1	1
141	641 50 31	Mechanical seal	RSiC/WCCR	1	1	1	1
145	83 04 53	Hex.socket hd screw M12X45-A4-80		4	4	4	4
228	663 85 00	Connection plate		1	1	1	1
229	667 40 01	Sticker		2	2	2	2
231	93 00 77	Shrink hose ID 6.4		*	*	*	*
231	93 00 78	Shrink hose ID 9.5		*	*	*	*
232	83 53 58	Terminal clamp WDU6/10		3	3	4	4
233	83 53 17	Terminal clamp WDU35/IK/ZA		6	6	6	6
233	83 53 61	Terminal clamp WDU16,1000V		8	8	8	8
234	83 53 49	Cross connection WQW35/2		3	3	3	3
234	83 53 67	Cross connection WQV16/2	WEIDMÜLLER WQV 16/2	4	4	4	4
234	650 20 02	Cross connection	WQV 16	1	1	1	1
234	650 20 03	Cross connection	WQV 35	1	1	1	1
235	83 53 54	End support WEW 35/2		2	2	2	2
236	83 53 50	Partition		1	1	1	1
239	441 46 00	El.lead through unit		1	1	1	1
239	734 59 00	El.lead through unit		1	1	1	1
240	607 48 00	Spring		1	1	1	1
241	82 71 33	O-ring 175X3.0 FPM		1	1	1	1
241	82 78 35	O-ring 175.0X3.0 NBR		1	1	1	1
242	608 22 10	adapter				1	1
242	608 22 11 (EX)	adapter		1	1		
242	642 11 00	adapter	Execution without cooling jacket			1	1
242	642 11 01 (EX)	adapter	Execution without cooling jacket	1	1		
243	83 02 97	Hex.socket hd screw M8X16-A4-70		2	2	2	2
245	82 75 01	O-ring 279.3X5.7 NBR		1	1	1	1
245	82 75 22	O-ring 279.3X5.7 FPM		1	1	1	1
246	82 78 39	O-ring 230X3 NBR		1	1	1	1

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
247	82 95 69	O-ring 84.4X4 FPM		1	1	1	1
248	608 27 00	Strip		1	1	1	1
249	82 32 50	Clip		1	1	1	1
251	642 13 00	Inspection screw		2	2	2	2
252	82 76 85	O-ring 17X3 NBR		2	2	2	2
252	82 79 15	O-ring 17X3 FPM		2	2	2	2
253	608 13 00	Cooling jacket INNER	Inner	1	1	1	1
254	608 14 00	Flow diffusor		1	1	1	1
256	608 42 00	Wire bow		4	4	4	4
264	82 40 69	Plain washer (33)-35MM		4	4	4	4
264	82 40 81	Plain washer (14)-20MM		4	4	4	4
264	82 40 82	Plain washer (20)-32MM		4	4	4	4
265	84 18 01	Seal sleeve (17)-20MM		2	2	2	2
265	84 18 02	Seal sleeve (20)-23MM		2	2	2	2
265	84 18 03	Seal sleeve (23)-26MM		2	2	2	2
265	84 18 04	Seal sleeve (26)-29MM		2	2	2	2
265	84 18 05	Seal sleeve (29)-32MM		2	2	2	2
265	84 18 06	Seal sleeve (32)-35MM		2	2	2	2
266	597 98 02	Ring		1	1	1	1
270	608 31 00	Lock washer		1	1		
313	82 71 72	O-ring 71.2X3 FPM		1	1	1	1
912	82 76 85	O-ring 17X3 NBR	Extra O-rings for Inspection screws	3	3	3	3
912	82 79 15	O-ring 17X3 FPM	Extra O-rings for Inspection screws	3	3	3	3

Hydraulic Parts

Overview

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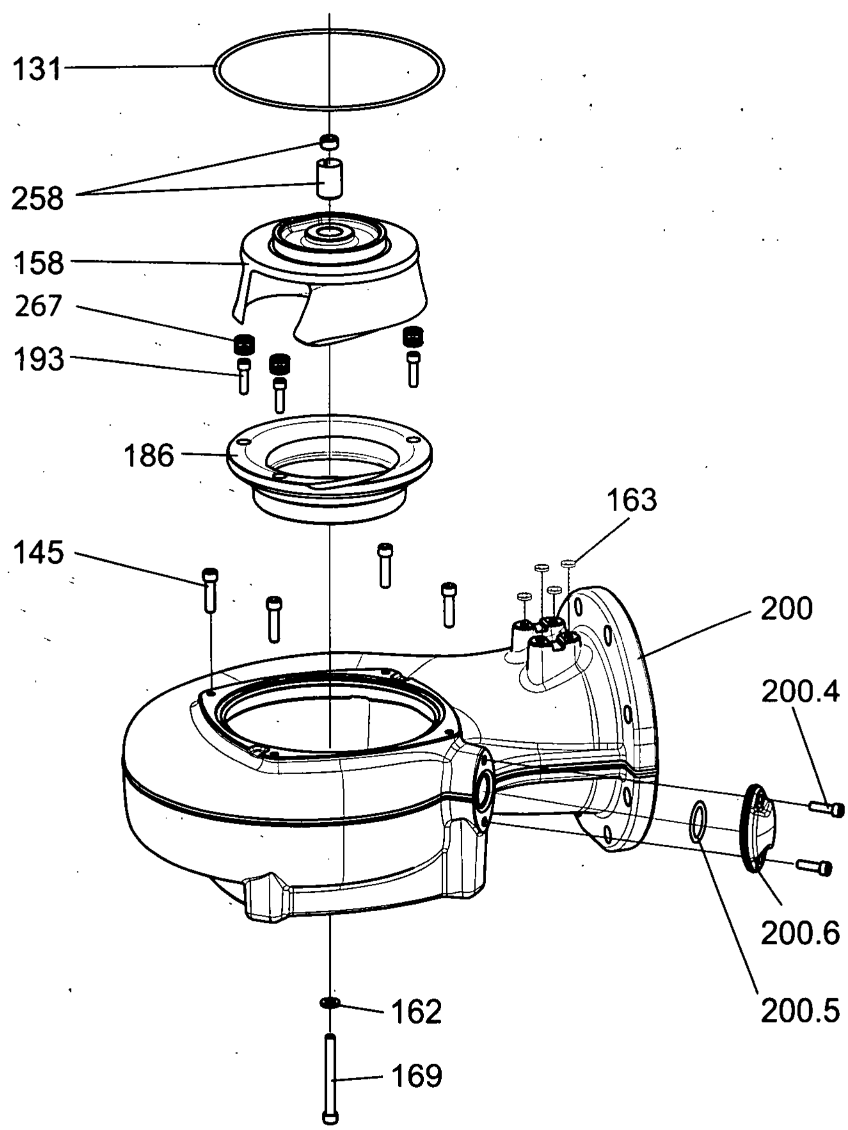
This chapter contains the following topics:

Topic

Exploded view: Hydraulic Parts N; LT, 4–Pole

"LT" Low Head. Curve: 410–416

N_ 3153 LT

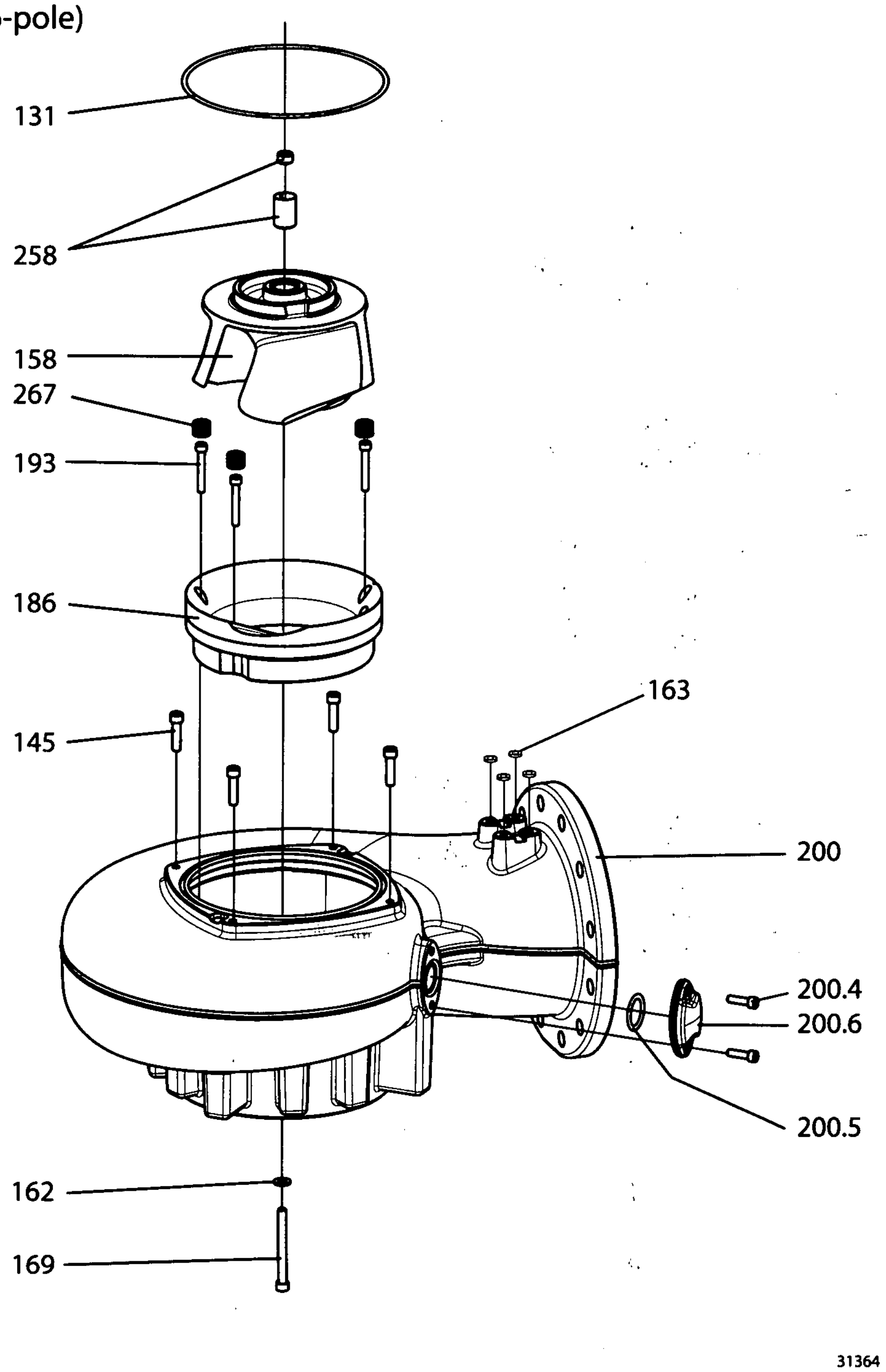


31261

Exploded view: Hydraulic Parts N; LT, 6–Pole

"LT" Low head Curve: 620, 621, 622, 623, 624, 625

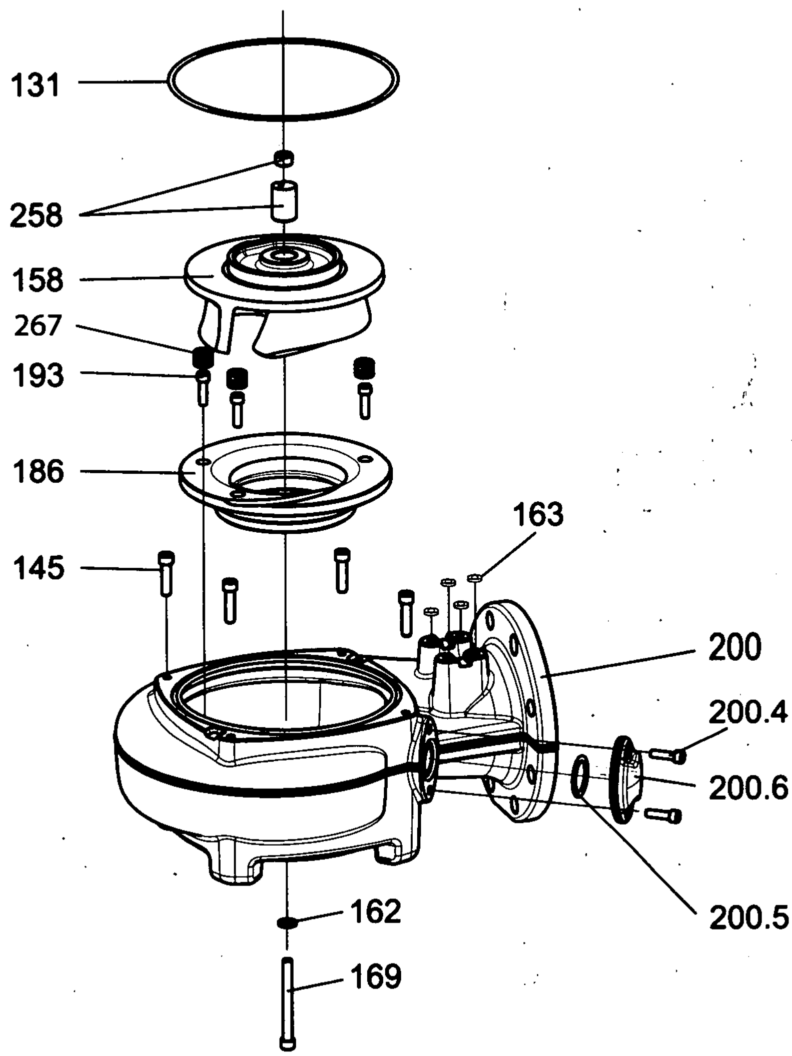
N_ 3153 LT (6-pole)



Exploded view: Hydraulic Parts N; MT

"MT" Medium head, Curve: 430–437

N_ 3153 MT

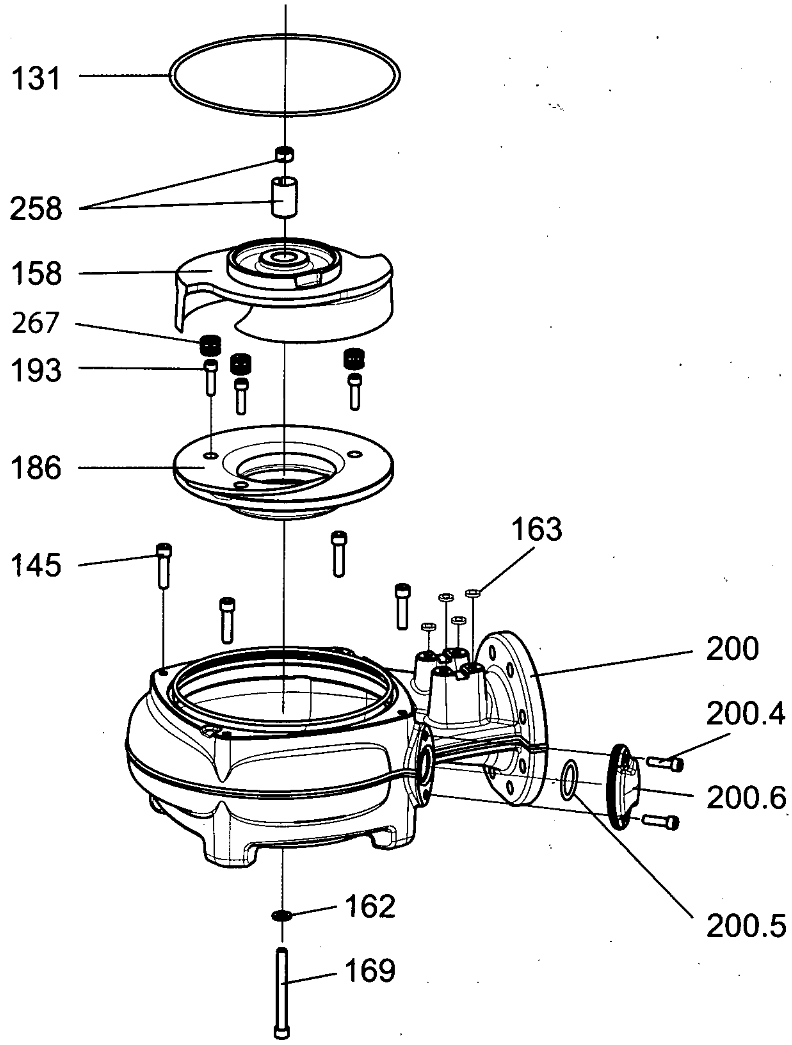


31260

Exploded view: Hydraulic Parts N; HT

"HT" High head Curve: 450-457,461-466

N_ 3153 HT

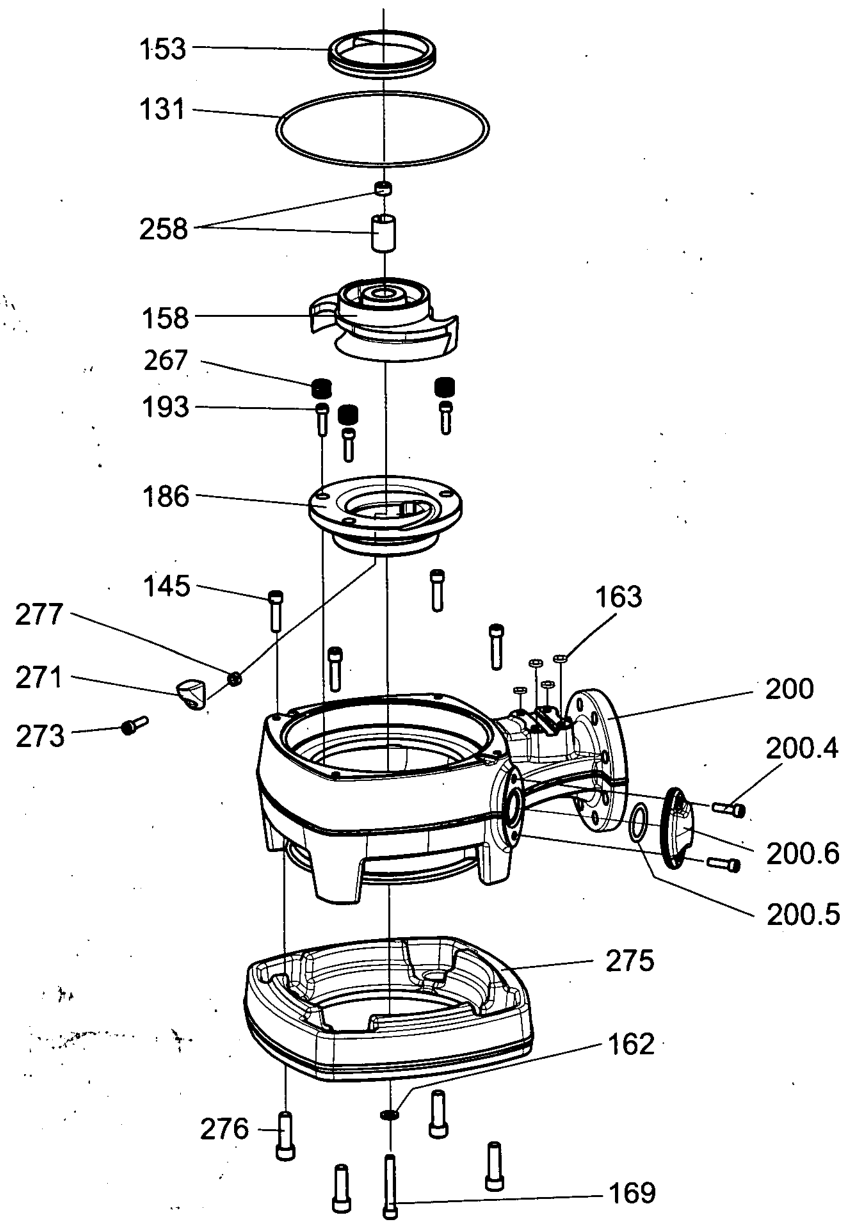


31259

Exploded view: Hydraulic Parts N; SH

"SH" Super high head Curve: 270, 272-276

N_ 3153 SH



31258

List of Hydraulic Parts

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
131	82 75 01	O-ring 279.3X5.7 NBR		1	1	1	1
131	82 75 22	O-ring 279.3X5.7 FPM		1	1	1	1
153	681 28 00	Insert ring		1	1	1	1
158	605 94 00	Impeller	"HT" High head. Curve no: 461, 60 Hz, 3-phase	1		1	
158	605 94 09	Impeller	"HT" High head. Curve: 462, 60 Hz, 3-phase	1		1	
158	605 94 22	Impeller	"HT" High head. Curve no: 463, 60 Hz, 3-phase	1		1	
158	605 94 32	Impeller	"HT" High head. Curve no: 464, 60 Hz, 3-phase	1		1	
158	605 94 46	Impeller	"HT" High head. Curve no: 465, 60 Hz, 3-phase	1		1	
158	605 94 55	Impeller	"HT" High head. Curve no: 466, 60 Hz, 3-phase	1		1	
158	654 77 00	Impeller	"LT" Low head. Curve no: 620, 50 Hz, 3-phase	1		1	
158	654 77 15	Impeller	"LT" Low head. Curve no: 621, 50 Hz, 3-phase	1		1	
158	654 77 30	Impeller	"LT" Low head. Curve no: 622, 50/60 Hz, 3-phase	1		1	
158	654 77 45	Impeller	"LT" Low head. Curve no: 623, 50/60 Hz, 3-phase	1		1	
158	654 77 62	Impeller	"LT" Low head. Curve no: 624, 50/60 Hz, 3-phase	1		1	
158	654 77 81	Impeller	"LT" Low head. Curve no: 625, 50/60 Hz, 3-phase	1		1	
158	685 15 00	Impeller	"SH" Super high head. Curve no: 270, 50 Hz, 3-phase	1		1	
158	685 15 18	Impeller	"SH" Super high head. Curve no: 272, 50 Hz, 3-phase	1		1	
158	685 15 27	Impeller	"SH" Super high head. Curve no: 273, 50/60 Hz, 3-phase	1		1	
158	685 15 39	Impeller	"SH" Super high head. Curve no: 274, 50/60 Hz, 3-phase	1		1	
158	685 15 48	Impeller	"SH" Super high head. Curve: 275, 50/60 Hz, 3-phase	1		1	
158	685 15 57	Impeller	"SH" Super high head. Curve: 276, 50/60 Hz, 3-phase	1		1	
158	696 48 00	Impeller	"HT" High head. Curve no: 450, 50 Hz, 3-phase	1		1	
158	696 48 14	Impeller	"HT" High head. Curve no: 451, 50 Hz, 3-phase	1		1	

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
158	696 48 28	Impeller	"HT" High head. Curve no: 453, 50/60 Hz, 3-phase.	1		1	
158	696 48 39	Impeller	"HT" High head. Curve no: 454, 50 Hz, 3-phase.	1		1	
158	696 48 50	Impeller	"HT" High head. Curve no: 455, 50 Hz, 3-phase.	1		1	
158	696 48 60	Impeller	"HT" High head. Curve no: 456, 50 Hz, 3-phase.	1		1	
158	696 49 00	Impeller	"MT" Medium head. Curve no: 430, 50 Hz, 3-phase	1		1	
158	696 49 08	Impeller	"MT" Medium head. Curve no: 431, 50 Hz, 3-phase	1		1	
158	696 49 20	Impeller	"MT" Medium head. Curve no: 432, 50 Hz, 3-phase	1		1	
158	696 49 32	Impeller	"MT" Medium head. Curve no: 433, 50/60 Hz, 3-phase	1		1	
158	696 49 42	Impeller	"MT" Medium head. Curve no: 434, 50/60 Hz, 3-phase	1		1	
158	696 49 52	Impeller	"MT" Medium head. Curve no: 435, 50/60 Hz, 3-phase	1		1	
158	696 49 65	Impeller	"MT" Medium head. Curve no: 436, 50/60 Hz, 3-phase	1		1	
158	696 49 75	Impeller	"MT" Medium head. Curve no: 437, 60 Hz, 3-phase	1		1	
158	696 50 00	Impeller	"LT" Low head. Curve 410, 50 Hz, 3-phase	1		1	
158	696 50 10	Impeller	"LT" Low head. Curve 411, 50 Hz, 3-phase	1		1	
158	696 50 22	Impeller	"LT" Low head. Curve 412, 50 Hz, 3-phase	1		1	
158	696 50 33	Impeller	"LT" Low head. Curve 413, 50/60 Hz, 3-phase	1		1	
158	696 50 43	Impeller	"LT" Low head. Curve 414, 50/60 Hz, 3-phase	1		1	
158	696 50 57	Impeller	"LT" Low head. Curve 415, 50/60 Hz, 3-phase	1		1	
158	696 50 63	Impeller	"LT" Low head. Curve 416, 60 Hz, 3-phase	1		1	
158	698 71 14	Impeller	"HT" High head. Curve 451, 50 Hz, 3-phase		1		1
158	698 71 39	Impeller	"HT" High head. Curve 454, 50 Hz, 3-phase		1		1
158	698 72 08	Impeller	"MT" Medium head. Curve: 431, 50 Hz, 3-phase		1		1
158	698 72 42	Impeller	"MT" Medium head. Curve: 434, 50/60 Hz, 3-phase		1		1

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
158	698 72 65	Impeller	"MT" Medium head. Curve: 436, 50/60 Hz, 3-phase		1		1
158	698 73 00	Impeller	"LT" Low head. Curve: 410, 50 Hz, 3-phase		1		1
158	698 73 33	Impeller	"LT" Low head. Curve: 413, 50/60 Hz, 3-phase		1		1
158	698 73 57	Impeller	"LT" Low head. Curve: 415, 50/60 Hz, 3-phase		1		1
158	699 26 18	Impeller	"SH" Super high head. Curve: 272, 50 Hz, 3-phase		1		1
158	699 26 39	Impeller	"SH" Super high head. Curve: 274, 50/60 Hz, 3-phase		1		1
158	699 26 57	Impeller	"SH" Super hig head. Curve: 276, 50/60 Hz, 3-phase, High Chrome		1		1
158	703 20 09	Impeller	"HT" High head. Curve: 462, 60 Hz, 3-phase		1		1
158	703 20 32	Impeller	"HT" High head. Curve: 464, 60 Hz, 3-phase		1		1
158	704 36 00	Impeller	"LT" Low head. Curve: 620, 50 Hz, 3-phase		1		1
158	704 36 30	Impeller	"LT" Low head. Curve: 622, 50/60 Hz, 3-phase		1		1
158	704 36 62	Impeller	"LT" Low head. Curve: 624, 50/60 Hz, 3-phase		1		1
162	82 38 00	Plain washer STAINLESS STEEL A4		1	1	1	1
163	82 69 40	Protective plug		4	4	4	4
169	83 04 55	Hex.socket hd screw M12X110-A4-80		1	1	1	1
169	83 04 66	Hex.socket hd screw M12X80-A4-80		1	1	1	1
186	702 28 00	Insert ring	"MT" version 091/181	1		1	
186	702 29 00	Insert ring	"MT" version 095/185		1		1
186	702 82 00	Insert ring	"HT" version 091/181	1		1	
186	702 83 00	Insert ring	"HT" version 095/185		1		1
186	702 85 00	Insert ring	"SH" version 091/181	1		1	
186	702 85 01	Insert ring	"SH" version 091/181 with guide pin	1		1	
186	702 86 00	Insert ring	"SH" version 095/185		1		1
186	702 86 01	Insert ring	"SH" version 095/185 with guide pin		1		1
186	702 88 00	Insert ring	"LT" 4-pole version 091/181	1		1	
186	702 89 00	Insert ring	"LT" 4-pole version 095/185		1		1
186	704 66 00	Insert ring	"LT" 6-pole version 091/181	1		1	

Pos. No	Part. No	Denomination		Qty/Version 091	095	181	185
186	704 67 00	Insert ring	"LT" 6-pole version 095/185		1		1
193	82 00 60	Hex.socket hd screw M10X70-A2-70		3	3	3	3
193	83 04 56	Hex.socket hd screw M10X35-A4-80		3	3	3	3
200	702 27 00	Pump housing	"MT" Medium head DN 150. Undrilled inlet, Prepared for Flush valve	1	1	1	1
200	702 27 03	Pump housing	"MT" Medium head DN 150. Drilled inlet, Prepared for zinc anodes (only for P and S install.) Prepared for Flush valve	1	1	1	1
200	702 27 06	Pump housing	"MT" Medium head. Drilled to: EN 1092-2 tab.9, ANSI B16.1-89; tab.5. Prepared for Flush valve	1	1	1	1
200	702 81 00	Pump housing	"HT" High head DN 100. Undrilled, Prepared for Flush valve	1	1	1	1
200	702 81 01	Pump housing	"HT" High head DN 100. Drilled to: EN 1092-2 tab.9. Prepared for Flush valve	1	1	1	1
200	702 81 03	Pump housing	"HT" High head DN 100. Drilled inlet. Prepared for zinc anodes (only for P and S installation). Prepared for Flush valve	1	1	1	1
200	702 81 05	Pump housing	"HT" High head DN 100. Drilled to: ANSI B16.1-89; tab.5. Prepared for Flush valve	1	1	1	1
200	702 84 00	Pump housing	"SH" Super high head DN 80. With or without guide pin. Prepared for flush valve.	1	1	1	1
200	702 84 01	Pump housing	"SH" Super high head DN 80. Drilled to: EN 1092-2 tab.9. With or without guide pin. Prep. for flush valve	1	1	1	1
200	702 84 03	Pump housing	"SH" Super high head DN 80. Drilled inlet. With or without guide pin. Prep. for flush valve and zinc anodes. Only P or S	1	1	1	1
200	702 84 05	Pump housing	"SH" Super high head DN 80. Drilled to: ANSI B16.1-89; tab.5. With or without guide pin. Prep. for flush valve	1	1	1	1
200	702 84 10	Pump housing	"SH" Super high head DN 80. Pumphousing with outlet sealing. With or without guide pin. Prep. for flush valve.	1	1	1	1
200	702 84 13	Pump housing	"SH" Super high head DN 80. Drilled inlet. With outlet sealing. Prep for zinc anodes and flush valve. P or S install.	1	1	1	1

Pos. No	Part. No	Denomination		Qty/Version			
				091	095	181	185
200	702 84 20	Pump housing	"SH" Super high head DN 100. With outlet sealing. With or without guide pin. Prep. for Flush valve.	1	1	1	1
200	702 84 23	Pump housing	"SH" Super high head DN 100. Dr. inlet. With oulet sealing. With or without guide pin. Prep for f. valve and z. anodes.	1	1	1	1
200	702 87 00	Pump housing	"LT" Low head DN 200. Undrilled inlet. Prepared for Flush valve.	1	1	1	1
200	702 87 03	Pump housing	"LT" Low head DN 200. Drilled inlet. Prepared for zinc anodes (only for P and S installation). Prepared for Flush valve	1	1	1	1
200	702 87 06	Pump housing	"LT" Low head DN 200. Drilled to: EN 1092-2 tab.8, ANSI B16.1-89; tab.5. Prepared for Flush valve.	1	1	1	1
200	702 87 07	Pump housing	"LT" Low head DN 200. Drilled to: EN 1092-2 tab.9. Prepared for Flush valve.	1	1	1	1
200	704 65 00	Pump housing	"LT" Low head DN 250. Undrilled. Prepared for flush valve.	1	1	1	1
200	704 65 01	Pump housing	"LT" Low head DN 250. Drilled to EN 1092-2 tab.8. Prepared for flush valve.	1		1	1
200	704 65 03	Pump housing	"LT" Low head DN 250. Drilled for S, T, Z and zinc anodes. Prepared for flush valve.	1	1	1	1
200	704 65 05	Pump housing	"LT" Low head DN 250. Drilled to ANSI B16.1-89; tab.5. Prepared for flush valve.	1	1	1	1
200	704 65 07	Pump housing	"LT" Low head DN 250. Drilled to EN 1092-2 tab.9. Prepared for flush valve.	1	1	1	1
200.3	84 90 93	Seal ring	Intended for pumphousing 7028410, 7028413	1	1	1	1
200.3	84 90 94	Seal ring	Intended for pumphousing 7028420, 7028423	1	1	1	1
200.4	83 04 56	Hex.socket hd screw M10X35-A4-80		2	2	2	2
200.5	82 81 93	O-ring 44,2X5,7 FPM		1	1	1	1
200.6	648 00 00	Cover		1	1	1	1
258	720 14 00	Sleeve unit		1	1	1	1
267	725 06 00	Plug		3	3	3	3
271	703 22 00	Lip		1	1	1	1
273	83 04 56	Hex.socket hd screw M10X35-A4-80		1	1	1	1
275	679 01 01	Counter weight		1	1	1	1

Pos. No	Part. No	Denomination	Qty/Version 091	095	181	185
276	82 01 07	Hex.socket hd screw M16X50-A2-70	4	4	4	4
277	82 23 33	Hexagon nut M10-A4-70	1	1	1	1

Sump Components

Overview

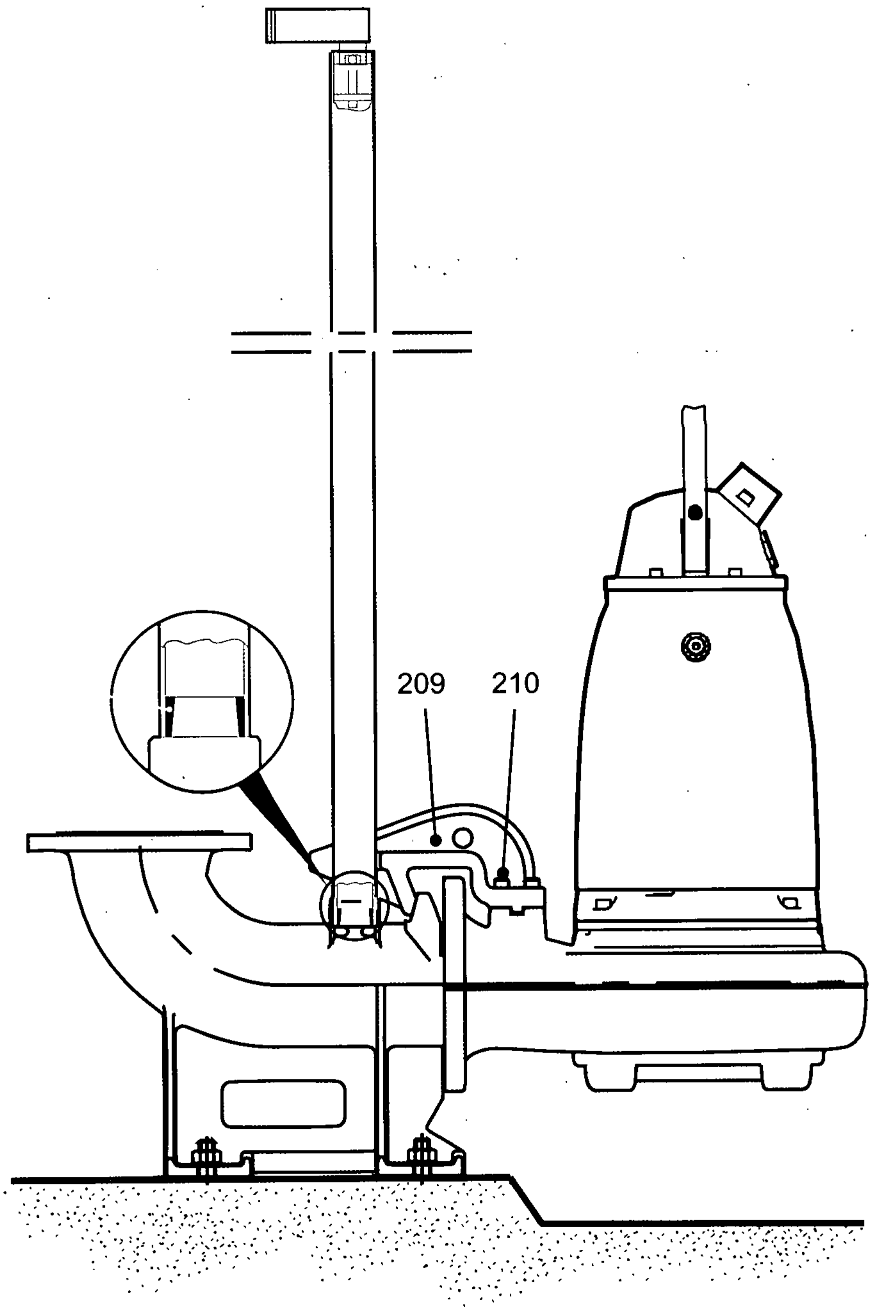
Table of Contents

This chapter contains the following topics:

Topic

View: Sump Components NP

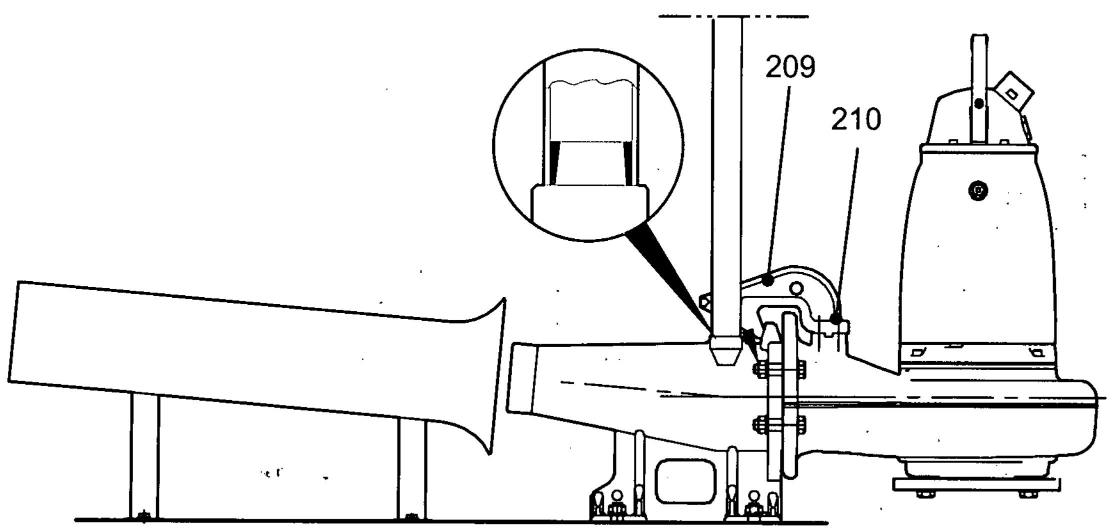
NP 3153



30582

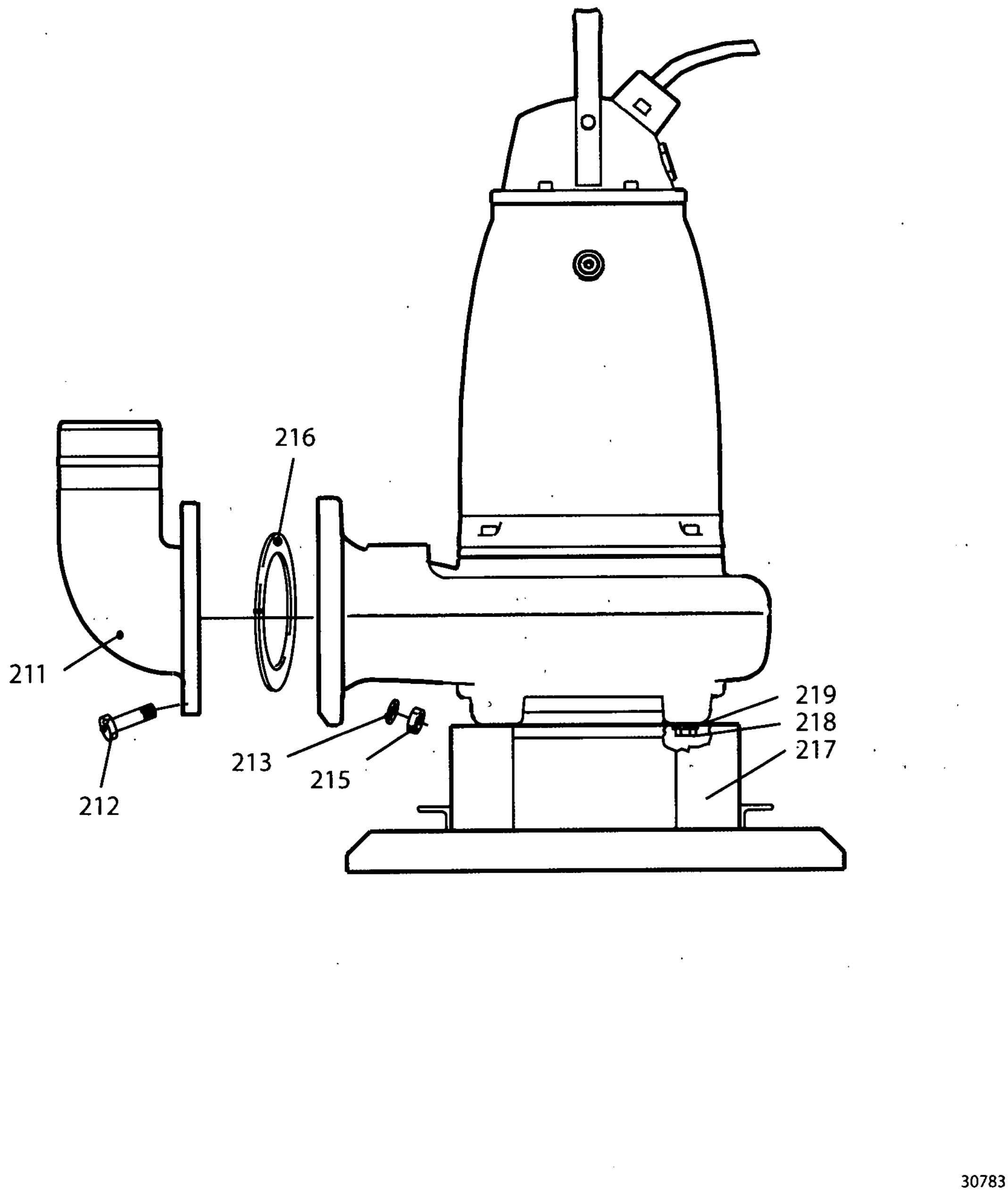
View: Sump Components NP; Hydroejector

NP 3153 Hydroejector



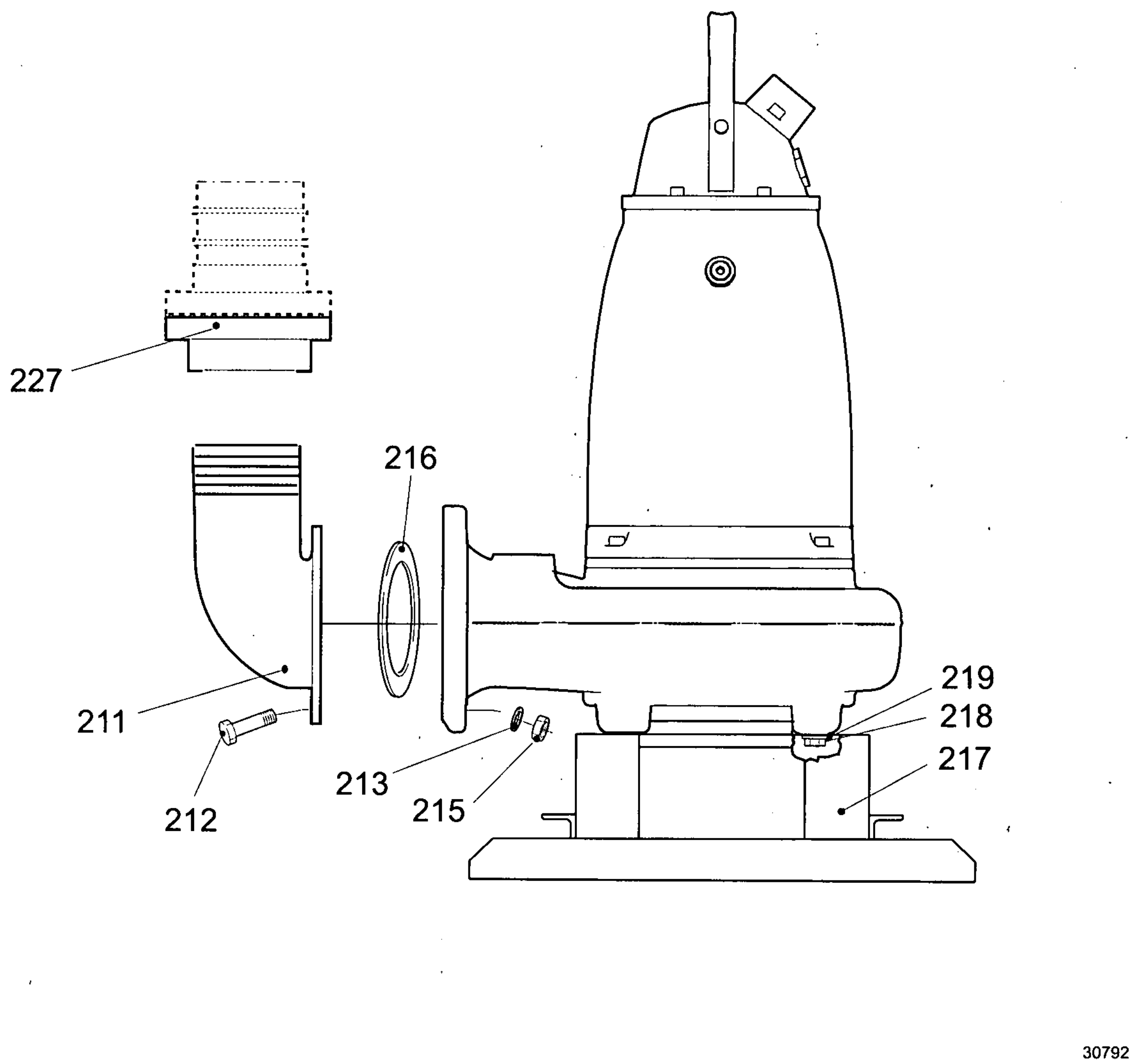
View: Sump Components NS

NS 3153



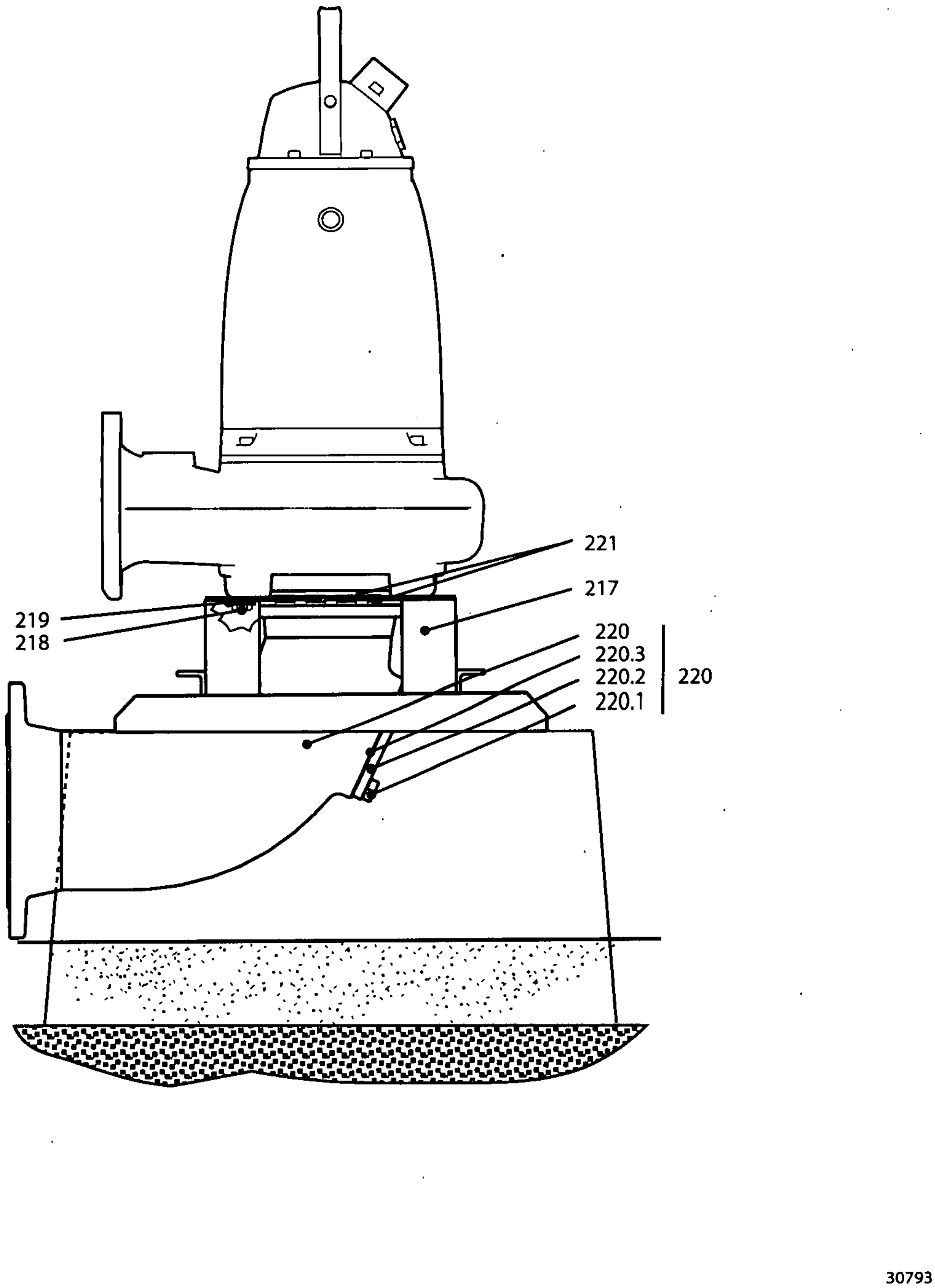
View: Sump Components NS with Quick coupling

NS 3153



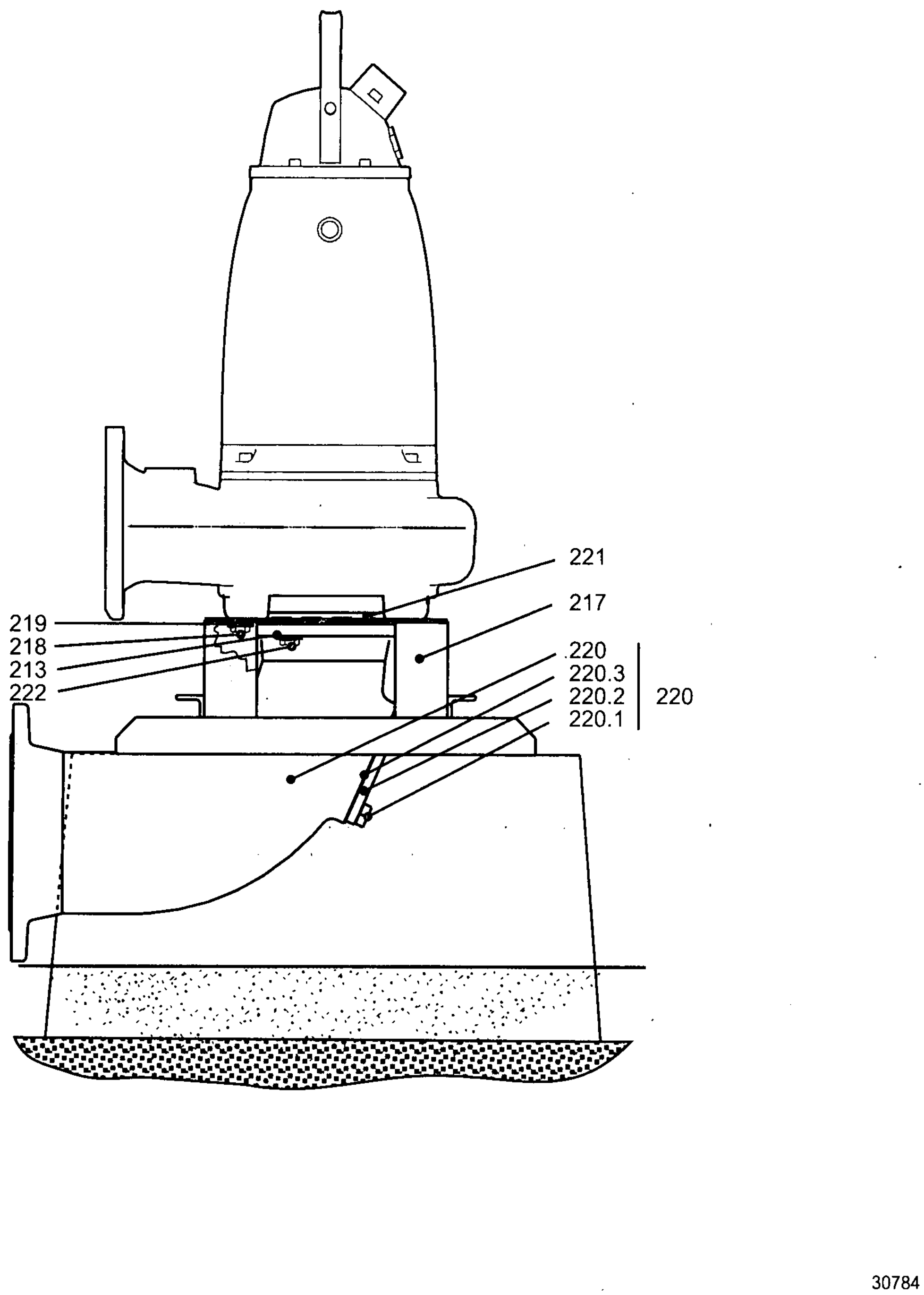
View: Sump Components NT; LT

NT 3153



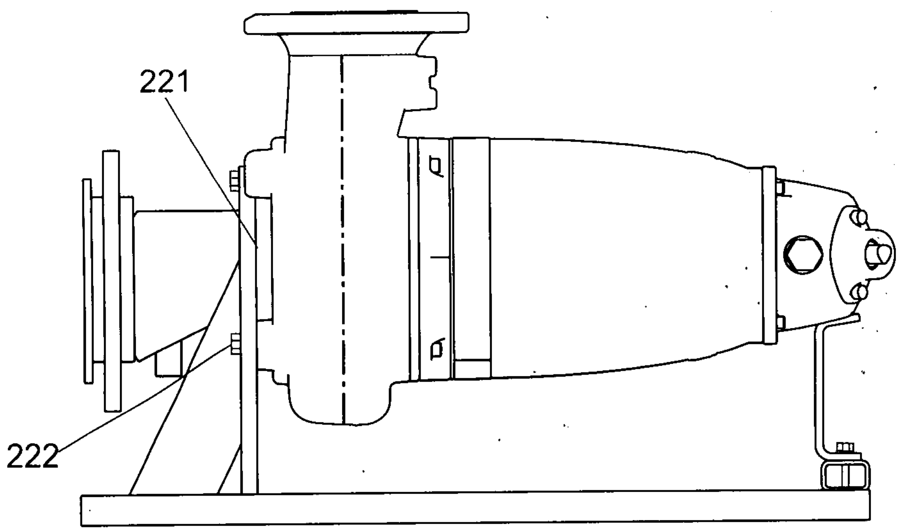
View: Sump Components NT; MT/HT/SH

NT 3153



View: Sump Components NZ

NZ 3153



List of Sump Components

Pos. No	Part. No	Denomination		Qty/Version 350	Qty/Version 390
209	651 07 01	Sliding bracket		1	1
210	83 04 53	Hex.socket hd screw M12X45-A4-80		4	4
211	259 82 04	Discharge connection	"HT/SH" Super/High head version DN 100 (4")	1	1
211	259 84 05	Discharge connection	"HT/SH" Super/High head version DN 100 (4") Threaded 4-8 NPSM Outer	1	1
211	259 84 06	Discharge connection	"HT" High head version DN 100 (4"), Thread : ISO G4A Outer	1	1
211	295 57 00	Discharge connection	"MT" Medium head version DN 150 (6")	1	1
211	309 31 00	Discharge connection	"MT" Medium head version DN 150 (6") Threaded 6-8 NPSM Outer	1	1
211	309 31 01	Discharge connection	"MT" Medium head version DN 150 (R6") Thread : ISO G6A Outer. Quick coupling: Storz	1	1
211	310 03 01	Discharge connection	"SH" Super high head version DN 75	1	1
211	385 52 03	Discharge connection 3-8 NPSM	"SH" Super high head version DN 75 Threaded:3-8 NPSM Outer	1	1
211	385 52 04	Discharge connection ISO G3	"SH" Super high head version DN 75 Threaded:ISO G3 Outer	1	1
212	81 49 36	Hexagon head screw M16X65-A4-70		4	4
212	84 34 07	Hexagon head screw M16X60-A2-70	Intended for, S -version "HT"	4	4
212	84 34 32	Hexagon head screw M20X70-A2-70	S-version "MT"	8	8
213	82 35 23	Plain washer 16-A2-A-170		4	8
213	82 35 26	Plain washer 20-A2-A-170		8	8
215	82 23 61	Hexagon nut M16-A2-70		4	4
215	82 23 62	Hexagon nut M20-A2-70		8	8
216	259 83 00	Gasket 4"		1	1
216	295 64 00	Gasket 6"		1	1
216	310 05 00	Gasket	Intended for "SH"	1	1
217	396 11 00	Stand compl.	S-installation MT, DN 150, HT/SH, DN 100, SH, DN 75. T-installation MT, DN 200, HT/SH, DN 150	1	1
218	84 34 03	Hexagon head screw M16X40-A2-70	T-version"MT", "HT", "SH", S-version "MT", "HT", "SH"	4	4
219	82 35 23	Plain washer 16-A2-A-170		4	4

Pos. No	Part. No	Denomination		Qty/Version 350	390
219	82 38 01	Plain washer STAINLESS STEEL A4		4	4
220	272 82 20	Suction pipe unit	"MT" Medium head version DN 200 (8"). Undrilled	1	1
220	272 82 26	Suction pipe unit	"MT" Medium head versionDN 200 (8"). Drilled to EN 1092-2 tab. 8, ANSI B16.1-89;tab.5	1	1
220	272 82 27	Suction pipe unit	"MT" Medium head versionDN 200 (8"). Drilled to EN 1092-2 tab. 9	1	1
220	295 60 20	Suction pipe unit	"HT/SH" Super High head version DN 150 (6"). Undrilled	1	1
220	295 60 26	Suction pipe unit	"HT/SH" Super/ High head version DN 150 (6"). Drilled to EN 1092-2 tab.9, ANSI B16.1-89; tab.5	1	1
220.1	81 52 17	Hexagon head screw 1/2 UNCX32-A2-70	(SH, HT) DN 150	4	4
220.1	81 52 49	Hexagon head screw	(MT) DN 200	4	4
220.2	274 45 00	Cleaning door	(MT) DN 200	1	1
220.2	295 53 00	Cleaning door	(SH, HT) DN 150	1	1
220.3	274 48 00	Gasket	(MT, LT) DN 200/250/300	1	1
220.3	295 54 00	Gasket	(SH, HT) DN 150	1	1
221	84 65 87	Gasket 150 PN10		1	1
221	84 65 93	Gasket 125 PN10		1	1
222	81 41 81	Hexagon head screw M16X40-A4-70		4	4
222	81 55 40	Hexagon head screw M16X50 A4-70		4	4
222	84 34 05	Hexagon head screw M16X50-A2-70		4	4
222	84 34 07	Hexagon head screw M16X60-A2-70		4	4
227	83 19 34	Coupling part DN 110 INNER THREAD G4		1	1
227	83 19 36	Coupling part DN 150 INNER THREAD G6		1	1

Parts for Service

Pos. No	Part. No	Denomination		Qty/Version			
				091	095	181	185
800	84 15 47	O-ring kit INTERMEDIATE SERVICE KIT	NBR O-rings < = 70 DEGR.C	1	1	1	1
800	84 15 48	O-ring kit INTERMEDIATE SERVICE KIT	FPM O-rings , Industry	1	1	1	1
900	657 17 08	Basic repair kit	NBR O-rings < = 70 DEGR.C DEGR.C. Standard. Incl. Mechanical Seal WCCR/WCCR	1	1	1	1
900	657 17 09	Basic repair kit	Warm water. Incl. 641 50 00 Mechanical Seal WCCR/WCCR	1	1	1	1
900	657 17 10	Basic repair kit	NBR O-rings < = 70 DEGR.C. Incl. Mechanical Seal WCCR/RSiC	1	1	1	1
900	657 17 11	Basic repair kit	FPM O-rings Industry. Incl. Mechanical Seal WCCR/RSiC	1	1	1	1
901	90 37 08	Monopropylene glycol "DOWCAL N"		*	*	*	*

ITT

What can ITT Water & Wastewater do for you?

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896676_6.0_en.US_2010-02_GPL.3153

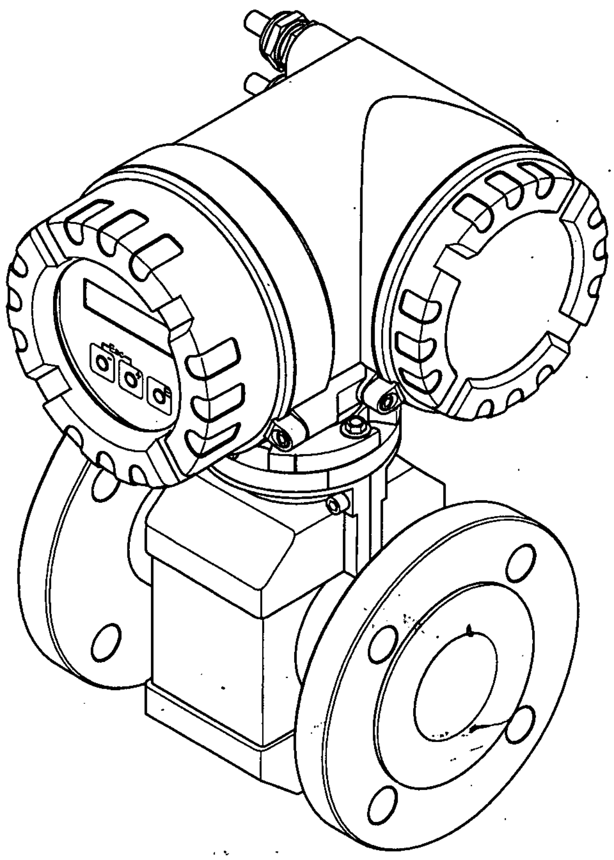
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Proline Promag 50

Electromagnetic Flow Measuring System

HART FIELD COMMUNICATION PROTOCOL



BA046D/06/en/03.05
50097090
Valid as of version:
V 2.00.XX (Device software)

Endress+Hauser
People for Process Automation

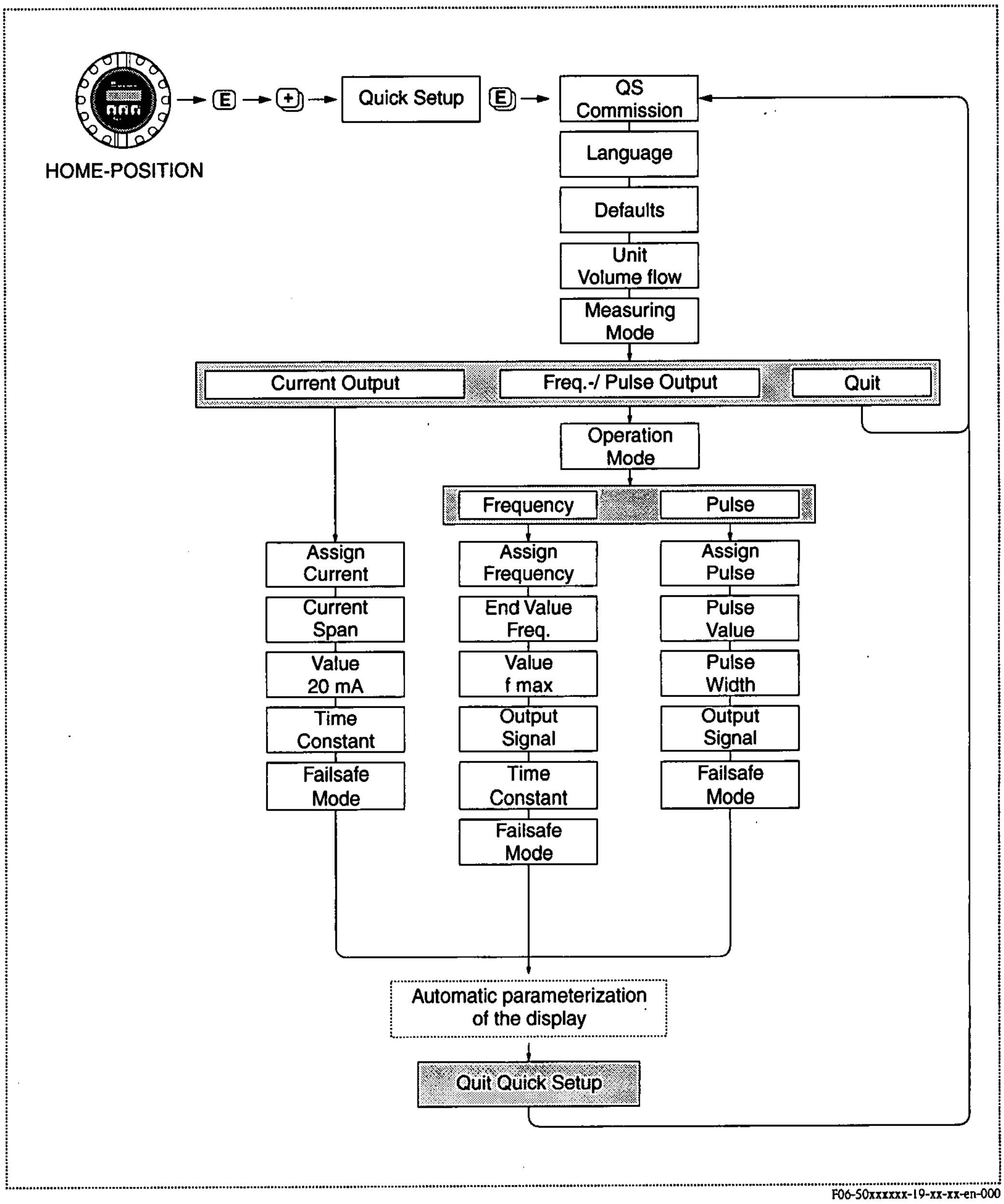
Brief operating instructions

These brief operating instructions show you how to configure the measuring device quickly and easily:

Safety instructions	Page 7
▼	
Installation	Page 13
▼	
Wiring	Page 47
▼	
Display and operating elements	Page 61
▼	
Commissioning with "QUICK SETUP"	Page 80 ff.
You can commission the measuring device quickly and easily, using the special "Quick Setup" menu. It enables to configure important basic functions using the local display, for example display language, measured variables, units engineering, type of signal, etc. The following adjustments can be made separately as necessary: – Empty-pipe/full-pipe adjustment for empty pipe detection (EPD) – Configuration of current output (active/passive)	
▼	
Customer-specific cofiguration	Page 62
Complex measuring operations necessitate additional functions that you can configure as necessary with the aid of the function matrix, and customize to suit the process parameters. All functions are described in detail, as is the function matrix itself, in the **"Description of Device Functions"** manual, which is a separate part of this Operating Instruction.	

Note!
Always start trouble-shooting with the checklist on Page 89, if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

"QUICK SETUP" commissioning



F06-50xxxxxx-19-xx-xx-en-000

Contents

1 Safety instructions

1.1 Designated use

The measuring device described in this Operating Manual is to be used only for measuring the flow rate of conductive fluids in closed pipes. A minimum conductivity of 20 μS/cm is required for measuring demineralized water. Most fluids can be metered, provided they have a minimum conductivity of 5 μS/cm, for example:

- acids, alkalis,
- drinking water, wastewater, sewage sludge,
- milk, beer, wine, mineral water, etc.

Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2 Installation, commissioning and operation

Note the following points:

- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- Endress+Hauser will be happy to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, unless the power supply is galvanically insulated.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an *integral part* of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (Ⓔx Europe, FM USA, CSA Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to this Operating Manual.

1.4 Return

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to Endress+Hauser:

- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
You will find a *preprinted* "Declaration of contamination" form at the back of this manual.

Warning!
- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

1.5 Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". They can, however, be a source of danger if used incorrectly or for other than the designated use.
Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in injury or a safety hazard. Comply strictly with the instructions and proceed with care.

Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device. Comply strictly with the instructions.

Note!
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

2 Identification

2.1 Device designation

The "Promag 50" flow measuring system consists of the following components:

- Promag 50 transmitter
- Promag W, Promag P or Promag H sensor

In the *compact version*, transmitter and sensor form a single mechanical unit; in the *remote version* they are installed separately.

2.1.1 Nameplate of the transmitter

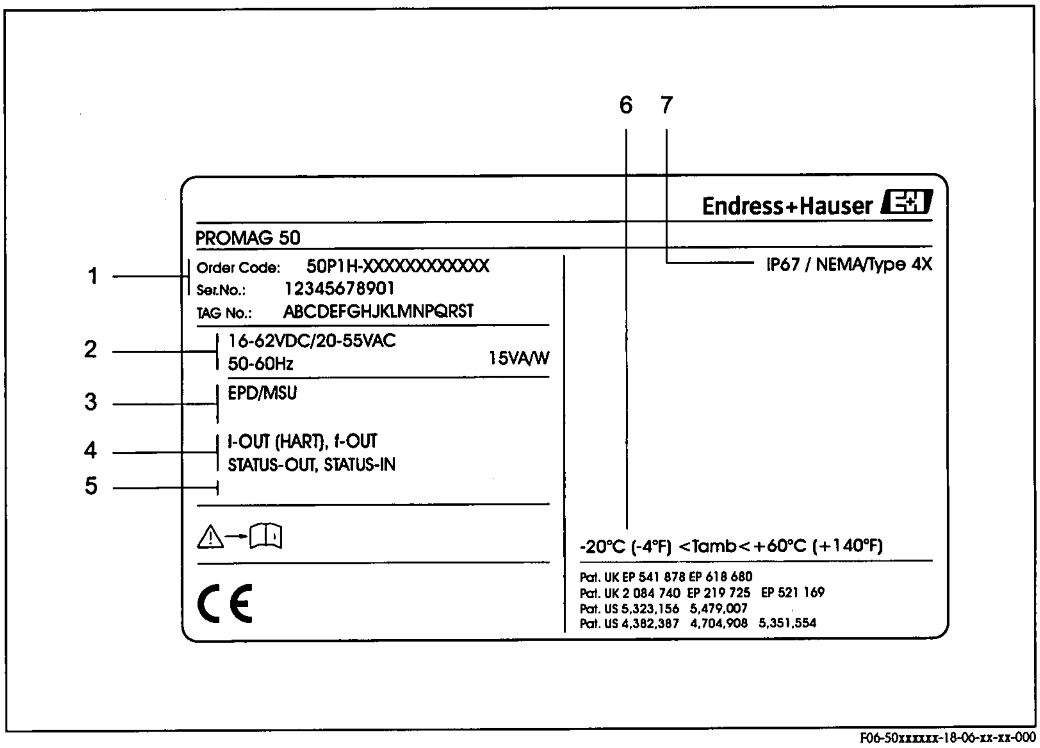


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Fig. 1: Nameplate specifications for the "Promag 50" transmitter (example)

1. *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2. *Power supply / frequency: 16...62 V DC / 20...55 V AC / 50...60 Hz*
   Power consumption: 15 VA / W
3. *Additional functions and software:*
   – EPD/MSU: with Empty Pipe Detection
   – ECC: with Electrode Cleaning Circuitry
4. *Outputs / inputs:*
   I-OUT (HART): with current output (HART)
   f-OUT: with pulse/frequency output
   STATUS-IN: with status input (auxiliary input)
   STATUS-OUT: with status output (switch output)
5. *Reserved for information on special products*
6. *Ambient temperature range*
7. *Degree of protection*

2.1.2 Nameplate of the sensor

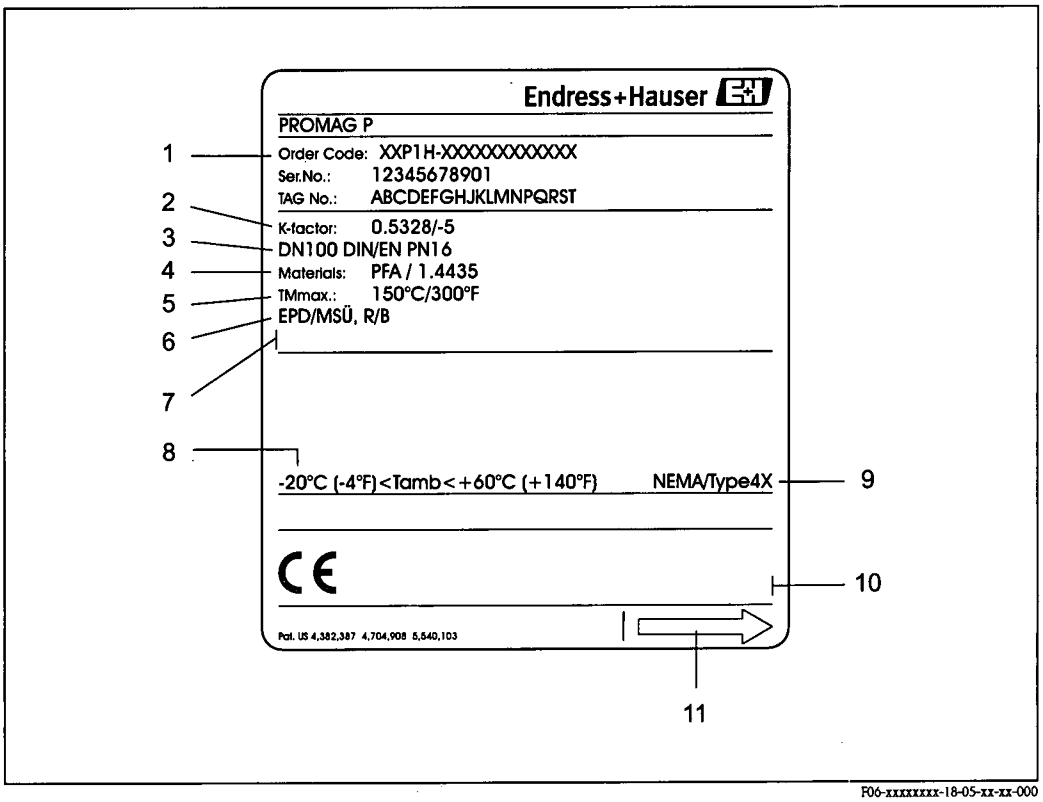

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Fig. 2: Nameplate specifications for the "Promag" sensor (example)

1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
2 Calibration factor: 0.5328; zero point: −5
3 Nominal diameter: DN 100
Pressure rating: EN (DIN) PN 16 bar
4 TMmax +150 °C (max. fluid temperature)
5 Materials:
– Lining: PFA
– Measuring electrodes: stainless steel 1.4435
6 Additional information (examples):
– EPD/MSU: with Empty Pipe Detection electrode
– R/B: with reference electrode
7 Reserved for information on special products
8 Ambient temperature range
9 Degree of protection
10 Reserved for additional information on device version (approvals, certificates)
11 Flow direction

2.1.3 Nameplate, connections

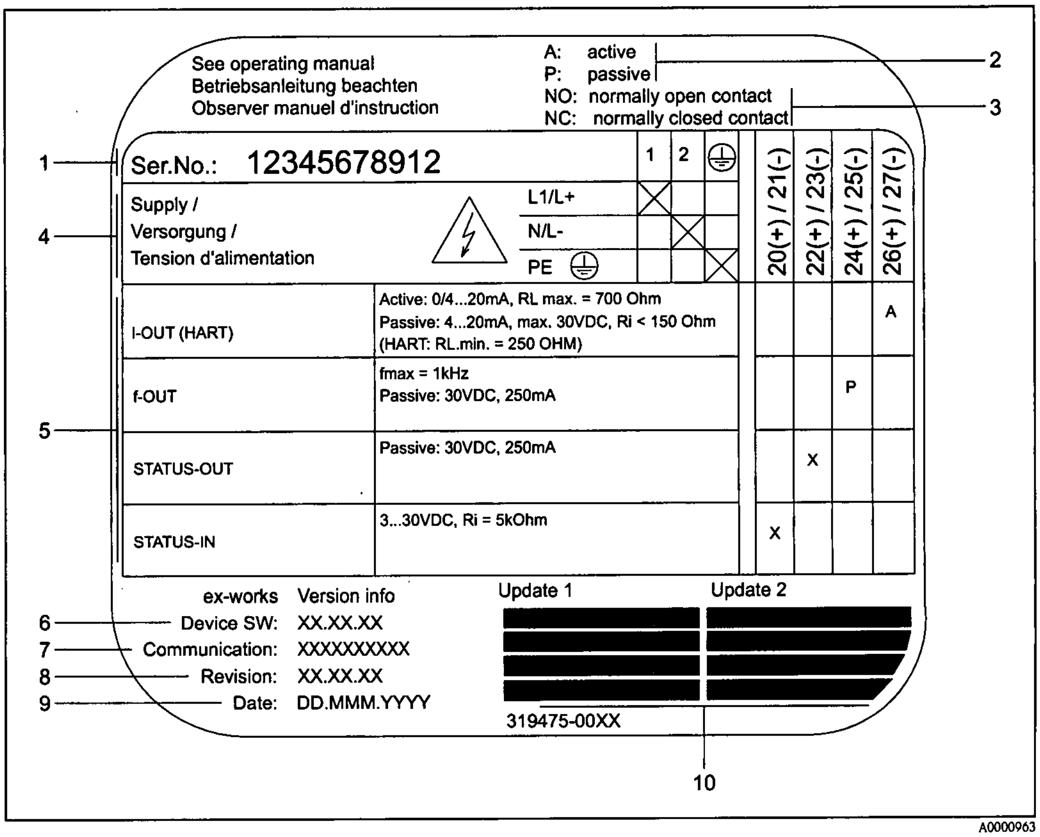

Fig. 3: Nameplate specifications for Proline transmitter (example)

1 *Serial number*
2 *Possible configuration of current output*
3 *Possible configuration of relay contacts*
4 *Terminal assignment, cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC*
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
5 *Signals present at inputs and outputs, possible configuration and terminal assignment (20...27), see also "Electrical values of inputs/outputs"*
6 *Version of device software currently installed*
7 *Installed communication type, e.g.: HART, PROFIBUS PA, etc.*
8 *Information on current communication software (Device Revision and Device Description), e.g.: Dev. 01 / DD 01 for HART*
9 *Date of installation*
10 *Current updates to data specified in points 6 to 9*

2.2 CE mark, declaration of conformity

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC reqiurements of EN 61326/A1.
The measuring system described in this Operating Manual is therefore in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

2.3 Registered trademarks

KALREZ ®, VITON ®
are registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP ®
is a registered trademark of Ladish & Co., Inc., Kenosha, USA

HART ®
is a registered trademark of HART Communication Foundation, Austin, USA

HistoROM™, S-DAT®, ToF Tool - Fieldtool® Package, Fieldcheck®, Applicator®
are registered trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until the device is ready to install. This is particularly important in the case of sensors with PTFE linings.

Special notes on flanged devices

Caution!
- The wooden covers mounted on the flanges before the device leaves the factory protect the linings on the flanges during storage and transportation. Do not remove these covers until *immediately before* the device is installed in the pipe.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

Transporting flanged devices (DN ≤ 300):
Use webbing slings slung round the two process connections (Fig. 4). Do not use chains, as they could damage the housing.

Warning!
Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.
At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.

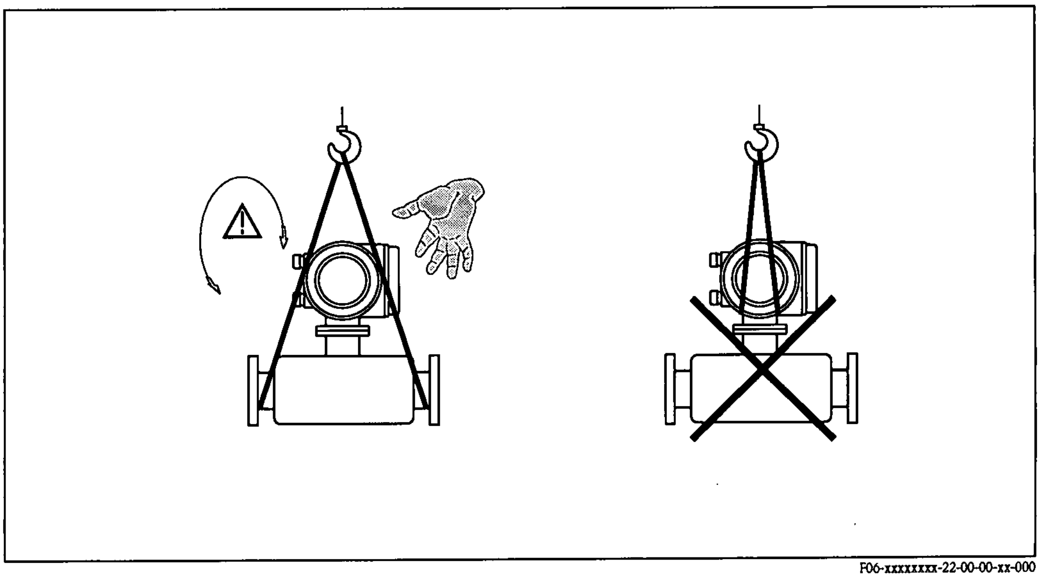

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Fig. 4: Transporting transmitters with DN ≤ 300

Transporting flanged devices (DN ≥ 350):
Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

Caution!
Do not attempt to lift the sensor with the tines of a fork-lift truck beneath the metal casing. This would buckle the casing and damage the internal magnetic coils.

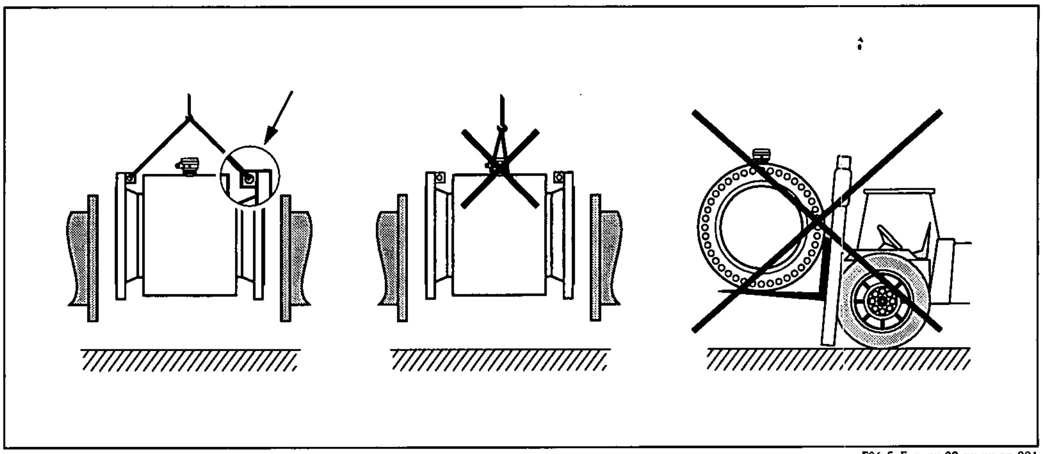

Fig. 5: Transporting sensors with DN ≥ 350

3.1.3 Storage

Note the following points:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

3.2 Installation conditions

3.2.1 Dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Information".

3.2.2 Mounting location

Correct measuring is possible only if the pipe is full. **Avoid** the following locations:
- Highest point of a pipeline. Risk of air accumulating
- Directly upstream a free pipe outlet in a vertical pipeline.

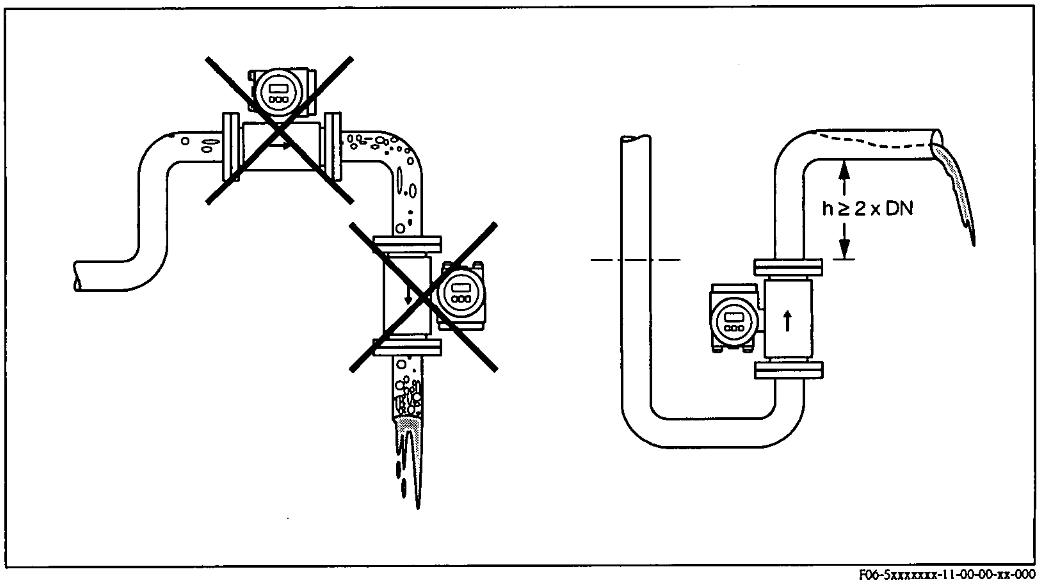

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Fig. 6: Location

Installation of pumps

Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on → Page 113.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → Page 110.

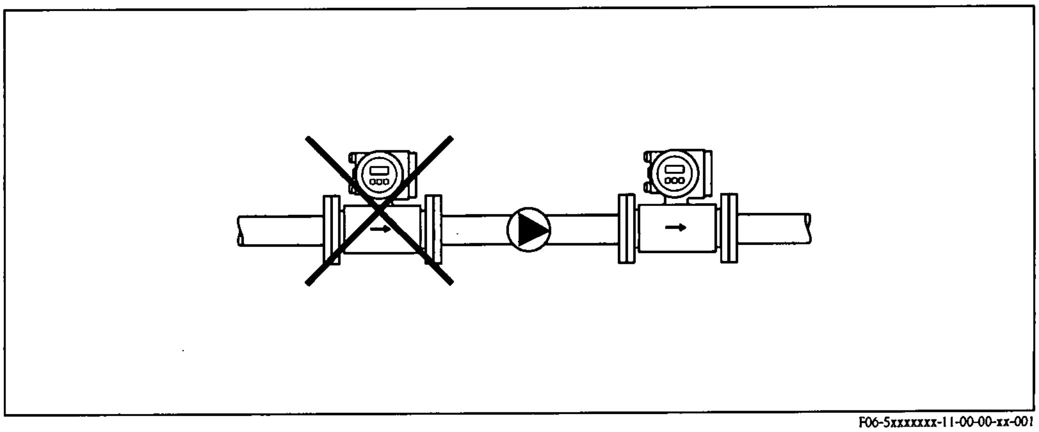

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Fig. 7: Installation of pumps

Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function (see Page 81) offers additional protection by detecting empty or partially filled pipes.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain.
It is advisable to install a cleaning valve.

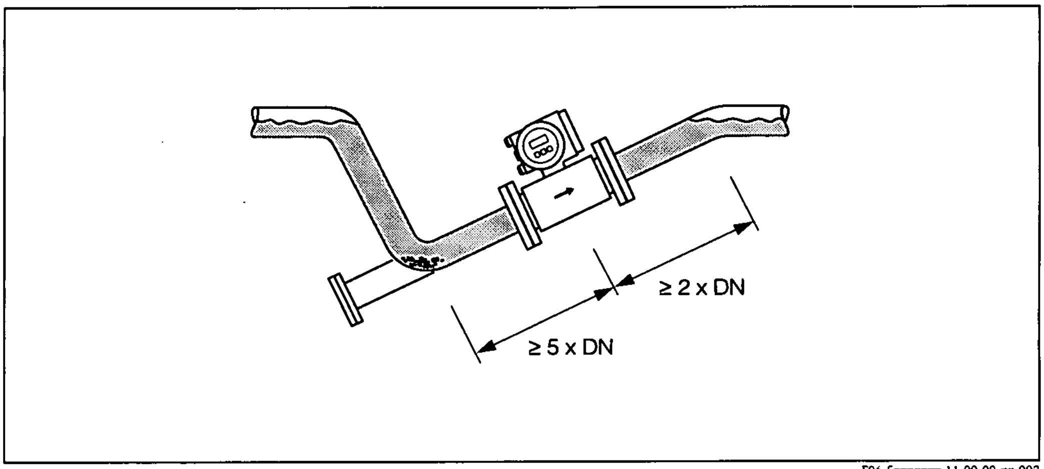

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Fig. 8: Installation in partially filled pipe

Down pipes
Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. These measures also prevent the system losing prime, which could cause air inclusions. Information on the lining's resistance to partial vacuum can be found on Page 113.

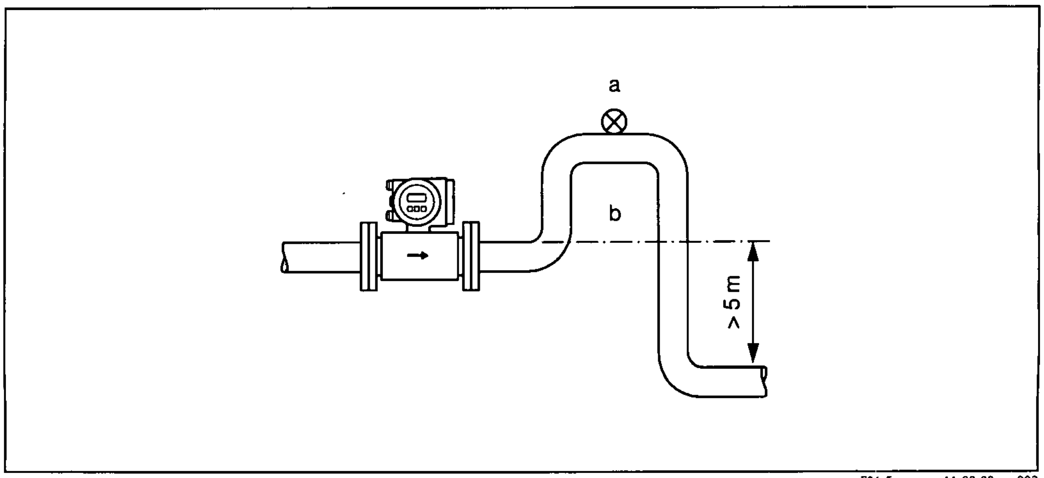

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Fig. 9: Measures for installation in a down pipe (a = vent valve; b = siphon)

3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, supplies a range of functions and accessories for correct measuring of problematic fluids:
- Electrode Cleaning Circuit (ECC) for applications with accretive fluids, e.g. electrically conductive deposits → "Description of Device Functions" manual.
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure (see Page 81)
- Exchangeable Measuring Electrodes for abrasive fluids (see Page 103)

Vertical orientation
This is the ideal orientation for self-emptying piping systems and for use in conjunction with Empty Pipe Detection.

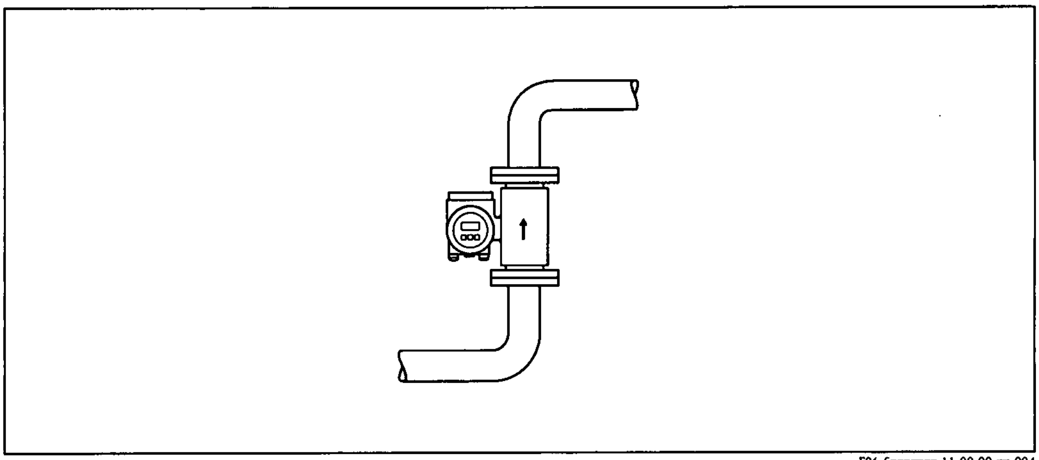
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Fig. 10: Vertical orientation

Horizontal orientation
The measuring electrode plane should be horizontal. This prevents brief insulation of the two electrodes by entrained air bubbles.

Caution!
Empty Pipe Detection functions correctly only when the measuring device is installed horizontally and the transmitter housing is facing upward (Fig. 11). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.

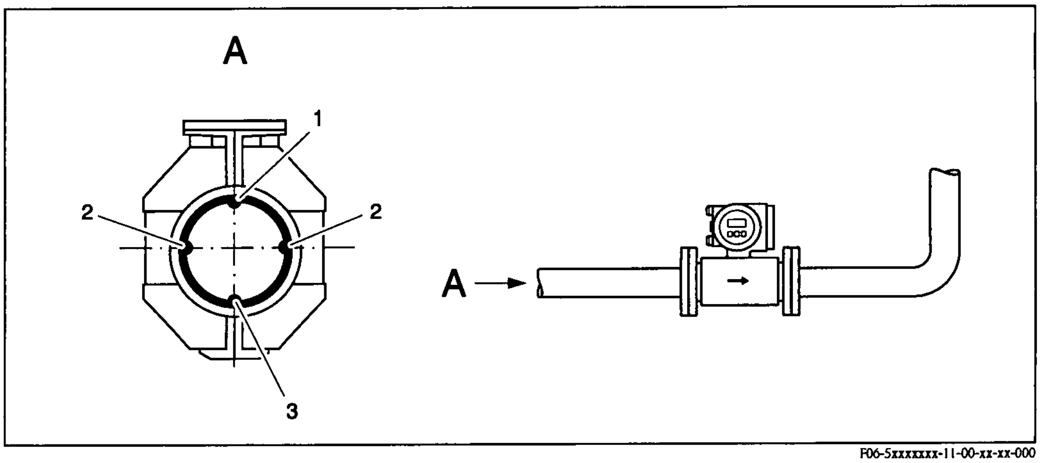

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Fig. 11: Horizontal orientation

1 EPD electrode for the detection of empty pipes (not with Promag H, DN 2...4)
2 Measurement electrodes for the signal acquisition
3 Reference electrode for the potential equalisation (not with Promag H)

Inlet and outlet runs

If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc. Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy.

- Inlet run ≥ 5 x DN
- Outlet run ≥ 2 x DN

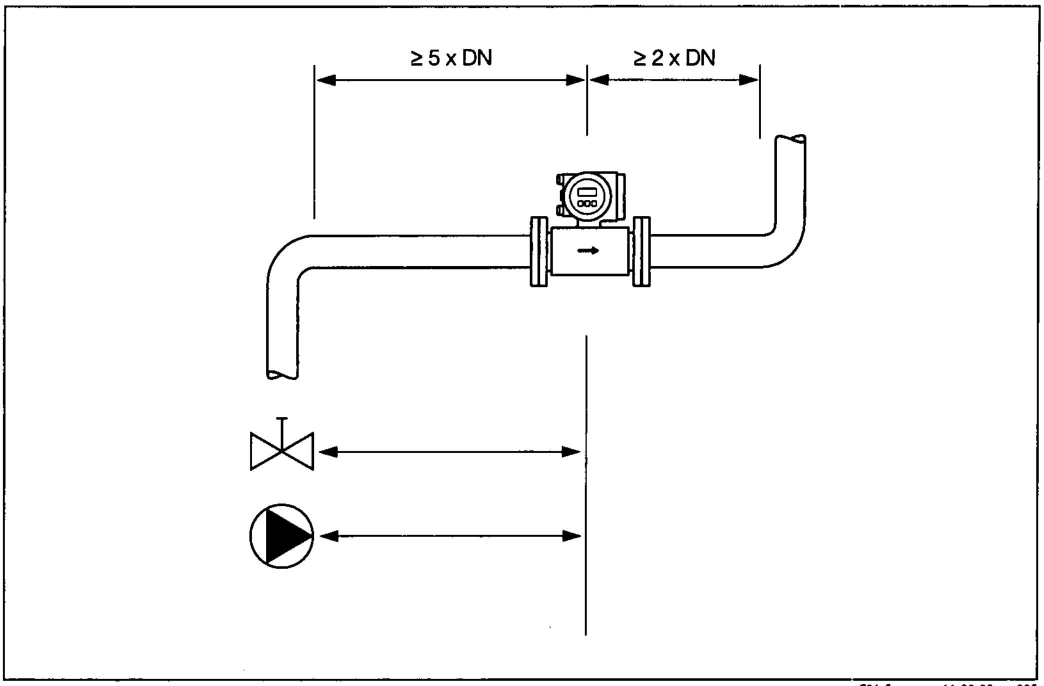

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Fig. 12: Inlet and outlet runs

3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!

It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information on resistance to vibration and shock can be found on → Page 110.

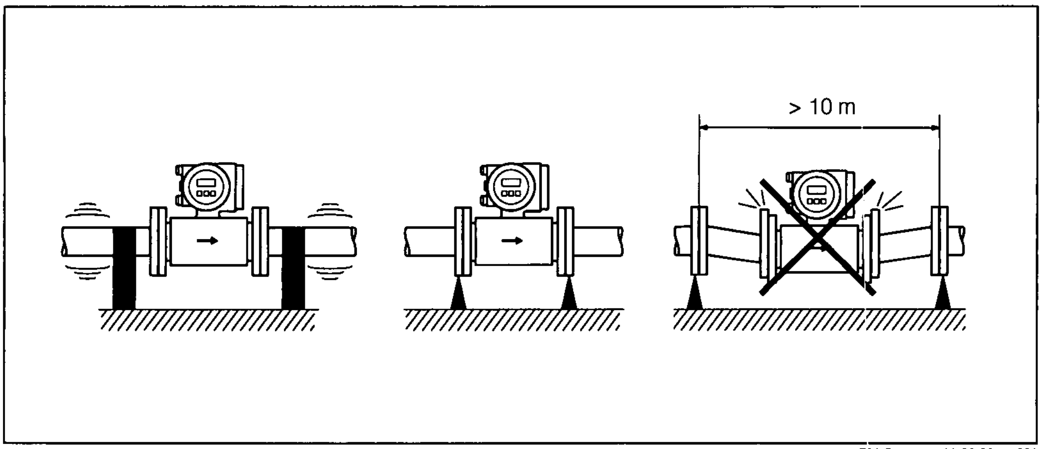

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Fig. 13: Measures to prevent vibration of the measuring device

3.2.5 Foundations, supports

If the nominal diameter is DN ≥ 350, mount the transmitter on a foundation of adequate load-bearing strength.

Caution!
Risk of damage. Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.

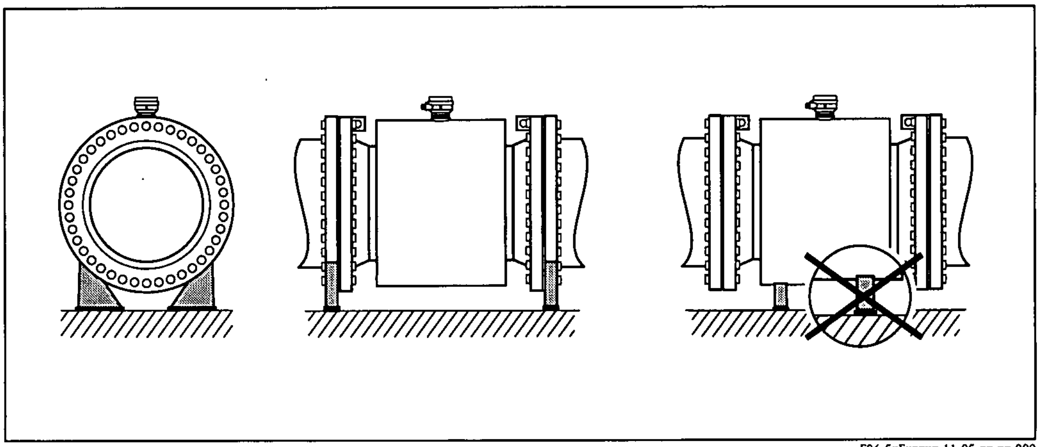

Fig. 14: Correct support for large nominal diameters (DN ≥ 350)

3.2.6 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 cross-section reduction:

Note!
The nomogram applies to fluids of viscosity similar to water.

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

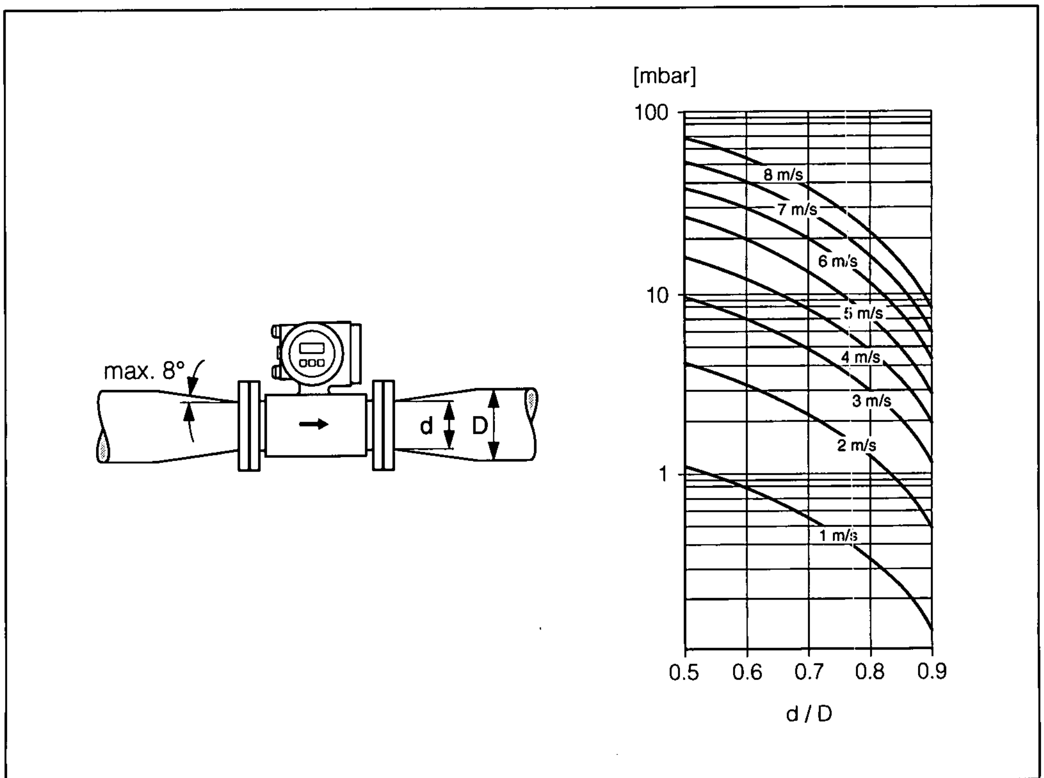

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Fig. 15: Pressure loss due to adapters

3.2.7 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor.
The optimum velocity of flow is 2...3 m/s. The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:
- v < 2 m/s: for abrasive fluids such as potter's clay, lime milk, ore slurry, etc.
- v > 2 m/s: for fluids producing build-up such as wastewater sludge, etc.

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (see Chap. 3.2.6).

Promag W

Flow rate characteristic values – Promag W (SI units)					
Nominal diameter		Recommended flow rate	Factory setting		
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
25	1"	9...300 dm^3/min	75 dm^3/min	0.50 dm^3	1 dm^3/min
32	1 1/4"	15...500 dm^3/min	125 dm^3/min	1.00 dm^3	2 dm^3/min
40	1 1/2"	25...700 dm^3/min	200 dm^3/min	1.50 dm^3	3 dm^3/min
50	2"	35...1100 dm^3/min	300 dm^3/min	2.50 dm^3	5 dm^3/min
65	2 1/2"	60...2000 dm^3/min	500 dm^3/min	5.00 dm^3	8 dm^3/min
80	3"	90...3000 dm^3/min	750 dm^3/min	5.00 dm^3	12 dm^3/min
100	4"	145...4700 dm^3/min	1200 dm^3/min	10.00 dm^3	20 dm^3/min
125	5"	220...7500 dm^3/min	1850 dm^3/min	15.00 dm^3	30 dm^3/min
150	6"	20...600 m^3/h	150 m^3/h	0.025 m^3	2.5 m^3/h
200	8"	35...1100 m^3/h	300 m^3/h	0.05 m^3	5.0 m^3/h
250	10"	55...1700 m^3/h	500 m^3/h	0.05 m^3	7.5 m^3/h
300	12"	80...2400 m^3/h	750 m^3/h	0.10 m^3	10 m^3/h
350	14"	110...3300 m^3/h	1000 m^3/h	0.10 m^3	15 m^3/h
400	16"	140...4200 m^3/h	1200 m^3/h	0.15 m^3	20 m^3/h
450	18"	180...5400 m^3/h	1500 m^3/h	0.25 m^3	25 m^3/h
500	20"	220...6600 m^3/h	2000 m^3/h	0.25 m^3	30 m^3/h
600	24"	310...9600 m^3/h	2500 m^3/h	0.30 m^3	40 m^3/h
700	28"	420...13500 m^3/h	3500 m^3/h	0.50 m^3	50 m^3/h
–	30"	480...15000 m^3/h	4000 m^3/h	0.50 m^3	60 m^3/h
800	32"	550...18000 m^3/h	4500 m^3/h	0.75 m^3	75 m^3/h
900	36"	690...22500 m^3/h	6000 m^3/h	0.75 m^3	100 m^3/h
1000	40"	850...28000 m^3/h	7000 m^3/h	1.00 m^3	125 m^3/h
–	42"	950...30000 m^3/h	8000 m^3/h	1.00 m^3	125 m^3/h
1200	48"	1250...40000 m^3/h	10000 m^3/h	1.50 m^3	150 m^3/h
–	54"	1550...50000 m^3/h	13000 m^3/h	1.50 m^3	200 m^3/h
1400	–	1700...55000 m^3/h	14000 m^3/h	2.00 m^3	225 m^3/h
–	60"	1950...60000 m^3/h	16000 m^3/h	2.00 m^3	250 m^3/h
1600	–	2200...70000 m^3/h	18000 m^3/h	2.50 m^3	300 m^3/h
–	66"	2500...80000 m^3/h	20500 m^3/h	2.50 m^3	325 m^3/h
1800	72"	2800...90000 m^3/h	23000 m^3/h	3.00 m^3	350 m^3/h
–	78"	3300...100000 m^3/h	28500 m^3/h	3.50 m^3	450 m^3/h
2000	–	3400...110000 m^3/h	28500 m^3/h	3.50 m^3	450 m^3/h

Flow rate characteristic values – Promag W (US units)					
Nominal diameter		Recommended flow rate	Factory setting		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1"	25	2.5...80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4...130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60...1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90...2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155...4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250...7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350...10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500...15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600...19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800...24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000...30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400...44000 gal/min	10500 gal/min	100 gal	180 gal/min
28"	700	1900...60000 gal/min	13500 gal/min	125 gal	210 gal/min
30"	–	2150...67000 gal/min	16500 gal/min	150 gal	270 gal/min
32"	800	2450...80000 gal/min	19500 gal/min	200 gal	300 gal/min
36"	900	3100...100000 gal/min	24000 gal/min	225 gal	360 gal/min
40"	1000	3800...125000 gal/min	30000 gal/min	250 gal	480 gal/min
42"	–	4200...135000 gal/min	33000 gal/min	250 gal	600 gal/min
48"	1200	5500...175000 gal/min	42000 gal/min	400 gal	600 gal/min
54"	–	9...300 Mgal/d	75 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1400	10...340 Mgal/d	85 Mgal/d	0.0005 Mgal	1.3 Mgal/d
60"	–	12...380 Mgal/d	95 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1600	13...450 Mgal/d	110 Mgal/d	0.0008 Mgal	1.7 Mgal/d
66"	–	14...500 Mgal/d	120 Mgal/d	0.0008 Mgal	2.2 Mgal/d
72"	1800	16...570 Mgal/d	140 Mgal/d	0.0008 Mgal	2.6 Mgal/d
78"	–	18...650 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d
–	2000	20...700 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d

Promag P

Flow rate characteristic values – Promag P (SI units)					
Nominal diameter		Recommended flow rate	Factory setting		
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
15	1/2"	4...100 dm^3/min	25 dm^3/min	0.20 dm^3	0.5 dm^3/min
25	1"	9...300 dm^3/min	75 dm^3/min	0.50 dm^3	1 dm^3/min
32	1 1/4"	15...500 dm^3/min	125 dm^3/min	1.00 dm^3	2 dm^3/min
40	1 1/2"	25...700 dm^3/min	200 dm^3/min	1.50 dm^3	3 dm^3/min
50	2"	35...1100 dm^3/min	300 dm^3/min	2.50 dm^3	5 dm^3/min
65	2 1/2"	60...2000 dm^3/min	500 dm^3/min	5.00 dm^3	8 dm^3/min
80	3"	90...3000 dm^3/min	750 dm^3/min	5.00 dm^3	12 dm^3/min
100	4"	145...4700 dm^3/min	1200 dm^3/min	10.00 dm^3	20 dm^3/min
125	5"	220...7500 dm^3/min	1850 dm^3/min	15.00 dm^3	30 dm^3/min
150	6"	20...600 m^3/h	150 m^3/h	0.025 m^3	2.5 m^3/h
200	8"	35...1100 m^3/h	300 m^3/h	0.05 m^3	5.0 m^3/h
250	10"	55...1700 m^3/h	500 m^3/h	0.05 m^3	7.5 m^3/h
300	12"	80...2400 m^3/h	750 m^3/h	0.10 m^3	10 m^3/h
350	14"	110...3300 m^3/h	1000 m^3/h	0.10 m^3	15 m^3/h
400	16"	140...4200 m^3/h	1200 m^3/h	0.15 m^3	20 m^3/h
450	18"	180...5400 m^3/h	1500 m^3/h	0.25 m^3	25 m^3/h
500	20"	220...6600 m^3/h	2000 m^3/h	0.25 m^3	30 m^3/h
600	24"	310...9600 m^3/h	2500 m^3/h	0.30 m^3	40 m^3/h

Flow rate characteristic values – Promag P (US units)					
Nominal diameter		Recommended flow rate	Factory setting		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or ~ 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1/2"	15	1.0...27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	25	2.5...80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4...130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60...1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90...2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155...4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250...7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350...10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500...15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600...19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800...24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000...30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400...44000 gal/min	10500 gal/min	100 gal	180 gal/min

Promag H

Flow rate characteristic values – Promag H (SI units)					
Nominal diameter		Recommended flow rate	Factory settings		
[mm]	inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
2	1/12"	0.06...1.8 dm^3/min	0.5 dm^3/min	0.005 dm^3	0.01 dm^3/min
4	5/32"	0.25...7 dm^3/min	2 dm^3/min	0.025 dm^3	0.05 dm^3/min
8	5/16"	1...30 dm^3/min	8 dm^3/min	0.10 dm^3	0.1 dm^3/min
15	1/2"	4...100 dm^3/min	25 dm^3/min	0.20 dm^3	0.5 dm^3/min
25	1"	9...300 dm^3/min	75 dm^3/min	0.50 dm^3	1 dm^3/min
40	1 1/2"	25...700 dm^3/min	200 dm^3/min	1.50 dm^3	3 dm^3/min
50	2"	35...1100 dm^3/min	300 dm^3/min	2.50 dm^3	5 dm^3/min
65	2 1/2"	60...2000 dm^3/min	500 dm^3/min	5.00 dm^3	8 dm^3/min
80	3"	90...3000 dm^3/min	750 dm^3/min	5.00 dm^3	12 dm^3/min
100	4"	145...4700 dm^3/min	1200 dm^3/min	10.00 dm^3	20 dm^3/min

Flow rate characteristic values – Promag H (US units)					
Nominal diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 Pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1/12"	2	0.015...0.5 gal/min	0.1 gal/min	0.001 gal	0.002 gal/min
5/32"	4	0.07...2 gal/min	0.5 gal/min	0.005 gal	0.008 gal/min
5/16"	8	0.25...8 gal/min	2 gal/min	0.02 gal	0.025 gal/min
1/2"	15	1.0...27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	22	2.5...65 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...1250 gal/min	300 gal/min	2 gal	4.0 gal/min

3.2.8 Length of connecting cable

In order to ensure measuring accuracy, comply with the following instructions when installing the remote version:

- Secure the cable run or route the cable in a conduit. Movement of the cable can falsify the measuring signal, particularly if the fluid conductivity is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalisation between sensor and transmitter, if necessary.
- The permissible cable length Lmax depends on the fluid conductivity (Fig. 16). A minimum conductivity of 20 µS/cm is required for measuring demineralized water.

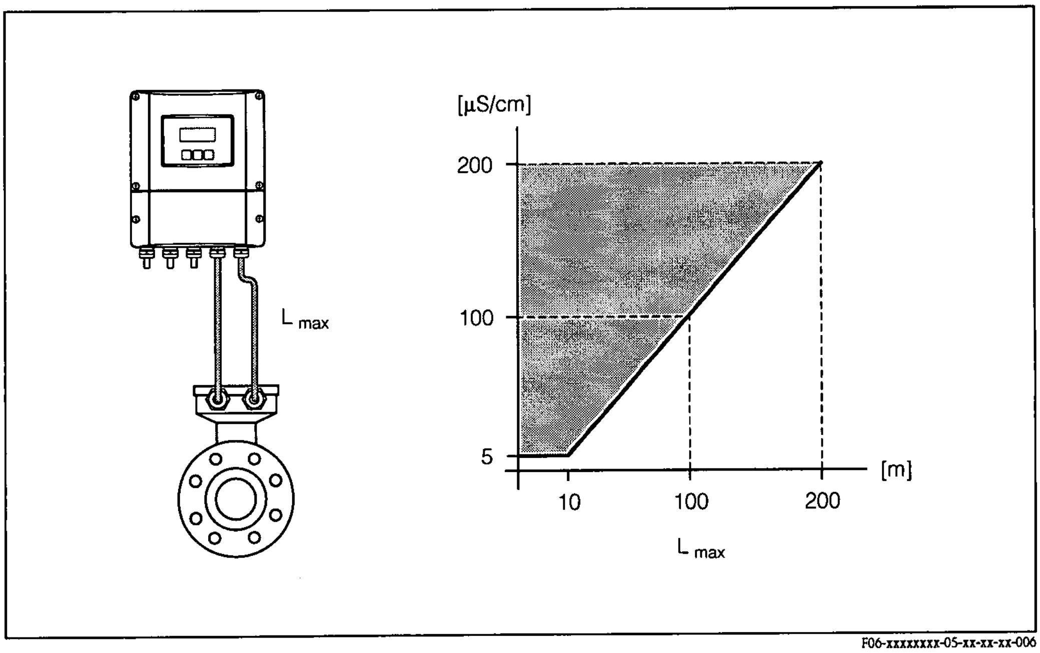

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Fig. 16: Permissible cable length for the remote version

Gray shaded area = permissible range
Lmax = length of connecting cable in [m]
Fluid conductivity in [µS/cm]

3.3 Installation instructions

3.3.1 Installing the Promag W sensor

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges:
- Observe in any case the necessary screw tightening torques on Page 28 ff.
- The mounting of additional ground disks is described on Page 27.

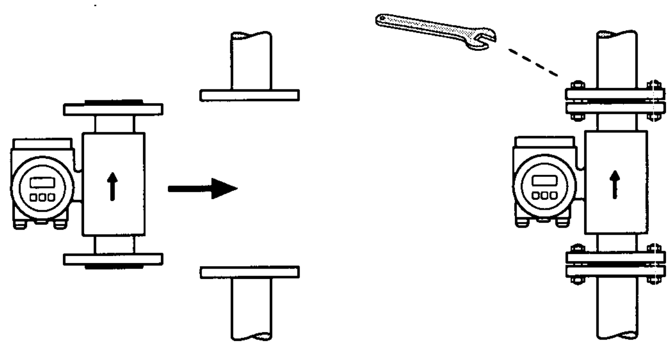
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Fig. 17: Installing the Promag W sensor

Seals
Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → additional seals are recommended.
- For DIN flanges, use only seals according to DIN EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit. Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable (DN 25...2000)
If necessary, the special ground cable for potential equalisation can be ordered as an accessory (see Page 85). Detailled assembly instructions → Page 57 ff.

Assembly with ground disks (DN 25...300)

Depending on the application, e.g. with lined or ungrounded pipes (see Page 56 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for potential equalisation. Ground disks can be ordered separately as an accessory from Endress+Hauser (see Page 85).

Caution!

- In this case, when using ground disks (including seals) the total fitting length increases! All the dimensions are provided in the separate documentation "Technical Information"
- Hard rubber lining → install additional seals between the sensor and ground disk and between the ground disk and pipe flange.
- Polyurethane lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (Fig. 18).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 18 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 28 ff.)
5. Connect the ground disk to ground → Page 58.

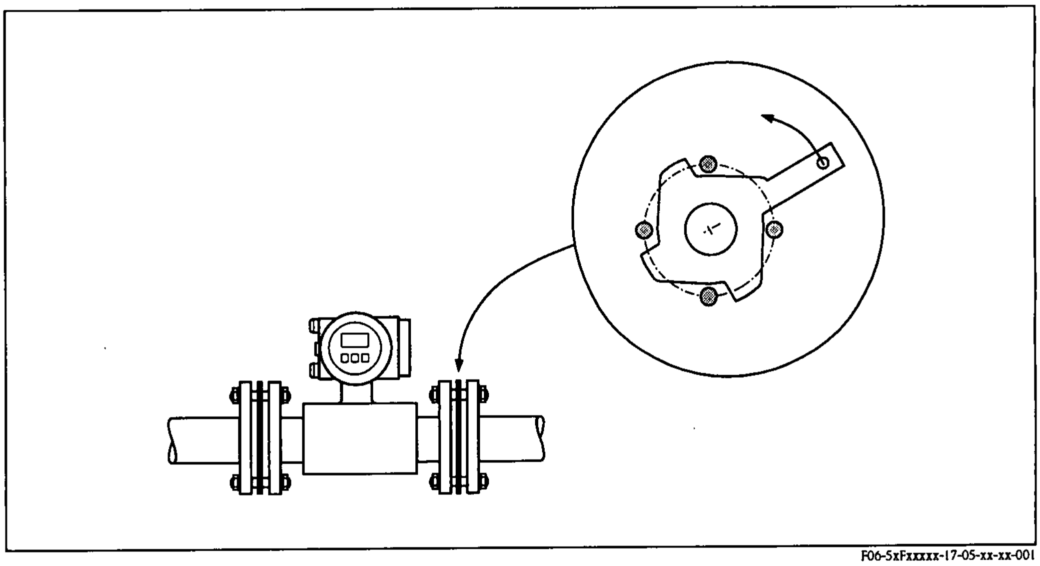

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Fig. 18: Assembly with ground disks (Promag W, DN 25...300)

Screw tightening torques (Promag W)

Note the following points:

- The tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners uniformly and in diagonally opposite sequence.
- Overtightening the fasteners will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Promag W Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	PN 40	4 x M 12	–	15
32	PN 40	4 x M 16	–	24
40	PN 40	4 x M 16	–	31
50	PN 40	4 x M 16	–	40
65 *	PN 16	8 x M 16	32	27
65	PN 40	8 x M 16	32	27
80	PN 16	8 x M 16	40	34
80	PN 40	8 x M 16	40	34
100	PN 16	8 x M 16	43	36
100	PN 40	8 x M 20	59	50
125	PN 16	8 x M 16	56	48
125	PN 40	8 x M 24	83	71
150	PN 16	8 x M 20	74	63
150	PN 40	8 x M 24	104	88
200	PN 10	8 x M 20	106	91
200	PN 16	12 x M 20	70	61
200	PN 25	12 x M 24	104	92
250	PN 10	12 x M 20	82	71
250	PN 16	12 x M 24	98	85
250	PN 25	12 x M 27	150	134
300	PN 10	12 x M 20	94	81
300	PN 16	12 x M 24	134	118
300	PN 25	16 x M 27	153	138
350	PN 10	16 x M 20	112	118
350	PN 16	16 x M 24	152	165
350	PN 25	16 x M 30	227	252
400	PN 10	16 x M 24	151	167
400	PN 16	16 x M 27	193	215
400	PN 25	16 x M 33	289	326
450	PN 10	20 x M 24	153	133
450	PN 16	20 x M 27	198	196
450	PN 25	20 x M 33	256	253
500	PN 10	20 x M 24	155	171
500	PN 16	20 x M 30	275	300
500	PN 25	20 x M 33	317	360

Promag W Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
600	PN 10	20 x M 27	206	219
600 *	PN 16	20 x M 33	415	443
600	PN 25	20 x M 36	431	516
700	PN 10	24 x M 27	246	246
700	PN 16	24 x M 33	278	318
700	PN 25	24 x M 39	449	507
800	PN 10	24 x M 30	331	316
800	PN 16	24 x M 36	369	385
800	PN 25	24 x M 45	664	721
900	PN 10	28 x M 30	316	307
900	PN 16	28 x M 36	353	398
900	PN 25	28 x M 45	690	716
1000	PN 10	28 x M 33	402	405
1000	PN 16	28 x M 39	502	518
1000	PN 25	28 x M 52	970	971
1200	PN 6	32 x M 30	319	299
1200	PN 10	32 x M 36	564	568
1200	PN 16	32 x M 45	701	753
1400	PN 6	36 x M 33	430	398
1400	PN 10	36 x M 39	654	618
1400	PN 16	36 x M 45	729	762
1600	PN 6	40 x M 33	440	417
1600	PN 10	40 x M 45	946	893
1600	PN 16	40 x M 52	1007	1100
1800	PN 6	44 x M 36	547	521
1800	PN 10	44 x M 45	961	895
1800	PN 16	44 x M 52	1108	1003
2000	PN 6	48 x M 39	629	605
2000	PN 10	48 x M 45	1047	1092
2000	PN 16	48 x M 56	1324	1261

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag W Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]			Hard rubber	Polyurethane
700	28"	Class D	28 x 1 1/4"	247	292
750	30"	Class D	28 x 1 1/4	287	302
800	32"	Class D	28 x 1 1/2"	394	422
900	36"	Class D	32 x 1 1/2"	419	430
1000	40"	Class D	36 x 1 1/2"	420	477
1050	42"	Class D	36 x 1 1/2"	528	518
1200	48"	Class D	44 x 1 1/2"	552	531
1350	54"	Class D	44 x 1 3/4"	730	633
1500	60"	Class D	52 x 1 3/4"	758	832
1650	66"	Class D	52 x 1 3/4"	946	955
1800	72"	Class D	60 x 1 3/4"	975	1087
2000	78"	Class D	64 x 2"	853	786

Promag W Nominal diameter		ANSI Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]	[lbs]		Hard rubber	Polyurethane
25	1"	Class 150	4 x 1/2"	–	7
25	1"	Class 300	4 x 5/8"	–	8
40	1 1/2"	Class 150	4 x 1/2"	–	10
40	1 1/2"	Class 300	4 x 3/4"	–	15
50	2"	Class 150	4 x 5/8"	–	22
50	2"	Class 300	8 x 5/8"	–	11
80	3"	Class 150	4 x 5/8"	60	43
80	3"	Class 300	8 x 3/4"	38	26
100	4"	Class 150	8 x 5/8"	42	31
100	4"	Class 300	8 x 3/4"	58	40
150	6"	Class 150	8 x 3/4"	79	59
150	6"	Class 300	12 x 3/4"	70	51
200	8"	Class 150	8 x 3/4"	107	80
250	10"	Class 150	12 x 7/8"	101	75
300	12"	Class 150	12 x 7/8"	133	103
350	14"	Class 150	12 x 1"	135	158
400	16"	Class 150	16 x 1"	128	150
450	18"	Class 150	16 x 1 1/8"	204	234
500	20"	Class 150	20 x 1 1/8"	183	217
600	24"	Class 150	20 x 1 1/4"	268	307

Promag W Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	10K	4 x M 16	–	19
25	20K	4 x M 16	–	19
32	10K	4 x M 16	–	22
32	20K	4 x M 16	–	22
40	10K	4 x M 16	–	24
40	20K	4 x M 16	–	24
50	10K	4 x M 16	–	33
50	20K	8 x M 16	–	17
65	10K	4 x M 16	55	45
65	20K	8 x M 16	28	23
80	10K	8 x M 16	29	23
80	20K	8 x M 20	42	35
100	10K	8 x M 16	35	29
100	20K	8 x M 20	56	48
125	10K	8 x M 20	60	51
125	20K	8 x M 22	91	79
150	10K	8 x M 20	75	63
150	20K	12 x M 22	81	72
200	10K	12 x M 20	61	52
200	20K	12 x M 22	91	80
250	10K	12 x M 22	100	87
250	20K	12 x M 24	159	144
300	10K	16 x M 22	74	63
300	20K	16 x M 24	138	124

Promag W Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
80	Table E	4 x M 16	49
100	Table E	8 x M 16	38
150	Table E	8 x M 20	64
200	Table E	8 x M 20	96
250	Table E	12 x M 20	98
300	Table E	12 x M 24	123
350	Table E	12 x M 24	203
400	Table E	12 x M 24	226
500	Table E	16 x M 24	271
600	Table E	16 x M 30	439

Promag W Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
80	Cl.14	4 x M 16	49
100 *	Cl.14	8 x M 16	38
150	Cl.14	8 x M 20	52
200	Cl.14	8 x M 20	77
250	Cl.14	8 x M 20	147
300	Cl.14	12 x M 24	103
350	Cl.14	12 x M 24	203
400	Cl.14	12 x M 24	226
500	Cl.14	16 x M 24	271
600	Cl.14	16 x M 30	393

* Designed acc. to EN 2129 (not to DIN 4087)

3.3.2 Installing the Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE lining, which is turned over the flanges. Consequently, do not remove these covers until *immediately before* the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on Page 36 ff.
- The mounting of additional ground disks is described on Seite 34.

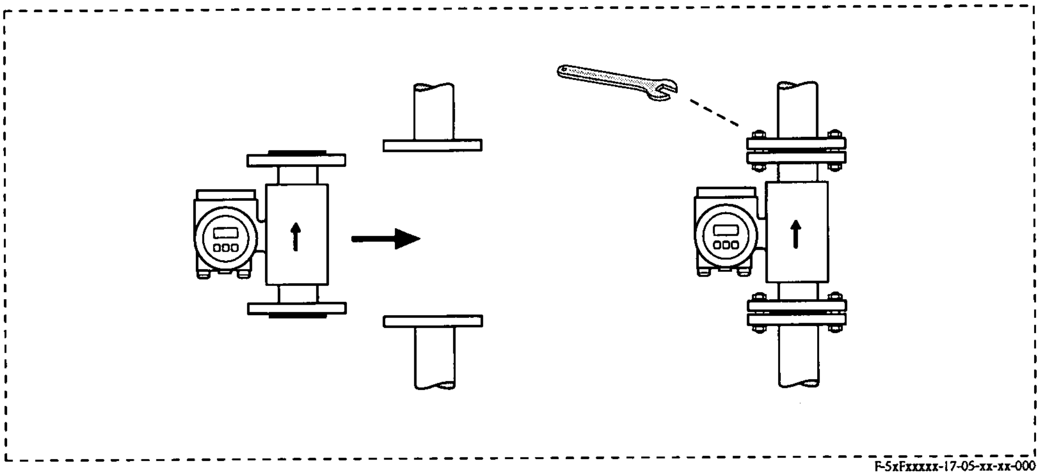
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Fig. 19: Installing the Promag P sensor

Seals
Comply with the following instructions when installing seals:
- Measuring tube linings with PFA or PTFE → **No** seals are required.
- In case you use seals with DIN flanges, use only seals according to DIN EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit. Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable (DN 15...600)
If necessary, a special ground cable for potential equalisation can be ordered as an accessory (see Page 85). Detailled assembly instructions → Page 57 ff.

Assembly with ground disks (DN 15...300)

Depending on the application, e.g. with lined or ungrounded pipes (see Page 56 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for the potential equalisation. Ground disks can be ordered separately as an accessory from Endress+Hauser (see Page 85).

Caution!

- In this case, when using ground disks (including seals) the total fitting length increases! All the dimensions are provided in the separate documentation "Technical Information".
- PTFE and PFA lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and the additional seal between the instrument and the pipe flange (Fig. 20).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 20 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 36 ff.)
5. Connect the ground disk to ground → Page 58.

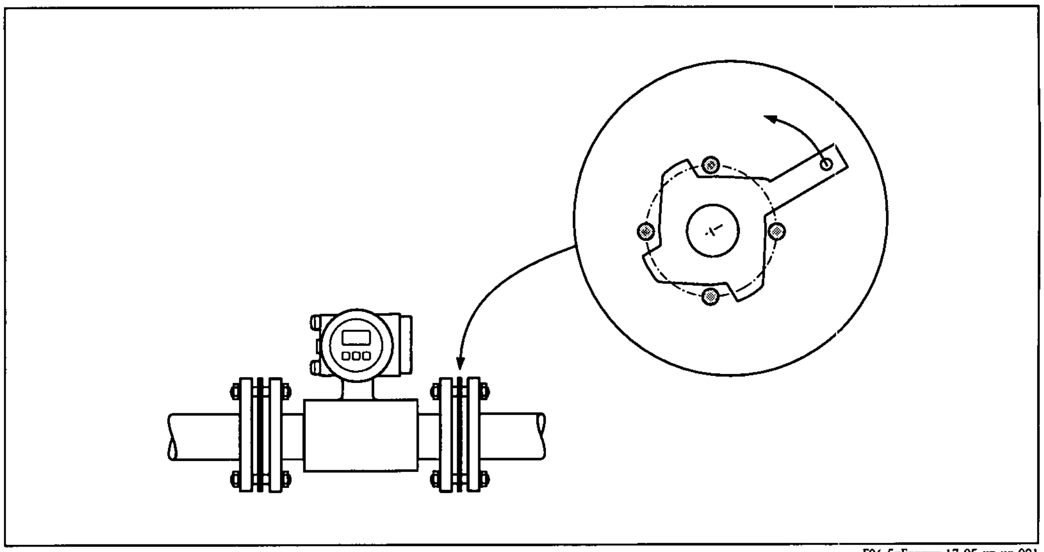

Fig. 20: Assembly with ground disks (Promag P, DN 15...300)

Installing the high-temperature version (with PFA lining)
The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications in which high ambient temperatures are encountered *in conjunction with* high fluid temperatures. The high-temperature version is obligatory if the fluid temperature exceeds +150 °C.

Note!
You will find information on permissible temperature ranges on → Page 111

Insulation
Pipes generally have to be insulated if they carry very hot fluids, in order to avoid energy losses and to prevent accidental contact with pipes at temperatures that could cause injury. Guidelines regulating the insulation of pipes have to be taken into account.

Caution!
Risk of measuring electronics overheating. The housing support dissipates heat and its entire surface area must remain uncovered. Make sure that the sensor insulation does not extend past the top of the two sensor shells (Fig. 21).

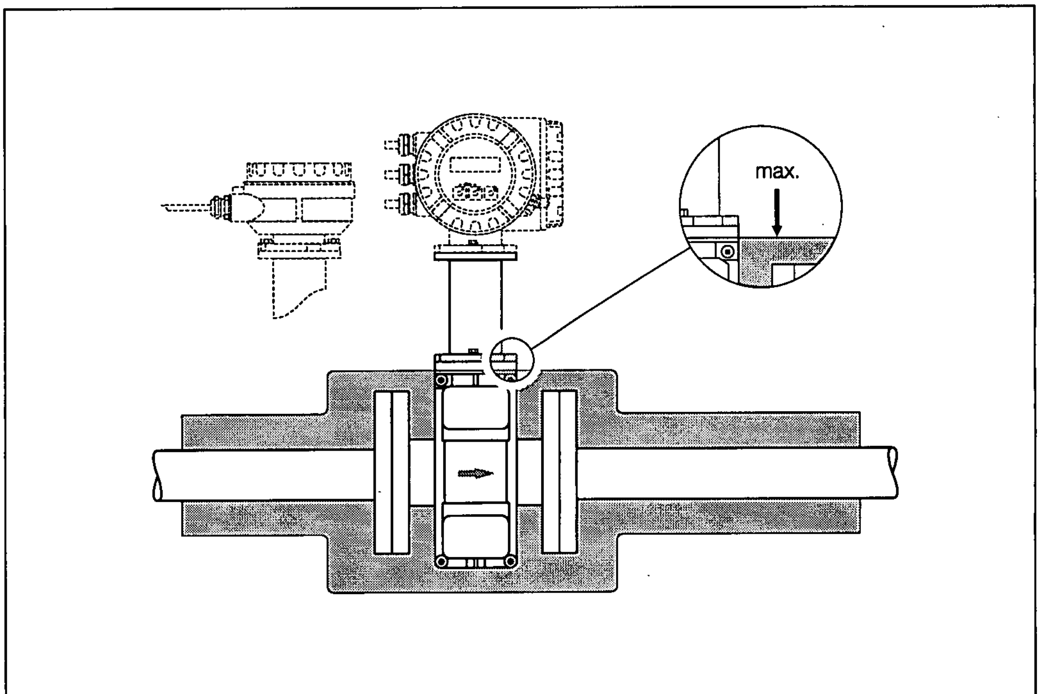

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Fig. 21: Promag P (high-temperature version): Insulating the pipe

Tightening torques for threaded fasteners (Promag P)

Note the following points:

- The tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners uniformly and in diagonally opposite sequence.
- Overtightening the fasteners will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Promag P Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
15	PN 40	4 x M 12	11	–
25	PN 40	4 x M 12	26	20
32	PN 40	4 x M 16	41	35
40	PN 40	4 x M 16	52	47
50	PN 40	4 x M 16	65	59
65 *	PN 16	8 x M 16	43	40
65	PN 40	8 x M 16	43	40
80	PN 16	8 x M 16	53	48
80	PN 40	8 x M 16	53	48
100	PN 16	8 x M 16	57	51
100	PN 40	8 x M 20	78	70
125	PN 16	8 x M 16	75	67
125	PN 40	8 x M 24	111	99
150	PN 16	8 x M 20	99	85
150	PN 40	8 x M 24	136	120
200	PN 10	8 x M 20	141	101
200	PN 16	12 x M 20	94	67
200	PN 25	12 x M 24	138	105
250	PN 10	12 x M 20	110	–
250	PN 16	12 x M 24	131	–
250	PN 25	12 x M 27	200	–
300	PN 10	12 x M 20	125	–
300	PN 16	12 x M 24	179	–
300	PN 25	16 x M 27	204	–
350	PN 10	16 x M 20	188	–
350	PN 16	16 x M 24	254	–
350	PN 25	16 x M 30	380	–
400	PN 10	16 x M 24	260	–
400	PN 16	16 x M 27	330	–
400	PN 25	16 x M 33	488	–
450	PN 10	20 x M 24	235	–
450	PN 16	20 x M 27	300	–
450	PN 25	20 x M 33	385	–
500	PN 10	20 x M 24	265	–
500	PN 16	20 x M 30	448	–

Promag P Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
500	PN 25	20 x M 33	533	–
600	PN 10	20 x M 27	345	–
600 *	PN 16	20 x M 33	658	–
600	PN 25	20 x M 36	731	–

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag P Nominal diameter		ANSI Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]	[lbs]		PTFE	PFA
15	1/2"	Class 150	4 x 1/2"	6	–
15	1/2"	Class 300	4 x 1/2"	6	–
25	1"	Class 150	4 x 1/2"	11	10
25	1"	Class 300	4 x 5/8"	14	12
40	1 1/2"	Class 150	4 x 1/2"	24	21
40	1 1/2"	Class 300	4 x 3/4"	34	31
50	2"	Class 150	4 x 5/8"	47	44
50	2"	Class 300	8 x 5/8"	23	22
80	3"	Class 150	4 x 5/8"	79	67
80	3"	Class 300	8 x 3/4"	47	42
100	4"	Class 150	8 x 5/8"	56	50
100	4"	Class 300	8 x 3/4"	67	59
150	6"	Class 150	8 x 3/4"	106	86
150	6"	Class 300	12 x 3/4"	73	67
200	8"	Class 150	8 x 3/4"	143	109
250	10"	Class 150	12 x 7/8"	135	–
300	12"	Class 150	12 x 7/8"	178	–
350	14"	Class 150	12 x 1"	260	–
400	16"	Class 150	16 x 1"	246	–
450	18"	Class 150	16 x 1 1/8"	371	–
500	20"	Class 150	20 x 1 1/8"	341	–
600	24"	Class 150	20 x 1 1/4"	477	–

Promag P Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
15	10K	4 x M 12	16	–
15	20K	4 x M 12	16	–
25	10K	4 x M 16	32	–
25	20K	4 x M 16	32	–
32	10K	4 x M 16	38	–
32	20K	4 x M 16	38	–
40	10K	4 x M 16	41	–
40	20K	4 x M 16	41	–
50	10K	4 x M 16	54	–
50	20K	8 x M 16	27	–
65	10K	4 x M 16	74	–
65	20K	8 x M 16	37	–
80	10K	8 x M 16	38	–
80	20K	8 x M 20	57	–
100	10K	8 x M 16	47	–
100	20K	8 x M 20	75	–
125	10K	8 x M 20	80	–
125	20K	8 x M 22	121	–
150	10K	8 x M 20	99	–
150	20K	12 x M 22	108	–
200	10K	12 x M 20	82	–
200	20K	12 x M 22	121	–
250	10K	12 x M 22	133	–
250	20K	12 x M 24	212	–
300	10K	16 x M 22	99	–
300	20K	16 x M 24	183	–

Promag P Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm]
			PTFE
25	Table E	4 x M 12	21
50	Table E	4 x M 16	42

Promag P Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm]
			PTFE
50	Cl.14	4 x M 16	42

3.3.3 Installing the Promag H sensor

The Promag H is supplied to order, with or without pre-installed process connections.
Pre-installed process connections are secured to the sensor with hex-head threaded fasteners.

Caution!

- The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (see Page 85).

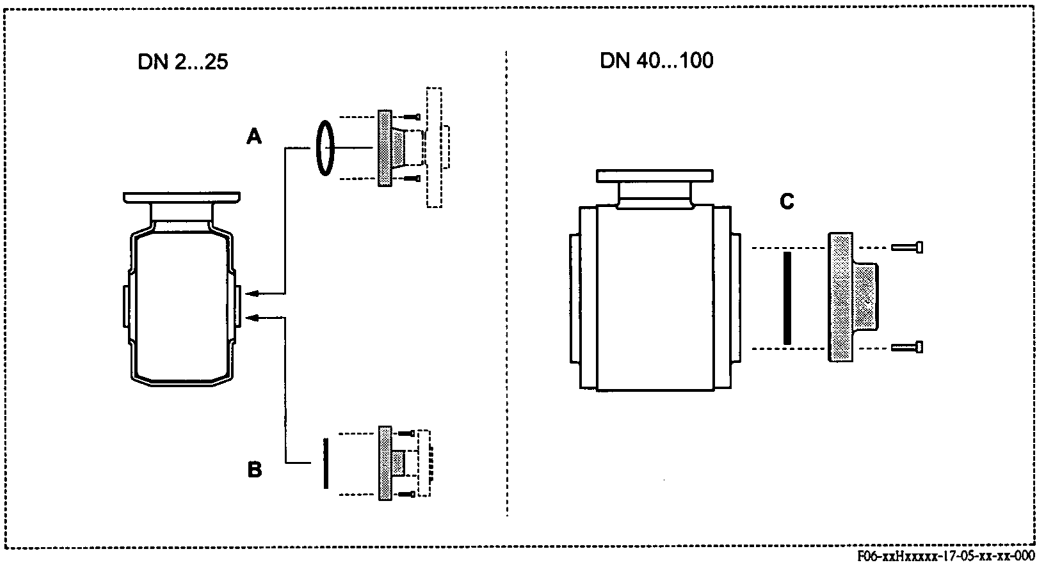

Fig. 22: Promag H process connections (DN 2...25, DN 40...100)

A: DN 2...25 / process connections with O-rings:
Welding flanges (DIN EN ISO 1127, ODT / SMS), flange (EN (DIN), ANSI, JIS), flange PVDF (EN (DIN), ANSI, JIS), external and internal pipe threads, hose connection, PVC adhesive fitting

B: DN 2...25 / process connections with aseptic gasket seals:
Weld nipples (DIN 11850, ODT / SMS), Clamp (ISO 2852, DIN 32676, L14 AM7), coupling (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

C: DN 40...100 / process connections with aseptic gasket seals:
Weld nipples (DIN 11850, ODT / SMS), Clamp (ISO 2852, DIN 32676), L14 AM7), coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flange DIN 11864-2

Seals

When installing the process connections, make sure that the seals are clean and correctly centered.

Caution!

- With metallic process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)! The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature. Replacement seals can be ordered as accessories → Page 85.

Usage and assembly of ground rings (DN 2...25)

In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalised using additional ground rings.
If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the electrochemical erosion of the electrodes.

Caution!

- Depending on the option ordered, plastic disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories (see Page 85). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on Page 117.
- Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.

1. Loosen the four hexagonal headed bolts (1) and remove the process connection from the sensor (5).
2. Remove the plastic disk (3), including the two O-ring seals (2, 4).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (4) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again. With plastic process connections, note the max. torques for lubricated threads (7 Nm).

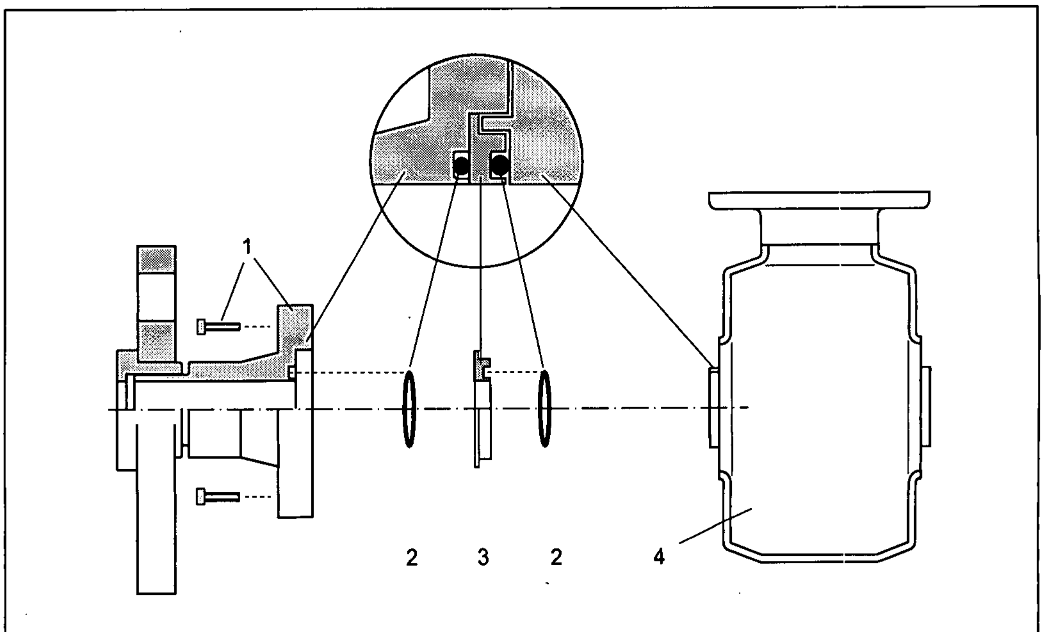

Fig. 23: Installing ground rings with a Promag H (DN 2...25)

1 = Hexagonal headed bolts (process connection)
2 = O-ring seals
3 = Ground ring or plastic disk (placeholder)
4 = Sensor Promag H

Welding the sensor into the piping (weld nipples)

Caution!
Risk of destroying the measuring electronics. Make sure that the welding machine is *not* grounded via the sensor or the transmitter.

1. Tack-weld the Promag H sensor into the pipe. A suitable welding jig can be ordered separately from Endress+Hauser as an accessory (see Page 85).
2. Remove the threaded fasteners from the process-connection flange. Remove the sensor complete with seal from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

Note!
- If thin-walled foodstuffs pipes are not welded correctly, the heat could damage the installed seal. It is therefore advisable to remove the sensor and the seal prior to welding.
- The pipe has to be spread approximately 8 mm to permit disassembly.

Cleaning with pigs
If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube and process connection into account.
All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Information".

3.3.4 Turning the transmitter housing

Turning the aluminum field housing

Warning!
The turning mechanism in devices with EEx d/de or FM/CSA Cl. I Div. 1 classification is not the same as that described here. The procedure for turning these housings is described in the Ex-specific documentation.

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing as far as it will go.
4. Turn the transmitter housing to the desired position (max. 2 x 90° in either direction).
5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.

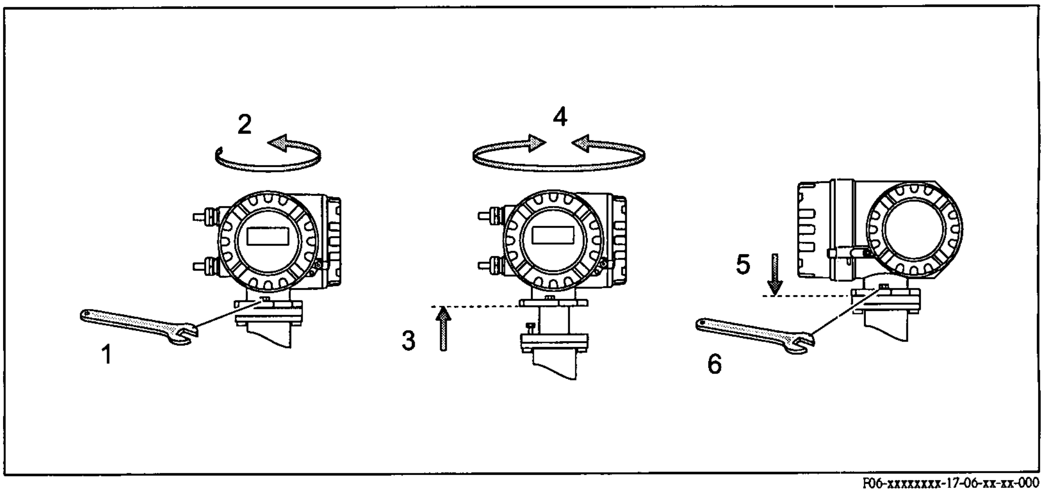

Fig. 24: Turning the transmitter housing (aluminum field housing)

Turning the stainless-steel field housing

1. Loosen the two securing screws.
2. Carefully lift the transmitter housing as far as it will go.
3. Turn the transmitter housing to the desired position (max. 2 x 90° in either direction).
4. Lower the housing into position.
5. Retighten the two securing screws.

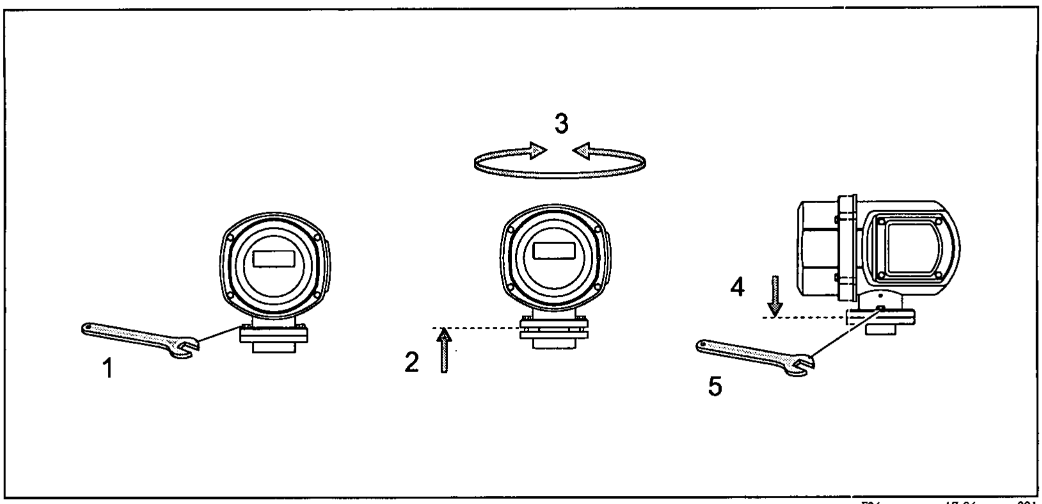

Fig. 25: Turning the transmitter housing (stainless-steel field housing)

3.3.5 Turning the local display

1. Remove the cover of the electronics compartment.
2. Press the side latches on the display module and remove it from the electronics compartment cover plate.
3. Rotate the display to the desired position (max. 4 x 45° in each direction), and place it back into the electronics compartment cover plate.
4. Screw the cover of the electronics compartment firmly onto the transmitter housing.

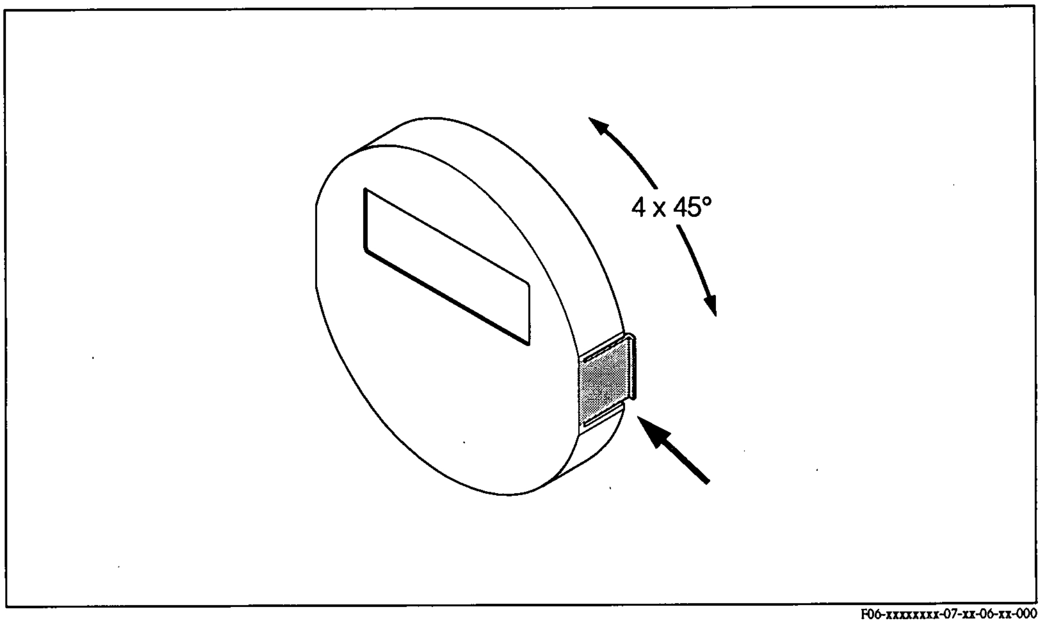

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Fig. 26: Turning the local display (field housing)

3.3.6 Installing the wall-mount transmitter housing

There are various ways of installing the wall-mount transmitter housing:
- Mounted directly on the wall
- Installation in control panel (with separate mounting kit, accessories → Page 85)
- Pipe mounting (with separate mounting kit, accessories → Page 85)

Caution!
- Make sure that ambient temperature does not exceed the permissible range (–20…+60 °C), (optional –40...+60 °C). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in Fig. 27.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm
   – Screw head: max. Ø 10.5 mm
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

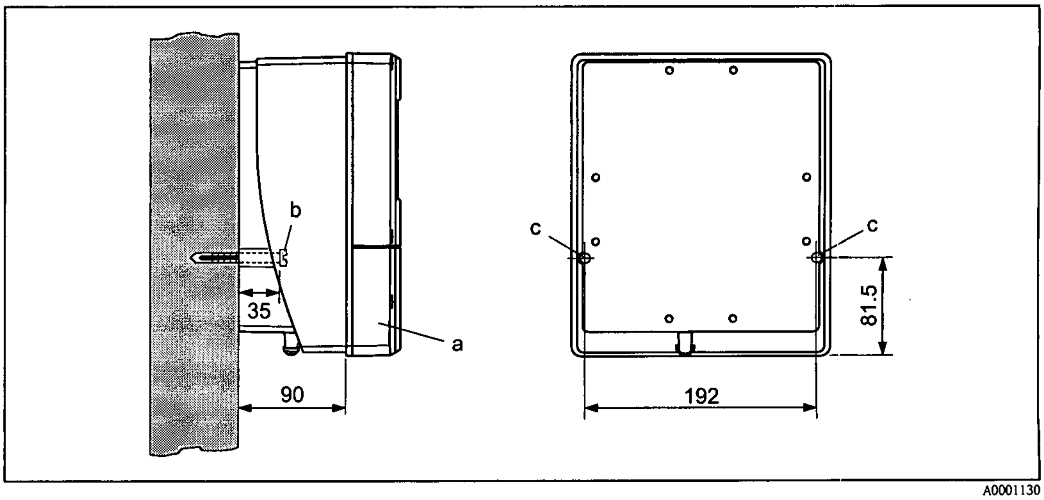

Fig. 27: Mounted directly on the wall

Panel installation

1. Prepare the opening in the panel (Fig. 28).
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel. Afterwards, tighten the locking nuts. Additional support is not necessary.

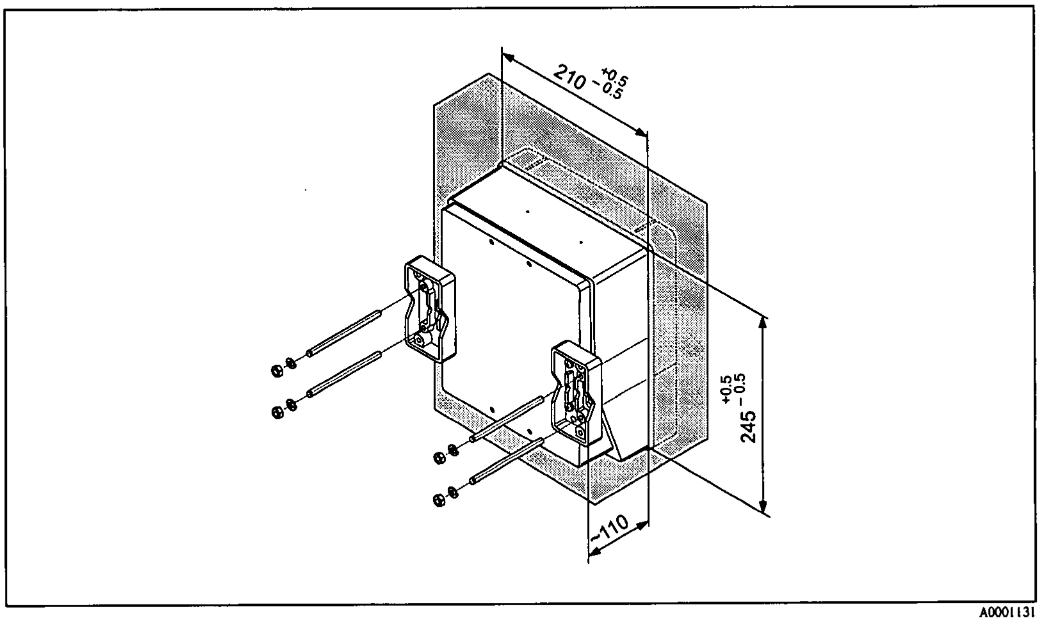

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Fig. 28: Panel Installation (wall-mount housing)

Pipe mounting

The assembly should be performed by following the instructions in Fig. 29.

Caution!
If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed +60 °C, which is the maximum permissible temperature.

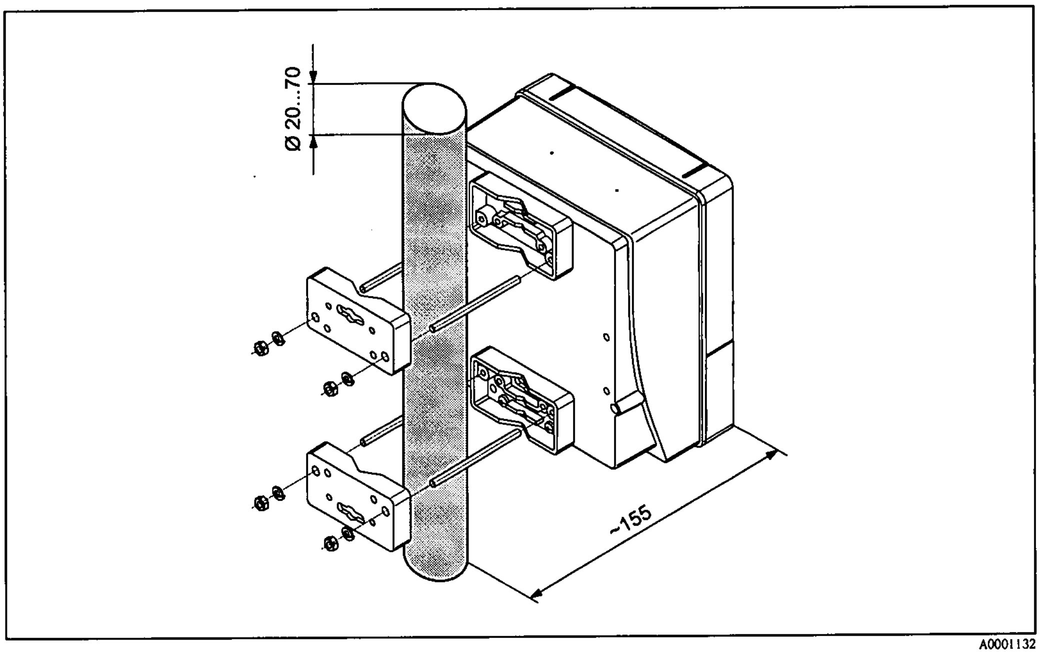

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Fig. 29: Pipe mounting (wall-mount housing)

3.4 Installation check

Perform the following checks after installing the measuring device in the pipe:

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	see Page 107 ff.
Installation	**Notes**
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Is the plane of the measuring-electrode axis correct?	Horizontal
Is the position of the Empty Pipe Detection (EPD) electrode correct?	see Page 17
Were all threaded fasteners tightened to the specified torques when the sensor was installed?	see Chap. 3.3
Were the correct seals installed (type, material, installation)?	Promag W → Page 26 Promag P → Page 33 Promag H → Page 39
Are the measuring-point number and labeling correct (visual inspection)?	–
Process environment / process conditions	**Notes**
Are the inlet and outlet runs to respected?	Inlet run ≥ 5 x DN Outlet run ≥ 2 x DN
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g by analogy with IEC 600 68-2-6 (see Page 110)

4 Wiring

Warning!
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to this Operating Manual. Please do not hesitate to contact your Endress+Hauser representative if you have any questions.
- If you use remote versions, connect each sensor *only* to the transmitter having the same serial number. Measuring errors can occur if the devices are not connected in this way.

4.1 Connecting the remote version

4.1.1 Connecting Promag W / P / H

Warning!
- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective conductor to the ground terminal on the housing before the power supply is applied.

Procedure (Fig. 30, Fig. 31):

1. Transmitter: Loosen the screws and remove cover (a) from the connection compartment.
2. Sensor: Remove cover (b) from the connection housing.
3. Feed signal cable (c) and coil cable (d) through the appropriate cable entries.

   Caution!
   - Make sure the connecting cables are secured (see Page 25).
   - Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.

4. Preterminate signal cable and coil current cable:
   Promag W, P → Refer to the information on Page 49
   Promag H → Refer to the information on Page 50

5. Establish the connections between sensor and transmitter in accordance with the wiring diagram:
   → Fig. 30, Fig. 31
   → wiring diagram inside the cover

   Caution!
   Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighboring cable shields inside the sensor connection housing.

6. Transmitter: Secure cover (a) on the connection compartment.
7. Sensor: Secure cover (b) on the connection housing.

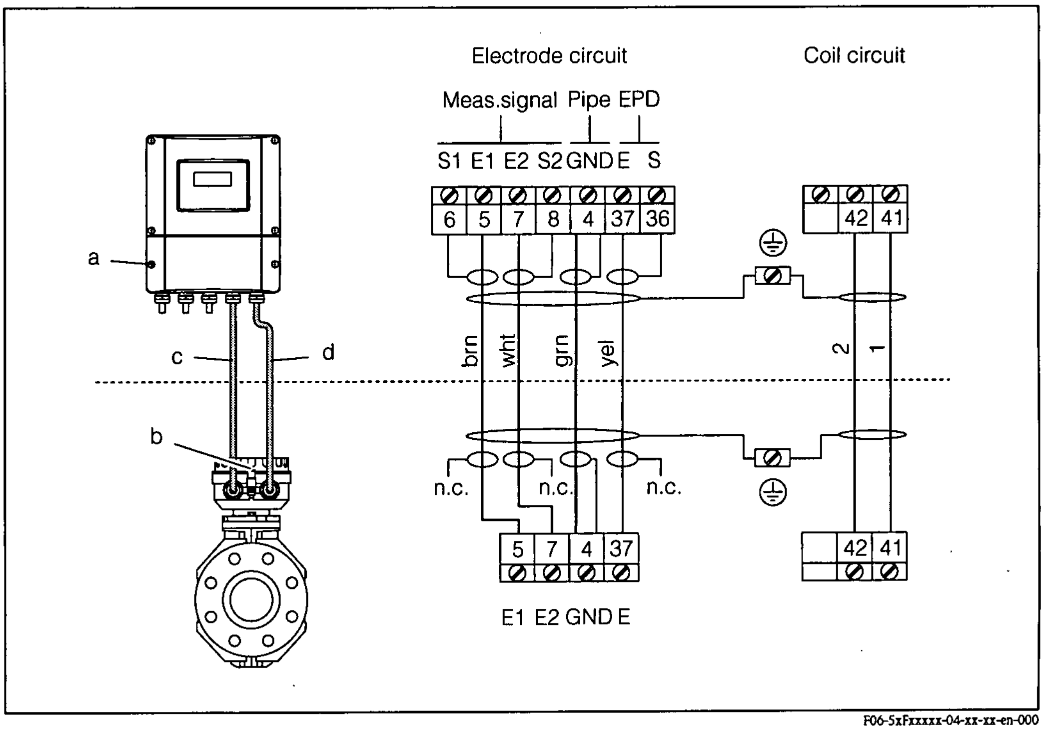


Fig. 30: Connecting the remote version of Promag W/P

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

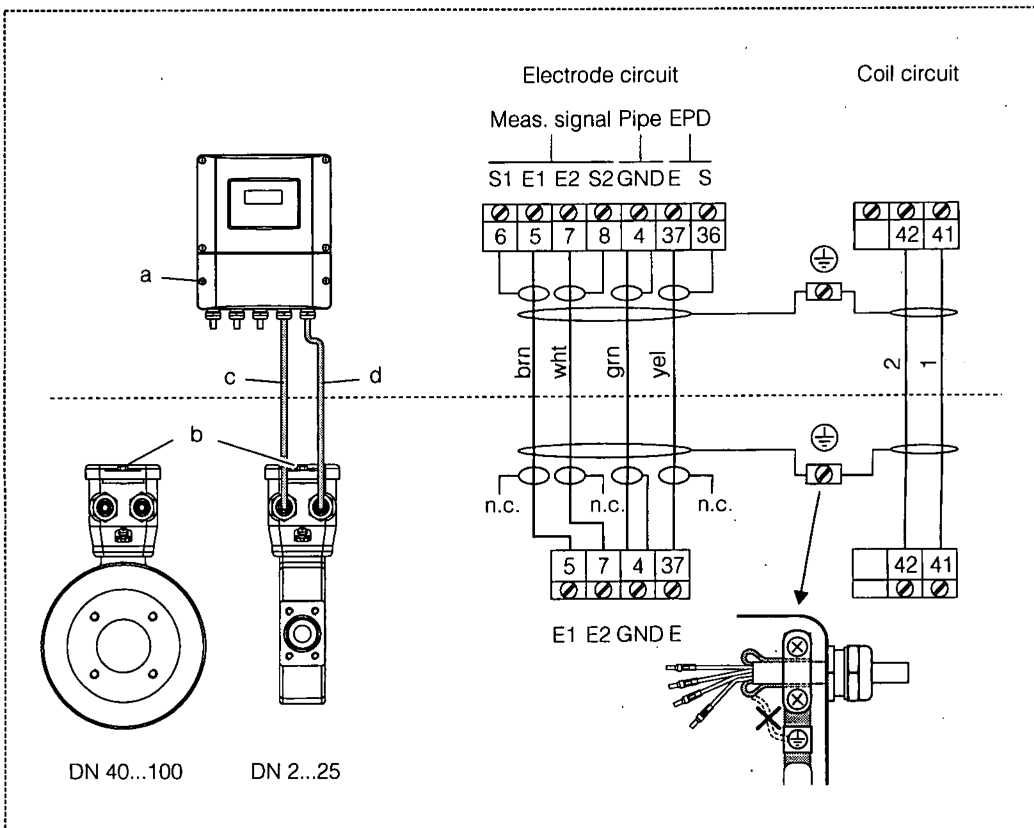


Fig. 31: Connecting the remote version of Promag H

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

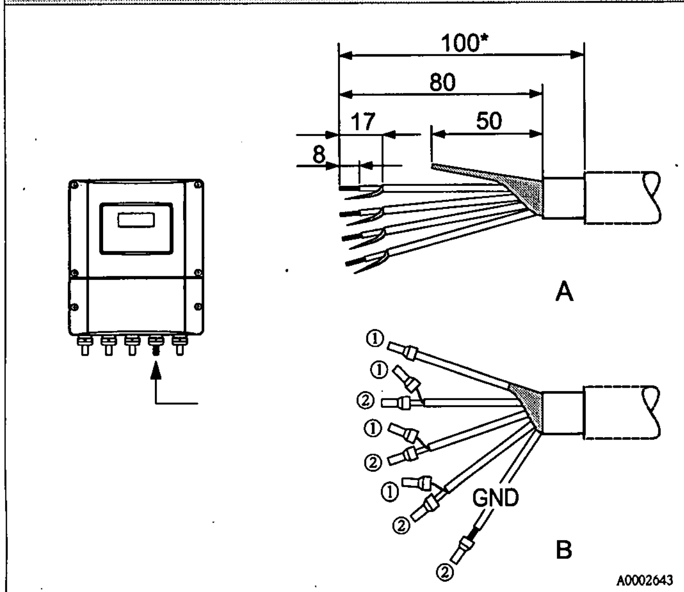
Cable termination for the remote version Promag W / Promag P

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with cable end sleeves (Detail B).

Caution!!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side.
  Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

TRANSMITTER

Signal cable



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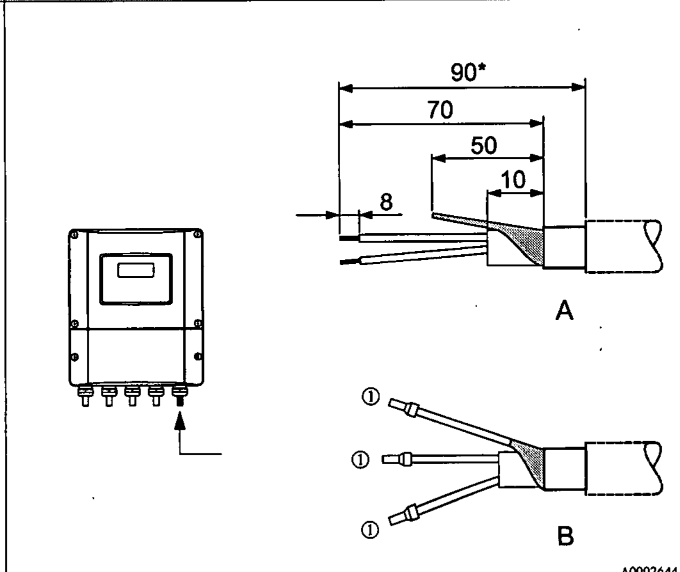
Coil current cable



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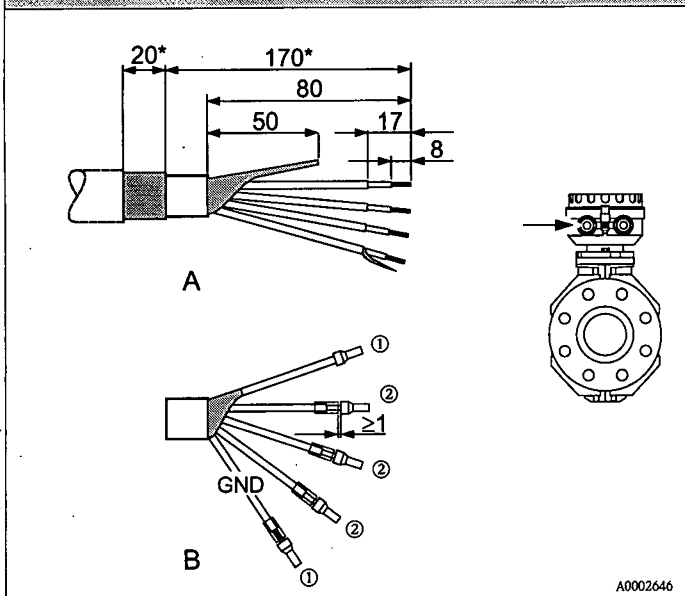
SENSOR

Signal cable



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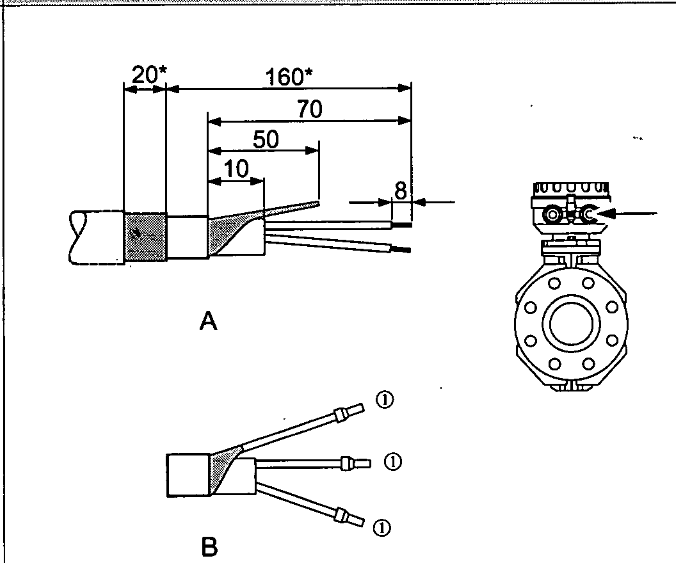
Coil current cable



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① = Red cable sleeves ∅ 1.0 mm
② = White cable sleeves ∅ 0.5 mm
* = Stripping for armoured cables only

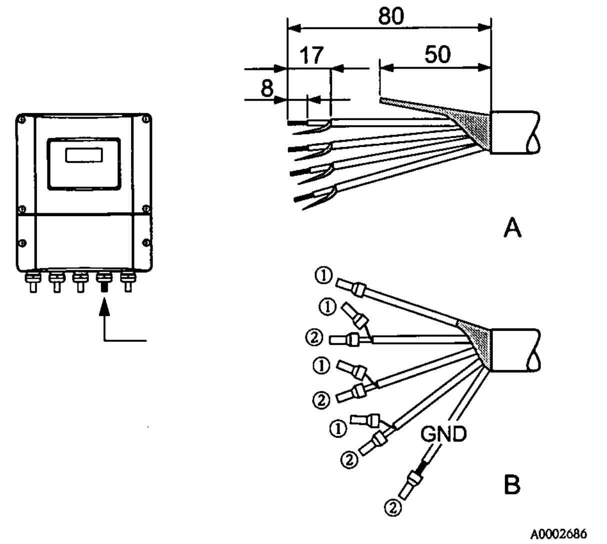
Cable termination for the remote version Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with cable end sleeves (Detail B).

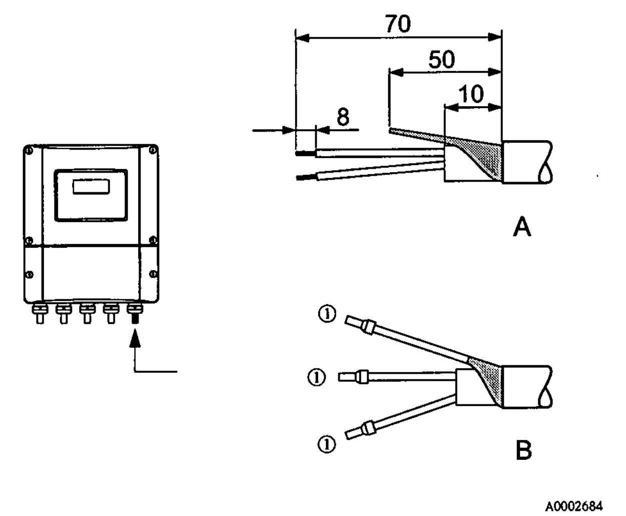
Caution!!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

TRANSMITTER

Signal cable

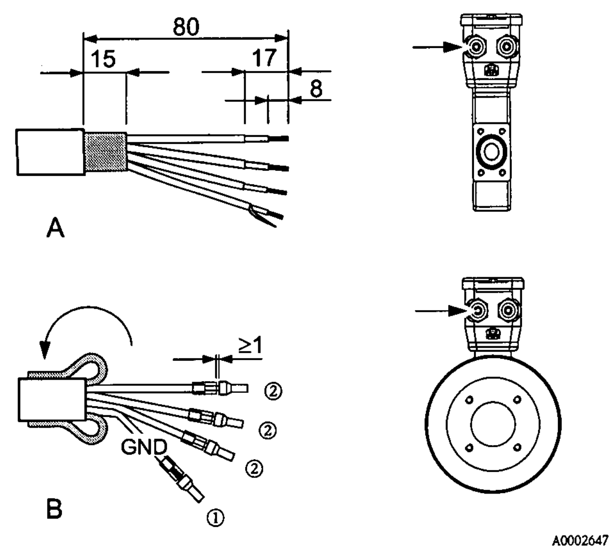


Coil current cable

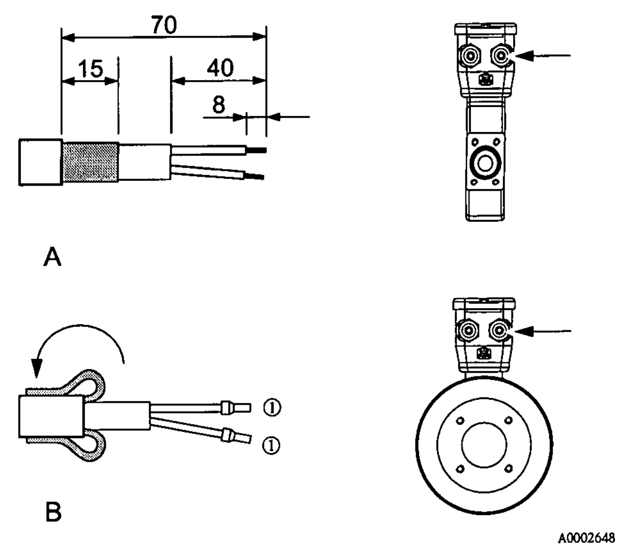


SENSOR

Signal cable



Coil current cable



① = Red cable sleeves ∅ 1.0 mm
② = White cable sleeves ∅ 0.5 mm

4.1.2 Cable specifications

Coil cable:
- 2 x 0.75 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Permanent operating temperature: –20...+80 °
- Cable cross-section: max. 2.5 mm^2

Signal cable:
- 3 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20...+80 °C
- Cable cross-section: max. 2.5 mm^2

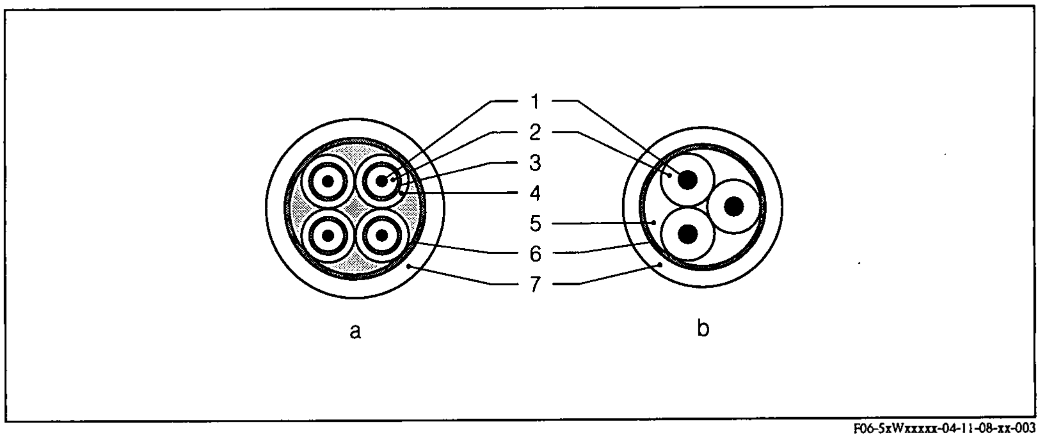


Fig. 32: Cable cross-section (a = Signal cable, b = Coil current cable)
1 = Core, 2 = Core insulation, 3 = Core shield, 4 = Core jacket, 5 = Core reinforcement, 6 = Cable shield, 7 = Outer jacket

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid. We recommend such cables for the following cases:
- Directly buried cable
- Cables endangered by rodents
- Device operation which should comply with the IP 68 standard of protection

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

4.2 Connecting the measuring unit

4.2.1 Transmitter

Warning!
- Risk of electric shock. Switch off the power supply before opening the device.
  Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective conductor to the ground terminal on the housing before the power supply is applied (not necessary if the power supply is galvanically isolated).
- Compare the specifications on the nameplate with the local voltage supply and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and signal cables (b) through the appropriate cable entries.
3. Connect the cables in accordance with the wiring diagram:
   - Wiring diagram (aluminium housing) → Fig. 33
   - Wiring diagram (stainless steel housing) → Fig. 34
   - Wiring diagram (wall-mount housing) → Fig. 35
   - Terminal assignment → Page 54
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

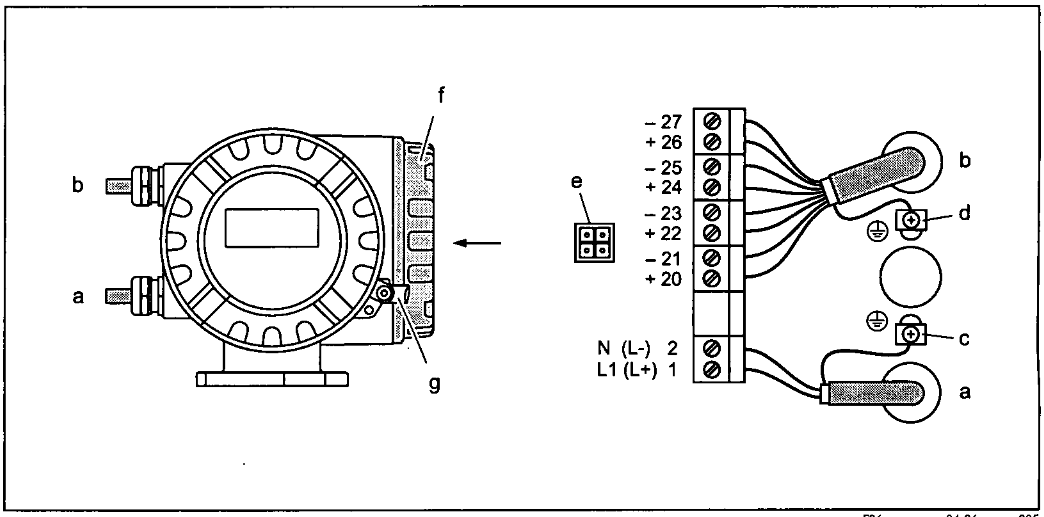


Fig. 33: Connecting the transmitter (aluminium field housing). Cable cross-section: max. 2.5 mm²

a *Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC*
  Terminal **No. 1:** *L1 for AC, L+ for DC*
  Terminal **No. 2:** *N for AC, L– for DC*
b *Signal cable: Terminals* **Nos. 20–27** *→ Page 54*
c *Ground terminal for protective conductor*
d *Ground terminal for signal cable shield*
e *Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)*
f *Cover of the connection compartment*
g *Securing clamp*

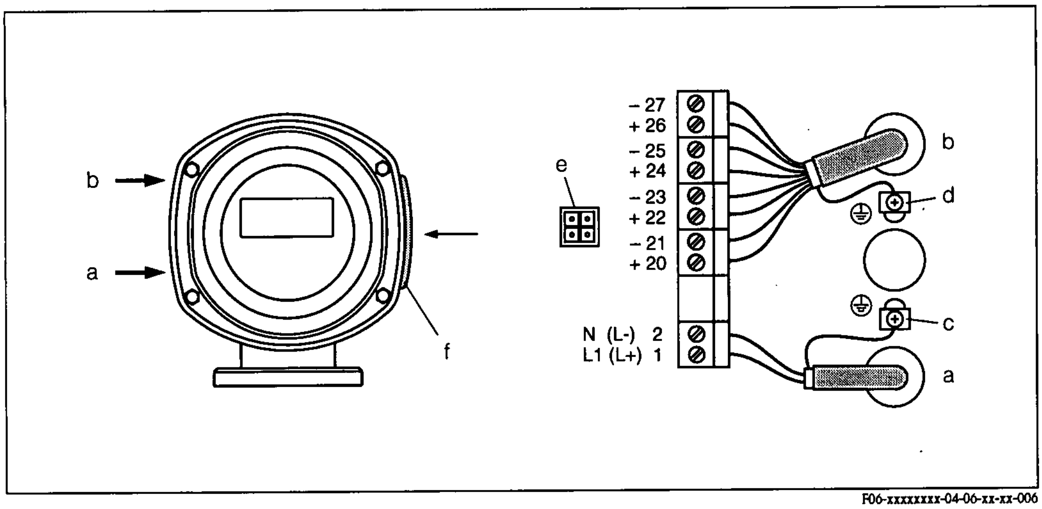


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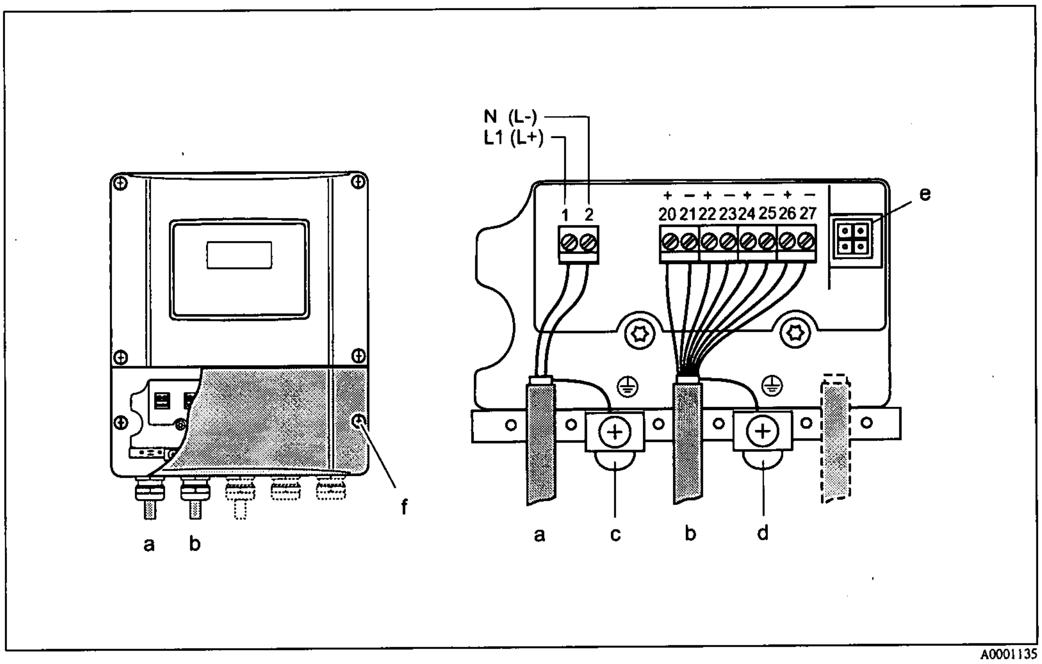
Fig. 34: Connecting the transmitter (stainless-steel field housing). Cable cross-section: max. 2.5 mm²

- *a* *Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC*
  Terminal **No. 1:** *L1 for AC, L+ for DC*
  Terminal **No. 2:** *N for AC, L– for DC*
- *b* *Signal cable: Terminals* **Nos. 20–27** *→ Page 54*
- *c* *Ground terminal for protective conductor*
- *d* *Ground terminal for signal cable shield*
- *e* *Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)*
- *f* *Cover of the connection compartment*



A0001135

Fig. 35: Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2.5 mm²

- *a* *Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC*
  Terminal **No. 1:** *L1 for AC, L+ for DC*
  Terminal **No. 2:** *N for AC, L– for DC*
- *b* *Signal cable: Terminals* **Nos. 20–27** *→ Page 54*
- *c* *Ground terminal for protective conductor*
- *d* *Ground terminal for signal cable shield*
- *e* *Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)*
- *f* *Cover of the connection compartment*

4.2.2 Terminal assignment

	Terminal No. (inputs / outputs)			
Order variant	20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
50***-***********W	–	–	–	Current output HART
50***-***********A	–	–	Frequency output	Current output HART
50***-***********D	Status input	Status output	Frequency output	Current output HART
50***-***********S	–	–	Frequency output Ex i	Current output Ex i active, HART
50***-***********T	–	–	Frequency output Ex i	Current output Ex i passive, HART

Status input (auxiliary input)
galvanically isolated, 3...30 V DC, R_i = 5 kΩ

Status output
Open collector, max. 30 V DC / 250 mA, galvanically isolated, freely configurable

Frequency output (passive)
Open collector, galvanically isolated, full scale frequency 2...1000 Hz (f_{max} = 1.25 kHz)
30 V DC, 250 mA

Current output (active/passive)
galvanically isolated, active: 0/4...20 mA, R_L < 700 Ω (HART: R_L ≥ 250 Ω)
passive: 4...20 mA, supply voltage V_S: 18...30 V DC, R_i ≥ 150 Ω

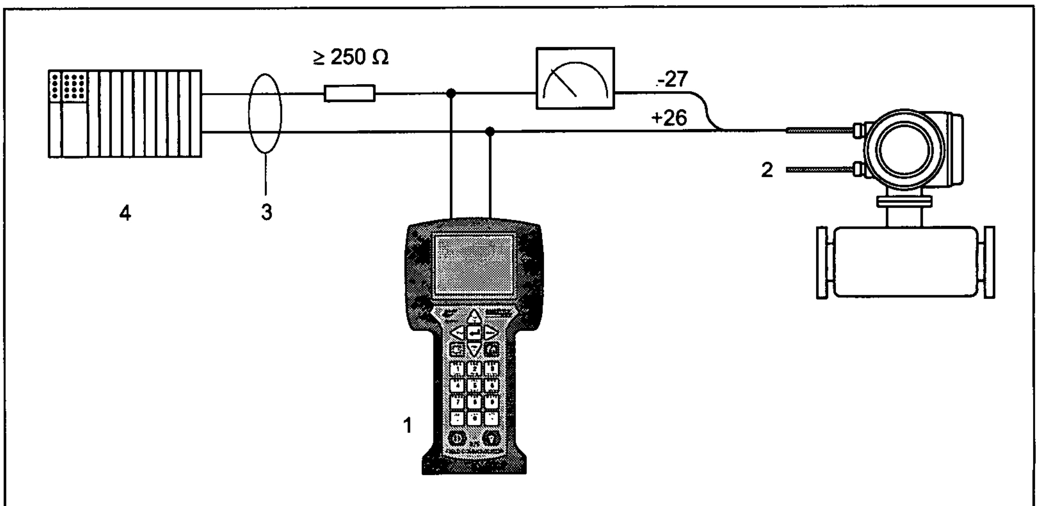
Ground connection, power supply → Page 52 ff.

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) / 27(−)
- Connection by means of the 4...20 mA circuit

Note!
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  CURRENT SPAN function → "4–20 mA HART" or "4–20 mA (25 mA) HART"
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

Connection of the HART handheld communicator

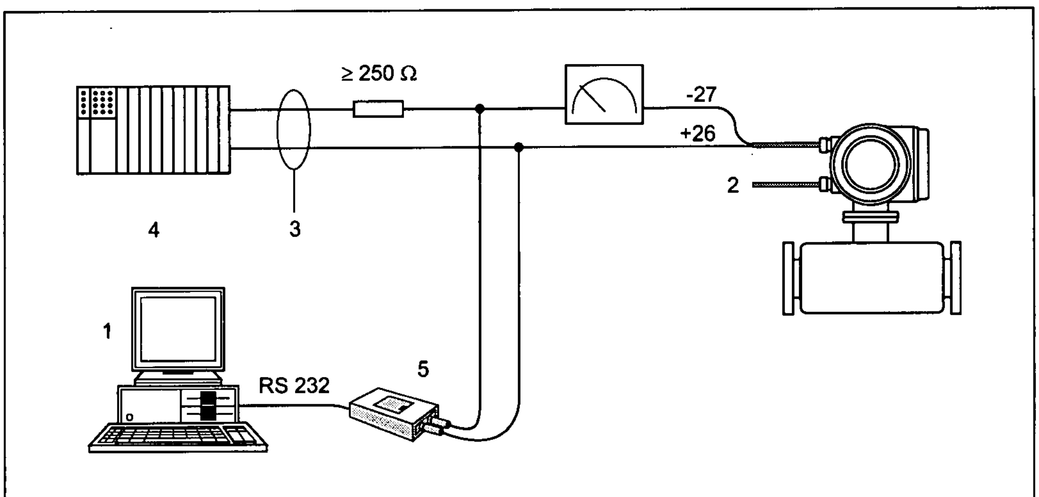


F06-xxxxxxxx-04-xx-xx-xx-007

Fig. 36: Electrical connection of the HART handheld communicator:
1 = HART communicator, 2 = power supply, 3 = shield, 4 = other evaluation devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with an operating software (e.g. "ToF Tool - Fieldtool Package"), a HART modem (e.g. "Commubox FXA 191") is needed.



F06-xxxxxxxx-04-xx-xx-xx-008

Fig. 37: Electrical connection of a PC with an operating software:
1 = PC with an operating software, 2 = power supply, 3 = shield, 4 = other evaluation devices or PLC with passive input, 5 = HART modem, e.g. Commubox FXA 191

4.3 Potential equalisation

4.3.1 Standard case

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a standard installed reference electrode which guarantees the required connection. This usually means that additional potential matching measures are unnecessary.

Promag W:
Reference electrode is standard

Promag P:
- Reference electrode is standard for electrode materials 1.4435, Alloy C-22 and tantalum.
- Reference electrode is optional for electrode material Pt/Rh.

Promag H:
- No reference electrode. The metallic process connection provides a permanent electrical connection to the fluid.
- If the process connections are made of a synthetic material, ground rings have to be used to ensure that potential is equalised (see Page 40). Ground rings can be ordered with the main product structure or as accessories → Page 85.

Note!
For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Also, observe company-internal grounding guidelines.

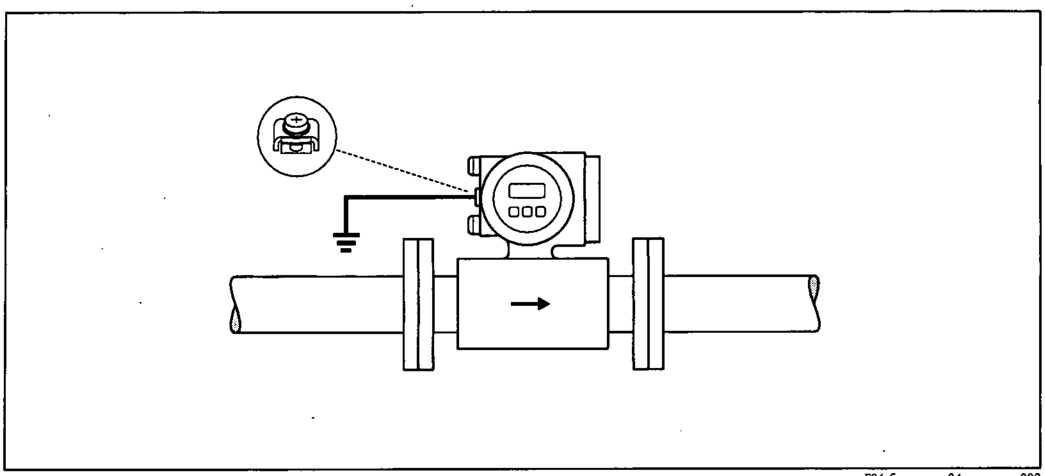


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Fig. 38: Potential equalisation by means of the transmitter's ground terminal

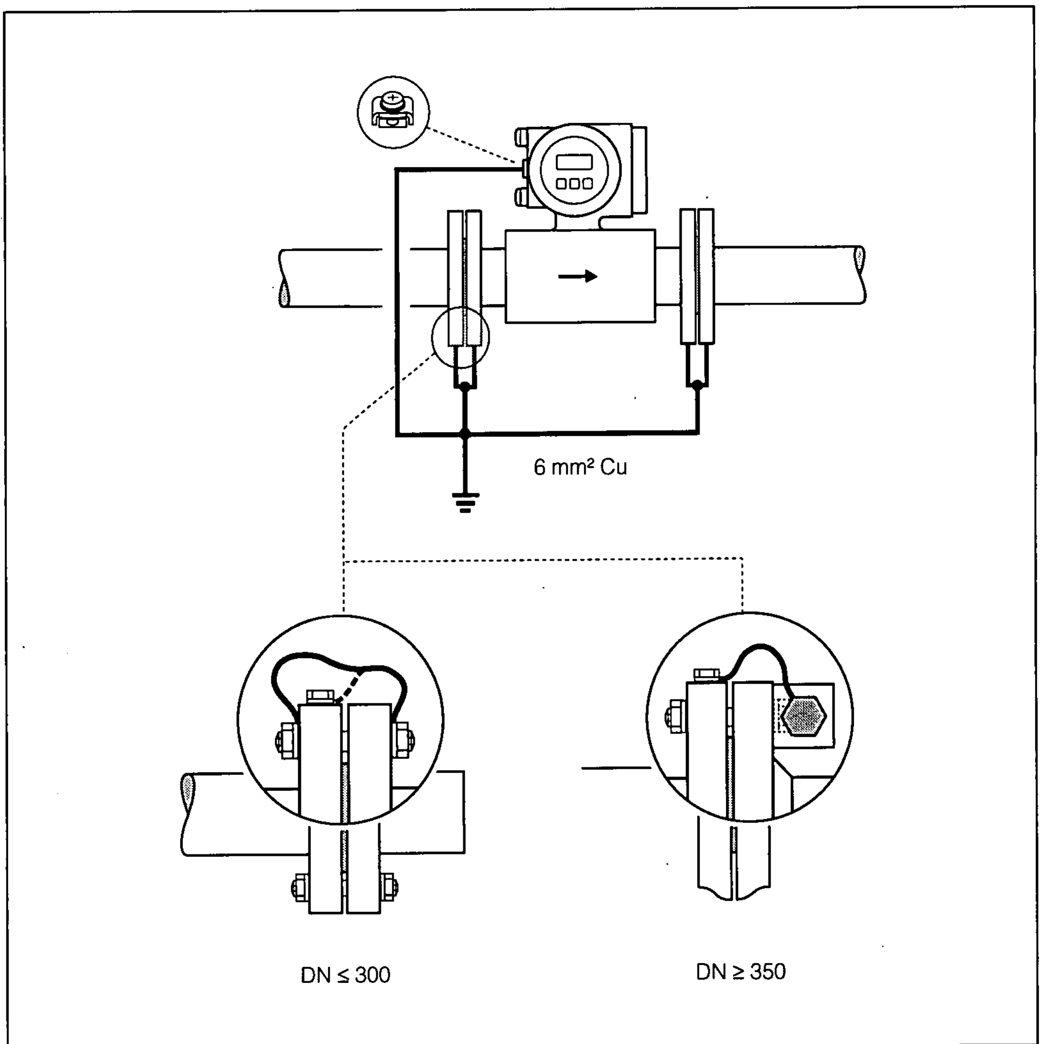
Caution!
For sensors without reference electrodes or without metal process terminals, carry out potential equalisation as per the instructions for special cases described below. These special measures are particularly important when standard grounding practice cannot be ensured or extremely strong matching currents are expected.

4.3.2 Special cases

Metal, ungrounded piping
In order to prevent outside influences on measurement, it is advisable to use ground cables to connect each sensor flange to its corresponding pipe flange and ground the flanges. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose (Fig. 39).

Caution!
Also, observe company-internal grounding guidelines.

Note!
The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser → Page 85.
- DN ≤ 300: The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- DN ≥ 350: The ground cable connects directly to the metal transport bracket.



F06-5xxxxxxx-04-xx-xx-003

Fig. 39: Potential equalisation with equalising currents in metallic, non-grounded piping systems

Plastic pipes and isolating lined pipes
Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, large matching currents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electrochemical decomposition of the electrodes. In such cases, e.g. for fibre-glass or PVC piping, it is recommended that you use additional ground disks for potential matching (Fig. 40).

Mounting of ground disks → Page 27, 34

Caution!
- Risk of damage by electrochemical corrosion. Note the electrochemical insulation rating, if the ground disks and measuring electrodes are made of different materials.
- Also, observe company-internal grounding guidelines.

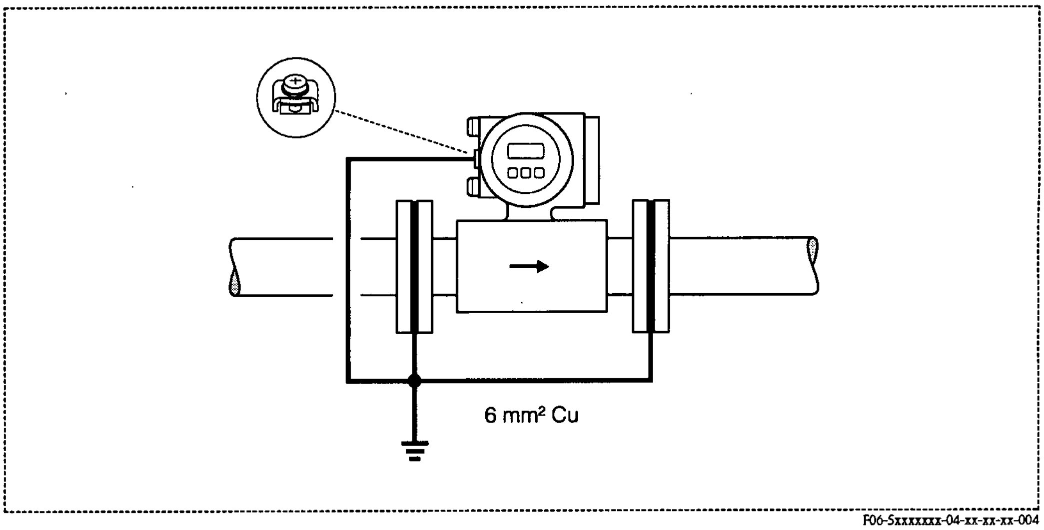


Fig. 40: Potential equalisation/ground disks with plastic pipes or lined pipes

Lined pipes (cathodic protection)
In such cases, install the measuring instrument without potential in the piping:
- When installing the measuring device, make sure that there is an electrical connection between the two piping runs (copper wire, 6 mm^2).
- Make sure that the installation materials do not establish a conductive connection to the measuring device and that the installation materials withstand the tightening torques applied when the threaded fasteners are tightened.
- Also comply with the regulations applicable to potential-free installation.

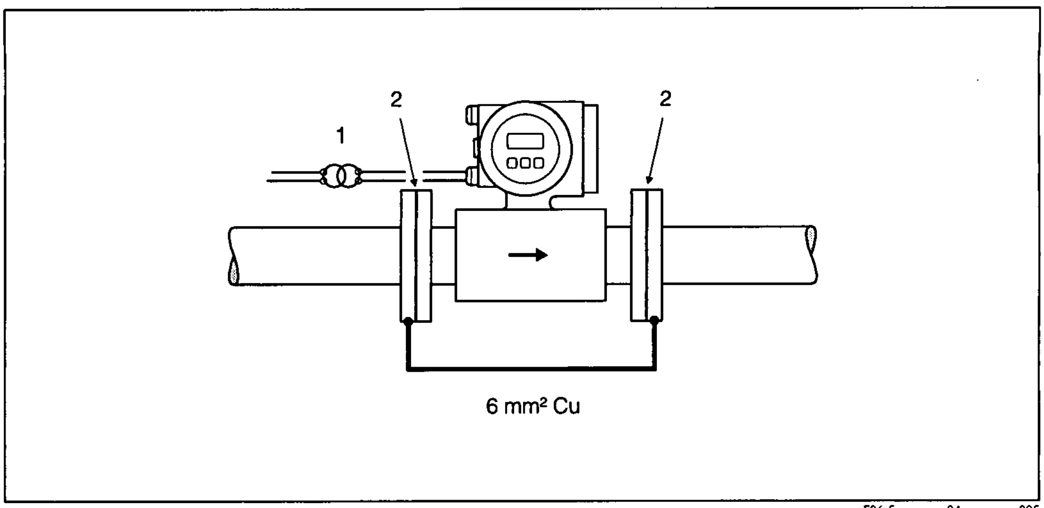


Fig. 41: Potential equalisation and cathode protection
1 = isolating transformer power supply, 2 = electrically insulated

4.4 Degree of protection

The devices fulfill all the requirements for IP 67. Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter (see Page 108).
- Firmly tighten the cable entries (Fig. 42).
- The cables must loop down before they enter the cable entries ("water trap", Fig. 42). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.

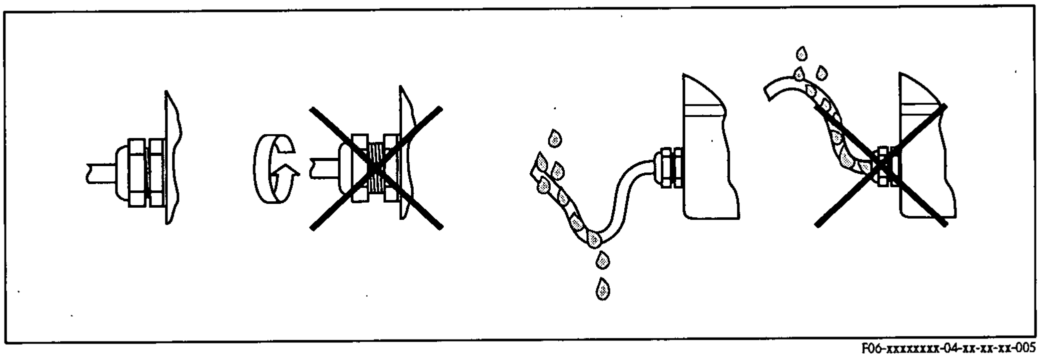


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Fig. 42: Installation instructions, cable entries

Caution!
Do not loosen the threaded fasteners of the Promag sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

Note!
The Promag W and Promag P sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters). In this case the transmitter must be installed remote from the sensor.

4.5 Electical connection check

Perform the following checks after completing electrical installation of the measuring device:

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	85...260 V AC (45...65 Hz) 20...55 V AC (45...65 Hz) 16...62 V DC
Do the cables comply with the specifications?	see Page 51, 108
Do the cables have adequate strain relief?	–
Cables correctly segregated by type? Without loops and crossovers?	–
Are the power-supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all screw terminals firmly tightened?	–
Have the measures for grounding/potential equalisation been correctly implemented?	see Page 56 ff.
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	see Page 59
Are all housing covers installed and firmly tightened?	–

5 Operation

5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device.

The display area consists of two lines; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bar graph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual).

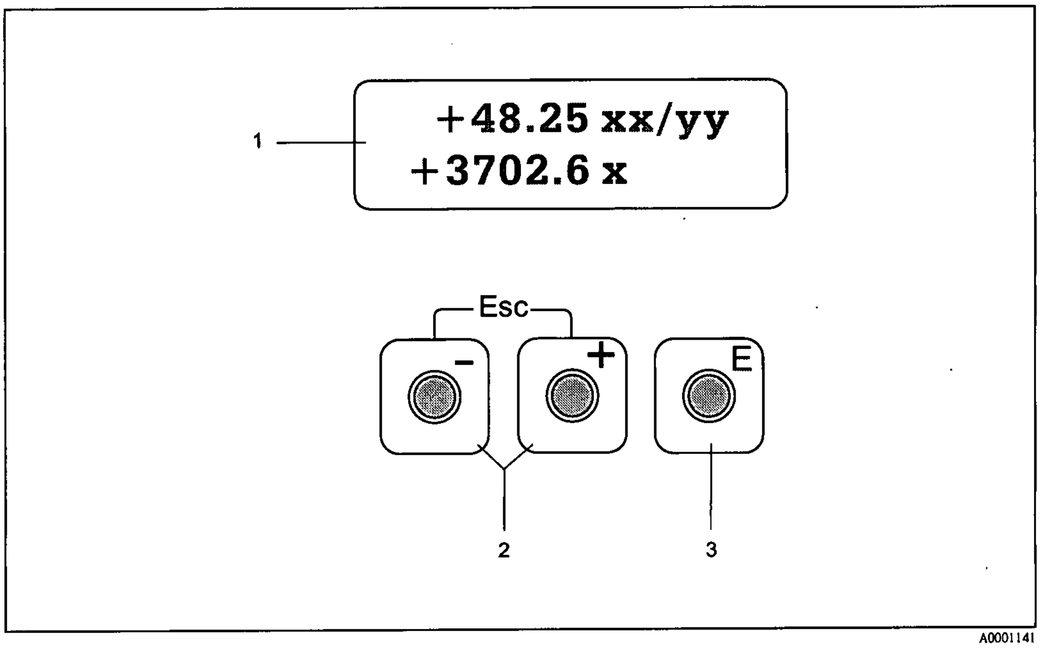

Fig. 43: Display and operating elements

Liquid-crystal display (1)
The backlit, two-line liquid-crystal display shows measured values, dialog texts, error messages and information messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).

Upper display line: Shows primary measured values, e.g. volume flow in [ml/min] or in [%].
Lower display line: Shows supplementary measured variables and status variables, e.g. totalizer reading in [m^3], bar graph, measuring point designation

Push buttons (2)
- *Enter numerical values, select parameters*
- *Select different function groups within the function matrix*

Press the +/– keys simultaneously to trigger the following functions:
- *Exit the function matrix step by step → HOME position*
- *Press and hold down +/– keys for longer than 3 seconds → Return directly to HOME position*
- *Cancel data entry*

Enter push button (3)
- *HOME position → Entry into the function matrix*
- *Save the numerical values you input or settings you change*

5.2 Brief operating instruction to the function matrix

Note!
- See the general notes on Page 63.
- Function descriptions → see the "Description of Device Functions" manual

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. CURRENT OUTPUT 1)
3. Select a function (e.g. TIME CONSTANT)

   Change parameter / enter numerical values:
   + - → select or enter enable code, parameters, numerical values
   E → save your entries

4. Exit the function matrix:
   – Press and hold down Esc key (- +) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (- +) → return step by step to HOME position

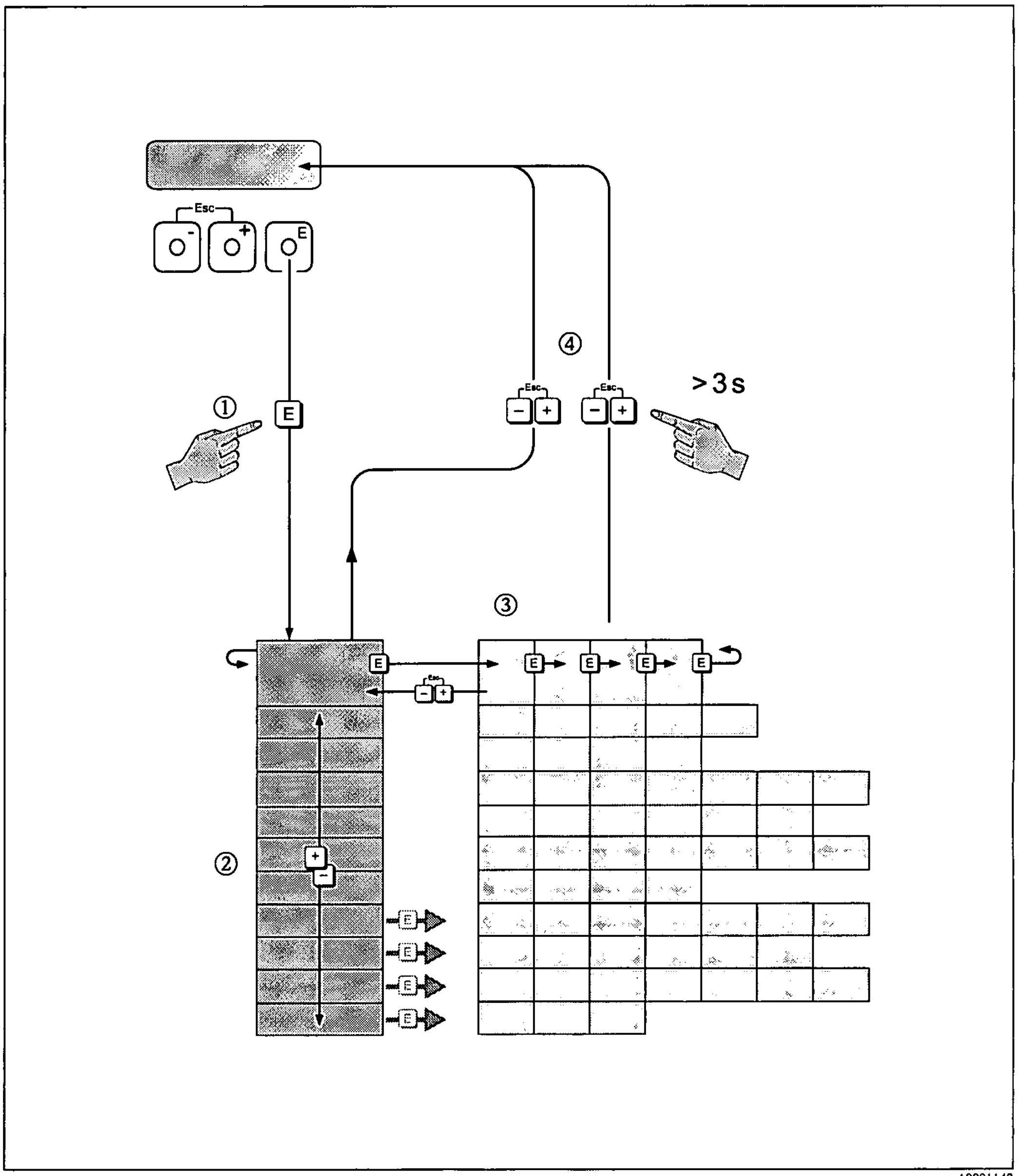

Fig. 44: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The Quick Setup menu (see Page 80) is adequate for commissioning in most instances. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:

- You select functions as described on Page 62.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press [+][-] to select "SURE [YES]" and press [E] again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

Note!

- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the power supply fails, all preset and parameterized values remain safely stored in the EEPROM.

Caution!

All functions are described in detail, including the function matrix itself, in the **"Description of Device Functions"** manual, which is a separate part of this Operating Instruction.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings.
A numerical code (factory setting = 50) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:

- If programming is disabled and the [+][-] key is pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled.
- The Endress+Hauser service organisation can be of assistance if you mislay your personal code.

Caution!

Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.
There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Endress+Hauser service organization. Please contact Endress+Hauser if you have any questions.

5.2.3 Disabling the programming mode

Programming is disabled if you do not press a key within 60 seconds following automatic return to the HOME position.
You can also disable programming in the "ACCESS CODE" function by entering any number (other than the customer's code).

5.3 Error messages

Type of error

Errors which occur during commissioning or measuring operation are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:

- *System errors:* This group comprises all device errors, e.g. communication errors, hardware faults, etc. → see Page 90
- *Process errors:* This group comprises all application errors, e.g. empty pipe, etc. → see Page 93

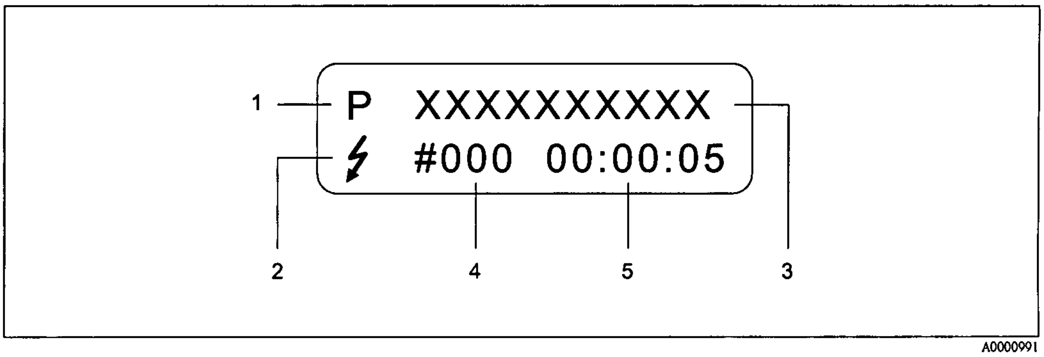

Fig. 45: Error messages on the display (example)

1 *Error type: P = process error, S = system error*
2 *Error message type: ϟ = fault message; ! = notice message*
3 *Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty*
4 *Error number: e.g. #401*
5 *Duration of most recent error occurrence in hours / minutes / seconds*

Error message types

Users have the option of weighting certain errors differently, in other words having them classed as **"Fault messages"** or **"Notice messages"**. You can define messages in this way with the aid of the function matrix → see the "Description of Device Functions" manual.
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)

- Displayed as → Exclamation mark (!), error type (S: system error, P: process error).
- The error in question has no effect on the outputs of the measuring device.

Fault message (ϟ)

- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix (see Page 95).

Note!
For security reasons, error messages should be output via the status output.

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART (see Page 55).

The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes. The HART master, e.g. a handheld terminal or PC-based operating programs (such as ToF Tool - Fieldtool Package), require device description (DD) files which are used to access all the information in a HART device.
Information is exclusively transferred using so-called "commands". There are three different command groups:

Universal commands:
All HART device support and use universal commands. The following functionalities are linked to them:
- Identify HART devices
- Reading digital measured values (volume flow, totalizer, etc.)

Common practice commands:
Common practice commands offer functions which are supported and can be executed by most but not all field devices.

Device-specific commands:
These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.

Note!
Promag 50 has access to all three command classes. On Page 69, you will find a list with all the supported "Universal Commands" and "Common Practice Commands".

5.4.1 Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:

Note!
The HART protocol requires the "4...20 mA HART" setting (individual options see device function) in the CURRENT SPAN function (current output 1).

HART handheld terminal DXR 375
Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "ToF Tool - Fieldtool Package"
Modular software package consisting of the service program "ToF Tool" for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and evolution of pressure measuring instruments as well as the "Fieldtool" service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193 or the HART protocol.

Contents of the "ToF Tool - Fieldtool Package":
- Commissioning, maintenance analysis
- Configuring flowmeters
- Service functions
- Visualisation of process data
- Trouble-shooting
- Controlling the "Fieldcheck" tester/simulator

Fieldcare
FieldCare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193.

Operating program "SIMATIC PDM" (Siemens)
SIMATIC PDM is a standardised, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Operating program "AMS" (Emerson Process Management)
AMS (Asset Management Solutions): program for operating and configuring devices

5.4.2 Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

Valid for software:	2.00.XX	→Function "Device software"
Device data HART		
Manufacturer ID:	11_{hex} (ENDRESS+HAUSER)	→ Function "Manufacturer ID"
Device ID:	41_{hex}	→ Function "Device ID"
HART version data:	Device Revison 6/ DD Revision 1	
Software release:	03.2005	

Operating program:	Sources for obtaining device descriptions:
Handheld terminal DXR 375	▪ Use update function of handheld terminal
ToF Tool - Fieldtool Package	▪ www.tof-fieldtool.endress.com (→ Download → Software → Device driver) ▪ CD-ROM (Endress+Hauser order number 50097200)
Fieldcare / DTM	▪ www.endress.com (→ Download → Software → Device driver) ▪ CD-ROM (Endress+Hauser order number 50097200)
AMS	▪ www.endress.com (→ Download → Software → Device driver) ▪ CD-ROM (Endress+Hauser order number 50097200)
SIMATIC PDM	▪ www.endress.com (→ Download → Software → Device driver) ▪ CD-ROM (Endress+Hauser order number 50097200)

Operation via the service protocol

Valid for device software:	2.00.XX	→Function "Device software"
Software release:	03.2005	

Operating program:	Sources for obtaining device descriptions:
ToF Tool - Fieldtool Package	▪ www.tof-fieldtool.endress.com (→ Download → Software → Device driver) ▪ CD-ROM (Endress+Hauser order number 50097200)

Tester/simulator:	Sources for obtaining device descriptions:
Fieldcheck	▪ Update by means of ToF Tool - Fieldtool Package via Fieldflash module

5.4.3 Device and process variables

Device variables:
The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (not assigned)
1	Volume flow
250	Totalizer 1
251	Totalizer 2

Process variables:
At the factory, the process variables are assigned to the following device variables:

- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

Note!
You can set or change the assignment of device variables to process variables using Command 51 (see Page 73).

5.4.4 Universal / Common practice HART commands

The following table contains all the universal and common practice commands supported by Promag 50.

Command No.	HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal Commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable *Factory setting:* Primary process variable = Volume flow Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: actual current of the primary process variable in mA – Bytes 4-7: Percentage of the set measuring range *Factory setting:* Primary process variable = Volume flow Note! You can set the assignment of device variables to process variables using Command 51.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
3	Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ▪ Primary process variable = Volume flow ▪ Second process variable = Totalizer 1 ▪ Third process variable = not assigned ▪ Fourth process variable = not assigned Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".
6	Set HART shortform address Access type = write	Byte 0: desired address (0...15) *Factory setting:* 0 Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message Note! You can write the user message using Command 17.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span Note! ■ The data relate to the primary process variable (= volume flow). ■ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: upper range, value for 20 mA – Bytes 7-10: lower range, value for 4 mA – Bytes 11-14: Damping constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H *Factory setting:* Primary process variable = Volume flow Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code "240".
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common Practice Commands			
34	Write damping value for primary process variable Access = write	Bytes 0–3: Damping value of the primary process variable in seconds *Factory setting:* Primary process variable = Volume flow	Displays the current damping value in the device: Bytes 0–3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1–4: upper range, value for 20 mA – Bytes 5–8: lower range, value for 4 mA *Factory setting:* Primary process variable = Volume flow Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1–4: upper range, value for 20 mA – Bytes 5–8: lower range, value for 4 mA Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset (Configuration changed) Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0–3: Output current in mA *Factory setting:* Primary process variable = Volume flow Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0–3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Volume flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table on Page 74

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Code 1 for volume flow ▪ Second process variable: Code 250 for totalizer 1 ▪ Third process variable: Code 0 for OFF (not assigned) ▪ Fourth process variable: Code 0 for OFF (not assigned) Note! You can set or change the assignment of device variables to process variables using Command 51.
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Code of the supported device variables:* See data on Page 68 *Factory setting:* ▪ Primary process variable = Volume flow ▪ Second process variable = Totalizer 1 ▪ Third process variable = OFF (not assigned) ▪ Fourth process variable = OFF (not assigned)	The variable assignment of the process variables is displayed as a response: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable
53	Write device variable unit Access = write	This command set the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: Device variable code – Byte 1: HART unit code *Code of the supported device variables:* See data on Page 68 Note! ▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ▪ If you change the unit of the device variable, this has no impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (2...20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles

5.4.5 Device status / Error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers information which are partly coded in bits (see table below).

Note!
You can find a detailed explanation of the device status and error messages and their elimination on Page 90 ff.

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
0-3	not assigned	–
0-4	not assigned	–
0-5	not assigned	–
0-6	not assigned	–
0-7	not assigned	–
1-0	not assigned	–
1-1	031	S-DAT: defective or missing
1-2	032	S-DAT: Error accessing saved values
1-3	not assigned	–
1-4	not assigned	–
1-5	051	I/O board and the amplifier board are not compatible.
1-6	not assigned	–
1-7	not assigned	–
2-0	not assigned	–
2-1	not assigned	–
2-2	not assigned	–
2-3	not assigned	–
2-4	not assigned	–
2-5	not assigned	–
2-6	not assigned	–
2-7	not assigned	–
3-0	not assigned	–
3-1	not assigned	–
3-2	not assigned	–
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board are not compatible.
3-5	not assigned	–
3-6	not assigned	–
3-7	not assigned	–
4-0	not assigned	–
4-1	not assigned	–
4-2	not assigned	–
4-3	251	Internal communication fault on the amplifier board.
4-4	261	No data reception between amplifier and I/O board

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
4-5	not assigned	–
4-6	not assigned	–
4-7	not assigned	–
5-0	321	Coil current of the sensor is outside the tolerance.
5-1	not assigned	–
5-2	not assigned	–
5-3	not assigned	–
5-4	not assigned	–
5-5	not assigned	–
5-6	not assigned	–
5-7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-0	340	
6-1	341	
6-2	342	
6-3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-4	344	
6-5	345	
6-6	346	
6-7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7-0	348	
7-1	349	
7-2	350	
7-3	351	Current output: flow is out of range.
7-4	352	
7-5	353	
7-6	354	
7-7	355	Frequency output: flow is out of range.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: the pulse output frequency is out of range.
8-4	360	
8-5	361	
8-6	362	
8-7	not assigned	–
9-0	not assigned	–
9-1	not assigned	–
9-2	not assigned	–
9-3	not assigned	–
9-4	not assigned	–
9-5	not assigned	–
9-6	not assigned	–
9-7	not assigned	–

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
10-0	not assigned	–
10-1	not assigned	–
10-2	not assigned	–
10-3	not assigned	–
10-4	not assigned	–
10-5	not assigned	–
10-6	not assigned	–
10-7	401	Measuring tube partially filled or empty
11-0	not assigned	–
11-1	not assigned	–
11-2	461	EPD calibration not possible because the fluid's conductivity is either too low or too high.
11-3	not assigned	–
11-4	463	The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect.
11-5	not assigned	–
11-6	not assigned	–
11-7	not assigned	–
12-0	not assigned	–
12-1	474	Maximum flow value entered is overshot.
12-2	not assigned	–
12-3	not assigned	–
12-4	not assigned	–
12-5	not assigned	–
12-6	not assigned	–
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-0	502	Upload and download of device files. Currently no other commands are possible.
13-1	not assigned	–
13-2	not assigned	–
13-3	not assigned	–
13-4	not assigned	–
13-5	not assigned	–
13-6	not assigned	–
13-7	not assigned	–
14-0	not assigned	–
14-1	not assigned	–
14-2	not assigned	–
14-3	601	Positive zero return active
14-4	not assigned	–
14-5	not assigned	–
14-6	not assigned	–

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
14-7	611	Simulation current output active
15-0	612	
15-1	613	
15-2	614	
15-3	621	Simulation frequency output active
15-4	622	
15-5	623	
15-6	624	
15-7	631	Simulation pulse output active
16-0	632	
16-1	633	
16-2	634	
16-3	641	Simulation status output active
16-4	642	
16-5	643	
16-6	644	
16-7	not assigned	–
17-0	not assigned	–
17-1	not assigned	–
17-2	not assigned	–
17-3	not assigned	–
17-4	not assigned	–
17-5	not assigned	–
17-6	not assigned	–
17-7	671	Simulation status input active
18-0	672	Simulation status input active
18-1	673	Simulation status input active
18-2	674	Simulation status input active
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of volume flow active
18-5	not assigned	–
18-6	not assigned	–
18-7	not assigned	–

6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:

- Checklist for "Installation check" → Page 46
- Checklist for "Electrical connection check" → Page 60

6.1.1 Switching on the measuring device

Once the connection checks (see Page 60) have been successfully completed, it is time to switch on the power supply. The device is now operational.
The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:

Display	
PROMAG 50 START UP ...	Start-up message
▼	
DEVICE SOFTWARE V XX.XX.XX	Current software version
▼	
SYSTEM OK → OPERATION	Beginning of normal measuring mode
▼	

Normal measuring mode commences as soon as start-up completes. Various measured-value and/or status variables (HOME position) appear on the display.

Note!
If start-up fails, an error message indicating the cause is displayed.

6.2 Application-specific commissioning

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. ToF Tool - Fieldtool Package. If the measuring device is equipped with a local display, all the important device parameters for standard operation can be configured quickly and easily by means of the "Commissioning" Quick Setup menu.

- Quick Setup "Commissioning", → Page 3 ff.

6.2.1 "Commissioning" Quick Setup menu

This Quick Setup menu guides you systematically through the setup procedure for all the major device functions that have to be configured for standard measuring operation.

Note!
In the case of measuring devices **without** a local display, the individual parameters and functions must be configured by means of a configuration program, such as ToF Tool - Fieldtool Package from Endress+Hauser.

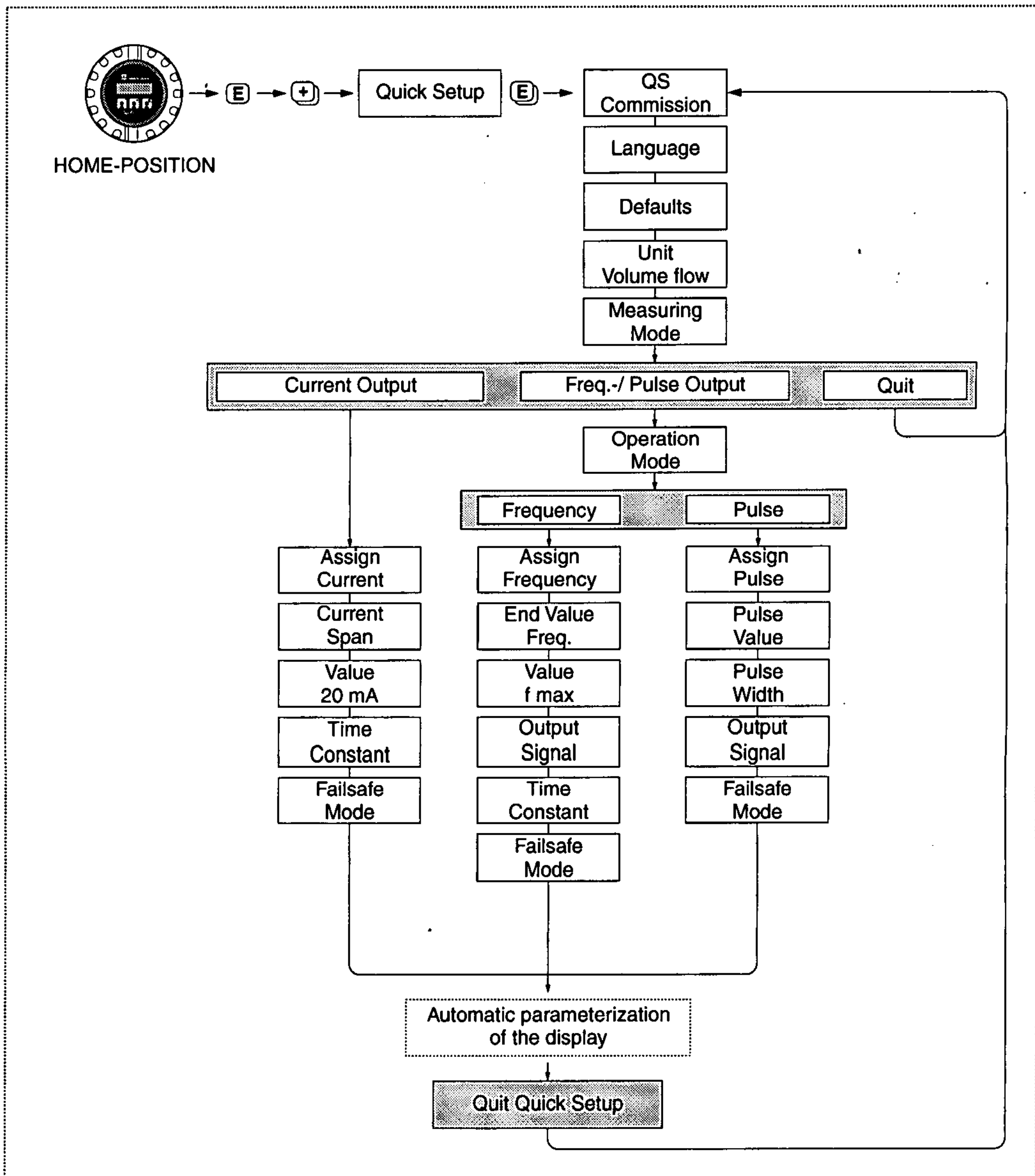

Fig. 46: Quick Setup for commissioning

6.2.2 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is completely full. This status can be permanently monitored using the Empty Pipe Detection:

- EPD = Empty Pipe Detection (with the help of an EPD electrode)
- OED = Open Electrode Detection (Empty Pipe Detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD).

Caution!
A detailed description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found in the separate "Description of Device Functions" Manual:

- EPD/OED ADJUSTMENT → Carrying out the adjustment.
- EPD → Switching on and off EPD/OED.
- EPD RESPONSE TIME → Input of the response time for EPD/OED.

Note!

- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 μS/cm). If the fluid conductivity differs from this reference, empty-pipe/full-pipe adjustment has to be performed again on site.
- The default setting for EPD/OED when the devices are delivered is OFF; the function has to be activated if required.
- The EPD/OED process error can be output by means of the configurable status output.

Performing empty-pipe and full-pipe adjustment (EPD/OED)

1. Select the appropriate function in the function matrix:
   HOME → E → +/- → PROCESS PARAMETER → E → +/- →
   EPD/OED ADJUSTMENT
2. Empty the piping. In case of an EPD adjustment, the wall of the measuring tube should be wetted with fluid for the adjustment procedure but this is not the case with an OED adjustment.
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm.
4. After empty-pipe adjustment, fill the piping with fluid.
5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E.
7. Now select the "EPD" function. Switch on Empty Pipe Detection by selecting the following settings:
   - EPD → Select ON STANDARD or ON SPECIAL and press E to confirm.
   - OED → Select OED and confirm with E.

   Caution!
   The adjustment coefficients must be valid before you can activate the EPD/OED function. If adjustment is incorrect the following messages might appear on the display:
   - FULL = EMPTY
     The adjustment values for empty pipe and full pipe are identical. In cases of this nature you **must** repeat empty-pipe or full-pipe adjustment!
   - ADJUSTMENT NOT OK
     Adjustment is not possible because the fluid's conductivity is out of range.

6.2.3 Current output: active/passive

The current output is configured as "active" or "passive" by means of various jumpers on the I/O board.

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Wait at least 10 minutes for heat to dissipate before opening an Ex-rated device.

1. Switch off power suppy.
2. Remove the I/O board → Page 98, 100
3. Position the jumper according to Fig. 47.

   Caution!
   Risk of destroying the measuring device. Set the jumpers exactly as shown in Fig. 47. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

4. Installation of the I/O board is the reverse of the removal procedure.

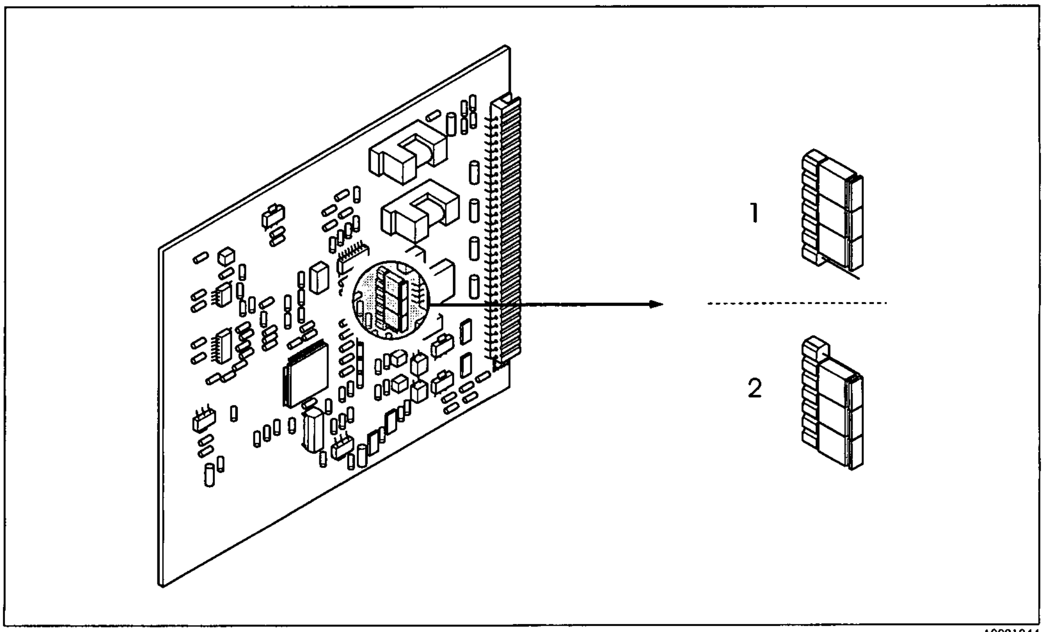

Fig. 47: Configuring the current output (I/O board)

1 Active current output (Factory setting)
2 Passive current output

6.3 Data storage device (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored.

6.3.1 HistoROM/S-DAT (sensor-DAT)

The S-DAT is an exchangeable data storage device in which all sensor relevant parameters are stored, i.e., diameter, serial number, calibration factor, zero point.

7 Maintenance

The Promag 50 flow measuring system requires no special maintenance.

7.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

7.2 Seals

The seals of the Promag H sensor must be replaced periodically, particularly in the case of gasket seals (aseptic version). The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories) → Page 85.

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. The Endress+Hauser service organisation can provide detailed information on the order codes of your choice.

8.1 Device-specific accessories

Accessory	Description	Order code
Transmitter Promag 50	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable type for the remote version – Cable entries – Display / power supply / operation – Software – Outputs / inputs	50XXX – XXXXX * * * * * * * *

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for transmitter Promag 50/53	Mounting kit for wall-mounted housing (remote version). Suitable for: – Wall mounting – Post mounting – Installation in control panel Mounting set for aluminium housings. Suitable for pipe mounting (3/4"...32")	DK5WM – *
Cable for remote version	Coil and signal cables, various lengths. Reinforced cable on request.	DK5CA – * *
Ground cable for Promag W, P	A set consists of two ground cables.	DK5GC – * * *
Ground disk for Promag W, P	Ground disk for potential equalisation	DK5GD – * * *
Mounting kit for Promag H	Mounting kit for Promag H, comprising: – 2 process connections – Threaded fasteners – Seals	DKH * * – * * *
Adapter connection for Promag A, H	Adapter connections for installing Promag 50 H instead of Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – * * * * *
Ground rings for Promag H	If the process connections are made of PVC or PVDF, ground rings are necessary to ensure that potential is matched. Set of ground rings, comprising: – 2 ground rings	DK5HR – * * *
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – * * *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor	DK5HM – * *
Welding jig for Promag H	Weld nipple as process connection: welding jig for installation in pipe.	DK5HW – * * *

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator DXR 375 hand-held terminal	Hand-held terminal for remote parameterisation and for fetching measured values via the current output HART (4...20 mA). Contact your Endress+Hauser representative for more information.	DXR375 – * * * *

8.4 Communication-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 - *
ToF Tool - Fieldtool Package	Modular software package consisting of the service program "ToF Tool" for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the "Fieldtool" service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193. Contents of the "ToF Tool - Fieldtool Package": – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Controlling the "Fieldcheck" tester/simulator Contact your Endress+Hauser representative for more information.	DXS10 - * * * * *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "ToF Tool - Fieldtool Package" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	DXC10 – * *

9 Trouble-shooting

9.1 Trouble-shooting instructions

Always start trouble-shooting with the checklist below, if faults occur after start-up or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Check the display	
No display visible and no output signals present.	1. Check the power supply → terminals 1, 2 2. Check the power line fuse → Page 102 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → Page 97
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 99, 101 2. Display module defective → order spare parts → Page 97 3. Measuring electronics defective → order spare parts → Page 97
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ⊞⊟ buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → Page 97

▼

Error messages on display

Errors which occur during commissioning or measuring operation are displayed immediately.
Error messages consist of a variety of icons: the meanings of these icons are as follows (example):

- Error type: **S** = system error, **P** = process error
- Error message type: ϟ = fault message, **!** = notice message
- **EMPTY PIPE** = Type of error, e.g. measuring tube is only partly filled or completely empty
- **03:00:05** = duration of error occurrence (in hours, minutes and seconds)
- **# 401** = error number

Caution!!
- See the information on Page 64!
- The measuring system interprets simulations and positive zero return as system errors, but displays them as notice message only.

Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → Page 90
Error number: No. 401 - 499	Process error (application error) has occurred → Page 93

▼

Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Page 94

9.2 System error messages

Serious system errors are **always** recognised by the instrument as "Fault message", and are shown as a lightning flash (ϟ) on the display. Fault messages immediately affect the inputs and outputs. Simulations and positive zero return, on the other hand, are classed and displayed as notice messages.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The procedures on Page 8 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of contamination" form. You will find a preprinted blank of the this form at the back of this manual.

Note!
The listed error message types below correspond to the factory setting.
Also observe the information on Page 64 and 95.

No.	Error message / Type	Cause	Remedy / spare part
S = System error ϟ = Fault message (*with* an effect on the outputs) ! = Notice message (*without* an effect on the outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE ϟ: # 001	Serious device error	Replace the amplifier board. Spare parts → Page 97
011	S: AMP HW EEPROM ϟ: # 011	Amplifier: Defective EEPROM	Replace the amplifier board. Spare parts → Page 97
012	S: AMP SW EEPROM ϟ: # 012	Amplifier: Error accessing EEPROM data	The EEPROM data blocks in which an error has occurred are displayed in the "TROUBLESHOOTING" function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL).
031	S: SENSOR HW DAT ϟ: # 031	Sensor DAT: 1. S-DAT is defective. 2. S-DAT is not plugged into the amplifier board or is missing.	1. Replace the S-DAT. Spare parts → Page 97 Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the S-DAT into the amplifier board → Page 99, 101
032	S: SENSOR SW DAT ϟ: # 032	Sensor: Error accessing the calibration values stored in the S-DAT.	1. Check whether the S-DAT is correctly plugged into the amplifier board → Page 99, 101 2. Replace the S-DAT if it is defective. Spare parts → Page 97. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → Page 97

No.	Error message / Type	Cause	Remedy / spare part
No. # 1xx → Software error			
101	S: GAIN ERROR AMP ϟ: # 101	Gain deviation compared to reference gain is greater than 2%.	Replace amplifier board. Spare parts → Page 97
111	S: CHECKSUM TOTAL ϟ: # 111	Totalizer checksum error	1. Restart the measuring device 2. Replace the amplifier board if necessary. Spare parts → Page 97
121	S: A / C COMPATIB. !: # 121	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). Note! – The indication on the display as notice message appears only for 30 seconds (with listing in "Previous system condition" function). – This condition can occur if only one electronics board has been exchanged; the extended software functionality is not available. The previously existing software functionality is still working and the measurement possible.	Module with lower software version has either to be actualizied by FieldTool with the required software version or the module has to be replaced. Spare parts → Page 97
No. # 2xx → Error in DAT / no communication			
251	S: COMMUNICATION I/O ϟ: # 251	Internal communication error on the amplifier board.	Remove the amplifier board. Spare parts → Page 97
261	S: COMMUNICATION I/O ϟ: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts
No. # 3xx → System limits exceeded			
321	S: TOL. COIL CURR. ϟ: # 321	Sensor: Coil current is out of tolerance.	1. Remote version: Switch off the power supply before connecting or discon-necting the cable of the coil (terminals 41/42). 2. Remote version: Switch off power supply and check wiring of terminals 41/42 → Page 47 ff. 3. Switch off the power supply and check the connectors of the coil cable → Page 99, 101 4. Replace measuring electro-nics boards if necessary. Spare parts → Page 97
339 ... 342	S: STACK CUR OUT n !: # 339...342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE" (see Page 95), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
343 ... 346	S: STACK FREQ. OUT n !: # 343...346		
347 ... 350	S: STACK PULSE OUT n !: # 347...350	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Reduce flow Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE" (see Page 95), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.

No.	Error message / Type	Cause	Remedy / spare part
351 ... 354	S: CURRENT RANGE n !: # 351...354	Current output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 ... 358	S: FREQ. RANGE n !: # 355...358	Frequency output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 ... 362	S: PULSE RANGE n !: # 359...362	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ 3. Reduce flow.
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until the procedure is finished.
No. # 6xx → Simulation mode active			
601	S: POS. ZERO-RETURN !: # 601	Positive zero return active Caution!! This message has the highest display priority!	Switch off positive zero return
611 ... 614	S: SIM. CURR. OUT. n !: # 611...614	Simulation current output active	Switch off simulation
621 ... 624	SIM. FREQ. OUT. n !: # 621...624	Simulation frequency output active	Switch off simulation
631 ... 634	S: SIM. PULSE n !: # 631...634	Simulation pulse output active	Switch off simulation
641 ... 644	S: SIM. STAT. OUT n !: # 641...644	Simulation status output active	Switch off simulation
671 ... 674	S: SIM. STATUS IN !: # 671...674	Simulation status input active	Switch off simulation

No.	Error message / Type	Cause	Remedy / spare part
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active	Switch off simulation
692	S: SIM. VOL. FLOW !: # 692	Simulation of volume flow active	Switch off simulation
698	S: DEV. TEST ACT. !: # 698	The measuring device is being checked on site via the test and simulation device.	–

9.3 Process error messages

Process errors can be defined as either "Fault" or "Notice" messages and can thereby be weighted differently. Determination of this is done via the function matrix (see the "Description of Device Functions" Manual).

Note!
The error types listed in the following correspond to the factory settings.
Also observe the information on Page 64 ff. and 95.

No.	Error message / Type	Cause	Remedy
P = Process error ϟ = Fault message (*with* an effect on the outputs) ! = Notice message (*without* an effect on the outputs)			
401	EMPTY PIPE ϟ: # 401	Measuring tube partially filled or empty	1. Check the process conditions of the plant 2. Fill the measuring tube
461	ADJ. NOT OK !: # 461	EPD/OED calibration not possible because the fluid's conductivity is either too low or too high.	The EPD/OED function cannot be used with fluids of this nature.
463	FULL = EMPTY ϟ: # 463	The EPD/OED calibration values for empty pipe and full pipe are identical, therefore incorrect.	Repeat calibration, making sure procedure is correct → Page 81

9.4 Process errors without messages

Symptoms	Rectification
Remark: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault. The functions outlined below, such as DISPLAY DAMPING, for example, are described in detail in the "Description of Device Functions" manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Remote version: – Switch off the power supply and check the wiring → Page 47 ff. – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalization → Page 56 ff. 2. Check the fluid for presence of gas bubbles. 3. In the "TIME CONSTANT" function (current output) → increase the value 4. In the "DISPLAY DAMPING" function → increase the value
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalization → Page 56 ff. 2. Check the fluid for presence of gas bubbles. 3. Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point.
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → Page 81 2. Remote version: Check the terminals of the EPD cable → Page 47 ff. 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the "BUS ADDRESS" function and change the setting to "0". 2. Value for creepage too high. Reduce corresponding value in the "Low flow cutoff" functions (ON-/OFF-VALUE).
The fault cannot be rectified or some other fault not described above has arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready to quote the following information: – Brief description of the fault – Nameplate specifications (Page 9 ff.): order code, serial number **Returning devices to Endress+Hauser** The procedures on Page 8 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a preprinted form at the back of this manual. **Replace transmitter electronics** Components in the measuring electronics defective → order spare parts → Page 97

9.5 Response of outputs to errors

Note!
The failsafe mode of totalizers, current, pulse and frequency outputs can be customized by means of various functions in the function matrix. You will find detailed information on these procedures in the "Description of Device Functions" manual.

Positive zero return and failsafe mode:
You can use positive zero return to set the signals of the current, pulse and frequency outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned.
This function takes priority over all other device functions: simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers	Process/system error is current	Positive zero return is activated
Caution!! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on Page 64 ff.		
Current output	*MINIMUM CURRENT* The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). *MAXIMUM CURRENT* The current output will be set to the higher value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). *HOLD VALUE* Measured value display on the basis of the last saved value preceding occurrence of the fault. *ACTUAL VALUE* Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	*FALLBACK VALUE* Signal output → no pulses *ACTUAL VALUE* Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"

Failsafe mode of outputs and totalizers		
	Process/system error is current	Positive zero return is activated
Frequency output	*FALLBACK VALUE* Signal output → 0 Hz *FAILSAFE LEVEL* Output of the frequency specified in the FALÌLSAFE VALUE function. *HOLD VALUE* Last valid value (preceding occurrence of the fault) is output. *ACTUAL VALUE* Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	*STOP* The totalizers are paused until the error is rectified. *ACTUAL VALUE* The fault is ignored. The totalizers continue to count in accordance with the current flow value. *HOLD VALUE* The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Status output	In the event of a fault or power supply failure: Status output → non-conductive	No effect on status output

9.6 Spare parts

Chap. 9.1 contains a detailed trouble-shooting guide. The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages. Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organisation by providing the serial number printed on the transmitter's nameplate (Page 9 ff.).

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (threaded fasteners, etc.)
- Mounting instructions
- Packaging

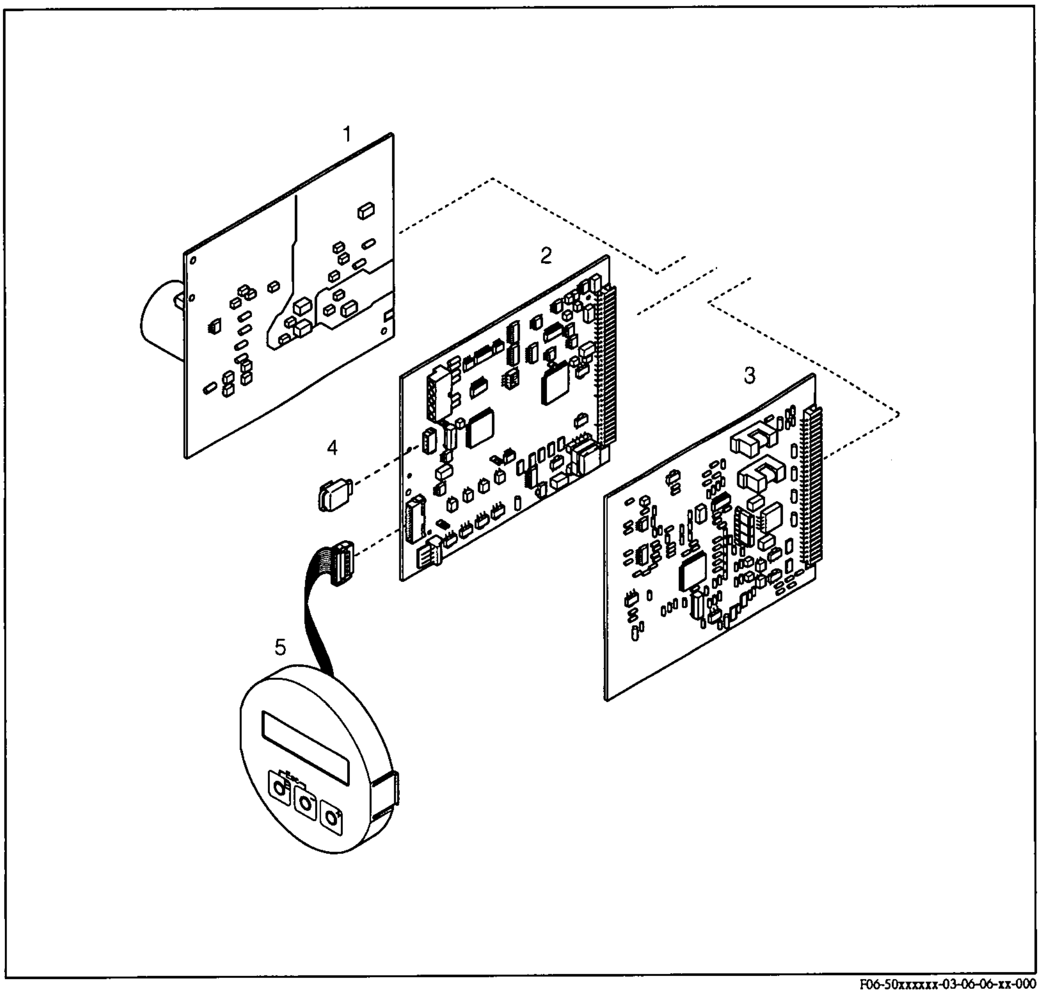

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Fig. 48: Spare parts for Promag 50 transmitter (field and wall-mounted housings)

1 Power supply board (85...260 V AC, 20...55 V AC, 16...62 V DC)
2 Amplifier board
3 I/O board
4 S-DAT (sensor data memory)
5 Display module

9.7 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards (Fig. 49)

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
   - Press in the latches (1.1) at the side and remove the display module.
   - Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Remove power supply board and I/O board (4, 6):
   Insert a suitable tool into the holes (3) provided for the purpose and pull the board clear of its holder.
5. Remove amplifier board (5):
   - Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
   - Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it to and fro.
   - Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

   Caution!
   Use only original Endress+Hauser parts.

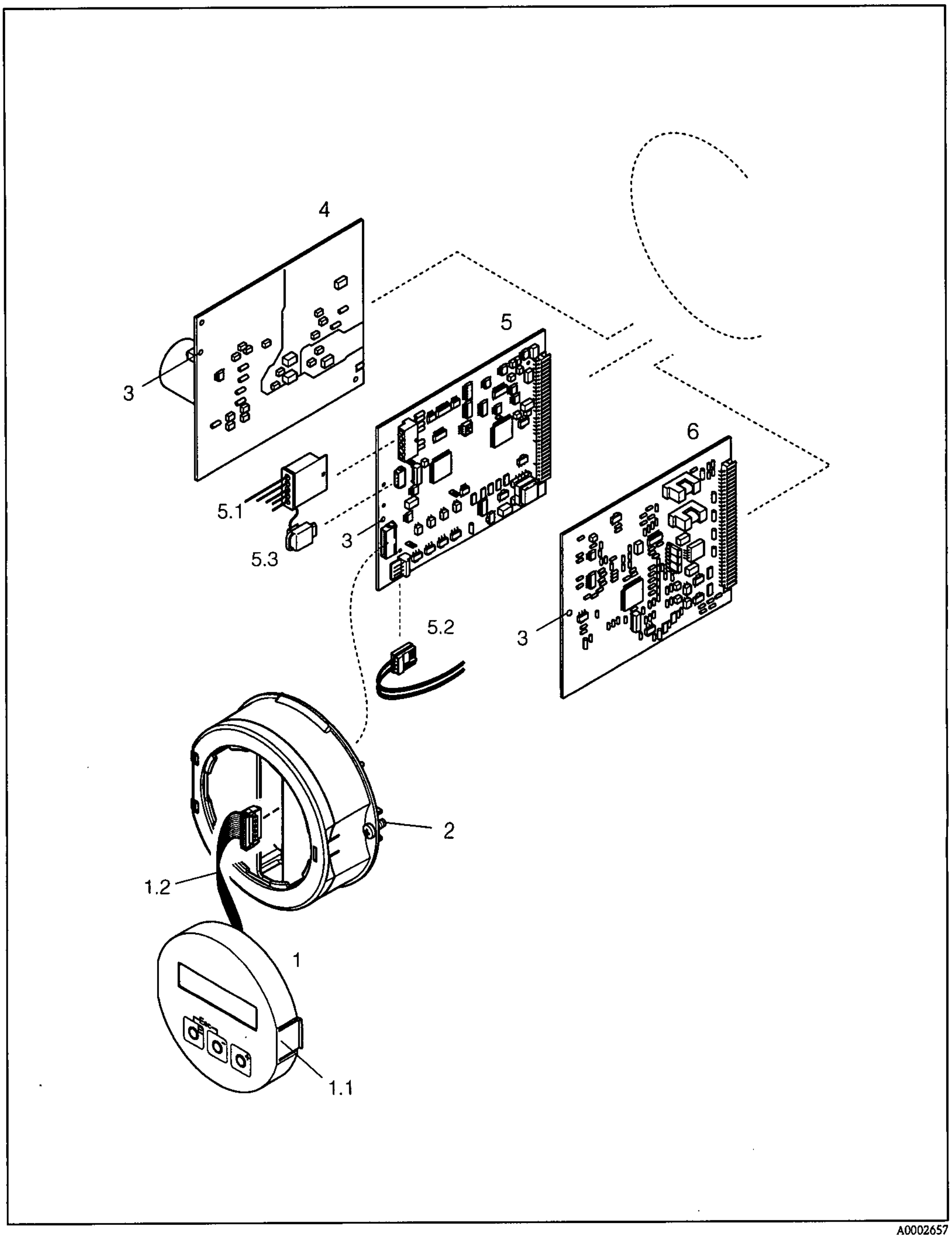

Fig. 49: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for tool, removal/installation
4 Power supply board
5 Amplifier board
5.1 Electrode signal cable (sensor)
5.2 Coil current cable (sensor)
5.3 S-DAT (sensor data memory)
6 I/O board

Wall-mounted housing: removing and installing printed circuit boards (Fig. 50)

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface, purpose-built for electrostatically sensitive devices.
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

1. Remove the screws and open the hinged cover (1) of the housing.
2. Remove screws of the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
3. Disconnect the following cable plugs from amplifier board (7):
   - Electrode signal cable plug (7.1) including S-DAT (7.3)
   - Plug of coil current cable (7.2). To do so, loosen the plug locking of the coil current cable and gently disconnect the plug from the board, i.e. without moving it to and fro.
   - Ribbon cable plug (3) of the display module
4. Remove the screws and remove the cover (4) from the electronics compartment.
5. Remove the boards (6, 7, 8):
   Insert a suitable tool into the hole (5) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

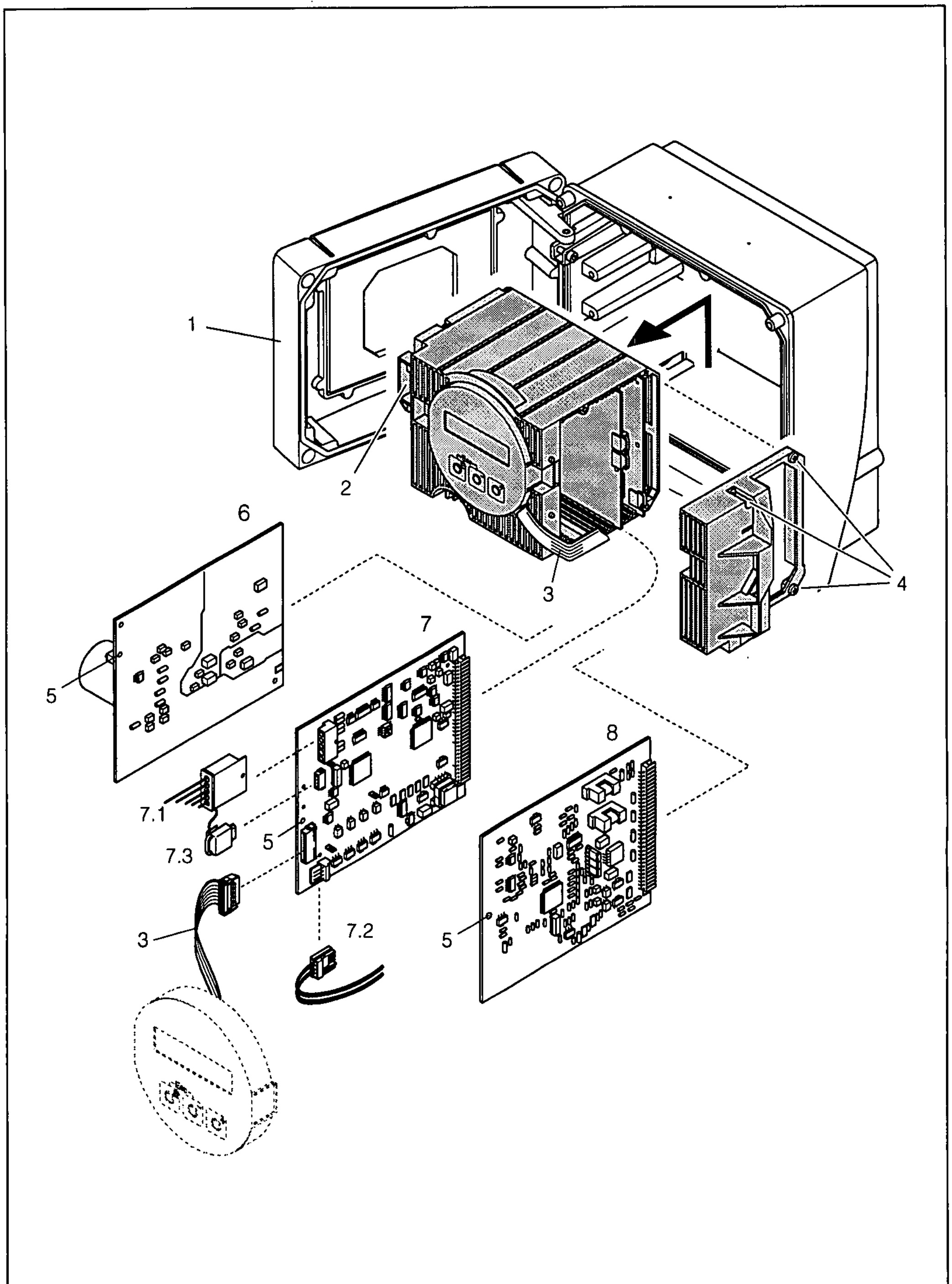

Fig. 50: Wall-mounted housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Cover of electronics compartment (3 screws)
5 Aperture for tool, removal/installation
6 Power supply board
7 Amplifier board
7.1 Electrode signal cable (sensor)
7.2 Coil current cable (sensor)
7.3 S-DAT (sensor data memory)
8 I/O board

9.8 Replacing the device fuse

Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is on the power supply board (Fig. 51).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board → Page 98, 100
3. Remove cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20...55 V AC / 16...62 V DC → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
   – Power supply 85...260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
   – Ex-rated devices → see the Ex documentation.
4. Assembly is the reverse of the disassembly procedure.

   Caution!
   Use only original Endress+Hauser parts.

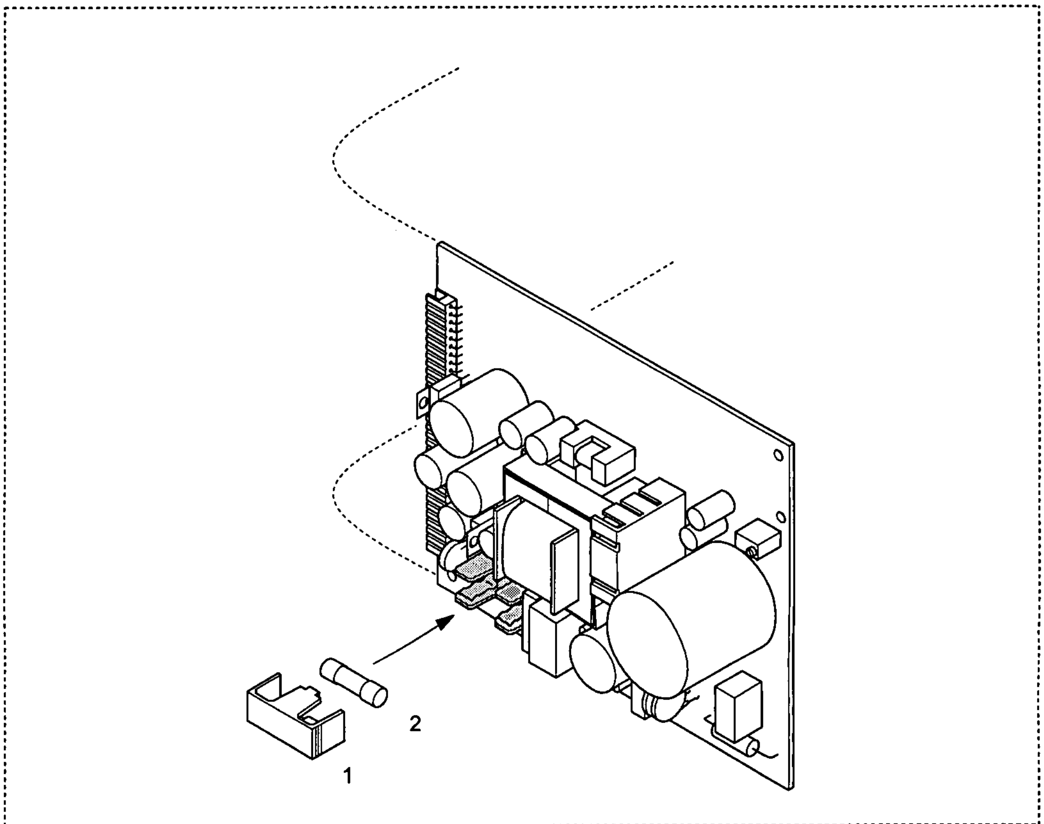

Fig. 51: Replacing the device fuse on the power supply board

1 Protective cap
2 Device fuse

9.9 Replacing exchangeable measuring electrodes

The Promag W sensor (DN 350...2000) is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions (see Page 104).

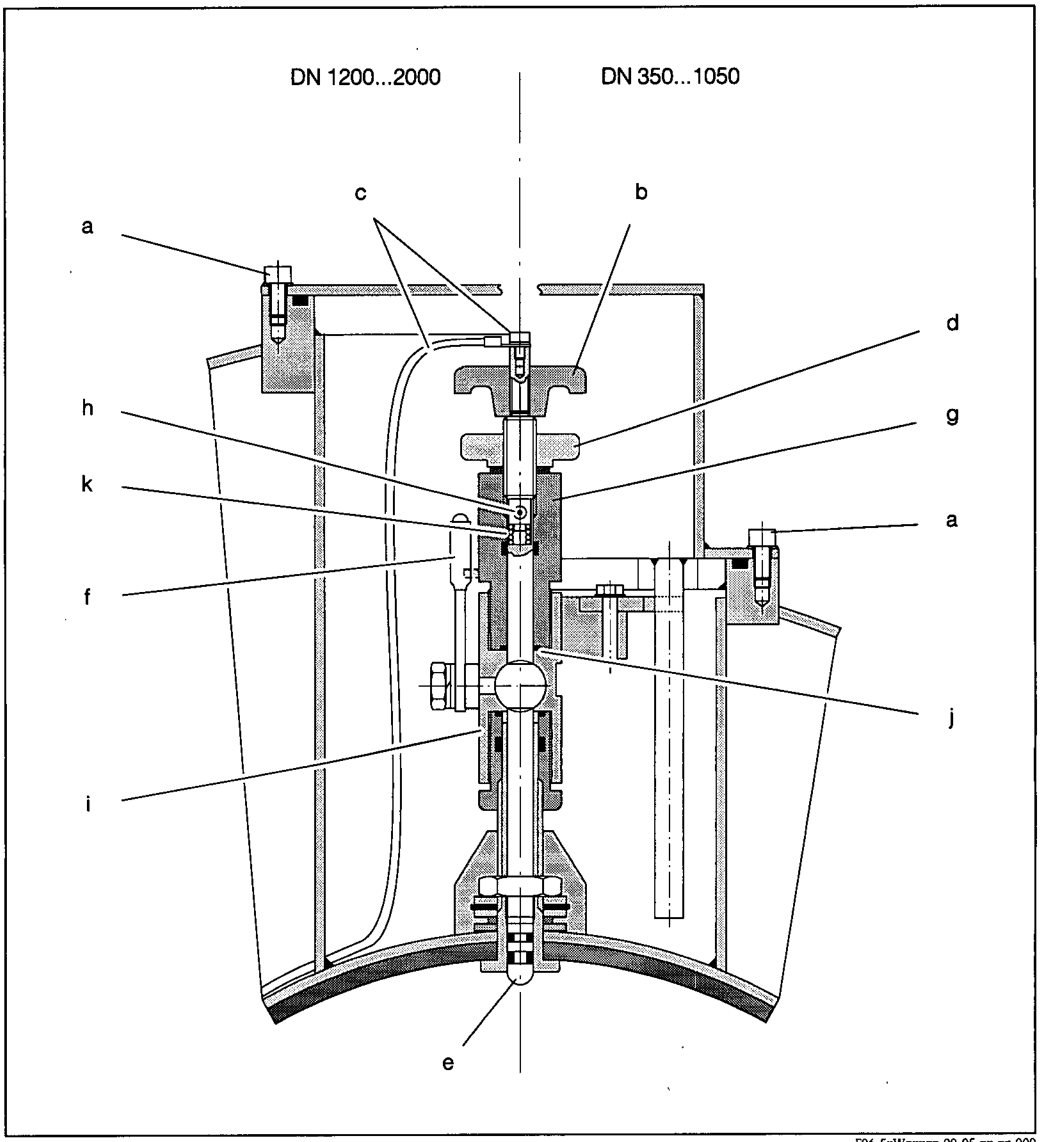

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Fig. 52: Apparatus for replacing exchangeable measuring electrodes (Replacing → Page 104)

a Allen screw
b Handle
c Electrode cable
d Knurled nut (locknut)
e Measuring electrode
f Stop cock
g Retaining cylinder
h Locking pin (for handle)
i Ball-valve housing
j Seal (retaining cylinder)
k Coil spring

Removing the electrode		Installing the electrode	
1	Loosen Allen screw (a) and remove the cover.	1	Insert new electrode (e) into retaining cylinder (g) from below. Make sure that the seals at the tip of the electrode are clean.
2	Remove electrode cable (c) secured to handle (b).	2	Mount handle (b) on the electrode and insert locking pin (h) to secure it in position. Caution!! Make sure that coil spring (k) is inserted. This is essential to ensure correct electrical contact and correct measuring signals.
2	Loosen knurled nut (d) by hand. This knurled nut acts as a locknut.	2	Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (g).
3	Remove electrode (e) by turning handle (b). The electrode can now be pulled out of retaining cylinder (g) as far as a defined stop. Warnung! Risk of injury. Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode.	3	Screw the retaining cylinder (g) onto ball-valve housing (i) and tighten it by hand. Seal (j) on the cylinder must be correctly seated and clean. Note! Make sure that the rubber hoses on retaining cylinder (g) and stop cock (f) are of the same color (red or blue).
4	Close stop cock (f) after pulling out the electrode as far as it will go. Warnung! Do not subsequently open the stop cock, in order to prevent fluid escaping.	4	Open stop cock (f) and turn handle (b) to screw the electrode all the way into the retaining cylinder.
5	Remove the electrode complete with retaining cylinder (g).	5	Screw knurled nut (d) onto the retaining cylinder. This firmly locates the electrode in position.
6	Remove handle (b) from electrode (e) by pressing out locking pin (h). Take care not to lose coil spring (k).	6	Use the Allen screw to secure electrode cable (c) to handle (b). Caution!! Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals.
7	Remove the old electrode and insert the new electrode. Replacement electrodes can be ordered separately from Endress+Hauser.	7	Reinstall the cover and tighten (a) Allen screw.

9.10 Software history

Date	Software version	Changes to software	Operating Instructions
03.2005	2.00.XX	Software expansion: – New / revised functionalities New functionalities: – DEVICE SOFTWARE → Device software displayed (NAMUR-recommendation 53) – Unit US Kgal	50097090/03.05
11.2004	Amplifier: 1.06.01 Communication module: 1.04.00	Software update relevant only for production	50097090/10.03
10.2003	Amplifier: 1.06.00 Communication module: 1.03.00	Software expansion: – Language groups – Flow direction pulse output selectable New functionalities: – Second Totalizer – Adjustable backlight (display) – Operation hours counter – Simulation function for pulse output – Access code for counter – Reset function (fault history) – Up-/download with FieldTool	50097090/10.03
08.2003	Communication module: 1.02.01	Software expansion: – New / revised functionalities Special documentation: – Current span NAMUR NE 43 – Failsafe mode function – Trouble-shooting function – System and process error messages – Response of status output	50097090/08.03
08.2002	Amplifier: 1.04.00	Software expansion: – New / revised functionalities Special documentation: – Current span NAMUR NE 43 – EPD (new mode) – Failsafe mode function – Acknowledge fault function – Trouble-shooting function – System and process error messages – Response of status output	50097090/08.02
03.2002	Amplifier: 1.03.00	Software expansion: – Suitability for custody transfer measurement Promag 50/51	none
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expansion: – New functionalities: New functionalities: – General instrument functions – "OED" software function – "Pulse width" software function	50097090/06.01

Date	Software version	Changes to software	Operating Instructions
09.2000	Amplifier: 1.01.01 Communication module: 1.01.00	Software expansion: – Functional adaptations	none
08.2000	Amplifier: 1.01.00	Software expansion: – Functional adaptations	none
04.2000	Amplifier: 1.00.00 Communication module: 1.00.00	Original software Compatible with: – FieldTool – Commuwin II (version 2.05.03 and higher) – HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1.	50097090/04.00

Note!
Usually, an upload or download between the different software versions is only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

Application	■ Measuring the flow rate of fluids in closed piping systems. ■ A minimum conductivity of ≥ 5 μS/cm is required for measuring; the minimum conductivity required in the case of demineralised water is ≥ 20 μS/cm. ■ Applications in measuring, control and regulation technology Liner specific applications: ■ Promag W (DN 25...2000): – Polyurethane lining for applications with cold water and for slightly abrasive fluids. – Hard rubber lining for all applications with water (especially for trinking water) ■ Promag P (DN 15...600): – PTFE lining for standard applications in chemical and process industries. – PFA lining for all applications in chemical and process industries; especially for high process temperatures and applications with temperature shocks. ■ Promag H (DN 2...100): PFA lining for all applications in chemical, process and food industries; especially for high process temperatures, for applications with temperature shocks and for applications with CIP or SIP cleaning processes.

10.1.2 Function and system design

Measuring principle	Electromagnetic flow measurement on the basis of Faraday's Law.
Measuring system	The measuring system consists of a transmitter and a sensor. Two versions are available: ■ Compact version: transmitter and sensor form a single mechanical unit. ■ Remote version: transmitter and sensor are installed separately. *Transmitter:* ■ Promag 50 *Sensor:* ■ Promag W (DN 25...2000) ■ Promag P (DN 15...600) ■ Promag H (DN 2...100)

10.1.3 Input

Measured variable	Flow rate (proportional to induced voltage)
Measuring range	Typically v = 0.01...10 m/s with the specified measuring accuracy
Operable flow range	Over 1000 : 1
Input signals	Status input (auxiliary input): U = 3...30 V DC, R_i = 5 kΩ, galvanically isolated Configurable for: totalizer reset, positive zero return

10.1.4 Output

Output signal	Current output: active/passive selectable, galvanically isolated, time constant selectable (0.01...100 s), full scale value selectable, temperature coefficient: typically 0.005% o.f.s./ °C; resolution: 0.5 µA ▪ active: 0/4...20 mA, R_L < 700 Ω (for HART: R_L ≥ 250 Ω) ▪ passive: 4...20 mA, supply voltage V_S: 18...30 V DC, R_i ≥ 150 Ω Pulse / frequency output: passive, open collector, 30 V DC, 250 mA, galvanically isolated ▪ Frequency output: full scale frequency 2...1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 10 s ▪ Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.5...2000 ms)
Signal on alarm	▪ Current output → failsafe mode selectable (e.g. to NAMUR recommendation NE 43) ▪ Pulse/frequency output → failsafe mode selectable ▪ Status output → “non-conductive” by fault or power supply failure Details → Page 95
Load	see “output signal”
Switching output	Status output: Open collector, max. 30 V DC / 250 mA, galvanically isolated Configurable for: error messages, Empty Pipe Detection (EPD/OED), flow direction, limit values
Low flow cutoff	Switch points for low flow cutoff are selectable
Galvanic isolation	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections	see Page 47 ff.
Cable entry	Power-supply and signal cables (inputs/outputs): ▪ Cable entry M20 x 1.5 (8...12 mm) ▪ Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm) ▪ Threads for cable entries 1/2" NPT, G 1/2" Connecting cable for remote version: ▪ Cable entry M20 x 1.5 (8...12 mm) ▪ Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm) ▪ Threads for cable entries 1/2" NPT, G 1/2"
Cable specifications	see Page 51
Supply voltage	85...260 V AC, 45...65 Hz 20...55 V AC, 45...65 Hz 16...62 V DC

Power consumption	AC: <15 VA (including sensor) DC: <15 W (including sensor) Switch-on current: ▪ max. 13.5 A (< 50 ms) at 24 V DC ▪ max. 3 A (< 5 ms) at 260 V AC
Power supply failure	Lasting min. 1 power cycle ▪ EEPROM saves measuring system data if power supply fails ▪ S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point, etc.)
Potential equalisation	see Page 56 ff.

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up time: 30 minutes

Installation:
- Inlet run >10 x DN
- Outlet run > 5 x DN
- Sensor and transmitter grounded.
- Sensor centered relative to the pipe.

Maximum measured error

Pulse output:
- ± 0.5% o.r. ± 1 mm/s (o.r. = of reading)
- Option: ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

Current output: plus typically ± 5 μA

Supply-voltage fluctuations have no effect within the specified range.

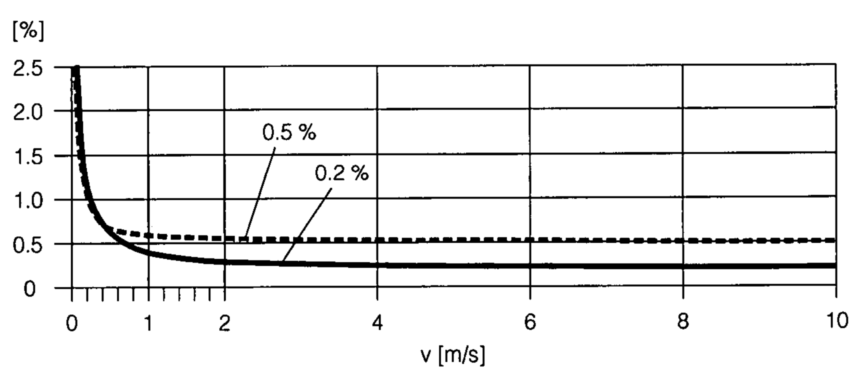

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Fig. 53: Max. measured error in % of reading

Repeatability

max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

10.1.7 Operating conditions

Installation

Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → see Page 15 ff.
Inlet and outlet runs	Inlet run: typically ≥ 5 x DN Outlet run: typically ≥ 2 x DN
Length of connecting cable	For the remote version the permissible cable length L_{max} depends on the conductivity of the medium → Page 25. A minimum conductivity of 20 μS/cm is required for measuring demineralized water.

Environment

Ambient temperature	Transmitter: ■ Standard: –20...+60 °C ■ Optional: –40...+60 °C Note! At ambient temperatures below –20 °C the readability of the display may be impaired. Sensor: ■ Flange material carbon steel: –10...+60 °C ■ Flange material stainless steel: –40...+60 °C Caution! It is not allowed to use the device beyond the min. and max. lining specified temperature values (→ "Medium temperature range"). Note the following points: ■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. ■ If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ "Medium temperature range").
Storage temperature	The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.
Degree of protection	■ Standard: IP 67 (NEMA 4X) for transmitter and sensor ■ Optional: IP 68 (NEMA 6P) for remote version of Promag W and P sensor
Shock and vibration resistance	Acceleration up to 2 g by analogy with IEC 60068-2-6 (high-temperature version: no data available)
CIP cleaning	Promag W: not possible Promag P: possible (note max. temperature) Promag H: possible (note max. temperature)
SIP cleaning	Promag W: not possible Promag P: possible with PFA (note max. temperature) Promag H: possible (note max. temperature)
Electromagnetic compatibility (EMC)	To EN 61326/A1 and NAMUR recommendation NE 21.

Process

Medium temperature range

The permissible fluid temperature depends on the lining of the measuring tube:

Promag W
0…+80 °C for hard rubber (DN 65…2000)
–20…+50 °C for polyurethane (DN 25…2000)

Promag P
–40…+130 °C for PTFE (DN 15…600), for restrictions → refer to diagrams
–20…+180 °C for PFA (DN 25…200), for restrictions → refer to diagrams

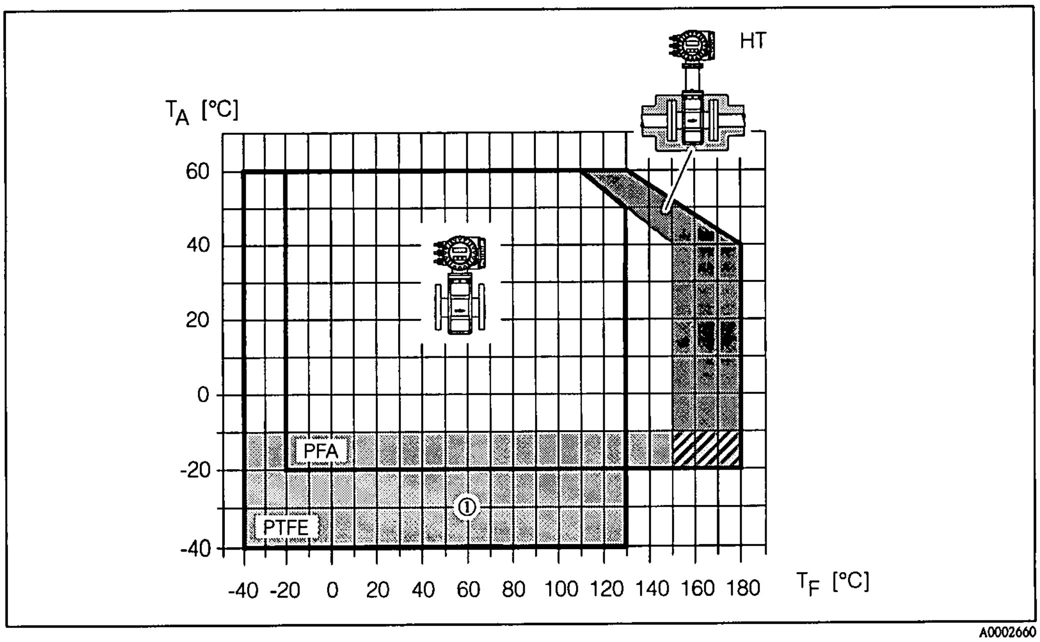


Fig. 54: Compact version Promag P (with PFA or PTFE lining)
T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation
① = Temperature range from –10 °C to –40 °C is valid for stainless steel flanges only

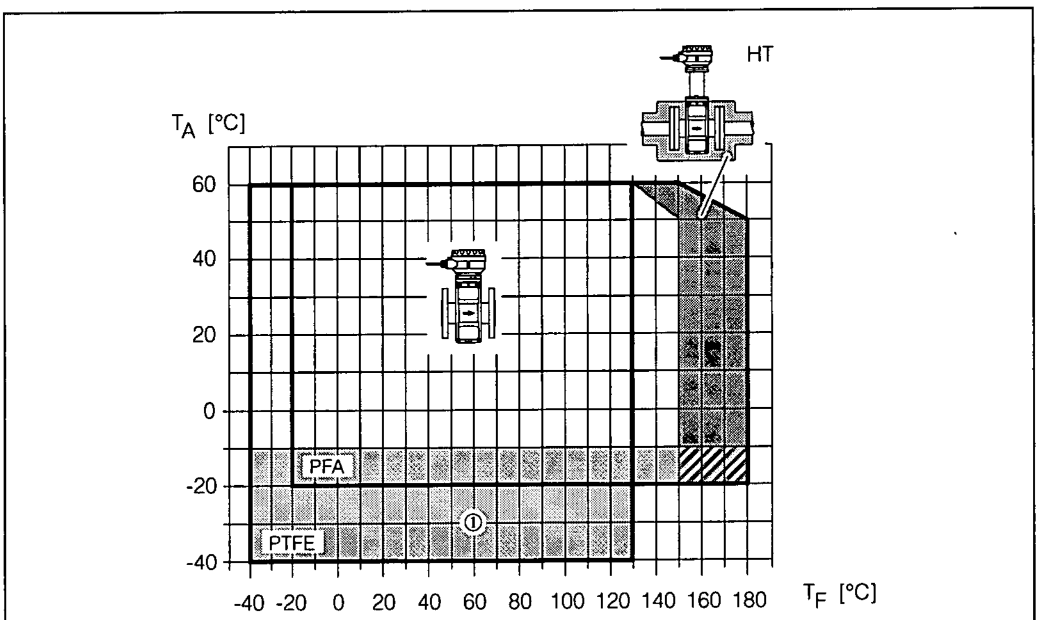


Fig. 55: Remote version Promag P (with PFA or PTFE lining)
T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation
① = Temperature range from –10 °C to –40 °C is valid for stainless steel flanges only

Promag H
Sensor:
- DN 2...25: –20...+150 °C
- DN 40...100: –20...+150 °C

Seal:
- EPDM: –20...+130 °C
- Silicone: –20...+150 °C
- Viton: –20...+150 °C
- Kalrez: –20...+150 °C

Conductivity

Minimum conductivity:
- ≥ 5 µS/cm for fluids generally
- ≥ 20 µS/cm for demineralised water

Note that in the case of the remote version, the requisite conductivity is also influenced by the length of the connecting cable → Page 25.

Limiting medium pressure range (nominal pressure)

Promag W
- EN 1092-1 (DIN 2501): PN 6 (DN 1200...2000), PN 10 (DN 200...2000), PN 16 (DN 65...2000), PN 25 (DN 200...1000), PN 40 (DN 25...150)
- ANSI B16.5: Class 150 (1...24"), Class 300 (1...6")
- AWWA: Class D (28...78")
- JIS B2238: 10K (DN 50...300), 20K (DN 25...300)

Promag P
- EN 1092-1 (DIN 2501): PN 10 (DN 200...600), PN 16 (DN 65...600), PN 25 (DN 200...600), PN 40 (DN 15...150)
- ANSI B16.5: Class 150 (1/2...24"), Class 300 (1/2...6")
- JIS B2238: 10K (DN 50...300), 20K (DN 15...300)

Promag H:
The permissible nominal pressure depends on the process connection and seal:
- 40 bar: flange, weld nipple (with O-ring seal)
- 16 bar: all other process connections

Pressure tightness (liner)

Promag W Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	50 °C	80° C	100 °C	130 °C	150 °C	180 °C
25...1000	1...40"	Polyurethane	0	0	–	–	–	–	–
65...2000	3...78"	Hard rubber	0	0	0	–	–	–	–

Promag P Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures					
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
15	1/2"	PTFE	0	0	0	100	–	–
25	1"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
32	–	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
40	1 1/2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
50	2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
65	–	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
80	3"	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
100	4"	PTFE / PFA	0 / 0	*	135 / 0	170 / 0	– / 0	– / 0
125	–	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
150	6"	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
200	8"	PTFE / PFA	200 / 0	*	290 / 0	410 / 0	– / 0	– / 0
250	10"	PTFE	330	*	400	530	–	–
300	12"	PTFE	400	*	500	630	–	–
350	14"	PTFE	470	*	600	730	–	–
400	16"	PTFE	540	*	670	800	–	–
450	18"	PTFE	Partial vacuum is impermissible					
500	20"	PTFE						
600	24"	PTFE						
* No value can be quoted.								

Promag H Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures					
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
2...100	1/12...4"	PFA	0	0	0	0	0	0

Limiting flow

see Page 20

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter (Promag H: only DN 8 and larger).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → Page 20

10.1.8 Mechanical construction

Design / dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation “Technical Information”.

Weight

Weight data of Promag W in kg

Nominal diameter		Compact version						Remote versin (without cable)						
								Sensor						Wall housing
[mm]	[inch]	EN (DIN) /AS*		JIS		ANSI/AWWA		EN (DIN) /AS*		JIS		ANSI/AWWA		
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1 1/4"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 1/2"	PN 40	9.4		8.3		9.4	PN 40	7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 1/2"		12.0		11.1		–		10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"	PN 16	16.0	10K	14.7		16.0	PN 16	14.0	10K	12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5	Class 150	25.5		23.5		22.5	Class 150	23.5	6.0
200	8"		45		41.9		45		43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"	PN 10	175				285	PN 10	173				283	6.0
600	24"		235				405		233				403	6.0
700	28"		355				400		353				398	6.0
–	30"		–				460		–				458	6.0
800	32"		435				550		433				548	6.0
900	36"		575				800		573				798	6.0
1000	40"		700				900		698				898	6.0
–	42"		–				1100		–				1098	6.0
1200	48"		850				1400		848				1398	6.0
–	54"		–			Class D	2200		–			Class D	2198	6.0
1400	–		1300				–		1298				–	6.0
–	60"		–				2700		–				2698	6.0
1600	–	PN 6	1700				–	PN 6	1698				–	6.0
–	66"		–				3700		–				3698	6.0
1800	72"		2200				4100		2198				4098	6.0
–	78"		–				4600		–				4598	6.0
2000	–		2800				–		2798				–	6.0

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)
* Flanges according AS are only available for DN 80, 100, 150...400, 500 and 600

Weight data of Promag P in kg														
Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Wall housing
[mm]	[inch]		EN (DIN) /AS*		JIS		ANSI		EN (DIN) /AS*		JIS		ANSI	
15	1/2"	PN 40	6.5	10K	6.5	Class 150	6.5	PN 40	4.5	10K	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1 1/4"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 1/2"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 1/2"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0

Transmitter Promag (compact version): 3.4 kg
High-temperature version: +1.5 kg
(Weight data valid for standard pressure ratings and without packaging material)
* Flanges according AS are only available for DN 25 and 50

Weight data of Promag H in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Wall housing
2	1/12"	5.2	2.5	6.0
4	5/32"	5.2	2.5	6.0
8	5/16"	5.3	2.5	6.0
15	1/2"	5.4	2.6	6.0
25	1"	5.5	2.8	6.0
40	1 1/2"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2 1/2"	9.5	7.5	6.0
80	3"	19.0	17.0	6.0
100	4"	18.5	16.5	6.0

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)

Materials

Promag W

Transmitter housing:
- Compact housing: powder coated die-cast aluminium
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:
- DN 25...300: powder-coated die-cast aluminium
- DN 350...2000: painted steel (Amerlock 400)

Measuring tube:
- DN < 350: stainless steel 1.4301 or 1.4306/304L; non-stainless flange material with Al/Zn protective coating
- DN > 300: stainless steel 1.4301/304; non-stainless flange material with Amerlock 400 paint

Flange:
- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AWWA: 1.0425
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2) (DN 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

Ground disks: : 1.4435/316L or Alloy C-22
Electrodes: 1.4435 or Alloy C-22, tantalum
Seals: Seals to DIN EN 1514-1

Promag P

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless steel field housing
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:
- DN 15...300: powder-coated die-cast aluminium
- DN 350...600: painted steel (Amerlock 400)

Measuring tube:
- DN < 350: stainless steel 1.4301 or 1.4306/304L; non-stainless flange material with Al/Zn protective coating
- DN > 300: stainless steel 1.4301/304; non-stainless flange material with Amerlock 400 paint

Flange:
- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350: with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 25) A105 or RSt37-2 (S235JRG2) (DN 50) A105 oder St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

Ground disks: 1.4435/316L or Alloy C-22
Electrodes: 1.4435, platinum/rhodium 80/20 or Alloy C-22, tantalum
Seals: Seals to DIN EN 1514-1

Promag H

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless-steel field housing 1.4301/316L
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing: 1.4301
Wall mounting (holder panel): 1.4301

Measuring tube: stainless steel 1.4301 or 1.4306/304L

Flange:
- All connections stainless-steel 1.4404/316L
- Flanges (EN (DIN), ANSI, JIS) made of PVDF
- Adhesive fitting made of PVC

Ground rings: 1.4435/316L, Option: tantalum, Alloy C-22

Electrodes:
- Standard: 1.4435
- Option: Alloy C-22, tantalum, platinum/rhodium 80/20 (up to DN 25 only)

Seals:
- DN 2...25: O-ring (EPDM, Viton, Kalrez) or gasket seal (EPDM, silicone, Viton)
- DN 40...100: gasket seal (EPDM, silicone)

Material load diagram

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the following documents:
- Technical Information "Promag 50/53W" (TI 046D/06/en)
- Technical Information "Promag 50/53P" (TI 047D/06/en)
- Technical Information "Promag 50/53H" (TI 048D/06/en)

Fitted electrodes

Promag W:
Measuring, reference and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum
- Optional: exchangeable measuring electrodes made of 1.4435 (DN 350...2000)

Promag P:
Measuring, reference and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20
- Optional: measuring electrodes made of platinum/rhodium 80/20

Promag H:
Measuring electrodes and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20
- DN 2...4: without EPD electrode

Process connections	Promag W: Flange connection: EN 1092-1 (DIN 2501); DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092-1, ANSI, AWWA, JIS, AS Promag P: Flange connection: EN 1092-1 (DIN 2501); DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092-1, ANSI, JIS, AS Promag H: ■ With O-ring: weld nipples (DIN EN ISO 1127, ODT / SMS), flanges (EN (DIN), ANSI, JIS), PVDF flanges (EN (DIN), ANSI, JIS), external pipe thread, internal pipe thread, hose connection, PVC adhesive fittings ■ With gasket seal: weld nipples (DIN 11850, ODT / SMS), clamps (ISO 2852, DIN 32676, L14 AM7), threaded fasteners (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flanges (DIN 11864-2
Surface roughness	■ PFA liner: ≤ 0.4 µm ■ Electrodes: – 1.4435, Alloy C-22: 0.3...0.5 µm – Tantalum, platinum/rhodium: 0.3...0.5 µm ■ Process connection Promag H: ≤ 0.8 µm (all data relate to parts in contact with medium)

10.1.9 Human interface

Display elements	■ Liquid-crystal display: illuminated, two lines with 16 characters per line ■ Custom configurations for presenting different measured values and status variables ■ 2 totalizers ■ At ambient temperatures below –20 °C the readability of the display may be impaired
Operating elements	■ Local operation with three push buttons (–, +, E) ■ "Quick Setup" menus for straightforward commissioning
Language group	Language groups available for operation in different countries: ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ■ South and east Asia (SEA): English, Japanese, Indonesian You can change the language group via the operating program "ToF Tool - Fieldtool Package."
Remote operation	Operation via HART protocol

10.1.10 Certificates and approvals

Ex Approvals	Information about currently available Ex versions (ATEX, FM, CSA) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

Sanitary compatibility	Promag W: No applicable approvals or certification Promag P: No applicable approvals or certification Promag H: ▪ 3A authorization and EHEDG-tested ▪ Seals in conformity with FDA (except Kalrez seals)
Pressure Equipment Directive	Measuring devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.
CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
Other standards and guidelines	EN 60529 Degrees of protection by housing (IP code) EN 61010 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures EN 61326/A1 (IEC 6326) Electromagne8tic compatibility (EMC requirements) NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment. NAMUR NE 43 Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal. NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics.

10.1.11 Ordering information

The Endress+Hauser service organisation can provide detailed ordering information and information on specific order codes on request.

10.1.12 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (see Page 85). The Endress+Hauser service organisation can provide detailed information on request.

10.1.13 Supplementary documentation

- System Information Promag (SI 028D/06/en)
- Technical Information Promag 50/53W (TI 046D/06/en)
- Technical Information Promag 50/53P (TI 047D/06/en)
- Technical Information Promag 50/53H (TI 048D/06/en)
- Description of Device Functions Promag 50 (BA 049D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

11 Index

Declaration of Contamination
Erklärung zur Kontamination

Endress+Hauser
People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or - even better - attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp ______________________

Serial number
Seriennummer ____________

Process data/ *Prozessdaten*

Temperature / *Temperatur* _______ [°C] Pressure / *Druck* _______ [Pa]

Conductivity / *Leitfähigkeit* _______ [S] Viscosity / *Viskosität* _______ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium *Medium im Prozess*								
Medium for process cleaning *Medium zur Prozessreinigung*								
Returned part cleaned with *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include security sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Reason for return / *Grund zur Rücksendung* ______________________

____

____

Company data / *Angaben zum Absender*

Company / *Firma* ______________________

____

Address / *Adresse*

____

____

Contact person / *Ansprechpartner* ______________________

Department / *Abteilung* ______________________

Phone number/ *Telefon* ______________________

Fax / E-Mail ______________________

Your order No. / *Ihre Auftragsnr.* ______________________

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.
Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfältig gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefahrbringender Menge sind.

P/SF/Konta VIII

____
(place, date / *Ort, Datum*)

____
(Company stamp and legally binding signature)
(Firmenstempel und rechtsverbindliche Unterschrift)

www.endress.com/worldwide

Endress+Hauser

People for Process Automation

BA046D/06/en/03.05
50097090
FM+SGML6.0

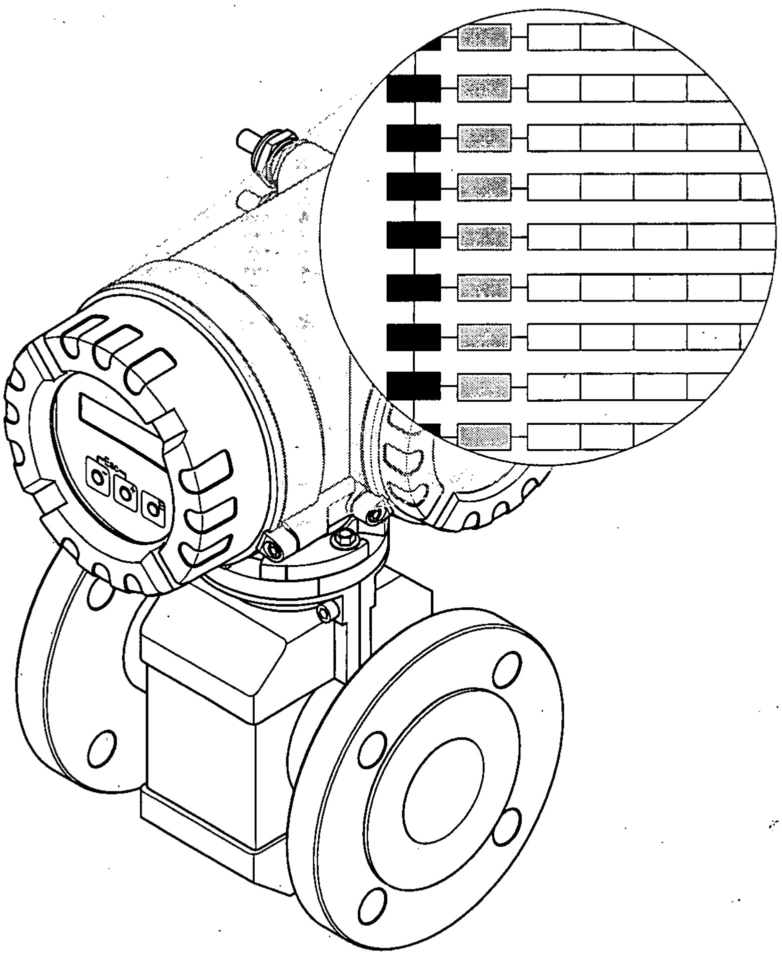
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Description of Device Functions

Proline Promag 50

Electromagnetic Flow Measuring System

HART® FIELD COMMUNICATION PROTOCOL



BA049D/06/en/03.05
50097085
Valid as of version:
V 2.00.XX (Device software)

Endress+Hauser
People for Process Automation

Contents

Registered trademarks

HART®
Registered trademark of the HART Communication Foundation, Austin, USA

S-DAT®
Registered trademarks of Endress+Hauser Flowtec AG, Reinach, CH

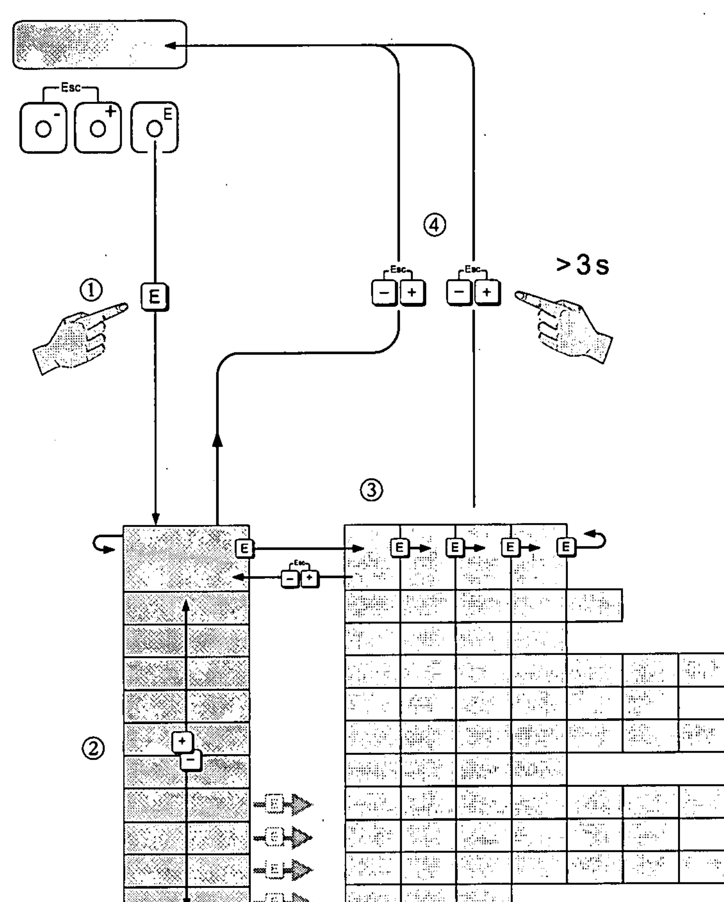
1 Function matrix Promag 50

1.1 The function matrix: layout and use

The function matrix is a two-level construct: the groups form one level and the groups' functions the other.
The groups are the highest-level grouping of the operating options for the measuring device.
A number of functions is assigned to each group.
You select a group in order to access the individual functions for operating and parameterizing the measuring device.
An overview of all the groups available is provided in the table of contents on Page 3 and in the graphical representation of the function matrix on Page 6.
An overview of all the functions available is provided on Page 6, complete with page references to the detailed function descriptions.
The descriptions of the individual functions start on Page 7.

Example of how to parameterize a function (in this case changing the language for the UI):

1. Enter into the function matrix (E-key).
2. Select the OPERATION group.
3. Select the LANGUAGE function, change the setting from ENGLISH to DEUTSCH with +- and save with E (all text on the display now appears in German).
4. Exit the function matrix (ESC > 3 seconds).



A0001142

1.2 Illustration of the function matrix

Function groups	Functions →									
MEASURING VALUES (P. 7)	VOLUME FLOW (P. 7)									
SYSTEM UNITS (P. 8)	UNIT VOL. FLOW (P. 8)	UNIT VOLUME (P. 9)	UNIT LENGTH (P. 9)							
QUICK SETUP (P. 10)	QUICK SETUP COMMISSION (P. 10)									
OPERATION (P. 11)	LANGUAGE (P. 11)	ACCESS CODE (P. 12)	PRIVATE CODE (P. 12)	STATUS ACCESS (P. 12)	ACCESS CODE COUNTER (P. 12)					
USER INTERFACE (P. 13)	ASSIGN LINE 1 (P. 13)	ASSIGN LINE 2 (P. 13)	100% VALUE (P. 13)	FORMAT (P. 14)	DISPL. DAMPING (P. 14)	CONTRAST LCD (P. 14)	BACKLIGHT (P. 15)	DISPLAY TEST (P. 15)		
TOTALIZER 1/2 (P. 16)	ASSIGN TOTALIZER (P. 16)	SUM (P. 16)	OVERFLOW (P. 16)	UNIT TOTALIZER (P. 16)	TOTALIZER MODE (P. 17)	RESET TOTALIZ. (P. 17)				
HANDLING TOTALIZ. (P. 18)	RESET ALL TOTAL. (P. 18)	FAILSAFE MODE (P. 18)								
CURRENT OUTPUT (P. 19)	ASSIGN CURRENT OUTP. (P. 19)	CURRENT SPAN (P. 20)	VALUE 20 mA (P. 21)	TIME CONSTANT (P. 21)	FAILSAFE MODE (P. 21)	ACTUAL CURRENT (P. 21)	SIMUL. CURRENT (P. 22)	VALUE SIM. CURRENT (P. 22)		
PULSE/FREQ. OUTP. (P. 23)	OPERATION MODE (P. 23)	ASSIGN FREQ. (P. 23)	END VALUE FREQ. (P. 23)	VALUE-f HIGH (P. 24)	OUTPUT SIGNAL (P. 25)	TIME CONSTANT (P. 27)	FAILSAFE MODE (P. 27)	FAILSAFE VALUE (P. 27)	ACTUAL FREQ. (P. 27)	SIMUL. FREQ. (P. 28)
	VALUE SIM. FREQ. (P. 28)	ASSIGN PULSE (P. 28)	PULSE VALUE (P. 29)	PULSE WIDTH (P. 29)	OUTPUT SIGNAL (P. 30)	FAILSAFE MODE (P. 32)	SIMULATION PULSE (P. 32)	VALUE SIM. PULSE (P. 33)		
STATUS OUTPUT (P. 34)	ASSIGN STATUS (P. 34)	ON-VALUE (P. 34)	OFF-VALUE (P. 35)	TIME CONSTANT (P. 35)	ACTUAL STATUS (P. 35)	SIM. SWITCH POINT (P. 35)	VAL. SIM. SWIT. PT. (P. 36)			
STATUS INPUT (P. 40)	ASSIGN STATUS (P. 40)	ACTIVE LEVEL (P. 40)	MIN. PULSE WIDTH (P. 40)	SIM. STATUS INP. (P. 40)	VALUE SIM. STATUS (P. 41)					
COMMUNICATION (P. 42)	TAG NAME (P. 42)	TAG DESCR. (P. 42)	BUS ADDRESS (P. 42)	HART PROTOCOL (P. 42)	MANUFACT. ID (P. 42)	DEVICE ID (P. 42)	DEVICE REVISION (P. 42)			
PROCESS PARAM. (P. 43)	ASSIGN LF CUT OFF (P. 43)	ON-VALUE (P. 43)	OFF-VALUE (P. 43)	EMPTY PIPE DET. (P. 44)	EPD/OED ADJ. (P. 46)	EPD/OED RES.TIME (P. 47)	ECC (P. 47)	ECC DURATION (P. 47)	ECC RECOVERY TIME (P. 48)	ECC CLEAN. CYCL. (P. 48)
SYSTEM PARAM. (P. 49)	INSTALL. DIRECT. (P. 49)	MEASURING MODE (P. 49)	POS. ZERO RETURN (P. 50)	SYSTEM DAMPING (P. 51)	INTEGRAT. TIME (P. 51)					
SENSOR DATA (P. 52)	K-FACTOR POS. (P. 52)	K-FACTOR NEG. (P. 52)	ZERO POINT (P. 52)	NOM. DIAMETER (P. 52)	MEAS. PERIOD (P. 53)	OVERVLTG TIME (P. 53)	EPD ELECTRODE (P. 53)	POLARITY ECC (P. 53)		
SUPERVISION (P. 54)	CURR. SYS. COND. (P. 54)	PREV. SYS. COND. (P. 54)	ASSIGN SYS. ERR. (P. 54)	ERROR CATEG. (P. 54)	ASSIGN PROC. ERR. (P. 54)	ERROR CATEG. (P. 55)	ALARM DELAY (P. 55)	SYSTEM RESET (P. 55)	OPERAT. HRS. (P. 55)	
SIMULAT. SYSTEM (P. 56)	SIM. FAILS. MODE (P. 56)	SIM. MEAS. VARIAB. (P. 56)	VAL.SIM.MEAS.VAR. (P. 56)							
SENSOR VERSION (P. 57)	SERIAL NUMBER (P. 57)	SENSOR TYPE (P. 57)	HW REV. SENS. (P. 57)	SW REV. NO. S-DAT (P. 57)						
AMPLIFIER VERS. (P. 57)	DEVICE SOFTWARE (P. 57)	SW REV. AMPL. (P. 57)	LANGUAGE GROUP (P. 57)	I/O MODULE TYPE (P. 57)	SW REV. I/O MOD. (P. 57)					

2 Group MEASURING VALUES

Function description MEASURING VALUES	
Note! ▪ The engineering unit of the measured variable displayed here can be set in the SYSTEM UNITS group, (see Page 8). ▪ If the fluid in the pipe flows backwards, a negative sign prefixes the flow reading on the display.	
VOLUME FLOW	The volume flow currently measured appears on the display. **User interface:** 5-digit floating-point number, including unit and sign (e.g. 5.5445 dm^3/min; 1.4359 m^3/h; –731.63 gal/d; etc.)

3 Group SYSTEM UNITS

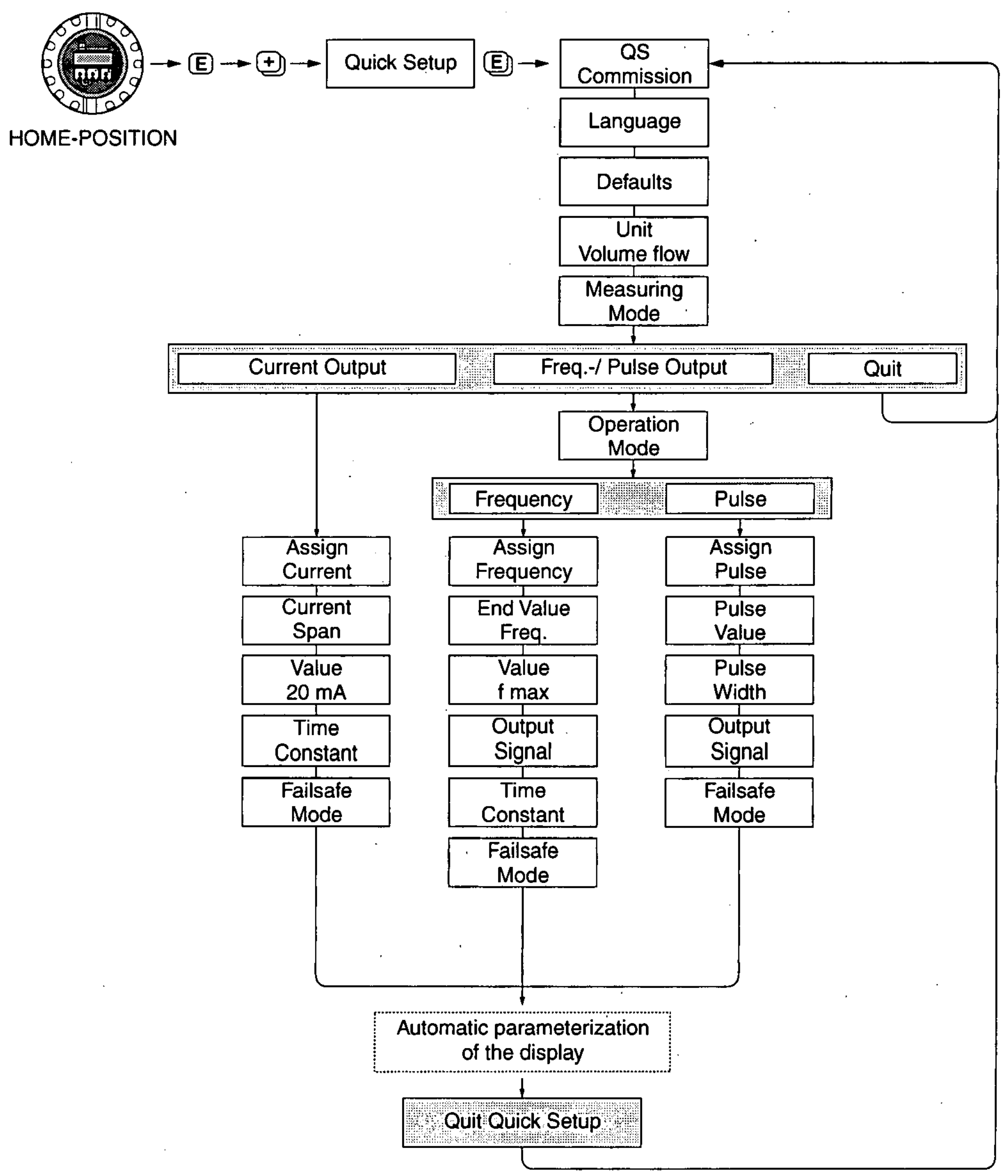
Function description SYSTEM UNITS	
Use this function group to select the unit for the measured variable.	
UNIT VOLUME FLOW	Use this function to select the unit for displaying the volume flow. The unit you select here is also valid for: ■ Current output ■ Frequency output ■ Switch points (limit value for volume flow, flow direction) ■ Low flow cut off **Options:** Metric: Cubic centimeter → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimeter → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic meter → m^3/s; m^3/min; m^3/h; m^3/day Milliliter → ml/s; ml/min; ml/h; ml/day Liter → l/s; l/min; l/h; l/day Hectoliter → hl/s; hl/min; hl/h; hl/day Megaliter → Ml/s; Ml/min; Ml/h; Ml/day US: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft^3/s; ft^3/min; ft^3/h; ft^3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Kilo gallon → Kgal/s; Kgal/min; Kgal/h; Kgal/day Million gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Imperial: Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description SYSTEM UNITS	
UNIT VOLUME	Use this function to select the unit for displaying the volume. The unit you select here is also valid for: ▪ Pulse weighting (e.g. m^3/p) **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml Mega US → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals) → bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). Note! The unit of the totalizers is independent of your choice here. The unit for each totalizer is selected separately for the totalizer in question.
UNIT LENGTH	Use this function to select the unit for displaying the length of the nominal diameter. The unit you select here is also valid for: ▪ Nominal diameter of sensor (see function NOMINAL DIAMETER on Page 48) **Options:** MILLIMETER INCH **Factory setting:** MILLIMETER (SI units: not for USA and Canada) INCH (US units: only for USA and Canada)

4 Group QUICK SETUP

Function description QUICK SETUP	
QUICK SETUP COMMISSION	Use this function to start the Quick Setup menu for commissioning. **Options:** YES NO **Factory setting:** NO

Note!
The display returns to the QUICK SETUP COMMISSION cell if you press the ESC key combination during interrogation.



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5 Group OPERATION

Function description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. Note! The displayed options depend on the available language group shown in the LANGUAGE GROUP function. **Options:** Language group WEST EU / USA: ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO NEDERLANDS PORTUGUESE Language group EAST EU / SCAND: ENGLISH NORSK SVENSKA SUOMI POLISH RUSSIAN CZECH Language group ASIA: ENGLISH BAHASA INDONESIA JAPANESE (Silbenschrift) **Factory setting:** Country-dependent (see Page 58 ff.) Note! ▪ If you press the +- keys simultaneously at startup, the language defaults to "ENGLISH". ▪ You can change the language group via the configuration program ToF Tool - Fieldtool Package. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

Function description OPERATION	
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the +- keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can enable programming by entering your personal code, (**factory setting = 50**, see function PRIVATE CODE on Page 12) **User input:** max. 4-digit number: 0...9999 Note! ■ The programming levels are disabled if you do not press a key within 60 seconds following automatic return to the HOME position. ■ You can also disable programming in this function by entering any number (other than the defined private code). ■ The Endress+Hauser service organization can be of assistance if you mislay your personal code.
PRIVATE CODE	Use this function to enter a personal code number for enabling programming. **User input:** 0...9999 (max. 4-digit number) **Factory setting:** 50 Note! ■ Programming is always enabled with the code "0". ■ Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code.
STATUS ACCESS	Use this function to check the access status for the function matrix. **User interface:** ACCESS CUSTOMER (parameterization possible) LOCKED (parameterization disabled)
ACCESS CODE COUNTER	Displays how often the customer code, service code or the digit "0" (code-free) has been entered to gain access to the function matrix. **Display:** max. 7-digit number: 0...9999999 **Factory setting:** 0

6 Group USER INTERFACE

Function description USER INTERFACE	
ASSIGN LINE 1	Use this function to define which display value is assigned to the main line (top line of the local display) for display during normal measuring operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % TOTALIZER 1 TOTALIZER 2 **Factory setting:** VOLUME FLOW
ASSIGN LINE 2	Use this function to define which display value is assigned to the additional line (bottom line of the local display) for display during normal measuring operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % VOLUME FLOW BARGRAPH IN % TOTALIZER 1 TAG NAME OPERATING/SYSTEM CONDITION FLOW DIRECTION TOTALIZER 2 **Factory setting:** TOTALIZER 1
100% VALUE	Note! This function is only available if VOLUME FLOW IN % or VOLUME FLOW BARGRAPH IN % was selected in the function ASSIGN LINE 1 or ASSIGN LINE 2. Use this function to define the flow value to be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. **Options:** XXXXX. – XXXX.X – XXX.XX – XX.XXX – X.XXXX **Factory setting:** X.XXXX Note! ▪ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ▪ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In such instances an arrow appears on the display between the measuring value and the engineering unit (e.g. 1.2 → l/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
DISPLAY DAMPING	Use this function to enter a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** 0...100 seconds **Factory setting:** 3 s Note! Setting the time constant to zero seconds switches off damping.
CONTRAST LCD	Use this function to optimize display contrast to suit local operating conditions. **User input:** 10...100% **Factory setting:** 50%

Function description USER INTERFACE	
BACKLIGHT	Use this function to optimize the backlight to suit local operating conditions. **User input:** 0...100% Note! Entering the value "0" means that the backlight is "switched off". The display then no longer emits any light, i.e. the display texts can no longer be read in the dark. **Factory setting:** 50%
DISPLAY TEST	Use this function to test the operability of the local display and its pixels. **Options:** OFF ON **Factory setting:** OFF Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for at least 0.75 seconds. 3. The main line and additional line show an "8" in each field for at least 0.75 seconds. 4. The main line and additional line show a "0" in each field for at least 0.75 seconds. 5. The main line and additional line show nothing (blank display) for at least 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to OFF.

7 Group TOTALIZER 1/2

Function description TOTALIZER 1/2	
ASSIGN TOTALIZER	Use this function to assign a measured variable (volume flow) to the totalizer. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW Note! The totalizer is reset to "0" as soon as the selection is changed.
SUM	Use this function to view the total for the totalizer measured variable aggregated since measuring commenced. The value can be positive or negative. **User interface:** max. 6-digit floating-point number, including sign and unit (e.g. 96,845.7 dm^3) Note! The totalizer response to faults is defined in the FAILSAFE MODE function (see Page 18).
OVERFLOW	Use this function to view the overflow for the totalizer aggregated since measuring commenced. Total flow quantity is represented by a floating decimal point number consisting of max. 6 digits. You can use this function to view higher numerical values (>999,999) as overflows. The effective quantity is thus the total of OVERFLOW plus the value returned by the SUM function. Example: Reading for 2 overflows: 2 E6 kg (= 2,000,000 dm^3) The value returned by the SUM function = 96,845.7 dm^3 Effective total quantity = 2,096,845.7 dm^3 **Display shows:** Integer with exponent, including sign and unit, e.g. 2 E6 dm^3
UNIT TOTALIZER	Use this function to define the unit for the totalizer. **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml Mega US → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals); bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description TOTALIZER 1/2	
TOTALIZER MODE	Use this function to define how the flow components are to be totalised. **Options:** BALANCE Positive and negative flow components. The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered. FORWARD Positive flow components only REVERSE Negative flow components only **Factory setting:** Totalizer 1 = BALANCE Totalizer 2 = FORWARD
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET). **Options:** NO YES **Factory setting:** NO Note! If the device is equipped with a status input and if it is appropriately configured, totalizer resetting can also be triggered by a pulse.

8 Group HANDLING TOTALIZER

Function description HANDLING TOTALIZER	
RESET ALL TOTALIZERS	Use this function to reset the totals (including all overflows) of the totalizers (1...2) to "zero". **Options:** NO YES **Factory setting:** NO Note! If the device has a status input and if it is appropriately configured, a reset for the totalizer (1...2) can also be triggered by a pulse (see the ASSIGN STATUS INPUT function on Page 31).
FAILSAFE MODE	Use this function to define the totalizer response in case of fault. **Options:** STOP The totalizer is paused until the fault is rectified. ACTUAL VALUE The totalizer continues to count on the basis of the current flow measuring value. The fault is ignored. HOLD VALUE The totalizer continues to count the flow that is based on the last valid flow measuring value (before the fault occurred). **Factory setting:** STOP

9 Group CURRENT OUTPUT

Function description CURRENT OUTPUT	
ASSIGN CURRENT OUTPUT	Use this function to assign a measured variable to the current output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW Note! If you select OFF, the only function shown in this group is the function (ASSIGN CURRENT OUTPUT).

Function description CURRENT OUTPUT

CURRENT SPAN

Use this function to define the current span. The selection specifies the operational range and the lower and upper signal on alarm. For the current output the option HART can be defined additionally.

Options:
0–20 mA
4–20 mA
4–20 mA HART
4–20 mA NAMUR
4–20 mA HART NAMUR
4–20 mA US
4–20 mA HART US
0–20 mA (25 mA)
4–20 mA (25 mA)
4–20 mA (25 mA) HART

Factory setting:
4–20 mA HART NAMUR

Current span, operational range and signal on alarm level

a	1	2	3
0-20 mA	0 - 20.5 mA	0	22
4-20 mA	4 - 20.5 mA	2	22
4-20 mA HART	4 - 20.5 mA	2	22
4-20 mA NAMUR	3.8 - 20.5 mA	3.5	22.6
4-20 mA HART NAMUR	3.8 - 20.5 mA	3.5	22.6
4-20 mA US	3.9 - 20.8 mA	3.75	22.6
4-20 mA HART US	3.9 - 20.8 mA	3.75	22.6
0-20 mA (25 mA)	0 - 24 mA	0	25
4-20 mA (25 mA)	4 - 24 mA	2	25
4-20 mA (25 mA) HART	4 - 24 mA	2	25

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a = Current span
1 = Operational range (measuring information)
2 = Lower signal on alarm level
3 = Upper signal on alarm level

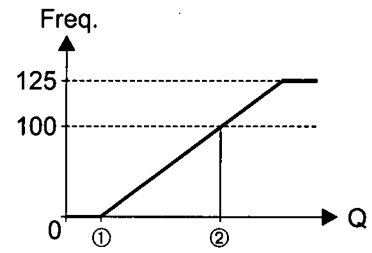
Note!
- When switching the hardware from an active (factory setting) to a passive output signal select a current span of 4–20 mA.
- If the measured value exceeds the measuring range a notice message is generated (#351...354, current span).
- In case of a fault the behaviour of the current output is according to the selected option in the function FAILSAFE MODE (see Page 21). Change the error category in the function ASSIGN SYSTEM ERROR (see Page 54) to generate a fault message instead of a notice message.

Function description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE 20 mA. In the SYMMETRY measuring mode, (see Page 45), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number, with sign **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). Note! ■ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ■ The value for 0 or 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** fixed-point number 0.01...100.00 s **Factory setting:** 3.00 s
FAILSAFE MODE	For safety reasons it is advisable to ensure that the current output assumes a predefined state in the event of a fault. The setting you select here affects only the current output. The failsafe mode of other outputs and the totalizers is defined in the corresponding function groups. **Options:** MIN. CURRENT The current output adopts the value of the lower signal on alarm level (as defined in the function CURRENT SPAN). MAX. CURRENT The current output adopts the value of the upper signal on alarm level (as defined in the function CURRENT SPAN). HOLD VALUE (**not recommended**) Measuring value output is based on the last measuring value saved before the error occurred . ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored . **Factory setting:** MIN. CURRENT
ACTUAL CURRENT	Use this function to view the computed actual value of the output current. **User interface:** 0.00...25.00 mA

Function description CURRENT OUTPUT	
SIMULATION CURRENT	Use this function to activate simulation of the current output. **Options:** OFF ON **Factory setting:** OFF Note! ■ The "SIMULATION CURRENT OUTPUT" notice message indicates that simulation is active. ■ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION CURRENT	Note! This function is not available unless the function SIMULATION CURRENT is active (= ON). Use this function to define a selectable value (e.g. 12 mA) to be output at the current output. This value is used to test downstream devices and the measuring device itself. **User input:** Floating-point number: 0.00...25.00 mA **Factory setting:** 0.00 mA Caution! The setting is not saved if the power supply fails.

10 Group PULSE/FREQUENCY OUTPUT

Function description PULSE/FREQUENCY OUTPUT	
This group is not available unless the measuring device is equipped with a pulse/frequency output.	
OPERATION MODE	Use this function to configure the output as a pulse output or frequency output. The functions available in this function group vary, depending on which option you select here. **Options:** PULSE FREQUENCY **Factory setting:** PULSE
ASSIGN FREQUENCY	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to assign a measured variable to the frequency output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW Note! If you select OFF, the only functions shown in this function group are the functions ASSIGN FREQUENCY and OPERATION MODE.
END VALUE FREQ.	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to define a full scale frequency for the frequency output. You define the associated measured value of the measuring range in the function VALUE-f HIGH on Page 24. **User input:** 4-digit fixed-point number 2...1250 Hz **Factory setting:** 1000 Hz Example: ▪ VALUE-f HIGH = 1000 l/h, end frequency = 1000 Hz: i.e. at a flow of 1000 l/h, a frequency of 1000 Hz is output. ▪ VALUE-f HIGH = 3600 l/h, end frequency = 1000 Hz: i.e. at a flow of 3600 l/h, a frequency of 1000 Hz is output. Note! ▪ In the FREQUENCY operating mode the output signal is symmetrical (on/off ratio = 1:1). At low frequencies the pulse duration is limited to a maximum of 2 seconds, i.e. the on/off ratio is no longer symmetrical. ▪ The initial frequency is always 0 Hz. This value is fixed and cannot be edited.

Function description PULSE/FREQUENCY OUTPUT	
VALUE-f HIGH	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to assign a value to the end value frequency. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE-f HIGH. In the SYMMETRY measuring mode, (see Page 45), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal...US-Mgal] corresponds to the factory setting for the final value (see Page 58 ff.)  A0001279 ① = *Value-f min.* ② = *Value-f high* Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ The value-f min. for the initial frequency always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL

Note!
Function is not available unless the FREQUENCY setting was selected in the OPERATION MODE function.

For selecting the output configuration of the frequency output.

Options:
PASSIVE - POSITIVE
PASSIVE - NEGATIVE

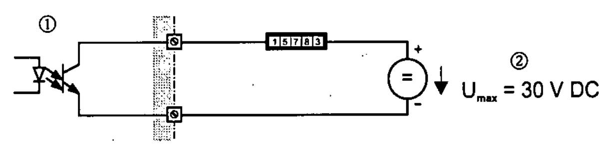
Factory setting: PASSIVE - POSITIVE

Explanation
- PASSIVE = power is supplied to the frequency output by means of an external power supply.

Configuring the output signal level (POSITIVE or NEGATIVE) determines the quiescent behaviour (at zero flow) of the frequency output.
The internal transistor is activated as follows:
- If POSITIVE is selected, the internal transistor is activated with a **positive** signal level.
- If NEGATIVE is selected, the internal transistor is activated with a **negative** signal level (0 V).

Note!
With the passive output configuration, the output signal levels of the frequency output depend on the external circuit (see examples).

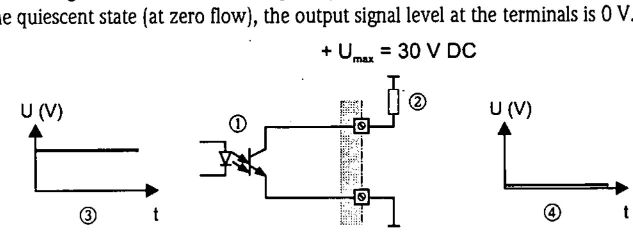
Example for passive output circuit (PASSIVE)
If PASSIVE is selected, the frequency output is configured as an open collector.



① = *Open collector*
② = *External power supply*

Note!
For continuous currents up to 25 mA (I_{max} = 250 mA / 20 ms).

Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is 0 V.



① = *Open collector*
② = *Pull-up resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

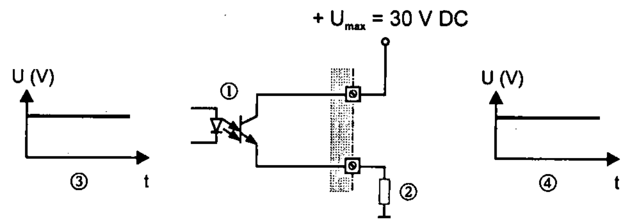
In the operating status (flow present), the output signal level changes from 0 V to a positive voltage level.

(continued on next page)

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL
(continued)

Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-down resistance.
In the quiescent state (at zero flow), a positive voltage level is measured via the pull-down resistance.



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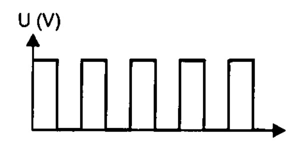
① = *Open collector*
② = *Pull-down resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



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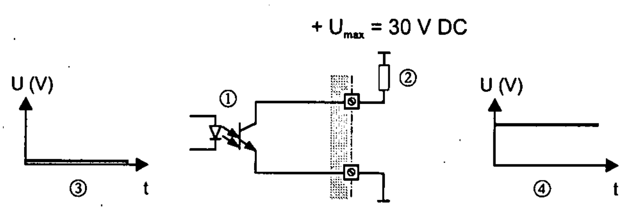
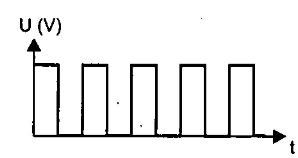
Example for output configuration PASSIVE-NEGATIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is at a positive voltage level.



F06-xxxxxxxx-04-xx-xx-002

① = *Open collector*
② = *Pull-up resistance*
③ = *Transistor activation in "NEGATIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

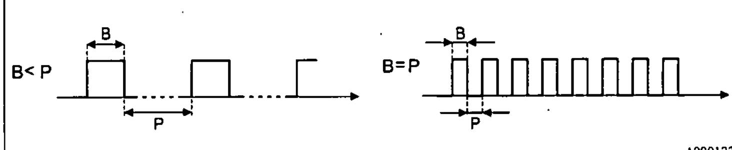
In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



A0001972

Function description PULSE/FREQUENCY OUTPUT	
TIME CONSTANT	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to enter a time constant defining how the frequency output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** Floating-point number 0.00...100.00 s **Factory setting:** 0.00 s
FAILSAFE MODE	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. For safety reasons it is advisable to ensure that the frequency output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the frequency output. It has no effect on other outputs and the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 Hz. FAILSAFE LEVEL Output is the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Measuring value output is based on the last measuring value saved before the error occurred. ACTUAL VALUE Measuring value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
FAILSAFE VALUE	Note! This function is not available unless FREQUENCY was selected in the OPERATION MODE function and FAILSAFE LEVEL was selected in the function FAILSAFE MODE. Use this function to define the frequency that the measuring device should output in the event of a fault. **User input:** max. 4-digit number: 0...1250 Hz **Factory setting:** 1250 Hz
ACTUAL FREQUENCY	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to view the computed value of the output frequency. **User interface:** 0...1250 Hz

Function description PULSE/FREQUENCY OUTPUT	
SIMULATION FREQUENCY	Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to activate simulation of the frequency output. **Options:** OFF ON **Factory setting:** OFF Note! ▪ The "SIMULATION FREQUENCY OUTPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION FREQUENCY	Note! This function is not available unless FREQUENCY was selected in the OPERATION MODE function and the function VALUE SIMULATION FREQUENCY is active (= ON). Use this function to define a selectable frequency value (e.g. 500 Hz) to be output at the frequency output. This value is used to test downstream devices and the measuring device itself. **User input:** 0...1250 Hz **Factory setting:** 0 Hz Caution! The setting is not saved if the power supply fails.
ASSIGN PULSE	Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to assign a measured variable to the pulse output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW Note! If you select OFF, the only functions shown in this function group are the functions ASSIGN PULSE and OPERATION MODE.

Function description PULSE/FREQUENCY OUTPUT	
PULSE VALUE	Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totalled by an external totalizer and in this way the total flow since measuring commenced can be registered. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). Note! The appropriate unit is taken from the group SYSTEM UNITS (see Page 8).
PULSE WIDTH	Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input:** 0.5...2000 ms **Factory setting:** 100 ms Pulse output is **always** with the pulse width (B) entered in this function. The intervals (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P).  B = Pulse width entered (the illustration applies to positive pulses) P= Intervals between the individual pulses Note! When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). Caution! If the pulse number or frequency resulting from the pulse value entered, (see function PULSE VALUE on Page 27), and from the current flowis too large to maintain the pulse width selected (interval P is smaller than the pulse width B entered), a system error message (pulse memory) is generated after buffering/balancing time.

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL

Note!
Function is not available unless the PULSE setting was selected in the OPERATION MODE function.

For selecting the output configuration of the pulse output.

Options:
PASSIVE - POSITIVE
PASSIVE - NEGATIVE

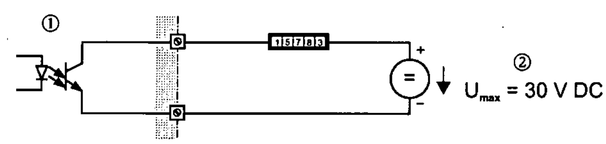
Factory setting: PASSIVE - POSITIVE

Explanation
- PASSIVE = power is supplied to the pulse output by means of an external power supply.

Configuring the output signal level (POSITIVE or NEGATIVE) determines the quiescent behaviour (at zero flow) of the pulse output.
The internal transistor is activated as follows:
- If POSITIVE is selected, the internal transistor is activated with a **positive** signal level.
- If NEGATIVE is selected, the internal transistor is activated with a **negative** signal level (0 V).

Note!
With the passive output configuration, the output signal levels of the pulse output depend on the external circuit (see examples).

Example for passive output circuit (PASSIVE)
If PASSIVE is selected, the pulse output is configured as an open collector.

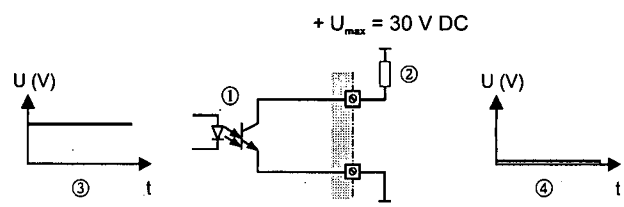


A0001225

① = *Open Collector*
② = *External power supply*

Note!
For continuous currents up to 25 mA (I_{max} = 250 mA / 20 ms).

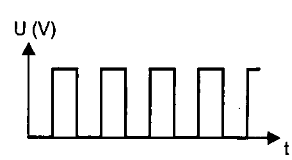
Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is 0 V.



F06-xxxxxxxx-04-xx-xx-xx-000

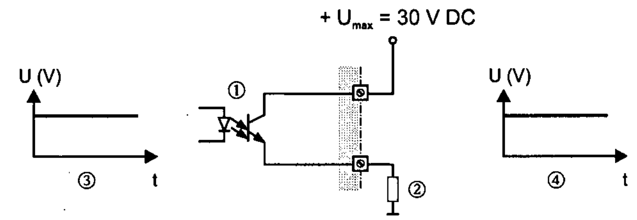
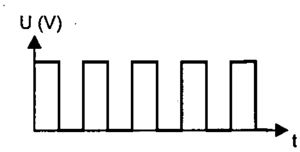
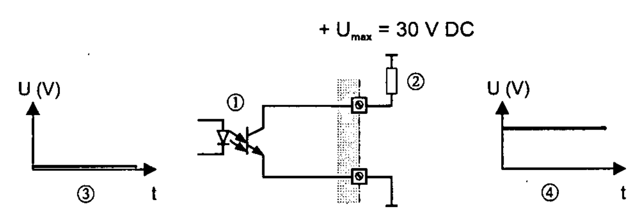
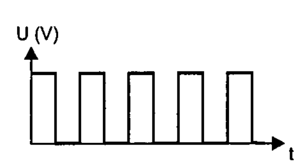
① = *Open Collector*
② = *Pull-Up-Resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from 0 V to a positive voltage level.



A0001967

(continued on next page)

Function description PULSE/FREQUENCY OUTPUT	
OUTPUT SIGNAL (continued)	**Example for output configuration PASSIVE-POSITIVE:** Output configuration with an external pull-down resistance. In the quiescent state (at zero flow), a positive voltage level is measured via the pull-down resistance.  F06-xxxxxxxx-04-xx-xx-xx-001 ① = *Open Collector* ② = *Pull-Down-Resistance* ③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)* ④ = *Output signal level in quiescent state (at zero flow)* In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.  A0001972 **Example for output configuration PASSIVE-NEGATIVE:** Output configuration with an external pull-up resistance. In the quiescent state (at zero flow), the output signal level at the terminals is at a positive voltage level.  F06-xxxxxxxx-04-xx-xx-xx-002 ① = *Open Collector* ② = *Pull-Up-Resistance* ③ = *Transistor activation in "NEGATIVE" quiescent state (at zero flow)* ④ = *Output signal level in quiescent state (at zero flow)* In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.  A0001972

Function description PULSE/FREQUENCY OUTPUT	
FAILSAFE MODE	Note! This function is not available unless the PULSE setting was selected in the function OPERATION MODE. For safety reasons it is advisable to ensure that the pulse output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the pulse output. It has no effect on other outputs and the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 pulse. ACTUAL VALUE Measuring value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
SIMULATION PULSE	Note! This function is not available unless the PULSE option was selected in the OPERATION MODE function. Use this function to activate simulation of the pulse output. **Options:** OFF COUNTDOWN The pulses specified in the VALUE SIMULATION PULSE function are output. CONTINUOUSLY Pulses are continuously output with the pulse width specified in the PULSE WIDTH function. Simulation is started once the CONTINUOUSLY option is confirmed with the E key. Note! Simulation is started by confirming the CONTINUOUSLY option with the E key. The simulation can be switched off again via the SIMULATION PULSE function. **Factory setting:** OFF Note! ■ The notice message #631 "SIM. PULSE" indicates that simulation is active. ■ The on/off ratio is 1:1 for both types of simulation. ■ The measuring device continues to measure while simulation is in progress, i.e. the current measured values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.

Function description PULSE/FREQUENCY OUTPUT	
VALUE SIMULATION PULSE	Note! This function is not available unless the COUNTDOWN option was selected in the SIMULATION PULSE function. Use this function to specify the number of pulses (e.g. 50) which are output during the simulation. This value is used to test downstream devices and the measuring device itself. The pulses are output with the pulse width specified in the PULSE WIDTH function. The on/off ratio is 1:1. Simulation is started once the specified value is confirmed with the E key. The display remains at "0" if the specified pulses have been output. **User input:** 0...10000 **Factory setting:** 0 Note! Simulation is started by confirming the simulation value with the E key. The simulation can be switched off again via the SIMULATION PULSE function. Caution! The setting is not saved if the power supply fails.

11 Group STATUS OUTPUT

Function description STATUS OUTPUT	
This group is not available unless the measuring device is equipped with a status output.	
ASSIGN STATUS OUTPUT	Use this function to assign a switching function to the status output. **Options:** OFF ON (operation) FAULT MESSAGE NOTICE MESSAGE FAULT MESSAGE or NOTICE MESSAGE EPD or OED (Empty Pipe Detection / Open Electrode Detection, only if active) FLOW DIRECTION VOLUME FLOW LIMIT VALUE **Factory setting:** FAULT MESSAGE Note! ▪ The behaviour of the status output is a normally closed behaviour, in other words the output is closed (transistor conductive) when normal, error-free measuring is in progress. ▪ It is very important to read and comply with the information on the switching characteristics of the status output, (see Page 34). ▪ If you select OFF, the only function shown in this function group is the function ASSIGN STATUS OUTPUT.
ON-VALUE	Note! This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the function ASSIGN STATUS OUTPUT. Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permissible. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.

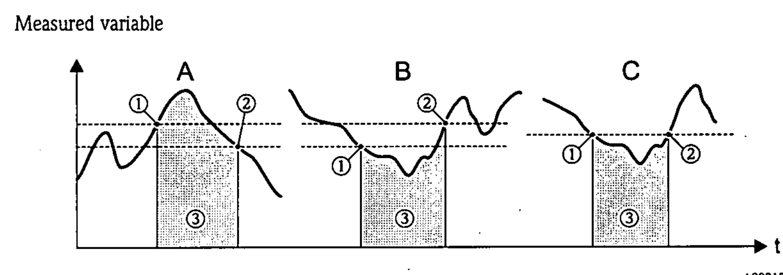
Function description STATUS OUTPUT	
OFF-VALUE	Note! This function is not available unless LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. Use this function to assign a value to the switch-off point (status output drops out). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permissible. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ If SYMMETRY is selected in the function MEASURING MODE (Page 45) and values with different signs are entered for the switch-on and switch-off points, the notice message "INPUT RANGE EXCEEDED" appears.
TIME CONSTANT	Use this function to enter a time constant defining how the measuring signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). The purpose of damping, therefore, is to prevent the status output changing state continuously in response to fluctuations in flow. **User input:** fixed-point number 0.00...100.00 s **Factory setting:** 0.00 s
ACTUAL STATUS OUTPUT	Use this function to check the current status of the status output. **User interface:** NOT CONDUCTIVE CONDUCTIVE
SIMULATION SWITCH POINT	Use this function to activate simulation of the status output. **Options:** OFF ON **Factory setting:** OFF Note! ▪ The "SIMULATION STATUS OUTPUT" message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.

Function description STATUS OUTPUT	
VALUE SIMULATION SWITCH POINT	Note! This function is not available unless the function SIMULATION SWITCH POINT is active (= ON). Use this function to define the switching response of the status output during the simulation. This value is used to test downstream devices and the measuring device itself. **Options:** NOT CONDUCTIVE CONDUCTIVE **Factory setting:** NOT CONDUCTIVE Caution! The setting is not saved if the power supply fails.

11.1 Information on the response of the status output

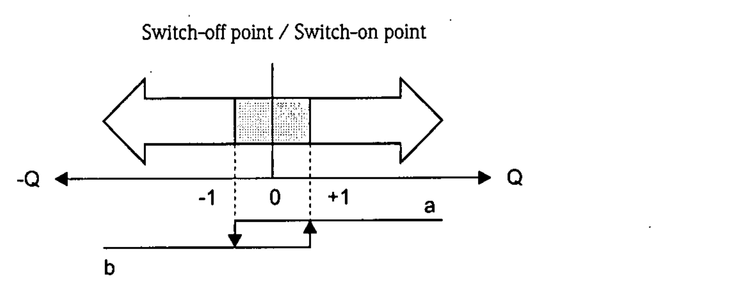
General
If you have configured the status output for "LIMIT VALUE" or "FLOW DIRECTION", you can configure the requisite switch points in the functions ON-VALUE and OFF-VALUE. When the measured variable in question reaches these predefined values, the status output switches as shown in the illustrations below.

Status output configured for limit value
The status output switches as soon as the measured variable undershoots or overshoots a defined switch point. Application: Monitoring flow or process-related boundary conditions.



A = Maximum safety → ① SWITCH-OFF POINT > ② SWITCH-ON POINT
B = Maximum safety → ① SWITCH-OFF POINT < ② SWITCH-ON POINT
C = Maximum safety → ① SWITCH-OFF POINT = ② SWITCH-ON POINT (this configuration is to avoid)
③ = Status output switched off (not conductive)

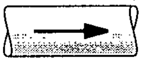
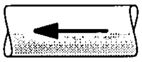
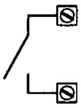
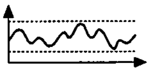
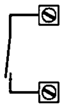
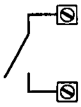
Status output configured for flow direction
The value entered in the function SWITCH-ON POINT defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m^3/h, the status output switches off at -1 m^3/h (not conductive) and switches on again at $+1$ m^3/h (conductive).
Set the switch point to 0 if your process calls for direct switchover (no switching hysteresis). If low flow cut off is used, it is advisable to set hysteresis to a value greater than or equal to the low flow cut off rate.



a = Status output conductive
b = Status output not conductive

11.2 Switching response of the status output

Function	Status		Open collector response (transistor)	
ON (operation)	System in measuring mode	XXX.XXX.XX Esc - + E A0001052	conductive	A0001237
	System not in measuring mode (power supply failed)	XXX.XXX.XX A0001291	not conductive	A0001238
Fault message	System OK	XXX.XXX.XX Esc - + E A0001052	conductive	A0001237
	(System or process error) Fault → Error response of outputs/inputs and totalizer	XXX.XXX.XX A0001291	not conductive	A0001238
Notice message	System OK	XXX.XXX.XX Esc - + E A0001052	conductive	A0001237
	(System or process error) Fault → Continuation of measuring	XXX.XXX.XX A0001291	not conductive	A0001238
Fault message or notice message	System OK	XXX.XXX.XX Esc - + E A0001052	conductive	A0001237
	(System or process error) Fault → Response to error or Note → Continuation of measuring	XXX.XXX.XX A0001291	not conductive	A0001238
Empty pipe detection (EPD) / Open electrode detection (OED)	Measuring tube full	A0001292	conductive	A0001237
	Measuring tube partially filled / empty measuring tube	A0001293	not conductive	A0001238

Function	Status		Open collector response (transistor)	
Flow direction	Forward	 A0001241	conduc-tive	 A0001237
	Reverse	 A0001242	not conduc-tive	 A0001238
Limit value Volume flow	Limit value not overshot or undershot	 A0001243	conduc-tive	 A0001237
	Limit value overshot or undershot	 A0001244	not conduc-tive	 A0001238

12 Group STATUS INPUT

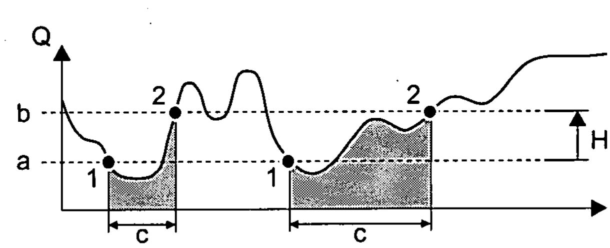
Function description STATUS INPUT	
This group is not available unless the measuring device is equipped with a status input.	
ASSIGN STATUS INPUT	Use this function to assign a switching function to the status input. **Options:** OFF RESET TOTALIZER 1 POSITIVE ZERO RETURN RESET TOTALIZER 2 RESET ALL TOTALIZERS **Factory setting:** OFF Note! Positive zero return is active as long as the active level is available at the status input (continuous signal). All other assignments react to a change in level (pulse) at the status input.
ACTIVE LEVEL	Use this function to define whether the assigned switch function, (see function ASSIGN STATUS INPUT) is released or sustained when the level is present (HIGH) or not present (LOW). **Options:** HIGH LOW **Factory setting:** HIGH
MINIMUM PULSE WIDTH	Use this function to define a minimum pulse width which the input pulse must achieve in order to trigger the selected switching function. **User input:** 20...100 ms **Factory setting:** 50 ms
SIMULATION STATUS INPUT	Use this function to activate simulation of the status input, i.e. to trigger the function assigned to the status input, (see function ASSIGN STATUS INPUT on Page 31). **Options:** OFF ON **Factory setting:** OFF Note! ▪ The "SIMULATION STATUS INPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the outputs. Caution! The setting is not saved if the power supply fails.

Function description STATUS INPUT	
VALUE SIMULATION STATUS INPUT	Note! This function is not available unless the function SIMULATION STATUS INPUT is active (= ON). Use this function to select the level to be simulated at the status input. **Options:** HIGH LOW **Factory setting:** LOW Caution! The setting is not saved if the power supply fails.

13 Group COMMUNICATION

Function description COMMUNICATION	
TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name at the local display or via the HART protocol. **User input:** max. 8-character text, permitted characters are: A–Z, 0–9, +, –, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. **User input:** max. 16-character text, permitted characters are: A–Z, 0–9, +, –, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (No text)
BUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input:** 0...15 **Factory setting:** 0 Note! Addresses 1...15: a constant 4 mA current is applied.
HART PROTOCOL	Use this function to display if the HART protocol is active. **User interface:** OFF = HART protocol not active ON = HART protocol active Note! The HART protocol is activated by selecting 4–20 mA HART or 4–20 mA (25 mA) HART in the function CURRENT SPAN (see Page 20).
MANUFACTURER ID	Use this function to view the manufacturer. **User interface:** – Endress+Hauser – 17 (≅ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. **User interface:** 41 (≅ 65 dez) for Promag 50
DEVICE REVISION	Use this function to view the device-specific revision of the HART command interface. **User interface:** E.g.: 5

14 Group PROCESS PARAMETER

Function description PROCESS PARAMETER	
ASSIGN LOW FLOW CUT OFF	Use this function to assign the switch point for low flow cut off. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW
ON-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). Note! The appropriate unit is taken from the group SYSTEM UNITS (see Page 8).
OFF-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-off point for low flow cut off. Enter the switch-off point as a positive hysteresis value from the switch-on point. **User input:** Integer 0...100% **Factory setting:** 50% Example:  A0001245 Q = Flow [volume/time] t = Time a = ON-VALUE LOW FLOW CUT OFF = 200 dm^3/h b = OFF-VALUE LOW FLOW CUT OFF = 10% c = Low flow cut off active 1 = Low flow cut off is switched on at 200 dm^3/h 2 = Low flow cut off is switched off at 220 dm^3/h H = Hysteresis

Function description PROCESS PARAMETER	
EMPTY PIPE DETECTION (EPD)	Flow cannot be measured correctly unless the measuring tube is full. This status can be monitored at all times with the Empty Pipe Detection function. Use this function to activate Empty Pipe Detection (EPD) or Open Electrode Detection (OED). ▪ EPD = Empty Pipe Detection (with the help of an EPD electrode) ▪ OED = Open Electrode Detection (empty pipe detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD). **Options:** OFF – ON SPECIAL – OED – ON STANDARD OFF (neither EPD nor OED are active) ON SPECIAL: Switching on the Empty Pipe Detection (EPD) for devices in remote version (transmitter and sensor are installed separately). OED: Switching on the Open Electrode Detection (OED). ON STANDARD: Switching on the Empty Pipe Detection (EPD) for: – Devices in compact version (transmitter and sensor form a single mechanical unit). – Applications where a facing and coating of the fluid on the measuring tube line and measuring electrode accrues. **Factory setting:** OFF Note! ▪ The options ON STANDARD and ON SPECIAL are not available unless the sensor is equipped with an EPD electrode. ▪ The default setting for the EPD/OED functions when the device is delivered is OFF. The functions must be activated as required. ▪ The devices are calibrated at the factory with water (approx. 500 μS/cm). If the conductivity of certain fluids deviates from this reference, empty pipe/full pipe adjustment must be performed again on site (see function EPD/OED ADJUSTMENT on page 46). ▪ The adjustment coefficients must be valid before you can switch on the EPD or OED. If these coefficients are not available, the function EPD/OED ADJUSTMENT is displayed (see Page 44). ▪ If there are problems with the adjustment, the following error messages appear on the screen: – ADJUSTMENT FULL = EMPTY: The adjustment values for empty pipe and full pipe are identical. In such instances, empty pipe adjustment/full pipe adjustment **must** be carried out **again**. – ADJUSTMENT NOT OK: Adjustment is not possible as the fluid conductivity values are outside the permitted range. (continued on next page)

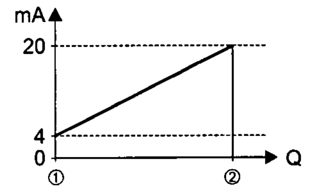
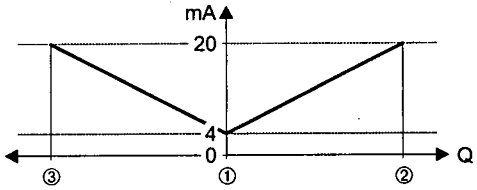
Function description PROCESS PARAMETER	
EMPTY PIPE DETECTION (EPD) (continued)	**Notes on empty pipe detection (EPD and OED)** ▪ Flow cannot be measured correctly unless the measuring pipe is completely full. This status can be monitored at all times by means of the EPD/OED. ▪ An empty or partially filled pipe is a process error. A default factory setting defines that a notice message is issued and that this process error has no effect on the outputs. ▪ The EPD/OED process error can be output via the configurable status output. ▪ Use the function ASSIGN PROCESS ERROR to define whether a notice or fault message should be triggered (see Page 54). ▪ A plausibility check of the adjustment values will only be executed by activating the empty pipe detection. If an empty or full pipe adjustment is performed during the empty pipe detection is active, the empty pipe detection has to be de- and again activated, after finishing the adjustment, to start the plausibility check. **Response to partially filled pipes** If the EPD/OED is switched on and responds to a partially filled or empty pipe, the notice message "EMPTY PIPE" appears on the display. If the pipe is partially empty and the EPD/OED is **not** switched on, the response can vary in identically configured systems: ▪ Flow reading fluctuates ▪ Zero flow ▪ Excessively high flow values **Notes on Open Electrode Detection (OED)** Open Electrode Detection (OED) functions like the Empty Pipe Detection (EPD). In contrast to the EPD where the measuring device must be equipped with a separate (optional) electrode, the OED detects partial filling by means of the two measuring electrodes which are present as standard (fluid no longer covers the measuring electrodes). Open electrode detection can also be used if: ▪ the sensor is not installed in the optimal position for using EPD (optimal = installed horizontally). ▪ the sensor is not equipped with an additional (optional) EPD electrode. Note! ▪ Cable connection length: When mounting a remote version, please observe the maximum permissible cable length of 15 metres in order to keep the OED function. ▪ OED empty pipe adjustment: To achieve the best results for the open electrode detection, it is important to have the electrodes surface as dry as possible (no liquid film) while the empty-pipe adjustment is being made. Even during normal operation, the OED function is only secured if there is no longer any liquid film present on the electrodes when the measuring pipe is empty.

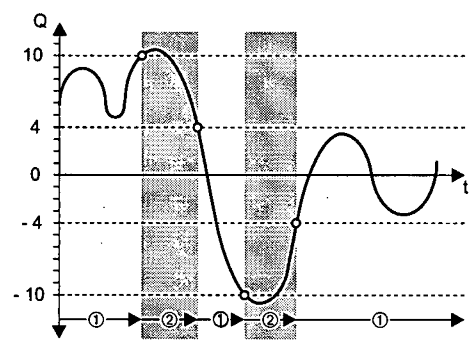
Function description PROCESS PARAMETER	
EPD/OED ADJUSTMENT	Use this function to activate the EPD/OED adjustment for an empty or full measuring tube. Note! A detailed description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found on Page 44. **Options:** OFF FULL PIPE ADJUST EMPTY PIPE ADJUST OED FULL ADJUST OED EMPTY ADJUST **Factory setting:** OFF **Procedure for EPD or OED empty-pipe / full-pipe adjustment** 1. Empty the piping. In case of an EPD adjustment, the wall of the measuring tube should be wetted with fluid for the adjustment procedure but this is not the case with an OED adjustment! 2. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm. 3. After empty-pipe adjustment, fill the piping with fluid. 4. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm. 5. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E. 6. Now select the "EMPTY PIPE DETECTION" function. Switch on Empty Pipe Detection by selecting the following settings: – EPD → Select ON STANDARD or ON SPECIAL and press E to confirm. – OED → Select OED and confirm with E. Caution! The adjustment coefficients must be valid before you can activate the EPD/OED function. If adjustment is incorrect the following messages might appear on the display: – FULL = EMPTY The adjustment values for empty pipe and full pipe are identical. In cases of this nature you **must** repeat empty-pipe or full-pipe adjustment **again**! – ADJUSTMENT NOT OK Adjustment is not possible because the fluid's conductivity is out of range.

Function description PROCESS PARAMETER	
EPD/OED RESPONSE TIME	Note! This function is not available unless ON STANDARD, ON SPECIAL or OED was selected in the EMPTY PIPE DETECTION function. Use this function to enter the time span for which the criteria for an "empty" pipe have to be satisfied without interruption before a notice message or fault message is generated. The setting defined here is used by the active empty pipe detection (EPD) or open electrode detection (OED). **User input:** fixed-point number 1.0...100 s **Factory setting:** 1.0 s Note! OED detection time: The recognition of open electrodes is, in contrast to the empty pipe detection (EPD), very slow reacting (delay at least 25 seconds) and is only activated after an aditional delay from the programmed response time! We recommend in most applications to use the empty pipe detection (EPD) which is an optimal solution for detecting partly filled measuring tubes.
ECC	Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to activate cyclical electrode cleaning. **Options:** OFF ON **Factory setting:** ON (only if the optional electrode cleaning function ECC is available) **Notes on electrode cleaning (ECC)** Conductive deposits on the electrodes and on the walls of the measuring tube (e.g. magnetite) can falsify measurement values. The Electrode Cleaning Circuitry (ECC) was developed to prevent such conductive deposits accreting in the vicinity of the electrodes. ECC functions as described above for all available electrode materials except tantalum. If tantalum is used as the electrode material, the ECC protects the electrode surface only against oxidation. Caution! If the ECC is switched off for a prolonged period in applications with conductive deposits, a layer forms inside the measuring tube and this can falsify measurement values. If the layer is allowed to accrete beyond a certain level, it might no longer be possible to remove it by switching on the ECC. If this happens the measuring tube must be cleaned and the layer removed.
ECC DURATION	Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the electrode cleaning duration. **User input:** fixed-point number 0.01...30.0 s **Factory setting:** 2.0 s

Function description PROCESS PARAMETER	
ECC RECOVERY TIME	Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the recovery time for which the last flow value measured prior to cleaning is retained. A recovery time is necessary as the signal outputs can fluctuate after electrode cleaning on account of electrochemical interference voltages. **User input:** max. 3-digit number: 1... 600 s **Factory setting:** 5 s Caution! The last value measured prior to cleaning is output for the duration of the recovery time (max. 600 s). This in turn means that the measuring system does not register changes in flow, e.g. stoppage, during this time span.
ECC CLEANING CYCLE	Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the cleaning cycle for electrode cleaning. **User input:** Integer: 30...10080 min **Factory setting:** 40 min

15 Group SYSTEM PARAMETERS

Function description SYSTEM PARAMETERS	
INSTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. **Options:** NORMAL (flow as indicated by the arrow) INVERSE (flow opposite to direction indicated by the arrow) **Factory setting:** NORMAL Note! Ascertain the actual direction of fluid flow with reference to the direction indicated by the arrow on the sensor (nameplate).
MEASURING MODE	Use this function to select the measuring mode for all outputs. **Options:** STANDARD SYMMETRY **Factory setting:** STANDARD The responses of the individual outputs in each of the measuring modes are described in detail on the following pages: **Current output and frequency output** STANDARD Only the flow components for the selected flow direction are totalled, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output:  A0001248 SYMMETRY The output signals of the current and frequency outputs are independent of the direction of flow (absolute amount of the measured variable). The "VALUE 20 mA" or "VALUE-f HIGH" ③ (e.g. backflow) corresponds to the mirrored VALUE 20 mA or VALUE-f HIGH ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output:  A0001249 Note! The direction of flow can be output via the configurable status output. (continued on next page)

Function description SYSTEM PARAMETERS	
MEASURING MODE (continued)	**Pulse output** STANDARD Only positive flow components are totalled. Negative components are not taken into account. SYMMETRY Positive and negative flow components are taken into account. Note! The direction of flow can be output via the configurable status output. **Status output** Note! The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. STANDARD The status output signal switches at the defined switch points. SYMMETRY The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration). Example for the SYMMETRY measuring mode: Switch-on point: Q = 4 Switch-off point: Q = 10 ① = Status output switched on (conductive) ② = Status output switched off (not conductive)  A0001247
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. **Options:** OFF ON → Signal output is set to the "ZERO FLOW" value. **Factory setting:** OFF

Function description SYSTEM PARAMETERS	
SYSTEM DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. high solids content, gas bubbles in the fluid, etc.). The system reaction time decreases with an increasing filter setting. **User input:** 0...15 **Factory setting:** 9 Note! The system damping acts on all functions and outputs of the measuring device.
INTEGRATION TIME	Use this function to set the integration time. Under normal circumstances it is not necessary to change the factory settings. **User input:** 3.3...65 ms **Factory setting:** 20 ms at 50 Hz → mains frequency (e.g. Europe) 16.7 ms at 60 Hz → mains frequency (e.g. USA) Caution! The integration time must not be selected with a greater value than the measuring period (see Page 53). Note! The integration time defines the duration of internal totaling of the induced voltage in the fluid (measured by the measuring electrode), i.e. the time in which the measuring device records the true flow (afterwards the magnetic field for the next integration is created from the opposite pole).

16 Group SENSOR DATA

Function description SENSOR DATA	
All sensor data (calibration factors, zero point and nominal diameter etc.) are set at the factory and saved on the S-DAT sensor memory chip. Caution! Under normal circumstances you should not change the following parameter settings, because changes affect numerous functions of the entire measuring facility in general and the accuracy of the measuring system in particular. For this reason, the functions described below cannot be changed even when you enter your personal code. Contact the Endress+Hauser service organization if you have any questions about these functions.	
K-FACTOR POSITIVE	Use this function to display the current calibration factor (positive flow direction) for the sensor. The calibration factor is determined and set at the factory. **User interface:** 5-digit fixed-point number: 0.5000...2.0000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
K-FACTOR NEGATIVE	Use this function to display the current calibration factor (negative flow direction) for the sensor. The calibration factor is determined and set at the factory. **User interface:** 5-digit fixed-point number: 0.5000...2.0000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
ZERO POINT	This function shows the current zero-point correction value for the sensor. Zero-point correction is determined and set at the factory. **User interface:** max. 4-digit number: –1000...+1000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
NOMINAL DIAMETER	This function shows the nominal diameter for the sensor. The nominal diameter depends on the size of the sensor and is set at the factory. **User interface:** 2...2000 mm or 1/12...78" **Factory setting:** Depends on the size of the sensor Note! This value is also provided on the sensor nameplate.

Function description SENSOR DATA	
MEASURING PERIOD	Use this function to set the time for a full measuring period. The duration of the measuring period is calculated from the rise time of the magnetic field, the brief recovery time, the integration time (which can be set) and the empty pipe detection time. **User input:** 0.0...1000 ms **Factory setting:** Depends on nominal diameter Note! The system checks the time entered and sets the measuring period which is actually used internally to a plausible value. If you enter 0 ms, the system automatically computes the shortest time.
OVERVOLTAGE TIME	Use this function to specify the time in which overvoltage is applied to the coil circuit in order to build up the magnetic field as fast as possible. The overvoltage time is adjusted automatically while measuring is in progress. The overvoltage time depends on the sensor type and the nominal diameter and is set at the factory. **User interface:** 4-digit floating-point number: 0.0...100.0 ms **Factory setting:** Depends on nominal diameter
EPD ELECTRODE	Use this function to check whether the sensor is equipped with an EPD electrode. **User interface:** YES NO **Factory setting:** YES → Electrode fitted as standard
POLARITY ECC	Use this function to display the actual current polarity for optional electrode cleaning (ECC). Electrode cleaning uses either a positive or negative current, depending on the electrode material. The measuring device automatically selects the correct polarity on the basis of the electrode-material data stored in the S-DAT. **User interface:** POSITIVE → for electrodes made of: 1.4435, Hastelloy C, platinum NEGATIVE → for electrodes made of: tantalum Caution! If the incorrect current is applied to the electrodes, the electrode material is destroyed.

17 Group SUPERVISION

Function description SUPERVISION	
CURRENT SYSTEM CONDITION	Use this function to check the present system status. **User interface:** "SYSTEM OK" or the fault / notice message with the highest priority.
PREVIOUS SYSTEM CONDITIONS	Use this function to view the fifteen most recent fault and notice messages since measuring last started. **User interface:** The last 15 fault/notice messages appear on the display
ASSIGN SYSTEM ERROR	Use this function to view all system errors and the associated error categories (fault message or notice message). By selecting a certain system error, its error category can be changed in the subsequent function ERROR CATEGORY. **Options:** CANCEL List of system errors Note! ■ You can exit this function as follows: select "CANCEL" and confirm with E. ■ A list of possible system errors is provided in the Operating Instructions Promag 50, BA 046D/06/en
ERROR CATEGORY	Note! This function is only available if a system error has been selected in the function ASSIGN SYSTEM ERROR. Use this function to define whether a system error triggers a notice message or a fault message. If you select FAULT MESSAGES, all outputs respond to an error in accordance with their defined error response patterns. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) Note! Press the E key twice to call up the ASSIGN SYSTEM ERROR function.
ASSIGN PROCESS ERROR	Use this function to view all process errors and the associated error categories (fault message or notice message). By selecting an individual process error, its error category can be changed in the subsequent function ERROR CATEGORY. **Options:** CANCEL List of process errors Note! ■ You can exit this function as follows: select "CANCEL" and confirm with E. ■ A list of possible process errors is provided in the Operating Instructions Promag 50, BA 046D/06/en

Function description SUPERVISION	
ERROR CATEGORY	Note! This function is only available if a process error has been selected in the function ASSIGN PROCESS ERROR. Use this function to define whether a process error triggers a notice message or a fault message. If you select FAULT MESSAGES, all outputs respond to an error in accordance with their defined error response patterns. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) Note! Press the E key twice to call up the ASSIGN PROCESS ERROR function.
ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on: ▪ Display ▪ Status output ▪ Current output ▪ Frequency output **User input:** 0...100 s (in steps of one second) **Factory setting:** 0 s Caution! If this function is activated error and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-order controller (process controller, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. **Options:** NO RESTART SYSTEM (restart without interrupting power supply) **Factory setting:** NO
OPERATION HOURS	The hours of operation of the device appear on the display. **Display:** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10...10,000 hours → display format = 0000:00 (hr:min) Hours of operation > 10,000 hours → display format = 000000 (hr)

18 Group SIMULATION SYSTEM

Function description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all inputs, outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. **Options:** ON OFF **Factory setting:** OFF
SIMULATION MEASURED VARIABLE	Use this function to set all inputs, outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words "SIMULATION MEASURAND" appear on the display. **Options:** OFF VOLUME FLOW **Factory setting:** OFF Caution! ▪ The measuring device cannot be used for measuring while this simulation is in progress. ▪ The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURED VARIABLE	Note! This function is not available unless the SIMULATION MEASURED VARIABLE function is active (= VOLUME FLOW). Use this function to specify a selectable value (e.g. 12 m^3/s). This value is used to test downstream devices and the measuring device itself. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] Caution! The setting is not saved if the power supply fails. Note! The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8)

19 Group SENSOR VERSION

Function description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the sensor.
SENSOR TYPE	Use this function to view the sensor type.
HARDWARE REVISION NUMBER SENSOR	Use this function to view the hardware revision number of the sensor.
SOFTWARE REVISION NUMBER S-DAT	Use this function to view the software revision number of the software used to create the content of the S-DAT

20 Group AMPLIFIER VERSION

Function description AMPLIFIER VERSION	
DEVICE SOFTWARE	Displays the current device software version.
SOFTWARE REVISION NUMBER AMPLIFIER	Use this function to view the software revision number of the amplifier.
LANGUAGE GROUP	Use this function to view the language group. The following language groups can be ordered: WEST EU / USA, EAST EU / SCAND., ASIA. **Display:** available language group Note! ▪ The language options of the available language group are displayed in the LANGUAGE function. ▪ You can change the language group via the configuration software ToF Tool - Fieldtool Package. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.
I/O MODULE TYPE	Use this function to view the configuration of the I/O module complete with terminal numbers.
SOFTWARE REVISION NUMBER I/O MODULE	Use this function to view the software revision number of the I/O module.

21 Factory settings

21.1 SI units (not for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Nominal diameter		Low flow cut off (approx. v = 0.04 m/s)		Full scale value (approx. v = 2.5 m/s)		Pulse value (approx. 2 pulses/s at v = 2.5 m/s)		Totalizer
[mm]	[inch]							
2	1/12"	0.01	dm^3/min	0.5	dm^3/min	0.005	dm^3	dm^3
4	5/32"	0.05	dm^3/min	2	dm^3/min	0.025	dm^3	dm^3
8	5/16"	0.1	dm^3/min	8	dm^3/min	0.10	dm^3	dm^3
15	1/2"	0.5	dm^3/min	25	dm^3/min	0.20	dm^3	dm^3
25	1"	1	dm^3/min	75	dm^3/min	0.50	dm^3	dm^3
32	1 1/4"	2	dm^3/min	125	dm^3/min	1.00	dm^3	dm^3
40	1 1/2"	3	dm^3/min	200	dm^3/min	1.50	dm^3	dm^3
50	2"	5	dm^3/min	300	dm^3/min	2.50	dm^3	dm^3
65	2 1/2"	8	dm^3/min	500	dm^3/min	5.00	dm^3	dm^3
80	3"	12	dm^3/min	750	dm^3/min	5.00	dm^3	dm^3
100	4"	20	dm^3/min	1200	dm^3/min	10.00	dm^3	dm^3
125	5"	30	dm^3/min	1850	dm^3/min	15.00	dm^3	dm^3
150	6"	2.5	m^3/h	150	m^3/h	0.025	m^3	m^3
200	8"	5.0	m^3/h	300	m^3/h	0.05	m^3	m^3
250	10"	7.5	m^3/h	500	m^3/h	0.05	m^3	m^3
300	12"	10	m^3/h	750	m^3/h	0.10	m^3	m^3
350	14"	15	m^3/h	1000	m^3/h	0.10	m^3	m^3
400	16"	20	m^3/h	1200	m^3/h	0.15	m^3	m^3
450	18"	25	m^3/h	1500	m^3/h	0.25	m^3	m^3
500	20"	30	m^3/h	2000	m^3/h	0.25	m^3	m^3
600	24"	40	m^3/h	2500	m^3/h	0.30	m^3	m^3
700	28"	50	m^3/h	3500	m^3/h	0.50	m^3	m^3
–	30"	60	m^3/h	4000	m^3/h	0.50	m^3	m^3
800	32"	75	m^3/h	4500	m^3/h	0.75	m^3	m^3
900	36"	100	m^3/h	6000	m^3/h	0.75	m^3	m^3
1000	40"	125	m^3/h	7000	m^3/h	1.00	m^3	m^3
–	42"	125	m^3/h	8000	m^3/h	1.00	m^3	m^3
1200	48"	150	m^3/h	10000	m^3/h	1.50	m^3	m^3
–	54"	200	m^3/h	13000	m^3/h	1.50	m^3	m^3
1400	–	225	m^3/h	14000	m^3/h	2.00	m^3	m^3
–	60"	250	m^3/h	16000	m^3/h	2.00	m^3	m^3
1600	–	300	m^3/h	18000	m^3/h	2.50	m^3	m^3
–	66"	325	m^3/h	20500	m^3/h	2.50	m^3	m^3
1800	72"	350	m^3/h	23000	m^3/h	3.00	m^3	m^3
–	78"	450	m^3/h	28500	m^3/h	3.50	m^3	m^3
2000	–	450	m^3/h	28500	m^3/h	3.50	m^3	m^3

Language

Country	Language
Australia	English
Austria	Deutsch
Belgium	English
Czech Republic	Czech
Denmark	English
England	English
Finland	Suomi
France	Francais
Germany	Deutsch
Hong Kong	English
Hungary	English
India	English
Indonesia	Bahasa Indonesia
Instruments International	English
Italy	Italiano
Japan	Japanese
Malaysia	English
Netherlands	Nederlands
Norway	Norsk
Poland	Polish
Portugal	Portuguese
Russia	Russian
Singapore	English
South Africa	English
Spain	Espanol
Sweden	Svenska
Switzerland	Deutsch
Thailand	English

Length

	Unit
Length	mm

21.2 US units (only for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Nominal diameter		Low flow cut off		Full scale value		Pulse value		Totalizer
[inch]	[mm]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
1/12"	2	0.002	gal/min	0.1	gal/min	0.001	gal	gal
5/32"	4	0.008	gal/min	0.5	gal/min	0.005	gal	gal
5/16"	8	0.025	gal/min	2	gal/min	0.02	gal	gal
1/2"	15	0.10	gal/min	6	gal/min	0.05	gal	gal
1"	25	0.25	gal/min	18	gal/min	0.20	gal	gal
1 1/4"	32	0.50	gal/min	30	gal/min	0.20	gal	gal
1 1/2"	40	0.75	gal/min	50	gal/min	0.50	gal	gal
2"	50	1.25	gal/min	75	gal/min	0.50	gal	gal
2 1/2"	65	2.0	gal/min	130	gal/min	1	gal	gal
3"	80	2.5	gal/min	200	gal/min	2	gal	gal
4"	100	4.0	gal/min	300	gal/min	2	gal	gal
5"	125	7.0	gal/min	450	gal/min	5	gal	gal
6"	150	12	gal/min	600	gal/min	5	gal	gal
8"	200	15	gal/min	1200	gal/min	10	gal	gal
10"	250	30	gal/min	1500	gal/min	15	gal	gal
12"	300	45	gal/min	2400	gal/min	25	gal	gal
14"	350	60	gal/min	3600	gal/min	30	gal	gal
16"	400	60	gal/min	4800	gal/min	50	gal	gal
18"	450	90	gal/min	6000	gal/min	50	gal	gal
20"	500	120	gal/min	7500	gal/min	75	gal	gal
24"	600	180	gal/min	10500	gal/min	100	gal	gal
28"	700	210	gal/min	13500	gal/min	125	gal	gal
30"	–	270	gal/min	16500	gal/min	150	gal	gal
32"	800	300	gal/min	19500	gal/min	200	gal	gal
36"	900	360	gal/min	24000	gal/min	225	gal	gal
40"	1000	480	gal/min	30000	gal/min	250	gal	gal
42"	–	600	gal/min	33000	gal/min	250	gal	gal
48"	1200	600	gal/min	42000	gal/min	400	gal	gal
54"	–	1.3	Mgal/d	75	Mgal/d	0.0005	Mgal	Mgal
–	1400	1.3	Mgal/d	85	Mgal/d	0.0005	Mgal	Mgal
60"	–	1.3	Mgal/d	95	Mgal/d	0.0005	Mgal	Mgal
–	1600	1.7	Mgal/d	110	Mgal/d	0.0008	Mgal	Mgal
66"	–	2.2	Mgal/d	120	Mgal/d	0.0008	Mgal	Mgal
72"	1800	2.6	Mgal/d	140	Mgal/d	0.0008	Mgal	Mgal
78"	–	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal
–	2000	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal

Language, length

	Unit
Language	English
Length	inch

22 Index of key words

Numerics

A

B

C

D

E

F

G

H

I

K

L

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