# QUEENSLAND URBAN UTILITIES 

## SP320 - OLD TOOWOOMBA ROAD <br> WEST IPSWICH <br> SEWAGE PUMPING STATION

## CIVIL AND MECHANICAL OPERATION AND MAINTENANCE MANUAL



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## 1. Electrical Installs

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## 2. Equipment Manuals

## Valveco <br> Heay Duty Knifegate <br> General Purpose Lugged Style Knifegates

## Heavy Duty General Purpose Lugged Style Knifegate Valve

## Features

- Compact design for easy installation and maintenance
- Both 304SS and 316SS valves available
- Available in metal \& resilient seat
- Uni \& bi-directional design
- One piece integral cast body, chest and lugs
- Integral cast in gate wedges minimize flow obstructions
- High flow rates with low pressure drops
- Gate guides to support gate
- Complies with AS6401 \& MSS SP-81 face to face dimensions
- Every valve pressure tested
- Gate machined over full length for optimum sealing
- 50 to 1200 mm sizes available, 50 to 600 mm kept in stock
- 10 bar pressure rating

- Specifically formulated PTFE impregnated packing material for increased service life and lower friction
- Specialised packing for chemical resistant or abrasive applications available on request
- Available with a variety of actuators including handwheel, chain wheel, quick acting lever, geared, electric, air or hydraulic cyliner actuator


## Options

- Bonneted, non-rising stem adapter, deflection cones, positioners, limit switches, solenoids, pneumatic failsafe \& shrouds.


## Applications

The Valveco Heavy Duty General Purpose Knifegate Valve is designed for a wide range of applications such as:

- Waste Water \& Water
- Mining
- Fly Ash Handling Plants
- Bulk Conveying
- Corrosive Environments
- Pulp \& Paper
- Food \& Beverage
- Chemical Plants


Standard Materials

| No. | Part Name | Material Code (ASTM) |
| :--- | :--- | :--- |
| 1 | Body | SS304, 316 or 316L (A351-CF8) |
| 2 | Gate | SS304, 316 or 316L (A351-CF8) |
| 3 | Packing Gland | SS304, 316 or 316L (A351-CF8) |
| 4 | Super Structure | SS304, 316 or 316L (A351-CF8) |
| 5 | Sleeve | Bronze Casting (C83600) |
| 6 | Packing | PTFE Impregnated Braided Fibre |
| 7 | Thrust Bearing | 2"- 12": Thrust Plate (Bronze) <br> 14"- 24": 51112 |
| 8 | Hand Wheel | Cast Iron |
| 9 | Seat Ring | SS304, 316 or 316L (A351-CF8) |
| 10 | Fasteners | SS304, 316 or 316L (A351-CF8) |
| 11 | Clevis | SS304, 316 or 316L (A351-CF8) |
| 12 | Resilient Seat <br> Replaceable Seat | Viton <br> NBR, EPDM, PTFE, Polyamide |

Dimensions

| Class | Size | 2 | 21/2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 50 | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| $\begin{gathered} 10 \mathrm{Bar} \\ \& \\ 150 \mathrm{lb} \end{gathered}$ | L mm | 48 | 51 | 51 | 51 | 57 | 57 | 70 | 70 | 76 | 76 | 89 | 89 | 114 | 114 |
|  | H mm | 350 | 410 | 440 | 520 | 595 | 660 | 880 | 1025 | 1190 | 1355 | 1530 | 1690 | 1880 | 2200 |
|  | PCD mm | 114 | 127 | 146 | 178 | 210 | 235 | 292 | 356 | 406 | 470 | 521 | 584 | 641 | 756 |
|  | W mm | 200 | 200 | 200 | 225 | 250 | 250 | 280 | 350 | 400 | 400 | 450 | 450 | 600 | 600 |
|  | N-H | 4-M16 | 4-M16 | 4-M16 | 4-M16 | 8-M16 | 8-M16 | 8-M16 | 8-M20 | 12-M20 | 12-M24 | 12-M24 | 12-M24 | 16-M24 | 16-M27 |
|  | Weight (kg) | 9.5 | 12 | 13 | 16 | 19 | 22 | 34 | 53 | 65 | 90 | 145 | 180 | 227 | 282 |

*other flange drilling available

## Pneumatic Actuation



Standard Materials

| No. | Part Name | Material Code (ASTM) |
| :--- | :--- | :--- |
| 1 | Body | SS304, 316 or 316L (A351-CF8) |
| 2 | Gate | SS304, 316 or 316L (A351-CF8) |
| 3 | Packing | PTFE Impregnated Braided Fibre |
| 4 | Packing Gland | SS304, 316 or 316L (A351-CF8) |
| 5 | Super Structure | SS304, 316 or 316L (A351-CF8) |
| 6 | Clevis | SS304 |
| 7 | Piston Rod | SS304 |
| 8 | Cylinder | Aluminium or Fibreglass |

Dimensions

| Class | Size | In | 2 | 21/2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | mm | 50 | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| $\begin{gathered} 10 \text { Bar } \\ \& \\ 150 \mathrm{lb} \end{gathered}$ | L mm |  | 48 | 51 | 51 | 51 | 57 | 57 | 70 | 70 | 76 | 76 | 89 | 89 | 114 | 114 |
|  | H mm |  | 500 | 561 | 574 | 675 | 750 | 815 | 966 | 1181 | 1340 | 1448 | 1648 | 1834 | 2020 | 2120 |
|  | PCD mm |  | 114 | 127 | 146 | 178 | 210 | 235 | 292 | 356 | 406 | 470 | 521 | 584 | 641 | 756 |
|  | $\mathrm{N}-\mathrm{H}$ |  | 4-M16 | 4-M16 | 4-M16 | 4-M16 | 8-M16 | 8-M16 | 8-M16 | 8-M20 | 12-M20 | 12-M24 | 12-M24 | 12-M24 | 16-M24 | 16-M27 |
|  | Weight (kg) |  | 11 | 13 | 15 | 21 | 25 | 31 | 58 | 103 | 137 | 158 | 172 | 202 | 256 | 494 |

*other flange drilling available

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# McBerns AutoWellWasher ${ }^{\text {TM }}$ 

(Australian Patent No. 655111)
(International Patent Appl.No.PCT/AU00/00084)

## INSTALLATION INSTRUCTIONS for WALL MOUNT BRACKET

Positioning of the device in the well can be critical to the effectiveness of the wash system. Configuration of wells can differ but, in general the Washer should be positioned in the clearest available space to ensure the rotating arms do not come in contact with guide rails, chains, probes, etc.
The mounting bracket is designed to pivot back against the wall (see Figure 1) so as

not to impede access when a pump needs to be removed.
Having chosen the position, the mounting bracket is secured to the wall by means of four 12 mm stainless steel Dynabolts ${ }^{\mathrm{TM}}$. The bolt holes should be drilled approximately 1 metre above the normal high water line.
If you need to use the bracket extension piece it should now be attached. The extension piece is not needed in all wells depending on diameter and internal configuration. If not used, save it for later installations when multiple extensions may be useful.
Once the bracket is secured, the Washer head is inserted in the semi-circular clamp and the two locknuts tightened.

Now attach the pivot chain to the lug near the Washer head and pass the chain through the "eye" nut which should be installed in the wall approx. 1 metre above the Washer. The chain then attaches to the chain retainer which is fixed to the lip of the well opening.


Now the water supply can be connected to the Washer head. You can use good quality $3 / 4$ " hose (not garden hose), poly, PVC, copper or whatever best suits your requirements. From our experience the hose method is easiest, as it can be simply dropped down the wall and secured out of harms way using electrical ties.

The next step is to set the rotation speed by adjusting the spray buckets. By loosening the bolt which passes through each bucket, the nozzle housing can rotate through 360 degrees (see Figure 2). The nozzles need to be pointing in opposite directions to cause the spray arms to rotate. Speed of rotation is affected by the angle at which the nozzles are set (Figure 3). Best results are obtained with slow rotation, but care must be taken to allow for drops in water pressure at times of peak water usage in the locality. A temporary drop in water pressure can cause the Washer to stop turning if the initial speed is set too low.


FIGURE 2


Fast Rotation


FIGURE 3

Now by twisting the nozzle buckets on the nipples which join them to the spray arms, the nozzles can be directed to wash the desired areas (Figure 4).
Each nozzle gives a wide fan of spray. Usually, one would be directed to cover the well wall from high to low water line. The other can be directed at a sharper angle to

hit the top of the pumps, probe/float switches, guide rails etc.
The last task while in the well is to double check that all nuts have been tightened. Above ground you should have already installed an approved back-flow prevention device to the water supply line. Australian Standard specifies a Reduced Pressure Zone (RPZ) valve, and we recommend a 25 mm model. Between this and the Washer a solenoid valve should be fitted in the water line. This solenoid is wired to the sewage pump control board so as to open when the pump turns on, and close when the pump stops. Thus the Washer operates as the well is being emptied

## THE WELL WASHER KIT CONTAINS:

Rotating Washer Assembly<br>Pivoting Mounting Bracket<br>Installation Instructions<br>$4 \times 12 \mathrm{~mm}$ SS Dynabolts<br>5 metres SS Chain<br>"Eye" nut \& SS Dynabolt

Chain Retainer with 2 SS Dynabolts

## TO INSTALL YOU NEED TO PROCURE:

Back flow prevention device. (Brand is your choice but we recommend 25 mm size.) 24 volt AC Solenoid. (Brand and type is best chosen by your Electrician).
Water conduit and connectors (water inlet for Washer head is 3/4" BSP male).


Please note the dimensions above are a guide only. Slight variations may occur.

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#  

## Operating Instructions

## Proline Promag 50

Electromagnetic flow measuring system

## HARTing



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## 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 $20 \mu \mathrm{~S} / \mathrm{cm}$ is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of $5 \mu \mathrm{~S} / \mathrm{cm}$.

Examples:

- 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

Please note the following:

- 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.
- With regard to special fluids, including fluids used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials.
However, minor changes in temperature, concentration or in the degree of contamination in the process may result in variations in corrosion resistance. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of wetted materials in a specific application.
The user is responsible for the choice of suitable wetted materials in the process.
- 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 apart from when special protective measures are taken (e.g. galvanically isolated SELV or PELV power supply)
- Invariably, local regulations governing the opening and repair of electrical devices apply.


### 1.3 Operational safety

Please note the following:

- 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 Ex documentation indicates the approval and the certification body (e.g. $\left.\varepsilon_{x}\right\rangle$ Europe, $\left\langle{ }^{\circledR m}\right.$ USA, © Clanada).
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR Recommendations NE 21 and NE 43.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.
- 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 these Operating Instructions.


### 1.4 Return

- 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 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use".
The devices can, however, be a source of danger if used incorrectly or for anything 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 flow measuring system consists of the following components:

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

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

### 2.1.1 Nameplate of the transmitter



Fig. 1: $\quad$ 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, power consumption
3 Additional information:
EPD/MSÜ: with Empty Pipe Detection
ECC: with electrode cleaning
4 Outputs available:
I-OUT (HART): with current output (HART)
f-OUT (HART): with frequency output
STATUS-IN: with status input (power supply)
5 Reserved for information on special products
$6 \quad$ Observe device documentation
7 Reserved for additional information on device version (approvals, certificates)
8 Permitted ambient temperature range
9 Degree of protection

### 2.1.2 Nameplate of the sensor



Fig. 2: $\quad$ 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 with zero point
3 Nominal diameter / Pressure rating
4 Fluid temperature range
5 Materials: lining/measuring electrodes
6 Reserved for information on special products
7 Permitted ambient temperature range
8 Observe device documentation
9 Reserved for additional information on device version (approvals, certificates)
10 Calibration tolerance
11 Additional information (examples):

- EPD/MSÜ: with Empty Pipe Detection electrode
- R/B: with reference electrode

12 Degree of protection
13 Flow direction

### 2.1.3 Nameplate, connections



Fig. 3: Nameplate specifications for 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 to $260 \mathrm{VAC}, 20$ to $55 \mathrm{VAC}, 16$ to $62 \mathrm{~V} D \mathrm{C}$ Terminal No. 1: L1 for $A C, L+$ for $D C$
Terminal No. 2: $N$ for $A C, L$ - for $D C$
5 Signals present at inputs and outputs, possible configuration and terminal assignment (20 to 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 Certificates and approvals

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 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use" and with the EMC requirements of IEC/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.

The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA)

### 2.3 Registered trademarks

KALREZ ${ }^{\circledR}$ and VITON ${ }^{\circledR}$
Registered trademarks of E.I. Du Pont de Nemours \& Co., Wilmington, USA
TRI-CLAMP ${ }^{\circledR}$
Registered trademark of Ladish \& Co., Inc., Kenosha, USA
$\mathrm{HART}^{\circledR}$
Registered trademark of the HART Communication Foundation, Austin, USA
HistoROM ${ }^{\text {TM }}$, S-DAT®, Field Xpert ${ }^{\text {TM }}$, FieldCare ${ }^{\circledR}$, Fieldcheck ${ }^{\circledR}$, Applicator ${ }^{\circledR}$
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

## 3 Installation

### 3.1 Incoming acceptance, transport and storage

### 3.1.1 Incoming acceptance

On receipt of the goods, check the following:

- 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 you are ready to install the device. 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 from the factory protect the linings on the flanges during storage and transportation. In case of Promag L they are additionally used to hold the lap joint flanges in place. Do not remove these covers until immediately before the device 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 $D N \leq 300$ ( $\leq 12$ ")

Use webbing slings slung round the two process connections. 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.


Fig. 4: $\quad$ Transporting sensors with $D N \leq 300\left(\leq 12^{\prime \prime}\right)$

Transporting flangeddevices DN > 300 (> 12")
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: $\quad$ Transporting sensors with $D N>300$ ( $>$ 12")

### 3.1.3 Storage

Please note the following:

- 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 $\rightarrow$ 置 101.
- 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.
- 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.


### 3.2 Installation conditions

### 3.2.1 Dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on $\rightarrow$ 目 116 .

### 3.2.2 Mounting location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following locations:

- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.


Fig. 6: Mounting 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 $\rightarrow 105$.

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 $\rightarrow 101$.


Fig. 7: Installation of pumps

## Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration.
The Empty Pipe Detection function (EPD $\rightarrow$ 直 74) 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.


Fig. 8: Installation in a partially filled pipe

## Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes whose length $\mathrm{h} \geq 5 \mathrm{~m}$ ( 16.4 ft ). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube.
This measure also prevents the system losing prime, which could cause air pockets. Information on the lining's resistance to partial vacuum can be found on $\rightarrow$ 目 105.


Fig. 9: Measures for installation in a down pipe
1 Vent valve
2 Pipe siphon
$h \quad$ Length of down pipe

### 3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. However, Promag offers the additional Empty Pipe Detection (EPD) function to ensure the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure:

- Electrode Cleaning Circuit (ECC) for applications with accretive fluids, e.g. electrically conductive deposits ( $\rightarrow$ "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 ( $\rightarrow$ 旺 74)
- Exchangeable Measuring Electrodes for abrasive fluids ( $\rightarrow$ 目 93)


## Vertical orientation

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


Fig. 10: Vertical orientation

## Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief insulation of the two measuring 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 ( $\rightarrow$ 10). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.


Fig. 11: Horizontal orientation
1 EPD electrode for the detection of empty pipes (not with Promag D and Promag H (DN 2 to $15 ; 1 / 12^{\prime \prime}$ to $1 / 2^{\prime \prime}$ ))
2 Measuring electrodes for signal detection
3 Reference electrode for the potential equalization (not with Promag D and H)

## Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications:

- Inlet run: $\geq 5 \times \mathrm{DN}$
- Outlet run: $\geq 2 \times$ DN


Fig. 12: Inlet and outlet runs

### 3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.
Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on resistance to vibration and shock can be found on $\rightarrow$ 目 101.


Fig. 13: $\quad$ Measures to prevent vibration of the device ( $L>10 \mathrm{~m}(32.8 \mathrm{ft})$ )

### 3.2.5 Foundations, supports

If the nominal diameter is $\mathrm{DN} \geq 350$, mount the sensor 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 ( $D N \geq 350$ )

### 3.2.6 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in largerdiameter pipes.
The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.
Note!
The nomogram only applies to liquids of viscosity similar to water.

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


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 between 2 and $3 \mathrm{~m} / \mathrm{s}(6.5$ to $9.8 \mathrm{ft} / \mathrm{s})$
The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:

- $\mathrm{v}<2 \mathrm{~m} / \mathrm{s}(\mathrm{v}<6.5 \mathrm{ft} / \mathrm{s})$ : for abrasive fluids
- $\mathrm{v}>2 \mathrm{~m} / \mathrm{s}(\mathrm{v}>6.5 \mathrm{ft} / \mathrm{s})$ : for fluids producing buildup

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor ( $\rightarrow$ 目 17) 。

## Recommended flow (SI units)

| Nominal diameter[mm] | Promag D | Promag L | Promag W | Promag P | Promag H |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Min./max. full scale value ( $\mathrm{v} \approx 0.3$ or $10 \mathrm{~m} / \mathrm{s}$ ) in [ $\mathrm{dm}^{3} / \mathrm{min}$ ] |  |  |  |  |
| 2 | - | - | - | - | 0.06 to 1.8 |
| 4 | - | - | - | - | 0.25 to 7 |
| 8 | - | - | - | - | 1 to 30 |
| 15 | - | - | - | 4 to 100 | 4 to 100 |
| 25 | 9 to 300 | - | 9 to 300 | 9 to 300 | 9 to 300 |
| 32 | - | - | 15 to 500 | 15 to 500 | - |
| 40 | 25 to 700 | - | 25 to 700 | 25 to 700 | 25 to 700 |
| 50 | 35 to 1100 | 35 to 1100 | 35 to 1100 | 35 to 1100 | 35 to 1100 |
| 65 | 60 to 2000 | 60 to 2000 | 60 to 2000 | 60 to 2000 | 60 to 2000 |
| 80 | 90 to 3000 | 90 to 3000 | 90 to 3000 | 90 to 3000 | 90 to 3000 |
| 100 | 145 to 4700 | 145 to 4700 | 145 to 4700 | 145 to 4700 | 145 to 4700 |
| 125 | - | 220 to 7500 | 220 to 7500 | 220 to 7500 | - |
| [mm] | Min./max. full scale value ( $\mathrm{v} \approx 0.3$ or $10 \mathrm{~m} / \mathrm{s}$ ) in [ $\mathrm{m}^{3} / \mathrm{h}$ ] |  |  |  |  |
| 150 | - | 20 to 600 | 20 to 600 | 20 to 600 | - |
| 200 | - | 35 to 1100 | 35 to 1100 | 35 to 1100 | - |
| 250 | - | 55 to 1700 | 55 to 1700 | 55 to 1700 | - |
| 300 | - | 80 to 2400 | 80 to 2400 | 80 to 2400 | - |
| 350 | - | - | 110 to 3300 | 110 to 3300 | - |
| 375 | - | - | 140 to 4200 | - | - |
| 400 | - | - | 140 to 4200 | 140 to 4200 | - |
| 450 | - | - | 180 to 5400 | 180 to 5400 | - |
| 500 | - | - | 220 to 6600 | 220 to 6600 | - |
| 600 | - | - | 310 to 9600 | 310 to 9600 | - |
| 700 | - | - | 420 to 13500 | - | - |
| 800 | - | - | 550 to 18000 | - | - |
| 900 | - | - | 690 to 22500 | - | - |
| 1000 | - | - | 850 to 28000 | - | - |
| 1200 | - | - | 1250 to 40000 | - | - |
| 1400 | - | - | 1700 to 55000 | - | - |
| 1600 | - | - | 2200 to 70000 | - | - |
| 1800 | - | - | 2800 to 90000 | - | - |
| 2000 | - | - | 3400 to 110000 | - | - |

## Recommended flow (US units)

| Nominal diameter [inch] | Promag D | Promag L | Promag W | Promag P | Promag H |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Min./max. full scale value ( $\mathrm{v} \approx 0.3$ or $10 \mathrm{~m} / \mathrm{s}$ ) in [gal/min] |  |  |  |  |
| $1^{1 / 12}{ }^{\prime \prime}$ | - | - | - | - | 0.015 to 0.5 |
| $5 / 32$ " | - | - | - | - | 0.07 to 2 |
| 5/16" | - | - | - | - | 0.25 to 8 |
| 1/2" | - | - | - | 1.0 to 27 | 1.0 to 27 |
| $1{ }^{\prime \prime}$ | 2.5 to 80 | - | 2.5 to 80 | 2.5 to 80 | 2.5 to 80 |
| 1/4" | - | - | 4 to 130 | 4 to 130 | - |
| $1^{1 / 2}{ }^{\prime \prime}$ | 7 to 190 | 7 to 190 | 7 to 190 | 7 to 190 | 7 to 190 |
| 2 " | 10 to 300 | 10 to 300 | 10 to 300 | 10 to 300 | 10 to 300 |
| 21/2" | 16 to 500 | 16 to 500 | 16 to 500 | 16 to 500 | 16 to 500 |
| 3" | 24 to 800 | 24 to 800 | 24 to 800 | 24 to 800 | 24 to 800 |
| 4" | 40 to 1250 | 40 to 1250 | 40 to 1250 | 40 to 1250 | 40 to 1250 |
| 5" | - | 60 to 1950 | 60 to 1950 | 60 to 1950 | - |
| $6 "$ | - | 90 to 2650 | 90 to 2650 | 90 to 2650 | - |
| 8" | - | 155 to 4850 | 155 to 4850 | 155 to 4850 | - |
| 10" | - | 250 to 7500 | 250 to 7500 | 250 to 7500 | - |
| 12 " | - | 350 to 10600 | 350 to 10600 | 350 to 10600 | - |
| 14" | - | - | 500 to 15000 | 500 to 15000 | - |
| 15" | - | - | 600 to 19000 | - | - |
| $16^{\prime \prime}$ | - | - | 600 to 19000 | 600 to 19000 | - |
| 18" | - | - | 800 to 24000 | 800 to 24000 | - |
| $20 "$ | - | - | 1000 to 30000 | 1000 to 30000 | - |
| $24 "$ | - | - | 1400 to 44000 | 1400 to 44000 | - |
| $28^{\prime \prime}$ | - | - | 1900 to 60000 | - | - |
| 30" | - | - | 2150 to 67000 | - | - |
| 32 " | - | - | 2450 to 80000 | - | - |
| $36 "$ | - | - | 3100 to 100000 | - | - |
| 40" | - | - | 3800 to 125000 | - | - |
| $42^{\prime \prime}$ | - | - | 4200 to 135000 | - | - |
| 48" | - | - | 5500 to 175000 | - | - |
| [inch] |  | n./max. full | e value ( v ~ 0.3 | m/s) in [ $\mathrm{Mgal} /$ |  |
| 54" | - | - | 9 to 300 | - | - |
| 60" | - | - | 12 to 380 | - | - |
| $66 "$ | - | - | 14 to 500 | - | - |
| $72 "$ | - | - | 16 to 570 | - | - |
| 78" | - | - | 18 to 650 | - | - |

### 3.2.8 Length of connecting cable

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

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permitted connecting cable length $\mathrm{L}_{\max }$ is determined by the fluid conductivity $(\rightarrow$ 16). A minimum conductivity of $20 \mu \mathrm{~S} / \mathrm{cm}$ is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of $5 \mu \mathrm{~S} / \mathrm{cm}$.
- The maximum connecting cable length is $10 \mathrm{~m}(32.8 \mathrm{ft})$ when empty pipe detection $(E P D \rightarrow$ 甼 74) is switched on.


Fig. 16: Permissible cable length for the remote version
Area shaded gray $=$ permitted range
Lmax $=$ connecting cable length in $[\mathrm{m}]$
Fluid conductivity in [ $\mu \mathrm{S} / \mathrm{cm}$ ]

### 3.3 Installation instructions

### 3.3.1 Installing the Promag D sensor

The sensor is installed between the pipe flanges with a mounting kit. The device is centered using recesses on the sensor ( $\rightarrow$ 22).
Note!
A mounting kit consisting of mounting bolts, seals, nuts and washers can be ordered separately $(\rightarrow$ 77). Centering sleeves are provided with the device if they are required for the installation.
Caution!
When installing the transmitter in the pipe, observe the necessary torques $(\rightarrow 23)$.


Fig. 17: Mounting the sensor
1 Nut
2 Washer
3 Mounting bolt
4 Centering sleeve
5 Seal

## Seals

When installing the sensor, make sure that the seals used do not project into the pipe cross-section.
Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.
Note!
Use seals with a hardness rating of $70^{\circ}$ Shore.

## Arrangement of the mounting bolts and centering sleeves

The device is centered using recesses on the sensor. The arrangement of the mounting bolts and the use of the centering sleeves supplied depend on the nominal diameter, the flange standard und the pitch circle diameter.

|  | Process connection |  |  |
| :---: | :---: | :---: | :---: |
|  | EN (DIN) | ANSI | JIS |
| DN 25 to 40 <br> (DN 1" to $11 / 2{ }^{\prime \prime}$ ) |  |  |  |
| $\begin{aligned} & \text { DN } 50 \\ & \text { (DN 2") } \end{aligned}$ |  |  | A0010825 |
| DN 65 |  | $\longrightarrow$ |  |
| DN 80 (DN 3") |  |  |  |
| $\begin{aligned} & \text { DN } 100 \\ & \text { (DN 4") } \end{aligned}$ |  |  |  |
| $\begin{aligned} & 1=\text { Mounting bolts with centering sleeves } \\ & 2=\text { EN (DIN) flanges: } 4 \text {-hole } \rightarrow \text { with centering sleeves } \\ & 3=\text { EN (DIN) flanges: } 8 \text {-hole } \rightarrow \text { without centering sleeves } \end{aligned}$ |  |  |  |

## Screw tightening torques (Promag D)

Please note the following:

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

The tightening torques apply to situations where an EPDM soft material flat seal (e.g. 70 Shore) is used.

Tightening torques, mounting bolts and centering sleeves for EN (DIN) PN 16

| Nominal diameter |  | Centering sleeve length | Tightenin with a proc | [ Nm ] <br> ge with a |
| :---: | :---: | :---: | :---: | :---: |
| [mm] | [mm] | [mm] | smooth seal face | raised face |
| 25 | $4 \times \mathrm{M} 12 \times 145$ | 54 | 19 | 19 |
| 40 | $4 \times$ M16 $\times 170$ | 68 | 33 | 33 |
| 50 | $4 \times$ M16 $\times 185$ | 82 | 41 | 41 |
| 65 ${ }^{1)}$ | $4 \times$ M16 $\times 200$ | 92 | 44 | 44 |
| $65^{2)}$ | $8 \times \mathrm{M} 16 \times 200$ | - 3) | 29 | 29 |
| 80 | $8 \times \mathrm{M} 16 \times 225$ | 116 | 36 | 36 |
| 100 | $8 \times$ M16 $\times 260$ | 147 | 40 | 40 |
| ) EN (DIN) | 4-hole $\rightarrow$ with ce 8 -hole $\rightarrow$ without is not required. T | sleeves ng sleeves is centered directly | e sensor housing. |  |

Tightening torques, mounting bolts and centering sleeves for JIS 10 K

| Nominal <br> diameter <br> [mm] | Mounting bolts <br> $[\mathrm{mm}]$ | Centering sleeve <br> length <br> [mm] | Tightening torque [Nm] <br> with a process flange with a <br> smooth seal face |  |
| :---: | :---: | :---: | :---: | :---: |
| 25 | $4 \times \mathrm{M} 16 \times 170$ | 54 | 24 | 24 |
| 40 | $4 \times \mathrm{M} 16 \times 170$ | 68 | 32 | 25 |
| 50 | $4 \times$ M16 $\times 185$ | $-{ }^{*}$ | 38 | 30 |
| 65 | $4 \times$ M16 $\times 200$ | $-{ }^{*}$ | 42 | 42 |
| 80 | $8 \times$ M16 $\times 225$ | $-{ }^{*}$ | 36 | 28 |
| 100 | $8 \times$ M16 $\times 260$ | $-{ }^{*}$ | 39 | 37 |
| * A centering sleeve is not required. The device is centered directly via the sensor housing. |  |  |  |  |

Tightening torques, mounting bolts and centering sleeves for ANSI Class 150

| Nominal diameter [inch] | Mounting bolts [inch] | Centering sleeve length [inch] | Tightening torque [lbf $\cdot \mathrm{ft}$ ] with a process flange with a |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | smooth seal face | raised face |
| 1" | $4 \times$ UNC $1 / 2^{\prime \prime} \times 5.70^{\prime \prime}$ | -* | 14 | 7 |
| $11 / 2 "$ | $4 \times$ UNC $1 / 2^{\prime \prime} \times 6.50{ }^{\prime \prime}$ | -* | 21 | 14 |
| 2 " | $4 \times$ UNC 5/8" $\times 7.50{ }^{\prime \prime}$ | -* | 30 | 27 |
| 3" | $4 \times$ UNC 5/8" $\times 9.25^{\prime \prime}$ | -* | 31 | 31 |
| 4" | $8 \times$ UNC 5/8" $\times 10,4{ }^{\prime \prime}$ | 5,79 | 28 | 28 |

## 3．3．2 Installing the Promag L sensor

Caution！
－The protective covers mounted on the two sensor flanges are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation．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 $\rightarrow$ 贯 25
－If grounding disks are used，follow the mounting instructions which will be enclosed with the shipment
－To comply with the device specification，a concentrical installation in the measuring section is required


Fig．18：Installing the Promag L sensor

## Seals

Comply with the following instructions when installing seals：
－No seals are required．
－For DIN flanges，use only seals according to 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 compounds such as graphite！An electrically conductive layer could form on the inside of the measuring tube and short－circuit the measuring signal．

## Ground cable

－If necessary，special ground cables for potential equalization can be ordered as an accessory （ $\rightarrow$ 冒 77）．
－Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on $\rightarrow$ 䀂 55 ．

## Screw tightening torques (Promag L)

Please note the following:

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

Promag L tightening torques for EN (DIN)

| Nominal diameter[mm] | EN (DIN) |  | Max. tightening torque |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Pressure rating [bar] | Threaded fasteners | Polyurethan <br> [ Nm ] | PTFE <br> [ Nm ] |
| 50 | PN 10/16 | $4 \times$ M 16 | 15 | 40 |
| 65* | PN 10/16 | $8 \times$ M 16 | 10 | 22 |
| 80 | PN 10/16 | $8 \times$ M 16 | 15 | 30 |
| 100 | PN 10/16 | $8 \times$ M 16 | 20 | 42 |
| 125 | PN 10/16 | $8 \times$ M 16 | 30 | 55 |
| 150 | PN 10/16 | $8 \times \mathrm{M} 20$ | 50 | 90 |
| 200 | PN 10 | $8 \times \mathrm{M} 20$ | 65 | 130 |
| 250 | PN 10 | $12 \times \mathrm{M} 20$ | 50 | 90 |
| 300 | PN 10 | $12 \times \mathrm{M} 20$ | 55 | 100 |
| * Designed acc. to EN 1092-1 (not to DIN 2501) |  |  |  |  |

Promag L tightening torques for ANSI

| Nominal diameter |  | ANSI <br> Pressure rating [lbs] | Threaded fasteners | Max. tightening torque |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Polyurethane |  | PTFE |  |
| [mm] | [inch] |  |  | [ Nm ] | [lbf •ft] | [ Nm ] | [lbf $\cdot \mathrm{ft}$ ] |
| 50 | 2 " | Class 150 | $4 \times 5 / 8{ }^{\prime \prime}$ | 15 | 11 | 40 | 29 |
| 80 | 3" | Class 150 | $4 \times 5 / 8{ }^{\prime \prime}$ | 25 | 18 | 65 | 48 |
| 100 | 4" | Class 150 | $8 \times 5 / 8 "$ | 20 | 15 | 44 | 32 |
| 150 | $6 "$ | Class 150 | $8 \times 3 / 4 "$ | 45 | 33 | 90 | 66 |
| 200 | 8" | Class 150 | $8 \times 3 / 4 "$ | 65 | 48 | 125 | 92 |
| 250 | $10 "$ | Class 150 | $12 \times 7 / 8^{\prime \prime}$ | 55 | 41 | 100 | 74 |
| 300 | 12" | Class 150 | $12 \times 7 / 8^{\prime \prime}$ | 68 | 56 | 115 | 85 |

### 3.3.3 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 $\rightarrow 26$
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment


Fig. 19: Installing the Promag $W$ sensor

## Seals

Comply with the following instructions when installing seals:

- Hard rubber lining $\rightarrow$ additional seals are always necessary.
- Polyurethane lining $\rightarrow$ no seals are required.
- For DIN flanges, use only seals according to 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 compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

## Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory ( $\rightarrow$ 目 77).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on $\rightarrow$ 冒 55


## Screw tightening torques (Promag W)

Please note the following:

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

Tightening torques for：

- EN（DIN）$\rightarrow$ 目 27
- JIS $\rightarrow$ 瞾 29
- ANSI $\rightarrow$ 冒 28
- AWWA $\rightarrow$ 冒 29
- AS $2129 \rightarrow$ 寿 30
- AS $4087 \rightarrow$ 寿 30

Promag $W$ tightening torques for EN（DIN）

| Nominal diameter ［mm］ | EN（DIN） <br> Pressure rating［bar］ | Threaded fasteners | Max．tightening torque［ Nm ］ |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | Hard rubber | Polyurethane |
| 25 | PN 40 | $4 \times$ M 12 | － | 15 |
| 32 | PN 40 | $4 \times$ M 16 | － | 24 |
| 40 | PN 40 | $4 \times$ M 16 | － | 31 |
| 50 | PN 40 | $4 \times$ M 16 | － | 40 |
| 65＊ | PN 16 | $8 \times$ M 16 | 32 | 27 |
| 65 | PN 40 | $8 \times$ M 16 | 32 | 27 |
| 80 | PN 16 | $8 \times$ M 16 | 40 | 34 |
| 80 | PN 40 | $8 \times$ M 16 | 40 | 34 |
| 100 | PN 16 | $8 \times$ M 16 | 43 | 36 |
| 100 | PN 40 | $8 \times \mathrm{M} 20$ | 59 | 50 |
| 125 | PN 16 | $8 \times$ M 16 | 56 | 48 |
| 125 | PN 40 | $8 \times \mathrm{M} 24$ | 83 | 71 |
| 150 | PN 16 | $8 \times \mathrm{M} 20$ | 74 | 63 |
| 150 | PN 40 | $8 \times \mathrm{M} 24$ | 104 | 88 |
| 200 | PN 10 | $8 \times \mathrm{M} 20$ | 106 | 91 |
| 200 | PN 16 | $12 \times \mathrm{M} 20$ | 70 | 61 |
| 200 | PN 25 | $12 \times \mathrm{M} 24$ | 104 | 92 |
| 250 | PN 10 | $12 \times \mathrm{M} 20$ | 82 | 71 |
| 250 | PN 16 | $12 \times \mathrm{M} 24$ | 98 | 85 |
| 250 | PN 25 | $12 \times \mathrm{M} 27$ | 150 | 134 |
| 300 | PN 10 | $12 \times \mathrm{M} 20$ | 94 | 81 |
| 300 | PN 16 | $12 \times \mathrm{M} 24$ | 134 | 118 |
| 300 | PN 25 | $16 \times$ M 27 | 153 | 138 |
| 350 | PN 6 | $12 \times \mathrm{M} 20$ | 111 | 120 |
| 350 | PN 10 | $16 \times \mathrm{M} 20$ | 112 | 118 |
| 350 | PN 16 | $16 \times$ M 24 | 152 | 165 |
| 350 | PN 25 | $16 \times$ M 30 | 227 | 252 |
| 400 | PN 6 | $16 \times \mathrm{M} 20$ | 90 | 98 |
| 400 | PN 10 | $16 \times$ M 24 | 151 | 167 |
| 400 | PN 16 | $16 \times \mathrm{M} 27$ | 193 | 215 |
| 400 | PN 25 | $16 \times$ M 33 | 289 | 326 |
| 450 | PN 6 | $16 \times \mathrm{M} 20$ | 112 | 126 |
| 450 | PN 10 | $20 \times$ M 24 | 153 | 133 |
| 450 | PN 16 | $20 \times$ M 27 | 198 | 196 |
| 450 | PN 25 | $20 \times$ M 33 | 256 | 253 |
| 500 | PN 6 | $20 \times$ M 20 | 119 | 123 |
| 500 | PN 10 | $20 \times$ M 24 | 155 | 171 |
| 500 | PN 16 | $20 \times$ M 30 | 275 | 300 |
| 500 | PN 25 | $20 \times$ M 33 | 317 | 360 |
| 600 | PN 6 | $20 \times$ M 24 | 139 | 147 |
| 600 | PN 10 | $20 \times$ M 27 | 206 | 219 |
| 600 ＊ | PN 16 | $20 \times$ M 33 | 415 | 443 |
| 600 | PN 25 | $20 \times$ M 36 | 431 | 516 |
| 700 | PN 6 | $24 \times$ M 24 | 148 | 139 |
| 700 | PN 10 | $24 \times$ M 27 | 246 | 246 |
| 700 | PN 16 | $24 \times$ M 33 | 278 | 318 |


| Nominal diameter [mm] | EN (DIN) <br> Pressure rating [bar] | Threaded fasteners | Max. tightening torque [ Nm ] |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | Hard rubber | Polyurethane |
| 700 | PN 25 | $24 \times$ M 39 | 449 | 507 |
| 800 | PN 6 | $24 \times$ M 27 | 206 | 182 |
| 800 | PN 10 | $24 \times$ M 30 | 331 | 316 |
| 800 | PN 16 | $24 \times$ M 36 | 369 | 385 |
| 800 | PN 25 | $24 \times \mathrm{M} 45$ | 664 | 721 |
| 900 | PN 6 | $24 \times$ M 27 | 230 | 637 |
| 900 | PN 10 | $28 \times$ M 30 | 316 | 307 |
| 900 | PN 16 | $28 \times$ M 36 | 353 | 398 |
| 900 | PN 25 | $28 \times$ M 45 | 690 | 716 |
| 1000 | PN 6 | $28 \times$ M 27 | 218 | 208 |
| 1000 | PN 10 | $28 \times$ M 33 | 402 | 405 |
| 1000 | PN 16 | $28 \times$ M 39 | 502 | 518 |
| 1000 | PN 25 | $28 \times$ M 52 | 970 | 971 |
| 1200 | PN 6 | $32 \times$ M 30 | 319 | 299 |
| 1200 | PN 10 | $32 \times$ M 36 | 564 | 568 |
| 1200 | PN 16 | $32 \times \mathrm{M} 45$ | 701 | 753 |
| 1400 | PN 6 | $36 \times$ M 33 | 430 | 398 |
| 1400 | PN 10 | $36 \times$ M 39 | 654 | 618 |
| 1400 | PN 16 | $36 \times \mathrm{M} 45$ | 729 | 762 |
| 1600 | PN 6 | $40 \times$ M 33 | 440 | 417 |
| 1600 | PN 10 | $40 \times \mathrm{M} 45$ | 946 | 893 |
| 1600 | PN 16 | $40 \times$ M 52 | 1007 | 1100 |
| 1800 | PN 6 | $44 \times$ M 36 | 547 | 521 |
| 1800 | PN 10 | $44 \times \mathrm{M} 45$ | 961 | 895 |
| 1800 | PN 16 | $44 \times \mathrm{M} 52$ | 1108 | 1003 |
| 2000 | PN 6 | $48 \times \mathrm{M} 39$ | 629 | 605 |
| 2000 | PN 10 | $48 \times \mathrm{M} 45$ | 1047 | 1092 |
| 2000 | PN 16 | $48 \times$ M 56 | 1324 | 1261 |

Promag W tightening torques for ANSI

| Nominal diameter |  | ANSI <br> Pressure rating [lbs] | Threaded fasteners | Max. tightening torque |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Hard rubber |  | Polyurethane |  |
| [mm] | [inch] |  |  | [ Nm ] | [lbf $\cdot \mathrm{ft}$ ] | [ Nm ] | [lbf • ft] |
| 25 | $1{ }^{\prime \prime}$ |  | Class 150 | $4 \times 1 / 2{ }^{\prime \prime}$ | - | - | 7 | 5 |
| 25 | $1{ }^{\prime \prime}$ | Class 300 | $4 \times 5 / 8{ }^{\prime \prime}$ | - | - | 8 | 6 |
| 40 | $1112{ }^{11}$ | Class 150 | $4 \times 1 / 2{ }^{1 \prime}$ | - | - | 10 | 7 |
| 40 | $11 / 2 "$ | Class 300 | $4 \times 3 / 4 "$ | - | - | 15 | 11 |
| 50 | 2 " | Class 150 | $4 \times 5 / 8{ }^{\prime \prime}$ | - | - | 22 | 16 |
| 50 | 2 " | Class 300 | $8 \times 5 / 8{ }^{\prime \prime}$ | - | - | 11 | 8 |
| 80 | 3" | Class 150 | $4 \times 5 / 8 "$ | 60 | 44 | 43 | 32 |
| 80 | $3{ }^{\prime \prime}$ | Class 300 | $8 \times 3 / 4 "$ | 38 | 28 | 26 | 19 |
| 100 | 4" | Class 150 | $8 \times 5 / 8{ }^{\prime \prime}$ | 42 | 31 | 31 | 23 |
| 100 | 4" | Class 300 | $8 \times 3 / 4 "$ | 58 | 43 | 40 | 30 |
| 150 | $6{ }^{\prime \prime}$ | Class 150 | $8 \times 3 / 4 "$ | 79 | 58 | 59 | 44 |
| 150 | $6 "$ | Class 300 | $12 \times 3 / 4 "$ | 70 | 52 | 51 | 38 |
| 200 | 8" | Class 150 | $8 \times 3 / 4 "$ | 107 | 79 | 80 | 59 |
| 250 | $10 "$ | Class 150 | $12 \times 7 / 8^{\prime \prime}$ | 101 | 74 | 75 | 55 |
| 300 | 12" | Class 150 | $12 \times 7 / 8{ }^{\prime \prime}$ | 133 | 98 | 103 | 76 |
| 350 | 14 " | Class 150 | $12 \times 1$ " | 135 | 100 | 158 | 117 |
| 400 | $16 "$ | Class 150 | $16 \times 1$ " | 128 | 94 | 150 | 111 |
| 450 | 18" | Class 150 | $16 \times 11 / 8 "$ | 204 | 150 | 234 | 173 |
| 500 | 20" | Class 150 | $20 \times 11 / 8 "$ | 183 | 135 | 217 | 160 |
| 600 | 24" | Class 150 | $20 \times 1 \frac{1}{4 \prime \prime}$ | 268 | 198 | 307 | 226 |

Promag W tightening torques for JIS

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

Promag $W$ tightening torques for $A W W A$

| Nominal diameter |  | AWWA <br> Pressure rating | Threaded fasteners | Max. tightening torque |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Hard rubber |  | Polyurethane |  |
| [mm] | [inch] |  |  | [ Nm ] | [ $\mathrm{lbf} \cdot \mathrm{ft}$ ] | [ Nm ] | [lbf $\cdot \mathrm{ft}$ ] |
| 700 | 28" | Class D | $28 \times 11 / 4 "$ | 247 | 182 | 292 | 215 |
| 750 | 30" | Class D | $28 \times 11 / 4 "$ | 287 | 212 | 302 | 223 |
| 800 | 32" | Class D | $28 \times 1 \frac{1}{2} 2^{\prime \prime}$ | 394 | 291 | 422 | 311 |
| 900 | $36 "$ | Class D | $32 \times 1{ }^{1 / 2} 2^{\prime \prime}$ | 419 | 309 | 430 | 317 |
| 1000 | 40" | Class D | $36 \times 11 / 2^{\prime \prime}$ | 420 | 310 | 477 | 352 |
| 1050 | 42" | Class D | $36 \times 1{ }^{1 / 2} 2^{\prime \prime}$ | 528 | 389 | 518 | 382 |
| 1200 | 48" | Class D | $44 \times 1 \frac{1}{2} 2^{\prime \prime}$ | 552 | 407 | 531 | 392 |
| 1350 | $54 "$ | Class D | $44 \times 13 / 4 "$ | 730 | 538 | 633 | 467 |
| 1500 | 601 | Class D | $52 \times 13 / 4 "$ | 758 | 559 | 832 | 614 |
| 1650 |  | Class D | $52 \times 13 / 4 "$ | 946 | 698 | 955 | 704 |
| 1800 | 72 | Class D | $60 \times 13 / 4 "$ | 975 | 719 | 1087 | 802 |
| 2000 | 78" | Class D | $64 \times 2$ " | 853 | 629 | 786 | 580 |

Promag W tightening torques for AS 2129

| Nominal diameter <br> [mm] | AS 2129 <br> Pressure rating | Threaded <br> fasteners | Max. tightening torque [Nm] <br> Hard rubber |
| :---: | :---: | :---: | :---: |
| 80 | Table E | $4 \times$ M 16 | 49 |
| 100 | Table E | $8 \times$ M 16 | 38 |
| 150 | Table E | $8 \times$ M 20 | 64 |
| 200 | Table E | $8 \times$ M 20 | 96 |
| 250 | Table E | $12 \times$ M 20 | 98 |
| 300 | Table E | $12 \times$ M 24 | 123 |
| 350 | Table E | $12 \times$ M 24 | 203 |
| 400 | Table E | $12 \times$ M 24 | 226 |
| 450 | Table E | $16 \times$ M 24 | 226 |
| 500 | Table E | $16 \times$ M 24 | 271 |
| 600 | Table E | $16 \times$ M 30 | 439 |
| 700 | Table E | $20 \times$ M 30 | 355 |
| 750 | Table E | $20 \times$ M 30 | 559 |
| 800 | Table E | $20 \times$ M 30 | 631 |
| 900 | Table E | $24 \times$ M 30 | 627 |
| 1000 | Table E | $24 \times$ M 30 | 634 |
| 1200 | Table E | $32 \times$ M 30 | 727 |

Promag W tightening torques for AS 4087

| Nominal diameter <br> $[\mathrm{mm}]$ | AS 4087 <br> Pressure rating | Threaded <br> fasteners | Max. tightening torque [Nm] <br> Hard rubber |
| :---: | :---: | :---: | :---: |
| 80 | PN 16 | $4 \times$ M 16 | 49 |
| 100 | PN 16 | $4 \times$ M 16 | 76 |
| 150 | PN 16 | $8 \times$ M 20 | 52 |
| 200 | PN 16 | $8 \times$ M 20 | 77 |
| 250 | PN 16 | $8 \times$ M 20 | 147 |
| 300 | PN 16 | $12 \times$ M 24 | 103 |
| 350 | PN 16 | $12 \times$ M 24 | 203 |
| 375 | PN 16 | $12 \times$ M 24 | 137 |
| 400 | PN 16 | $12 \times$ M 24 | 226 |
| 450 | PN 16 | $12 \times$ M 24 | 301 |
| 500 | PN 16 | $16 \times$ M 24 | 271 |
| 600 | PN 16 | $16 \times$ M 27 | 393 |
| 700 | PN 16 | $20 \times$ M 27 | 330 |
| 750 | PN 16 | $20 \times$ M 30 | 529 |
| 800 | PN 16 | $20 \times$ M 33 | 631 |
| 900 | PN 16 | $24 \times$ M 33 | 627 |
| 1000 | PN 16 | $24 \times$ M 33 | 595 |
| 1200 | PN 16 | $32 \times$ M 33 | 703 |

## 3．3．4 Installing the Promag P sensor

Caution！
－The protective covers mounted on the two sensor flanges guard the PTFE，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 $\rightarrow$ 眉 32
－If grounding disks are used，follow the mounting instructions which will be enclosed with the shipment


Fig．20：Installing the Promag P sensor

## Seals

Comply with the following instructions when installing seals：
－PFA or PTFE lining $\rightarrow$ No seals are required！
－For DIN flanges，use only seals according to 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 compounds such as graphite！An electrically conductive layer could form on the inside of the measuring tube and short－circuit the measuring signal．

## Ground cable

－If necessary，special ground cables for potential equalization can be ordered as an accessory $(\rightarrow$ 畀 77）．
－Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on $\rightarrow$ 面 55

## 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 $+150^{\circ} \mathrm{C}$ ．
Note！
You will find information on permissible temperature ranges on $\rightarrow$ 且 102

## 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：$\quad$ Promag P（high－temperature version）：Insulating the pipe

## Tightening torques for threaded fasteners（Promag P）

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

- EN（DIN）$\rightarrow$ 置 33
- ANSI $\rightarrow$ 眉 34
- JIS $\rightarrow$ 冨 34
- AS $2129 \rightarrow$ 甼 35
- AS $4087 \rightarrow$ 宜 35

Promag P tightening torques for EN (DIN)

| Nominal diameter [mm] | EN (DIN) <br> Pressure rating [bar] | Threaded fasteners | Max. tightening torque [ Nm ] |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | PTFE | PFA |
| 15 | PN 40 | $4 \times \mathrm{M} 12$ | 11 | - |
| 25 | PN 40 | $4 \times$ M 12 | 26 | 20 |
| 32 | PN 40 | $4 \times$ M 16 | 41 | 35 |
| 40 | PN 40 | $4 \times$ M 16 | 52 | 47 |
| 50 | PN 40 | $4 \times$ M 16 | 65 | 59 |
| 65 * | PN 16 | $8 \times$ M 16 | 43 | 40 |
| 65 | PN 40 | $8 \times$ M 16 | 43 | 40 |
| 80 | PN 16 | $8 \times$ M 16 | 53 | 48 |
| 80 | PN 40 | $8 \times$ M 16 | 53 | 48 |
| 100 | PN 16 | $8 \times$ M 16 | 57 | 51 |
| 100 | PN 40 | $8 \times \mathrm{M} 20$ | 78 | 70 |
| 125 | PN 16 | $8 \times$ M 16 | 75 | 67 |
| 125 | PN 40 | $8 \times$ M 24 | 111 | 99 |
| 150 | PN 16 | $8 \times$ M 20 | 99 | 85 |
| 150 | PN 40 | $8 \times \mathrm{M} 24$ | 136 | 120 |
| 200 | PN 10 | $8 \times \mathrm{M} 20$ | 141 | 101 |
| 200 | PN 16 | $12 \times \mathrm{M} 20$ | 94 | 67 |
| 200 | PN 25 | $12 \times \mathrm{M} 24$ | 138 | 105 |
| 250 | PN 10 | $12 \times \mathrm{M} 20$ | 110 | - |
| 250 | PN 16 | $12 \times \mathrm{M} 24$ | 131 | - |
| 250 | PN 25 | $12 \times \mathrm{M} 27$ | 200 | - |
| 300 | PN 10 | $12 \times \mathrm{M} 20$ | 125 | - |
| 300 | PN 16 | $12 \times \mathrm{M} 24$ | 179 | - |
| 300 | PN 25 | $16 \times \mathrm{M} 27$ | 204 | - |
| 350 | PN 10 | $16 \times \mathrm{M} 20$ | 188 | - |
| 350 | PN 16 | $16 \times \mathrm{M} 24$ | 254 | - |
| 350 | PN 25 | $16 \times$ M 30 | 380 | - |
| 400 | PN 10 | $16 \times \mathrm{M} 24$ | 260 | - |
| 400 | PN 16 | $16 \times \mathrm{M} 27$ | 330 | - |
| 400 | PN 25 | $16 \times$ M 33 | 488 | - |
| 450 | PN 10 | $20 \times$ M 24 | 235 | - |
| 450 | PN 16 | $20 \times$ M 27 | 300 | - |
| 450 | PN 25 | $20 \times$ M 33 | 385 | - |
| 500 | PN 10 | $20 \times$ M 24 | 265 | - |
| 500 | PN 16 | $20 \times$ M 30 | 448 | - |
| 500 | PN 25 | $20 \times$ M 33 | 533 | - |
| 600 | PN 10 | $20 \times$ M 27 | 345 | - |
| 600 * | PN 16 | $20 \times$ M 33 | 658 | - |
| 600 | PN 25 | $20 \times$ M 36 | 731 | - |
| * Designed acc. to EN 1092-1 (not to DIN 2501) |  |  |  |  |

Promag P tightening torques for ANSI

| Nominal diameter |  | ANSI <br> Pressure rating [lbs] | Threaded fasteners | Max. tightening torque |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | PTFE |  | PFA |  |
| [mm] | [inch] |  |  | [ Nm ] | [lbf $\cdot \mathrm{ft}$ ] | [ Nm ] | [lbf $\cdot \mathrm{ft}$ ] |
| 15 | $1 / 2{ }^{\prime \prime}$ | Class 150 | $4 \times 1 / 2{ }^{\prime \prime}$ | 6 | 4 | - | - |
| 15 | $1 / 2{ }^{1}$ | Class 300 | $4 \times 1 / 2^{\prime \prime}$ | 6 | 4 | - | - |
| 25 | $1{ }^{\prime \prime}$ | Class 150 | $4 \times 1 / 2^{\prime \prime}$ | 11 | 8 | 10 | 7 |
| 25 | $1{ }^{\prime \prime}$ | Class 300 | $4 \times 5 / 8{ }^{\prime \prime}$ | 14 | 10 | 12 | 9 |
| 40 | $11 / 2 "$ | Class 150 | $4 \times 1 / 21$ | 24 | 18 | 21 | 15 |
| 40 | $11 / 2 "$ | Class 300 | $4 \times 3 / 4 "$ | 34 | 25 | 31 | 23 |
| 50 | 2 " | Class 150 | $4 \times 5 / 8{ }^{\prime \prime}$ | 47 | 35 | 44 | 32 |
| 50 | 2 " | Class 300 | $8 \times 5 / 8{ }^{\prime \prime}$ | 23 | 17 | 22 | 16 |
| 80 | 3" | Class 150 | $4 \times 5 / 8{ }^{\prime \prime}$ | 79 | 58 | 67 | 49 |
| 80 | $3 "$ | Class 300 | $8 \times 3 / 4 "$ | 47 | 35 | 42 | 31 |
| 100 | 4" | Class 150 | $8 \times 5 / 8{ }^{\prime \prime}$ | 56 | 41 | 50 | 37 |
| 100 | $4 "$ | Class 300 | $8 \times 3 / 4 "$ | 67 | 49 | 59 | 44 |
| 150 | $6 "$ | Class 150 | $8 \times 3 / 4 "$ | 106 | 78 | 86 | 63 |
| 150 | $6 "$ | Class 300 | $12 \times 3 / 411$ | 73 | 54 | 67 | 49 |
| 200 | 8" | Class 150 | $8 \times 3 / 4 "$ | 143 | 105 | 109 | 80 |
| 250 | 10" | Class 150 | $12 \times 7 / 8{ }^{\prime \prime}$ | 135 | 100 | - | - |
| 300 | 12 " | Class 150 | $12 \times 7 / 8{ }^{\prime \prime}$ | 178 | 131 | - | - |
| 350 | 14 " | Class 150 | $12 \times 1$ " | 260 | 192 | - | - |
| 400 | $16 "$ | Class 150 | $16 \times 1$ " | 246 | 181 | - | - |
| 450 | 18" | Class 150 | $16 \times 11 / 8{ }^{\prime \prime}$ | 371 | 274 | - | - |
| 500 | 20 | Class 150 | $20 \times 11 / 8{ }^{\prime \prime}$ | 341 | 252 | - | - |
| 600 | 24 " | Class 150 | $20 \times 1 \frac{1}{4}{ }^{\prime \prime}$ | 477 | 352 | - | - |

Promag P tightening torques for JIS

| Nominal diameter [mm] | JIS <br> Pressure rating | Threaded fasteners | Max. tightening torque [ Nm ] |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | PTFE | PFA |
| 25 | 10K | $4 \times$ M 16 | 32 | 27 |
| 25 | 20K | $4 \times$ M 16 | 32 | 27 |
| 32 | 10K | $4 \times$ M 16 | 38 | - |
| 32 | 20K | $4 \times$ M 16 | 38 | - |
| 40 | 10K | $4 \times$ M 16 | 41 | 37 |
| 40 | 20K | $4 \times$ M 16 | 41 | 37 |
| 50 | 10K | $4 \times$ M 16 | 54 | 46 |
| 50 | 20K | $8 \times$ M 16 | 27 | 23 |
| 65 | 10K | $4 \times$ M 16 | 74 | 63 |
| 65 | 20K | $8 \times$ M 16 | 37 | 31 |
| 80 | 10K | $8 \times$ M 16 | 38 | 32 |
| 80 | 20K | $8 \times$ M 20 | 57 | 46 |
| 100 | 10K | $8 \times$ M 16 | 47 | 38 |
| 100 | 20K | $8 \times \mathrm{M} 20$ | 75 | 58 |
| 125 | 10K | $8 \times \mathrm{M} 20$ | 80 | 66 |
| 125 | 20K | $8 \times \mathrm{M} 22$ | 121 | 103 |
| 150 | 10K | $8 \times \mathrm{M} 20$ | 99 | 81 |
| 150 | 20K | $12 \times \mathrm{M} 22$ | 108 | 72 |
| 200 | 10K | $12 \times \mathrm{M} 20$ | 82 | 54 |
| 200 | 20K | $12 \times \mathrm{M} 22$ | 121 | 88 |
| 250 | 10K | $12 \times \mathrm{M} 22$ | 133 | - |
| 250 | 20K | $12 \times \mathrm{M} 24$ | 212 | - |
| 300 | 10K | $16 \times \mathrm{M} 22$ | 99 | - |
| 300 | 20K | $16 \times \mathrm{M} 24$ | 183 | - |

Promag P tightening torques for AS 2129

| Nominal diameter <br> $[\mathrm{mm}]$ | AS 2129 <br> Pressure rating | Threaded <br> fasteners | Max. tightening torque [Nm] <br> PTFE |
| :---: | :---: | :---: | :---: |
| 25 | Table E | $4 \times \mathrm{M} 12$ | 21 |
| 50 | Table E | $4 \times \mathrm{M} 16$ | 42 |

Promag P tightening torques for AS 4087

| Nominal diameter <br> $[\mathrm{mm}]$ | AS 4087 <br> Pressure rating | Threaded <br> fasteners | Max. tightening torque [Nm] <br> PTFE |
| :---: | :---: | :---: | :---: |
| 50 | PN 16 | $4 \times$ M 16 | 42 |

### 3.3.5 Installing the Promag $H$ sensor

The sensor is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with 4 or 6 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 ( $\rightarrow$ 嘼 77).


Abb. 22: Promag H process connections (DN 2... 25 / DN 40...100, 1/12"...1" / DN 1½"...4")
A = DN 2 ...25, 1/12"...1"/ process connections with O-ring

- welding flanges (DIN EN ISO 1127, ODT / SMS),
- flange (EN (DIN), ANSI, JIS ), flange PVDF (EN (DIN), ANSI, JIS )
- external and internal thread, hose connection, PVC adhesive fitting
$B=D N 2 \ldots 25,1 / 12^{\prime \prime} \ldots 1$ "/ process connections with aseptic gasket veal
- 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
$C=D N 40 \ldots 100,11 / 2 \ldots 4$ "/ process connections with aseptic gasket seal
- 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 metal 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 ( $7 \mathrm{Nm} / 5.2 \mathrm{lbf} \mathrm{ft}$ ). 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 $\rightarrow$ R 77 .


## Usage and assembly of ground rings (DN 2 to $25,1 / 12$ " to $1^{\prime \prime}$ )

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 equalized 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 ( $\rightarrow$ 77). 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 $\rightarrow$ 亩 112.
- Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.

1. Loosen the four or six hexagonal headed bolts (1) and remove the process connection from the sensor (4).
2. Remove the plastic disk (3), including the two O-ring seals (2).
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 (2) 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 ( $7 \mathrm{Nm} / 5.2 \mathrm{lbf} \mathrm{ft}$ ).


Fig. 23: Installing ground rings with Promag H (DN 2 to 25, 1/12" to 1 " )
$1=$ Hexagonal-headed bolt (process connection)
$2=$ O-ring seals
$3=$ Ground ring or plastic disk (spacer)
4 = Sensor

## Welding the transmitter 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 sensor into the pipe. A suitable welding jig can be ordered separately as an accessory ( $\rightarrow$ 具 77).
2. Loosen the screws on the process connection flange and remove the sensor, complete with the 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 the measuring tube and process connection into account. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Documentation" $\rightarrow$ 盲 116.

### 3.3.6 Turning the transmitter housing

## Turning the aluminum field housing

Warning!
The turning mechanism in devices with Ex 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:

- Promag D: approx. 10 mm ( 0.39 inch) above the securing screws
- Promag L, W, P, H: to the stop

4. Turn the transmitter housing to the desired position:

- Promag D: max. $180^{\circ}$ clockwise or max. $180^{\circ}$ counterclockwise
- Promag L, W, P, H: max. $280^{\circ}$ clockwise or max. $20^{\circ}$ counterclockwise

5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.


Fig. 24: $\quad$ 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. $2 \times 90^{\circ}$ in either direction).
4. Lower the housing into position.
5. Retighten the two securing screws.


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

### 3.3.7 Turning the onsite display

1. Unscrew the cover of the electronics compartment from the transmitter housing.
2. Press the side latches on the display module and remove it from the electronics compartment cover plate.
3. Turn the display to the desired position (max. $4 \times 45^{\circ}$ in both directions) and reset it onto the cover plate of the electronics compartment.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.


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

### 3.3.8 Installing the wall-mount housing

There are various ways of installing the wall-mount transmitter housing:

- Direct wall mounting
- Installation in control panel (with separate mounting kit, accessories) $\rightarrow$ 胃 42- Pipe mounting (with separate mounting kit, accessories) $\rightarrow$ 贯 42

Caution!

- Make sure that the ambient temperature does not exceed the permissible range at the mounting location, -20 to $+60^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+{ }^{\circ} 140 \mathrm{~F}\right)$, optional -40 to $+60^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+140^{\circ} \mathrm{F}\right)$. 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 the graphic.
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 $6.5 \mathrm{~mm}\left(0.26^{\prime \prime}\right)$
- Screw head: max. $\varnothing 10.5 \mathrm{~mm}\left(0.41^{\prime \prime}\right)$

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-mounted installation

1. Prepare the opening in the panel as illustrated in the graphic.
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.


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

## Pipe mounting

The assembly should be performed by following the instructions in the graphic.
Caution!
If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed $+60^{\circ} \mathrm{C}\left(+140^{\circ} \mathrm{F}\right)$, which is the maximum permissible temperature.


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

## 3．4 Post－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．？ | $\rightarrow$ 目 100 |
| Installation | Notes |
| Does the arrow on the sensor nameplate match the actual direction of flow through the pipe？ | － |
| Is the position of the measuring electrode plane correct？ | $\rightarrow$ 目 15 |
| Is the position of the empty pipe detection electrode correct？ | $\rightarrow$ 目 15 |
| Were all screws tightened to the specified torques when the sensor was installed？ | Promag D $\rightarrow$ 目 23 <br> Promag L $\rightarrow$ 叟 25 <br> Promag W $\rightarrow 26$ <br> Promag $P \rightarrow$ 異 32 |
| Were the correct seals used（type，material，installation）？ | Promag D $\rightarrow 21$ <br> Promag L $\rightarrow$ 苜 24 <br> Promag W $\rightarrow$ 宜 26 <br>  <br> Promag H $\rightarrow$ 眉 36 |
| Are the measuring point number and labeling correct（visual inspection）？ | － |
| Process environment／process conditions | Notes |
| Were the inlet and outlet runs respected？ | Inlet run $\geq 5 \times \mathrm{DN}$ <br> Outlet run $\geq 2 \times$ 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 68－2－8 |

## 4 Wiring

## Warning！

When connecting Ex－certified devices，see the notes and diagrams in the Ex－specific supplement to these Operating Instructions．
Please do not hesitate to contact your Endress＋Hauser representative if you have any questions．
Note！
The device does not have an internal circuit breaker．For this reason，assign the device a switch or power－breaker switch capable of disconnecting the power supply line from the mains．

## 4．1 Connecting the remote version

## 4．1．1 Connecting Promag D，L，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．

Caution！
－Only sensors and transmitters with the same serial number can be connected to one another． Communication problems can occur if the devices are not connected in this way．
－Risk of damaging the coil driver．Always switch off the power supply before connecting or disconnecting the coil cable．

## Procedure

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

## （3）Caution！

Route the connecting cables securely（see＂Connecting cable length＂$\rightarrow$ 目 44）．
4．Terminate the signal and coil current cable as indicated in the table：
Promag D，L，W，P $\rightarrow$ Refer to the table $\rightarrow$ R 47
Promag H $\rightarrow$ Refer to the＂Cable termination＂table $\rightarrow$ 愳 48
5．Establish the wiring between the sensor and the transmitter．
The electrical wiring diagram that applies to your device can be found：
－In the corresponding graphic：
$\rightarrow 30$（Promag D）$\rightarrow 31$（Promag L，W，P）；$\rightarrow$ 32 （Promag H）
－In the cover of the sensor and transmitter
（4）Note！
The cable shields of the Promag H sensor are grounded by means of the strain relief terminals （see also the＂Cable termination＂table $\rightarrow$ 負 48）
（3）Caution！
Insulate the shields of cables that are not connected to eliminate the risk of short－circuits with neighboring cable shields inside the connection housing．
6．Transmitter：Screw the cover on the connection compartment（a）．
7．Sensor：Secure the cover on the connection housing（b）．

## Promag D



Fig. 30: $\quad$ Connecting the remote version of Promag $D$
a Wall-mount housing connection compartment
$b \quad$ Cover of the sensor connection housing
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colors/Terminal No.:
$5 / 6=$ braun, $7 / 8=$ white, $4=$ green, $37 / 36=$ yellow

Promag L, W, P


Fig. 31: $\quad$ Connecting the remote version of Promag $L, W, P$
a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colors/Terminal No.:
$5 / 6=$ braun, $7 / 8=$ white, $4=$ green, $37 / 36=$ yellow

## Promag H



Fig. 32: $\quad$ Connecting the remote version of Promag $H$
a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colors/Terminal No.:
$5 / 6=$ braun, $7 / 8=$ white, $4=$ green, $37 / 36=$ yellow

Cable termination for the remote version
Promag D / Promag L / Promag W / Promag P
Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: © $=$ red ferrules, $\varnothing 1.0 \mathrm{~mm}$; (2) = white ferrules, $\varnothing 0.5 \mathrm{~mm}$ ).

* Stripping only for reinforced cables

Ch Caution!
When fitting the connectors, pay attention to the following points:

- Signal cable $\rightarrow$ Make sure that the ferrules do not touch the wire shield on the sensor side.

Minimum distance $=1 \mathrm{~mm}$ (exception "GND" = green cable)

- Coil current cable $\rightarrow$ Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.


SENSOR
Signal cable

Cable termination for the remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: (1) = red ferrules, $\varnothing 1.0 \mathrm{~mm}$; (2) = white ferrules, $\varnothing 0.5 \mathrm{~mm}$ ).
Caution!
When fitting the connectors, pay attention to the following points:

- Signal cable $\rightarrow$ Make sure that the ferrules do not touch the wire shield on the sensor side.

Minimum distance $=1 \mathrm{~mm}$ (exception "GND" = green cable).

- Coil current cable $\rightarrow$ 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

## SENSOR

Signal cable

### 4.1.2 Cable specifications

## Signal cable

- $3 \times 0.38 \mathrm{~mm}^{2}$ PVC cable with common, braided copper shield ( $\varnothing \sim 7 \mathrm{~mm}$ ) and individually shielded cores
- With Empty Pipe Detection (EPD): $4 \times 0.38 \mathrm{~mm}^{2}$ PVC cable with common, braided copper shield $(\varnothing \sim 7 \mathrm{~mm})$ and individually shielded cores
- Conductor resistance: $\leq 50 \Omega / \mathrm{km}$
- Capacitance: core/shield: $\leq 420 \mathrm{pF} / \mathrm{m}$
- Permanent operating temperature: -20 to $+80^{\circ} \mathrm{C}$
- Cable cross-section: max. $2.5 \mathrm{~mm}^{2}$


## Coil cable

- $2 \times 0.75 \mathrm{~mm}^{2}$ PVC cable with common, braided copper shield ( $\varnothing \sim 7 \mathrm{~mm}$ )
- Conductor resistance: $\leq 37 \Omega / \mathrm{km}$
- Capacitance: core/core, shield grounded: $\leq 120 \mathrm{pF} / \mathrm{m}$
- Operating temperature: -20 to $+80^{\circ} \mathrm{C}$
- Cable cross-section: max. $2.5 \mathrm{~mm}^{2}$
- Test voltage for cable insulation: $\geq 1433$ V AC r.m.s. $50 / 60 \mathrm{~Hz}$ or $\geq 2026$ V DC


Fig. 33: 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

## Reinforced connecting cables

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid. Reinforced connecting cables should be used when laying the cable directly in the ground, if there is a risk of damage from rodents or if using the measuring device below IP 68 degree of protection.

## Operation in zones of severe electrical interference.

The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326.
Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

### 4.2 Connecting the measuring unit

### 4.2.1 Connecting the 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 energized. 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. Also comply with national regulations governing the installation of electrical equipment.

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and the signal cable (b) through the appropriate cable entries.
3. Perform the wiring:

- Wiring diagram (aluminum housing) $\rightarrow$ 34
- Wiring diagram (stainless steel housing) $\rightarrow 35$
- Wiring diagram (wall-mount housing) $\rightarrow 36$
- Terminal assignment $\rightarrow$ 嘼 52

4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.



Fig. 34: Connecting the transmitter (aluminum field housing). Cable cross-section: max. $2.5 \mathrm{~mm}^{2}$
a Cable for power supply: 85 to 260 V AC, 20 to 55 VAC, 16 to 62 VDC
Terminal No. 1: L1 for $A C, L+$ for $D C$
Terminal No. 2: $N$ for $A C, L-$ for $D C$
b Signal cable: Terminals Nos. $20-27 \rightarrow$ 目 52
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
$f \quad$ Cover of the connection compartment
$g \quad$ Securing clamp


Fig. 35: Connecting the transmitter (stainless steel field housing); cable cross-section: max. $2.5 \mathrm{~mm}^{2}$
a Cable for power supply: 85 to 260 VAC, 20 to 55 V AC, 16 to 62 V DC
Terminal No. 1: L1 for AC, $L+$ for DC
Terminal No. 2: $N$ for $A C, L$ - for $D C$
b Signal cable: Terminals Nos. 20-27 $\rightarrow$ 目 52
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
$f \quad$ Cover of the connection compartment


Fig. 36: Connecting the transmitter (wall-mount housing); cable cross-section: max. $2.5 \mathrm{~mm}^{2}$
a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
Terminal No. 1: L1 for AC, $L+$ for $D C$
Terminal No. 2: $N$ for AC, $L-$ for $D C$
$b \quad$ Signal cable: Terminals Nos. $20-27 \rightarrow$ 目 52
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
$f \quad$ Cover of the connection compartment

### 4.2.2 Terminal assignment

|  | Terminal No. (inputs / outputs) |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
| Order version | $20(+) / 21(-)$ | $22(+) / 23(-)$ | $24(+) / 25(-)$ | $\mathbf{2 6 ( + ) / 2 7 ( - )}$ |
| $50^{* * * * * * * * * * * * * * * W}$ | - | - | - | Current output <br> HART |
| $50^{* * * * * * * * * * * * * * * A ~}$ | - | - | Frequency output | Current output <br> HART |
| $50^{* * * * * * * * * * * * * * * D ~}$ | Status input | Status output | Frequency output | Current output <br> HART |
| $50^{* * * * * * * * * * * * * * * S ~}$ | - | - | Frequency output <br> Ex i | Current output, Ex i, <br> active, HART |
| $50^{* * * * * * * * * * * * * * * T ~}$ | - | - | Frequency output <br> Ex i | Current output, Ex i, <br> passive, HART |

Note!
Functional values of the inputs and outputs $\rightarrow 97$

### 4.2.3 HART connection

Users have the following connection options at their disposal:

- Direct connection to transmitter by means of terminals $26(+)$ and 27 (-)
- Connection by means of the 4 to 20 mA circuit.
- The measuring loop's minimum load must be at least $250 \Omega$.
- After commissioning, make the following settings:
- CURRENT SPAN function $\rightarrow$ "4-20 mA HART"
- Switch HART write protection on or off $\rightarrow$ 置 64


## Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".


Fig. 37: Electrical connection of HART handheld Field Xpert SFX100
1 HART handheld Field Xpert SFX100
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input

## Connection of a PC with an operating software

In order to connect a PC with operating software (e.g. "FieldCare"), a HART modem (e.g. "Commubox FXA195") is needed.


Fig. 38: Electrical connection of a PC with operating software

[^0]
## 4．3 Potential equalization

## Warning！

The measuring system must be included in the potential equalization．
Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential．This is ensured by the reference electrode integrated in the sensor as standard．
The following should also be taken into consideration for potential equalization：
－Internal grounding concepts in the company
－Operating conditions，such as the material／grounding of the pipes（see Table）

## 4．3．1 Potential equalization for Promag D

－No reference electrode is integrated！
For the two ground disks of the sensor an electrical connection to the fluid is always ensured．
－Exampels for connections $\rightarrow$ 目 54

## 4．3．2 Potential equalization for Promag W，P，L

－Reference electrode integrated in the sensor as standard
－Exampels for connections $\rightarrow$ 冒 55

## 4．3．3 Potential equalization for Promag H

No reference electrode is integrated！
For the metal process connections of the sensor an electrical connection to the fluid is always ensured．
Caution！
If using process connections made of a synthetic material，ground rings have to be used to ensure that potential is equalized（ $\rightarrow$ 目 37）．The necessary ground rings can be ordered separately from Endress＋Hauser as accessories（ $\rightarrow$ 77）．

## 4．3．4 Exampels for potential equalization connections for Promag D

## Standard case

Operating conditions
When using the measuring device in a：
－Metal，grounded pipe
－Plastic pipe
－Pipe with insulating lining
Potential equalization takes place via the ground terminal of the
transmitter（standard situation）．
When installing in metal pipes，we recommend you connect the
ground terminal of the transmitter housing with the piping．

## Special cases

Operating conditions
When using the measuring device in a:
Metal pipe that is not grounded
This connection method also applies in situations where:
Customary potential equalization cannot be ensured
Potential equalization takes place via the ground terminal of the
transmitter and the two pipe flanges.
Here, the ground cable (copper wire, $6 \mathrm{~mm}^{2}$ (0.0093 in ${ }^{2}$ )) is
mounted directly on the conductive flange coating with flange
screws.
When using the measuring device in a:

- Pipe with a cathodic protection unit
The device is installed potential-free in the pipe.
Only the two flanges of the pipe are connected with a ground
cable (copper wire, 6 mm ${ }^{2}$ (0.0093 in ${ }^{2}$ ). Here, the ground cable
is mounted directly on the conductive flange coating with flange
screws.
Note the following when installing:
- The applicable regulations regarding potential-free installation
must be observed.
There should be no electrically conductive connection
between the pipe and the device.
The mounting material must withstand the applicable
torques.


### 4.3.5 Exampels for potential equalization connections for Promag L, W, P

## Standard case

Operating conditions
When using the measuring device in a:

- Metal, grounded pipe
Potential equalization takes place via the ground terminal of the
transmitter (standard situation).
When installing in metal pipes, we recommend you connect the
ground terminal of the transmitter housing with the piping.


## Special cases

Operating conditions
When using the measuring device in a:

- Metal pipe that is not grounded
This connection method also applies in situations where:
- Customary potential equalization cannot be ensured
- Excessively high equalizing currents can be expected
Both sensor flanges are connected to the pipe flange by means of
a ground cable (copper wire, $6 \mathrm{~mm}^{2}(0.0093$ in 2 ) and grounded.
Connect the transmitter or sensor connection housing, as
applicable, to ground potential by means of the ground terminal
provided for the purpose.
Ground cable installation depends on the nominal diameter:
- DN $\leq 300$ : The ground cable is mounted directly on the
conductive flange coating with the flange screws.
- DN $\geq 350$ : The ground cable is mounted directly on the
metal transport bracket.
Note!
The ground cable for flange-to-flange connections can be
ordered separately as an accessory from Endress+Hauser. ordered separately as an accessory from Endress+Hauser.

When using the measuring device in a:

- Plastic pipe
- Pipe with insulating lining

This connection method also applies in situations where:

- Customary potential equalization cannot be ensured
- Excessively high equalizing currents can be expected

Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, min. $6 \mathrm{~mm}^{2}\left(0.0093 \mathrm{in}^{2}\right)$ ). When installing the ground disks, please comply with the enclosed Installation Instructions.

Fig. 43: $\quad$ Via the ground terminal of the transmitter and the flanges of the pipe


Fig. 44: Via the ground terminal of the transmitter


Fig. 45: Potential equalization and cathodic protection

1 Power supply isolation transformer
2 Electrically isolated

### 4.4 Degree of protection

The devices meet all the requirements of IP 67 degree of protection.
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 $\rightarrow$ 冒 49 .
- Firmly tighten the cable entries.
- The cables must loop down before they enter the cable entries ("water trap"). 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.


Fig. 46: Installation instructions, cable entries

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

Note!
The Promag L, Promag W and Promag P sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters ( 10 ft )). In this case the transmitter must be installed remote from the sensor.
The Promag L sensors with IP 68 rating are only available with stainless steel flanges.

## 4．5 Post－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 to 250 V AC（ 50 to 60 Hz ） <br> － 20 to $28 \mathrm{~V} \mathrm{AC}(50$ to 60 Hz$)$ 11 to 40 V DC |
| Do the cables used comply with the necessary specifications？ | $\rightarrow$ 目 49 |
| Do the cables have adequate strain relief？ | － |
| Is the cable type route completely isolated？ 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 equalization been correctly implemented？ | $\rightarrow$ 目 54 |
| Are all cable entries installed，firmly tightened and correctly sealed？ Cables looped as＂water traps＂？ | $\rightarrow$ 目 57 |
| 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 ( $\rightarrow$ "Description of Device Functions" manual).



2


3

Fig. 47: Display and operating elements
1 Liquid crystal display
The 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 [m3], bar graph, measuring point designation

2 Plus/minus keys

- 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 $\rightarrow$ HOME position
- Press and hold down +/- keys for longer than 3 seconds $\rightarrow$ Return directly to HOME position
- Cancel data entry

3 Enter key

- HOME position $\rightarrow$ Entry into the function matrix
- Save the numerical values you input or settings you change


### 5.2 Brief operating instructions on the function matrix

Note!

- See the general notes on $\rightarrow$ 冒 61 .
- Detailed description of all the functions $\rightarrow$ "Description of Device Functions" manual

The function matrix comprises two levels, namely the function groups and the functions of the function groups.
The groups are the highest-level grouping of the control options for the device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the device.

1. HOME position $\rightarrow$ $\rightarrow$ Enter the function matrix
2. Select a function group (e.g. OPERATION)
3. Select a function (e.g. LANGUAGE)

Change parameter/enter numerical values:
団 $\rightarrow$ select or enter enable code, parameters, numerical values
E $\rightarrow$ save your entries
4. Exit the function matrix:

- Press and hold down Esc key ( - ) for longer than 3 seconds $\rightarrow$ HOME position
- Repeatedly press Esc key $(\exists \pm) \rightarrow$ return step by step to HOME position


Fig. 48: $\quad$ Selecting functions and configuring parameters (function matrix)

## 5．2．1 General notes

The Quick Setup menu（ $\rightarrow$ 71）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 $\rightarrow$ 畺 60 ．
－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 胃 to select＂SURE［ YES ］＂and press［ 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 configured 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 these Operating Instructions．

## 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（ $\rightarrow$ see the＂Description of Device Functions＂manual）．
Comply with the following instructions when entering codes：
－If programming is disabled and the 过 operating elements are pressed in any function，a prompt for the code automatically appears on the display．
－If＂ 0 ＂is specified as the customer＇s code，programming is always enabled．
－The Endress＋Hauser service organization 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 the operating elements 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 Displaying error messages

### 5.3.1 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 $\rightarrow$ 置 81:

This group comprises all device errors, e.g. communication errors, hardware faults, etc.

- Process errors $\rightarrow$ 贯 83:

This group comprises all application errors, e.g. empty pipe, etc.


Fig. 49: Error messages on the display (example)
1 Error type:
$-P=$ process error

- $S$ = system error

2 Error message type:
$-\rangle=$ 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 and seconds)

### 5.3.2 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 ( $\rightarrow$ "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 $\rightarrow$ 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 $\simeq \not \approx$ )

- Displayed as $\rightarrow$ Lightning flash ( $\langle$ ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.

The response of the individual outputs (failsafe mode) can be defined in the function matrix using the "FAILSAFE MODE" function ( $\rightarrow$ "Description of Device Functions" manual).

## 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 $\rightarrow$ 冒 53.

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 FieldCare), 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 classes:

- 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!
The device has access to all three command classes. A list of all the "Universal commands" and
"Common practice commands" is provided on $\rightarrow$ 眉 65.

### 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:

## Field Xpert HART Communicator

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 "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 FXA193.

## Operating program "SIMATIC PDM" (Siemens)

SIMATIC PDM is a standardized, 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 device software: | $2.03 . X X$ | $\rightarrow$ Function DEVICE SOFTWARE |
| :--- | :--- | :--- |
| Device data HART |  |  |
| Manufacturer ID: <br> Device ID: <br> HART version data: <br> Software release: | $11_{\text {hex }}$ (ENDRESS+HAUSER) <br> $41_{\text {hex }}$ <br> Device Revision 6/ DD Revision 1 | $\rightarrow$ Function MANUFACTURER ID <br> $\rightarrow$ Function DEVICE ID |
| Operating program: | 07.2009 |  |$|$| Sources for obtaining device descriptions: |
| :--- | :--- |


| Tester/simulator: | Sources for obtaining device descriptions: |
| :--- | :--- |
| Fieldcheck | Update by means of FieldCare with the flow device FXA193/291 DTM in the <br> Fieldflash module |

Note!
The "Fieldcheck" tester/simulator is used for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress+Hauser representative for more information.

### 5.4.3 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 |

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

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

Note!
You can set or change the assignment of device variables to process variables using Command 51.

### 5.4.4 Switching HART write protection on/off

The HART write protection can be switched on and off using the HART WRITE PROTECT device function ( $\rightarrow$ "Description of Device Functions" manual).

### 5.4.5 Universal and common practice HART commands

The following table contains all the universal commands supported by the device.

| 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. <br> The response consists of a 12 byte device ID: <br> - Byte 0: fixed value 254 <br> - Byte 1: Manufacturer ID, $17=\mathrm{E}+\mathrm{H}$ <br> - Byte 2: Device type ID, 65 = Promag 50 <br> - Byte 3: Number of preambles <br> - Byte 4: Universal commands rev. no. <br> - Byte 5: Device-specific commands rev. no. <br> - Byte 6: Software revision <br> - Byte 7: Hardware revision <br> - Byte 8: Additional device information <br> - Bytes 9-11: Device identification |
| 1 | Read primary process variable Access type = read | none | - Byte 0: HART unit code of the primary process variable <br> - Bytes 1-4: Primary process variable <br> Factory setting: <br> Primary process variable = Volume flow <br> Note! <br> - Manufacturer-specific units are represented using the HART unit code " 240 ". <br> - You can change the assignment of device variables to process variables using Command 51. |
| 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 <br> - Bytes 4-7: \% value of the set measuring range <br> Factory setting: <br> Primary process variable $=$ Volume flow <br> Note! <br> You can change the assignment of device variables to process variables using Command 51. |
| 3 | Read the primary process variable as current in mA and four dynamic process variables Access type = read | none | 24 bytes are sent as a response: <br> - Bytes 0-3: primary process variable current in mA <br> - Byte 4: HART unit code of the primary process variable <br> - Bytes 5-8: Primary process variable <br> - Byte 9: HART unit code of the second process variable <br> - Bytes 10-13: Second process variable <br> - Byte 14: HART unit code of the third process variable <br> - Bytes 15-18: Third process variable <br> - Byte 19: HART unit code of the fourth process variable <br> - Bytes 20-23: Fourth process variable <br> Factory setting: <br> - Primary process variable = Volume flow <br> - Second process variable = Totalizer 1 <br> - Third process variable $=$ OFF (not assigned) <br> - Fourth process variable $=$ OFF (not assigned) <br> Note! <br> - Manufacturer-specific units are represented using the HART unit code " 240 ". <br> - You can change 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) |
| :---: | :---: | :---: | :---: |
| 6 | Set HART shortform address Access type = write | Byte 0: desired address (0 to 15) <br> Factory setting: 0 <br> Note! <br> 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. <br> The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: <br> - Byte 0: fixed value 254 <br> - Byte 1: Manufacturer ID, $17=\mathrm{E}+\mathrm{H}$ <br> - Byte 2: Device type ID, 65 = Promag 50 <br> - Byte 3: Number of preambles <br> - Byte 4: Universal commands rev. no. <br> - Byte 5: Device-specific commands rev. no. <br> - Byte 6: Software revision <br> - Byte 7: Hardware revision <br> - Byte 8: Additional device information <br> - Bytes 9-11: Device identification |
| 12 | Read user message Access type $=$ read | none | Bytes 0-24: User message <br> Note! <br> You can write the user message using Command 17. |
| 13 | Read TAG, descriptor and date Access type $=$ read | none | - Bytes 0-5: TAG <br> - Bytes 6-17: descriptor <br> - Bytes 18-20: Date <br> Note! <br> 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 <br> - Byte 3: HART unit code of sensor limits and measuring range of the primary process variable <br> - Bytes 4-7: Upper sensor limit <br> - Bytes 8-11: Lower sensor limit <br> - Bytes 12-15: Minimum span <br> Note! <br> - The data relate to the primary process variable (= volume flow). <br> - 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 <br> - Byte 1: Transfer function ID <br> - Byte 2: HART unit code for the set measuring range of the primary process variable <br> - Bytes 3-6: upper range, value for 20 mA <br> - Bytes 7-10: lower range, value for 4 mA <br> - Bytes 11-14: Damping constant in [s] <br> - Byte 15: Write protection ID <br> - Byte 16: OEM dealer ID, $17=\mathrm{E}+\mathrm{H}$ <br> Factory setting: Primary process variable $=$ Volume flow <br> Note! <br> - Manufacturer-specific units are represented using the HART unit code "240". <br> - You can change the assignment of device variables to process variables using Command 51. |


| Command No. <br> HART command / Access type | Command data <br> (numeric data in decimal form) | Response data <br> (numeric data in decimal form) |  |
| :--- | :--- | :--- | :--- |
| 16 | Read the device production <br> number <br> Access type = read | none | Bytes 0-2: Production number |
| 17 | Write user message <br> Access = write | You can save any 32-character long text in the device <br> under this parameter: <br> Bytes 0-23: Desired user message | Displays the current user message in the device: <br> Bytes 0-23: Current user message in the device |
| 18 | Write TAG, descriptor and date $=$ write | With this parameter, you can store an 8 character <br> TAG, a 16 character descriptor and a date: <br> - Bytes 0-5: TAG <br> - Bytes 6-17: descriptor <br> - Bytes 18-20: Date | Displays the current information in the device: <br> - Bytes 0-5: TAG <br> - Bytes 6-17: descriptor <br> Bytes 18-20: Date |
| 19 | Write the device production <br> number <br> Access = write | Bytes 0-2: Production number |  |

The following table contains all the common practice commands supported by the device.

| 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 <br> Access = write | Bytes 0-3: Damping value of the primary process variable "volume flow" in seconds <br> Factory setting: <br> Primary process variable $=$ Current output damping | Displays the current damping value in the device: Bytes 0-3: Damping value in seconds |
| 35 | Write measuring range of primary process variable <br> Access = write | Write the desired measuring range: <br> - Byte 0: HART unit code of the primary process variable <br> - Bytes 1-4: upper range, value for 20 mA <br> - Bytes 5-8: lower range, value for 4 mA <br> Factory setting: <br> Primary process variable $=$ Volume flow <br> Note! <br> - The start of the measuring range ( 4 mA ) must correspond to the zero flow. <br> - 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: <br> - Byte 0: HART unit code for the set measuring range of the primary process variable <br> - Bytes 1-4: upper range, value for 20 mA <br> - Bytes 5-8: lower range, value for 4 mA <br> Note! <br> - Manufacturer-specific units are represented using the HART unit code " 240 ". <br> - You can change the assignment of device variables to process variables using Command 51. |
| 38 | Device status reset (configuration changed) <br> Access = write | none | none <br> Note! <br> It is also possible to execute this HART command when write protection is activated (= ON)! |
| 40 | Simulate input current of primary process variable <br> Access = write | Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: <br> Bytes 0-3: Output current in mA <br> Factory setting: <br> Primary process variable $=$ Volume flow <br> Note! <br> 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: <br> Bytes 0-3: Output current in mA |
| 42 | Perform master reset <br> Access = write | none | none |


| Command No. HART command / Access type |  | Command data (numeric data in decimal form) | Response data (numeric data in decimal form) |
| :---: | :---: | :---: | :---: |
| 44 | Write unit of primary process variable <br> Access = write | Set unit of primary process variable. Only units which are suitable for the process variable are transferred to the device: <br> Byte 0: HART unit code <br> Factory setting: <br> Primary process variable $=$ Volume flow <br> Note! <br> - If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. <br> - If you change the unit of the primary process variable, this has a direct impact on the system units. | The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code <br> Note! <br> 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 $\rightarrow$ 青 69 |
| 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: <br> - Byte 0: Device variable code to the primary process variable <br> - Byte 1: Device variable code to the second process variable <br> - Byte 2: Device variable code to the third process variable <br> - Byte 3: Device variable code to the fourth process variable <br> Factory setting: <br> - Primary process variable: Code 1 for volume flow <br> - Second process variable: Code 250 for totalizer <br> - Third process variable: Code 0 for OFF (not assigned) <br> - Fourth process variable: Code 0 for OFF (not assigned) |
| 51 | Write assignment of the device variables to the four process variables Access = write | Setting of the device variables to the four process variables: <br> - Byte 0: Device variable code to the primary process variable <br> - Byte 1: Device variable code to the second process variable <br> - Byte 2: Device variable code to the third process variable <br> - Byte 3: Device variable code to the fourth process variable <br> Factory setting: <br> - Primary process variable: Volume flow <br> - Second process variable: Totalizer 1 <br> - Third process variable: OFF (not assigned) <br> - Fourth process variable: OFF (not assigned) | The variable assignment of the process variables is displayed as a response: <br> - Byte 0: Device variable code to the primary process variable <br> - Byte 1: Device variable code to the second process variable <br> - Byte 2: Device variable code to the third process variable <br> - Byte 3: Device variable code to the fourth process variable |
| 53 | Write device variable unit Access = write | This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: <br> - Byte 0: Device variable code <br> - Byte 1: HART unit code <br> Code of the supported device variables: See information $\rightarrow$ 盲 64 <br> Note! <br> - If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. <br> - If you change the unit of the device variable, this has a direct impact on the system units. | The current unit of the device variables is displayed in the device as a response: <br> - Byte 0: Device variable code <br> - Byte 1: HART unit code <br> Note! <br> 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 (4 to 20) | The current number of preambles is displayed in the response telegram: Byte 0: Number of preambles |

### 5.4.6 Device status and error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers information which is 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 $\rightarrow$ 贯 69
- Bits and bytes not listed are not assigned.

| Byte | Bit | Error No. | Short error description |
| :---: | :---: | :---: | :---: |
| 0 | 0 | 001 | Serious device error |
|  | 1 | 011 | Measuring amplifier has faulty EEPROM |
|  | 2 | 012 | Error when accessing data of the measuring amplifier EEPROM |
| 1 | 1 | 031 | S-DAT: defective or missing |
|  | 2 | 032 | S-DAT: Error accessing saved values |
|  | 5 | 051 | I/O and the amplifier are not compatible. |
| 3 | 3 | 111 | Totalizer checksum error |
|  | 4 | 121 | I/O board and amplifier not compatible. |
| 4 | 3 | 251 | Internal communication fault on the amplifier board. |
|  | 4 | 261 | No data reception between amplifier and I/O board |
| 5 | 0 | 321 | Coil current of the sensor is outside the tolerance. |
|  | 7 | 339 | Flow buffer: <br> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. |
| 6 | 0 | 340 |  |
|  | 1 | 341 |  |
|  | 2 | 342 |  |
|  | 3 | 343 | Frequency buffer: <br> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. |
|  | 4 | 344 |  |
|  | 5 | 345 |  |
|  | 6 | 346 |  |
|  | 7 | 347 | Pulse buffer: <br> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. |
| 7 | 0 | 348 |  |
|  | 1 | 349 |  |
|  | 2 | 350 |  |
|  | 3 | 351 | Current output: Flow is out of range. |
|  | 4 | 352 |  |
|  | 5 | 353 |  |
|  | 6 | 354 |  |
|  | 7 | 355 | Frequency output: <br> Flow is out of range. |
| 8 | 0 | 356 |  |
|  | 1 | 357 |  |
|  | 2 | 358 |  |


| Byte | Bit | Error No. | Short error description |
| :---: | :---: | :---: | :---: |
| 8 | 3 | 359 | Pulse output: <br> Flow is out of range. |
|  | 4 | 360 |  |
|  | 5 | 361 |  |
|  | 6 | 362 |  |
| 10 | 7 | 401 | Measuring tube partially filled or empty |
| 11 | 2 | 461 | EPD calibration not possible because the fluid's conductivity is either too low or too high. |
|  | 4 | 463 | The EPD calibration values for empty pipe and full pipe are identical, and therefore incorrect. |
| 12 | 1 | 474 | Maximum flow value entered is overshot |
|  | 7 | 501 | Amplifier software version is loaded. Currently no other commands are possible. |
| 13 | 0 | 502 | Upload/download of device files. Currently no other commands are possible. |
| 14 | 3 | 601 | Positive zero return active |
|  | 7 | 611 | Simulation current output active |
| 15 | 0 | 612 |  |
|  | 1 | 613 |  |
|  | 2 | 614 |  |
|  | 3 | 621 | Simulation frequency output active |
|  | 4 | 622 |  |
|  | 5 | 623 |  |
|  | 6 | 624 |  |
|  | 7 | 631 | Simulation pulse output active |
| 16 | 0 | 632 |  |
|  | 1 | 633 |  |
|  | 2 | 634 |  |
|  | 3 | 641 | Simulation status output active |
|  | 4 | 642 |  |
|  | 5 | 643 |  |
|  | 6 | 644 |  |
| 17 | 7 | 671 | Simulation of the status input active |
| 18 | 0 | 672 |  |
|  | 1 | 673 |  |
|  | 2 | 674 |  |
|  | 3 | 691 | Simulation of response to error (outputs) active |
|  | 4 | 692 | Simulation of volume flow active |

## 6 Commissioning

### 6.1 Function check

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

- Checklist for "Post-installation check" $\rightarrow$ 眉 43- Checklist for "Post-connection check" $\rightarrow$ 寿 58


### 6.2 Switching on the measuring device

Once the connection checks 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:


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.

### 6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the operating program, e.g. FieldCare.
If the measuring device is equipped with a local display, all the important device parameters for standard operation, as well as additional functions, can be configured quickly and easily by means of the following Quick Setup menu.

### 6.3.1 "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.


A0005413-EN
Fig. 50: "OUICK SETUP COMMISSIONING" menu for the rapid configuration of important device functions

### 6.4 Configuration

### 6.4.1 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.

1. Switch off power supply.
2. Remove the I/O board $\rightarrow 88$
3. Position the jumper $\rightarrow 51$

B Caution!
Risk of destroying the measuring device. Set the jumpers exactly as shown in the graphic. Pay strict attention to the position of the jumpers as indicated in the graphic.
4. Installation of the I/O board is the reverse of the removal procedure.


Fig. 51: Configuring current outputs using jumpers (I/O board)
1 Active current output (factory setting)
2 Passive current output

### 6.5 Adjustment

### 6.5.1 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!
Detailed information on the empty-pipe/full-pipe adjustment procedure can be found in the
"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. $500 \mu \mathrm{~S} / \mathrm{cm}$ ). 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 when the devices are delivered is OFF; the function has to be activated if required.
- The EPD process error can be output by means of the configurable relay output.


## Performing empty-pipe and full-pipe adjustment (EPD)

1. Select the appropriate function in the function matrix:

HOME $\rightarrow$ ■ $\rightarrow+$ PROCESS PARAMETER $\rightarrow$ ■ $\rightarrow+$ + $\rightarrow$ EPD ADJUSTMENT
2. Empty the piping:

- The wall of the measuring tube should still be wet with fluid during EPD empty pipe adjustment
- The wall of the measuring tube/the measuring electrodes should no longer be wet with fluid during OED empty pipe 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 $E^{\text {E }}$ to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing $\mathrm{E}^{\text {. }}$
7. Switch on empty pipe detection in the EPD function:

- EPD empty pipe adjustment: Select ON STANDARD or ON SPECIAL and press to confirm
- OED empty pipe adjustment: Select OED and confirm with $E$.
(3) Caution!

The adjustment coefficients must be valid before you can activate the EPD 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.

### 6.6 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. It is possible to plug these modules into other devices to copy device configurations from one device to another, for example.

### 6.6.1 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

No special maintenance work is required.

### 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) $\rightarrow$ 苜 77 .

## 8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

### 8.1 Device-specific accessories

| Accessory | Description | Order code |
| :---: | :---: | :---: |
| Proline Promag 50 transmitter | Transmitter for replacement or storage. Use the order code to define the following specifications: <br> - Approvals <br> - Degree of protection/version <br> - Cable for remote version <br> - Cable entry <br> - Display/power supply/operation <br> - Software <br> - Outputs/inputs | 50XXX - XXXXX****** |

### 8.2 Measuring principle-specific accessories

| Accessory | Description | Order code |
| :---: | :---: | :---: |
| Mounting set for Promag 50 transmitter | Mounting set for the transmitter (remote version). Suitable for: <br> - Wall mounting <br> - Pipe mounting <br> - Panel-mounted installation <br> Mounting set for aluminum field housing. Suitable for: <br> - Pipe mounting | DK5WM - * |
| Wall-mounting kit for Promag H | Wall-mounting kit for the Promag H sensor. | DK5HM - ** |
| Cable for remote version | Coil and signal cables, various lengths. | DK5CA - ** |
| Mounting kit for Promag D, wafer version | Mounting kit consisting of: <br> - Mounting bolts <br> - Nuts incl. washers <br> - Flange seals <br> - Centering sleeves (if required for the flange) | DKD** - ** |
| Set of seals for Promag D | Set of seals consisting of two flange seals. | DK5DD - *** |
| Mounting kit for Promag H | Mounting kit consisting of: <br> - 2 process connections <br> - Threaded fasteners <br> - Seals | DKH** - **** |
| Set of seals for Promag H | For regular replacement of the seals of the Promag H sensor. | DK5HS - *** |
| Welding jig for Promag H | Weld nipple as process connection: welding jig for installation in pipe. | DK5HW - *** |
| Adapter connection for Promag A, H | Adapter connections for installing a Promag 10 H instead of a Promag 30/33 A or Promag 30/33 H DN 25. | DK5HA - ***** |
| Ground rings for Promag H | Ground rings for potential equalization. | DK5HR - *** |
| Ground cable for Promag L, W, P | Ground cable for potential equalization. | DK5GC - *** |
| Ground disk for Promag L, W, P | Ground disk for potential equalization. | DK5GD - * **** |


| Accessory | Description | Order code |
| :--- | :--- | :--- |
| Process display <br> RIA45 | Multifunctional 1-channel display unit: <br> - Universal input <br> - Transmitter power supply <br> - Limit relay <br> - Analog output | RIA45 - ****** |
| Process display <br> RIA251 | Digital display device for looping into the 4 to 20 mA current loop. | RIA251 - ** |
| Field display unit <br> RIA16 | Digital field display device for looping into the 4 to 20 mA current <br> loop. | RIA16 - *** |
| Application Manager <br> RMM621 | Electronic recording, display, balancing, control, saving and event <br> and alarm monitoring of analog and digital input signals. Values <br> and conditions determined are output by means of analog and <br> digital output signals. Remote transmission of alarms, input values <br> and calculated values using a PSTN or GSM modem. | RMM621 - <br> $* * * * * * * * *$ |

### 8.3 Communication-specific accessories

| Accessory | Description | Order code |
| :---: | :---: | :---: |
| HART Communicator Field Xpert SFX 100 | Handheld terminal for remote configuration and for obtaining measured values via the HART current output ( 4 to 20 mA ) and FOUNDATION Fieldbus. <br> Contact your Endress+Hauser representative for more information. | SFX100 - ******* |
| Fieldgate FXA320 | Gateway for remote interrogation of HART sensors and actuators via Web browser: <br> - 2-channel analog input (4 to 20 mA ) <br> - 4 binary inputs with event counter function and frequency measurement <br> - Communication via modem, Ethernet or GSM <br> - Visualization via Internet/Intranet in Web browser and/or WAP cellular phone <br> - Limit value monitoring with alarm by e-mail or SMS <br> - Synchronized time stamping of all measured values. | FXA320 - ***** |
| Fieldgate FXA520 | Gateway for remote interrogation of HART sensors and actuators via Web browser: <br> - Web server for remote monitoring of up to 30 measuring points <br> - Intrinsically safe version [EEx ia]IIC for applications in hazardous areas <br> - Communication via modem, Ethernet or GSM <br> - Visualization via Internet/Intranet in Web browser and/or WAP cellular phone <br> - Limit value monitoring with alarm by e-mail or SMS <br> - Synchronized time stamping of all measured values <br> - Remote diagnosis and remote configuration of connected HART devices | FXA520 - **** |
| FXA195 | The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port | FXA195 - * |

### 8.4 Service-specific accessories

| Accessory | Description | Order code |
| :--- | :--- | :--- |
| Applicator | Software for selecting and planning flowmeters. The Applicator <br> software can be downloaded from the Internet or ordered on <br> CD-ROM for installation on a local PC. <br> Contact your Endress+Hauser representative for more information. | DXA80 - * |
| Fieldcheck | Tester/simulator for testing flowmeters in the field. When used in <br> conjunction with the "FieldCare" software package, test results can <br> be imported into a database, printed out and used for official <br> certification. <br> Contact your Endress+Hauser representative for more information. | 50098801 |
| FieldCare | FieldCare is Endress+Hauser's FDT-based asset management tool. <br> It can configure all intelligent field units in your system and helps <br> you manage them. By using status information, it is also a simple <br> but effective way of checking their status and condition. | See the product page on <br> the Endress+Hauser <br> Web site: |
| www.endress.com |  |  |
| Memograph M graphic <br> display recorder | The Memograph M graphic display recorder provides information <br> on all the relevant process variables. Measured values are recorded <br> correctly, limit values are monitored and measuring points <br> analyzed. The data are stored in the 256 MB internal memory and <br> also on a DSD card or USB stick. <br> Memograph M boasts a modular design, intuitive operation and a <br> comprehensive security concept. The ReadWin ${ }^{\circledR}$ 2000 PC <br> software is part of the standard package and is used for configuring, <br> visualizing and archiving the data captured. <br> The mathematics channels which are optionally available enable <br> continuous monitoring of specific power consumption, boiler <br> efficiency and other parameters which are important for efficient <br> energy management. | RS* <br> e***** |
| FXA193 | Service interface from the device to the PC for operation via <br> FieldCare. | FXA193 - * |

## 9 Troubleshooting

## 9．1 Troubleshooting instructions

Always start troubleshooting 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 supply voltage $\rightarrow$ terminals 1,2 <br> 2．Check the power line fuse $\rightarrow$ P 92 <br> 85 to 260 V AC： 0.8 A slow－blow／ 250 V <br> 20 to 55 V AC／ 16 to 62 V DC： 2 A slow－blow／ 250 V <br> 3．Measuring electronics defective $\rightarrow$ order spare parts $\rightarrow$ 目 77 |
| 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 $\rightarrow$ R 88 <br> 2．Display module defective $\rightarrow$ order spare parts $\rightarrow 77$ <br> 3．Measuring electronics defective $\rightarrow$ order spare parts $\rightarrow 77$ |
| Display texts are in a foreign language． | Switch off power supply．Press and hold down both the $\ddagger \square$ 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． | Electronics board defective $\rightarrow$ order spare parts $\rightarrow$ 目 77 |
| $\downarrow$ |  |
| Error messages on display |  |
| Errors which occur during commissioning or measuring operation are displayed immediately． <br> Error messages consist of a variety of icons：the meanings of these icons are as follows（example）： <br> －Error type： $\mathbf{S}=$ system error， $\mathbf{P}=$ process error <br> －Error message type：$\{=$ fault message，$!=$ notice message <br> －EMPTY PIPE＝Type of error，e．g．measuring tube is only partly filled or completely empty <br> －03：00：05＝duration of error occurrence（in hours，minutes and seconds） <br> －\＃401＝error number <br> Caution！ <br> －See the information on $\rightarrow$ 冒 62 ！ <br> －The measuring system interprets simulations and positive zero return as system errors，but displays them as notice message only． |  |
| Error number： <br> No． 001 － 399 <br> No．501－699 | System error（device error）has occurred $\rightarrow$ 目 81 |
| Error number： No．401－499 | Process error（application error）has occurred $\rightarrow$ 且 83 |
| $\downarrow$ |  |
| Other error（without error message） |  |
| Some other error has occurred． | Diagnosis and rectification $\rightarrow$ 目 84 |

### 9.2 System error messages

Serious system errors are always recognized by the device as "Fault message", and are shown as a lightning flash ( $\langle$ ) on the display. Fault messages immediately affect the outputs.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures on $\rightarrow$ 眉 6 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 master copy of this form at the back of this manual.

Note!
Also observe the information on $\rightarrow$ 目 62 .


| No. | Error message / Type | Cause | Remedy (spare part $\rightarrow$ 目 87) |
| :---: | :---: | :---: | :---: |
| No. \# 3xx $\rightarrow$ System limits exceeded |  |  |  |
| 321 | $\begin{aligned} & \text { S: TOL. COIL CURR. } \\ & \text { ל: \# } 321 \end{aligned}$ | Sensor: <br> Coil current is out of tolerance. | Warning! <br> Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards! <br> Remote version: <br> 1. Check wiring of terminals $41 / 42 \rightarrow 44$ <br> 2. Check coil current cable connector. <br> Compact and remote version: <br> Replace measuring electronics boards if necessary |
| $\begin{gathered} 339 \\ \text { to } \\ 342 \end{gathered}$ | S: STACK CUR OUT n !: \# 339 to 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. <br> 2. Increase or reduce flow, as applicable. |
| $\begin{gathered} 343 \\ \text { to } \\ 346 \end{gathered}$ | S: STACK FREO. OUT n !: \# 343 to 346 |  | MESSAGE ( 伩 <br> - Configure the fault response of the output to "ACTUAL VALUE" so that the temporary buffer can be cleared. <br> - Clear the temporary buffer by the measures described under Item 1. |
| $\begin{gathered} 347 \\ \text { to } \\ 350 \end{gathered}$ | S: STACK PULSE OUT n !: \# 343 to 346 | 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 <br> 2. Increase the max. pulse frequency if the totalizer can handle a higher number of pulses. <br> 3. Increase or reduce flow, as applicable. <br> Recommendations in the event of fault category $=$ FAULT <br>  <br> - Configure the fault response of the output to "ACTUAL VALUE" so that the temporary buffer can be cleared. <br> - Clear the temporary buffer by the measures described under Item 1. |
| $\begin{aligned} & 351 \\ & \text { to } \\ & 354 \end{aligned}$ | S: CURRENT RANGE n !: \# 351 to 354 | Current output: flow is out of range. | 1. Change the upper or lower limit setting, as applicable. <br> 2. Increase or reduce flow, as applicable. |
| $\begin{array}{\|l\|} \hline 355 \\ \text { to } \\ 358 \end{array}$ | S: FREQ. RANGE n !: \# 355 to 358 | Frequency output: flow is out of range. | 1. Change the upper or lower limit setting, as applicable. <br> 2. Increase or reduce flow, as applicable. |
| $\begin{array}{\|l\|} \hline 359 \\ \text { to } \\ 362 \end{array}$ | $\begin{aligned} & \text { S: PULSE RANGE } \\ & \text { !: \# } 359 \text { to } 362 \end{aligned}$ | Pulse output: the pulse output frequency is out of range. | 1. Increase the setting for pulse weighting <br> 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). <br> Determine the pulse width: <br> - Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. <br> - 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. <br> Example: <br> The maximum input frequency of the connected counter is 10 Hz . The pulse width to be entered is: $\frac{1}{2 \cdot 10 \mathrm{~Hz}}=50 \mathrm{~ms}$ <br> 3. Reduce flow. |


| No． | Error message／Type | Cause | Remedy（spare part $\rightarrow$ 䍙 87） |
| :---: | :---: | :---: | :---: |
| No．\＃5xx $\rightarrow$ Application error |  |  |  |
| 501 | $\begin{aligned} & \text { S: SW.-UPDATE ACT. } \\ & \text { !: \# } 501 \end{aligned}$ | New amplifier or communication（I／O module） software version is loaded． <br> Currently no other functions are possible． | Wait until the procedure is finished． The device will restart automatically． |
| 502 | $\begin{aligned} & \text { S: UP-/DOWNLOAD ACT } \\ & \text { !: \# } 502 \end{aligned}$ | Uploading or downloading the device data via operating program． <br> Currently no other functions are possible． | Wait until the procedure is finished． |
| No．\＃6xx $\rightarrow$ Simulation mode active |  |  |  |
| 601 | S：POS．ZERO－RETURN ！：\＃ 601 | Positive zero return active <br> Caution！ <br> This message has the highest display priority！ | Switch off positive zero return |
| $\begin{array}{\|l} \hline 611 \\ \text { to } \\ 614 \end{array}$ | S：SIM．CURR．OUT．n ！：\＃ 611 to 614 | Simulation current output active |  |
| $\begin{array}{\|l} \hline 621 \\ \text { to } \\ 624 \end{array}$ | S：SIM．FREO．OUT．n <br> ！：\＃ 621 to 624 | Simulation frequency output active | Switch off simulation |
| $\begin{array}{\|l} \hline 631 \\ \text { to } \\ 634 \end{array}$ | S：SIM．PULSE n <br> ！：\＃ 631 to 634 | Simulation pulse output active | Switch off simulation |
| $\begin{array}{\|l} \hline 641 \\ \text { to } \\ 644 \end{array}$ | S：SIM．STAT．OUT n ！：\＃ 641 to 644 | Simulation status output active | Switch off simulation |
| $\begin{array}{\|l} \hline 671 \\ \text { to } \\ 674 \end{array}$ | S：SIM．STATUS IN n ！：\＃ 671 to 674 | Simulation status input active | Switch off simulation |
| 691 | S：SIM．FAILSAFE $\text { !: \# } 691$ | Simulation of response to error（outputs）active | Switch off simulation |
| 692 | S：SIM．MEASURAND ！：\＃ 692 | Simulation of a measured variable active（e．g．mass flow）． | Switch off simulation |
| 698 | S：DEV．TEST ACT． <br> ！：\＃ 698 | The measuring device is being checked on site via the test and simulation device． | － |

## 9．3 Process error messages

Note！
Also observe the information on $\rightarrow$ 目 62 ．

| No． | Error message／Type | Cause | Remedy（spare part $\rightarrow$ 目 87） |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \mathrm{P}=\text { Process error } \\ & \text { h = Fault message (with an effect on the outputs) } \\ & !\text { = Notice message (without an effect on the outputs) } \end{aligned}$ |  |  |  |
| 401 | EMPTY PIPE <br> 々：\＃ 401 | Measuring tube partially filled or empty | 1．Check the process conditions of the plant <br> 2．Fill the measuring tube |
| 461 | ADJ．NOT OK ！：\＃ 461 | EPD calibration not possible because the fluid＇s conductivity is either too low or too high． | The EPD function cannot be used with fluids of this nature． |
| 463 | $\begin{aligned} & \text { FULL = EMPTY } \\ & \text { ל: \# } 463 \end{aligned}$ | The EPD calibration values for empty pipe and full pipe are identical，therefore incorrect． | Repeat calibration，making sure procedure is correct $\rightarrow$ 目 74. |

### 9.4 Process errors without messages

| Symptoms | Rectification |
| :---: | :---: |
| Remark: You may have to change or cor | rect certain settings in functions in the function matrix in order to rectify the fault. |
| Flow values are negative, even though the fluid is flowing forwards through the pipe. | 1. Remote version: <br> - Switch off the power supply and check the wiring $\rightarrow 44$ <br> - If necessary, reverse the connections at terminals 41 and 42 <br> 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 $\rightarrow 54$ <br> 2. Check the fluid for presence of gas bubbles. <br> 3. In the "SYSTEM DAMPING" function $\rightarrow$ 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 $\rightarrow 54$ <br> 2. Check the fluid for presence of gas bubbles. <br> 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 $\rightarrow 74$ <br> 2. Remote version: Check the terminals of the EPD cable $\rightarrow$ R 44 <br> 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". <br> 2. Value for creepage too high. Reduce the value in the "LOW FLOW CUTOFF" function. |
| The fault cannot be rectified or some other fault not described above has arisen. <br> In these instances, please contact your Endress+Hauser service organization. | The following options are available for tackling problems of this nature: <br> Request the services of an Endress+Hauser service technician <br> If you contact our service organization to have a service technician sent out, please be ready to quote the following information: <br> - Brief description of the fault <br> - Nameplate specifications ( $\rightarrow$ 目 7): order code, serial number <br> Returning devices to Endress+Hauser <br> The necessary procedures ( $\rightarrow$ 国 6 ) must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. <br> Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a master copy of this form at the back of this manual. <br> Replace transmitter electronics <br> Components in the measuring electronics defective $\rightarrow$ order spare parts $\rightarrow 77$ |

### 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.

You can use positive zero return to set the signals of the current, pulse and status 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 $\rightarrow$ 贯 65

| Current output | MINIMUM VALUE <br> $0-20 \mathrm{~mA} \rightarrow 0 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA} \rightarrow 2 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ HART $\rightarrow 2 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ NAMUR $\rightarrow 3.5 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ HART NAMUR $\rightarrow 3.5 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ US $\rightarrow 3.75 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ HART US $\rightarrow 3,75 \mathrm{~mA}$ <br> $0-20 \mathrm{~mA}(25 \mathrm{~mA}) \rightarrow 0 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}(25 \mathrm{~mA}) \rightarrow 2 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}(25 \mathrm{~mA})$ HART $\rightarrow 2 \mathrm{~mA}$ <br> MAXIMUM VALUE <br> $0-20 \mathrm{~mA} \rightarrow 22 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA} \rightarrow 22 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ HART $\rightarrow 22 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ NAMUR $\rightarrow 22.6 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ HART NAMUR $\rightarrow 22.6 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ US $\rightarrow 22.6 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ HART US $\rightarrow 22.6 \mathrm{~mA}$ <br> $0-20 \mathrm{~mA}(25 \mathrm{~mA}) \rightarrow 25 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}(25 \mathrm{~mA}) \rightarrow 25 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}(25 \mathrm{~mA})$ HART $\rightarrow 25 \mathrm{~mA}$ <br> HOLD VALUE <br> Last valid value (preceding occurrence of the fault) is output. <br> ACTUAL VALUE <br> Measured value display on the basis of the current flow measurement. The fault is ignored. | Output signal corresponds to "zero flow" |
| :---: | :---: | :---: |
| Pulse output | MIN/MAX VALUE $\rightarrow$ FALLBACK VALUE <br> Signal output $\rightarrow$ no pulses <br> HOLD VALUE <br> Last valid value (preceding occurrence of the fault) is output. <br> ACTUAL VALUE <br> 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 |
| :--- | :--- | :--- |
| output | FALLBACK VALUE <br> Signal output $\rightarrow$ O Hz <br> FAILSAFE LEVEL <br> Output of the frequency specified in the FALÌLSAFE VALUE <br> function. <br> HOLD VALUE <br> Measured value display on the basis of the <br> last saved value preceding occurrence of the fault. <br> ACTUAL VALUE <br> Measured value display on the basis of the current flow <br> measurement. The fault is ignored. | Output signal corresponds to <br> "zero flow" |
| Totalizer | STOP <br> The totalizers are paused until the error is rectified. <br> ACTUAL VALUE <br> The fault is ignored. The totalizer continues to count in accordance <br> with the current flow value. <br> HOLD VALUE <br> The totalizer continues to count the flow in accordance with the <br> last valid flow value (before the error occurred). | Totalizer stops |
| Status output | In the event of a fault or power supply failure: <br> Status output $\rightarrow$ non-conductive | No effect on status output |

### 9.6 Spare parts

Detailed troubleshooting instructions are provided in the previous sections $\rightarrow 80$
The measuring device, moreover, provides additional support in the form of continuous selfdiagnosis 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 organization by providing the serial number printed on the transmitter's nameplate $\rightarrow 7$

Spare parts are shipped as sets comprising the following parts:

- Spare part
- Additional parts, small items (threaded fasteners, etc.)
- Mounting instructions
- Packaging


Fig. 52: $\quad$ Spare parts for Promag 50 transmitter (field and wall-mounted housings)
1 Power unit board ( 85 to 260 V AC, 20 to $55 \mathrm{VAC}, 16$ to 62 VDC )
2 Amplifier board
3 I/O board (COM module)
4 HistoROM / S-DAT (sensor data memory)
5 Display module

### 9.6.1 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards $\rightarrow 53$
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.

Caution!
Use only original Endress+Hauser parts.

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. 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.

4. Remove the screws and remove the cover (2) from the electronics compartment.
5. Remove the boards $(4,6)$ : Insert a suitable tool into the hole (3) provided for the purpose and pull the board clear of its holder.
6. 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.

7. Installation is the reverse of the removal procedure.


Fig. 53: 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 installing/removing boards |
| 4 | Power supply board |
| 5 | Amplifier board |
| 5.1 | Electrode signal cable (sensor) |
| 5.2 | Coil current cable (sensor) |
| 5.3 | Histo-ROM / S-DAT (sensor data memory) |
| 6 | I/O board |

## Wall-mount housing: removing and installing printed circuit boards $\rightarrow$ 苜 91

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.
Caution!
Use only original Endress+Hauser parts.

1. Switch off power supply.
2. Remove the screws and open the hinged cover (1) of the housing. Remove screws of the electronics module (2).
3. Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
4. 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.

5. Remove the screws and remove the cover (4) from the electronics compartment.
6. 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.
7. Installation is the reverse of the removal procedure.


Fig. 54: Wall-mount 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 installing/removing boards |
| 6 | Power supply board |
| 7 | Amplifier board |
| 7.1 | Electrode signal cable (sensor) |
| 7.2 | Coil current cable (sensor) |
| 7.3 | Histo-ROM / S-DAT (sensor data memory) |
| 8 | I/O board |

### 9.6.2 Replacing the device fuse

## $\triangle$

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 ( $\rightarrow$ 目 92) .
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board: field housing $\rightarrow$ 眉 88, wall-mount housing $\rightarrow 90$
3. Remove cap (1) and replace the device fuse (2).

Use only fuses of the following type:

- Power supply 20 to 55 V AC / 16 to 62 V DC $\rightarrow 2.0$ A slow-blow / 250 V ; $5.2 \times 20 \mathrm{~mm}$
- Power supply 85 to $260 \mathrm{~V} \mathrm{AC} \rightarrow 0.8$ A slow-blow / $250 \mathrm{~V} ; 5.2 \times 20 \mathrm{~mm}$
- Ex-rated devices $\rightarrow$ see the Ex documentation.

4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.


Fig. 55: Replacing the device fuse on the power supply board
1 Protective cap
$2 \quad$ Device fuse

### 9.6.3 Replacing the exchangeable electrode

The Promag W sensor (DN 350 to 2000; 14" to 78 ") is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions.


Fig. 56: Apparatus for replacing exchangeable measuring electrodes
View $A=$ DN 1200 to 2000 (48" to 78")
View B = DN 350 to 1050 (14" to 42")
1 Allen screw
2 Handle
3 Electrode cable
4 Knurled nut (locknut)
5 Measuring electrode
6 Stop cock (ball valve)
7 Retaining cylinder
8 Locking pin (for handle)
9 Ball-valve housing
10 Seal (retaining cylinder)
11 Coil spring


### 9.7 Return

Caution!
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.
The following steps must be taken before returning a flow measuring device to Endress+Hauser, e.g. for repair or calibration:

- 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 EC REACH Regulation No. 1907/2006.
- 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 these Operating Instructions.


### 9.8 Disposal

Observe the regulations applicable in your country!

### 9.9 Software history

| Date | Software version | Changes to software | Operating <br> Instructions |
| :---: | :--- | :--- | :--- |
| 11.2009 | Amplifier: <br> V 2.03.XX | Introduction of Calf history | $71106181 / 12.09$ <br> $71105332 / 11.09$ |
| 06.2009 | Amplifier: <br> V 2.02.XX | Introduction of Promag L <br> Amplifier: | Introduction of Promag D <br> Introduction of new nominal diameter <br> Communication module: <br> 1.04 .00 |
| 11.2004 .2009 | Software update relevant only for production <br> Amplifier: <br> Communication module: <br> 1.03 .00 | - Flow direction pulse output selectable <br> - Language groups <br> New functionalities: <br> - Second Totalizer <br> - Adjustable backlight (display) <br> - Operation hours counter <br> - Simulation function for pulse output <br> - Counter for access code <br> - Reset function (fault history) <br> - Up-/download with FieldTool | $50097089 / 10.03$ |
| 10.2003 | $51088677 / 03.09$ |  |  |


| Date | Software version | Changes to software | Operating Instructions |
| :---: | :---: | :---: | :---: |
| 08.2003 | Communication module: $1.02 .01$ | Software expansion: <br> - New / revised functionalities <br> New functionalities: <br> - Current span NAMUR NE 43 <br> - Failsafe mode function <br> - Troubleshooting function <br> - System and process error messages <br> - Response of status output | 50097089 / 08.03 |
| 08.2002 | Amplifier: $1.04 .00$ | Software expansion: <br> - New / revised functionalities <br> New functionalities: <br> - Current span NAMUR NE 43 <br> - EPD (new mode) <br> - Failsafe mode function <br> - Acknowledge fault function <br> - Troubleshooting function <br> - System and process error messages <br> - Response of status output | 50097089 / 08.02 |
| 03.2002 | Amplifier: $1.03 .00$ | Software expansion: <br> - Suitability for custody transfer measurement Promag 50/51 | none |
| 06.2001 | Amplifier: $1.02 .00$ <br> Communication module: $1.02 .00$ | Software expansion: <br> - New functionalities: <br> New functionalities: <br> - General device functions <br> - "OED" software function <br> - "Pulse width" software function | 50097089 / 06.01 |
| 09.2000 | Amplifier: <br> 1.01.01 <br> Communication module: <br> 1.01.00 | Software expansion: <br> - Functional adaptations | none |
| 08.2000 | Amplifier: $1.01 .00$ | Software expansion: <br> - Functional adaptations | none |
| 04.2000 | Amplifier: $1.00 .00$ <br> Communication module: $1.00 .00$ | Original software <br> Compatible with: <br> - FieldTool <br> - Commuwin II (version 2.05 .03 and higher) <br> - HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD1 | 50097089 / 04.00 |

Note!
Uploads or downloads between the individual software versions are only possible with a special service software.

## 10 Technical data

### 10.1 Technical data at a glance

### 10.1.1 Application

$\rightarrow$ 䆚 5

### 10.1.2 Function and system design

Measuring principle Electromagnetic flow measurement on the basis of Faraday's Law.

| Measuring system | $\rightarrow$ 目7 |
| :---: | :---: |
|  | 10.1.3 Input |
| Measured variable | Flow velocity (proportional to induced voltage) |
| Measuring range | Typically $\mathrm{v}=0.01$ to $10 \mathrm{~m} / \mathrm{s}(0.033$ to $33 \mathrm{ft} / \mathrm{s}$ ) with the specified accuracy |
| Operable flow range | Over 1000: 1 |
| Input signal | Status input (auxiliary input) <br> - Galvanically isolated <br> - $\mathrm{U}=3$ to 30 V DC <br> - $\mathrm{Ri}=5 \mathrm{k} \Omega$ <br> - Can be configured for: totalizer reset, positive zero return, error message reset. |

### 10.1.4 Output

## Current output

- Galvanically isolated
- Active/passive can be selected:
- Active: $0 / 4$ to $20 \mathrm{~mA}, \mathrm{R}_{\mathrm{L}}<700 \Omega$ (HART: $\mathrm{R}_{\mathrm{L}} \geq 250 \Omega$ )
- Passive: 4 to 20 mA , supply voltage $\mathrm{V}_{\mathrm{S}} 18$ to 30 V DC, $\mathrm{R}_{\mathrm{i}} \geq 150 \Omega$ )
- Time constant can be selected ( 0.01 to 100 s )
- Full scale value adjustable
- Temperature coefficient: typ. $0.005 \%$ o.f.s. $/{ }^{\circ} \mathrm{C}$, resolution: $0.5 \mu \mathrm{~A}$
o.f.s. $=$ of full scale value

Pulse/frequency output

- Galvanically isolated
- Passive: 30 V DC / 250 mA
- Open collector
- Can be configured as:
- Pulse output

Pulse value and pulse polarity can be selected, max. pulse width adjustable ( 0.5 to 2000 ms )

- Frequency output

Full scale frequency 2 to $1000 \mathrm{~Hz}\left(\mathrm{f}_{\max }=1.25 \mathrm{~Hz}\right.$ ), on/off ratio $1: 1$, pulse width max. 10 s .

| Signal on alarm | Current output <br> Failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43) |
| :--- | :--- |
|  | Pulse/frequency output <br> Failsafe mode can be selected <br> Status output <br>  <br> "Not conductive" in the event of fault or power supply failure |
| Load | See "Output signal" |
| Status output |  |
| ■ Galvanically isolated |  |
| ■ Max. 30 V DC/250 mA collector |  |
| ■ Can be configured for: error messages, empty pipe detection (EPD), flow direction, limit values |  |

## 10．1．5 Power supply

Electrical connections $\rightarrow$ 眉 44

| Supply voltage （power supply） | － 85 to $260 \mathrm{~V} \mathrm{AC}$,45 to 65 Hz <br> － 20 to $55 \mathrm{~V} \mathrm{AC}, 45$ to 65 Hz <br> － 16 to 62 V DC |
| :---: | :---: |
| Cable entry | Power supply and signal cables（inputs／outputs）： |
|  | －Cable entry M20 $\times 1.5$（ 8 to $12 \mathrm{~mm} / 0.31$ to 0.47 inch） <br> －Sensor cable entry for armored cables M20 $\times 1.5$（ 9.5 to $16 \mathrm{~mm} / 0.37$ to 0.63 inch） <br> －Threads for cable entries $1 / 2{ }^{\prime \prime}$ NPT，G $1 / 2{ }^{\prime \prime}$ |
|  | Connecting cable for remote version： |
|  | －Cable entry M20 $\times 1.5$（ 8 to $12 \mathrm{~mm} / 0.31$ to 0.47 inch） <br> －Sensor cable entry for armored cables M20 $\times 1.5$（ 9.5 to $16 \mathrm{~mm} / 0.37$ to 0.63 inch） <br> －Threads for cable entries $1 / 2$＂NPT，G $1 / 2{ }^{1}$ |
| Cable specifications | $\rightarrow$ 目 50 |
| Power consumption | Power consumption |
|  | －AC：$<15$ VA（incl．sensor） <br> －DC：＜15 W（incl．sensor） |
|  | Switch－on current |
|  | －Max 3 A（ $<5 \mathrm{~ms}$ ）for 260 V AC <br> －Max．13．5 A（ $<5 \mathrm{~ms}$ ）for 24 V DC |
| Power supply failure | －Lasting min． 1 cycle frequency： <br> －EEPROM saves measuring system data <br> －S－DAT：exchangeable data storage chip which stores the data of the sensor（nominal diameter， serial number，calibration factor，zero point etc．） |
| Potential equalization | $\rightarrow$ 目 54 |

## 10．1．6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI／VDE 2641：
－Fluid temperature：$+28{ }^{\circ} \mathrm{C} \pm 2 \mathrm{~K}$
－Ambient temperature：$+22^{\circ} \mathrm{C} \pm 2 \mathrm{~K}$
－Warm－up period： 30 minutes

## Installation：

－Inlet run $>10 \times \mathrm{DN}$
－Outlet run $>5 \times$ DN
－Sensor and transmitter grounded．
－The sensor is centered in the pipe．

Maximum measured error ■ Current output：plus typically $\pm 5 \mu \mathrm{~A}$
－Pulse output：$\pm 0.5 \%$ o．r．$\pm 1 \mathrm{~mm} / \mathrm{s}$
Option：$\pm 0.2 \%$ o．r．$\pm 2 \mathrm{~mm} / \mathrm{s}$（o．r．$=$ of reading）
（o．r．$=$ of reading）
Fluctuations in the supply voltage do not have any effect within the specified range．


Fig．57：Max．measured error in \％of reading

| Repeatability | Max．$\pm 0.1 \%$ o．r．$\pm 0.5 \mathrm{~mm} / \mathrm{s}$（o．r．$=$ of reading） |
| :---: | :---: |
|  | 10．1．7 Operating conditions：Installation |
| Installation instructions | Any orientation（vertical，horizontal），restrictions and installation instructions $\rightarrow 13$ |
| Inlet and outlet run | If possible，install the sensor upstream from fittings such as valves，T－pieces，elbows，etc．The following inlet and outlet runs must be observed in order to meet accuracy specifications（ $\rightarrow$ 胃 16， $\rightarrow$ 12）： <br> －Inlet run：$\geq 5 \times \mathrm{DN}$ <br> －Outlet run：$\geq 2 \times \mathrm{DN}$ |
| Adapters | $\rightarrow$ 目 17 |
| Length of connecting cable | $\rightarrow$ 目 20 |

### 10.1.8 Operating conditions: Environment

Ambient temperature range - Transmitter:

- Standard: -20 to $+60^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+140^{\circ} \mathrm{F}\right)$
- Optional: -40 to $+60^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+140^{\circ} \mathrm{F}\right)$
(2) Note!

At ambient temperatures below $-20\left(-4^{\circ} \mathrm{F}\right)$ the readability of the display may be impaired.

- Sensor:
- Flange material carbon steel: -10 to $+60^{\circ} \mathrm{C}\left(+14\right.$ to $\left.+140^{\circ} \mathrm{F}\right)$
- Flange material stainless steel: -40 to $+60^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+140^{\circ} \mathrm{F}\right)$

Caution!

- The permitted temperature range of the measuring tube lining may not be undershot or overshot $(\rightarrow$ "Operating conditions: Process" $\rightarrow$ "Medium temperature range").
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.
Storage temperature The storage temperature corresponds to the operating temperature range of the measuring
transmitter and the appropriate measuring sensors.
Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid
unacceptably high surface temperatures.
E A storage location must be selected where moisture does not collect in the measuring device. This
will help prevent fungus and bacteria infestation which can damage the liner.
- Standard: IP 67 (NEMA 4X) for transmitter and sensor
- Optional: IP 68 (NEMA 6P) for remote version of Promag L, W and P sensor. Promag L only with stainless steel flanges.

Shock and vibration resistance Acceleration up to 2 g following IEC 60068-2-6
(high-temperature version: no data available)

CIP cleaning
Caution!
The maximum fluid temperature permitted for the device may not be exceeded.
CIP cleaning is possible:
Promag P, Promag H
CIP cleaning is not possible:
Promag D, Promag L, Promag W
SIP cleaning
Caution!
The maximum fluid temperature permitted for the device may not be exceeded.
SIP cleaning is possible:
Promag H
SIP cleaning is not possible:
Promag D, Promag L, Promag W, Promag P

Electromagnetic compatibility
(ENC)

- As per IEC/EN 61326 and NAMUR Recommendation NE 21
- Emission: to limit value for industry EN 55011


### 10.1.9 Operating conditions: Process

Medium temperature range The permissible temperature depends on the lining of the measuring tube

## Promag D

0 to $+60^{\circ} \mathrm{C}\left(+32\right.$ to $\left.+140^{\circ} \mathrm{F}\right)$ for polyamide

Promag L

- -20 to $+50^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+122^{\circ} \mathrm{F}\right)$ for polyurethane (DN 50 to 300)
- -20 to $+90^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+194^{\circ} \mathrm{F}\right)$ for PTFE (DN 50 to 300)


## Promag $W$

- 0 to $+80^{\circ} \mathrm{C}\left(+32\right.$ to $\left.+176^{\circ} \mathrm{F}\right)$ for hard rubber (DN 65 to 2000)
- -20 to $+50^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+122^{\circ} \mathrm{F}\right)$ for polyurethane (DN 25 to 1200)


## Promag P

Standard

- -40 to $+130^{\circ} \mathrm{C}\left(-40\right.$ to $\left.+266^{\circ} \mathrm{F}\right)$ for PTFE (DN 15 to $600 / 1 / 2^{\prime \prime}$ to 24 "), Restrictions $\rightarrow$ see the following diagrams
- -20 to $+130^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+266^{\circ} \mathrm{F}\right)$ for PFA/HE (DN 25 to $200 / 1^{\prime \prime}$ to $\left.8^{\prime \prime}\right)$, Restrictions $\rightarrow$ see the following diagrams
- -20 to $+150{ }^{\circ} \mathrm{C}\left(-4\right.$ to $+302^{\circ} \mathrm{F}$ ) for PFA (DN 25 to $200 / 1^{\prime \prime}$ to 8 "), Restrictions $\rightarrow$ see the following diagrams
Optional
High-temperature version (HT): -20 to $+180^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+356^{\circ} \mathrm{F}\right)$ for PFA (DN 25 to $200 / 1^{\prime \prime}$ to $\left.8^{\prime \prime}\right)$


[^1]

Abb. 59: Remote version Promag P (with PFA- or PTFE-lining)
$T_{A}=$ ambient temperature; $T_{F}=$ fluid temperature; $H T=$ high-temperature version with insulation
(1) $=$ light gray area $\rightarrow$ temperature range from -10 to $-40^{\circ} \mathrm{C}\left(-14\right.$ to $\left.-40^{\circ} \mathrm{F}\right)$ is valid for stainless steel version only (2) = diagonal hatched area $\rightarrow$ foam lining (HE) and degree of protection IP68 $=$ fluid temperature $\max .130^{\circ} \mathrm{C} / 260^{\circ} \mathrm{F}$

Promag H
Sensor:

- DN 2 to 25: -20 to $+150^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+302^{\circ} \mathrm{F}\right)$
- DN 40 to 100: -20 to $+150^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+302^{\circ} \mathrm{F}\right)$

Seals:

- EPDM: -20 to $+150^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+302^{\circ} \mathrm{F}\right)$
- Silicone: -20 to $+150^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+302^{\circ} \mathrm{F}\right)$
- Viton: -20 to $+150{ }^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+302^{\circ} \mathrm{F}\right)$
- Kalrez: -20 to $+150^{\circ} \mathrm{C}\left(-4\right.$ to $\left.+302^{\circ} \mathrm{F}\right)$

Conductivity
The minimum conductivity is $\geq 5 \mu \mathrm{~S} / \mathrm{cm}(\geq 20 \mu \mathrm{~S} / \mathrm{cm}$ for demineralized water $)$
Note!
Note that in the case of the remote version, the requisite minimum conductivity is also influenced by the length of the connecting cable $\rightarrow$ 目 20

Medium pressure range
(nominal pressure)

Promag D

- EN 1092-1 (DIN 2501)
- PN 16
- ANSI B 16.5
- Class 150
- JIS B2220
- 10 K


## Promag L

- EN 1092-1 (DIN 2501)
- PN 10 (DN 50 to 300)
- PN 16 (DN 50 to 150)
- EN 1092-1, lap joint flange, stampel plate
- PN 10 (DN 50 to 300)
- ANSI B 16.5
- Class 150 (2" to 12")


## Promag W

- EN 1092-1 (DIN 2501)
- PN 6 (DN 350 to 2000)
- PN 10 (DN 200 to 2000)
- PN 16 (DN 65 to 2000)
- PN 25 (DN 200 to 1000)
- PN 40 (DN 25 to 150)
- ANSI B 16.5
- Class 150 (1" to 24")
- Class 300 (1" to 6")
- AWWA
- Class D (28" to 78")
- JIS B2220
- 10 K (DN 50 to 300)
- 20 K (DN 25 to 300)
- AS 2129
- Table E (DN 80, 100, 150 to 1200)
- AS 4087
- PN 16 (DN 80, 100, 150 to 1200)


## Promag P

- EN 1092-1 (DIN 2501)
- PN 10 (DN 200 to 600)
- PN 16 (DN 65 to 600)
- PN 25 (DN 200 to 600)
- PN 40 (DN 15 to 150)
- ANSI B 16.5
- Class 150 ( $1 / 2$ " to 24")
- Class 300 ( $1 / 22^{\prime \prime}$ to 6")
- JIS B2220
- 10 K (DN 50 to 300)
- 20 K (DN 15 to 300)
- AS 2129
- Table E (DN 25, 50)
- AS 4087
- PN 16 (DN 50)


## Promag H

The permissible nominal pressure depends on the process connection and the seal:

- 40 bar $\rightarrow$ flange, weld nipple (with O-ring seal)
- $16 \mathrm{bar} \rightarrow$ all other process connections

Pressure tightness

## Promag D

Measuring tube: 0 mbar abs ( 0 psi abs) with a fluid temperature of $\leq 60^{\circ} \mathrm{C}\left(\leq 140^{\circ} \mathrm{F}\right)$

Promag L (Measuring tube lining: Polyurethane)

| Promag L <br> Nominal diameter |  | Resistance of measuring tube lining to partial vacuum <br> Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |
| :---: | :---: | :---: | :---: | :---: |
| [\mathrm{mm}]{} | [inch] | $\mathbf{2 5}{ }^{\circ} \mathrm{C}$ | $\mathbf{5 0}{ }^{\circ} \mathrm{C}$ | $\mathbf{8 0 ^ { \circ }} \mathbf{\mathrm { C }}$ |
|  | $27^{\circ} \mathrm{F}$ | $\mathbf{1 2 2}^{\circ} \mathrm{F}$ | $\mathbf{1 7 6}^{\circ} \mathrm{F}$ |  |
|  | 2 to $12^{\prime \prime}$ | 0 | 0 | - |

Promag L
Measuring tube lining: PTFE

| Promag L <br> Nominal diameter |  | Resistance of measuring tube lining to partial vacuum <br> Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| [mm] | [inch] | $25^{\circ} \mathrm{C}$ |  | $90^{\circ} \mathrm{C}$ |  |
|  |  | $77^{\circ} \mathrm{F}$ |  | $194{ }^{\circ} \mathrm{F}$ |  |
|  |  | [mbar] | [psi] | [mbar] | [psi] |
| 50 | 2 " | 0 | 0 | 0 | 0 |
| 65 | - | 0 | 0 | 40 | 0.58 |
| 80 | 3" | 0 | 0 | 40 | 0.58 |
| 100 | 4" | 0 | 0 | 135 | 1.96 |
| 125 | - | 135 | 1.96 | 240 | 3.48 |
| 150 | $6 "$ | 135 | 1.96 | 240 | 3.48 |
| 200 | 8" | 200 | 2.90 | 290 | 4.21 |
| 250 | 10" | 330 | 4.79 | 400 | 5.80 |
| 300 | 12" | 400 | 5.80 | 500 | 7.25 |

Promag W

| Promag W Nominal diameter |  | Measuring tube lining | Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $25^{\circ} \mathrm{C}$ | $50^{\circ} \mathrm{C}$ | $80^{\circ} \mathrm{C}$ | $100^{\circ} \mathrm{C}$ | $130{ }^{\circ} \mathrm{C}$ | $150{ }^{\circ} \mathrm{C}$ | $180{ }^{\circ} \mathrm{C}$ |
| [mm] | [inch] |  | $77^{\circ} \mathrm{F}$ | $122{ }^{\circ} \mathrm{F}$ | $176{ }^{\circ} \mathrm{F}$ | $212{ }^{\circ} \mathrm{F}$ | $266{ }^{\circ} \mathrm{F}$ | $302{ }^{\circ} \mathrm{F}$ | $356{ }^{\circ} \mathrm{F}$ |
| 25 to 1200 | 1 to 48" | Polyurethane | 0 | 0 | - | - | - | - | - |
| 65 to 2000 | 3 to 78" | Hard rubber | 0 | 0 | 0 | - | - | - | - |

Promag P
Measuring tube lining: PFA

| Promag P <br> Nominal diameter |  | Resistance of measuring tube lining to partial vacuum <br> Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $25^{\circ} \mathrm{C}$ | $80^{\circ} \mathrm{C}$ | $100{ }^{\circ} \mathrm{C}$ | $130{ }^{\circ} \mathrm{C}$ | $150{ }^{\circ} \mathrm{C}$ | $180{ }^{\circ} \mathrm{C}$ |
| [mm] | [inch] | $77^{\circ} \mathrm{F}$ | $176{ }^{\circ} \mathrm{F}$ | $212{ }^{\circ} \mathrm{F}$ | $266{ }^{\circ} \mathrm{F}$ | $302{ }^{\circ} \mathrm{F}$ | $356{ }^{\circ} \mathrm{F}$ |
| 25 | $1{ }^{\prime \prime}$ | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | - | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | $1^{1 / 2 "}$ | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | $2 "$ | 0 | 0 | 0 | 0 | 0 | 0 |
| 65 | - | 0 | * | 0 | 0 | 0 | 0 |
| 80 | 3" | 0 | * | 0 | 0 | 0 | 0 |
| 100 | 4" | 0 | * | 0 | 0 | 0 | 0 |


| Promag P <br> Nominal diameter |  | Resistance of measuring tube lining to partial vacuum <br> Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $25^{\circ} \mathrm{C}$ | $80^{\circ} \mathrm{C}$ | $100{ }^{\circ} \mathrm{C}$ | $130{ }^{\circ} \mathrm{C}$ | $150{ }^{\circ} \mathrm{C}$ | $180{ }^{\circ} \mathrm{C}$ |
| [mm] | [inch] | $77^{\circ} \mathrm{F}$ | $176{ }^{\circ} \mathrm{F}$ | $212{ }^{\circ} \mathrm{F}$ | $266{ }^{\circ} \mathrm{F}$ | $302{ }^{\circ} \mathrm{F}$ | $356{ }^{\circ} \mathrm{F}$ |
| 125 | - | 0 | * | 0 | 0 | 0 | 0 |
| 150 | $6 "$ | 0 | * | 0 | 0 | 0 | 0 |
| 200 | 8" | 0 | * | 0 | 0 | 0 | 0 |

Promag P
Measuring tube lining: PTFE

| Promag P <br> Nominal diameter |  | Resistance of measuring tube lining to partial vacuum <br> Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| [mm] | [inch] | $25^{\circ} \mathrm{C}$ |  | $80^{\circ} \mathrm{C}$ | $100^{\circ} \mathrm{C}$ |  | $130{ }^{\circ} \mathrm{C}$ |  | $150{ }^{\circ} \mathrm{C}$ | $180{ }^{\circ} \mathrm{C}$ |
|  |  | $77^{\circ} \mathrm{F}$ |  | $176^{\circ} \mathrm{F}$ | $212{ }^{\circ} \mathrm{F}$ |  | $266{ }^{\circ} \mathrm{F}$ |  | $302{ }^{\circ} \mathrm{F}$ | $356{ }^{\circ} \mathrm{F}$ |
|  |  | [mbar] | [psi] |  | [mbar] | [psi] | [mbar] | [psi] |  |  |
| 15 | $1 / 2{ }^{\prime \prime}$ | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | - | - |
| 25 | $1{ }^{\prime \prime}$ | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | - | - |
| 32 | - | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | - | - |
| 40 | $1^{11 / 2 "}$ | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | - | - |
| 50 | $2{ }^{\prime \prime}$ | 0 | 0 | 0 | 0 | 0 | 100 | 1.45 | - | - |
| 65 | - | 0 | 0 | * | 40 | 0.58 | 130 | 1.89 | - | - |
| 80 | 3" | 0 | 0 | * | 40 | 0.58 | 130 | 1.89 | - | - |
| 100 | 4" | 0 | 0 | * | 135 | 1.96 | 170 | 2.47 | - | - |
| 125 | - | 135 | 1.96 | * | 240 | 3.48 | 385 | 5.58 | - | - |
| 150 | 6" | 135 | 1.96 | * | 240 | 3.48 | 385 | 5.58 | - | - |
| 200 | 8" | 200 | 2.90 | * | 290 | 4.21 | 410 | 5.95 | - | - |
| 250 | 10" | 330 | 4.79 | * | 400 | 5.80 | 530 | 7.69 | - | - |
| 300 | 12" | 400 | 5.80 | * | 500 | 7.25 | 630 | 9.14 | - | - |
| 350 | 14" | 470 | 6.82 | * | 600 | 8.70 | 730 | 10.59 | - | - |
| 400 | 16" | 540 | 7.83 | * | 670 | 9.72 | 800 | 11.60 | - | - |
| 450 | 18" |  |  |  | Partial vac | m is im | rmissible! |  |  |  |
| 500 | 20" |  |  |  |  |  |  |  |  |  |
| 600 | $24 "$ |  |  |  |  |  |  |  |  |  |
| * No value can be quoted. |  |  |  |  |  |  |  |  |  |  |

Promag H (Measuring tube lining: PFA)

| Promag H <br> Nominal diameter |  | Resistance of measuring tube lining to partial vacuum <br> Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $25^{\circ} \mathrm{C}$ | $80^{\circ} \mathrm{C}$ | $100^{\circ} \mathrm{C}$ | $130{ }^{\circ} \mathrm{C}$ | $150{ }^{\circ} \mathrm{C}$ | $180{ }^{\circ} \mathrm{C}$ |
| [mm] | [inch] | $77^{\circ} \mathrm{F}$ | $176{ }^{\circ} \mathrm{F}$ | $212{ }^{\circ} \mathrm{F}$ | $266{ }^{\circ} \mathrm{F}$ | $302{ }^{\circ} \mathrm{F}$ | $356{ }^{\circ} \mathrm{F}$ |
| 2 to 100 | 1/12 to 4" | 0 | 0 | 0 | 0 | 0 | 0 |

Limiting flow $\rightarrow$ 思 18

- 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 (see "Adapters" $\rightarrow$ 目17)


### 10.1.10 Mechanical construction

Design, dimensions
The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the


Promag D

| Weight data of Promag D in kg |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Nominal diameter |  | Compact version | Remote version (without cable) |  |
| $[\mathrm{mm}]$ | [inch] |  | Sensor | Transmitter |
| 25 | 1" | 4.5 | 2.5 | 6.0 |
| 40 | $11 / 2 "$ | 5.1 | 3.1 | 6.0 |
| 50 | $2^{\prime \prime}$ | 5.9 | 3.9 | 6.0 |
| 65 | $21 / 2{ }^{\prime \prime}$ | 6.7 | 4.7 | 6.0 |
| 80 | 3" | 7.7 | 5.7 | 6.0 |
| 100 | 4" | 10.4 | 8.4 | 6.0 |
| Transmitter Promag (compact version): 3.4 kg (Weight data valid without packaging material) |  |  |  |  |

Promag L (lap joint flanges)

| Weight data of Promag L in kg |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal diameter <br> [mm] [inch] |  | Compact version |  |  |  | Remote version (without cable) |  |  |  |  |
|  |  |  |  |  |  | Transmitter |
|  |  | EN (DIN) | ANSI |  | EN (DIN) |  | ANSI |  |  |
| 50 | $2{ }^{\prime \prime}$ |  |  |  |  | $\frac{0}{z}$ | 10.6 | $\begin{aligned} & \stackrel{0}{n} \\ & \stackrel{\pi}{\sigma} \\ & \stackrel{\omega}{\omega} \end{aligned}$ | 10.6 | $\frac{0}{z}$ | 8.6 | $\begin{aligned} & 0 \\ & \stackrel{n}{2} \\ & \underset{\sim}{心} \end{aligned}$ | 8.6 | 6.0 |
| 65 | $21 / 2 "$ | 12.0 | - | 10.0 | - |  | 6.0 |  |  |  |
| 80 | $3{ }^{\prime \prime}$ | 14.0 | 14.0 | 12.0 | 12.0 |  | 6.0 |  |  |  |
| 100 | 4" | 16.0 | 16.0 | 14.0 | 14.0 |  | 6.0 |  |  |  |
| 125 | 5" | 21.5 | - | 19.5 | - |  | 6.0 |  |  |  |
| 150 | $6 "$ | 25.5 | 25.5 | 23.5 | 23.5 |  | 6.0 |  |  |  |
| 200 | 8" | $\frac{0}{z}$ | 45 | 45 | $\frac{0}{Z}$ | 43 | 43 |  | 6.0 |  |  |
| 250 | $10 "$ |  | 65 | 65 |  | 63 | 73 |  | 6.0 |  |  |
| 300 | 12" |  | 70 | - |  | 68 | - |  | 6.0 |  |  |
| Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings |  |  |  |  | ithout | gin | terial) |  |  |  |  |

Promag L (lap joint flanges, stamped plate)

| Weight data of Promag L in kg |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal diameter [mm] [inch] |  | Compact version EN (DIN) |  | Remote version (without cable) |  |  |
|  |  | Sensor EN (DIN) | Transmitter |
| 50 | $2^{\prime \prime}$ |  |  | $\frac{0}{Z}$ | 7.2 | $\frac{0}{z}$ | 5.2 | 6.0 |
| 65 | $21 / 2 "$ | 8.0 | 6.0 |  | 6.0 |  |
| 80 | 3" | 9.0 | 7.0 |  | 6.0 |  |
| 100 | $4 "$ | 11.5 | 9.5 |  | 6.0 |  |
| 125 | 5" | 15.0 | 13.0 |  | 6.0 |  |
| 150 | $6{ }^{\prime \prime}$ | 19.0 | 17.0 |  | 6.0 |  |
| 200 | $8{ }^{\prime \prime}$ | 37.5 | 35.5 |  | 6.0 |  |
| 250 | 10 | 56.0 | 54.0 |  | 6.0 |  |
| 300 | 12" | 57.0 | 55.0 |  | 6.0 |  |
| Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings and without packaging material) |  |  |  |  |  |  |

Promag W


[^2]*Flanges according to AS are only available for DN 80, 100, 150 to 400, 500 and 600

Promag P


Promag H

| Weight data of Promag H in kg |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Nominal diameter |  | Compact version DIN | Remote version (without cable) |  |
| [mm] | [inch] |  | Sensor | Transmitter |
| 2 | 1/12" | 5.2 | 2 | 6.0 |
| 4 | 5/32" | 5.2 | 2 | 6.0 |
| 8 | 5/16" | 5.3 | 2 | 6.0 |
| 15 | $1 / 2{ }^{\prime \prime}$ | 5.4 | 1.9 | 6.0 |
| 25 | $1{ }^{\prime \prime}$ | 5.5 | 2.8 | 6.0 |
| 40 | $11 / 2 "$ | 6.5 | 4.5 | 6.0 |
| 50 | $2{ }^{\prime \prime}$ | 9.0 | 7.0 | 6.0 |
| 65 | $21 / 2 "$ | 9.5 | 7.5 | 6.0 |
| 80 | $3{ }^{\prime \prime}$ | 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) |  |  |  |  |

Weight (US units)

## Promag D

| Weight data of Promag D in lbs |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Nominal diameter |  | Compact version | Remote version (without cable) |  |
| [mm] | [inch] |  | Sensor | Transmitter |
| 25 | $1{ }^{\prime \prime}$ | 10 | 6 | 13 |
| 40 | $1^{1 / 21}$ | 11 | 7 | 13 |
| 50 | 2" | 13 | 9 | 13 |
| 80 | 3" | 17 | 13 | 13 |
| 100 | 4" | 23 | 19 | 13 |
| Transmitter Promag (compact version): 7.5 lbs (Weight data valid without packaging material) |  |  |  |  |

Promag L (ANSI)

| Weight data of Promag L in lbs |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal diameter |  | Compact version |  | Remote version (without cable) |  |  |
| [mm] | [inch] |  |  | Sensor |  | Transmitter |
| 50 | 2 " | $\begin{aligned} & \stackrel{i n}{w} \\ & \stackrel{\ddot{\circ}}{3} \end{aligned}$ | 23 |  | 19 | 13 |
| 80 | 3" |  | 31 |  | 26 | 13 |
| 100 | $4{ }^{\prime \prime}$ |  | 35 |  | 31 | 13 |
| 150 | $6 "$ |  | 56 |  | 52 | 13 |
| 200 | $8{ }^{\prime \prime}$ |  | 99 |  | 95 | 13 |
| 250 | 10" |  | 143 |  | 161 | 13 |

## Promag P (ANSI/AWWA)

## Weight data of Promag P in lbs

| Nominal diameter  <br> $[\mathrm{mm}]$ $[$ inch $]$ |  | Compact version |  | Remote version (without cable) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Transmitter |
| 15 | $1 / 21$ |  |  | $\begin{aligned} & \text { on } \\ & \text { a } \\ & \text { 藏 } \end{aligned}$ | 14 | $\begin{aligned} & \frac{i n}{w} \\ & \stackrel{a}{3} \end{aligned}$ | 10 | 13 |
| 25 | $1{ }^{\prime \prime}$ | 16 | 12 |  | 13 |  |
| 40 | $11 / 21$ | 21 | 16 |  | 13 |  |
| 50 | $2 "$ | 23 | 19 |  | 13 |  |
| 80 | 3" | 31 | 26 |  | 13 |  |
| 100 | $4{ }^{\prime \prime}$ | 35 | 31 |  | 13 |  |
| 150 | $6 "$ | 56 | 52 |  | 13 |  |
| 200 | $8{ }^{\prime \prime}$ | 99 | 95 |  | 13 |  |
| 250 | 10" | 165 | 161 |  | 13 |  |
| 300 | 12 " | 243 | 238 |  | 13 |  |
| 350 | 14 " | 386 | 381 |  | 13 |  |
| 400 | $16 "$ | 452 | 448 |  | 13 |  |
| 450 | 18" | 562 | 558 |  | 13 |  |
| 500 | $20 "$ | 628 | 624 |  | 13 |  |
| 600 | 24 " | 893 | 889 |  | 13 |  |

[^3]Promag W (ANSI/AWWA)

| Weight data of Promag W in lbs |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal diameter <br> [mm] <br> [inch] |  | Compact version |  | Remote version (without cable) |  |  |
|  |  | Sensor | Transmitter |
| 25 | $1{ }^{\prime \prime}$ |  |  |  | 16 | $\begin{aligned} & \stackrel{0}{\tilde{m}} \\ & \underset{\sim}{\ddot{m}} \end{aligned}$ | 12 | 13 |
| 40 | $11 / 2 "$ | 21 | 16 |  | 13 |  |
| 50 | 2 " | 23 | 19 |  | 13 |  |
| 80 | 3" | 31 | 26 |  | 13 |  |
| 100 | 4" | 35 | 31 |  | 13 |  |
| 150 | $6 "$ | 56 | 52 |  | 13 |  |
| 200 | 8" | 99 | 95 |  | 13 |  |
| 250 | 10" | 143 | 161 |  | 13 |  |
| 300 | 12" | 243 | 238 |  | 13 |  |
| 350 | $14 "$ | 386 | 381 |  | 13 |  |
| 400 | $16^{\prime \prime}$ | 452 | 448 |  | 13 |  |
| 450 | 18" | 562 | 558 |  | 13 |  |
| 500 | 201 | 628 | 624 |  | 13 |  |
| 600 | 24 " | 893 | 889 |  | 13 |  |
| 700 | 28 " | $\begin{aligned} & \text { ص } \\ & \text { ॐ } \\ & \text { ひ̈ } \end{aligned}$ | 882 | $\begin{aligned} & \text { ص } \\ & \text { ॐ } \\ & \text { む̃ } \end{aligned}$ | 878 | 13 |
| - |  |  | 1014 |  | 1010 | 13 |
| 800 | 32" |  | 1213 |  | 1208 | 13 |
| 900 | $36 "$ |  | 1764 |  | 1760 | 13 |
| 1000 | 40 |  | 1985 |  | 1980 | 13 |
| - | $42^{\prime \prime}$ |  | 2426 |  | 2421 | 13 |
| 1200 | 48" |  | 3087 |  | 3083 | 13 |
| - | 54" |  | 4851 |  | 4847 | 13 |
| - | $60 "$ |  | 5954 |  | 5949 | 13 |
| - | $66 "$ |  | 8159 |  | 8154 | 13 |
| 1800 | 72 |  | 9041 |  | 9036 | 13 |
| - | 78" |  | 10143 |  | 10139 | 13 |
| Transmitter Promag (compact version): 7.5 lbs <br> (Weight data valid for standard pressure ratings and without packaging material) |  |  |  |  |  |  |

Promag H

| Weight data of Promag H in lbs |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Nominal diameter |  | Compact version | Remote version (without cable) |  |
| [mm] | [inch] |  | Sensor | Transmitter |
| 2 | 1/12" | 11 | 4 | 13 |
| 4 | 5/32" | 11 | 4 | 13 |
| 8 | 5/16" | 12 | 4 | 13 |
| 15 | 1/2" | 12 | 4 | 13 |
| 25 | $1{ }^{\prime \prime}$ | 12 | 6 | 13 |
| 40 | $1^{1 / 21}$ | 14 | 10 | 13 |
| 50 | 2" | 20 | 15 | 13 |
| 65 | $21 / 21$ | 21 | 17 | 13 |
| 80 | 3" | 42 | 37 | 13 |
| 100 | $4{ }^{4}$ | 41 | 36 | 13 |
| Transmitter Promag (compact version): 7.5 lbs (Weight data valid for standard pressure ratings and without packaging material) |  |  |  |  |

## Material

## Promag D

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing: powder-coated die-cast aluminum
- Measuring tube: polyamide, O-rings EPDM
(Drinking water approvals: WRAS BS 6920, ACS, NSF 61, KTW/W270)
- Electrodes: 1.4435/316L
- Ground disks: 1.4301/304


## Promag L

- Transmitter housing:
- Compact housing: powder-coated die-cast aluminum
- Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing: powder-coated die-cast aluminum
- Measuring tube: stainless steel 1.4301 or $1.4306 / 304 \mathrm{~L}$
- Electrodes: 1.4435, Alloy C-22
- Flange
- EN 1092-1 (DIN 2501): 1.4306; 1.4307; 1.4301; RSt37-2 (S235JRG2)
- ANSI: A105; F316L
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L or Alloy C-22


## Promag W

- Transmitter housing:
- Compact housing: powder-coated die-cast aluminum
- Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
- DN 25 to 300: powder-coated die-cast aluminum
- DN 350 to 2000: with protective lacquering
- Measuring tube
- DN $\leq 300$ : stainless steel 1.4301 or $1.4306 / 304 \mathrm{~L}$
(for flanges made of carbon steel with $\mathrm{Al} / \mathrm{Zn}$ protective coating)
- DN $\geq 350$ : stainless steel 1.4301 or $1.4306 / 304$
(for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435 or Alloy C-22, Tantalum
- Flange
- EN 1092-1 (DIN2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B ( $\mathrm{DN} \leq 300$ with $\mathrm{Al} / \mathrm{Zn}$ protective coating; $\mathrm{DN} \geq 350$ with protective lacquering)
- ANSI: A105; F316L
(DN $\leq 300$ with $\mathrm{Al} / \mathrm{Zn}$ protective coating; $\mathrm{DN} \geq 350$ with protective lacquering)
- AWWA: 1.0425
- JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
(DN $\leq 300$ with $\mathrm{Al} / \mathrm{Zn}$ protective coating; $\mathrm{DN} \geq 350$ with protective lacquering)
- 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)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L, Alloy C-22, Titanium, Tantalum


## Promag P

- Transmitter housing:
- Compact housing: powder-coated die-cast aluminum
- Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
- DN 15 to 300: powder-coated die-cast aluminum
- DN 350 to 2000: with protective lacquering
- Measuring tube
- DN $\leq 300$ : stainless steel 1.4301 or $1.4306 / 304 \mathrm{~L}$; for flanges made of carbon steel with $\mathrm{Al} / \mathrm{Zn}$ protective coating
- DN $\geq 350$.: stainless steel 1.4301 or $1.4306 / 304$ L; for flanges made of carbon steel with $\mathrm{Al} /$ Zn protective coating
- Electrodes: 1.4435 , Platinum, Alloy C-22, Tantalum, Titanium
- Flange
- EN 1092-1 (DIN2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B
(DN $\leq 300$ : with $\mathrm{Al} / \mathrm{Zn}$ protective coating; $\mathrm{DN} \geq 350$ with protective lacquering)
- ANSI: A105; F316L
( $\mathrm{DN} \leq 300$ with $\mathrm{Al} / \mathrm{Zn}$ protective coating; $\mathrm{DN} \geq 350$ with protective lacquering)
- AWWA: 1.0425
- JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
(DN $\leq 300$ with $\mathrm{Al} / \mathrm{Zn}$ protective coating; $\mathrm{DN} \geq 350$ with protective lacquering)
- AS 2129
- (DN 25) A105 or RSt37-2 (S235JRG2)
- (DN 40) A105 or St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L or Alloy C-22


## Promag H

- Transmitter housing:
- Compact housing: powder-coated die-cast aluminum or stainless steel field housing (1.4301/316L)
- Wall-mounted housing: powder-coated die-cast aluminum
- Window material: glas or polycarbonate
- Sensor housing: stainless steel 1.4301
- Wall mounting kit: stainless steel 1.4301
- Measuring tube: stainless steel 1.4301
- Electrodes:
- Standard: 1.4435
- Option: Alloy C-22, Tantalum, Platinum
- Flange:
- All connections stainless-steel 1.4404/316L
- EN (DIN), ANSI, JIS made of PVDF
- Adhesive fitting made of PVC
- Seals
- DN 2 to 25: O-ring (EPDM, Viton, Kalrez), gasket seal (EPDM, Viton, silicone)
- DN 40 to 100: gasket seal (EPDM, Viton, silicone)
- Ground rings: 1.4435/316L (optional: Tantalum, Alloy C-22)

Material load diagram
The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the "Technical Information" documents of the device in question:
List of supplementary documentation $\rightarrow 116$.

| Fitted electrodes | Promag D |
| :---: | :---: |
|  | - 2 measuring electrodes for signal detection |
|  | Promag L, W and P |
|  | - 2 measuring electrodes for signal detection <br> - 1 EPD electrode for empty pipe detection <br> - 1 reference electrode for potential equalization |
|  | Promag H |
|  | - 2 measuring electrodes for signal detection <br> - 1 EPD electrode for empty pipe detection (apart from DN 2 to 15) |
| Process connections | Promag D |
|  | Wafer version $\rightarrow$ without process connections |
|  | Promag L |
|  | Flange connections: <br> - EN 1092-1 (DIN 2501) <br> - ANSI |
|  | Promag $W$ and $P$ |
|  | Flange connections: <br> - EN 1092-1 (DIN 2501) <br> - $\mathrm{DN} \leq 300=$ form A <br> - DN $\geq 350$ = flat face <br> - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1 <br> - ANSI <br> - AWWA (only Promag W) <br> - JIS <br> - AS |
|  | Promag H |
|  | With O-ring: <br> - Weld nipple DIN (EN), ISO 1127, ODT/SMS <br> - Flange EN (DIN), ANSI, JIS <br> - Flange made of PVDF EN (DIN), ANSI, JIS <br> - External thread <br> - Internal thread <br> - Hose connection <br> - PVC adhesive fitting |
|  | With gasket seal: <br> - Weld nipple DIN 11850, ODT/SMS <br> - Clamp ISO 2852, DIN 32676, L14 AM7 <br> - Threaded joint DIN 11851, DIN 11864-1, ISO 2853, SMS 1145 <br> - Flange DIN 11864-2 |
| Surface roughness | All data relate to parts in contact with fluid. |
|  | - Liner $\rightarrow$ PFA: $\leq 0.4 \mu \mathrm{~m}$ ( $15 \mu \mathrm{in}$ ) <br> - Electrodes: 0.3 to $0.5 \mu \mathrm{~m}$ ( 12 to $20 \mu \mathrm{in}$ ) <br> - Process connection made of stainless-steel (Promag H): $\leq 0.8 \mu \mathrm{~m}$ (31 $\mu \mathrm{in}$ ) |

### 10.1.11 Human interface

| Display elements | - Liquid crystal display: illuminated, two-line, 16 characters per line <br> - Custom configurations for presenting different measured-value and status variables <br> - 2 totalizers |
| :---: | :---: |
| $8$ | Note! <br> At ambient temperatures below $-20\left(-4^{\circ} \mathrm{F}\right)$ the readability of the display may be impaired. |
| Operating elements | - Local operation with three keys $(-\boxed{\square} \pm, \Xi)$ <br> - "Quick Setup" menus for straightforward commissioning |
| Language groups | Language groups available for operation in different countries: <br> - Western Europe and America (WEA): <br> English, German, Spanish, Italian, French, Dutch and Portuguese <br> - Eastern Europe/Scandinavia (EES): <br> English, Russian, Polish, Norwegian, Finnish, Swedish and Czech <br> - Southeast Asia (SEA): <br> English, Japanese, Indonesian <br> Note! <br> You can change the language group via the operating program "FieldCare". |
| Remote operation | Operation via HART protocol and Fieldtool <br> 10.1.12 Certificates and approvals |
| 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. |
| C-tick mark | The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA) |
| Ex approval | Information about currently available Ex versions (ATEX, FM, CSA, IECEx, NEPSI etc.) 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 D, L, W and P |
|  | No applicable approvals or certification |
|  | Promag H <br> - 3A authorization and EHEDG-tested <br> - Seals: in conformity with FDA (except Kalrez seals) |
| Drinking water approval | Promag D, L and W |
|  | - WRAS BS 6920 <br> - ACS <br> - NSF 61 <br> - KTW/W270 |
|  | Promag P and H |
|  |  |

## Promag D and L

No pressure measuring device approval

## Promag W, P and H

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 fluid and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.

Other standards and guidelines

- EN 60529

Degrees of protection by housing (IP code).

- EN 61010-1

Safety requirements for electrical equipment for measurement, control and laboratory use

- IEC/EN 61326

Electromagnetic compatibility (EMC requirements)

- ANSI/ISA-S82.01

Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2, Installation Category II.

- CAN/CSA-C22.2 (No. 1010.1-92)

Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I.

- NAMUR NE 21

Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.

- NAMUR NE 43

Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.

### 10.1.13 Ordering information

Your Endress+Hauser service organization can provide detailed ordering information and information on the order codes on request.

### 10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor $\rightarrow$ 異 77.
Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

### 10.1.15 Documentation

- Flow measuring technology (FA005D/06)
- Technical Information Promag 50D (TI082D/06)
- Technical Information Promag 50L (TI097D/06)
- Technical Information Promag 50W, 53W (TI046D/06)
- Technical Information Promag 50P, 53P (TI047D/06)
- Technical Information Promag 50H, 53H (TI048D/06)
- Description of Device Functions Promag 50 HART (BA049D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.


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## People for Process Automation

## Declaration of Hazardous Material and De-Contamination Erklärung zur Kontamination und Reinigung



Please reference the Return Authorization Number (RA\#), obtained from Endress+Hauser, on all paperwork and mark the RA\# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility. Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA\#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to 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 und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp

Serial number
Seriennummer

Used as SIL device in a Safety Instrumented System / Einsatz als SIL Gerät in Schutzeinrichtungen


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

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.
Description of failure / Fehlerbeschreibung $\qquad$

Company data / Angaben zum Absender
Company / Firma __ Phone number of contact person / Telefon-Nr. Ansprechpartner:

Address / Adresse
Fax / E-Mail $\qquad$
Your order No. / Ihre Auftragsnr.
"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."
"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

People for Process Automation



## A. $100 \%$ FLOW AREA

For improved flow charact rintict and lower head loss, the Val-Matic Swing-Flox Check Volve provides $100 \%$ unrestricted flow area.

## B. REINFORCED DISC

The one piece precision molded dise is steel and nylen reinforced to provide years of trouble free parformance. It is backed by a 25 year warranty for the flex portion of the disc. ITeated for proof of design - see page 5.)

## C. ONE MOVING PART

The Memory-Flex ${ }^{\text {C }}$ dise, the only moving part, ossures long life with minimal maintonance. No packing or O-tings, mechanical hinges, pivot pins or bearings to wear out.

## D. DOMED ACCESS PORT

Full sife top occes pert allows removal of dise without removing volve from line: Accers cover includes a drilled and tapped port for inutallation of optional Dise Position Indicator.

## E. DROP TIGHT SEATING

The synihetic reinforced dise, with its intearal O-ring type sagal design cisures positive seating at high and low pressures.

## F. NON.SLAM CLOSURE

"Short Disc Stroke" combined with Memory-Flox Disc Action reduces polentially destructive water hammer.

## G. BACKFLOW ACTUATOR (Not Shown)

Body is drilled and tapped for installation of optional beckflow ectuator (see options),

## H. NON-CLOG DESIGN

The unrestritted full How areo combined with amooth streamlined contovring allows passage of large solids minimizing the potential for cloggins.

## 1. MECHANICAL DISC POSITION

INDICATOR* (Optional)
Provides clear indication or the valvo's dite poriliton. Con also be provided wih a SCADA compatible limit switch for off site monitoring (see options).

## d. FUSION BONDED EPOXY

Fusion Bonded Epoxy (FBE) is provided standard on the interior and exterior of the valve. The FBE is ANSI/NSF 61 cerified. Other coatings are available on request.

## INSTALLATION DIMENSIONS AND CONSTRUCTION

| VALVE slze | $\begin{gathered} \text { MODEI } \\ \# \end{gathered}$ | A | $E$ | F1 | F2 | H | 1 | K | L |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | 502A | 8 | 2 | $\mathrm{N} / \mathrm{A}$ | 37/1\% | -1/2 | $63 / 4$ | 7/8 | 11/2 |
| $21 / 7$ | 525 A | 8 1/2 | $21 / 2$ | $\mathrm{N} / \mathrm{A}$ | $3 \mathrm{z} / 1$ | -1/2 | 7 | 5/8 | 11/2 |
| 3 | 503A | 9 1/2 | 3 | 7s/4 | 51/411 | $-3 / 8$ | 7.1/2 | $3 / 4$ | 13/4 |
| 4 | 504A | $111 / 3$ | 4 | $81 / 4$ | $53 / 4$ | $11 / 2$ | $71 / 4$ | $23 / 4$ | 23/4 |
| 6 | 506A | 15 | 6 | 9 a/8 | 67/11 | 2 | 12 | 61/4 | $31 / 4$ |
| 8 | 503A | $191 / 2$ | 8 | 11 | $83 / 1$ | 2 | $153 / 4$ | $71 / 2$ | 41/4 |
| 10 | 510A | 24 1/2 | 10 | 13.818 | $103 / 4$ | 4 | $203 / 8$ | 8 | 51/4 |
| 12 | 512 A | 27.1/2 | 12 | 15 | $121 / 2$ | $31 / 2$ | 221/2 | 10 | $61 / 2$ |
| 14 | 514 A | 31 | 14 | 17 3/6 | 13 | 4 | $261 / 4$ | 11:5/8 | $71 / 2$ |
| 16 | 516 A | 32 | 16 | $187 / 8$ | $141 / 4$ | 45.8 | 30 | $131 / 4$ | $85 / 8$ |
| 18 | 518A | 36 | 18 | 20 | 151/4 | 51/4 | 33 $1 / 4$ | 15 | 9, 3/4 |
| 20 | 520 A | 40 | 20 | $213 / 3$ | $167 / 1$ | $57 \%$ | \|37 1/2 | 163.3 | 10\%/3 |
| 24 | 524 A | 48 | 24 | 23.78 | $191 / 4$ | 7 | 45 | 20 | 13 |
| 30 | 530 | 56 | 30 | 27 5/8 | 23 | -5/8 | $411 / 4$ | 12 | 6 |
| 36 | 536 | 63 | 36 | 31 | $273 / 4$ | -6 1/8] | $43.1 / 2$ | 8 | 6 |


"Dinemion "E" repretech nominal vcive dize.
Nitee Plianyed endi corform to Ahsis1cil Oloe 123

| MATERIALS OF CONSTIUCTION |  |  |  |
| :---: | :---: | :---: | :---: |
| Component |  | Standand | Optional |
| Sody und Cover |  | Ductie Hon A5TM.A536 Grade 65-45.12 | Stolidens Seel Brenze |
| Dis\% |  |  | Vien [FKM/ ASTM D2000-HK |
| Coastry: | Interior | Furion Bonded Epoxy* | Tuaber Liding |
|  | Expriat | Fution bonded Epexy ${ }^{\text {² }}$ | Cemult Fostary |

Coment fectory fer odilifional menterial and soobley nitioms.
*ANSI/NSF 61 Cersifiention

| ANSI MAXIMUM PRESSURE-TEMPERATURERATING |  |  |
| :---: | :---: | :---: |
| Meximum Non-Sheck Working Prossure (P.SS) ANSI Class 125 |  |  |
| Tempersture ${ }^{\text {P }}$ \% | $2^{-2}-24^{\prime \prime}$ | $30^{\prime \prime}-36^{\prime \prime}$ |
| $100^{\circ}$ |  |  |
| $150^{\circ}$ | 250 | 150 |
| $200^{*}$ | 235 | 135 |
| Hydrontatic Test Presuures | 375 | 230 |

## HEAD LOSS CHART



FLOW OF WATER IN GALLONS PER MINUTE
Consult factory for Digester Gas Service
Flow Tests performed by the Utah Water

Research Laboratory of Utah State
University.

## SAMPLE SPECIFICATIONS

The check valve shall be of the Swing-Flex" full body fianged type, with a domed access cover and only one moving port - the valve disc.

The valve body thall have full flow equal to nominal pipe diameter of ony point through the volve. The seating surface shall be on a $45^{\circ}$ angle to minimize disc travel. The top access port shall be full size, allowing removal of the disc without remoral of the valve from the pipeline and shall include a port for installation of an optional mechanical position indicator.

The disc shall be of one piece construction, precition molded with an integral O-ring type sealing surfoce and contain steel and nyion reinforcements in both the Memory Flex "and central disc areas The flex portion of the disc shall be worranted for 25 years. Non-slam dosing characteristic shall be provided through a short $35^{\circ}$ disc stroke and a

Memory-Flex ${ }^{-}$disc return action.
A mechanical indicator shall be provided when specified to provide disc position indication on valves $3^{\prime \prime}$ and larger. The indicator shall have continuous contoct with the disc under all operating condifions to ossure accurate ditc position indication.

A limit switch will be provided when specified to indicate oper/closed position to a remote locotion. The mechorical type limit switch shall be activated by the external position indicator. The switch shall be rated for NEMA 4, 6, or $6 P$ and shall have U.L. rated 5 amp , 125 , or 250 VAC contacts.

Boskflow copabilities shall be available by means of an optional screw type bockflow actuctor. Both the disc position indicator and backflow actuator thall be copoble of installation without special tools.

The valve body and cover shall be ASTM A536 Grode 65-45-12, Class B Ductile Iron. The disc sholl be Bunc-N (NER), ASTM D2000-8G.

The interior and exterior of the valve shall be coated with an ANSI/NSF 61 opproved Fusion Bonded Epoxy.

The valve sholl be proof of derign cycle fested $1,000,000$ times with no signs of wear or distortion to the valve cisc or seat and shail remain drop tight at both high and low pressures. The test results shall be independently certified.

The monufacturer sholl have a minimum of five years experience in the manufacture of flexible disc type check valves.

The valve shall be Val-Matic Swing-Flex ${ }^{*}$ series 500 and thall be designed, manufactured and tested in occordance with ANSI/AWWA Standard C508.

## INDEPENDENT PROOF OF DESIGN TEST

In the cose of the Val-Matic Swing-Flex ${ }^{4}$ Oheck Yolve, we have taken quality ossurance one step further by having the valve cycle tested, Uflizing an eight-inch Swing-Flex ${ }^{*}$ with optional signal switch, the valve was cycled over $1,000,000$ (one million) times.

To place one million cycles in perspective, it would toke an average of 100 cycles per doy for more then 27 years
to equal the $1,000,000$ cycles. Upcn conclusion, PSI/Pittsburgh Testing Laboratory Division reported the follow. ing results

1. After $1,000,000$ cycles the volve's dise showed no signs of fatigue or stress crecks.
2. After $1,000,000$ cycles the valve seating areas showed no signs of weor
or distortion. The valve seating remained drop tight during the low end high pressure hydrostatic tests.
3. After $1,000,000$ cycles the signal switch continued to function as designed.

Copies of the PSI/Pittrburgh Testing Laboratory Division report ere available upon requert,

## QUALITY ASSURANCE

Val-Matic's Quality Assurance is the sum of imaginative design, solid engineering, careful monu. facturing and dedicoted people.

These all combine to ensure total customer satisfoction. We recognize the need for, and encouroge, individual pride and the self-satisfaction, which is goined in producing reliable ond quality valves.

This quality attitude permeates through the corporation from the president to our newest employee.

Testing (right) is the bockbone of our quality assurance. Every Swing-Flex ${ }^{\text {© }}$ Check Valve is $100 \%$ tested including a seat test to assure drop tight sealing and hydrostatic testing to assure the integrity of the casting.


3 ming-ties ${ }^{4}$ Velve at test.

## EFFICIENCY..... RELIABILITY BY DESIGN!

Efficiency and reliobility through simplicity of design is the key to the superior performance and long life of the ValMatic Swing-Flex ${ }^{*}$ Check Valve.

## ENERGY EFFCIENT BY DESIGN

The treamlined centour of the Swing-Flex ${ }^{*}$ body provides $100 \%$ flow area with no restrictions at any point through the valve (Figure 1.) Flow tests performed by an independent laberatory have shown thet this unique body design produces minimal head lass through the valve. Flow and heod less charts, developed from the test dato, ore thown on Poge 4.

## DISC STABILIZATION BY DESIGN

In the full open position, the disc is stabilized by using body contouring to ease the direction of flow towards the disc assuting long disc life (Figure 1).

## NON-CIOGGING BY DESIGN

Clog resistant performance is achieved by maintaining an unobstructed $100 \%$ flow area, smooth streamlined body contouring and the simplicity of one moving part. The entrapmert or hang-up of solids and stringy materiols is minimized by the ellimingtion of meckanical devices in the valve derign. The standard $4^{\prime \prime}$ Swing-Flex is designed to pass a $3^{\prime \prime}$ solld.

## NON-SLAM CLOSING BY DESIGN

The non-slam closing characteristic of the Swing-Flex ${ }^{*}$ Oheck Valve is ochieved by utilizing o "Shart Disc Stroke" in conjunction with the unique "Memory-Flex" action" of the valve's disc. The $35^{\circ}$ stroke, o result of the angled seat, is less than half the typicol $80^{\circ}$ to $90^{\circ}$ stroke of a conventional swing check valve. (Figures 18 2) The feature is similar to that found in high performance tilted disc check volver.

## VAL-MATIC SWING-FLEX ${ }^{*}$ VALVE

Fifure 1


## CONVENTIONAL SWING CHECK VALVE

Figure 2


The short ditc stroke and "Memory-Filex" action" (Figure 1) serve to reduce the cloting time of the valve. This reduced cloting time minimizes flow reversal and the resultant water hommer normally associated with the sudden stoppoge of reverse flow.

## REHABILTY BY DESICN

Operational reliability is achieved by utilizing fust one moving part, the Memory-Flex "disc. Extended life is --
designed into the disc by the inclusion of steel and nylon reinforcements. The steel and nylon are precision molded into the disc, providing a tough, duroble disc with a 25 -year warronty". (Figure 3)

Unlike a conventional horizontal swing check valve, the $\mathrm{Swing}^{2}$-Flex ${ }^{2}$ has no packing or O-rings, mechanical hinges, thafts, pivgt pint, or bearings to wear out (Figure 3.) Upon conclusion of a $1,000,000$ (one millisen) cycle test, on independent testing laboratory reported that the volve had no visible signs of wear ond remoined drop tight. (See Page 5.)


Figure 1

## POSTIVE SHUT OFF BY DESIGN

The Memory-Flex ${ }^{*}$ dise with its integral O-ring type seal detign assures drop tight seating of both high and low working pressures. Each and every volve is tested to this stondord. A certified report in available upon requert.

## OPTIONAL ACCESSORIES

RUBBER UNING - Unlke conventionol rwing check valves, the Swing-Flex ${ }^{*}$ Check Volve is designed to accept synthetic or notural rubber lining. Body lining soupled with syrthetic Memory-Fiex ${ }^{*}$ discs makes the Swing-Flex" ideally wited for systems containing obrasive oe corrosive filid.


DISC POSITION INDICATOR - The cover mounted disc position indicotor provictes dear indication of the volve's diac position. A SCADA corpotible limit iwitch con aho be provided. Both can be provided of the fime of valve purchose or for field installotion of a later dote.

BACKFLOW ACTUATOR .- Avollable for use when manval backflow operation is required. Mott commonly tsed for priming pumpt, bock flusting, draiking lines and sytem testing. The Vel-Maric sockflow Actuator con be provided of the thre of ralve purchase or for field installotion at a leter dove.



## Make the change to QUALITY! Specify $\sqrt{\text { AL MATIC }}$

Vol Matic's quelity of design end meticylous warkmanthip hos $1 e t$ the stenderes by which all others are mecoured. Qualisy desien lectures wheh on Type 316 stainless steel tifm os mendard on Air Releave, Ait/Vacrum and Combination Ait Valvel.combined restient/metol to metal teating for Silem Gaeck ValVet.,tobilized componenti thet provide extended IIfe of the Dual Dike Check Velves_high strength and wear reshtent aluminum branze trife as standard for Tilied Dsc' Check valves unreshiced full flow arec through Swing-flex Check Volves.ineavy duty itoinles steel sereened inlet on Sure Seal Foot Valves, a Com-Centric:

Plug Vake with more requestad features then eny other occentric plug volve, and the Arerican-BFV Batteffly Volve that provides a fiek reploceable seet whithout the need for spercal fools. There fearures coupled with our artention to derail pur Var-Maric valves in a closs by mersselves.

Val-Matic is totclily committed to provicing the highes qually volves ond outitanding service to our cuitomers. Complete arstomer satisfaction is our gool.

## The perfect fit for all water industry applications

One solution for all your needs

- designed for use in all water and waste water applications, from sewage plants to distribution networks

State-of-the-art memory technology

- revolutionary data storage enables transmitter interchange and commissioning without the need for re-configuration

Versatile and simple configuration

- 'Through-the-Glass' (TTG) configuration eliminating the need to remove the cover
- smart key based functionality
- 'Easy Setup' function

VeriMaster in situ verification software option

- enables the customer to perform in situ verification of the flowmeter system


MID and OIML R49 approved with R49 self-checking

- Type-approved to accuracy Class 1 and Class 2 for any pipe orientation and bidirectional flows
- Type P-approved continuous self-checking of the sensor and transmitter to ensure the highest accuracy and long term performance

Innovative sensors for all applications

- optimized full-bore series for optimum turndown / low pressure drop, irrigation applications
- full-bore series for general-purpose water metering applications
- buriable sensors eliminating the need for costly chamber construction


## HART, PROFIBUS DP and MODBUS

- Access to all status information

Unparalleled service ability

- fault-finding Help texts on the display
- minimized downtime with replaceable electronics cartridges



## The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.
As a world leader in process automation technology our worldwide presence, comprehensive service and application-oriented know-how make ABB a leading supplier of flow measurement products.

## Introduction

## Setting the standard for the Water Industry

The WaterMaster range, available in sizes 10 to 2400 mm ( $3 / 8$ to 96 in .), is designed specifically for use on the many diverse applications encountered in the Water and Waste-water industry. The modular design concept offers flexibility, cost-saving operation and reliability while providing a long service life and exceptionally low maintenance.

Integration into ABB asset management systems and use of the self-monitoring and diagnostic functions increase the plant availability and reduce downtimes.

## VeriMaster - the verification tool

An easy-to-use utility, available through the infra red service port, it uses the advanced self-calibration and diagnostic capability of WaterMaster, coupled with fingerprinting technology, to determine the accuracy status of the WaterMaster flowmeter to within $\pm 1 \%$ of its original factory calibration. VeriMaster also supports printing of calibration verification records for regulatory compliance.


## Diagnostic functions

Using its diagnostic functions, the flowmeter monitors both its own operability and the process. Limit values for the diagnostic parameters can be set locally. When these limits are exceeded, an alarm is tripped. In the event of an error, diagnostic-dependent help text appears on the display and this considerably simplifies and accelerates the troubleshooting procedure.
In accordance with NAMUR NE107, alarms and warnings are classified with the status of 'Maintenance Required', 'Check Function', 'Failure' and 'Out of Specification'.

## Flow performance

Utilizing its advanced filtering methods, the WaterMaster improves accuracy even under difficult conditions by separating the noise from the measuring signal. WaterMaster has an operating flow range with $\pm 0.4$ \% accuracy as standard ( $\pm 0.2$ \% optional) in both forward and reverse flow directions.

## Easy and quick commissioning

'Fit-and-Flow' data storage inside WaterMaster eliminates the need to match sensor and transmitter in the field. On initial installation, the self-configuration sequence automatically replicates into the transmitter all calibration factors, meter size and serial numbers, as well as customer site-specific settings, eliminating the potential for error.

## Intuitive, convenient navigation

The 'Easy Setup' function reliably guides unpracticed users through the menu step by step. The smart key based functionality makes handling a breeze - it's just like using a cell phone. During configuration, the permissible range of each parameter is indicated on the display and invalid entries are rejected.

## Universal transmitter - powerful and flexible

The backlit display can be rotated easily without the need for tools. The contrast is adjustable and the display fully-configurable. The character size, number of lines and display resolution (number of decimal points) can be set as required. In multiplex mode, several different display options can be pre-configured and invoked one after the other.
The smart modular design of the transmitter unit enables easy disassembly without the need to unscrew cables or unplug connectors. HART is used as the standard communications protocol. Optionally, the transmitter is available with PROFIBUS DP or MODBUS communication.

## Assured quality

WaterMaster is designed and manufactured in accordance with international quality procedures (ISO 9001) and all flowmeters are calibrated on nationally-traceable calibration rigs to provide the end-user with complete assurance of both quality and performance of the flowmeter.


## WaterMaster

Electromagnetic flowmeter

## WaterMaster - always the first choice

WaterMaster sets the standard for the water industry. The specification, features and user benefits offered by this range are based on ABB's worldwide experience in this industry and they are all targeted specifically to the industry's requirements.

## Submersible and buriable

WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the Water and Waste Industry. The sensors are, as standard, inherently submersible (IP68, NEMA $6 P$ ), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding.

A unique feature of the WaterMaster sensors is that sizes DN40 to DN2400 ( $1 \frac{1}{2} / 2$ to 96 in . NB) are buriable; installation simply involves excavating to the underground pipe, fitting the sensor, cabling back to the transmitter and then backfilling the hole.


The WaterMaster family

## Overview of the WaterMaster

A wide range of features and user benefits are built into WaterMaster as standard:

- bi-directional flow
- OIML-type continuous self-checking, with alarms, ensures both sensor and transmitter accuracy
- true electrode and coil impedance measurement
- comprehensive simulation mode
- universal switch-mode power supply (options are available for AC and DC supplies)
- comprehensive self-diagnostics compliant with NAMUR NE107
- programmable multiple-alarm capability

■ bus options: HART (4 to 20 mA ), PROFIBUS DP (RS485), MODBUS (RS485)

- 3 configurable pulse / frequency and alarm outputs
- advanced infrared service port supports remote HMI, HART, cyclic data out and parameter download
- VeriMaster in situ verification software available as option
- read-only switch and ultra-secure service password for total security



## OIML / MID approved

WaterMaster has been type tested and Internationally approved to the highest accuracy class 1 and 2 for cold and hot potable water meters - OIML R49-1 (Organisation Internationale de Métrologie Légale). For full details, OIML R49 is available to download from www.oiml.org. Its requirements are very similar to other International standards, such as EN14154 and ISO4064.

WaterMaster has been assessed by type approval at the National Measurement Office (NMO) to OIML R49 and passed to the very highest accuracy designations for sizes DN40 to DN200 ( $1^{1} / 2$ to 8 in. NB).

The approval is for:

- Class 1 and Class 2 accuracy (calibration option)
- Environmental class T50 for water temperatures of 0.1 to $50^{\circ} \mathrm{C}$ ( 32.18 to $122^{\circ} \mathrm{F}$ )
- Electromagnetic Environment E2 $(10 \mathrm{~V} / \mathrm{m})$
- Any pipe orientation
- 5 Diameters upstream pipe
- O Diameters downstream pipe
- Pressure Loss Class <0.25 bar (3.62 psi)
- Integral or remote transmitter (<200 m [<656 ft.] cable)
- DN40 to DN200 ( $1^{1} / 2$ to 8 in . NB), bi-directional flow

A major advance in WaterMaster is the self-checking capabilities that meet and exceed the R49 requirements and is the first electromagnetic flowmeter to be approved to OIML Type P permanent self checking during normal operation (not just at startup) and alarm indication for:

- transmitter and sensor status, with an accuracy alarm
- program ROM and RAM status
- double, independent storage of totalizer values, in both the sensor and transmitter non-volatile memories
- display test

The OIML R49-1 certificate of conformity is available from:

## http://www.abb.com/product/seitp330/b42ec2377d3293cd c12573de003db93b.aspx

WaterMaster is also approved under the EU Measuring Instruments Directive (MID) 2004/22/EC, that covers putting into use water flowmeters for certain applications. MID WaterMaster is secured against tamping and is available as an option, along with fingerprinting for ABB VeriMaster in situ verification product, with certificate printout to $\pm 1 \%$ accuracy.
WaterMaster certificates of EC type-examination of a measuring instrument are available from:
http://www.abb.com/product/seitp330/b42ec2377d3293cd c12573de003db93b.aspx

## Superior control through advanced sensor design

The innovative, patented octagonal sensor design improves flow profile and reduces up- and down-stream piping requirements for the most commonly used sizes of 40 to $200 \mathrm{~mm}\left(1^{1} / 2\right.$ to 8 in.). This optimized full bore meter provides very impressive results in the most difficult of installation requirements.
The content below is the extract from OIML R49 test requirements:
6.8 Flow disturbance tests (R 49-1, 5.3.4)

### 6.8.1 Object of tests

To verify that the meter complies with the requirements of 5.3.4 in $R$ 49-1 for forward flow and where appropriate for reverse flow (see $R$ 49-1, 3.2.5).

Note 1: The effects on the error (of indication) of a water meter of the presence of specified, common types of disturbed flow upstream and downstream of the meter are measured.


Recommended upstream / downstream conditions
Note 2: Types 1 and 2 disturbance devices are used in the tests to create left-handed (sinistrorsal) and right-handed (dextrorsal), rotational velocity fields (swirl), respectively. The flow disturbance is of a type usually found downstream of two $90^{\circ}$ bends directly connected at right angles. A type 3 disturbance device creates an asymmetric velocity profile usually found downstream of a protruding pipe joint, single bend, or a gate valve not fully opened.


## WaterMaster octagonal bore

The unique design of the reduced-bore sensor conditions the flow profile in the measuring section so that distortions in the flow profile, either upstream or downstream, are flattened. The result is excellent in situ flowmeter performance, even with very bad hydraulic installation conditions.

## WaterMaster

Electromagnetic flowmeter

## Specification

## WaterMaster specification to OIML R49 Class 1



WaterMaster specification to OIML R49 Class 2


Although OIML R49 does not define the flow accuracy below Q1, WaterMaster continues to measure flow at lower flow rates down to a cutoff velocity of $\pm 5 \mathrm{~mm} / \mathrm{s}( \pm 0.2 \mathrm{in} . / \mathrm{s})$. The accuracy between cutoff and Q1 is typically $\pm 0.9 \mathrm{~mm} / \mathrm{s}( \pm 0.04$. in. $/ \mathrm{s}$ ).

WaterMaster
Electromagnetic flowmeter
WaterMaster optimized full-bore meter / full-bore meter flow performance ( $\mathrm{m}^{3} / \mathrm{h}$ )

|  |  |  | Standard Calibration 0.4 \% Class 2 |  |  | High Accuracy Calibration 0.2 \% Class 1 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Q4 } \\ \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{gathered}$ | $\begin{aligned} & \text { Q3 } \\ & \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{aligned}$ | $\begin{aligned} & \mathrm{Q}_{0.4 \%} \\ & \left(\mathrm{~m}^{3} / \mathrm{h}\right) \end{aligned}$ | $\begin{gathered} \text { Q2 } \\ \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{gathered}$ | $\begin{aligned} & \text { Q1 } \\ & \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{aligned}$ | $\begin{aligned} & \text { Qo.2\% } \\ & \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{aligned}$ | $\begin{gathered} \text { Q2 } \\ \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{gathered}$ | $\begin{gathered} \text { Q1 } \\ \left(\mathrm{m}^{3} / \mathrm{h}\right) \end{gathered}$ |
| 10 | 3.1 | 2.5 | 0.167 | 0.02 | 0.006 | 0.31 | 0.02 | 0.012 |
| 15 | 7.9 | 6.3 | 0.42 | 0.04 | 0.016 | 0.8 | 0.05 | 0.03 |
| 20 | 12.5 | 10 | 0.67 | 0.063 | 0.025 | 1.3 | 0.08 | 0.05 |
| 25 | 20 | 16 | 1.1 | 0.13 | 0.05 | 2 | 0.13 | 0.08 |
| 32 | 31.25 | 25 | 1.67 | 0.13 | 0.08 | 3 | 0.20 | 0.13 |
| 40* | 50 | 40 | 4.2 | 0.25 | 0.1 | 6 | 0.32 | 0.2 |
| 50* | 79 | 63 | 4.2 | 0.4 | 0.16 | 8 | 0.5 | 0.32 |
| 65* | 125 | 100 | 6.7 | 0.63 | 0.25 | 13 | 0.8 | 0.5 |
| 80* | 200 | 160 | 11 | 1 | 0.4 | 16 | 1.3 | 0.8 |
| 100* | 313 | 250 | 17 | 1.6 | 0.63 | 25 | 2 | 1.3 |
| 125* | 500 | 400 | 27 | 2.5 | 1 | 40 | 3.2 | 2 |
| 150* | 788 | 630 | 42 | 4 | 1.6 | 63 | 5 | 3.2 |
| 200* | 1,250 | 1,000 | 67 | 6.3 | 2.5 | 100 | 8 | 5 |
| 250 | 2,000 | 1,600 | 107 | 10 | 4 | 160 | 13 | 8 |
| 300 | 3,125 | 2,500 | 167 | 16 | 6.3 | 250 | 20 | 13 |
| 350 | 5,000 | 4,000 | 267 | 25 | 10 | 400 | 32 | 20 |
| 400 | 5,000 | 4,000 | 267 | 25 | 10 | 400 | 32 | 20 |
| 450 | 7,875 | 6,300 | 420 | 39 | 16 | 630 | 50 | 32 |
| 500 | 7,875 | 6,300 | 420 | 39 | 16 | 630 | 50 | 32 |
| 600 | 12,500 | 10,000 | 667 | 63 | 25 | 1000 | 80 | 50 |
| 700 | 20,000 | 16,000 | 1067 | 100 | 40 | 1600 | 160 | 100 |
| 750 / 760 | 20,000 | 16,000 | 1067 | 100 | 40 | 1600 | 160 | 100 |
| 800 | 20,000 | 16,000 | 1067 | 100 | 40 | 1600 | 160 | 100 |
| 900 | 31,250 | 25,000 | 1667 | 156 | 63 | 2500 | 250 | 156 |
| 1000 | 31,250 | 25,000 | 1667 | 156 | 63 | 2500 | 250 | 156 |
| 1050 | 31,250 | 25,000 | 1667 | 156 | 63 | 2500 | 250 | 156 |
| 1100 | 31,250 | 25,000 | 1667 | 156 | 63 | 2500 | 250 | 156 |
| 1200 | 50,000 | 40,000 | 2667 | 250 | 100 | 4000 | 400 | 250 |
| 1350 | 78,750 | 63,000 | 4200 | 394 | 158 | 6300 | 630 | 394 |
| 1400 | 78,750 | 63,000 | 4200 | 394 | 158 | 6300 | 630 | 394 |
| 1500 | 78,750 | 63,000 | 4200 | 394 | 158 | 6300 | 630 | 394 |
| 1600 | 78,750 | 63,000 | 4200 | 394 | 158 | 6300 | 630 | 394 |
| 1650 | 78,750 | 63,000 | 4200 | 394 | 158 | 6300 | 630 | 394 |
| 1800 | 125,000 | 100,000 | 6667 | 625 | 250 | 10000 | 1000 | 625 |
| 1950 | 125,000 | 100,000 | 6667 | 625 | 250 | 10000 | 1000 | 625 |
| 2000 | 125,000 | 100,000 | 6667 | 625 | 250 | 10000 | 1000 | 625 |
| 2100 | 125,000 | 100,000 | 6667 | 625 | 250 | 10000 | 1000 | 625 |
| 2200 | 200,000 | 160,000 | 16000 | 1600 | 640 | 16000 | 1600 | 1000 |
| 2400 | 200,000 | 160,000 | 16000 | 1600 | 640 | 16000 | 1600 | 1000 |

* OIML R49 Certificate of Conformance to Class 1 and Class 2, with OIML R49 and MID versions available.

Note. OIML R49-1 allow Class 1 for meters only with $Q_{3} \geq 100 \mathrm{~m}^{3} / \mathrm{h}$. Meters outside this range have been tested and conform to Class 1.

WaterMaster
Electromagnetic flowmeter

WaterMaster optimized full-bore meter / full-bore meter flow performance (GPM)

|  |  | $\begin{gathered} \text { Q3 } \\ \text { (GPM) } \end{gathered}$ | Standard Calibration 0.4 \% Class 2 |  |  | High Accuracy Calibration 0.2 \% Class 1 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Q4 } \\ \text { (GPM) } \end{gathered}$ |  | Qo.4\% <br> (GPM) | $\begin{gathered} \text { Q2 } \\ \text { (GPM) } \end{gathered}$ | $\begin{gathered} \text { Q1 } \\ \text { (GPM) } \end{gathered}$ | $\begin{aligned} & \text { Qo.2\% } \\ & \text { (GPM) } \end{aligned}$ | $\begin{gathered} \text { Q2 } \\ \text { (GPM) } \end{gathered}$ | Q1 <br> (GPM) |
| NPS/NB (DN) |  |  |  |  |  |  |  |  |
| $3 / 8$ (10) | 13.8 | 11 | 0.73 | 0.06 | 0.035 | 1.38 | 0.09 | 0.053 |
| 1/2 (15) | 34.7 | 27.7 | 1.85 | 0.14 | 0.09 | 3.48 | 0.22 | 0.14 |
| $3 / 4$ (20) | 55 | 44 | 2.94 | 0.22 | 0.14 | 5.5 | 0.35 | 0.22 |
| 1 (25) | 88 | 70.4 | 4.7 | 0.35 | 0.22 | 8.8 | 0.57 | 0.35 |
| $1^{1 / 4}(32)$ | 137.6 | 110 | 7.3 | 0.57 | 0.35 | 13.2 | 0.88 | 0.57 |
| $1^{1 / 2}(40)$ | 220 | 176 | 18.5 | 0.89 | 0.56 | 26.4 | 1.41 | 0.88 |
| 2 (50) | 347 | 277 | 18.5 | 1.41 | 0.88 | 34.7 | 2.22 | 1.39 |
| $2^{1 / 2}(65)$ | 550 | 440 | 29.4 | 2.24 | 1.40 | 55.0 | 3.52 | 2.20 |
| 3 (80) | 881 | 704 | 47.0 | 3.58 | 2.24 | 70.4 | 5.64 | 3.52 |
| 4 (100) | 1,376 | 1,101 | 73.4 | 5.59 | 3.49 | 110 | 8.81 | 5.50 |
| 5 (125) | 1,376 | 1,101 | 73.4 | 5.59 | 3.49 | 110 | 8.81 | 5.50 |
| 6 (150) | 3,467 | 2,774 | 185 | 14.1 | 8.81 | 277 | 22.2 | 13.9 |
| 8 (200) | 5,504 | 4,403 | 294 | 22.4 | 14.0 | 440 | 35.2 | 22.0 |
| 10 (250) | 8,806 | 7,045 | 470 | 35.8 | 22.4 | 704 | 56.4 | 35.2 |
| 12 (300) | 13,759 | 11,007 | 734 | 55.9 | 34.9 | 1,101 | 88.1 | 55.0 |
| 14 (350) | 22,014 | 17,611 | 1,174 | 89.5 | 55.9 | 1,761 | 141 | 88.1 |
| 16 (400) | 22,014 | 17,611 | 1,174 | 89.5 | 55.9 | 1,761 | 141 | 88.1 |
| 18 (450) | 34,673 | 27,738 | 1,849 | 141 | 88.1 | 2,774 | 222 | 139 |
| 20 (500) | 34,673 | 27,738 | 1,849 | 141 | 88.1 | 2,774 | 222 | 139 |
| 24 (600) | 55,036 | 44,029 | 2,935 | 224 | 140 | 4,403 | 352 | 220 |
| 27/28* (700) | 88,057 | 70,446 | 7,045 | 451 | 282 | 7,045 | 704 | 440 |
| 30 (760) | 88,057 | 70,446 | 7,045 | 451 | 282 | 7,045 | 704 | 440 |
| 32 (800) | 88,057 | 70,446 | 7,045 | 451 | 282 | 7,045 | 704 | 440 |
| 36 (900) | 137,590 | 110,072 | 11,007 | 704 | 440 | 11,007 | 1,100 | 688 |
| 39/40* (1000) | 137,590 | 110,072 | 11,007 | 704 | 440 | 11,007 | 1,100 | 688 |
| 42 (1050) | 137,590 | 110,072 | 11,007 | 704 | 440 | 11,007 | 1,100 | 688 |
| 48 (1200) | 220,143 | 176,115 | 17,611 | 1,127 | 704 | 17,611 | 1,761 | 1,101 |
| 54 (1400) | 346,726 | 277,381 | 27,738 | 1,775 | 1,110 | 27,738 | 2,773 | 1,733 |
| 60 (1500) | 346,726 | 277,381 | 27,738 | 1,775 | 1,110 | 27,738 | 2,773 | 1,733 |
| 66 (1600) | 346,726 | 277,381 | 27,738 | 1,775 | 1,110 | 27,738 | 2,773 | 1,733 |
| 72 (1800) | 550,358 | 440,287 | 44,029 | 2,818 | 1,761 | 44,029 | 4,403 | 2,752 |
| 78 (2000) | 550,358 | 440,287 | 44,029 | 2,818 | 1,761 | 44,029 | 4,403 | 2,752 |
| 84 (2200) | 880,573 | 704,459 | 70,446 | 4,509 | 2,818 | 70,446 | 7,045 | 4,403 |
| 96 (2400) | 880,573 | 704,459 | 70,446 | 4,509 | 2,818 | 70,446 | 7,045 | 4,403 |

[^4]
## WaterMaster

Electromagnetic flowmeter

## Specification - sensor

## Functional specification

Pressure limitations
As per flange rating - non approved
PN16 for OIML R49, MID Approved
Pressure equipment directive 97/23/EC
This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt.
Temperature limitations
Ambient temperature
Remote transmitter -20 to $70^{\circ} \mathrm{C}\left(-4\right.$ to $\left.158^{\circ} \mathrm{F}\right)$
Integral transmitter -20 to $60^{\circ} \mathrm{C}\left(-4\right.$ to $\left.140^{\circ} \mathrm{F}\right)$
Process temperature -6 to $70^{\circ} \mathrm{C}\left(21\right.$ to $\left.158{ }^{\circ} \mathrm{F}\right)$ - non approved 0.1 to $50^{\circ} \mathrm{C}\left(32.2\right.$ to $\left.122^{\circ} \mathrm{F}\right)$ - OIML R49 T50 Approved

IP rating
IP68 (NEMA 6) to 10 m ( 33 ft .) depth
IP67 (NEMA 4X)
Buriable (sensor only)
FEV, FEF and FEW (DN700 to 2400 [27/28* to 96 in. NB)
to 5 m (16 ft.)
*Size is dependent on flange specification
Conductivity
$>5 \mu \mathrm{~S} \mathrm{~cm}^{-1}$
Transmitter mounting Integral or remote
Electrical connections
20 mm glands
$1 / 2 \mathrm{in}$. NPT
20 mm armored glands
Sensor cable
ABB WaterMaster cable available in two forms standard and armored Maximum length 200 m (660 ft.)

## Physical specification

## Wetted parts

Electrode material
Stainless steel $316 \mathrm{~L} / 316 \mathrm{Ti}$
Super-austenitic steel
Hastelloy ${ }^{\circledR}$ C-22 and Hastelloy C4
(other electrode materials available on request)
Potential equalizing rings
Minimum of 1 recommended
(for insulated bore upstream and downstream pipes)

Lining material / potable water approvals

|  |  |  | Potable Water Approvals |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Code | Size Range | Liner | WRAS | WRAS $60^{\circ} \mathrm{C}$ | ACS | NSF | $\begin{aligned} & \text { AZI } \\ & \text { NZS } \\ & 4020 \end{aligned}$ |
| FEW | $\begin{gathered} \text { DN10 }-32 \\ \left(3 / 8-1^{1 / 4} \mathrm{in} . \mathrm{NB}\right) \end{gathered}$ | PTFE | $\checkmark$ |  |  |  |  |
| FEV | $\begin{gathered} \text { DN4O - } 200 \\ \left(1^{11 / 2}-8 \text { in. NB }\right) \end{gathered}$ | Polypropylene | $\checkmark$ |  |  | NSF-61 | $\checkmark$ |
| FEF | $\begin{aligned} & \text { DN250-600 } \\ & (10-24 \mathrm{in} . \mathrm{NB}) \end{aligned}$ | Elastomer | $\checkmark$ |  | $\checkmark$ | NSF-61 | $\checkmark$ |
| FEW | $\begin{gathered} \text { DN700 - } 2400 \\ \left(27 / 28^{\star}-96\right. \text { in. } \\ \text { NB) } \end{gathered}$ | Elastomer | $\checkmark$ |  |  |  |  |
| FEW | $\begin{gathered} \text { DN700 - } 2400 \\ \left(27 / 28^{*}-96 \mathrm{in.}\right. \\ \text { NB) } \end{gathered}$ | Hard rubber |  | $\checkmark$ |  | NSF approved material |  |

*Size is dependent on flange specification
Lining protection plates
Not required
Installation conditions (recommended)
Upstream $\geq 5$ D
Downstream $\geq 2 \mathrm{D}$
Pressure loss

| Negligible at Q3 | All full bore meters |
| :--- | :--- |
| $<0.25$ bar (<3.62 psi) at Q3 | FEV (DN40 to $200\left[1 \frac{1}{2}\right.$ to 8 in. NB]) |

## Non-wetted parts

Flange material
Carbon steel (DN20 to DN2400 [ $3 / 4$ to 96 in. NB])
Stainless steel (DN10 to DN2400 [ $3 / 8$ to 96 in. NB])

Housing material
Carbon steel FEV (DN40 to 200 [1 $1 / 2$ to 8 in . NB])
FEW (DN700 to 2400 [18 to 96 in. NB])
Plastic
FEF (DN250 to 600 [10 to 24 in . NB])
Aluminium $\quad$ FEW (DN10 to 400 [ $3 / 8$ to 16 in. NB])
Terminal box material
Polycarbonate, aluminium or stainless
Cable gland material
Plastic, brass or stainless steel
Paint specification
Paint coat $\geq 70 \mu \mathrm{~m}$ thick RAL 9002 (light grey)

## WaterMaster

Electromagnetic flowmeter

## Specification - transmitter <br> Functional specification

| Power supply |  |
| :--- | :--- |
| Mains | 85 to $265 \mathrm{VAC} @<7 \mathrm{VA}$ |
| Low voltage | $24 \mathrm{VAC}+10 \% /-30 \% @<7 \mathrm{VA}$ |
| DC | $24 \mathrm{~V} \pm 30 \% @<0.4 \mathrm{~A}$ |

Supply voltage fluctuations within the specified range have no effect on accuracy

Digital Outputs (3)
Rating 30 V @ 220 mA , open collector, galvanically isolated
Maximum output frequency 5250 Hz
1 off dedicated to Alarm / Logic, programmable function
2 off configurable to either Pulse / Frequency or Alarm/Logic function
Current output - HART FEX100 variant
4 to 20 mA or 4 to $12 / 20 \mathrm{~mA}$, galvanically isolated
Maximum loop resistance $750 \Omega$
HART protocol Version 5.7 (HART registered)
Signal levels compliant with NAMUR NE 43 ( 3.8 to 20.5 mA )
Low alarm 3.6 mA, High alarm 21.8 mA
Additional accuracy
$\pm 0.1$ \% of reading
Temperature coefficient: typically $< \pm 20 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$
RS485 Communications - PROFIBUS FEX100-DP variant Registered name: FEX100-DP
RS485 (9.6kbps to 1.5 Mbps ), galvanically isolated
DPV0, DPV1
PA Profile 3.01
Standard idents: 9700, 9740, 9741
FEX100-DP specific ident: 3431
3 Concurrent MS2 master connections
RS485 Communications - MODBUS FEX100-MB variant MODBUS RTU protocol
RS485 (9.6kbps to 115.2 kbps ), galvanically isolated
Electrical connections
20 mm glands $1 / 2 \mathrm{in}$. NPT, 20 mm armored glands
Temperature limitations
Ambient temperature -20 to $60^{\circ} \mathrm{C}\left(-4\right.$ to $\left.140^{\circ} \mathrm{F}\right)$
Temperature Typically $< \pm 10 \mathrm{ppm} /{ }^{\circ} \mathrm{C} @ \mathrm{Vel} \geq 0.5 \mathrm{mls}$ coefficient

Environmental protection
Humidity: 0 to $100 \%$
Rating: IP67 (NEMA 4X) to 1m (3.3 ft.) depth
Tamper-proof security
Write access prevented by internal switch combined with external security seals for MID applications

Languages
English, French, German, Italian, Spanish, Polish
Infrared service port
USB adapter (accessory), USB 1.1. and 2.0 compatible
Driver software for Windows 2000, XP, 7 (32-bit) and Vista
Housing material
Powder-coated aluminium with glass window
Paint specification
Paint coat $\geq 70 \mu \mathrm{~m}$ thick RAL 9002 (light grey)
Transmitter vibration testing
Vibration level: $7 \mathrm{~m} / \mathrm{s}^{2}$
Frequency range: 20 to 150 Hz
No. of sweeps in 3 orthogonal planes: 20
Undetectable shift in transmitter span or zero performance
Hazardous approvals (HART variant only)
FM \& FMc Class 1 Div 2
(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG /T4, Ta=60C; Type 4X, IP67 - for transmitter and integral mounting Ta=70C, Type 6P, IP68 - for remote sensor type, IP67 on DN10 to 32 [ $3 / 8$ to $\left.1 \frac{1}{4} / 4 \mathrm{in.NB}\right]$ )
(FMc listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG /T4, Ta=60C; Type 4X, IP67 - for transmitter and integral mounting Ta=70C, Type 6P, IP68 - for remote sensor type, IP67 on DN10 to 32 [ $3 / 8$ to $\left.1 \frac{1}{1 / 4} \mathrm{in} . \mathrm{NB}\right]$ )
FET, FEV, FEW and FEF DN700 to $2200\left(27 / 28^{\star}\right.$ to 84 in. NB) only
*Size is dependent on flange specification
Declaration of Conformance
Copies of CE and PED certification will be available on request.
WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to $200\left[1 \frac{1}{2}\right.$ to 8 in.NB]). Copies of accuracy certification are available on request.
WaterMaster (FEV DN40 to 200 [11/2 to 8 in.NB]) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

## WaterMaster

Electromagnetic flowmeter

## Transmitter connections

## Transmitter terminal connections overview

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and safety precautions - refer to the User Guide OI/FET100-EN.


Cable gland / conduit entry (remote transmitter shown)
Sensor cable terminal connections and recommended cable lengths


Sensor cable connections at transmitter terminal block - standard system

## WaterMaster

Electromagnetic flowmeter

## Power supply connections

AC power supply


AC power supply connections
DC (and low voltage AC) power supply


DC (and low voltage $A C$ ) power supply connections

## WaterMaster

Electromagnetic flowmeter

## Configuration DIP switches

Three configuration DIP switches are mounted on the transmitter backplane board.

These are factory-set as follows:

- Remote transmitter - all OFF
- Integral transmitter - SW3 ON

For MID-compliant flowmeters the read-only / MID protection switch is set to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.
From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.


## Configuration DIP switches

## Converter module identification

Note. The communications bus type is HART FEX100 if not specified on the converter module label. An example of the PROFIBUS FEX100-DP variant converter module label is shown below.


Converter module identification

## Output connections

Frequency outputs


PLC / Datalogger connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.


Electromechanical connections


Telemetry / Electronic counters connections

Alarm outputs


Alarm output connections


Alarm output connections

## Note.

- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in Electromechanical connections and Telemetry / Electronic counters connections, opposite.
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).


Relay and timers output connections
Note. Relay and timer switch shown for example only.

Contact input


Open collector (or grounded contact) connections

## PLC interface



## PLC - common -ve connections



PLC - Common +ve connections

## Note.

- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA .


## WaterMaster

Electromagnetic flowmeter

Current output（4 to 20 ma ）－HART（FEX100）variant

| Q日Q日QQ日Q |
| :---: |
| $\begin{aligned} & 3132 \mathrm{XXXX} 42415161 \\ & \begin{array}{l} 52 \\ 62 \end{array} \\ & \hline \end{aligned}$ |
| Refer to IM／WMP for HART－Protocol communication details |

Current output（4 to 20 mA ）－HART（FEX100）variant

RS485 communications－PROFIBUS（FEX100－DP）and MODBUS（FEX100－MB）variants


WaterMaster RS485 backplane connections to PROFIBUS／MODBUS networks

Test point access
Note．A typical DVM probe can access（fit）the PCB＇s test holes．

＊These 2 test points are connected on the HART FEX100 backplane only（they are present on the PROFIBUS FEX100－DP／MODBUS FEX100－MB backplane but not connected）

Transmitter PCB board test point access

## Digital communication

The transmitter has the following options for digital communication．

## HART protocol

The unit is registered with HART Communication Foundation．


HART－Protocol connection（remote installation shown）

| HART protocol |  |
| :--- | :--- |
| Configuration | Directly on the Device <br> Software Asset Vision Basic（＋HART－DTM） |
| Transmission | Install a HART modem（FSK［Frequency Shift <br> Keyed］－Modem）for HART－Communication when <br> connecting to a PC．The HART－Modem converts <br> the analog 4 to 20 mA signal into a digital output <br> signal（Bell Standard 202）and connects to the <br> PC using a USB（or RS232C）connector |
| Max．signal <br> amplitude | 1.2 mAss |
| Current output <br> load | Min．250 2, max．$=560 \Omega$ |
| Cable | AWG 24 twisted |
| Max．cable length | 1500 m（4921 ft．） |
| Baud rate | 1.200 baud |
| Display | Log． $1: 1,200 \mathrm{~Hz}$ <br> Log．0： 2.200 Hz |

## System integration

WaterMaster can be integrated into control systems and configuration devices using any Frame application，such as ABB AssetVision or similar third－party applications．ABB Device Type Managers（DTMs）for WaterMaster provide a unified structure for accessing device parameters，configuring and operating the devices and diagnosing problems．FDT（Field Device Tool） technology standardizes the communication and configuration interface between all field devices and host systems．

## PROFIBUS DP protocol

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

| PROFIBUS DP ID no. | 0x3431 |
| :--- | :--- |
| Alternative standard ID no. | 0x9701 or 0x9741 |
| Configuration | Directly on the device <br> Software Asset Vision Basic <br> (+PROFIBUS DP-DTM) |
| Transmission signal | Accuracy to IEC 61158-2 |
| Cable | Shielded, twisted cable (accurate to IEC <br> $61158-2$, types A or B) |

All devices are connected in a bus structure ('line') as shown in below. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment. Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.


Typical PROFIBUS network

## System integration

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format.

This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

## - General specifications

Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.

- DP slave-related specifications

Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

## MODBUS protocol

MODBUS is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.modbus.org).

Using the MODBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment. WaterMaster FEX100-MB follows the specification for Modbus Over Serial Line V1.02, using 2-wire TIA/EIA-485 (RS485) physical layer.


Typical MODBUS RS485 2-wire network Installation

## Cable Properties

The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).
For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m ( 3280 ft .). Where 4 -wire cabling is used as a 2-wire cabling system the maximum length must be divided by 2. The tap cables must be short, never more than 20 m (65.6 ft .). If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m ( 131 ft .) divided by n .

The maximum serial data transmission line length for RS485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) - standard screened or twisted pair cable.
- Up to 300 m (984 ft.) - twin twisted pair with overall foil screen and an integral drain wire - for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) - twin twisted pair with separate foil screens and integral drain wires - for example, Belden 9729 or equivalent.

Category 5 cables may be used for RS485-MODBUS to a maximum length of 600 m (1968 ft.). For the balanced pairs used in an RS485-system, a characteristic impedance with value higher than $100 \Omega$ is preferred especially for 19200 and higher Baud rates.

## Installation requirements

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and Safety precautions refer to User Guide OI/FEF/FEV/FEW-EN.

## Unpacking the flowmeter

Care must be taken when lifting the flowmeter to use the lifting hooks provided or sling under the body of the meter. Never lift using the terminal connection box of the sensor cable as this will cause damage and invalidate warranty.


## Grounding

The flowmeter sensor must be connected to ground potential. For technical reasons, this potential should be identical to the potential of the metering fluid. For plastic or insulated lined pipelines, the fluid is grounded by installing a minimum of 1 earthing rings. When there are stray potentials present in the pipeline, an earthing ring is recommended on both ends of the meter sensor.


## Mounting

The installation conditions shown below must be observed to achieve the best operational results.
The sensor tube must always be completely full.


The flow direction must correspond to the identification plate. The device measures the flowrate in both directions. Forward flow is the factory setting.


The devices must be installed without mechanical tension (torsion, bending). If required support the pipeline.


The flange seals must be made from a compatible material for the fluid and fluid temperatures if required.
(

Seals must not extend into the flow area since possible turbulence could influence the device accuracy.


The pipeline may not exert any unallowable forces and torques on the device, such as vibration.


The flowmeter must not be submitted to any localized heat during installation; take care to remember this is a measuring instrument.


The flowmeter must not be exposed to direct sunlight or provide for appropriate sun protection where necessary.


The cable to the flowmeter should be installed neatly or within a conduit, both loose or conduit should have a u shape below the terminal connection box height to allow any water run off to avoid any capillary action into the flowmeter sensor.


## Electrode axis

Electrode axis should be horizontal if at all possible or no more than $45^{\circ}$ from horizontal.


## Up and Down stream pipe sections

The metering principle is independent of the flow profile as long as standing eddies do not extend into the metering section, such as may occur after double elbows, in the event of tangential inflow or where half-open gate valves are located upstream of the flowmeter sensor. In such cases, best practice installation measures should be put in place to normalize the flow profile.

- Whereever possible do not install fittings (for example, manifolds, valves) directly in front of the flowmeter sensor.
- Butterfly valves should be installed so that the valve plate does not extend into the flowmeter sensor.
- Valves or other turn-off components should be installed in the Downstream pipe section.
Experience has shown that, in most installations, straight upstream sections $3 \times$ DN long and straight downstream sections $2 \times$ DN long are normally sufficient. We would recommend conditions of $5 \times$ DN straight upstream and $2 \times$ DN straight downstream where possible.



## WaterMaster

Electromagnetic flowmeter

## Transmitter dimensions

Integral transmitter
Dimensions in mm (in.)


Remote transmitter
Dimensions in mm (in.)


## Sensor dimensions

FEW - DN10 to $32(3 / 8$ to $1 / 1 / 4 \mathrm{in}$. NB)


DN10 to 32( $3 / 8$ to $1 \frac{1}{1} 4$ in. NB) (FEW)

|  |  | Dimensions in mm (in.) |  |  |  |  |  |  | Approx. weight in kg (lb) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | F | C | E | G | A | Integral | Remote |
| DN10 ( $3 / 8 \mathrm{in}$.) | PN40 | 90 (3.54) | 200 (7.87) | 350 (13.78) | 82 (3.23) | 275 (10.83) | 230 (9.06) | 113 (4.45) | 6 (13.2) | $4 \text { (8.8) }$ |
|  | CL150 | 90 (3.54) |  |  |  |  |  |  |  |  |
|  | CL300 | 95 (3.74) |  |  |  |  |  |  |  |  |
| DN15 <br> ( $1 / 2 \mathrm{in}$.) | PN40 | 95 (3.74) | 200 (7.87) | 350 (13.78) | 82 (3.23) | 275 (10.83) | 230 (9.06) | 113 (4.45) |  |  |
|  | CL150 | 90 (3.54) |  |  |  |  |  |  |  |  |
|  | CL300 | 95 (3.74) |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { DN20 } \\ & (3 / 4 \mathrm{in} .) \end{aligned}$ | PN40 | 105 (4.13) | 200 (7.87) | 350 (13.78) | 82 (3.23) | 275 (10.83) | 230 (9.06) | 113 (4.45) | 8.5 (18.7) | 6.5 (14.3) |
|  | CL150 | 98 (3.86) |  |  |  |  |  |  |  |  |
|  | CL300 | 117 (4.61) |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { DN25 } \\ & \text { (1 in.) } \end{aligned}$ | PN40 | 115 (4.53) | 200 (7.87) | 350 (13.78) | 82 (3.23) | 275 (10.83) | 230 (9.06) | 113 (4.45) |  |  |
|  | CL150 | 108 (4.25) |  |  |  |  |  |  |  |  |
|  | CL300 | 124 (4.88) |  |  |  |  |  |  |  |  |
| DN32 <br> ( $1^{1 / 4} \mathrm{in}$.) | PN40 | 140 (5.51) | 200 (7.87) | 350 (13.78) | 92 (3.62) | 275 (10.83) | 230 (9.06) | 113 (4.45) |  |  |
|  | CL150 | 117 (4.61) |  |  |  |  |  |  |  |  |
|  | CL300 | 133 (5.24) |  |  |  |  |  |  |  |  |

DN10 to $32\left(\beta / 8\right.$ to $1^{1 / 4}$ in. NB) (FEW) dimensions / weights

## WaterMaster

Electromagnetic flowmeter

FEV - DN40 to 200 ( $1^{1 ⁄ 2}$ to 8 in. NB)


DN40 to 200 (11⁄2 to 8 in. NB) (FEV)

|  |  | Dimensions in mm (in.) |  |  |  |  |  |  | Approx. weight in kg (lb) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | F | C | E | G | X | Integral | Remote |
| DN40$\text { ( } \left.1^{1 ⁄ 2} \text { in. }\right)$ | EN1092-1 PN10, PN40 | 150 (5.91) | 200 (7.87) | 260 (10.24) | 30.4 (1.20) | 185 (7.28) | 138 (5.43) | 30 (1.18) | 15 (33) | 13 (29) |
|  | ASME B16.5 CLASS 150 | 127 (5.00) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 140 (5.51) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 140 (5.51) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D E | 135 (5.31) |  |  |  |  |  |  |  |  |
|  | AS4087 PN14 | 135 (5.31) |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { DN50 } \\ & (2 \text { in. }) \end{aligned}$ | EN1092-1 PN10, PN16 | 165 (6.50) | 200 (7.87) | 270 (10.63) | 38.3 (1.51) | 195 (7.68) | 146 (5.75) | 38 (1.50) | 16 (35) | 14 (31) |
|  | ASME B16.5 CLASS 150 | 152.4 (6.00) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 155 (6.10) |  |  |  |  |  |  |  |  |
|  | AS4087 PN21 | 165 (6.50) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 165 (6.50) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D E | 150 (5.91) |  |  |  |  |  |  |  |  |
|  | AS4087 PN14, PN16 | 150 (5.91) |  |  |  |  |  |  |  |  |
| DN65$\text { ( } 2^{1 ⁄ 2} \text { in.) }$ | AS4087 PN14, PN16 | 165 (6.50) | 200 (7.87) | 275 (10.83) | 45.2 (1.78) | 200 (7.87) | 152 (5.98) | 48 (1.89) | 18 (40) | 16 (35) |
|  | AS2129 TABLE C D E | 165 (6.50) |  |  |  |  |  |  |  |  |
|  | EN1092-1 PN10 | 185 (7.28) |  |  |  |  |  |  |  |  |
|  | EN1092-1 PN16 | 185 (7.28) |  |  |  |  |  |  |  |  |

DN40 to 200 (1½ to 8 in. NB) (FEV) dimensions / weights

## WaterMaster

Electromagnetic flowmeter

|  |  | Dimensions in mm (in.) |  |  |  |  |  |  | Approx. weight in kg (lb) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | F | C | E | G | X | Integral | Remote |
| DN80 (3 in.) | EN1092-1 PN10, PN16 | 200 (7.87) | 200 (7.87) | 280 (11.02) | 51.5 (2.03) | 205 (8.07) | 156 (6.14) | 61 (2.40) | 19 (42) | 17 (37) |
|  | ASME B16.5 CLASS 150 | 190 (7.48) |  |  |  |  |  |  |  |  |
|  | JIS 7.5K | 211 (8.31) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 185 (7.28) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D E | 185 (7.28) |  |  |  |  |  |  |  |  |
|  | AS4087 PN14, PN16 | 185 (7.28) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 205 (8.07) |  |  |  |  |  |  |  |  |
|  | AS4087 PN21 | 205 (8.07) |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \hline \begin{array}{l} \text { DN100 } \\ (4 \mathrm{in} .) \end{array} \end{aligned}$ | EN1092-1 PN10, PN16 | 220 (8.66) | 250 (9.84) | 320 (12.60) | 63.75 (2.51) | 245 (9.65) | 196.8 (7.75) | 70 (2.76) | 22 (49) | 20 (44) |
|  | ASME B16.5 CLASS 150 | 228.6 (9.00) |  |  |  |  |  |  |  |  |
|  | JIS 7.5K | 238 (9.37) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 210 (8.27) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D | 215 (8.46) |  |  |  |  |  |  |  |  |
|  | AS4087 PN14, PN16 | 215 (8.46) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE E | 215 (8.46) |  |  |  |  |  |  |  |  |
|  | AS4087 PN21 | 230 (9.06) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 230 (9.06) |  |  |  |  |  |  |  |  |
| $\begin{array}{\|l\|l} \hline \text { DN125 } \\ \text { (5 in.) } \end{array}$ | EN1092-1 PN10, PN16 | 250 (9.84) | 250 (9.84) | 320 (12.60) | 63.75 (2.51) | 245 (9.65) | 197 (7.76) | 70 (2.76) | 29 (64) | 27 (60) |
|  | ASME B16.5 CLASS 150 | 254 (10.00) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 250 (9.84) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D E | 255 (10.04) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 280 (11.02) |  |  |  |  |  |  |  |  |
| DN150 (6 in.) | EN1092 PN10, PN16 | 285 (11.22) | 300 (11.81) | 340 (13.39) | 84.4 (3.32) | 265 (10.43) | 217 (8.54) | 103 (4.06) | 35 (77) | 33 (73) |
|  | ASME B16.5 CLASS 150 | 279 (10.98) |  |  |  |  |  |  |  |  |
|  | JIS 7.5k | 290 (11.42) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 280 (11.02) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D | 280 (11.02) |  |  |  |  |  |  |  |  |
|  | AS4087 PN14, PN16 | 280 (11.02) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE E | 280 (11.02) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 305 (12.01) |  |  |  |  |  |  |  |  |
|  | AS4087 PN21 | 305 (12.01) |  |  |  |  |  |  |  |  |
| $\begin{array}{\|l\|l} \hline \text { DN200 } \\ \text { (8 in.) } \end{array}$ | EN1092-1 PN10 | 340 (13.39) | 350 (13.78) | $365 \text { (14.37) }$ | 109.8 (4.32) | 290 (11.42) | 243 (9.57) | $150 \text { (5.91) }$ | $52 \text { (115) }$ | 50 (110) |
|  | EN1092-1 PN16 | 340 (13.39) |  |  |  |  |  |  |  |  |
|  | ASME B16.5 CLASS 150 | 345 (13.58) |  |  |  |  |  |  |  |  |
|  | JIS 7.5K | 342 (13.46) |  |  |  |  |  |  |  |  |
|  | JIS 10K | 330 (12.99) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE C D | 335 (13.19) |  |  |  |  |  |  |  |  |
|  | AS4087 PN14, PN 16 | 335 (13.19) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE E | 335 (13.19) |  |  |  |  |  |  |  |  |
|  | AS2129 TABLE F | 370 (14.57) |  |  |  |  |  |  |  |  |
|  | AS4087 PN21 | 370 (14.57) |  |  |  |  |  |  |  |  |

DN40 to 200 (1½ to 8 in. NB) (FEV) dimensions / weights (Continued)

## WaterMaster

Electromagnetic flowmeter

## FEF - DN250 to 600 (10 to 24 in. NB)

Dimensions in mm (in.)



DN250 to 600 (10 to 24 in. NB) (FEF)

|  |  | Dimensions in mm (in.) |  |  |  |  | Approx. weight in kg (lb) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | c | G | A |  |
| DN250 | ASME B16.5 CLASS 150 | 405 (15.94) | 450 (17.72) | 215 (8.46) | 301 (11.85) | 300 (11.81) | 88 (194) |
|  | ASME B16.5 CLASS 300 | 445 (17.52) | 490 (19.29) |  |  |  |  |
|  | EN1092-1 PN10 | 395 (15.55) | 450 (17.72) |  |  |  |  |
|  | EN1092-1 PN16 | 405 (15.94) | 450 (17.72) |  |  |  |  |
|  | EN1092-1 PN25 | 425 (16.73) | 490 (19.29) |  |  |  |  |
|  | EN1092-1 PN40 | 450 (17.72) | 490 (19.29) |  |  |  |  |
|  | JIS 5K | 385 (15.16) | 450 (17.72) |  |  |  |  |
|  | JIS 10K | 400 (15.75) | 450 (17.72) |  |  |  |  |
|  | AS4087 PN14, PN16 | 405 (15.94) | 450 (17.72) |  |  |  |  |
|  | AS2129 TABLE C D |  | 450 (17.72) |  |  |  |  |
|  | AS2129 TABLE E |  | 450 (17.72) |  |  |  |  |
|  | AS4087 PN21 | 430 (16.93) | 450 (17.72) |  |  |  |  |
|  | AS2129 TABLE F |  | 450 (17.72) |  |  |  |  |

DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

## WaterMaster

Electromagnetic flowmeter

|  |  | Dimensions in mm (in.) |  |  |  |  | Approx. weight in kg (lb) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | C | G | A |  |
| $\begin{array}{\|l\|} \hline \text { DN300 } \\ \text { (12 in.) } \end{array}$ | ASME B16.5 CLASS 150 | 485 (19.09) | 500 (19.69) | 231 (9.09) | 317 (12.48) | 352 (13.86) | 128 (282) |
|  | ASME B16.5 CLASS 300 | 520 (20.47) | 540 (21.26) |  |  |  |  |
|  | EN1092-1 PN10 | 445 (17.52) | 500 (19.69) |  |  |  |  |
|  | EN1092-1 PN16 | 460 (18.11) | 500 (19.69) |  |  |  |  |
|  | EN1092-1 PN25 | 485 (19.09) | 540 (21.26) |  |  |  |  |
|  | EN1092-1 PN40 | 515 (20.28) | 540 (21.26) |  |  |  |  |
|  | JIS 5K | 430 (16.93) | 500 (19.69) |  |  |  |  |
|  | JIS 10K | 445 (17.52) | 500 (19.69) |  |  |  |  |
|  | AS4087 PN14, PN16 | 455 (17.91) | 500 (19.69) |  |  |  |  |
|  | AS2129 TABLE TABLE C D | 455 (17.91) | 500 (19.69) |  |  |  |  |
|  | AS2129 TABLE E | 455 (17.91) | 500 (19.69) |  |  |  |  |
|  | AS4087 PN21 | 490 (19.29) | 500 (19.69) |  |  |  |  |
|  | AS2129 TABLE F | 490 (19.29) | 500 (19.69) |  |  |  |  |
| DN350(14 in.) | ASME B16.5 CLASS 150 | 535 (21.06) | 550 (21.65) | 257.5 (10.14) | 346 (13.62) | 376 (14.80) | 100 (220) |
|  | ASME B16.5 CLASS 300 | 585 (23.03) | 570 (22.44) |  |  |  |  |
|  | EN1092-1 PN10 | 505 (19.88) | 550 (21.65) |  |  |  |  |
|  | EN1092-1 PN16 | 520 (20.47) | 550 (21.65) |  |  |  |  |
|  | EN1092-1 PN25 | 555 (21.85) | 570 (22.44) |  |  |  |  |
|  | EN1092-1 PN40 | 580 (22.83) | 570 (22.44) |  |  |  |  |
|  | JIS 5K | 480 (18.90) | 550 (21.65) |  |  |  |  |
|  | JIS 7.5K | 530 (20.87) | 550 (21.65) |  |  |  |  |
|  | JIS 10K | 490 (19.29) | 550 (21.65) |  |  |  |  |
|  | AS4087 PN14, PN16 | 525 (20.67) | 550 (21.65) |  |  |  |  |
|  | AS2129 TABLE C D E | 525 (20.67) | 550 (21.65) |  |  |  |  |
|  | AS4087 PN21 | 550 (21.65) | 550 (21.65) |  |  |  |  |
|  | AS2129 TABLE F | 550 (21.65) | 550 (21.65) |  |  |  |  |
|  | AS4087 PN35 | 550 (21.65) | 570 (22.44) |  |  |  |  |
|  | AS2129 TABLE H | 550 (21.65) | 570 (22.44) |  |  |  |  |
| DN375 <br> (15 in.) | AS4087 PN14, PN16 | 550 (21.65) | 550 (21.65) | 257.5 (10.14) | 346 (13.62) | 376 (14.80) | 115 (253) |
|  | AS2129 TABLE C | 550 (21.65) | 550 (21.65) |  |  |  |  |
|  | AS4087 PN35 | 580 (22.83) | 570 (22.44) |  |  |  |  |
| $\begin{aligned} & \text { DN400 } \\ & \text { (16 in.) } \end{aligned}$ | ASME B16.5 CLASS 150 | 600 (23.62) | 600 (23.62) | 285 (11.22) | 371 (14.61) | 420 (16.54) | 115 (253) |
|  | ASME B16.5 CLASS 300 | 650 (25.59) | 620 (24.41) |  |  |  |  |
|  | EN1092-1 PN10 | 565 (22.24) | 600 (23.62) |  |  |  |  |
|  | EN1092-1 PN16 | 580 (22.83) | 600 (23.62) |  |  |  |  |
|  | EN1092-1 PN25 | 620 (24.41) | 620 (24.41) |  |  |  |  |
|  | EN1092-1 PN40 | 660 (25.98) | 620 (24.41) |  |  |  |  |
|  | JIS 5K | 540 (21.26) | 600 (23.62) |  |  |  |  |
|  | JIS 7.5K | 582 (22.91) | 600 (23.62) |  |  |  |  |
|  | JIS 10K | 560 (22.05) | 600 (23.62) |  |  |  |  |
|  | AS4087 PN14, PN16 | 580 (22.83) | 600 (23.62) |  |  |  |  |
|  | AS2129 TABLE C D E | 580 (22.83) | 600 (23.62) |  |  |  |  |
|  | AS4087 PN21 | 610 (24.02) | 600 (23.62) |  |  |  |  |
|  | AS2129 TABLE F | 610 (24.02) | 600 (23.62) |  |  |  |  |
|  | AS4087 PN35 | 610 (24.02) | 620 (24.41) |  |  |  |  |
|  | AS2129 TABLE H | 610 (24.02) | 620 (24.41) |  |  |  |  |

DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights (Continued)

## WaterMaster

Electromagnetic flowmeter


DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights (Continued)

## WaterMaster

Electromagnetic flowmeter

FEW - DN700 to 2400 (28 to 96 in. NB)


DN700 to 2400 (28 to 96 in. NB) (FEW)

|  |  | Dimensions in mm (in.) |  |  |  |  |  |  | Approx. weight in kg (lb) <br> Remote |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | F | C | E | G | A |  |  |
| $\begin{aligned} & \text { DN700 } \\ & \text { (28 in.) } \end{aligned}$ |  |  | $910 \text { (35.83) }$ |  |  |  |  | 444 (17.48) | 216 (475) | 214 (471) |
|  |  |  |  |  |  |  |  | 282 (620) | 280 (616) |
|  |  |  |  |  |  |  |  | 225 (495) | 223 (491) |
|  |  |  |  |  |  |  |  | 303 (667) | 301 (662) |
|  |  |  |  |  |  |  |  | 337 (741) | 335 (737) |
|  |  |  |  |  |  |  |  | 249 (548) | 247 (543) |
|  |  |  |  |  |  |  |  | 280 (616) | 278 (612) |
|  |  |  |  |  |  |  |  | 359 (790) | 357 (785) |
|  |  |  |  |  |  |  |  | 263 (579) | 261 (574) |
|  |  |  |  |  |  |  |  | 337 (741) | 335 (737) |
|  |  |  |  |  |  |  |  | 471 (10.36) | 469 (1032) |
|  |  |  |  |  |  |  |  | 586 (1289) | 584 (1285) |
|  |  |  |  |  |  |  |  | 472 (1038) | 470 (1034) |
|  |  |  |  |  |  |  |  | 715 (1573) | 713 (1569) |
|  |  |  |  |  |  |  |  | 539 (1186) | 537 (1181) |
|  |  |  |  |  |  |  |  | 503 (1107) | 501 (1102) |
|  |  |  |  |  |  |  |  | 323 (711) | 321 (706) |
|  |  |  |  |  |  |  |  | 631 (1388) | 629 (1384) |

DN700 to 2400 (28 to 96 in. NB) (FEW) dimensions / weights

WaterMaster
Electromagnetic flowmeter


DN700 to 2400 (28 to 96 in. NB) (FEW) dimensions / weights (Continued)

WaterMaster
Electromagnetic flowmeter

|  |  | Dimensions in mm (in.) |  |  |  |  |  |  | Approx. weight in kg (lb) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DN | Mating flange type | D | L | F | C | E | G | A | Integral | Remote |
| $\begin{gathered} \hline \text { DN1000 } \\ (40 \mathrm{in} .) \end{gathered}$ | JIS 5K | 1195 (47.05) | 1300 (51.18) | 755 (29.71) | 554 (21.81) | 679 (26.73) | 681 (26.81) | 624 (24.57) | 441 (970) | 439 (966) |
|  | JIS 10K | 1235 (48.62) |  |  |  |  |  |  | 572 (1258) | 570 (1254) |
|  | PN6 | 1175 (46.26) |  |  |  |  |  |  | 466 (1025) | 464 (1021) |
|  | PN10 | 1230 (48.43) |  |  |  |  |  |  | 674 (1483) | 672 (1478) |
|  | PN16 | 1255 (49.41) |  |  |  |  |  |  | 879 (1934) | 877 (1929) |
|  | AWWA C207 CLASS B | 1289 (50.75) |  |  |  |  |  |  | 503 (1107) | 501 (1102) |
|  | AWWA C207 CLASS D | 1289 (50.75) |  |  |  |  |  |  | 659 (1450) | 657 (1445) |
|  | AWWA C207 CLASS E | 1289 (50.75) |  |  |  |  |  |  | 1028 (2262) | 1026 (2257) |
|  | AWWA C207 CLASS F | 1378 (54.25) |  |  |  |  |  |  | 1367 (3007) | 1365 (3003) |
|  | AS4087 PN16 | 1255 (49.41) |  |  |  |  |  |  | 831 (1828) | 829 (1824) |
|  | AS2129 TABLE-D | 1255 (49.41) |  |  |  |  |  |  | 610 (1342) | 608 (1338) |
|  | AS2129 TABLE-E | 1255 (49.41) |  |  |  |  |  |  | 833 (1833) | 831 (1028) |
|  | PN25 | 1320 (51.97) |  |  |  |  |  |  | 1207 (2655) | 1205 (2651) |
|  | PN40 | 1360 (53.54) |  |  |  |  |  |  | 1413 (3109) | 1411 (3104) |
|  | AS4087 PN35 | 1275 (50.20) |  |  |  |  |  |  | 1244 (2737) | 1242 (2732) |
|  | ASME CL150 SERIES A | 1290 (50.79) |  |  |  |  |  |  | 1149 (2528) | 1147 (2523) |
|  | ASME CL300 SERIES A | 1240 (48.82) |  |  |  |  |  |  | 1349 (2968) | 1347 (2963) |
|  | ASME CL150 SERIES B | 1175 (46.26) |  |  |  |  |  |  | 738 (1624) | 736 (1619) |
|  | ASME CL300 SERIES B | 1275 (50.20) |  |  |  |  |  |  | 1487 (3271) | 1485 (3267) |
| DN1050 | AWWA C207 CLASS B | 1346 (5299) | 1365 (53.74) | 808 (31.82) | 608 (23.92) | 733 (28.84) | 735 (28.92) | 624 (24.57) | 564 (1241) | 562 (1236) |
| (42 in.) | AWWA C207 CLASS D | 1346 (5299) |  |  |  |  |  |  | 669 (1472) | 667 (1467) |
|  | AWWA C207 CLASS E | 1346 (5299) |  |  |  |  |  |  | 1143 (2515) | 1141 (2510) |
|  | AWWA C207 CLASS F | 1448 (57.01) |  |  |  |  |  |  | 1568 (3450) | 1566 (3445) |
|  | ASME CL150 SERIES B | 1225 (48.23) |  |  |  |  |  |  | 809 (1780) | 807 (1775) |
|  | ASME CL150 SERIES A | 1345 (52.95) |  |  |  |  |  |  | 1289 (2836) | 1287 (2831) |
|  | ASME CL300 SERIES A | 1290 (50.79) |  |  |  |  |  |  | 1527 (3359) | 1525 (3355) |
|  | ASME CL300 SERIES B | 1335 (52.56) |  |  |  |  |  |  | 1704 (3749) | 1702 (3744) |
| DN1100 | JIS 5K | 1305 (51.38) | 1430 (56.30) |  |  |  |  |  | 510 (1122) | 508 (1118) |
| (44 in.) | JIS 10K | 1345 (52.95) |  |  |  |  |  |  | 689 (1516) | 687 (1511) |
|  | AWWA C207 CLASS B | 1403 (55.24) |  |  |  |  |  |  | 615 (1353) | 613 (1349) |
|  | AWWA C207 CLASS D | 1403 (55.24) |  |  |  |  |  |  | 807 (1775) | 805 (1771) |
|  | AWWA C207 CLASS E | 1404 (55.26) |  |  |  |  |  |  | 1205 (2651) | 1203 (2647) |
|  | AWWA C207 CLASS F | 1505 (59.25) |  |  |  |  |  |  | 1719 (3782) | 1717 (3777) |
| DN1200 | JIS 5K | 1420 (55.91) | 1560 (61.42) | 860 (33.85) | 659 (25.94) | 784 (30.87) | 786 (30.94) | 802 (31.57) | 651 (1432) | 649 (1428) |
|  | JIS 10K | 1465 (57.68) |  |  |  |  |  |  | 967 (2127) | 965 (2123) |
|  | PN6 | 1405 (55.31) |  |  |  |  |  |  | 710 (1562) | 708 (1558) |
|  | PN10 | 1455 (57.28) |  |  |  |  |  |  | 1107 (2435) | 1105 (2431) |
|  | PN16 | 1485 (58.46) |  |  |  |  |  |  | 1363 (2999) | 1361 (2994) |
|  | AWWA C207 CLASS B | 1511 (59.49) |  |  |  |  |  |  | 772 (1698) | 770 (1694) |
|  | AWWA C207 CLASS D | 1511 (59.49) |  |  |  |  |  |  | 999 (2198) | 997 (2193) |
|  | AWWA C207 CLASS E | 1511 (59.49) |  |  |  |  |  |  | 1458 (3208) | 1456 (3203) |
|  | AWWA C207 CLASS F | 1651 (65.00) |  |  |  |  |  |  | 2400 (5280) | 2398 (5276) |
|  | AS4087 PN16 | 1490 (58.66) |  |  |  |  |  |  | 1253 (2757) | 1251 (2752) |
|  | AS2129 TABLE-D | 1490 (58.66) |  |  |  |  |  |  | 1023 (2251) | 1021 (2246) |
|  | AS2129 TABLE-E | 1490 (58.66) |  |  |  |  |  |  | 1272 (2798) | 1270 (2794) |
|  | PN25 | 1530 (60.24) |  |  |  |  |  |  | 1559 (3430) | 1557 (3425) |
|  | PN40 | 1575 (62.01) |  |  |  |  |  |  | 2133 (4693) | 2131 (4688) |
|  | AS4087 PN35 | 1530 (60.24) |  |  |  |  |  |  | 2115 (4653) | 2113 (4649) |
|  | ASME CL150 SERIES A | 1510 (59.45) |  |  |  |  |  |  | 1707 (3755) | 1705 (3751) |
|  | ASME CL300 SERIES A | 1465 (57.68) |  |  |  |  |  |  | 2163 (4759) | 2161 (4754) |
|  | ASME CL150 SERIES B | 1390 (54.72) |  |  |  |  |  |  | 1085 (2387) | 1083 (2383) |
|  | ASME CL300 SERIES B | 1510 (59.45) |  |  |  |  |  |  | 2352 (5174) | 2350 (5170) |

DN700 to 2400 (28 to 96 in. NB) (FEW) dimensions / weights (Continued)

## WaterMaster

Electromagnetic flowmeter


DN700 to 2400 (28 to 96 in. NB) (FEW) dimensions / weights (Continued)

## WaterMaster

Electromagnetic flowmeter

## Ordering information

Electromagnetic flowmeter WaterMaster - FEW11, FEW12 and FEW18


## WaterMaster

Electromagnetic flowmeter


[^5]Electromagnetic flowmeter WaterMaster FEV11, FEV12 and FEV18


## WaterMaster

Electromagnetic flowmeter

| Variant digit number | 1... 5 | 6 | 7... 9 | 10 | 11 | 12 | 13 | 14, 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Flowmeter system, optimized full bore, integral mount | FEV11 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Flowmeter system, optimized full bore, remote mount | FEV12 |  | xxx | X | X | X | X | xx | X | X | x | x | X | X | X | X | X |
| Optimized full bore sensor only, for use with WaterMaster transmitter/remote | FEV18 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Temperature range installation / ambient temperature range |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  |  |
| Nameplate |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Signal cable length and type* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Without signal cable 5 m (15 ft.) cable 10 m (30 ft.) cable 20 m (60 ft.) cable <br> 30 m (100 ft.) cable 50 m ( 165 ft .) cable 80 m (260 ft.) cable 100 m ( 325 ft .) cable 150 m (490 ft.) cable Special length > 150 m (> 490 ft .) |  |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & 0 \\ & 1 \\ & 2 \\ & 3 \\ & 4 \\ & 5 \\ & 6 \\ & 7 \\ & 8 \\ & 9 \end{aligned}$ |  |  |  |
| Explosion protection certification |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| General purpose (non-Ex design) <br> FM Class 1 Div. 2 <br> FMc Class 1 Div. 2 <br> Others |  |  |  |  |  |  |  |  |  |  |  |  |  |  | A G P Z |  |  |
| Protection class transmitter / protection class sensor |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| IP67 (NEMA 4X) / IP67 (NEMA 4X) - integral IP67 (NEMA 4X) / IP68 (NEMA 6P) - cable not fitted and IP67 (NEMA 4X) / IP68 (NEMA 6P) - cable fitted and | nd not po otted |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 2 3 |  |
| Cable conduits* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| M20 $\times 1.5$ (plastic) <br> NPT ${ }^{1 / 2}$ in. (blanked when cable not fitted) M20 SWA (armored) <br> M20 SWA sensor, M20 x 1.5 (plastic) power / output Without |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | A B D F Y |

Power supply

## Without

100... $230 \mathrm{~V} \mathrm{AC}, 50 \mathrm{~Hz}$

24 V AC or 24 V DC, 50 Hz
$100 \ldots 230 \mathrm{~V} \mathrm{AC}$,
24 V AC or $24 \mathrm{VDC}, 60 \mathrm{~Hz}$
Others
Input and output signal type
HART + $20 \mathrm{~mA}+$ pulse + contact output
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)
Without

## Without

Factory defaults / standard diagnostics

* The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered For FM or FMC Approved versions, NPT only permitted


## WaterMaster

Electromagnetic flowmeter


[^6]Electromagnetic flowmeter WaterMaster FEF12 and FEF18 (Sizes up to DN2400 [96 in. NB] still available on request)


## WaterMaster

Electromagnetic flowmeter


Configuration type / diagnostics type
Without
Factory defaults / standard diagnostics
Options***

## Accessories

Configuration lead AC
Documentation language

| German | M1 | French | M4 | Swedish | M7 | Portuguese |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Italian | M2 | English | M5 (default) | Finnish | M8 |  |
| Spanish |  |  |  | Danish | MF |  |
| M3 |  |  | M |  |  |  |

## Verification type

Without fingerprint V0
VeriMaster
V3

Potable water approvals

| WRAS - cold water approval | CWA |
| :--- | :--- |
| NSF-61 meter approval | CWC |
| ACS | CWF |
| Without | CWY |

Power supply frequency (sensor FEF 18 only)
$50 \mathrm{~Hz} \quad$ F5 $60 \mathrm{~Hz} \quad$ F6

## Number of testpoints

## 1Point

T1

[^7]
## WaterMaster

Electromagnetic flowmeter

Electromagnetic flowmeter WaterMaster - FEW31, FEW32 and FEW38 (FEF still available on request)


## WaterMaster

Electromagnetic flowmeter


## WaterMaster

Electromagnetic flowmeter


[^8]
## WaterMaster

Electromagnetic flowmeter

Electromagnetic flowmeter transmitter for WaterMaster FET10 and FET12

*The transmitter converter module Input and Output Signal Type must match the transmitter backplane output configuration (HART or PROFIBUS) - see OI/FET100-EN.
**Add codes for options

## WaterMaster

Electromagnetic flowmeter

## Common accessories

| Accessory | Item Number |
| :---: | :---: |
| WaterMaster AC Fuse F1 Type T $250 \mathrm{~mA} \mathrm{A/S} \mathrm{TR5}$ | B20411 |
| WaterMaster DC Fuse F2 Type T 2 A A/S TR5 | B20412 |
| WaterMaster Infra Red Comms Pack | MJBX9932 |
| WaterMaster Backplane PCB Board (STD) | WATX2505 |
| WaterMaster Sensor PCB Board | WATX2506 |
| WaterMaster Comms Cable | WEBC2500 |
| Signal cable for remote WaterMaster transmitter 5 m ( 15 ft. ) <br> 10 m (30 ft.) <br> 20 m (60 ft.) <br> 30 m (100 ft.) <br> 50 m (165 ft.) <br> 80 m (260 ft.) <br> 100 m (325 ft.) <br> 150 m (490 ft.) <br> 500 m (1650 ft.) | STT4500/05 <br> STT4500/10 <br> STT4500/20 <br> STT4500/30 <br> STT4500/50 <br> STT4500/80 <br> STT4500/100 <br> STT4500/150 <br> STT4500/500 |
| ```Armored signal cable for remote WaterMaster transmitter 5 m ( 15 ft. ) 10 m (30 ft.) 20 m (60 ft.) 30 m (100 ft.) 50 m (165 ft.) 80 m (260 ft.) 100 m ( 325 ft .) 150 m (490 ft.) 500 m (1650 ft.)``` | STT4501/05 <br> STT4501/10 <br> STT4501/20 <br> STT4501/30 <br> STT4501/50 <br> STT4501/80 <br> STT4501/100 <br> STT4501/150 <br> STT4501/500 |

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## Installation, Care and Maintenance

3301


Flygt

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## SAFETY

This manual contains basic information on the installation, operating and maintenance and should be followed carefully. It is essential that these instructions are carefully read before installation or commissioning by both the installation crew as well as those responsible for operation or maintenance. The operating instructions should always be readily available at the location of the unit.

## Identification of safety and warning symbols



## General Danger:

Safety instructions in this manual, which could cause danger to life if not observed, have been specifically highlighted with this general danger symbol.


## High Voltage:

The presence of a dangerous voltage is identified with this safety symbol.

## WARNING!

Non-observance to this warning could damage the unit or affect its function

## Qualifications of personnel

An authorized (certified) electrician and mechanic shall carry out all work.

## Safety regulations for the owner/operator

All government regulations, local health and safety codes shall be complied with.
All dangers due to electricity must be avoided (for details consult the regulations of your local electricity supply company).

Unilateral modification and spare parts manufacturing

Modifications or changes to the unit/installation should only be carried out after consulting with Flygt.
Original spare parts and accessories authorized by the manufacturer are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation.

## Dismantling and re-assembly

If the pump has been used to pump hazardous media, care must be taken that, when draining the leakage, personnel and environment are not endangered.

All waste and emissions such as used coolant must be appropriately disposed of. Coolant spills must be cleaned up and emissions to the environment must be reported.
The pumping station must be kept tidy and in good order at all times.
All government regulations shall be observed.

## NOTES FOR EX-PRODUCTS

- Only Ex-approved pumps may be used in an explosive or flammable environment.
- Do not open the pump when an explosive gas atmosphere may be present.
- Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and can not be energized. This applies to the control circuit as well.
- All mechanical work on the explosion-proof motor section must be performed by personnel authorized by Flygt.
- Electrical connection on the explosion-proof motor must be made by authorized personnel.
- Thermal contacts must be connected to protection circuit intended for that purpose according to the approval of the product.
- The pump may be used only in accordance with the approved motor data stated on the data plates.
- Intrinsically safe circuits are normally required (Ex i) for the automatic level control system by level regulator if mounted in zone 0 .
- This equipment must be installed in conformity to prescriptions in international or national rules ( IEC/EN 60079-14).
- The maintenance operation must be made in conformity to the international or national standards (IEC/EN 60079-17).
- The yield stress of fastener elements in the product must be in conformity with the value specified in the table for "Material of fastener" on the approval drawing or the parts specified in the part list for the product.
- According to the ATEX directive the Ex-pump must never run dry. Permitted minimum water level, see dimensional drawing for the pump. Dry running at service and inspection is only permitted outside the Ex area.
- The user must know about the risks due the electric current and the chemical and physical characteristics of the gas and/or vapours present in hazardous areas.
- Flygt disclaims all responsibility for work done by untrained, unauthorized personnel.


## GUARANTEE

ITT Flygt undertakes to remedy faults in products sold by Flygt provided:

- that the fault is due to defects in design, materials or workmanship;
- that the faults are reported to Flygt or Flygt's representative during the guarantee period;
- that the product is used only under condition described in the Installation, Care and Maintenance manual and in applications for which it is intended;
- that the monitoring equipment incorporated in the product is correctly connected and in use;
- that all service and repair work is done by a work shop authorized by Flygt;
- that genuine Flygt parts are used.

Hence, the guarantee does not cover faults caused by deficient maintenance, improper installation, incorrectly executed repair work or nomal wear and tear.
Flygt assumes no liability for either bodily injuries, material damages or economic losses beyond what is stated above.
Flygt guarantees that spare parts will be kept for 15 years after that the manufacture of this product has been discontinued.

## DATA PLATE INTERPRETATION



## Approval plates

These approval plates apply to an explosion-proof submersible Flygt pump. The plates are used together with the general data plate on the pump.

EN: European Norm
ATEX Directive
EN 50014, EN 50018, EN 1127-1
(Ex) II 2 G EEx dII B T3

A Serial number
B Product code + Number
C Curve code / Propeller code
D Country of origin
E Product number
F Additional information
G Phase; Type of current; Frequency
H Rated voltage
I Thermal protection
$J$ Thermal class
K Rated shaft power
L International standard
M Degree of protection
N Rated current
O Rated speed
P Max. submergence
Q Direction of rotation: L=left, R=right
R Duty class
S Duty factor
T Product weight
U Locked rotor code letter
$\checkmark$ Power factor
X Max. ambient temperature
Y Notified body/ Only for EN-apparoved Ex-products
Z Read Installation Manual

EN approval for the Cable entry
Certificate number: INERIS 03ATEX9008 U (Ex) II 2 G or IM2 EExdIIC or EExdI


[^9]

## PRODUCT DESCRIPTION

## Introduction

Thank you for buying a submersible ITT Flygt pump. In this Installation, Care and Maintenance manual you will find general information on how to install and service the 3301 pump to give it a long and reliable life.

## Application

This Installation, Care and Maintenance manual applies to a submersible Flygt pump.
The pump is intended to be used for;

- pumping of waste water
- pumping of raw or clean water
- pumping of sludge


## Installation alternatives

$\mathbf{P}=$ semi permanent wet well arrangement with pump installed by means of twin guide bars with automatic connection to discharge.
$\mathbf{S}=$ transportable version with hose connection or flange for connection to discharge pipeline.
T = permanent dry well or in-line arrangement with flange connection to suction and discharge pipework; vertical mounting.
$\mathbf{Z}=$ permanent dry well or in-line arrangement with flange connection to suction and discharge pipework; horizontal mounting.

In $\mathbf{T}, \mathbf{S}$ and $\mathbf{Z}$ installations the pump must be equipped with cooling jacket.
For further information on applications, contact your nearest Flygt representative.

## Pump versions

$\mathrm{LT}=$ low head execution
MT = medium head execution
$\mathrm{HT}=$ high head execution
Liquid temperature:max. $40^{\circ} \mathrm{C}\left(104^{\circ} \mathrm{F}\right)$
Also available in an execution for liquid temperature up to $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)$ only with cooling jacket.

Higher temperatures than $40^{\circ} \mathrm{C}\left(104^{\circ} \mathrm{F}\right)$ are not permitted for the Ex-approved pumps.

Liquid density: max. $1100 \mathrm{~kg} / \mathrm{m}^{3}$ (9.2 lb per US gal.)
The pH of the pumped liquid: 5.5-14
Lowest liquid level: See illustration page 8
Depth of immersion: max. 20 m ( 65 ft )

## Recycling

Local and/or private laws and regulations regarding recycling must be followed. If there are no laws or regulations, or the product is not accepted by an authorized recycling company, the product or it's parts can be returned to the nearest Flygt sales company or service workshop.

## Weights

Weight including connections, but without motor cable in kg (lb).

| Pump type | With cooling <br> jacket | Withoutcooling <br> jacket |
| :--- | ---: | ---: |
| NP 3301 HT | $850(1874)$ | Discharge <br> connection |
| NP 3301 MT | $930(2050)$ | $780(1720)$ <br> NP 3301 LT <br> NS 3301 HT |
| NS 3301 MT | $920(1896)$ | $142(2623)$ |
| NS 3301 LT | $1120(2469)$ | $239(527)$ |
|  | $1110(22028)$ | - |
| NT 3301 HT | $980(2160)$ | - |
| NT 3301 MT | $1090(2403)$ | - |
| NT 3301 LT | $1360(2998)$ |  |
| NZ 3301 HT | $970(2138)$ | - |
| NZ 3301 MT | $1050(2315)$ | - |
| NZ 3301 LT | $1250(2756)$ |  |

## Motor data

$50 \mathrm{~Hz}, 55.0 \mathrm{~kW}$, $1475 \mathrm{r} / \mathrm{min}$
3-phase, 4-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 106 | 410 |
| 400 D | 103 | 435 |
| 415 D | 98 | 400 |
| 440 D | 95 | 430 |
| 500 D | 82 | 335 |
| 660 Y | 61 | 243 |
| 690 Y | 59 | 250 |

$50 \mathrm{~Hz}, 70.0 \mathrm{~kW}$, $1475 \mathrm{r} / \mathrm{min}$
3-phase, 4-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 134 | 875 |
| 400 D | 127 | 800 |
| 415 D | 121 | 745 |
| 440 D | 119 | 800 |
| 500 D | 102 | 640 |
| 660 Y | 81 | 370 |
| 690 Y | 73 | 455 |

$50 \mathrm{~Hz}, 45.0 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$
3-phase, 6-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 93 | 510 |
| 400 D | 93 | 545 |
| 415 D | 89 | 520 |
| 440 D | 90 | 555 |
| 500 D | 72 | 410 |
| 660 Y | 54 | 297 |
| 690 Y | 53 | 315 |

$50 \mathrm{~Hz}, 55.0 \mathrm{~kW}$, $985 \mathrm{r} / \mathrm{min}$
3-phase, 6-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 119 | 685 |
| 400 D | 113 | 660 |
| 415 D | 104 | 565 |
| 440 D | 103 | 610 |
| 500 D | 91 | 535 |
| 660 Y | 68 | 415 |
| 690 Y | 65 | 395 |

$50 \mathrm{~Hz}, 37.0 \mathrm{~kW}, 735 \mathrm{r} / \mathrm{min}$
3-phase, 8-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 87 | 475 |
| 400 D | 80 | 425 |
| 415 D | 77 | 400 |
| 440 D | 78 | 435 |
| 500 D | 65 | 350 |
| 660 Y | 51 | 275 |
| 690 Y | 46 | 219 |

## Motor data

60 Hz , 85 hp , (63 kW) 1775 r/min
3-phase, 4-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 127 | 600 |
| 460 D | 101 | 430 |
| 575 D | 80 | 335 |
| 600 D | 78 | 218 |

$60 \mathrm{~Hz}, 105 \mathrm{hp}$, ( 78 kW ) 1780 r/min 3-phase, 4-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 149 | 1035 |
| 460 D | 121 | 810 |
| 575 D | 97 | 650 |
| 600 D | 95 | 680 |

60 Hz, 70 hp, (52 kW) 1185 r/min 3-phase, 6-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :--- |
| 380 D | 107 | 655 |
| 460 D | 89 | 560 |
| 575 D | 70 | 425 |
| 600 D | 70 | 445 |

60 Hz, 85 hp, ( 63 kW) 1185 r/min 3-phase, 6-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 135 | 865 |
| 460 D | 109 | 685 |
| 575 D | 88 | 550 |
| 600 D | 88 | 580 |

$60 \mathrm{~Hz}, 60 \mathrm{hp}$, (45 kW) 885 r/min
3-phase, 8-pole

| Voltage <br> V | Rated <br> current A | Starting <br> current A |
| :---: | :---: | :---: |
| 380 D | 99 | 555 |
| 460 D | 80 | 440 |
| 575 D | 65 | 365 |
| 600 D | 65 | 385 |

## DESIGN OFTHE PUMP

## Motor

Squirrel-cage 3-phase induction motor for 50 Hz or 60 Hz .
The motor is started by means of direct on-line or star delta start.
The motor can be run continuously or intermittently with a maximum of 30 evenly spaced starts per hour. Flygt motors are tested in accordance with IEC 34-1.

The stator is insulated in accordance with class H ( $180^{\circ} \mathrm{C}, 360 \mathrm{~F}$ ). The motor is designed to supply its rated output at $\pm 10 \%$ variation of the rated voltage. Without overheating the motor, $\pm 10 \%$ variation of the rated voltage can be accepted provided that the motor does not run continuously at full load.

## Bearings

The support and main bearing of the shaft are both double row angular contact ball bearings.

## Mechanical seal unit

The pump has one shaft mechanical seal unit consisting of two independently operating seals:

Alt I Inner seal: Corrosion resistant cemented carbideWCCR/WCCR
Outer seal: Corrosion resistant cemented carbideWCCR/WCCR

Alt II Inner seal: Corrosion resistant cemented carbideWCCR/WCCR
Outer seal: Silicon Carbide RSiC/RSiC


## Monitoring equipment

The stator incorporates three thermal contacts connected in series that activate an alarm at overtemperature.
The thermal contacts: open at $140^{\circ} \mathrm{C}$ ( 285 F ). The sensors shall be connected to Flygt's monitoring unit MiniCAS II or equivalent unit.
The monitoring equipment shall be of a design that makes automatic restart impossible.
The 3301 is supplied with inspection sensor FLS10 for sensing the presence of any liquid in the inspection chamber.

## Cooling

The pump is cooled by the ambient liquid. For lowest liquid level, see illustration below.


## Seal housing

A coolant fluid lubricates and cools the mechanical seal unit and acts as a buffer between the pumped media and the electric motor.

Inspection chamber The inspection chamber is equipped with a FLS10 leakage sensor to prevent damages on the motor.

Flow diffusor
Provides heat transfer from the coolant to the pumped media.

## Shaft

The shaft is delivered with the rotor as an integral part. Shaft material; stainless steel.

## Cooling

The motor is cooled by a closed loop cooling system. An integrated coolant pump circulates the coolant whenever the pump is operated.

Seal housing
The coolant lubricates and cools the mechanical seal unit and acts as a buffer between the pumped media and the electric motor.

## TRANSPORTATION AND STORAGE

The pump may be transported and stored in a vertical or horizontal position. Make sure that the pump cannot roll or fall over.

## WARNING!

Always lift the pump by its lifting handle never by the motor cable or the hose.

The pump is frostproof as long as it is operating or is immersed. If the pump is hoisted from the sump when the temperature is below the freezing point, the impeller and shaft seal may freeze.

A frozen impeller and shaft seal can be thawed by allowing the pump to stand immersed in the liquid for a short period before it is started. Never use a naked
flame to thaw the pump. The pump should run for a few seconds after being taken up in order to expel all remaining water from the hydraulic end.

For longer periods of storage, the pump must be protected against moisture and heat. The impeller should be rotated by hand occasionally (for example every other month) to prevent the shaft seals from sticking together. If the pump is stored for more than 6 months, this rotation is mandatory.
After a long period of storage, the pump should be inspected before it is put into operation. Pay special attention to the shaft seal and the cable entry.

Follow the instructions under the heading "Before starting".

## INSTALLATION

## Handling equipment

Always pay extra attention to safety aspects when working with lifting equipment.
Lifting equipment is required for handling the pump.
The lifting chain and the schackle should be in stainless steel and inspected every year.


The minimum height between the lifting hook and the floor shall be sufficient to lift the pump out of the sump.

The lifting equipment shall be able to hoist the pump straight up and down in the sump, preferably without the need for resetting the lifting hook.

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

Make sure that the lifting equipment is securely anchored and in good condition.

Check that the lifting handle and chain are in good condition.

To ensure proper installation, please see the dimensions on the dimensional drawing.

WARNING! The end of the cable must not be submerged. It must be above flood level, as water could penetrate through the cable into the junction box or the motor.

For automatic operation of the pump (level control), it is recommended that the level regulators should be used at low voltage. The data sheet delivered with the regulators gives the permissible voltage. Local rules may specify otherwise.

Clean out all debris from the sump before the pump is lowered down and the station is started.


- Minimum stop level should be according to the dimensional drawing.
- The pump must never run dry or on snore.


## Safety precautions

In order to minimize the risk of accidents in connection with service and installation work, the following rules should be followed:

1. Never work alone. Use a lifting harness, safety line and a respirator as required. Do not ignore the risk of drowning.
2. Make sure there are no dangerous gases within the work area.
3. Check the explosion risk before welding or using electric hand tools.
4. Before the pump is installed check that the cable and cable entry have not been damaged during the transportation.
5. Observe strict cleanliness. Do not ignore health hazards.
6. Bear in mind the risk of electrical accidents.
7. Make sure that the lifting equipment is in good condition and comply to local ordinances.
8. Provide a suitable barrier around the work area, e.a. guard rail.
9. Make sure you have a clear path of retreat.
10. Use safety helmet, safety goggles and protective shoes.
11. All personnel who work with sewage systems must be vaccinated against diseases to which they may be exposed.
12. A first-aid kit must be close at hand.
13. Note that special rules apply to installation in explosive athmosphere.
Follow all health and safety rules and local codes and ordinances.

## Installation alternatives

## P- installation



In the $P$ - installation, the pump is installed on a stationary discharge connection and operates completely or partially submerged in the pumped liquid. In addition to the pump the following items are required:

Guide bars consisting of two hot dip galvanized or stainless steel pipes.
Guidebar bracket for attaching the guide bars to the access frame or 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.
Bushings for vibration damping between the guide bars and the discharge connection.

## Instructions

- Provide a barrier around the pump pit, for example a guardrail.
- Arrange for a cable between the sump and the electric control box. Make sure that the cables are not sharply bent or pinched.
- Place the access frame in position.
- Align the frame so that it is horizontal and then grout it in place.
- Grout the anchor bolts in place. Be careful when aligning and positioning the discharge connection in relation to the access frame.
- Place the discharge connection in position and tighten the nuts.
- Secure the guide bars in the bracket.
- Check that the guide bars are placed vertically by using a level or a plumb line.
- Connect the discharge pipe to the discharge connection.
- Bolt the cable holder to the access frame. Thread the level regulator cables through the holes in the cable holder and adjust the height of the level regulators.
- Protect bolts and nuts with corrosion preventive compound.
- Lower the pump along the guide bars.
- Fasten the lifting chain (stainless steel) on the access frame and the cables on the cable holder. Make sure that the cables cannot be sucked into the inlet of the pump. Support straps are required for deep installations.
- Run the cables up to the electric control box.
- Clean out debris from the sump before starting up the station.
- The pump can be hoisted up along the guide bars for inspection without any connections having to be undone.


## Installation alternatives

## S- installation



In the S- installation, the pump is transportable and intended to operate completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe, see "Parts list".
The pump stands on a base stand.
WARNING! Watch for the starting jerk which can be powerful.

## T/Z- installation



T


Z

In the T- installation, the pump is installed in a stationary position in a dry well next to the wet sump.

In the Z-installation the pump is installed in a horizontal position on a support stand and a bell-mouth is connected to the inlet pipe.

The pump has a watertight motor and will therefore not be damaged in the event of flooding.

The pump is equipped with a cooling jacket.

In addition to the pump the following items are required:

Support stand for anchoring the pump to a base.
Shut-off valves to permit the pump to be removed for service.

Level regulators or other control equipment for start, stop and alarm.

WARNING! The risk of freezing is particularly significant at certain T- or Z-installations.

## Instruction

Bolt the base stand to the concrete base by means of the anchor bolts. Bolt the pump to the base stand and the suction connection.
Connect the motor cable, suction line and discharge line.
Make sure that the weight of the pump does not bear on the system piping.

## ELECTRICALCONNECTIONS

$/ / /$

- 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.
- If the pump is equipped with automatic level control, there is a risk of sudden restart.
- If persons are likely to come into physical contact with the pump or pumped media (liquid), e.g on construction sites and farms, the earthed (grounded) socket must have an additional earth-(ground-) fault protection device (GFI) connected.

All electrical work shall be carried out under the supervision of an authorized electrician. Local codes and regulations shall be complied with.


All electrical equipment must be earthed (grounded). This applies to both pump equipment and any monitoring equipment. Failure to heed this warning may cause a lethal accident. Make sure that the earth (ground) lead is correctly connected by testing it.

- Check the data plate to determine which voltage supply is valid for your pump.
- Check that the main voltage and frequency agree with the specifications on the pump data plate.
- If the pump can be connected to different voltages, the connected voltage is specified by a yellow sticker.
- Connect the motor cable to the starter equipment as illustrated in the wiring diagrams.
- When the pump is connected to the public mains it may cause flicker of incandescent lamps when starting. In this case the supply authority should be notified before installing the pump.

Leads that are not in use must be isolated.
The cable should be replaced if the outer sheath is damaged. Contact a Flygt service shop.
Make sure that the cable does not have any sharp bends and is not pinched.

Under no circumstances may the starter equipment be installed in the sump.
WARNING! For safety reasons, the earth (ground) lead should be approx. 150 mm (6.0") longer than the phase and monitoring leads. If the motor cable is jerked loose by mistake, the earth (ground) lead should be the last lead to come loose from its terminal. This applies to both ends of the cable.

The motor is convertible between different voltages as stated on the data plate. This conversion is done on the terminal board or the contactor.


- Bear in mind the risk of electrical shock and the risk of explosion if the electrical connections are not correctly carried out.

When using a variable-frequency-drive (VFD) the shielded cable (type NSSHÖU.../3E+St) should be used in order to fulfil European CE requirements. Contact your Flygt representative and ask your VFD-supplier for electrical limitations. Also please see VFDrecommendation Flygt article no. 893472

## Connection of stator and motor leads

- Check on the data plate which connection, Y, D or YD, is valid for the voltage supply. Then, depending on voltage, arrange the connection on the terminal board in accordance with Y, D or YD. See figure.
- Connect the motor cable to the connection block, U1, V1, W1 and earth (ground). Connect the leads from the motor control circuit.
- If star-delta start is used, motor cables are connected as shown in the figure. Links (jumper strips) are not used with star-delta start.
- Make sure that the pump is correctly earthed (grounded).
- Install the O-ring (33) and connection cover (32).
- Tighten the screws and the gland nut so that the cable entry unit bottoms out.
- Connect the motor cable to the starter equipment. Check the direction of rotation, see "Before starting".
- If the direction of rotation is wrong, transpose two of the phase leads.
- Remember that the starting surge with the direct-on line start can be up to six times higher than the rated current. Make sure that the fuses and circuit breakers are of the proper amperage.
- The incorporated thermal contacts must be connected and in use. The pump must be connected to an overload protection which must be set to rated power.



## CABLE CHART

SUBCAB $^{\circledR} 4 \mathrm{GX} /$ SUBCAB $^{\circledR}$ AWG, 6-leads, Y
3301


| Mains | $\begin{aligned} & \text { SUBCAB }{ }^{\ominus} \\ & \text { Lead } \end{aligned}$ | SUBCAB ${ }^{\oplus}$ AWG <br> Lead | Terminal board |
| :---: | :---: | :---: | :---: |
| L1 <br> L2 <br> L3 <br> Groundcheck GC | brown <br> black <br> grey <br> yellow/green | red <br> black <br> white <br> yellow/green <br> yellow | U1 <br> W 1 <br> V1 <br> $(1)$ |
| Control | SUBCAB ${ }^{\circ}$ <br> Cable lead | SUBCAB ${ }^{\ominus}$ AWG Cable lead | Terminal board |
| $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | orange blue | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ |
| Stator leads connection: Stator lead |  | Terminal board |  |
| U1, red <br> W2, black <br> V1, brown <br> U2, green <br> W1, yellow <br> V2, blue |  | U1 <br> W 2 <br> V1 <br> U2 <br> W 1 <br> V2 |  |

SUBCAB $^{\circledR} 4 \mathrm{GX} /$ SUBCAB $^{\circledR}$ AWG, 6-leads, D
3301


| Mains | $\begin{aligned} & \text { SUBCAB }{ }^{\ominus} \\ & \text { Lead } \end{aligned}$ | $\begin{aligned} & \text { SUBCAB }{ }^{\circ} \text { AWG } \\ & \text { Lead } \end{aligned}$ | Terminal board |
| :---: | :---: | :---: | :---: |
| L1 <br> I2 L3 <br> Groundcheck GC | brown <br> black <br> grey <br> yellow/green | red <br> black <br> white <br> yellow/green <br> yellow | U1 <br> W 1 <br> V1 <br> ( 1 |
| Control | SUBCAB ${ }^{\circ}$ <br> Cable lead | SUBCAB ${ }^{\ominus}$ AWG <br> Cable lead | Terminal board |
| $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | orange <br> blue | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ |
| Stator leads connection: Stator lead |  | Terminal board |  |
| U1, red <br> W2, black <br> V1, brown <br> U2, green <br> W1, yellow <br> V2, blue |  | U1 <br> W 2 <br> V1 <br> U2 <br> W 1 <br> V2 |  |

## CABLE CHART

SUBCAB ${ }^{\circledR}$ 7GX,
6-leads, Y/D
3301


| Mains | Lead | Lead |
| :---: | :---: | :---: |
| L1 | 1 | U1 |
| L2 | 2 | W 1 |
| L3 | 3 | V1 |
| L1 | 4 | W 2 |
| I2 | 5 | V2 |
| L3 | 6 | U2 |
| (1) | yellow/green | (1) |
| Control | Cable lead | Terminal board |
| T1 | T1 | T1 |
| T2 | T2 | T2 |
| Stator leads connection: <br> Stator lead <br> Terminal board |  |  |
| U1, red |  |  |
| W2, black |  |  |
| V1, brown |  |  |
| U2, green |  |  |
| W1, yellow |  |  |
| V2, blue |  |  |

SUBCAB $^{\circledR} 4 \mathrm{GX} /$ SUBCAB $^{\circledR}$ AWG, 2 motor cables in parallel, 6-leads, Y
3301


| Mains | $\begin{aligned} & \text { SUBCAB }{ }^{\oplus} \\ & \text { Lead } \end{aligned}$ | $\begin{aligned} & \text { SUBCAB }{ }^{\odot} \text { AWG } \\ & \text { Lead } \end{aligned}$ | Terminal board |
| :---: | :---: | :---: | :---: |
| L1 <br> L2 <br> L3 <br> Groundcheck GC | brown <br> black <br> grey <br> yellow/green | red <br> black <br> white <br> yellow/green <br> yellow | U1 <br> W 1 <br> V1 <br> (1) |
| Control | SUBCAB ${ }^{\circ}$ <br> Cable lead | SUBCAB ${ }^{\ominus}$ AWG Cable lead | Terminal board |
| $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | orange blue | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ |
| Stator leads connection: <br> Stator lead Terminal board |  |  |  |
| U1, red <br> V1, brown <br> W1, yellow <br> U2, green* <br> V2, blue* <br> W2, black* |  | U1 <br> V1 <br> W 1 |  |
| *Connected together at terminal |  |  |  |

## CABLE CHART

SUBCAB $^{\circledR} 4 \mathrm{GX} /$ SUBCAB $^{\circledR}$ AWG, 2 motor cables in parallel, 6-leads, D
3301


| Mains | $\text { SUBCAB }{ }^{\oplus}$ <br> Lead | SUBCAB ${ }^{\oplus}$ AWG <br> Lead | Terminal board |
| :---: | :---: | :---: | :---: |
| L1 <br> L1 <br> L2 <br> L2 <br> L3 <br> L3 <br> Groundcheck GC | brown <br> brown <br> black <br> black <br> grey <br> grey <br> yellow/green | red <br> red <br> black <br> black <br> white <br> white <br> yellow/green <br> yellow | U1 <br> U1 <br> W 1 <br> W 1 <br> V1 <br> V1 <br> (1) |
| Control | SUBCAB ${ }^{\circ}$ <br> Cable lead | SUBCAB ${ }^{\oplus}$ AWG <br> Cable lead | Terminal board |
| $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ | orange blue | $\begin{aligned} & \mathrm{T} 1 \\ & \mathrm{~T} 2 \end{aligned}$ |
| Stator leads connection: <br> Stator lead Terminal board |  |  |  |
| U1, red <br> V1, brown <br> W1, yellow <br> U2, green <br> V2, blue <br> W2, black |  | U 1 <br> V1 <br> W 1 |  |

SUBCAB ${ }^{\circledR}$ 4GX,
2 motor cables, Y/D, 6-leads
3301


Bild 17

| Mains | Lead | Terminal board |
| :--- | :--- | :--- |
| L1 | brown | U1 |
| L2 | black | grey |
| L3 | brown | V1 |
| L1 | black | W 2 |
| L2 | grey | V2 |
| L3 | yellow/green | U2 |
| I | Cable lead | Terminal board |
| Control | T1 | T1 |
| T1 | T2 |  |
| T2 | Terminal board |  |
| Stator leads connection: | U1 |  |
| Stator lead |  |  |
| U1, red |  |  |
| W2, black | W 2 |  |
| V1, brown | V1 |  |
| U2, green |  |  |
| W1, yellow |  |  |
| V2, blue | U2 |  |

## CABLE CHART

## SUBCAB ${ }^{\circledR}$ Screened, 6-leads, Y

3301


| Mains | Lead | Lead |
| :--- | :--- | :--- |
| L1 | Brown | U 1 |
| L2 | Black | W 1 |
| L3 | Grey | V1 |
| I | Screen from leads | $\left(\begin{array}{l}\text { I }\end{array}\right.$ |
| Control | Cable lead | Terminal board |
| T1 | White T1 | T1 |
| T2 | White T2 | T2 |
| T3 | White T3 |  |
| T4 | Thite T4 |  |
| Stator leads connection: |  |  |
| Stator lead | U16 |  |
| U1, red |  |  |
| W2, black |  |  |
| V1, brown |  |  |
| U2, green |  |  |
| W1, yellow |  |  |
| V2, blue | W 2 |  |

SUBCAB ${ }^{\circledR}$ Screened, 6-leads, D
3301


| Mains | Lead | Lead |
| :--- | :--- | :--- |
| L1 | Brown | U1 |
| L2 | Black | W 1 |
| L3 | Grey | V1 |
| I | Screen from leads | I |
| Control | Cable lead | Terminal board |
| T1 | White T1 | T1 |
| T2 | White T2 | T2 |
| T3 | White T3 | T15 |
| T4 | White T4 | T16 |
| Stator leads connection: | U1 |  |
| Stator lead | W2 |  |
| U1, red | V1 |  |
| W2, black | U2 |  |
| V1, brown |  |  |
| U2, green |  |  |
| W1, yellow |  |  |
| V2, blue |  |  |

## CABLE CHART

## NSSHÖU ../3E+st, 6-leads, Y

3301



NSSHÖU ../3E+st, 6-leads, D
3301


| Mains | Lead | Lead |
| :--- | :--- | :--- |
| L1 | Brown | U1 |
| L2 | Black | W 1 |
| L3 | Grey | V1 |
| I | Screen from leads | I |
| Control | Cable lead | Terminal board |
| T1 | Black T1/1 | T1 |
| T2 | Brown T2/2 | T2 |
| T3 |  |  |
| Stator leads connection: | Terminal board |  |
| Stator lead | U1 |  |
| U1, red | W 2 |  |
| W2, black | V1 |  |
| V1, brown |  |  |
| U2, green |  |  |
| W1, yellow |  |  |
| V2, blue | U2 |  |

## Sensor connections

Monitoring equipment
FLS10 is a small float switch and it is installed in the inspection chamber. FLS is connected to max 12 V .

Thermal switches are incorporated into the stator and are rated $250 \mathrm{~V}, 2,5 \mathrm{~A}(\cos \varphi=1) / 1,6 \mathrm{~A}(\cos \varphi=0,6)$.

The sensors are connected as standard to the Flygt monitoring relay MiniCAS II (see diagrams below).
In case optional sensors are used the more advanced monitoring relay MAS 711 can be used.

For a PTC-thermistor (PTC = Positive Temperature Coefficient), there is a significant increase in resistance at a certain temperature that can be utilized for monitoring the temperature.
PTC-thermistor
$\mathrm{T}=25^{\circ} \mathrm{C}$
$R \leq 100$ Ohm
$\mathrm{T}=135^{\circ} \mathrm{C}\left(\mathrm{T}_{\text {REF }}-5^{\circ} \mathrm{C}\right)$
$R \leq 550$ Ohm
$\mathrm{T}=145^{\circ} \mathrm{C}\left(\mathrm{T}_{\text {REF }}+5^{\circ} \mathrm{C}\right) \quad \mathrm{R} \geq 1330 \mathrm{Ohm}$

Three thermistors are connected in series and have a resistance of approx. 150-300 ohms at room temperature.

The label in the junction box shows if the pump is equipped with optional sensors.


The pump is as standard equipped with either thermal contacts or thermistors.


## B)Thermistors



FLS10 + thermal contacts
$0 \mathrm{~mA}=$ Overtemperature
$10 \mathrm{~mA}=O K$
$28 \mathrm{~mA}=$ Leakage
Tolerance 10\%


Sensor Connection Table
(For further information please contact Flygt representative.)

| Sensor | Sensor lead | Thermal connection | Control cable | Connected to |
| :---: | :---: | :---: | :---: | :---: |
| Thermal contacts FLS10 | White <br> Brown <br> White+Brown | $\begin{aligned} & \text { T1 } \\ & \text { T2 } \\ & \text { T15 } \end{aligned}$ | T1/*Orange T2/*Blue = SubCab /* SubCabAWG | Mini CAS II Mini CAS II |
| Thermistors FLS10 | Red <br> Red <br> Brown <br> Brown | $\begin{aligned} & \text { T1 } \\ & \text { T2 } \\ & \text { T15 } \\ & \text { T16 } \end{aligned}$ | $\begin{aligned} & 1 \\ & 2 \\ & 3 \\ & 4 \end{aligned}$ | Thermistor relay <br> Thermistor relay <br> Mini CAS II <br> Mini CAS II |

## OPERATION

## Before starting

- Check that the visible parts of the pump and installation are undamaged and in good condition.
- Remove the fuses or open the circuit breaker and check that the impeller can be rotated freely.
- Verify that the supply voltage matches the pump data plate voltage rating.
- Conduct insulation integrity check.
- Conduct phase to phase resistant check.
- Check that the monitoring equipment works.
- Check the direction of rotation. The impeller shall rotate clockwise, as viewed from above. When started, the pump will jerk in the opposite direction to the direction in which the impeller rotates. See figure.
- In case of dry installation, check the direction of rotation through the inlet elbow access cover.
- Transpose two phase leads if the impeller rotates in the wrong direction (3-phase).

- Before starting work on the pump, make sure that the pump is isolated from the power supply and cannot be energized. This applies to the control circuit as well.

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- In some installations the pump surface and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.
- In some installations and at certain operating points on the performance curve, the noise level of 70 dB or the noise level specified for the actual pump may beexceeded.


Watch the starting jerk which can be powerful.

## CARE AND MAINTENANCE

## Service/Inspection

Flygt recommends a preventive maintenance program based on Intermediate and Major Services at regular intervals. For standard sewage applications where the temperature of the pumped liquid is $40^{\circ} \mathrm{C}\left(104^{\circ} \mathrm{F}\right)$ or less an Intermediate Service should be performed every 8000 hours or every 2 years, whichever occurs first.

| Pump | Intermediate Service running 8000 h or $\mathbf{2}$ years |
| :---: | :---: |
| Junction box | Check that it is clean and dry. |
| Terminal board | Check that the connections are properly tightened. |
| Insulation check | Check that the resistance between earth and phase lead is more than $5 \mathrm{M} \Omega$. Conduct phase to phase resistance check. |
| Cable | Check that the rubbersheating (jacket) is undamaged. |
| Seal housing | Fill up with new coolant if necessary. Check freezing point (lower than $-13^{\circ} \mathrm{C}\left(9^{\circ} \mathrm{F}\right)$ ). |
| Inspection chamber | Drain all liquid if any. Check the resistance of FLS10. Normal value approx. $1200 \Omega$, alarm approx. $430 \Omega$. |
| O-rings | Always replace the O-rings of the filling plugs and at the junction cover. Always grease new O-rings. |
| Thermal contacts | Check the resistance. Normally closed circuit; interval 0-1 $\Omega$. |
| Thermistor | Check the resistance 20-250 $\Omega$, (measuring voltage max 2 V DC). |
| Impeller | Checkimpeller clearance and adjust if necessary. |
| Lifting handle | Check the screws and the condition of the lifting handle. |
| Rotation direction | Check the rotation of the impeller. |
| Lifting device | Check that local safety regulations are followed. |
| Voltage and amperage | Check running values. |

The time between Major Service could vary con-siderably depending on operating conditions and the need for a Major Service will be determind during the regular Intermediate Services.
However, a minimum of 20000 hours of operation could be anticipated.
For applications other than sewage water or for specific operating conditions, other service intervals may be recommended.

| Pumpstation | Intermediate Service <br> running 8 000 h or 2 years |
| :--- | :--- |
| Electrical Check that they are clean and dry. <br> cabinets/panels  |  |
| Connectionto Check that the connections are <br> power properly tightened. <br> Overload and <br> otherprotections Check correct settings. <br> Personnel safety Check guard rails, covers and other <br> protections  |  |
| Level regulators | Check condition and function. |


| Pump | Major Service |
| :--- | :--- |
| Support and main <br> bearing. | Replace with new bearings. |
| Mechanical seal <br> unit. | Replace with new seal units. |
| Pump station same as Intermediate Service |  |


| If any indication of <br> alarm between in- <br> spections, please <br> see instructions <br> below. | Actions |
| :--- | :--- |
| FLS10 | Drain the fluid in the inspection <br> chamber. Fill with new coolant <br> if necessary. Check freezing <br> point (lower than -13 $\left.{ }^{\circ} \mathrm{C}\left(9^{\circ} \mathrm{F}\right)\right)$. <br> Check the inspection chamber <br> again after one week of ope- <br> ration. If leakage has occured, <br> drain the fluid and change the <br> mechanical seal unit and <br> replace with new coolant. |
| Thermistor/Thermal |  |
| contact | Check coolant level. <br> (pump with cooling jacket) <br> Check start and stop levels. <br> Check that the impeller can |
| rotate freely. |  |

The following points are important in connection with work on the pump:

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- Check every year that the lifting equipment is in good condition.

The pump is designed for use in liquids which can be a healthrisk. In order to prevent injury to the eyes and skin, observe the following points when working on the pump:

- Make sure that the pump has been thoroughly cleaned.
- Beware of the risk of infection.
- Follow local safety regulations.
- Always wear goggles and rubber gloves.
- Rinse the pump thoroughly with clean water before starting work.
— Rinse the components in water after dismantling.
— The coolant chamber may be under pressure. Hold a rag over the filling plug to prevent splatter.
Proceed as follows if fluids have splashed into your eyes:
- Rinse your eyes immediately in running water for 15 minutes. Hold your eyelids apart with your fingers.
- Contact an eye specialist.

On your skin:

- Remove contaminated clothes.
- Wash your skin with soap and water.
- Seek medical attention, if required.


## Changing the coolant



Filling coolant
Filling plug in/out 44 Nm (33 ft lb)

(1)


## Emptying coolant

 (with cooling jacket)

1. Lift the pump horizontally with two overhead cranes and place on a relief table.
2. Turn the pump so that one of the filling plugs holes faces downwards.
WARNING! If the mechanical seal unit leaks, the seal housing may be under pressure. Hold a rag over the filling plug to prevent splatter.
3. Unscrew the filling plug. It is easier to drain the wa-ter-glycol if the other filling plug is also removed.
4. Pump without cooling jacket: Raise the pump to an upright position. Fill with coolant to the same level as the filling plugs; approx. 11 litres (12 US quarts).
Pump with cooling jacket; approx. 47 litres (50 US quarts).
Coolant: a mix of water and stabilized monopropyleneglycol in a mixture ratio of 70/30 \% volume part.

Known trade marks of monopropyleneglycol are: Dowcal N (individual components are approved by FDA), Dowcal 20. These are non-poisonous, heat-and-cold resistant and inhibiting of corrosion.

Use of other type of glycol jeopardize the function of the pump.

If there is no risk of freezing even clean water with anti-corrosive is acceptable as coolant.
5. Always replace the O-rings of the filling plugs. Put the plugs back and tighten them.

## Removing the impeller

1. 



Place the pump horizontally. Remove the flush valve cover and it's O-ring. Insert a rod (wood or plastic) through the hole and lock the impeller in place. Remove the impeller screw.
3.


Install the impeller and screw. Tighten ligthly by hand, just to prevent the impeller from falling off.
2.


Using a 17 mm hexagon bit adaptor (allen socket) with a $100 \mathrm{~mm}\left(4^{\prime \prime}\right)$ extension (minimum length) turn the gland screw counter clockwise until the impeller breaks free from the shaft.
4.

5.


Place the drive unit horizontally. Remove the impeller screw.


Worn impellers can have very sharp edges. Use protective gloves!

WARNING! 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.

## Installing and setting clearance

If you fail with the impeller installation, you must start again from step 1)


Make sure that the end of the shaft is clean and free from burrs. Polish off any flaws with fine emery cloth. Grease the end of the shaft, conical sleeve, the threads of the gland screw and the impeller screw. Align the edge of the gland screw with the edge of the conical sleeve so that they are flush.
2.


Before assembling, check that the impeller screw is clean and easy to screw into the shaft end (a). This is to prevent the shaft to rotate with the impeller screw. Assemble the conical sleeve and the impeller onto the shaft. Fit the impeller screw onto the shaft. Tighten the impeller screw lightly by hand, just to prevent the impeller from falling off.
4.


Place the pump horizontally. Remove the flush valve cover and it's O-ring. Insert a rod (wood or plastic) through the hole and lock the impeller in place. Remove the impeller screw.
5.


Turn the gland screw clockwise until the impeller makes contact with the pump housing. Tighten it a further $1 / 8$ turn, $45^{\circ}$. This will insure the correct clearance between the impeller and the bottom of the pump housing in the next step.
6.


Fit the washer and the greased impeller screw and tighten, torque to $187 \mathrm{Nm}(140 \mathrm{ft} \mathrm{lb})+1 / 8$ turn $\left(45^{\circ}\right)$. Remove the rod used to lock the impeller. Fit the Oring, flush valve cover and secure with screws, torque to $44 \mathrm{Nm}(33 \mathrm{ft} \mathrm{lb})$.

Removing the impeller - dry installation version, NT


Remove the drive unit from the pump housing.
3.


Using a 17 mm hexagon bit adaptor (allen socket) with a $100 \mathrm{~mm}\left(4^{\prime \prime}\right)$ extension (minimum length) turn the gland screw counter clockwise until the impeller breaks free from the shaft. Remove the impeller.
2.


Place the drive unit horizontally. Lock the impeller in place and remove the impeller screw.

WARNING! 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.


Worn impellers can have very sharp edges. Use protective gloves!

## Installing and setting clearance



Make sure that the end of the shaft is clean and free from burrs. Polish off any flaws with fine emery cloth. Grease end of shaft, conical sleeve and the threads of the gland screw and the impeller screw. Unscrew the gland screw approximately 5 mm .
2.


Measure and note the distance A.
3.


Before assembling, check that the impeller screw is clean and easy to screw into the shaft end (a). This to prevent the shaft to rotate with the impeller screw. Assemble the conical sleeve and the impeller onto the shaft. Fit the impeller screw with washer onto the shaft and tighten to 187 Nm ( 140 ft lb ).
5.


Lift the drive unit out of the pump housing and remove the impeller and conical sleeve.
7.

Fit the conical sleeve, impeller and impeller screw with washer and tighten to $187 \mathrm{Nm}(140 \mathrm{ft} \mathrm{lb})+1 / 8$ turn $\left(45^{\circ}\right)$.

4.


Make sure that the O-ring is removed from the seal housing cover. Place the drive unit in the pump housing. Check the distance between the seal housing cover and the pump housing with a feeler gauge.
Check diametrically at four points.
Note the largest measured distance, B. See fig.
6.


Calculate the measure C according to formula:

$$
C=A-B-0,5 \mathrm{~mm}
$$

Unscrew the gland screw until C is reached.


Fit a new greased O-ring to the seal housing cover. Fit the drive unit to the pump housing. Adjust its position so that the inspection hole is on the same side as the hole for the flush valve. Tighten the screws in diagonally opposite pairs.

## FAULT TRACING (TROUBLE SHOOTING)

A universal instrument multimeter (VOM), a test lamp (continuity tester) and wiring diagram are required in order to carry out fault tracing on the electrical equipment.
Fault tracing shall be done with the power supply disconnected and locked off, except for those checks which cannot be performed without voltage.
Always make sure that there is no one near the pump when the power supply is turned on.

Use the following checklist as an aid to fault tracing. It is assumed that the pump and installation have formerly functioned satisfactorily.
Electrical work shall be performed by an authorized electrician.
Follow local safety regulations and observe recommended safety precautions.

## 1. Pump fails to start



Check the cause:

- If the stator temperature is high, check that the impeller rotates freely.
- If there is a fault in the thermistors/thermal contacts, contact a Flygt service shop.
- If the FLS10 indicates an alarm.
- Check that the overload protection is reset.
a) Fault in level equipment (start level regulator). Clean or replace.
b) Fault in control equipment.

Check:

- that the thermal contacts have not opened.
- that all connections are intact.
- relay and contactor coils.
- that the control switch "Man/Auto" makes contact in both positions.

Check:

- that the main power switch is on.
- that there is control voltage to the starter equipment and its fuses are intact.
- that there is voltage in each phase of the supply line.
- that all fuses have continuity and are tight.
- that the overload protection is reset.
- that there is no brake in the motor cable.

Clean.
Clean the sump.

## 2. Pump starts but motor protection trips



## 3. The pump does not stop (when level control is used)



Contact Flygt service shop.

## 4.The pump starts-stops-starts in rapid sequence



Contact Flygt service shop.

## 5. Pump runs but delivers too little or no water

Check:
— direction of rotation of pump, see "Before starting".

- that valves are open and intact.
- that pipes and impeller are not clogged.
— that the impeller rotates freely.
— that the suction lift has not been altered.
- for leakage in the pump installation.
— for wear on the impeller, pump and casing/flange.
See also under "Inspection".
Do not override the motor protection repeatedly if it has tripped.


## SERVICE LOG

| Most recent <br> service date | Pump No. | Hours of <br> operation | Remarks | Sign. |
| :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |

## Parts List

## Flygt 3301.090/095/180/185



Engineered for life

## Parts List

## Flygt 3301.090/095/180/185

## Overview

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## 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

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## Data Plate Interpretation

Introduction

## 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

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.
$\qquad$

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: <br> - L = Left <br> - $\mathrm{R}=$ 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 <br> 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 |  |
|  | 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 <br> 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:
$\left\langle\varepsilon_{x}{ }_{\text {IM2 }}\right.$ EEx de I
$\langle\varepsilon x\rangle$ IM2 EEx dI
$\left\langle\varepsilon x{ }_{\| I 2 G}\right.$ EEx de IIB T3
( $\varepsilon_{x}$ |I2G 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
$\langle\varepsilon x\rangle$ II 2 G or IM2 EEx dIIC or EEx dl

## 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.


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.


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.


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.

## Motor Parts

## Overview

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This chapter contains the following topics:

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



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


31115EX


Exploded view: Motor Parts, Standard version without Cooling jacket


## Exploded view: Motor Parts, Standard version with Cooling jacket



31115


## List of Motor Parts

| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 용 | 용 | $\stackrel{\text { ㅇ }}{\sim}$ | $\stackrel{\infty}{\sim}$ |
| 1 | 6085000 | Lifting handle |  | 1 | 1 | 1 | 1 |
| 2 | 830458 | Hex.socket hd screw M16X60-A4-80 |  | 2 | 2 | 2 | 2 |
| 2 | 843412 | Hexagon head screw M16X90-A2-70 |  | 1 | 1 | 1 | 1 |
| 4 | 823523 | Plain washer 16-A2-A 140 |  | 1 | 1 | 1 | 1 |
| 7 | 834552 | Cable tie |  | 1 | 1 | 1 | 1 |
| 7 | 834559 | Cable tie 200X2,4 PA 6/6-55+105 |  | 1 | 1 | 1 | 1 |
| 8 | 6306800 | Data plate USE 6306801 AS SPARE PART |  | 2 | 2 | 2 | 2 |
| 8 | 6306900 | Certificate plate EX |  | 1 | 1 |  |  |
| 8 | 6307000 | Certificate plate FM APPROVED |  | 1 | 1 |  |  |
| 8 | 6307600 | Plate HOT WATER PRODUCT |  |  |  | 1 | 1 |
| 9 | 839350 | Marking strip 5-GW(T1;T2;T15;T16) |  | 1 | 1 | 1 | 1 |
| 9 | 839351 | Marking strip W5;V5;U5;V2;W1;U2;V1;W2;U |  | 1 | 1 | 1 | 1 |
| 9 | 6500900 | Connection plate |  | 1 | 1 | 1 | 1 |
| 9 | 6501000 | Connection plate |  |  |  | 1 | 1 |
| 9 | 6577900 | Connection plate |  | 1 | 1 | 1 | 1 |
| 9 | 6815800 | Plate |  | 1 | 1 | 1 | 1 |
| 9 | 6989400 | Connection plate |  | 1 | 1 | 1 | 1 |
| 9 | 6989700 | Connection plate |  | 1 | 1 | 1 | 1 |
| 10 | 822088 | Drive screw 4X5-A2-70 |  | 4 | 4 | 4 | 4 |
| 13 | 6421600 | Earthing plate |  | 1 | 1 |  |  |
| 14 | 941922 | Control cable SUBCAB 7X1,5 MM2 OD=15-17 |  | * | * | * | * |
| 15 | 3978100 | Gland screw |  | 1 | 1 | 1 | 1 |
| 21.1 | 824061 | Plain washer (10)-22MM |  | 1 | 1 | 1 | 1 |
| 21.2 | 841790 | Seal sleeve (10)-12MM |  | 1 | 1 | 1 | 1 |
| 21.2 | 841792 | Seal sleeve (14)-16MM |  | 1 | 1 | 1 | 1 |
| 21.3 | 6785812 | Cable clip (10)-12MM |  | 1 | 1 | 1 | 1 |
| 21.3 | 6785816 | Cable clip (14)-16MM |  | 1 | 1 | 1 | 1 |
| 23 | 941783 | Motor cable SUBCAB S3X10+3X10/3+4X1,5 | Max $70^{\circ} \mathrm{C}$ ( $158^{\circ} \mathrm{F}$ ) (23) $-26,0 \mathrm{~mm}$. Screened | * | * | * | * |
| 23 | 941784 | Motor cable SUBCAB S3X16+3X16/3+4X1,5 | $\max 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(29,0)-32,0$ <br> mm . Screened | * | * | * | * |
| 23 | 941785 | Motor cable SUBCAB S3X25+3X16/3+4X1,5 | $\begin{aligned} & \text { SUBCAB } S 3 \times 25+3 \times 16 / 3+4 \times 1,5, \\ & \text { max } 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(30,0)-33,0 \\ & \mathrm{~mm} \text {. Screened. } \end{aligned}$ | * | * | * | * |


| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 응 | 용 | $\underset{\sim}{\infty}$ | $\stackrel{\infty}{\infty}$ |
| 23 | 941786 | Motor cable SUBCAB S3X35+3X16/3+4X1,5 | SUBCAB S $3 \times 35+3 \times 16 / 3+4 \times 1,5$, $\max 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(32,0)-35,0$ mm . Screened. | * | * | * | * |
| 23 | 941787 | Motor cable SUBCAB S3X50+3X25/3+4X1,5 | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(38,0)-42,0 \mathrm{~mm}$. Screened | * | * | * | * |
| 23 | 941788 | Motor cable SUBCAB S3X70+3X35/3+4X1,5 | $\begin{aligned} & \text { SUBCAB S3x70+3x35/3+4x1,5, } \\ & \text { max } 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(42,0)-46,0 \\ & \mathrm{~mm} \text {. Screened. } \end{aligned}$ | * | * | * | * |
| 23 | 942056 | Motor cable SUBC 4G6+2X1.5MM2 23-25 | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(23)-25 \mathrm{~mm}$ | * |  | * |  |
| 23 | 942057 | Motor cable SUBC 4G10+2X1,5MM2 26-28 | $\operatorname{Max} 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(26)-28 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942058 | Motor cable SUBC 4G16+2X1,5 MM2 26-28 | $\operatorname{Max} 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(26)-28 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942062 | Motor cable SUBC750RN $4 \mathrm{G} 25+2 \mathrm{X} 1,5$ | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(32.5)-34.5 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942063 | Motor cable SUBCAB4G35+2X1,5MM2 | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(36.5)-38.5 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942066 | Motor cable SUBCAB 750V RN 4G50MM2 | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(41)-45 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942067 | Motor cable SUBCAB 750V RN 4G70MM2 | $\operatorname{Max} 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(45)-49 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942081 | Motor cable SUBC 7G6+2X1,5MM2 24-28 | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(24.3)-28.3 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942109 | Motor cable SUBC 6AWG/3-2-1-GC 30-32 | $\operatorname{Max} 70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(30)-32 \mathrm{~mm}$ | * |  | * |  |
| 23 | 942110 | Motor cable SUBC 4AWG/3-2-1-GC 33-35 | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(32.8)-34.8 \mathrm{~mm}$ | * | * | * | * |
| 23 | 942111 | Motor cable SUBCAB 1AWG/3-2-1-GC | Max $70^{\circ} \mathrm{C}\left(158^{\circ} \mathrm{F}\right)(40.7)-42.7 \mathrm{~mm}$ | * | * | * | * |
| 24 | 6056100 | Entrance flange | Cast iron |  |  | 2 | 2 |
| 24 | 6056101 | Entrance flange | Cast iron | 2 | 2 |  |  |
| 24 | 6056120 | Entrance flange | ISO 7/1-Rp 1 1/4 |  |  | 2 | 2 |
| 24 | 6056121 | Entrance flange | ISO 7/1-Rp 1 1/4 | 2 | 2 |  |  |
| 24 | 6056122 | Entrance flange | ISO 7/1-Rp2 |  |  | 2 | 2 |
| 24 | 6056123 | Entrance flange | ISO 7/1-Rp2 | 2 | 2 |  |  |
| 24 | 6056124 | Entrance flange | 1 1/2-11.5 NPT |  |  | 2 | 2 |
| 24 | 6056125 | Entrance flange | 1 1/2-11.5 NPT | 2 | 2 |  |  |
| 24 | 6056126 | Entrance flange | 2-11.5 NPT |  |  | 2 | 2 |
| 24 | 6056127 | Entrance flange | 2-11.5 NPT | 2 | 2 |  |  |
| 24.6 | 6331101 | Gland screw 1 1/4" ISO.FOR METALHOSE | ISO 7/1-R1 1/4 33.0mm | 2 | 2 | 2 | 2 |
| 24.6 | 6331104 | Gland screw 1 1/2" NPT.FOR METALHOSE | 1 1/2-11.5 NPT 36.0mm | 2 | 2 | 2 | 2 |
| 24.6 | 6331105 | Gland screw |  | 2 | 2 | 2 | 2 |


| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | ; | 용 | $\underset{\sim}{\infty}$ | $\stackrel{\sim}{\infty}$ |
| 24.6 | 6331106 | Gland screw | 2-11.5 NPT 47.0mm. METALHOSE | 2 | 2 | 2 | 2 |
| 25 | 844109 | Plate |  | 1 | 1 | 1 | 1 |
| 25 | 4334706 | Plate |  | 2 | 2 | 2 | 2 |
| 26 | 830453 | Hex.socket hd screw M12X45-A4-80 |  | 4 | 4 | 4 | 4 |
| 31 | 827467 | O-ring 69,5X3,0 NBR |  | 2 | 2 | 2 | 2 |
| 31 | 828175 | O-ring 69,5X3,0 FPM |  | 2 | 2 | 2 | 2 |
| 32 | 6085110 | Entrance cover |  |  |  | 1 | 1 |
| 32 | 6085111 | Entrance cover |  | 1 | 1 |  |  |
| 32 | 6085112 | Entrance cover |  |  |  | 1 | 1 |
| 32 | 6085113 | Entrance cover |  | 1 | 1 |  |  |
| 32 | 6085114 | Entrance cover |  |  |  | 1 | 1 |
| 32 | 6085115 | Entrance cover |  | 1 | 1 |  |  |
| 32 | 6085116 | Entrance cover |  |  |  | 1 | 1 |
| 32 | 6085117 | Entrance cover |  | 1 | 1 |  |  |
| 33 | 827502 | O-ring 289,3X5,7 NBR |  | 1 | 1 | 1 | 1 |
| 33 | 828151 | O-ring 289,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 35 | 830458 | Hex.socket hd screw M16X60-A4-80 |  | 6 | 6 | 6 | 6 |
| 45 | 820011 | Hex.socket hd screw EXT. GROUND SCREW M6X12 |  | 4 | 4 | 2 | 2 |
| 49 | 834248 | End sleeve H16/24 |  | 6 | 6 | 6 | 6 |
| 49 | 834249 | End sleeve H25/30 |  | 6 | 6 | 6 | 6 |
| 49 | 834250 | End sleeve H35/30D |  | 3 | 3 | 3 | 3 |
| 49 | 834251 | End sleeve H50/36 |  | 6 | 6 | 6 | 6 |
| 49 | 834252 | End sleeve H70/40 |  | 3 | 3 | 3 | 3 |
| 53 | 820011 | Hex.socket hd screw EXT. GROUND SCREW M6X12 |  | 4 | 4 | 4 | 4 |
| 54 | 6086200 | Rail |  | 1 | 1 | 1 | 1 |
| 56 | 6057300 | Earthing plate |  | 1 | 1 | 1 | 1 |
| 56 | 6421600 | Earthing plate |  | 2 | 2 | 2 | 2 |
| 58 | 829277 | Protective cap |  | 1 | 1 | 1 | 1 |
| 60 | 825626 | Spring washer 119,5×100,5X1,2 |  | 1 | 1 | 1 | 1 |
| 61 | 833021 | Ball bearing 3311A-2Z/C3VT113 |  | 1 | 1 | 1 | 1 |
| 69 | 6085200 | Stator housing |  |  |  | 1 | 1 |
| 69 | 6085201 | Stator housing |  | 1 | 1 |  |  |
| 72 | 827505 | O-ring 339,3X5,7 NBR |  | 1 | 1 | 1 | 1 |
| 72 | 827523 | O-ring 339,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 73 | 6631700 | Shaft unit | For motor 35-29-4 | 1 | 1 | 1 | 1 |
| 73 | 6631701 | Shaft unit | For motor 35-25-4 | 1 | 1 | 1 | 1 |


|  |  | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pos. No | Part. No |  |  | 앙 | 용 | $\underset{\sim}{\infty}$ | $\stackrel{\infty}{\sim}$ |
| 73 | 6631800 | Shaft unit | For motor 35-29-6 | 1 | 1 | 1 | 1 |
| 73 | 6631801 | Shaft unit | For motor 35-25-6 | 1 | 1 | 1 | 1 |
| 73 | 6631900 | Shaft unit | For motor 35-29-8 | 1 | 1 | 1 | 1 |
| 79 | 6423101 | Stator 35-25-4a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}, 1475$ <br> r/min. 660-690V Y/380-400V <br> D. 3-phase, $60 \mathrm{~Hz}, 63 \mathrm{~kW}$ ( 85 hp ), <br> $1775 \mathrm{r} / \mathrm{min}$. 460 V D | 1 | 1 | 1 | 1 |
| 79 | 6423102 | Stator 35-25-4a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}, 1475$ r/min. 415-440V D. | 1 | 1 | 1 | 1 |
| 79 | 6423104 | Stator 35-25-4a | 3-phase, $60 \mathrm{~Hz}, 63 \mathrm{~kW}$ ( 85 hp ), 1775 r/min. 575-600V D | 1 | 1 | 1 | 1 |
| 79 | 6423107 | Stator 35-25-4a | 3-phase, $60 \mathrm{~Hz}, 63 \mathrm{~kW}$ ( 85 hp ), <br> $1775 \mathrm{r} / \mathrm{min}$. 380V D | 1 |  | 1 | 1 |
| 79 | 6548101 | Stator 35-25-6a | 3-phase, $50 \mathrm{~Hz}, 45 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$. $660-690 \mathrm{~V}$ Y/ $380-400 \mathrm{~V}$ D. 3-phase, $60 \mathrm{~Hz}, 52 \mathrm{~kW}$ ( 70 hp ), $1185 \mathrm{r} / \mathrm{min} .460 \mathrm{~V}$ D | 1 | 1 | 1 | 1 |
| 79 | 6548102 | Stator 35-25-6a | 3-phase, $50 \mathrm{~Hz}, 45 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$. 415-440V D. | 1 | 1 | 1 | 1 |
| 79 | 6548104 | Stator 35-25-6a | 3-phase, $60 \mathrm{~Hz}, 52 \mathrm{~kW}$ (70 hp), 1185 r/min. 575-600V D | 1 | 1 | 1 | 1 |
| 79 | 6548106 | Stator 35-25-6a | 3-phase, $60 \mathrm{~Hz}, 52 \mathrm{~kW}$ (70 hp), 1185 r/min. 380V D | 1 |  | 1 | 1 |
| 79 | 6548201 | Stator 35-29-6a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}$, $985 \mathrm{r} / \mathrm{min}$. 690 V Y/ 400 V D. 3-phase, 60 Hz , 63 kW ( 85 hp ), $1185 \mathrm{r} / \mathrm{min} .460 \mathrm{~V}$ D | 1 | 1 | 1 | 1 |
| 79 | 6548202 | Stator 35-29-6a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$. 415-440V D. | 1 | 1 | 1 | 1 |
| 79 | 6548204 | Stator 35-29-6a | 3-phase, $60 \mathrm{~Hz}, 63 \mathrm{~kW}$ ( 85 hp ), $1185 \mathrm{r} / \mathrm{min}$. $575-600 \mathrm{~V}$ D | 1 | 1 | 1 | 1 |
| 79 | 6548206 | Stator 35-29-6a | 3-phase, $60 \mathrm{~Hz}, 63 \mathrm{~kW}$ ( 85 hp ), $1185 \mathrm{r} / \mathrm{min}$. 380V D | 1 |  | 1 | 1 |
| 79 | 6548208 | Stator 35-29-6a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$. 660 V Y / 380V D. | 1 | 1 | 1 | 1 |
| 79 | 6638001 | Stator 35-29-4a | 3-phase, 50 Hz, 70 kW, 1475 r/min. 690V Y/ 400V D. 3-phase, $60 \mathrm{~Hz}, 78 \mathrm{~kW}$ (105 hp), 1780 r/min. 460V D | 1 | 1 | 1 | 1 |
| 79 | 6638002 | Stator 35-29-4a | 3-phase, 50 Hz, 70 kW, 1475 r/min. 415-440V D. | 1 | 1 | 1 | 1 |
| 79 | 6638004 | Stator 35-29-4a | 3-phase, $60 \mathrm{~Hz}, 78 \mathrm{~kW}$ (105 hp), 1780 r/min. 575-600V D | 1 | 1 | 1 | 1 |
| 79 | 6638006 | Stator 35-29-4a | 3-phase, $60 \mathrm{~Hz}, 78 \mathrm{~kW}$ (105 hp), $1780 \mathrm{r} / \mathrm{min}$. 380V D | 1 |  | 1 | 1 |
| 79 | 6638008 | Stator 35-29-4a | 3-phase, 50 Hz, 70 kW, 1475 r/min. 660 V Y/ 380V D. | 1 | 1 | 1 | 1 |


| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | ৪ | ㅇㅇㅇ | $\stackrel{\circ}{\infty}$ | $\stackrel{\infty}{\infty}$ |
| 79 | 6663101 | Stator 35-29-8a | 3-phase, $50 \mathrm{~Hz}, 37 \mathrm{~kW}, 735 \mathrm{r} / \mathrm{min}$. 690 V Y/ 400V D. 3-phase, 60 Hz , 45 kW ( 60 hp ), $885 \mathrm{r} / \mathrm{min} .460 \mathrm{~V}$ D | 1 | 1 | 1 | 1 |
| 79 | 6663102 | Stator 35-29-8a | 3-phase, $50 \mathrm{~Hz}, 37 \mathrm{~kW}, 735 \mathrm{r} / \mathrm{min}$. 415-440V D. | 1 | 1 | 1 | 1 |
| 79 | 6663104 | Stator 35-29-8a | 3-phase, $60 \mathrm{~Hz}, 45 \mathrm{~kW}$ ( 60 hp ), $885 \mathrm{r} / \mathrm{min}$. 575-600V D | 1 | 1 | 1 | 1 |
| 79 | 6663106 | Stator 35-29-8a | 3-phase, $60 \mathrm{~Hz}, 45 \mathrm{~kW}$ (60 hp), 885 r/min. 380V D | 1 | 1 | 1 | 1 |
| 79 | 6663108 | Stator 35-29-8a | 3-phase, $50 \mathrm{~Hz}, 37 \mathrm{~kW}, 735 \mathrm{r} / \mathrm{min}$. 660 V Y/ 380V D. | 1 | 1 | 1 | 1 |
| 79 | 6792702 | Stator 35-25-4a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}, 1475$ r/min. 415-440V D (With thermistors). |  |  | 1 | 1 |
| 79 | 6792802 | Stator 35-29-4a | 3-phase, 50 Hz, 70 kW, 1475 r/min. 415-440V D (With thermistors). |  |  | 1 | 1 |
| 79 | 6792902 | Stator 35-25-6a | 3-phase, $50 \mathrm{~Hz}, 45 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$. 415-440V D (With thermistor). |  |  | 1 | 1 |
| 79 | 6793002 | Stator 35-29-6a | 3-phase, $50 \mathrm{~Hz}, 55 \mathrm{~kW}, 985 \mathrm{r} / \mathrm{min}$. 415-440V D (With thermistors). |  |  | 1 | 1 |
| 79 | 6793102 | Stator 35-29-8a | 3-phase, $50 \mathrm{~Hz}, 37 \mathrm{~kW}, 735 \mathrm{r} / \mathrm{min}$. 415-440V D (With thermistors). |  |  | 1 | 1 |
| 82 | 6085900 | Cooling jacket |  | 1 | 1 | 1 | 1 |
| 82 | 6085901 | Cooling jacket STAINLESS STEEL (ASTM329) |  | 1 | 1 | 1 | 1 |
| 83 | 827876 | O-ring 370,0X5,7 NBR |  | 1 | 1 | 1 | 1 |
| 83 | 829577 | O-ring 370,0X5,7 FLUOR |  | 1 | 1 | 1 | 1 |
| 84 | 827512 | O-ring 479.3X5.7 NBR |  | 1 | 1 | 1 | 1 |
| 84 | 828152 | O-ring 479,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 88 | 6558000 | Cable entry unit (23)-26MM |  | 2 | 2 | 2 | 2 |
| 88 | 6558001 | Cable entry unit (26)-29MM |  | 2 | 2 | 2 | 2 |
| 88 | 6558002 | Cable entry unit (29)-32MM |  | 2 | 2 | 2 | 2 |
| 88 | 6558003 | Cable entry unit (32)-35MM |  | 2 | 2 | 2 | 2 |
| 88 | 6558004 | Cable entry unit (35)-38MM |  | 2 | 1 | 2 | 1 |
| 88 | 6558005 | Cable entry unit (38)-41MM |  | 2 | 1 | 2 | 1 |
| 88 | 6558006 | Cable entry unit (41)-44MM |  | 2 | 2 | 2 | 2 |
| 88 | 6558007 | Cable entry unit (44)-47MM |  | 2 | 1 | 2 | 1 |
| 88.1 | 824136 | Plain washer | For cable (23)-35 mm | 4 | 4 | 4 | 4 |
| 88.1 | 824139 | Plain washer | For cable (35)- 53 mm | 4 | 4 | 4 | 4 |
| 88.2 | 841929 | Seal sleeve | (23)- 26 | 2 | 2 | 2 | 2 |
| 88.2 | 841930 | Seal sleeve | (26)-29 | 2 | 2 | 2 | 2 |
| 88.2 | 841931 | Seal sleeve | (29)- 32 | 2 | 2 | 2 | 2 |
| 88.2 | 841932 | Seal sleeve | (32)- 35 | 2 | 2 | 2 | 2 |


| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 8 | ¢ | 은 | $\stackrel{\infty}{\sim}$ |
| 88.2 | 841933 | Seal sleeve | (35)- 38 | 2 | 2 | 2 | 2 |
| 88.2 | 841934 | Seal sleeve | (38)- 41 | 2 | 2 | 2 | 2 |
| 88.2 | 841935 | Seal sleeve | (41)- 44 | 2 | 2 | 2 | 2 |
| 88.2 | 841936 | Seal sleeve | (44)- 47 | 2 | 2 | 2 | 2 |
| 88.3 | 6111402 | Ring |  | 1 | 1 | 1 | 1 |
| 101 | 6505100 | Cable unit FLS10 |  | 1 | 1 | 1 | 1 |
| 103 | 6630400 | Level sensor FLS10 |  | 1 | 1 | 1 | 1 |
| 105 | 6085300 | Bearing holder |  |  |  | 1 | 1 |
| 105 | 6085301 | Bearing holder |  | 1 | 1 |  |  |
| 107 | 825929 | Retaining ring SGA 95 |  | 1 | 1 | 1 | 1 |
| 108 | 824428 | Supporting washer 95X115X3,5 |  | 2 | 2 | 2 | 2 |
| 109 | 833028 | Ball bearing 3319A-2Z/C3VT113 |  | 1 | 1 | 1 | 1 |
| 110 | 830764 | Retaining ring $73 / 4{ }^{\prime \prime}$ |  | 1 | 1 | 1 | 1 |
| 120 | 6421300 | Inspection screw |  | 1 | 1 | 1 | 1 |
| 122 | 827685 | O-ring 17,0X3,0 NBR |  | 1 | 1 | 1 | 1 |
| 122 | 827915 | O-ring 17,0X3,0 FPM |  | 1 | 1 | 1 | 1 |
| 129 | 6085600 | Seal housing cover |  | 1 | 1 | 1 | 1 |
| 221 | 846581 | Gasket 350 PN 10 |  | 1 | 1 | 1 | 1 |
| 221 | 3454400 | Gasket |  | 1 | 1 | 1 | 1 |
| 221 | 3844500 | Gasket 8" |  | 1 | 1 | 1 | 1 |
| 222 | 843435 | Hexagon head screw M20X90-A2-70 |  | 12 | 12 | 12 | 12 |
| 222 | 843437 | Hexagon head screw M20X110-A2-70 |  | 16 | 16 | 16 | 16 |
| 222 | 843438 | Hexagon head screw M20X120-A2-70 |  | 16 | 16 | 16 | 16 |
| 227 | 831936 | Coupling part DN 150 INNER THREAD G6 |  | 1 | 1 | 1 | 1 |
| 228 | 6638500 | Connection plate | Intended for 7-lead cable | 1 | 1 | 1 | 1 |
| 228 | 6638500 | Connection plate |  | 1 | 1 | 1 | 1 |
| 231 | 930078 | Shrink hose ID 9,5 |  |  |  | * |  |
| 231 | 930081 | Shrink hose |  |  |  | * |  |
| 232 | 835358 | Terminal clamp WEIDMüLLER WDU6/10 |  | 3 | 3 | 4 | 4 |
| 233 | 835317 | Terminal clamp WDU35/K/ZA |  | 8 | 8 | 8 | 8 |
| 233 | 835361 | Terminal clamp WDU16,1000V |  | 8 | 8 | 8 | 8 |
| 233 | 835362 | Terminal clamp WEIDMüLLER WDU 70 N |  | 8 | 8 | 8 | 8 |
| 234 | 835349 | Cross connection WQW35/2 |  | 4 | 4 | 4 | 4 |
| 234 | 835355 | Cross connection WEIDMüLLER WQV 70N /3 |  | 1 | 1 | 1 | 1 |


| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 응 | 毋ூ | ¢ | $\stackrel{\infty}{\infty}$ |
| 234 | 835363 | Cross connection WEIDMüLLER WQV 70N/2 |  | 4 | 4 | 4 | 4 |
| 234 | 835367 | Cross connection WQV 16/2 |  | 4 | 4 | 4 | 4 |
| 234 | 6502002 | Cross connection |  | 1 |  | 1 |  |
| 234 | 6502003 | Cross connection |  | 1 | 1 | 1 | 1 |
| 235 | 835354 | End support WEW 35/2 |  | 2 | 2 | 2 | 2 |
| 236 | 835350 | Partition |  | 1 | 1 | 1 | 1 |
| 239 | 6508400 | El lead through unit |  | 1 | 1 | 1 | 1 |
| 239 | 6508403 | El lead through unit |  | 1 | 1 | 1 | 1 |
| 240 | 6074805 | Spring |  | 1 | 1 | 1 | 1 |
| 241 | 827504 | O-ring 319.3X5.7 NBR |  | 1 | 1 | 1 | 1 |
| 241 | 828164 | O-ring 319,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 242 | 6085400 | adapter |  |  |  | 1 | 1 |
| 242 | 6085401 | adapter |  | 1 | 1 |  |  |
| 242 | 6085510 | adapter |  |  |  | 1 | 1 |
| 242 | 6085511 | adapter |  | 1 | 1 |  |  |
| 243 | 830461 | Hex.socket hd screw M12X25-A4-80 |  | 2 | 2 | 2 | 2 |
| 245 | 827512 | O-ring 479.3X5.7 NBR |  | 1 | 1 | 1 | 1 |
| 245 | 828152 | O-ring 479,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 246 | 827884 | O-ring 405,26X3,53 NBR |  | 1 | 1 | 1 | 1 |
| 247 | 828173 | O-ring 149,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 249 | 823250 | Clip |  | 1 | 1 | 1 | 1 |
| 251 | 6421300 | Inspection screw |  | 2 | 2 | 2 | 2 |
| 252 | 827685 | O-ring 17,0x3,0 NBR |  | 2 | 2 | 2 | 2 |
| 252 | 827915 | O-ring 17,0x3,0 FPM |  | 2 | 2 | 2 | 2 |
| 253 | 6085800 | Cooling jacket |  | 1 | 1 | 1 | 1 |
| 254 | 6085700 | Flow diffusor |  | 1 | 1 | 1 | 1 |
| 256 | 6084400 | Wire bow |  | 4 | 4 | 4 | 4 |
| 257 | 824438 | Supporting washer 170X200X3,5 |  | 1 | 1 | 1 | 1 |
| 258 | 7201700 | Sleeve unit |  | 1 | 1 | 1 | 1 |
| 267 | 7250700 | Plug |  | 4 | 4 | 4 | 4 |
| 270 | 6083100 | Lock washer |  | 1 | 1 |  |  |
| 313 | 828159 | O-ring 119,5X3,0 FPM |  | 1 | 1 | 1 | 1 |
| 912 | 827685 | O-ring 17,0x3,0 NBR | Extra O-rings for Inspection screws | 3 | 3 | 3 | 3 |
| 912 | 827915 | O-ring 17,0×3,0 FPM | Extra O-rings for Inspection screws | 3 | 3 | 3 | 3 |

## Hydraulic Parts

## Overview

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## Exploded view: Hydraulic Parts N; LT, 6-pole

"LT" Low Head Curve: 620, 622, 624, 626, 628
N_ 3301 LT 6-pole


## Exploded view: Hydraulic Parts N; LT, 8-pole

"LT" Low Head Curve: 810, 812, 814, 816, 818
N_3301 LT 8-pole


## Exploded view: Hydraulic Parts N; MT

"MT" Medium Head Curve: 630, 632, 634, 636, 638, 639
N_3301 MT


## Exploded view: Hydraulic Parts N; HT

"HT" High Head Curve: 450, 452, 454, 456, 458, 460, 462, 464, 466, 468
N_3301 HT


31344

## List of Hydraulic Parts

| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 8 |  | $\stackrel{\sim}{\sim}$ | $\stackrel{\infty}{\infty}$ |
| 130 | 827884 | O-ring 405,26X3,53 NBR |  | 1 | 1 | 1 | 1 |
| 131 | 827512 | O-ring 479.3X5.7 NBR |  | 1 | 1 | 1 | 1 |
| 131 | 828152 | O-ring 479,3X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 133 | 830458 | Hex.socket hd screw M16X60-A4-80 |  | 6 | 6 | 6 | 6 |
| 141 | 6417000 | Mechanical seal WCCR/WCCR, DIAM. 80 |  | 1 | 1 | 1 | 1 |
| 141 | 6417001 | Mechanical seal WCCR/RSIC, DIAM. 80 |  | 1 | 1 | 1 | 1 |
| 145 | 830463 | Hex.socket hd screw M 20X70-A4 80 |  | 4 | 4 | 4 | 4 |
| 158 | 6059600 | Impeller | N - "HT" High head. Curve no: $460,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6059610 | Impeller | N - "HT" High head. Curve no: $462,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6059620 | Impeller | N - "HT" High head. Curve no: $464,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6059630 | Impeller | N - "HT" High head. Curve no: $466,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6059640 | Impeller | N - "HT" High head. Curve no: $468,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086300 | Impeller | N - "HT" High head. Curve no: $450,50 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086310 | Impeller | N - "HT" High head. Curve no: $452,50 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086320 | Impeller | N - "HT" High head. Curve no: $454,50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086330 | Impeller | N - "HT" High head. Curve no: $456,50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086340 | Impeller | N - "HT" High head. Curve no: $458,50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086920 | Impeller | N - "MT" Medium head. Curve no: 630, $50 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086930 | Impeller | N - "MT" Medium head. Curve no: $632,50 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086940 | Impeller | N - "MT" Medium head. Curve no: $634,50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086950 | Impeller | N - "MT" Medium head. Curve no: $636,50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086960 | Impeller | N - "MT" Medium head. Curve no: $638,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6086970 | Impeller | N - "MT" Medium head. Curve no: $639,60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |


|  |  | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pos. No | Part. No |  |  | 앙 | 毋ூ | $\underset{\sim}{\infty}$ | $\stackrel{\sim}{\sim}$ |
| 158 | 6697209 | Impeller | N - "LT" Low head. Curve no: 620, $50 \mathrm{~Hz}, 3-$ phase | 1 |  | 1 |  |
| 158 | 6697220 | Impeller | N - "LT" Low head. Curve no: 622, 50 Hz , 3-phase | 1 |  | 1 |  |
| 158 | 6697232 | Impeller | N - "LT" Low head. Curve no: 624, $50 / 60 \mathrm{~Hz}$, 3-phase | 1 |  | 1 |  |
| 158 | 6697242 | Impeller | N - "LT" Low head. Curve no: 626, $50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6697250 | Impeller | N - "LT" Low head. Curve no: 628, $60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6697312 | Impeller | N - "LT" Low head. Curve no: 810, 50 Hz , 3-phase | 1 |  | 1 |  |
| 158 | 6697323 | Impeller | N - "LT" Low head. Curve no: 812, $50 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6697336 | Impeller | N - "LT" Low head. Curve no: 814, $50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 6697345 | Impeller | N - "LT" Low head. Curve no: 816, $50 / 60 \mathrm{~Hz}$, 3-phase | 1 |  | 1 |  |
| 158 | 6697357 | Impeller | N - "LT" Low head. Curve no: 818, $50 / 60 \mathrm{~Hz}, 3$-phase | 1 |  | 1 |  |
| 158 | 7043220 | Impeller | N - "MT" Medium head. Curve no: 630, 50Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043240 | Impeller | N - "MT" Medium head. Curve no: 634, 50/60Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043260 | Impeller | N - "MT" Medium head. Curve no: 638, 60Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043310 | Impeller | N - "HT" High head. Curve no: 462, 60Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043330 | Impeller | N - "HT" High head. Curve no: 466, 60Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043410 | Impeller | N - "HT" High head. Curve no: $452,50 \mathrm{~Hz}, 3$-phase |  | 1 |  | 1 |
| 158 | 7043420 | Impeller | N - "HT" High head. Curve no: 454, 50Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043430 | Impeller | N - "HT" High head. Curve no: 456, 50Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7043909 | Impeller | N - "LT" Low head. Curve no: 620, 50 Hz , 3-phase |  | 1 |  | 1 |
| 158 | 7043932 | Impeller | N - "LT" Low head. Curve no: 624, 50/60Hz, 3-phase |  | 1 |  | 1 |
| 158 | 7044012 | Impeller | N - "LT" Low head. Curve no: 810, 50 Hz , 3-phase |  | 1 |  | 1 |
| 158 | 7044033 | Impeller | N - "LT" Low head. Curve no: 814, 50/60Hz, 3-phase |  | 1 |  | 1 |
| 162 | 823801 | Plain washer |  | 1 | 1 | 1 | 1 |


|  |  | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pos. No | Part. No |  |  | 앙 | 용 | $\stackrel{\text { - }}{\sim}$ | $\stackrel{\infty}{\infty}$ |
| 169 | 830460 | Hex.socket hd screw M16X120-A4 80 |  | 1 | 1 | 1 | 1 |
| 186 | 7045600 | Insert ring |  | 1 | 1 | 1 |  |
| 186 | 7045700 | Insert ring |  |  | 1 |  | 1 |
| 186 | 7045900 | Insert ring |  | 1 |  | 1 |  |
| 186 | 7046000 | Insert ring |  |  | 1 |  | 1 |
| 186 | 7047500 | Insert ring |  | 1 |  | 1 |  |
| 186 | 7047600 | Insert ring |  |  | 1 |  | 1 |
| 186 | 7047800 | Insert ring |  | 1 |  | 1 |  |
| 186 | 7047900 | Insert ring |  |  | 1 |  | 1 |
| 193 | 830453 | Hex.socket hd screw M12X45-A4-80 |  | 4 | 4 | 4 | 4 |
| 200 | 7045500 | Pump housing | "MT" Medium head DN250. Undrilled inlet. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7045501 | Pump housing | "MT" Medium head DN250. Drilled to EN 1092-2 tab.8. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7045503 | Pump housing | "MT" Medium head DN250. Drilled inlet. Prepared for flush valve and zinc anodes. Only for $P$ and $S$ installation. | 1 | 1 | 1 | 1 |
| 200 | 7045505 | Pump housing | "MT" Medium head DN250. Drilled to ANSI B16.1-89 tab. 5. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7045507 | Pump housing | "MT" Medium head DN250. Drilled to EN 1092-2 tab. 9. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7045800 | Pump housing | "HT" High head DN150. Undrilled inlet. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7045803 | Pump housing | "HT" High head DN150. Drilled inlet. Prepared for flush valve and zinc anodes. Only for $P$ and $S$ installation. | 1 | 1 | 1 | 1 |
| 200 | 7045806 | Pump housing | "HT" High head DN150. Undrilled inlet. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047400 | Pump housing | "LT" Low head DN300. Undrilled inlet. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047401 | Pump housing | "LT" Low head DN300. Drilled to EN 1092-2 tab. 8. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047403 | Pump housing | "LT" Low head DN300. Drilled inlet. Prepared for flush valve and zinc anodes. Only for $P$ and $S$ installation. | 1 | 1 | 1 | 1 |


| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
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| 200 | 7047405 | Pump housing | "LT" Low head DN300. Drilled to ANSI B16.1-89 tab. 5. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047407 | Pump housing | "LT" Low head DN300. Drilled to EN 1092-2 tab. 9. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047700 | Pump housing | "LT" Low head DN350. Undrilled inlet. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047701 | Pump housing | "LT" Low head DN350. Drilled to EN 1092-2 tab. 8. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047703 | Pump housing | "LT" Low head DN350. Drilled inlet. Prepared for flush valve and zinc anodes. Only for $P$ and $S$ installation. | 1 | 1 | 1 | 1 |
| 200 | 7047705 | Pump housing | "LT" Low head DN350. Drilled to ANSI B16.1-89 tab. 5. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200 | 7047707 | Pump housing | "LT" Low head DN350. Drilled to EN 1092-2 tab. 9. Prepared for flush valve. | 1 | 1 | 1 | 1 |
| 200.4 | 830456 | Hex.socket hd screw M10X35-A4-80 |  | 2 | 2 | 2 | 2 |
| 200.5 | 828193 | O-ring 44,2X5,7 FPM |  | 1 | 1 | 1 | 1 |
| 200.6 | 6480000 | Cover |  | 1 | 1 | 1 | 1 |

## Sump Components

## Overview

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## Exploded view: Sump Components NP

NP 3301


## Exploded view: Sump Components NS with Quick coupling

NS 3301


## Exploded view: Sump Components NT

NT 3301


Exploded view: Sump Components NZ
NZ 3301


## List of Sump Components

|  |  | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pos. No | Part. No |  |  | 응 | 용 | $\stackrel{\circ}{\square}$ | $\stackrel{\infty}{\square}$ |
| 209 | 4548700 | Sliding bracket | Installation P, "LT". 8-poles. Guide bar dimension: 80 mm | 1 | 1 | 1 | 1 |
| 209 | 6073800 | Sliding bracket | Installation P; "LT", "MT", "HT". Guide br dimension: 80 mm | 1 | 1 | 1 | 1 |
| 209 | 6698400 | Sliding bracket | Option: retrofit - Big \& Grey | 1 | 1 | 1 | 1 |
| 210 | 830458 | Hex.socket hd screw M16X60-A4-80 |  | 4 | 4 | 4 | 4 |
| 211 | 2955700 | Discharge connection | "HT" High head DN 150 | 1 | 1 | 1 | 1 |
| 211 | 3093100 | Discharge connection | "HT" High head DN 150. Thread : 6-8 NPSM Outer | 1 | 1 | 1 | 1 |
| 211 | 3093101 | Discharge connection | "HT" High head DN 150. Thread : ISO G6 outer, Quick Coupling | 1 | 1 | 1 | 1 |
| 211 | 3793200 | Discharge connection | "MT" Medium head DN 200 | 1 | 1 | 1 | 1 |
| 211 | 4576800 | Discharge connection "LT" LOW HEAD DN 300 | "LT" Low head DN 250. Intended for 6-pole. | 1 | 1 | 1 | 1 |
| 211 | 4792600 | Discharge connection | "MT" Medium head DN 250 | 1 | 1 | 1 | 1 |
| 212 | 843434 | Hexagon head screw M20X80-A2-70 | Intended for version NS; HT | 8 | 8 | 8 | 8 |
| 212 | 843435 | Hexagon head screw M20X90-A2-70 | Intended for version NS;MT | 12 | 12 | 12 | 12 |
| 213 | 823526 | Plain washer 20-A2-A 140 | Intended for version NT, NS and NZ; LT, MT, HT | 24 | 24 | 24 | 24 |
| 214 | 809596 | Stud 24X100-A2-70 | Intended for NP-version 8-pole | 2 | 2 | 2 | 2 |
| 214 | 809604 | Stud 24X120-A2-70 | Intended for NP-version 8-pole | 2 | 2 | 2 | 2 |
| 214.1 | 822363 | Hexagon nut M24-A2-70 | Intended for NP-version 8-pole | 4 | 4 | 4 | 4 |
| 214.2 | 823528 | Plain washer | Intended for NP-version 8-pole | 4 | 4 | 4 | 4 |
| 215 | 822362 | Hexagon nut M20-A2-70 |  | 12 | 12 | 12 | 12 |
| 216 | 2956400 | Gasket 6" |  | 1 | 1 | 1 | 1 |
| 216 | 3802501 | Gasket |  | 1 | 1 | 1 | 1 |
| 216 | 3844500 | Gasket 8" |  | 1 | 1 | 1 | 1 |
| 217 | 4378801 | Stand compl. |  | 1 | 1 | 1 | 1 |
| 218 | 843405 | Hexagon head screw M16X50-A2-70 |  | 4 | 4 | 4 | 4 |
| 219 | 823523 | Plain washer 16-A2-A 140 |  | 4 | 4 | 4 | 4 |
| 220 | 3817730 | Suction connect.unit | "HT" High head DN 250. Undrilled | 1 | 1 | 1 | 1 |
| 220 | 3817731 | Suction pipe unit | "HT" High head DN 250. Drilled to EN 1092-2 tab. 8 | 1 | 1 | 1 | 1 |
| 220 | 3817735 | Suction pipe unit | "HT" High head DN 250. Drilled to ANSI B16.1-89; tab. 5 | 1 | 1 | 1 | 1 |
| 220 | 3817737 | Suction pipe unit | "HT" High head DN 250. Drilled to EN 1092-2 tab. 9 | 1 | 1 | 1 | 1 |


|  |  | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pos. No | Part. No |  |  | 앙 | గం | $\underset{\sim}{\infty}$ | $\stackrel{\infty}{\sim}$ |
| 220 | 3847400 | Suction connect.unit | "MT" Medium head DN 300. Undrilled | 1 | 1 | 1 | 1 |
| 220 | 3847401 | Suction pipe unit | "MT" Medium head DN 300. Drilled toEN 1092-2 tab. 8 | 1 | 1 | 1 | 1 |
| 220 | 3847405 | Suction pipe unit | "MT" Medium head DN 300. Drilled to ANSI B16.1-89; tab. 5 | 1 | 1 | 1 | 1 |
| 220 | 3847407 | Suction pipe unit | "MT" Medium head DN 300. Drilled to EN 1092-2 tab. 9 | 1 | 1 | 1 | 1 |
| 220 | 4378900 | Suction connect.unit | "LT" Low head DN 400. Undrilled. Intended for 8-pole | 1 | 1 | 1 | 1 |
| 220 | 4378901 | Suction pipe unit | "LT" Low head DN 400. Drilled to EN 1092-2 tab.8. Intended for 8 -pole | 1 | 1 | 1 | 1 |
| 220 | 4378905 | Suction pipe unit | "LT" Low head DN 400. Drilled to ANSI B16.1-89; tab.5. Intended for 8-pole | 1 | 1 | 1 | 1 |
| 220 | 4378907 | Suction pipe unit | "LT" Low head DN 400. Drilled to EN 1092-2 tab.9. Intended for 8 -pole | 1 | 1 | 1 | 1 |
| 220.1 | 814155 | Hexagon head screw M12X30-A2-70 | For 4378900-07 | 6 | 6 | 6 | 6 |
| 220.1 | 814156 | Hexagon head screw M12X35-A2-70 | For 3817730-37, 3847400-07 | 4 | 4 | 4 | 4 |
| 220.2 | 2744501 | Cleaning door | For 3817730-37, 3847400-07 | 1 | 1 | 1 | 1 |
| 220.2 | 3201900 | Cleaning door | For 4378900-07 | 1 | 1 | 1 | 1 |
| 220.3 | 2744800 | Gasket | For 3817730-37, 3847400-07 | 1 | 1 | 1 | 1 |
| 220.3 | 3200700 | Gasket | For 4378900-07 | 1 | 1 | 1 | 1 |
| 220.4 | 827178 | Plug | For 4378900-07 | 1 | 1 | 1 | 1 |

## Parts for Service

List of Parts for Service

| Pos. No | Part. No | Denomination |  | Qty/Version |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 앙 | 용 | $\underset{\sim}{\infty}$ | $\stackrel{\sim}{\sim}$ |
| 800 | 829700 | O-ring kit 3301.180.796 | NBR | 1 | 1 | 1 | 1 |
| 800 | 829701 | O-ring kit 3301.180.796 | FPM Industry | 1 | 1 | 1 | 1 |
| 900 | 6571705 | Basic repair kit 3301.180 | IS-Kit NBR | 1 | 1 | 1 | 1 |
| 900 | 6571706 | Basic repair kit 3301.180 | IS-Kit FPM Industry | 1 | 1 | 1 | 1 |
| 901 | 903708 | Monopropylene glycol "DOWCAL N" |  | * | * | * | * |

## 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.


## ITT

## Water \& Wastewater

## Flygt N-Pumps 3153, 3171, 3202 \& 3301

## A new generation of submersible wastewater pumps



Engineered for life

## New generation Flygt N-Pumps

## New levels of efficiency in wastewater handling

The new generation Flygt $N$-Pumps have been engineered to give you efficient, reliable and troublefree pumping over long duty periods. And by improving your operational economy, this new series of pumps can have a dramatic effect on the total life costs of your installation.
Externally, you'll notice the difference straight away: these smooth new shapes are easy to keep clean and easier to service. But it's inside where the difference really counts.

At the heart of the new generation Flygt N Pumps, you'll find the patented N -technique in the hydraulic end design. The unique, semi-open impeller, combined with the relief groove in the volute, has been proven to reduce the risk of clogging and maintain pumping efficiency, even under the worst of conditions.

We've taken operational serviceability even further by using class H insulated motors with improved cooling: less heat, less wear and tear. And there's a separate inspection chamber for rapid checking and maintenance.


At the heart of the Flygt N-Pump is the proven N -impeller. The unique semi open design of the impeller reduces the risk of clogging and maintains pumping efficiency over longer periods of time.

## Methods of installation



NS


A semi-permanent, freestanding installation.
Transportable version with pipe or hose connection.


For semi-permanent wet well installations. The pump is installed with twin guide bars on a discharge connection.


A vertically-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipe work.

To reduce the cost of installation, ITT Water \& Wastewater has standardized many of the main elements of pumping stations so that they can be combined in different combinations to match specific site conditions. The examples illustrated here show the flexibility of the system, and provide some guidelines for optimizing the design of your own station.

NZ


A horizontally-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipe work.

## Pumping capacities up to 550l/s, 8,700gpm

The broad range of pumping capacities offered by the Flygt $N$-pump range, coupled with the selfcleaning advantages of the impeller and volute design, opens up new possibilities for cost-effective operation in a wide variety of applications. These include:

- Wastewater pumping
- Raw water pumping
- Cooling water
- Sludge handling
- Storm water handling
- Industrial effluent handling

This new pump design has undergone extensive testing in the field. The results from these tests show considerably lower energy consumption and fewer running problems. The highest efficiency value for a typical single-vane pump in a best-specific speed range is around 70\% efficiency. By comparison, Flygt N-Pumps deliver 80\% or better - equating to $15 \%$ less power consumption.
In several installations where clogging of the conventional pump was an issue, the power saving was as great as $50 \%$.
Choosing the optimum pump is further simplified through the use of WebFLYPS, ITT Water \& Wastewater's dedicated pump selection software.



Demonstrating the pumping performance of the New Generation Flygt N-Pumps
Flygt N-pumps


## Product quality means attention to details

## Cable entry

The cable entrance is designed to incorporate both a seal and a strain relief function.

## Cooling system

In normal applications the surrounding liquid cools the pump. In more demanding applications, or when dry installed, all pumps can be provided with an internal closed cooling system. The coolant is circulated around the stator housing by an integrated pump.

## Seal wear protection

Spin-out ${ }^{T M}$ is a patented design that protects the outer seal by expelling abrasive particles from the seal chamber.

## International standards approvals

All pumps are tested and approved in accordance with national and international standards (IEC 34-1, CSA). They are also available in explosionproof versions - Factory Mutual and European Norm (FM and EN) approvals.

## Monitoring

Thermal sensors embedded in the stator windings help prevent overheating. The inspection chamber is equipped with a leakage sensor.

## Long life bearings

Bearings in all Flygt pumps have been designed to provide a minimum 50,000 hour service life.

## Inspection Chamber

A separate inspection chamber, below the bearings, further increases operational reliability. The built-in sensor gives an early alert of any fluid build-up and allows for simple checking and maintenance.


# Sustained higher hydraulic efficiency 

The revolutionary design of the self cleaning impeller is complemented by a special relief groove in the volute. This patented combination, which provides a self-cleaning flow path through the pump, greatly reduces the risk of clogging and makes the Flygt $N$-Pump series an ideal solution for high-efficiency pumping over long duty periods. That means lower overall energy consumption: a significant factor in reducing the whole life cost of your pumping operation.


The red line in the graph shows how the efficiency decreases when a conventional wastewater pump in continuous operation gets clogged.

The green line shows how a conventional wastewater pump that runs intermittently also has a generally low efficiency due to clogging. Temporary efficiency gains may be achieved through back flushing of the pump.
The blue line shows the Flygt $N$-Pump.

## Quality engineered for longer life

## New motor design

Rather than using standard, off-the-shelf motors, ITT Water \& Wastewater has always manufactured its own units. Each one is specifically designed and produced for safe, reliable operation in submersible applications. Designing our own motors also allows us to build-in wide margins of safety for a long and trouble-free service life.

All motors in the new generation Flygt N -Pumps are squirrel cage induction units. Stator windings are trickle impregnated in resin (Class H insulation) and rated at $180^{\circ} \mathrm{C}\left(355^{\circ} \mathrm{F}\right)$, allowing for up to 30 starts per hour. However, since the maximum temperature rise does not exceed $80^{\circ} \mathrm{C}\left(176^{\circ} \mathrm{F}\right)$, this prolongs the operational life of the motor winding. In addition, thermal contacts are rated to $140^{\circ} \mathrm{C}\left(284^{\circ} \mathrm{F}\right)$ to prevent unnecessary tripping.

The new trickle impregnation with resin gives excellent insulation with less risk of air pockets. Rotor losses have been considerably reduced and heat generation is concentrated around the stator, which is easier to cool than the rotor. This also means less heat on the bearings.
The stator is heat-shrink fitted in the housing for superior heat transfer, and locked against rotation for perfect alignment with the rotor assembly. As a further measure of protection against leakage, there are no external locking bolts.



## Seal wear protection

Spin-out ${ }^{\text {TM }}$ is a patented design that protects the outer seal by expelling abrasive particles from the seal chamber. As an integral part of the cast-iron housing, Spin-out is as simple as it is effective.

## Deflection-proof shaft

A short overhang of the shaft virtually eliminates shaft deflection. This results in significantly increased seal and bearing life, low vibration and quiet operation.


## Easier service and maintenance

The new generation Flygt N -Pumps feature numerous advanced technical solutions which together help to minimize the risk of downtime, and reduce the overall costs of your pumping operation.

An inspection chamber between the seal unit and the bearings helps increase operational reliability, and allows for rapid spot checks and maintenance. A built-in sensor provides an early warning of any fluid build-up in the case of a seal failure, thus reducing the risk of expensive repair work.

The impeller fastener is a patent pending design, making the tasks of removing, trimming and mounting the impeller much simpler and faster.


Smoother, rounder design of the exterior casing keeps the pump cleaner; an increasingly important health and safety factor when servicing. Fewer external screws also make it easier to disassemble and re-assemble the pump.

The Plug-in ${ }^{\text {TM }}$ seal unit provides a perfect fit and faster, simpler replacement. The design also protects the seal surfaces during disassembly and mounting.


## Keeping your station in top form

Supplying our customers with problem-free solutions is our goal at ITT Water \& Wastewater - and that means more than simply supplying the correct pump for your particular application. The following are examples of some of the ancillary equipment and systems which we can supply as aids to improving the all-round efficiency of your operation.


## The sump designed to clean itself

The unique design of The Optimal Pump station sump, with its integrated discharge connections, is an ideal cost-efficient solution for new stations and retro-fitting older stations. The sump has been hydraulically optimized to improve the flow over the sump floor during pumping. The result: increased turbulence, causing resuspension of settled solids and the entrainment of floating debris, which can then be pumped away during the operating cycle.

Special discharge connections are available in $100 \mathrm{~mm} / 4^{\prime \prime}$ and $150 \mathrm{~mm} / 6^{\prime \prime}$ sizes for NP3153 and NP3171.

Flygt Flush valve: the automatic desludger
Developed specifically to be fitted to all standard Flygt submersible pumps, the Flygt Flush Valve operates completely automatically.
Attached easily to the volute of the pump, the valve is open at the start of each pumping cycle and water is forced through the valve in a powerful jet flushing stream. Water in the sump is immediately subjected to intense turbulence, and all the sludge deposits, as well as floating solids, are resuspended before being pumped out. The valve closes automatically after approximately 20 seconds, and reopens again after pump stop, ready for the next pumping cycle.

## Flygt APF: automatic cleaning up to $\mathbf{4 0}$ times a day

Flygt APF is the maintenance-free control system that ensures clean stations even when you're dealing with the most heavily-contaminated wastewater.
The Flygt APF is simply connected to the main control system, which it overrides during cleaning cycles by operating the pumps down to the level at which air starts to be drawn into the pump. At this level, controlled turbulence and maximum velocities cause any solids, which have settled on the sump floor, to be drawn into the pump together with any debris floating on the surface. The unit can be programmed to operate up to 40 times a day.

## Upgrading and servicing



ITT Water \& Wastewater's design philosophy has always been to build equipment that gives you maximum return for your investment: and that means designing pumps for a long service life with minimum downtime.

If you already operate an installation with Flygt C-Pumps, the Flygt N-Pump upgrade kit gives you an opportunity to further extend the operational life of your equipment and gain the superior pumping efficiencies of the N-Pump range.

Each kit contains everything you need to upgrade your existing Flygt pumps to N-Pump standard, and there's a kit available for most Flygt C-Pump models (please check with your representative which models apply). Kits are easy to install and fully supported by the ITT Water \& Wastewater Service Network.

The upgrade kit allows you to:

- Cut the cost of regular and emergency maintenance by reducing the risk of clogging
- Boost the operational efficiency of your existing equipment
- Improve the return on your original investment


## World-wide service network

No two pumping stations and systems will be alike, so the level of maintenance and support that you require from your service partner will differ according to your particular situation. With ITT Water \& Wastewater, you can choose the type of support package that precisely fits your needs.

From simply supplying pumps to your specifications, to full service assistance on system planning, design, construction, implementation, operation or maintenance: Our total service concept means that you get the service you need, on your terms.

## 15-year spare parts guarantee

We guarantee availability of spare parts for 15 years after we stop production of a pump model. This is just one of the ways in which ITT Water \& Wastewater guarantees its long-term commitment to customers.

## 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.

## www.ittwww.com



## Features:

- 100\% unrestricted flow area for improved flow characteristics and lower head loss
- One piece precision molded steel disc reinforced with nylon and backed by a 25 year warranty
- Memory-flex disc is the only moving part for long life and minimal maintainance
- Full sized top access port allows disc removal without removing valve from line
- Integral O-ring in disc assures positive seating at high and low pressures
-"Short Disc Stroke" combined with memory flex disc action reduces potentially destructive water hammer
- Backflow capabilities are available by means of an optional screw type backflow actuator
- Every Swing-Flex ${ }^{\circledR}$ Check Valve is $100 \%$ tested including a seat test to assure drop tight sealing and hydrostatic testing to assure the integrity of the casting


Technical Data

- Sizes: DN50-600 (2"- 24")
- Max. Working Pressure: 1600kPa
- Ductile Iron Body
- Fusion Bonded Epoxy Coated
- Buna-N Encapsulated Disc
- Flanges Drilled AS4087 Class 16
- 316 Stainless Steel Fasteners And Plugs
- Lay Length To AS3578 \& AS4794


HYDRO TEST PRESSURE:
1.5 TIMES COLD WORKING PRESSURE - CWP

SEE DRAWNG NO. M M-502AU-M FOR STANDARD MATERIALS OF CONSTRUCTION.
DRAWING DEPICTS 375 mm SIZE TO SCALE
AS4087 CLASS 16, Millimeters

| $\begin{array}{\|c} \hline \text { VALVE } \\ \text { SIZE } \\ \hline \end{array}$ | $\begin{gathered} \hline \text { MODEL } \\ \text { NO. } \\ \hline \end{gathered}$ | $\begin{aligned} & \text { CWP } \\ & \text { BAR } \end{aligned}$ | A | B | C | D | $E$ | F | G | K | $\begin{array}{\|l\|} \hline \text { BOLT } \\ \text { SIZE } \\ \hline \end{array}$ | $\begin{array}{\|l\|} \hline \mathrm{NO} . \mathrm{OF} \\ \text { BOLTS } \\ \hline \end{array}$ | $\begin{aligned} & \text { WT. } \\ & \text { Kg. } \end{aligned}$ |
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| 100 | 504AU | 16 | 330 | 178 | 215 | 19 | 102 | 146 | 54 | 210 | M16 | 4 | 32 |
| 150 | 506AU | 16 | 410 | 235 | 280 | 21 | 152 | 173 | 54 | 284 | M16 | 8 | 57 |
| 200 | 508AU | 16 | 540 | 292 | 335 | 22 | 203 | 213 | 73 | 406 | M16 | 8 | 109 |
| 250 | 510AU | 16 | 640 | 356 | 405 | 24 | 245 | 273 | 80 | 533 | M20 | 8 | 190 |
| 300 | 512AU | 16 | 700 | 406 | 455 | 30 | 305 | 317 | 88 | 610 | M20 | 12 | 290 |
| 375 | 515AU | 16 | 820 | 495 | 550 | 30 | 375 | 330 | 92 | 591 | M24 | 12 | 330 |
| 450 | 518AU | 16 | 970 | 584 | 640 | 32 | 457 | 388 | 80 | 718 | M24 | 12 | 546 |
| 600 | 524AU | 16 | 1220 | 756 | 813 | 48 | 610 | 489 | 127 | 914 | M27 | 16 | 998 |

## 3. Odour Control \& Generator Slab

CONCRETE FIELD TESTING INFORMATION,SHEET - AS1012.1,3.1,8.1
ABS 9695040538642 Moóres Pocket Road, Tivoli Qld 4305
Wray: 0401075054 Ph: 0732819131 Fax: 0732827224




#  \& Quarries ABMAL RESOURCES (QLD) PTY LIMITED ABN 46009671809 <br> Level 6,88 Musk Ave, Kelvin Grove QLD 4059 <br> PO Box 125 Kelvin Grove QLD 4059 <br> Telephone (07) 38677600 <br> Facsimile (07) 38677699 

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additives/Extras: $5.6 \mathrm{M3}$

Cusiomer accepts the receipt andor the return of the procuct and the on-site adjustments as documented on this docket, subject to the conditions of sale overleaf.


Prev. Docket:TRK \# :

DriverD412 $7276 \quad 21$ CRN LOBBS ST (PUMPING STATION)
Instructions:
 \& Quarries

ABN 46009671809

Level 6. 88 Musk Ave, Kelvin Grove QLD 4059
PO Box 125 Kelvin Grove QLD 4059
Telephane (07) 38677600
Facsimile (07) 38677699
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MORGAN BROS

## 44261807 Date:

Time Batched: 09:39 QLD

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Contact Beral for more information and a Materiai Saiety Data Sheet
Additives/Extras:
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Customer accepts the receipt and/or the return of the product and the on-site adjustments as documented on this docket. subject to the conditions of sale overleat.

Driver $04127276 \quad 21$ CRN LOBBS ST (PUMPING STATION)
nstructions:

 \& Quarries ABN 46009671809
Level 6, 88 Musk Ave, Kelvin Grove QLD 4059
PO Box 125 Kelvin Grove OLD 4059
Telephone (07) 38677600
Facsimile (07) 38677699
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Customer accepts the receipt and/ar the return of the product and the on-site adjustments as documented on this docket, subject to the conditions of sale overleat.


Prev. Docket:TRK \#: 40292

DriverQ412 7276.21 CRN LOBBS ST (PUMPING STATION)
Instructions:

#  \& Quarries ABMAL RESOURCES (QLD) PTY LIMITED ABN 46009671809 <br> Level 6,88 Musk Ave, Kelvin Grove QLD 4059 <br> PO Box 125 Kelvin Grove QLD 4059 <br> Telephone (07) 38677600 <br> Facsimile (07) 38677699 

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## No: <br> Date: <br> 44261799

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Contact Boral for more informalion and a Material Safety Data Sheet.
additives/Extras: $5.6 \mathrm{M3}$

Cusiomer accepts the receipt andor the return of the procuct and the on-site adjustments as documented on this docket, subject to the conditions of sale overleaf.


Prev. Docket:TRK \# :

DriverD412 $7276 \quad 21$ CRN LOBBS ST (PUMPING STATION)
Instructions:

Boral Concrete \& Quarries

Level 6, 88 Musk Ave, Kelvin Grove QLD 4059
PO Box 125 Kelvin Grove QLD 4059
Telephone (07) 38677800
Facsimile (07) 38677699

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44261649

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Customer accepts the receipt andor the return of the product and the on-site adjustments as documented on this docket. subject to the conditions of sale overleaf.

Driver instructions OA12 727621 OPP LEICHHARDT PARK, NEAREST ST LOBBS ST.

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ABN 46009671809
Level 6,88 Musk Ave, Kelvin Grove QLD 4059
PO Box 125 Kelvin Grove QLD 4059
Telephone (07) 38677600
Facsimile (07) 38677699

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Conlact Boral tor more information and a Material Salely Dala Sneet.
Additives/Extras:



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Prev. Docket:

Driver 412727621 OPP LEICHHARDT PARK, Instructions: NEAREST ST LOBBS ST.

Sheehy \& Partners Pty. Ltd.
3 Gregory Terrace, Spring Hill, Qld, 4000

RE: GEOTECHNICAL INVESTIGATION
SP01; Old Toowoomba Rd, West Ipswich

### 1.0 Introduction

The work in this investigation was carried out to determine general geotechnical information regarding the proposed building area.

A single test bore with an adjacent scala cone penetrometer probe was undertaken on the 14 February 2012 at the location shown on the attached sketch.

Test locations have been located as per client instructions or as reasonably determined on site by the field officer. Any recommendations made in this report pertain to the area investigated, as defined by the Site Plan attached.

### 2.0 Investigation Results

The proposed building area is sparsely grassed with a no significant trees in close proximity. There is a very slight slope across the building site with the drainage characteristics considered moderate at the time of the investigation.

The soil profile, as established by the test bore, generally consists of weak uncontrolled high plasticity clay fill to a depth of approximately 1.2 m , overlying stiff and very stiff high plasticity natural clays.

Local knowledge of these insitu clays defines them as potentially highly reactive.
No groundwater was encountered in the test bore at the time of the investigation.
A more detailed description of the soil profile and test results can be found in Appendix '1'.

### 3.0 Engineering Assessment

Based on the results of the field and laboratory investigation, and taking into account the existing environmental conditions, the site would be classified as a 'P' - Problem Site, as defined by AS2870, due to the presence of filled ground greater than 0.4 m in depth.

The filled ground is not considered suitable for the support of isolated pad or strip loads or uniform slab loadings.

All footings should be founded into the underlying very stiff natural clays.
The existing fills could be removed and replaced / recompacted to $98 \%$ standard compaction, once the subgrade is proof rolled to ensure its suitability to support compaction loads. Alternatively, any slab on ground could be designed and constructed as suspended units.

A summary of allowable bearing pressures for footings is presented below.

|  | Allowable Bearing Pressure (kPa) |  |
| :--- | :---: | :---: |
| Material type \ footing element | Shaft | End |
| Very stiff Natural clay - strip <br> (200mm penetration) | - | 150 |
| Very stiff Natural clay - bored piers <br> (300mm penetration) | 15 | 250 |

Shaft adhesion should only be applied over that portion of the pile founded below the depth of influence and / or filled ground.

No problems are anticipated with bulk, trench or bored pier excavations using small to medium sized equipment, e.g., Cat D4 or backhoe.

### 4.0 Limits of Investigation

Recommendations given in this report are based on the information supplied by the client in conjunction with the findings of the investigation. Any change in the type or form of construction may make the recommendations invalid.

If soil conditions differing from those shown on the borelogs are encountered during construction, Civiltech Engineering should be advised immediately.

## Yours Faithfully


B.E., M.I.E.Aust. R.P.E.Q. (No. 2951)

## Appendix 1: Test Bore and Laboratory Test Results

| DEPTH | CLASSIFICATION | SAMPLE | Scala Cone |
| :--- | :--- | :---: | :---: |
|  | Bore 1 |  | Blows/100mm |
| 0.00 | Fill Topsoil |  | 4 |
| 0.10 | Fill Clay (CH) Stiff, high plasticity, grey yellow brown, moist |  | 3 |
| 1.20 | Natural Clay (CH) Stiff, high plasticity, grey brown, moist | $0.8:$ U50 | 1 |
| 1.80 | As above but very stiff | 2 |  |
| 3.00 | Borehole Discontinued |  | 2 |
|  |  |  | 1 |
|  |  |  | 2 |
|  |  |  | 1 |
|  |  |  | 1 |
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|  |  |  | 6 |
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|  |  |  | 10 |

SITE PLAN


# Compliance Certificate for building Design or Specification 

NOTE

Sheehy \& Partners Pty Ltd Job No. 7789

This is to be used for the purposes of section 10 of the Building Act 1975 and/or section 46 of the Building Regulation 2006.

RESTRICTION: A building certifier (class B) can only give a compliance certificate about whether building work complies with the BCA or a provision of the QDC. A building certifier (Class B) can not give a certificate regarding QDC boundary clearance and site cover provisions.

## 1. Property description

This section need only be completed if details of street address and property description are applicable.
EG. In the case of (standard/generic) pool design/shell manufacture and/or patio and carport systems this section may not be applicable.

The description must identify all land the subject of the application.
The lot \& plan details (eg. SP / RP) are shown on title documents or a rates notice.
If the plan is not registered by title, provide previous lot and plan details.
2. Description of component/s certified Clearty describe the extent of work covered by this cerififcate, e.g. all structural aspects of the steel roof beams.

## 3. Basis of certification

Detail the basis for giving the cerificate and the extent to which tests, specifications, rules, standards, codes of practice and other publications, were relied upon.

## 4. Reference documentation

Clearly identify any relevant documentation, e.g. numbered structural engineering plans.

Sheehy \& Partners Structural Engineering Drawings numbered 7789-S00, 7789-S01, 7789-502 and 7789-503.
Civiltech Engineering Geotechnical Investigation Report number 12015 dated 16 February 2012.
Kellog Brown \& Root project arrangement drawings dated 29.07.2011.
Siemens Water Technologies equipment arrangement drawings for project number 20338 dated 12.01.2012.

All structural aspects of the foundations and slabs on ground as indicated on Sheehy \& Partners Drawings numbered 7789-S00, 7789-S01, 7789-S02 and 7789-S03 in their most up to date revision.

Documents relied upon include the project arrangement drawings, equipment vendor drawings and geotechnical investigation report for the project and the following current Australian Standard Codes:

Structural Design Actions Code AS/NZS 1170
Residential Slabs and Footings Code AS2870
Concrete Structures Code AS3600
Piling Code AS2159
Design Criteria are as indicated on the project structural drawings.
Limitations on the certification:

1. The issue of this certificate in no way reduces the responsibility of the Builder to undertake all building works consistent with the relevant plans, Building Act and Regulations and good building practice.
2. Proprietary items (eg deformed reinforcement bar, welded mesh etc) are deemed to be covered by the manufacturer's certification.


Form 15 continued

| Form 15 continued |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :---: |
| 5. Building certifier reference number | Building certifier reference number |  |  |  |  |

# Inspection Certificate / Aspect Certificate / QBSA Licensee Aspect Certificate 

| NOTE <br> Sheehy \& Partners Fty Ltd Job No. 77 P9 | This is to be used for the purposes of section 10(c) of the Building Act 1975 and/or section 47 of the Building Regulation 2006. |
| :---: | :---: |
| 1. Finclicate the type of certificale | Inspection Certificate for <br> Stage of building work (for single detached class 1a or class 10 building or structure) <br> (indicate the stage) $\qquad$ <br> Aspect of building work <br> (indicate the aspect) Completed concrete slabs and foundations $\square$ QBSA Licensee Aspect Certificate <br> Scope of the work <br> Scope of the work covered by the licence class under the Queensland Building Services Authority Regulation 2003 for the aspect being certified, eg scope of work for a waterproofing licence is "installing waterproofing materials or systems for preventing moisture penetration". An aspect being certified may include "wet area sealing to showers". |
| 2. Property description <br> The description must identify all land the subject of the application. <br> The lot \& plan details (eg. SP / RP) are shown on title documents or a rates notice. If the plan is not registered by title, provide previous lot and plan details. | Street address (nclude no., street, suburb / locality \& positoode) <br> Lot \& plan details (Attach list if necossary) $\square$ <br> In which local government area is the land situated? <br> loswich |
| 3. Building description | Building description Class of building / structure <br> Foundation slabs for pump station odour control units 10 b |
| 4. Description of component/s certified Clearly describe the extent of work covered by this certificate, e.g. all structural aspects of the steel root beams. | All structural aspects of the foundations and slabs on ground as indicated on Sheehy \& Partners Drawings numbered 7789-S00, 7789-S01, 7789-S02 and 7789-S03 in their most up to date revision. |

5. Basis of cerlification

Detail the basis for giving the certificate and the extent to which tests, specifications, rules, standards, codes of practice and other publications, were relied upon.

Documents relied upon include the project arrangement drawings, equipment vendor drawings and geotechnical investigation report for the project and the following current Australian Standard Codes:

Structural Design Actions Code AS/NZS 1170
Residential Slabs and Footings Code AS2870
Concrete Structures Code AS3600
Piling Code AS2159

Design Criteria are as indicated on the project structural drawings.
Limitations on the certification:

1. The issue of this certificate in no way reduces the responsibility of the Builder to undertake all building works consistent with the relevant plans, Building Act and Regulations and good building practice.
2. The certificate has been based on periodic inspections normally conducted prior to the final completed construction by the Builder of the elements concerned (ie the actual completed structure was not inspected)
3. The certificate does not cover issues such as the Builder's activities after the inspection, plumbing, waterproofing, termite protection, equipment installation and other matters that are the Builder's responsibility.
4. Proprietary items (eg welded wire reinforcement mesh etc) are deemed to be covered by the manufacturer's certification.
5. Obtaining local government approvals for changes in the approved materials or detail variations remain the responsibility of the Builder.
6. Reference documentation
Clearly identify any relevant documentation,
e.g. numbered structural engineering plans.
7. Build ing certifier reference number
and developmenf approval number
B. Building Certiter or compelent
person details

A competent person must be assessed as competent before carrying out the inspection.
The builder for the work cannot give a stage cerificate of inspection.
A competent person is assessed by the building certifier for the work as competent to practice in an aspect of the building and specification design, because of the individual's skill, experience and qualifications. The competent person must be registered or licensed under a law applying in the State to practice the aspect.
If no relevant law requires the individual to be licensed or registered, the certifier must assess the individual as having appropriate experience, qualifications or skills to be abte to give the help.
If the chief executive issues any guidelines for assessing a competent person, the building certifier must use the guidelines when assessing the person.

| Sheehy \& Partners Structural Engineering Drawings numbered 7789-S00, 7789-S01, 7789-S02 and 7789-S03. |
| :---: |
| Civiltech Engineering Geotechnical Investigation Report number 12015 dated 16 February 201 |
| Kellog Brown \& Root project arrangement drawings dated 29.07.201 |
| Siemens Water Technologies equipment arrangement drawings for project number 12.01.2012. |

Building certifier reference number Development approval number

| Building certifier reference number |
| :--- |
|  |
| Development approval number |
| Name (in full) |
| Scott McDonald |
| Company name if applicable |
| Sheehy \& Partners |

Email address

| scottmc@sheehy.com.au |
| :--- |
| Postal address |
| 3 Gregory Terrace  <br> Spring Hill QLD  <br> Licence class Licence number <br> RPEQ 8023 |

The Building Act 1975 is administered by the Department of Infrastructure and Planning

Form 16 continued
9. Signature of building certifier, competent person or QBSA licensee

Inspection Certificate for stage or aspect

QBSA Licensee Aspect Certificate
$\square$ A person who may under s43 give a QBSA licensee certificate for the aspect if it complies with the requirements for self assessable building work under the Building Regulation 2006 s 44.


Date
4/07/2012





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## 4. Pipe Work, Valves, Pumps Install










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SP320 Old Toowoomba Rd Leichhardt SPS－Civil and Mechanical OM Manual

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## 5. Platform

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## BRIDGING ORDER FORM

## ICR Drafting Pty Ltd

Model: 1112018
Client : LOGAN STEEL

Date: 2/04/2012
Contract : 1112-018
Time: 10:10:21 AM
Site : URBAN UTILITIES PUMP STATIONS
Detailer: MCS
PHASE = SP001

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| (RIGHT END) |  |  | QTY | LENGTH |
| :---: |
| (PURLIN CTRS) |$\quad$ MARK NO.




| Mark | No. | Section Size | $\begin{aligned} & \text { Mass } \\ & (\mathrm{kg} / \mathrm{m}) \end{aligned}$ | Grade | Length <br> (m) | Area (m2) | $\begin{gathered} \text { Mass } \\ (\mathrm{t}) \end{gathered}$ | Cut Note |
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| CL01 | 34 | A253MPG | 0.59 | 300+ | 0.993 | 1.896 | 0.020 |  |
| CL02 | 404 | A253MPG | 0.59 | 300+ | 1.257 | 28.499 | 0.299 |  |
| CL05 | 2 | A253MPG | 0.59 | 300+ | 0.573 | 0.064 | 0.001 |  |
| CL06 | 91 | A253MPG | 0.59 | 300+ | 1.139 | 5.818 | 0.061 |  |
| CL07 | 4 | A253MPG | 0.59 | 300+ | 0.903 | 0.203 | 0.002 |  |
| CL08 | 5 | A253MPG | 0.59 | 300+ | 0.964 | 0.271 | 0.003 |  |
| CL09 | 2 | A253MPG | 0.59 | 300+ | 0.333 | 0.038 | 0.000 |  |
| CL10 | 15 | A253MPG | 0.59 | 300+ | 1.090 | 0.918 | 0.010 |  |
| CL11 | 2 | A253MPG | 0.59 | 300+ | 0.483 | 0.054 | 0.001 |  |
| CL12 | 2 | A253MPG | 0.59 | 300+ | 0.177 | 0.020 | 0.000 |  |
| CL13 | 2 | A253MPG | 0.59 | 300+ | 0.753 | 0.085 | 0.001 |  |
| CL14 | 4 | A253MPG | 0.59 | 300+ | 0.150 | 0.034 | 0.000 |  |
| CL15 | 2 | A253MPG | 0.59 | 300+ | 0.813 | 0.091 | 0.001 |  |
| CL16 | 2 | A253MPG | 0.59 | 300+ | 0.180 | 0.020 | 0.000 |  |
| CL17 | 122 | A253MPG | 0.59 | 300+ | 0.639 | 4.384 | 0.046 |  |
| CL18 | 10 | A253MPG | 0.59 | 300+ | 0.464 | 0.261 | 0.003 |  |
| CL19 | 122 | A253MPG | 0.59 | 300+ | 1.232 | 8.439 | 0.089 |  |
| CL20 | 2 | A253MPG | 0.59 | 300+ | 0.843 | 0.095 | 0.001 |  |
| CL21 | 10 | A253MPG | 0.59 | 300+ | 1.060 | 0.595 | 0.006 |  |
| CL22 | 2 | A253MPG | 0.59 | 300+ | 0.303 | 0.034 | 0.000 |  |
| CL23 | 19 | STANDARBP | 5.89 | 300+ | 0.146 | 0.500 | 0.016 |  |
| CL24 | 56 | TREADEND | 2.55 | 300+ | 0.243 | 1.942 | 0.035 |  |
| CL25 | 224 | T4A253MPG | 0.59 | 300+ | 0.640 | 8.062 | 0.084 |  |
| CL26 | 12 | ANGLEBP | 5.10 | 300+ | 0.172 | 0.325 | 0.011 |  |
| PL01 | 11 | 300X16PL | 37.68 | 300+ | 0.300 | 2.191 | 0.124 |  |
| PL02 | 20 | 100X10FL | 7.85 | 300+ | 0.150 | 0.700 | 0.024 |  |
| PL03 | 20 | 65X10FL | 5.10 | 300+ | 0.140 | 0.446 | 0.014 |  |
| PL04 | 10 | 150X10FL | 11.78 | 300+ | 0.160 | 0.542 | 0.019 |  |
| PL05 | 1 | 150X10FL | 11.78 | 300+ | 0.219 | 0.060 | 0.002 | BEV'D |
| PL06 | 3 | 50X6FL | 2.35 | 300+ | 0.100 | 0.035 | 0.001 |  |
| PL07 | 1 | 250X10FL | 19.62 | 300+ | 0.334 | 0.128 | 0.005 | BEV'D |
| PL08 | 1 | 150X10FL | 11.78 | 300+ | 0.254 | 0.066 | 0.002 | BEV'D |
| PL09 | 1 | 150X10FL | 11.78 | 300+ | 0.219 | 0.060 | 0.002 | BEV'D |
| PL10 | 3 | 75X16FL | 9.42 | 300+ | 0.300 | 0.171 | 0.008 |  |
| PL11 | 3 | 75X5FL | 2.94 | 300+ | 0.140 | 0.069 | 0.001 |  |
| PL12 | 5 | 150X10FL | 11.78 | 300+ | 0.170 | 0.276 | 0.010 | BEV'D |
| PL13 | 17 | 50X10FL | 3.92 | 300+ | 0.150 | 0.323 | 0.010 |  |
| PL14 | 1 | 180X10FL | 14.13 | 300+ | 0.220 | 0.080 | 0.003 | BEV'D |
| PL15 | 1 | 150X10FL | 11.78 | 300+ | 0.256 | 0.067 | 0.002 | BEV'D |
| PL16 | 2 | 150X10FL | 11.78 | 300+ | 0.220 | 0.117 | 0.004 | BEV'D |
| PL17 | 1 | 250X10FL | 19.62 | 300+ | 0.234 | 0.096 | 0.003 | BEV'D |
| PL18 | 2 | 150X10FL | 11.78 | 300+ | 0.256 | 0.128 | 0.004 | BEV'D |
| PL19 | 1 | 150X10FL | 11.78 | 300+ | 0.254 | 0.066 | 0.002 | BEV'D |
| PL20 | 1 | 75X10FL | 5.89 | 300+ | 0.190 | 0.034 | 0.001 |  |
| PL21 | 1 | 115X10PL | 9.03 | 300+ | 0.190 | 0.050 | 0.002 |  |
| PL22 | 1 | 250X10FL | 19.62 | 300+ | 0.334 | 0.125 | 0.004 | BEV'D |
| PL23 | 9 | 150X10FL | 11.78 | 300+ | 0.185 | 0.517 | 0.018 | BEV'D |
| PL24 | 1 | 200X10FL | 15.70 | 300+ | 0.210 | 0.084 | 0.003 | BEV'D |
| PL25 | 1 | 200X10FL | 15.70 | 300+ | 0.220 | 0.073 | 0.003 | BEV'D |
| PL26 | 1 | 200X10FL | 15.70 | 300+ | 0.250 | 0.096 | 0.003 | BEV'D |
| PL27 | 1 | 150X10FL | 11.78 | 300+ | 0.219 | 0.060 | 0.002 | BEV'D |
| PL28 | 1 | 200X10FL | 15.70 | 300+ | 0.300 | 0.112 | 0.004 | BEV'D |
| PL29 | 1 | 200X10FL | 15.70 | 300+ | 0.300 | 0.103 | 0.004 | BEV'D |
| PL30 | 1 | 200X10FL | 15.70 | 300+ | 0.200 | 0.081 | 0.003 | BEV'D |
| PL31 | 1 | 180X10FL | 14.13 | 300+ | 0.300 | 0.104 | 0.004 | BEV'D |
| PL32 | 1 | 200X10FL | 15.70 | 300+ | 0.300 | 0.095 | 0.003 | BEV'D |
| PL33 | 3 | 150X10FL | 11.78 | 300+ | 0.170 | 0.156 | 0.005 | BEV'D |
| PL34 | 7 | 150X10FL | 11.78 | 300+ | 0.185 | 0.378 | 0.013 | BEV'D |
| PL35 | 1 | 150X10FL | 11.78 | 300+ | 0.300 | 0.085 | 0.003 | BEV'D |
| PL36 | 1 | 200X10FL | 15.70 | 300+ | 0.220 | 0.075 | 0.003 | BEV'D |
| PL37 | 1 | 100X10FL | 7.85 | 300+ | 0.180 | 0.042 | 0.001 |  |
| PL38 | 1 | 200X10FL | 15.70 | 300+ | 0.500 | 0.214 | 0.008 |  |
| PL39 | 3 | 75X10FL | 5.89 | 300+ | 0.190 | 0.101 | 0.003 |  |
| PL40 | 5 | 250X10FL | 19.62 | 300+ | 0.250 | 0.519 | 0.019 | BEV'D |
| PL41 | 2 | 250X10FL | 19.62 | 300+ | 0.455 | 0.385 | 0.014 | BEV'D |
| PL42 | 1 | 150X10FL | 11.78 | 300+ | 0.350 | 0.099 | 0.004 | BEV'D |
| PL43 | 3 | 150X10FL | 11.78 | 300+ | 0.190 | 0.150 | 0.005 | BEV'D |




| Client | LOGAN | STEEL |  |  |  |  | 02-04-12 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Contract | LOGAN | STEL - J \& P RICHARSDON | ARSDON | Time |  |  | 10:09:35 |  |
| Site | URBAN | UTILITIES PUMP STATIONS |  |  |  | Draughtsman | MCS |  |
| PHASE | SP001 |  |  |  |  |  |  |  |
| Mark | No. | Section Size | $\begin{gathered} \text { Mass } \\ (\mathrm{kg} / \mathrm{m}) \end{gathered}$ | Grade | Length (m) | $\begin{aligned} & \text { Area } \\ & (\mathrm{m} 2) \end{aligned}$ | Mass (t) | Cut Note |
| PL19 | 1 | 150X10FL | 11.78 | 300+ | 0.254 | 0.066 | 0.002 | BEV'D |
| PL23 | 9 | 150X10FL | 11.78 | 300+ | 0.185 | 0.517 | 0.018 | BEV'D |
| PL27 | 1 | 150X10FL | 11.78 | 300+ | 0.219 | 0.060 | 0.002 | BEV'D |
| PL33 | 3 | 150X10FL | 11.78 | 300+ | 0.170 | 0.156 | 0.005 | BEV'D |
| PL34 | 7 | 150X10FL | 11.78 | 300+ | 0.185 | 0.378 | 0.013 | BEV'D |
| PL35 | 1 | 150X10FL | 11.78 | 300+ | 0.300 | 0.085 | 0.003 | BEV'D |
| PL42 | 1 | 150X10FL | 11.78 | 300+ | 0.350 | 0.099 | 0.004 | BEV'D |
| PL43 | 3 | 150X10FL | 11.78 | 300+ | 0.190 | 0.150 | 0.005 | BEV'D |
| PL46 | 3 | 150X10FL | 11.78 | 300+ | 0.190 | 0.150 | 0.005 | BEV'D |
| Totals for | 150× | X10FL |  |  | ttings | 2.976 | 0.104 |  |
| PL14 | 1 | 180X10FL | 14.13 | 300+ | 0.220 | 0.080 | 0.003 | BEV'D |
| PL31 | 1 | 180X10FL | 14.13 | 300+ | 0.300 | 0.104 | 0.004 | BEV'D |
| Totals for | 180× | X10FL |  |  | ttings | 0.184 | 0.007 |  |


| PL24 | 1 | 200X10FL | 15.70 | 300+ | 0.210 | 0.084 | 0.003 | BEV'D |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PL25 | 1 | 200X10FL | 15.70 | 300+ | 0.220 | 0.073 | 0.003 | BEV'D |
| PL26 | 1 | 200X10FL | 15.70 | 300+ | 0.250 | 0.096 | 0.003 | BEV'D |
| PL28 | 1 | 200X10FL | 15.70 | 300+ | 0.300 | 0.112 | 0.004 | BEV'D |
| PL29 | 1 | 200X10FL | 15.70 | 300+ | 0.300 | 0.103 | 0.004 | BEV'D |
| PL30 | 1 | 200X10FL | 15.70 | 300+ | 0.200 | 0.081 | 0.003 | BEV'D |
| PL32 | 1 | 200X10FL | 15.70 | 300+ | 0.300 | 0.095 | 0.003 | BEV'D |
| PL36 | 1 | 200X10FL | 15.70 | 300+ | 0.220 | 0.075 | 0.003 | BEV'D |
| PL38 | 1 | 200X10FL | 15.70 | 300+ | 0.500 | 0.214 | 0.008 |  |
| Totals for | 200 | X10FL |  | 9 | tings | 0.934 | 0.033 |  |
| PL07 | 1 | 250X10FL | 19.62 | 300+ | 0.334 | 0.128 | 0.005 | BEV'D |
| PL17 | 1 | 250X10FL | 19.62 | 300+ | 0.234 | 0.096 | 0.003 | BEV'D |
| PL22 | 1 | 250X10FL | 19.62 | 300+ | 0.334 | 0.125 | 0.004 | BEV'D |
| PL40 | 5 | 250X10FL | 19.62 | 300+ | 0.250 | 0.519 | 0.019 | BEV'D |
| PL41 | 2 | 250X10FL | 19.62 | 300+ | 0.455 | 0.385 | 0.014 | BEV'D |


| Totals for | 250X10FL |  | 10 Fittings |  |  | 1.252 | 0.045 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CL01 | 34 | A253MPG | 0.59 | 300+ | 0.993 | 1.896 | 0.020 |
| CL02 | 404 | A253MPG | 0.59 | 300+ | 1.257 | 28.499 | 0.299 |
| CL05 | 2 | A253MPG | 0.59 | 300+ | 0.573 | 0.064 | 0.001 |
| CL06 | 91 | A253MPG | 0.59 | 300+ | 1.139 | 5.818 | 0.061 |
| CL07 | 4 | A253MPG | 0.59 | 300+ | 0.903 | 0.203 | 0.002 |
| CL08 | 5 | A253MPG | 0.59 | 300+ | 0.964 | 0.271 | 0.003 |
| CL09 | 2 | A253MPG | 0.59 | 300+ | 0.333 | 0.038 | 0.000 |
| CL10 | 15 | A253MPG | 0.59 | 300+ | 1.090 | 0.918 | 0.010 |
| CL11 | 2 | A253MPG | 0.59 | 300+ | 0.483 | 0.054 | 0.001 |
| CL12 | 2 | A253MPG | 0.59 | 300+ | 0.177 | 0.020 | 0.000 |
| CL13 | 2 | A253MPG | 0.59 | 300+ | 0.753 | 0.085 | 0.001 |
| CL14 | 4 | A253MPG | 0.59 | 300+ | 0.150 | 0.034 | 0.000 |
| CL15 | 2 | A253MPG | 0.59 | 300+ | 0.813 | 0.091 | 0.001 |
| CL16 | 2 | A253MPG | 0.59 | 300+ | 0.180 | 0.020 | 0.000 |
| CL17 | 122 | A253MPG | 0.59 | 300+ | 0.639 | 4.384 | 0.046 |
| CL18 | 10 | A253MPG | 0.59 | 300+ | 0.464 | 0.261 | 0.003 |
| CL19 | 122 | A253MPG | 0.59 | 300+ | 1.232 | 8.439 | 0.089 |
| CL20 | 2 | A253MPG | 0.59 | 300+ | 0.843 | 0.095 | 0.001 |
| CL21 | 10 | A253MPG | 0.59 | 300+ | 1.060 | 0.595 | 0.006 |
| CL22 | 2 | A253MPG | 0.59 | 300+ | 0.303 | 0.034 | 0.000 |
| CL25 | 224 | T4A253MPG | 0.59 | 300+ | 0.640 | 8.062 | 0.084 |
| Totals for | T4A253MPG |  | 1063 |  | tings | 59.881 | 0.628 |
| CL26 | 12 | ANGLEBP | 5.10 | 300+ | 0.172 | 0.325 | 0.011 |







| ICR Draft | ( Pty Ltd | STRUCAD SITE BOLT |  | LOCATION LIST |  |  | Model : 1112018 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Client | LOGAN STEE |  |  |  |  |  |  | 02-04-12 |
| Contract | LOGAN STEL | $J$ \& P RIC | HARSDO |  |  |  |  | 10:09:35 |
| Site | URBAN UTIL | IES PUMP S | TATION |  |  | ug | tsman | MCS |
| PHASE | SP001 |  |  |  |  |  |  |  |
| Mark | Location | Diam | Grade | Type | Length | No | Conne | ted Parts |
| 1M18 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M18 | 1M22 |
| 1M18 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M18 | 1M22 |
| 1M18 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M18 | 1M22 |
| 1M18 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M18 | 1M12 |
| 1M18 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M18 | 1M12 |
| 1M18 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M18 | 1M24 |
| 1M18 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M18 | 1M24 |
| 1M19 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M19 | 1M08 |
| 1M19 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M19 | 1M13 |
| 1M19 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M19 | 1M48 |
| 1M20 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M20 | 1M13 |
| 1M20 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M20 | 1M14 |
| 1M20 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M20 | 1M48 |
| 1M20 | 1/A/23400 | 20 | 8.8S | BNW | 50 | 2 | 1M20 | 1M48 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |
| 1M21 | 1/A/23400 | 16 | 8.8S | BNW | 40 | 1 | 1M21 | 1M23 |



| ICR Draf | g Pty Ltd | STRUCAD SITE BOLT LOCATION LIST |  |  |  | Model : 1112018 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Client | LOGAN STEEL |  |  |  | Date |  |  | : 02-04-12 |
| Contract | LOGAN STEL - J \& P RICHARSDON |  |  |  | Time |  |  | : 10:09:35 |
| Site | URBAN UTILITIES PUMP STATIONS |  |  |  | Draughtsman |  |  | : MCS |
| PHASE | SP001 |  |  |  |  |  |  |  |
| Mark | Location | Diam | Grade | Type | Length | No | Connec | cted Parts |
| AS-04 | 1/A/22031 | 16 | 8.8S | BNW | 50 | 2 | AS-04 | AS-05 |
| AS-04 | 1/A/23234 | 16 | 8.8S | BNW | 50 | 2 | AS-04 | AS-05 |
| AS-02 | 1/A/20562 | 16 | CHE | RAMSET | 190 | 2 | AS-02 |  |
| AS-02 | 1/A/20562 | 16 | CHE | RAMSET | 190 | 2 | AS-02 |  |
| AS-02 | 1/A/20829 | 16 | 8.8S | BNW | 50 | 2 | AS-02 | AS-03 |
| AS-02 | 1/A/20829 | 16 | 8.8S | BNW | 50 | 2 | AS-02 | AS-03 |
| AS-02 | 1/A/22031 | 16 | 8.8S | BNW | 50 | 2 | AS-02 | AS-03 |
| AS-02 | 1/A/22031 | 16 | 8.8S | BNW | 50 | 2 | AS-02 | AS-03 |
| AS-02 | 1/A/23234 | 16 | 8.8S | BNW | 50 | 2 | AS-02 | AS-03 |
| AS-02 | 1/A/23234 | 16 | 8.8S | BNW | 50 | 2 | AS-02 | AS-03 |
| AS-01 | 1/A/20562 | 16 | CHE | RAMSET | 190 | 2 | AS-01 |  |
| AS-01 | 1/A/20829 | 16 | 8.8S | BNW | 50 | 2 | AS-01 | AS-03 |
| AS-01 | 1/A/22031 | 16 | 8.8S | BNW | 50 | 2 | AS-01 | AS-03 |
| AS-01 | 1/A/23234 | 16 | 8.8S | BNW | 50 | 2 | AS-01 | AS-03 |

ICR Drafting Pty Ltd STRUCAD HOT-ROLLED MEMBER LIST Model : 1112018

| Client | LOGAN | STEFL |  |  |  |  | -04-12 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Contract : | LOGAN | STEL - J \& P | ARSDON |  |  |  | 0:09:35 |  |
| Site | URBAN | UTILITIES PU | ATIONS |  |  | htsman | CS |  |
| PHASE : | SP001 |  |  |  |  |  |  |  |
| Mark | No. | Section Size | Mass <br> (kg/m) | Grade | Length <br> (m) | Area $(\mathrm{m} 2)$ | Mass ( t ) | Cut Note |
| 1M11 | 1 | 200UB25 | 25.40 | 300+ | 1.944 | 1.807 | 0.049 |  |
| $1 \mathrm{M12}$ | 1 | 200 UB25 | 25.40 | 300+ | 3.373 | 3.131 | 0.086 |  |
| 1M13 | 1 | 200UB25 | 25.40 | 300+ | 3.250 | 3.017 | 0.082 |  |
| 1M14 | 1 | 200UB25 | 25.40 | 300+ | 3.346 | 3.106 | 0.085 |  |
| 1M15 | 1 | 200UB25 | 25.40 | 300+ | 3.266 | 3.032 | 0.083 |  |
| 1M17 | 1 | 200UB25 | 25.40 | 300+ | 1.034 | 0.964 | 0.026 |  |
| 1M19 | 1 | 200UB25 | 25.40 | 300+ | 1.944 | 1.807 | 0.049 |  |
| 1M20 | 1 | 200UB25 | 25.40 | 300+ | 1.034 | 0.964 | 0.026 |  |
| 1M24 | 1 | 200UB25 | 25.40 | 300+ | 2.269 | 2.108 | 0.058 |  |
| Totals for | 2001 | U25 |  | 9 | mbers | 19.938 | 0.544 |  |
| 1M01 | 1 | 200X75PFC | 22.90 | 300+ | 3.170 | 2.187 | 0.073 |  |
| 1M02 | 1 | 200X75PFC | 22.90 | 300+ | 3.373 | 2.326 | 0.077 |  |
| 1M04 | 1 | 200X75PFC | 22.90 | 300+ | 3.250 | 2.242 | 0.074 |  |
| 1M06 | 1 | 200X75PFC | 22.90 | 300+ | 3.373 | 2.326 | 0.077 |  |
| 1M07 | 1 | 200X75PFC | 22.90 | 300+ | 1.848 | 1.277 | 0.042 |  |
| 1M08 | 1 | 200X75PFC | 22.90 | 300+ | 3.250 | 2.242 | 0.074 |  |
| 1M09 | 1 | 200X75PFC | 22.90 | 300+ | 1.848 | 1.277 | 0.042 |  |
| 1M10 | 1 | 200X75PFC | 22.90 | 300+ | 3.170 | 2.187 | 0.073 |  |
| 1M18 | 2 | 200X75PFC | 22.90 | 300+ | 1.034 | 1.434 | 0.047 |  |
| 1M21 | 2 | 200X75PFC | 22.90 | 300+ | 3.266 | 4.506 | 0.150 |  |
| 1M25 | 1 | 200X75PFC | 22.90 | 300+ | 2.146 | 1.482 | 0.049 |  |
| 1M48 | 3 | 200X75PFC | 22.90 | 300+ | 1.081 | 2.248 | 0.074 |  |
| 11-PART | 2 | 200X75PFC | 22.90 | 300+ | 4.249 | 5.654 | 0.188 | BEV'D |
| 12-PART | 2 | 200X75PFC | 22.90 | 300+ | 0.243 | 0.294 | 0.009 | BEV'D |
| 13-PART | 1 | 200X75PFC | 22.90 | 300+ | 0.243 | 0.147 | 0.005 | BEV'D |
| 14-PART | 2 | 200X75PFC | 22.90 | 300+ | 4.249 | 5.654 | 0.188 | BEV'D |
| 37-PART | 1 | 200X75PFC | 22.90 | 300+ | 0.213 | 0.126 | 0.004 | BEV'D |
| Totals for | 200X | 75PFC |  | 24 | mbers | 37.609 | 1.247 |  |


| 1M26 | 1 | 90X6EA | 8.22 | 300+ | 1.887 | 0.661 | 0.015 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1M27 | 1 | 90X6EA | 8.22 | 300+ | 1.206 | 0.416 | 0.009 |
| 1M28 | 1 | 90X6EA | 8.22 | 300+ | 1.851 | 0.648 | 0.015 |
| 1M29 | 1 | 90X6EA | 8.22 | 300+ | 1.462 | 0.508 | 0.012 |
| 1M30 | 1 | 90X6EA | 8.22 | 300+ | 1.530 | 0.533 | 0.012 |
| 1M31 | 1 | 90X6EA | 8.22 | 300+ | 2.167 | 0.762 | 0.017 |
| 1M32 | 1 | 90X6EA | 8.22 | 300+ | 2.027 | 0.712 | 0.016 |
| 1M33 | 1 | 90X6EA | 8.22 | 300+ | 2.006 | 0.704 | 0.016 |
| 1M34 | 1 | 90X6EA | 8.22 | 300+ | 2.108 | 0.741 | 0.017 |
| Totals for | 90X | 6EA |  |  | Members | 5.687 | 0.129 |
| 1M22 | 2 | 65X6EA | 5.87 | 300+ | 1.034 | 0.511 | 0.011 |
| 1M23 | 2 | 65X6EA | 5.87 | 300+ | 3.266 | 1.672 | 0.038 |
| 1M35 | 1 | 65X6EA | 5.87 | 300+ | 2.146 | 0.545 | 0.012 |
| Totals for | 65X | 6EA |  |  | Members | 2.727 | 0.061 |
| 1M49 | 8 | 65X5EA | 4.56 | 300+ | 0.179 | 0.382 | 0.007 |
| Totals for | 65X | EA |  |  | Members | 0.382 | 0.007 |
| 1M03 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.586 | 1.515 | 0.070 |
| 1M05 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.563 | 1.501 | 0.070 |
| 1M16 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.531 | 1.483 | 0.069 |
| 1M36 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.868 | 1.679 | 0.078 |
| 1M37 | 2 | 150X6.0SHS | 26.20 | 300+ | 2.634 | 3.084 | 0.143 |
| 1M38 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.788 | 1.632 | 0.076 |
| 1M39 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.746 | 1.608 | 0.074 |
| 1M40 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.897 | 2.864 | 0.133 |

ICR Drafting Pty Ltd STRUCAD HOT-ROLLED MEMBER LIST Model : 1112018

| Client | $:$ LOGAN STEEL | Date | $: 02-04-12$ |
| :--- | :--- | :--- | :--- | :--- |
| Contract | $:$ LOGAN STEL J \& P RICHARSDON | Time | 10:09:35 |
| Site | $:$ URBAN UTILITIES PUMP STATIONS | Draughtsman | MCS |
| PHASE | $:$ SPO01 |  |  |


| Mark | No. | Section Size | $\begin{aligned} & \text { Mass } \\ & (\mathrm{kg} / \mathrm{m}) \end{aligned}$ | Grade | Length (m) | Area <br> (m2) | Mass <br> ( t ) | Cut Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1M41 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.897 | 2.864 | 0.133 | BEV ' ${ }^{\text {d }}$ |
| 1M42 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.987 | 2.917 | 0.135 | BEV'D |
| 1M43 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.987 | 2.917 | 0.135 | BEV'D |
| 1M44 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.897 | 2.864 | 0.133 | BEV'D |
| 1M45 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.987 | 2.917 | 0.135 | BEV'D |
| 1M46 | 1 | 150X6.0SHS | 26.20 | 300+ | 5.038 | 2.946 | 0.137 | BEV'D |
| 1M47 | 1 | 150X6.0SHS | 26.20 | 300+ | 5.038 | 2.946 | 0.137 | BEV'D |
| Totals for | 150 | X6.0SHS |  | 16 | mbers | 35.738 | 1.656 |  |
| 1M50 | 1 | 48X4.0CHS | 4.37 | 300+ | 4.000 | 0.573 | 0.017 |  |
| Totals for | 48X | 4.0CHS |  | 1 | embers | 0.573 | 0.017 |  |
| 01-PART | 19 | 48.3CHSSTAUNCHI | 5.56 | 300+ | 1.133 | 3.122 | 0.076 |  |
| 07-PART | 12 | 48.3CHSSTAUNCHI | 5.56 | 300+ | 0.952 | 1.622 | 0.040 | BEV ' ${ }^{\text {d }}$ |
| Totals for | 48. | 3CHSSTAUNCHION |  | 31 | embers | 4.744 | 0.116 |  |
| 02-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 6.842 | 0.859 | 0.021 | BEV'D |
| 03-PART | 11 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.502 | 0.643 | 0.016 | BEV'D |
| 04-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.187 | 0.021 | 0.001 | BEV'D |
| 05-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.502 | 0.059 | 0.001 | BEV'D |
| 09-PART | 4 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.346 | 0.166 | 0.004 | BEV'D |
| 10-PART | 5 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.346 | 0.207 | 0.005 | BEV'D |
| 15-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.838 | 0.104 | 0.003 | BEV'D |
| 16-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 1.637 | 0.204 | 0.005 | BEV'D |
| 19-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 3.605 | 0.450 | 0.011 | BEV'D |
| 23-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 5.643 | 0.707 | 0.017 | BEV'D |
| 26-PART | 3 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.120 | 0.044 | 0.001 | BEV'D |
| 30-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.187 | 0.021 | 0.001 | BEV'D |
| 32-PART | 4 | 42.4CHSTOPRAIL | 4.00 | 300+ | 4.441 | 2.234 | 0.054 | BEV'D |
| $33-\mathrm{PART}$ | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 1.921 | 0.238 | 0.006 | BEV'D |
| 35-PART | 4 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.517 | 0.234 | 0.006 | BEV'D |
| $36-\mathrm{PART}$ | 4 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.349 | 0.155 | 0.004 | BEV'D |
| 38-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 0.163 | 0.017 | 0.000 | BEV'D |
| 40-PART | 1 | 42.4CHSTOPRAIL | 4.00 | 300+ | 2.617 | 0.328 | 0.008 | BEV'D |
| Totals for | 42. | 4CHSTOPRAIL |  | 46 | embers | 6.693 | 0.163 |  |
| 06-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 1.738 | 0.172 | 0.004 |  |
| 08-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 6.500 | 0.643 | 0.016 |  |
| 17-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 0.831 | 0.082 | 0.002 |  |
| 18-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 1.471 | 0.146 | 0.004 |  |
| 20-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 3.263 | 0.323 | 0.008 |  |
| 24-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 5.301 | 0.525 | 0.013 |  |
| 31-PART | 3 | 33.7CHSMIDRAIL | 3.50 | 300+ | 0.123 | 0.036 | 0.001 | BEV'D |
| 34-PART | 4 | 33.7CHSMIDRAIL | 3.50 | 300+ | 4.178 | 1.652 | 0.040 | BEV'D |
| $39-\mathrm{PART}$ | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 0.157 | 0.014 | 0.000 | BEV'D |
| 41-PART | 1 | 33.7CHSMIDRAIL | 3.50 | 300+ | 2.451 | 0.243 | 0.006 |  |
| Totals for | 33. | 7CHSMIDRAIL |  | 15 | embers | 3.834 | 0.093 |  |
| 21-PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 0.881 | 0.188 | 0.004 |  |
| 22-PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 1.685 | 0.358 | 0.008 |  |
| 25-PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 2.032 | 0.432 | 0.010 |  |
| 27 -PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 3.721 | 0.790 | 0.018 |  |
| 28-PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 6.970 | 1.479 | 0.033 |  |
| 29-PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 5.759 | 1.222 | 0.027 |  |
| 42-PART | 1 | 100X6KICKPLATE | 4.71 | 300+ | 2.665 | 0.566 | 0.013 |  |



ICR Drafting Pty Ltd
PARTS LIST BY MARK
Model : 1112018

| Client | LOGAN | STEEL | Date | 02-04-12 |
| :---: | :---: | :---: | :---: | :---: |
| Contract | LOGAN | STEL - J \& P RICHARSDON | Time | 10:09:35 |
| Site | URBAN | UTILITIES PUMP STATIONS | Draughtsman | MCS |
| PHASE | SP001 |  |  |  |


| Mark | Qty | Section Size | $\begin{aligned} & \text { Mass } \\ & (\mathrm{kg} / \mathrm{m}) \end{aligned}$ | Grade | Length <br> (m) | Area (m2) | $\begin{array}{r} \text { Mass } \\ (\mathrm{t}) \end{array}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1G01 | 8 | A253MPG | 0.59 | 300+ | 1.257 | 20.080 | 0.211 |
| 1G02 | 1 | A253MPG | 0.59 | 300+ | 1.257 | 2.288 | 0.024 |
| 1G03 | 1 | A253MPG | 0.59 | 300+ | 1.257 | 2.463 | 0.026 |
| 1G04 | 1 | A253MPG | 0.59 | 300+ | 1.257 | 1.475 | 0.015 |
| 1G05 | 1 | A253MPG | 0.59 | 300+ | 1.257 | 2.242 | 0.024 |
| 1G06 | 1 | A253MPG | 0.59 | 300+ | 1.090 | 2.454 | 0.026 |
| 1G07 | 2 | A253MPG | 0.59 | 300+ | 0.639 | 2.667 | 0.028 |
| 1G08 | 1 | A253MPG | 0.59 | 300+ | 0.464 | 1.275 | 0.013 |
| 1G09 | 1 | A253MPG | 0.59 | 300+ | 0.639 | 1.285 | 0.013 |
| $1 \mathrm{G10}$ | 2 | A253MPG | 0.59 | 300+ | 1.139 | 4.571 | 0.048 |
| $1 \mathrm{G11}$ | 1 | A253MPG | 0.59 | 300+ | 1.139 | 2.035 | 0.021 |
| $1 \mathrm{G12}$ | 1 | A253MPG | 0.59 | 300+ | 1.232 | 2.415 | 0.025 |
| $1 \mathrm{G13}$ | 2 | A253MPG | 0.59 | 300+ | 1.232 | 4.927 | 0.052 |
| $1 \mathrm{G14}$ | 1 | A253MPG | 0.59 | 300+ | 1.232 | 2.415 | 0.025 |
| $1 \mathrm{G15}$ | 1 | A253MPG | 0.59 | 300+ | 1.257 | 0.810 | 0.008 |
| $1 \mathrm{G16}$ | 28 | T4A253MPG | 0.59 | 300+ | 0.640 | 11.011 | 0.130 |
| 1M01 | 1 | 200X75PFC | 22.90 | 300+ | 3.170 | 2.187 | 0.073 |
| 1M02 | 1 | 200X75PFC | 22.90 | 300+ | 3.373 | 2.603 | 0.087 |
| 1M03 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.586 | 1.854 | 0.087 |
| 1M04 | 1 | 200X75PFC | 22.90 | 300+ | 3.250 | 2.316 | 0.077 |
| 1M05 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.563 | 1.848 | 0.086 |
| 1M06 | 1 | 200X75PFC | 22.90 | 300+ | 3.373 | 2.472 | 0.082 |
| 1M07 | 1 | 200X75PFC | 22.90 | 300+ | 1.848 | 1.277 | 0.042 |
| 1M08 | 1 | 200X75PFC | 22.90 | 300+ | 3.250 | 2.570 | 0.086 |
| 1M09 | 1 | 200X75PFC | 22.90 | 300+ | 1.848 | 1.277 | 0.042 |
| 1M10 | 1 | 200X75PFC | 22.90 | 300+ | 3.170 | 2.401 | 0.080 |
| 1M11 | 1 | 200UB25 | 25.40 | 300+ | 1.944 | 1.860 | 0.051 |
| 1M12 | 1 | 200UB25 | 25.40 | 300+ | 3.373 | 3.791 | 0.108 |
| 1M13 | 1 | 200UB25 | 25.40 | 300+ | 3.250 | 3.582 | 0.102 |
| 1M14 | 1 | 200UB25 | 25.40 | 300+ | 3.346 | 3.336 | 0.093 |
| 1M15 | 1 | 200UB25 | 25.40 | 300+ | 3.266 | 3.074 | 0.084 |
| 1M16 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.531 | 1.822 | 0.085 |
| 1M17 | 1 | 200UB25 | 25.40 | 300+ | 1.034 | 1.071 | 0.029 |
| 1M18 | 2 | 200X75PFC | 22.90 | 300+ | 1.034 | 1.434 | 0.047 |

ICR Drafting Pty Ltd
PARTS LIST BY MARK
Model : 1112018

| Client | $\vdots$ LOGAN STEEL | Date | 02-04-12 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Contract | $:$ LOGAN STEL J \& P RICHARSDON | Time | 10:09:35 |
| Site | $\vdots$ URBAN UTILITIES PUMP STATIONS | Draughtsman | MCS |
| PHASE | $:$ SP001 |  |  |


| Mark | Qty | Section Size | $\begin{aligned} & \text { Mass } \\ & (\mathrm{kg} / \mathrm{m}) \end{aligned}$ | Grade | Length (m) | $\begin{aligned} & \text { Area } \\ & \text { (m2) } \end{aligned}$ | Mass <br> ( t ) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1M19 | 1 | 200UB25 | 25.40 | 300+ | 1.944 | 1.860 | 0.051 |
| 1M20 | 1 | 200UB25 | 25.40 | 300+ | 1.034 | 1.071 | 0.029 |
| 1M21 | 2 | 200X75PFC | 22.90 | 300+ | 3.266 | 4.506 | 0.150 |
| 1M22 | 2 | 65X6EA | 5.87 | 300+ | 1.034 | 0.511 | 0.011 |
| 1 M 23 | 2 | 65X6EA | 5.87 | 300+ | 3.266 | 1.672 | 0.038 |
| 1M24 | 1 | 200UB25 | 25.40 | 300+ | 2.269 | 2.469 | 0.070 |
| 1M25 | 1 | 200X75PFC | 22.90 | 300+ | 2.146 | 1.482 | 0.049 |
| 1M26 | 1 | 90X6EA | 8.22 | 300+ | 1.887 | 0.661 | 0.015 |
| 1M27 | 1 | 90X6EA | 8.22 | 300+ | 1.206 | 0.416 | 0.009 |
| 1M28 | 1 | 90X6EA | 8.22 | 300+ | 1.851 | 0.648 | 0.015 |
| 1M29 | 1 | 90X6EA | 8.22 | 300+ | 1.462 | 0.508 | 0.012 |
| 1M30 | 1 | 90X6EA | 8.22 | 300+ | 1.530 | 0.533 | 0.012 |
| 1M31 | 1 | 90X6EA | 8.22 | 300+ | 2.167 | 0.762 | 0.017 |
| 1M32 | 1 | 90X6EA | 8.22 | 300+ | 2.027 | 0.712 | 0.016 |
| 1M33 | 1 | 90X6EA | 8.22 | 300+ | 2.006 | 0.704 | 0.016 |
| 1M34 | 1 | 90X6EA | 8.22 | 300+ | 2.108 | 0.741 | 0.017 |
| 1M35 | 1 | 65X6EA | 5.87 | 300+ | 2.146 | 0.545 | 0.012 |
| 1M36 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.868 | 1.877 | 0.084 |
| 1M37 | 2 | 150X6.0SHS | 26.20 | 300+ | 2.634 | 3.480 | 0.156 |
| 1M38 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.788 | 1.830 | 0.082 |
| 1M39 | 1 | 150X6.0SHS | 26.20 | 300+ | 2.746 | 1.805 | 0.081 |
| 1M40 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.897 | 3.297 | 0.152 |
| 1M41 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.897 | 3.430 | 0.156 |
| 1 M 42 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.987 | 3.289 | 0.153 |
| 1M43 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.987 | 3.530 | 0.161 |
| 1M44 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.897 | 3.431 | 0.157 |
| 1M45 | 1 | 150X6.0SHS | 26.20 | 300+ | 4.987 | 3.474 | 0.159 |
| 1M46 | 1 | 150X6.0SHS | 26.20 | 300+ | 5.038 | 3.499 | 0.160 |
| 1M47 | 1 | 150X6.0SHS | 26.20 | 300+ | 5.038 | 3.509 | 0.161 |
| 1M48 | 3 | 200X75PFC | 22.90 | 300+ | 1.081 | 2.647 | 0.088 |
| 1M49 | 8 | 65X5EA | 4.56 | 300+ | 0.179 | 0.441 | 0.008 |
| 1M50 | 1 | 48X4.0CHS | 4.37 | 300+ | 4.000 | 0.630 | 0.019 |
| AS-12 | 1 | 42.4CHSTOPRA | 4.00 | 300+ | 0.838 | 0.835 | 0.020 |




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## 6. QUU Drawings AS INSTALLED
























## 7. Spray Coating

## certificate of <br> This is to certify that the management systems of <br> Construct Environmental

have been formally assessed by International Certifications and found to comply with the requirements of

## AS/NZS 4801:2001

Occupational Health \& Safety Management Systems - Specifications with guidance for use

## Scope of Registration:

Asset Rehabilitation associated with the mining, water and sewerage, civil construction, hydro electrical, tanking and marine sectors including rehabilitation and protection of various substrates including steel, timber and concrete.

## Registered Site(s):

32 Cessna Drive, Caboolture , QLD , 4510, Australia
 New Zealand (www.jas-anz.org/register). This certificate remains the property of International Certifications Limited and must be returned upon request. It must not be altered or defaced in any way and deliberate misuse of the certificate will result
Active: $05 / 11 / 2015$

## certifícate of <br> This is to certify that the management systems of <br> Construct Environmental

have been formally assessed by International Certifications and found to comply with the requirements of

## Eco Warranty:2010

Environmental Management Systems - Requirements

03 Jun 2011
Issue Date

11 May 2014
Expiry Date

D. L. Evans

Managing Director International Certifications Ltd


## Scope of Registration:

Asset Rehabilitation associated with the mining, water and sewerage, civil construction, hydro electrical, tanking and marine sectors including rehabilitation and protection of various substrates including steel, timber and concrete

## Registered Site(s):

32 Cessna Drive , Caboolture, QLD , 4510, Australia


This certificate is issued by International Certifications Limited, 138 Harris Road, East Tamaki, Auckland, New Zealand, 2141 (www.intlcert.com). This certificate remains the property of International Certifications Limited and must be returned upon request. It must not be altered or defaced in any way and deliberate misuse of the certificate will result in cancellation without notification.

## certificate of <br> This is to certify that the management systems of <br> Construct Environmental

have been formally assessed by International Certifications and found to comply with the requirements of

## ISO 9001:2008

Quality Management Systems - Requirements

03 Jun 2011
Issue Date

11 May 2014
Expiry Date

D. L. Evans

Managing Director International Certifications Ltd


## Scope of Registration:

Asset Rehabilitation associated with the mining, water and sewerage, civil construction, hydro electrical, tanking and marine sectors including rehabilitation and protection of various substrates including steel, timber and concrete.

## Registered Site(s):

32 Cessna Drive , Caboolture , QLD , 4510, Australia


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This is to certify that the management systems of

## Construct Environmental

have been formally assessed by International Certifications and found to comply with the requirements of

## ISO 14001:2004

Environmental Management Systems - Requirements with guidance for use

03 Jun 2011
Issue Date

11 May 2014
Expiry Date

D. L. Evans

Managing Director International Certifications Ltd


## Scope of Registration:

Asset Rehabilitation associated with the mining, water and sewerage, civil construction, hydro electrical, tanking and marine sectors including rehabilitation and protection of various substrates including steel, timber and concrete.

## Registered Site(s):

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## certificate of

This is to certify that the management systems of

## Construct Environmental

have been formally assessed by International Certifications and found to comply with the requirements of

## OHSAS 18001:2007

Occupational Health \& Safety Management Systems - Requirements

03 Jun 2011
Issue Date

11 May 2014
Expiry Date

D. L. Evans

Managing Director International Certifications Ltd


## Scope of Registration:

Asset Rehabilitation associated with the mining, water and sewerage, civil construction, hydro electrical, tanking and marine sectors including rehabilitation and protection of various substrates including steel, timber and concrete.

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Active: $05 / 11 / 2015$

# 5prayWal/ 

spray-applied polyurethane for structural rehabilitation, infiltration control, corrosion management and peace of mind
. . .the gold standard

## TYPICAL USES

SprayWall is ideally designed for applications on surfaces that are exposed to acids, corrosives and other caustic elements.

Some of the structures include:

## - Manholes

- Lift Stations
- Wet Wells
- Tanks
- Grit Chambers
- Clarifiers
- Digesters
- Junction Boxes
- Pipelines (Man Entry Only)
- Tunnels
- Secondary Containment
- Lagoons

DESCRIPTION
SprayWall is a $100 \%$ VOC-free self-priming polyurethane coating which reinstates structural integrity, provides infiltration control and chemical resistance for concrete, steel, masonry, fiberglass and other surfaces.

Developed for use in ambient operating conditions up to $140^{\circ} \mathrm{F} / 60^{\circ} \mathrm{C}$, SprayWall is a tough, corrosion and abrasion resistant coating that can be spray applied at any desired thickness in a single mobilization.

Spraywall's quick curing time allows the newly protected structure to be returned to service immediately after the application is completed.

## COLOR

Gold is the standard product color. SprayWall's color is derived from the natural coloration of our raw materials.

## SOLIDS BY VOLUME \& VOC'S <br> 100\% VOC (Volatile Organic Compounds) Free

## COVERAGE

16 square feet per gallon at $1 / 10^{\prime \prime}(100$ mil) thickness. .4 square meters per liter at 2.5 mm thickness.

## APPLICATION METHOD

SprayWall is applied by utilizing a proprietary heated plural component spray system. Complete integrated spray system information is available by contacting Sprayroq technical support.

## SURFACE TEMPERATURE

$55^{\circ} \mathrm{F} / 13^{\circ} \mathrm{C}$ minimum recommended
$122^{\circ} \mathrm{F} / 50^{\circ} \mathrm{C}$ maximum recommended for optimum protection

## CURE \& RECOAT TIME

After the $A$ and $B$ components are mixed, SprayWall begins to gel in about 8 seconds, with a tack free condition after one minute. Within 30 minutes, the initial cure is completed and the structure is capable of accepting flow while the complete curing continues for the next 4-6 hours.

SprayWall may be applied up to 500 mils $\left(1 / 2^{\prime \prime} / 13 \mathrm{~mm}\right)$ thick in a single application.

Note: If several coats are applied, no more than 1 hour should be allowed between coat applications. Surfaces should be cleaned thoroughly to remove any contaminants between coats. In addition, all precaution should be taken to protect the application surfaces between coats.


Biobased ${ }^{*}$ Content 0\%
*Biobased Content
Biobased percentage is defined by the amount of biobased, recycled or renewable source materials contained in the finished manufactured spray-applied product


## PREPARATION

Surfaces to be treated must be cleaned of all oil, grease, rust, scale, deposits and other debris or contaminants. All resins, including SprayWall, require a clean and dry substrate for optimal technical performance of the product.

## STEEL

Solvent Cleaning (SSPC-SP1) may be necessary for steel. Surfaces to be coated should be prepared in accordance with SSPC-SP10 or NACE No.2: "Near White Blast Cleaning".

When applicable, an alternate procedure may be employed using high ( $>5,000 \mathrm{psi} />34.5 \mathrm{MPa}$ ) or ultrahigh ( $>10,000 \mathrm{psi} />69.0 \mathrm{MPa}$ ) pressure water cleaning or water with sand injection and approved rust inhibitors. The surface profile must be a minimum of 2 mils $/ 0.05 \mathrm{~mm}$.

## CONCRETE AND MASONRY

Low (2,500-3,000 psi / 17.2-20.7 MPa) to high ( $>5,000 \mathrm{psi} />34.5 \mathrm{MPa}$ ) pressure water cleaning, shot blasting, abrasive blasting or combination acid etching and water cleaning can be used to prepare these surfaces.

## FIBERGLASS

Prepare fiberglass by rinsing, neutralizing, scarifying and cleaning with water or a mixture of water and solvent. Be sure that all dust and loose particles are removed. The surface should be thoroughly dry before application of SprayWall.

## PACKAGING

SprayWall is sold exclusively to Sprayroq Certified Partners in $1,500 \mathrm{lb} . / 680.4 \mathrm{~kg}$ sets of material.

COMPONENTS \& MIX RATIO
Part A, Resin.
Part B, Hardener.
$.65: 1.00$ by volume

## SHELF LIFE \& STORAGE

Shelf Life: 1 year in sealed, unmixed containers at $60^{\circ} \mathrm{F} / 15^{\circ} \mathrm{C}$. Store in a sheltered area between $60^{\circ} \mathrm{F}$ and $85^{\circ} \mathrm{F} / 15^{\circ} \mathrm{C}$ and $30^{\circ} \mathrm{C}$.

## SAFETY

Consult the Material Safety Data Sheet for this product concerning health and safety information before using. Strictly follow all notices on the Material Safety Data Sheet and container label. If you do not fully understand the notices and procedures provided or if you cannot strictly comply with them, do not use this product. Actual safety measures are dependent on application methods and work environment. Contact Sprayroq to obtain a copy of the Material Safety Data Sheet at 205-957-0020.

## WARRANTY AND DISCLAIMER

As best determined, the technical data represented for all Sprayroq products is deemed to be accurate. All products are to be applied by trained and approved Sprayroq Certified Partners only and in strict accordance with the directions for usage and installation of the Sprayroq product.

Sprayroq guarantees the products to conform to the quality assurance procedures established by Sprayroq and its resin blending partners. We assume no responsibility for coverage, performance or injuries resulting from the use of our products.

Liability, if any, is limited to the replacement of the product for a period of three years from the date of application only. Sprayroq is not responsible for any treble expenses, liquidated damages or related labor expenses stemming from the use of this product. No other warranty is made by Sprayroq, expressed or implied, statutory or by operation of the law, including merchantability and fitness for a particular purpose.

## SprayWaII <br> PERFORMANCE TESTING

## ABOUT SPRAYROQ

Sprayroq ${ }^{\oplus}$, Inc. develops specialized protective lining systems for a variety of ever increasing markets and applications worldwide.

Established water and wastewater markets for our products include: municipal, industrial, telecommunication, chemical plants, paper mills refineries, electrical and power generation customers.

Sprayroq, Inc. partners with contractors worldwide to promote and install our protective coating and lining systems. Sprayroq Certified Partners are licensed, trained and supported by Sprayroq operations, technical and marketing staff to efficiently and successfully operate in specific geographic territories.

PO Box 101717 • 4707 Alton Court • Birmingham, AL 35210 USA 205.957.0020 $\cdot 205.957 .0021$ (f) • Toll Free in USA 800.634.0504

## Process Specification

## Structural Rehabilitation \& Corrosion Protection for Circular Structures in Wastewater Collection Systems and Potable Water Systems

## SECTION 1: GENERAL

### 1.01 DESCRIPTION

This specification includes all work, materials and equipment required for the structural rehabilitation of circular structures. The purpose is to eliminate infiltration, repair voids, restore structural integrity and provide corrosion protection by the application of a spray-applied monolithic resin liner to the wall and bench surfaces of brick/concrete structures or structures produced with any other masonry construction material. These structures include, but are not limited to manholes, wet wells, lift stations and pump stations.

### 1.02 QUALITY ASSURANCE

A. Furnish materials of quality required by the American Society for Testing and Materials (ASTM) standards or other approved standards and specifications.
B. Provide guarantee against defective materials and workmanship in accordance with the requirements of these specifications.
C. The contractor installing the finished protective liner will be a certified trained applicator of the specified process.
D. Provide verifiable independent third party creep test results documenting no less than $70 \%$ retention of flexural modulus of elasticity after 50 years of service. The third party testing firm may not be affiliated with the manufacturer in any way.

### 1.03 REFERENCES

American Society for Testing and Materials (ASTM) Annual Book of Standards:
A. ASTM D638-91: Test Method for Tensile Properties of Plastics.
B. ASTM D790-91: Test Methods for Flexural Properties of Unreinforced and reinforced Plastics and Electrical Insulating Materials.

### 1.04 PROJECT/SITE CONDITIONS

Co-ordinate with the Construction Manager for traffic control during rehabilitation work at each designated location.

### 1.05 SEQUENCING

All required interruptions of flow through manholes, wet wells, pump stations or any other
portion of the plant sanitary sewer system shall be coordinated with and approval received from the Facility Manager or Construction Manager prior to the interruption.

## SECTION 2: PRODUCTS

### 2.01 MATERIALS

## I. Infiltration Control mix:

A. Minor Infiltration.

## 1. Cementicious Grout (De Neef Industrial Products)

A rapid-setting cementitious grout or chemical grout specifically formulated for leak control should be used to stop minor water infiltration. It should be mixed and applied according to the manufacturer's recommendations and should meet the following minimum requirements.

| Compressive strength | ASTM C 109 | $1,800 \mathrm{psi} @ 1 / 2 \mathrm{hr}$ <br> $4,000 \mathrm{psi} @ 24 \mathrm{hrs}$ <br> $5,000 \mathrm{psi} @ 7$ days |
| :--- | :--- | :--- |
| Tensile strength | ASTM C 190 | $300 \mathrm{psi} @ 7$ days |
|  |  | $350 \mathrm{psi} @ 28$ days |

## B. Very Active Infiltration

## 1. Chemical Grout (De Neef Industrial Chemicals)

a. A chemical grout must be used for stopping very active infiltration, filling voids and should be mixed and applied according to manufacturer's recommendations. The cementitious grout should be volume stable having a minimum 1 day compressive strength of 50 psi and a 28 day compressive strength of 250 psi .
b. Chemical grouts can be used for stopping very active infiltration and should be mixed and applied per manufacturer's recommendations.

## II. Patching and profiling mix:

A. Cementicious Compound (Strong Seal or equivalent product)

A quick setting cementitious material can be used to bring the substrate to profile by filling voids, cracks, missing mortar and other substrate defects. It should be mixed and applied according to the manufacturer's recommendations and should meet the following minimum requirements.

| Compressive strength | ASTM C 109 | $1000 \mathrm{psi} @$ 1 hr <br> 3500 psi @ 48 hrs <br> $5000 \mathrm{psi} @ 28$ days |
| :--- | :--- | :--- |
| Tensile strength | ASTM C 307 | $200 \mathrm{psi} @ 24$ hrs <br> $300 \mathrm{psi} @$ days |

## III. Resin Based Liner:

A. The resin based material shall be used to form the sprayed on/structural enhanced monolithic liner covering all interior surfaces of the structure including benches and inverts of manholes. The finished liner shall be SprayWall® as manufactured by Sprayroq, Inc. or approved equal and conform to the minimum physical requirements listed below.

| Compressive strength | ASTM D 695 | $10,500 \mathrm{psi}$ |
| :--- | :--- | :--- |
| Tensile strength | ASTM D 638 | $7,000 \mathrm{psi}$ |
| Flexural strength | ASTM D 790 | $12,000 \mathrm{psi}$ |
| Bond |  | Shall exceed tensile strength of substrate |
| Flexural modulus (initial) | ASTM D 790 | $735,000 \mathrm{psi}$ |
| Density |  | $87 \pm \mathrm{pcf}$ |

a. The finished structure shall be corrosion resistant to: Hydrogen Sulfide; $20 \%$ sulfuric Acid; 17\% Nitric Acid; 5\% Sodium Hydroxide; road salts for winter conditions as well as other common ingredients of the sanitary sewage environment.
b. The wall of the resin based liner will be structurally designed to withstand the hydraulic load generated by the groundwater table \& restore structural integrity. The long term ( 50 yr .) value of the flexural modulus of elasticity will be a minimum of $500,000 \mathrm{psi}$ and is an integral part of the engineering equation used to design the wall thickness of the structural liner.

For this reason the value of the long term flexural modulus of the proposed product will be certified by an independent, third party testing lab and submitted with the design calculations for each individual structure.

Definition- Long term value will be identified as initial flexural modulus less the reduction in value caused by Creep over a fifty (50) year minimum period and verified by DMA testing.
B. Other Materials: Because of the advantages associated with rapid cure and infinite thickness capabilities, no resin based materials other than polyurethane shall be used to achieve the structural enhancement without prior approval of the Construction Manager.

## SECTION 3: EXECUTION

### 3.01 INSPECTION

A. Evaluation of Atmosphere: Prior to entering structures, an evaluation of the atmosphere will be conducted to determine the presence of toxic, flammable vapors or possible lack of oxygen. The evaluation shall be in accordance with local, state or federal safety regulations.
3.02 PREPARATION
A. Place covers over all pipe openings to prevent extraneous material from entering the sewer system. All foreign material shall be removed from the structures' wall and bench/floor using a pressure water spray (minimum 2500 psi ). The use of acid for cleaning purposes, no matter how dilute, will not be allowed. Loose or protruding brick, mortar and concrete shall be removed by using a mason's hammer and chisel. Fill any large voids with quick setting patch mix as described in Paragraph (2.01 IIA). The surface to be repaired must be clean and free of any loose materials.
B. Minor leaks shall be stopped using the quick-setting specially formulated infiltration control mix (paragraph 2.01 IA ) and shall be mixed and applied per manufacturer's recommendations. When severe infiltration is present, drilling may be required in order to pressure grout outside the structure using either a cementitious or chemical grout (paragraph 2.01 IB ). Manufacturer's recommendations shall be followed when pressure grouting is required.

### 3.03 <br> INSTALLATION/APPLICATION

A. Application Temperatures: Application of liner shall not be made unless the ambient temperature inside the structure is 50 degrees or higher.
B. Bench/Invert Repair:

1. The manhole bench must be sprayed but depending on availability and future plans, some judgment consideration will have to be made regarding the invert. Important issue here is the necessity to insure a monolithic system is achieved.
2. After blocking flow through the structure and thorough cleaning/preparatory work has been achieved. The sprayed on resin-based liner shall be applied to the invert, bench and wall areas in the same manner as specified for the liner application below. The spray shall be applied such that the entire structure receives a structurally enhanced monolithic liner.
3. The finished invert surfaces shall be smooth, free of ridges and will be sloped in the direction of flow. Special care shall be used to insure a smooth transition between the new manhole invert and intersecting pipeline inverts such that flow will not be impaired.
C. Liner Application: The resin based liner shall be manually sprayed on to all surfaces by a trained technician who is experienced in the application of a spray applied resin and has been certified by the manufacturer. Appropriate personal protection equipment shall be utilized but in every case when applying the liner, the sprayer and personnel in direct contact with the spray atmosphere, will always be protected by supplied air.

The minimum thickness of the material applied is to be no less than 250 mils ( $1 / 4$ ") in order to support structural integrity. No other products such as cement or grouts may be used as part of the structural reinstatement, however, said products may be used as part of the repair process prior to sprayed application of the structure as specified in 2.01 IIA.

Application of the spray applied material must be completed in one (1) mobilization in order to minimize the disruption and cost of excessive bypassing, pipeline plugging, traffic control and all other support services.

The finished manhole must be returned to full service immediately after the spray
application is complete.
D. Curing: The structure should be allowed to cure for 24 hours and return to ambient temperature prior to any physical testing, including vacuum testing.

FIELD QUALITY CONTROL
A. The following test/inspection will be performed by the Construction Manager.

1. Visually verify the absence of leaks from infiltration.
B. The following tests shall be performed by the Contractor.
2. Vacuum Test: A vacuum test conforming to the requirements of ASTM C1244 shall be performed for every lined manhole or circular structure where practical.

## Construct Envionmental

Document: QUU12-04

Queensland Urban Utilities<br>Level 6, Brisbane Transit Centre<br>171 Roma Street<br>Brisbane

To Whom It May Concern:
RE : WARRANTY ON SPRAYWALL COATING FOR IPSWICH PUMP WELLS -SP01- Old Toowoomba Road, SP33-McAuliffe Street and SP34-Brisbane Road.HALLCO ENGINEERING.

Please accept this letter as confirmation that we are happy to extend the warranty to a total of ten (10) years, on the coating of the pump wells through Ipswich.

As licensed applicators of Sprayroq, our staff have been extensively trained in the preparation and coating of various projects including pump stations. Strict conditions are contained in our contract with Sprayroq to ensure projects are completed in the manner specified by Sprayroq.

These requirements, coupled with the quality of the Spraywall product, and our International Certifications for Quality, WPH\&S and Environment offer our clients the highest level of comfort that they are receiving the best available service in their coatings contractor.

Sprayroq, offers a three (3) year warranty as a standard and we, Construct Environmental Pty Ltd are happy to extend that warranty to ten years based on a number of conditions -

1/ The coating supplied will be monolithic, in that it will be one coating, unbroken throughout the pump well. Should penetrations be required postproject, Construct Environmental must be employed to "make good" the area after the penetration is complete.

The overall effectiveness of the coating is based on a number of crucial factors, one of which is that there are no areas where gas/acid can gain access to the protected substrate behind the coating.

2/ The pump station will be used day to day to collect and deliver sewerage and all the chemicals etc which can be reasonably expected.

The Spraywall product has been proven in test conditions and in completed projects to resist the chemicals generally and reasonably found in sewer.

Any abnormally high level of chemical/s (not generally or reasonably found in sewerage) should be made known to Construct Environmental who may decide to complete an inspection of the coating to ensure its longevity.

As part of our standard procedure, Construct Environmental completes an inspection of all of the projects completed after the first year and then after three years. These inspections are designed to ensure we identify, address any issues as soon as possible.

In this case, we will conduct inspections at 1 year, 3 years, five years and ten years.

Spraywall has been life tested in these conditions. The results show, after 50 years exposed to the environmental and chemical conditions found in a sewer system, a loss of just $27 \%$ of its physical properties is the resultant.

It is with this in mind that I have no hesitation in complying with the requested extension of the warranty.

I trust that this document provides the satisfaction you require. Please feel free to contact me regarding this matter at any time.

Kind Regards,
Dave Turnbull
Managing Director

## Construct Emironmental

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# Construct fuvionmental 

| Business: | Construct Environmental Pty Ltd |
| :---: | :---: |
| Project Designation: |  |
| Jurisdiction: | All |
| System: | Quality, Health, Safety and Environmental Management System |
| Sub-System: | Operational Risk Management |
| Sub-System Reference: | 4.4.6 |
| Revision Number: | 6 |
| Document Owner: | Construct Environmental Directors Group or their nominated representative |
|  | If the document manifests in application to a Project, the most senior manager appointed to the Project |
| Approved: | Directors of Construct Environmental |
| Date Approved: | 13 ${ }^{\text {th }}$ September 2012 |
| Sub-System Purpose: | This QHSEMS Sub-System seeks to ensure that the Business and / or its Projects have an ongoing methodology for managing risk. |
|  | Furthermore, this QHSEMS Sub-System seeks to provide processes to ensure product realisation. |
| Sub-System Specification: | This QHSEMS Sub-System is to: |
|  | - Provide for a process of documenting work methodology <br> - Provide for standards to be embedded into work methodology |
|  | - Provide for a process to continually identify emerging quality, health, safety and environmental management risk. |
|  | Furthermore, this QHSEMS Sub-System is to: |
|  | - Provide for processes that determine: |
|  | - Requirements specified by the customer, including the requirements for delivery and post-delivery activities |
|  | - Requirements not stated by the customer but necessary for specified or intended use, where known and intended use |
|  | - Statutory and regulatory requirements applicable to the product delivery |

- Provide for processes to ensure a review is conducted prior to the commitment to supply a product to the customer
- Provide for processes that determine and implement effective arrangements for communicating with customers
- Provides for processes to ensure that purchased product conforms to specified purchase requirements to the extent of the control applied to the supplier and the purchased product dependent upon the effect of the purchased product on subsequent product realisation or the final product.
- Provides for processes to ensure that purchasing information describes the product to be purchased
- Provide for the inspection or other activities necessary for ensuring that purchased product meets specified purchase requirements.
- Provide for processes to ensure planning and carrying out of production are under controlled conditions
- Provides for processes to validate product where the resulting output cannot be verified by subsequent monitoring or measurement and as a consequence deficiencies become apparent only after the product is in use or the service has been delivered
- Provide for processes to identify the product by suitable means throughout product realisation
- Provide for processes to ensure the identification, verification, protection and safeguard of customer property provided for use or incorporation into the product
- Provide for the preservation of the product during internal processing and delivery to the intended destination in order to maintain conformity to requirements.
- Provide for processes to determine the monitoring and measurement to be undertaken and the monitoring and measuring equipment needed to provide evidence of conformity of product to determined requirements
- Provide for processes to ensure that monitoring and measurement can be carried out and are carried out in a manner that is consistent with monitoring and measurement requirements.

Sub-System Scope:
This QHSEMS Sub-System applies to:

- All workplaces over which the Business and /or its Projects has control or partial control
- All operations over which the Business and /or its Projects has control or partial control
- Everyone who may affect the health or safety of persons and / or the environment and / or product realisation
while the persons are at a workplace over which the Business and /or its Projects has control or partial control
- Everyone who may affect the health or safety of persons and / or the environment and / or product realisation as a result of involvement in operations over which the Business and /or its Projects has control or partial control
- A person whose health or safety may be affected while at a workplace over which the Business and /or its Projects has control or partial control
- Where applicable, an environment that may be affected by the Business and / or its Projects in circumstances where the Business and /or its Projects has control or partial control over that environment
- Where applicable, a product that may be affected by the Business and / or its Projects in circumstances where the Business and /or its Projects has control or partial control over that products realisation.

This QHSEMS Sub-System or parts thereof apply to a Project in circumstances where it does not manifest specifically as part of a Project Quality, Health, Safety and Environmental Management System whether integrated or otherwise.
This QHSEMS Sub-System or parts thereof do not apply in the circumstances detailed above in the event that there is statutory requirement that another Quality, Health, Safety and Environmental Management System or parts thereof is imposed upon a party to which this Quality, Health, Safety and Environmental Management System would have applied in any other circumstance.

This QHSEMS Sub-System or parts thereof do not apply in circumstances detailed above in the event that there is a statutory requirement in the legal jurisdiction in which the QHSEMS SubSystem is being applied that is contrary to the content of the QHSEMS Sub-System or parts thereof. In this case the statutory requirement applies.

## Reference Material:

This QHSEMS Sub-System is intrinsically linked to other QHSEMS Sub-Systems as referenced.

Where provided for, reference material associated with the operation of this QHSEMS Sub-System is located in the Technical Library including the following material:

- Legislation and subordinate legislation (Regulation) applicable to the legal jurisdiction in which this QHSEMS Sub-System is applied
- Codes of Practice / Recognised Standards published by a statutory body applicable to the legal jurisdiction in which this QHSEMS Sub-System is applied
- Other material published by government, industry and union bodies whether published in the legal jurisdiction in which this QHSEMS Sub-System is applied or otherwise
- International and National Standards
- Other selected technical guidance including case law.

| Responsibilities: | Responsibilities articulated in this QHSEMS Sub-System are in <br> addition to those detailed in the QHSEMS Sub-System 4.4.1 <br> Structure and Responsibilities. |
| :--- | :--- |
| Definitions: | Common definitions are detailed in QHSEMS Sub System 4.1 <br> Quality, Health, Safety and Environmental Management System <br> Guide. |
| In this QHSEMS Sub-System, product means a material, product, |  |
| item or good supplied as standard or fabricated/manufactured but |  |
| may also mean a service when such a definition makes sense when |  |
| placed into context. |  |$\quad$| 4.4.6.F1 Form - Method Statement / Work Procedure Template |
| :--- |
| Registers and Forms: |
| 4.4.6.F2 Form - Inspection and Test Plan Template |
| 4.4.6.R1 Register - Approved Methods / Work Procedures |


| Record of Amendment |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Ser | Revision Number | Date Amended | Author | Amendment Type | Approved |
| 1 | A | 28 February 2011 | A. Harrod | Initial Draft | NA |
| 2 | 0 | 31 March 2011 | A. Harrod | Initial Issue | D. Cook <br> M. Johnson |
| 3 | 1 | 20 April 2011 | A. Rowden | Proof Read | D. Cook |
| 4 | 2 | 20 June 2011 | A. Harrod | Technical Review | D. Cook |
| 5 | 3 | 19 July 2011 | A. Harrod | Reformat | D. Cook <br> M. Johnson |
| 6 | 4 | 10 August 2011 | A. Harrod | Technical Review | D. Cook <br> M. Johnson |
| 7 | 5 | 24 October 2011 | A. Harrod | Review for International Version | D. Cook <br> M. Johnson |
| 8 | 6 | $\begin{gathered} 13^{\text {th }} \text { September } \\ 2012 \end{gathered}$ | D Turnbull | Review for Construct Environmental | D Turnbull |

### 1.0 Technical Library

Identification of standards of good practice associated with managing risk applicable to the activities of the Business and / or its Projects requires a degree of knowledge of the documents that articulate that practice.

Those documents may include the following:

- Legislation and subordinate legislation (Regulation)
- Codes of Practice / Recognised Standards published by a statutory body
- Other material published by government, industry and union bodies
- International and / or National Standards
- Other selected technical guidance including case law.

The repository for these documents (where provided for) is the Technical Library.
Furthermore, the Technical Library is to be used as a repository for a range documents detailing practices that have been used throughout the Business and / or its Projects in order that other users in similar circumstances can reference and use them. These documents are to include:

- A QHSEMS as it manifests in application to a Project
- Any document articulating a work methodology such as work procedures, method statements, standard operating procedures, Inspection and Test Plans and Quality Plans
- Risk assessments of significance such as Project broad-brush risk identification and assessment
- Quality, Health, Safety and Environmental Management Alerts.

The Group Systems Manager is responsible for the structure and content of the Technical Library and is to ensure that it reflects the contexts in which the Business and / or its Projects executes its undertakings.

The Group Systems Manager is responsible for the currency of the Technical Library. The Group Systems Manager is to use all possible means reasonably available to ensure currency including, but not limited to:

- Subscription to publishers of the material
- Monitoring of web sites associated with the publishers of the material
- Consultation with statutory bodies
- Consultation with stakeholders.

The most senior manager appointed to a Project or their nominated representative, must, as a minimum, forward the following documents generated by the Project to the Group Systems Manager for deposit into the Technical Library:

- The QHSEMS as it manifests in application to the Project
- Any document articulating a work methodology such as work procedures, method statements and standard operating procedures
- Risk assessments of significance such as Project broad-brush risk identification and assessment
- Quality, Health, Safety and Environmental Management Alerts.

The most senior manager appointed to a Project or their nominated representative may create a Project specific Technical Library. In circumstances where the most senior manager appointed to a Project or their nominated representative creates a Project specific Technical Library, an authorised manager or person is to be responsible for those matters detailed above to which the Group Systems Manager is responsible.

A copy of all contributions to a Project specific Technical Library is to be forwarded to the Group Systems Manager in order for their deposit into the Technical library.

Furthermore, all stakeholders, including contractors and suppliers, are invited to contribute material to the Technical Library.

Furthermore, where material is observed in the Technical Library that is no longer current, information about its obsoleteness is to be forwarded to the Group Systems Manager or their nominated representative for action.

Access to the Technical Library is to be in accordance with QHSEMS Sub-System 4.5.3 Records and Records Management

In accordance with QHSEMS Sub-System 4.4.3 Consultation, Communication and Reporting, information including information stored in the Technical Library, must be made available and communicated by a manager, supervisor, worker and / or other risk owner at such a time and in such a way to ensure that workers and others, the environment and / or product realisation is not exposed to unacceptable risk in circumstances where having the information would have, or may have, prevented or minimised the exposure to an acceptable / tolerable level.

## $2.0 \quad$ Other Resources

In addition to those previously stated, other documents that may articulate standards of good practice include:

- Designer's / manufacturer's / suppliers drawing / instructions associated with plant, materials and structures
- Environmental impact studies
- Safety Data Sheets associated with hazardous substances and dangerous goods.


## The repository for these documents is to be at Project level.

An authorised manager is responsible for the structure, content and currency of the repository given any statutory (for example, hazardous substance register) or QHSEMS (for example, location of OEM for plant) requirement / s.

### 3.0 Statutory Requirements to Document a Work Methodology

In this part, an authorised manager is a manager authorised to approve work subject to specified risk levels in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning.

In this Part, a work procedure is taken to read as meaning any document expressing a way of doing work or interacting with the work environment in words. Terminology may vary across industry sectors and legal jurisdiction but may include work instruction, safe work method statement or a standard operating procedure.

Where a statutory requirement for a work procedure exists, an authorised manager and / or a risk owner is to ensure:

- It is developed in a way that complies with the requirement
- Its content complies with the requirement
- Its technical content in regard to work methodology reflects, where reasonably practicable, standards of good practice
- It is implemented, monitored and reviewed in accordance with the requirement.

An authorised manager and / or a risk owner is to meet any statutory requirement for a risk assessment to accompany a developed work procedure.

The Technical Library is the repository for information in regard to statutory requirements.

### 4.0 Documenting and Approving a Work Methodology in Other Circumstances

In this part, an authorised manager is a manager authorised to approve work subject to specified risk levels in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning.

Not withstanding any statutory requirement, a work procedure must be developed in the following circumstances:

- When placed into context, work is complex, unusual, unfamiliar and / or difficult
- The work requires the interaction of many people or systems
- Where a critical risk to health, safety, the environment, or product realisation arises from the work or work environment
- The work is designated in accordance with QHSEMS Sub-System 4.4.2 Training and Competence
- The work is live electrical work
- The work is high-risk work or high-risk activity as defined by a statute.

Nothing in this part excludes an authorised manager and / or risk owner from requiring a documented work procedure in other circumstances.

Work procedures, and any subsequent amendment, are to be approved by an authorised manager and / or a risk owner relevant to the risk associated with the work or work environment in accordance with QHSEMS Sub-System 4.3.1, Risk Management Planning. Approval is to be in writing and embedded into the work procedure document.

An authorised manager and / or risk owner must only approve a work procedure if its work methodology or its description of a work environment reflects, where reasonably practicable, standards of good practice.

In documenting a work methodology in the circumstances detailed above, where provided for, reference is to be made, and consideration given, to the standards of good practice located in the Technical Library and / or a contract or other agreement detailing product specification.

An approved work procedure forms part of the QHSEMS or a QHSEMS as it manifests in application to a Project.

The Technical Library is the repository for work procedures that have been previously documented and used. These documents may be retrieved from the Technical Library and used in circumstances where the work methodology to be used forms the content or part of the content of the work procedure. Nothing in this Part implies that an authorised manager or risk owner must not review a work procedure retrieved from a Technical Library prior to doing the work in accordance with this QHSEMS Sub-System.

### 5.0 Review of Documented Work Methodology

In this part, an authorised manager is a manager authorised to approve work subject to specified risk levels in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning.

A work procedure is to be reviewed by the authorised manager and / or a risk owner in consultation with those workers executing the work before each occasion that work described in a work procedure is undertaken. The review is, as a minimum, to be undertaken in the context of
undertaking a pre-work risk identification and risk assessment as detailed in QHSEMS Sub-System 4.3.1 Risk Management Planning and:

- Any change to the standards of good practice
- Any change in product specification
- Any change in design
- Any change in the work environment
- Any change in the personnel performing the work or their physical or mental condition
- Any change in the plant, substances, materials and structures.

The review is to be recorded on a Record of Pre-Shift Meeting in accordance with QHSEMS SubSystem 4.4.3 Consultation, Communication and Reporting.

Furthermore, a work procedure is to be reviewed by the authorised manager and / or a risk owner in consultation with those workers executing the work in the following circumstances:

- There is a statutory requirement
- There is evidence that a risk assessment used to develop the procedure is no longer valid
- Unacceptable injury or illness, damage to the environment or product nonconformity results from exposure to a risk to which the procedure relates
- There are warning signs that unacceptable injury or illness, damage to the environment or product nonconformity resulting from exposure to a risk to which the procedure relates may manifest
- A significant change is proposed in the product design or specification, workplace or in work practices to which the risk procedure relates
- There is a request from a worker representative, or any other person affected by expose to the risk to which the risk procedure relates.


### 6.0 Workers to be Competent in Executing a Documented Work Methodology

All workers performing work that is subject in an approved work procedure are to be educated and trained in its content in accordance with QHSEMS Sub-System 4.4.2 Training and Competence and a documented record of that training made on the work procedure or other document before work commences.

A person is not to undertake work or interact with a work environment subject to a work procedure unless:

- They were involved in the compilation of the work procedure including any associated risk assessment
- If they weren't involved in the original compilation of the work procedure including any associated risk assessment, they have been given the opportunity to comment on it
- They have read or been read the work procedure
- They understand the work procedure
- They have the skills and knowledge to implement the content of the work procedure or that part for which they are to participate
- They have signed the work procedure.

Managers, supervisors and other risk owners are to communicate work methodology using the following communication mechanisms:

- Through communication with the chain of authority

Reference: QHSEMS Sub-System 4.4.3 Consultation, Communication and Reporting

- Through participation in workplace specific and work area induction

Reference: QHSEMS Sub-System 4.4.2 Training and Competence

- Through participation in pre-shift meetings

Reference: QHSEMS Sub-System 4.4.3 Consultation, Communication and Reporting
Other communication mechanisms that may be used include those in accordance with QHSEMS SubSystem 4.4.3 Consultation, Communication and Reporting.

### 7.0 Access to a Documented Work Methodology

Where there is a statutory requirement, an authorised manager and / or risk owner must ensure:

- A list of the current work procedures is kept at the workplace in a location that is easily accessible by each worker or other person at the workplace; and
- A copy of the current work procedure for a particular activity at the workplace is available to, and is kept in a location that is easily accessible by, each worker carrying out the activity; and
- The list and each work procedure are kept in a format that is easy to use and understand.

In all other cases, a risk owner is to ensure a work procedure is be reasonably accessible to a worker doing work or interacting with the work environment subject of the work procedure, or any other person who may interact with the work or work environment in which the work is being undertaken.

### 8.0 Compliance with a Documented Work Methodology

A worker and others who do work or interact with the work environment subject to the work procedure is to comply with the content of a work procedure.

If a person does not believe that the method of work or the work environment described in a work procedure affords the required protection against injury, illness, damage to the environment or product realisation, they are not to proceed with the task or interact with the environment - they are to report the matter with the risk owner in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning.

### 9.0 Content of a Documented Work Methodology

In this part, an authorised manager is a manager authorised to approve work subject to specified risk levels in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning.

For the purposes of this QHSEMS Sub-System, a work procedure may be articulated in very precise description terms or the converse, in dot points constituting reminders as to what is required. The nature and extend of the information is to be context specific, that is, depending on the nature of the work and / or work environment and the skill and knowledge of the workers executing the work.

So there is no doubt, in addition to matters relating to the health and safety of workers and others, a work procedure includes ways of doing work and interacting with the workplace in a way that does not expose the environment or product realisation to unacceptable risk.

Furthermore, a work procedure may include technical specification for the purposes of product realisation.

Furthermore, a process flow diagram or a drawing articulating a design or product specification may be taken to express a work procedure in circumstances a person who is
required to understand it does so. However, nothing in this Part exempts a written work procedure in circumstances required by this QHSEMS Sub-System despite the documenting of a process flow diagram or drawing articulating a design or product specification.

Nothing in this Part precludes a written work procedure being augmented by pictures and diagrams.

A documented job analysis may be used as a work procedure in circumstances where a job analysis methodology has been used to determine the work methodology and the work subject to the job analysis is only to be undertaken on an irregular basis. In all other circumstances, the content of a job analysis is to form the basis of a formally documented work procedure.
The authorised manager and / or a risk owner is to append any associated risk assessment including any job analysis to a work procedure in circumstances where a risk assessment including any job analysis was used to develop the work procedure in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning.

As a minimum, the following information must be embedded in written form into a work procedure:

- A description of the work and / or the environment in which the work is to be undertaken
- The risks to health, safety, the environment and product realisation
- A description of the measures to be implemented to control those risks to an acceptable / tolerable level
- A description of how the risk control measures are to be monitored
- A post incident plan for circumstances where the risk is realised including, in circumstances where the risk is a critical risk arising from the work and / or the work environment, the risk barriers and controls proposed to reduce the likelihood of consequences should the risk be realised and the measures to be used to mitigate the consequence should the risk be realised
- A field for an authorised manager and / or risk owner to approve the work procedure
- A field for all participants to acknowledge (by signature) the following:
- They were involved in the compilation of the work procedure including any associated risk assessment
- If they weren't involved in the original compilation of the work procedure including any associated risk assessment, they have been given the opportunity to comment on it
- They have read or been read the work procedure
- They understand the work procedure
- They have the skills and knowledge to implement the content of the work procedure.

Nothing in this part requires or prevents health, safety, environmental management and / or product realisation information (including technical specification) from being integrated into one document.
Nothing in this part requires, in circumstances where the health, safety, environmental management and / or product realisation information (including technical specification) is not integrated into one document, that the separate documents detailing the health, safety, environmental management and / or product realisation information (including technical specification) need to be of the same type.
An authorised manager and / or risk owner is to ensure a work procedure is written in a way that it is understandable by persons carrying out the work or interacting with the work environment.

## Caution:

Not withstanding the above, an authorised manager and / or risk owner is not to presume that a person carrying out work subject to a documented work procedure is capable of reading and / or understanding its content.

Not withstanding the above, an authorised manager and / or risk owner is not to simplify a work procedure in a technical sense. Any inability of the user of the work procedure to understand its technical content implies the user is not competent to perform the task or activity.

### 11.0 Working in a Location Controlled by Another Person

In the case where a worker or other person is required to enter a location controlled by a risk owner whose work or work environment is subject to a work procedure, the worker or other person entering the location is to read, or be read, the work procedure and sign it acknowledging they have identified and understood the nature of the risk within the location and how that risk is controlled to acceptable / tolerable levels.

Furthermore, a risk owner and / or a worker entering a location controlled by a risk owner, and subject to a work procedure, to do work is to compile a work procedure detailing how the interaction will take place within acceptable / tolerable levels of risk. The risk owner in control of the location is to be satisfied that the work procedure articulates the risk controls and barriers necessary for the other risk owner and / or a worker entering the location to remain within acceptable / tolerable levels of risk.

So there is no doubt, nothing in this QHSEMS Sub-System excludes a risk owner from requiring a documented work procedure in circumstances where the risk owner is doing work in a location owned or otherwise controlled by another risk owner (such as a Principal Contractor) in circumstances where the other risk owner does not require a documented work procedure.

Despite the above, and so there is no doubt, a risk owner doing work in a location owned or otherwise controlled by another risk owner (such as a Principal Contractor) in circumstances where the other risk owner has a requirement to document a work procedure, may comply with the requirements of the other risk owner in regard to work procedure format / content in circumstances where that content serves the purpose for which work methodology is documented that is, to ensure all risk that is high-risk in doing the work or associated with the work environment has been considered, is treated to ensure the risk is acceptable / tolerable and the information is available to those who interact with the source from which the risk arises in order that they do not necessarily have to depend on a cognitive recall ability to apply the risk treatments at the correct time and in the correct sequence.

### 12.0 Monitoring Work Activity

In accordance with the requirements of their responsibilities stated in QHSEMS Sub-System 4.4.1 Structure and Responsibilities, and QHSEMS Sub-System 4.5.1 Monitoring and Measurement, managers, supervisors and other risk owners are to monitor activities documented on a work procedure to the extent necessary to determine whether the workers and other persons doing the work or interacting with the work and work environment are complying with the work procedure and must stop the work when safe to do so in circumstances where there is non-compliance. Given these circumstances, the risk owner must determine the reason for non-compliance to ensure organisational factors are not driving the behaviour and, given those factors, is to take corrective action in accordance with QHSEMS Sub-System 4.5.2 Incident Investigation, Corrective and Preventative Action.

### 13.0 Managing Contractors

This part applies in circumstances where a contractor is engaged by the Business and / or a Project to do work for the Business and / or Project under a contract for service but does not include circumstances where the contractor is engaged by the Business and / or Project on behalf of a client.

The most senior manager appointed to a Project may waive this part in circumstances where a contractor engages in low risk work and is defined as, and complies with, the requirements imposed on a visitor.

### 13.1 Management Stages

Managing quality, health, safety and environmental management aspects associated with the engagement of contractors is to have three main stages.

The stages are:

- Determine the specification to be embedded into the contract
- Determine the contractor's capability to meet the specification
- Engage and monitor the contractor.


### 13.2 Contract Specification

Quality, health, safety and environmental management requirements are to be clearly identified in a contract specification. Several key messages are to be conveyed:

- The Business and / or its Projects considers quality, health, safety and environmental management as an important value in the way it conducts its business
- Contractors are required to comply with the contract specification.

Where there is an absence of a written contract, the message is to be conveyed during induction to the workplace / work area in accordance with QHSEMS Sub-System 4.4.2 Training and Competence.
In circumstances where a contractor is to perform high-risk work, an authorised manager or person is to consider the following when determining specification:

- The requirement of establishing the contractor's ability to undertake an analysis and evaluation of risk based on the contracted works, and design and apply risk controls and barriers in order to perform work within acceptable / tolerable levels of risk
- The requirement of establishing the contractor's ability to document work methodology including a way of doing work, organising the workplace and realising product to specification.


### 13.3 Contractor Evaluation

During evaluation an authorised manager or person is to verify contractor capability to comply with the contract specification.

In circumstances where a contractor is to perform high-risk work, the most senior manager appointed to the Project may direct that the evaluation process involve the examination of a QHSEMS and verification of its operation. Furthermore, it may involve:

- Evaluation of reports on quality, health, safety and environmental management performance
- Undertaking interviews or discussions to confirm the contractors understanding of specific quality, health, safety and environmental management issues related to the contract and the contractor's ability to respond accordingly.

Contractors who cannot demonstrate that they can adequately meet the contract specification are not to be considered in the selection process until they can.
The Business and / or its Projects may assist a contractor meet the contract specification.

### 13.4 Managing Contractors

### 13.4.1 Contractors Performing Work Other Than IAW Part 13.4.2

This part applies in circumstances where the most senior manager appointed to a Project has not invoked a requirement to manage a contractor in accordance with part 13.4.2.

A person engaging a contractor to do work for the Business and / or a Project must be an authorised manager or person.

A contactor engaged by an authorised manager or person is not to commence work unless:

- Where reasonably practicable, evidence of the contractor's or contractor's employees' capability to do the work competently has been identified (for example, an electricians licence, membership to an approved industry body requiring specified competencies)
- A discussion has taken place between the contractor and the authorised manager or person who controls the workplace in which the contractor will work or other nominated risk owner to ensure: the work and work environment will not adversely effect the contractor (i.e. the authorised manager or person and other risk owners must inform the contractor about matters over which the Business and / or the Project has control that may effect the contractor and their employees); and the contractor's work and work environment will not adversely effect others, the environment or product realisation
- The risk barriers or controls that have been determined as a result of the discussion are implemented
- The contractor has been inducted to the workplace or work area to the extent required of QHSEMS Sub-System 4.4.2 Training and Competence.

A contractor engaged by an authorised manager or person is not to commence work unless they have acknowledged and agreed to the following, as a minimum, in writing:

[^11]
## appointed to the Project

- Implement technically adequate systems and methods of work that represent industry good practice and from which risk is as low as reasonably practicable
- Provide and maintain adequate facilities for the welfare of their workers including ensuring access to those facilities
- Provide a competent workforce capable of implementing technically adequate systems and methods of work that represent industry good practice and from which risk is as low as reasonably practicable
- Provide supervision to the extent necessary to ensure their workforce implements technically adequate systems and methods of work that represent industry good practice and from which risk is as low as reasonably practicable
- To monitor the work environment and the plant, substances, materials, and structures being used by their workforce to ensure risk is, and remains, as low as reasonably practicable
- Take all reasonable precautions to ensure that people other than their workers are not exposed to unacceptable risks to their health and safety arising from the conduct of the contractor's business or undertaking
- Know at all times which of their workers is at the workplace, their location and the task in which they are engaged
- Respond to unacceptable risk by stopping work and not recommencing work until it can be undertaken in a technically adequate way that represents industry good practice and from which risk is as low as reasonably practicable
- Provide for first aid arrangements should their workers need first aid
- Immediately respond to incidents in a way that eliminates, or where elimination is not reasonably practicable, reduces consequences to as low as reasonably practicable
- Report all incidents and unacceptable risk arising from the work or workplace to the Business or the most senior manager appointed to a Project or their representative
- Consult genuinely with the Business or the most senior manager appointed to a Project or their representative as required to ensure a coordinate approach to achieving the highest quality, health, safety and environmental management standards.

A worker, who is an employee of a contractor, is not to engage in work (the agreement) unless they have acknowledged and agreed to the following, as a minimum, in writing:

A worker, being the undersigned and in regard to the work and work environment subject to this agreement, agrees that:

- In circumstances where they have a statutory obligation / duty of care, they will comply with that obligation / duty of care and / or responsibility
- They will take reasonable care for their own health and safety
- They will take reasonable care that their own acts or omissions do not adversely affect the health and safety of other persons, the environment or product realisation
- They will comply, so far as they are reasonably able, with any instruction that is given by a person with the authority to give the instruction to allow the person or any other person to comply with their statutory obligations / duty of care
- They will convey information known to them to other persons of a type the other person needs to know in order that the other person may fulfil their statute obligations / duty of care, and / or they need to know to protect themselves and others from the risk of injury or illness, and protect the environment and product conformity
- They will take reasonable steps to prevent risks to health and safety, impact on the environment environment or product realisation by notifying their employer of any matter that, to their knowledge, may affect the capacity of any other person to comply with their statutory obligation / duty of care
- Before starting work and frequently during work, they will carefully examine the work environment for the appearance of any danger to the health and safety of themselves and others, unacceptable impact on the environment or product realisation
- They will take action (within his or her capability) to eliminate risk and if the elimination of the risk is not within their capability, to immediately take all available steps to prevent exposure to the unacceptable risk and report it to their employer
- They will report immediately any sub-standard conditions or activities, or injury or illness to their employer
- They will place any unserviceable plant, substance, material, structure or personal protective equipment out of


## Furthermore, the undersigned agrees:

- They were involved in the design of the work method to be used including any associated risk assessment
- If they weren't involved in the original design of the work method to be used including any associated risk assessment, they have been given the opportunity to comment on it
- They understand the work method to be implemented or that part for which they are to participate
- They have the skills and knowledge to implement the work method or that part for which they are to participate
- They will work in accordance with the work method or that part for which they are to participate unless due to a change the work method presents unacceptable risk
- If unacceptable risk arises from the work or work environment they will stop work and not recommence work until the risk is acceptable / tolerable
- They will have access to assistance if an incident occurs
- They will conduct a self-assessment and be fit to do the work - they will not be unacceptably fatigued, overly stressed or impaired by drugs or alcohol
- They will have access to, and will use, fit for purpose plant, substances, materials and structures that are safe if they are used properly.

During the work, the risk barriers and controls are to be monitored by an authorised manager or person to ensure:

- Work and the work environment controlled by the Business and / or the Project does not adversely affect the contractor or an employee of the contractor; and
- The contractor's work and work environment does not adversely affect others, the environment or product realisation.

In this part, monitoring activity is determined by what is reasonable and in accordance with QHSEMS Sub-System 4.5.1 Monitor and Measurement. Nothing in this part requires a person monitoring contractor activity to technically understand the work methodologies used by the contractor unless there is a statutory requirement to do so.

### 13.4.2 Contractors Performing Work Other Than IAW 13.4.1

This part applies in circumstances where the most senior manager appointed to a Project invokes its application.

This part is said to be invoked in circumstances where the contractor engages in high-risk work unless the most senior manager appointed to the Project decides that by invoking the requirements of part 13.4.1, the risk can be managed.

The following details the process steps to be applied in the administration and management of contractors. The process steps may be performed in an order other than detailed provided the purpose of this Sub-System is not compromised.

Each step is to be performed by an authorised manager or person.

| Step | Action |
| :---: | :---: |
| 1 | Design the contract specification |
| 2 | Approve the contract specification |
| 3 | Identify contractors to participate in pre-qualification |


| 4 | Determine pre-qualification criteria |
| :---: | :---: |
| 5 | Detail pre-qualification requirements to contractors |
| 6 | Conduct pre-qualification assessment and evaluation |
| 7 | Approve the short-listing of contractors |
| 8 | Invite requests for proposal |
| 9 | Provide the contractor with an electronic copy of the QHSEMS or relevant parts thereof in order that they may accurately resource for its requirements |
| 10 | Evaluate submitted proposals |
| 11 | Select the contractor to perform the work |
| 12 | Present the contract to the successful contractor ensuring that any special management requirements are embedded or append the contract document |
| 13 | Inform unsuccessful contractors |
| 14 | Direct the submission of pre-mobilisation information: <br> - Requiring evidence pertaining to the qualifications and current competence of the contractor and their employees in regard to the contracted works in accordance with QHSEMS SubSystem 4.4.2 Training and Competence including evidence that the contracted work will be supervised by competent supervisors <br> - Requiring evidence that plant used by the contractor is safe and without risk to health if used properly in accordance with QHSEMS Sub-System 4.4.6HS Plant - General including evidence that it has been maintained, serviced and repaired in accordance with manufacturer's specifications (or other specified standard) and by competent persons <br> - Requiring evidence that the work methodology to be executed is technical adequacy in accordance with this QHSEMS Sub-System. |
| 15 | Assess and evaluate pre-mobilisation information provided by the contractor and advise of any corrective action required |
| 16 | Mobilise the contractor to the workplace inclusive of providing workplace and work area specific induction training in accordance with QHSEMS Sub-System 4.4.2 Training and Competence |
| 17 | Commence work |
| 18 | Conduct monitoring activity in accordance with QHSEMS 4.5.1 Monitoring and Measurement |
| 19 | Demobilise the contractor ensuring the following: <br> - All plant deployed by the contractor has been withdrawn <br> - All excess material owned by the contractor has been removed <br> - All hazardous substances/dangerous goods owned by the contractor has been removed <br> - All waste owned by the contractor has been removed <br> - All amenities owned by the contractor has been removed <br> - All incident analysis which involve the contractor have been completed <br> - All expired Permits to Work owned by the contractor has been discharged <br> - Work areas have been rehabilitated |
| 20 | Evaluate contractor performance |

### 13.4.3 Business and / or its Projects Obligation to the Contractor

Nothing in this Sub-System exempts the Business and / or its Projects from ensuring the health and safety of a contractor or an employee of a contractor as a result of its business or an undertaking.

Note:
A contractor or an employee of a contractor is not to be provided with any plant, substance, material or structure that is usually under the control of the Business and / or a Project unless otherwise approved by an authorised manager. In making such an approval, the authorised manager must be cognisant that the Business and / or one of it Project's exposure to risk is increased as a result of the approval.

### 13.4.4 Directing a Contractor to Cease Work as a Result of Unacceptable Risk Arising from their Work Activity

In circumstances where unacceptable risk to product realisation, health and safety of workers and others and / or the environment arises from activity undertaken by a contractor or employees of a contractor, the contractor or employees of the contractor are to be directed to cease work in accordance with QHSEMS Sub-Systems 4.3.1 Risk Management Planning and 4.5.1 Monitoring and Measurement. Work is not to recommence unless the work is performed within acceptable / tolerable risk levels.

### 13.4.5 Contractor Responsibility for Sub-Contractors

Contractors are responsible and accountable for all sub-contractors and their employees engaged by them. All submissions made by a sub-contractor to the Business and / or a Project must be through, and endorsed by, the contractor unless otherwise specifically exempt by an authorised manager. An omission or oversight on behalf of a sub-contractor or its employees to meet the specification of a particular contract will be taken to be an omission or oversight by the contractor to meet its requirements.

### 13.4.6 Work Procedures Submitted by Contractors

In this part, a risk owner is a contractor to the Business and / or one of its Projects.
Where a statutory requirement for a work procedure exists, a risk owner is to ensure:

- It is developed in a way that complies with the requirement
- Its content complies with the requirement
- It is submitted to an authorised manager or person prior to the work commencing
- It is implemented, monitored and reviewed in accordance with the requirement.

Furthermore, the risk owner must meet any statutory requirement for a risk assessment to accompany a developed work procedure.

Not withstanding any statutory requirement, a risk owner must not commence work subject to a work procedure required in the circumstances expressed in this QHSEMS Sub-System unless an authorised manager or person has received and approved a document articulating the work methodology. Where it is reasonable practicable, the authorised manager or person must only approve the work methodology if it meets the standards of good practice.

Nothing in this part reduces the statutory obligation / duty of care of the risk owner.
Nothing in this part requires the Business and / or its Projects to know about the technical requirements of a particular method of work or work environment in circumstances where it is not reasonably practicable to know.

In accordance with the requirements of QHSEMS Sub-System 4.5.1 Monitor and Measurement, an authorised manager or person or other risk owner is to monitor activities documented on the work procedure to the extent necessary to determine whether the contractors workers and others doing the work or interacting with the work environment are complying with the work procedure and must stop the work when risk is at an acceptable / tolerable level to do so in circumstances where there is non-compliance and it is reasonably practicable to be aware of that non-compliance.

### 14.0 Work Procedures Submitted by Contractors in Specified Circumstances

In this part, a risk owner is a contractor to the Business and / or one of its Projects.
In this part, the Business and / or a Project are appointed by a client to manage the work or work environment.

Where a statutory requirement for a work procedure exists, a risk owner is to ensure:

- It is developed in a way that complies with the requirement
- Its content complies with the requirement
- It is submitted to an authorised manager or person prior to the work commencing
- It is implemented, monitored and reviewed in accordance with the requirement.

Furthermore, the risk owner must meet any statutory requirement for a risk assessment to accompany a developed work procedure.
Not withstanding any statutory requirement, a risk owner must not commence work subject to a work procedure required in the circumstances expressed in this QHSEMS Sub-System unless an authorised manager or person has received and approved a document articulating the work methodology. Where it is reasonable practicable, the authorised manager or person must only approve the work methodology if it meets the standards of good practice.

Nothing in this part reduces the statutory obligation / duty of care of the risk owner.
Nothing in this part requires the Business and / or its Projects to know about the technical requirements of a particular method of work or work environment in circumstances where it is not reasonably practicable to know.

In accordance with the requirements of QHSEMS Sub-System 4.5.1 Monitor and Measurement, an authorised manager or person or other risk owner is to monitor activities documented on the work procedure to the extent necessary to determine whether the contractors workers and others doing the work or interacting with the work environment are complying with the work procedure and must stop the work when risk is at an acceptable / tolerable level to do so in circumstances where there is non-compliance.

### 15.0 Provision of Products

Nothing in this part is designed to or implies that a manager or person, whether authorised by the most senior manager appointed to a Project or not, is permitted to exceed an approved financial delegation (if one has been imposed).

So there is no doubt, a risk owner is a person who has the resources, authority and competence to realise the product or part thereof.

### 15.1 Communication

Formal lines of communication and mechanisms of interfacing with a customer are to be established early in any relationship between the risk owner and a customer. However, a Director of the Business and / or the most senior manager appointed to a Project or an authorised manager may nominate a risk owner who is authorised to communicate with a customer in circumstances where the communication is critical to product realisation.

Communication between a risk owner and a customer are, where practicable, and in all cases where demanded by the customer, to be undertaken at each step in the product realisation process in circumstances where that particular step is critical to the realisation.

Communications that are critical to product realisation are to be determined by the risk owner but must include those demanded by the customer. Communication critical to product realisation is to be embedded into a Quality Plan or, in circumstances where the communication constitutes a hold point or observation point, an Inspection and Test Plan.

Communication mechanisms may include, but are not limited to, those as provided for in QHSEMS Sub-System 4.4.3 Consultation, Communication and Reporting.

Communications critical to product realisation are to be recorded.

### 15.2 Approval to Commit to Provide a Product

In this part, an invitation includes an open invitation to tender or quote for work from a customer that is targeted as a result of its potential to be income producing.
All invitations to the Business and / or a Project from a customer or potential customer to provide for a quote for a product are to be accepted. The invitation is to include an objective description of product specification, delivery and post-delivery activities, if any.
Details of the invitation are to be recorded against a 'Job Number' in circumstances where the product is in excess of a specified criteria (i.e. financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project. In the absence of such a determination, all invitations are to be recorded.

A risk owner / $s$ is to review all invitations for the provision of a product. Details of the review are to be recorded in circumstances where the product is in excess of a specified criteria (i.e. financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project. In the absence of such a determination, all reviews are to be recorded.

Review processes and decisions in regard to commitment are to be based on consideration of the following:

- Scope of work - product and / or service specification
- Quality assurance evidential requirements
- Health, safety and environmental management requirements
- Human resources requirements
- Infrastructure requirements
- Plant and equipment requirements
- Any other customer specifications
- Requirements not stated by the customer but necessary for product and / or service realisation
- Capability to meet customer specifications
- Resource gaps in meeting customer specification and the capability to meet the gap
- Schedule of realisation required by the customer
- Formal lines of communication and interfacing
- Commercial viability.

The risks associated with commitment to provide the product is to be assessed in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and other criteria as provided for in other

Business / Project specific systems such as those associated with financial and / or logistic management (where they are provided for).
Statutory requirements are to be considered in accordance with QHSEMS Sub-System 4.3.2 Legal and Other Requirements. Information in regard to statutory requirements is available in the Technical Library.

The most senior manager appointed to a Project is to obtain approval from the Directors of the Buisness prior to commitment to supply a particular product to a customer unless otherwise provided for in this QHSEMS Sub-System or previously approved by the Directors of the Business.

A risk owner, whether a manager, supervisor, worker or otherwise, is to obtain approval from a Director of the Business or the most senior manager appointed to the Project prior to commitment to supply a particular product to a customer unless otherwise provided for in this QHSEMS SubSystem or previously approved by a Director of the Business or the most senior manager appointed to the Project. A risk owner, whether a manager, supervisor, worker or otherwise who is approved to commit is an authorised manager or person.

Approval is to be made in the context of financial (including approved financial delegations) and logistic management requirements being compiled with.

In circumstances where the product is in excess of a specified criteria (i.e. financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project, and so there is no doubt, commitment is not to be made unless a Purchase Order or other type of document constituting a form of contractual arrangement between the Business and / or the Project and the customer has been populated and signed by parties authorised to sign such a document to make it legally binding in a legal jurisdiction and in circumstances where such a binding can be made legal.
In circumstances where the product is in excess of a specified criteria (i.e. financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project, approval to commit by a Director of the Business or the most senior manager appointed to a Project or an authorised manager or person is to be recorded. In the absence of such a determination, all approvals to commit are to be recorded.

### 15.3 Variation to Specification

A request by a customer for a change to the product specification post agreement is to be reviewed and approved in accordance with the process detailed in clause 1.2.

### 15.4 Design and Development

Reserved.

### 15.5 Procurement of Products Used in Product Realisation

In this part:

- A supplier is a person, organisation or other approved party providing product to the Project
- A receiver is an authorised person responsible for the receipt, inspection and release of purchased products for the provision of product realisation.


### 15.5.1 Evaluation and Selection of Suppliers

This part applies to product that is critical to product realisation. What product is critical to product realisation is to be determined by the risk owner. However, the most senior manager appointed to a

Project, an authorised manager or the customer may direct a risk owner as to what constitutes a product that is critical to product realisation. Furthermore, this part applies in circumstances where the risk of non-conformity resulting from a procured product used in product realisation exceeds a particular tolerance, or the product exceeds specified criteria (i.e. a financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project.
The suppliers of product that are critical to product realisation are to be evaluated and approved.
The following criteria is to be considered in selecting the most suitable suppliers for use:

- Experience and technical capability
- Demonstrated performance
- Suitable resources
- Appropriate health, safety and environmental management systems and system application
- Appropriate quality management systems and system application
- Valid and suitable securities and insurance's including, where required, professional indemnity to the required levels
- Customer specification.

An authorised manager or person may approve a supplier of product that is critical to product realisation. Approved suppliers are to be registered.
Re - evaluation of suppliers of product that is critical to product realisation is to be conducted on a continuous basis by a risk owner through the following activities (as appropriate):

- Suitability of products received
- Performance of the product once installed
- Supplier performance in delivery, support and correcting non conformances detected
- Result of audits of supplier's premises, including facilities and systems of work.

Re-evaluation is to be recorded and registered.
Where formal evaluation / re-evaluation of suppliers may not be possible such as in the case of customer nominated suppliers, risk owners are to monitor supplier performance and report on unsatisfactory supplier performance to the customer.
Reports of non-conformance are to be made through the chain of authority and administered in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and Sub-System 4.5.2 Incident Investigation, Corrective and Preventative Action.
In circumstances where a supplier is also a contractor, they are to be managed in accordance with QHSEMS Sub-System 4.4.6HS Contractor Management.

So there is no doubt, information in regard to the procurement of product critical to product realisation is to be embedded into a Quality Plan or an Inspection and Test Plan.

### 15.5.2 Purchasing Information

This part applies to product that is critical to product realisation. What product is critical to product realisation is to be determined by the risk owner. However, the most senior manager appointed to a Project, an authorised manager or the customer may direct a risk owner as to what constitutes a product that is critical to product realisation. Furthermore, this part applies in circumstances where the risk of non-conformity resulting from a procured product used in product realisation exceeds a particular tolerance, or the product exceeds specified criteria (i.e. a financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project.

Purchasing mechanisms of product that is critical to product realisation is to be in accordance with the applied Project financial management system.

Purchasing information of product that is critical to product realisation is to be in the form of a document as required by the applied Project financial management system. All purchasing information is to have a clear description of the product required. The following may also be included where applicable:

- Reports, certificates or other compliance records required
- Reference to applicable standards, codes and statutory requirements in relation to the product
- Reference to attached specifications drawings, procedures and inspection plans etc.

The number of quotations required prior to the placing of orders is as defined in the applied Project financial management system or as demanded by the customer.

Approval to purchase is to be in accordance with the applied Project financial management system.

### 15.5.3 Receiving Procured Product Used to Realise Product

This part applies to product that is critical to product realisation. What product is critical to product realisation is to be determined by the risk owner. However, the most senior manager appointed to a Project, an authorised manager or the customer may direct a risk owner as to what constitutes a product that is critical to product realisation. Furthermore, this part applies in circumstances where the risk of non-conformity resulting from a procured product used in product realisation exceeds a particular tolerance, or the product exceeds specified criteria (i.e. a financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project.

In circumstances where this part does not apply, the product is said to be released under concession. Materials released under concession are to be positively identified to permit later recall and/or replacement in the event of non-conformance to specified requirements.
Mechanisms associated with receiving procured product is to be in accordance the applied Project financial and / or logistic management system.

Incoming materials are not to be used or processed until they have been inspected or otherwise verified as conforming to the specified requirements.

The nature of receiving inspection is to be determined by the risk owner. However, the most senior manager appointed to a Project, an authorised manager or the customer may direct a risk owner as to what constitutes the nature of a receiving inspection.

Suitably competent workers are to conduct incoming inspection of procured product.
The procured product is to be verified on receipt against the relevant document on which the purchasing information was articulated or other specification to ensure that the delivery is complete, undamaged and conforming to purchase requirements.

In the event that the procured product is incomplete, damaged, incorrect grade or size, the worker receiving the procured product is to isolate (if practical) and clearly mark it. Reporting of nonconforming product is in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and Sub-System 4.5.2 Incident Investigation, Corrective and Preventative Action.

### 16.0 Control of Production Realisation

### 16.1 Resource Availability

Relevant managers are to ensure that risk owners have the following, where applicable, in order to achieve product realisation for which they have been nominated by the relevant manager:

- Scope of work - product specification and information that describes the characteristics of the product
- Human, financial and material resources
- Skills and knowledge
- Authority to act.

The provision of human, financial and material resources is to be in accordance with the QHSEMS where provide for in that system and / or other applied Group / Project specific systems such as those designed specifically for management of those disciplines.

Risk owners are to ensure that workers and others over who they have management and / or supervisory control have access to the following, where applicable, in order to achieve product realisation:

- Scope of work - product specification and information that describes the characteristics of the product
- Work instructions articulating the work environment and work methodology required for acceptable tolerances of health, safety, environmental and product realisation risk
- Skills and knowledge
- Suitable plant and equipment
- Monitoring and measuring devices and inspection and test data
- Suitable infrastructure
- Formal lines of communication and interfacing to necessary stakeholders.


### 16.2 Execution / Quality Plans

Execution of product realisation is a function of the relevant risk owner.
Execution is a holistic process and is to be in accordance with the QHSEMS and other applied Business and / or Project systems such as human, financial and logistic management systems.

In circumstances where the product is in excess of a specified criteria (i.e. financial or volumous benchmark) as determined by a Director of the Business, the most senior manager appointed to a Project or the customer, a Quality Plan is to be documented by the risk owner in order to systematical manage product realisation. A risk owner is responsible for the documenting of the Quality Plan.

The Quality Plan may take the form of:

- A Tactical QHSE Management Plan as described in QHSEMS Sub-System 4.3.4 QHSE Management Plans
- A QHSE Operational Management Plan as described in QHSEMS Sub-System 4.3.4 QHSE Management Plans
- In another form as directed by the most senior manager appointed to a Project or the customer.

Not withstanding the format in which a Quality Plan is documented, a Quality Plan is to embed, as a minimum, the following information:

- Specific allocation of responsibilities and authorities and the management procedures to apply for the delivery of the contract, including those for selection, engagement and control of subcontractors and suppliers
- The name, qualifications and experience of key personnel
- The communication processes to be implemented in management of the activities of the Contract
- The controls to be applied for management of amendments to the Contract documents as work under the Contract proceeds
- The quality records to be maintained and those to be submitted to the Customer
- Schedules of Inspection and Test Plans giving the dates by which these are to be prepared
- Product identification systems
- Inspection and Test Plans including a copy of the NATA terms of registration for compliance testing laboratories (where relevant).

Nothing in this part excludes a Quality Plan being integrated into a work procedure (embedding technical specification) in accordance with QHSEMS Sub-System 4.4.6 Operational Risk Management provided such a form, given all circumstances, provides for the information to ensure product realisation.

In whatever form the Quality Plan takes, it is to articulate the processes required to enable the transformation of inputs into outputs of a particular specification. Where required to value add to the understanding and application of the Quality Plan, an output from one process may directly form the input to another.

In developing a Quality Plan, the risk owner may apply a methodology known as "Plan-Do-CheckAct" (PDCA) to all processes. PDCA can be briefly described as follows:

- Plan: establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies
- Do: implement the processes
- Check: monitor and measure processes and product against objectives and requirements for the product and report the results
- Act: take actions to continually improve process performance.



### 16.3 Non-Conforming Product

Non-conforming product is to be identified, marked and separated (where practicable).
In circumstances where the product is in excess of a specified criteria (i.e. financial or volumous benchmark) as determined by a Director of the Business or the most senior manager appointed to a Project, non-conforming product is to be reported and administered in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and Sub-System 4.5.2 Incident Investigation, Corrective and Preventative Action.

### 16.4 Product Identification

This part only applies in circumstances where:

- The customer;
- The most senior manager appointed to a Project;
- The risk owner; or
- A statutory requirement,
requires it to be applied.
Products realised by the Business and / or a Project are to be identified by some suitable means during all stages of realisation from initiation through to final completion. Methods of identification are a matter for the most senior manager appointed to a Project or an authorised manager but may include:
- Job Number / Service Number / Work Order Number
- Product description
- Stock code number
- Product type or grade
- Colour code.

Where product traceability is specified, the method of traceability, the process and responsibilities are to be documented. Nothing in this part precludes the traceability process and responsibilities from being embedded into a Quality Plan.

### 16.5 Customer Property Used in Product Realisation

In this part customer property may include, but not be restricted to, material product, plant and/or equipment, drawings and/or documentation and intellectual property.
Mechanisms associated with receiving customer property used in product realisation are to be in accordance the applied Project financial and / or logistic management systems.

Incoming customer property is not to be used or processed until it has been inspected or otherwise verified as conforming to the specified requirements.
The nature of receiving inspection is to be determined by the risk owner. The most senior manager appointed to a Project or an authorised manager may direct a risk owner as to what constitutes the nature of a receiving inspection.

Suitably competent workers are to conduct incoming inspection of the customer property.

The customer property is to be verified on receipt against the relevant document on which the acquisition information was articulated or other specification to ensure that the delivery is complete, undamaged and conforming to agreed requirements.

In the event that the customer property is incomplete, damaged or non-conforming, the worker receiving the property is to isolate (if practical) and clearly mark it. Reporting of non-conforming customer property is to be made through the chain of authority and in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and Sub-System 4.5.2 Incident Investigation, Corrective and Preventative Action.

The risk owner is to implement process that ensures customer property is protected and safeguarded.
Where applicable, the most senior manager appointed to a Project or authorised manager is to implement process that ensures that any customer property that is lost, damaged or otherwise found to be unsuitable for use after receipt, is reported to the customer and records maintained of that communication in accordance with QHSEMS Sub-System 4.4.3 Consultation, Communication and Reporting.
Reports of lost, damaged or otherwise found to be unsuitable for use customer property after receipt are to be made through the chain of authority and in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and Sub-System 4.5.2 Incident Investigation, Corrective and Preventative Action.

### 16.6 In Process Inspection, Testing and Monitoring

Nothing in this part exempts a manager, supervisor or other risk owner from performing their duties in accordance with QHSEMS Sub-System's 4.4.1 Structure and Responsibilities or 4.5.1 Monitor and Measure.

In process inspection is to be performed and documented during the execution of works in an Inspection and Test Plan or other approved document.
Inspection and test procedures are to be included in the Inspection and Test Plan or other approved document and are to include:

- The work process and associated inspection and test points
- The allocation of responsibilities for carrying out the inspections and testing
- The required frequency of the inspections and testing
- The methods to be used for measurements and tests
- The criteria for acceptance
- Measurements or tests which involve use of calibrated equipment
- All witness and hold points.

A hold point means an identified point in the process beyond which work is not to proceed without written authorisation embedded into the Inspection and Test Plan or other approved document.

Hold points are to apply as follows:

- As specified by the customer or as otherwise nominated by the risk owner
- On issue of a report of unacceptable risk / nonconformance report.

The entity giving written authorisation is the risk owner unless:

- Another entity is nominated by the most senior manager appointed to a Project
- Another entity is provided for in an agreement with the customer.

To obtain the authorisation to proceed past a specified hold point, evidence is to be presented that all applicable work has been completed and tested and inspected in accordance with the Inspection and Test Plan or other approved document.

To obtain authorisation to proceed past a hold point associated with a nonconformance, evidence is to be presented that the applicable work can be completed and tested and inspected in accordance with the Inspection and Test Plan or other approved document despite the authorisation to proceed and that to proceed will not interfere with a subsequent analysis of the non-conformance if an analysis is required in accordance with QHSEMS Sub-System 4.5.3 Incident Investigation, Corrective and Protective Action.

Witness points mean an identified point in a process where an entity, including the customer, may observe an activity.

Unless specified otherwise, the risk owner is to give the entity, including the customer if specified, notice of at least one working day of an approaching witness point but may proceed with the activity when the period of notice has expired whether or not the entity, including the customer if specified, elects to witness the activity.
Compliance inspections and tests are to be carried out by the risk owner to ensure compliance with the Inspection and Test Plan or other approved requirements and are to include at least all inspections and tests which are specified in a contract.
Where nominated by the customer and in circumstances where good practice dictates, all compliance testing is to be carried out by laboratories registered with NATA and certified for the appropriate tests.

All compliance assessment, inspections and tests are to be traceable to the product subject to the assessment, inspections and tests.
If the results indicate nonconformance, no further testing is to be be permitted until a nonconformance report has been submitted and the risk owner has approved corrective action.

The risk owner is to provide the customer with preliminary results of all compliance tests carried out within 24 hours of tests being completed unless otherwise agreed with the customer. Corresponding NATA certified results are to be submitted where applicable.

The frequency of testing for compliance is not to be less than the minimum requirements nominated in the Inspection and Test Plan or other approved document. Minimum testing frequencies and minimum number of tests may be stated in a relevant technical standard. Where a minimum testing frequency or minimum number of tests is not given, it will be nominated by the risk owner and submitted to the customer at least 14 days prior to the commencement of testing.

Specified testing frequencies represent a minimum testing requirement. The risk owner remains responsible for performing sufficient tests and inspections to ensure that product complies with all requirements of the contract, including testing during the performance of the work to ensure that processes remain in control.

Where required by a risk owner, the status of the product with respect to witnessing, verification, monitoring or review is to be identified throughout all production stages by either maintaining the status indicators on the items produced or by recording the status for tracking purposes on approved documents such as:

- Checklists
- Marking of items
- Inspection tags or labels
- Notes on drawings.


### 16.7 Final Inspection

No product is to be released or otherwise submitted to the customer for acceptance until all witnessing, verification, monitoring or review activities specified in the relevant Inspection and Test Plan or other approved document have been satisfactorily completed and the associated data and documentation evidencing such is available and approved by the relevant risk owner.

The results of the final inspection are to be recorded on the Inspection and Test Plan or other approved document.

### 16.8 Validation

Processes where the resulting output cannot be verified until the product is in use are deemed special processes. To ensure that the finished result will meet the specified requirements, special processes is to be validated prior to the commencement of work. Validation is carried out by performing qualification tests on samples of the output of the process. Following validation, satisfactory conformance can only be assumed through monitoring and controlling the process and its parameters and generating objective evidence during the process.

A risk owner is to ensure that special processes are identified and carried out under controlled conditions by qualified personnel using suitable equipment according to the specified requirements and established criteria.

Despite the above, where practicable, no product is to be released until all inspections, tests, monitoring and / or verification activities specified in the relevant Inspection and Test Plan or other approved document have been satisfactorily completed and the associated data and documentation evidencing such is available and approved by an authorised manager.

### 16.9 Release of Product

In this part, an authorised manager where practicable, is not the risk owner responsible for production prior to the final inspection.
So there is no doubt, the implementation of product release or submission to the customer for acceptance is a function of an authorised manager or person.

### 16.10 Delivery of Product to the Customer

Product delivery to the customer without incurring product non-conformance is to be in accordance with agreed arrangements (with the customer) and in accordance with the applied Project logistic management system.
Not withstanding the above, the risk owner is to communicate with the manager / person responsible to the application of the logistic management system in ensure for the preservation of the product during delivery to the intended destination in order to maintain conformity to requirements.
In circumstances where a critical risk to the product arises from the delivery process, measures to ensure risk is acceptable / tolerable are to be detailed in a Quality Plan.

In the absence of the manager / person and / or logistic management system, the risk owner is to ensure preservation of the product during delivery to the intended destination in order to maintain conformity to requirements.

### 17.0 Monitoring and Measuring Equipment

In this part:

- Monitoring and measurement equipment is equipment used to demonstrate the conformance of a product to a specific requirement
- Monitoring and measurement equipment is equipment that is owned, hired or loaned by the risk owner.

The requirements stated in this QHSEMS Sub-System in addition to those expressed in QHSEMS Sub-System 4.5.1 Monitoring and Measurement.

### 17.1 Identification, Status and Labelling

A risk owner is to identify equipment to be used to monitor and / or measure the conformance of a product to a specific requirement.

All monitoring and measurement equipment is to be permanently identified with a unique identification.

The risk owner is to establish and maintain a register detailing monitoring and measurement equipment description, unique identification number, location, frequency of calibration required and identity of the person / s authorised to calibrate it. The register may take the form as defined in QHSEMS Sub-System 4.4.6HS Plant - General.

Calibration of monitoring and measurement equipment is to be recorded in the register.
Monitoring and measurement equipment is to be readily identifiable with the calibration due date and the calibrator's identification attached. However, the identification may be attached to the container of the monitoring and measurement equipment where there is insufficient room on the monitoring and measurement equipment for the information to be attached.

### 17.2 Calibration

Monitoring and measurement equipment is to be calibrated against referenced international or national measurement standards. In circumstances where suitable standards do not exist, manufacturer's specifications or Project requirements are to be used. Project requirements are a matter for the risk owner.

Calibration may be performed either internally to a Project or externally through an acceptable supplier. All calibration is to be performed by a competent person.

Calibration of monitoring and measurement equipment that is found to be suspect is to be repeated to prove acceptability of the results.

Where monitoring and measurement equipment is to be sent to an external organisation for calibration, the requirements for calibration and supply of a calibration record are to be communicated (e.g. in a purchase order) by the risk owner. On receipt, calibration records are to be reviewed by the risk owner to ensure the equipment is suitable for use. Where discrepancies are found the risk owner is to seek clarification and/or re issuing of reports as required.

### 17.3 Protection and Use

Monitoring and measurement equipment is to be stored, handled and used in accordance with the prescribed standard to ensure it is protected from damage, deterioration or loss, and its accuracy and fitness for use is maintained.

Monitoring and measurement equipment is to be stored in the respective container (where available).

Monitoring and measurement equipment stored for extended periods need not be maintained until required for use.

Where possible, safeguards on the monitoring and measurement equipment are to be present to avoid tampering which may invalidate its calibration status. If these safeguards have been tampered
with or the monitoring and measurement equipment has been damaged or is suspect, it is to be recalibrated to ensure its suitability.
Monitoring and measurement equipment that is out of calibration, damaged, failed in operation or suspected of having deviated from its established measurement capability, is to be promptly removed from use, identified or segregated and the risk owner advised in accordance with QHSEMS Sub-System 4.4.6HS Removing Unserviceable Plant From Service. A review of measurements made may be repeated to confirm previous readings.

Reports of monitoring and measuring equipment that is out of calibration, damaged, failed in operation or suspected of having deviated from its established measurement capability are to be administered in accordance with QHSEMS Sub-System 4.3.1 Risk Management Planning and SubSystem 4.5.2 Incident Investigation, Corrective and Preventative Action in circumstances where the risk owner believes such action is required.

### 18.0 Work Packages

This part applies in circumstances where a Director of the Business and / or the most senior manager appointed to a Project requires it to be applied.

In this part, a work pack is a package of information that is provided to a risk owner which contains information required to execute work within acceptable / tolerable levels of risk to product realisation, the health and safety of workers and others and / or the environment.

For the purposes of this QHSEMS Sub-System, a work pack is compiled by a work planner based on a specific scope of work. A work planner may be: an employee of the Business and / or its Projects; a contractor engaged by the Business and / or its Projects; or a customer of the Business and / or its Projects.

Work planners may use a range of expertise to assemble the information required to meet a particular scope of work including in the disciplines of:

- Project management
- Quality management
- Occupational health and safety management
- Environmental management
- Engineering
- Operations
- Human resource management
- Finance
- Logistics
- Administration.

The content of a work pack will vary depending upon the scope of work to which the pack relates. However, a work planner must assemble the following into a work pack for it to constitute a credible package of information:

- A registered / referenced number
- The name of the nominated risk owner for the execution of the work subject to the work pack
- A scope of work
- A work methodology
- An Inspection and Test Plan.

Other information that may be contained in a work pack, but not limited to, include:

- Quality Plan
- Budget information
- Manpower requirements
- Plant and equipment requirements
- Drawing
- Equipment data sheets
- Safety data sheets
- Permits
- Other specialist plans e.g. demolition plans; heavy lift plans; asbestos removal plans; isolation lists; blinding / deblinding lists etc.

An authorised manager is to approve the issue of a work pack to a nominated risk owner.
An issued work pack is to have an identifying number and is to be traceable for the purposes of:

- Positive identification and traceability of all work activities, measurements and tests
- Monitoring the quality of product
- Submission of work to the customer under the cover of a conformance report
- Rejection of work
- Application of concession provisions for below standard work
- Application of bonus provisions for above standard work.

An authorised manager must not issue a work pack to a nominated risk owner unless the authorised manager is satisfied that the content of the work pack represents information that, if followed by a risk owner to which it will be issued, the work will be performed within acceptable / tolerable risk to product realisation, the health and safety of workers and others involved or exposed to the work and / or the environment. To this end an authorised manager may engage a range of expertise to validate the technical content of the work pack.
A nominated risk owner issued a work pack by an authorised manager is to review the content prior to engaging in the execution of work. In circumstances where a nominated risk owner does not believe the information contained in the work pack or part thereof represents executing work within acceptable / tolerable risk to product realisation, the health and safety of workers and others who may be exposed to the work, or the environment, the risk owner is to report the matter to the authorised manager.

Furthermore, a nominated risk owner is not a risk owner unless the person has the resources, competence and authority to execute the work in the manner expressed in the work pack. In circumstances where a nominated risk owner does not have the resources, competence or authority to execute work in the manner expressed in the work pack they are not a risk owner and they must report the manner to the authorised manager.

An authorised manager receiving such a report is to consult with the nominated risk owner in a review of the work pack's content or that part of which is under investigation or, where resources, competence or authority is the issue, provide the resources, competence and / or authority or refer the matter to an authority that can.

A work pack containing information that represents the execution of work within acceptable / tolerable levels of risk to product realisation, the health and safety of workers and others who may be exposed with the work and the environment is to be complied with.

Authority to amend the detail of a work pack after the commencement of work lies with the authorised manager. Not withstanding this, an authorised manager may express a threshold under which the risk owner may make change.

### 18.0 Records

In circumstances where this QHSEMS Sub-System provides for forms and registers in accordance with QHSEMS Sub-System 4.5.3 Records and Record Management, the records are to be made, populated and administered.

As a minimum, the following records are to be populated and maintained as evidence of the operation of this QHSEMS Sub-System:

- Approved Method Statements / Work Procedures
- Records showing that Method Statements / Work Procedures are reviewed prior to each use or given a change to an input that resulted in the Method Statement / Work Procedure
- Records showing a person who is involved in the execution of a Method Statement / Work Procedure or interacts in some way with the work and / or work environment subject to the Method Statement / Work Procedure is competent to do so
- Records of communication about work methodology (in accordance with QHSEMS SubSystem 4.4.3 Consultation, Communication and Reporting)
- Records showing that the execution of a Method Statement / Work Procedure is monitored
- Given the identification of less than adequate compliance with a Method Statement / Work Procedure, where applicable, records as expressed in QHSEMS Sub-System 4.3.1 Risk Management Planning
- Register of invitations to provide a product
- Review of invitations to provide a product and subsequent approvals
- Inspection and Test Plans for product realisation
- Evidence of product conformance
- Inspection and calibration of measuring and test equipment.

Compilation instruction and administration pertaining to the forms and registers are embedded in the respective documents.

Nothing in this QHSEMS Sub-System prevents other forms and registers being designed and implemented by a Project subject to approval in accordance with QHSEMS Sub-System 4.3.4 QHSE Management Plans.


This is to certify that the management systems of

## Construct Environmental

have been formally assessed by International Certifications and found to comply with the requirements of

## ISO 9001:2008

Quality Management Systems - Requirements

03 Jun 2011
Issue Date

11 May 2014
Expiry Date

D. L. Evans

Managing Director International Certifications Ltd


JAS-ANZ


This certificate of registration is issued by International Certifications Limited, 138 Harris Road, East Tamaki, Auckland New Zealand, 2013 (www.inticert.com). Accreditations by Intemational Accreditation Bureau Australia New Zealand (www.ibaanz.org) and Joint Accreditation System of Australia and New Zealand (www.jas-anz.org/register), Joint Accreditation System of Australia and New Zealand is a signatory to the IAF multi-lateral agreement (www.iaf.nu). This certificate remains the property of International Certifications Limited and must be returned upon request. It must not be altered or defaced in any way and deliberate misuse of the certificate will result in cancellation without notification.
Quality, H afety and Environmental System
4.4.6Q.F1
INSPECTION and TEST PLAN


## Construct funionmental

JOB SUMMARY

Leichhardt Pump Station
Halco

HAL001.1
Date: 16 August 2012

Construct

| Project Details: |  |
| :--- | :--- |
| Project Title: | Leichhardt Pump Station |
| Job Number: | HAL001.1 |
| Client / Principal Contractor: | Halco |
| Job Description: | Leichhardt Pump Station |
| Site Location: | Old Toowoomba Road, Liechhardt |
| Prepared for: | Qld Urban Utilities |
| Client Contact Details: | Brad James |
| Prepared by: | 16-August-2012 |
| Date: |  |


| Initial Inspection Details: |  |
| :--- | :--- |
| Dimensions: | mm Dia x mm Depth |
| Alternate Water Supply <br> Required: | No |
| Special Water Requirements: | NA |
| Shutdowns/ Lockouts Required: | NA |

## Initial Inspection Image:

| Preparation Details: |  |
| :--- | :--- |
| Initial Substrate Preparation: | 5000 PSI High Pressure Water Blast |
| Condition of Substrate: | Walls Were At Acceptable Standard To Spray |
| Repairs to Substrate: | NA |
| Condition of Benches: | Benches Were At Acceptable Standard To Spray |
| Repairs to Benches: | NA |
| Description of Infiltrations: | NA |
| Repairs to Infiltrations: | NA |



| Coating Details: |  |
| :--- | :--- |
| Ambient Temperature: | $24^{\circ} \mathrm{C}$ |
| Dry Film Thickness: | 6 mm Structural Coating On Wet Side <br> 3 mm Chemical Resistance Coating On Dry Side |
| Additional Comments: | There Were Heaps Of "Bug" Holes On The Dry Side |

Completed Coating Image:

## Construct <br> environmental

## Extra photos:



## Construct <br> environmental



Quality, Health, Safety and Environmental Management System

## Construct environmental



## Construct finvionmental



## Construct <br> environmental



## Construct environmental



Constructennionmental


Construct /nvironmental



## Construct



## Construct <br> environmental



## Construct <br> environmental



## Construct environmental

Queensland Urban Utilities<br>Level 6, Brisbane Transit Centre<br>171 Roma Street<br>Brisbane

To Whom It May Concern:

## RE : WARRANTY ON SPRAYWALL COATING FOR IPSWICH PUMP WELLS - HALLCO ENGINEERING.

Please accept this letter as confirmation that we are happy to extend the warranty to a total of ten (10) years, on the coating of the pump wells through Ipswich.

As licensed applicators of Sprayroq, our staff have been extensively trained in the preparation and coating of various projects including pump stations. Strict conditions are contained in our contract with Sprayroq to ensure projects are completed in the manner specified by Sprayroq.

These requirements, coupled with the quality of the Spraywall product, and our International Certifications for Quality, WPH\&S and Environment offer our clients the highest level of comfort that they are receiving the best available service in their coatings contractor.

Sprayroq, offers a three (3) year warranty as a standard and we, Construct Environmental Pty Ltd are happy to extend that warranty to ten years based on a number of conditions -

1/ The coating supplied will be monolithic, in that it will be one coating, unbroken throughout the pump well. Should penetrations be required post-project, Construct Environmental must be employed to "make good" the area after the penetration is complete.

The overall effectiveness of the coating is based on a number of crucial factors, one of which is that there are no areas where gas/acid can gain access to the protected substrate behind the coating.

2/ The pump station will be used day to day to collect and deliver sewerage and all the chemicals etc which can be reasonably expected.

The Spraywall product has been proven in test conditions and in completed projects to resist the chemicals generally and reasonably found in sewer.

Any abnormally high level of chemical/s (not generally or reasonably found in sewerage) should be made known to Construct Environmental who may decide to complete an inspection of the coating to ensure its longevity.
www.inticert.com

## Construct

As part of our standard procedure, Construct Environmental completes an inspection of all of the projects completed after the first year and then after three years. These inspections are designed to ensure we identify, address any issues as soon as possible.

In this case, we will conduct inspections at 1 year, 3 years, five years and ten years.
Spraywall has been life tested in these conditions. The results show, after 50 years exposed to the environmental and chemical conditions found in a sewer system, a loss of just $27 \%$ of its physical properties is the resultant.

It is with this in mind that I have no hesitation in complying with the requested extension of the warranty.

I trust that this document provides the satisfaction you require. Please feel free to contact me regarding this matter at any time.

Kind Regards,

Dave Turnbull
Managing Director

## Construct Enironmental

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PO Box 1158 | Caboolture | Qld | 4510
P | 0733856168
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W | www.constructenvironmental.com.au


## 8. Old Toowoomba Road <br> Commissioning Plan

## Typical New Sewage Pump Station

## Commissioning Plan

| Site ID and Name | SP320 |
| :--- | :--- |
| Commissioning Date(s) | $\dot{C} O$ CTOSER 2012. |

In Attendance

| Name | Role During Commissioning | Company |
| :--- | :--- | :--- |
| DrRefis WEDLEy | Contractor | J\&f Richaro son |
|  |  |  |
|  |  |  |
|  |  |  |

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## 1 ELECTRICAL WORKS CHECKLIST

The following checklist is to be completed and signed by the electrical contractor.

### 1.1 SWITCHBOARD FACTORY ACCEPTANCE TEST

| Task | Completed |
| :--- | :--- |
| FAT has been completed as per QUU FAT Document and all defects that were <br> identified have been rectified. | $7 / 2$ |

### 1.2 SWICHBOARD ELECTRICAL INSPECTION

| Task | Completed |
| :--- | :--- |
| The following QUU Factory Inspection has been completed and all defects have <br> been rectified. <br> CHE28 Factory Inspection Checks - Switchboard | $7 / 7 / 2$ |

### 1.3 RADIO ANTENNA MAST LOCATION

| Contractor Task | Result |
| :--- | :--- |
| Check the location of the antenna mast and ensure that the new position will not <br> be directly below electrical transmission lines. | Location <br> OK $亠$ <br> Antenna <br> dir. |

### 1.4 SUPPLY AUTHORITY



### 1.5 TELECOMMUNICATION AUTHORITY (FOR SITES LAND LINES)

| Contractor Task $N / A$. | Result |
| :--- | :--- | :--- |



Contactor's Supervisor
Name: DARREN WERLEY.
Date: ...2 $14!!$
Signature:

QUU Commissioning Manager
Name:
Date:
Signature: ......

## 2 ELECTRICAL INSTALLATION CHECKS

### 2.1 INSTALL NEW SWITCHBOARD

### 2.1.1 Install Switchboard

| Contractor Task | Outcome |  |
| :--- | :--- | :--- |
| Install and connect the required mains and earth. | OK |  |
| Record the cable insulation resistance of the 3 phases | 130 | A Megohm |
|  | 130 | B _Megohm. |
|  | 130 | C_Megohm |
| Record earth resistance | O / ohms |  |
| Point to point phase continuity | R to L1 OKQ |  |
|  | Wto L2 OK区 |  |
| Install the direct connected kWhr Meter | B to L3 OKQ |  |

### 2.1.2 Install Generator Mains (For Sites with Permanent Generators)

| Contractor Task |  | Outcome |
| :---: | :---: | :---: |
| Record insulation resistance of the 3-phases | $\begin{aligned} & 30 \\ & 30 \\ & 30 \end{aligned}$ | $\begin{aligned} & \text { A_Megohm } \\ & \text { B_Megohm. }^{\text {C_ Meg }} \\ & \text { C- } \\ & \text { Megohm } \end{aligned}$ |
| Record earth resistance |  | O-1 ohms |
| Point to point phase continuity |  | $\begin{aligned} & \text { R to L1 OKG } \\ & \text { Wto L2 OKV } \\ & \text { B to L3 OK } \end{aligned}$ |

### 2.1.3 Energise New Switchboard

| Contractor Task | Outcome |
| :--- | :--- |
| Retrieve mains 3-phase polc fuses from lock out box as per QUU Isolation and <br> Lock Out procedurc. | OK DW |
| Ensure new switchboard main incomer is turned "Off". | OK B W W. |
| Install the 3-phase pole fuses. | OK Bu |


| Turn on mains switch | OK D. DW |
| :--- | :--- |
| Check 3 phase voltages | AB 415 V |
|  | BC 4.5 V |
|  | CA 416 V |
| Check MEN connection. | OK W D Wi |

Contactor's Supervisor
Name: DARREN.NEREEY
Date: .. $/ 1 \subset / 1 \%$
Signature:


QUU Commissioning Manager
Name:
Date:
Signature: $\qquad$

### 2.2 CONNECT FIELD INSTRUMENTATION TO NEW SWITCHBOARD

### 2.2.1 Field Devices

| Contractor Task | Outcome |
| :---: | :---: |
| Install and connect the hydrostatic level probe to the transmitter | $\begin{aligned} & \text { OK } \mathbb{D} \quad \mathrm{D} \\ & 0 \text { to (m) } \end{aligned}$ |
| Connect the delivery pressure probe to the transmitter | $\begin{array}{\|l\|} \hline \text { OK } \bar{\triangle} \\ 0 \text { to } \quad(\mathrm{m}) \end{array}$ |
| Connect the delivery flow meter to the flow meter transmitter | $\begin{array}{\|l\|} \hline \text { OK } \nabla^{\prime} \\ 0 \text { to } \quad(1 / s) \\ \hline \end{array}$ |
| Install and connect the Multitrode LR3 wet well high level relay Probe | $\begin{array}{\|l\|l\|} \hline \text { OK } \mathbb{Q} \\ 0 \text { to } & \text { (m) } \end{array}$ |
| Install and connect the Multitrode SIR surcharge imminent level relay Probe | $\begin{aligned} & \hline \text { OK ब } \triangle \sim \\ & 0 \text { to } \quad(\mathrm{m}) \end{aligned}$ |
| Connect the moisture in oil sensor for each pump (sites with option A only) | $\begin{aligned} & \text { OK } \overline{\text { N }} \mathrm{PW} \\ & \text { N/A } \end{aligned}$ |
| Connect the moisture in stator for each pump (sites with option BI only) | $\begin{aligned} & \text { OK } \mathbb{D} D W \\ & \text { N/A } \square \end{aligned}$ |
| Connect the motor bearing temperature for each pump (sites with option B2 only) |  |
| Connect the reflux valve micro switch for each pump (sites with option $\mathbf{C}$ only) | OK $V$ / DW N/A |
| Connect the upstream manhole surcharge imminent probe (sites with option D only) | $\begin{aligned} & \text { OK } \nabla / D W \\ & \text { N/A } \square \end{aligned}$ |
| Connect the Multitrode LR2 sump pump start/ stop probes (sites with option E only) | $\begin{aligned} & \text { OK } \mathbb{O} \quad \mathrm{DW} \\ & \mathrm{~N} / \mathrm{A} \square \end{aligned}$ |
| Connect the Multitrode LR4 sump pump high/trip probes (sites with option E only) | $\begin{aligned} & \text { OK } \mathbb{N} / \mathrm{DM} \\ & \text { N } \end{aligned}$ |
| Connect the sump pump (sites with option E only) | $\begin{aligned} & \text { OK Q/D~ } \\ & \text { N/A } \square \end{aligned}$ |
| Connect the generator IO cables (sites with option F only) | $\begin{aligned} & \text { OK } \mathbb{V} \text { DU } \\ & \text { N/A } \square \end{aligned}$ |
| Connect the thermistors for each pump (sites with option 1 only) | $\begin{aligned} & \text { OK } Q^{\sigma} \square \\ & \text { N/A } \square \end{aligned}$ |

### 2.2.2 Radio Antenna Installation

QUU Programmer Task

Outcome

### 2.2.3 Radio antenna Installation

| QUU Programmer Task | Outcome |
| :--- | :--- |
| QUU programmer must complete the following procedures |  |
| From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.) | $/ /$ |
| Section 1: Setup and Pre-Commissioning Checks |  |

### 2.2.4 Electrical Inspection

| QUU Electrical Inspector | Outcome |
| :--- | :--- |
| The following QUU Site Inspection tests have been completed and all defects <br> have been rectified. |  |
| CHE68 Site Inspection Checks - Cables | $/$ |
| CHE69 Site Inspection Checks - Electric Motors | $/$ |
| CHE70 Site Inspection Checks - Instruments | $/$ |
| CHE71 Site Inspection Checks - Switchboards | $/$ |
| CHE72 Site Inspection Checks - Cable Ladder/Tray/Duct | $/$ |

## 3 CIVIL STRUCTURE TESTING

Before this test can commence, the electrical installation of the wet well level sensor must be complete and the SCADA system must be recording the wet well level.

### 3.1 TESTING FOR LIQUID RETAINING STRUCTURES (7 DAY FILL TEST)

As per section 7 of AS 3735, civil structures must be tested of liquid tightness. A printout of the wet well level over the entire test period shall be attached in the commissioning report.

| Contractor Task | Outcome |
| :--- | :--- |
| Fill the wet well |  |
| As per the following proeedure the wet well shall be filled to the |  |
| sureharge imminent level: |  |
| With the formal agreement of the engineer, the structure should be | OK $\square$ |
| filled at uniform rate of not greater that 2 m in a 24 hour period. |  |
| When first filled the liquid shall maintained by the addition of further |  |
| liquid for a stabilising period of 7 days while absorption and |  |


| autogenic healing takes place. <br> After the stabilising period the level of the liquid surface shall be <br> recorded at 24 hour intervals for test period of 7 days. |  |  |  |
| :--- | :--- | :--- | :--- |
|  | Date (dd/mm/yy) | Time (hah: :mm) | Level (mAHD) |
| Initial level |  |  |  |
| Day 1 |  |  |  |
| Day 2 |  |  |  |
| Day 3 |  |  |  |
| Day 4 |  |  |  |
| Day 5 |  |  |  |
| Day 6 |  |  |  |
| Day 7 |  |  |  |

### 3.2 TESTING FOR LIQUID TIGHTNESS (7 DAY EMPTY TEST)

Once the structure has been tested for liquid retention, the wet well and upstream system must also be tested for system infiltration. To do this the wet well must be emptied and the wet well level monitored over a 7 day period. A printout of the wet well level over the entire test period shall be attached in the commissioning report.

| Contractor Task |  | Outcome |  |
| :--- | :--- | :--- | :--- |
| Empty the wet well below the stop duty A level record the wet well <br> level at 24 hour intervals for test period of 7 days. | OK $\square$ |  |  |
|  | Date (dd/mm/yy) | Time (hh::mm) | Level (mAHD) |
| Initial level |  |  |  |
| Day 1 |  |  |  |
| Day 2 |  |  |  |
| Day 3 |  |  |  |
| Day 4 |  |  |  |
| Day 5 |  |  |  |
| Day 6 |  |  |  |
| Day 7 |  |  |  |

## ELECTRICAL, MECHANICAL \& HYDRAULIC COMMISSIONING

To ensure that the station is fully operations BEFORE it is cut into the live sewage system, the station shall undergo a full functional test by closing the rising main
isolation valve and recirculating flow through the flow meter and back to the wet well via the scour system.

### 4.1 MECHANICAL INTEGRITY CHECKS

| Contractor Task | Outcome |
| :--- | :--- |
| Visual examination of the whole of the Works for completeness and acceptable <br> standard of workmanship and finish. | OK |
| Inspect pump mounting bolts, guide rail, flange and support bracket bolts have <br> been tightened | OK |
| Visual inspections to ensure all sealing gaskets are in place; all supporting <br> brackets have been fastened. | OK |
| Operational testing of all valves and check on sealing and direction of closing, <br> reflux valves mounted for the correct direction of flow | OK |

### 4.2 HYDRAULIC PRESSURE TEST

| Contractor Task | Outcome |
| :--- | :--- |
| Visual inspection for leaks during hydraulic pressure test for the pump <br> discharge piping up to the rising main isolation valve. Pressure test shall be 1.5 <br> times the pump shut off head | OK |

### 4.3 FLOWMETER INTEGRITY CHECKS

| Contractor Task | Outcome |
| :--- | :--- |
| Visual examination of the whole of the Works for completeness and acceptable <br> standard of workmanship and finish. | OK $\square \mathcal{D}$. |
| Inspect and check flange bolts for tightness, visual inspections to ensure all <br> sealing gaskets are in place. | OK $\square \mathcal{O}$ |

### 4.4 ELECTRICAL COMMISSIONING OF PUMPS

| QUU Programmer \& Contractor Task | Outcome |
| :--- | :--- |
| Check the rotation of each pump by bumping the pump On / Off via the local <br> "Emergency Start" switch. | PmplOK |
| PUMP 1: <br> While running the pump via the Emergency Start switch - Check the 3-phase <br> motor current. | B__Amp_ Amps |


| PUMP 2: |  |
| :--- | :--- |
| While running the pump via the Emergency Start switch - Check the 3-phase | A___ Amps <br> motor current. |
| At this stage the Brisbane Water Programmer must complete the following <br> procedures |  |
| From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.) <br> Section2: On Site Commissioning Procedure | OK $\square$ |

### 4.5 SCADA TESTING

| QUU Programmer \& Contractor Task | Outcome |
| :--- | :--- |
| The QUU Programmer must complete the following procedures with the |  |
| assistance from the Commissioning Engineer and SCADA Commissioning |  |
| Engineer in the Control Room. | OK $\square$ |
| From the SSM086 Standard Fixed Speed Sewage Pumping Station (S.A.T.) |  |
| Section3 : SCADA Commissioning Procedure |  |

### 4.6 PRELIMINARY PUMP PERFORMANCE CHECKS

A single pump performance curve at the indicated Hz , for each pump, shall be generated by throttling of the scour valve. The curve to be plotted from five points while pump is operating 50 Hz at QUUL and TWL. Plotted points are to be Head v Flow.

| Contractor Task | Outcome |
| :---: | :---: |
| Fill the wet well with clean water to the Top Water Level (TWL)-See Drawing 486/5/7-0048-005 | OK $\square \mathrm{N} / \mathrm{A}$ |
| Close rising main isolation valve and check pigging connection isolation valve closed | OK $\quad \mathrm{N} / 4$ |
| Check both pump isolation valves open | OK ${ }^{\text {d }}$ |
| Partially open Scour valve | OK $\square^{\text {/ }}$ D |
| Open air bleed/Anue well washer pump 1 and 2 | OK $\mathrm{O}_{3}$ |
| Run pump 1 and bleed air from the discharge piping/ stop pump | OK $\square^{\sim}$ |
| Run pump 2 and bleed air from the discharge piping/ stop pump | OK ${ }^{\text {a m }}$ |
| Isolate air bleeds and Anue well washer | OK区/3u |
| Operate pump I from 50 to 25 Hz at 5 Hz increments, check for abnormal movement or vibration | OK $\square$ |
| Operate pump 2 from 50 to 25 Hz at 5 Hz increments, check for abnormal movement or vibration | OK $\square$ |
| Visual inspection of both pumps and all piping, fittings and flanged joints for | $\mathrm{OK}[D$ |

## leakage.

### 4.7 PUMP CURVES PERFORMANCE CHECKS

| Contractor Task | Outcome |
| :--- | :--- |
| The tables in section 4.8 and 4.9 are to be filled out by checking the pump <br> curve performance by throttling the scour valve until flow meter records the <br> required flow (l/s) and recording the discharge pressure, motor amps and <br> voltage readings in the table provided. | OK |
| Open Anue washer isolation valve, operate Pump 2, check operation of Anue <br> well washer | OK |
| Pump curves to be generated from tabled information and added to the "As <br> Constructed Drawings" | OK |

### 4.8 TOP WATER OPERATION

### 4.8.1 $\quad 50 \mathrm{~Hz}$ Operation

| Pump <br> Number | Hz | Flow L/s | Discharge <br> Pressure <br> (mAHD) | Wet well <br> Level <br> (mAHD) | Motor <br> Amps | Voltage |
| :---: | :---: | :---: | :--- | :--- | :--- | :--- |
| 1 | $\mathbf{5 0}$ | 0 |  |  |  |  |
| 1 | 50 | 50 |  |  |  |  |
| 1 | 50 | 100 |  |  |  |  |
| 1 | 50 | 125 |  |  |  |  |
| 1 | 50 | 150 |  |  |  |  |
| 2 | 50 | 0 |  |  |  |  |
| 2 | 50 | 50 |  |  |  |  |
| 2 | 50 | 100 |  |  |  |  |
| 2 | 50 | 125 |  |  |  |  |
| 2 | 50 | 150 |  |  |  |  |

### 4.8.2 $\quad 33 \mathrm{~Hz}$ OPERATION

| Pump <br> Number | Hz | Flow L/s | Discharge <br> Pressure <br> (mAHD) | Wet well <br> Level <br> (mAHD) | Motor <br> Amps | Voltage |
| :---: | :--- | :---: | :--- | :--- | :--- | :--- |
| $\mathbf{1}$ | $\mathbf{3 3}$ | $\mathbf{0}$ |  |  |  |  |


| 1 | 33 | 40 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 33 | 60 |  |  |  |  |
| 1 | 33 | 100 |  |  |  |  |
| 1 | 33 | 120 |  |  |  |  |
| 2 | 33 | 0 |  |  |  |  |
| 2 | 33 | 40 |  |  |  |  |
| 2 | 33 | 60 |  |  |  |  |
| 2 | 33 | 100 |  |  |  |  |
| 2 | 33 | 120 |  |  |  |  |

### 4.8.3 $\quad 25 \mathrm{~Hz}$ OPERATION

| Pump <br> Number | Hz |  | Flow L/s | Discharge <br> Pressure <br> (mAHD) | Wet well <br> Level <br> (mAHD) | Motor <br> Amps |
| :---: | :---: | :---: | :--- | :--- | :--- | :--- |
| 1 | 25 | 0 |  |  | Voltage |  |
| 1 | 25 | 40 |  |  |  |  |
| 1 | 25 | 60 |  |  |  |  |
| 1 | 25 | 100 |  |  |  |  |
| 2 | 25 | 0 |  |  |  |  |
| 2 | 25 | 40 |  |  |  |  |
| 2 | 25 | 60 |  |  |  |  |
| 2 | 25 | 100 |  |  |  |  |

## 5 FUNCTIONALITY TESTING OF VFD

The following test should be carried out once the "SSM085 Standard Fixed Speed SP FAT vl-10.doc" has been completed. NOTE: the VFD drive has 2 setups - local and remote - both of which are configurable. To ensure full functionality, the test below are often repeated for both local and remote mode.

| Task | VFD 1 | VFD 2 |
| :---: | :---: | :---: |
| Local/Remote Mode Setup: When the station local-remote selector switch is selected to <br> Remote: $\quad$ setup 1 is active on both Drives <br> Local: $\quad$ setup 2 is active on both Drives | ㅁ | ㅁ |
| Drive in Auto Mode: <br> In both local and remote modes repeat the following: <br> Ensure that the Auto mode is active <br> Press the "Hand Start" button on the keypad <br> Ensure that the Auto mode feedback deactivates <br> Press the "Auto Start" button on the keypad <br> Ensure that the Auto mode is active | $\square$ $\square$ $\square$ | $\square$ $\square$ $\square$ $\square$ |
| Run Command, Speed Control and Speed Feedback, Run at Maximum |  |  |
| In Remote: - Setup 1 - DO FOR BOTH PUMPS SEPERATLY <br> Command the pump to run via the digital output from the PLC. <br> Ensure that the VFD runs and the running signal is received from by the RTU. <br> Ensure that the VFD speed is controlled by the RTU Analog output. <br> Ensure that the speed of the pump from the VFD to the RYU is accurate. <br> Ensure that the Maximum Speed is 50 Hz (or whatever the current design max is). <br> Initiatc Surcharge Pumping mode. <br> Ensure that all required pumps are commanded to run at maximum speed and that the run at max is active. <br> Stop Surcharge Pumping mode but activate duty A and then Duty B start commands <br> Ensure that the duty A and then the duty B pumps are commanded to run at the PID speed control and that the speed feedback is accurate. <br> Set the Drive to run in remote at minimum speed, then force the run at max output. <br> Ensure that the drive runs at maximum speed. | $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ | $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ |
| In Local: Setup 2 - DO FOR BOTH PUMPS SEPERATLY <br> Command the pump to run via the start pushbutton (output from the PLC) <br> Ensure that the VFD runs and the running signal is received from by the | $\square$ | $\square$ |

## RTU.

Ensure that the VFD speed is controlled by the POT.
Ensure that the Maximum Speed is 50 Hz (or whatever the current design max is)
Ensure that the speed of the pump from the VFD to the RTU is accurate. If the site is interlocked: Try to start 2nd pump
Ensure that it gets commanded to run and does so
If the site is interlocked: Try to start 2nd pump
Ensure that it does NOT get commanded to run and does not run
Set the Drive to run in local at minimum speed, then force the run at max output.
Ensure that the drive DOES NOT runs at maximum speed.
VFD Ready / Thermistor Fault / Reset: (Repeat the following for local \& remote modes)
Trigger the thermistor fault.
Ensure that the VFD ready signal deactivates (fault).
Re-enable the thermistor and ensure that the VFD is still not ready.
Activate the reset output from the PLC.
Ensure that the VFD resets.

| $\square$ | $\square$ |
| :---: | :---: |
| $\square$ | $\square$ |
| $\square$ | $\square$ |
| $\square$ | $\square$ |
| $\square$ | $\square$ |
| $\square$ | $\square$ |
| $\square$ | $\square$ |
| $\square$ | $\square$ |

Testing Officer : Name $\qquad$

Signature : Date

## 9. Photos





















( 1

















$\square$







## 6

 Coseses) $\frac{1}{4}$ (1): (2)




















2. Equipment Manuals

|  |
| :--- |
|  <br> Generator Slab |
|  |

4. Pipe Work, Valves, Pumps Install

5. Platform


ELECTRICAL SWITCHBOARD

OPERATION AND MAINTENANCE MANUAL

Developed by:


J \& P RICHARDSON INDUSTRIES CAMPBELL AVENUE WACOL QLD 4076

ABN 23001952325 ACN 001952325

Ph. (07) 32712911
Fax. (07) 32713623


[^0]:    $1 \quad$ PC with operating software
    2 Auxiliary energy
    3 Shielding
    4 Other devices or PLC with passive input
    5 HART modem, e.g. Commubox FXA195

[^1]:    Abb. 58: Compact version Promag P (with PFA- or PTFE-lining)
    $T_{A}=$ ambient temperature; $T_{F}=$ fluid temperature; $H T=$ high-temperature version with insulation
    (1) $=$ light gray area $\rightarrow$ temperature range from -10 to $-40^{\circ} \mathrm{C}\left(-14\right.$ to $\left.-40^{\circ} \mathrm{F}\right)$ is valid for stainless steel version only
    (2) $=$ diagonal hatched area $\rightarrow$ foam lining (HE) and degree of protection IP $68=$ fluid temperature
    $\max .130^{\circ} \mathrm{C} / 266^{\circ} \mathrm{F}$

[^2]:    Transmitter Promag (compact version): 3.4 kg
    (Weight data valid for standard pressure ratings and without packaging material)

[^3]:    Transmitter Promag (compact version): 7.5 lbs
    High-temperature version: 3.3 lbs
    (Weight data valid for standard pressure ratings and without packaging material)

[^4]:    *Size is dependent on flange specification

[^5]:    * For FM or FMC Approved versions, NPT only permitted.
    ** Add codes for options.

[^6]:    ${ }^{* *}$ Add codes for options

[^7]:    Size is dependent on flange specification
    **The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered.
    For FM or FMC Approved versions, NPT only permitted.
    ***Add codes for options.

[^8]:    * FM approval in process. FEF product still available with full FM approval
    ** The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered.
    For FM or FMC Approved versions, NPT only permitted.
    *** Add codes for options.

[^9]:    A Approval
    Approval authority + Approval Number Approval for Class I
    Approved drive unit
    E Stall time
    F Starting current/Rated current
    G Duty class
    H Duty factor
    I Input power
    J Rated speed
    K Controller
    L Additional information
    M Max. ambient temperature
    N Serial number
    ATEX marking

[^10]:    

[^11]:    In this part, the Business or the most senior manager appointed to the Project means the entity or person engaging the contractor to do work under a contract, whether that contract is written or verbally agreed.
    In this part, a contractor includes a contractor who is an employer, their employees or a self-employed person (where applicable / relevant).
    In this part, risk means risk to health and safety of workers and others, impact on the environment and the risk to product realisation.
    The contractor undertakes to know, understand and comply with their statutory health and safety and environmental management obligations / duties of care and other statutory and contractual obligations including obligations to product realisation to a specified standard.
    The contractor undertakes to comply with lawful instructions given by the Business or the most senior manager appointed to a Project or their nominated representative.
    Furthermore, and not withstanding the above, the contractor undertakes to:

    - Ensure sufficient resources are reasonably available to meet its statutory obligations / duties of care and other contractual obligations including obligations to product realisation to a specified standard
    - Be diligent in becoming informed about the risks arising from the work and work environment associated with the activity of the Business or that which is directed by the most senior manager appointed to the Project or their representative and inform their workforce of those risks and the risk controls and barriers implemented to reduce risk to an acceptable / tolerable level
    - Provide and maintain of a work environment that does not present unacceptable risk
    - Provide and maintain plant, materials, structures and substances that do not present unacceptable risk if used properly
    - Not to use plant, materials, structures or substances owned an entity other than the contractor unless express permission has been granted by the entity including, where applicable, the Business or the most senior manager

