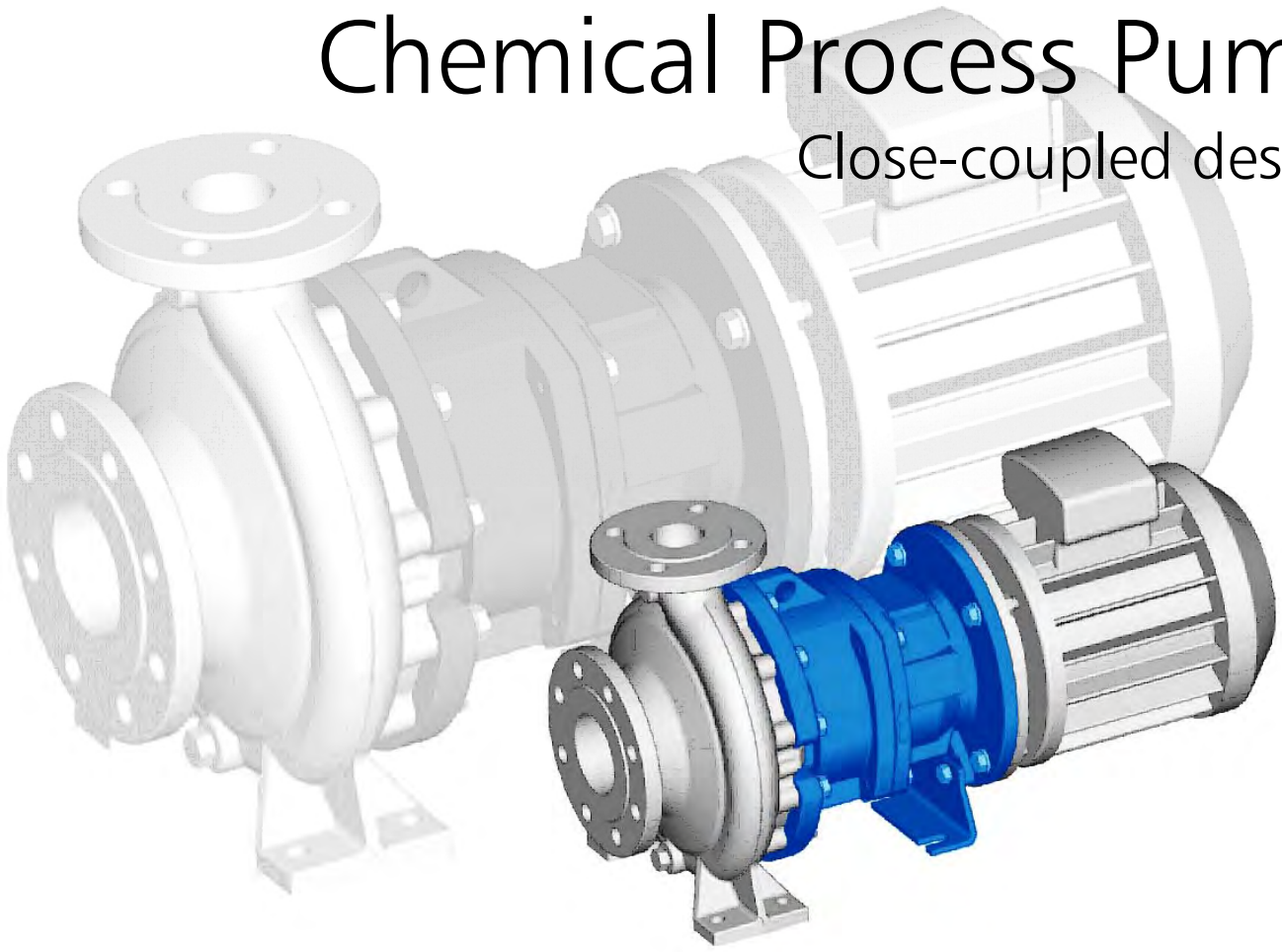
INSTALLATION AND OPERATING INSTRUCTIONS

MODEL ICMB

Magnetic Drive Chemical Process Pump

Close-coupled design



Keep for future use!

This operating manual must be strictly observed before transport, installation, commissioning etc. in order avoid endangering.

Subject to change without notice.

ITT

Engineered for life

9330-055-en Revision 13 Edition 24/08/2011

List of Contents

Relevant documents

- Data sheet
- Sectional drawing pumps
- GA drawing
- Performance curves
- Spare parts list
- Operating manual motor*
- Declaration of conformity for the entire unit to Machine Directive 2006/42/EC
- Pump to ATEX :
  Declaration of conformity for the pump to Directive 94/9/EC *

* if contained in the scope of delivery

1 Technical Data

Manufacturer :

ITT Goulds Pumps
Millwey Rise Industrial Estate
Axminster, Devon,
EX13 5HU
UK
Tel : +44 (0)1297-639100
Fax : +44 (0)1297-630476

Designation :

Series ICMB, Magnetic Chemical Process Pump, close-coupled design

Technical specifications to ISO 15783 and DIN ISO 5199

Connecting dimensions to ISO 2858 / DIN EN 22858

Flange connecting dimensions:
DIN EN 1092-2, type B
(ISO 7005-2, type B) PN 16

ATEX 95 Directive 94/9/EC

Machine Directive 2006/42/EC

Housing materials :

Standard Stainless steel (1.4408),

Optional Ductile cast iron, Duplex, Hastelloy C, titanium

Flow rates : up to 90 m^3/h (at 2900 rpm)

Delivery heads : up to 65 m LC (at 2900 rpm)

Housing discharge pressure :

ICMB max. 16 bar

Temperature range : - 40 °C to + 180 °C

Temperature classes : see Section 2.5.6

Admissible ambient conditions for pumps acc. to directive 94/9/ EG (ATEX 95) :

Ambient temperature range: - 20 °C to + 40 °C
(higher temperature after consulting the manufacturer)

Ambient pressure range: 0,8 barabs to 1,1 barabs

Sizes:

40-25-160 *****
50-32-160
65-40-160
80-50-160
40-25-200 *****
50-32-200
65-40-200
80-50-200

***** Low-Flow sizes:
not included in ISO 2858 / DIN EN 22858

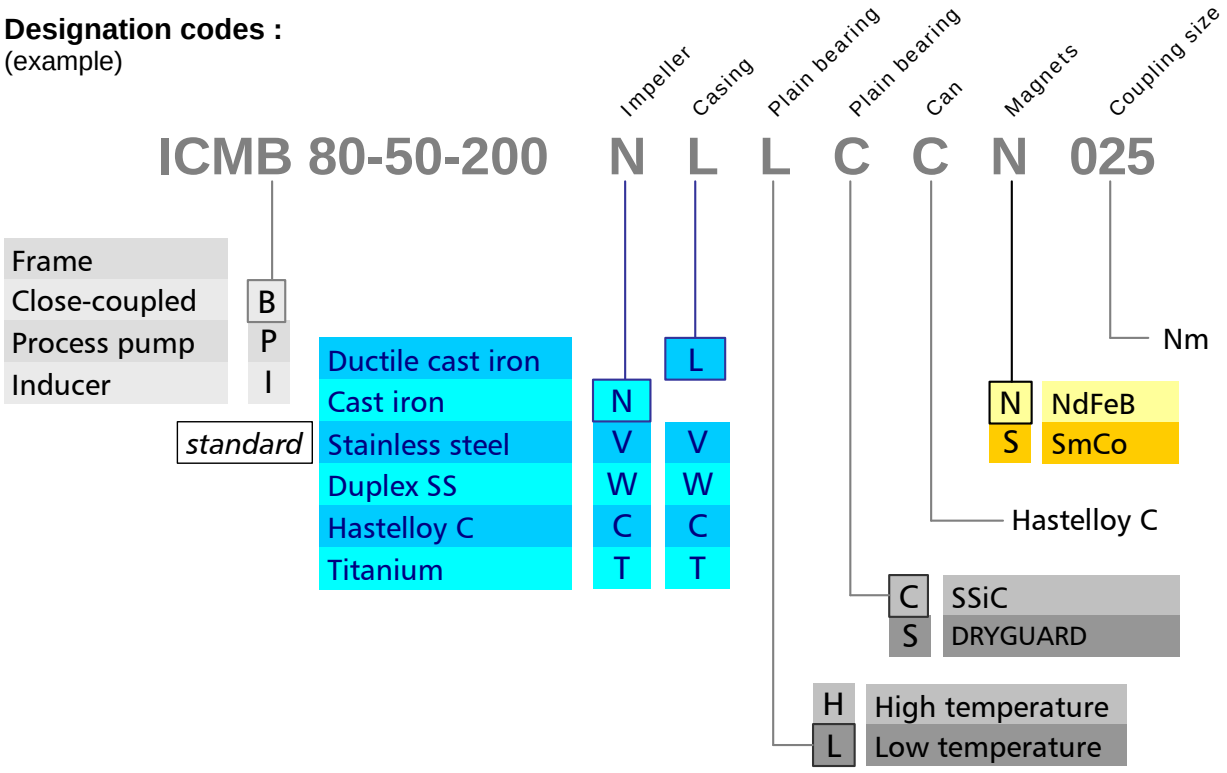
Weight :

See installation drawing

Dimensions :

See installation drawing

Designation codes :
(example)



1.1 Intended use

The pump is equipped with a permanent-magnet synchronous drive. It is suitable for the leak-free conveyance of aggressive, toxic, ignitable or hot liquids.

The observance of the specified physical limits is important for perfect functioning and safe operation, especially with regard to explosion protection to prevent potential sources of ignition (see **Section 2.5**):

- It must be ensured that the pump is always filled with liquid during operation.
- For safe pump operation, we recommend a flow rate which lies between 0.3 and 1.1 Q_{opt}. The maximum operating temperature must never be exceeded. See **Section 2.5.7.** In case of doubt, you must consult the manufacturer.
- The manufacturer must be consulted in the event of entrainment of gas >2% as well as solids in order to avoid a lack of lubrication and dry-running.
- The plant NPSH value (NPSHA) should be 0.5 m higher than the NPSH value of the pump (NPSHR). See also **Section 5.4.1.**

Inadmissible modes of operation, even for a short period, may result in serious damage to the unit.

In connection with explosion protection, potential sources of ignition (overheating, electrostatic and induced charges, mechanical and electric sparks) may result from these inadmissible modes of operation; their occurrence can only be prevented by adhering to the intended use.

Furthermore, reference is made in this connection to the Directive 95/C332/06 (ATEX 118a) which contains the minimum regulations for improving the occupational health and safety of the workers who may be at risk from an explosive atmosphere.

This unit must not be operated above the values specified in the data sheet as regards the fluid to be conveyed, flow rate, speed, density, delivery head and operating temperature as well as the motor rating.

The instructions contained in the operating manual or contract documentation must be observed; if necessary consult the manufacturer.

All important features are documented in the data sheet included in the scope of delivery.

In the event of operating conditions other than those described in the data sheet, the following are to be checked again:

- design of the pump
- design of the accessories
- resistance of the materials.

1.2 Tightening torques

Screws greased, tighten in diametrically opposite sequence.

Housing screws 901/3

Pump size	No. x size	Nm
40-25-160	8 x M12	48
50-32-160	8 x M12	48
65-40-160	8 x M12	48
80-50-160	8 x M12	48
40-25-200	12 x M12	48
50-32-200	12 x M12	48
65-40-200	12 x M12	48
80-50-200	12 x M12	48

Pipe screws, flanges to DIN/ISO

DN	No. x size	Nm
25	4 x M12	12
32	4 x M16	18
40	4 x M16	22
50	4 x M16	30
65	4 x M16	40
80	8 x M16	25

Impeller nut 231

	No. x size	Nm
	1 x M12x1,5	35

Plain bearing cartridge screws 901/1

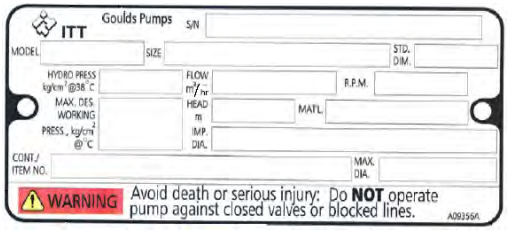
	3 x M8	12 Nm

1.3 Type plate, dry-running, CE and housing markings

The stainless steel type plate is firmly riveted to the bearing pedestal:

If the operator attaches his identification, it must be ensured that the pump matches the application in question.

Example of type plate:



CE-marking:

When CE applies

When CE & ATEX applies

Housing identification:

The following are visible on the housing according to DIN EN 19:

- Nominal size
- Rated pressure
- Housing material
- Manufacturer's identification
- Melt number/Foundry identification
- Foundry date

2 Notes on safety

This operating manual contains fundamental information which is to be observed during installation, operation and maintenance. **It must be read before installation and commissioning**.

This operating manual must always be available at the place of use of the machine/plant.

In addition to the general notes on safety under the main heading “Safety”, special notes on safety are included at other points and must be observed.

Installation, operation and maintenance are to be performed by skilled staff.

The area of responsibility, authority and supervision of the staff must be exactly regulated by the customer.

If the staff do not have the necessary expertise, they are to be trained and instructed.

If necessary, this can be provided by the manufacturer/supplier on behalf of the machine operator.

General hazard symbol! People may be put at risk.

Safety symbol! The pump and its function may be put at risk if this safety symbol is not observed.

EU Symbol! Explosion-protected equipment must be identified for work in explosive atmospheres.

Warning of a magnetic field!

Warning of electric power!

This warning sign must be used if people with a pacemaker are at risk, e.g. from a strong magnetic field.

It is imperative to observe signs attached directly to the pump / unit, e.g.:

- Direction of rotation arrow
- Warning against dry-running

and they are to be kept legible.

Non-observance of the notes on safety may result in the loss of any and all claims for damages.

Non-observance may involve the following hazards :

- Failure of important functions of the machine/plant.
- Failure of electronic equipment and measuring instruments due to magnetic fields.
- Risk to people and their personal property from magnetic fields.
- Risk to people from electric, mechanical and chemical effects.
- Risks to the environment through leaks of hazardous substances.

If the unit is used in potentially explosive areas, special attention is to be paid to the sections identified with “Ex” in this operating manual.

2.1 For the customer/operator

The following must be observed:

- The notes on safety contained in this operating manual,
- the prevailing regulations on accident prevention,
- in-house work, operating and safety regulations of the customer.
- Hot or cold machine parts must be protected by the customer against being touched.
- No protective facilities may be removed when the machine is in operation.
- Hazards due to electricity are to be excluded.
- Leaks of hazardous media (e.g. explosive, toxic, hot) must be removed so that no risk arises for people and the environment. The statutory provisions are to be observed.

Caution when using the units in potentially explosive area! Inadmissible modes of operation must be prevented.

2.2 For maintenance

In principle, work on the unit may only be performed when it is at a standstill.
It is imperative to observe the procedure for stopping the machine described in this operating manual. See **Section 6.3**.

Pumps which convey media which are a health hazard must be decontaminated.

All safety and protective facilities must be remounted or enabled immediately after the end of work.

In the assemble state, if the safety notes (see also **Section 5.1 and 7.5.2**) are observed, the magnetic drives do not cause any risks or have any affect on the environment.

During dismantling and assembly as well as during transport and storage of the magnetic drives as single components, the notes on safety in **Section 7.5.2** must be observed.

The points listed in **Section 6.1** must be followed before recommissioning.

2.3 Conversion work and production of spare parts by the customer

Conversion of or changes to the machine are only admissible after consultation with the manufacturer.

Original spare parts and accessories authorised by the manufacturer serve to enhance safety.

The use of other parts may annul the liability for any resultant consequences.

2.4 Inadmissible modes of operation

The operational safety of the machine supplied is only guaranteed if it is used properly in accordance with **Section 1.1** of this operating manual.

The operating limits specified in the data sheet must under no circumstances be exceeded.

2.5 Explosion protection

If the units are used in potentially explosive areas, the measures and notes in **Sections 2.5.1 to 2.5.8** are imperative to guarantee the explosion protection.

2.5.1 Filling the unit

During pump operation the wetted interior of the pump must always be filled with the liquid medium.
This prevents any explosive atmosphere and the risk of dry-running.

If the customer cannot ensure this, we recommend that appropriate monitoring facilities be provided.

All auxiliary, heating and cooling systems must also be carefully filled.

2.5.2 Special operating conditions

In the standard design the can chamber and the plain bearings are cooled and lubricated by a flushing flow.

The cooling flow may be interrupted and an inadmissible rise in temperature may occur due to properties of the liquid (e.g. sticking, possibly by an inadmissible ingress of solids, clogging, ingress of gas etc.). Appropriate monitoring facilities are to be provided. See **Section 5.6**.

For safe pump operation, we recommend a flow rate of 0.3 to 1.1 Q_{opt}. If the pump is operated outside this range, it must be ensured that the max. admissible flow rate according to the pump characteristic curve is not exceeded and that the max. admissible operating temperature according to **Section 2.5.6** is observed.
If the cooling flow is too low or there is none at all, this may lead to an inadmissible rise in temperature on the metallic can owing to eddy current losses.

If the flow rate is too high, the differential pressure upstream and downstream of the plain bearings could fall so much that a lack of lubrication or dry-running may occur.
If the flow rate is too low, the medium may heat up so much owing to the fluid friction that the max. admissible surface temperature of the relevant temperature class is exceeded.
Overloading, overheating, non-observance of the design data or the incorrect selection of the magnetic drive can lead to the decoupling of the inner and outer magnet assemblies. As a result, eddy currents are induced on the can and the inner and outer magnet assemblies and an inadmissible rise in temperature may occur.
The situation is to be remedied by providing appropriate monitoring facilities. See **Section 5.6**.

The plant NPSH value (NPSHA) should be 0.5 m higher than the NPSH value of the pump (NPSHR) to prevent a lack of lubrication or dry-running of the plain bearings.

2.5.3 Identification

The identification on the pump relates to the pump section. A separate declaration of conformity must be provided for the motor and for other attachments as well as corresponding identification.

Example of the identification of the pump section: CE Ex II 2 G/D T1-T... .

The identification indicates the theoretically available range of the temperature classes. The admissible temperature depending on the pump design are derived in accordance with **Section 2.5.6**. The same applies to the drive.

For an overall unit (pump, motor) with various temperature classes, the lowest class in each case applies as follows:

Example 1: Pump **T3**, motor **T4**
T3 applies, i.e. the unit may only be used in atmospheres which may ignite at temperatures <200 °C (+ safety margin). The maximum medium temperature of the pump for this example is 135° C (see table in **Section 2.5.6**).

Example 2 : Pump **T4**, Motor **T3**
T3 applies, i.e. the unit may only be used in atmospheres which may ignite at temperatures <200 °C (+ safety margin).

2.5.4 Check of the direction of rotation

If there is also a risk of explosion during the installation phase, the check of the direction of rotation must under no circumstances be conducted by briefly switching on the unfilled pump in order to prevent an inadmissible rise in temperature at the plain bearings.

We recommend you to only perform a check of the direction of rotation with filled pump and with a rotating field instrument. See also **Section 6.1.2.**

2.5.5 Mode of operation of the pump

The pump may only be started with the suction side shut-off element fully opened and the discharge side shut-off element slightly opened. Start-up against a closed check valve is also possible. The discharge side shut-off element is to be regulated to the operating design point directly after run-up. See also **Section 5.4.1**.

Operation with closed shut-off elements in the suction and/or discharge lines is not permitted!

There is a risk that even after a short time high surface temperatures on the pump housing may occur owing to rapid heating of the liquid in the pump interior.

A rapid rise in the pressure inside the pump involves the risk of overloading to the point of bursting.

The pump must not be in operation in the unfilled or partially filled state (dry running). This results in serious damage to the pump and additional risks to the environment can arise.

Dry-running cannot only occur with an insufficiently filled interior but also in the event of high gas contents in the liquid medium.

Operation of the pump outside the admissible operating range may also lead to dry-running (e.g. due to evaporation in the interior).

2.5.6 Temperature limits

In the normal operating condition the highest temperatures are to be expected at the mettalic can and in the area of the rolling bearings.

In the case of liquids >40 °C the surface temperature of the pump housing is generally lower than the temperature of the liquid.

If the pump is heated (e.g. heating jacket), it must be ensured that the temperature classes prescribed in the annex are observed.

The entire pump surface must have free contact with the environment.

During operation of the pump it must be ensured that excessive deposits of dust are prevented (regular cleaning) in order to prevent the pump surface from heating to above the admissible temperature.

The following table contains the resultant theoretical limit values of the temperature of the liquid medium allowing for the temperature classes according to EN 13463-1.

Temperature class acc. to EN 13463-1	Limit value of the temperature of the liquid
T6 (85 °C)	60 °C [1)]
T5 (100 °C)	75 °C [1)]
T4 (135 °C)	110 °C [1)]
T3 (200 °C)	135 °C [2)]
T2 (300 °C)	135 °C [2)]
T1 (450 °C)	135 °C [2)]

1) The limit values specified for the temperature of the medium at the pump inlet are determined for the most unfavourable case (high speed, low flow rate, low heat capacity of the medium, large magnetic drive ....). Under favourable operating conditions the limit values specified may be increased by up to 10 K after consultation with the manufacturer.

2) For ambient temperatures lower than 40 °C higher medium temperatures may also be permitted after consultation with the manufacturer.

The admissible operating temperature of the pump is indicated in the data sheet of the pump.

The plant customer must ensure that the prescribed operating temperature is observed. The maximum admissible temperature of the liquid medium at the pump inlet depends on the temperature class and the selected lining material required in each case.

2.5.7 Maintenance

For safe and reliable operation, it must be ensured with regular inspection intervals that the unit is properly serviced and kept in a perfect technical condition.

If auxiliary systems (e.g. external flushing, cooling, heating) are installed, a check must be made to see whether monitoring facilities are required to safeguard their operation.

2.5.8 Electric peripheral equipment

Electric peripheral equipment, e.g. pressure, temperature and flow sensors etc. must comply with the prevailing safety requirements and explosion protection provisions.

Regular checks of the motor bearings in accordance with the operating manual of the motor manufacturer. Observe ATEX notes.

3 Transport and storage

The pump or the unit must be transported properly. It must be ensured that during transport the pump/unit remains in the horizontal position and does not slip out of the transport suspension points.

A pump or motor can be suspended from the ring bolt provided for this purpose.

The suspension points are not suitable for transporting a complete unit, i.e. pump with base plate and motor.

In this case, the slinging points for the ropes on the base plate are to be used. See **Fig. 1**.

The slinging ropes must not be attached to free shaft ends or to the ring bolt of the motor.

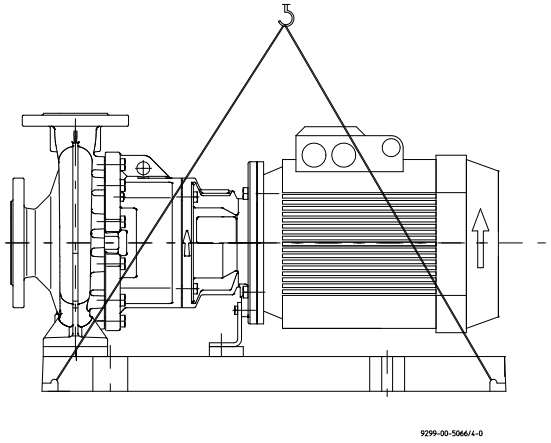


Fig. 1

Directly after receipt of the goods, the consignment must be checked for completeness and any in-transit damage.

Damaged pumps must not be installed in the plant.

When unpacking magnetic drives as single parts, the relevant notes in **Section 7.5.2** must be observed.

Handle goods carefully to prevent damage.

Flange covers serve as protection during transport and must not be removed.

If the unit is not installed immediately after delivery, it must be put into proper storage.

It should be stored in a dry, vibration-free room as at constant a temperature as possible.

If magnetic drives are stored as single parts, the relevant notes in **Section 7.5.2** are to be observed.

In the case of **prolonged storage** conservation agents on machined component surfaces and packing with a desiccant may be necessary.

3.1 Return consignments

Pumps which have conveyed aggressive or toxic media must be well flushed and cleaned before being returned to the manufacturer's works.

A **General Safety Certificate** on the field of application is to be enclosed with the returned goods.

Pre-printed forms are enclosed with the installation and operating manual.

Safety precautions and decontamination methods are to be mentioned.

4 Product description

The housing dimensions of the pump model ICMB comply with ISO 2858 / DIN EN 22858.

The technical requirements and nominal ratings of the pump models ICMB comply with ISO 2858 / DIN EN 22858 / ISO 15783 / DIN ISO 5199.

The **sectional drawing** shows the pump set-up. See **Section 9**.

The metal housing **100** has an axial suction nozzle and radial discharge nozzle. The housing drain screw **103** permits the entire pump including the can interior to be drained.

The impeller **230** is of closed design. The back vanes serve to offset the axial thrust. The impeller is attached to the magnet assembly shaft by an impeller nut **231** and key **940/2** and rests against the distance washer **551/1**.

The plain bearing pedestal **339** has flushing bores which serve to dissipate the heat on the can and lubricate the plain bearing cartridge **310**. Depending on the pump design, connection tapped bores can be provided on the plain bearing pedestal to permit access to the pump interior (e.g. for monitoring devices or external flushing).

The plain bearing cartridge **310** encapsulates all the individual parts of the bearing system and permits the exchange of the complete unit in one piece. It is attached to the plain bearing pedestal with hex. screws **901/1**. The inner magnet assembly **859** is fitted with permanent magnets. These magnets of the inner magnet assembly are protected against the medium by a corrosion-resistant metallic cover. The inner magnet assembly and shaft are one piece.

A parallel pin **562/1** serves as an anti-torsion insert for the plain bearing cartridge.

The inner magnet assembly accommodates axial vanes to promote the flushing flow.

The metallic can **159** seals the pump interior against the atmosphere to ensure it is leak-proof.

The lantern **344** is screwed against the housing with hex. screws **901/3** and washers **554/3**. Both the housing gasket **401** and the can gasket **406** are tightly sealed through the direct action of the bolting force. The lantern has a safety rubbing surface which protects the can against damage from the drive magnet assembly if the rolling bearings become defective.

The hex. screws **901/5** prevent the individual parts from falling apart when the entire slide-in unit is being removed from the pump housing. These screws are not provided in some pump sizes. Instead the set-screws **904/2** perform this function.

Should the can become defective, the flat gasket **400/1** at least seals the medium against the atmosphere for a short period.

The adapter **346** joins the motor flange to the lantern.
The torque is transmitted from the motor through the key **940/1** to the hollow drive shaft **216** and then to the drive magnet assembly **858**.
The magnets are stuck into the drive magnet assembly. It is axially secured by the hex. socket screw **914/1**.

The flushing/cooling flow is fed into the can chamber through the flushing bores in the plain bearing pedestal. The flushing flow passes through the plain bearings back into the housing. The rotating magnets generate an eddy current in the can which heats the flushing/cooling flow.

Design details are provided in the sectional drawing, **Section 9**.
Additional information is also contained in the **Brochure** and **Pricebook**.

5 Installation

5.1 Safety regulations

Equipment which is operated in potentially explosive areas must satisfy the explosion protection regulations.

People with a pacemaker are at risk from the strong magnetic field of the magnetic drive. It may be life-threatening for them to stay at a distance of less than 500 mm to the pump.

5.2 Installation of pump/unit

The structural work must be prepared in accordance with the dimensions in the installation drawing.

Method of installation: on a grouted base plate and firm foundation

- Align base plate on the ground foundation.
- Insert foundation bolts and grout base plate.
- Do not tighten the foundation bolts uniformly and firmly until the mortar has set.

5.3 Alignment of pump – coupling - motor

The following information is of a general nature. If necessary, special notes of the coupling manufacturer are to be observed.

- Prior to alignment work, loosen the support bracket **183**. Align the unit with the housing so that there is no tension and retighten the support bracket.
- Use supports in the direct vicinity of the bolts foundation/base plate.

5.4 Piping

Before the pump is installed, both, the suction and supply lines as well as the discharge line are to be cleaned.

Dirt or damage to the sealing surfaces is best avoided if the flange covers remain on the flanges until just before installation.

Use flange gaskets suitable for the medium.

The screw tightening torques in **Section 1.2** are to be observed for tightening the flange screws.

5.4.1 Nominal size

The operating design point of a centrifugal pump lies at the intersection of the pump curve and the pipe curve, see **Fig. 2**. The pump curve is provided by the pump manufacturer. The pipe curve is determined using diagrams or PC programs.

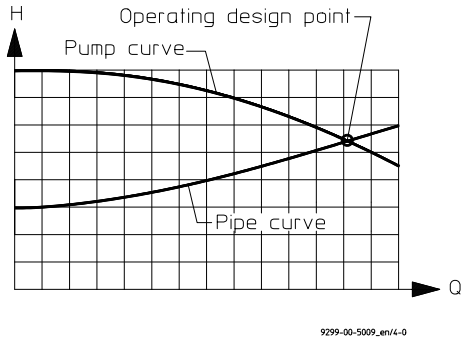


Fig. 2

Under no circumstances can the nominal size of the piping be derived from the connected nominal size of the pump.

The pipe nominal size can also be determined using the flow rate as a rough guide.

$$v(m/s) = \frac{Q(m^3/s)}{A(m^2)}$$

The velocity in the suction line should not exceed 2.0 m/s and 5.0 m/s in the discharge line.

When determining the suction line nominal size, the NPSH value (net positive suction head) must also be observed. The **NPSHR value** required for the pump is specified in the data sheet.

The NPSHR available in the plant should be at least 0.5 m higher than the NPSHR required for the pump. Otherwise, this will lead to a drop in the delivery head, cavitation or even failure of the pump.

5.4.2 Nozzle loads

The pump can be subjected to nozzle loads in accordance with ISO 5199. See also **Pricebook**.

Changes in the length of the piping caused by temperature are to be allowed for by appropriate measures, e.g. the installation of expansion joints.

5.4.3 Suction line

The suction lines must always be laid on a rising gradient towards the pump. Otherwise, gas bubbles may form which considerably reduce the suction line cross section. Eccentric transition elements must be installed between different pipe diameters.

Valves which disrupt the course of flow should not be installed directly upstream of the pump.

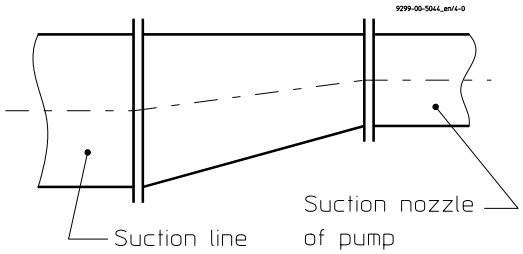


Fig. 3

5.4.4 Supply lines

Supply lines should vent towards the reservoir and are therefore to be laid with a constant downward gradient towards the pump. Should the piping internals upstream of the pump be horizontal, a low point can, of course, be located upstream of these internals. From here the pipe is then laid with an upward gradient to the pump so that the gas bubbles which form here can escape through the pump.
Valves which disrupt the course of flow should not be installed directly upstream of the pump.

5.4.5 Discharge line

Do not arrange the shut-off valve directly above the pump but initially provide a transition section.
The discharge nozzle velocity of the medium can – if necessary – be reduced.

5.4.6 Venting and evacuating

Venting can take place into the discharge line or upstream of the discharge valve.
A venting line can also be used as a bypass, drain or flushing line.
The pump housing is fitted with a drain connection as a standard feature.

5.5 Not Used

5.6 Monitoring facilities

Appropriate monitoring facilities are to be recommended, depending on the requirements placed on operational safety and availability of the unit.

Goulds provides information on request and can supply:

- Flow meters
- Filling level indicators
- Motor load monitors
- Temperature monitors
- Rolling bearing monitors
- Leak monitors
- Pump management "Pump Smart"®

5.7 Drive

The power consumption of the pump at the operating design point is specified in the data sheet and works certificate. If the operating design point was not known when the pump was dispatched, the power consumption can be read off the appropriate performance curves. The max. density, the max. viscosity and a safety margin are to be allowed for.

Care must be taken when selecting the motor size to ensure that the excess power is not too great. During start-up the magnetic drive could otherwise stop.

The magnetic drive rating at the nominal speed of 2900 rpm is given in the pump data sheet.

If the motor power exceeds this rating, it is necessary to check the stoppage of the magnetic drive.

The same also applies if the required drive rating exceeds 80 % of the magnetic drive rating.

Consult ITT Goulds if necessary.

Different operating data can be achieved without changing the pump through the use of different speeds, e.g. by means of a frequency converter.

The pump with base plate and motor is illustrated in the **installation drawing**.

The **operating manual of the motor manufacturer** must be observed.

A motor with a valid ATEX certificate is to be used if employed in zone 1 and 2.

5.8 Electric connection

Only have the electric connection performed by a qualified electrician. Compare the available mains voltage with the information on the type plate of the motor and select a suitable circuit.
It is urgently recommended to use motor protection facilities (motor protection switch).

In potentially explosive areas IEC 60079-14 must also be observed for the electrical installation.

It must be ensured that the pump is grounded. This can be achieved in the simplest case by using a toothed-lock washer or a contact disc at the housing support if the substructure itself is grounded.
Otherwise, grounding must be ensured by other means, e.g. cable bridges.

Units supplied by Goulds (pump and base plates) are to be grounded using suitable devices on the base plate.

6 Commissioning/Shutdown

6.1 Initial commissioning

Normally, the pumps have already been test-run with water. Unless special agreements have been made, there could still be residual amounts of water in the pump. This must be noted in view of a possible reaction with the medium.

6.1.1 Filling the pump housing

- Check to see whether the screws on the suction flange, discharge flange, housing flange and drain flange are tightened. When retightening the housing screws, make sure that the support bracket is undone. Otherwise, the pump could be deformed. For screw tightening torques see **Section 1.2**.
- Open the suction line fully so that the medium can flow into the pump.
- Open the discharge valve so that the air in the pump can escape.
- If air cannot be vented into the discharge line, e.g. a drop in pressure in this line is not permitted, venting must be performed upstream of the discharge valve.
- Monitor the venting operation until no air but only liquid emerges.
- Close the discharge valve again until only the minimum flow rate is obtained after the motor has been started.

6.1.2 Start-up

- Check the direction of rotation of the motor with a rotary field instrument.
- As viewed from the motor, the direction of rotation of the pump is clockwise. See also the **direction of rotation arrow** of the pump.

If no rotating field instrument is available, the motor may also be activated briefly, with the pump filled, so that it does run up. You can observe the direction of rotation through the fan hood.

The pump must not run dry during the check of the direction of rotation.

The pump must be completely filled with liquid. The maximum admissible flow rate must not be exceeded.

Otherwise the plain bearings can run dry in both cases.

- Switch the motor on.
- Set the desired flow by opening the discharge valve.

When the motor is running but the pump is not conveying, this means that the magnetic drive has stopped.

Switch the motor off immediately to prevent overheating of the magnets.

Then proceeded as follows:

- Close discharge valve down to the position "minimum flow rate".
- Start motor again.

If the magnetic drive stops again, look for the cause.

6.2 Operating limits

The operating limits of the pump/unit in terms of pressure, temperature, power and speed are entered in the data sheet and it is imperative to observe them!

6.2.1 Abrasive media

If liquids with abrasive constituents are conveyed, increased wear at the pump is to be expected.

The inspection intervals should be reduced compared with the usual times.

6.2.2 Min./max. flow rate

The operating range generally recommended lies at 0.3 Q_{opt} to 1.1 Q_{opt}. Consult the manufacturer for operation outside this range and observe **Section 2.5.2.**

6.3 Shutdown

- Close discharge valve down to the position "minimum flow rate"
- Switch motor off.
- Close discharge valve completely.

Only close the suction line if the pump is to be evacuated or dismantled.

For all work on the machine, make sure that the motor cannot be inadvertently switched on.

If the pump is to be evacuated or flushed, observe the local regulations.

It is recommended to wait one hour before the pump is dismantled from the plant to permit static peak charges to be eliminated.

If the pump is returned to the manufacturer's, clean the pump very thoroughly.
See also **Section 3.1**.

6.4 Restarting

When the pump is restarted, it must be ensured that all the relative steps as described in **Section 6.1** are repeated, depending on the progress of the shutdown operation.

6.5 Inadmissible modes of operations and their consequences (examples)

Inadmissible modes of operation, even for a short time, can result in serious damage to the unit.

In connection with explosion protection, potential sources of ignition (overheating, electrostatic and induced charges, mechanical and electric sparks) may result from these inadmissible modes of operation; their occurrence can only be prevented by adhering to the intended use.

Pump is started up without medium :

- The plain bearings in the pump may be destroyed.
- Other pump components may be destroyed due to overheating.

Suction line not opened or not opened fully :

- Pump suffers cavitation – material damage.
- Pump does not achieve the necessary head or flow rate.
- Pump may be destroyed due to overheating.

Discharge valve closed too much :

- Pump may be destroyed due to overheating.
- Axial thrust too great.

Discharge valve opened too much :

- Pump can cavitate. Particularly severe with an empty discharge line.
- Risk of pressure surge.
- Possible damage to the plain bearings.
- Magnetic drive may stop.
- Motor may be overloaded.

Suction valve and discharge valve closed :

- Destruction due to rapid overheating and sharp rise in pressure.

Control of the pump with the suction valve :

- Cavitation – the flow is only to be regulated on the discharge side.

Operation with magnetic drive stopped :

- If no heat is dissipated, damage to the inner and drive magnet assemblies may occur.

7 Maintenance

7.1 Screw connections of the housing

After initial loading by the operating pressure and operating temperature the tightening torques of all connection screws must be checked at the following points:

- housing flange
- suction flange
- discharge flange

See also **Section 6.1, para. 1**.

Other inspections are to be performed regularly, depending on the operating requirements.

7.2 Motor

The operating manual of the motor manufacturer must be observed.

A motor with a valid ATEX certificate is to be used if employed in zone 1 and 2.

Observe the ATEX notes of the motor manufacturer.

7.3 Cleaning

Care must be taken when cleaning the pump to ensure that it is not exposed to a strong water jet.
The ingress of water into the bearing pedestal would substantially impair bearing lubrication.

7.4 Stand-by pumps

If a pump is on stand-by, it is to be started up from time to time. Regularly turn the shaft by hand in the direction of rotation.
This operation is to be performed more often for pumps which are exposed to very strong vibrations from the plant.
When dismantling the pump from the plant, drain it, thoroughly clean it, seal with flange covers and store in accordance with the instructions.

7.5 Notes on dismantling

All repair and maintenance work is to be performed by skilled staff using appropriate tools and original spare parts.

Is the necessary **documentation** available?

Has the pump been taken out of operation, evacuated and flushed correctly? See also **Section 6.3.**

7.5.1 Protective clothes

Even if the pump has been properly evacuated and rinsed, residue of the medium may still remain in the pump.
Example: Between sealing surfaces or in the bearing seats.

Protective clothing in accordance with the regulations is to be worn.

Protective clothing is also to be worn even if only the bearing pedestal is to be removed. It may be that medium has penetrated into the lantern chamber through the can.

7.5.2 Magnetic fields

Caution! Strong magnetic fields

Risk during dismantling and in the vicinity of magnetic drives as single parts.
Remove loose parts and other magnetisable metals from the work bench. They could otherwise be attracted : **Risk of accident !**

Place any tools needed at a safe distance.

Keep electronic equipment and measuring instruments at a distance. In cases of doubt ask the equipment manufacturer.

Hold magnetic drives as single parts firmly or secure. Otherwise, they could be attracted, for example, by a vice: **Risk of accident !**

People with an artificial pacemaker
Keep torso **at a minimum distance of 500 mm**.

Mechanical watches and electric data carriers as well as digital watches or pocket calculators:
150 mm distance.

Data carriers such as credit cards, cheque cards, ID cards with magnetic strips or magnetic tapes:
150 mm distance.

7.6 Dismantling

There are three possibilities for dismantling:

1. Dismantling the entire pump from the plant.
2. Dismantling the entire slide-in unit, i.e. the housing remains in the plant.
3. Removing only the drive section, i.e. the pump does not need to be drained (back-pull-out design).

Dismantling of the entire pump is described.

7.6.1 Removing of drive section

**Caution! Magnetic forces!
Risk of accident!**

Axial forces are produced when the drive section is pulled out of the lantern. These forces diminish again abruptly after it has been removed.

The operating torque of the magnetic coupling installed is specified on the **type plate**.

- Secure complete pump on a workbench or worktop.
- Secure motor **800/1** to a crane by a lifting screw.
- Undo adapter screwing **901/4, 554/4**.
- If necessary, remove adapter **346** from the centring of the lantern **344** using 2 levers.

  If required you have the possibility to use the two threaded holes in the beating frame for jacking screws (M12).
- Lift unit with a crane out of the lantern.
- Remove flat gasket **400/1**.

7.6.2 Dismantling drive section

- Undo hex. socket screw **914/1** in counterclockwise direction.
- Pull off drive magnet assembly **858**.
- Undo screwing **901/7, 554/7, 920/7**.
- Pull adapter **346** off motor flange (possibly using two levers).
- Undo setscrew **904/1**.
- Pull hollow drive shaft **216** off motor shaft.
- Remove support bracket **183**.

7.6.3 Removing lantern, can and plain bearing pedestal

- Undo housing screwing **901/3, 554/3**.
- Do not undo the two screws **901/5** (if installed). They hold the lantern **344**, can **159** and plain bearing pedestal **339** together.
- Pull the entire slide-in unit out of the housing **100**.
- If the housing does not move (e.g. owing to corrosion at the centering), remove the two plastic plugs from the lantern **344**.
- Screw in jacking screws M8 and use them to press off the lantern.

7.6.4 Dismantling lantern, can and plain bearing pedestal

- Place the unit lantern **344** / plain bearing pedestal **339** / impeller **230** on the workbench with the impeller facing upwards.
- Remove the two hex. screws **901/5** or the 3 setscrews **904/2** (depending on size).
- Remove lantern **344** and can **159**.
- Place remaining unit on the inner magnet assembly.
- Place strap wrench around the impeller and undo the impeller nut **231** counterclockwise.
- Pull off impeller **230**.
- Remove key **940/2**, distance washer **551/1** and intermediate ring **509/2**.

- Pull the plain bearing cartridge **310** with plain bearing pedestal **339** out of the inner magnet assembly **859**.
- Remove 2nd intermediate ring **509/1** from the inner magnet assembly **859**.
- If the inner magnet assembly or inner magnet assembly shaft has to be replaced (split inner magnet assembly):
  Push the inner magnet assembly shaft **220** and key **940/2** out of the inner magnet assembly **859** with a hydraulic press. Make sure that the thread for the impeller nut is not damaged.
- Undo screws **901/1** and remove plain bearing cartridge **310** from the plain bearing pedestal **339**.

7.6.5 Dismantling the plain bearing

The plain bearing cartridge **310** is one unit which - if necessary - is replaced completely.

7.7 Notes on assembly

All the details in **Section 7.5** are to be observed, in particular the notes on safety.

Good mechanical engineering practice is to be observed for assembly work.

Use original spare parts. See also **Section 2.3**. Do not use defective parts.

Apply Anti Seize paste to close-tolerance surfaces (not on stainless steel parts) and screw thread prior to assembly.

Check whether all parts fit and only then perform assembly.

Important dimensions are to be checked before assembly, e.g. by fitting parts together as a test.

These important dimensions are centerings, bearing seats or bearing clearances.

During assembly, gaskets **400**, **401** and **406** are to be replaced, intermediate rings **509** must be replaced.

Prior to assembly, remove any metallic particles adhering to parts fitted with magnets.

7.8 Assembly

A complete assembly operation is described in the following.
Sub-sections can be deduced from this.

7.8.1 Drive section

- Mount support bracket **183** with hex. screws **901/2** and contact discs **557/2** on adapter **346.** The attachment slots of the support surface face towards the housing.
- Insert key **940/3** into the motor shaft.
- Push hollow drive shaft right onto the motor shaft, attach with setscrew **904/1** and secure with a drop of Loctite 234, for example.
- Mount adapter **346** on motor.
- Mount drive magnet assembly **858** onto the hollow drive shaft so that the driver cams engage.
- Screw in hex. socket screw **914/1** with tooth lock washer **557/1**. Secure thread, with a drop e.g of Loctite 234. A hex. socket screw key with a minimum length of 120 mm is required for tightening.

7.8.2 Plain bearing pedestal with impeller, inner magnet assembly and plain bearings

- Insert the plain bearing cartridge **310** into the centering of the plain bearing pedestal **339**.
- Move the plain bearing cartridge into a position which permits all 3 hex. screws **901/1** to be inserted.
- Tighten screws with an open-jaw wrench.
  For tightening torques, see **Section 1.2**.
- For single-part inner magnet assembly:
  If the parallel pin **562/1** in the clearance bore in the inner magnet assembly **859** has to be replaced, force it in carefully. It is to protrude by about 3 mm towards the impeller. See **Fig. 5**.

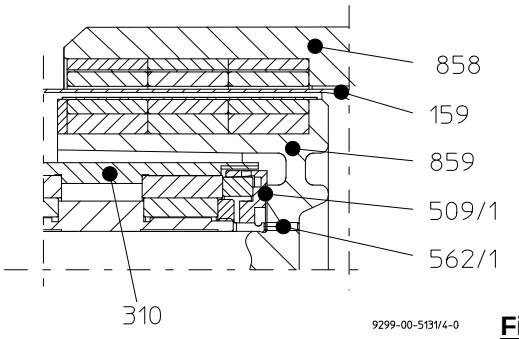


Fig. 5

- For split inner magnet assembly (if necessary):

Press the inner magnet assembly shaft **220** with key **940/4** fully into the inner magnet assembly **859**. See sectional drawings in **Section 9**.

- Cut out a small corner on the inside diameter of the intermediate ring **509/1** so that a recess is produced for the parallel pin **562/1** (single-part inner magnet assembly) or the key **940/4** (split inner magnet assembly).
- Then mount the intermediate ring **509/1** onto the shaft of the inner magnet assembly **859**.
- Apply Anti Seize assembly paste to the shaft and impeller holder.
- Place inner magnet assembly on the workbench and mount the pre-assembled unit plain bearing pedestal / plain bearing cartridge from above onto the inner magnet assembly. **Make sure that the parallel pin 562/1 engages in the carrier groove of the plain bearing cartridge.** To facilitate alignment, the plain bearing pedestal can be turned to and fro slightly.
- Mount 2nd intermediate ring **509/2** onto the drive shaft.
- Mount distance washer **551/1**.
- Insert key **940/2**.
- Mount impeller **230**.
- Insert PTFE O-ring **912/1** into the groove of the impeller nut **231**.
- Tighten impeller nut. Secure it with a drop of e. g. Loctite 234. Countercheck the inner magnet assembly with a strap wrench.
  For tightening torques, see **Section 1.2**.
- It must be possible to easily turn the plain bearing pedestal **339** by hand. When raising the plain bearing pedestal, a slight axial play of the plain bearing of up to 1 mm must be felt.
- The axial play of the plain bearing is automatically set during assembly.

7.8.3 Can and lantern

- Place the can gasket **406** in the centering on the plain bearing pedestal **339**.
- Mount can **159** and lantern **344**.
- Screw the two connection screws **901/5** or the 3 setscrews **904/2** (depending on size) of the lantern **344** into the plain bearing pedestal **339** and tighten.

7.8.4 Final assembly

- Secure the housing **100** with the suction nozzle facing downwards on a workbench or worktop.
- Insert the housing gasket **401** into the housing centering.
- Insert the unit pre-assembled as described in **Sections 7.8.2** and **7.8.3** into the housing so that the crane hook of the lantern faces the centre of the discharge nozzle.
- Screw in the housing screws **901/3** with washers **554/3** and tighten.
  For tightening torques, see **Section 1.2**.
- Insert flat gasket **400/1** into the centering of the lantern **344**.

Introduce the drive section pre-assembled as per **Section 7.8.1** into the lantern.
It results in **strong axial forces**.

- Screw in hex. screws **901/4** with washers **554/4** and tighten.
- Insert plastic plugs into the tapped bores for the jacking screws on the lantern **344**.
- Turn the inner magnet assembly shaft by hand to check its function. Check by looking into the suction nozzle whether the impeller turns.

7.9 Tests

The pumps are tested with water at the manufacturer's.

The operating data measured are documented in a **test certificate**.

The following conveying data can be checked using the **pump performance curves**:

- Flow rate
- Head
- Power requirement
- NPSHR

8 Faults

Faults may result from inadmissible modes of operation. Such inadmissible modes of operation – even brief ones – may cause serious damage to the unit.
In connection with explosion protection, potential sources of ignition (overheating, electrostatic and induced charges, mechanical and electric sparks) can result from these inadmissible modes of operation; their occurrence can only be prevented by adhering to the intended use.
See also **Section 6.5**.

Should there be any uncertainty about the remedy to be applied, please inquire at the in-house pump office or at the pump manufacturer's.

No delivery :

- Is the pump filled and vented?
- Is the suction line open, vented, cleaned and correctly laid?
- Is the discharge line open, vented, cleaned and correctly laid?
- Is the geodetic head too high?
- Is air being drawn in?
- Has the magnetic drive stopped?

Flow rate too low :

- Have the pump, suction line and discharge line been completely vented, filled and cleaned?
- Have any strainers installed been cleaned?
- Are all shut-off devices closed?
- Is the geodetic head too high?
- Is the NPSHA too low or the NPSHR too high?
- Are the pipe resistances too high?
- Is the viscosity too high?
- Is the direction of rotation correct?
- Is the speed too low or the impeller diameter too small?
- Are pump parts worn?
- Gas in the medium?

Flow rate too high :

- Is the geodetic head too low?
- Are the pipe or nozzle resistances too low?
- Is the pump speed too low or the impeller diameter too large?

Delivery pressure too high :

- Is the speed too high or the impeller diameter too large?
- Is the density too high?

Motor consumes too much electricity :

- Is the flow rate, density or viscosity too high?
- Is the speed too high or the impeller diameter too large?

Pump does not run smoothly or creates noises:

- Are the rolling bearings of the motor damaged?
- Are parts of the hydraulics damaged?
- Is the flow rate too low or too high?
- Is the impeller balanced?
- Is the pump twisted?
- Is there foreign matter in the pump?

Leak from the pump :

- Are all screws tightened to the correct tightening torque?
- Were the sealing surfaces assembled in a clean state?
- Have approved gaskets been installed?

9 Sectional drawing

9.1 **ICMB** close-coupled design