FLOWSERVE

USER INSTRUCTIONS

Durco® MARK 3™ ISO MAG

CBMM/CBME

Sealless magnetic drive single stage centrifugal pumps

Installation

Operation

Maintenance

FLOWSERVE Document N°: PUIOM000266 (EN) July 2020

Original Instructions

⚠ ***These instructions must be read prior to installing, operating, and maintaining this equipment.***

Experience In Motion

Document Version

Initial Release, 31-July - 2020

CONTENTS

1 General Information

1.1 Scope of manual

NOTICE

These instructions must be kept close to the product's operating location or directly with the product.

- These instructions must be read prior to installing, operating, using, or maintaining the equipment in any region worldwide.
- The equipment must not be put into service until all of the safe operating conditions noted in the instructions have been met.
- Failure to comply with the information provided in the User Instructions is considered to be misuse. Personal injury, product damage, delay in operation, or product failure caused by misuse are not covered by the Flowserve warranty.

The following user information covers the Durco MARK 3 ISO MAG sealless centrifugal pumps type CBME (Close coupled design) and CBMM (long coupled design) including optional features:

- Free flow filter or external circulation
- Secondary control
- Heating jackets
- Heat barrier (only CBME)

These instructions are intended to familiarize the reader with the product and its permitted use. Operating the product in compliance with these instruction is important to help ensure reliability in service and avoid risks. These instructions may not take into account all local regulations; ensure such regulations are observed by all personnel, including those installing the product. Always coordinate repair activities with operations personnel, and follow all plant safety requirements and applicable safety and health legislation. Supplementary user instructions determined from the contract requirements for buy-out equipment such as driver, instrumentation, controller, sub-driver, seals, sealant system, mounting component etc., are delivered sepparatly.

1.2 Disclaimer

Information in this User Instruction is believed to be complete and reliable. In spite of all Flowserve's efforts to provide comprehensive information and instructions, sound engineering and safety practices should always be used. Please consult with a qualified engineer.

Flowserve manufactures products to applicable International Quality Management System Standards as certified and audited by external Quality Assurance organizations. Genuine parts and accessories have been designed, tested, and incorporated into the products to help ensure continued product quality and performance in use. As Flowserve cannot test parts and accessories sourced from other vendors the incorrect incorporation of such parts and accessories may adversely affect the performance and safety features of the product. The failure to properly select, install, or use authorized Flowserve parts and accessories is considered to be misuse. Damage or failure caused by misuse is not covered by Flowserve's warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in use.

1.3 Symbol explanation

Table 1: Used symbols

	Information	This symbol indicates a recommendation and important information for handling the product.
▷	Hazard prevention	This symbol indicates hazard prevention measures.
✓	Prerequisites	This symbol refers to the prerequisite conditions in operating instructions.
	Repetition	This symbol in operating instructions refers to repetition of a sequence of actions.
	Result	This symbol refers to the result of operating instructions or sequence of actions.
▶	Step	This symbol refers to an individual step.
	Spare	This symbol indicates spares required in a maintenance/service step.
	Special tool	This symbol refers to special tools required in an installation or maintenance/service step.
	Personnel	This symbol refers to a section for specially authorised personnel.
	Consumables	This symbol refers to consumables required in an installation or maintenance/service step.
	Protective equipment	This symbol refers to protective equipment required in an installation or maintenance/service step.
	Documentation	This symbol refers to supplier documentation required in an installation or maintenance/service step.

1.4 Certification

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform to the Marking Directives applicable to Flowserve products (i.e. Machinery Directive, Low Voltage Directive, Electromagnetic Compatibility (EMC) Directive, Pressure Equipment Directive (PED), Equipment for Potentially Explosive Atmospheres (ATEX), etc.). The standard certification for products of the Durco MARK 3 ISO MAG include (example certificates can be found in Annex of these user instructions):

- ✓ Directive 2006/42/EC (CE marking)
- ✓ Directive 2014/34/EC (Atex marking)

Note: Additional certifications are possible on request (e.g. CUTR, EC 1935/2004, …) contact FLOWSERVE for specific applications where other certification is required. If applicable, copies of other certificates sent separately to the Purchaser should be obtained by the Purchaser for retention with this User Instructions.

1.5 Units

The units of measure used in this document are according to the metric system (eg. Kg, m, s, …)

1.6 Warranty

Warranty conditions can be found in the contractual agreements. A warranty is provided as part of applicable provisions.

2 Safety Information

2.1 Intended use

NOTICE

The product/system must not be operated beyond the parameters specified for the application.

- If there is any doubt as to the suitability of the product/system for the application intended, contact FLOWSERVE for advice, quoting the serial number.

⚠WARNING

Installing, operating, or maintaining the product/system in any way that is not covered in this User Instruction could cause death, serious personnel injury, or damage to the equipment. This includes any modification to the product/system or use of the parts not provided by Flowserve.

- Only operate the product/system when it has successfully passed all acceptance criteria.
- Do not operate the product/system in a partially assembled condition.
- If the conditions of service on the customer's purchase order change (i.e. pumping fluid, temperature, or duty conditions) the user should seek written agreement from Flowserve before start-up.
- Observe equipment labels, such as arrows designating the direction of rotation, warning signs, etc., and keep them in a legible condition. Replace damaged and/or illegible labels immediately.

2.2 Safety symbols and description

This User Instruction contains specific safety markings where non-observance of an instruction would cause a hazard. The specific safety markings are:

Table 2: Definition of safety symbols and markings

Symbol	Description
⚠ DANGER	**DANGER** This symbol indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠WARNING	**WARNING** This symbol indicates a hazardous situation which, if not avoided, could result in death or serious injury
⚠CAUTION	**CAUTION** This symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury

SAFETY INSTRUCTIONS	**Safety Instruction** This symbol indicates specific safety-related instruction or procedures
NOTICE	**NOTICE** This symbol is used to address practices not related to physical injury

Table 3: Additional symbols

Symbol	Description
	**SAFETY ALERT** This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
	**ELECTRICAL HAZARD** This symbol indicates electrical safety instructions where non-compliance would affect personnel safety and could result in loss of life
	**TOXIC HAZARD** This symbol indicates "hazardous substances and toxic fluid" safety instructions where non-compliance would affect personnel safety and would damage the equipment or property
	**ATEX EXPLOSION PROTECTION** This symbol indicates explosive atmosphere marking according to ATEX. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion

	**Caustic**
	Risk of entrapment
	Risk of crushing
	Risk of fire
	Risk of burning
	Hanging load
	Risk of slipping
	Irritating
	Risk for environmental damage
	Risk for material damage

2.3 Personnel actions in case of incident, critical failure or accident

If one or more critical failures are detected, it is necessary to decommission the equipment to find out and eliminate the causes of these failures. In case of any incidents and / or accidents, personnel are required to comply, first of all, with the relevant local instructions developed and accepted by the end-user operator

2.4 Critical failures

Following critical failures can lead to an incident or an accident:

- Permanent loss of tightness of joints against the external environment;
- Destruction or loss of the tightness of the pump body or auxiliary elements;
- Leaks of the working or cooling media;
- Failure of equipment controlling the operation parameters;

2.5 General hazard sources

2.5.1 Mechanical Hazards

Mechanical energy can cause personal injury and material damage. Mechanical hazards during installation and maintenance can be divided up as follows.

a) Lifting limits and guidelines

NOTICE

The load values mentioned in this section are Flowserve recommendations only.

- ▷ All lifting must be done in compliance with site safety protocol, local regulations, and related industry standards.

Many precision parts have sharp corners which require appropriate personal protective equipment during handling. Prior to any attempt to lift an item, employees must first determine the approximate weight and stability of the load.

- ▷ Large, unstable, or awkward loads should always be handled with the assistance of additional personnel or appropriate mechanical means.
- ▷ Excessive loads should only be lifted by appropriate mechanical means and in accordance with current local legislation or with the assistance of additional personnel.
- ▷ Lifting items may be prohibited without assistance if the lift is repetitive and/or awkward (i.e., away from the body, above the shoulders or below the knees) thus placing excessive stress on the personnel.
- ▷ Repetitive lifting of any kind should be evaluated as part of a documented end-user safety program.

b) Rotating and other moving parts

⚠WARNING

Rotating and other moving parts may cause injury during installation and maintenance

Work.

- ▷ Guards must not be removed while the pump is operational.

2.5.2 Electrical hazards

⚠ DANGER

Electrical power can cause serious injuries and even death. It is often the cause of material damage, in particular fires.

- ▷ Never do maintenance or installation works when the unit is connected to power
- ▷ Always make sure local regulations are complied with.

Carry out the following safety measures prior to working on electrical devices:

- ▷ Wear insulated shoes with rubber soles.
- ▷ Disconnect the system from the electrical supply.
- ▷ Safeguard the system against activation.
- ▷ Use a suitable measuring instrument to check that the system has been electrically isolated. Observe a five second discharge time for capacitors.
- ▷ Cover neighboring live parts and attach appropriate warning signs.


Damaged earthing can cause serious personal injury and damage to property. ▷ Following repairs or other work, always ensure that all earthing is re-established.


Apart from this user instructions, also refer to the user instructions of all auxiliary devices installed on the pump and in the installation.

2.5.3 Additional hazards

Irritant and toxic substances


Pumped media and equipment can be irritating to eyes, skin and the respiratory system.

Gas accumulations


Pumped media and equipment can cause suffocation.

Hot/cold components


Motors, pumps, fluids and equipment may become hot or cold during operation and cause burns when touched.

Corners and sharp edges

WARNING 
Corners and sharp edges can be the cause of tripping, falling and entrapment accidents and skin injuries.

Magnetic field

DANGER
Magnetic-drive coupling pumps contain powerful permanent magnets. There are still uncertainties with regards to the effect magnetic fields have on pacemakers. ▷ Keep data carriers and electronic components away from dismantled components ▷ Persons carrying inside their body a pacemaker or other electronic devices should not be involved in assembly or maintenance works on magnetic drive pumps.

2.6 Responsibility of the operating company

NOTICE
The owner is the person who operates the equipment or commissions a third party with its use and is responsible for the protection of the user, personnel or third party.

The following tasks fall under the responsibility of the owner:

- ▷ Implementing the valid occupational safety provisions,
- ▷ Generating a risk assessment for the conditions at the site of operation,
- ▷ Generating work instructions for the operation of the equipment in the installation,
- ▷ Updating the work instructions in accordance with the valid provisions,
- ▷ Deployment of personnel qualified for the activity,
- ▷ Regular training of personnel,
- ▷ Informing of risks at the workplace and
- ▷ Providing the necessary personal protective equipment.

2.7 Qualified personnel and targeted group

All personnel involved in the operation, installation and maintenance of the unit must be qualified to carry out the work involved. Qualified personnel for installation, operation and maintenance of the equipment are characterized by:

- Fulfillment of the qualification required for the activity
- Knowledge of the current operating instructions
- Knowledge of the applicable operational safety regulations
- Knowledge of local rescue facilities.

If the personnel in question does not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required the operator may ask the manufacturer / supplier to provide applicable training.

SAFETY INSTRUCTIONS

Always co-ordinate repair activities with operation and health and safety personnel and follow all plant safety requirements and applicable safety and health laws and regulations.

2.7.1 Specialist for electrical installation

Low-voltage electrician with standard tools for connecting electric motors and determining the rotating electric field.

2.7.2 Machine fitter

Specialist personnel for installation, maintenance, repair and overhaul of machine and plant components in mechanical and plant engineering sector using standard tools.

2.7.3 Transport specialist

Trained in handling hand pallet trucks, forklifts or cranes, depending on application.

2.7.4 Packaging specialist

Experience in the safe packaging of machines for transport

2.8 Industrial health and safety measures

Follow industry safety standards including the use of appropriate equipment in required areas.

2.9 Potentially explosive atmospheres

All instructions for equipment installed in potentially explosive atmospheres must be followed to help ensure explosion protection. For ATEX, both electrical and non-electrical equipment must meet the requirements of the European Explosion Protection Directive 2014/34/EU. Always observe the regional legal Ex requirements, e.g. Ex electrical items outside the EU may be required certified to other than ATEX e.g. IECEx, UL.

ⓘ Potential ignition sources at the equipment:

- Hot surfaces
- Mechanically generated sparks
- Electrical systems
- Static electricity
- Leakage of flammable liquids
- Buildup of explosive mixtures

WARNING

- ▷ Use equipment only in the zone for which it is appropriate.
- ▷ Always check that all equipment is suitably rated and/or certified for the classification of the specific atmosphere in which they are to be installed and used.

2.9.1 Hot surfaces

2.9.1.1 Pump

NOTICE

The pump surface temperature largely depends on the temperature of the liquid handled.

- Temperature classes can only be defined in relation to the temperature of the fluid handled (see Table 4)
- The user is responsible to make sure the temperature class of the equipment is suitable for the zone it is installed in.

WARNING

Insulation could lead to elevated surface temperatures

- Always ensure that the surfaces of areas with elevated temperatures (e.g. bearing supports, lantern) have free contact with the atmosphere to allow convective heat removal!

Table 4: ATEX temperature classes

Temperature class according to ISO 80079-36	Maximum surface temperature according to ISO 80079-36	Max. permissible temperature of the liquid handed defined by FLOWSERVE
T1	450 °C	**400 °C**
T2	300 °C	**275 °C**
T3	200 °C	**175 °C**
T4	135 °C	**110 °C**
T5	100 °C	**Consult FLOWSERVE**

The values in the table refer to an ambient temperature between -20°C to 40°C. For other ambient temperatures, contact FLOWSERVE.

NOTICE

Table 4 only takes the ATEX temperature class into consideration. Pump design or material, as well as component design or material, may further limit the maximum working temperature of the liquid.

- The operating limits for the installed equipment must be observed.
- Grease lubricated bearings are not allowed for temperature class T5.

NOTICE

- For pumps with heating jackets the use of Table 4 also applies. In this case, the liquid with the highest temperature should be used.
- The auto ignition temperature of the heating/cooling liquid used has to be considered when defining the required temperature class of the equipment.
- In case auxiliary heating equipment is installed (e.g. jacketing or tracing), the user is responsible for compliance with the Directive 2014/34/EC (Atex) and resulting surface temperature.

WARNING

Dry run could result in excessive surface temperatures

- Always ensure the pump is properly filled and vented and does not run dry.
- Only check motor direction of rotation with the pump decoupled. For close coupled pumps where decoupling is not feasible, check the direction of rotation only with the pump primed and vented.

WARNING

Insufficient flow could result in excessive surface temperatures.

- Never run pump against completely closed discharge valve.
- Make sure the minimum flow for the equipment is adhered to.
- For liquids with physical properties strongly deviating from water the minimum flow needs to be checked against the maximum allowable surface temperature. For critical services, a detailed analysis should be performed. Contact FLOWSERVE.

WARNING

Dynamic contact between rotating and static components could lead to excessive surface temperatures or burning deposits.

- In dirty or dusty environments, regular checks must be made and dirt removed from areas around close clearances, bearing housings and motors.
- Make sure the allowable running clearances are adhered to. Refer to chapter 0.
- For applications where there is a risk of (ferro)magnetic particles entering the pump, provisions need to be taken to make sure that no (ferro)magnetic particles reach the area of the inner magnet (eg. by external circulation, suction strainer, ...)

2.9.1.2 Pump set assemblies

In the case pump set assemblies (combination of pump, motor and other auxiliary equipment), the temperature class is determined by the equipment with the lowest class. E.g. for a pumped liquid temperature of 100°C the combination with a T3 motor would result in a temperature class T3 for the complete assembly. For combinations of close coupled pumps and motor the heat transfer between pump and motor can lead to elevated temperatures at the motor flange and shaft. The maximum allowed surface temperatures specified by the motor manufacturer must be observed. If these maximum allowable temperatures are not known, the general stated maximum ambient temperature for which the installed motor has been certified needs to be considered. In general 40°C applies as a minimum.

2.9.2 Electrical systems

NOTICE

For pump sets with electrical devices (eg. motor, temperature measurement device), the installed devices need to be certified in accordance with the zone they are installed in.

2.9.3 Mechanically generated sparks

WARNING

Eliminate the risk of sparking and excessive surface temperatures due to mechanical stresses.

- Always make sure the coupling is aligned correctly, refer also to chapter 5.
- For hot applications, make sure to check the alignment with pump at operating temperature.
- Apply adequate provisions to allow for thermal expansion in hot or cold applications.

WARNING

Eliminate the risk of sparks during maintenance works!

- Tools used during maintenance in the installation must be approved for the applicable zone.
- Always move the equipment to safe area for dismantling.

2.9.4 Leakage of flammable liquids

WARNING

In case of flammable liquids, leakage to the atmosphere could create a hazardous situation.

- Only qualified personnel should do assembly and installation works, taking in to account the assembly and installation instructions.
- Prior to first start-up always check tightening torques.
- Avoid entrapment of liquid in the pump and associated piping during operation due to closing of valves, which could cause dangerous pressures to occur.
- The use of brittle materials for pressure containing parts that are directly exposed to the atmosphere is not allowed when handling flammable media. Pumps with ceramic containment shell shall only be used with closed lantern.
- When handling flammable media, make sure that the fluid does not contain any abrasive particles. In case of doubt, contact FLOWSERVE.
- For applications where there is a risk of (ferro)magnetic particles entering the pump, provisions need to be taken to make sure that no (ferro)magnetic particles reach the area of the inner magnet (eg. by external circulation, suction strainer, ...)
- Make sure the area of the installation is well ventilated.

2.9.5 Buildup of explosive mixtures

WARNING

Buildup of explosive mixtures inside the equipment must be avoided!

- Always ensure the pump is properly filled and vented.
- Never run the pump dry.
- Make sure if a suction strainer is installed that it is not clogged and regularly checked.

2.9.6 Static electricity

WARNING

Eliminate the risk of sparks generated by static electricity.

- Make sure metal baseplates are properly earthed. In case a non-metal baseplate is used all components must be earthed individually.
- Make sure the interface between pump and baseplate is electrically conductive. If this cannot be assured, the pump should be earthed individually.
- Make sure all auxiliary equipment installed has equipotential bonding with the earthing provision of the installation.
- Do not rub non-metallic or coated surfaces with a dry cloth.
- The applied painting systems by Flowserve allows the equipment to be used for all gas groups including IIC. If a special paint system or repainting is required, contact Flowserve.

2.9.7 ATEX marking

2.9.7.1 Pump

Durco MARK 3 ISO MAG pumps are classified as group II, category 2 equipment according to the marking on the nameplate and declaration of conformity. An example declaration of conformity can be found in Annex of these user instructions, with example marking as below;

II 2 G Ex h IIC T5…T1 Gb

2.9.7.2 Pump sets

In case FLOWSERVE scope of supply includes a complete pump set assembly of pump and motor with optionally auxiliary equipment (coupling, instrumentation, etc.) a pump set nameplate and declaration of conformity can be provided. These user instructions consider the additional hazards of pump sets considering the combination of components such as pump, motor, coupling and guards listed in these user instructions.

2.10 Protective equipment

- Follow applicable regulations. Wear work clothes such as safety shoes. Use safety equipment specified in the hazard information. Non- limitative list of Personal protective equipment:
  - Safety glasses
  - Safety gloves
  - Protective clothing

2.11 Safety devices

Secure the pump unit on the operator's side using circuit breakers.

2.12 Secure against being switched on again

Use the "Work in progress" indicating plate or follow the operator's instructions. An indicating plate at the current workplace is not sufficient because many systems can be controlled from other locations. If possible, lock the position of switches, switch off components and disconnectors.

3 Product Description

3.1 General product description

Pumps of Durco Mark 3 ISO MAG range are seal less magnetic drive single stage centrifugal chemical process pumps according to ISO 2858, ISO 5199 and ISO 15783. They provide dependable, leak-free performance in all types of applications. A magnetic-drive coupling transmits the torque of the motor to the pump wetted shaft. For the CBME design, the outer magnet of the magnetic-drive coupling is located on the motor shaft end (3). The CBMM design has a bearing bracket with drive shaft (2) connected to the outer magnet and a coupling is used to transmit torque from the motor shaft to the drive end shaft. Energy is transmitted through magnetic fields on the inner magnet connected to the pump shaft which is carried in two plain bearings lubricated by the liquid handled. Between outer magnet and inner magnet, a containment shell provides hermetic sealing between the wetted pump areas and the atmosphere.

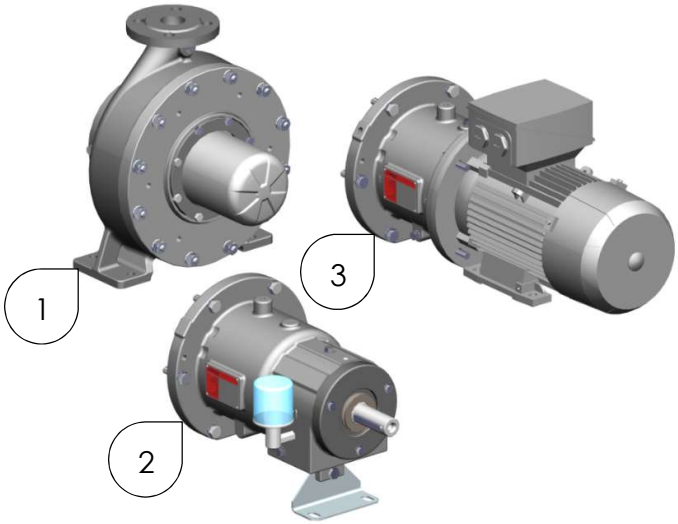


Figure 1: 3D view of contained volute (1), CBMM drive end (2) and CBME drive end (3)

3.2 Scope of delivery

MARK 3 ISO MAG pumps can be delivered pump only or mounted as a pump unit together with motor, baseplate and auxiliary equipment. The pumps require as a minimum the combination with a driver (eg. 3-phase asynchronous motor) to function properly.

3.3 Design

3.3.1 Pump casing

The pump casing is designed with a horizontal centerline end inlet and a vertical centerline top outlet that makes it self-venting. The hydraulic performance is according to ISO 2858. For ease of maintenance, the pump is constructed so that pipe connectors do not have to be disturbed when internal maintenance is required. Wear rings are internal machined and non-replaceable.

3.3.2 Impeller

A closed impeller with wear rings is fitted inside the pump. Impellers are locked on the shaft with key and by clamping. Depending on the magnet system clamping of the impeller is done by means of an impeller nut or machined boss on the shaft.

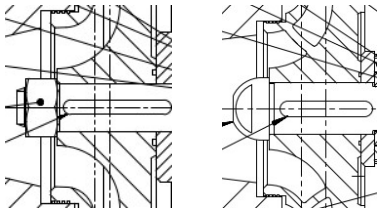


Figure 2: impeller locking for magnet system 1,2,4 and 6 (left) and magnet system 3 (right)

3.3.3 Magnet coupling

The magnetic coupling comprises the outer magnet rotor (1) and the inner magnet rotor (2) as well as a containment shell (3) hermetically sealing the inside from the outside. The magnet rotors and containment shell are installed concentrically. Individual magnet plates (4) are arranged on the magnets in circumferential direction with alternating polarity. Easily magnetizable steel serves as carrier. The containment shell is available in 3 standard options: Hastelloy 2.4610, high efficiency 2.4610 and ceramic. All 3 options are interchangeable and can be fitted to any pump by using a matching clamping ring 2542.1

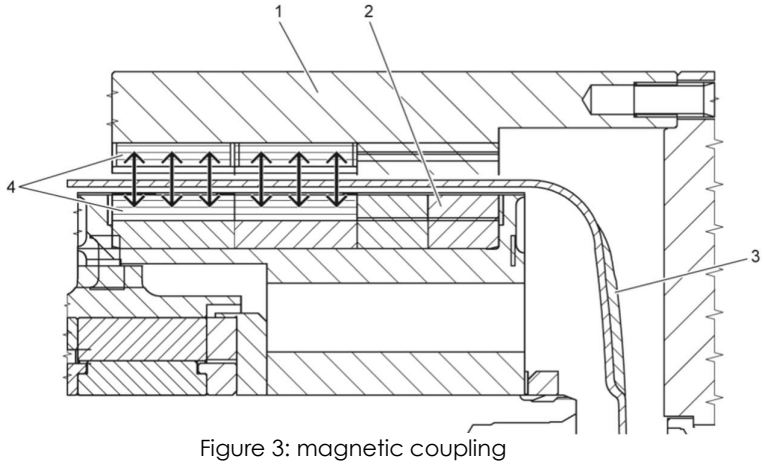


Figure 3: magnetic coupling

The moving magnets create eddy currents in the metal containment shell. These eddy currents together with frictional losses generate heat resulting in a temperature increase in the area of the magnet coupling. To limit this temperature increase, a partial flow of the pumped liquid is forced through the magnet chamber to allow heat dissipation.

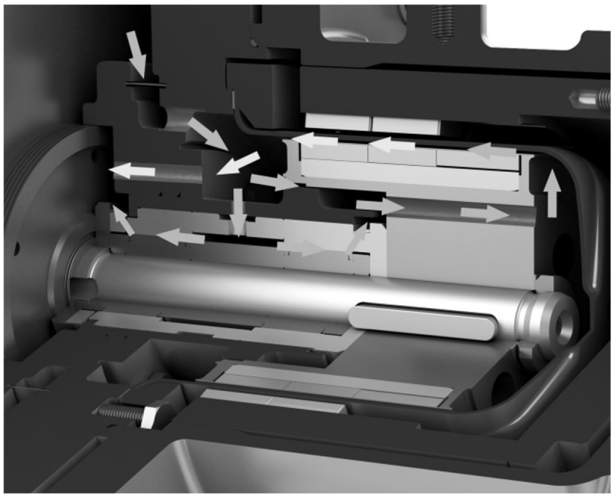


Figure 4: Magnet coupling partial flow

3.3.3.1 Secondary control

The pumps of the MARK 3 ISO MAG series can be optionally equipped with a stand-by dynamic seal in lieu of the inboard bearing isolator. This seal together with the O-ring 4610.1 reduces the risk of uncontrolled leakage by minimizing the leakage towards the oil bath and atmosphere in case of containment shell failure.

NOTICE

The secondary control sealing device needs a pressure differential to close and seal. It is not possible to use the secondary control option for applications with a suction pressure lower than 0,5barg.

3.3.4 Bearings

3.3.4.1 Slide bearings (CBMM and CBME)

Slide bearing cartridge

The wetted shaft that is connected to the pump impeller and internal magnet is supported by 2 radial slide bearings (1). Axial thrust acts on the rear plain bearing (3) during normal operation with a gap of 0,5-1mm in the front plain bearing (2). The materials of construction of stationary and rotating parts is SSiC/SSiC with maximum wear resistance. In the case of liquids with very low lubricating characteristics, a carbon/SSiC combination can be installed. Contact FLOWSERVE.

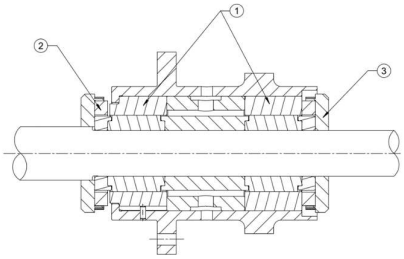


Figure 5: Slide bearing cartridge

Additional slide bearing for heat barrier design

Pumps with heat barrier are executed with a special shaft that has an extended length. To support the overhung inner magnet, an additional radial slide bearing is installed. This radial bearing also acts as a throttle bush to limit the hot partial flow to the inner magnet area.

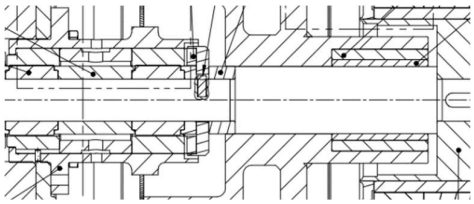


Figure 6: additional slide bearing heat barrier design

NOTICE
Only ceramic containment shells with closed lantern can be used with heat barrier.

3.3.4.2 Anti-friction roller bearings

Bearing housing (CBMM)

The drive end shaft of CBMM design is supported by two anti-friction roller bearings, at the inboard (3011.1) and outboard (3011.2). The bearings are lubricated with oil splash or greased for life.

NOTICE
For explosion hazardous applications, grease lubricated bearings should not be used for zones with temperature class T5.

A wavy spring (0128) is installed at the inboard bearing to create axial preloading. To protect the bearings against liquid and dirt entering, *Flowserve bearing gard* labyrinth seals (4330.1/4330.2) are installed as a standard. Other types of bearing isolators can be installed on request. Contact FLOWSERVE.

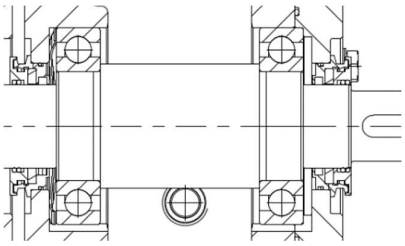


Figure 7: CBMM bearing configuration

Motor lantern (CBME)

CBME pumps use a lantern for a closed coupled connection between the pump and motor. In this case, the outer magnet rotor is mounted with a driving flange on the motor shaft which is supported by the drive end roller bearing of the motor.

3.3.5 Strainer

MARK 3 ISO MAG pumps are standard equipped with a self cleaning strainer element installed between the internal and external cover with a rectangular mesh size of 0,4mm x 4mm. The strainer avoids accidental solids passing through the pump to flow to the magnet chamber.

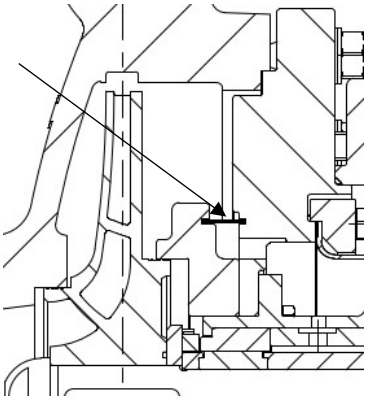


Figure 8: standard strainer

3.3.5.1 Free flow filter (option)

For applications containing solids, a free flow filter can be installed as an option to replace the standard strainer. The filter is installed between the pump casing discharge flange and the installation. All liquid discharged by the pump passes through the filter. The internal flow channel from pump casing pressure side to the magnet chamber is closed and replaced by an external flanged connection that is connected to the outlet of the free flow filter. The pressure inside the discharge line creates a partial flow through the filter strainer element to the magnet chamber. The strainer element has a rectangular mesh size of 0,4mm x 4mm. Solids blocked by the strainer element are flushed to the process by the main flow passing through the filter.

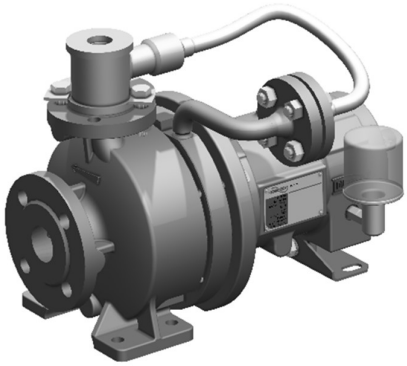


Figure 9: Free flow filter connection

3.3.5.2 External flow (option)

The boundary conditions for external flow cooling of the magnet coupling largely depend on the application. Additional instructions have to be added to the order and a copy should be kept with these user instructions. Contact FLOWSERVE.

3.4 Connections

3.4.1 Standard connections

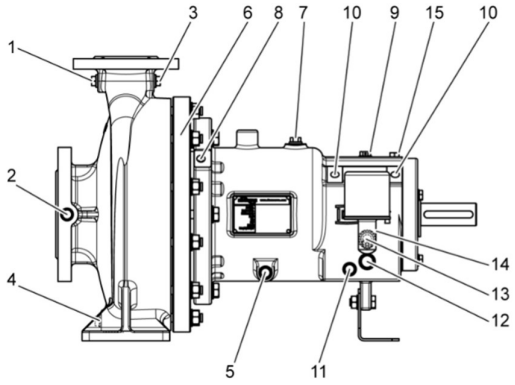


Figure 10: connections

Item number	Designation	Design	
1	Pressure gauge	CBMM / CBME	*Optional*
2	Pressure gauge / vacuum gauge	CBMM / CBME	*Optional*
3	Circulation (plan 11)	CBMM / CBME	*Optional*
4	Pump drainage	CBMM / CBME	*Optional*
5	Lantern drainage / Leak detector – liquid detection device	CBMM / CBME	*Optional*
6	External flow/free flow filter connection	CBMM / CBME	*Optional*
7	Leak detector – pressure detection device	CBMM / CBME	*Optional*
8	Containment shell temperature sensor	CBMM / CBME	*Optional*
9	Oil filling/ Vent plug	CBMM	
10	Bearing temperature sensor	CBMM	*Optional*
11	Oil drainage	CBMM	
12	Oil cooling	CBMM	*Optional*
13	Sight glass	CBMM	
14	Constant level oiler	CBMM	
15	Vibration sensor	CBMM	

3.4.2 Pumps with heating jackets (option)

MARK 3 ISO MAG pumps can be delivered on request with jacketed casing and/or cover for applications where heating/cooling is required. For applications using steam as heating agent, it is advised to use the bottom connections as outlet connection.

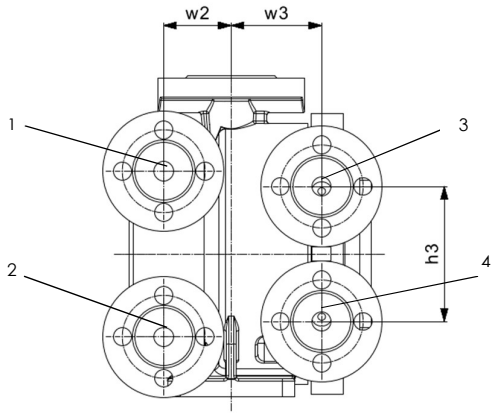


Figure 11: heating jacket connections

Item number	Designation	Design
1	Casing jacket outlet	CBMM / CBME
2	Casing jacket inlet	CBMM / CBME
3	Cover jacket outlet	CBMM / CBME
4	Cover jacket inlet	CBMM / CBME

3.4.3 Pumps with free flow filter or external circulation (option)

Item number	Designation	Design
1	Inlet of internal circulation with free flow filter	CBMM / CBME
2	Outlet of external circulation	CBMM / CBME
3	Inlet of external circulation	CBMM / CBME

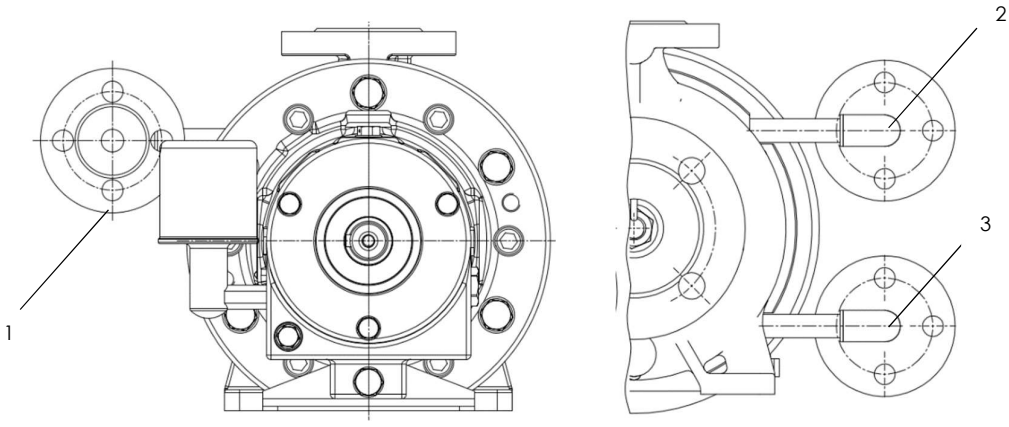


Figure 12: Circulation flow connections

3.5 Tools, equipment, and fixtures

No special tools are required for the installation and operation of the pump unit. All work can be carried out with standard tools.

✗ The following measuring tools are required for the installation of the pump unit:

- Dial gauge
- Ruler
- Feeler gauge

4 Packaging, Transportation and Storage

4.1 Consignment receipt

NOTICE

Any shortage and/or damage must be reported immediately to Flowserve and must be received in writing.

▷ Immediately after receipt of the product/system it must be checked against the delivery/shipping documents for its completeness and that there has been no damage in transportation.

The following symbols are used to label the packaging:

	This side up		Fragile
	Keep dry		Protect from direct sunlight
	Centre of gravity		Do not use hooks
	Attachment point		

4.2 Removal of preservation

In general, a preservation coating is only applied to pumps (ductile) cast iron and cast steel pumps. To remove the preservative coating, the pump should be filled and drained several times using appropriate agents, e.g. solvent naphta, diesel oil, or an alkaline detergent. Flush with water, if necessary.

NOTICE 

To avoid corrosion the pump must not be left unused after removing the preservation.

WARNING 

Solvents and alkalis impose risk of environmental damage.

▷ Collect solvents and cleaning agents or lye and dispose of properly

4.3 Lubricants and auxiliary material

NOTICE

If the order has not been expressly for an oil-free and grease-free pump, grease and mounting pastes have been used during pump assembly. If residual material of this must not come into contact with the liquid handled, clean the pump using a cold cleaner, before it is installed in the system.

4.4 Packaging

✓ The pump unit is cleaned and decontaminated.

- Securely anchor the pump unit.
- Use sturdy packaging.
- Attach the declaration of contamination to the packaging.
- Attach the marking to the packaging

4.5 Transportation

DANGER

Hanging loads, risk of personnel injury.

- ▷ Only use suitable lifting equipment and wear appropriate protective equipment!
- ▷ Only lift the pump in horizontal position!
- ▷ The installed slide bearings are susceptible to shock and vibrations, handle with care!
- ▷ Do not attempt to lift the pump or the pump set using eyebolts on the components.

1. Attach the pump/pump unit.
2. Bring the pump/pump unit to the destination with suitable means of transport.
3. Set down safely.
4. Remove the lifting tackle

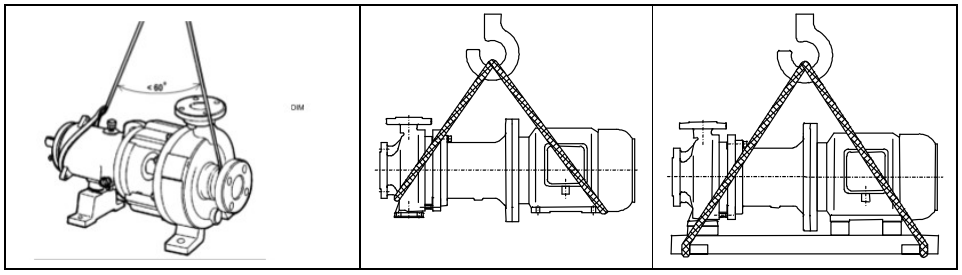


Figure 13: attaching pumps and pump-motor assemblies for lifting

4.6 Storage

- Location: Closed, dry and vibration-free room at 5 °C to 40 °C / Humidity: to 80 %

✓ Pump unit is preserved for temporary storage

- ▷ Once a month, turn the shaft several times by hand, e.g. via the motor's fan.
- ▷ Renew the preservation every six months.

5 Installation

5.1 Assembly

If a bare shaft pump is delivered without drive system, base plate and accessories the user is responsible for the selection and assembly of the complete pump set. The assembly and installation of a pump set may only be carried out by personnel with special knowledge of the service and maintenance work for pump units/pumps, personnel from the manufacturer or from a workshop authorized by the manufacturer.

NOTICE

In potentially explosive atmospheres, the person carrying out the installation must ensure that the originally compliant parts of the pump unit still comply with the regulations when they are put into operation.

5.1.1 Drive system

The drive system should have a uniform drive torque. Three-phase asynchronous motors meet these requirements. Select the degree of protection of the electric drive system depending on the mounting position and requirement of the installation site. Provide smooth start for switchgear of the drive system. The coupling may otherwise break off due to moments of inertia of the machine parts. For drive systems other than three-phase asynchronous motors, contact FLOWSERVE.

NOTICE

The output from a variable frequency drive (VFD) can cause additional heating effects in the motor. For pumps sets with a VFD, the ATEX Certification for the motor must state that it covers the situation where electrical supply is from a VFD. This requirement still applies even if the VFD is located in a safe area.

5.1.2 Connecting parts

Select connecting parts such as couplings according to the torque to be transmitted, switching frequency and operating time. For use in potentially explosive atmospheres, observe the applicable regulations. In potentially explosive atmospheres, FLOWSERVE recommends using failsafe couplings.

5.1.3 Protective devices

Install protective equipment in accordance with the applicable regulations. For example, implement the contact protection in such a way that no contact between the contact protection and rotating parts is possible during operation and in the event of foreseeable misuse, such as stepping on the contact protection. Protective devices from FLOWSERVE meet these requirements.

5.1.4 Mounting structure

Design the structure (eg base plate/frame) in accordance with the applicable regulation. FLOWSERVE base plates and frames meet these requirements.

5.2 Inspection and preparation

- ✓ The pump unit is undamaged
- ✓ The protection class of the electric drive system corresponds to the requirements of the installation site.
- ✓ The foundation has the necessary strength and texture.
- ✓ The installation site corresponds to the installation plan.
- ✓ Mounting position is corresponding to the requirements of the equipment.
- ✓ The recommended distance from the surroundings is at least 0.5 m.
- ✓ The subsurface is level and vibration-free.
- ✓ The drill holes are dust-free.
- ✓ Pipelines are available according to the installation plan.

5.3 Depreserving

Refer to chapter 4.2 for instructions to remove preserving agents.

5.4 Foundation

NOTICE

There are many methods of installing pump units to their foundations. The correct method depends on the size of the pump unit, its location and noise and vibration limitations. Non-compliance with the provision of correct foundation and installation may lead to failure of the pump and, as such, would be outside the terms of the warranty.

- Personnel
  - Machine fitter
- Personal protective equipment
  - Protective gloves
- Parts/spare components
  - Foundation bolts
  - Shims
- Consumables
  - Concrete or chemical anchor
  - ✓ The preparations according to the installation plan have been completed.
  - ✓ The drill holes are dust-free.

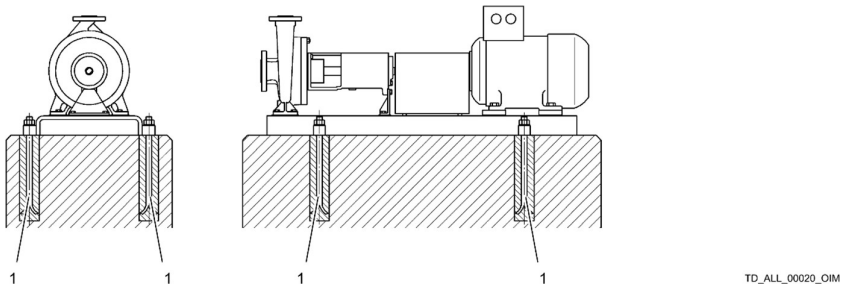


Figure 14: pump foundation

1. Place the pump unit on the foundation.
2. Align the pump unit horizontally on the discharge branch. Permissible position deviation: 0.5 mm/m.
    a. If necessary, insert shims for height compensation. Always place the shims to the left and right in the immediate vicinity of the foundation.
    b. If the distance between the foundation bolts is greater than 800 mm, insert shims in the middle of the base plate. The shims must lie flat.
3. Insert the foundation bolts (1) into the drill holes provided with concrete or chemical anchor.
4. Allow the concrete or chemical anchor to set according to manufacturer's instructions.
5. Evenly tighten the foundation bolts crosswise

5.5 Connecting piping

⚠ DANGER

Exceeding the permissible loads at the ports. Leaks of hot, toxic, corrosive or burning media!

- ▷ Do not use the pump as a fixed point for pipelines.
- ▷ Observe the permissible forces and torques at the pump branch.
- ▷ Compensate for expansion of the pipeline when the temperature rises.

- Personnel
    - Machine fitter
- Parts/spare components
    - Gaskets (e. g. flat gasket ring DIN 2690 NBR with steel insert)
    - Hexagon screws for flange connections (e.g. M 16 x 60 8.8)

- ✓ On the suction side, there is a section of sufficient length to calm the flow.
- ✓ The nominal diameters of the pipelines correspond to those of the pump connections at least.
- ✓ To prevent air cushions forming on the suction side, nominal diameter transitions are designed with eccentric transition pieces.
- ✓ The pipelines are connected directly in front of the pump free from any tension.
- ✓ Thoroughly clean, flush and blow through containers, pipelines and connections.
- ✓ Hydrostatic testing of the piping system is complete.

1. If necessary, insert filters in the pipeline.
2. Remove the flange covers on the suction and discharge branch of the pump.
3. Connect the pump branch to the pipeline.
    1. Insert a gasket.
    2. Tighten the hexagon screws crosswise to the required tightening torque

NOTICE

To ensure favourable flow conditions:

- ▷ An area of steady flow over a length of 15 x suction nozzle diameter should be provided upstream from the suction nozzle; its diameter should be the nominal diameter of the suction nozzle.

5.5.1 Additional instructions for pumps with Free flow filter

- Parts/spare components
  - Extended length bolts

The free flow filter supplied by Flowserve is a clamped design which needs to be installed between the pump discharge flange and the installation piping.

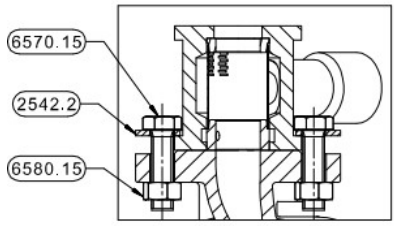


Figure 15: Free flow filter

NOTICE

The free flow filter is assembled at the factory on the pump with a ring (2542.2), nuts (6580.15) and bolts (6570.15). The supplied ring with nuts and bolts are intended for transportation purposes only and should not be used for final installation!

1. Remove ring (2542.2), nuts (6580.15) and bolts (6570.15).
2. Insert gasket between pump discharge and free flow filter
3. Insert gasket between free flow filter and piping of the installation
4. Tighten the hexagon screws crosswise to the required tightening torque

5.6 Coupling

The following only applies to pumps with a free shaft end type CBMM. Close coupled pumps CBME have the outer magnet rotor mounted directly on the motor shaft.

5.5.1 Inspection

- Personnel
  - Machine fitter
- Special tools/gauges
  - Shaft alignment system

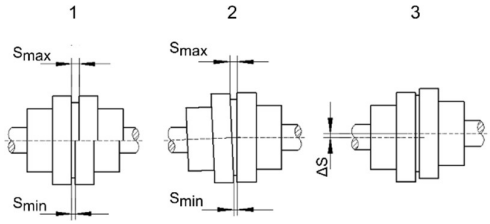


Figure 16: Coupling offset; Axial (1), Angular (2), Radial (3)

1. Remove the contact protection.
2. Check the coupling alignment with the shaft alignment system. For permissible misalignments, see the technical data or documentation of the coupling. If the permissible misalignments are exceeded, align the pump unit as described in the following section.
3. Check the function of the coupling/shaft.
   a. Turn the coupling/shaft by hand.
   b. The coupling and shaft can be easily rotated.
4. Mount the contact protection.
5. Tighten the screws with the prescribed tightening torque of the installed coupling
6. Check if there is any contact between the coupling and coupling guard

5.6.2 Alignment

- Personnel
  - Machine fitter
- Special tools/gauges
  - Shaft alignment system
- Consumables
  - Shims

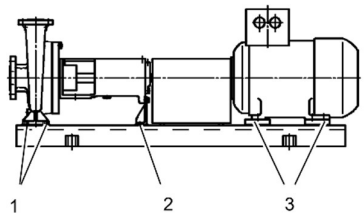


Figure 17: Pump set with pump (1) and motor (3)

1. Remove the contact protection.
2. Loosen the pump and motor fixing screws.
3. Align the pump unit so that permissible misalignments are adhered to
   a. Align the pump and motor to each other; if necessary, level with suitable shims.
   b. Check the coupling alignment with the shaft alignment system.
   - Repeat the following steps until the pump unit and motor are fixed in place against rotation.
4. Tighten the screws step by step
5. Check the coupling alignment with the shaft alignment systems
6. Mount the coupling guard and tighten the screws
7. Check if there is any contact between the coupling and coupling guard

5.7 Bearing bracket lubrication

NOTICE

The following only applies for pumps supplied with oil lubricated bearings. Grease lubricated pumps and electric motors are supplied pre-greased unless specifically stated otherwise.

⚠WARNING

Hazardous lubricants. Risk for environmental damage

▷ Catch and collect spilled lubricants and dispose of them properly.

5.7.1 Recommended oil lubricants

Table 5: Recommended lubrication oils

Temperature	Speed	DIN 51502	ARAL	BP	Castrol	Shell	FUCHS
Bearing < 80°C	< 1500 min^{-1}	CL 68	Motanol HE 68	Turbinol X 68	Aircol PD 68	Morlina 68	Renolin DTA 68
	> 1500 min^{-1}	CL 46	Motanol HE 46	Turbinol X 46	Aircol PD 46	Morlina 46	Renolin DTA 46
Bearing > 80°C		CL 100	Motanol HE 100	Energol RC-R 100	Aircol PD 100	Morlina 100	Renolin DTA 100
Ambient < 0°C		CL 22	Vitam GF 22	Bartran 22	Hyspin ZZ 22	Morlina 22	Renolin DTA 22

NOTICE

Mixing lubricants can cause damage to the roller bearings. If any lubricant residues are present, flush the bearing carrier with the lubricant intended for the operational use.

5.7.2 Filling

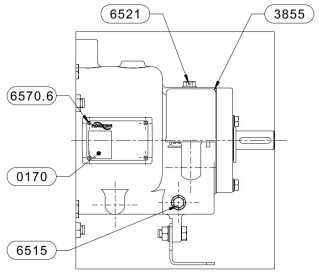


Figure 18: Oil lubricated bearing bracket with constant level oiler (3855), breather plug (6521) and drain plug (6515)

1. Determine the type of lubrication. Refer to pump datasheet or contact FLOWSERVE.
2. Fill the bearing housing with correct grade of oil to the correct level, i.e. by use of the sight glass or constant level oiler bottle.

Figure 19: Allowable oil level by using the sight glass

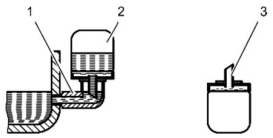


Figure 20: Constant level oiler with connection elbow (1) and reservoir (2) with filling pipe(3)

1. Remove the vent plug.
2. Pull the reservoir out of the connection elbow.

Figure 21: Allowable oil level by using the constant level oiler

3. Fill oil through the bore for the vent plug until the oil enters the connection elbow.
   ↻ Repeat the following steps until the reservoir is 80% full.
   1. Fill the reservoir to the maximum.
   2. Insert the reservoir into the connection elbow.
   3. Install the vent plug.
   4. After approx. 5 minutes, check the oil level in the reservoir.
4. To check the function of the oil level regulator, slowly drain the oil from the screwed plug until air bubbles rise in the reservoir.

Table 6: Oil filling volumes

		SIZE								
		025	**032**	**040**	**050**	**065**	**080**	**100**	**125**	**150**
Nominal impeller diameter	**125**	0,25 l	0,25 l	0,25 l	–	–	–	–	–	–
	160	0,25 l	0,25 l	0,25 l	0,25 l	0,4 l	0,4 l	–	–	–
	200	0,25 l	0,25 l	0,25 l	0,25 l	0,4 l	0,4 l	0,4 l	–	–
	250	–	0,4 l	0,4 l	0,4 l	0,4 l	0,4 l	0,4 l	0,4 l	0,4 l
	315	–	–	0,4 l	0,4 l	0,4 l	0,4 l	0,4 l	0,4 l	–
	400	–	–	–	–	–	0,4 l	0,4 l	0,4 l	–

⚠WARNING Ex

Insufficient bearing lubrication could result in excessive surface temperatures.

▷ Make sure the bearing bracket is sufficiently filled with oil at all times during operation

NOTICE

Excessive oil volume leads to an increase in temperature and oil leakage.

NOTICE

Other drivers and gearboxes, if appropriate, should be lubricated in accordance with their manuals.

5.8 Establishing the electrical connections

- Personnel
  - Specialist for electrical installations

✓ A frequency transformer is installed for the operating conditions if, in accordance with applicable regulations and/or the application, this is necessary to operate the pump unit.

✓ The selected connection type meets operational specifications and the regulations of the local utility company.

✓ The overcurrent protection device and mains disconnection device are installed according to the rating plate and technical data.

1. Connect the motor according to the wiring diagram in the terminal box or on the type plate.
2. Check the equipotential bonding between the pump and base plate.
3. Earth the base plate.

NOTICE

With star-delta starting of centrifugal pumps, the change-over from star to delta is likely to involve a higher supply system loading than direct delta starting. Moreover, the acceleration torque resulting from switching will lead to a moment surge which may result in decoupling.

- ▷ Use direct connection of the motor.
- ▷ Observe local regulations with regards to the allowable motor powers for direct connection.
- ▷ Use a soft starter or variable frequency drive if direct connection is not possible.

NOTICE

Lower torque couplings could be selected when using a soft starter or variable frequency drive. Exceeding the starting torque will damage the pump.

- ▷ Make sure the magnet coupling torque is selected for the application it used in.
- ▷ Consult the pump datasheet for the selection parameters of the magnet coupling torque. When in doubt, contact FLOWSERVE.

6 Commissioning

- ✓ The piping system provided by the customer has been cleaned.
- ✓ The pump unit is electrically connected according to the regulations.
- ✓ The pump unit is properly earthed.
- ✓ The lubricants have been checked.
- ✓ The pump unit is undamaged

6.1 Filling

- Personnel
  - Machine fitter

1. Fill pump and suction line with pumped medium.
2. Vent the pump and pipeline using proper venting methods according to the installation site.
3. Fully open the shut-off valve of the suction line.

DANGER 

Pump and pipeline system filled and/or vented incorrectly. Leaks of hot, toxic, corrosive or burning media!

- ▷ Observe safety regulations and procedures when handling the pumped media.

DANGER 

If hot fluids are pumped, the pump surface temperature will increase considerably. Risk of burning.

- ▷ Provide adequate safety measures to prevent touching of hot surfaces.

NOTICE 

Installation or maintenance works on piping systems could lead to contamination of the system with liquids or particles that can damage the pump (eg. metal dust from grinding).

- ▷ Always make sure to properly flush the piping system prior to connecting it to the pump.

NOTICE 

Thermal shock could lead to cracking of ceramic bearings and ceramic containment shell.

- ▷ The temperature of the liquid handled inside the pump should be changed with a maximum of 100K/min. Use extreme care when filling the pump with a hot fluid!

6.1.1 Additional instructions for pumps with free flow filter

WARNING

Partial dry run could lead to excessive surface temperatures. Air pockets could hold an explosive mixture.

- ▷ Always make sure the connection line between pump and free flow filter is continuously rising.

6.1.2 Additional instructions for pumps with external circulation

WARNING

Partial dry run could lead to excessive surface temperatures. Air pockets could hold an explosive mixture.

- ▷ Always make sure sufficient liquid is inside the external circulation system.
- ▷ Always make sure the pressure of the external circulation system is higher than the pressure inside the magnet chamber.

✓ Make sure the external circulation inlet and outlet are properly connected.

1. If isolation valves are installed in the external circulation circuit, open them.
2. Flush and vent the external circulation circuit until all air is removed.

6.2 Direction of rotation

Prior to starting the pump, make sure the motor direction of rotation is corresponding to the pump direction of rotation, indicated by an arrow on the pump.

WARNING

Dry run could result in excessive surface temperatures and failure of pump components.

- ▷ Only check motor direction of rotation with the pump decoupled. For close coupled pumps where decoupling is not feasible, check the direction of rotation only with the pump primed as described below.

✓ The pump, suction line and, if applicable, the primary tank is vented and filled with pumped medium.
✓ The filling and venting lines are closed.
✓ The pump is not at high operational temperature.

1. Completely open the shut-off valve in the supply/suction line.
2. Close or slightly open the control valve in the discharge line.
3. Allow the motor to briefly start up by switching it on and immediately off again, observing the direction of rotation of the motor.

↳ The direction of rotation of the motor must correspond with the arrow for rotational sense on the pump.

4. If the direction of rotation is incorrect, check the electrical connection of the motor and, if applicable, the switchgear.

6.3 Initial start-up

NOTICE

Abnormal noises, vibrations, temperatures or leaks will lead to product damage. When detected:
- ▷ Switch off the product immediately.
- ▷ Do not put the product back into operation until the causes have been identified and solved.

- ✓ The piping system provided by the customer has been cleaned.
- ✓ The pump, suction line and, if applicable, the primary tank is vented and filled with pumped medium.
- ✓ The shut-off valve in the suction or feed line is fully open.
- ✓ The required auxiliary systems and media are activated (eg. shaft sealing supply system, external circulation, heating media, …)
- ✓ The pump operational temperature is reached.

1. Completely open the shut-off valve in the supply/suction line.
2. Slightly open the control valve in the discharge line.
3. After reaching the speed, slowly open the control valve in the discharge line and adjust to the operating point.

6.3.1 Check of normal operation

- Personnel
  - Machine fitter

- ✓ Operating temperature has been reached

1. Check for correct operation. Watch out for abnormal noises, vibrations, temperatures, and leaks.
2. Check that the operating conditions are reached.

7 Operation

Personnel
- Machine fitter

7.1 Start-up

✓ All prerequisites of chapter 0 are adheared to.

1. Switch on the motor.
2. Check the pressure gauges at the pressure measuring points. If there is no continuous increase in the delivery pressure as the speed increases, stop the motor and carefully bleed all air from the pump and system.
3. Once the operating speed has been reached, open the control valve in the discharge line to adjust the duty point of the pump.

WARNING

Dry run could lead to excessive surface temperatures.

- ▷ Ensure the pump is always properly filled and vented and does not run dry.
- ▷ Install appropriate dry run protection device if the system application could create dry run conditions (refer also to chapter 0)

WARNING

Operation with the control valve closed will lead to a considerable temperature increase and pressure build up as all energy consumed by the pump is converted into heat. High temperatures are quickly generated especially in the area of the metal containment shell.

- ▷ Only operate the pump with closed control valve if the minimum flowrate is ensured through a bypass line.
- ▷ Provide adequate safety measures (e.g. overflow valve) to ensure that the permissible pump casing pressure is not exceeded as a result of malfunction during operation.

7.1.1 Additional instructions for pumps with external circulation

NOTICE

- ▷ Make sure the external circulation circuit is activated prior to staring the pump.

7.2 Normal operation

7.2.1 Switching frequency

Table 7: Switching frequency

Rated motor power P	Perm. number of switching actuations
P < 12 kW	8 starts per hour
12 kW < P < 100 kW	8 starts per hour
P > 100 kW	5 starts per hour

NOTICE

These values are applicable for a uniform start-stop pattern. Risk of decoupling.

▷ Before restarting, always make sure that the pump rotor is at rest.

7.2.2 Minimum flow

Minimum continuous stable flow is the lowest flow at which the pump can operate and still meet the bearing life, shaft deflection and bearing housing vibration limits documented in the latest version of ISO 5199. The minimum flow for a specific pump can be found on the pump datasheet. For liquids with significantly different physical properties than water, it may be necessary to narrow the permissible operating range in accordance with the formula below, in order to prevent an impermissible increase in temperature. Disregarding the mechanical losses and the heat dissipation by thermal radiation and conduction, the increase in temperature related to a particular flowrate is obtained using the formula:

$$\Delta T = 3{,}6 \cdot \frac{P(1-\eta)}{\rho \cdot Q \cdot c}$$ **in °K**

P	Driving power in kW
η	Pump efficiency
ρ	Density of the liquid handled in kg/dm³
Q	Flowrate in m³/h
c	Specific heat capacity of the liquid handled in kJ/kgK

WARNING

Running the pump below minimum thermal flow could result in excessive surface temperatures.

▷ Do not run pump below minimum flow. In case of doubt, contact FLOWSERVE.

7.2.3 Reduced head

Note that when discharge head drops, the pump's flow rate usually increases rapidly. Check motor for temperature rise as this may cause overload. If overloading occurs, throttle the discharge.

7.2.4 Surging condition

A rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

7.2.5 Roller bearings

For pumps with open stool / open bearing bracket, the temperature of the roller bearings should not exceed 80°C even at pumped liquid temperatures of 350°C. Oil cooling can be fitted as an option for applications where this is required, contact FLOWSERVE.

WARNING

Insulation will reduce convective heat removal. Risk of excessive surface temperatures.

▷ To allow sufficient convective heat removal, stools and bearing brackets should not be insulated!

7.3 Monitoring

If the installation and/or application creates a risk for exceeding the allowable use of the pump, additional monitoring equipment could be used.

7.3.1 Power monitor

A motor load monitor monitors the electric power consumption of the driver. Boundary conditions can be set and an error message or an emergency stop can be generated when reaching the set values.

7.3.1.1 Magnetic drive decoupling

Exceeding the maximum torque of the magnetic drive can be caused by several failure modes (eg. blocker rotor, exceeding maximum flow rate, ...). The motor power consumption will decrease considerably to the level required only for rotating the outer rotor. Magnetic drive decoupling can be detected by setting a min. value for the motor power.

7.3.1.2 Minimum and maximum flow rate

A power monitor can be used to indirectly monitor minimum and maximum flow rates by using the pump hydraulic curve and power curve to set the minimum and maximum power set points of the power monitor to the corresponding flow rates at a given speed.

7.3.1.3 Dry run

In most cases, the absorbed power during dry run will be lower than the absorbed power at minimum operating flow. A power monitor can be used to indirectly monitor dry run conditions by using the pump hydraulic curve and power curve to set the minimum power set points of the power monitor.

7.3.2 Temperature probe on the containment shell

A temperature monitoring device in direct contact with the metallic containment shell can be used to detect clogging of the internal strainer or free flow filter, for connections see 3.4. In general, for water-like liquids, an alarm setting of 10K above pumped liquid temperature can be used. For liquids with strongly deviating physical properties from water, contact FLOWSERVE.

NOTICE

Non-conductive materials do not allow correct temperature measurement readings.

- ▷ The use of a temperature probe on the containment shell is only possible with metal containment shells.

7.3.3 Bearing temperature monitoring (CBMM only)

If bearing temperatures are to be monitored it is essential that a benchmark temperature is recorded at the commissioning stage and after the bearing temperature has stabilized.

1. Record the bearing temperature (t) during normal operating conditions
2. Set the alarm at (t+5) °C
3. In any case always make sure the alarm value is 10°C below the maximum allowable surface temperature for applications in explosion hazardous environments.

7.3.4 Vibration measurements / condition monitoring

Alarm and trip values for installed pumps should be based on the actual measurements (N) taken on the pump in the fully commissioned as new condition. Measuring vibration at regular intervals will then show any deterioration in pump or system operating conditions.

Vibration measurements can be used to detect more than only bearing failure, if processed and analyzed correctly. Flowserve has a range of condition monitoring devices which can be used to monitor pumps and detect different failure modes (eg. closed discharge valve, cavitation, …). Contact your local FLOWSERVE representative.

7.3.5 Secondary control

NOTICE

The secondary control option is not intended for continued operation after failure of the primary pressure boundary. A monitoring device to detect the leakage has to be installed.

- After detection of leakage of the containment shell, the pump should be stopped immediately.
- After the pump was stopped, service should be performed on the pump as soon as possible to solve the leakage.

7.3.5.1 Liquid detection device

A liquid detection device can be installed on the stool/bearing bracket drain connection to monitor containment shell leakage. For cold applications where there is potential condensation inside the stool/bearing bracket, this type of detection device could lead to inaccurate monitoring.

7.3.5.2 Pressure detection device

A pressure detection device can be installed on the top of the stool/bearing bracket to monitor containment shell leakage resulting in pressures above atmospheric pressure.

7.4 Shut-down

1. Switch off the motor.
2. Close discharge side control valve.
3. Close suction side shut-off valve.

WARNING Ex

Freezing of liquid inside pump could break pressure containing parts leading to leakage of process liquid to the atmosphere.

- For applications and installations where there is a risk of freezing, always drain the pump and auxiliary equipment after stopping it or provide adequate heating provisions.
- Apply preservative coating where there is a risk for corrosion with drained pump.

7.4.1 Longer periods of pump not running

For longer periods without operation of the pump, a monthly operation of the pump unit is required to avoid deposits in the pump and suction inlet and prevent blockages.

- ✓ Sufficient pumped medium is available for a functional run of the pump.

1. Start up the pump unit.
2. Operate the pump unit for 5 minutes within the allowable operating range.
3. Check noise and vibration levels
4. Power down the pump unit.

7.5 Cleaning

NOTICE

Aggressive cleaning and flushing media may damage the pump.

- ▷ Adjust the type and duration of cleaning operations to the housing and sealing materials used.

8 Maintenance

8.1 Limit states criteria

Upon reaching one of the below limit states, it is necessary to suspend the operation of the equipment, and then decide to overhaul or decommissioning and disposal. The criteria for the limiting state of the equipment are:

- Achievement of the designated lifetime
- destruction or loss of density of the main material and (or) welds;
- distortion of the geometric dimensions of the casing or its parts;
- reduced performance without considering external factors and normal wear.

8.2 Schedule

Make sure a maintenance plan and schedule is adopted, in line with these User Instructions.

Table 8: Recommended maintenance checklist

No.	Service	Schedule / Cycles	Criteria	Action	
				Good	Inadequate
1	Routine inspection	Daily/weekly	Check operating behavior. Ensure noise, vibration and bearing temperatures are normal	Grease lubricated bearings, replace minimum every 24 months or 17 500 operating hours	Refer to chapter 9
			Check that there are no abnormal fluid or lubricant leaks (static and dynamic seals)	Minimum replace after every 24 months or 17 500 operating hours	Replace seals
			Check the level and condition of oil lubricant	Change oil at least every 6months (mineral oils) or 18 months (synthetic oils)	Oil change
			Check any auxiliary supplies eg heating/cooling (if fitted) are functioning correctly.	No action	Refer to auxiliary equipment user instructions
2	Periodic inspection	Every six months	Check foundation bolts for security of attachment and corrosion.	No action	Replace parts
			Check coupling for correct alignment and worn driving elements.	No action	Refer to coupling user instructions and chapter 5.6
			Secondary control: Check leak tightness of bearing gard	No Action	Replace secondary control bearing gard
3	Visual inspection of slide bearings	8000 h or 2 years	Groove depth of axial bearings should not be lower than 1.9mm. All slide bearing parts should be free of cracks or heavy wear scratches.	No action	Replace parts

8.3 Cross sectional drawings and parts list

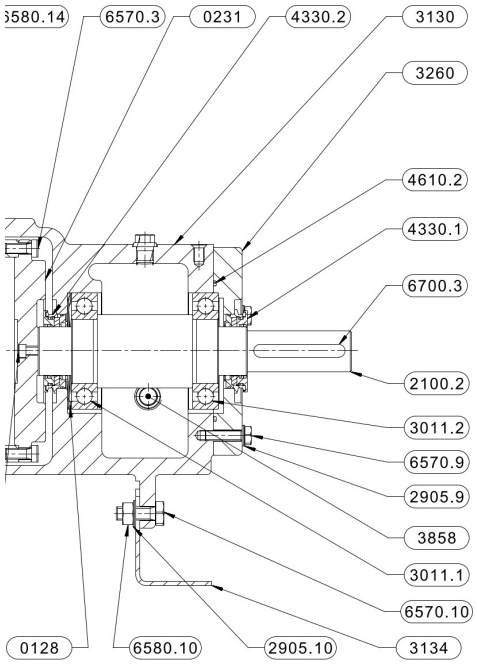
8.3.1 Parts list

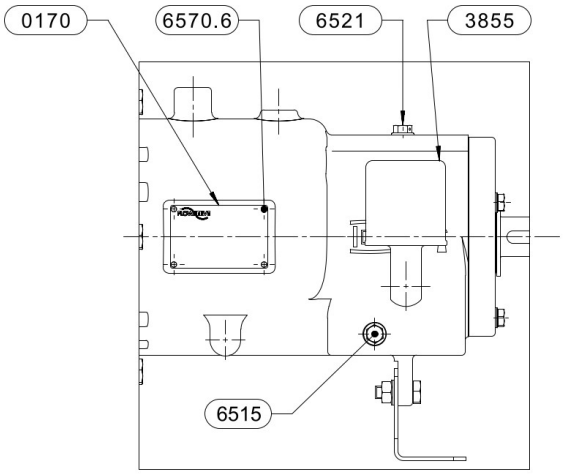
Below table summarizes the common parts referenced to on the cross sectional drawings. For a complete detailed parts list contact Flowserve.

Table 9: Parts list

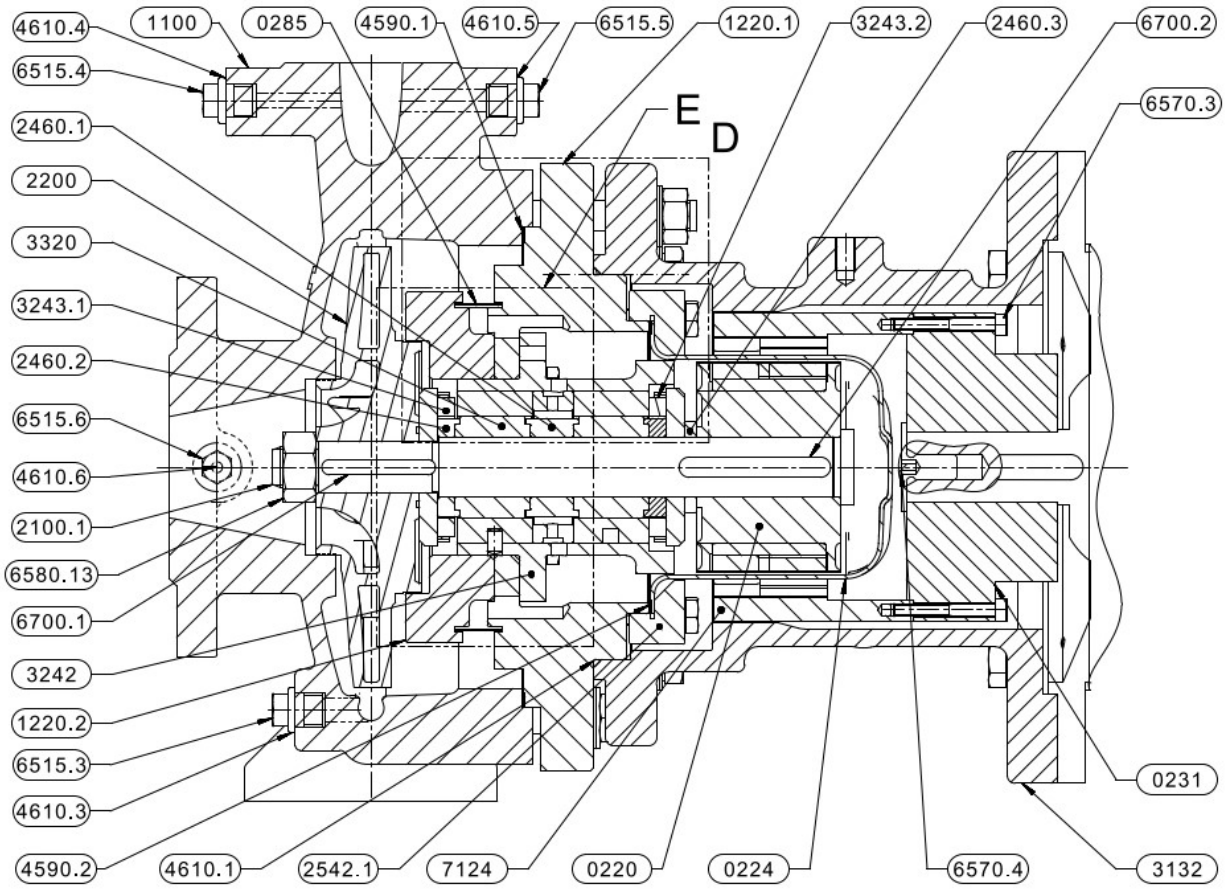
Item	Description	Item	Description	Item	Description
1100	Volute casing	2900	Clamping disk	4610.x	O-ring
1220.1	External cover	2905.x	Disc/washer	6541.x	Lock washer
1220.2	Internal cover	3011.x	Radial groove ball bearing	6570.x	Hexagon bolt/screw
2100.1	Wetted Shaft	3130	Bearing bracket	6572.x	Stud
2100.2	Drive shaft	3260	Bearing bracket cover	6700.x	Key
2200	Impeller	3132	Lantern/motor stool	6580.x	Hexagon nut
0220	Interior Magnet Assembly	3242	Bearing carrier assembly	6580.13	Shaft nut
0224	Isolation Shroud	3243.1	Thrust bearing assembly	6811	Cylindrical pin
0231	Driving Flange	3243.2	Thrust bearing assembly	7124	Outer magnet rotor
0170	Name plate	3320	Bearing bush	9035.x	Protection guard
0285.1	Strainer / Filter Insert	3855	Constant oil level regulator	6515.x	Screwed plug
0285.2	Strainer / Filter Insert	3858	Oil sight glass	1911	Heat barrier
0128	Wavy spring	4590.x	Sealing ring/gasket	1680	Bush assembly
2460.x	Spacer ring	4330.x	Radial shaft seal ring	5406	Strainer cover
2542.1	Clamping ring				

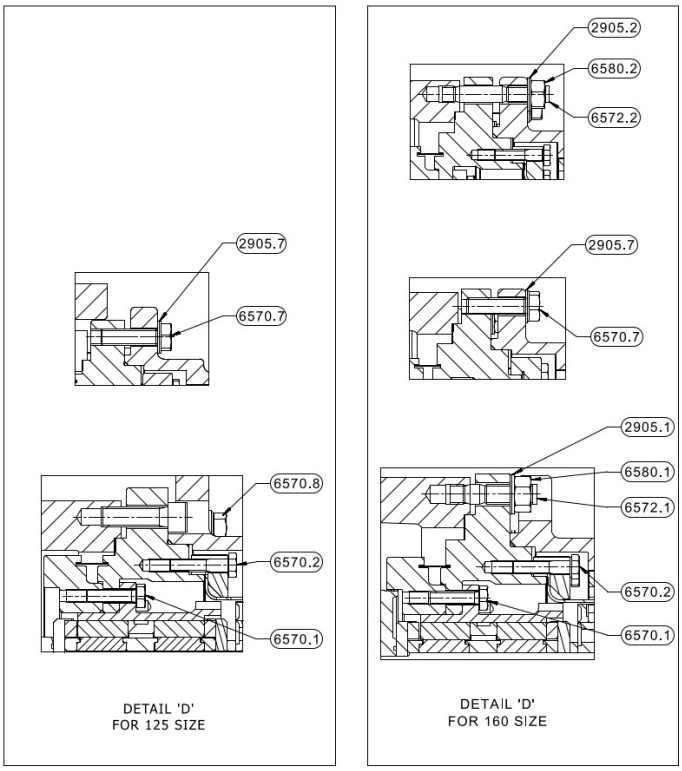
8.3.2 Bearing housing (CBMM)



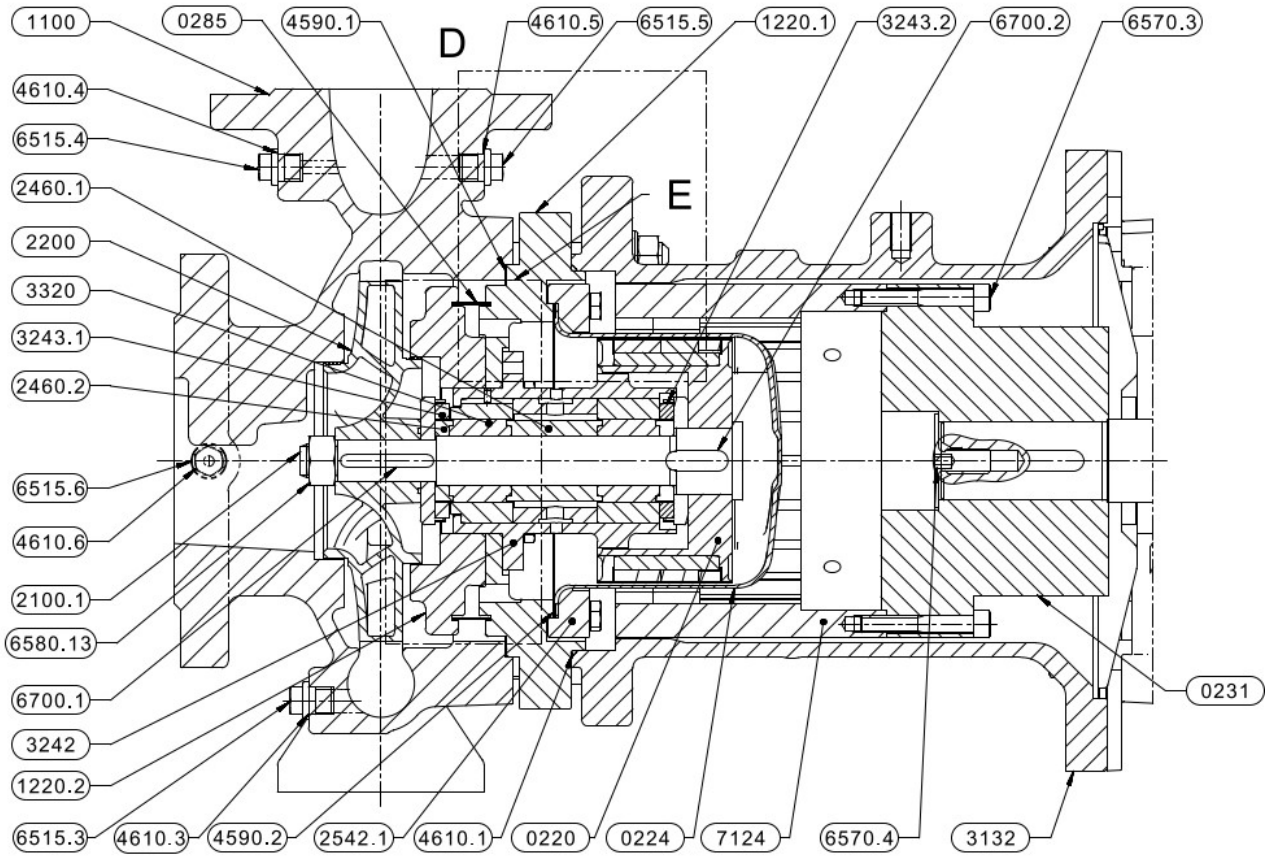


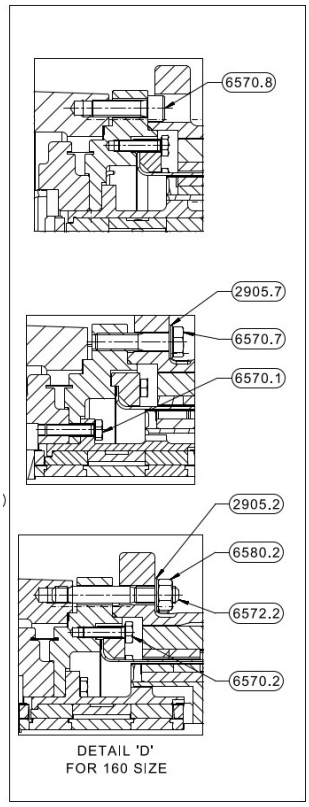
8.3.3 Magnet system 1

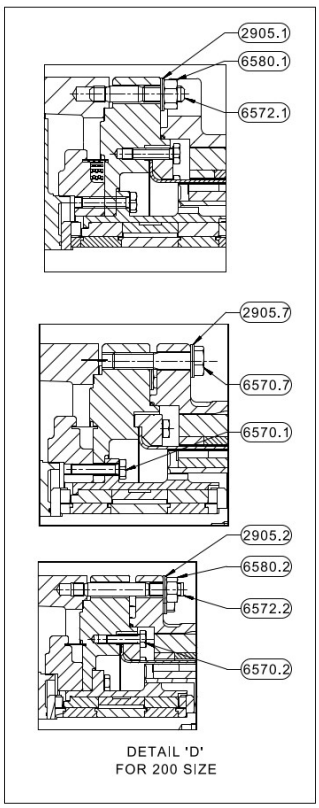




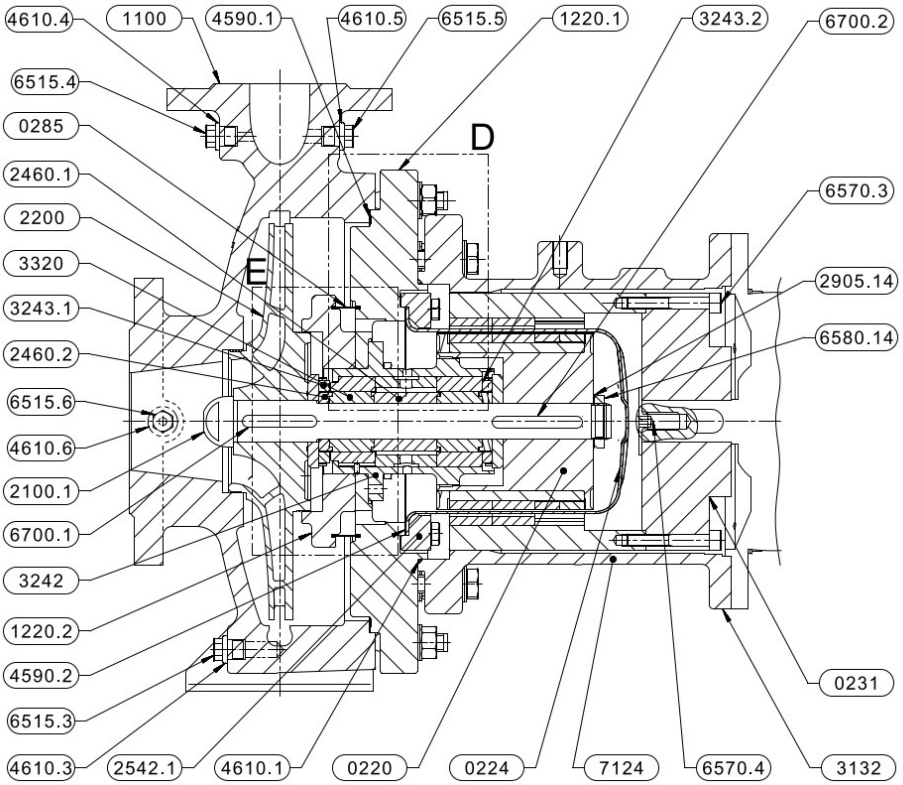
8.3.4 Magnet system 2

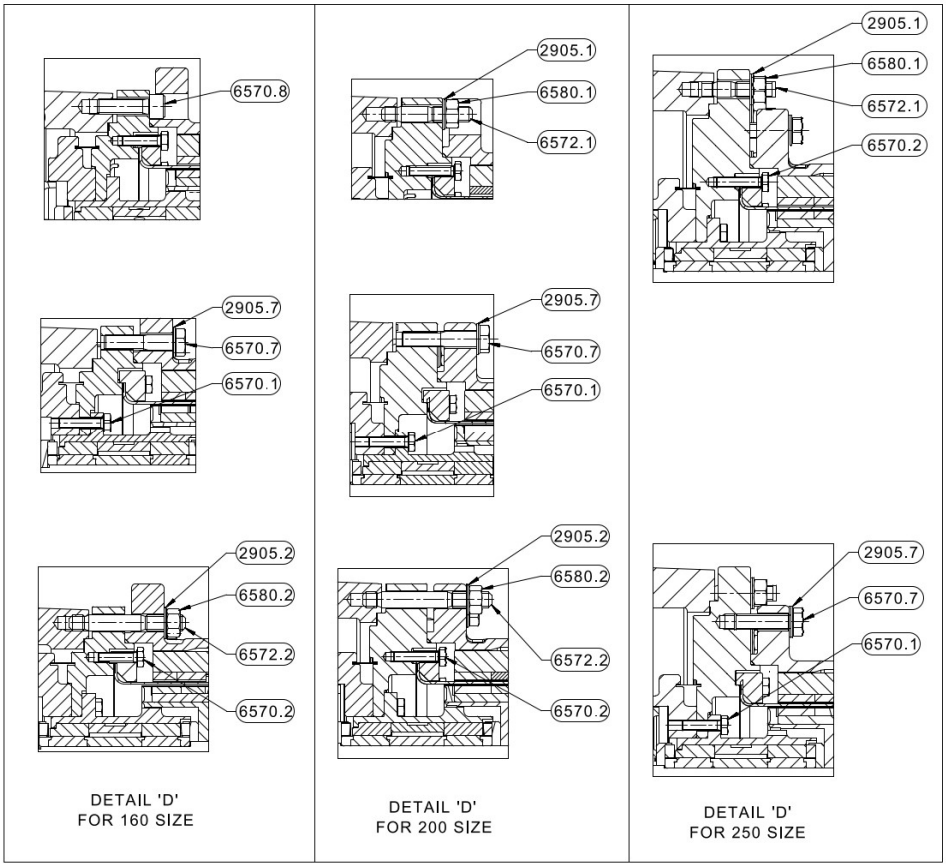




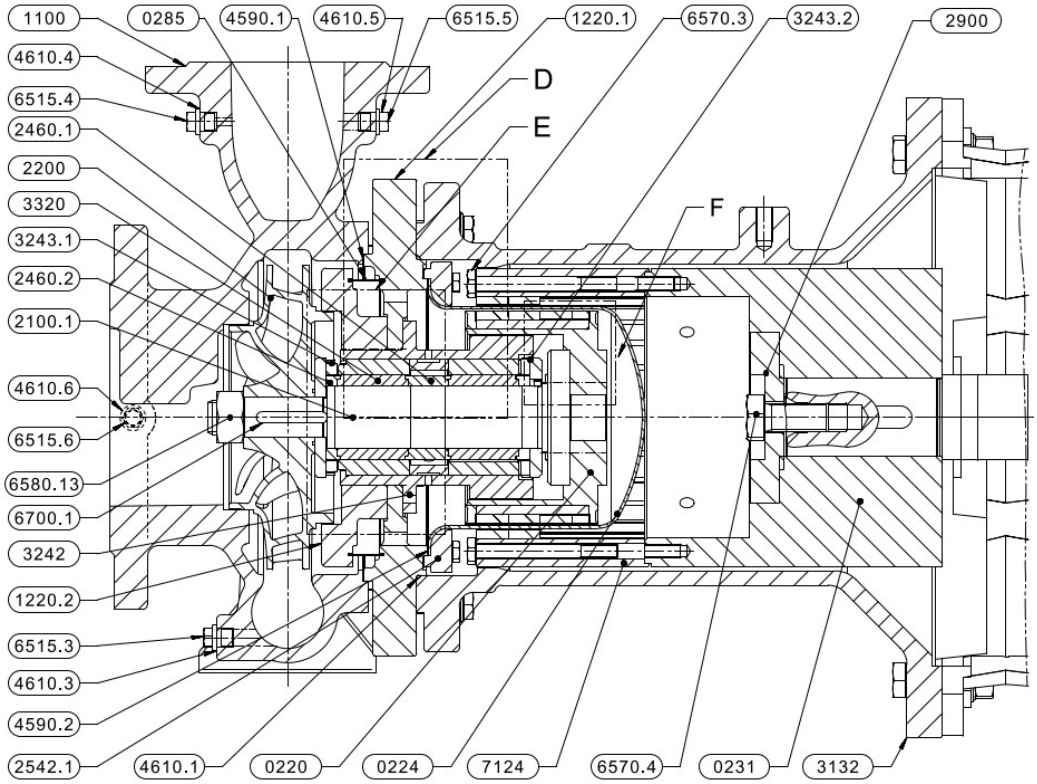


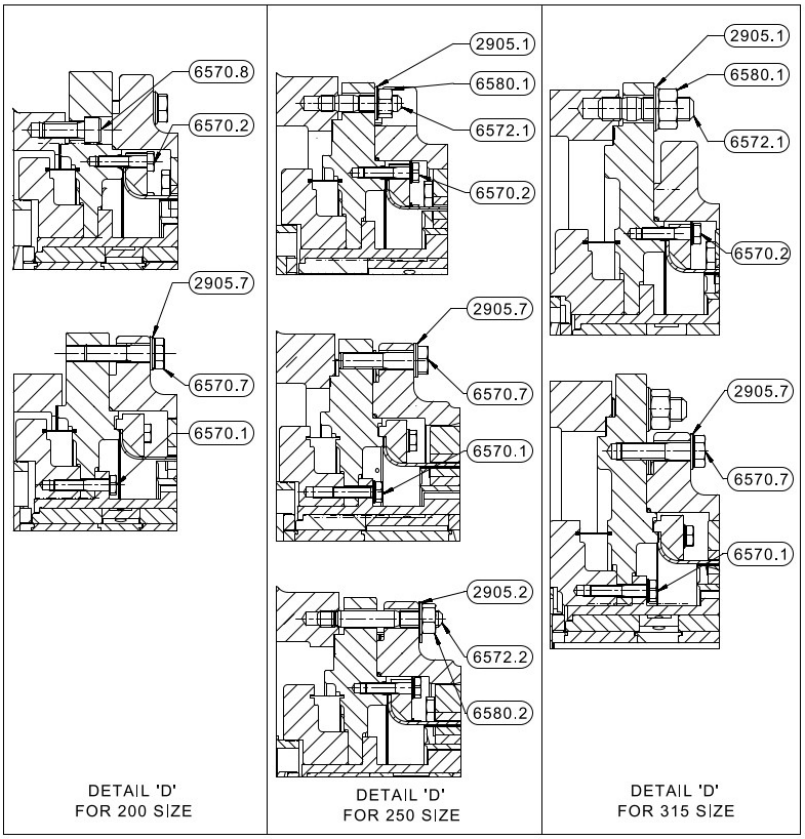
8.3.5 Magnet system 3



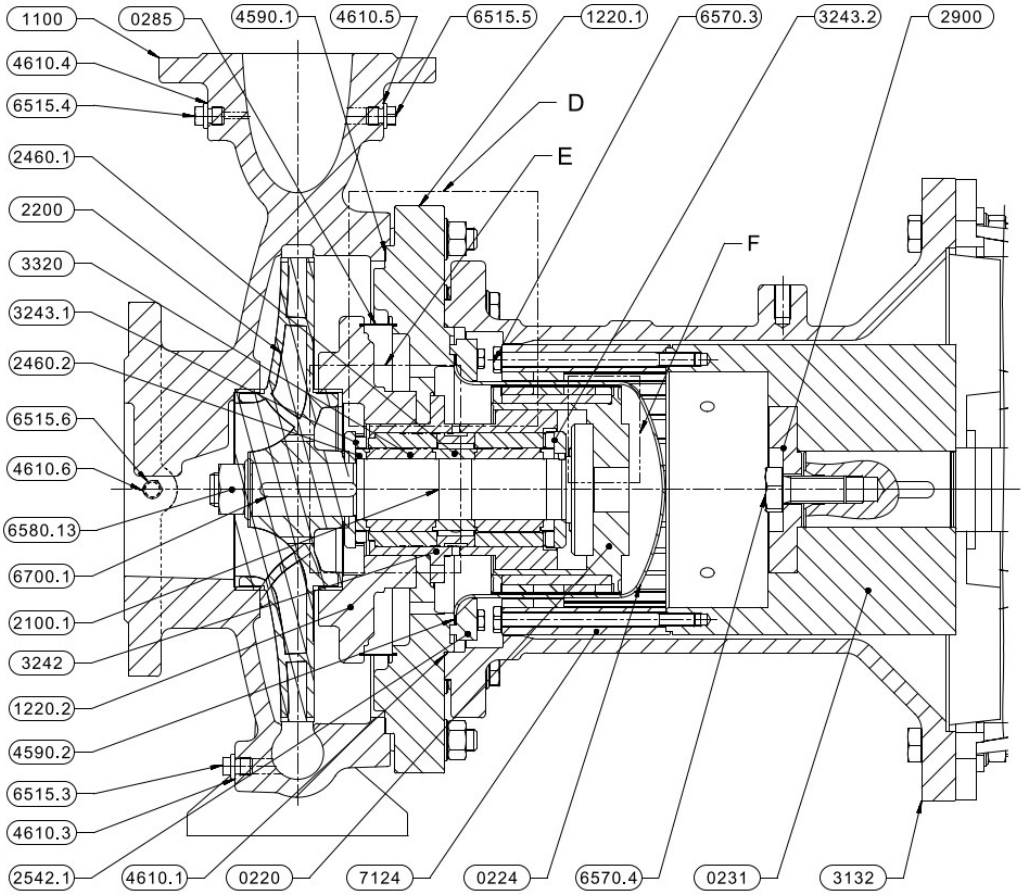


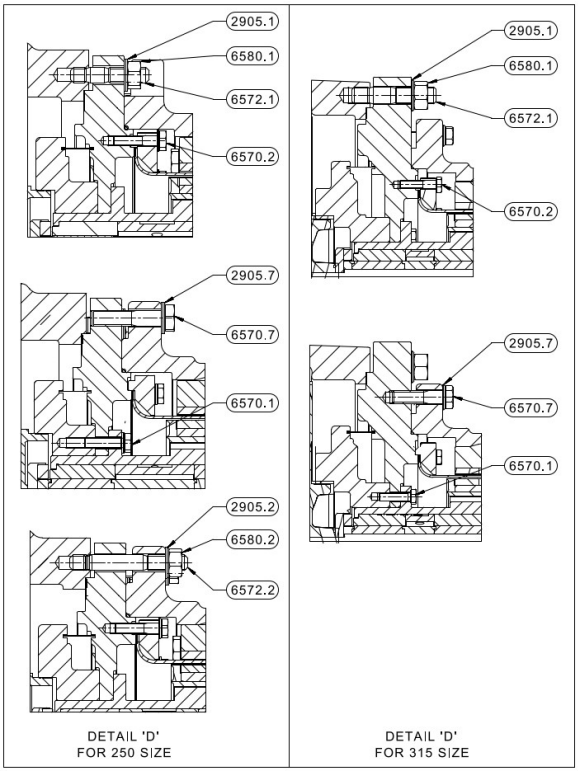
8.3.6 Magnet system 4 and 6 frame 45



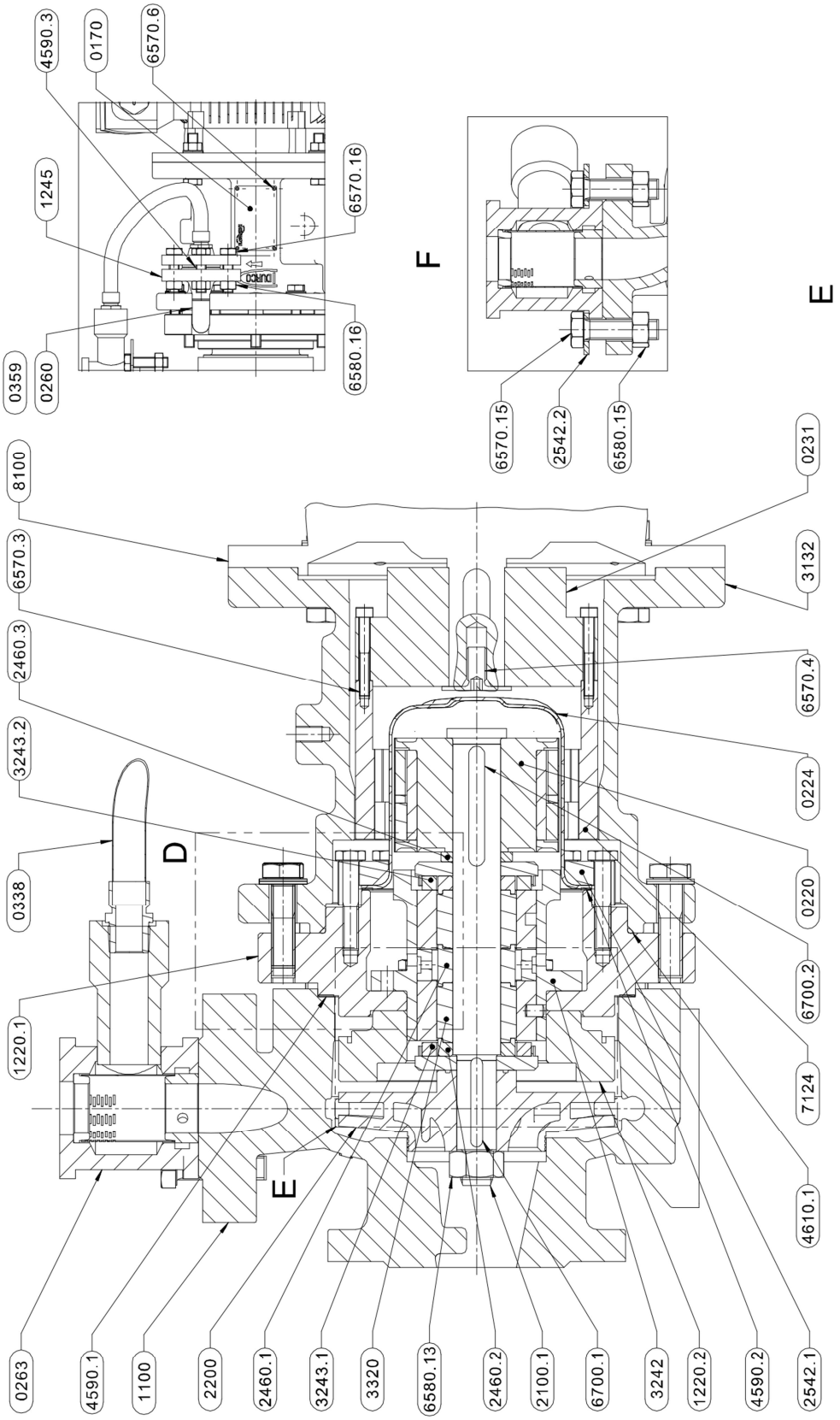


8.3.7 Magnet system 4 and 6 frame 55

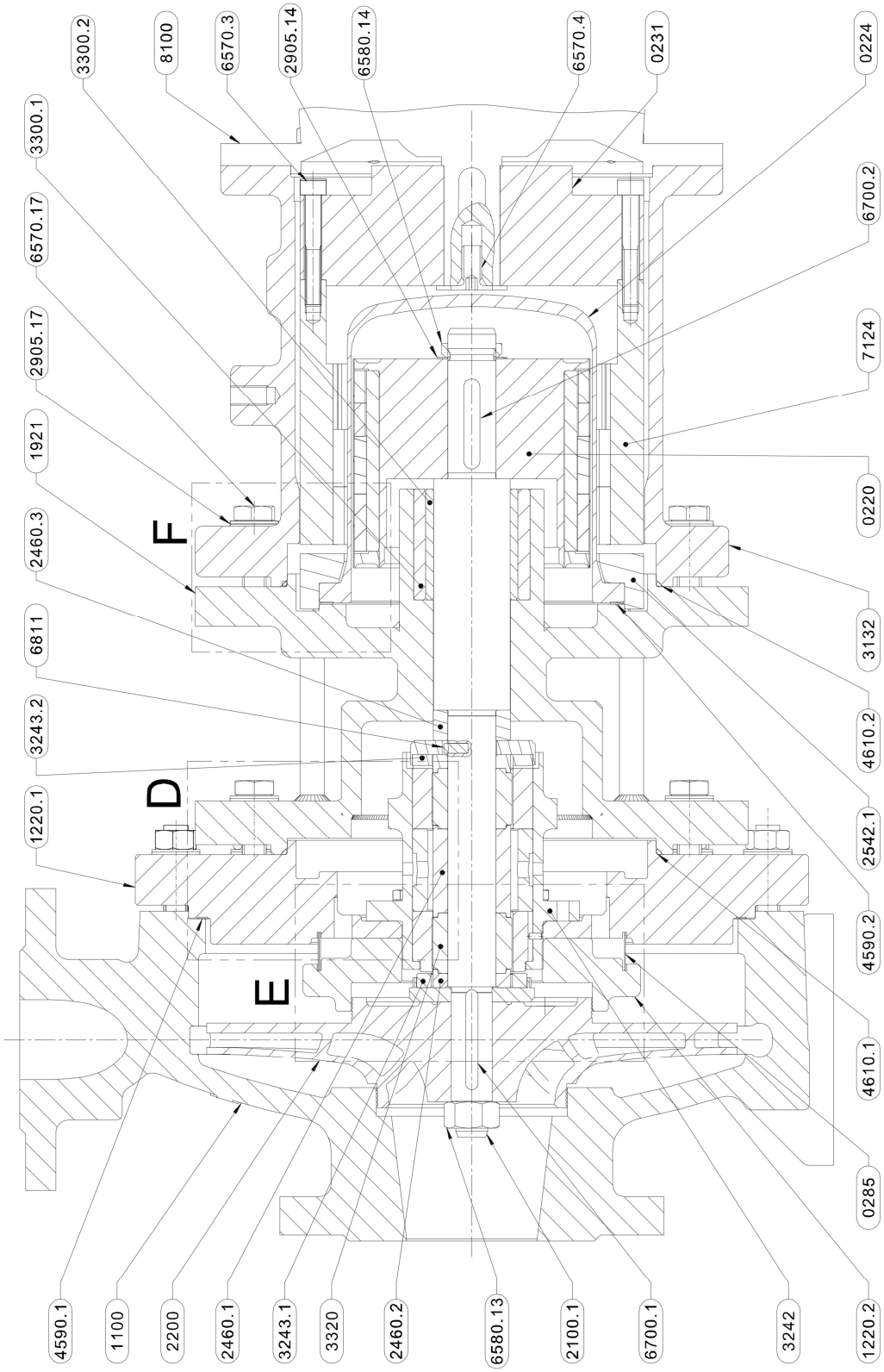




8.3.8 Execution with free flow filter



8.3.9 Execution with heat barrier



8.4 Spare parts

When ordering spare parts, the following information should be provided to Flowserve:

a) Product serial number (can be found on the nameplate)
b) Product size (can be found on the nameplate)
c) Part name and part number – taken from the parts list/sectional drawing
d) Number of the parts required

NOTICE

Any change to the original design specification (modification or use of non-standard part) will invalidate the product certification.

▷ Only replacement parts to the original design specification should be used and obtained from Flowserve.

8.4.1 Replacement parts for maintenance

Table 10: maintenance parts

Component description	Pump type	Item number	Comments
Cover gasket	CBME/CBMM	4590.1	Do not reuse after dismantling
Containment shell gasket	CBME/CBMM	4590.2	Do not reuse after dismantling
Lantern/bearing bracket O-ring	CBME/CBMM	4610.1	Can be reused if in good condition after dismantling
Shaft nut	CBME/CBMM	6580.13/ 6580.14+2905.14	Do not reuse after dismantling 3 times
Wavy spring (CBMM)	CBMM	0128	Do not reuse after dismantling
Cover O-ring (CBMM)	CBMM	4610.2	Can be reused if in good condition after dismantling
Secondary control sealing device (option)	CBME/CBMM	4330.3	Do not reuse if pump has operated with liquid/pressure inside lantern/bearing bracket (failure of containment shell).

8.4.2 Recommended spare parts for 2years operation

Also refer to table Table 10: maintenance parts

Table 11: Recommended spare parts for 2 years operation

Item no.	Designation	Item no.	Designation
3242	Radial bearing carrier assembly	4590.1	Cover gasket
3243.1	Thrust bearing carrier assembly	4590.2	Containment shell gasket
3243.2	Thrust bearing carrier assembly	4610.1	Lantern/bearing bracket O-ring
3011.1	Radial ball bearing (CBMM)	6580.13/ 6580.14+2905.14	Shaft nut
3011.2	Radial ball bearing (CBMM)	0128	Wavy spring (CBMM)
4330.1	Labyrinth seal (CBMM)	4610.2	Cover O-ring (CBMM)
4330.2	Labyrinth seal (CBMM)		

8.5 Disassembly

⚠WARNING

Magnetic fields could lead to attraction of foreign objects. Risk of injury!

- ▷ Keep (ferro)magnetic materials and tools away from the magnetic parts of the pump.

8.5.1 Disassembly of drive end

MARK 3 ISO MAG pumps have two different types of back pullout assemblies. The standard back pull out can be used to do maintenance on the complete pump without having to dismantle the pump casing from the users installation. The contained back pull out can be used to do maintenance on the drive end without having to dismantle the wetted parts from the users installation.

⚠WARNING

Untightening casing screws could lead to leakage of process liquid. The contained back pull out is not intended to be used with system under high pressure.

- ▷ Make sure the pump casing is not pressurized by the system when dismantling the drive end with contained back pull-out.

NOTICE

The outer magnet is attracted by the inner magnet. Unsupported loosening of the bearing bracket/ lantern screws will damage the pump.

- ▷ Use studs to guide bearing bracket/lantern when pulling back.
- ▷ Do not place any fingers between the interface of pump and bearing bracket/lantern while dismantling.

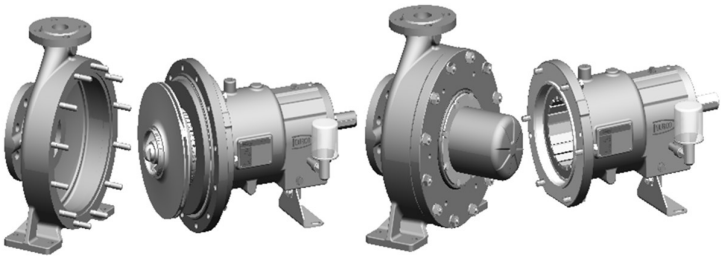
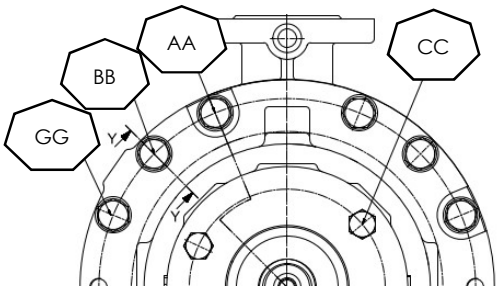
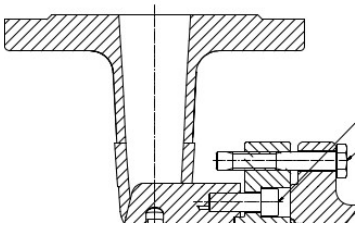
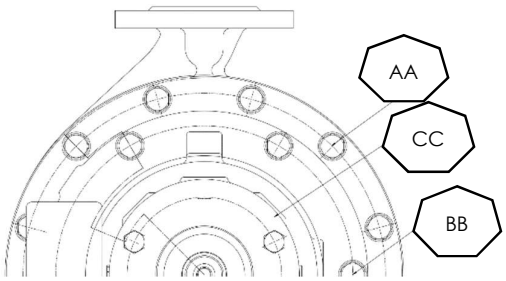


Figure 22: standard (left) and contained (right) back pull-out

Table 12: Back pull-out configurations

Impeller size/ magnet system	**Sketch**	**Fastners to be released**	
		Standard back pull-out	Contained back pull-out
125/MS1 160/MS1 160/MS2 200/MS2 160/MS3 200/MS3 250/MS6 250/MS4			BB & GG
200/MS4 200/MS6		Allways 2 phased dismantling for standard back pull-out	
250/MS3 315/MS6 315/MS4		AA	BB

After dismantling the back pull-out follow below steps to further disassemble the drive end.

8.5.1.1 CBME pumps

1. Release bolts 6570.11
2. Remove lantern 3132
3. Release shaft screw 6570.4 (for magnet system 4 and 6, remove locking disk 2900)
4. Withdraw the complete outer magnet rotor 7124 from the motor shaft end.

8.5.1.2 CBMM pumps

1. Release locking screw 6570.4
2. Block the outer magnet rotor 7124 and unscrew it by turning the shaft 2100.2 counter clockwise (RH thread)
3. Withdraw the outer magnet rotor from the bearing bracket.
4. Release the bolts 6570.9 and remove the bearing bracket cover 3260 and bearing isolators 4330.1 and 4330.2
5. Pull out the shaft 2100.2 with bearings 3011.1 and 3011.2 and remove spring 0128.
6. Remove the bearings 3011.1 and 3011.2 from the shaft.

8.5.2 Disassembly of pump wetted parts

✓ Place the pump in vertical position with the suction flange pointing downwards

1. Release bolts 6570.2
2. Remove clamping ring 2542.1 and containment shell 0224
3. Release fastners connecting the cover 1220.1 to the pump casing 1100
4. Withdraw the complete pull-out assembly from the volute casing.

The next steps depend on the type of magnet coupling (refer also to the cross sectional drawings)

8.5.2.1 Magnet system 1,2,4 and 6

1. Release shaft nut 6580.13.
2. Withdraw impeller 2200 and thrust bearing 3243.1 from shaft 2100.1
3. Remove key 6700.1
4. Withdraw complete assembly of cover 1220.1, cover 1220.2 and bearing carrier 3242
5. Remove bearing bushes 3320 and spacer rings 2460.2 and 2460.1
6. Remove thrust bearing 3243.2 (for magnet system 1 also spacer ring 2460.3) from the shaft.
7. Remove inner magnet 0220 from the shaft (for magnet system 4 and 6, first release srews 6570.5)

8.5.2.2 Magnet system 3

1. Release shaft nut 6580.14
2. Withdraw inner magnet 0220 and thrust bearing 3243.2 from shaft 2100.1
3. Remove key 6700.2
4. Withdraw complete assembly of cover 1220.1, cover 1220.2 and bearing carrier 3242
5. Remove bearing bushes 3320 and spacer rings 2460.2 & 2460.1
6. Remove thrust bearing 3243.1 and impeller 2200 from the shaft.
7. Release bolts 6570.1 to dismantle the covers 1220.1 & 1220.2, bearing carrier 3242 and strainer 0285.

NOTICE

Material relaxation could lead to insufficient clamping.

▷ Do not reuse the shaft nuts if they have been dismantled more than 3 times.

8.5.2.3 CBME pumps with heat barrier

1. Release shaft nut 6580.14
2. Withdraw inner magnet 0220 from shaft 2100.1
3. Withdraw heat barrier 1921
4. Release shaft nut 6580.13.
5. Withdraw impeller 2200 and thrust bearing 3243.1 from shaft 2100.1
6. Remove key 6700.1
7. Withdraw complete assembly of cover 1220.1, cover 1220.2 and bearing carrier 3242
8. Remove bearing bushes 3320 and spacer rings 2460.2 and 2460.1
9. Remove thrust bearing 3243.2 and spacer ring 2460.3 from the shaft.

8.6 Reassembly

- Consumables
  - Spare parts (refer to chapter
  - Mounting grease
- ✓ All parts are clean. Reused parts are cleaned after disassembly with a suitable diluting agent.
- ✓ The magnet rotors are free from any metal particles and dust
- ✓ The difference in diameter between impeller and casing wear rings should be between 0,3 and 0,5mm. If the wear rings are found to be excessively worn, it may be necessary to install wear rings on the impeller or in the cover or volute casing. For details, contact Flowserve.
- ✓ Check plain bearings for damage and wear, replace the bearings even if the ceramic bushes exhibit only hairline cracks

8.6.1 Tightening torques

The following tightening torques apply (in Nm):

Table 13: tightening torques

M8	M12	M16
26 Nm	59 Nm	98 Nm

Tightening torque for shaft nut: 50 Nm

NOTICE

Uneven tightening could lead to heavy material stresses and improper alignment of sealing surfaces.

▷ Tighten screws always crosswise.

8.6.2 Bearing carrier position

The installation position of the bearing cartridge controls the partial flow rate and the pressure level in the discharge side wear ring of the impeller. Two installation positions and different partial flow rates can be adjusted by turning the bearing cartridge by 90°. Installation position 1 is for small flowrates and a small axial thrust of the pump, to ensure a sufficient partial flow. Installation position 2 is for large heads and/or heavy axial thrusts acting on the pump and/or NPSH problems. The following table shows the correct installation positions for the different pump sizes.

Installation position 1:
Install the bearing cartridge 3242 such that the two partial flow holes (∅ 9mm) are on the horizontal axis and in line with the holes in the casing covers (1220.1&1220.2). This ensures the partial flow returns through the
holes to the back of the impeller.
Installation position 2:
Install the bearing cartridge 3242 such that the partial flow holes (∅ 9mm) are on the vertical axis. The small partial flow hole (∅ 6mm) will then be on the horizontal axis, above one of the holes in the casing covers (1220.1&1220.2). This ensures the partial flow returns through this small hole to the back of the impeller.

Table 14: bearing cartridge installation

Size	Installation position at speed (rpm)		Size	Installation position at speed (rpm)	
	< 1800	> 1800		< 1800	> 1800
40-25-125	1	1	**40-25-200**	1	1
50-32-125	1	1	**50-32-200**	1	1
65-40-125	1	1	**65-40-200**	1	1
80-50-125	1	1	**80-50-200**	1	1
100-65-125	1	1	**100-65-200**	1	2
40-25-160	1	1	**125-80-200**	1	2
50-32-160	1	1	**125-100-200**	1	2
65-40-160	1	1	**50-32-250**	1	2
80-50-160	1	1	**65-40-250**	1	2
40-25-200	1	2	**80-50-250**	1	2
50-32-200	1	2	**100-65-250**	1	2
65-40-315	1	2	**125-80-250**	1	2
80-50-315	1	2	**125-100-250**	1	2
100-65-315	1	2	**150-125-250**	1	2
			200-150-250	1	2

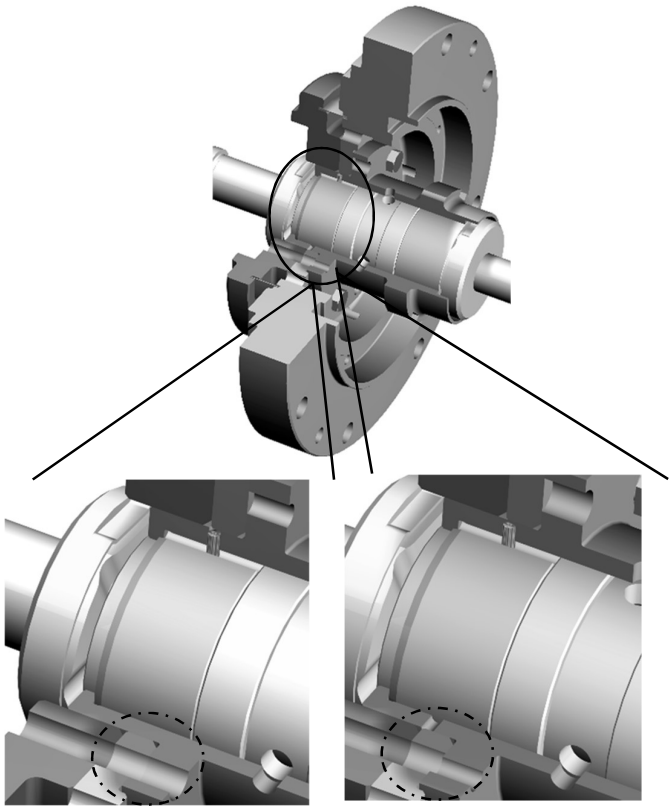


Figure 23: bearing carrier position

8.6.3 Assembly of the pump

8.6.3.1 Magnet system 1,2,4 and 6

1. Place cover 1220.2 on a flat surface, install strainer 0285 followed by cover 1220.1
2. Install bearing carrier 3242 and tighten bolts 6570.1 (refer to chapter 0 for mounting position)
3. Install the inner magnet 0220 on the shaft 2100.1 followed by the thrust bearing 3243.2, bearing bushes 3320 and spacer rings 2460.1 & 2460.2.
4. Install thrust bearing 3243.1 followed by impeller 2200.
5. Lock the above assembly by tightening lock nut 6580.13

8.6.3.2 Magnet system 3

1. Place cover 1220.2 on a flat surface, install strainer 0285 followed by cover 1220.1
2. Install bearing carrier 3242 and tighten bolts 6570.1 (refer to chapter 0 for mounting position)
3. Install key 6700.1 and impeller 2200 followed by thrust bearing 3243.1 on the shaft.
4. Install the bearing bushes 3320 and spacer rings 2460.1 & 2460.2. followed by thrust bearing 3243.2 and the inner magnet 0220.
5. Lock the above assembly by tightening lock nut 6580.14

After completing the above steps:

Install the containment shell 0224 with clamping ring 2542.1 on the cover 1220.1 Don't forget to install gasket 4590.2. Use new gaskets every time the containment shell has been dismantled.

WARNING

The inner magnet exerts a heavy force of attraction on the clamping ring. Risk of injury!

▷ Support clamping ring steadily while sliding it over the containment shell.

Mount the pull-out assembly to the volute casing. Tighten all screws/bolts.

8.6.4 Assembly of the drive end

8.6.4.1 CBMM pumps

1. Install bearings 3011.1 & 3011.2 on the shaft 2100.2
2. Install spring 0128 in the bearing bracket at inboard bearing housing
3. Install the shaft 2100.2 with bearings 3011.1 & 3011.2 in the bearing bracket.
4. Install the bearing isolator 4330.2 at inboard bearing.
5. Install the bearing isolator 4330.1 in the bearing bracket cover 3260 and mount the cover 3260 on the bearing bracket. Tighten screws 6570.9

NOTICE

Wrong lubricants can damage the O-rings of the bearing isolators and lead to leakage.

▷ The standard bearing isolators installed are FLOWSERVE type *Bearing gard.* The recommended mounting grease for these isolators is *Pac-ease (P-80)*.

6. Connect the outer magnet rotor 7124 and shaft 2100.2 by blocking the outer magnet rotor and turning the shaft clockwise. Lock the outer magnet rotor by tightening screw 6570.4.

WARNING

Dynamic contact between static and rotating parts could lead to excessive surface temperatures!

▷ Prior to assembling the drive end to the pump cover always check the gap between outer magnet rotor 7124 and bearing bracket 3130. Make sure the outer magnet rotor turns freely without touching the lantern/bearing bracket inner surface.

7. Use studs to assemble the drive end on the pump and connect following the configuration of Table 12

8.6.4.2 CBME pumps

1. Mount the outer magnet rotor 7124 on the motor shaft and tighten locking screw 6570.4 (for magnet system 4 and 6 make sure to install first locking disk 2900.)
2. Mount the lantern 3132 on the motor and tighten screws 6570.11.

WARNING (Ex)

Dynamic contact between static and rotating parts could lead to excessive surface temperatures!

- ▷ Prior to assembling the drive end to the pump cover always check the gap between outer magnet rotor 7124 and lantern 3132. Make sure the outer magnet rotor turns freely without touching the lantern/bearing bracket inner surface.

3. Mount the assembly of lantern, motor and outer magnet rotor on the pump. Use studs to guide the assembly and avoid the outer magnet being pulled against the containment shell.

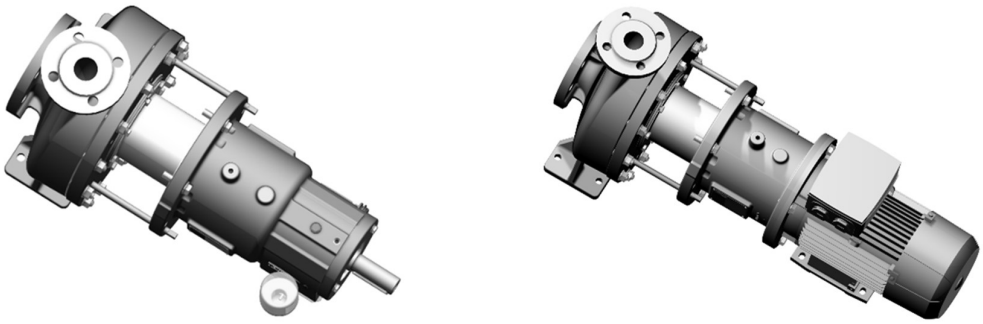


Figure 24: Assembly of drive end and wet end for CBMM (left) and CBME (right)

8.6.5 Special instructions for pumps with secondary control

The secondary control seal needs a setting step after assembly to make sure the rotor and stator of the seal are correctly aligned.

- Use *Pac-ease (P-80)* mounting grease to install the *FLOWSERVE bearing gard.*

1. Assemble the drive end following the instructions of chapter 8.6.4
2. Pressurize the stool (CBME) or bearing bracket (CBMM) to a pressure of 3.5barg using connection "7", refer to Figure 10: connections
3. Release the pressure of the stool/bearing bracket again to atmospheric pressure

8.7 Service procedures

SAFETY INSTRUCTIONS

Any work on the machine must be performed when it is at a standstill and de-energized state. It is imperative that the procedure for shutting down the machine is followed.

- ▷ Before working on the equipment, take measures to prevent an uncontrolled start. Put a warning board on the starting device with the words: "***Machine under repair: do not start***".
- ▷ With electric drive equipment, lock the main switch open and withdraw any fuses. Put a warning board on the fuse box or main switch with the words: "***Machine under repair: do not connect***".)

8.7.1 Bearing oil change

1. Unscrew the screwed plug.
2. Remove the vent plug.
3. Completely drain the oil.
4. If a different oil from the previous oil is to be used, rinse the bearing bracket.
5. Screw in the screwed plug.
6. Install the vent plug.
7. Dispose of used oil properly.
8. (re-)fill

8.7.2 Coupling torsional backslash (CBMM pumps only)

⚠WARNING

Unintended switching on of the machine. Risk of crushing due to moving parts!

- ▷ Prior to working on moving parts make sure the pump set is disconnected from the mains power.
- ▷ Safeguard against undesired switching on of the mains power.

1. Disassemble coupling guard.
2. Turn one coupling-half against the other without torque until the stop unit.
3. Mark the positions of the coupling-halves to each other.
4. Mark the positions of the coupling-halves to each other.
5. Turn the coupling-halves as far as possible in the other direction free of torque.
6. Determine torsional backlash ΔSb by measuring the distance between the markings.
7. If the permissible torsional backlash is exceeded, see chapter 9.7 Couplings, page 48, inform service personnel.
8. Fit coupling guard.
9. Tighten screws with prescribed tightening torque (refer to coupling instruction manual).

9 Troubleshooting Guide

Table 15: troubleshooting

Description	Possible causes	Possible remedy
Insufficient flow	Differential pressure too high	Make sure the calculated pressure losses match with the pump curve at the required flow Re-adjust the control valve Check the system and filters for blockages/contamination
	Residual gas in pump or piping system	Bleed all air from pump and system
	Suction lift too high or insufficient NPSHA	Check liquid levels, open suction side shut-off valves.
	Wrong direction of rotation	Re-connect the motor, interchanging two of three supply wires.
	Leakage in casing or suction pipework.	Replace casing seal. Check flange connections.
	Clogged impeller	Clean the pump and check for any blockages inside.
No liquid delivered with motor in operation	Wrong direction of rotation	Re-connect the motor, interchanging two of three supply wires.
	The max. torque of the magnetic coupling has been exceeded, i.e. decoupling has occurred.	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magnetic coupling - motor - pump is in accordance with the data sheet. If the selection of magnetic coupling torque was based on VFD operation, the pump should not be started direct on-line. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings.
	Pump not filled or liquid contains too much gas	Bleed the air and fill pump and suction or feed line.

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Description	Possible causes	Possible remedy
Pump leakage	Leakage in casing seal	Check tightening torque of tie bolts. Check condition of gaskets Check the system and filters for blockages/contamination
	Defective containment shell	Check the containment shell, replace if damaged.
Temperature increase in the pump	Wrong direction of rotation	Re-connect the motor, interchanging two of three supply wires.
	Residual gas in pump or pipeline	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magnetic coupling - motor - pump is in accordance with the data sheet. If the selection of magnetic coupling torque was based on VFD operation, the pump should not be started direct on-line. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings.
	Suction lift too high or insufficient NPSHA	Bleed the air and fill pump and suction or feed line.
	The filtering screen for the partial flow installed in the pump is dirty	Dismantle the pump and clean the filtering screen.
Unsteady running of pump, excessive noise	Suction lift too high or insufficient NPSHA.	Check liquid levels, open suction side shut-off valves. Clean suction side filters and dirt traps.

Description	Possible causes	Possible remedy
Unsteady running of pump, excessive noise	The max. torque of the magnetic coupling has been exceeded, i.e. decoupling has occurred.	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magnetic coupling - motor - pump is in accordance with the data sheet. If the selection of magnetic coupling torque was based on VFD operation, the pump should not be started direct on-line. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings.
	Residual gas in pump or pipeline	Bleed the air and fill pump and suction or feed line.
	Pump distorted	Check pump installation and alignment.
	Foreign matter in the pump	Dismantle and clean the pump
Motor load monitor low limit alarm	Decoupling of magnetic coupling	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magne¬tic coupling - motor - pump is in accordance with the data sheet. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings. Check the operating point.
	Flowrate below the min. permissible level	
	Operating conditions differ from the pump dataseet (eg. specific gravity)	
Motor load monitor high limit alarm **Motor circuit breaker switches off**	Flowrate above permissible max. level	Check the operating point. Check that pump turns freely. Check internal plain bearings. Check if the pump is blocked by contamination.
	Increased friction in the pump	
	Requirements as to pumping conditions not met.	

10 Decommissioning and Recommissioning

10.1 Decommissioning

10.1.1 Preparatory measures

↻ With sticky or abrasive conveyance medium it is necessary to implement a flushing procedure prior to switching the pump set off.

1. Close pressure-side control valve.
2. Switch motor off.
3. Switch off external/auxiliary supplies
4. Once the pump comes to a standstill close all further shut-off valves.

✓ Pump is at ambient temperature and pressure-free

10.1.2 Disconnect electrical supply

⚠WARNING

Work on the product by unqualified personnel. Risk of death from electric shock!

▷ Work must be carried out only by personnel specialized in electrical installations.

1. Switch off power supply
2. Secure against switching on again
3. Disconnect motor terminals and secure cable ends

10.1.3 Disassembly and emptying

⚠WARNING

Opening the connections. Risk of leaking hot, toxic, corrosive or burning conveyance.

▷ Observe the valid safety regulations.

▷ Wear appropriate personal protective equipment.

⚠WARNING

Hanging loads. Risk of crushing.

▷ Only use suitable lifting equipment.

NOTICE

Leaking conveyance medium. Risk for environmental damage!

▷ Contain leaking conveyance medium, collect and dispose of correctly.

1. Place tank beneath suction flange.
2. Slightly loosen flange connection pipe, suction side.
3. Slightly loosen flange connection pipe, pressure side.

4. Contain leaking conveyance medium.
5. Release flange connection pipe, pressure side.
6. Release flange connection pipe, suction side.
7. Unscrew coupling guard.
8. Release coupling.
9. Release pump from base plate.
10. Lift pump slowly with hoisting equipment
11. Contain leaking conveyance medium.
12. Dispose of leaking conveyance medium.

↳ Pump is ready for cleaning.

10.1.4 Cleaning

Consumables

- Cleaning agent
- Neutralizing agent

✓ Pump is at a workstation with cleaning table suitable for chemical works.

Lift pump slowly until it is vertical with suction flange pointing downwards. Repeat this until no conveyance medium leaks out of the suction flange.

1. Flush pump with cleaning agent.
2. If necessary flush the pump with neutralising agent.
3. Flush pump with neutral liquid.
4. Blow through the pump to dry it with dry gas (e.g. nitrogen).

10.1.5 Preserving

Consumables

- Suitable preservation media (e.g. klübertop K01-601)

✓ Pump is correctly disassembled, emptied and cleaned.

✓ Pump material spheroidal graphite iron

1. Close suction branch with blind flange.
2. Fill pump with preservative.
3. Turn pump shaft when filling.
4. Wait two minutes.
5. Position collection tank.
6. Carefully open suction flange.
7. Lift pump slowly with hoisting equipment.
8. Contain leaking fluid and dispose of correctly.
9. Close pump openings with locking caps.

↳ Pump is preserved for 6 months in storage.

10.2 Recommissioning

Follow the instructions in chapter 6, prior to start the installation/commissioning works perform below checks.

1. Visual inspection for damage.
2. Change gaskets in accordance with the maintenance schedule.
3. Check the ease of movement of the shaft.

11 Returns and Disposal

11.1 Returns

Prior to sending the equipment to a FLOWSERVE service department, follow below steps.

1. Complete declaration of contamination
2. Send the declaration of contamination to the service department
3. Close the openings of the pump properly
4. Pack the pump securely for transport and send it to the service department.

NOTICE

Pumps sent to a FLOWSERVE service department will only be unpacked and opened with a correctly filled corresponding declaration of decontamination.

11.2 Disposal and recycling

At the end of the equipment service life, the relevant materials and parts should be recycled or disposed of using local environmental regulation methods. If the product contains substances which are harmful to the environment, then the removal or disposal of the equipment must be in accordance with local/regional regulations. This includes any liquid and/or gas in the "seal system" or utility.

WARNING

Refer to Safety Data Sheets and make sure that hazardous substances or toxic fluids are disposed of safely and that the correct personal protective equipment is used. All activities involving hazardous substances or toxic fluids must be in compliance with published safety standards.

12 Technical Data

12.1 Technical limits

NOTICE

Below information can be used for general guidance. The equipment is allways selected according to the specifications and conditions reffered to on the pump datasheet. Contact FLOWSERVE in case of doubt.

12.1.1 Ambient conditions

Temperature : -20°C to 40°C
Humidity : 80%

Special executions for lower ambient temperatures are available on request. Contact FLOWSERVE.

12.1.2 Designated metrics

- Designated lifetime : 20 years
- Designated shelf life : 6 months before re-preservation
- Operating hours between major overhaul : refer to chapter 8.2

12.1.3 Temperature limits

12.1.3.1 Casing and cover

- Ductile cast iron casing : -40°C to 350°C (1)
- Cast steel : -40°C to 400°C (1) (2)
- Stainless steel : -70°C to 350°C (1)
- Duplex stainless steel : -70°C to 250°C (1)

12.1.3.2 Shaft

- Duplex stainless steel shaft : -70°C to 300°C (1)
- Chrome steel shaft : -40°C to 400°C (1) (2)

12.1.3.3 Containment shell

- Hastelloy standard : -70°C to 350°C (1)
- Hastelloy high efficiency : -70°C to 180°C (1)
- Ceramic : -40°C to 400°C (1) (2)

(1)Liquid temperatures above 180°C are only allowed with open lantern / open bearing bracket
(2)Liquid temperatures above 350°C are only allowed with heat barrier

12.1.3.4 Secondary control sealing device

The max allowable temperature of the pumped liquid for pumps with secondary control sealing device is 180°C. Pumps with open lantern / open bearing bracket are not to be used in applications where secondary control is required.

12.1.4 Pressure limits

12.1.4.1 Casing and cover

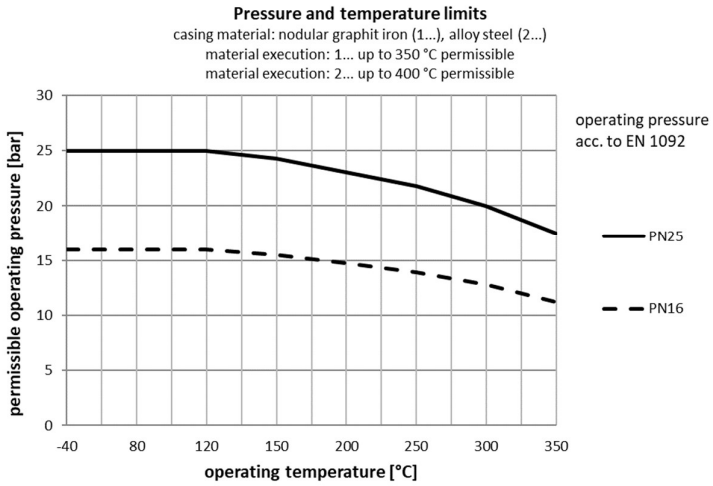

Figure 25: Pressure & temperature limits (DCI & cast steel)

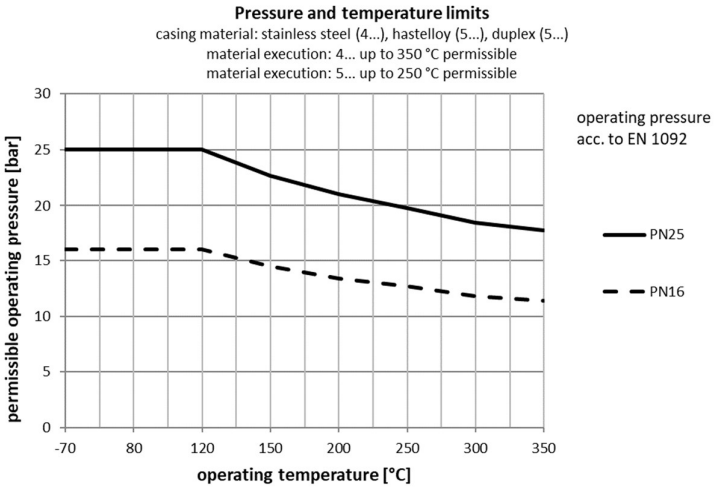

Figure 26: Pressure & temperature limits (stainless & duplex)

12.1.4.2 Containment shell

All 3 standard available types of containment shell have a design pressure of 25barg for the complete allowable operating temperature range stated above (chapter 12.1.2).

12.1.4.3 Secondary control

The back-up seal used for secondary control has a design pressure of 25barg for the complete allowable operating temperature range stated above (chapter 12.1.2).

12.1.4.4 Heating jackets

Heating jackets are designed to order. Contact FLOWSERVE.

12.2 Nameplate

Refer to the nameplate fixed to the pump for the pump type, duty and specific marking. An example can be found below.

FLOWSERVE	Flowserve SIHI (Belgium) bvba 't Hofveld 1 - 1702 Groot-Bijgaarden		
Type			
TAG			
Q	m^3/h	n	rpm
H	mlc	P	kW
ρ	kg/m3	t	°C
⌀	mm	date	
CE ⟨Ex⟩ Ex II 2G Ex h IIC T5…T1 Gb			
Serial nr :			

Figure 27: Nameplate

12.3 Noise level

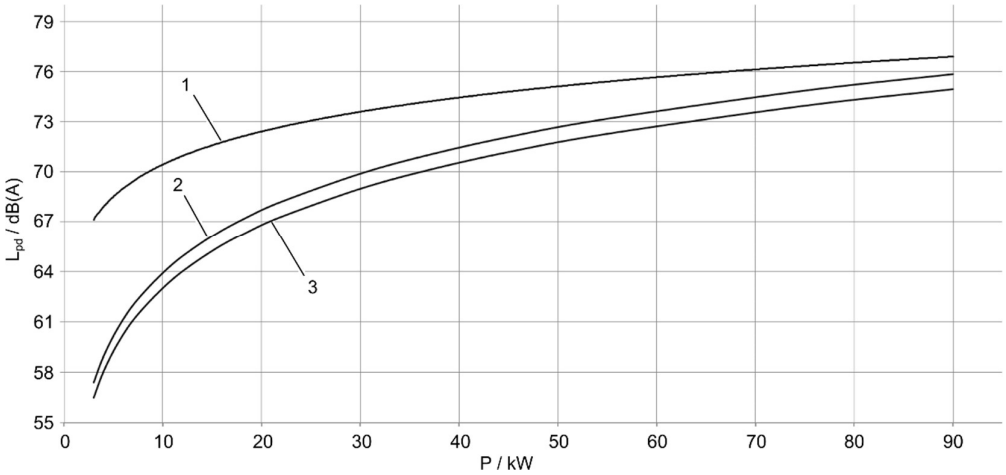

Figure 28: Noise emissions for: a pump running at 2900 rpm (2) and1450 rpm (3) and a pump set running at 2900 rpm (1)

12.4 Maximum flange forces and moments

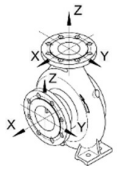

Figure 29:Flange forces and moments

12.4.1.1 According to ISO 5199 Pump family 1A [Material Execution - 1B, 1E, 1R, 1U]

Size	Forces in N (lbf)						Forces in N (lbf)						Moments in Nm (lbf*ft)			
	Suction						Discharge						Suction		Discharge	
	Mx	My	Mz	Fx	Fy	Fz	Mx	My	Mz	Fx	Fy	Fz	∑M	∑F	∑M	∑F
40-25-125	455 (340)	315 (240)	368 (280)	438 (100)	385 (90)	350 (80)	315 (240)	210 (160)	245 (190)	263 (60)	245 (60)	298 (70)	665 (500)	683 (160)	455 (340)	455 (110)
50-32-125	490 (370)	350 (260)	403 (300)	578 (130)	525 (120)	473 (110)	385 (290)	263 (200)	298 (220)	315 (80)	298 (70)	368 (90)	718 (530)	910 (210)	560 (420)	578 (130)
65-40-125	525 (390)	385 (290)	420 (310)	735 (170)	648 (150)	595 (140)	455 (340)	315 (240)	368 (280)	385 (90)	350 (80)	438 (100)	770 (570)	1155 (260)	665 (500)	683 (160)
80-50-125	640 (475)	460 (342)	520 (386)	1000 (743)	900 (669)	820 (609)	560 (416)	400 (297)	460 (342)	600 (446)	540 (401)	660 (490)	940 (698)	1580 (1174)	1040 (609)	773 (773)
100-65-125	700 (520)	500 (371)	580 (431)	1340 (995)	1200 (891)	1080 (802)	640 (475)	460 (342)	520 (386)	900 (669)	820 (609)	1000 (743)	1040 (773)	2100 (1560)	940 (698)	1580 (1174)
40-25-160	455 (340)	315 (240)	368 (280)	438 (100)	385 (90)	350 (80)	315 (240)	210 (160)	245 (190)	263 (60)	245 (60)	298 (70)	665 (500)	683 (160)	455 (340)	455 (110)
50-32-160	490 (370)	350 (260)	403 (300)	578 (130)	525 (120)	473 (110)	385 (290)	263 (200)	298 (220)	315 (80)	298 (70)	368 (90)	718 (530)	910 (210)	560 (420)	578 (130)
65-40-160	525 (390)	385 (290)	420 (310)	735 (170)	648 (150)	595 (140)	455 (340)	315 (240)	368 (280)	385 (90)	350 (80)	438 (100)	770 (570)	1155 (260)	665 (500)	683 (160)
80-50-160	560 (420)	403 (300)	455 (340)	875 (200)	788 (180)	718 (170)	490 (370)	350 (260)	403 (300)	525 (120)	473 (110)	578 (130)	823 (610)	1383 (320)	718 (530)	910 (210)
100-65-160	613 (460)	438 (330)	508 (380)	1173 (270)	1050 (240)	945 (220)	525 (390)	385 (290)	420 (310)	648 (150)	595 (140)	735 (170)	910 (680)	1838 (420)	770 (570)	1155 (260)
125-80-160	735 (550)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	560 (420)	403 (300)	455 (340)	788 (180)	718 (170)	875 (200)	1068 (790)	2170 (490)	823 (610)	1383 (320)
40-25-200	455 (340)	315 (240)	368 (280)	438 (100)	385 (90)	350 (80)	315 (240)	210 (160)	245 (190)	263 (60)	245 (60)	298 (70)	665 (500)	683 (160)	455 (340)	455 (110)
50-32-200	490 (370)	350 (260)	403 (300)	578 (130)	525 (120)	473 (110)	385 (290)	263 (200)	298 (220)	315 (80)	298 (70)	368 (90)	718 (530)	910 (210)	560 (420)	578 (130)
65-40-200	525 (390)	385 (290)	420 (310)	735 (170)	648 (150)	595 (140)	455 (340)	315 (240)	368 (280)	385 (90)	350 (80)	438 (100)	770 (570)	1155 (260)	665 (500)	683 (160)
80-50-200	560 (420)	403 (300)	455 (340)	875 (200)	788 (180)	718 (170)	490 (370)	350 (260)	403 (300)	525 (120)	473 (110)	578 (130)	823 (610)	1383 (320)	718 (530)	910 (210)
100-65-200	613 (460)	438 (330)	508 (380)	1173 (270)	1050 (240)	945 (220)	525 (390)	385 (290)	420 (310)	648 (150)	595 (140)	735 (170)	910 (680)	1838 (420)	770 (570)	1155 (260)
125-80-200	735 (550)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	560 (420)	403 (300)	455 (340)	788 (180)	718 (170)	875 (200)	1068 (790)	2170 (490)	823 (610)	1383 (320)
125-100-200	875 (650)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	613 (460)	438 (330)	508 (380)	1050 (240)	945 (220)	1173 (270)	1068 (790)	2170 (490)	910 (680)	1838 (420)
50-32-250	490 (370)	350 (260)	403 (300)	578 (130)	525 (120)	473 (110)	385 (290)	263 (200)	298 (220)	315 (80)	298 (70)	368 (90)	718 (530)	910 (210)	560 (420)	578 (130)
65-40-250	525 (390)	385 (290)	420 (310)	735 (170)	648 (150)	595 (140)	455 (340)	315 (240)	368 (280)	385 (90)	350 (80)	438 (100)	770 (570)	1155 (260)	665 (500)	683 (160)
80-50-250	560 (420)	403 (300)	455 (340)	875 (200)	788 (180)	718 (170)	490 (370)	350 (260)	403 (300)	525 (120)	473 (110)	578 (130)	823 (610)	1383 (320)	718 (530)	910 (210)
100-65-250	613 (460)	438 (330)	508 (380)	1173 (270)	1050 (240)	945 (220)	525 (390)	385 (290)	420 (310)	648 (150)	595 (140)	735 (170)	910 (680)	1838 (420)	770 (570)	1155 (260)
125-80-250	735 (550)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	560 (420)	403 (300)	455 (340)	788 (180)	718 (170)	875 (200)	1068 (790)	2170 (490)	823 (610)	1383 (320)
125-100-250	875 (650)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	613 (460)	438 (330)	508 (380)	1050 (240)	945 (220)	1173 (270)	1068 (790)	2170 (490)	910 (680)	1838 (420)
150-125-250	875 (650)	613 (460)	718 (530)	1750 (400)	1575 (360)	1418 (320)	735 (550)	525 (390)	665 (500)	1243 (280)	1120 (260)	1383 (320)	1278 (950)	2748 (620)	1068 (790)	2170 (490)
200-150-250	1138 (840)	805 (600)	928 (690)	2345 (530)	2100 (480)	1890 (430)	875 (650)	613 (460)	718 (530)	1575 (360)	1418 (320)	1750 (400)	1680 (1240)	3658 (830)	1278 (950)	2748 (620)
65-40-315	525 (390)	385 (290)	420 (310)	735 (170)	648 (150)	595 (140)	455 (340)	315 (240)	368 (280)	385 (90)	350 (80)	438 (100)	770 (570)	1155 (260)	665 (500)	683 (160)
80-50-315	560 (420)	403 (300)	455 (340)	875 (200)	788 (180)	718 (170)	490 (370)	350 (260)	403 (300)	525 (120)	473 (110)	578 (130)	823 (610)	1383 (320)	718 (530)	910 (210)
100-65-315	613 (460)	438 (330)	508 (380)	1173 (270)	1050 (240)	945 (220)	525 (390)	385 (290)	420 (310)	648 (150)	595 (140)	735 (170)	910 (680)	1838 (420)	770 (570)	1155 (260)
125-80-315	735 (550)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	560 (420)	403 (300)	455 (340)	788 (180)	718 (170)	875 (200)	1068 (790)	2170 (490)	823 (610)	1383 (320)
125-100-315	875 (650)	525 (390)	665 (500)	1383 (320)	1243 (280)	1120 (260)	613 (460)	438 (330)	508 (380)	1050 (240)	945 (220)	1173 (270)	1068 (790)	2170 (490)	910 (680)	1838 (420)
150-125-315	875 (650)	613 (460)	718 (530)	1750 (400)	1575 (360)	1418 (320)	735 (550)	525 (390)	665 (500)	1243 (280)	1120 (260)	1383 (320)	1278 (950)	2748 (620)	1068 (790)	2170 (490)

12.4.1.2 According to ISO 5199 Pump family 1B [Material Execution - 2B, 2R, 4B, 4K, 4L, 4R, 5K, 5L]

Size	Forces in N (lbf)						Forces in N (lbf)						Moments in Nm (lbf*ft)			
	Suction						Discharge						Suction		Discharge	
	Mx	My	Mz	Fx	Fy	Fz	Mx	My	Mz	Fx	Fy	Fz	∑M	∑F	∑M	∑F
40-25-125	910 (680)	630 (470)	735 (550)	875 (200)	770 (180)	700 (160)	630 (470)	420 (310)	490 (370)	525 (120)	490 (120)	595 (140)	1330 (990)	1365 (310)	910 (680)	910 (210)
50-32-125	980 (730)	700 (520)	805 (600)	1155 (260)	1050 (240)	945 (220)	770 (570)	525 (390)	595 (440)	630 (150)	595 (140)	735 (170)	1435 (1060)	1820 (410)	1120 (830)	1155 (260)
65-40-125	1050 (780)	770 (570)	840 (620)	1470 (340)	1295 (300)	1190 (270)	910 (680)	630 (470)	735 (550)	770 (180)	700 (160)	875 (200)	1540 (1140)	2310 (520)	1330 (990)	1365 (310)
80-50-125	759 (562)	545 (403)	616 (456)	1185 (877)	1067 (790)	972 (719)	664 (491)	474 (351)	545 (403)	711 (526)	640 (474)	782 (579)	1114 (824)	1873 (1386)	1233 (912)	916 (678)
100-65-125	830 (614)	539 (439)	687 (508)	1588 (1175)	1422 (1052)	1280 (947)	759 (562)	545 (403)	616 (456)	1067 (790)	972 (719)	1185 (877)	1233 (912)	2489 (1842)	1114 (824)	1873 (1386)
40-25-160	910 (680)	630 (470)	735 (550)	875 (200)	770 (180)	700 (160)	630 (470)	420 (310)	490 (370)	525 (120)	490 (120)	595 (140)	1330 (990)	1365 (310)	910 (680)	910 (210)
50-32-160	980 (730)	700 (520)	805 (600)	1155 (260)	1050 (240)	945 (220)	770 (570)	525 (390)	595 (440)	630 (150)	595 (140)	735 (170)	1435 (1060)	1820 (410)	1120 (830)	1155 (260)
65-40-160	1050 (780)	770 (570)	840 (620)	1470 (340)	1295 (300)	1190 (270)	910 (680)	630 (470)	735 (550)	770 (180)	700 (160)	875 (200)	1540 (1140)	2310 (520)	1330 (990)	1365 (310)
80-50-160	1120 (830)	805 (600)	910 (680)	1750 (400)	1575 (360)	1435 (330)	980 (730)	700 (520)	805 (600)	1050 (240)	945 (220)	1155 (260)	1645 (1220)	2765 (630)	1435 (1060)	1820 (410)
100-65-160	1225 (910)	875 (650)	1015 (750)	2345 (530)	2100 (480)	1890 (430)	1050 (780)	770 (570)	840 (620)	1295 (300)	1190 (270)	1470 (340)	1820 (1350)	3675 (830)	1540 (1140)	2310 (520)
125-80-160	1470 (1090)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1120 (830)	805 (600)	910 (680)	1575 (360)	1435 (330)	1750 (400)	2135 (1580)	4340 (980)	1645 (1220)	2765 (630)
40-25-200	910 (680)	630 (470)	735 (550)	875 (200)	770 (180)	700 (160)	630 (470)	420 (310)	490 (370)	525 (120)	490 (120)	595 (140)	1330 (990)	1365 (310)	910 (680)	910 (210)
50-32-200	980 (730)	700 (520)	805 (600)	1155 (260)	1050 (240)	945 (220)	770 (570)	525 (390)	595 (440)	630 (150)	595 (140)	735 (170)	1435 (1060)	1820 (410)	1120 (830)	1155 (260)
65-40-200	1050 (780)	770 (570)	840 (620)	1470 (340)	1295 (300)	1190 (270)	910 (680)	630 (470)	735 (550)	770 (180)	700 (160)	875 (200)	1540 (1140)	2310 (520)	1330 (990)	1365 (310)
80-50-200	1120 (830)	805 (600)	910 (680)	1750 (400)	1575 (360)	1435 (330)	980 (730)	700 (520)	805 (600)	1050 (240)	945 (220)	1155 (260)	1645 (1220)	2765 (630)	1435 (1060)	1820 (410)
100-65-200	1225 (910)	875 (650)	1015 (750)	2345 (530)	2100 (480)	1890 (430)	1050 (780)	770 (570)	840 (620)	1295 (300)	1190 (270)	1470 (340)	1820 (1350)	3675 (830)	1540 (1140)	2310 (520)
125-80-200	1470 (1090)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1120 (830)	805 (600)	910 (680)	1575 (360)	1435 (330)	1750 (400)	2135 (1580)	4340 (980)	1645 (1220)	2765 (630)
125-100-200	1750 (1300)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1225 (910)	875 (650)	1015 (750)	2100 (480)	1890 (430)	2345 (530)	2135 (1580)	4340 (980)	1820 (1350)	3675 (830)
50-32-250	980 (730)	700 (520)	805 (600)	1155 (260)	1050 (240)	945 (220)	770 (570)	525 (390)	595 (440)	630 (150)	595 (140)	735 (170)	1435 (1060)	1820 (410)	1120 (830)	1155 (260)
65-40-250	1050 (780)	770 (570)	840 (620)	1470 (340)	1295 (300)	1190 (270)	910 (680)	630 (470)	735 (550)	770 (180)	700 (160)	875 (200)	1540 (1140)	2310 (520)	1330 (990)	1365 (310)
80-50-250	1120 (830)	805 (600)	910 (680)	1750 (400)	1575 (360)	1435 (330)	980 (730)	700 (520)	805 (600)	1050 (240)	945 (220)	1155 (260)	1645 (1220)	2765 (630)	1435 (1060)	1820 (410)
100-65-250	1225 (910)	875 (650)	1015 (750)	2345 (530)	2100 (480)	1890 (430)	1050 (780)	770 (570)	840 (620)	1295 (300)	1190 (270)	1470 (340)	1820 (1350)	3675 (830)	1540 (1140)	2310 (520)
125-80-250	1470 (1090)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1120 (830)	805 (600)	910 (680)	1575 (360)	1435 (330)	1750 (400)	2135 (1580)	4340 (980)	1645 (1220)	2765 (630)
125-100-250	1750 (1300)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1225 (910)	875 (650)	1015 (750)	2100 (480)	1890 (430)	2345 (530)	2135 (1580)	4340 (980)	1820 (1350)	3675 (830)
150-125-250	1750 (1300)	1225 (910)	1435 (1060)	3500 (790)	3150 (710)	2835 (640)	1470 (1090)	1050 (780)	1330 (990)	2485 (560)	2240 (510)	2765 (630)	2555 (1890)	5495 (1240)	2135 (1580)	4340 (980)
200-150-250	2275 (1680)	1610 (1190)	1855 (1370)	4690 (1060)	4200 (950)	3780 (850)	1750 (1300)	1225 (910)	1435 (1060)	3150 (710)	2835 (640)	3500 (790)	3360 (2480)	7315 (1650)	2555 (1890)	5495 (1240)
65-40-315	1050 (780)	770 (570)	840 (620)	1470 (340)	1295 (300)	1190 (270)	910 (680)	630 (470)	735 (550)	770 (180)	700 (160)	875 (200)	1540 (1140)	2310 (520)	1330 (990)	1365 (310)
80-50-315	1120 (830)	805 (600)	910 (680)	1750 (400)	1575 (360)	1435 (330)	980 (730)	700 (520)	805 (600)	1050 (240)	945 (220)	1155 (260)	1645 (1220)	2765 (630)	1435 (1060)	1820 (410)
100-65-315	1225 (910)	875 (650)	1015 (750)	2345 (530)	2100 (480)	1890 (430)	1050 (780)	770 (570)	840 (620)	1295 (300)	1190 (270)	1470 (340)	1820 (1350)	3675 (830)	1540 (1140)	2310 (520)
125-80-315	1470 (1090)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1120 (830)	805 (600)	910 (680)	1575 (360)	1435 (330)	1750 (400)	2135 (1580)	4340 (980)	1645 (1220)	2765 (630)
125-100-315	1750 (1300)	1050 (780)	1330 (990)	2765 (630)	2485 (560)	2240 (510)	1225 (910)	875 (650)	1015 (750)	2100 (480)	1890 (430)	2345 (530)	2135 (1580)	4340 (980)	1820 (1350)	3675 (830)
150-125-315	1750 (1300)	1225 (910)	1435 (1060)	3500 (790)	3150 (710)	2835 (640)	1470 (1090)	1050 (780)	1330 (990)	2485 (560)	2240 (510)	2765 (630)	2555 (1890)	5495 (1240)	2135 (1580)	4340 (980)

Annex A: **Example D**eclaration of Conformity

SIHI® Pumps CE

EC declaration of conformity

- Original -

The manufacturer:

Flowserve SIHI bvba
't hofveld 1
B-1702 Groot-bijgaarden

declares herewith that the product

Pumpset consisting of:
Pump: CBME 050125 C0 1AV 4B 1D0 A 34
Motor: •••

Serial number: •••

fulfils all relevant provisions of the Directive Machinery 2006/42/EC.

Furthermore the aforementioned product complies with the provisions of the EC Directives:

- **Explosion Protection 2014/34/EU (ATEX) as follows:**

Pump: II 2 G Ex h IIC T5...T1 Gb
Motor: •••

Harmonised standards used:

EN 809
DIN EN ISO 12100
EN 1127-1
EN ISO 80079-36 & 80079-37

Other technical standards and specifications used:

Person authorised to compile the technical file:

•••
•••
•••
•••
•••

Place, date:

Groot-bijgaarden, ••.••.••••

Person empowered to draw up this declaration:

Product Line Manager — •••

Operation Manager — •••

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Flowserve factory contacts:

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Zone Gosset – 't Hofveld 1

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Local Flowserve representative: To find your local Flowserve representative use the Sales Support Locator System found at www.flowserve.com

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