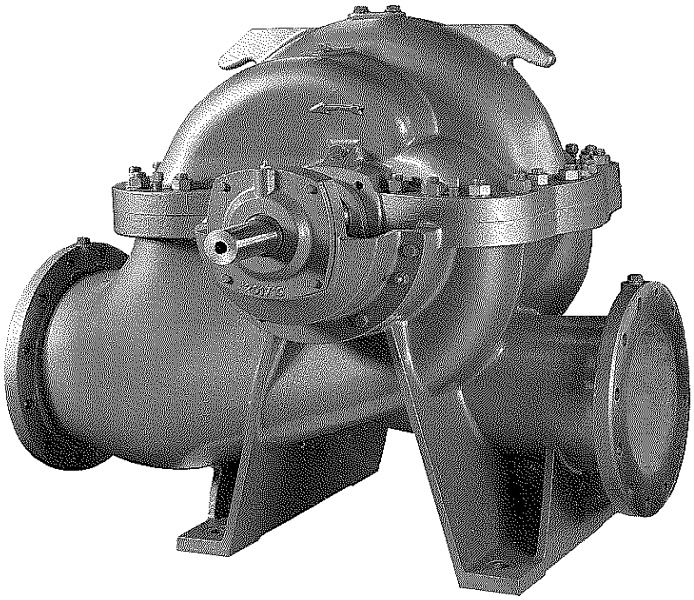
FLOWSERVE®

Pump Division



Type: LNGT

CENTRIFUGAL PUMP

USER INSTRUCTIONS:
INSTALLATION, OPERATION, MAINTENANCE

PCN=00083107 02-08 [E]

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

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1 INTRODUCTION AND SAFETY

1.1 General

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

Flowserve products are designed, developed and manufactured with state-of-the-art technologies in modern facilities. The unit is produced with great care and commitment to continuous quality control, utilizing sophisticated quality techniques, and safety requirements.

Flowserve is committed to continuous quality improvement and being at service for any further information about the product in its installation and operation or about its support products, repair and diagnostic services.

These instructions are intended to facilitate familiarization with the product and its permitted use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. The instructions may not take into account local regulations; ensure such regulations are observed by all, including those installing the product. Always coordinate repair activity with operations personnel, and follow all plant safety requirements and applicable safety and health laws and regulations.

These instructions should be read prior to installing, operating, using and maintaining the equipment in any region worldwide. The equipment must not be put into service until all the conditions relating to safety noted in the instructions, have been met.

1.2 CE marking and approvals

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform with the applicable CE Marking Directives covering Machinery and, where applicable, Low Voltage Equipment, Electromagnetic Compatibility [EMC], Pressure Equipment Directive [PED] and Equipment for Potentially Explosive Atmospheres [ATEX].

Where applicable the Directives and any additional Approvals cover important safety aspects relating to machinery and equipment and the satisfactory provision of technical documents and safety instructions. Where applicable this document incorporates information relevant to these Directives and Approvals.

To confirm the Approvals applying and if the product is CE marked, check the serial number plate markings and the Certification. [See section 9, *Certification*.]

1.3 Disclaimer

Information in these User Instructions is believed to be reliable. In spite of all the efforts of Flowserve Pump Division to provide sound and all necessary information the content of this manual may appear insufficient and is not guaranteed by Flowserve as to its completeness or accuracy.

Flowserve manufactures products to exacting 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 their 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 products. 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 the Flowserve warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in their use.

1.4 Copyright

1.5 Duty conditions

This product has been selected to meet the specifications of your purchaser order. The acknowledgement of these conditions has been sent separately to the Purchaser. A copy should be kept with these instructions.

The product must not be operated beyond the parameters specified for the application. If there is any doubt as to the suitability of the product for the application intended, contact Flowserve for advice, quoting the serial number.

If the conditions of service on your purchase order are going to be changed [for example liquid pumped, temperature or duty] it is requested that the user seeks the written agreement of Flowserve before start up.

1.6 Safety

1.6.1 Summary of safety markings

These User Instructions contain specific safety markings where non-observance of an instruction would cause hazards. The specific safety markings are:

DANGER This symbol indicates electrical safety instructions where non-compliance will involve a high risk to personal safety or the loss of life.

This symbol indicates safety instructions where non-compliance would affect personal safety and could result in loss of life.

This symbol indicates "hazardous and toxic fluid" safety instructions where non-compliance would affect personal safety and could result in loss of life.

CAUTION This symbol indicates safety instructions where non-compliance will involve some risk to safe operation and personal safety and would damage the equipment or property.

This symbol indicates explosive atmosphere zone marking according to ATEX. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion.

This symbol is used in safety instructions to remind not to rub non-metallic surfaces with a dry cloth; ensure the cloth is damp. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion.

Note: This sign is not a safety symbol but indicates an important instruction in the assembly process.

Denotes the focussing of attention on the importance of reading the instructions for use.

1.6.2 Personnel qualification and training

All personnel involved in the operation, installation, inspection and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question do not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required the operator may commission the manufacturer/supplier to provide applicable training.

Always coordinate repair activity with operations and health and safety personnel, and follow all plant safety requirements and applicable safety and health laws and regulations.

1.6.3 Safety action

This is a summary of conditions and actions to prevent injury to personnel and damage to the environment and to equipment. For products used in potentially explosive atmospheres section 1.6.4 also applies.

DANGER NEVER DO MAINTENANCE WORK WHEN THE UNIT IS CONNECTED TO POWER

GUARDS MUST NOT BE REMOVED WHILE THE PUMP IS OPERATIONAL

DRAIN THE PUMP AND ISOLATE PIPEWORK BEFORE DISMANTLING THE PUMP
The appropriate safety precautions should be taken where the pumped liquids are hazardous.

HANDLING COMPONENTS
Many precision parts have sharp corners and the wearing of appropriate safety gloves and equipment is required when handling these components. To lift heavy pieces above 25 kg [55 lb] use a crane appropriate for the mass and in accordance with current local regulations.

THERMAL SHOCK
Rapid changes in the temperature of the liquid within the pump can cause thermal shock, which can result in damage or breakage of components and should be avoided.

NEVER APPLY HEAT TO REMOVE IMPELLER
Trapped lubricant or vapor could cause an explosion.

HOT [and cold] PARTS
If hot or freezing components or auxiliary heating supplies can present a danger to operators and persons entering the immediate area action must be taken to avoid accidental contact. If complete protection is not possible, the machine access must be limited to maintenance staff only, with clear visual warnings and indicators to those entering the immediate area. Note: bearing housings must not be insulated and drive motors and bearings may be hot.

If the temperature is greater than 68 °C [175 °F] or below 5 °C [20 °F] in a restricted zone, or exceeds local regulations, action as above shall be taken.

CAUTION PREVENT EXCESSIVE EXTERNAL PIPE LOAD
Do not use pump as a support for piping. Do not mount expansion joints, unless allowed by Flowserve in writing, so that their force, due to internal pressure, acts on the pump flange.

CAUTION ENSURE CORRECT LUBRICATION
[See section 5, *Commissioning, start up, operation and shutdown*.]

CAUTION START THE PUMP PREFERABLY WITH OUTLET VALVE PARTLY OPENED
[Unless otherwise instructed at a specific point in the Supplementary User Instructions.]
This is recommended to minimize the risk of overloading and damaging the pump motor at full or zero flow. Pumps may be started with the valve further open only on installations where this situation cannot occur. The pump outlet control valve may need to be adjusted to comply with the duty following the run-up process. [See section 5.6, *Commissioning start-up, operation and shutdown*.]

CAUTION NEVER RUN THE PUMP DRY

CAUTION INLET VALVES TO BE FULLY OPEN WHEN PUMP IS RUNNING
Running the pump at zero flow or below the recommended minimum flow continuously will cause damage to the seal.

CAUTION DO NOT RUN THE PUMP AT ABNORMALLY HIGH OR LOW FLOW RATES
Operating at a flow rate higher than normal or at a flow rate with no back pressure on the pump may overload the motor and cause cavitation. Low flow rates may cause a reduction in pump/bearing life, overheating of the pump, instability and cavitation/vibration.

1.6.4 Products used in potentially explosive atmospheres

Ex Measures are required to:

- Avoid excess temperature
- Prevent build up of explosive mixtures
- Prevent the generation of sparks
- Prevent leakages
- Maintain the pump to avoid hazard

The following instructions for pumps and pump units when installed in potentially explosive atmospheres must be followed to help ensure explosion protection. Both electrical and non-electrical equipment must meet the requirements of European Directive 94/9/EC.

1.6.4.1 Scope of compliance

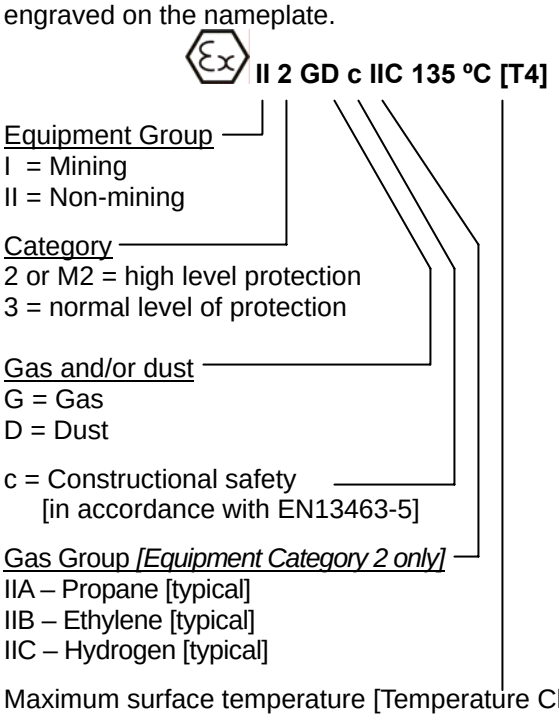
Ex Use equipment only in the zone for which it is appropriate. Always check that the driver, drive coupling assembly, seal and pump equipment are suitably rated and/or certified for the classification of the specific atmosphere in which they are to be installed.

Where Flowserve has supplied only the bare shaft pump, the Ex rating applies only to the pump. The party responsible for assembling the pump set shall select the coupling, driver and any additional equipment, with the necessary CE Certificate/ Declaration of Conformity establishing it is suitable for the area in which it is to be installed.

The output from a variable frequency drive [VFD] can cause additional heating affects in the motor and so, for pumps sets with a VFD, the ATEX Certification for the motor must state that it is covers the situation where electrical supply is from the VFD. This particular requirement still applies even if the VFD is in a safe area.

1.6.4.2 Marking

An example of ATEX equipment marking is shown below. The actual classification of the pump will be engraved on the nameplate.



1.6.4.3 Avoiding excessive surface temperatures

ENSURE THE EQUIPMENT TEMPERATURE CLASS IS SUITABLE FOR THE HAZARD ZONE

Pumps have a temperature class as stated in the ATEX Ex rating on the nameplate. These are based on a maximum ambient of 40 °C [104 °F]; refer to Flowserve for higher ambient temperatures.

The surface temperature on the pump is influenced by the temperature of the liquid handled. The maximum permissible liquid temperature depends on the temperature class and must not exceed the values in the table that follows.

The temperature rise at the seals and bearings and due to the minimum permitted flow rate is taken into account in the temperatures stated.

Temperature class to EN13463-1	Maximum surface temperature permitted	Temperature limit of liquid handled [* depending on material and construction variant - check which is lower]
T6	85 °C [185 °F]	Consult Flowserve
T5	100 °C [212 °F]	Consult Flowserve
T4	135 °C [275 °F]	115 °C [239 °F] *
T3	200 °C [392 °F]	180 °C [356 °F] *

The responsibility for compliance with the specified maximum liquid temperature is with the plant operator.

Temperature classification “Tx” is used when the liquid temperature varies and the pump could be installed in different hazardous atmospheres. In this case the user is responsible for ensuring that the pump surface temperature does not exceed that permitted in the particular hazardous atmosphere.

If an explosive atmosphere exists during the installation, do not attempt to check the direction of rotation by starting the pump unfilled. Even a short run time may give a high temperature resulting from contact between rotating and stationary components.

Where there is any risk of the pump being run against a closed valve generating high liquid and casing external surface temperatures it is recommended that users fit an external surface temperature protection device.

Avoid mechanical, hydraulic or electrical overload by using motor overload trips, temperature monitor or a power monitor and make routine vibration monitoring checks.

In dirty or dusty environments, regular checks must be made and dirt removed from areas around close clearances, bearing housings and motors.

1.6.4.4 Preventing sparks

To prevent a potential hazard from mechanical contact, the coupling guard must be non-sparking.

To avoid the potential hazard from random induced current generating a spark, the earth contact on the baseplate must be used.

Avoid electrostatic charge: do not rub non-metallic surfaces with a dry cloth; ensure cloth is damp.

The coupling must be selected to comply with 94/9/EC and correct alignment must be maintained.

1.6.4.5 Preventing leakage

The pump must only be used to handle liquids for which it has been approved to have the correct corrosion resistance.

Avoid entrapment of liquid in the pump and associated piping due to closing of suction and discharge valves, which could cause dangerous excessive pressures to occur if there is heat input to the liquid. This can occur if the pump is stationary or running.

Bursting of liquid containing parts due to freezing must be avoided by draining or protecting the pump and ancillary systems.

Where there is the potential hazard of a loss of a seal barrier fluid or external flush, the fluid must be monitored.

If leakage of liquid to atmosphere can result in a hazard, the installation of a liquid detection device is recommended.

1.6.4.6 Maintenance to avoid the hazard

CORRECT MAINTENANCE IS REQUIRED TO AVOID POTENTIAL HAZARDS WHICH GIVE A RISK OF EXPLOSION

The responsibility for compliance with maintenance instructions is with the plant operator.

To avoid potential explosion hazards during maintenance, the tools, cleaning and painting materials used must not give rise to sparking or adversely affect the ambient conditions. Where there is a risk from such tools or materials, maintenance must be conducted in a safe area.

It is recommended that a maintenance plan and schedule is adopted. [See section 6, *Maintenance.]*

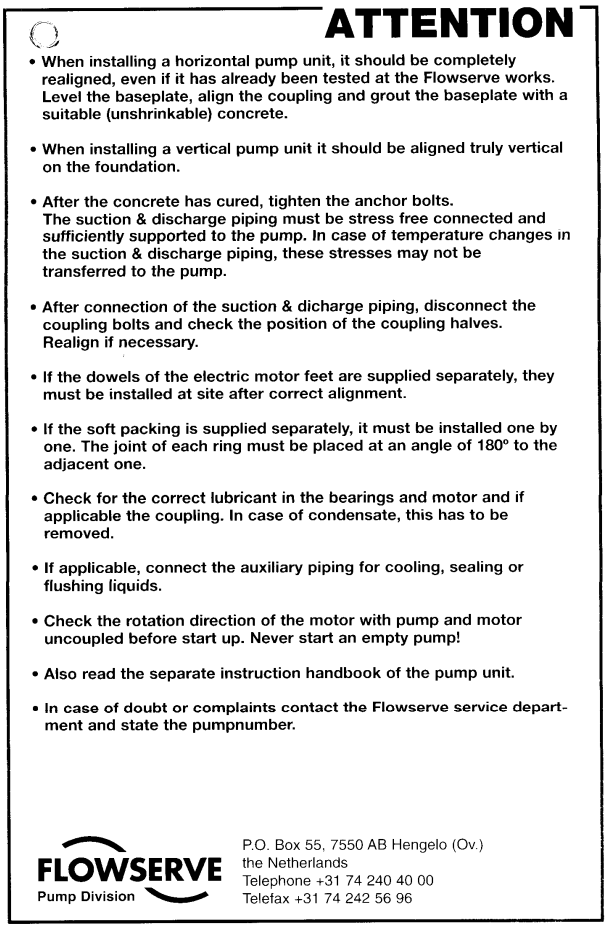
1.7 Nameplate and warning labels

1.7.1 Nameplate

Every pump has a name plate made in stainless steel with information regarding operating condition as capacity, total dynamic head, rotational speed, specific gravity and serial number. For details of nameplate, see the *Declaration of Conformity*.

1.7.2 Warning labels

The pump has been shipped with 1 or more warning labels. Follow the instructions on these labels carefully.



ATTENTION

- When installing a horizontal pump unit, it should be completely realigned, even if it has already been tested at the Flowserve works. Level the baseplate, align the coupling and grout the baseplate with a suitable (unshrinkable) concrete.
- When installing a vertical pump unit it should be aligned truly vertical on the foundation.
- After the concrete has cured, tighten the anchor bolts. The suction & discharge piping must be stress free connected and sufficiently supported to the pump. In case of temperature changes in the suction & discharge piping, these stresses may not be transferred to the pump.
- After connection of the suction & dicharge piping, disconnect the coupling bolts and check the position of the coupling halves. Realign if necessary.
- If the dowels of the electric motor feet are supplied separately, they must be installed at site after correct alignment.
- If the soft packing is supplied separately, it must be installed one by one. The joint of each ring must be placed at an angle of 180° to the adjacent one.
- Check for the correct lubricant in the bearings and motor and if applicable the coupling. In case of condensate, this has to be removed.
- If applicable, connect the auxiliary piping for cooling, sealing or flushing liquids.
- Check the rotation direction of the motor with pump and motor uncoupled before start up. Never start an empty pump!
- Also read the separate instruction handbook of the pump unit.
- In case of doubt or complaints contact the Flowserve service department and state the pumpnumber.

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Pump Division

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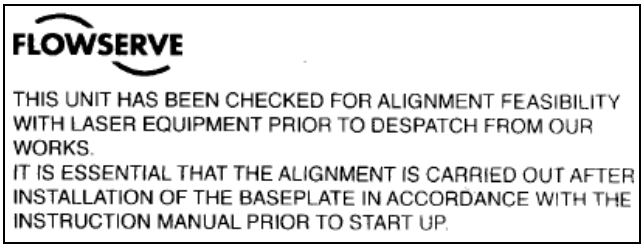


1.8 Specific machine performance

For performance parameters see section 1.5, *Duty conditions*. When the contract requirement specifies these to be incorporated into User Instructions these are included in the Supplementary User Instructions. Where performance data has been supplied separately to the purchaser these should be obtained and retained with these User Instructions if required.

1.9 Noise level

When pump noise level exceeds 85 dBA attention must be given to prevailing Health and Safety Legislation, to limit the exposure of plant operating personnel to the noise. The usual approach is to control exposure time to the noise or to enclose the machine to reduce emitted sound. You may have already specified a limiting noise level when the equipment was ordered, however if no noise requirements were defined then machines above a certain power level will exceed 85 dBA. In such situations consideration must be given to the fitting of an acoustic enclosure to meet local regulations. Pump noise level is dependent on a number of factors - the type of motor fitted, the operating capacity, pipe work design and acoustic characteristics of the building.

Typical sound pressure levels measured in dB and A-weighted are shown in the table below the figures are indicative only, they are subject to a +3 dB tolerance, and cannot be guaranteed.

The values are based on the noisiest ungeared electric motors that are likely to be encountered. They represent sound pressure levels at 1 m [3.3 ft] from the directly driven pump, for "free field over a reflecting plane".

If a pump unit only has been purchased, for fitting with your own driver, then the "pump only" noise levels from the table should be combined with the level for the driver obtained from the supplier. If the motor is driven by an inverter, it may show an increase in noise level at some speeds. Consult a Noise Specialist for the combined calculation.

For units driven by equipment other than electric motors or units contained within enclosures, see the accompanying information sheets and manuals.

Typical sound pressure level, dBA, L_{pA} at 1 m reference 20 µPa *[L_{wA} sound power 1 pW where L_{pA} >85 dBA]*

Motor size and speed kW [hp]	3550 r/min		2900 r/min		1750 r/min		1450 r/min	
	Pump and motor **dB[A]**	Pump only **dB[A]**	Pump and motor **dB[A]**	Pump only **dB[A]**	Pump and motor **dB[A]**	Pump only **dB[A]**	Pump and motor **dB[A]**	Pump only **dB[A]**
<0.55 [<0.75]	71 *[88]*	66 *[83]*	64 *[81]*	62 *[79]*	64 *[81]*	62 *[79]*	63 *[80]*	62 *[79]*
0.75 [1]	74 *[91]*	66 *[83]*	67 *[84]*	62 *[79]*	67 *[84]*	62 *[79]*	63 *[80]*	62 *[79]*
1.1 [1.5]	74 *[91]*	68 *[85]*	67 *[84]*	64 *[81]*	67 *[84]*	64 *[81]*	65 *[82]*	64 *[81]*
1.5 [2]	77 *[94]*	70 *[87]*	70 *[87]*	66 *[83]*	70 *[87]*	66 *[83]*	66 *[83]*	66 *[83]*
2.2 [3]	78 *[95]*	72 *[89]*	71 *[88]*	68 *[85]*	71 *[88]*	68 *[85]*	68 *[85]*	68 *[85]*
3 [4]	81 *[98]*	74 *[91]*	74 *[91]*	70 *[87]*	74 *[91]*	70 *[87]*	70 *[87]*	70 *[87]*
4 [5]	82 *[99]*	75 *[92]*	75 *[92]*	71 *[88]*	75 *[92]*	71 *[88]*	71 *[88]*	71 *[88]*
5.5 [7.5]	90 [*107*]	77 *[94]*	83 *[100]*	73 *[90]*	76 *[93]*	73 *[90]*	72 *[89]*	71 *[88]*
7.5 [10]	90 [*107*]	78 *[95]*	83 *[100]*	74 *[91]*	77 *[94]*	74 *[91]*	73 *[90]*	72 *[89]*
11 [15]	91 [*108*]	80 *[97]*	84 *[101]*	76 *[93]*	78 *[95]*	76 *[93]*	74 *[91]*	73 *[90]*
15 [20]	92 [*109*]	83 *[100]*	85 [*102*]	79 *[96]*	80 *[97]*	79 *[96]*	76 *[93]*	75 *[92]*
18.5 [25]	92 [*109*]	83 *[100]*	85 [*102*]	79 *[96]*	80 *[97]*	79 *[96]*	76 *[93]*	75 *[92]*
22 [30]	92 [*109*]	83 *[100]*	85 [*102*]	79 *[96]*	81 *[98]*	79 *[96]*	77 *[94]*	75 *[92]*
30 [40]	100 [*117*]	85 [*102*]	93 [*110*]	81 *[98]*	84 *[101]*	80 *[97]*	80 *[97]*	76 *[93]*
37 [50]	100 [*117*]	86 [*103*]	93 [*110*]	82 *[99]*	84 *[101]*	80 *[97]*	80 *[97]*	76 *[93]*
45 [60]	100 [*117*]	87 [*104*]	93 [*110*]	83 *[100]*	84 *[101]*	80 *[97]*	80 *[97]*	76 *[93]*
55 [75]	100 [*117*]	88 [*105*]	95 [*112*]	84 *[101]*	86 [*103*]	81 *[98]*	82 *[99]*	77 *[94]*
75 [100]	100 [*117*]	90 [*107*]	95 [*112*]	86 [*103*]	88 [*105*]	81 *[98]*	83 *[100]*	78 *[95]*
90 [120]	100 [*117*]	90 [*107*]	95 [*112*]	86 [*103*]	90 [*107*]	81 *[98]*	85 [*102*]	78 *[95]*
110 [150]	100 [*117*]	91 [*108*]	95 [*112*]	87 [*104*]	91 [*108*]	83 *[100]*	86 [*103*]	79 *[96]*
150 [200]	101 [*118*]	92 [*109*]	96 [*113*]	88 [*105*]	91 [*108*]	83 *[100]*	86 [*103*]	79 *[96]*
200 [270]	[1]	[1]	[1]	[1]	[1]	83 [100]	[1]	80 [97]
300 [400]	-	-	-	-	[1]	84 [101]	[1]	81 [98]
500 [670]	-	-	-	-	[1]	85 [102]	[1]	83 [100]
1000 [1300]	-	-	-	-	[1]	86 [103]	[1]	86 [103]
1500 [2000]	-	-	-	-	[1]	90 [107]	[1]	88 [105]

[1] Motors in this range are generally job specific and noise levels should be calculated based on actual equipment installed. For 960 r/min reduce 1450 r/min values by 5 dBA

2. TRANSPORT AND STORAGE

2.1 Consignment receipt and unpacking

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

Any shortage and or damage must be reported immediately to Flowserve Pump Division and received in writing within one month of receipt of the equipment. Later claims cannot be accepted.

Check any crate, boxes and wrappings for any accessories or spare parts that may be packed separately with the equipment or attached to side walls of the box or equipment.

Each product has a unique serial number. Check that this number corresponds with that advised and always quote this number in correspondence as well as when ordering spare parts or further accessories.

2.2 Handling

Boxes, crates, pallets or cartons may be unloaded using fork-lift vehicles or slings dependent on their size and construction.

2.3 Lifting

Fully trained personnel must carry out lifting, in accordance with local regulations. The driver and pump weights are recorded on their respective General Arrangement Drawing.

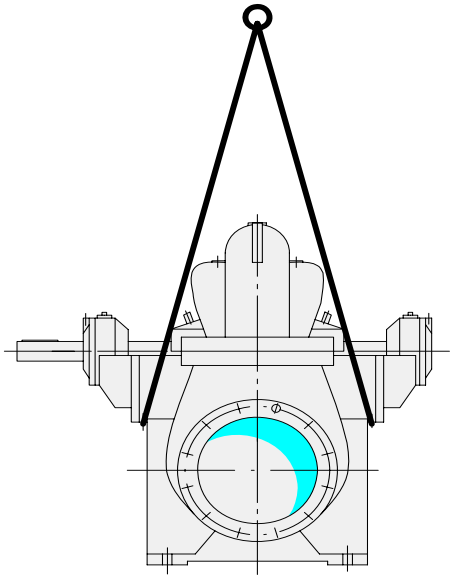
A crane must be used for all pump sets, components and accessories in excess of 25 kg [55 lb]. Fully trained personnel must carry out lifting, in accordance with local regulations. The driver and pump weights are recorded on their respective nameplates.

CAUTION The pump is fitted with auxiliary piping. Remove this piping before the pump is lifted to avoid damage to these pipes and even the pump. After erection of the pumps this piping can be re-assembled easily. With every lifting operation this procedure has to be repeated.

CAUTION Unsafe lifting is never allowed!

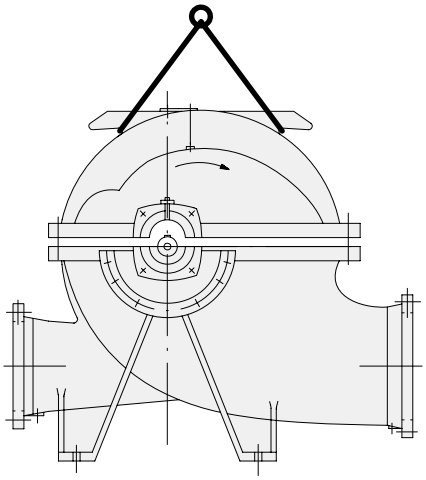
CAUTION To avoid distortion, the pump unit should be lifted as shown. Unless otherwise specified in the supplementary instructions.

Lift the centrifugal pump by attaching the lifting cables around that part of the pump casing to which the bearing pedestals are attached. To prevent the pump unit from being damaged, use a spreader.



2.3.1 Lifting the upper half of the pump casing

Lift the upper half of the pump casing using the lifting lugs [or holes] attached to this half.

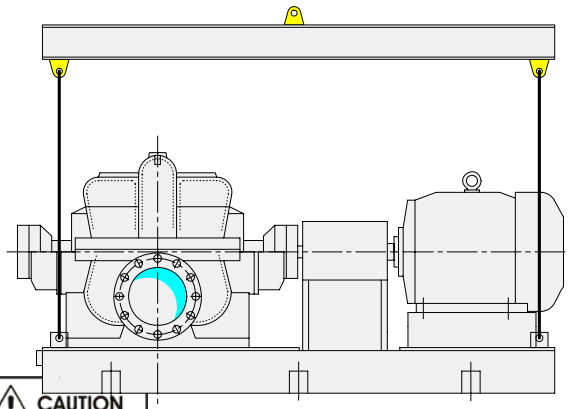


2.3.2 Lifting with foundation frame

[If applicable]

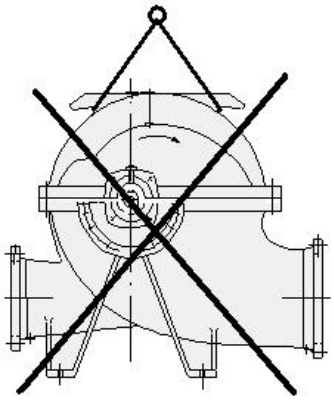
Lifting lugs have been welded to the foundation frame for lifting purposes. The unit should be hoisted using these lifting lugs.To

prevent the electric motor and/or pipe lines from being damaged, use a spreader.

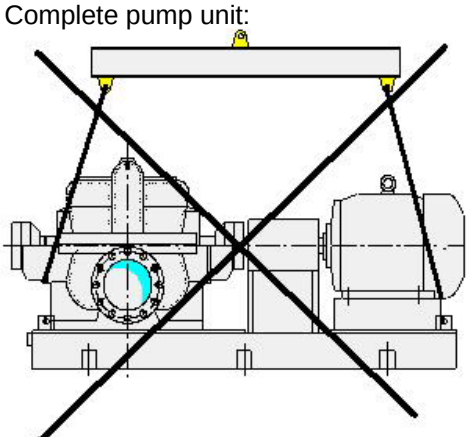


CAUTION The pump should not be lifted as shown:

Bare shaft pump:



Complete pump unit:



The driver and pump weight is recorded on their respective nameplates. The total weight is mentioned on the General Arrangement Drawing.

2.4 Storage

CAUTION Store the pump in a clean, dry location away from vibration. Leave piping connection covers in place to keep dirt and other foreign material out of pump casing. Turn pump at intervals to prevent brinelling of the bearings and the seal faces, if fitted, from sticking.

The pump may be stored as above for up to 6 months. Consult Flowserve for preservative actions when a longer storage period is needed.

2.5 Recycling and scrapping at the end of product life

At the end of the service life of the product or its parts, the relevant materials and parts should be recycled or disposed of using an environmentally acceptable method and local regulations. If the product contains substances that are harmful to the environment, these should be removed and disposed of in accordance with current regulations. This also includes the liquids and or gases that may be used in the "seal system" or other utilities.

Make sure that hazardous substances are disposed of safely and that the correct personal protective equipment is used. The safety specifications must be in accordance with the current regulations at all times.

3 PUMP DESCRIPTION

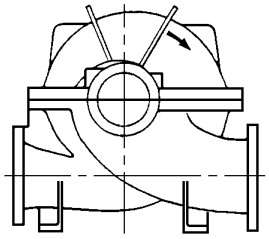
3.1 Configurations and Specific feature

3.1.1 Configurations

The LNGT type pump is a single stage, double suction, horizontal split volute type centrifugal pump designed for water transport and cooling duties in industrial and potable water systems, power stations, irrigation and drainage pumping stations, fire fighting and marine systems, in refineries and in petro-chemical and chemical plants.
It can be used with motor, steam turbine and gasoline or diesel engine drives.

LNGT pumps are used for the following reasons:
- High efficiency
- Low NPSH requirements
- Pump shaft carried in two bearings one on either side.
- Quick and easy inspection of internals.

The pumps feature a double volute, but some small sizes have a single volute.
The LNGT has the following configuration:



LNGT horizontal suction and discharge nozzles [inline]

3.1.2 Specific features

The pump casing is axially split. The suction and delivery nozzles are integral with the pump casing bottom half and they are in line regarding the horizontal centerline.

The two pump casing halves are assembled by means of studs and nuts. Dismantling the pump casing upper half allows quick inspection of the pump internals, without it being necessary to disturb the suction and delivery piping.

The rotor assembly can be easily removed. Removal of pump casing and bearing housing upper halves. If necessary use the jack screws. Removal rotor assembly is now possible. Reassembling of upper halves by means of dowel pins. No realignment is needed.

The stuffing box chambers are part of the pump casing.
In standard configuration, the pump has gland packing rings with a lantern ring. Local to the lantern rings, the stuffing box chambers have a connection for flushing, in case needed. Single mechanical seals are also available.

The space between pump casing and bearing housing is designed in such a way, that the packing rings can be replaced without it being necessary to dismantle the pump. With various pump sizes, the casing is of the double-volute type in order to reduce radial force on the impeller and consequently the shaft deflection.

The pump shaft is supported on either side of the impeller by roller bearings or journal bearings situated outside the pump casing. The bearings are grease lubricated. Re-lubrication is possible through the grease nipple in the bearing cover. All pump sizes can also be provided with oil-bath lubricated bearings. The bearing housings are standard sealed with a V-ring (Labyrinth ring) together with a retaining and/or thrower. Bearing isolators are optional.

Sleeves local to the stuffing boxes protect the pump shaft from effects of the pumped medium and from wear local to the packing rings. On either side of the impeller, replaceable case wear rings are fitted to protect the pump casing. It is also possible to provide the impeller with impeller wear rings. The impeller wear rings are locked with set screws to prevent co-rotation. The casing wear rings are locked with dowel pin in the lower half casing to prevent co-rotation.

Efficiency
The impeller and pump casings were designed, using advanced techniques and extensive model testing, which ensures optimum efficiency, thus reducing the energy consumption.

Inlet conditions
Optimum design of the double-suction impeller and optimum, elaborate test base, shaping of the suction boxes provide the possibility of working at low NPSH values.

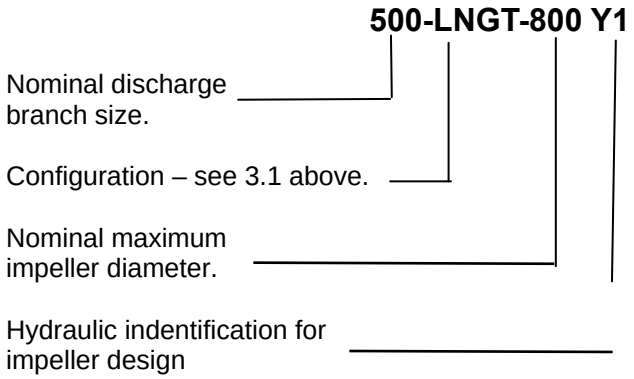
Vibration/noise
The impeller is dynamically balanced, so the pump amply satisfies maximum vibration levels e.g. as demanded in standard VDI 2056. The generously sized suction boxes also add to a low noise level.

Interchange ability
The well-thought-out design ensures optimum interchange ability of parts with those of other sizes in the LNGT range.

Direction of rotation
The pumps are suited for both clockwise and counter-clockwise rotation.

3.2 Name nomenclature

The pump size will be engraved on the nameplate typically as below:



The typical nomenclature above is the general guide to the LNGT configuration description.

Identify the actual pump size and serial number from the pump nameplate. Check that this agrees with the applicable certification provided.

3.3 Design of major parts

Pump casing [1213 + 1214]
The pump has its main casing gasket axial to the shaft allowing maintenance to the rotating element by removing the upper half casing [1213]. Suction and discharge branches are in the bottom half [1214] and therefore remain undisturbed.

Impeller [2200]
The double suction impeller is fully shrouded and may be fitted with optional hub rings.
The impeller can be executed with staggered vanes to minimize vibration.

Shaft [2100]
The large diameter stiff shaft, mounted on bearings, has a keyed drive end.

Pump bearings and lubrication
Ball bearings (journal and thrust) are fitted as standard and may be either oil or grease lubricated, protected by V-ring (Labyrinth ring) seals.

Bearing isolators or stationary labyrinths may be fitted as an option in the bearing covers to protect the bearings.

Bearing housing [3200]
Two grease nipples enable grease lubricated bearings to be replenished between major service intervals. For oil lubricated bearings, a constant level oiler is fitted.

Stuffing box [4110]
The stuffing box housing is designed for gland packing rings. Mechanical seal is an option

Shaft seal [4010]
The mechanical seal[s] attached to the pump shaft seals the pumped liquid from the environment.
Gland packing may be fitted as an option.

Driver
The driver is normally an electric motor. Different drive configurations may be fitted such as internal combustion engines, turbines, hydraulic motors etc driving via couplings, belts, gearboxes, drive shafts etc.

Accessories
Accessories may be fitted when specified by the customer.

3.4 Performance and operating limits

This product has been selected to meet the specifications of your purchase order. See section 1.5.

The following data is included as additional information to help with your installation. It is typical, and factors such as temperature, materials, and seal type may influence this data. If required, a definitive statement for your particular application can be obtained from Flowserve.

3.4.1 Operating limits

Pumped liquid temperature limits*	- 20 to + 145 ºC* [- 4 to + 176 ºF]
Maximum ambient temperature*	- 20 to + 40 ºC [- 4 to +104 ºF]
Maximum soft solids in suspension*	up to 3 % by volume [refer for size limits]
Maximum pump speed	refer to the nameplate

* Subject to written agreement from Flowserve.

3.4.2 Pump and impeller data

Pump size	Impeller minimum passage size mm [in.] = outlet width	Nominal wear ring diameter mm Case wear ring only	Nominal wear ring diameter mm Case- and impeller wear ring	Mean radial wear ring clearance mm	Approx. oil capacity, both bearings liter
150LNGT375F	17 [0.67]	210.4	230.4	0.2	
150LNGT375G	24 [0.94]	210.4	230.4	0.2	
150LNGT375H	26.4 [1.04]	190.35	210.35	0.175	
150LNGT400F	22 [0.87]	190.35	210.35	0.175	
150LNGT400G	19 [0.75]	210.4	230.4	0.2	
150LNGT475F	18 [0.71]	190.35	210.35	0.175	
200LNGT300F	27.5 [1.08]	210.4	230.4	0.2	
200LNGT350F	18.3 [0.72]	210.4	230.4	0.2	
200LNGT400F	19 [0.75]	230.45	250.45	0.225	
200LNGT425F	23.4 [0.92]	210.4	230.4	0.2	
200LNGT475F	26.6 [1.05]	230.45	250.45	0.225	
200LNGT500F	18 [0.71]	210.4	230.4	0.2	
200LNGT550F	20 [0.79]	230.45	250.45	0.225	
200LNGT600F	20.6 [0.81]	240.45	260.45	0.225	
250LNGT325F	30.6 [1.2]	230.45	250.45	0.225	
250LNGT425F	23 [0.91]	255.45	275.45	0.225	
250LNGT500F	35 [1.38]	270.45	290.45	0.225	
250LNGT575F	30 [1.18]	270.45	290.45	0.225	
250LNGT575G	32 [1.26]	270.45	290.45	0.225	
250LNGT625F	34.8 [1.37]	285.45	305.45	0.225	
300LNGT275F	41.3 [1.63]	255.45	275.45	0.225	
300LNGT300F	62 [2.44]	240.45	260.45	0.225	
300LNGT300G	49 [1.93]	210.4	240.45	0.2 / 0.225	
300LNGT400F	33 [1.3]	270.45	290.45	0.225	
300LNGT400G	37 [1.46]	250.45	270.45	0.225	
300LNGT425F	34.8 [1.37]	300.5	320.5	0.25	
300LNGT500F	26 [1.02]	285.45	305.45	0.225	
300LNGT725F	26 [1.02]	295.45	315.45	0.225	
350LNGT325F	74 [2.91]	300.5	320.5	0.25	
350LNGT400F	58 [2.28]	300.5	320.5	0.25	
350LNGT400G	61 [2.4]	300.5	320.5	0.25	
350LNGT450F	39 [1.54]	300.5	320.5	0.25	
350LNGT525F	33 [1.3]	340.5	360.5	0.25	
350LNGT600F	28 [1.1]	340.5	360.5	0.25	
350LNGT600G	40 [1.57]	340.5	360.5	0.25	
350LNGT600H	34 [1.34]	290.45	335.45	0.225	
350LNGT675F	44.5 [1.75]	375.5	395.5	0.25	
400LNGT350F	90 [3.54]	300.5	320.5	0.25	
400LNGT550F	43.5 [1.71]	375.5	395.5	0.25	
500LNGT375F	85 [3.35]	340.5	360.5	0.25	
500LNGT450F	78.3 [3.08]	340.5	360.5	0.25	
500LNGT650F	35 [1.38]	375.5	395.5	0.25	
800LNGT1250Y1	125 [4.92]	-	779 / 780	0.6 / 0.6	

- note: 779/780 = DE / NDE

4 INSTALLATION

4.1 Location

The pump should be located to allow room for access, ventilation, maintenance and inspection with ample headroom for lifting and should be as close as practicable to the supply of liquid to be pumped.

Refer to the general arrangement drawing for the pump set.

4.2 Foundation

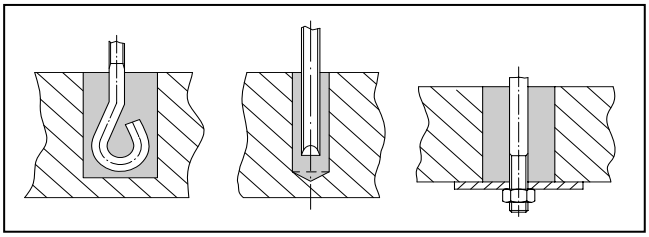
CAUTION There are many methods of installing pump units to their foundations. The correct method depends on the size of the pump unit, its location and noise vibration limitations. Non-compliance with the provision of correct foundation and installation may lead to failure of the pump and, as such, would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

The surface onto which the pump unit is to be placed should be of a material, which is sufficiently hard and strong to provide a permanent, non-flexible support to the entire bearing surface of the pump unit.

The surface should also be smooth and level and should be able to absorb normal vibrations and loads the pump unit is subjected to during operation. A concrete foundation is the most suitable surface.

4.2.1 Grouting

Where applicable, grout in the foundation bolts. See picture below for possible foundation bolt types.
Prepare the recesses in the surface according to following picture following the general arrangement of the pump unit when doing so.



If the surface is concrete, follow the steps below:

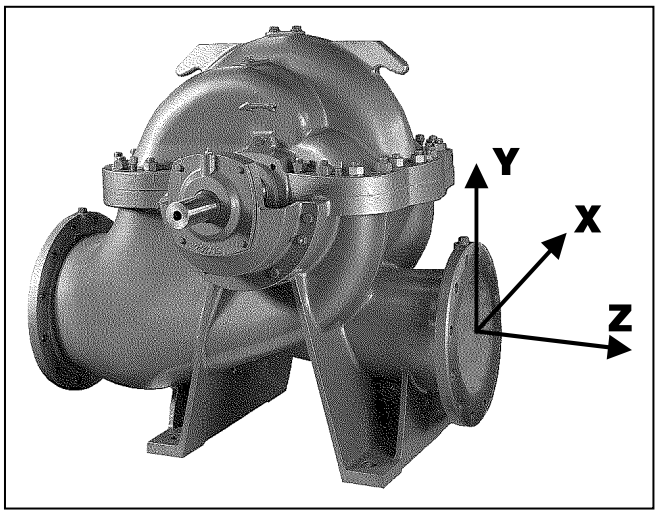
- Do not place the pump unit on the surface until the surface is **fully** cured.
- Fill the recesses with water at least 24 hours before grouting the foundation bolts. Moistening the recesses will ensure a better bond between the grout of the foundation bolts and the surface.
- Remove the water from the recesses at the time the foundation bolts are being grouted.

4.2.2 Positioning of the foundation bolts

Hoist the pump unit and position it above the surface according to the lifting instructions.
Place the foundation bolts with nuts in the foundation frame.

When positioning the pump unit, make allowance for the following:

- The foundation bolts should be free to move in the surface recesses.
- The level of the centerline of the suction and delivery connections should match the centerline of the pipelines to be connected.
- The position of the suction and delivery connections for the X- and Z-axis



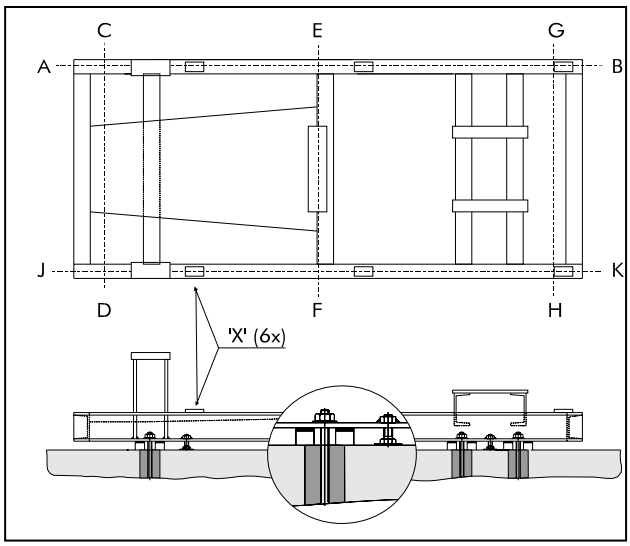
- The vertical distance between the surface and the foundation frame [40 mm] to enable grouting.
- Put steel filler blocks onto the surface on both sides of the foundation bolts
- Place the pump unit on the filler blocks.
- Adjust the pump unit so that it is roughly horizontal and at the required level height using [thin] shims between the steel filler blocks and the foundation frame. In doing this, the foundation frame should be positioned so that the suction and delivery flanges can be fitted to the pipe flanges free of strain. Make sure that in doing so, the flanges to be interconnected are parallel within 0.1 mm of each other.
- Check whether the bolts fit easily into the bolt holes of the flanges. Fasten the foundation bolts by filling the recesses using non-

shrinking grout [for example Pagel V1 or equivalent].
- Leave the grout to cure according to the grout manufacturer's instructions.

4.2.3 Adjusting the foundation frame

Use a calibrated machine levelling instrument accurate to 0.02 mm/m[1]. Make sure to measure in both directions by placing the levelling instrument on the reference locations which have been fitted on the foundation frame for this purpose. If a shaft seal protector has been fitted, it should be removed.

- Adjust the foundation frame horizontally in A-B direction to a degree of accuracy of 0.05 mm/m[1] using thin shims, see Figure 3.
- Tighten the foundation nuts along the A-B axis using a torque of ¼ of the maximum allowable tightening torque [M_{max}] for the foundation bolt.
- Adjust the foundation frame in C-D, E-F and G-H directions to a degree of accuracy of 0.05 mm/m[1] using thin shims.
- Tighten the foundation nuts using a torque of ¼ of the maximum allowable tightening torque [M_{max}] for the foundation bolt.



- Check whether all foundation nuts are tight.
- Align the electric motor to the centerline of the pump using shims between the supporting faces of the foundation frame and the feet of the motor. The maximum allowable deviation, both axially and radially, should not exceed 0.05 mm and depends on the coupling type.
- Loosen all adjusting bolts and measure whether the foundation frame is level in all directions to a degree of accuracy of 0.05 mm/m[1].
- Check whether the position and level height in the centerline of the suction and delivery connections are correct. If not, adjust these as described above.
- Fill the outer edges of the foundation frame, including shims, **completely** with non-shrinking grout [for example Pagel V1 or equivalent]. Leave the grout to cure according to manufacturer's instructions.
- Check whether the nuts of the foundation bolts are still tight and, where necessary, retighten these to the correct torque [¼ M_{max}].
- Reassemble the shaft seal protection if this has been removed to enable horizontal alignment
- If required, draw up a report of the entire alignment procedure.

4.3 Initial alignment

4.3.1 Thermal expansion

CAUTION The pump and motor will normally have to be aligned at ambient temperature and should be corrected to allow for thermal expansion at operating temperature. In pump installations involving high liquid temperatures, the unit should be run at the actual operating temperature, shut down and the alignment checked immediately.

4.3.2 Alignment methods

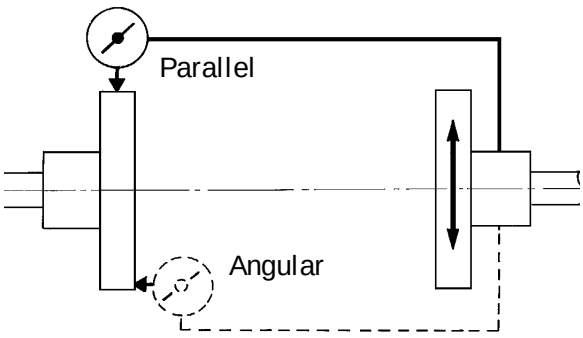
DANGER Ensure pump and driver are isolated electrically and the half couplings are disconnected.

CAUTION The alignment MUST be checked.

Although the pump will have been aligned at the factory it is most likely that this alignment will have been disturbed during transportation or handling. If necessary, align the motor to the pump, not the pump to the motor.

Horizontal pumps – LNGT
Alignment is achieved by adding or removing shims under the motor feet and also moving the motor horizontally as required. In some cases where the alignment cannot be achieved it will be necessary to move the pump before recommencing the above procedure.

For couplings with narrow flanges use a dial indicator as shown below to check both parallel and angular alignment.



Maximum permissible misalignment at working temperature:

Parallel 0.1 mm [0.008 in.] TIR
Angular 0.05 mm [0.004 in.] TIR

When checking parallel alignment, the total indicator read-out [TIR] shown is twice the value of the actual shaft displacement.

Align in the vertical plane first, then horizontally by moving motor. When performing final alignment, check for soft-foot under the driver. A TIR indicator placed on the coupling, reading in the vertical direction, should not indicate more than 0.05 mm [0.002 in.] movement when any driver foot fastener is loosened.

While the pump is capable of operating with the maximum misalignment shown above, maximum pump reliability is obtained by near perfect alignment of 0.05 to 0.10 mm [0.002 to 0.004 in.] TIR parallel and
0.05 mm [0.002 in.] per 100 mm [4 in.] of coupling flange diameter as TIR angular misalignment. This covers the full series of couplings available.

Pumps with thick flanged non-spacer couplings can be aligned by using a straight-edge across the outside diameters of the coupling hubs and measuring the gap between the machined faces using feeler gauges, measuring wedge or calipers.

When the electric motor has sleeve bearings it is necessary to ensure that the motor is aligned to run on its magnetic centerline.

Refer to the motor manual for details.

A button [screwed into one of the shaft ends] is normally fitted between the motor and pump shaft ends to fix the axial position.

CAUTION If the motor does not run in its magnetic centre the resultant additional axial force may overload the pump thrust bearing.

Complete piping as below and see sections 4.7, *Final shaft alignment check* up to and including section 5, *Commissioning, start up, operation and shutdown* before connecting driver and checking actual rotation.

4.4 Piping

CAUTION Protective covers are fitted to the pipe connections to prevent foreign bodies entering during transportation and installation. Ensure that these covers are removed from the pump before connecting any pipes.

4.4.1 Suction and discharge pipe work

In order to minimize friction losses and hydraulic noise in the pipe work it is good practice to choose pipe work that is one or two sizes larger than the pump suction and discharge. Typically main pipe work velocities should not exceed 2 m/s [6 ft/sec] suction and 3 m/s [9 ft/sec] on the discharge.

Take into account the available NPSH which must be higher than the required NPSH of the pump.

CAUTION Never use the pump as a support for piping.

Maximum forces and moments allowed on the pump flanges vary with the pump size and type. To minimize these forces and moments that may, if excessive, cause misalignment, hot bearings, worn couplings, vibration and the possible failure of the pump casing, the following points should be strictly followed:

- Prevent excessive external pipe load
- Never draw piping into place by applying force to pump flange connections
- Do not mount expansion joints so that their force, due to internal pressure, acts on the pump flange. It is recommended that expansion joints use threaded rod to limit any forces of this type

The table in 4.4.3.1 and 4.4.3.2 summarizes the maximum forces and moments allowed on LNGT pump casings. Refer to Flowserve for other configurations.

CAUTION Ensure piping and fittings are flushed before use.

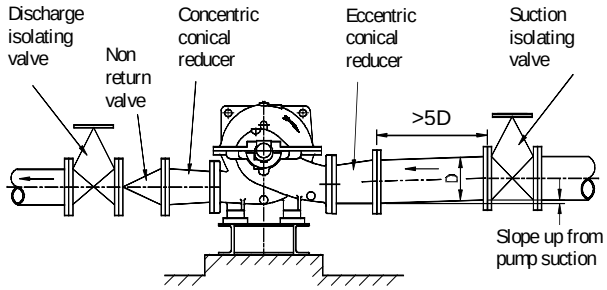
.

4.4.2 Suction piping

Refer to the diagrams below for typical designs of suction piping for both flooded suction and suction lift.

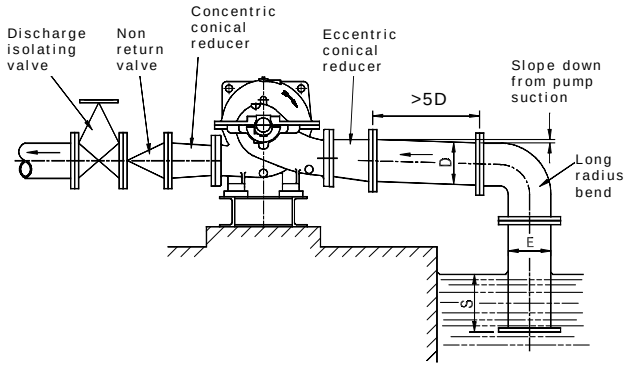
a) The inlet pipe should be one or two sizes larger than the pump inlet bore and pipe bends should be as large a radius as possible.
b) Pipe work reducers should be conical and have a maximum total angle of divergence of 15 degrees.
c) On suction lift the piping should be inclined up towards the pump inlet with eccentric reducers incorporated to prevent air locks.
d) On positive suction, the inlet piping must have a constant fall towards the pump.
e) Flow should enter the pump suction with uniform flow, to minimize noise and wear. This is particularly important on large or high-speed pumps which should have a minimum of five diameters of straight pipe on the pump suction between the elbow and inlet flange. See section 10.3, *Reference 1,* for more detail.
f) Inlet strainers, when used, should have a net `free area' of at least three times the inlet pipe area.
g) Do not install elbows at an angle other than perpendicular to the shaft axis. Elbows parallel to the shaft axis will cause uneven flow.
h) Except in unusual circumstances strainers are not recommended in inlet piping. If considerable foreign matter is expected a screen installed at the entrance to the wet well is preferable.
i) Fitting an isolation valve will allow easier maintenance.
j) Never throttle pump on suction side and never place a valve directly on the pump inlet nozzle.

Typical design – flooded suction



Note:
Ideally reducers should be limited to one pipe diameter change,
ie 150 mm [6 in.] to 200 mm [8 in.]. Must have a maximum total angle of divergence of 15 degrees.

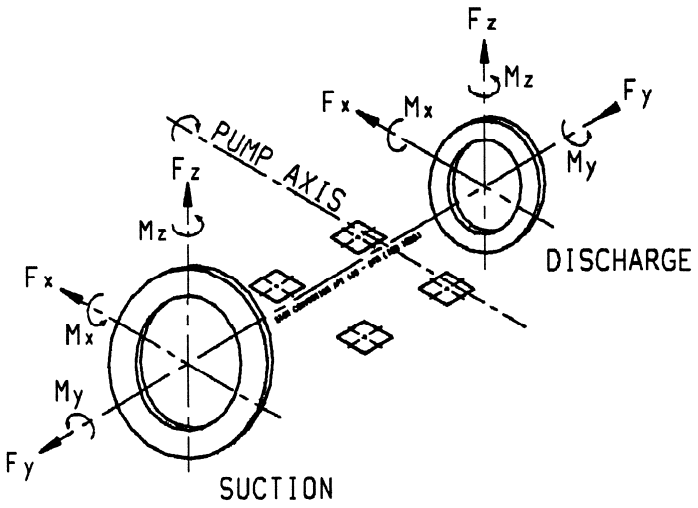
Typical design – suction lift



Notes:
1. S = Minimum submergence >3E.
2. Ideally reducers to be limited to one pipe diameter change, ie 150 mm [6 in.] to 200 mm [8 in.]. Must have a maximum total angle of divergence of 15 degrees.

Maximum forces and moments allowed on LNGT pump flanges

4.4.3.1 SI units



Type and size	Maximum forces [F] in kN and moments [M] in kNm											
	Suction						Discharge					
	Fx	Fy	Fz	Mx	My	Mz	Fx	Fy	Fz	Mx	My	Mz
150LNGT375	5.76	7.20	4.64	2.70	1.35	2.00	4,32	5.40	3.48	1.75	0.90	1.35
150LNGT400	5.76	7.20	4.64	2.70	1.35	2.00	4,32	5.40	3.48	1.75	0.90	1.35
150LNGT475	5.76	7.20	4.64	2.70	1.35	2.00	4,32	5.40	3.48	1.75	0.90	1.35
200LNGT300	7.20	9.00	5.80	3.85	1.90	2.90	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT350	7.20	9.00	5.80	3.85	1.90	2.90	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT400	8.64	10.80	6.96	6.25	3.05	4.70	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT425	5.76	7.20	4.64	2.70	1.35	2.00	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT475	7.20	9.00	5.80	3.85	1.90	2.90	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT500	5.76	7.20	4.64	2.70	1.35	2.00	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT550	7.20	9.00	5.80	3.85	1.90	2.90	5.76	7.20	4.64	2.70	1.35	2.00
200LNGT600	5.76	7.20	4.64	2.70	1.35	2.00	5.76	7.20	4.64	2.70	1.35	2.00
250LNGT325	7.20	9.00	5.80	3.85	1.90	2.90	7.20	9.00	5.80	3.85	1.90	2.90
250LNGT425	8.64	10.80	6.96	6.25	3.05	4.70	7.20	9.00	5.80	3.85	1.90	2.90
250LNGT500	8.64	10.80	6.96	6.25	3.05	4.70	7.20	9.00	5.80	3.85	1.90	2.90
250LNGT575	8.64	10.80	6.96	6.25	3.05	4.70	7.20	9.00	5.80	3.85	1.90	2.90
250LNGT625	8.64	10.80	6.96	6.25	3.05	4.70	7.20	9.00	5.80	3.85	1.90	2.90
300LNGT275	10.00	12.60	8.12	6.50	3.20	4.85	8.64	10.80	6.96	6.25	3.05	4.70
300LNGT300	10.00	12.60	8.12	6.50	3.20	4.85	8.64	10.80	6.96	6.25	3.05	4.70
300LNGT400	11.50	14.40	9.28	7.50	3.75	5.55	8.64	10.80	6.96	6.25	3.05	4.70
300LNGT425	11.50	14.40	9.28	7.50	3.75	5.55	8.64	10.80	6.96	6.25	3.05	4.70
300LNGT500	10.00	12.60	8.12	6.50	3.20	4.85	8.64	10.80	6.96	6.25	3.05	4.70
300LNGT725	10.00	12.60	8.12	6.50	3.20	4.85	8.64	10.80	6.96	6.25	3.05	4.70
350LNGT325	11.50	14.40	9.28	7.50	3.75	5.55	10.00	12.60	8.12	6.50	3.20	4.85
350LNGT400	14.40	18.00	11.60	9.40	4.70	6.95	10.00	12.60	8.12	6.50	3.20	4.85
350LNGT450	14.40	18.00	11.60	9.40	4.70	6.95	10.00	12.60	8.12	6.50	3.20	4.85
350LNGT525	14.40	18.00	11.60	9.40	4.70	6.95	10.00	12.60	8.12	6.50	3.20	4.85
350LNGT600	11.50	14.40	9.28	7.50	3.75	5.55	10.00	12.60	8.12	6.50	3.20	4.85
350LNGT675	14.40	18.00	11.60	9.40	4.70	6.95	10.00	12.60	8.12	6.50	3.20	4.85
400LNGT350	14.40	18.00	11.60	9.40	4.70	6.95	11.50	14.40	9.28	7.50	3.75	5.55
400LNGT550	14.40	18.00	11.60	9.40	4.70	6.95	11.50	14.40	9.28	7.50	3.75	5.55
500LNGT375	17.20	21.60	13.90	11.75	5.90	8.70	14.40	18.00	11.60	9.40	4.70	6.95
500LNGT450	17.20	21.60	13.90	11.75	5.90	8.70	14.40	18.00	11.60	9.40	4.70	6.95
500LNGT650	17.20	21.60	13.90	11.75	5.90	8.70	14.40	18.00	11.60	9.40	4.70	6.95
500LNGT800	17.20	21.60	13.90	11.75	5.90	8.70	14.40	18.00	11.60	9.40	4.70	6.95
600LNGT875	23.00	28.80	18.56	16.00	8.00	11.90	17.20	21.60	13.90	11.75	5.90	8.70
600LNGT1150	28.80	36.00	23.20	20.00	10.00	14.80	17.20	21.60	13.90	11.75	5.90	8.70
700LNGT700	28.80	36.00	23.20	20.00	10.00	14.80	20.00	25.20	16.24	14.10	7.05	10.50
900LNGT650	28.80	36.00	23.20	20.00	10.00	14.80	25.80	32.40	20.80	17.60	8.80	13.00
900LNGT1050	34.40	43.20	27.80	24.00	12.00	17.80	25.80	32.40	20.80	17.60	8.80	13.00
1000LNGT750	28.80	36.00	23.20	20.00	10.00	14.80	28.80	36.00	23.20	20.00	10.00	14.80

4.4.3.2 Imperial units

Type and size	Maximum forces [F] in lbf and moments [M] in lbf•ft – multiply by 1000											
	Suction						Discharge					
	Fx	Fy	Fz	Mx	My	Mz	Fx	Fy	Fz	Mx	My	Mz
150LNGT375	3.87	4.83	3.11	3.66	1.83	2.71	2.90	3.63	2.34	2.37	1.22	1.83
150LNGT400	3.87	4.83	3.11	3.66	1.83	2.71	2.90	3.63	2.34	2.37	1.22	1.83
150LNGT475	3.87	4.83	3.11	3.66	1.83	2.71	2.90	3.63	2.34	2.37	1.22	1.83
200LNGT300	4.83	6.05	3.90	5.21	2.57	3.93	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT350	4.83	6.05	3.90	5.21	2.57	3.93	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT400	5.81	7.26	4.68	8.46	4.13	6.36	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT425	3.87	4.83	3.11	3.66	1.83	2.71	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT475	4.83	6.05	3.90	5.21	2.57	3.93	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT500	3.87	4.83	3.11	3.66	1.83	2.71	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT550	4.83	6.05	3.90	5.21	2.57	3.93	3.87	4.83	3.11	3.66	1.83	2.71
200LNGT600	3.87	4.84	3.12	3.66	1.83	2.71	3.87	4.83	3.11	3.66	1.83	2.71
250LNGT325	4.83	6.05	3.90	5.21	2.57	3.93	4.83	6.05	3.90	5.21	2.57	3.93
250LNGT425	5.81	7.26	4.68	8.46	4.13	6.36	4.83	6.05	3.90	5.21	2.57	3.93
250LNGT500	5.81	7.26	4.68	8.46	4.13	6.36	4.83	6.05	3.90	5.21	2.57	3.93
250LNGT575	5.81	7.26	4.68	8.46	4.13	6.36	4.83	6.05	3.90	5.21	2.57	3.93
250LNGT625	5.81	7.26	4.68	8.46	4.13	6.36	4.83	6.05	3.90	5.21	2.57	3.93
300LNGT275	6.72	8.47	5.46	8.80	4.33	6.57	5.81	7.26	4.68	8.46	4.13	6.36
300LNGT300	6.72	8.47	5.46	8.80	4.33	6.57	5.81	7.26	4.68	8.46	4.13	6.36
300LNGT400	7.73	9.68	6.24	10.15	5.08	7.51	5.81	7.26	4.68	8.46	4.13	6.36
300LNGT425	7.73	9.68	6.24	10.15	5.08	7.51	5.81	7.26	4.68	8.46	4.13	6.36
300LNGT500	6.72	8.47	5.46	8.80	4.33	6.57	5.81	7.26	4.68	8.46	4.13	6.36
300LNGT725	6.72	8.47	5.46	8.80	4.33	6.57	5.81	7.26	4.68	8.46	4.13	6.36
350LNGT325	7.73	9.68	6.24	10.15	5.08	7.51	6.72	8.47	5.46	8.80	4.33	6.57
350LNGT400	9.68	12.10	7.80	12.73	6.36	9.41	6.72	8.47	5.46	8.80	4.33	6.57
350LNGT450	9.68	12.10	7.80	12.73	6.36	9.41	6.72	8.47	5.46	8.80	4.33	6.57
350LNGT525	9.68	12.10	7.80	12.73	6.36	9.41	6.72	8.47	5.46	8.80	4.33	6.57
350LNGT600	7.73	9.68	6.24	10.15	5.08	7.51	6.72	8.47	5.46	8.80	4.33	6.57
350LNGT675	9.68	12.10	7.80	12.73	6.36	9.41	6.72	8.47	5.46	8.80	4.33	6.57
400LNGT350	9.68	12.10	7.80	12.73	6.36	9.41	7.73	9.68	6.24	10.2	5.08	7.51
400LNGT550	9.68	12.10	7.80	12.73	6.36	9.41	7.73	9.68	6.24	10.2	5.08	7.51
500LNGT375	11.56	14.52	9.34	15.91	7.99	11.8	9.68	12.10	7.80	12.7	6.36	9.41
500LNGT450	11.56	14.52	9.34	15.91	7.99	11.8	9.68	12.10	7.80	12.7	6.36	9.41
500LNGT650	11.56	14.52	9.34	15.91	7.99	11.8	9.68	12.10	7.80	12.7	6.36	9.41
500LNGT800	11.56	14.52	9.34	15.91	7.99	11.8	9.68	12.10	7.80	12.7	6.36	9.41
600LNGT875	15.46	19.35	12.47	21.66	10.8	16.1	11.56	14.52	9.34	15.9	7.99	11.8
600LNGT1150	19.35	24.19	15.59	27.08	13.5	20.0	11.56	14.52	9.34	15.9	7.99	11.8
700LNGT700	19.35	24.19	15.59	27.08	13.5	20.0	13.44	16.93	10.91	19.1	9.54	14.2
900LNGT650	19.35	24.19	15.59	27.08	13.5	20.0	17.34	21.77	13.98	23.8	11.9	17.6
900LNGT1050	23.11	29.03	18.68	32.49	16.2	24.1	17.34	21.77	13.98	23.8	11.9	17.6
1000LNGT750	19.35	24.19	15.59	27.08	13.5	20.0	19.35	24.19	15.59	27.1	13.5	20.0

4.4.3.2 Notes

1. F= External force, tensile or compression.
   M= External moment, CW or CCW
2. Forces and Moments may be applied simultaneously in any direction.
3. Values apply to all materials.
4. Higher loads may be acceptable,if direction and magnitude of individual loads are known: approval needed.
5. Pumps must be on rigid foundations and baseplates.
6. Pump/Baseplate should not be used as pipe anchor. Expansion joints must be properly tied.
7. Specified pump foot bolt torque must be used. Bolt Yield Strength > 300 N/mm² [>43000 psi]
8. Sign Convention follows API 610 10th Edition / ISO 13709 and ISO 1503

4.4.4 Discharge piping
See section 4.6.2 for typical pipe work design.

A non-return valve should be located in the discharge pipe work to protect the pump from excessive back pressure and hence reverse rotation when the unit is stopped.

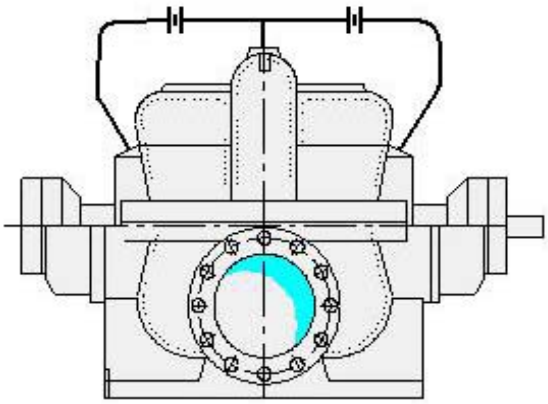
Pipe work reducers should have a maximum total angle of divergence of 9 degrees.

Fitting an isolation valve will allow easier maintenance.

4.4.5 Auxiliary piping

4.4.5.1 Drains
Pipe pump casing drains and gland leakage to a convenient disposal point.

4.4.5.2 Pumps fitted with packed gland
When suction pressure is below ambient pressure it is necessary to feed the gland packing with liquid to provide lubrication and prevent the ingress of air. This is normally achieved with a supply from the pump discharge volute to the stuffing box. An orifice plate is fitted into the supply line [flanges or unions] to control the pressure to the gland/stuffing box.



If the pumped liquid is dirty and cannot be used for sealing, a separate clean compatible liquid supply to the gland at 1 bar [15 psi] above suction pressure is recommended.

4.4.5.3 Pumps fitted with mechanical seals
Single seals requiring re-circulation will normally be provided with the auxiliary piping from pump casing already fitted.

If the seal requires an auxiliary quench then a connection must be made to a suitable source of liquid flow, low pressure steam or static pressure from a header tank. Recommended pressure is 0.35 bar [5 psi] or less. Check *General arrangement drawing*.

Special seals may require different auxiliary piping to that described above. See Supplementary User Instructions, Seal User Instructions and or Flowserve if unsure of correct method or arrangement.

For pumping hot liquids, to avoid seal damage, it is recommended that any external flush/cooling supply be continued after stopping the pump.

4.4.6 Final checks
Check the tightness of all bolts in the suction and discharge pipe work. Check also the tightness of all foundation bolts.

4.5 Final shaft alignment check
After connecting piping to the pump, rotate the shaft several times by hand to ensure there is no binding and all parts are free.

Recheck the coupling alignment, as previously described, to ensure no pipe strain. If pipe strain exists, correct piping.

4.6 Electrical connections
DANGER Electrical connections must be made by a qualified Electrician in accordance with relevant local national and international regulations.

It is important to be aware of the EUROPEAN DIRECTIVE on potentially explosive areas where compliance with IEC60079-14 is an additional requirement for making electrical connections.

It is important to be aware of the EUROPEAN DIRECTIVE on electromagnetic compatibility when wiring up and installing equipment on site. Attention must be paid to ensure that the techniques used during wiring/installation do not increase electromagnetic emissions or decrease the electromagnetic immunity of the equipment, wiring or any connected devices. If in any doubt contact Flowserve for advice.

DANGER The motor must be wired up in accordance with the motor manufacturer's instructions [normally supplied within the terminal

box] including any temperature, earth leakage, current and other protective devices as appropriate. The identification nameplate should be checked to ensure the power supply is appropriate.

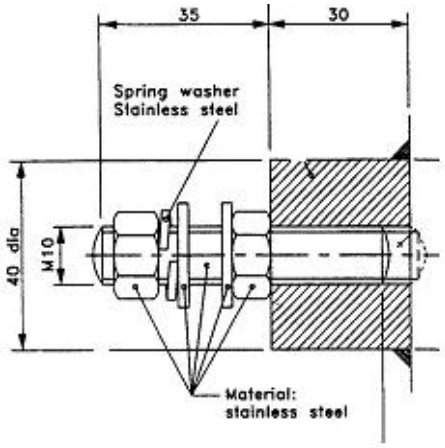
A device to provide emergency stopping must be fitted.

If not supplied pre-wired to the pump unit, the controller/starter electrical details will also be supplied within the controller/starter.

For electrical details on pump sets with controllers see the separate wiring diagram.

CAUTION See section 5.3, *Direction of rotation* before connecting the motor to the electrical supply.

Baseplates have a special earthing boss for discharging [static] electricity as shown below. Connect the earthing boss of the pump unit in accordance with the applicable instructions or commission an approved electrical engineer to carry out the work.



When this earthing boss is not applied this is written in the Supplementary User Instructions.

4.7 Protection systems

The following protection systems are recommended particularly if the pump is installed in a potentially explosive area or is handling a hazardous liquid. If in doubt consult Flowserve.

If there is any possibility of the system allowing the pump to run against a closed valve or below minimum continuous safe flow a protection device should be installed to ensure the temperature of the liquid does not rise to an unsafe level.

If there are any circumstances in which the system can allow the pump to run dry, or start up empty, a power monitor should be fitted to stop the pump or prevent it from being started. This is particularly relevant if the pump is handling a flammable liquid.

If leakage of product from the pump or its associated sealing system can cause a hazard it is recommended that an appropriate leakage detection system is installed.

To prevent excessive surface temperatures at bearings it is recommended that temperature or vibration monitoring are carried out. See sections 5.7.4 and 5.7.5.

5 COMMISSIONING, START-UP, OPERATION AND SHUTDOWN

CAUTION ***These operations must be carried out by fully qualified personnel.***

5.1 Pre-commissioning procedure

5.1.1 Lubrication

Determine the mode of lubrication of the pump set, eg grease, oil, product lubrication etc.

CAUTION For oil lubricated pumps, fill the bearing housing with correct grade of oil to the correct level.
sight [gauge] glass and/or constant level oiler [CLO].

When fitted with a constant level oiler, the bearing housing should be filled by unscrewing or hinging back the transparent bottle and filling the bottle with oil.

Note: Check General Arrangement drawing whether another filling point is indicated. Read also the applicable section in the User Manual for the attached instrumentation.

The oil filled bottle should then be refitted so as to return it to the upright position. Filling should be repeated until oil remains visible within the bottle.

Approximate oil volumes are shown in section 3.4.2, *Pump and impeller data*.

Grease lubricated pumps and electric motors are supplied pre-greased.

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

CAUTION In the case of product lubricated bearings the source of product supply should be checked against the order. There may be requirements for an external clean supply, particular supply pressure or the commencement of lubrication supply before pump start-up.

5.2 Pump lubricants

5.2.1 Recommended lubricants, fill quantities

See applicable tab in the User manual for Lubrication relation table. See also Supplementary User Instructions and/or refer to section 3.4.2, *Pump and impeller data*

5.2.2 CAUTION Lubrication schedule

5.2.2.1 Oil lubricated bearings

Normal oil change intervals are 4 000 operating hours or at least every 6 months. For pumps on hot service or in severely damp or corrosive atmosphere, the oil will require changing more frequently. Lubricant and bearing temperature analysis can be useful in optimizing lubricant change intervals.

The lubricating oil should be a high quality mineral oil having foam inhibitors. Synthetic oils may also be used if checks show that the rubber oil seals will not be adversely affected.

The bearing temperature may be allowed to rise to 40 ºC [122 ºF].above ambient, but should not exceed 80 ºC [176 ºF]. A continuously rising temperature, or an abrupt rise, indicate a fault.

5.2.2.2 Grease lubricated bearings

When grease nipples are fitted, one charge between grease changes is advisable for most operating conditions, ie 2 000 hours interval.

Normal intervals between grease changes are 4 000 hours or at least every 6 months.

The characteristics of the installation and severity of service will determine the frequency of lubrication. Lubricant and bearing temperature analysis can be useful in optimizing lubricant change intervals.

The bearing temperature may be allowed to rise to 55 ºC [131 ºF] above ambient but should not exceed 95 °C [204 °F]. For most operating conditions a quality grease having a lithium soap base and NLGI consistency of No 2 or No 3 is recommended. The drop point should exceed 175 ºC [350 ºF].

CAUTION Never mix greases containing different bases, thickeners or additives.

5.3 Direction of rotation

CAUTION Ensure the pump is given the same rotation as the pump direction arrow cast on the pump casing.To avoid dry running the pump must either be filled with liquid or have the flexible coupling disconnected before driver is switched on.

CAUTION If maintenance work has been carried out to the site's electricity supply, the direction of rotation should be re-checked as above in case the supply phasing has been altered.

5.4 Guarding

Guarding is supplied fitted to the pump set. If this has been removed or disturbed ensure that all the protective guards around the pump coupling and exposed parts of the shaft are securely fixed.

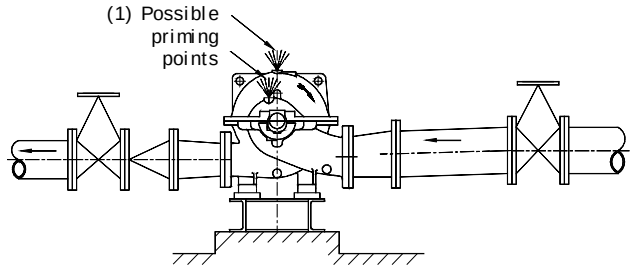
5.5 Priming and auxiliary supplies

CAUTION Ensure all electrical, hydraulic, pneumatic, sealant and lubrication systems [as applicable] are connected and operational.

CAUTION Ensure the inlet pipe and pump casing are completely full of liquid before starting continuous duty operation.

5.5.1 Suction pressure above atmospheric pressure

Open vent connection [1] on top of the pump upper casing to allow the trapped air to escape. Let liquid run out until free from air bubbles.

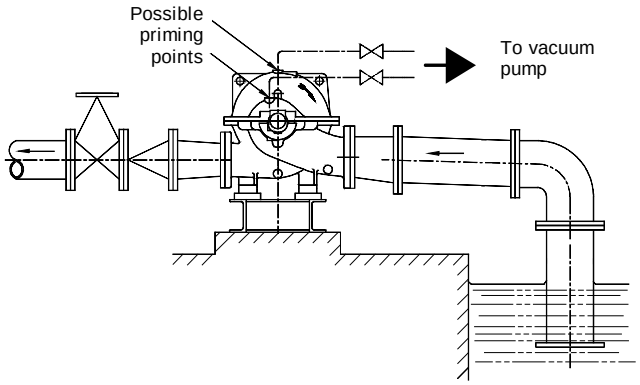


5.5.2 Suction lift with foot valve fitted

Fill suction pipe and casing with liquid at a pressure of 1 to 2 bar from an external source. Vent as described in section 5.5.1.

5.5.3 Suction lift without foot valve

Pump casing vents on the suction volute must be connected to an external vacuum pump priming system. If in doubt please consult Flowserve.



5.6 Starting the pump

a) CAUTION Ensure flushing and/or cooling/ heating liquid supplies are turned ON before starting the pump.
b) CLOSE the outlet valve.
c) OPEN all inlet valves.
d) Prime the pump.
e) Ensure all vent connections are closed before starting.
f) Start motor and check outlet pressure.
g) If the pressure is satisfactory, slowly OPEN outlet control valve.
h) CAUTION Do not run the pump with the outlet valve closed for a period longer than 30 seconds.
i) If NO pressure, or LOW pressure, STOP the pump. Refer to section 7, *Faults; causes and remedies*, for fault diagnosis.

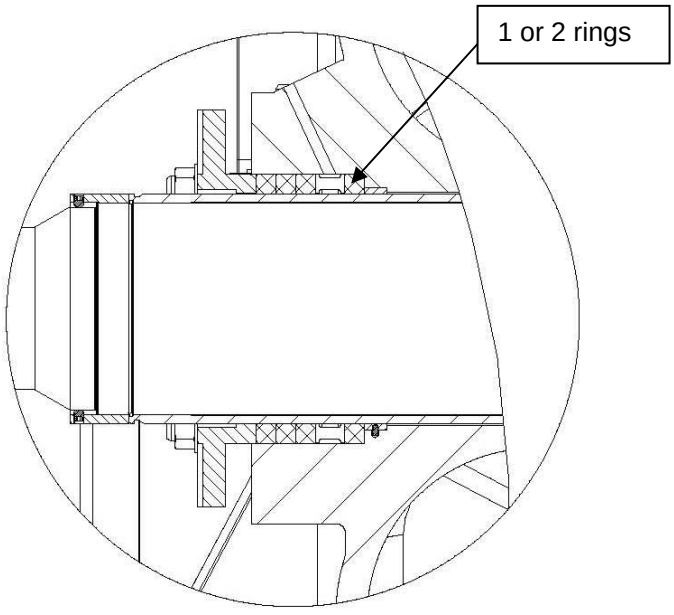
5.7 Running the pump

5.7.1 Venting the pump

Vent the pump to enable all trapped air to escape taking due care with hot or hazardous liquids.

Under normal operating conditions, after the pump has been fully primed and vented, it should be unnecessary to re-vent the pump.

5.7.2 Pumps fitted with gland packing



If the pump has a packed gland there must be some leakage from the gland. Gland nuts should initially be finger-tight only. Leakage should take place soon after the stuffing box is pressurized.

The gland must be adjusted evenly to give visible leakage and concentric alignment of the gland ring [4131[to avoid excess temperature. If no leakage takes place the packing will begin to overheat. If overheating takes place the pump should be stopped and allowed to cool before being re-started. When the pump is re-started, check to ensure leakage is taking place at the packed gland.

If hot liquids are being pumped it may be necessary to slacken the gland nuts to achieve leakage.

The pump should be run for 30 minutes with steady leakage and the gland nuts tightened by 10 degrees at a time until leakage is reduced to an acceptable level, normally a minimum of 120 drops per minute is required. Bedding in of the packing may take another 30 minutes.

Care must be taken when adjusting the gland on an operating pump. Safety gloves are essential. Loose clothing must not be worn to avoid being caught up by the pump shaft. Shaft guards must be replaced after the gland adjustment is complete.

CAUTION Never run gland packing dry, even for a short time.

5.7.3 Pumps fitted with mechanical seal

Mechanical seals require no adjustment. Any slight initial leakage will stop when the seal is run in.

Before pumping dirty liquids it is advisable, if possible, to run in the pump mechanical seal using clean liquid to safeguard the seal face.

CAUTION External flush or quench should be started before the pump is run and allowed to flow for a period after the pump has stopped.

CAUTION Never run a mechanical seal dry, even for a short time.

5.7.4 Bearings

If the pumps are working in a potentially explosive atmosphere, temperature or vibration monitoring at the bearings is recommended.

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.

- Record the bearing temperature [t] and the ambient temperature [ta]
- Estimate the likely maximum ambient temperature [tb]
- Set the alarm at [t+tb-ta+5] °C [[t+tb-ta+10] °F[and the trip at 100 °C [212 °F] for oil lubrication and 105 °C [220 °F] for grease lubrication

It is important, particularly with grease lubrication, to keep a check on bearing temperatures. After start up the temperature rise should be gradual, reaching a maximum after approximately 1.5 to 2 hours. This temperature rise should then remain constant or marginally reduce with time. [Refer to section 6.2.3.1 for further information.]

5.7.5 Normal vibration levels, alarm and trip

For guidance, pumps generally fall under a classification for rigid support machines within the International rotating machinery standards and the recommended maximum levels below are based on those standards.

CAUTION Alarm and trip values for installed pumps should be based on the actual measurements [N] taken on site on the bearing housings of the pump in the fully commissioned as new condition. The example [N] value is given for the preferred operating flow region [typically this may extend to 70 to 120% of the pump best efficiency point]; outside the preferred flow region the actual vibration experienced may be multiplied by up to two.

These standard values can vary with the rotational speed and the power absorbed by the pump. For any special case, contact your nearest Flowserve office.

Measuring vibration at regular intervals will show any deterioration in pump or system operating conditions.

Vibration velocity – unfiltered		Horizontal pumps mm/s [in./s] r.m.s.
Normal	**N**	≤ 5.6 [0.22]
Alarm	**N** x 1.25	≤ 7.1 [0.28]
Shutdown trip	**N** x 2.0	≤ 11.2 [0.44]

5.7.6 Stop/start frequency

Pump sets are normally suitable for the number of equally spaced stop/starts per hour shown in the table below. Check actual capability of the driver and control/starting system before commissioning.

Motor rating kW [hp]	Maximum stop/starts per hour
Up to 15 [20]	15
Between 15 [20] and 90 [120]	10
90 [120] to 150 [200]	6
Above 150 [200]	Refer

Where duty and standby pumps are installed it is recommended that they are run alternately every week.

5.8 Stopping and shutdown

a) CAUTION Close the outlet valve, but ensure that the pump runs in this condition for no more than a few seconds.
b) Stop the pump.
c) Switch off flushing and/or cooling/heating liquid supplies at a time appropriate to the process.
d) CAUTION For prolonged shut-downs and especially when ambient temperatures are likely to drop below freezing point, the pump and any cooling and flushing arrangements must be drained or otherwise protected.

5.9 Hydraulic, mechanical and electrical duty

This product has been supplied to meet the performance specifications of your purchase order, however it is understood that during the life of the product these may change. The following notes may help the user decide how to evaluate the implications of any change. If in doubt contact your nearest Flowserve office.

5.9.1 Specific gravity [SG]

Pump capacity and total head in meters [feet] do not change with SG, however pressure displayed on a pressure gauge is directly proportional to SG. Power absorbed is also directly proportional to SG. It is therefore important to check that any change in SG will not overload the pump driver or over-pressurize the pump.

5.9.2 Viscosity

For a given flow rate the total head reduces with increased viscosity and increases with reduced viscosity. Also for a given flow rate the power absorbed increases with increased viscosity, and reduces with reduced viscosity. It is important that checks are made with your nearest Flowserve office if changes in viscosity are planned.

5.9.3 Pump speed

CAUTION Changing pump speed effects flow, total head, power absorbed, $NPSH_R$, noise and vibration. Flow varies in direct proportion to pump speed, head varies as speed ratio squared and power varies as speed ratio cubed. The new duty, however, will also be dependent on the system curve. If increasing the speed, it is important therefore to ensure the maximum pump working pressure is not exceeded, the driver is not overloaded, $NPSH_A > NPSH_R$, and that noise and vibration are within local requirements and regulations.

5.9.4 Net positive suction head [$NPSH_A$]

NPSH available [$NPSH_A$] is a measure of the head available in the pumped liquid, above its vapor pressure, at the pump suction branch.

NPSH required [$NPSH_R$] is a measure of the head required in the pumped liquid, above its vapor pressure, to prevent the pump from cavitating. It is important that $NPSH_A > NPSH_R$. The margin between $NPSH_A > NPSH_R$ should be as large as possible.

If any change in $NPSH_A$ is proposed, ensure these margins are not significantly eroded. Refer to the pump performance curve to determine exact requirements particularly if flow has changed.
If in doubt please consult your nearest Flowserve office for advice and details of the minimum allowable margin for your application.

5.9.5 Pumped flow

Flow must not fall outside the minimum and maximum continuous safe flow shown on the pump performance curve and or data sheet.

6 MAINTENANCE

6.1 General

It is the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is carried out by authorized and qualified personnel who have adequately familiarized themselves with the subject matter by studying this manual in detail. [See also section 1.6.2.]

Any work on the machine must be performed when it is at a standstill. It is imperative that the procedure for shutting down the machine is followed, as described in section 5.8.

On completion of work all guards and safety devices must be re-installed and made operative again.

Before restarting the machine, the relevant instructions listed in section 5, *Commissioning, start up, operation and shut down* must be observed.

Oil and grease leaks may make the ground slippery. Machine maintenance must always begin and finish by cleaning the ground and the exterior of the machine.

If platforms, stairs and guard rails are required for maintenance, they must be placed for easy access to areas where maintenance and inspection are to be carried out. The positioning of these accessories must not limit access or hinder the lifting of the part to be serviced.

When air or compressed inert gas is used in the maintenance process, the operator and anyone in the vicinity must be careful and have the appropriate protection.

Do not spray air or compressed inert gas on skin.

Do not direct an air or gas jet towards other people. Never use air or compressed inert gas to clean clothes.

Before working on the pump, 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".***

Never clean equipment with inflammable solvents or carbon tetrachloride. Protect yourself against toxic fumes when using cleaning agents.

6.2 Maintenance schedule


It is recommended that a maintenance plan and schedule is adopted, in line with these User Instructions. It should include the following:

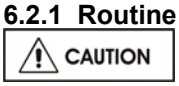
a) Any auxiliary systems installed must be monitored, if necessary, to ensure they function correctly.
b) Gland packings must be adjusted correctly to give visible leakage and concentric alignment of the gland follower to prevent excessive temperature of the packing or follower.
c) Check for any leaks from gaskets and seals. The correct functioning of the shaft seal must be checked regularly.
d) Check bearing lubricant level, and if the hours run show a lubricant change is required.
e) Check that the duty condition is in the safe operating range for the pump.
f) Check vibration, noise level and surface temperature at the bearings to confirm satisfactory operation.
g) Check dirt and dust is removed from areas around close clearances, bearing housings and motors.
h) Check coupling alignment and re-align if necessary.

Our specialist service personnel can help with preventative maintenance records and provide condition monitoring for temperature and vibration to identify the onset of potential problems.

If any problems are found the following sequence of actions should take place:

a) Refer to section 7, *Faults; causes and remedies*, for fault diagnosis.
b) Ensure equipment complies with the recommendations in this manual.
c) Contact Flowserve if the problem persists.

6.2.1 Routine inspection [daily/weekly]



The following checks should be made and the appropriate action taken to remedy any deviations:

a) Check operating behavior. Ensure noise, vibration and bearing temperatures are normal.
b) Check that there are no abnormal fluid or lubricant leaks [static and dynamic seals] and that any sealant systems [if fitted] are full and operating normally.
c) Check that shaft seal leaks are within acceptable limits.
d) Check the level and condition of oil lubricant. On grease lubricated pumps, check running hours since last recharge of grease or complete grease change.
e) Check any auxiliary supplies eg heating/cooling, if fitted, are functioning correctly.


Refer to the manuals of any associated equipment for routine checks needed.

6.2.2 Periodic inspection [six monthly]

a) CAUTION Check foundation bolts for security of attachment and corrosion.
b) Check pump running records for hourly usage to determine if bearing lubricant requires changing.
c) The coupling should be checked for correct alignment and worn driving elements.

Refer to the manuals of any associated equipment for periodic checks needed.

6.2.3 Re-lubrication

Lubricant and bearing temperature analysis can be useful in optimizing lubricant change intervals. In general however, the following is recommended.

6.2.3.1 Oil lubrication

CAUTION Maintaining the correct oil level is very important.

If the pump is supplied with a constant level oiler the oil level will be automatically maintained and as long as oil is visible in the glass bottle there is no need to refill. If however a sight glass has been fitted then regular checks should be made to ensure the level is maintained at the centre of the glass window.

Refer to section 5.1.1 for methods of oil fill, section 5.2.1 for oil grade recommendations and 5.7.4 for the schedule and temperature limits.

6.2.3.2 Grease lubrication

CAUTION See section 5.2.2 for grease recommendations.

Regrease - via grease nipples every 2 000 hours or sooner depending on the severity of the application.

6.2.4 Mechanical seals

No adjustment is possible. When leakage reaches an unacceptable level the seal will need replacement.

6.2.5 Gland packing

The stuffing box split gland can be completely removed for re-packing or to enable the addition of extra rings of packing.

The stuffing box is normally supplied with a lantern ring to enable a clean or pressurized flush to the centre of the packing. If not required, this can be replaced by an extra two rings of packing.

There must always be a small leakage, normally a minimum of 120 drops per minute to atmosphere to lubricate and cool the packing is required.

6.3 Spare parts

6.3.1 Ordering of spares

Flowserve keep records of all pumps that have been supplied. When ordering spares the following information should be quoted:

1) Pump serial number.
2) Pump size.
3) Part name – taken from section 8.
4) Part number – taken from section 8.
5) Number of parts required.

The pump size and serial number are shown on the pump nameplate.

To ensure continued satisfactory operation, replacement parts to the original design specification should be obtained from Flowserve.

Any change to the original design specification [modification or use of a non-standard part] will invalidate the pump's safety certification.

6.3.2 Storage of spares

Spares should be stored in a clean dry area away from vibration. Inspection and re-treatment of metallic surfaces [if necessary] with preservative is recommended at 6 monthly intervals.

6.4 Recommended spares and consumable items

For start up purposes:

1 - complete set of gland packing [if applicable]
1 - basic mechanical seal [if applicable]
1 - set of gaskets and O-rings

optional: 2 - mechanical seals

For 2 years operation:

1 - set of bearings [journal and thrust]
1 - set of gland packings [if applicable]
2 – lantern rings [if applicable]
2 - basic mechanical seals [if applicable]
2 – set of shaft sleeves
2 - set of gaskets and O-rings
2 – set of casing wear rings
2 – set of impeller wear rings [if applicable]

For 4 years operation:

1 - set of bearings [journal and thrust]
2 - sets of gland packing [if applicable]
2 – lantern rings [if applicable]
2 - basic mechanical seal [if applicable]
2 – set of shaft sleeves
2 - set of gaskets and O-rings
1 – impeller
2 - set of casing wear rings
2 – set of impeller wear rings [if applicable]
2 - set of bearing isolators
2 – set of throath bushes

Note: Please refer to this manual for spares of applicable buy outs.

6.5 Tools required

A typical range of tools that will be required to maintain these pumps is listed below.

Readily available in standard tool kits, and dependent on pump size:

- Open ended spanners [wrenches] to suit up to M 48 screws/nuts
- Socket spanners [wrenches], up to M 48 screws
- Allen keys, up to 10 mm [A/F]
- Range of screwdrivers
- Soft mallet

More specialized equipment:

- Bearing pullers
- Bearing induction heater
- Dial test indicator
- C-spanner [wrench] - for removing shaft nut. [If difficulties in sourcing are encountered, consult Flowserve.]

6.6 Fastener torques

See applicable section in the Manual for Fastener torques. Also read the Supplementary User Instructions.

6.7 Renewal clearances

As wear takes place between the impeller and casing ring the overall efficiency of the pump set will decrease. To maintain optimum efficiency it is recommended that rings are replaced and the impeller renovated when the radial clearance detailed in section 3.4.2 has doubled to 0.6 to 0.8 mm [0.024 to 0.032 in.], depending on pump size.

6.8 Disassembly

Refer to section 1.6, *Safety*, before dismantling the pump.

CAUTION Before dismantling the pump for overhaul, ensure genuine Flowserve replacement parts are available.

Refer to sectional drawings for part numbers and identification.

The pump unit can be disassembled without using any special or auxiliary tools.

Besides the instructions below, refer to the sectional drawing of the pump unit

The following activities should be carried out prior to disassembly of the pump:

- DANGER Stop the pump. Please refer to the procedure for stopping the pump..
- Secure the pump unit; make sure that the electric motor cannot start up unexpectedly while maintenance work is being carried out. Disconnect the electric motor from the mains in accordance with the instructions provided by the relevant supplier. Attach a warning sign to the switch box.
- Drain off the fluid in the pump unit. To do this, remove the plug [6569] underneath the pump casing or use the device in the drain pipe. Collect the fluid in a drip tray. If hazardous fluids are being pumped, use personal protection equipment and dispose of the drained-off fluid in an environment-friendly manner.
- Flush the pump thoroughly, so that no dangerous fluids remain inside. Dispose of the drained flushing fluid using an environment-friendly method. If the pump was flushed by a third party, make sure that it has been released for disassembly.
- Fit the plug [6569] into the pump casing or close the device in the drain pipe.
- Mark all components to be absolutely sure of their correct position during assembly.
- Disconnect any auxiliary piping, e.g. for the cooling, sealing and flushing fluids of the mechanical seal.
- Disassemble the protective cover local to the coupling.

Disassemble, if present, the coupling spacer between the pump unit and electric motor in

accordance with the instructions provided by the relevant supplier.
If no coupling with spacer is present, disassemble the coupling in accordance with the instructions provided by the relevant supplier and remove the electric motor in line with the instructions of the relevant supplier.

6.8.1 Disassembly of the upper half [1214] of the pump casing

Remove the upper half of the pump casing according to the following procedure;

- Remove the nuts [6581] from the gland stud bolts [6572].
- Slide the glands [4120] as far as possible towards the bearing housings; do not stop sliding until the gland stud bolts are free.
- Remove the nuts [6581] from the pump casing stud bolts [6572]
- Separate the upper half from the bottom half of the pump casing using distance bolts [6575]. Turn the distance bolts clockwise a few times in sequence, so that the upper half comes away evenly from the bottom half of the pump casing. This working method prevents the wearing rings and centring shoulders from being damaged.
- Attach the lifting gear to the lifting lugs of the upper half, giving appropriate consideration to the lifting instructions. as described.
- Turn the distance bolts clockwise a few times in sequence until the centring shoulder is free. Be careful when doing so, because the play between the impeller or the impeller wearing ring and the casing wearing ring is very limited.
- Remove the packing [4590] from both the top and the bottom halves of the pump casing and dispose of the packing material correctly. This packing should be used only once.
- Remove the taper dowel pins [6810] from the upper half of the pump casing.

6.8.2 Disassembly of the rotor from the bottom half of the pump casing

This procedure describes how to remove the rotor, including bearing housings, from the bottom half of the pump casing.

- Remove the hexagon head bolts [6577] at the bearing housings.
- Remove the taper dowel pins [6810] from the bearing housings.
- Attach the lifting gear around the bearing housings. Carefully hoist the rotor, including the bearing housings, from the bottom half of the pump casing in order to prevent parts from being damaged. When doing so, appropriate consideration should be given to the lifting instructions.

6.8.3 Disassembly of the bearing housing covers

This procedure describes how to remove the bearing housing covers.

- Remove the V-ring (Labyrinth ring) (Labyrinth ring) [4330] from the pump shaft. The V-ring (Labyrinth ring) (Labyrinth ring) should be disposed off correctly. During assembly, the old V-ring (Labyrinth ring) (Labyrinth ring) should be replaced by a new one.
- Remove the hexagon head bolts [6577].
- Remove the bearing housing covers [3266]

6.8.4 Disassembly of the roller bearings

This procedure describes how to remove the roller bearings from the pump shaft and the bearing housings.

- Bend the lips of the circlip [6541] open and turn the shaft nut [2910] from the pump shaft.
- Remove the circlip.
- Remove the roller bearings [3012] from the pump shaft and from the bearing housings using the correct tools.
- Remove the ring [2510] from the pump shaft. This ring is used to center the impeller within the pump casing.

6.8.5 Disassembly of the bearing housings

This procedure describes how to remove the bearing housings.

- Remove the bearing housings [3200]. Mark the bearing brackets in order to distinguish the drive-side bearing bracket from the non-drive side bearing bracket during assembly.

6.8.6 Disassembly of the casing wearing ring[s]

This procedure describes how to remove the casing wearing rings.

The casing wearing rings were removed while disassembling the rotor from the bottom half of the pump casing and are now loosely arranged around the impeller or the impeller wearing ring.

- Remove the casing wearing rings [1500], including the cylindrical pins [6811].

6.8.7 Disassembly of the throwers and V-rings (Labyrinth rings)

This procedure describes how to remove the throwers and V-rings (Labyrinth rings) from the pump shaft.

- Loosen the set screws [6570] from the thrower [6570] until the set screw is free from the pump shaft.
- Remove the throwers [2540] from the pump shaft.
- Remove the V-ring (Labyrinth ring) (Labyrinth ring) [4330] from the pump shaft. The V-ring (Labyrinth ring) (Labyrinth ring) should be disposed off correctly. During assembly, the old ring should be replaced by a new one.

6.8.8 Disassembly of the mechanical seal

This procedure describes how to remove the mechanical seal.

- Remove the circlip from the mechanical seal in accordance with the supplier's instructions, until the mechanical seal is released from the pump shaft.
- Slide the mechanical seal [4200] from the pump shaft.

6.8.9 Disassembly of the sleeves

This procedure describes how to remove the sleeves from the pump shaft.

- Loosen the set screw [6570] from the sleeves until they are free from the pump shaft.
- Slide the sleeves [2445] from the pump shaft.

6.8.10 Disassembly of the impeller

This procedure describes how to remove the impeller from the pump shaft.

- Remove the O-rings [4610]. These O-rings ensure that the retaining rings do not move in relation to each other.
- Remove the retaining rings [2531].
- Slide the impeller [2200] from the pump shaft and remove key [6700] which is now accessible.

6.8.11 Disassembly of the impeller wearing ring[s], if present

During assembly, the impeller wearing rings [2300] were shrunk or pressed onto the impeller. Use an appropriate puller tool to remove the impeller wearing ring[s].

- Remove the set screw [6570] which are used to secure the impeller wearing ring to the impeller.
- Remove the impeller wearing ring from the impeller using the puller tool.

6.9 Assembly

To assemble the pump consult the sectional drawings, see section 8, *Parts list and drawings*.

Ensure threads, gasket and O-ring mating faces are clean and that ball bearings are C3 fit. Apply thread sealant to non-face sealing pipe thread fittings.

Inspect the internal pump parts for:

- breakage/cracks;
- corrosion;
- wear;
- clogging;
- other irregularities.

Clean all parts thoroughly prior to assembly. Replace all parts which are worn or damaged.

Always apply assembly paste to surfaces which could damage one another during assembly.

6.9.1 Assembly of the impeller wearing ring[s], if present

This procedure describes how to assemble the impeller wearing rings on both sides of the impeller.

- Clean the assembly surfaces of the impeller wearing ring [2300] and the impeller [2200].
- Use the appropriate personal protection equipment and clothing while heating and assembling the impeller wearing ring.
- CAUTION Heat the impeller wearing ring to a temperature of 120° to 150°C. Be careful during assembly of chromium-sprayed impeller wearing rings. Quick heating or cooling down could loosen the sprayed-on chromium layer.
- Slide the impeller wearing ring straight over the impeller and allow the assembly to cool down.
- Drill three holes, each spaced at 120°, local to the transition between the impeller wearing ring and the impeller. Make sure that the holes are so deep, that the set screws [6570] do not protrude from the face of the impeller wearing ring and the impeller.
- Tap screw thread into the three holes and remove any residual metal.
- Fit the set screws.
- Secure the set screw using a center punch.

6.9.2 Assembly of the impeller

This procedure describes how to assemble the impeller to the pump shaft.

- Clean the assembly surfaces of the impeller [2200] and the pump shaft [2110].
- Position the key [6700] into the pump shaft.
- Slide the impeller over the pump shaft.
- Position the impeller correctly by placing the retaining rings [2531] in the pump shaft.

6.9.3 Assembly of the sleeves

This procedure describes how to assemble the sleeves to the pump shaft.

- Clean the assembly surfaces of the sleeves [2445] and the pump shaft [2110].
- Carefully slide the sleeve over the pump shaft.
- CAUTION ***The sleeve should be slipped over the pump shaft until a clearance of 1 mm remains between the impeller and the shaft sleeve.***
- Fit the set screws [6570] [if necessary, drill new securing holes in the pump shaft if the set screws do not fit into the old securing holes].
- Secure the set screws using a center punch.

6.9.4 Assembly of the casing wearing ring[s]

This procedure describes how to assemble the casing wearing rings in the pump casing.

- Clean the assembly surfaces of the casing wearing ring [1500] and the pump casing [1213 and 1214].
- Position the cylindrical pin [6811] into the casing wearing ring.
- CAUTION Check whether this cylindrical ring is fully seated in the groove of the lower half of the pump casing. If required, the groove should be machined using a pneumatically driven manual cutter. If the wearing ring is not fully seated, it may be incorrectly aligned in the pump casing during assembly and will start to rub.
- Position the casing wearing ring [1500] on the impeller [2300]. Make sure that the tapered side of the ring points towards the outside of the impeller.

6.9.5 Assembly of the upper half of the pump casing

This procedure describes how to assemble the upper half of the pump casing to the bottom half of the pump casing.

- Clean the assembly surfaces of the bottom and upper halves of the pump casing [1213 and 1214] and make sure that the inside of the pump casing is clean.
- Fit the gasketing material [4590] between the two casing halves. Fitting the gasketing material between the two pump halves is called 'tapping' the gasket. When tapping the gasket, the gasket sheet is placed on the upper half of the pump casing. This gasket sheet should be secured into place using taper dowel pins [6810] to prevent it from sliding while tapping. Then a plastic mallet is used to tap along the sharp edges of the pump casing. The gasketing material is sheared and cut off by the sharp edges.
- Having finished the tapping procedure, you must now finish cut the gasket. Do this by positioning the upper half of the pump casing on the bottom half and cutting the excess gasketing material from the bore holes using a small knife. Once again the taper dowel pins are used to secure the gasketing material and to correctly position the top and bottom halves of the pump casing in relation to each other. When finishing the gasket, you should work very accurately to prevent leakage.
- Remove the upper half of the pump casing.
- Position the pump shaft [2110] with the shaft sleeves [2445], the impeller [2200] and the casing wearing rings [1500] around the impeller into the bottom half of the pump casing. Make sure that you check the impeller's direction of rotation.
- Make sure that the casing wearing ring is positioned correctly (position the cylindrical pins [6811] correctly into the recesses).
- Position the upper half of the pump casing on the bottom half and secure it with locating dowels.
- Fit the nuts [6581] to the stud bolts [6572] of the pump casing [1213 and 1214]. To prevent the cover and sealing from becoming warped, the nuts should be tightened evenly working your way from the inside to the outside. Finally, tighten the nuts to the prescribed tightening torque.

6.9.6 Assembly of the mechanical seal, throwers and V-rings (Labyrinth rings).

This procedure describes how to pre-assemble the mechanical seal, the throwers and V-rings (Labyrinth ring).

- Slide the mechanical seal [4200] over the pump shaft [2110] until it seats against the pump casing.
- Slide the thrower [2540] as far as possible over the pump shaft [2110].
- Slide the V-rings (Labyrinth rings) [4330] as far as possible over the pump shaft [2110].

6.9.7 Assembly of the bearing housings

This procedure describes how to assemble the bearing housings to the pump casing.

If required, replace the V-rings (Labyrinth ring) [4330] according to the following procedure:

- Remove the V-ring (Labyrinth ring) from each bearing housing [3200] using the appropriate puller tool.
- Press the new V-ring (Labyrinth ring) into each bearing housing using the appropriate pressing tool.

Assembly of the bearing housings:

- Clean the assembly surfaces of the bearing housings [3200] and the pump casing [1213 and 1214].
- Position the bearing housings against the pump casing and secure them using the taper dowel pins [6810].
- Fit the hexagon head bolts [6577].
- Tighten the hexagon head bolts of the bearing housings to the prescribed tightening torque

6.9.8 Assembly of the roller bearings

This procedure describes how to assemble the roller bearings in the bearing housings.

- Clean the assembly surfaces of the bearing housings [3200], the pump shaft [2110] and the roller bearings [3012].
- Position the washer [2905] on the pump shaft.
- Fill the roller bearings with bearing grease.
- Fit the roller bearing [3012] on the non-driven side so that it is seated against the stops of both the bearing housing and the washer. Make sure that the coding of the bearing points to the front.
- Attach the circlip [6541] and tighten the shaft nut [2910].
- Bending the lips of the circlip will secure the shaft nut.
- Fit the roller bearing [3012] on the driven side. Slide the roller bearing so that it is seated against the pump shaft stop. Make sure that the coding of the bearing points to the front.

When assembling the bearings, you should use a hydraulic jack. This will ensure that the forces on the bearing are divided evenly, which will prevent the bearing from becoming warped and will ensure that the bearing is fully seated against the contact surface.

6.9.9 Assembly of the bearing housing covers

This procedure describes how to assemble the bearing-casing covers.

If required, replace the V-ring (labyrinth ring) [4330] according to the following procedure:

- Remove the labyrinth ring from the bearing cover [3260] using the appropriate puller tool.
- Press the new labyrinth ring into the bearing cover using the appropriate pressing tool.

Assembly of the bearing covers:

- Clean the assembly surfaces of the bearing housings [3200] and the bearing housing covers [3260].
- Fill 1/3 of the bearing housings with grease, if the bearings are grease lubricated.
- Position the bearing covers on the bearing housings.
- Fit the hexagon head bolts [6577].

6.9.10 Assembly of the V-rings (Labyrinth rings) and throwers

This procedure describes how to assemble the V-rings (Labyrinth rings) and the throwers on the pump shaft.

- Slide the V-rings (Labyrinth rings) [4330] into the correct position.
- Slide the throwers [2540] into the correct position.
- Fit the set screws.
- Secure these set screws using a center punch.

6.9.11 Assembly of the mechanical seal

This procedure describes how to assemble the mechanical seal.

- Clean the assembly surfaces of the mechanical seal [443].
- Screw the seal plate into position against the pump casing.
- Fit the circlip of the mechanical seal in accordance with supplier's instructions until the mechanical seal is secured on the pump shaft.

6.9.12 Assembly of the remaining components

- Assemble the coupling between the pump unit and the electric motor according to the instructions provided by the relevant supplier.
- If required, replace the gaskets between the flanges of the pipe work.
- Connect all auxiliary lines according to the dimensioned sketch. Fit the protective cover at the coupling.
- Carry out the instructions for starting up the pump.

6.9.13 Stuffing box assembly

6.9.13.1 Gland packing

Insert inner two rings of packing, then lantern ring halves and finally 2 or 3 more rings of packing. Loosely fit the gland [4120] and connect flush line.

6.9.13.2 Component mechanical seal [4200.1]

 Refer to separate User Instructions supplied with the mechanical seal.

Fasten seal covers [4213] complete with O-ring [4610.9] using screws [6570.7]. Connect flush line. Connect any auxiliary piping.

6.9.13.3 Cartridge mechanical seal [4200]

 If optional cartridge seals are fitted, refer to separate User Instructions supplied with the seal for securing and activating the seal.

7 FAULTS; CAUSES AND REMEDIES

FAULT SYMPTOM

Pump overheats and seizes	Bearings have short life	Pump vibrates or is noisy	Mechanical seal has short life	Mechanical seal leaks excessively	Pump requires excessive power	Pump loses prime after starting	Insufficient pressure developed	Insufficient capacity delivered	Pump does not deliver liquid	PROBABLE CAUSES	POSSIBLE REMEDIES
										A. System troubles	
●									●	Pump not primed.	Check complete filling. Vent and/or prime.
		●				●		●	●	Pump or suction pipe not completely filled with liquid.	
		●				●		●	●	Suction lift too high or level too low.	Check $NPSH_A$>$NPSH_R$, proper submergence, losses at strainers and fittings.
●		●						●	●	Insufficient margin between suction pressure and vapor pressure.	
						●	●	●		Excessive amount of air or gas in liquid.	Check and purge pipes and system.
						●		●	●	Air or vapor pocket in suction line.	Check suction line design for vapor pockets.
						●		●		Air leaks into suction line.	Check suction pipe is airtight.
						●		●		Air leaks into pump through mechanical seal, sleeve joints, casing joint or pipe plugs.	Check and replace faulty parts. CONSULT FLOWSERVE.
		●						●		Foot valve too small.	Investigate replacing the foot valve.
		●						●		Foot valve partially clogged.	Clean foot valve.
		●				●		●	●	Inlet of suction pipe insufficiently submerged.	Check out system design.
							●	●	●	Speed too low.	CONSULT FLOWSERVE.
					●					Speed too high.	CONSULT FLOWSERVE.
							●	●	●	Total head of system higher than differential head of pump.	Check system losses. Remedy or CONSULT FLOWSERVE.
					●					Total head of system lower than pump design head.	
					●					Specific gravity of liquid different from design.	Check and CONSULT FLOWSERVE.
					●		●	●		Viscosity of liquid differs from that for which designed.	
●		●								Operation at very low capacity.	Measure value and check minimum permitted. Remedy or CONSULT FLOWSERVE.
	●	●			●					Operation at high capacity.	Measure value and check maximum permitted. Remedy or CONSULT FLOWSERVE.
										B. Mechanical troubles	
●	●	●	●	●	●					Misalignment due to pipe strain.	Check the flange connections and eliminate strains using elastic couplings or a method permitted.
		●								Improperly designed foundation.	Check setting of baseplate: tighten, adjust, grout base as required.

FAULT SYMPTOM

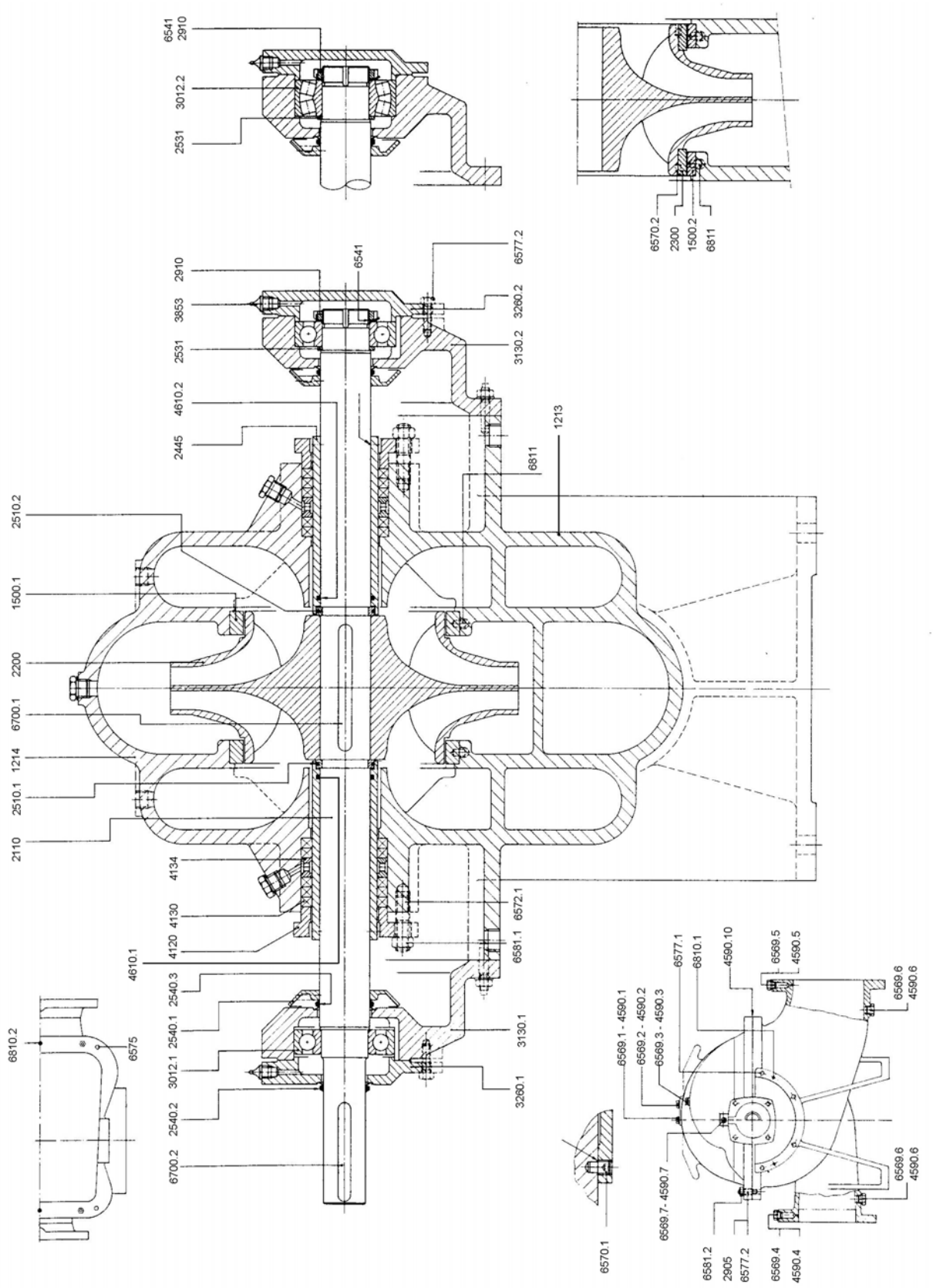
Pump overheats and seizes	Bearings have short life	Pump vibrates or is noisy	Mechanical seal has short life	Mechanical seal leaks excessively	Pump requires excessive power	Pump loses prime after starting	Insufficient pressure developed	Insufficient capacity delivered	Pump does not deliver liquid	PROBABLE CAUSES	POSSIBLE REMEDIES
	●	●	●	●	●					Shaft bent.	Check shaft runouts are within acceptable values. CONSULT FLOWSERVE.
●	●	●			●					Rotating part rubbing on stationary part internally.	Check and CONSULT FLOWSERVE, if necessary.
●	●	●	●	●						Bearings worn.	Replace bearings.
					●		●	●		Wearing ring surfaces worn.	Replace worn wear ring/surfaces.
		●					●	●		Impeller damaged or eroded.	Replace or CONSULT FLOWSERVE for improved material selection.
				●						Leakage under sleeve due to joint failure.	Replace joint and check for damage.
			●	●						Shaft sleeve worn or scored or running off centre.	Check and renew defective parts.
			●	●	●					Mechanical seal improperly installed.	Check alignment of faces or damaged parts and assembly method used.
			●	●	●					Incorrect type of mechanical seal for operating conditions.	CONSULT FLOWSERVE.
●	●	●	●	●						Shaft running off centre because of worn bearings or misalignment.	Check misalignment and correct if necessary. If alignment satisfactory check bearings for excessive wear.
●	●	●	●	●						Impeller out of balance resulting in vibration.	Check and CONSULT FLOWSERVE.
			●	●	●					Abrasive solids in liquid pumped.	
			●	●						Internal misalignment of parts preventing seal ring and seat from mating properly.	
			●	●						Mechanical seal was run dry.	Check mechanical seal condition and source of dry running and repair.
			●	●						Internal misalignment due to improper repairs causing impeller to rub.	Check method of assembly, possible damage or state of cleanliness during assembly. Remedy or CONSULT FLOWSERVE, if necessary.
●	●	●								Excessive thrust caused by a mechanical failure inside the pump.	Check wear condition of impeller, its clearances and liquid passages.
	●	●								Excessive grease in ball bearings.	Check method of regreasing.
	●	●								Lack of lubrication for bearings.	Check hours run since last change of lubricant, the schedule and its basis.
	●	●								Improper installation of bearings [damage during assembly, incorrect assembly, wrong type of bearing etc].	Check method of assembly, possible damage or state of cleanliness during assembly and type of bearing used. Remedy or CONSULT FLOWSERVE, if necessary.
	●	●								Damaged bearings due to contamination.	Check contamination source and replace damaged bearings.
										C. MOTOR ELECTRICAL PROBLEMS	
		●			●		●	●		Wrong direction of rotation.	Reverse 2 phases at motor terminal box.

FAULT SYMPTOM

Pump overheats and seizes	Bearings have short life	Pump vibrates or is noisy	Mechanical seal has short life	Mechanical seal leaks excessively	Pump requires excessive power	Pump loses prime after starting	Insufficient pressure developed	Insufficient capacity delivered	Pump does not deliver liquid	PROBABLE CAUSES	POSSIBLE REMEDIES
					●			●		Motor running on 2 phases only.	Check supply and fuses.
	●	●						●		Motor running too slow.	Check motor terminal box connections and voltage.

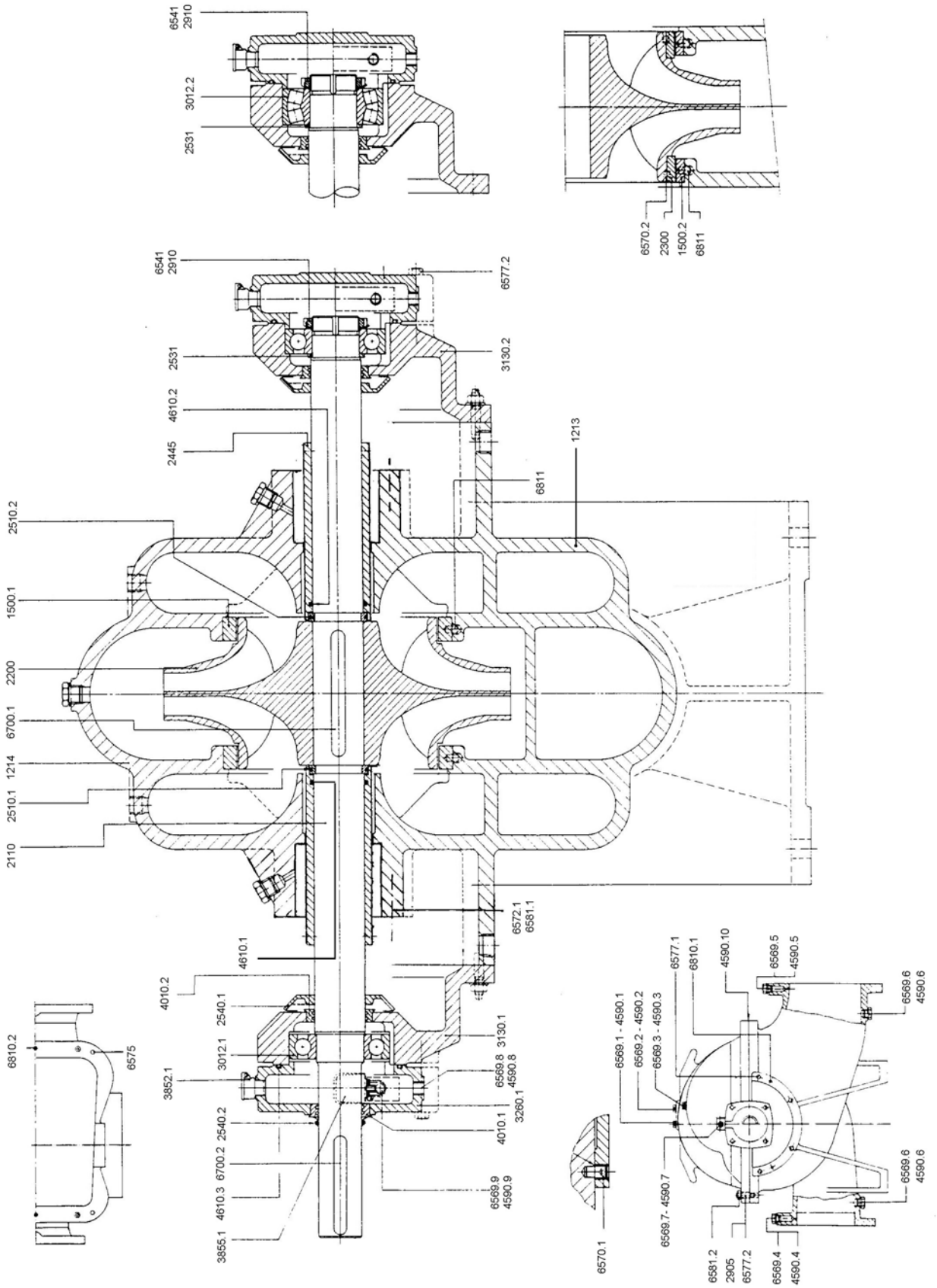
8 PARTS LISTS AND DRAWINGS

8.1 LNGT – grease lubricated, packed gland [single or double volute]



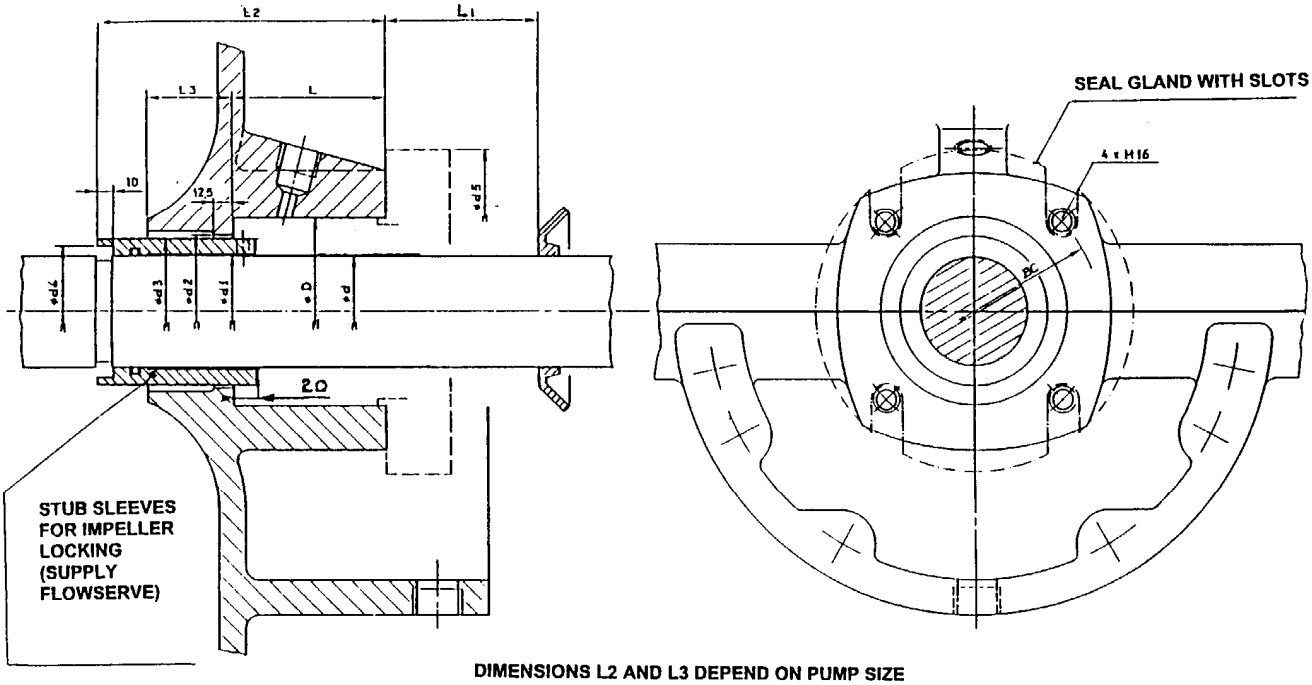
Ref no	Description
1213	Casing half, lower
1214	Casing half, upper
1500	Casing wear ring
2110	Shaft, pump
2200	Impeller
2300	Impeller wear ring
2445	Shaft sleeve
2510	Spacer ring
2531	Retaining ring
2540	Thrower
2905	Washer
2910	Shaft nut
3012	Roller bearing
3130	Bearing bracket
3260	Bearing cover
3853	Grease nipple
4010	Shaft seal
4120	Gland
4130	Gland packing rings
4134	Lantern ring
4330	Labyrinth ring
4590	Gasket
4610	O-ring
6541	Lock washer
6570	Set screw
6572	Stud
6575	Jack screw
6581	Hexagon nut
6569	Screw plug
6700	Key
6810	Taper dowel pin
6811	Cylindrical pin

8.2 LNGT – oil lubricated, packed gland [single or double volute]



Ref no	Description
1213	Casing half, lower
1214	Casing half, upper
1500	Casing wear ring
2110	Shaft, pump
2200	Impeller
2300	Impeller wear ring
2445	Shaft sleeve
2510	Spacer ring
2531	Retaining ring
2540	Thrower
2905	Washer
2910	Shaft nut
3012	Roller bearing
3130	Bearing bracket
3260	Bearing cover
3855	Constant level oiler
3852	Oil fill cup
4010	Shaft seal
4330	Labyrinth ring
4590	Gasket
4610	O-ring
6541	Lock washer
6570	Set screw
6572	Stud
6575	Jack screw
6581	Hexagon nut
6569	Screw plug
6700	Key
6810	Taper dowel pin
6811	Cylindrical pin

8.3 LNGT – Stuffing box



DIMENSIONS L2 AND L3 DEPEND ON PUMP SIZE

Shaft group	Dimensions in mm										
	Shaft d .. g6	Sleeve d .. H7	d1 ± 01	0 d2.-0.1	0 d3.-0.2	+0.1 d4 .. 0	D5	+0.1 D .. 0	L	L1	BC
1	55		55,3	70,8	70	65	175	95	92,5	89	135
2	65		65,3	85,8	85	75	190	110	92,5	99	150
3-3A	80		80,3	100,8	100	90	215	125	92,5	97	170
4A	90		90,3	110,8	110	100	230	135	92,5	97	185
5A	105		105,3	125,8	125	115	240	157	117	95	205

8.4 General Arrangement Drawing

The typical general arrangement drawing and any specific drawings required by the contract will be sent to the Purchaser separately unless the contract specifically calls for these to be included into the User Instructions. If required, copies of other drawings sent separately to the Purchaser should be obtained from the Purchaser and retained with these User Instructions.

9 CERTIFICATION

Certificates determined from the Contract requirements are provided with these instructions where applicable. Examples are certificates for CE marking, ATEX marking etc. If required, copies of other certificates sent separately to the Purchaser should be obtained from the Purchaser for retention with these User Instructions.

10 OTHER RELEVANT DOCUMENTATION AND MANUALS

10.1 Supplementary User Instructions

Supplementary instructions such as for a driver, instrumentation, controller, seals, sealant system etc are provided as separate documents in their original format. If further copies of these are required they should be obtained from the supplier for retention with these User Instructions.

10.2 Change notes

If any changes, agreed with Flowserve Pump Division, are made to the product after its supply, a record of the details should be maintained with these User Instructions.

10.3 Additional sources of information

Reference 1:
NPSH for Rotordynamic Pumps: a reference guide, Europump Guide No. 1, Europump & World Pumps, Elsevier Science, United Kingdom, 1999.

Reference 2:
Pumping Manual, 9th edition, T.C. Dickenson,
Elsevier Advanced Technology, United Kingdom, 1995.

Reference 3:
Pump Handbook, 2nd edition, Igor J. Karassik et al, McGraw-Hill Inc., New York, 1993.

Reference 4:
ANSI/HI 1.1-1.5, Centrifugal Pumps - Nomenclature, Definitions, Application and Operation.

Reference 5:
ANSI B31.3 - Process Piping.

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