



Flowserve Pump Division

I.O.M. Installation, Operation and Maintenance

IDP[®] Pumps
Models CPX, CPXR & CPXN

FRAME MOUNTED
CHEMICAL PROCESS PUMPS

Instruction Manual C937KH013 - 03/02
(incorporating C937KH054)

INTRODUCTION



Flowserve

Flowserve's products and brands are the leading names in their fields: the CPX range of process pumps specifically focus on demanding chemical process applications. The pumps are manufactured at modern facilities, utilising state of art equipment and sophisticated quality control techniques. Flowserve is proud of earning preferred supplier status to many of world's leading processing companies. Engineered, manufactured, sold and serviced to ISO 9001 quality certification, Flowserve pumps are truly world class products.

With more than 120 years of experience in servicing the needs of world-wide process industries, Flowserve has become the unchallenged leader in hydraulic design engineering, materials expertise and application know-how. Committed to continuous quality improvement, Flowserve controls the complete product life cycle - from application engineering, design, melting and casting, to cellular manufacturing, to assembly and testing, to the supply of aftermarket products, repair and diagnostic services.

Flowserve is on hand to provide technical support and special services specific to the needs of its customers.

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CE Mark System

It is a legal requirement that machinery and equipment put into service within the European Union shall conform with the applicable European Union Directives covering Machinery, Low Voltage Equipment and EMC.

Where applicable the European Union Directives cover important Safety aspects relating to machinery and equipment and the satisfactory provision of technical documents and safety instructions. This document incorporates information relevant to these Directives. *The Manual should be read prior to installing, operating, using and maintaining the equipment. The equipment must not be put into service until all the conditions relating to safety noted in the Manual have been met.*

Disclaimer








Flowserve manufactures products to exacting International Quality Management System Standards (ISO 9001) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories have been designed, tested and incorporated into the products to 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 authorised Flowserve parts and accessories is considered to be misuse. Damage or failure caused by misuse is not covered by Flowserve's warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in their use.

1 NAMEPLATE & WARNING LABELS

1.1 Nameplate

For details of nameplate, see the Declaration of conformity.


1.2 Warning labels

FLOWSERVE		WARNING	J218JZ250
ESSENTIAL PROCEDURES BEFORE STARTING:			
	INSTALL AND OPERATE EQUIPMENT IN ACCORDANCE WITH THE INSTRUCTION MANUAL SUPPLIED SEPARATELY.		ENSURE ALL EXTERNAL CONNECTIONS TO THE PUMP / SHAFT SEALING AND DRIVER ARE CONNECTED AND OPERATIONAL.
	ENSURE GUARDS ARE SECURELY IN PLACE.		FULLY PRIME UNIT AND SYSTEM. DO NOT RUN UNIT DRY.
	ENSURE CORRECT DIRECTION OF ROTATION.		FAILURE TO FOLLOW THESE PROCEDURES MAY RESULT IN PERSONAL INJURY AND / OR EQUIPMENT DAMAGE
			

		J218JZ265	
	ENSURE CORRECT DRIVER DIRECTION OF ROTATION WITH COUPLING ELEMENT / PINS REMOVED: OTHERWISE SERIOUS DAMAGE MAY RESULT.	KONTROLLE VORGESCHRIEBENER DREHRICHTUNG ! HIERZU KUPPLUNGSZWISCHENSTÜCK / KUPPLUNGSBOLZEN ENTFERNEN. ANDERENFALLS ERNSTHAFTE SCHÄDEN !	
	VERIFIER LE SENS CORRECT DE ROTATION DU MOTEUR. <u>POMPE DESACCOUPLEE / ENTRETOISE DEMONTEE. NE PAS SUIVRE CETTE RECOMMANDATION PEUT CONDUIRE A DE GRAVES DOMMAGES POUR LA POMPE</u>	ZORG VOOR JUISTE ROTATIERICHTING VAN DRIJFAS WAARBIJ DE KOPPELELEMENTEN / PENNEN VERWIJDERD ZIJN: VERZUM KAN ERNSTIGE SCHADE TOT GEVOLG HEBBEN.	
CDC: 603 604 610 612 621 623 624			

		J218/268	
ENSURE UNIT ON A FIRM FOUNDATION AND THAT COUPLING FACES ARE IN CORRECT ALIGNMENT PRIOR TO AND AFTER BOLTING BASEPLATE DOWN AND FIXING PIPEWORK. SEE MANUAL FOR TOLERANCES.		PUMP MUSS AUF FESTEM FUNDAMENT STEHEN. KUPPLUNGSHÄLFTEN <u>KORREKT AXIAL AUSRICHTEN</u> . DANN PUMPE AUF GRUNDPLATTE FESTSPANNEN UND ANSSCHLUSSLEITUNGEN BEFESTIGEN. TOLERANZEN S. BEDIEUNGSANLEITUNG.	
	S'ASSURER QUE LE GROUPE ELECTROPOMPE EST FERMEMENT INSTALLE SUR SON MASSIF. VERIFIER LE LIGNAGE DE L'ACCOUPEMENT <u>AVANT ET APRES FIXATION DU SOCLE ET DE LA TUYAUTERIE. VOIR LES TOLERANCES D'ALIGNMENT SUR LA NOTICE</u>	ZORG DAT POMPEENHEID OP EEN STEVIGE ONDERGROND OPGESTELD STAAT EN DAT KOPPELING CORRECT UITGELIJNT IS ZOWEL VOOR-ALS NADAT DE GRONDPLAAT MET BOUTEN IS VASTGEZET EN DE LEIDINGEN GEINSTALLEERD ZIJN. ZIE HANDLEIDING VOOR TOELAABARE SPELINGEN.	
CDC: 603 604 610 612 621 623 624			

Oil lubricated units only

		J218JZ262	
	WARNING	THIS MACHINE MUST BE FILLED WITH OIL BEFORE STARTING	
	ATTENTION	CETTE MACHINE DOIT ÊTRE REMPLIE D'HUILE AVANT LA MISE EN MARCHÉ	
	ACHTUNG	DIESE MASCHINE IST VOR DEM STARTEN MIT ÖL ZÜ FULLEN	
	WAARSCHUWING	DEZE MACHINE MOET VOOR HET STARTEN MET OLIE GEVULD WORDEN	
CDC: 603 604 610 612 621 623 624			

2 SAFETY

2.1 Duty conditions

2.1.1 This pump has been selected to meet the duty and service conditions advised on your order. The acknowledgement of these conditions has been sent separately to the Purchaser. A copy should be kept with this manual.

2.1.2 If there is any doubt as to the suitability of the pump for the application intended, contact Flowserve for advice, quoting the pump serial number.

2.2 Safety action

Always co-ordinate repair activity with operations personnel, and follow all plant safety requirements and applicable safety and health laws/regulations.

THIS IS A SUMMARY OF CONDITIONS AND ACTIONS TO PREVENT INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT.


ATTENTION This sign indicates safety instructions where non-compliance would affect personal safety.




This symbol indicates electrical safety instructions where non-compliance would affect personal safety.



This symbol indicates safety instructions where non-compliance would affect the safe operation or protection of the pump or pump unit.

2.2.1  PREVENT EXCESSIVE EXTERNAL PIPE LOAD


Do not use pump as a support for piping. Do not mount expansion joints so that their force, due to internal pressure, acts on the pump flange.


2.2.2  ONLY CHECK DIRECTION OF MOTOR ROTATION WITH COUPLING ELEMENT/PINS REMOVED


Starting in reverse direction of rotation will damage the pump.

2.2.3  START THE PUMP WITH OUTLET VALVE CLOSED


This is recommended to avoid the risk of overloading and damaging the pump motor at full flow. Pumps may be started with the valve open only on installations where this situation cannot occur.


2.2.4  ENSURE CORRECT LUBRICATION (See: *Making ready for operation - Lubrication.*)

2.2.5  NEVER RUN THE PUMP DRY

2.2.6  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 the shaft, packing or mechanical seal to run hot and fail within a short time.

2.2.7  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.

2.2.8  NEVER DO MAINTENANCE WORK WHILST THE UNIT IS CONNECTED TO POWER

2.2.9 **ATTENTION** NEVER APPLY HEAT TO REMOVE IMPELLER
Trapped lubricant or vapour could cause an explosion.

2.2.10 **ATTENTION** 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 30kg (66lbs) use a crane corresponding to the mass and in accordance with current local regulations.

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

2.2.12 **ATTENTION** FLUORO-ELASTOMERS (When fitted to high temperature units).
When a pump has experienced temperatures over 250°C(482°F), partial decomposition of fluoro-elastomers (eg viton) will occur. In this condition these are extremely dangerous and skin contact must be avoided.

2.2.13 **ATTENTION** 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. Thermal shock should be avoided, particularly so where the material of the pump is not resistant to such loading.

2.2.14 **ATTENTION** HOT (and cold) PARTS
If hot or freezing components or auxiliary heating supplies can present a danger to operators, they must be shielded to avoid accidental contact. If complete protection is not possible, machine access must be limited to maintenance staff only. Note: drive motors and bearings may be hot.

IF THE TEMPERATURE IS GREATER THAN 80°C (175°F) OR BELOW 5°C (20°F), A VISUAL WARNING INDICATOR SUCH AS A WARNING PLATE MUST BE PLACED CLEARLY ON THE EQUIPMENT.

2.2.15 **ATTENTION** HAZARDOUS LIQUIDS
When the pump is handling hazardous liquids care must be taken to avoid liquid contact using the appropriate health and safety procedures. Pump location and personnel access/training should consider and address these site dangers.

2.3 Potentially explosive atmospheres

Always check that the driver, drive coupling assembly and pump equipment are suitably rated and/or certified for the classification of the specific atmosphere in which they are to be installed. See section 17, *Certification*.

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4 PUMP TECHNICAL DATA

4.1 Performance

For performance parameters see the paragraph on *Safety - Duty conditions*. When specified by the contract, performance data has been supplied separately to the purchaser and should be obtained and retained with this manual if required.

4.2 Noise level

When pump noise level exceeds 85dBA 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 85dBA.

Pump noise level is dependent on a number of factors - the type of motor fitted, the operating capacity, pipework design and acoustic characteristics of the building.

The levels specified in the table below are estimated and not guaranteed.

The dBA values are based on the noisiest ungeared electric motors that are likely to be encountered. They are Sound Pressure levels at 1m (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. Consult a Noise Specialist for this calculation.

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

4.3 Pressure limits

4.3.1 The operating pressure has been selected to meet your specified requirements. See the paragraph on *Safety - Duty conditions* for details.

4.3.2 The pressure and temperature operating limits for the flanges are in accordance with the relevant National or International standards unless advised otherwise.

4.3.3 Heating/cooling jackets are designed for operation up to 6.0 bar (87psi).

4.4 Recommended screw torques

Screw position	Screw size	Torque Nm (lbf ft)
Casing and seal cover	M8	16 (12)
	M10	25 (18)
	M12	35 (26)
	M16	80 (59)
	M20	130 (96)

4.5 Flange loads

The permissible flange loading is dependent on a number of factors such as dimensions, flange rating, pressure, temperature, material, pump configuration, etc. The recommendations contained in the section on pipework connections should be followed to eliminate these loads.

When requested the permissible flange loading will have been supplied separately to the purchaser and should be obtained and retained with this manual.

If in doubt contact Flowserve for information.

Motor size		3550 rpm		2900 rpm		1750 rpm		1450 rpm	
		Pump & motor dBA	Pump only dBA	Pump & motor dBA	Pump only dBA	Pump & motor dBA	Pump only dBA	Pump & motor dBA	Pump only dBA
kW	(hp)								
<0.55	(<0.75)	71	66	64	62	64	62	63	62
0.75	(1)	74	66	67	62	67	62	63	62
1.1	(1.5)	74	68	67	64	67	64	65	64
1.5	(2)	77	70	70	66	70	66	66	66
2.2	(3)	78	72	71	68	71	68	68	68
3	(4)	81	74	74	70	74	74	70	70
4	(5)	82	75	75	71	75	75	71	71
5.5	(7.5)	90	77	83	73	76	75	72	71
7.5	(10)	90	78	83	74	77	76	73	72
11	(15)	91	80	84	76	78	77	74	73
15	(20)	92	83	85	79	80	79	76	75
18.5	(25)	92	83	85	79	80	79	76	75
22	(30)	92	83	85	79	81	79	77	75
30	(40)	100	85	93	81	84	80	80	76
37	(50)	100	86	93	82	84	80	80	76
45	(60)	100	87	93	83	84	80	80	76
55	(75)	102	88	95	84	86	81	82	77
75	(100)	100	90	95	86	88	81	83	78
90	(120)	97	90	92	86	90	81	85	78
110	(150)	100	91	95	87	91	83	86	79
150	(200)	101	92	96	88	91	83	86	79

4.6 Pump lubricants

4.6.1 Recommended oil lubricants

Centrifugal pump lubrication	Oil	Splash lubrication		Force feed lubrication
	Viscosity mm ² /s 40°C	32	68	46
	Temp. maximum °C (°F)	65 (149)	80 (176)	-
	Designation according to DIN51502 ISO VG	HL/HLP 32	HL/HLP 68	HL/HLP 46
Oil companies and lubricants	BP	BP Energol HL32 BP Energol HLP32	BP Energol HL68 BP Energol HLP68	BP Energol HL46 BP Energol HLP46
	DEA	Anstron HL32 Anstron HLP32	Anstron HL68 Anstron HLP68	Anstron HL46 Anstron HLP46
	Elf	OLNA 32 HYDRELEF 32 TURBELF 32 ELFOLNA DS32	TURBELF SA68 ELFOLNA DS68	TURBELF SA46 ELFOLNA DS46
	Esso	TERESSO 32 NUTO H32	TERESSO 68 NUTO H68	TERESSO 46 NUTO H46
	Mobil	Mobil DTE oil light Mobil DTE13 MobilDTE24	Mobil DTE oil heavy medium Mobil DTE26	Mobil DTE oil medium Mobil DTE15M Mobil DTE25
	Q8	Q8 Verdi 32 Q8 Haydn 32	Q8 Verdi 68 Q8 Haydn 68	Q8 Verdi 46 Q8 Haydn 46
	Shell	Shell Tellus 32 Shell Tellus 37	Shell Tellus 01 C 68 Shell Tellus 01 68	Shell Tellus 01 C 46 Shell Tellus 01 46
	Texaco	Rando Oil HD 32 Rando Oil HD-AZ-32	Rando Oil 68 Rando Oil HD C-68	Rando Oil 46 Rando Oil HD B-46
	Wintershall (BASF Group)	Wiolan HN32 Wiolan HS32	Wiolan HN68 Wiolan HS68	Wiolan HN46 Wiolan HS46

4.6.2 Bearing sizes and oil capacities

Frame size	Medium duty bearings		Heavy duty bearings		Optional oil bearings		Oil capacity (approx.)
	Pump end	Drive end	Pump end	Drive end	Pump end	Drive end	
	Ball bearing	Duplex back-to-back AC	Roller bearing	Duplex back-to-back AC	Roller bearing	Duplex back-to-back AC	
1	6207 C3	3306 C3	NUP 207 C3	7306	NUP 207 C3	7306	0.5 litres
2	6309 C3	3309 C3	NUP 309 C3	7309	NUP 309 C3	7309	1.2 litres
3	6311 C3	3311 C3	NUP 311 C3	7311	NUP 311 C3	7311	1.2 litres
4	6313 C3	3313 C3	NUP 313 C3	7313	NUP 313 C3	7313	1.5 litres

Note: The bearing sizes do not constitute a purchasing specification.

4.6.3 Recommended grease lubricants

Grease	Grease nipples	
	NLGI 2 *	NLGI 3 **
Temp. range °C (°F)	-20 to +100 (-4 to +212)	-20 to +100 (-4 to +212)
Designation according to DIN	K2K-20	K2K 30
BP	Energrease LS2	Energrease LS3
DEA	Glissando 20	Glissando 30
Elf	Elfmulti 2	Elfmulti 3
Esso	Beacon 2	Beacon 3
Mobil	Mobilux 2	Mobilux 3
Q8	Rembrandt 2	Rembrandt 3
Shell	Alvania Fett G2 Alvania Fett R2	Alvania R3
Texaco	Multilak 20 Multilak EP2	Multilak 30 Multilak EP3
Wintershall (BASF Group)	Wiolub LFK 2	-
SKF	LGMT 2	LGMT 3
Silkolene	G55/T	G56/T

* NLGI 2 is an alternative grease and is not to be mixed with other grades

** Factory packed bearings for the temperature range with grease nipples

4.6.4 Grease lubricated bearing capacities

Frame size	Pump end	Drive end
	Ball/roller bearing	Duplex back-to-back AC
1	45 cm ³	75 cm ³
2	105 cm ³	150 cm ³
3	150 cm ³	300 cm ³
4	240 cm ³	450 cm ³

5 PRODUCT DESCRIPTION

5.1 General

The pump is a modular designed centrifugal pump that can be built to achieve almost all chemical liquid pumping requirements.

5.2 Pump casing

- The pump casing is designed with a horizontal centreline end inlet and a vertical centreline top outlet which makes it self venting.
- For ease of maintenance, the pump is constructed so that pipe connectors do not have to be disturbed when internal maintenance is required.

5.3 Impeller

An open impeller is fitted. (On the CPXR the impeller is recessed into the back of the casing.)

5.4 Shaft

The large diameter stiff shaft, mounted on bearings, has a keyed drive end.

5.5 Bearing housing

The bearing housing enables adjustment of impeller face clearance via the bearing carrier jacking screws.

5.6 Pump bearings and lubrication

The pump is fitted with ball and/or roller type bearings which may be configured differently dependent on use. The bearings may be oil or grease lubricated.

5.7 Seal housing

- The seal housing has spigots between the pump casing and bearing housing for optimum concentricity.
- A fully confined gasket forms the seal between the pump casing and the seal housing.
- The seal housings designs provide improved performance of mechanical seals.
- The design enables one of a number of sealing options to be fitted.

5.8 Shaft seal

The mechanical seal(s) attached to the drive shaft seals the pumped liquid from the environment. Gland packing may be fitted as an option.

5.9 Driver

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

5.10 Accessories

- Accessories may be fitted when specified by the customer.
- Fan cooling is available for high temperature operation. This is a fan fitted within the coupling guard to blow cooling air over the bearing housing and shaft.

6 STORAGE

- 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.
- Warranty for the pumps will normally be for 12 months. Extension of this period can only be achieved with the prior agreement of Flowserve and would necessitate inspection prior to putting the pump into service.

7 INSTALLATION

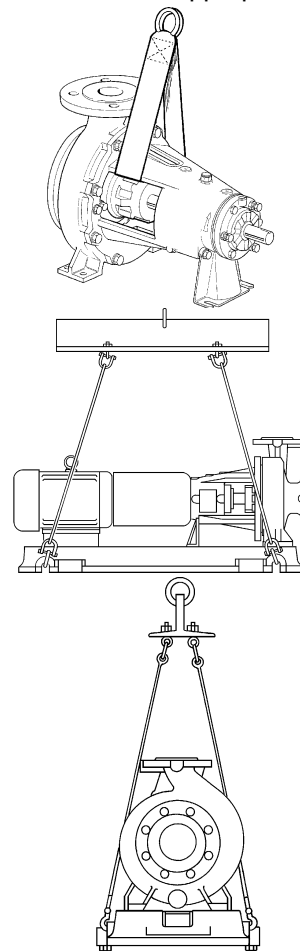
7.1 Unpacking and inspection

The pump should be checked against the delivery advice note and any damage or shortage reported immediately to Flowserve. Any crate, carton or wrappings should be checked for any spare parts or accessories that may be packed with the pump.

7.2 Handling

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

7.2.2 The pump and cast iron baseplate set should be handled as shown in the appropriate diagram.



7.2.3 Where the baseplate is folded steel there are no specific lifting points provided for this complete machine set (unless so identified). Any lifting points that can be seen are provided only for dismantling parts for servicing. Slings, ropes and other lifting gear should be positioned where they cannot slip and where a balanced lift is obtained.

7.3 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.

7.4 Foundation

7.4.1 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.

7.4.2 The baseplate should be mounted onto a firm foundation, either an appropriate thickness of quality concrete or sturdy steel framework. It should NOT be distorted or pulled down onto the surface of the foundation, but should be supported to maintain the original alignment.

7.4.3 Install the baseplate onto packing pieces evenly spaced and adjacent to foundation bolts. Level with shims between baseplate and packing pieces. The pump and driver are aligned before dispatch. Check alignment of pump and motor half coupling. If this is incorrect, it indicates that the baseplate has become twisted and should be corrected by re-shimming.

7.5 Grouting

7.5.1 Where applicable, grout in the foundation bolts.

7.5.2 After adding pipework connections and rechecking the coupling alignment, the baseplate should then be grouted in accordance with good engineering practice. Fabricated steel, cast iron and epoxy baseplates can be filled with grout. Folded steel baseplates should be grouted to locate their packing pieces. If in any doubt, please contact your nearest service centre for advice.

7.5.3 Grouting provides solid contact between the pump unit and foundation, prevents lateral movement of vibrating equipment and dampens resonant vibrations.

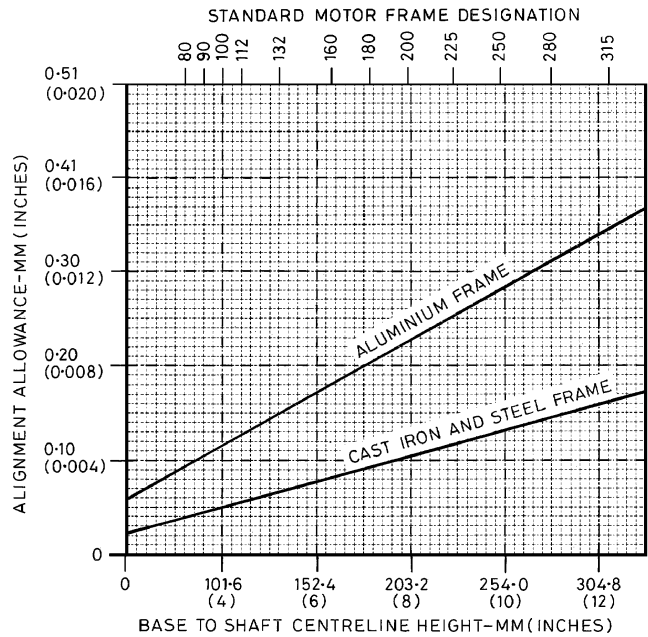
7.6 Alignment of couplings

7.6.1 Thermal expansion

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.

Motor and pump centre line height adjustment:



Graph based on the assumptions that:

- a) Operating temperature rise of the motor frame is 50°C
- b) Packing piece/motor stool is not affected

Operation

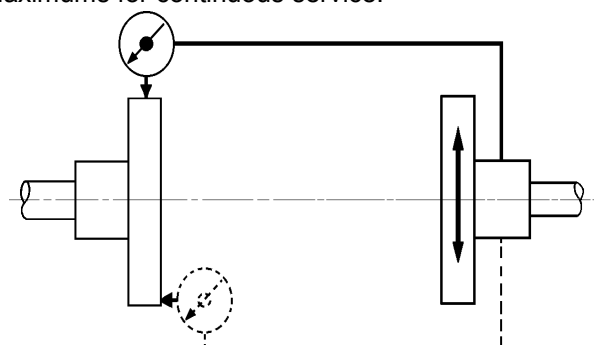
- 1 Enter graph at base to shaft centre line height
- 2 Read line for frame material
- 3 Set motor shaft and coupling LOW by figure on left-hand side

7.6.2 Alignment methods

7.6.2.1 Ensure the pump and motor half couplings are disconnected.

7.6.2.2 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. Align the motor to the pump, not the pump to the motor. Alignment is achieved by adding or removing shims from 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.

7.6.2.3 For couplings with narrow flanges, use a dial indicator gauge as shown. The alignment values are maximums for continuous service.




Permissible misalignment limits at working temperature:

- *Parallel alignment* - 0.25mm (0.010") TIR max.
- *Angular alignment*
 - 0.3mm (0.012") TIR maximum for couplings not exceeding 100mm (4") flange diameter
 - 0.5mm (0.020") TIR maximum for couplings over 100mm (4") diameter


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

7.7 Electrical connections

7.7.1  Electrical connections should be made by a qualified Electrician in accordance with the relevant local national and international regulations.

7.7.2 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.

7.7.3  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.

7.7.4 **ATTENTION** A device to provide emergency stopping shall be fitted.

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

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

7.7.7  **WARNING:** See paragraphs on 'direction of rotation' before connecting the motor to the electrical supply.

7.8 Pipework connections

7.8.1 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.

7.8.2 Maximum forces and moments allowed on the pump flanges vary with the pump size and type. To minimise these forces and moments which may 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.

7.8.3 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. On suction lift the piping should be inclined up towards the pump inlet with eccentric reducers incorporated to prevent air locks. On positive suction, the inlet piping must have a constant fall towards the pump.

7.8.4 Allow a minimum of two pipe diameters of straight section between the elbow and inlet flange. Inlet strainers, when used, should have a net 'free area' of at least three times the inlet pipe area.

7.8.5 Fitting an isolator and non-return valves can allow easier maintenance. Never throttle pump on suction side and never place a valve directly on the pump inlet nozzle.

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

7.8.7 Piping and fittings should be flushed before use.

7.8.8 Piping for corrosive liquids should be arranged to allow pump flushing before removal of a unit.

7.9 Final piping 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 there is no pipe strain. If pipe strain exists, correct piping.

7.10 Auxiliary piping

7.10.1 The connections which are to be piped up will have been fitted with protective metal or plastic plugs which will need to be removed.

7.10.2 *Pumps fitted with packed glands*
When suction pressure is below ambient pressure and differential head is less than 10 metres, it may be necessary to feed gland packing with liquid to provide lubrication and prevent the ingress of air.

7.10.3 *Pumps fitted with mechanical seals*

7.10.3.1 The conical design of the single internal seal housing provides excellent liquid circulation around the seal and will not normally require a separate flush.

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

7.10.3.3 Flowserve seal connections are designated as follows:

- Q - quench
- F - flush
- D - drain outlet
- BI - barrier fluid in (double seals)
- BO - barrier fluid out (double seals)
- H - heating jacket
- C - cooling jacket

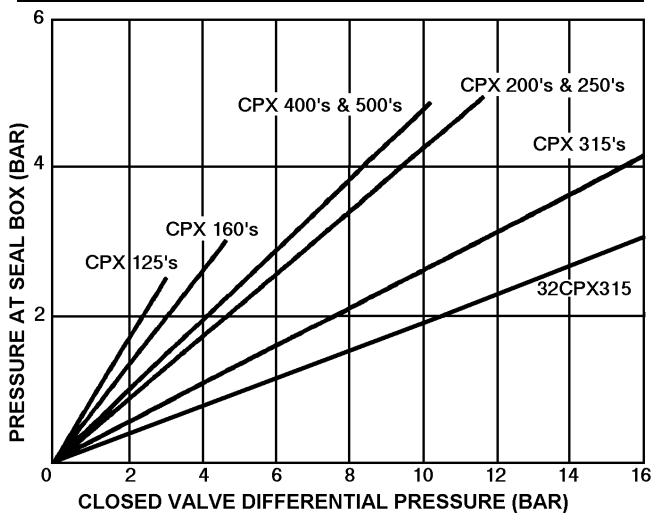
7.10.3.4 Seal housings/covers having an auxiliary quench connection, require connection to a suitable source of liquid flow, low pressure steam or static pressure from a header tank. Recommended pressure is 0.35 bar (5psi) or less.

7.10.3.5 Double seals require a barrier liquid between the seals, compatible with the pumped liquid.

7.10.3.6 With back-to-back double seals, the barrier liquid should be at a minimum pressure of 1 bar above the maximum pressure on the pump side of the inner seal. The barrier liquid pressure must not exceed limitations of the seal on the atmospheric side. For toxic service the barrier liquid supply and discharge must be in a safe area.

7.10.3.7 Seal chamber pressure v generated head:

MECHANICAL SEAL	Use seal manufacturer's limits or ask seal manufacturer to verify seal pressure
GLAND PACKING	Maximum stuffing box pressure = 5 Bar (3500rpm), 7 Bar (2900rpm) and 10 Bar (1450 & 1750rpm)



NOTES:

- a) Total seal pressure is equal to pressure at seal plus suction pressure.
- b) For pumped liquid viscosities greater than 440 Centistokes multiply the generated pressure by 1.25 for 125, 160 and 200 size pumps and by 2.0 for larger sizes.
- c) Differential pressure in bar equals head in metres multiplied by specific gravity all divided by 10.19.

7.10.3.8 Special seals may require modification to auxiliary piping described above. Consult Flowserve if unsure of correct method or arrangement.

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


7.10.3.10 Tandem seals require a barrier liquid between the seals compatible with the pumped liquid.

7.10.4 *Pumps fitted with heating/cooling jackets*
Connect the heating/cooling pipes from the site supply. The top connection should be used as the outlet to ensure complete filling/venting of the annulus.

8 MAKING READY FOR OPERATION

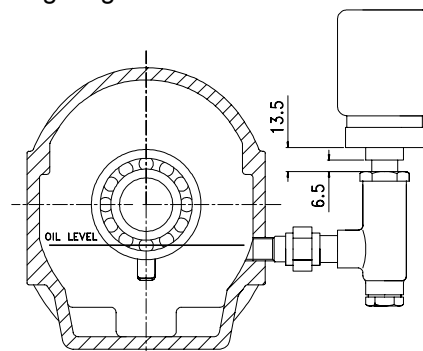
8.1 Lubrication

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

8.1.2  For oil lubricated pumps, fill the bearing housing with correct grade of oil to the correct level, ie sight glass or constant level oiler bottle.



8.1.2.1 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. Where an adjustable body Denco oiler is fitted this should be set to the height shown in the following diagram.




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


8.1.3 To fill the bearing housing with oil, unscrew the oil filler/breather and fill through the orifice.


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

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

8.2 Direction of rotation

8.2.1  Serious damage can result if the pump is started or run in the wrong direction of rotation.

8.2.2  The pump is shipped with the coupling element removed. Ensure the direction of rotation of the motor is correct before fitting the coupling element. Direction of rotation must correspond to the direction arrow.

8.2.3  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.

8.3 ATTENTION Guarding

Guarding is supplied fitted to the pump set. If this has been removed or disturbed ensure that all the protective guards are securely refitted.


8.4 Open impeller clearance

The impeller clearance is set in the factory. This may require adjustment because of piping attachment or increase in temperatures. For setting instructions refer to the Preventative Maintenance and Servicing section of this book.

8.5 Primary and auxiliary supplies

Ensure all electrical, hydraulic, pneumatic, sealant and lubrication systems (as applicable) are connected and operational.


8.6 Filling and priming

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

8.6.2 Priming may be carried out with an ejector, vacuum pump interceptor or other equipment, or by flooding from the inlet source.

8.6.3 When in service, pumps using inlet pipes with foot valves may be primed by passing liquid back from the outlet pipe through the pump.

9 STARTING THE PUMP

9.1  Ensure flushing and/or cooling/heating liquid supplies are turned ON, before starting pump.


9.2 CLOSE the outlet valve.

9.3 OPEN all inlet valves.

9.4 Prime the pump.

9.5 Start motor and check the outlet pressure.

9.6 If the pressure is satisfactory, slowly OPEN the outlet valve.

9.7  Do not run the pump with the outlet valve closed for a period longer than 30 seconds.

9.8 If NO pressure, or LOW pressure, STOP the pump. Refer to Operating Difficulties chart for fault diagnosis.

10 RUNNING

10.1 Pumps fitted with packed glands

10.1.1 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 pressurised. 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 it should be checked to ensure leakage is taking place at the packed gland.


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

10.1.3 The pump should be run for ten minutes with steady leakage and the gland nuts tightened by 10 degrees at a time until leakage is reduced to an acceptable level, normally 30 to 120 drops per minute. Bedding in of the packing may take another 15 minutes.

10.2 Pumps fitted with mechanical seals

10.2.1 Mechanical seals require no adjustment. Any slight initial leakage will stop when the seal is run in. Seals will always leak in operation.

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

10.2.3  For external flush or quench, this should be started before the pump is run and allowed to flow for a period after the pump has stopped.

10.3 Stop/start frequency

Generally 6 stop/starts per hour may be satisfactory. Refer frequent stop/starting to the motor manufacturer.


STANDBY PUMPS SHOULD BE RUN ALTERNATELY.

11 STOPPING AND SHUTDOWN

11.1 Close the outlet valve, but ensure that the pump runs in this condition for no more than a few seconds.

11.2 Stop the pump.

11.3 Switch off flushing and/or cooling/heating liquid supplies at a time appropriate to the process.

11.4  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.

12 PREVENTATIVE MAINTENANCE AND SERVICING

12.1 Maintenance schedule

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.

12.2 Routine inspection (daily/weekly)

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

- Check operating behaviour; ensure noise, vibration and bearing temperatures are normal.
- 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.
- Check that shaft seal leaks are within acceptable limits.
- Check the level and condition of oil lubricant. On grease lubricated pumps, check running hours since last recharge of grease or complete grease change.
- Check any auxiliary supplies eg heating/cooling (if fitted) are functioning correctly.
- Refer to the manuals of any associated equipment for routine checks needed.

12.3 Periodic inspection (6 monthly)

- Check foundation bolts for security of attachment and corrosion.
- Check pump running records for hourly usage to determine if bearing lubricant requires changing.
- The coupling should be checked for correct alignment and worn driving elements.
- Refer to the manuals of any associated equipment for periodic checks needed.

12.4 Lubrication data


12.4.1 Oil lubricated bearings

- Normal oil change intervals are 4000 operating hours. 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 optimising lubricant change intervals.
- The lubricating oil should be a high quality oil having oxidation and foam inhibitors, or synthetic oil.
- The bearing temperature may be allowed to rise to 50°C above ambient, but should not exceed 82°C (API 610 limit). A continuously rising temperature, or an abrupt rise, indicate a fault.

- Pumps which handle high temperature liquids may require their bearings to be cooled to prevent bearing temperatures exceeding their limits.

12.4.2 Grease lubricated bearings

- When grease nipples are fitted, one charge between grease changes is advisable for most operating conditions; ie 2000 hours interval.
- Normal intervals between grease changes are 4000 hours. The characteristics of the installation and severity of service will determine the frequency of lubrication. Lubricant and bearing temperature analysis can be useful in optimising lubricant change intervals.
- 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°C.

 **WARNING:** Never mix greases containing different bases, thickeners or additives.

12.5 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 pressurised flush to the centre of the packing. If not required, this can be replaced by an extra 2 rings of packing.

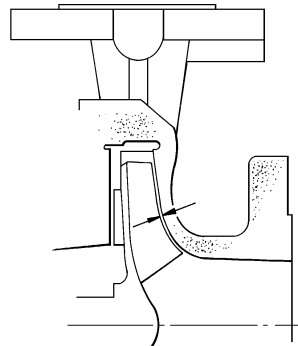
12.6 Mechanical seals

When leakage becomes unacceptable the seal will need replacement.

12.7 Setting CPX & CPXN impeller front clearance

This procedure may be required after the pump has been dismantled or a different clearance is required.

- Before carrying out this procedure ensure that the mechanical seal(s) fitted can tolerate a change in their axial setting, otherwise it will be necessary to dismantle the unit and reset the seal axial position after adjusting the impeller clearance.

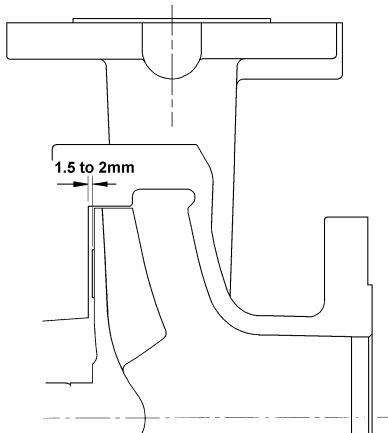


Temp (°C)	Clearance (mm)			
	Impellers up to 210mm	Impellers 211 to 260mm	Impellers over 260mm (except *)	(*)150CPX400 (*)200CPX400 (*)150CPX500
50	0.3	0.4	0.5	1.0
100	0.4	0.5	0.6	1.0
150	0.5	0.6	0.7	1.1
200	0.6	0.7	0.8	1.2
250	0.7	0.8	0.9	1.3

- Disconnect the coupling if it has limited axial flexibility.
- Record the gap between the bearing carrier and bearing housing using feeler gauges.
- Loosen the bearing carrier nuts and screws and back off the bearing carrier jacking screws by 2mm.
- Tighten the bearing carrier screws evenly, drawing the bearing carrier towards the bearing housing, until the impeller contacts the pump casing. Turn the shaft, during this procedure, until a detectable rub is obtained. This is the zero clearance position.
- Set a dial indicator to zero on the shaft end or measure the bearing carrier to bearing housing gap and record the measurement.
- Slacken the bearing carrier screws.
- Tighten jacking screws evenly (about one flat at a time) until the dial indicator or feeler gauge shows the correct impeller clearance from the zero clearance position. This clearance should be between 0.3 and 2mm depending on the nature of the pumped fluid.
- Evenly tighten the bearing housing screws keeping the dial indicator or feeler gauges reading the correct setting. Then tighten the hex nuts to lock the jacking screws in position.
- Compare the original and final gaps between the bearing carrier and housing to check if the movement of the shaft has exceeded the seal capability (over/under compression of seal). Re-position the seal to correct this.
- Check that the shaft can turn freely without binding.
- If a cartridge seal is fitted it should be reset at this point.
- Ensure the coupling distance between shaft ends (DBSE) is correct. Reset/re-align if necessary.

12.8 Setting CPXR impeller clearance

- The shaft position should be set to dimension 'Z' in the table shown in the section '*Bearing housing and rotating element assembly*', after which the impeller back clearance will be a nominal 1.5 to 2mm as illustrated.



- The impeller does not have a fine front clearance setting and adjustment of the impeller is not normally required.


- If the back clearance is altered, ensure that the mechanical seal(s) fitted can tolerate a change in their axial setting, otherwise it will be necessary to dismantle the unit and reset the seal axial position after adjusting the impeller clearance.
- Disconnect the coupling if it has limited axial flexibility.
- Record the gap between the bearing carrier and bearing housing using feeler gauges.
- Loosen the bearing carrier nuts and screws and back off the bearing carrier jacking screws by 2mm.
- Tighten jacking screws evenly (about one flat at a time) until the feeler gauge shows the correct impeller clearance.
- Evenly tighten the bearing housing screws keeping the feeler gauges reading the correct setting. Tighten the hex nuts to lock the jacking screws in position.
- Compare the original and final gaps between the bearing carrier and housing to check if the movement of the shaft has exceeded the seal capability (over/under compression of seal). Re-position the seal to correct this.
- Check that the shaft can turn freely without binding.
- If a cartridge seal is fitted it should be reset at this point.
- Ensure the coupling distance between shaft ends (DBSE) is correct. Reset/re-align if necessary.

13 DISMANTLING AND ASSEMBLY

13.1 Dismantling

13.1.1 **WARNING:**

Refer to safety section before dismantling the pump.

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

13.1.3 *Bearing housing assembly*

To remove, proceed as follows:

- Disconnect all auxiliary pipes and tubes where applicable.
- Remove coupling guard and disconnect coupling.
- If oil lubricated frame, drain oil by removing drain plug.
- Record the gap between the bearing carrier and bearing housing so that this setting can be used during workshop assembly.
- Place hoist sling through bearing housing window.
- Remove casing screws and support foot to baseplate screws.
- Remove bearing housing assembly from pump casing.
- The two threaded holes in the bearing housing flange can be used for jacking screws to assist with removal.
- Remove pump casing gasket and discard. A replacement gasket will be required for assembly.
- Clean gasket mating surfaces.

13.1.4 Impeller removal

ATTENTION

NEVER APPLY HEAT TO REMOVE THE IMPELLER. TRAPPED OIL OR LUBRICANT MAY CAUSE AN EXPLOSION

- Fit a chain wrench or bolt a bar to the holes in the coupling half, or fit a keyed shaft wrench directly to the shaft.
- Using gloved hands, raise the wrench above the work bench by turning the impeller clockwise as viewed from the impeller end of the shaft.
- Give the impeller a quick turn counter-clockwise to strike the wrench handle against the work bench surface or a wooden block. This will free the impeller from the shaft.
- The loosened impeller has an O-ring that should be discarded. Use a new O-ring for assembly.

13.1.5 Seal housing and seal

The seal manufacturer's instructions should be followed for dismantling and assembly, but the following guidance should assist with most seal types:

- Remove shaft guard (if fitted).
- Remove the seal cover nuts, if a separate seal cover is fitted, and slide the seal cover away.
- Remove the seal housing screws.
- Loosen the grub screws (used in most mechanical seals).
- Carefully pull off the seal housing and mechanical seal rotating element(s).
- Remove the seal cover.
- Remove shaft sleeve (if fitted).
- On non-cartridge seals the stationary seat remains in the seal housing/cover with its sealing member. Remove only if damaged or worn out.
- On pumps fitted with gland packing, the packing and lantern ring should be removed only if the packing is to be replaced.

13.1.6 Bearing housing

- Pull off the pump half of the coupling and remove the coupling key.
- Remove support foot (if necessary).
- Remove the pump side liquid flinger and/or labyrinth seal rotary half (depending on option fitted).
- Slacken the nuts and remove bearing carrier screws.
- Tighten bearing carrier jacking screws evenly to initiate bearing carrier release.
- Remove bearing carrier and shaft assembly from the bearing housing by pulling it towards the coupling end.
- Remove bearing circlip (or bearing carrier locking ring if paired angular contact bearings are fitted). NB: bearing carrier locking rings are left-hand thread.
- Remove drive side liquid flinger and/or labyrinth seal rotary half (depending on option fitted).
- Remove bearing carrier.
- Remove pump side bearing.
- Release the self locking drive side bearing nut and remove drive side bearing.

- When pressing bearings off the shaft, use force on the inner race only.

13.2 Examination of parts

13.2.1 Used parts must be inspected before assembly to ensure the pump will subsequently run properly. In particular, fault diagnosis is essential to enhance pump and plant reliability.

13.2.2 Casing, seal housing and impeller

Inspect for excessive wear, pitting, corrosion, erosion or damage and any sealing surface irregularities. Replace as necessary.

13.2.3 Shaft and sleeve (if fitted)

Replace if grooved or pitted. With the bearing mounting diameters (or bearing outer) supported by V-blocks, check that the shaft runouts are within 0.025mm (0.001in) at the coupling end and 0.050mm (0.002in) at the sleeve end.

13.2.4 Gaskets and O-rings

After dismantling, discard and replace.

13.2.5 Bearings

It is recommended that bearings are not re-used after any removal from the shaft.

13.2.6 Bearing isolators, labyrinths or lip seals (if fitted)

- The lubricant, bearings and bearing housing seals are to be inspected for contamination and damage. If oil bath lubrication is utilised, these provide useful information on operating conditions within the bearing housing. If bearing damage is not due to normal wear and the lubricant contains adverse contaminants, the cause should be corrected before the pump is returned to service.
- Labyrinth seals and bearing isolators should be inspected for damage but are normally non-wearing parts and can be re-used.
- Bearing seals are not totally leak free devices. Oil from these may cause staining adjacent to the bearings.

13.2.7 Bearing housing and carrier

Inspect the bearing carrier circlip groove, ensure it is free from damage and that housing lubrication passages are clear. Replace grease nipples or the filter breather (where fitted) if damaged or clogged. On oil lubricated versions, the oil level sight glass should be replaced if oil stained.

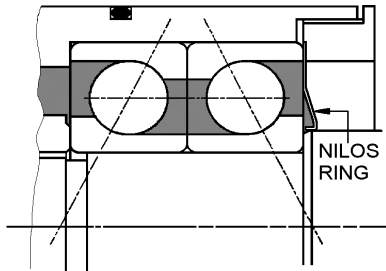
13.3 Assembly

13.3.1 To assemble the pump consult the sectional drawings.

13.3.2 Ensure threads, gasket and O-ring mating faces are clean. Apply thread sealant to non-face sealing pipe thread fittings.

13.3.3 *Bearing housing and rotating element assembly*

- Clean the inside of the bearing housing, bearing carrier and bores for bearings. Attach bearing housing support foot. Press drive side bearing(s) on to shaft.
- The double row thrust bearing will not normally have a single filling slot, as such bearings are limited to taking thrust in only one direction. If such a bearing replacement is used, it must be positioned on the shaft so that the bearing filling slot faces the impeller end of the shaft.
- If duplex heavy duty bearings are to be fitted, these must be mounted back-to-back, as shown below:



Nilos ring (clearance type) is only fitted on grease lubricated option units

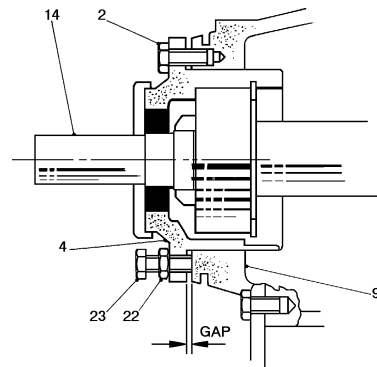
- The following methods are recommended for fitting the bearings onto the shaft:

Method 1: Use a hotplate, hot bath, oven or induction heater to heat the bearing race so it can easily be placed in position then allowed to shrink and grip the shaft. It is important that the temperature is not raised above 100°C (212°F).

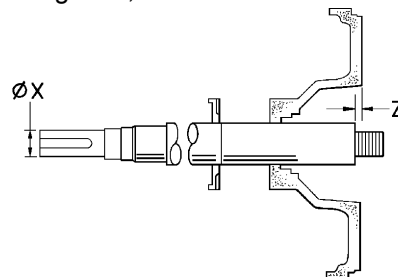
Method 2: Press the bearing onto the shaft using equipment that can provide a steady, even load to the inner race. Take care to avoid damaging the bearing and shaft.

- With bearings at ambient temperature, screw on the drive side self-locking bearing nut (with its polyamide insert facing away from the bearing) until tight.
- With double row thrust bearings place the inner bearing circlip over the shaft, with the tapered face facing the impeller end.
- With the heavy duty bearing option, the locking ring should be placed between the bearings with the face marked 'left-hand thread' facing the impeller end.
- Press pump side bearing onto the shaft using Method 1 or 2 above.
- With the NUP roller bearing option, the loose ring should be against the shaft shoulder.
- Fit O-ring on the bearing carrier. Lightly lubricate the bearing carrier bore and O-ring.
- If a separate labyrinth type bearing housing seal is used there may be a drain hole which should be at the 6 o'clock position facing the bearing.
- Fit drive side radial lip seal (if fitted) into the bearing carrier, having filled the position between the two lips with grease.
- Ensure the shaft keyway edges are free of burrs. During installation, use shimming or tape over the keyway to avoid damaging the drive side bearing seals.

- Slide the bearing carrier onto the shaft/bearing assembly and insert inner circlip into the carrier groove or screw up the bearing locking ring.
- On grease lubricated pumps, pump grease through the grease nipple in the bearing carrier until grease is visible in the bearing races.
- Check shaft for free rotation.
- Fit the pump side labyrinth into the bearing housing ensuring the drain hole faces the bearing and is at the 6 o'clock position.
- Install the shaft assembly into the bearing housing until the gap is approximately 5mm (0.2in).

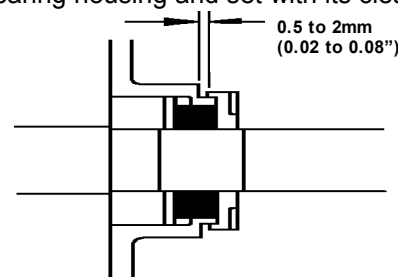


- Fit the bearing carrier screws but do not tighten.
- Press drive side liquid flinger and pump side liquid flinger onto shaft where applicable. These should be set 0.5 to 2mm (0.02 - 0.08in) (light contact for elastomer type) from the bearing carrier and bearing housing respectively.
- The pump side flinger (this feature is integral with some proprietary labyrinth seals) should only be set in its final position after setting the shaft axial position.
- Temporarily fit the seal housing (with any internal anti-vortex rib at the topmost position). The shaft may now be positioned in relation to the seal housing face, as shown below:



Bearing housing	Dia. X mm (in)	Z mm (in)
Frame 1	24 (0.945)	9 (0.354)
Frame 2	32 (1.260)	17 (0.669)
Frame 3	42 (1.654)	9 (0.354)
Frame 4	48 (1.890)	22 (0.866)

- The pump side flinger may then be moved towards the bearing housing and set with its clearance.



13.3.4 Seal housing and seal assembly

- Extreme cleanliness is required. The sealing faces and shaft or sleeve surface must be free from scratches or other damage.
- Refer to the seal arrangement section for seal diagrams.
- Carefully press the stationary seat into the mechanical seal housing or cover, ensuring that the seating ring is not deformed. Where an anti-rotation pin is fitted ensure that correct engagement with the slot is achieved.
- Place any separate seal covers over the shaft.
- Refer to manufacturer's instructions to position the mechanical seal rotating elements. Tighten any drive screws in the seal drive collar. For precise compression most cartridge seals should be set after complete pump assembly.
- Fit the seal housing into the bearing housing and tighten all fasteners.

13.3.5 Gland packed stuffing box assembly

- Assemble the gland packing into the stuffing box housing before fitting on to the shaft.
- Stagger the joints in the gland packing by 90 degrees to each other.
- The lantern ring halves (if required) should be positioned mid-way along the packing.
- Position the gland squarely against the last ring and tighten the gland nuts finger-tight only. Install into bearing housing assembly and fit the two screws to hold the seal housing in place. Check that the shaft rotates freely.

13.3.6 Impeller assembly and setting

- Fit a new O-ring into the impellers using a small amount of grease to hold it in place. Apply anti-galling compound (which does not contain copper) to the impeller thread to help subsequent removal. Assemble impeller onto the shaft.
- Tighten the impeller. Use the same method as in disassembly but rotating in opposite direction. A few sharp strikes will tighten it to the correct level.

13.3.7 Assembly of bearing housing into casing

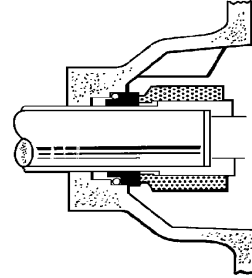
- Fit a new gasket into the casing.
- Install the bearing housing assembly into the pump casing. Coat the screws with anti-galling compound and tighten into casing.
- Check impeller front clearance against original setting, or process requirement and adjust as necessary. (See *Preventative maintenance and servicing* section.)
- Ensure that all other items have been re-attached and all fasteners tightened, then follow instructions in the *Installation* sections of this manual.

14 SEALING ARRANGEMENTS

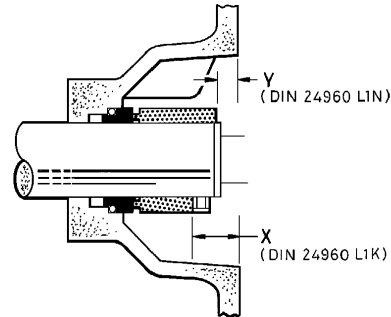
The following section shows details of the seal arrangements. Contact your nearest Flowserve sales office or service centre if you require further information or are unsure of the specific arrangement supplied. Refer also to the section on *Auxiliary piping* in this manual.

14.1 Single seal types

14.1.1 Single stepped balanced seal

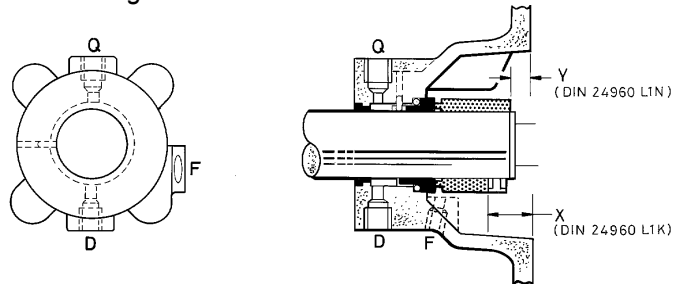


14.1.2 Single unbalanced (or inherently balanced) seal



Bearing housing	Setting dimension	
	X	Y
Frame 1	23.5	11.0
Frame 2	34.0	19.0
Frame 3	33.5	11.0
Frame 4	51.5	24.0

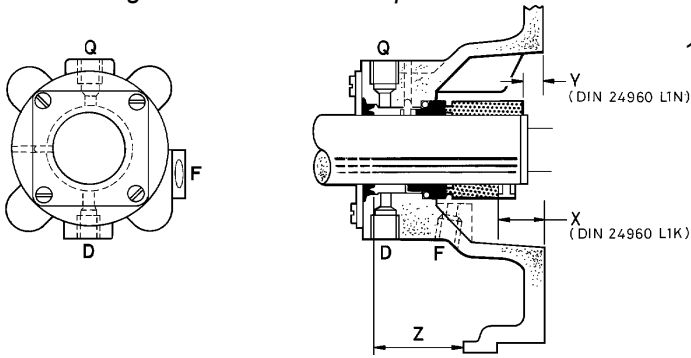
14.1.3 Single seal with external neck bush



Q - Rp 1/4" quench
 D - Rp 1/4" drain
 F - Rp 1/4" flush

Bearing housing	Setting dimension	
	X	Y
Frame 1	23.5	11.0
Frame 2	34.0	19.0
Frame 3	33.5	11.0
Frame 4	51.5	24.0

14.1.4 Single seal with external lip seal



Q - Rp 1/4" quench
 D - Rp 1/4" drain
 F - Rp 1/4" flush
 Z - Position of lip seal hard sleeve

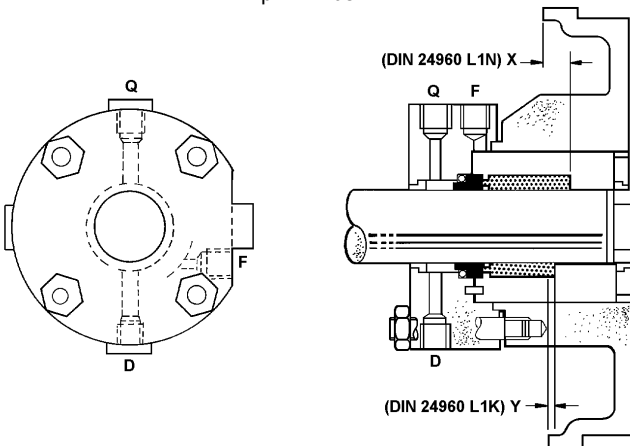
NB: Lever flange away after fitting hard sleeve to shaft.

Bearing housing	Setting dimension	
	X	Y
Frame 1	23.5	11.0
Frame 2	34.0	19.0
Frame 3	33.5	11.0
Frame 4	51.5	24.0

Pump size	Setting dimension Z			
	Frame 1	Frame 2	Frame 3	Frame 4
125	41.5	-	-	-
160	41.5	49.0	-	-
200	36.5	49.0	-	-
250	-	44.0	45.0	-
315	-	44.0	45.0	65.0
400	-	-	36.5	57.0
500	-	44.0	45.0	65.0

14.1.5 Single internal seal with internal and external neck bush

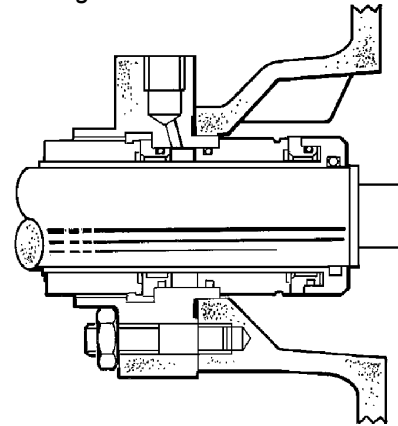
Q - Rp 1/4" quench
 D - Rp 1/4" drain
 F - Rp 1/4" flush



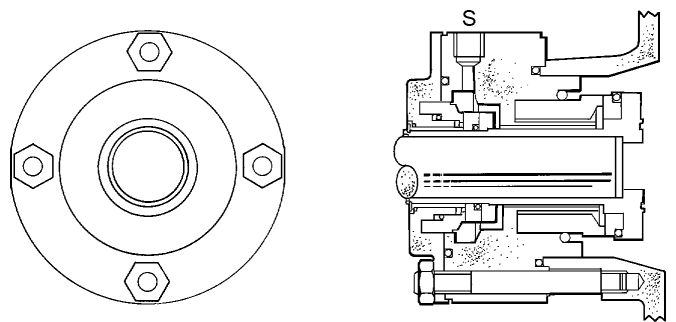
Pump size	Setting dimensions							
	Frame 1		Frame 2		Frame 3		Frame 4	
	X	Y	X	Y	X	Y	X	Y
125	12.5	0	-	-	-	-	-	-
160	12.5	0	5.5	-9.5	-	-	-	-
200	17.5	5.0	5.5	-9.5	-	-	-	-
250	-	-	10.6	-4.4	18.3	-4.3	-	-
315	-	-	10.6	-4.4	18.3	-4.3	-4.7	-32.3
400	-	-	-	-	27.0	4.3	3.5	-24.0
500	-	-	10.6	-4.4	18.3	-4.3	-4.7	-32.3

14.2 Cartridge seal types

14.2.1 Cartridge seal in conical seal housing



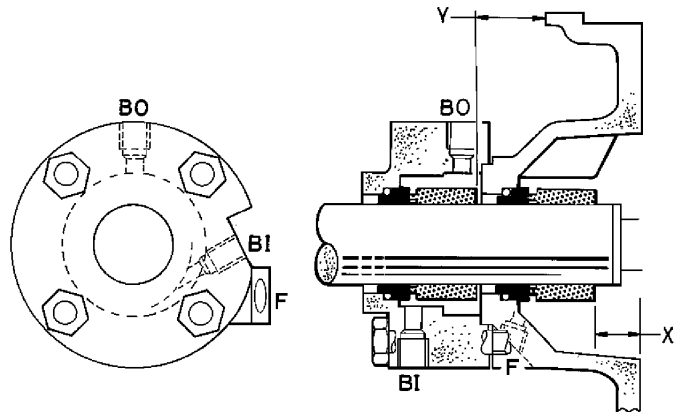
14.2.2 DIN 24960 "C" cartridge seal



For 'S' see seal supplier's instructions.

14.3 Tandem seal types

14.3.1 Tandem seal with EPA circulation



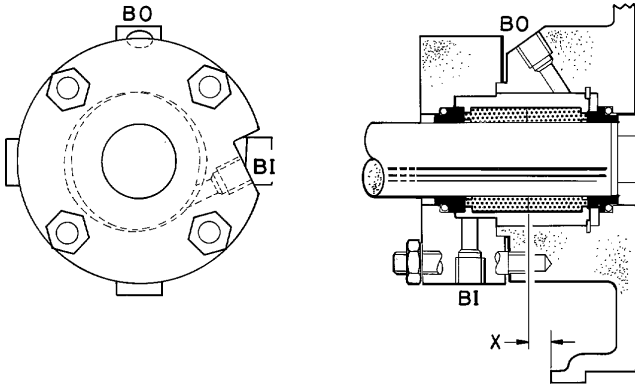
BI - Rp 1/4" barrier liquid inlet.
 BO - Rp 1/4" barrier liquid outlet.
 F - Rp 1/4" flush.

Pump size	Setting dimensions							
	Frame 1		Frame 2		Frame 3		Frame 4	
	X	Y	X	Y	X	Y	X	Y
125	20.0	31.5	-	-	-	-	-	-
160	20.0	31.5	28.0	41.5	-	-	-	-
200	20.0	26.5	28.0	41.5	-	-	-	-
250	-	-	28.0	36.4	27.5	33.7	-	-
315	-	-	28.0	36.4	27.5	33.7	45.5	56.7
400	-	-	-	-	27.5	25.3	45.5	48.3
500	-	-	28.0	36.4	27.5	33.7	45.5	56.7

14.4 Double seal types

14.4.1 Double back-to-back seal with EPA circulation

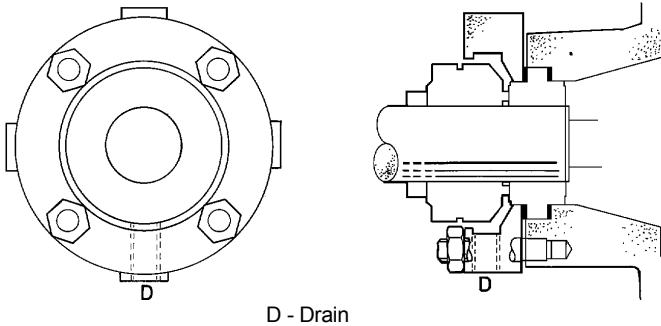
BI - Rp 1/4" barrier liquid inlet
BO - Rp 1/4" barrier liquid outlet



Pump size	Setting dimension X			
	Frame 1	Frame 2	Frame 3	Frame 4
125	11.0	-	-	-
160	11.0	17.5	-	-
200	6.0	17.5	-	-
250	-	12.4	14.4	-
315	-	12.4	14.3	32.3
400	-	-	5.7	24.0
500	-	12.4	14.3	32.3

14.5 External seal types

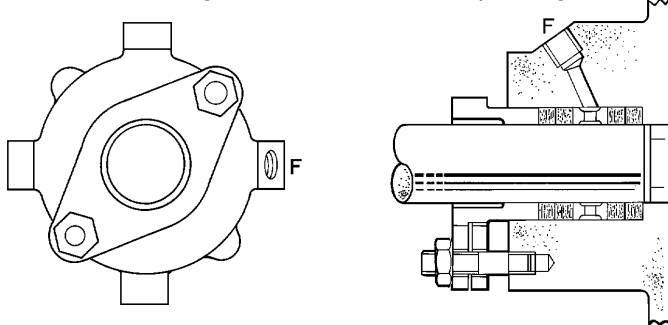
14.5.1 External seal



D - Drain

14.6 Packed gland seal types

14.6.1 Packed gland with modern fibre packing



F - Rp 1/4" flush

15 SPARE PARTS**15.1 Ordering of spares**

Flowserve keeps 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.
4. Part number.
5. Number of parts required.

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

15.3 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.

15.4 Storage of spares

Spares should be stored in a clean dry area away from vibration. Inspection and retreatment of metallic surfaces (if necessary) with preservative is recommended at 6 monthly intervals.

16 GENERAL ARRANGEMENT DRAWING

The typical general arrangement drawing and any specific drawings required by the Contract will be sent to the Purchaser separately. If required these should be obtained from the Purchaser and retained with this manual.

17 CERTIFICATION

Any certificates eg materials, hydraulic tests, conformities, Ex protection for an explosive atmosphere, performance test curves etc as determined by the contract requirements, will be sent to the Purchaser separately. If required, copies of these should be obtained from the Purchaser for retention with this manual.

18 SUPPLEMENTARY INSTRUCTION MANUALS

See also the supplementary instruction manuals supplied with this manual eg for electric motors, controllers, engines, gearboxes, sealant systems etc.

19 CHANGE NOTES

Change notes and errata (if any) will be included on a separate page(s) within the manual. If changes are made to the pump after supply, this manual will require updating.

15.5 Recommended spares for two years operation (as per VDMA 24296)

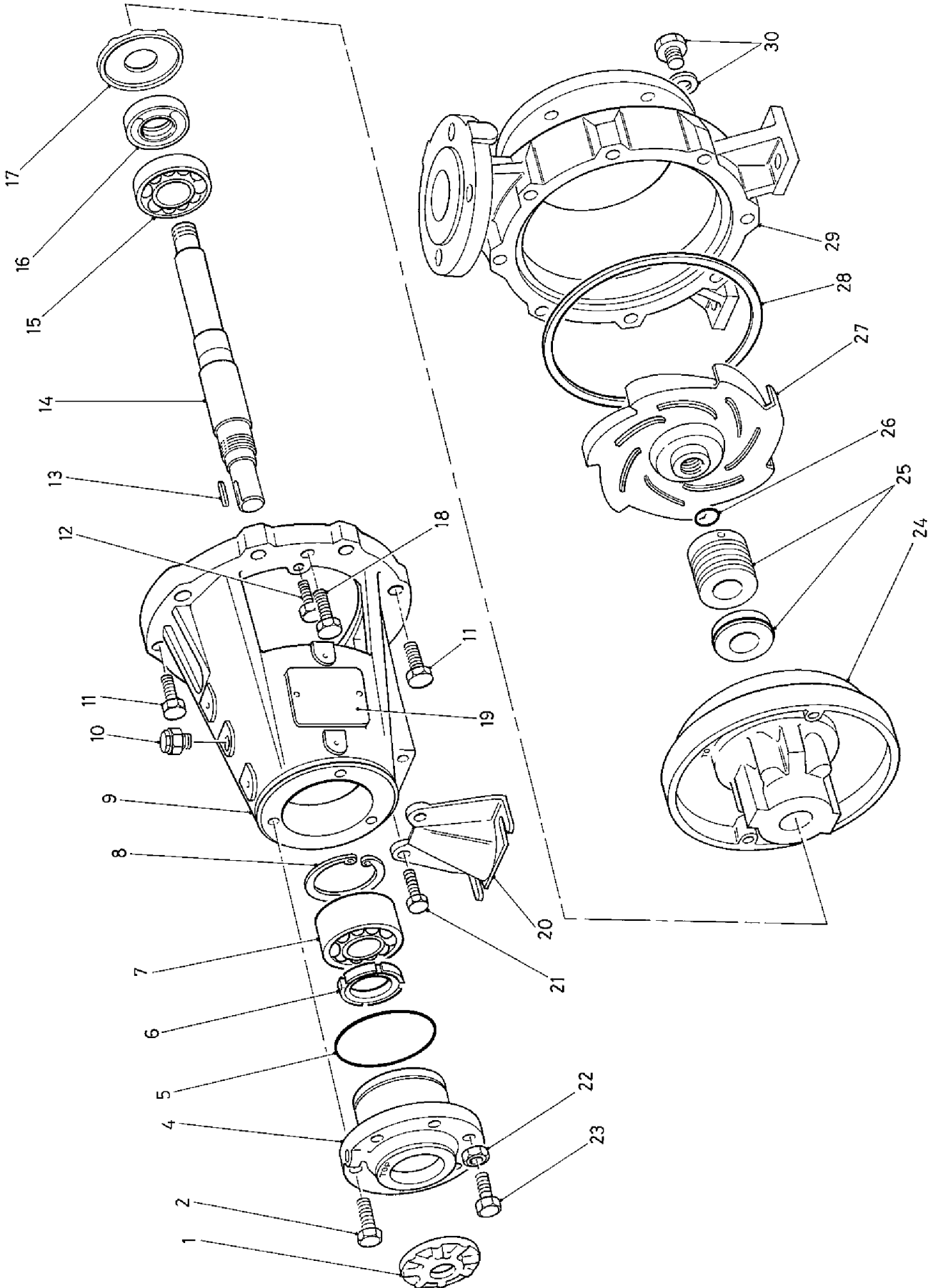
Part no.	Designation	Number of pumps (including stand-by)						
		2	3	4	5	6/7	8/9	10(+)
2200	Impeller	1			2		3	30%
2100	Shaft	1		2			3	30%
3712	Bearing nut	1		2		3	4	50%
2450	Shaft sleeve	2			3		4	50%
3042	Bearing - pump side	1		2		3	4	50%
3041	Bearing - drive side	1		2		3	4	50%
4590/1*	Pump casing gasket	4	6	8		9	12	150%
4610/1	O-ring - impeller	4	6	8		9	12	150%
4610/10*	O-ring - carrier	4	6	8		9	10	100%
2540/2	Pump side liquid flinger	1	2			3		30%
4130	Gland Packing - set	2		3			4	40%
4120	Gland halves	1	2			3		30%
4200	Mechanical seals	1	2			3		30%
-	Power end	-	-	-	-	-	1	2

* NB for CPXR replace with the following parts:

4590	Pump casing gasket	8	12	16		18	24	300%
4610/2	O-ring - carrier	4	6	8		9	10	100%

20 SECTIONAL ARRANGEMENT DRAWINGS AND PARTS LISTS

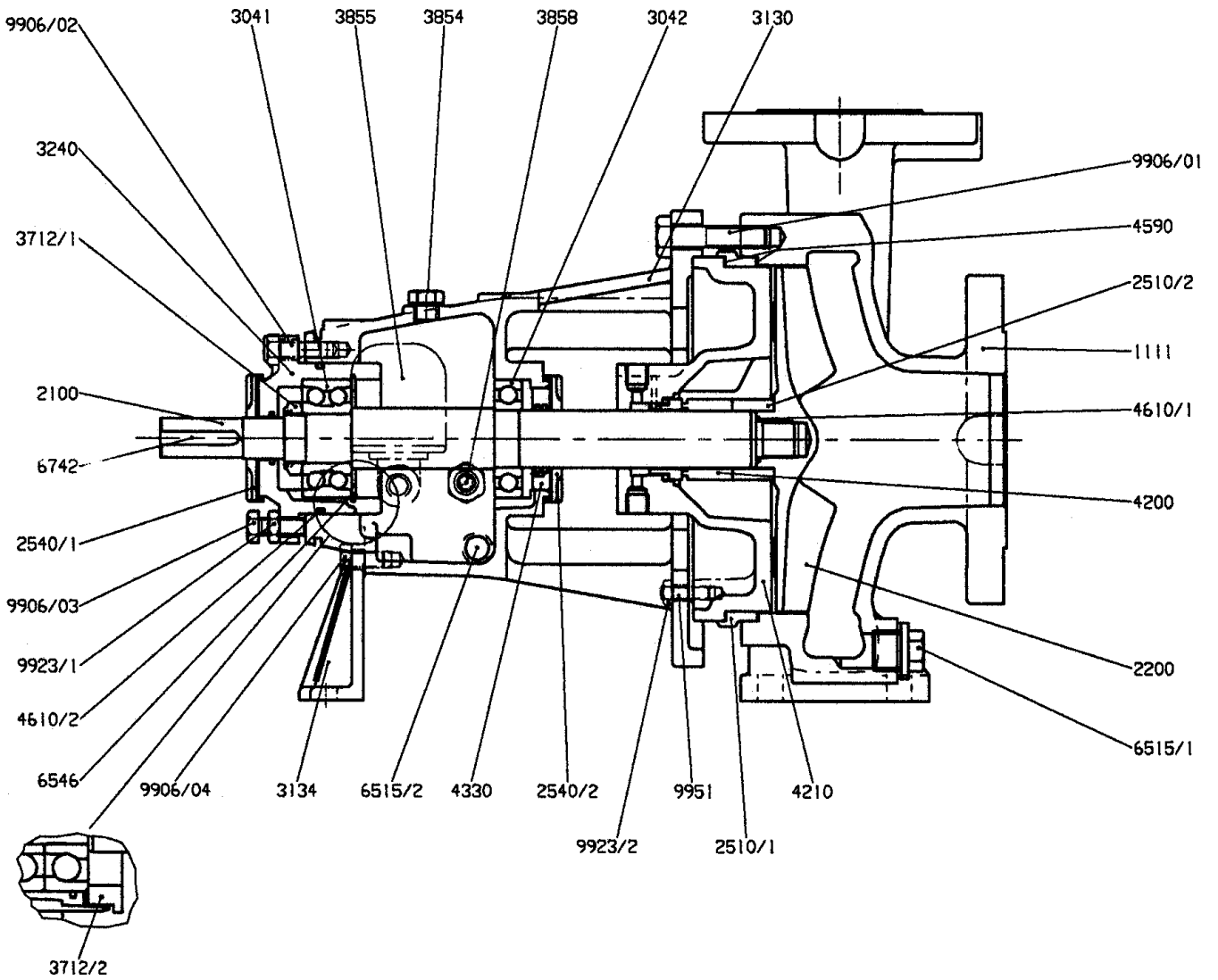
20.1 CPX and CPXN



Item no	Description	Europump part no
1	Drive side liquid flinger	2540/1
2	Hex screw	9906/2
3*	Shaft sleeve	2450
4	Bearing carrier	3240
5	O-ring	4610/2
6	Bearing nut	3712/1
7	Drive side bearing	3041
8	Inner circlip	6546
9	Bearing housing	3130
10	Oil filler plug/breather (customer option)	3854
11	Hex screw	9906/1
12	Hex screw	9906/5
13	Coupling key	6742
14	Shaft	2100
15	Pump side bearing	3042
16	Pump side labyrinth seal	4300/2
17	Pump side liquid flinger	2540/2
18	Jacking screw (use item 11)	6575
19	Nameplate	-
20	Support foot	3134
21	Hex screw	9906/4
22	Hex nut	9923
23	Hex screw (jacking point)	9906/3
24	Mechanical seal housing	4210
25	Mechanical seal	4200
26	O-ring	4610/1
27	Impeller	2200
28	Pump casing gasket	4590/1
29	Pump casing (Note: CPXN has centre line mounting feet)	1111
30	Casing drain plug and sealing washer (customer option)	6515

* Not illustrated: 2450 optional shaft sleeve

20.2 CPXR



Europump no.	Description
1111	Pump casing
2100	Shaft
2200	Impeller
2510/1	Distance ring
2510/2	Seal setting collar (L1K)
2540/1	Flinger (liquid) drive side
2540/2	Flinger (liquid) pump side
3041	Bearing (drive side) ang. cont.
3042	Bearing (pump side) ball
3130	Bearing housing
3134	Support foot
3240	Bearing carrier
3712/1	Bearing nut
3712/2	Bearing nut outer
3854	Oil filler plug (oil lubrication only)
3855	Constant level oiler (oil lubrication only)
3858	Sight glass (oil lubrication only)
4200	Mechanical seal
4210	Mechanical seal housing

4330	Labyrinth seal (pump side)
4590	Pump casing gasket
4610/1	O-ring
4610/2	O-ring
6515/1	Drain plug (optional)
6515/2	Drain plug (magnetic) (oil lubrication only)
6546	Inner circlip
6742	Coupling key
9906/01	Hex screw
9906/02	Hex screw
9906/03	Hex screw
9906/04	Hex screw
9923/1	Hex nut
9923/2	Hex nut
9951	Stud

Items not illustrated

2450	Shaft sleeve
3853	Grease nipples (grease lubrication only)

21 OPERATING DIFFICULTIES

SYMPTOMS

	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 ↓									
SUCTION TROUBLES										
Pump not primed.	●									●
Pump or suction pipe not completely filled with liquid.	●	●	●						●	
Suction lift too high.	●	●	●						●	
Insufficient margin between suction pressure and vapour pressure.	●	●							●	●
Excessive amount of air or gas in liquid.		●	●	●						
Air or vapour pocket in suction line.	●	●		●						
Air leaks into suction line.		●		●						
Air leaks into pump through mechanical seal, sleeve joints, casing joint or pipe lugs.		●		●						
Foot valve too small.		●							●	
Foot valve partially clogged.		●							●	
Inlet of suction pipe insufficiently submerged.	●	●		●					●	
SYSTEM TROUBLES										
Speed too low.	●	●	●							
Speed too high.					●					
Total head of system higher than head of pump.	●	●	●							
Total head of system lower than pump design head.					●					
Specific gravity of liquid different from design.					●					
Viscosity of liquid differs from that for which designed.		●	●		●					
Operation at very low capacity.									●	●
Operation at high capacity.					●				●	●
MECHANICAL TROUBLES										
Misalignment due to pipe strain.					●	●	●	●	●	●
Improperly designed foundation.									●	
Shaft bent.					●	●	●	●	●	
Rotating part rubbing on stationary part internally.					●				●	●
Bearings worn.							●	●	●	●
Wearing ring surfaces worn.		●	●		●					
Impeller damaged or eroded.		●	●						●	
Leakage under sleeve due to joint failure.							●			
Shaft sleeve worn or scored or running off centre.							●	●		
Mechanical seal improperly installed.							●	●	●	
Incorrect type of mechanical seal for operating conditions.							●	●	●	
Shaft running off centre because of worn bearings or misalignment.							●	●	●	●
Impeller out of balance resulting in vibration.							●	●	●	●
Abrasive solids in liquid pumped.							●			
Internal misalignment of parts preventing seal ring and seat from mating properly.							●	●		
Mechanical seal was run dry.							●	●		
Internal misalignment due to improper repairs causing impeller to rub.							●	●		
Excessive thrust caused by a mechanical failure inside the pump.									●	●
Excessive grease in ball bearings.									●	●
Lack of lubrication for bearings.									●	●
Improper installation of bearings (damage during assembly, incorrect assembly, wrong type of bearing etc).									●	●
Damaged bearings due to contamination.									●	●
MOTOR ELECTRICAL PROBLEMS										
Wrong direction of rotation.		●	●		●				●	
Motor running on 2 phases only.		●			●					
Motor running too slow, check terminal box.		●							●	●

Notes:

Notes:



Europe, Middle East & Africa

Flowserve Limited (Pump Division)
Harley House, 94 Hare Lane
Claygate, Esher, Surrey KT10 0RB
United Kingdom

Tel +44 (0)1372 463 700
Fax +44 (0)1372 460 190

Latin America

Flowserve S.A. de C.V.
Avenida Paseo de la Reforma #30
2nd Floor, Colonia Juarez Centro
Mexico, D.F.Z.C. 06040

Tel +52 5705 5526
Fax +52 5705 1125

USA and Canada

Flowserve Corporation (Pump Division)
Millennium Center, 222 Las Colinas Blvd.
15th Floor, Irving, TX 75039-5421, USA

Tel +1 972 443 6500
Toll free 800 728 PUMP (7867)
Fax +1 972 443 6800

Asia Pacific

Flowserve Pte Ltd (Pump Division)
200 Pandan Loop, #06-03/04
Pantech 21, Singapore 128388

Tel +65 775 3003
Fax +65 779 4607

Visit our web site at: www.flowserve.com

Your Flowserve factory contact:

**Flowserve Pumps Limited
PO Box 17, Newark
Notts NG24 3EN
United Kingdom**

Telephone (24 hours) +44 (0)1636 494 600
Sales & Admin Fax +44 (0)1636 705 991
Repair & Service Fax +44 (0)1636 494 833
E.mail inewark@flowserve.com

Your local Flowserve representative:

*To find your local Flowserve representative, please
use the Sales Support Locator System found at
www.flowserve.com*