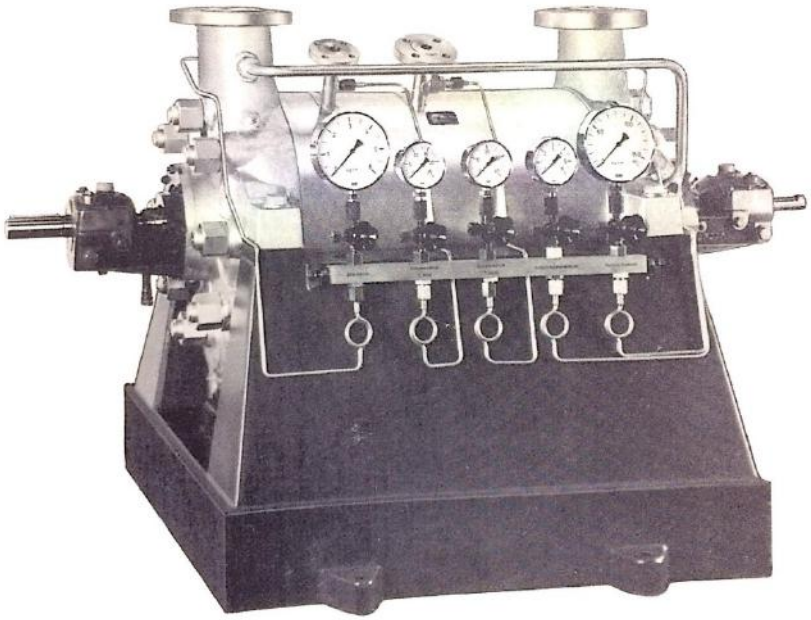
KSB HDA

High-pressure centrifugal pump



1. Application

The KSB HDA series is recommended for boiler feedwater and power plants, production under pressure at pressure and descaling.

2. General Description

Horizontal, multistage, with radially split suction, discharge and stage casings. The sealing between the stage casings is metallic and the union of the components with tie bolts keeps the junction of metallic surfaces under pressure. The stage casings and tie bolts are covered with a jacket.
The pump is supported at the shaft centerline.

3. Designation

KSB HDA 100 / 7

- KSB — Brand
- HDA — Model
- 100 — Discharge nozzle diameter (mm)
- 7 — Number of stages

4. Operation Data

Sizes	- DN 40 up to 150
Flow	- up to 580 m^3/h
Head	- up to 1.400 m
Temperature	- up to 200 ºC
Speed	- up to 5.500 rpm
Final pressure	- up to 116 bar

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Type Series Booklet HDA
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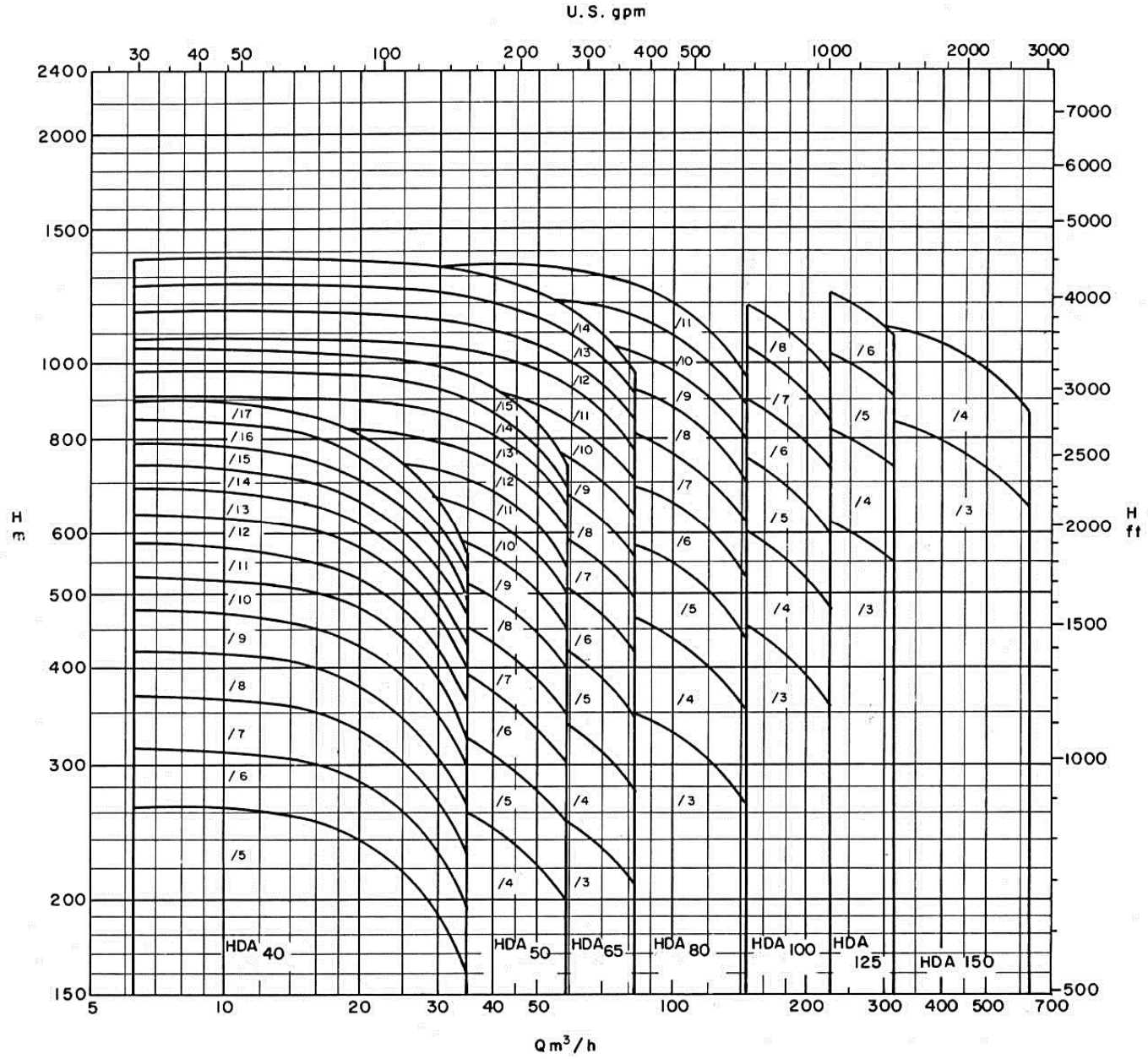
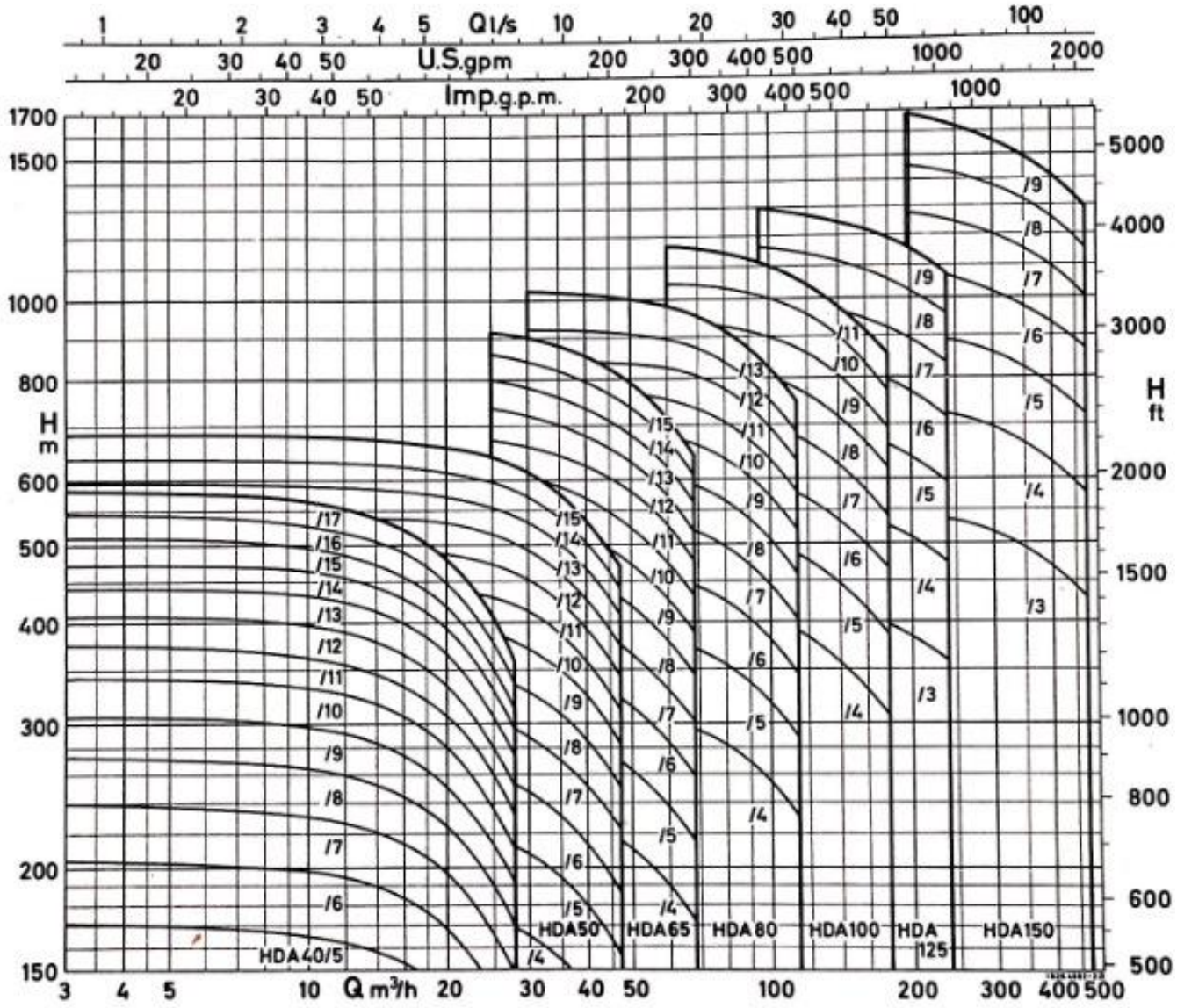
5. Selection chart – 60 Hz



Speed: 3550 rpm

6. Selection chart – 50 Hz



Speed: 2900 rpm

7. Technical Data

Design Data \ Pump Size				40	50	65	80	100	125	150
Maximum suction pressure (bar)				30					25	
Maximum discharge pressure (bar)		Mat. Variant	01	85						
			02 e 03	90	95				100	
			04	116	130				135	
Maximum differential pressure per stage (bar)		Mat. Variant	01	17						20
			02 e 03	20						22
			04	20						22
Maximum hydrostatic test pressure (bar)	1st stage	Mat. Variant	01 a 04	60						
	Series stages		01	105						
			02	110	115				120	
			03 e 04	140	140				140	
Minimum flow				Indicated on the characteristic curve						
Maximum flow				1.15 x Qopt.						
Min./Max. temperature (ºC)				See item 9.2						
Rotation direction				Drive on suction side: clockwise (viewed from the drive side)						
Flanges (1)	Suction	Mat. Variant	01	ANSI B16.1 - 250 lbs						
			02 a 04	ANSI B16.5 - 150 lbs						
	Discharge		02 a 04	ANSI B16.5 – 600 e 900 lbs						
Bearings		Hydrodynamic DxL (mm)		35x50		45x60		50x60	50x70	75x85
Oil volume per bearing (l)		Hydrodynamic		0.4				0.5	0.7	1.3
Oil flow for forced feed lubrication (l/s) per bearing				0.033		0.05		0.066	0.1	0.133
Additional oil flow necessary for axial thrust bearing device lubrication (l/s)				0.1				0.133	N/A	0,166
Axial thrust bearing device, execution with roller bearings		Angular-contact type, two seats, for pumps with plain bearings		3309-C3		3310-C3				
		Oil volume		0.2		0,4				
Max. allowable P/n, shaft (kW/rpm) – Material		SAE1045		0,0625		0,1333		0,1785	0,159 (4)	0,56 (4)
		AISI 6F3		0,0700		0,1600		0,2200	0,279 (4)	0,70 (4)

Bearing type (2)	GR	GP	GR	GP	GR	GP	GR	GP	GR	GP	GRE	GR	GP	GR	GP
3	-	-	-	-	-	-	-	-	-	-	3600	3000	3600	3000	3600
4	-	-	3600	5500	3600	5000	3600	4500	3600	4000	3600	3000	3600	3000	3600
5	3600	5500	3600	5500	3600	5000	3600	4500	3600	4000	3600	3000	3600	3000	3350
6	3600	5500	3600	5500	3600	5000	3600	4500	3600	4000	3600	3000	3500	3000	3250
7	3600	5500	3600	5500	3600	5000	3600	4500	3600	3750	-	3000	3250	3000	3000
8	3600	5500	3600	5500	3600	4650	3600	4200	3500	3500	-	3000	3000	3000	3000
9	3600	5500	3600	5250	3600	4350	3600	3800	3350	3350	-	3000	3000	3000	3000
10	3600	5500	3600	4950	3600	4150	3450	3700	3150	3150	-	-	-	-	-
11	3600	5500	3600	4750	3600	4000	3300	3550	3000	3000	-	-	-	-	-
12	3600	5370	3600	4500	3550	3800	3150	3400	-	-	-	-	-	-	-
13	3600	5150	3600	4350	3400	3650	3000	3250	-	-	-	-	-	-	-
14	3600	4900	3600	4200	3250	3500	-	-	-	-	-	-	-	-	-
15	3600	4800	3600	4000	3150	3400	-	-	-	-	-	-	-	-	-
16	3600	4400	-	-	-	-	-	-	-	-	-	-	-	-	-
17	3600	4000	-	-	-	-	-	-	-	-	-	-	-	-	-

Maximum speed per number of stages (3)

Minimum number of stages		5	4				3	
Moment of inertia $J=GD^2/4$ (Kgm^2) with water	1st stage	0.0072	0.0121	.0219	0.0318	0.0660	0.2166	0.3700
	each additional stage	0.00415	0.0075	0.0158	0.0211	0.0442	0.1681	0.2200
3		-	-	-	-	-	605	900
4		-	149	211	264	393	660	1000
5		128	161,5	229	287	432	715	1100
6		137,5	174	247	310	466	770	1200
7		147	186,5	265	333	500	825	1300
8		156,5	199	283	356	534	880	1400
9		166	211,5	301	379	563	935	1500
10		175,5	224	319	402	602	-	-
11		185	236,5	337	425	635	-	-
12		194,5	249	355	448	-	-	-
13		204	261,5	373	471	-	-	-
14		213,5	274	391	-	-	-	-
15		223	286,5	409	-	-	-	-
16		232,5	-	-	-	-	-	-
17		232,5	-	-	-	-	-	-

Final pump weight per number of stages in kg

Table 1 – Technical Data

The pressure shall not be lower than 25% of pressure at operating point, neither lower than 15 bar.

(1) Other flanges standards, upon request

(2) Bearing types:
GR – plain bearings with lubrication by oil ring
GP oil ring – plain bearings with forced feed lubrication
GRE – plain bearings, lubrication by oil ring and special bearing casing (ribbed). In this execution it is not possible to install the lift off device for axial thrust balance. Therefore this bearing is only recommended for stable and continuous applications, with few start-ups and shutdowns, it is also fundamental that only a coupling with double gear is used for this bearing execution.

(3) The speed can be exceeded by 10% for a short period time, considering the allowable pressure limitations according to figure 3

(4) Shaft with two keys for drive.

8. General Description

8.1 Casing

Top suction and discharge flanges. Flanges on the stage casing for extraction of one or more partial flows of feedwater for use elsewhere.

8.2 Impeller

Radial, closed, single suction impeller.

8.3 Shaft

Pump shaft is provided with shaft protection sleeve and spacer sleeve.

8.4 Shaft sealing

The shaft is sealed by packing. Option for shaft sealing by mechanical seal is available.
Cooling chamber is necessary for temperatures above 105ºC.

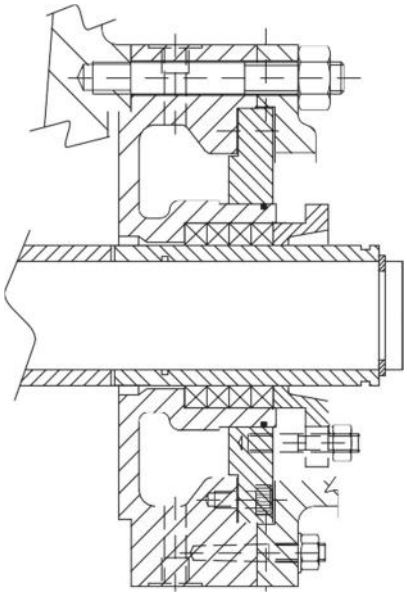


Fig.1 – Shaft sealing by gland packing with cooling chamber

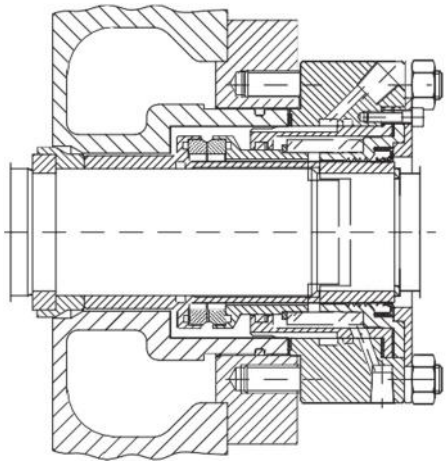


Fig.2 – Shaft sealing by mechanical seal

8.5 Axial thrust balance

Axial thrust balance by balance disc, with balance line piping towards the suction casing or suction tank.

8.6 Description and principle of operation of the axial thrust balance device

The pumped medium flows through the suction casing (106) to the first impeller. It leaves the impeller (230), pressurizes its shoulders and flows to the diffuser (171.1) and from diffuser to the next impeller inlet.
This process is repeated on each stage, while the pressure is increased by an equal value successively, i.e. by the capacity of head of the stage.
From the last impeller, the medium flows to the balance disc chamber and to last stage diffuser (171.2). From the last stage diffuser to the pressure casing and to the discharge piping
An axial force A, which is caused by the differential pressure from the area between DSP (wear ring inner diameter) and e Da (stage sleeve diameter) acts on each impeller. See Figure 3. This axial thrust tends to displace the impeller to pump suction side.

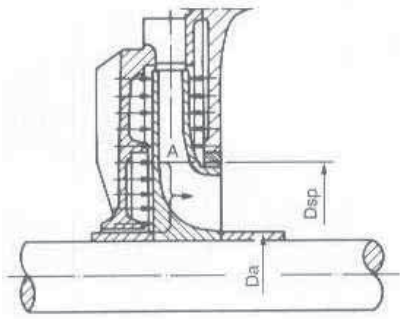


Fig.3 - Impeller axial thrust

A specific balance device is necessary to balance the axial thrust. This device consists of a balance disc (601), balance disc seat (602) and balance line piping, acting through the radial clearance between the throttle bushing of the balance disc seat (602) and the spacer sleeve (525.2) - clearance “B” – and the axial clearance between disc and balance disc seat – clearance “C”.
For example, if clearance “C” is very small, roughly the pump final pressure will act on disc chamber, displacing the rotor to the discharge side, and clearance C will increase. If the clearance C is too big, there will be a pressure relief on the disc chamber, reducing the axial thrust and returning the rotor to the suction side. During the operation, an average clearance will be set and pump will be axially balanced. See Figure 4.

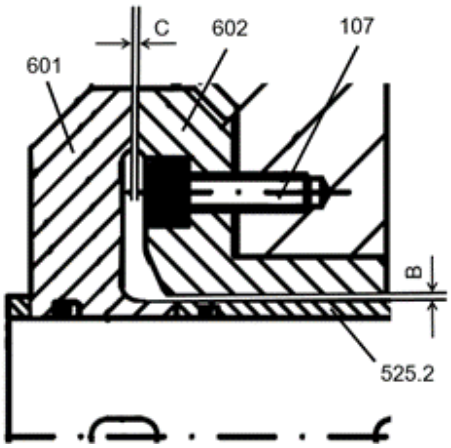


Fig.4 - Axial thrust balance device

On the back of the balance disc, between the discharge casing (107) and gland packing (451) there is a chamber where the balance piping is installed and can be returned to suction casing or tank, depending on specific conditions. See Figures 6 and 10.

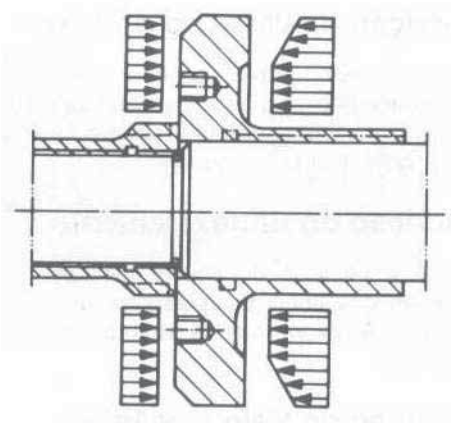


Fig.5 – Axial forces on the balance disc

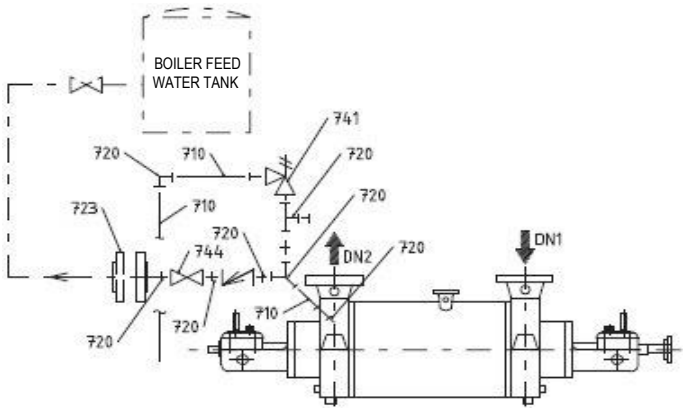


Fig.6 – Balance line piping sketch with return to the suction tank

Caution: Minimum differential pressure to displace the disc is 15 bar. For lower values, the clearance "C" shown on Figure 4 will not exist and the balance device will be violently worn by friction.

8.7 Bearings

The bearings are installed in two flanged bearing brackets on both ends of the pump, with plain bearings with lubrication by oil rings or forced feed lubrication.

8.8 Accessories (optional)

8.8.1 Drive

Direct drive by flexible coupling or indirect drive by means of gearbox, electric motor, turbine, diesel motor, etc.

8.8.2 Coupling

Flexible coupling sleeve to allow pump shaft axial displacement.

8.8.3 Coupling protection

KSB standard

8.8.4 Baseplate

KSB standard made of steel.

8.8.5 Suction strainer

Suction strainer must always be installed on the suction piping in order to protect the pump.

8.8.6 Temperature sensors (PT100)

The temperature sensors are installed on the bearings to monitor their temperature

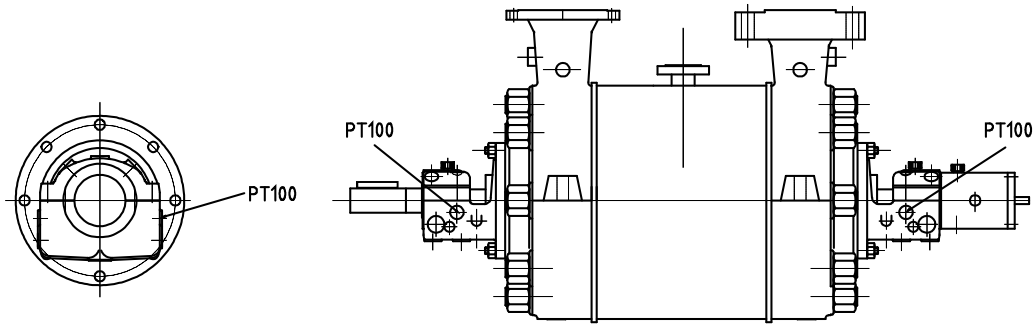


Fig.7 - Temperature sensors positioning

8.8.7 Vibration sensors

They can be installed on the bearings with features depending of customer's specification and bearing type.

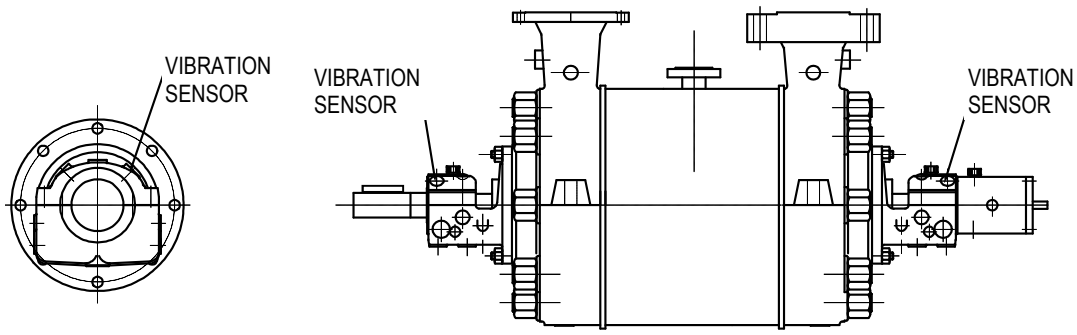


Fig.8 – Vibration sensors position

9. Technical Data

9.1 Discharge flow for axial thrust balance

The flows of discharge Q_E are average values resulting from various measurements shown on Figure 9. These flows refer to a pump speed n = 3550 rpm, 60 Hz and may be linearly calculated to other speeds.

The discharge flow returns to the pump suction flange or to the boiler feed of the pump, according to the flow temperature and the number of stages (see Figure 10). Conditions: Q min = 20% of $Q\eta_{opt}$ and $NPSH_{available} \cong NPSH_{required}$.

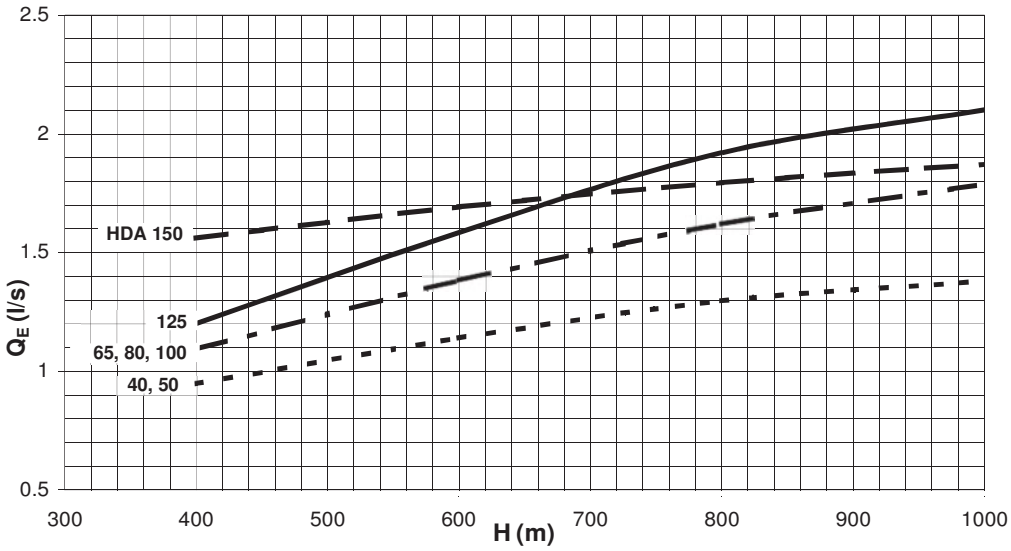


Figure 9 - Flows of discharge Q_E in $l/_s$ for speed of 3550 rpm

Discharge flow connection DN 25 (1")

In case of return to the boiler feed of the pump, it is necessary to increase the diameter of the discharge flow to DN 40 (1 ½") when:

a) Pipe extension is larger than or equal to 20 m, for sizes 40 and 50;
b) Pipe extension is larger than or equal to 10 m, from size 65 on.

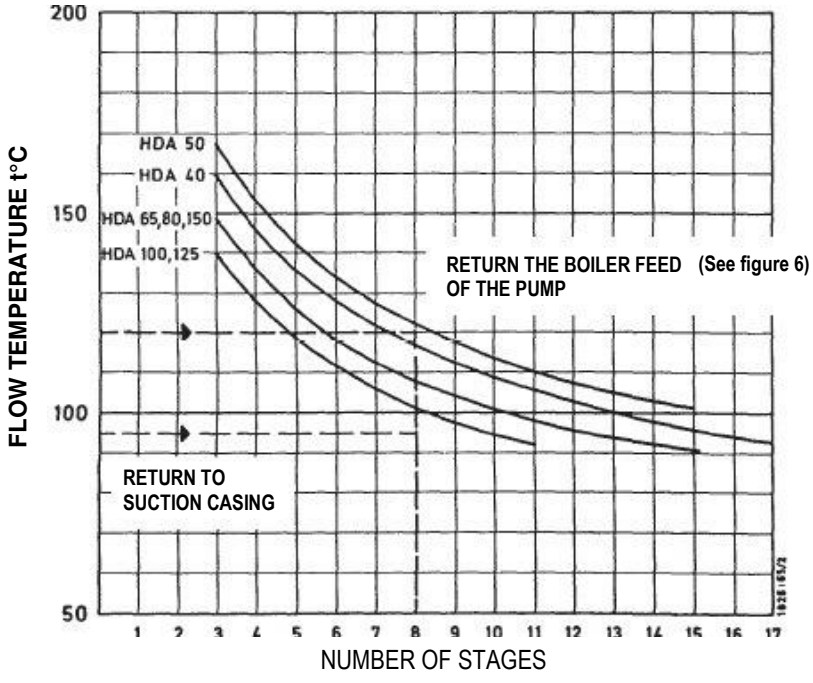


Figure 10 - Values for flow return

9.2 Pressure and temperature limits

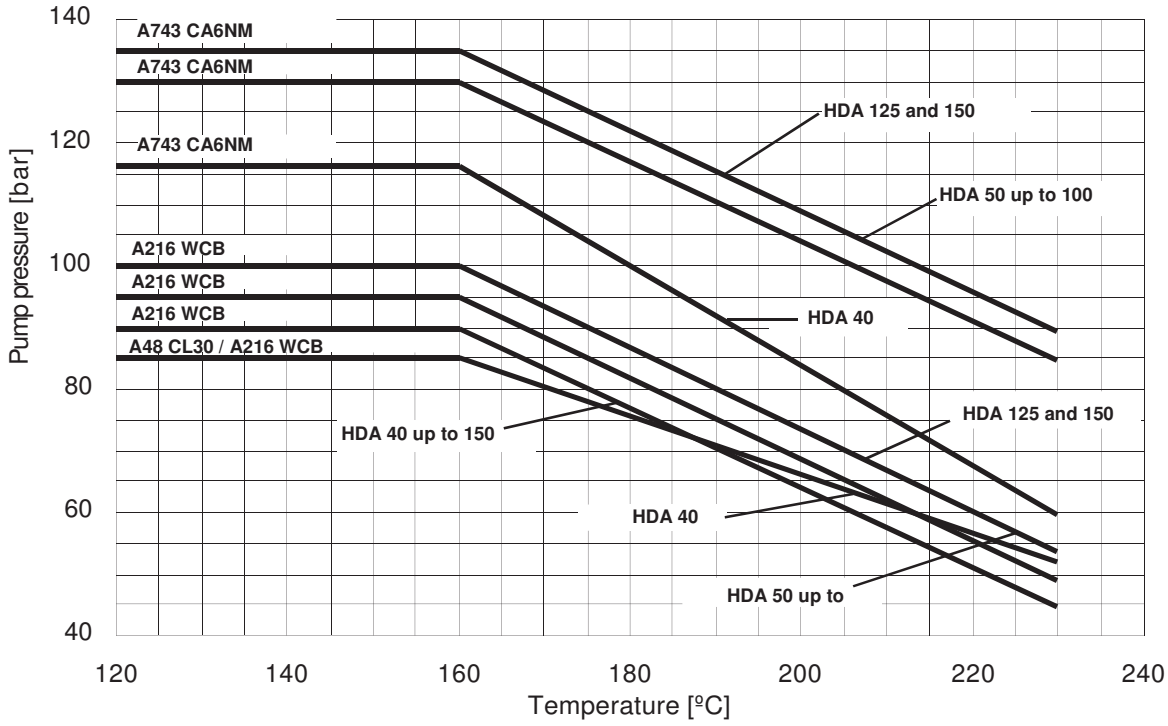


Figure 11- Pressure and temperature limits (with pre-warming)

Figure 11 sets the pressure limitations valid for pumps whose temperatures differences between the pump operating condition and the medium are small, for example.

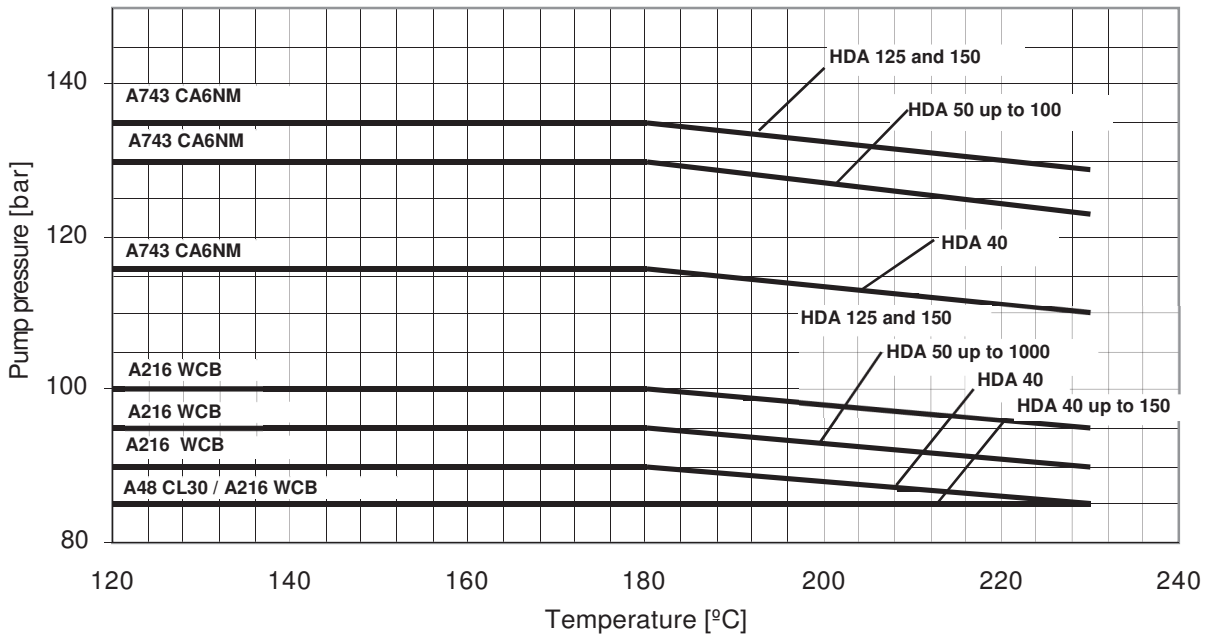


Figure 12 - Pressure and temperature limits (cold start-up)

9.3 Speed limits according to impeller diameter and material

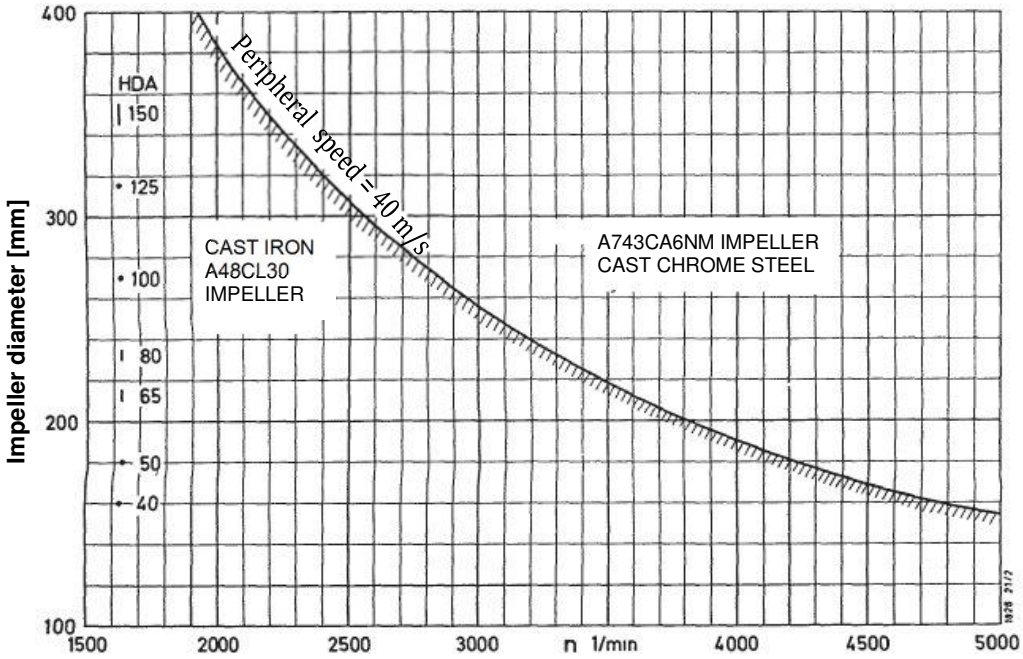


Figure 13 – Speed limits according to impeller material

A48 CL30 impellers for peripheral speed of up to 40m/s are allowable. Above this limit, cast chrome steel impellers can be used (figure 13).

9.4 Critical Speeds

Figure 14 shows critical speeds, which are defined according to hydraulic features.

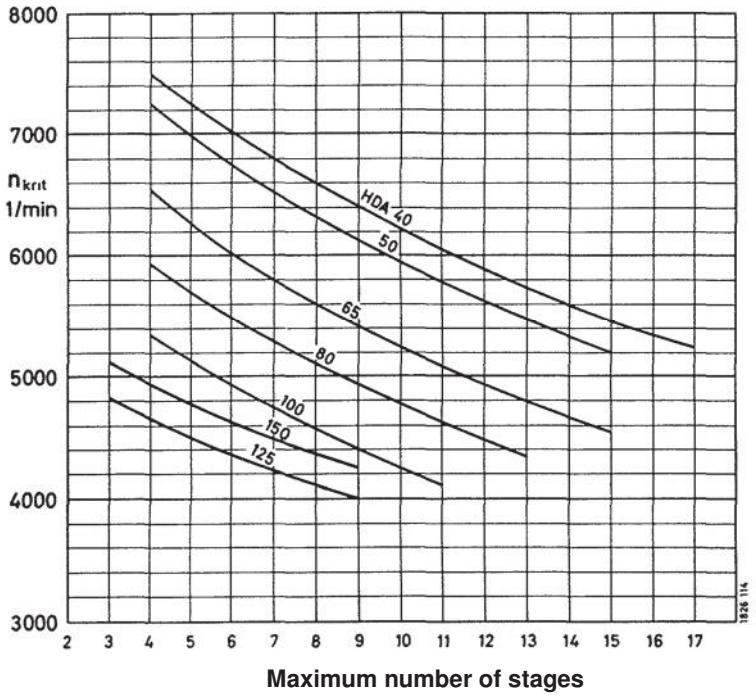
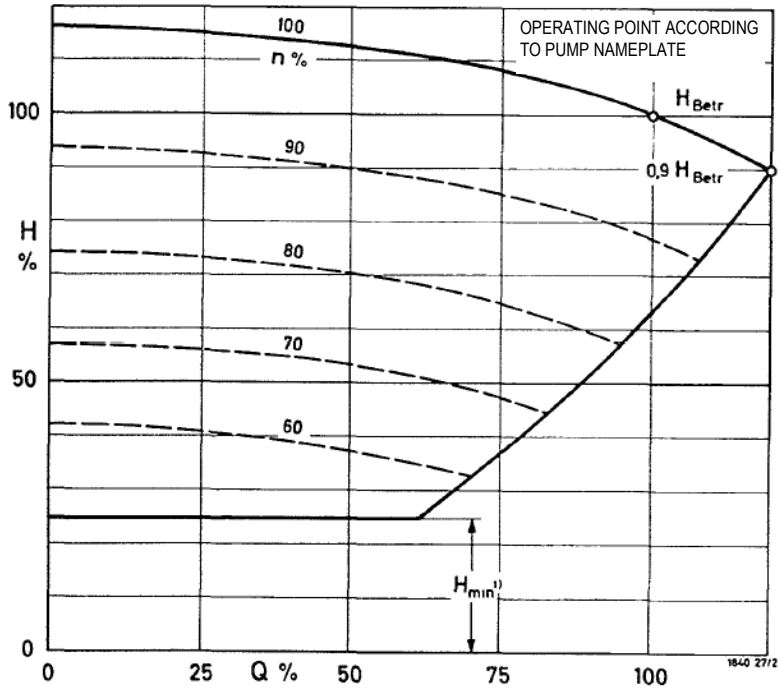


Figure 14 – Critical Speeds according to the number of stages

9.5 Speed regulation

For driving machines with speed regulation (turbine, gearbox, frequency inverter, etc.) there will be other values for the head, shown on Figure 15 graph.

For example, if pump speed is 80% of the nominal speed, when the pump operates with ¾ of load the head is only 65% of pump head, comparing to 100% load and nominal speed.



1) See item 6 – Technical Data

Figure 15 – Speed regulation

9.6 NPSH required

In order to avoid cavitation, the NPSH available shall always be higher than NPSH required (safety margin and tolerances for construction and dimensions are not considered on the catalogues).
The graph on Figure 16 shows the relations between factors.
For constant pressure of the suction tank water, the safety margin for Qmax shall be of at least 1 m.
In case the strainer is installed inside the suction piping, the loss on the strainer is approximately 2 m for Qmax, assuming that free area of the strainer is three times bigger than free suction piping area. For detailed information about the losses on the suction strainer, please contact KSB.
If HDA pump receives inlet pressure required by a pre-pump (BOOSTER type), the pressure provided by this pre-pump shall be considered to determine the NPSH required of HDA.

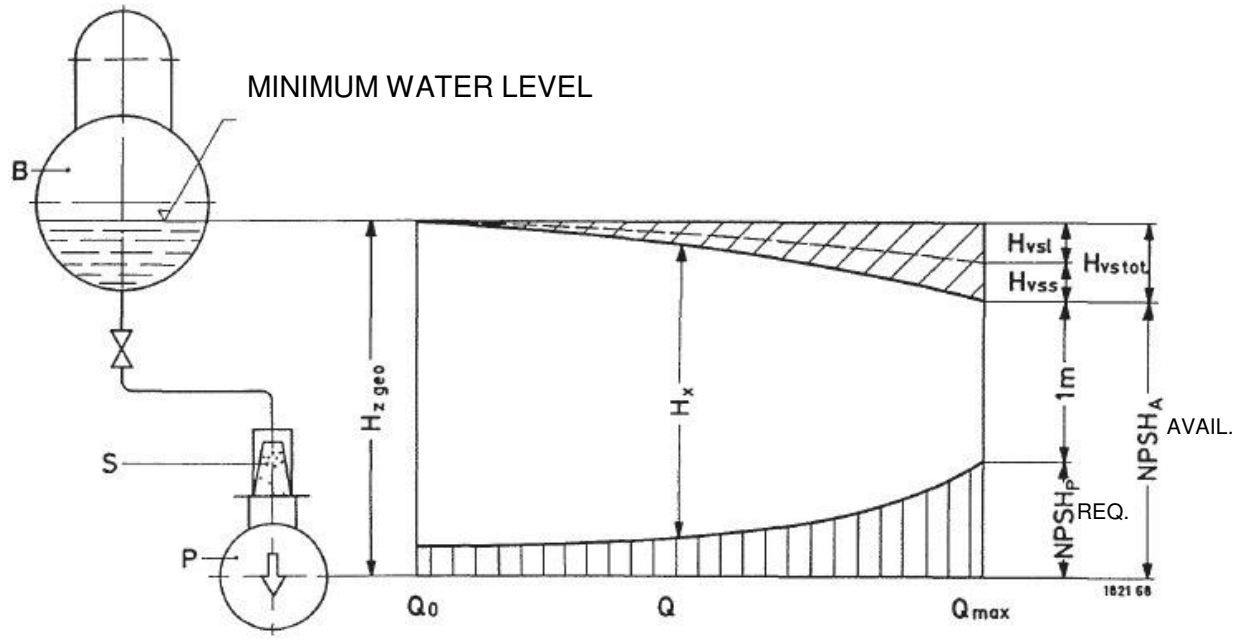


Figure 16

NPSH req.	=	NPSH required [m]
NPSH avail.	=	NPSH available [m]
Hz geo	=	Geodesic height of pump flow inlet [m]
Hvstot	=	Losses due to friction inside inlet piping, including strainer losses [m]
Hvsl	=	Losses at boiler outlet and piping up to pump, without strainer losses [m]
Hvss	=	Strainer losses [m]
Hx	=	Safety head
B	=	Boiler feed of the pump
P	=	Pump
S	=	Suction strainer

10. Design

High pressure horizontal multistage centrifugal pump.
The casings of various stages and tie bolts are installed inside a cover.
The suction and discharge casings have top flanges. The pump feet are supported on shaft centerline position to avoid thermal expansion.

10.1 Assembly of pump set and work environment

The pumps and motors including other accessories are installed on a common baseplate on most of the cases, and inside closed areas.

For hot water pumps it is possible to pre warm the pump with the pump flow during operation (see figure 17).

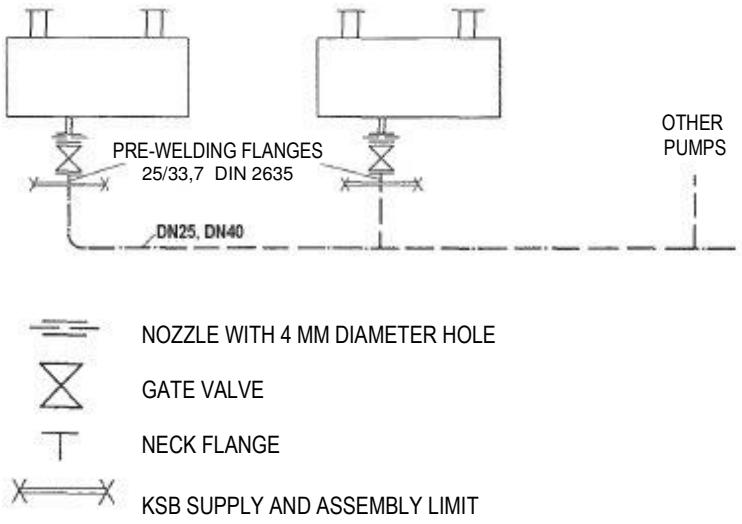


Figure 17 – Cold water pumps installation outdoors

For cold water pumps installed outdoors it is possible to install heating coil between the pump casing and the baseplate during the low temperature period (figure 18)

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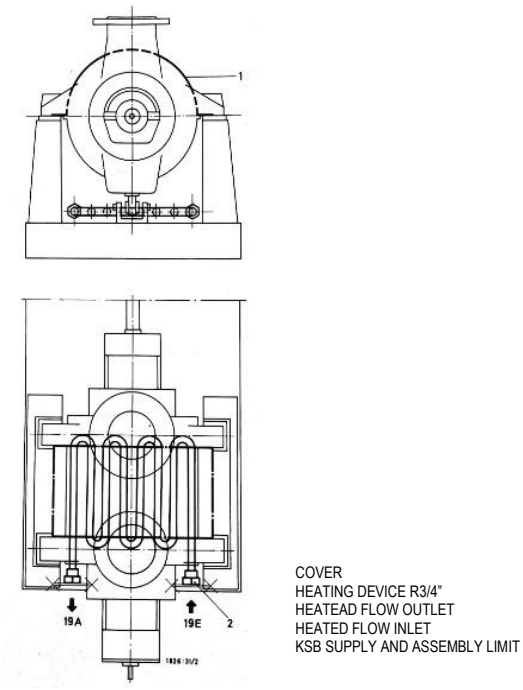


Figure 18 – Pump with heating device

10.2 Casing

HDA pumps are provided with suction, stage and pressure casings installed radially segmented to the shaft.
The casings are assembled with metal-to-metal joints (without sealing gasket) to avoid leakage.
Diffusers are installed inside the stages and pressure casings. Wear rings are installed inside suction and stage casings.
Standardized pressure classes according to ANSI standard, other standards may be applied upon request.

Pump Size	Suction casing		Pressure casing
	A48 CL30	A216 GR. WCB and A743 CA6NM	A216 GR. WCB and A743 CA6NM
40 50 65 80 100 125 150	250 lbs.	150 lbs.	600 lbs or 900 lbs

Table 2 - Flange nominal pressure according to ANSI standard

For flanges connections, see item Dimensions.

10.3 Impellers

HDA pumps are provided with radial impellers, clockwise direction, single or double suction. Impellers are fastened to shaft by keys; the distance between the impellers is made through stages spacer sleeve, and spacer sleeves on suction side and discharge side.

10.4 Shaft

Tha shaft is made in a single piece in different materials and protected by shaft protection sleeves and spacer sleeves, according to specified variant. In standard variant the shell and impellers fastening areas are provided with chrome surface treatment.
Shaft mechanical strength depends on shaft and coupling material.
Remark: Couplings that do not allow axial flotation (E.g.: Steelflex from “Falk”) are not applicable to this pump type, due to rotor axial displacement during start-up.

10.5 Bearings and Lubrication Types

10.5.1 Bearings

HDA pumps bearings do not need to absorb axial forces because these forces are balanced by the hydraulic balance thrust device.
For bearings sizes and oil quantity on bearing housings, see Tables 3, 4, 5 and 6.
The maximum bearing temperature is considered 45ºC above ambient temperature and shall not exceed 80ºC.
For applications with ambient temperatures above 45ºC and pumped water temperature above 150ºC it is necessary to cool the bearing housing when plain bearings are used, see figure 21.
It is not necessary to cool the bearings if the bearings lubrication is by forced feed lubrication. Plain bearings clearance is approximately 0.001 x shaft Ø.

Table 3 — Pumps with plain bearings and lubrication by oil ring

Pump Size	Plain bearings inner Ø x length (mm)	Oil volume per bearing (l)
40 and 50	35 x 50	0.4
65	45 x 60	0.4
80	45 x 60	0.4
100	50 x 60	0.5
125 (GR Bearing)	50 x 70	0.56
125 (GR Bearing)	50 x 70	1.90
150	75 x 85	1.3

Table 4 — Pumps with plain bearings and forced feed lubrication

Pump Size	Plain bearings inner Ø x length (mm)	Oil flow for lubrication under pressure
40 and 50	35 x 50	0.033
65	45 x 60	0.050
80	45 x 60	0.050
100	50 x 60	0.066
125	50 x 70	0.100
150	75 x 85	0.133

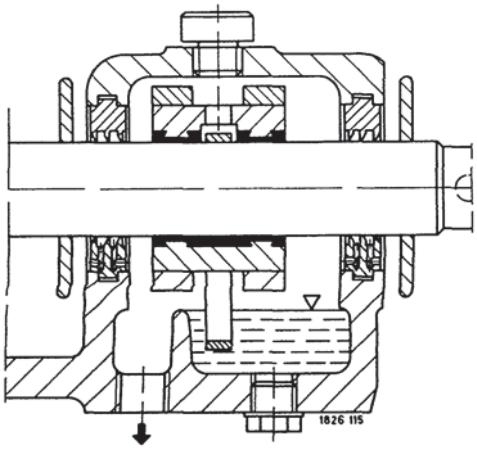


Figure 20 – Plain bearings sealing for outdoors installation (standard execution)

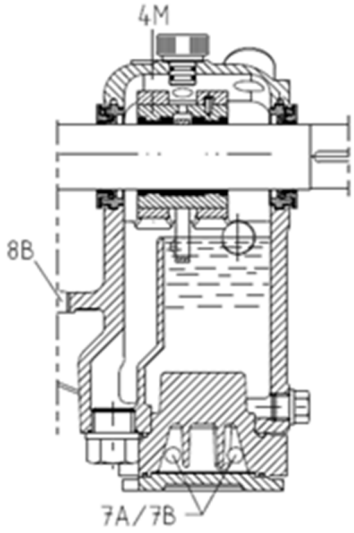
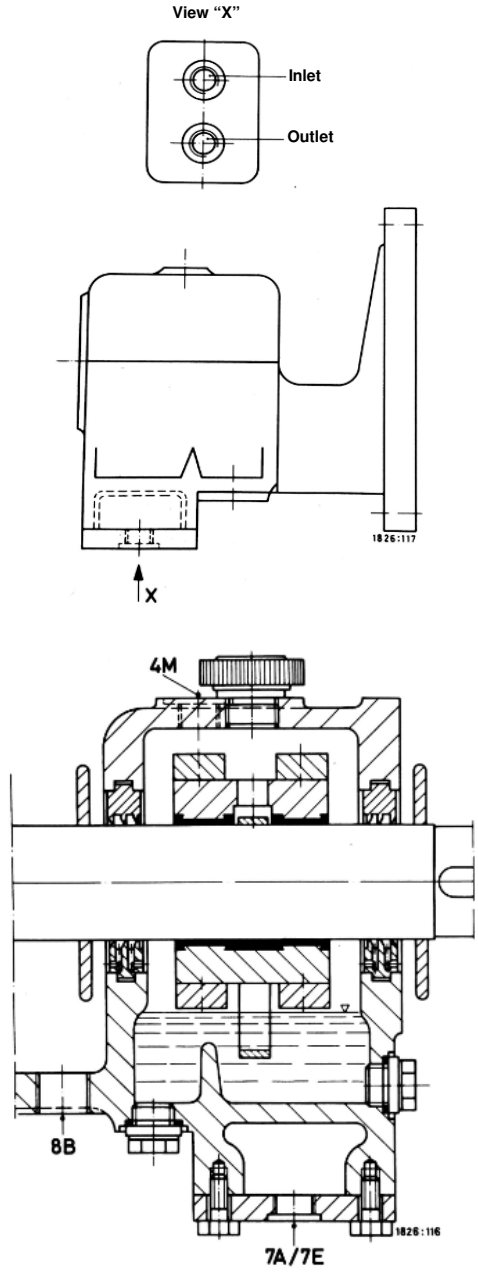


Figure 20A - Valid only for HDA 125 with finned bearing housing (GRE)



CONNECTIONS	DESIGNATION
4M	TEMPERATURE MEASUREMENT POINT
7A	COOLING WATER OUTLET
7E	COOLING WATER INLET
8B	DRIPPING WATER DRAIN

Figure 21 – Bearing housing cooling

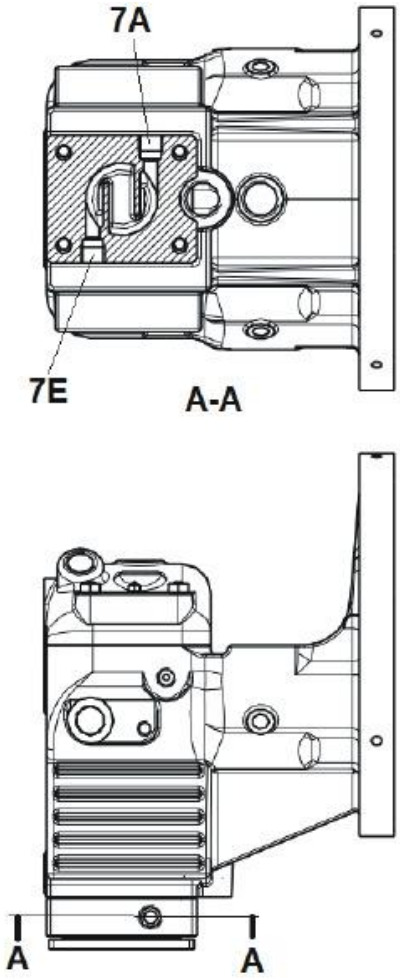


Figure 21A - (Valid only for HDA 125 with finned bearing housing (GRE))

10.5.2 Lift-off device

For speeds below 50% of nominal speed, with discharge pressure below 25% of pressure at operating point or below 15 bar, the axial thrust balance device (balance disc and balance disc seat) is roughly without any effect i.e. disc and balance disc seat would have metallic contact. In order to avoid the wear of these parts it is necessary to limit the pump speed to a minimum speed in case of automatic regulation. During start-up and shutdown it is unavoidable to cross the speed ranges mentioned above (for example more than one time a day in case of electric motor, or in case of turbine driven pump, when the turbine operates for a long time period of time in low speed) it is recommended to use a lift-off device.
The aim of this device is to avoid metallic contact between disc and balance disc seat and to balance axial hydraulic thrust which occurs in low speeds.
Depending on the pump size and speed there are two types of lift-off device i.e. execution with roller bearings (figure 22) and with segment bearings (figures 23 and 24). For plain bearings with forced feed lubrication the device shall be used as shown on figures 23 and 24.These executions require pressurized oil and consumption according to Table 6.

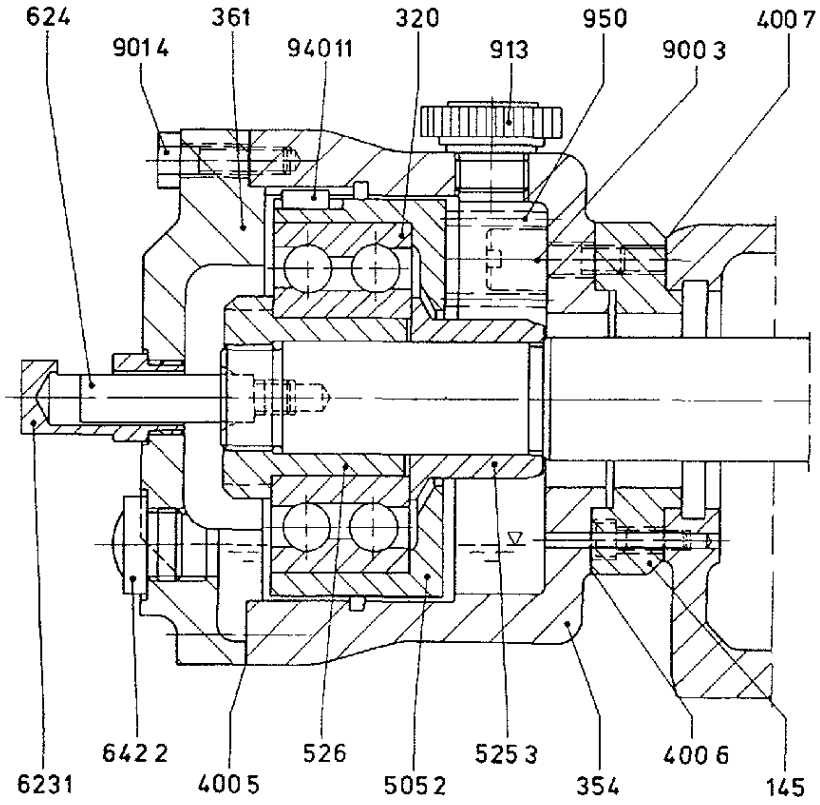


Figure 22 — Lift-off device with roller bearings for pumps with plain bearings

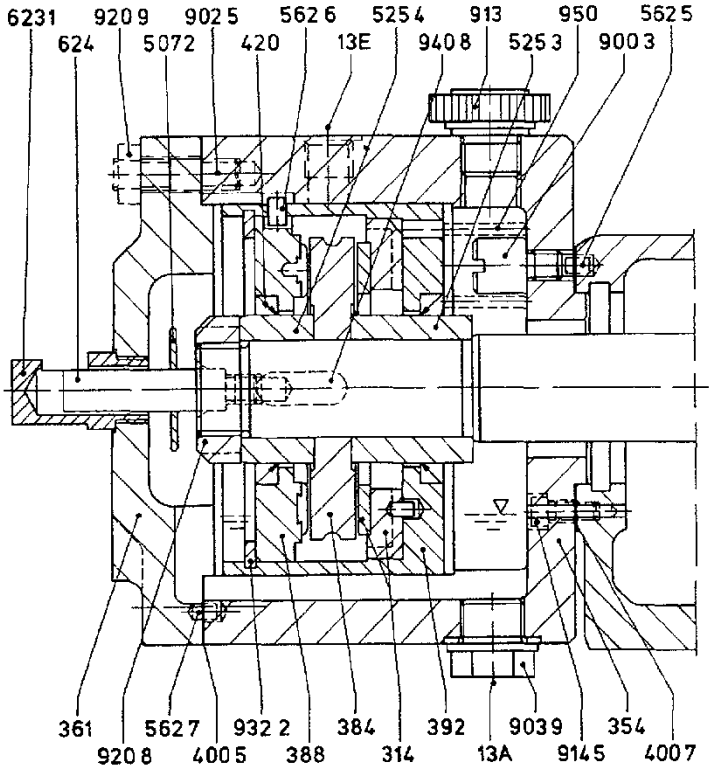


Figure 23 — Lift-off device with forced feed lubrication for pumps with plain bearings

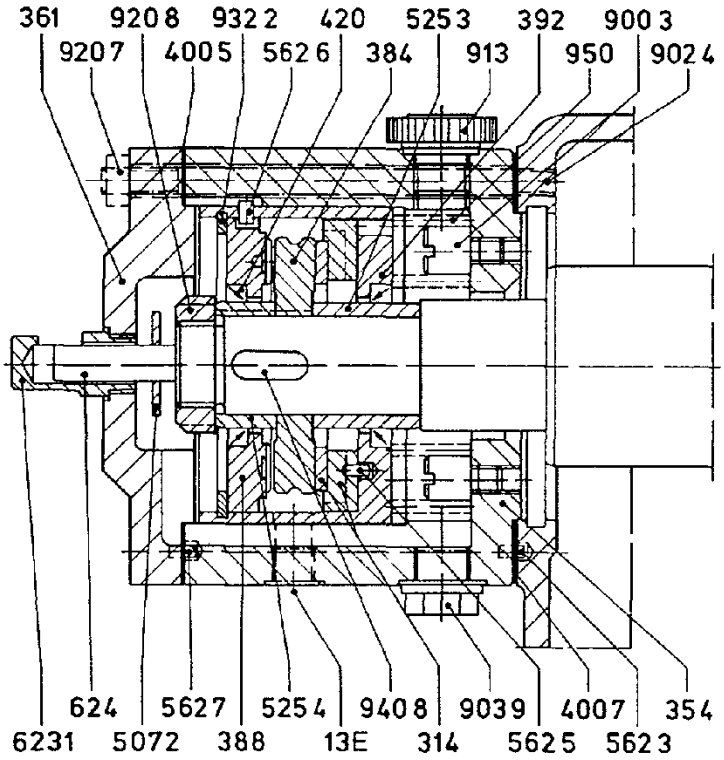


Figure 24 — Lift-off device with forced feed lubrication for pumps with plain bearings (only HDA 150).

Parts qty. per pump	Part nº	Description	Lift-off device					
			Execution with roller bearing			Execution with segment bearings		
			Pump with roller bearing			Pump with plain bearing		
			Fig. 22	Material	WSZ	Fig. 23 and 24	Material	WSZ
			Material		(internal)	Material		(internal)
			DIN 17007			DIN 17007		
1	145	Adapter	10.033	SAE1045	260	-	-	-
2	160.2	Cover	-	-	-	-	-	-
1	314	Thrust bearing	-	-		-	St/Lg Sn 80	9801
1	320	Roller bearing	-	Steel	-	-	-	-
1	354	Thrust bearing housing	0.6025	A48Cl30	1821	0.6025	A48Cl30	1821
1	361	Bearing end cover	0.6025	A48Cl30	1821	0.6025	A48Cl30	1821
1	384	Thrust bearing plate	-	-	-	1.0542.6	AISI 420	361
1	388	Balance disc seat plate	-	-	-	1.0542.6	St/Lg Sn 80	361
1	392	Bearing segment carrier	-	-	-	1.0542.6	SAE1045	361
1	400.5[3)]	Gasket	-	Hydraulic Cardboard	5126	-	Hydraulic Cardboard	5126
1	400.6	Gasket	-	Hydraulic Cardboard	5126	-	-	-
1	400.7	Gasket	-	Hydraulic Cardboard	5126	-	Hydraulic Cardboard	5126
2	420	Shaft seal ring	-	-	-	-	Steel/NB	9801
1	505.2	Loose collar	-	AISI 420	7501	-	-	-
1	507.2	Thrower	-	-	-	-	AISI 316	-
1	525.3	Spacer sleeve	-	AISI 420	7501	-	AISI 420	1812
1	525.4	Spacer sleeve	-	-	-	-	AISI 420	1812
1	526	Centering sleeve	-	Steel	7501	-	-	-
3	562.3	Cylindrical Pin	-	-	-	-	SAE1045	-
1	562.5	Cylindrical Pin	-	-	-	-	SAE1045	-
2	562.6	Cylindrical Pin	-	-	-	-	SAE1045	-
2	562.7	Cylindrical Pin	-	-	-	-	SAE1045	-
1	623.1	Shaft position indicator	-	Brass	353	-	Brass	353
1	624	Pin wear indicator	-	SAE1020	353	-	SAE1020	353
1	642.2	Oil level sight glass	-	Brass/Glass	-	-	-	-
2	672	Venting device	-	Aluminum	-	-	Aluminum	-
8	900.3	Screw	-	SAE1045	353	-	SAE1045	353
8	901.4	Hexagon head bolt	-	SAE1045	-	-	-	-
4	902.4[1)]	Stud	-	-	-	-	SAE1045	-
4	902.5[2)]	Stud	-	-	-	-	SAE1045	-
4	902.7	Stud	-	-	-	-	-	-
1	903.4	Screwed plug	-	-	-	-	-	-
1	903.9	Screwed plug	-	-	-	-	Steel	-
4	920.7[1)]	Nut	-	-	-	-	SAE1045	-
4	920.8	Nut	-	-	-	-	SAE1045	-
4	920.9[2)]	Nut	-	-	-	-	SAE1045	-
4	920.14	Nut	-	-	-	-	-	-
1	920.15	Nut	-	-	-	-	-	-
1	932.2	Circlip	-	-	-	-	Spring Steel	-
1	940.8	Key	-	-	-	-	AISI 420	-
1	940.11	Key	-	AISI 420	-	-	-	-
8	950	Spring	-	Spring Steel	-	-	Spring Steel	-

1) Only for size 150
2) Only for sizes 40 to 125
3) For pressure segment bearings 2 parts
Recommended spare parts

13A Oil outlet
13B Oil outlet
13E Oil inlet

Table 5 — Materials for lift-off device

10.5.3 Lubrication types

10.5.3.1 Execution with plain bearings = lubrication with oil ring or forced feed lubrication

For bearings with forced feed lubrication it is recommended to change the oil every 8000 hours of operation or after maximum two years. For plain bearing and oil ring lubrication it is recommended to carry out first oil change after 500 hours of operation, and the next oil changes after 8000 hours or within maximum 1 year.
The oil control in the reservoir or the strainer control of the lube oil system must be performed monthly.
Figure 25 and table 6 show the size and the position of the connections of the bearing housing.
In case of pump driven by steam turbine, the oil feed can be provided by the turbine lube oil system.
In case of pump driven by electric motor, a lube oil system only for the electric motor must be provided separately with block construction which consists in oil reservoir and gear pump driven by electric motor, with heat exchanger, oil filter, internal piping, pressure switches, accessories and instrumentation. The lube oil system installation is set to turn on the main electric motor with the pressure switch right after the oil pump motor starts to operate.

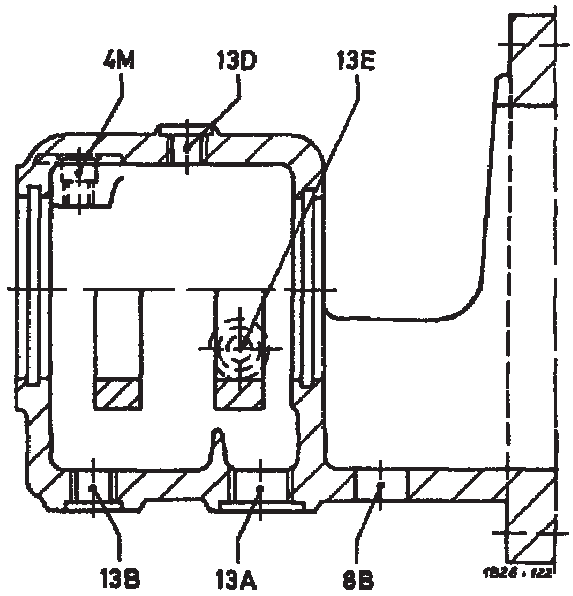


Figure 25 - Connections

Pump Size	Oil			Connection for temperature control 4M	Vent plug cover 13D	Dripping outlet 8B
	Inlet 13E	Outlet 13A	Drain 13B			
40	R ¼"	R ¾"	R ½"	R $^{3}/_{8}$"	R ½"	R ½"
50	R ¼"	R ¾"	R ½"	R $^{3}/_{8}$"	R ½"	R ½"
65	R ¼"	R ¾"	R ½"	R $^{3}/_{8}$"	R ½"	R ½"
80	R ¼"	R ¾"	R ½"	R $^{3}/_{8}$"	R ½"	R ½"
100	R $^{3}/_{8}$"	R ¾"	R ½"	R $^{3}/_{8}$"	R ½"	R ½"
125	R $^{3}/_{8}$"	R 1"	R ½"	R $^{3}/_{8}$"	R ½"	R ½"
150	R $^{3}/_{8}$"	R 1"	R ½"	R $^{3}/_{8}$"	R ½"	R ¾"

Table 6 — Bearing housing connections for lube oil system for plain bearings

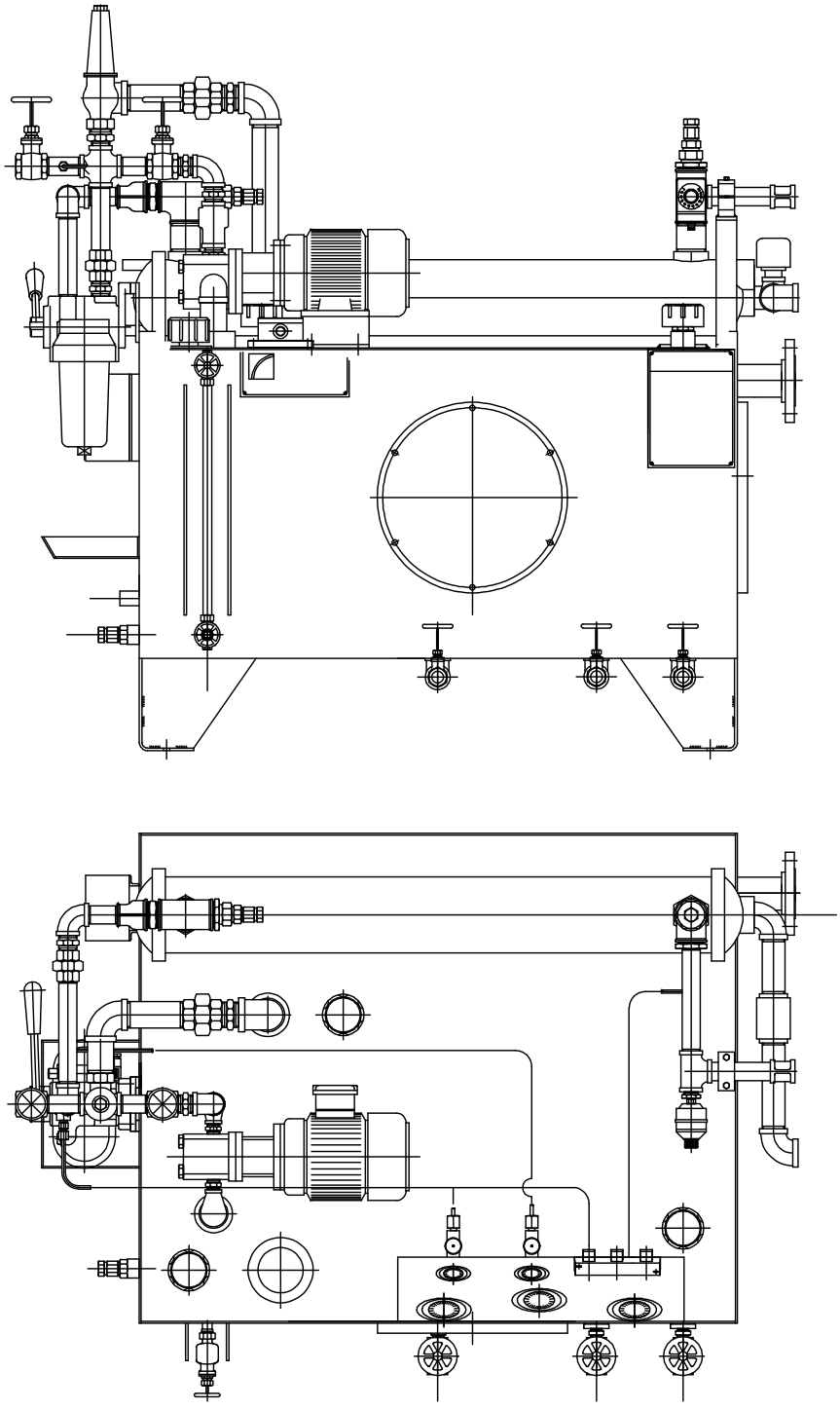


Figure 26 – Lube oil system (example)

Pump Size	Lube oil system pump flow consumption (l/s)	
	Without lift-off device	With lift-off device
40, 50, 65 and 80	0.083	0.166
100, 125 and 150	0.166	0.333

Table 7 — Lube oil system according to pump size and execution

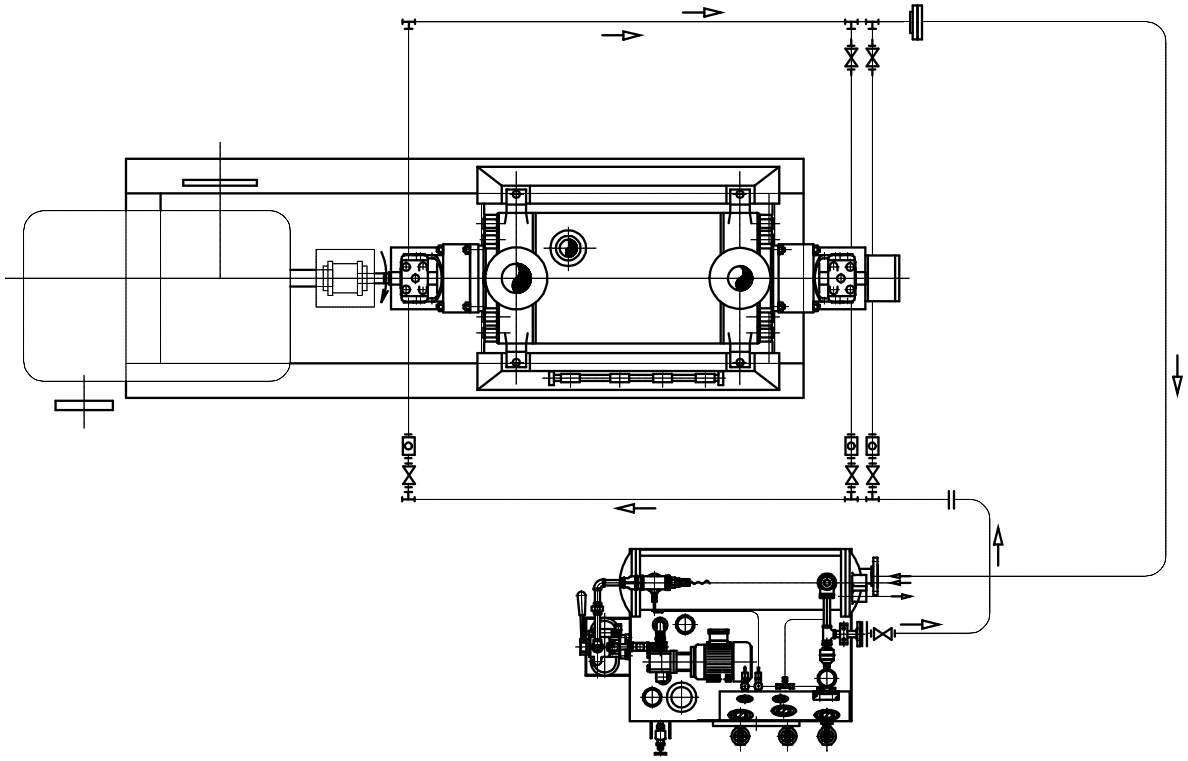


Figure 27 — Lube oil system at the side of the pump for pump bearings lubrication only

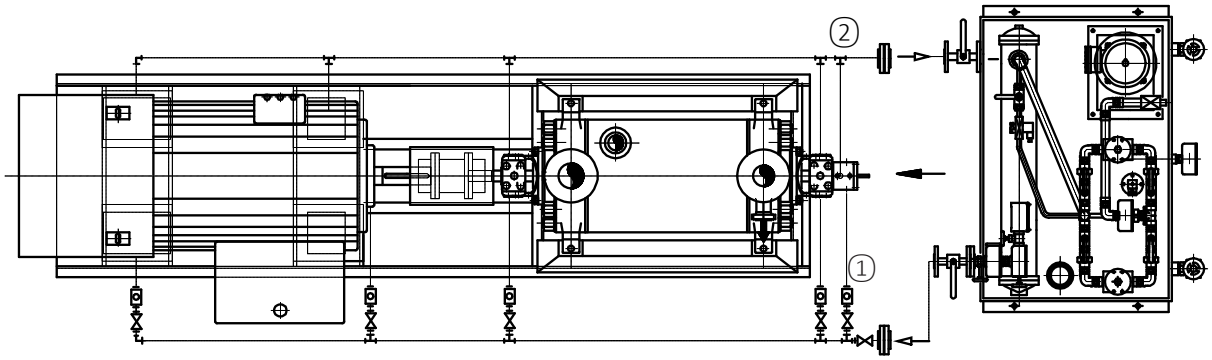


Figure 30 — Lube oil system behind the pump, for lubrication of the pump bearings, or gearbox or electric motor bearings

Pump Size	For maximum oil flow consumption	Connections for oil piping PN 6 ①	Connections for oil return piping PN 6 ②
40 e 50	0.133 l/s	R ¾"	R 2"
65 e 80	0.150 l/s	R ¾"	R 2"
100	0.200 l/s	R 1"	R 2"
125	0.266 l/s	R 1"	R 2"
150	0.300 l/s	R 1"	R 2"

① The numbers 1 and 2 refer to the position of the connections shown on figures 27 and 28.

Table 10 – Oil piping

10.6 Shaft sealing

10.6.1 Gland packing

The standard gland packing material for hot water application is PTFE with graphite. There are 4 packing rings on each side.
The gland packing leakage shall be of approximately 10 to 20 ml/min depending on the sealing conditions.

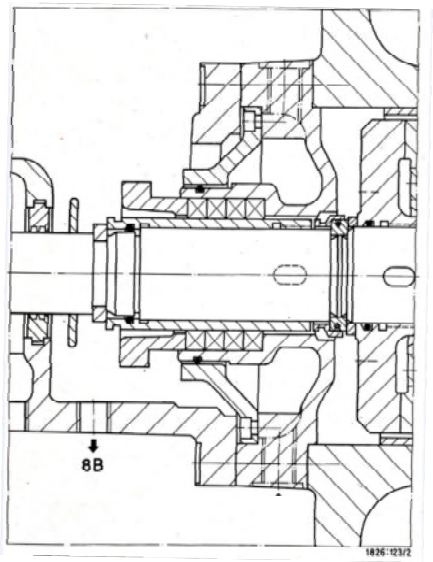


Figure 29 – Standard execution with gland packing
(from –5ºC to 105ºC)

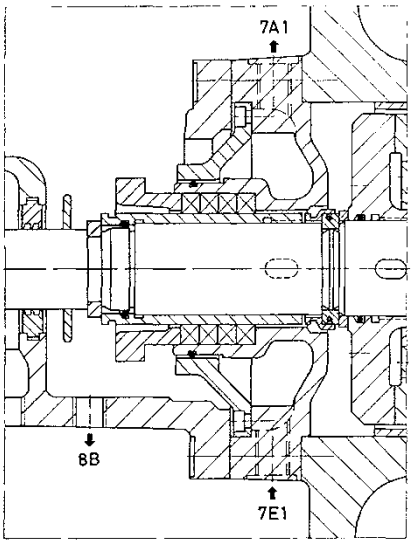


Figure 31 — Standard execution with gland packing
(from 105ºC to 150ºC)

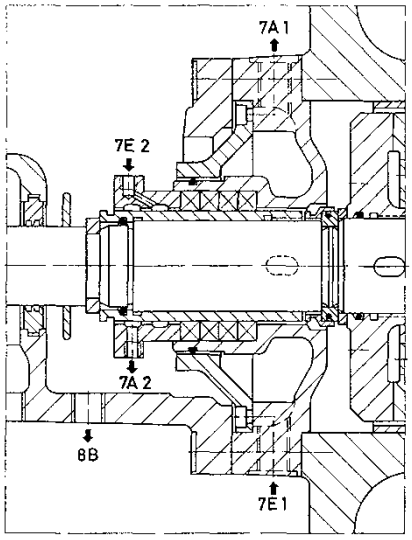


Figure 32 — Gland packing execution with cooling
for temperatures > 150ºC

Pump Size	Seal chamber dimensions (mm)	Gland packing rings		Length	
		Quantity	☐ mm	per ring (mm)	total (mm)
40 and 50	Ø 45/ 65 x 45	4	10	180	720
65 and 80	Ø 66/ 90 x 50	4	12	255	1020
100	Ø 70/ 95 x 50	4	12	265	1060
125	Ø 80/ 105 x 50	4	12	300	1200
150	Ø 101/ 125 x 53	4	12	365	1460

Table 9 — Seal chamber and packing gland dimensions

Gland packing friction losses

The gland packing losses are determined by the acceleration power shown on Figure 32.

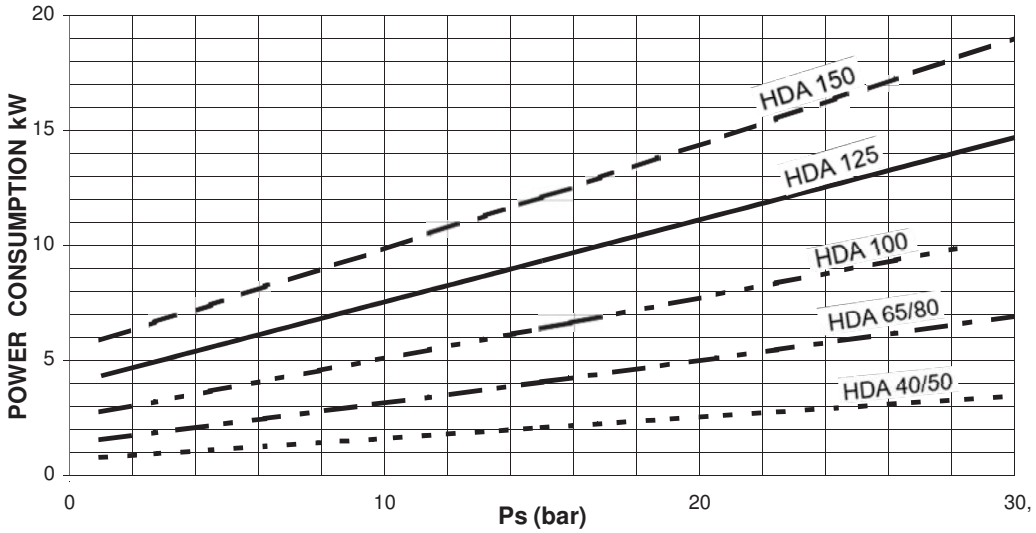


Figure 32 – Power losses by gland packing (per pump)

Caution: For other speeds the losses are calculated according to the speed ratio.

10.6.2 Mechanical Seal

The shaft sealing by mechanical seal and sealing plan shall be agreed between KSB, the customer and the seal supplier. As a reference, the table below indicates its common applications:

Pumped medium	Temperature	Seal plan	Mechanical seal type
Water	167ºC	21 / 61	J.C.8B1T
Water	122ºC	02	01-H75G115 BdB
Water	145ºC	02	01-H75G115 BdB
Water	145ºC	11	J.C.8B1T
Water	167ºC	21	J.C.8B1T
Water	40ºC	32	J.C.8B1T-0

Table 10

10.7 Cooling

10.7.1 Shaft sealing by gland packing

Clean water without shall be used for gland packing cooling. It shall not contain solids that may cause pipe clogging with time, for example: condensate.

10.7.1.1 Pumped medium temperature between 106ºC and 150ºC

FEED

RETURN

BLOCK VALVE

GATE VALVE

SIGHT FLOW INDICATOR

COLLECTING TANK

SUPPLYING AND ASSEMBLY LIMITATION (KSB)

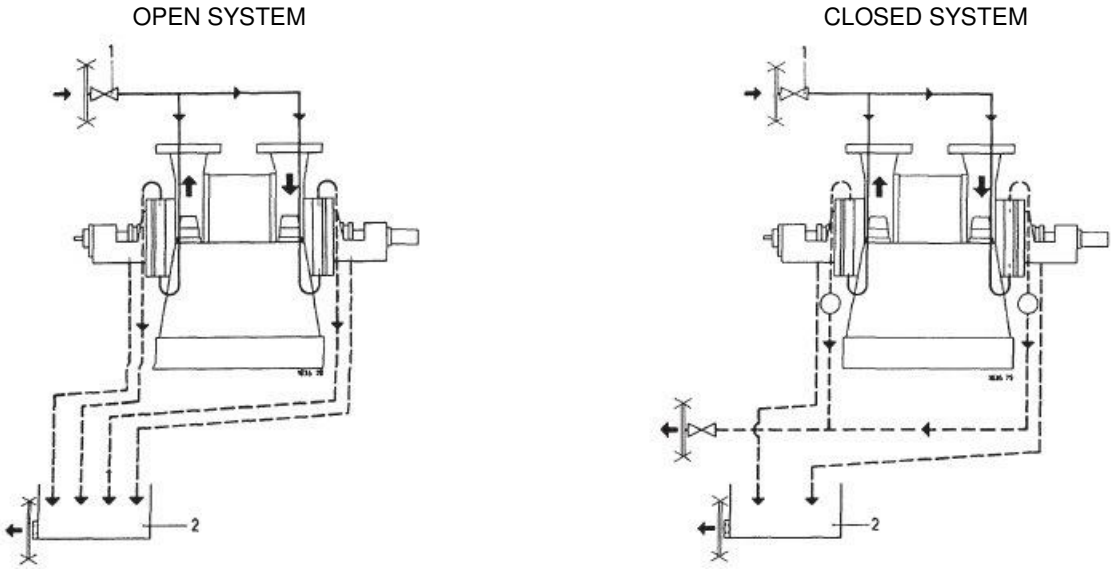
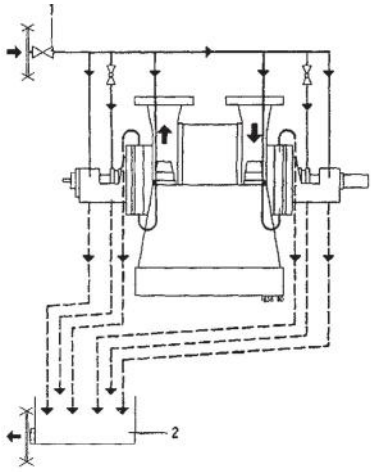


Figure 33 – Stuffing box cooling

10.7.1.2 Pumped medium temperature above 150ºC

OPEN SYSTEM



CLOSED SYSTEM

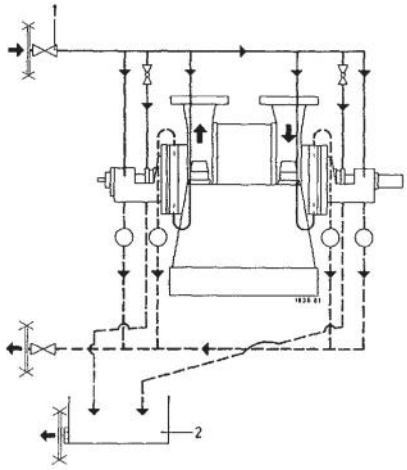


Figure 34 — Gland packing cooling, gland follower and bearing

Remark: Bearing cooling only for ambient temperature > 45ºC and medium temperature > 150ºC

Open system

Pump Size	Block valve 1) internal thread	Collecting container 2) of waste water
40	R1"	R1"
50	R1"	R1"
65	R1¼"	R1"
80	R1¼"	R2"
100	R1¼"	R2"
125	R1½"	R3"
150	R1½"	R3"

Closed system

Pump Size	Block valve 1) internal thread	Collecting container 2) of waste water
40	R1"	R1"
50	R1"	R1"
65	R1¼"	R1"
80	R1¼"	R1"
100	R1¼"	R1"
125	R1½"	R1"
150	R1½"	R1"

Table 11 — Connections for gland packing cooling of figures 33 and 34

10.7.2 Shaft sealing by Mechanical Seal

The required and suitable cooling must be agreed between KSB, the customer and the seal supplier. There are the following cooling arrangements as a reference:

10.7.2.1 With seal flushing plan and without cooling (from -5 ºC up to +70ºC)

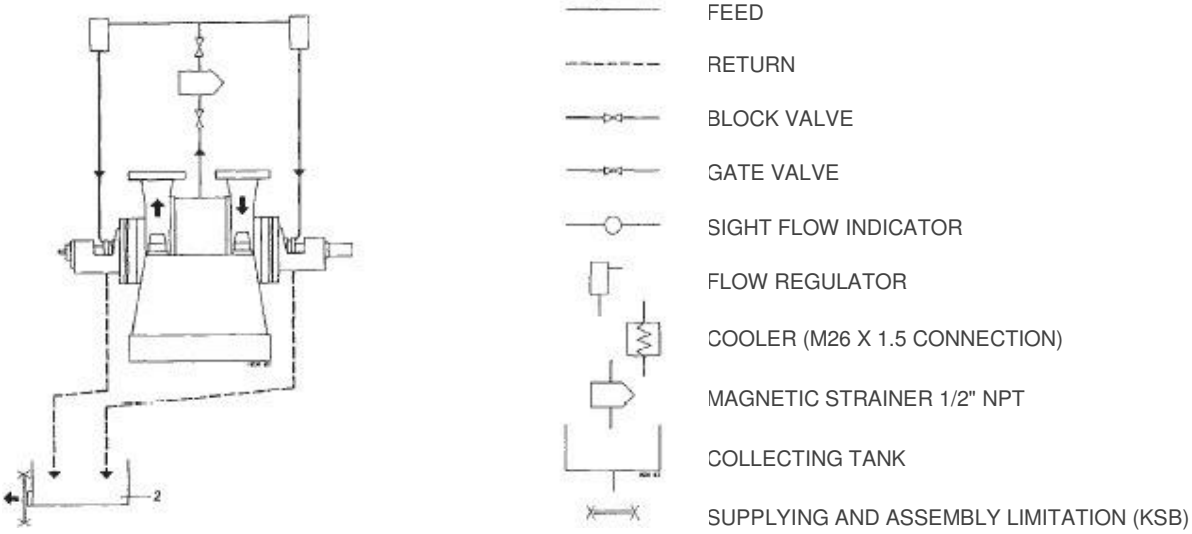


Figure 35 - Cooling with extraction and seal flushing plan

10.7.2.2 Without seal flushing plan and with seal chamber cooling (from 71 up to 120ºC)

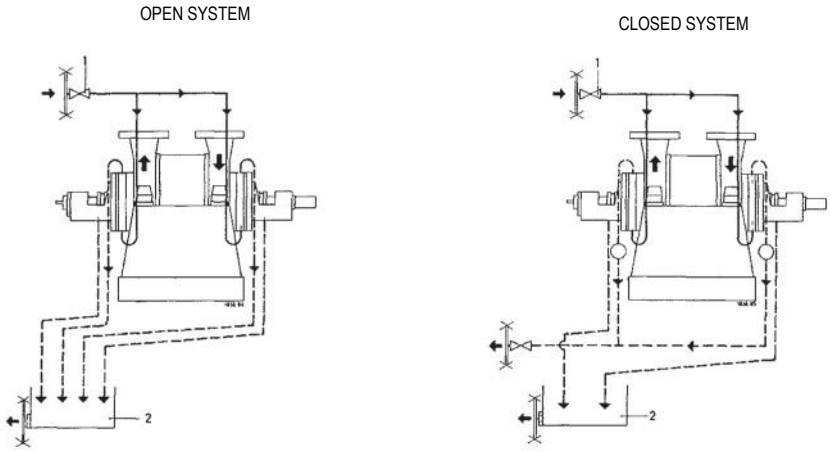


Figure 36

10.7.2.3 With seal chambers cooling and mechanical seals in parallel

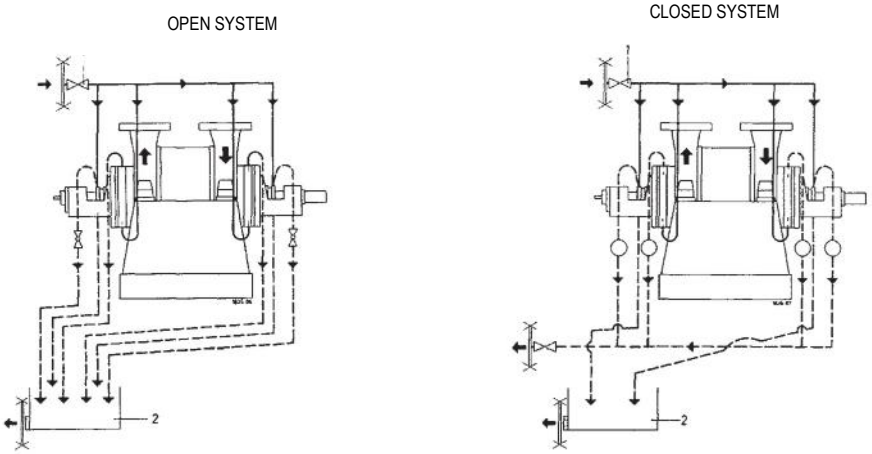


Figure 37

10.7.2.4 For ambient temperature > 45 ºC and a pumped medium temperature > 150ºC and up to 180ºC an additional cooling of bearing housings is required (see figure 37).

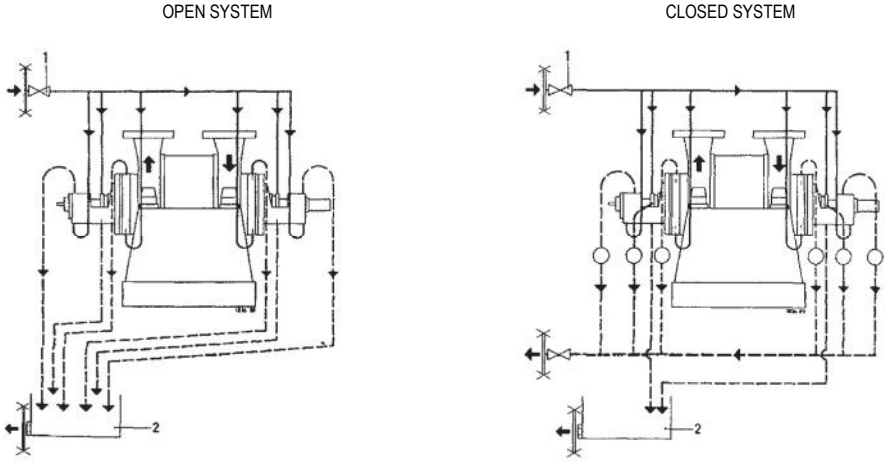


Figure 38

10.7.2.5 With seal flushing plan to a heat exchanger for each mechanical seal and seal chamber cooling at the following temperature conditions:

For sizes HDA 40 up to 100, T = 181 up to 230 ºC, see figure 40
For sizes HDA 125 and 150, T = 181 up to 200 ºC, see figure 40
For ambient temperature > 45 ºC additional cooling of bearing housings is required. See Figure 39.

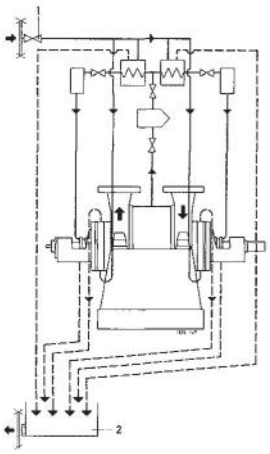


Figure 39

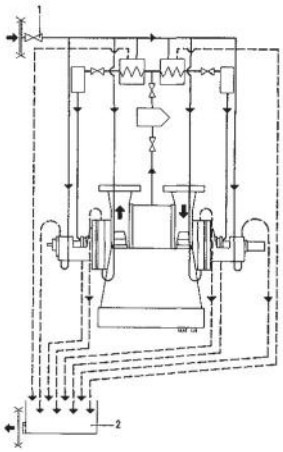


Figure 40

Open system

Pump Size	Block valve 1) internal thread	Collecting container 2) of waste water
40	R1"	R1"
50	R1"	R1"
65	R1¼"	R1"
80	R1¼"	R2"
100	R1¼"	R2"
125	R1½"	R3"
150	R1½"	R3"

Closed system

Pump Size	Block valve 1) internal thread	Collecting container 2) of waste water
40	R1"	R1"
50	R1"	R1"
65	R1¼"	R1"
80	R1¼"	R1"
100	R1¼"	R1"
125	R1½"	R1"
150	R1½"	R1"

Table 12 — Cooling connections of figures 34 to 39

The required cooling water flow is indicated on Figure 41. In this diagram the heating of a cooling liquid of Δt = 10 ºC was considered. When the temperature Δt changes, the cooling liquid quantity can be calculated with this formula:

$$\frac{10.Q}{\Delta t} = \text{effective cooling liquid quantity}$$

Cooling liquid temperature at the outlet shall not exceed 50ºC. The values on the diagram shall have an increase of approximately 10% for the gland follower cooling.
Add 10% for bearing cooling.

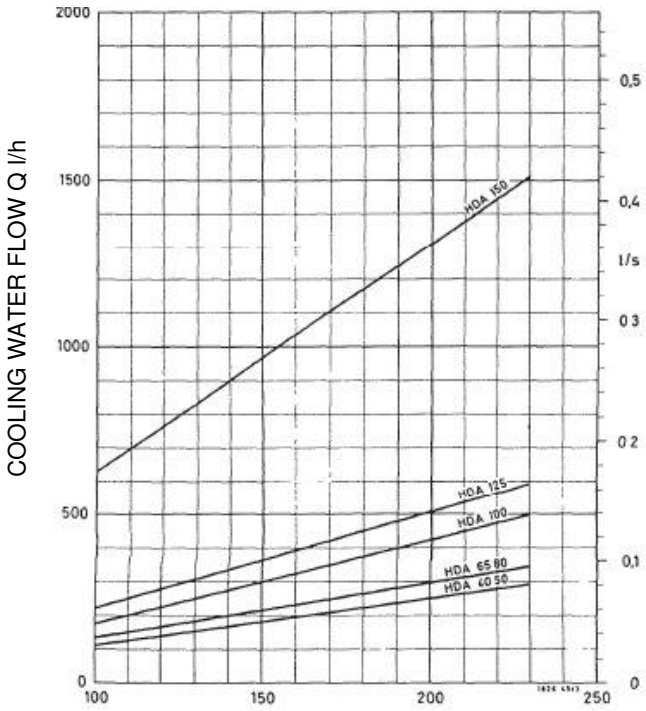


Figure 41 – Cooling liquid

10.8 Heating chamber

Stuffing box, execution with hot water

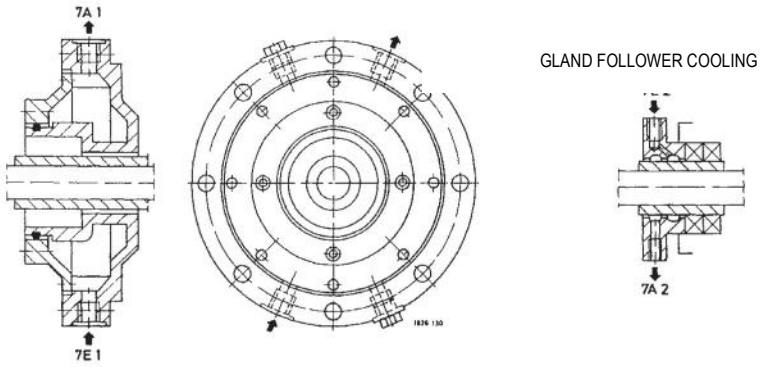


Figure 42

10.9 Inertia

Figure 43 shows the moment of inertia curve during start-up with closed valve. The moment of inertia during start-up will be approximately 10% of the nominal moment of inertia.

A - pump start-up to maximum speed
B - valve opening
C - open valve

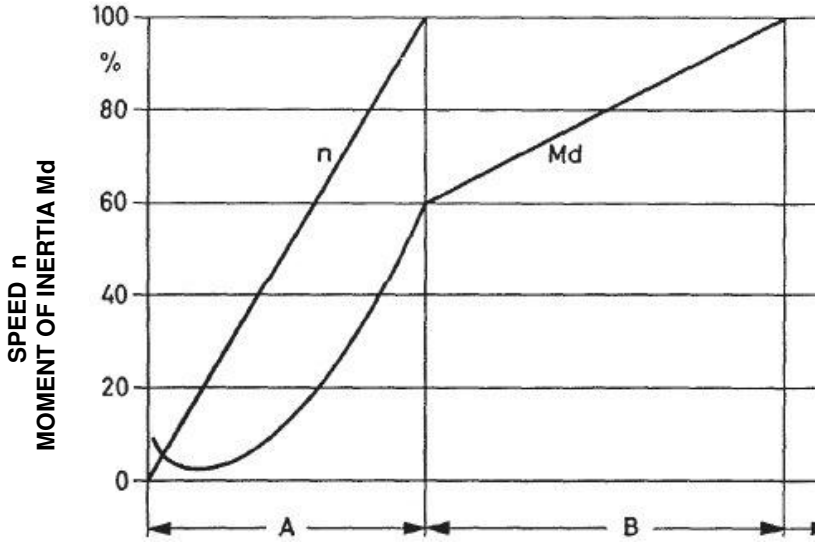


Figure 43 – Moment of inertia curve during start-up

10.10 Drive

The transmission can be direct with flexible coupling or indirect with gearbox and flexible coupling connected to the electric motor, steam turbine or internal-combustion motor. The power margin shall be 15% for power of up to 50 kW and of 10% for power above 50 KW.

10.11 Couplings

Usually flexible couplings with spacer are be used with HDA pumps. It avoids the need of dismantling the pump or driver from the baseplate to check the bearings or the shaft protection sleeve.
Required length for spacer is indicated in Table 13.

Pump Size	Spacer length
40 - 80	140 mm
100	150 mm
125	210 mm
150	230 mm

Table 13 - Minimum length required for flexible coupling spacer

10.11.1 Coupling guard

The coupling guard size depends on the coupling size and shall be fastened on the baseplate.

10.11.2 Baseplates

With robust construction they are usually designed to support the pump and the driver on the same skid. They are designed according to the project.

11. Materials

The standardized materials variants are provided on Table 15, according to the pumped medium type.

11.1 Directives for materials selection for boiler feedwater pumps

11.1.1 General Rules

- Pressure limit
Above 100 bar at operating point cast chrome steel material shall be used for casing and internal parts (variant 04).

- Speed limit
Up to n = 3600 rpm (for HDA125 and 150 up to 3000 rpm). For higher speeds, material variant 04 shall be used.

- Water for boiler feed
Water shall be free of abrasive solids.

- pH value
Feedwater with pH values between 7.0 and 10.5 (for 20 ºC)

- Feedwater temperature
The maximum temperature of the feedwater is 230 ºC

- Water preparation
There are two processes for feedwater preparation:
- total desalination: demineralized boiler feedwater
- partial desalination: boiler water (prepared with low hardness residue, maximum chlorine content of 150 ppm, sulphate maximum content of 100 ppm).

Remark: The feedwater pumps material for nuclear plants is usually cast chrome steel.

- Oxygen content
The maximum oxygen content shall be is 0,03 ppm O_2, for continuous operation of 0,02 ppm O_2, these values shall not be exceeded.
The maximum oxygen content shall be accurately considered for all operating conditions before the pump inlet (start-up and shutdown). Higher oxygen contents are more corrosive, especially for feedwater with partial desalinations.

Maximum dissolved oxygen content		< 0.02 ppm (short time ≤ 0.03 ppm)	<0.03 ppm (short time ≤ 0.04 ppm)
Preparation		Partial desalination	Total desalination
pH for 20 ºC	≥ 9.3	01. 02 or 03	01 or 02
	≥ 8.5		03
	≥ 7.0	04	04

Table 14 – Material selection, based on dissolved oxygen concentration

Caution: For unfavorable operation (intermittent, high switching-frequency, etc.) or when the oxygen content and pH-value are not controlled, due to the lack of equipment/instruments, or lack of overview of personnel surveillance, superior material variant must be selected.

Dimension:
1 ppm (part per million) = 1 mg/l (for density = 1)

- Operation type
Intermittent operation (many start-ups), with shutdown during the weekend (risk of oxygen enrichment inside the installations with thermal degassing) and when the unit will operate many times with partial load, there is a risk of erosion-corrosion.
Continuous operation with spare pump to start operation immediately (approximately 1 time/month) is the preferred operation type.
For start-up in new installations the feedwater pumps must be protected against shutdown corrosion (operation disturbances during start-up allow oxygen presence in the system).

12. Material variants

Part	Description	Qty	01	02	03	04
106	Suction casing	1	A48 CL30	A216 Gr. WCB	A216 Gr. WCB	A743 CA6NM
107	Pressure casing	1	A216 Gr. WCB	A216 Gr. WCB	A216 Gr. WCB	A743 CA6NM
108.1	Stage casing	S-1	A216 Gr. WCB	A216 Gr. WCB	A216 Gr. WCB	A743 CA6NM
65	Cooling chamber cover	2	A48 CL30	A216 Gr. WCB	A748CF8M	A743 CA6NM
171.1	Diffuser	S-1	A48 CL30	A216 Gr. WCB	A748CF8M	A743 CA6NM
171.2	Last stage diffuser	1	A48 CL30	A216 Gr. WCB	A743 CF8M	A743 CA6NM
210	Shaft 1)	1	SAE1045/ chrome	SAE1045/ chrome	SAE1045/ chrome	SAE1045/ chrome
230	Impeller	S-1	A48 CL30	A216 Gr. WCB	A743 CF8M	A743 CA6NM
231	Suction impeller	1	A48 CL30	A216 Gr. WCB	A743 CF8M	A743 CA6NM
400.1	Gasket	1	Klingersil	Klingersil	Klingersil	Klingersil
400.2	Gasket	2	Klingersil	Klingersil	Klingersil	Klingersil
411.3	Joint ring	2	Cu	Cu	Cu	Cu
412.1	O' Ring	5	Viton70	Viton70	Viton70	Viton70
412.2	O' Ring	1	Viton70	Viton70	Viton70	Viton70
412.3	O' Ring	2	Viton70	Viton70	Viton70	Viton70
412.4	O' Ring	2	NB80	NB80	NB80	NB80
412.5	O' Ring	2	Viton70	Viton70	Viton70	Viton70
451	Stuffing box housing	2	A48 CL35	A216 Gr. WCB	A216 Gr. WCB	A743 CA6NM
452.1	Gland follower w/o cooling	2	G-CUSN10	G-CUSN10	G-CUSN10	G-CUSN10
461	Gland packing	2	Teflon with graphite			
501	Split ring	1	AISI 420	AISI 420	AISI 420	AISI 420
502.1	Casing wear ring / suction stage	1	AISI 420	AISI 420	AISI 420	AISI 420
502.2	Casing wear ring	S-1	AISI 420	AISI 420	AISI 420	AISI 420
504.1	Spacer ring	1	AISI 420	AISI 420	AISI 420	AISI 420
505.1	Loose collar	1	AISI 420	AISI 420	AISI 420	AISI 420
507.1	Thrower	2	AISI 316	AISI 316	AISI 316	AISI 316
512	Wear ring for balance disc and balance disc seat assembly	1	AISI 316	AISI 316	AISI 316	AISI 420
521	Stage sleeve	S-1	AISI 420	AISI 420	AISI 420	AISI 420
524.1	Shaft protecting sleeve / suction side	1	AISI 420	AISI 420	AISI 420	AISI 420
524.2	Shaft protecting sleeve / pressure side	1	AISI 420	AISI 420	AISI 420	AISI 420
525.1	Spacer sleeve / suction side	1	AISI 420	AISI 420	AISI 420	AISI 420
525.2	Spacer sleeve / pressure side	1	AISI 420	AISI 420	AISI 420	AISI 420
540	Sleeve/ pressure side only sizes 125 and 150	1	AISI 420	AISI 420	AISI 420	AISI 420
541	Interstage sleeve for sizes 125 and 150	S-1	AISI 420	AISI 420	AISI 420	AISI 420
550.1	Washer	16	SAE1020	SAE1020	SAE1020	SAE4140
601	Balance disc	1	AISI 316	AISI 316	AISI 316	1.4024.09
602	Balance disc seat	1	AISI 420	AISI 420	AISI 420	RWA 350
680	Guard	1	SAE1020	SAE1020	SAE1020	SAE1020
702	Balance line piping	1	STEEL	STEEL	STEEL	STEEL
900.1	Allen grub screw	4	AISI 316	AISI 316	AISI 316	AISI 316
902.1	Stud	2	SAE1045	SAE1045	SAE1045	SAE1045
902.2	Stud	4	AISI 316	AISI 316	AISI 316	AISI 316
905	Tie bolt	8	A193 Gr.B7	A193 Gr.B7	A193 Gr.B7	A193 Gr.B7
914	Socket head cap screw	8	AISI 316	AISI 316	AISI 316	AISI 316
920.1	Washer	16	A194 Gr.2H	A194 Gr.2H	A194 Gr.2H	A194 Gr.2H
920.2	Washer	16	SAE 1020/6	SAE 1020/6	SAE 1020/6	SAE 1020/6
920.3	Washer	4	AISI 304	AISI 304	AISI 304	AISI 304
932.3	Circlip	2	SPRING STEEL	SPRING STEEL	SPRING STEEL	SPRING STEEL

1) = Check P/n. If required, use other material

= Recommended spare parts

S = no. of stages

Table 15

12.1 Clearances

Information about efficiency and head on the characteristic curves refers to a clearance of 0.3 mm between the impeller and the wear ring (material variants 01 to 03).

Chrome-steel wear rings (material variant 04) require a clearance increase to 0.4 mm, and efficiency corrections (η):

- HDA 40 up to 80: -2%
- HDA 100 up to 150: -1%

13. Forces and Moments

Piping forces and moments shall not overload the pump. When required in specific cases a pre-calculation for all forces and moments, and its possible allowable combinations shall meet the following formula:

$$320000\ D \geq \sqrt{(3F_x)^2 + (F_y)^2 + (3F_z)^2} + \frac{0,3}{D}\sqrt{(1,3Mx)^2 + (2My)}$$

Dimensions:
F in N
M in N.m
D in m

Remark: Forces and moments may load simultaneously the suction and pressure nozzles.

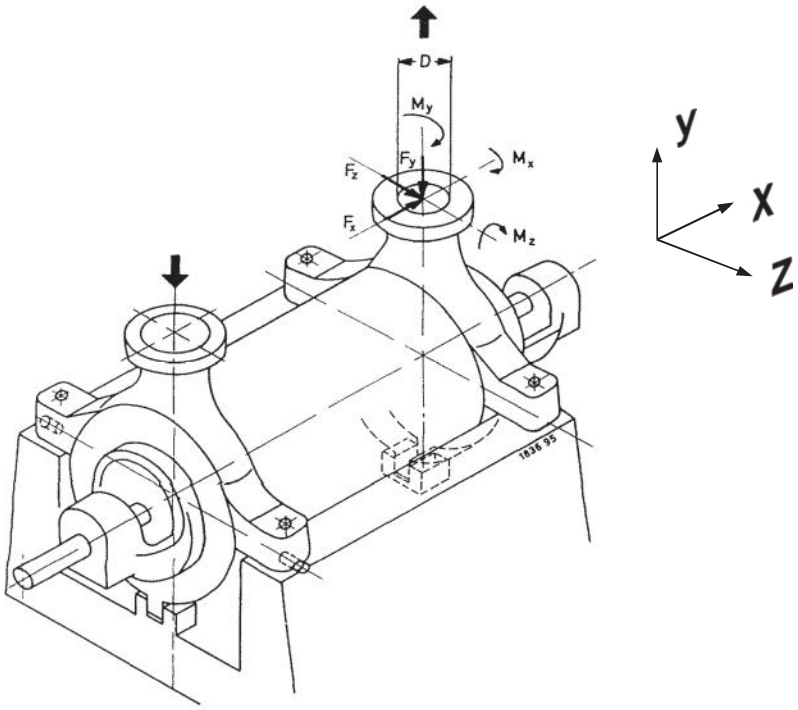


Figure 44 - Forces and moments on pump nozzles

Letter F indicates the direction of the forces and letter M indicates the direction of the moments of inertia, and letter D indicates the suction and discharge flanges diameter.

It is not recommended to fasten pump after heating the connections and pipes, as this may cause vibrations and high wear on the pump and coupling. The pump positioning and fastening of the pump and its accessories with pins shall only be made in cold condition as shown on Figure 45.

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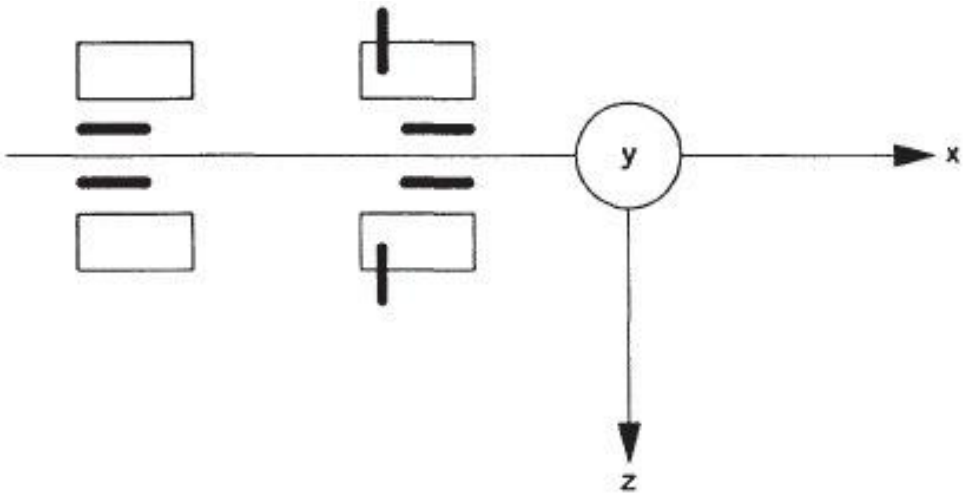


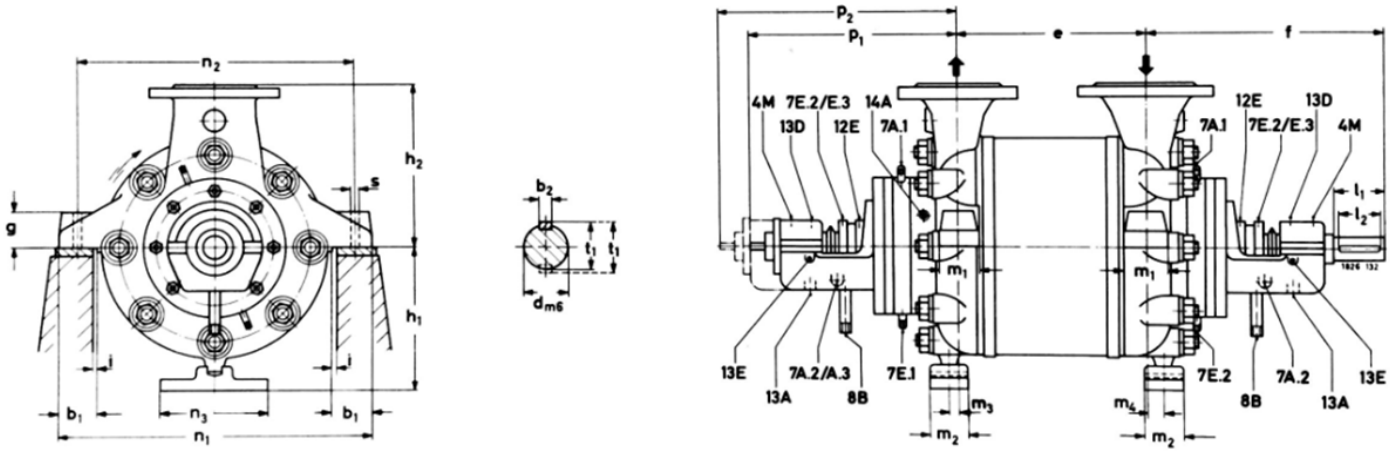
Figure 45 - Pump fastening to the baseplate by pins

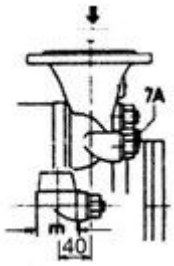
13.1. Center of gravity position
The pump center of gravity position is approximately at the half of the pump.

14. Spare parts

Recommended spare parts are indicated on the materials variants table.

15. Dimensions





Detail of suction casing foot for HDA 125 double suction

Figure 46

Dimensions in mm

Plain Bearings Execution																					
Pump Size	Suction flange	Pressure flange	Pump dimensions	e (for each stage)																	
	DN1	DN2	b_1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	f	g	h_1
40	50	40	70	186	234	282	330	378	426	474	522	570	618	666	714	762	810	858	400	50	210
50	65	50	70	199	251	303	355	407	459	511	563	615	667	719	771	823	--	--	405	50	235
65	80	65	70	240	300	360	420	480	540	600	660	720	780	840	900	960	--	--	480	60	250
80	100	80	80	240	305	370	435	500	565	630	695	760	825	890	--	--	--	--	485	60	275
100	125	100	90	290	360	430	500	570	640	710	780	850	--	--	--	--	--	--	515	60	310
125	150	125	110	335	420	505	590	675	760	845	--	--	--	--	--	--	--	--	570	80	355
125+	150	125	110	NA	460	545	630	715	800	885	--	--	--	--	--	--	--	--	665	80	355
150	200	150	120	402	498	594	690	786	882	978	--	--	--	--	--	--	--	--	630	90	395

+With double suction

Table 16

Plain Bearings Execution																		
Pump Size	Pump dimensions													Shaft end				
	h_2	i	m_1	m_2	m_3	m_4	n_1	n_2	n_3	p_1	p_2	p_2	s	b_2	d m_6	l_1	l_2	t_1
40	250	5	60	60	15	20	445	395	170	329	478	483	17	10	34	85	70	37
50	275	5	70	60	15	20	490	440	170	334	483	488	17	10	34	85	70	37
65	325	5	70	60	15	25	530	470	170	368	519	522	22	12	44	130	120	47
80	350	5	80	60	25	25	605	545	170	378	532	529	22	12	44	130	120	47
100	400	5	90	60	25	25	680	620	170	400	552	555	22	14	48	140	120	51,5
125	450	5	100	60	40	35	820	750	170	555	707	711	24	14	48	140	120	51,5
125+	450	5	100	60	40	65	820	750	170	555	707	711	24	14	48	140	120	51,5
150	500	5	120	60	40	40	920	840	170	496	647	651	33	20	74	140	120	83

+With double suction

Table 17

* With lift-off device, with roller bearings
** With lift-off device, with segment bearings

Plain Bearings Execution								
Pump Size	Connections							
	Cooling liquid							
	Stuffing box housing	Gland follower	Bearing housing cooling 7E.3/7A3	Sealing fluid	Air outlet	Pressure lubricant		Discharge liquid
	7E.1/7A.1	7E.2/7A.2		8B	13D	13E	13A	14A
40	R 3/8"	R 1/8"	R ¼"	R ½"	R ½"	R ¼"	R ¾"	R 3/8"
50	R 3/8"	R 1/8"	R ¼"	R ½"	R ½"	R ¼"	R ¾"	R 3/8"
65	R ½"	R 1/8"	R 3/8"	R ½"	R ½"	R ¼"	R ¾"	R 3/8"
80	R ½"	R 1/8"	R 3/8"	R ½"	R ½"	R ¼"	R ¾"	R ½"
100	R ½"	R 1/8"	R 3/8"	R ½"	R ½"	R 3/8"	R ¾"	R ½"
125	R ½"	R ¼"	R ¼"	R ½"	R ½"	R 3/8"	R 1"	R 1"
150	R ¾"	R ¼"	R ¼"	R ¾"	R ½"	R 3/8"	R 1"	R 1 ¼"

Table 18

16. Cross-section drawing and Parts list

16.1 Standard execution sizes 40 up to150 with plain bearings and gland packing

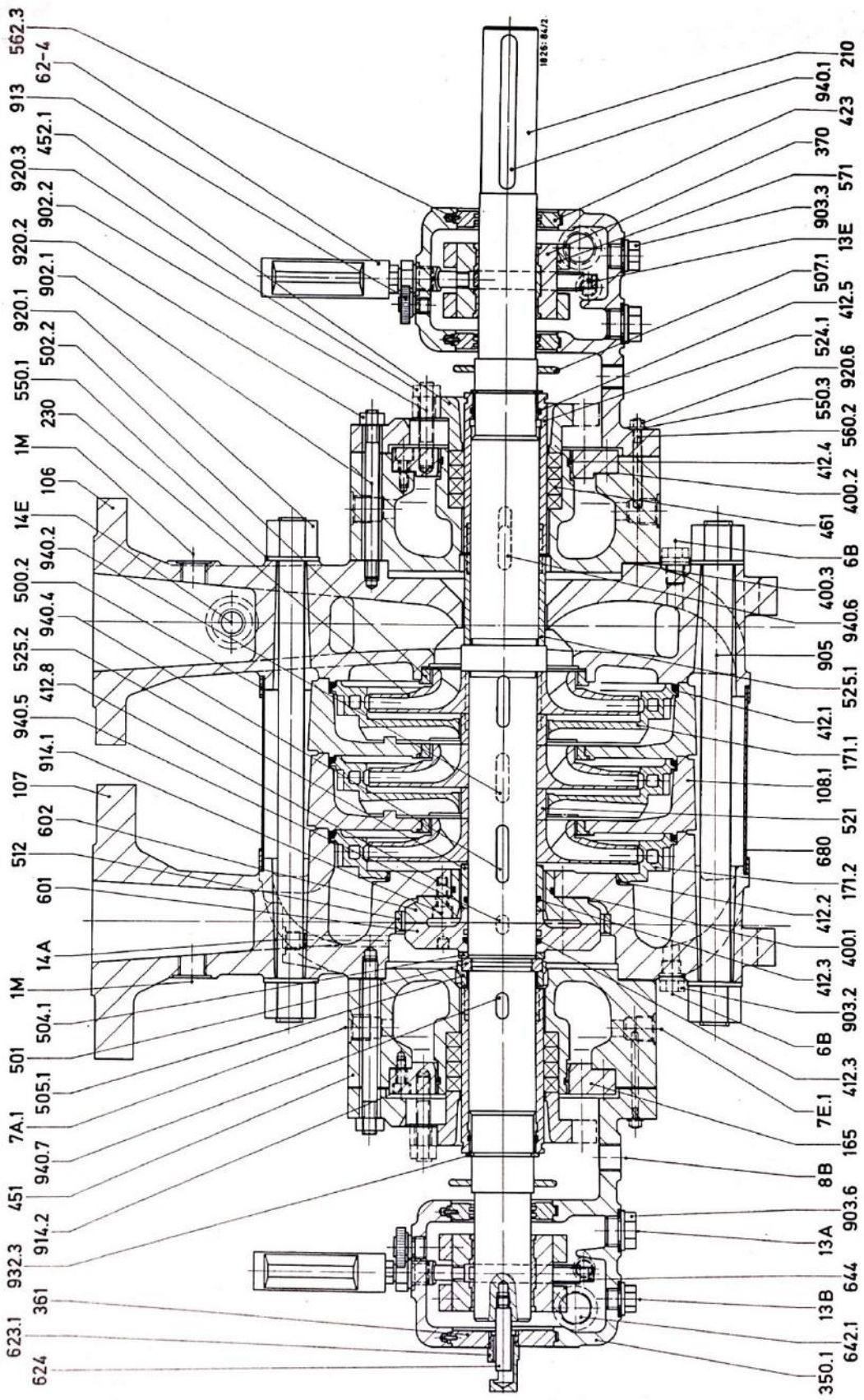


Figure 47 – Standard execution sizes 65 up to 150 with plain bearings and gland packing
(For specific details for sizes 125, see fig.50)

Standard executions sizes 40 up to 150 with plain bearings and gland packing

Parts list

Part no.	Description
106	Suction casing
107	Pressure casing
108.1	Stage casing
108.2	Stage casing with extraction
108.3	Stage casing with extraction
160.3	Cover
165	Cooling chamber cover
171.1	Diffuser
171.2	Last stage diffuser
210	Shaft
230	Impeller
350	Bearing housing
361	Bearing end cover
370	Bearing shell
400.1	Gasket
400.2	Gasket
400.3	Gasket
400.9	Gasket
412.1	O' ring
412.2	O' ring
412.4	O' ring
412.46	O' ring (GRE-HDA125 bearing)
412.5	O' ring
423	Labyrinth ring
451	Stuffing box housing
452.1	Gland follower without cooling
452.2	Gland follower with cooling
461	Gland packing
500.2	Ring
501	Segmental ring
502.1	Casing wear ring
901.46	Hex bolt (GRE-HDA125 bearing)
901.6	Hex bolt
902.1	Stud
902.2	Stud
903.2	Plug
903.3	Plug
903.6	Plug
905	Rod
913	Vent cover
914.1	Socket head cap screw
914.2	Socket head cap screw
920.1	Hexagon nut
920.2	Hexagon nut
920.3	Hexagon nut
920.6	Hexagon nut
932.3	Circlip
940.1	Key for coupling
940.2	Key for impeller
940.4	Key for last stage impeller

Part no.	Description
502.2	Casing wear ring
503.1	Impeller wear ring (only for size 150)
503.2	Impeller wear ring
504.1	Spacer ring
505.1	Loose collar
507.1	Thrower
512	Wear ring for balance disc and balance disc eat assembly
521	Stage sleeve
524.1	Shaft protection sleeve, suction side
524.2	Shaft protection sleeve, pressure side
525.1	Spacer sleeve, suction side
525.2	Spacer sleeve
525.5	Blind stage spacer sleeve
540	Sleeve
541	Stage sleeve
54-1	Blind stage sleeve
550.1	Washer
500.3	Washer
560.2	Tapered pin
562.3	Cylindrical pin
571	Clamp
601	Balance disc
602	Balance disc seat
623.1	Shaft position indicator
624	Pin wear indicator
62-4	Thermometer
642.1	Oil level sight glass
644	Oil ring
752	Cooling chamber seat (GRE-HDA125 bearing)
680	Guard
900	Screw
940.5	Key for balance disc
940.6	Key for shaft protection sleeve
940.7	Key for shaft protection sleeve
1M	Connection for pressure gauge
6B	Pump drain
7A1	Cooling liquid outlet/ stuffing box outlet
7E1	Cooling liquid inlet/ stuffing box inlet
7A2	Cooling liquid outlet/ gland follower outlet
7E2	Cooling liquid inlet/ gland follower inlet
7A3	Cooling liquid outlet/ bearing housing
7E3	Cooling liquid inlet/ bearing housing
8B	Bearing housing drain
13A	Oil outlet
13B	Oil outlet
13E	Oil inlet
14A	Hydraulic balance liquid outlet
14E	Hydraulic balance liquid inlet

16.2 Standard execution sizes 40 up to 150 with plain bearings and mechanical seal

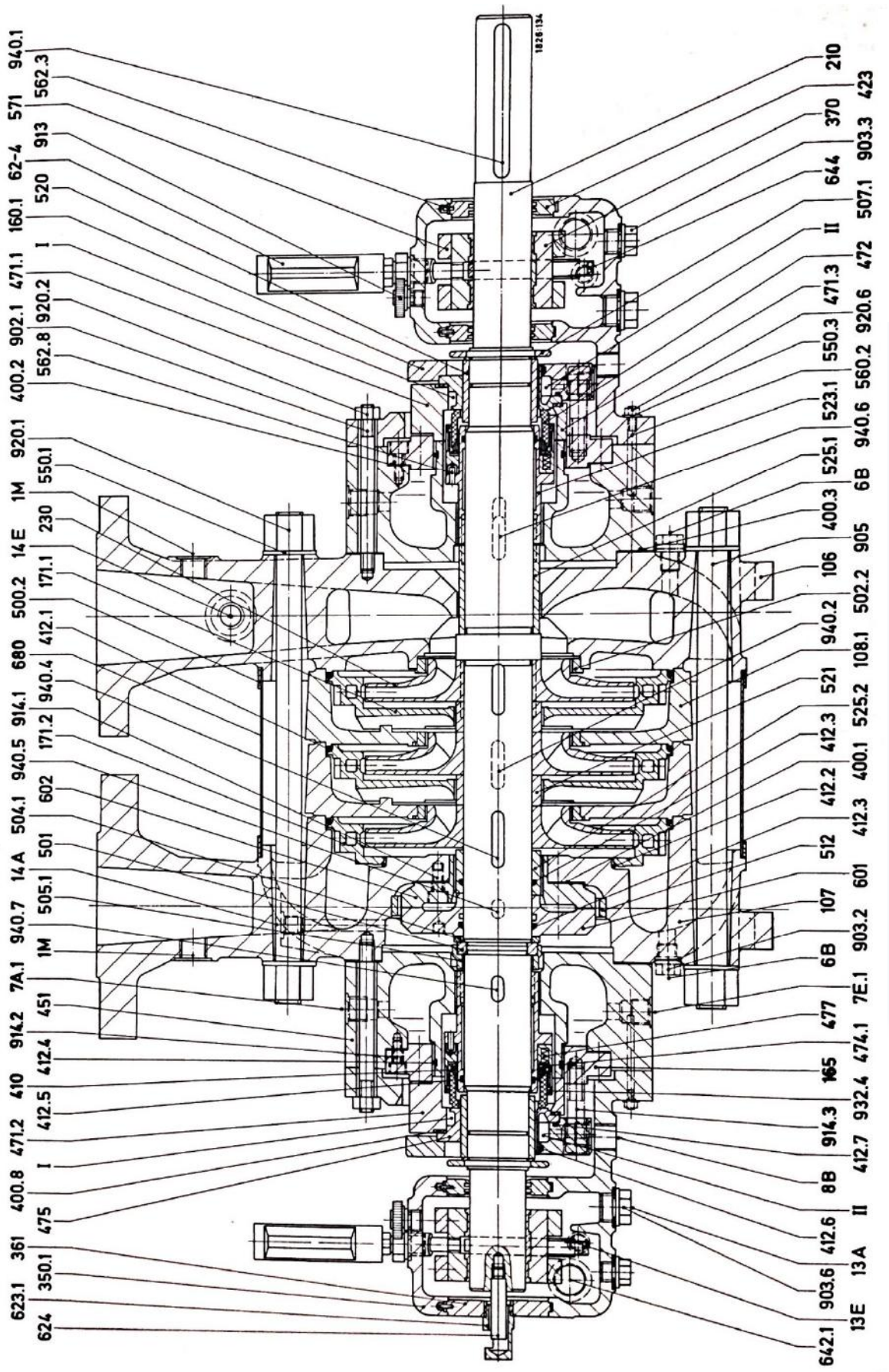


Figure 48 – Standard execution sizes 65 up to 150 with plain bearings and mechanical seals
(For specific details for sizes 125, see fig.50)

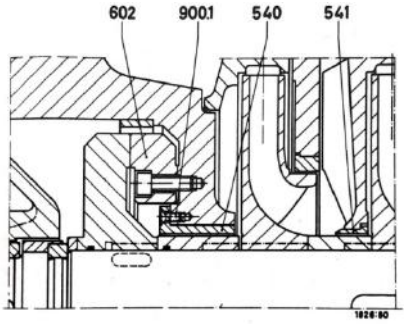
Standard executions sizes 40 up to 150 with plain bearings and mechanical seal

Parts list

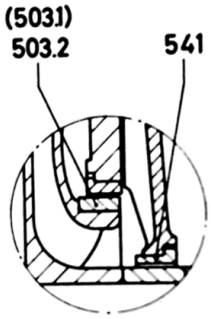
Part no.	Description
106	Suction casing
107	Pressure casing
108.1	Stage casing
108.2	Stage casing with extraction
108.3	Stage casing with extraction
160.1	Cover
160.3	Cover
165	Cooling chamber cover
171.1	Diffuser
171.2	Last stage diffuser
210	Shaft
230	Impeller
231	Impeller with double suction
350.1	Bearing housing
361	Bearing end cover
370	Bearing shell
400.1	Gasket
400.2	Gasket
400.3	Gasket
400.4	Gasket
400.8	Gasket
400.9	Gasket
410	Profiled joint
412.1	O' ring
412.2	O' ring
412.3	O' ring
412.4	O' ring
412.5	O' ring
412.6	O' ring
412.7	O' ring
423	Split labyrinth ring
451	Stuffing box housing
471.1	Seal cover, suction side
562.8	Cylindrical Pin
571	Clamp
601	Balance disc
602	Balance disc seat
623.1	Shaft position indicator
624	Pin wear indicator
62-4	Thermometer
642.1	Oil level sight glass
644	Oil ring
680	Guard
900.1	Screw
901.6	Hexagonal head bolt
902.1	Stud
903.2	Screwed plug
903.3	Screwed plug
903.6	Screwed plug
905	Tie bolt
913	Vent plug
914.1	Socket head cap screw
914.2	Socket head cap screw
914.3	Socket head cap screw
920.1	Hexagon nut

Part no.	Description
471.2	Seal cover, pressure side
471.3	Seal cover
472	Spring-load ring
473	Spring-load ring hold
474.1	Thrust ring
475	Seat ring
477	Spring
500.2	Ring
501	Split ring
502.1	Casing Wear ring
502.2	Casing wear ring
503.1	Impeller wear ring (only for size 150)
503.2	Impeller wear ring
504.1	Spacer ring
504.2	Spacer ring
505.1	Loose collar
507.1	Thrower
512	Wear ring for balance disc and balance disc seat assembly
520	Spacer sleeve
521	Stage spacer sleeve
523.1	Shaft protection sleeve
523.2	Shaft protection sleeve
525.1	Spacer sleeve, suction side
525.2	Spacer sleeve, pressure side
525.2	Blind stage spacer sleeve
540	Sleeve
541	Stage sleeve
54-1	Blind stage sleeve
550.1	Washer
550.3	Washer
560.2	Tapered pin
562.1	Cylindrical Pin
562.3	Cylindrical Pin
920.6	Hexagon nut
932.3	Circlip
932.4	Circlip
940.1	Key for coupling
940.2	Key for impeller
940.4	Key for last stage impeller
940.5	Key for balance disc
940.6	Key for shaft protection sleeve
940.7	Key for shaft protection sleeve
940.9	Key for mechanical seal
1M	Connection for pressure gauge
6B	Pump drain
7A1	Cooling liquid outlet, stuffing box
7E1	Cooling liquid inlet, stuffing box
7A3	Cooling liquid outlet/ bearing housing
7E3	Cooling liquid inlet/ bearing housing
8B	Bearing housing drain
13A	Oil outlet
13E	Oil inlet
14A	Balance liquid outlet
14E	Balance liquid inlet

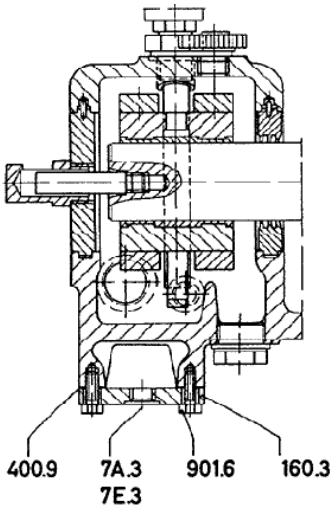
16.3 Specific details



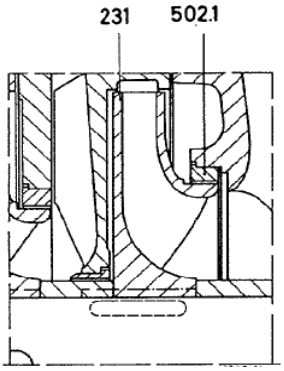
SIZES 125 AND 150
BALANCE DISC SEAT
AND STAGE SLEEVE



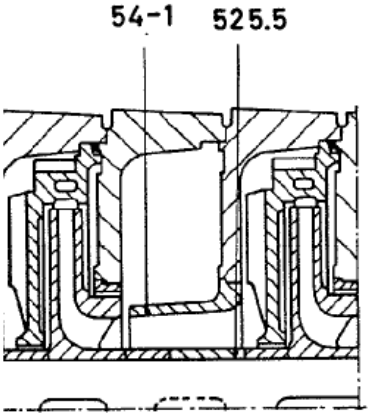
IMPELLER WEAR RING
AND STAGE SLEEVE



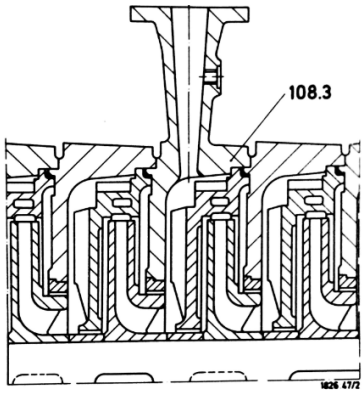
BEARING HOUSING COOLING



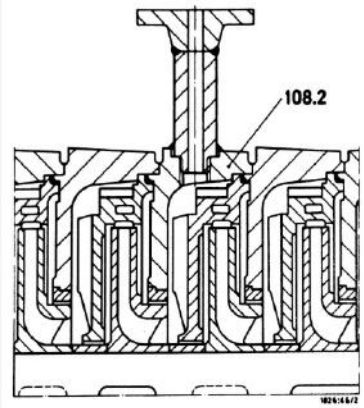
SIZE 150
SUCTION IMPELLER



BLIND STAGE



STAGE CASING WITH
CAST EXTRACTION



STAGE CASING WITH
THREADED AND WELDED EXTRACTION

Figure 49 – Specific details

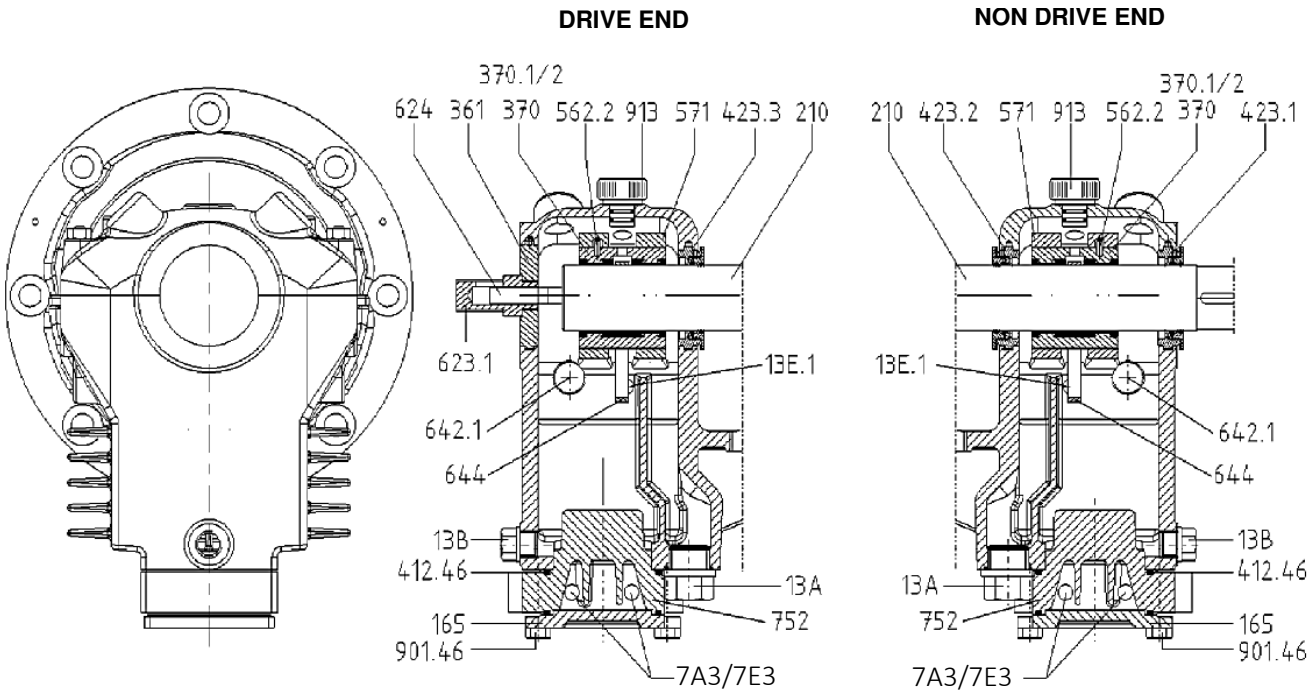


Figure 50 – Finned bearing bracket (GRE), valid only for HDA 125

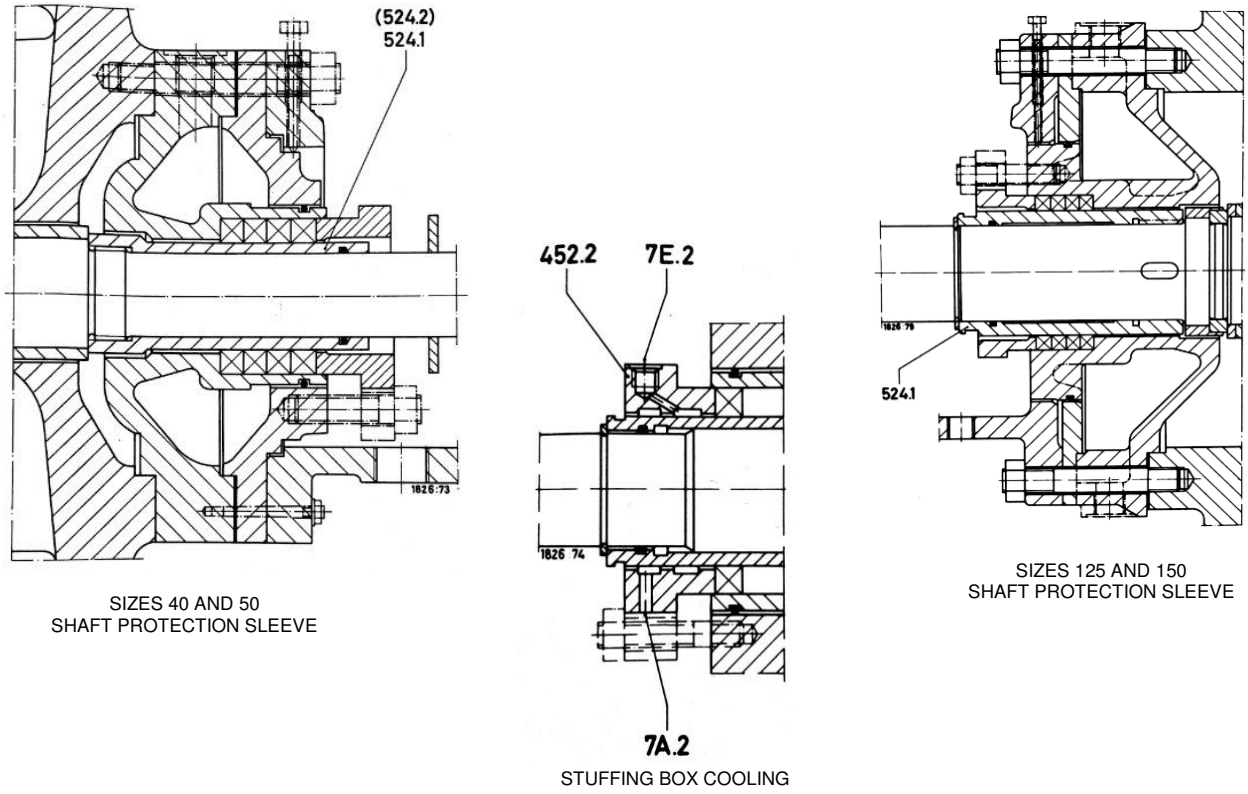


Figure 51 – Specific details for standard execution with plain bearings and packing.

16.4 Special features

16.4.1 Blind Stage

In case of future operation with higher pressure than first operating condition, one or more impellers will be replaced by blind stage bushing and spacer sleeve. The impellers required for the future operation will be supplied with the pump.

PART Nº	DESCRIPTION
525.5	SPACER SLEEVE
54-1	BLIND STAGE BUSHING

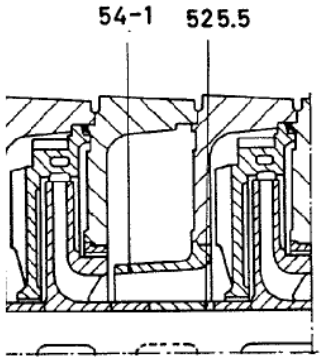


Figure 52 – Blind stage

16.4.2 Stage casing with extraction

When a lower pressure is required in parallel to the pump final pressure (for example, for injection inside an intermediate heat exchanger) stage casings with a connection for extraction can be supplied.

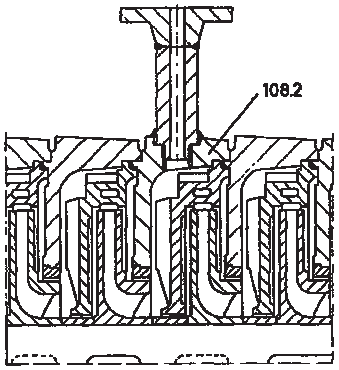


Figure 53 – Stage casing with threaded and welded extraction

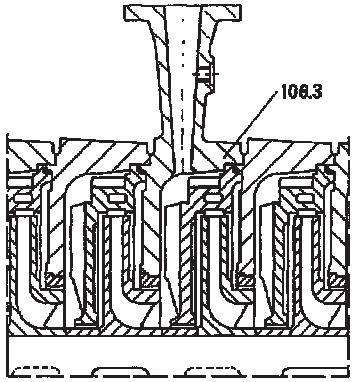


Figure 54 – Stage casing with cast extraction

Pump Size	Threaded and Welded Extraction		Cast Extraction	
	DN	Maximum partial flow Q (l/sec)	DN	Maximum partial flow Q (l/sec)
40	15	2	40	8
50	15	2	50	12.5
65	25	4	65	19.5
80	25	4	80	30.5
100	25	4	100	47
125	25	4	125	75
150	25	4	150	105.5

Table 19 — Technical data for figures 53 and 54

16.4.2.1 Material variants for threaded and welded extraction

HDA 40 up to 150	Stage casing (material)	Extraction (material)
	A216 WCB	SAE 1020
	A743 CA6NM	AISI 316

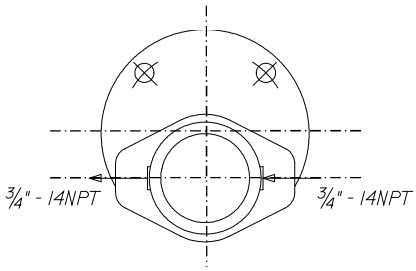
Table 20 - Materials for stage casing with extraction

16.4.3 Lubricating oil pump installed on the pump shaft

The gear pump is used on pumps with lift-off device and forced feed lubrication. It is driven by a gear set installed on the main shaft pump.
The purpose of the lubrication oil pump is to supply pressurized oil on the main pump bearings without the need for the lube oil system continuous operation, saving energy and ensuring suitable lubrication.

Part	Qty.	Description
400.29	1	Gasket
525.4	1	Spacer sleeve
87-1	1	Pinion
872	1	Gear
99.3	1	Gear pump
902.29	2	Stud
904.29	1	Grub screw
916.29	1	Plug
920.29	2	Nut

Table 21 – Gear pump parts



View “X”

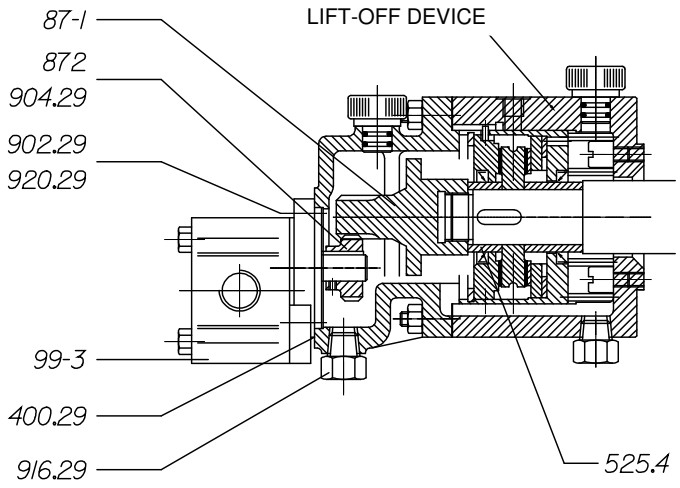


Figure 55 – Pump shaft gear pump

16.4.4 Minimum flow valve installation

Minimum flow can be maintained by a minimum flow valve installed at the discharge piping. The selection of this valve shall be made on a case by case basis.

16.4.5 Strainers

Strainers are frequently necessary to protect the pump from impurities on the installation and to protect the clearances between the stationary and rotating pump components against contamination.
A strainer is especially important if the vessels and pipes were not completely picked and blown during the commissioning of new installations. Besides that the welding residue, scrubs or similar impurities often appear after some period of time after maintenance or repair.
The strainers can be installed on the suction piping, on horizontal or vertical position, at the nearest possible location to the pump nozzles as preferred position.
It is recommended to install temporary strainers inside the suction piping.

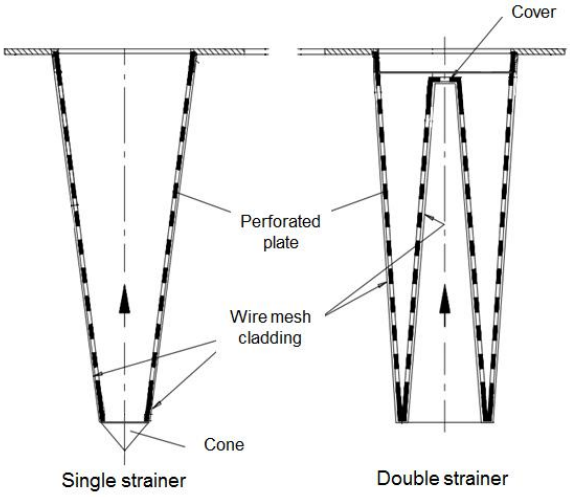


Figure 56 – Single and Double strainer

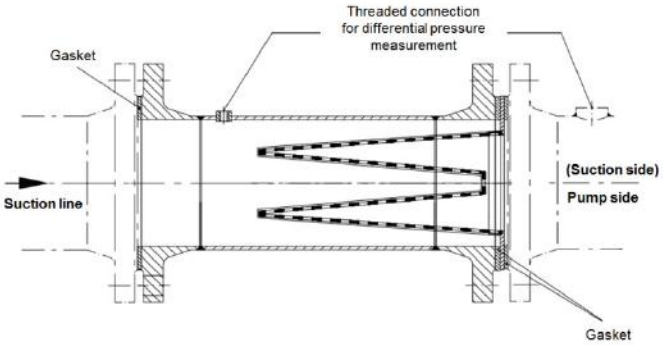


Figure 57 – Example of horizontal installation

A threaded connection on the upstream and downstream piping of the suction strainer filter assembly should be provided for differential pressure monitoring

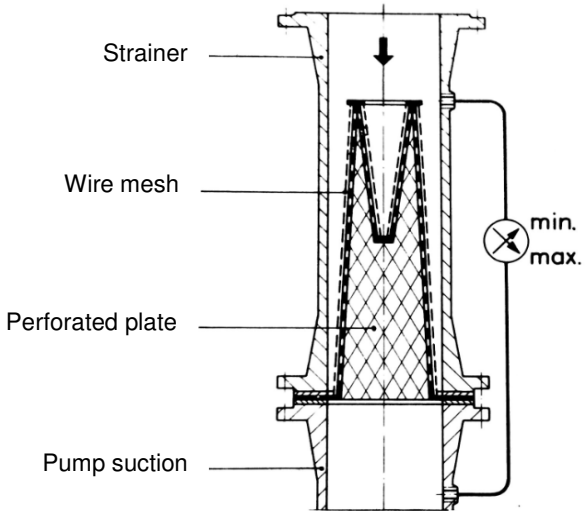


Figure 58 – Suction strainer with monitoring

16.4.7 Special tools

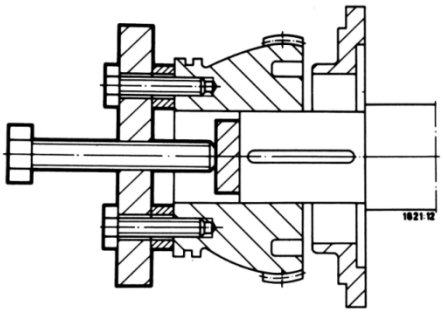


Figure 59 – Special tool for coupling removal

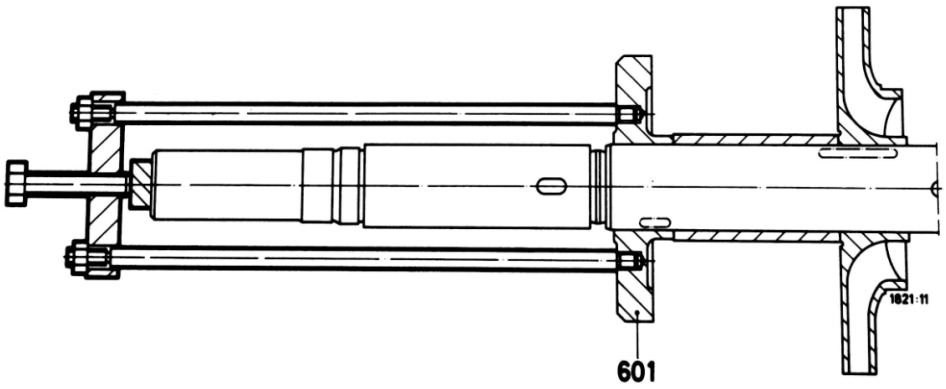
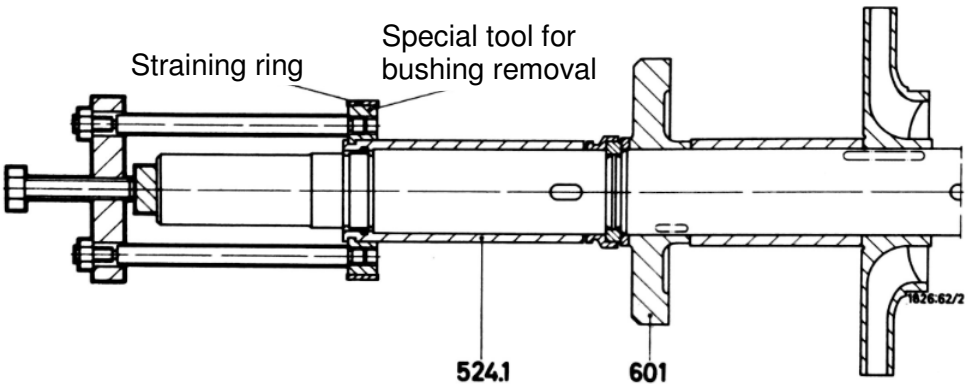


Figure 60 — Special tool for balance disc removal



Part no.	Designation
524.1	Shaft protection sleeve
601	Balance disc

Figure 61 — Special tool for shaft protection sleeve removal

16.4.8 Tools

Pump Size	Closed wrench (N 85)	Ring wrench (N 89)	Allen Wrench (DIN 911)		Pliers for safety rings (DIN 5254)
	DN	DN			
40	46	27	6		--
50	46	30	6		--
65	--	36	6	8	A40
80	--	41	6	8	A40
100	--	41	6	10	A40
125	--	60	6	8	A40
150	--	75	10	--	A40

Table 22 - Tools

17. Characteristic curves

See characteristic curves booklet A1826.4P.

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