Contents

1 Design

APP process pump is a horizontal, single stage, single entry, radially split, volute casing pump of back pull out type design. The pump dimensions are in accordance with ISO 2858.

2 Application

APP pumps are used for continuous operation in process industries, for the pumping of clean, abrasive/corrosive liquids and various stocks (up to 8% consistancy).

3 Designation

APP GC m 4 2 - 150

- Type of series
- Material of wetted parts
- Mechanical seal
- Bearing Bracket
- Sr.no. of casing cover in that bearing bracket
- Discharge nozzle diameter (in mm)

Material of wetted parts

i) Cast Iron construction : GC
ii) Stainless Steel construction : C

4 Operating parameters

4.1 Capacity & total head

APP Pumps are available in the following range

Capacity : Q up to 132 l / s .
Head : H up to 105 mtr.
Pump sizes : DN from 50 to 150 mm
operating temperature : -100 to +180 ^{O}C
Consistancy : up to 8%

The operation of a pump at any point on the standard curve (within the permissible range) is possible as long as NPSH abailable > NPSH required and maximum permissible pumping power & discharge pressure is not exceeded.

5 Change in the characteristics

When the stock is pumped with APP pump; the characteristic changes as shown in the fig. no. 1.

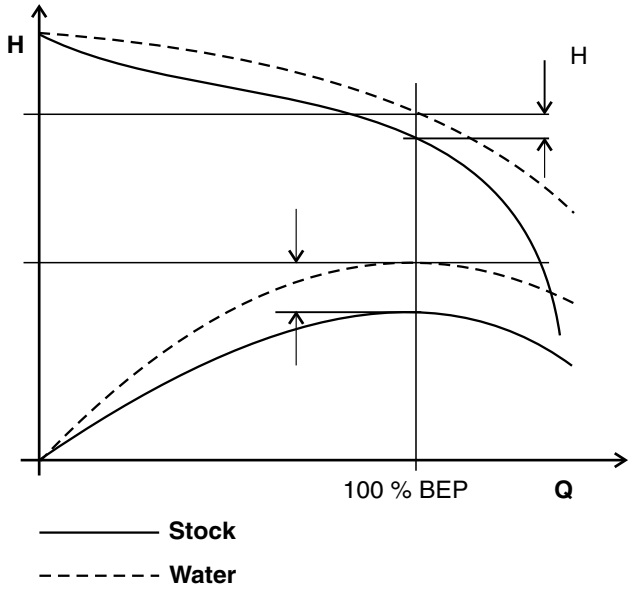


Fig. no. 1.

- Head decreases by ΔH
- Efficiency decreases by $\Delta\eta$
- Capacity remains constant
- Power demand increases due to change in head & efficiency

6 Present programme available

Bearing bracket / Casing cover / Programme co-relation of the pump is as follows.

Casing cover	Discharge flange diameter a in mm						Braring bracket
	50	65	80	100	125	150	
11	A						1
21		A					2
22	A	A	A				2
31				A		A	3
32		A	A	A	A		3
42						A	4

7 Selection procedure

If the duty parameters are as follows,

Capacity : 108 m^3/hr.
Head : 15 m
Temperature : 30 ^{0}C
Consistancy : 6 %
Quality of stock : Bleached
Density : 1.05 kg/dm^3
Speed : 1480 rpm

After refering the family curves of 1480 rpm, APP 22-80 is found the most suitable pump.

7.1 To calculate the change in head

$$\Delta H = \frac{Kk}{Km} \times \Delta H'$$

Where,
Kk is the size coefficient (from table no. 1)
Km is the stock quality coefficient (from table no. 2)
Substitute the values of Kk, Km, Δ H' in the formule to get,

$$\Delta H = \frac{1.2}{1.0} \times 2.5$$

$$= 3.0$$

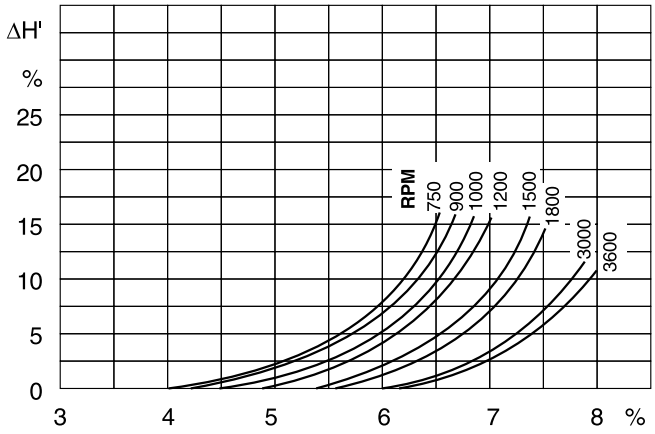


Fig. no. 2

7.1.1 Size coefficient

Suction size	65	80	100	125	150	>150
Kk	3	2.3	1.6	1.2	1.0	1.0

Table no. 1

7.1.2 Stock quality coefficient

Stock type	Km
Chemical	
Bleached	1.0
Unbleached	0.95
Knotter	0.95
Unscreened	0.9
Mechanical stocks	0.9

Table no. 2

7.2 To determine the equivalent head & capacity at the water rating, use the following formula

$$H_{water} = \frac{100 + \Delta H}{100} \times H_{stock}$$

$$H_{water} = \frac{100 + 3.0}{100} \times 15$$

Hence Hwater = 15.45 m = 15.5 m

Since Qwater = Qstock

Qwater = 108 m^3/hr.

7.3 To calculate the change in efficiency, the formula is :

$$\eta_{stock} = \frac{100 - \Delta\eta}{100} \times \Delta_{water}$$

Where $\Delta\eta = \frac{Kk}{Km} \times \Delta\eta'$

If $\Delta\eta'$ is the change in efficiency (from fig. no. 3).

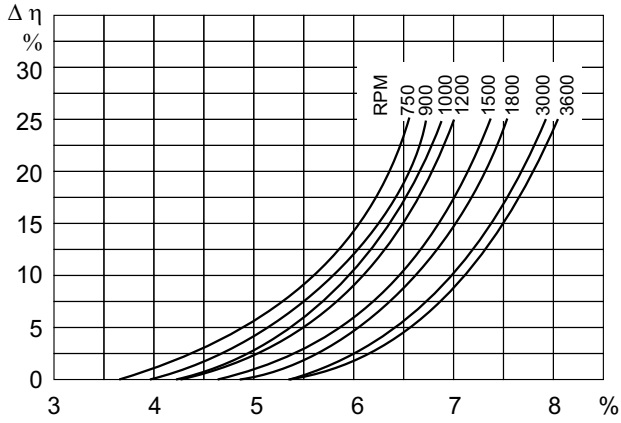


Fig. no. 3

Read the value of η water from the performance curve considering Hwater & Qwater and then substitute the values in the formula.

From the characteristics curve of APP 22-80 at 1480 rpm (Curve no. K 000430) the efficiency is 72.5%.

$$\Delta\eta = \frac{1.2}{1.0} \times 6 = 7.2$$

$$\eta_{stock} = \frac{100 - 7.2}{100} \times 72.5$$

$$= 67.28\ \%$$

$$\approx 67\ \%$$

7.4 To establish the NPSHr

$$NPSH_{stock} = \frac{Ki}{Km} \times (NPSHr\ water + 0.5\ m)$$

(0.5m added as a safety margin)

Where Ki is stock quality coefficient (from fig. no. 4)

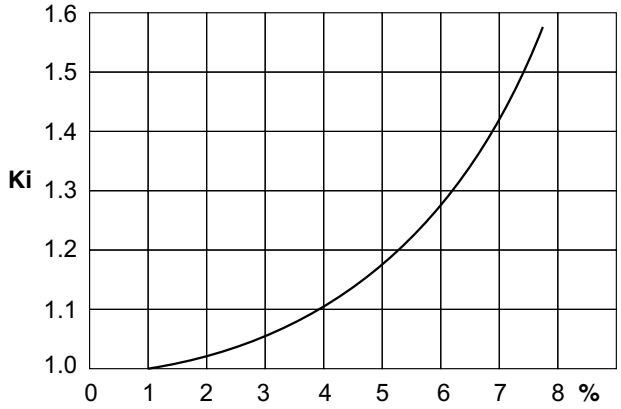


Fig. no. 4

Read the values & substitute in the formula to get,

$$NPSHstock = \frac{1.27}{1.0} X (4.5 + 0.5)$$

$$= 6.35 \text{ m}$$

7.5 Calculate the power requirement from Qstock, Hstock, ηstock

$$BkW = \frac{Qstock X Hstock}{367 \times \eta stock} X \text{ Sp. Gravity}$$

$$= \frac{108 \times 15}{367 \times 0.67} X 1.05$$

$$= 6.92 \text{ kW}$$

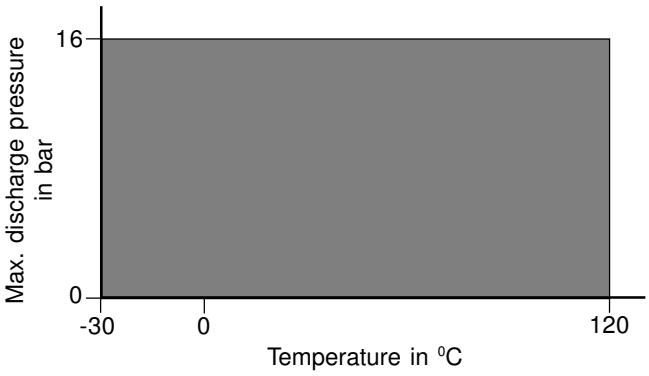
Considering the safety margin of 30% over the required BkW; (for power reserve refer table no. 10.)

6.92 X 1.3 = 8.99 kW

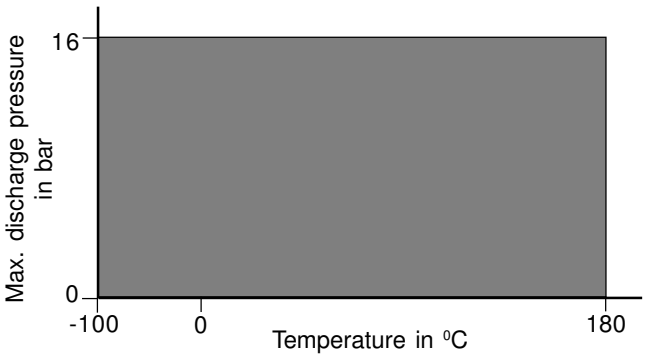
Hence selected motor of 9.3 kW (4 pole).

8 Pressure & temperature limits

8.1 For APP GC



8.2 For APP C



9 Speed

The speeds are in accordance with the characteristic curves, but the other speeds can also be used. However the limitations specified in the point no. 9.1 & 9.2 must be taken into account.

9.1 Maximum permissible speed of rotation of impeller

$$d2 = \frac{48 X 10^6}{\pi X n}$$

where,
d2 = Outer speed of the impeller in mm
n = Speed of rotation in rpm

Max. permissible speed of rotation of the impeller is 80 m/s.

9.2 Highest permissible speed of rotation of the pump (for open impeller)

Pump type	Max. speed	Pump type	Max. speed
11 - 50	3500	31 - 150	1760
21 - 65	3560	32 - 65	1740
22 - 50	3560	32 - 80	1750
22 - 65	3560	32 - 100	1760
22 - 80	3560	32 - 125	1770
31 - 100	3560	42 - 150	1770

Table no. 3

10 Shaft sealing

Shaft sealing can either be done by gland packing or by means of mechanical seal.

For mechanical seal details refer **table on page no. 4**.

Changeover from gland packing execution to single mechanical seal execution or vice-versa is possible by using corresponding interchangeable parts.

10.1 Additional parts required for changeover

A) Change over from gland packing to mechanical seal

a. Shaft protection sleeve
b. Mechanical seal
c. Seal cover with gaskets, O-Rings & flushing line

B) Change over from mechanical seal to gland packing

a. Shaft protection sleeve
b. Gland packing
c. Lantern ring
d. Stuffing box gland
e. Neck bush

10.2 Stuffing box dimensions

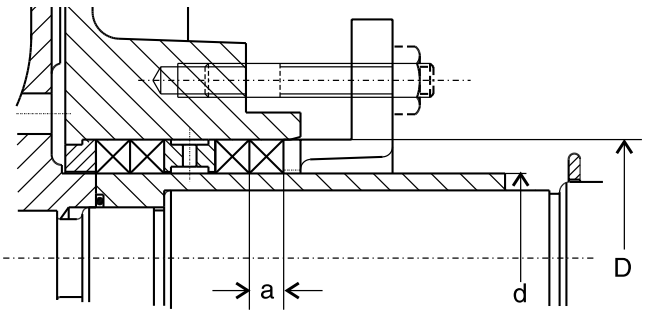


Fig. no. 5

Bearinng Bracket	Stuffing box dimension D	d	a	No. of packing rings
1	60	40	10	Refer fig. no. 10
2	70	50	10	
3	85	60	12.5	
4	95	70	12.5	

Table no. 4 All dimensions are in mm

11 Flanges

APP pump flanges can be drilled according to following standards

For C.I. - ANSI B 16.1 Cl. 125 RF
DIN 2533 / PN 16 RF

For S.S. - ANSI B 16.5 Cl. 150 RF
DIN 2543 / PN 16 RF

But outer diameter & thickness of the flange is as per KSB standard. (Refer Table no. 5)

Nozzle size in mm	Outer diameter in mm	Thickness in mm
50	165	20
65	185	18
80	200	20
100	229	20
125	270	22
150	305	22
200	350	24

Table no. 5

12 Drive

The prime mover can be electric motor or steam turbine. The prime mover can be coupled through the flexible coupling or through the gear box.

12.1 Direction of rotation

Always clockwise looking from drive end.

13 Coupling

The coupling between pump & prime mover can be either flexible or gear type. Preferably spacer type couplings are recommended for ease of maintenance & to take maximum advantage of back pull out feature i.e. maintenance without disturbing the mounting of the volute casing in pipe line & mounting of the prime mover. Spacer length should be suitably selected. For minimum spacer length refer point no. 20.

14 Materials

Part no.	Description	Material execution	
		GC	C
102	Volute casing	C.I.	SS 2324
135	Wear plate	SS 2324	
161	Casing cover	C.I.	SS 2324
210	Shaft	ASTM A Type 410	
230	Impeller	SS 2324	
330	Bearing Bkt.	C.I.	
344	Brg. Bkt. Lantern	C. I.	
360	Brg. Cover	C. I.	
452	Stuffing box gland	CF 8M	
458	Lantern ring	GFT	
524	Shaft prot. sleeve	AISI 329	
914	Impeller bolt	ASTM A 193 Gr. B 8M	

Table no. 6

Mechanical seal details

Make	Type	Material of const.	API Code	Seal faces	Type	Size - Bearing bracket			
Flowserve	SRO	EM5--VV	USTFN	SiC / C	Single	1.375"	1.75"	2.25"	2.625"
Flowserve	SRO	EM5--VV	UDTFN	SiC / C	Double Back to Back	1.375"	1.75"	2.25"	2.625"
Burgmann	M7N	AQ1VGG	USTFN	SiC / C	Single	35 mm	45 mm	55 mm	65 mm
Burgamnn	M7N-D	AQ1VGG	UDTFN	SiC / C	Double Back to Back	35 mm	45 mm	55 mm	65 mm
EPIL	P12(1008)	LFAB	USTFN	SiC / C	Single	D22	D28	D36	D42
EPIL	P12(1008)	LFAB	UDTFN	SiC / C	Double Back to Back	D22	D28	D36	D42

15 Auxillary connections

The auxillary connections required for APP pump are indicated in the Table no. 7.

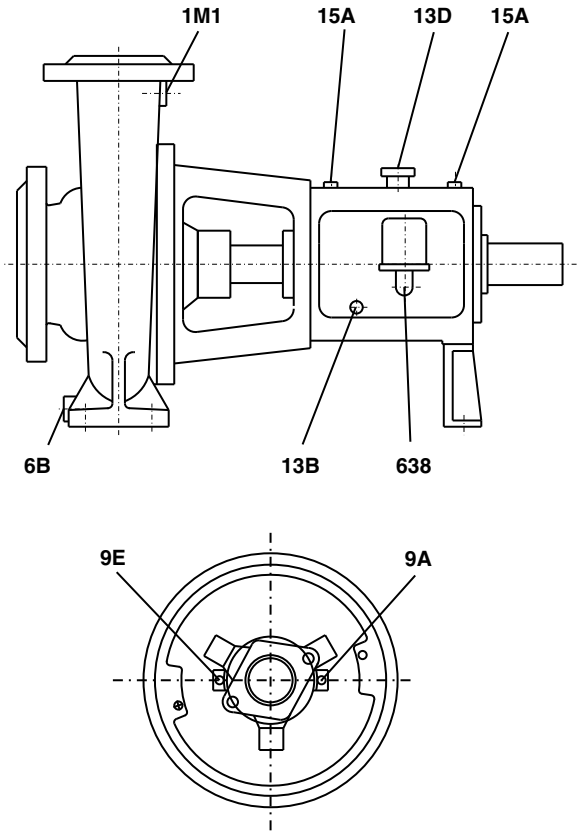


Fig. no. 6

Connection code	Description	Size
1M1	Pressure guage	G 3/8" - ISO 228
6B	Casing drain	G 3/8" - ISO 228
9E / 9A	Sealing liquid inlet / outlet	G 3/8" - ISO 228
13D	Vent plug	R 1/2" - ISO 228
13 B	Lubricant drain	G 1/2" - ISO 228
638	Constant level oiler	R 1/4" - ISO 228
15A	Grease filling	G 1/8" - ISO 228

Table no. 7

16 Painting

As per KSB standard

17 Testing

17.1 Pump testing

Performance testing of the pump is carried out as per DIN 1944 class II or IS:5120.

17.2 Material testing

Material testing is carried out as per following norms.

QN 11049 - For APP GC
QN 11050 - For APP C

18 Technical Data

18.1 Casing

Radially split single volute casing. The suction nozzle is axial and the discharge nozzle is vertically upwards.

18.2 Impeller

Open impeller with twisted vanes. For impeller outlet width and no. of vanes refer Table no. 8.

Pump type	Outlet width at full dia. in mm	No. of vanes
11-50	16	3
21-65	22	4
22-50	14	3
22-65	18	3
22-80	24	4
31-100	32	4
31-150	41	5
32-65	16	3
32-80	22	3
32-100	24	4
32-125	32	4
42-150	38	5

Table no. 8

18.2.1 Clearnace

The clearance between the backvane of the impeller & the casing cover is 1.0 ± 0.5 mm. The clearance between the impeller and the wear plate is 0.5mm. The wear plate can be adjusted towards the impeller by 3 - 4mm. If more adjustment is needed, then the impeller & the wear plate have to be changed in order to maintain the given clearance.

18.3 Balancing

All impellers are static balanced. Balancing accuracy is according to ISO 1940 G 6.3

18.4 Axial thrust balancing

The axial thrust is balanced by the balancing holes & the back vanes provided on the back shroud of the impeller.

18.5 Maximum permissible P/n values

Bearing bracket	p/n value shaft material ASTMA 276 Type 410
1	0.022
2	0.05
3	0.13
4	0.21

Table no. 9

18.6 Power reserve for drives

Motor power	Power reserve
1 to 7.5 kW	Approx. 30%
7.5 to 20 kW	Approx. 25%
20 to 50 kW	Approx. 15%
Above 50 kW	Approx. 10%

Table no. 10

Motor Power should not be < 1 kW

18.7 Moment of inertia & bare pump weight

Pump size	Weight in kg.	Moment of Gyration in kgm²
11-50	66	0.06
21-65	90	0.092
22-50	104	0.12
22-65	106	0.18
22-80	111	0.272
31-100	160	0.392
31-150	205	0.68
32-65	165	0.312
32-80	170	0.44
32-100	180	0.56
32-125	190	0.76
42-150	250	1.04

Table no. 11

18.8 Torque speed curve

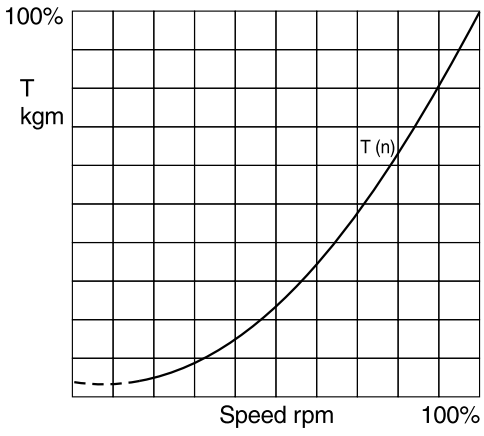


Fig. no. 10

18.9 Forces & Moments

The table no. 12 shows the maximum external forces & moments towards the pump flanges. The forces & moments are valid for cast steel pump with grouted basepframe. The values given in the table no. 12 are valid for Cast Steel. For C.I. multiply the values given in the table no. 12 by 0.5.

The maximum permissible joint effect of the forces & moments should not be less than or equal to 1.

i.e.

$$\left(\frac{\Sigma\,|Fv|}{|Fvmax|}\right)^2 + \left(\frac{\Sigma\,|Fh|}{|Fhmax|}\right)^2 + \left(\frac{\Sigma\,|Mt|}{|Mtmax|}\right)^2 \leq 1$$

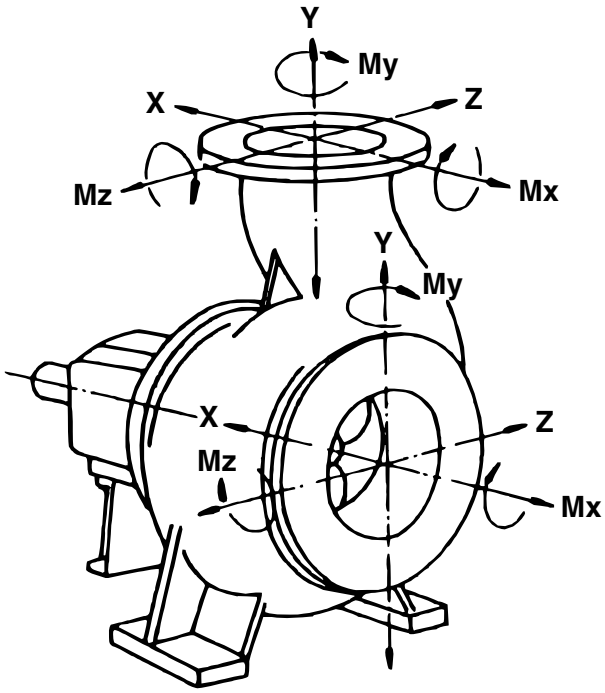


Fig. no. 7

|Fv| = |Fy| = Forces in the Y direction
|Fh| = |Fx| + |Fz| = Forces in the direction X & Z
|Mt| = |Mx| + |My| + |Mz| = Moments in the direction X, Y, & Z

Pump type	Forces N		Moments Nm
	Fvmax*	Fhmax !	Mt max #
11-50	5100	3900	1300
21-65	6200	4700	2000
22-50	5100	3900	1300
22-65	6200	4700	2000
22-80	6900	5400	2500
31-100	8600	7000	3700
31-150	15800	13200	7800
32-65	6200	4700	2000
32-80	6900	5400	2500
32-100	8600	7000	3700
32-125	11500	10000	5800
42-150	15800	13200	7800

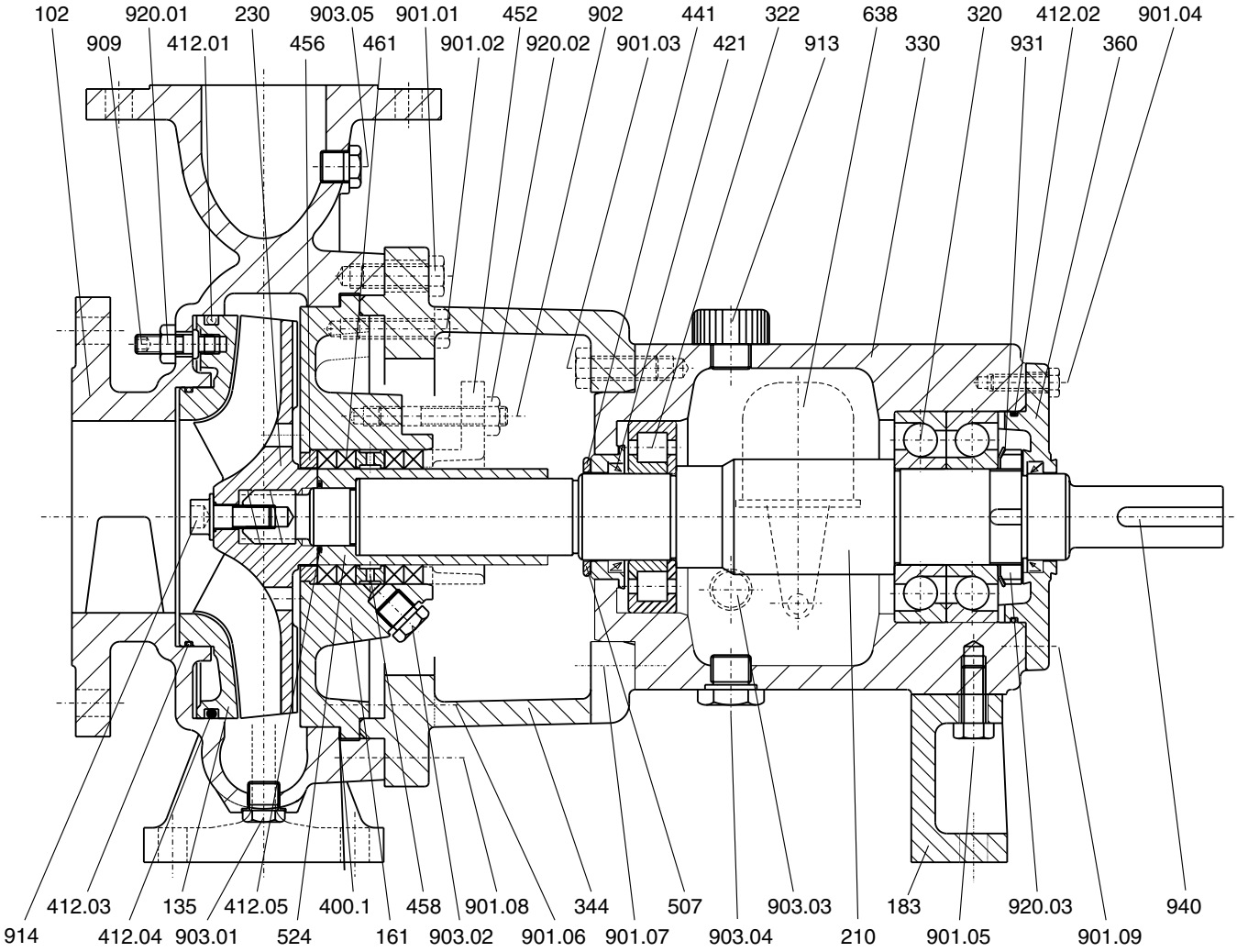
Table no. 12

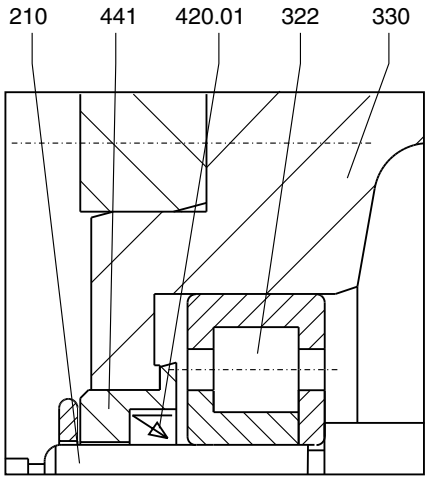
* $\sum$ (2/3IFv Discharge flangel+IFv Suction flangel) ≤ Fvmax.
! $\sum$ (IFv Discharge flangel+IFh Suction flangel) ≤ Fhmax.
$\sum$ (IMt Discharge flangel+IMt Suction flangel) ≤ Mtmax.

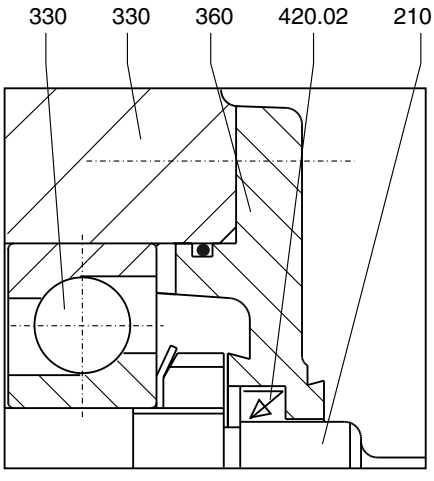
18.10 Sealing liquid

Sealing liquid is the clean water or other appropriate liquid used to cool & lubricate the packings. The flow rate should be 2-3 lpm and the pressure should be more by 0.05 MPa than the stuffing box pressure.
Maximum solid material content of the clean water should be 2mg/l.

19 Sectional drawing & List of components





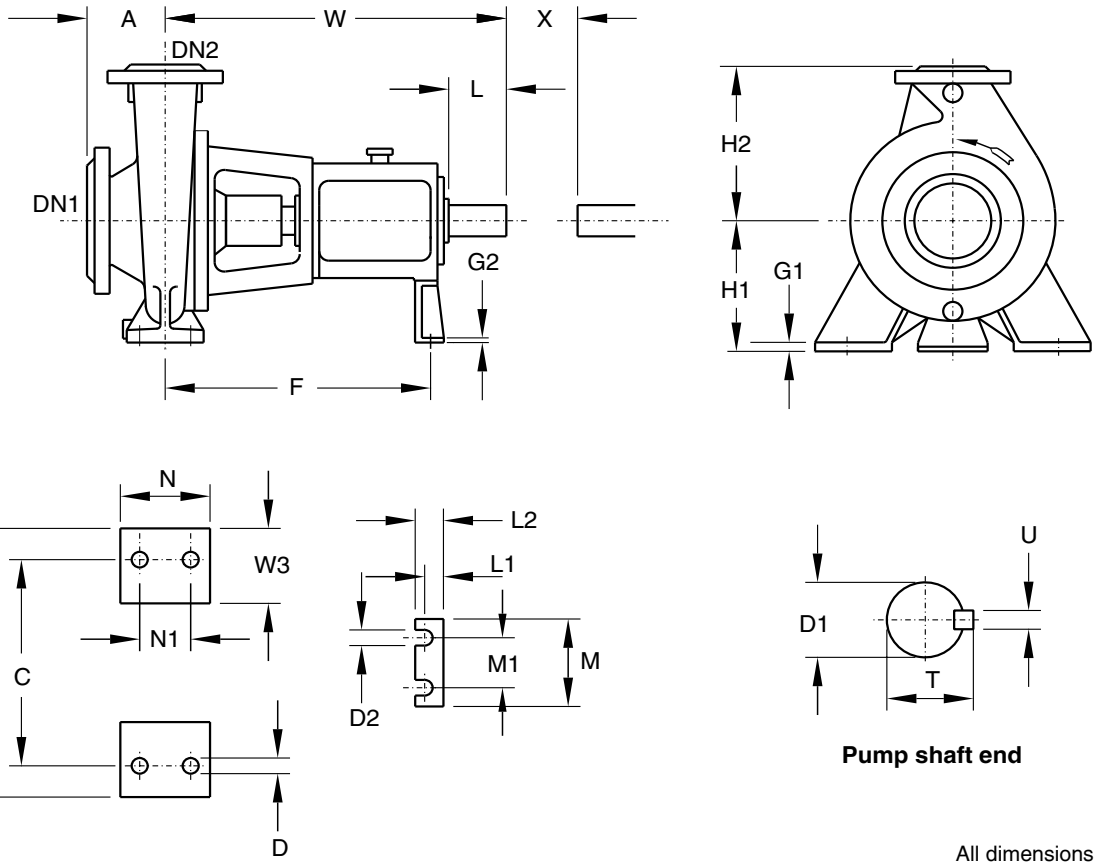


List of components

Part no.	Description
102	Volute casing
135	Wear plate
161	Casing cover
183	Support foot
210	Shaft
230	Impeller
320	Angular contact ball bearings
322	Antifirction bearings
330	Bearing housing
344	Bearinng bracket lanten
360	Bearing cover
400.1	Gasket
412.01-05	O-ring
420.01-02	Oil seal
423	Labyrinth ring
441	Seal casing
452	Stuffing box gland

Part no.	Description
456	Neck bush
458	Lantern ring
461	Gland packing
507	Splash ring
524	Shaft protection sleeve
638	Constant level oiler
901.01-.05	Hex. head bolt
901.06-.09	Hex. head bolt for jacking
902	Stud
903.01	Hex. head plug
909	Adjusting screw
913	Vent plug
914	Impeller bolt
920.01-.02	Hex. head nut
931	Lock washer
940	Key

20 Dimensional drawing



Pump shaft end

All dimensions are in mm

Dimension	Pump size											
Pump	**11-50**	**21-65**	**22-50**	**22-65**	**22-80**	**31-100**	**31-150**	**32-65**	**32-80**	**32-100**	**32-125**	**42-150**
DN1	80	100	80	100	125	125	200	100	125	125	150	200
DN2	50	65	50	65	80	100	150	65	80	100	125	150
A	100	100	125	125	125	140	160	125	125	140	140	160
W	385	500	500	500	500	530	530	530	530	530	530	670
H1	160	180	180	200	225	225	280	225	250	250	280	315
H2	200	225	225	250	280	280	375	280	315	315	355	400
Foot												
W3	45	55	55	65	65	65	85	65	65	65	85	85
G1	15	18	18	20	20	20	20	20	20	20	20	25
G2	12.5	15	15	15	15	15	15	15	15	15	15	18
L1	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	20
N	100	125	125	160	160	160	200	160	160	160	200	200
N1	70	95	95	120	120	120	150	120	120	120	150	150
L2	45					50						60
C1	255	300	300	340	370	370	470	370	370	370	470	520
C	212	250	250	280	315	315	400	315	315	315	400	450
M	145	145	145	145	145	145	145	145	145	145	145	180
M1	110	110	110	110	110	110	110	110	110	110	110	140
D	15	15	15	19	19	19	24	19	19	19	24	24
D2	15	15	15	15	15	15	15	15	15	15	15	20
F	285	370	370	370	370	370	370	370	370	370	370	500
Shaft end												
D1k7	24	32	32	32	32	42	42	42	42	42	42	48
L	50	80	80	80	80	110	110	110	110	110	110	110
T	27	35	35	35	35	45	45	45	45	45	45	51.5
U	8	10	10	10	10	12	12	12	12	12	12	14
X	100	140	140	140	140	140	140	140	140	140	140	180

21 Design data

	Pump size											
	11-50	**21-65**	**22-50**	**22-65**	**22-80**	**31-100**	**31-150**	**32-65**	**32-80**	**32-100**	**32-125**	**42-150**
Bearing bracket	**1**	**2**				**3**						**4**
Casing												
Type (single / double)	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single	Single
Casing thickness	9	10	9	10	11	11	14	10	11	13	13	13
Casing thk. in C.I..	8	8	8	8	9	9	12	8	9	9	10	13
Max. working pressure	Refer point no. 8											
Test pressure	-											
Impeller												
Front clearance	0.5											
Back clearance	1 ± 0.5											
Max. solid diameter	16	22	14	18	24	32	41	16	22	24	32	38
Max. shaft deflection at stuffing box	0.5											
Stuffing box												
Bore	60	70	70	70	70	85	85	85	85	85	85	95
Depth	64	64	64	64	64	78	78	78	78	78	78	78
Shaft sleeve dia. at gland packing	40	50	50	50	50	60	60	60	60	60	60	70
Packing size	10	10	10	10	10	12.5	12.5	12.5	12.5	12.5	12.5	12.5
No. of packing rings	4	4	4	4	4	4	4	4	4	4	4	4
Lantern ring width	15	15	15	15	15	17	17	17	17	17	17	17
Nech bush clearance	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Nearest obstruction	64.5	76	76	76	76	66	66	66	66	66	66	107
Shaft diameter												
At impeller	23	30	30	30	30	40	40	40	40	40	40	45
Under sleeve	30	40	40	40	40	50	50	50	50	50	50	60
Between bearings	50	60	60	60	60	70	70	70	70	70	70	80
At coupling	24	32	32	32	32	42	42	42	42	42	42	48
Bearings												
Radial bearing type	NUP 307	NUP 309				NUP 311						NUP 313
Thrust brg. BECBP	2x7308	7310				2 x 7312						2x7314
Radial brg. life (hrs. x 10^3)	1000	1000	1000*	1000*	200	34	100	1000*	1000*	370	75	200
Thrust brg. life (hrs. x 10^3)	450	1000	200	300	100	32	130	1000*	1000*	350	120	430
Bearing span	107	170	170	170	170	152	152	152	152	152	152	222
Shaft overhang	184	200	200	200	200	216	216	216	216	216	216	275
Miscellaneous												
Bare pump weight kg.	66	90	104	106	111	160	205	165	170	180	190	250
Mass moment of inertia (kgm^2)	0.015	0.023	0.03	0.045	0.068	0.098	0.17	0.078	0.11	0.14	0.19	0.26
p/n value	0.022	0.05	0.05	0.05	0.05	0.13	0.13	0.13	0.13	0.13	0.13	0.21

All dimensions are in mm

*Minimum L10h-life, full impeller diameter / max. speed / direct coupled / 50%BEP - 100%BEP