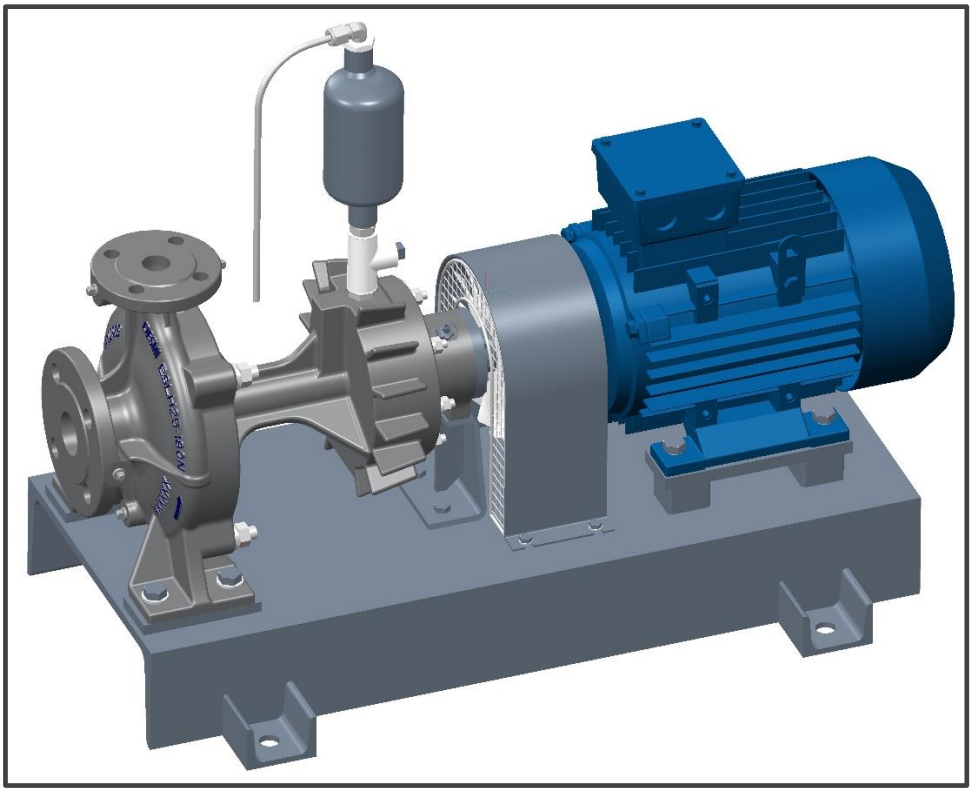
DESMI

OPERATION AND MAINTENANCE INSTRUCTIONS

DESMI end suction centrifugal pump

ESLHT/-17 W180



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Special pump No. .....

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1. PRODUCT DESCRIPTION

These operation and maintenance instructions apply to the DESMI ESLHT pump in /-17 execution.

The ESLHT pump is designed for horizontal assembly with the pressure flange pointing upwards. The pump is a single-stage end suction centrifugal pump equipped with stainless steel shaft, balanced mechanical shaft seal mounted in a separate chamber with cooling ribs and fan cooling and closed impeller. Between impeller and shaft sealing, a carbon bearing is built in that is flushed from the pressure side of the pump.

The pump can be used as standard for water with temperatures up to 180°C – possibly higher temperatures in agreement with DESMI. Higher temperatures may be permitted if, for example, any working pressure allowed in the pump housing at the current temperature, pumped liquid, maximum suction pressure, pump size, speed, current shaft seal and maximum ambient temperature make it possible. Max. operating pressure and speed ranges are specified in operational data.

If the pump is to be used for liquids other than water, other rubber types are likely to be used for O-rings and any other materials for the other liquid-affected parts of the pump - contact DESMI accordingly.

1.1 DELIVERY

- Check on delivery that the shipment is complete and undamaged.
- Defects and damages, if any, to be reported to the carrier and the supplier immediately in order that a claim can be advanced.

2. TECHNICAL DATA

The pumps are manufactured in various material combinations which are specified in the type number on the name plate. See below.

2.1 EXPLANATION OF THE TYPE NUMBER

The pump are provided with a name plate. The type number indicated on the name plate is built up as follows:

ESLHTXXX-YYY-MR-Z

XXX: Pressure branch diameter, YYY: Standard impeller diameter
M: The material combination of the pump.
R: The assembly combination of the pump.
Z: Other variants

M may be the following:
A: Casing and shaft seal cover : SG iron (GGG40 as standard). Impeller: SS
S: Casing : SS.: Impeller: SS

R may be the following:

17 W180 : Special design for 180°C

Z may be the following:

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i : PN16 flanges
j : PN25 flanges
k : Special flange
l : Other shaft seal
m : BS flanges
n : ANSI flanges
o : Shockproof design
p : Other design
q : JIS flanges

Any use of the pump is to be evaluated on the basis of the materials used in the pump. In case of doubt, contact the supplier.

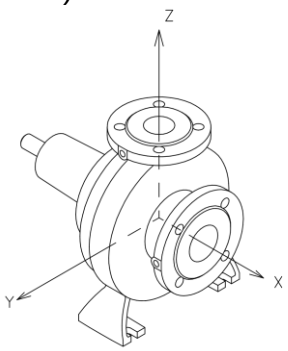
If the pumps are designed for special purposes the following is to be indicated:

Pump No. :
Pump type :
Application :
Comment :

2.2 TECHNICAL DESCRIPTION

The noise level indicated is the airborne noise including the motor. The noise depends on the motor type supplied, as the noise from the pump can be calculated as the noise level of the motor + 2dB(A). The noise level is for pumps with electric motors.
The capacity of the pump appears from the name plate on the pump. If the pump has been delivered without motor, the pump capacity is to be indicated on the plate when mounting the motor.

The permissible loads on the flanges appear from the following table. The values apply to standard pumps in SG iron (GGG40).



DN mm	Forces (N)				Torques (Nm)			
	F_Y	F_z	F_X	$\sum F$	M_y	M_z	M_x	$\sum M$
25	250	320	250	480	300	150	260	420
40	400	500	400	750	400	200	300	550
50	500	600	550	1000	450	250	350	600

In connection with the permissible loads on the flanges the following is to be observed:

$$\left(\frac{\sum F_{calculated}}{\sum F_{Max.permissible}}\right)^2 + \left(\frac{\sum M_{calculated}}{\sum M_{Max.permissible}}\right)^2 \prec 2$$

where index “calc” is the values calculated by the user.
At the same time none of the forces or moments may exceed the indicated figure multiplied

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by 1.4.

3. INSTALLATION

3.1 MOUNTING/FASTENING

The pump should be mounted and fastened on a solid base plate or wall mounted frame so distortion is avoided.

When installing the pump check that it is earthed to avoid an electrical potential in the pump.

The max. permissible loads on the flanges stated in paragraph 2.2 are to be observed.

At installations pumping hot or very cold liquids, the operator must be aware that it is dangerous to touch the pump surface and, consequently, he must take the necessary safety measures.

3.2 WIRING

Wiring to be carried out by authorised skilled workmen according to the rules and regulations in force.

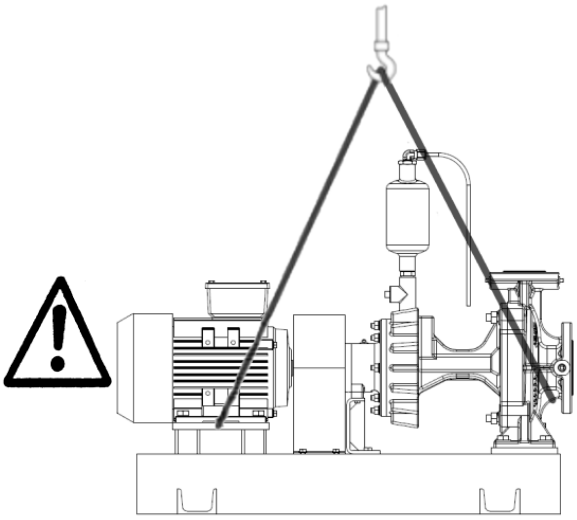
4. TRANSPORT/STORAGE

The weights of the pumps in standard combination (without motor) are stated in the following table, and the pumps are to be lifted as shown below.

Pump	Weight in kg without motor & base plate
ESLHT 25-180N	40
ESLHT 40-180N	43

The pump is to be stored in a dry area.
Before shipment the pump is to be fastened securely on pallets or the like.

The pump is to be lifted in the following way:



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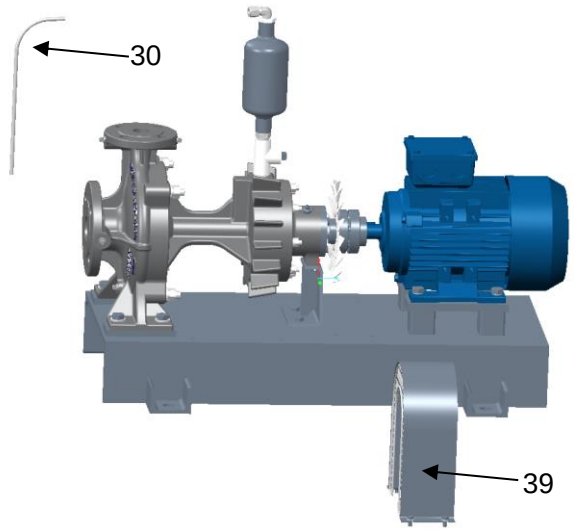
The lifting straps must not bear against sharp edges and corners.

5. DISMANTLING

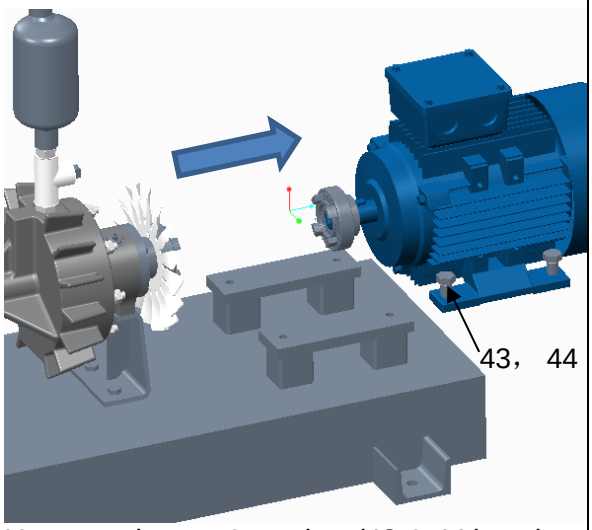
Before dismantling the pump make sure that it has stopped. Empty the pump of liquid before it is dismantled from the piping system. If the pump has been pumping dangerous liquids you are to be aware of this and take the necessary safety measures.
If the pump has been pumping hot liquids, take great care that it is drained before it is removed from the piping system.

5.1 DISMANTLING OF ESLHT25-180N/A-17 W180 / ESLHT40-180N/A-17 W180

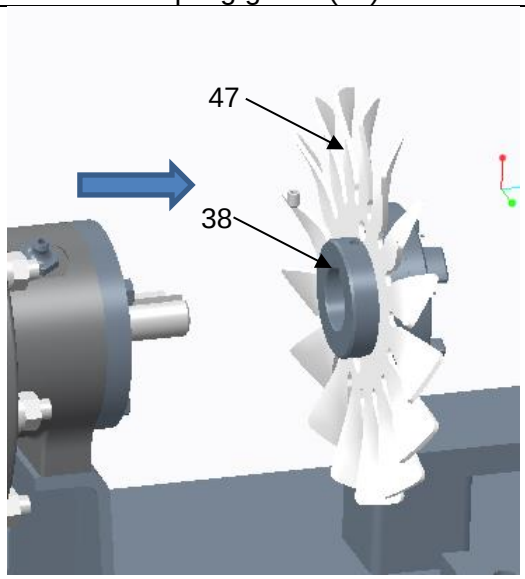
5.1.1 DISMANTLING COUPLING



Dismantle the stainless steel pipe (30) then remove the coupling guard (39)



Unscrew the nut & washer (43 & 44) and remove the motor



Unscrew the coupling point screw and remove the coupling (38) with the cooling

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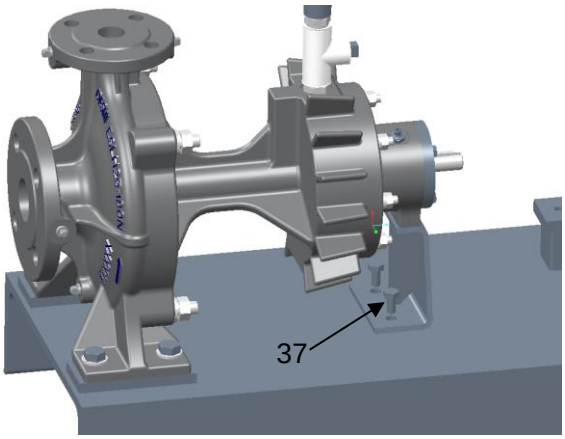
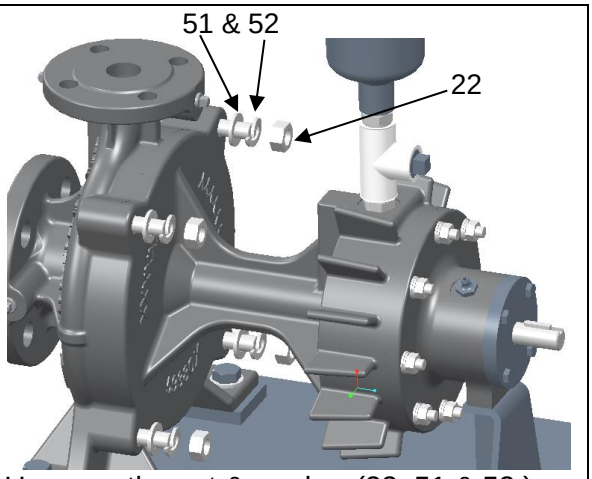
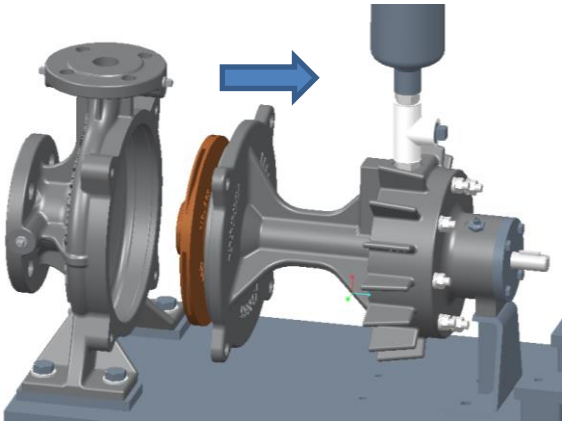
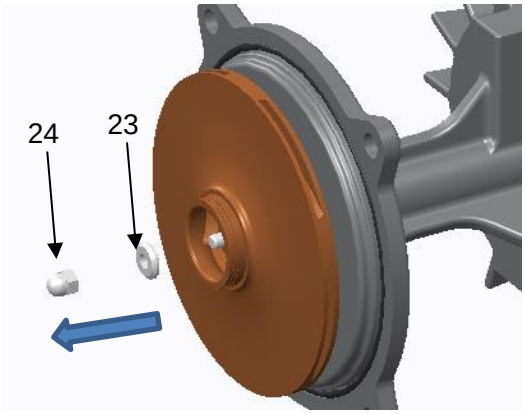
fan (47)	

5.1.2 DISMANTLING REAR COVER AND IMPELLER

 Unscrews the set screws (37)	 Unscrew the nut & washer (22, 51 & 52)
 Remove rear cover unit.	 Remove the cap nut (24) & washer (23)

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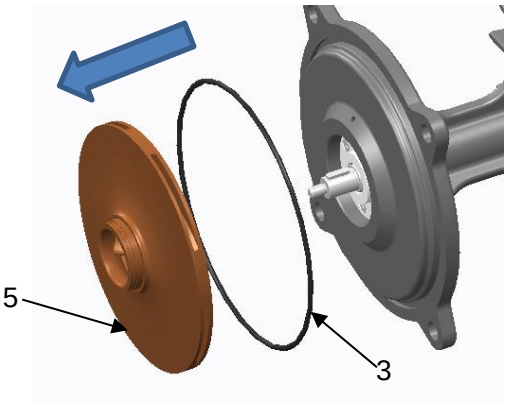
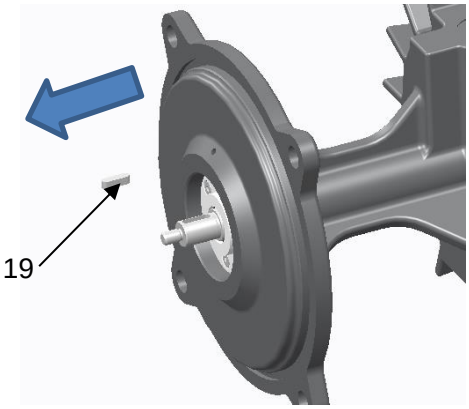
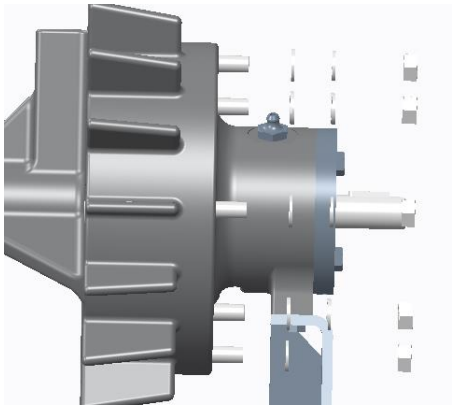


Remove the impeller (5) and O-ring (3)

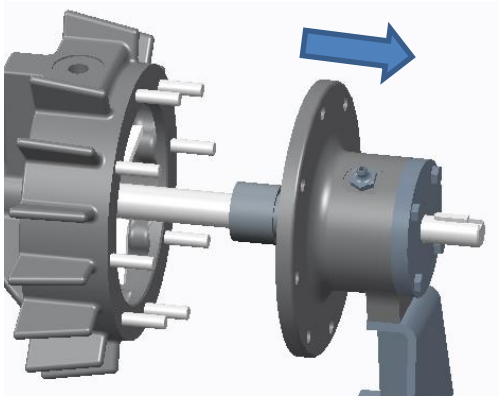
5.1.3 DISMANTLING SHAFT SEAL & BEARING



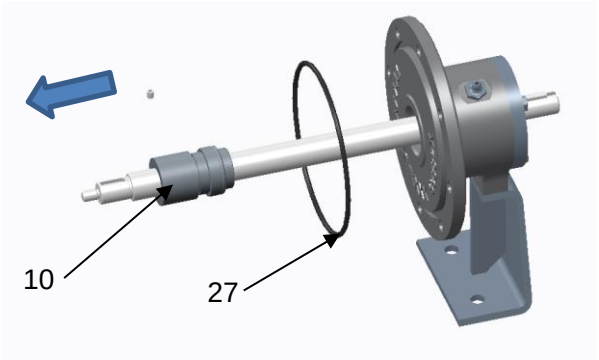
Remove the impeller key (19)



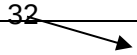
Unscrew nut & washer (16,18 & 50)



Lift the bearing with bearing housing



Unscrew the mechanical point screw and remove the mechanical seal (10) and O-ring (27)



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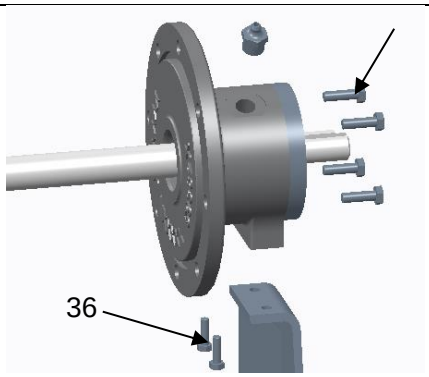
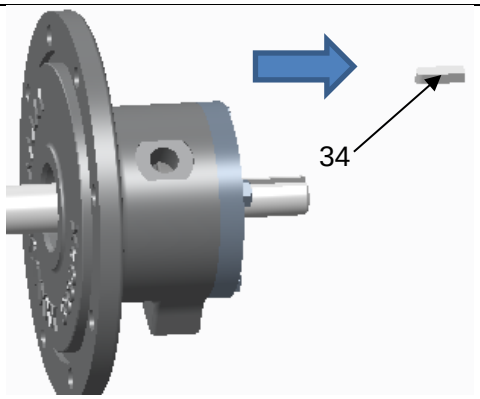
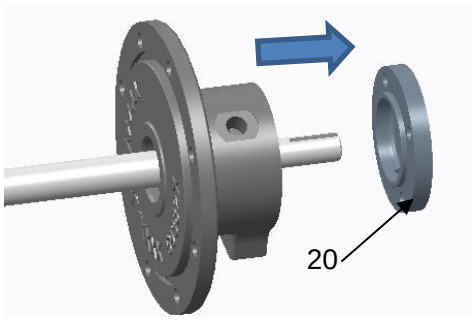


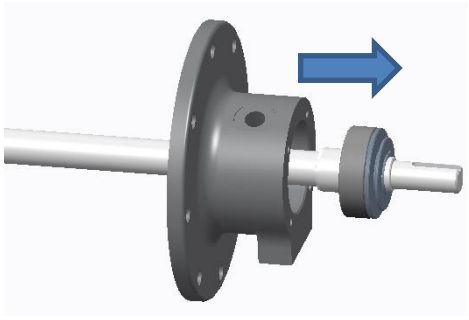
Unscrew set screws (35 & 36) and remove the grease nipple (32)



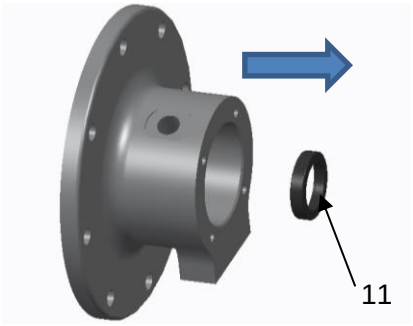
Remove the key (34)



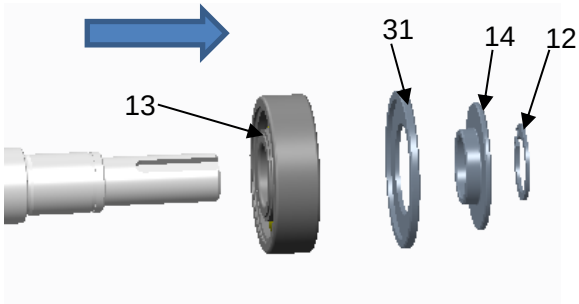
Remove the bearing cover (20)



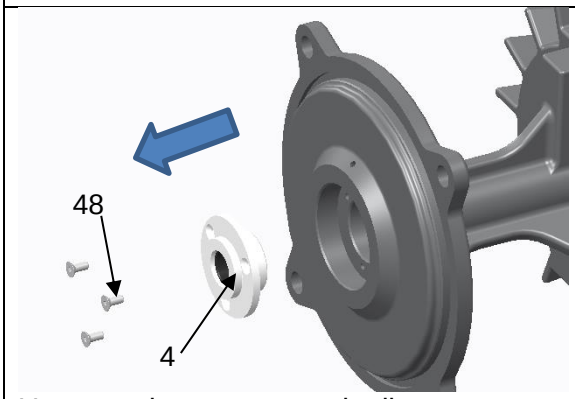
Take out the shaft with ball bearing



Take out the oil seal ring (11)



Remove the SNAP ring (12) and take out the ball bearing (13), grease valve ring (14) and orifice ring (31)



Unscrew the counter sunk allen screws (48) the carbon bearing (4)

5.3 INSPECTION

When the pump has been dismantled, check the following parts for wear and damage:

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- Pump casing/impeller: Max. clearance 0.3-0.6 mm measured in radius.
- Shaft seal/shaft seal cover: Check the seat for flatness and cracks.
  Check the rubber parts for elasticity.
- Bearings : Replace in case of wear and noise.
- Sliding bearing/shaft : Wear= max. 0.5 mm diameter difference.

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6. ASSEMBLING

Referring to the reverse process of dismantling.

6.1 FITTING CARBON BEARING AND VORTEX BREAKER

Fit the carbon bearing (4) and vortex breaker (8) into the rear cover (7) then tighten the counter sunk Allen screws(9 & 48).

6.2 FITTING SHAFT WITH BEARINGS

Before fitting the oil sealing ring (11), clean the recess in the bearing house (15), then lead the shaft with ball bearing into bearing housing and fit the bearing cover (20).

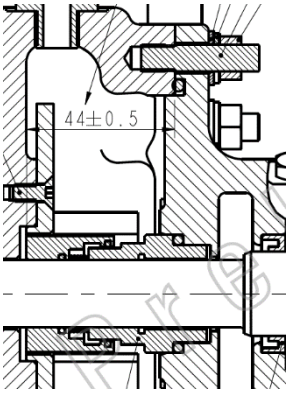
6.3 FITTING SHAFT SEAL

Before fitting the seat, clean the recess in the bearing house. When fitting the seat, remove the protective coating without scratching the lapped surface. Dip the outer rubber ring of the seat into soapy water. Now press the seat into place with the fingers and check that all parts are correctly imbedded.

If it is necessary to use tools for assembling, then protect the sliding surface of the seat to prevent it from being scratched or cut. Lubricate the inner surface of the slide ring rubber bellows with soapy water and push it over the shaft. The use of a conical fitting bush as shown on the assembly drawing is recommended to avoid that the rubber bellows is cut.

Push the slide ring over the shaft with the hand. If the rubber bellows is tight, use a fitting tool and take care that the slide ring is not damaged. If the carbon ring is not fixed, it is important to check that it is fitted correctly, i.e. the chamfered/lapped side is to face the seat. The carbon ring can be held by a little grease.

It has to be made sure the length from ELK shaft seal end to bearing house flange being within 44 +/- 0.5mm of the nominal length as shown below.



Notice ! Never use mineral oil / fat as grease, as rubber parts as standard are in EPDM.

Notice ! Never put grease on the sliding surfaces! They must be completely dry, dust-free and clean during the mounting procedure. Also any fingerprints shall be removed with alcohol or another suitable solvent.

ELK shaft seals must be turned after installation ... so O-rings, springs and sliding surfaces can slip into right placement before pressure testing. This is done by mounting the seal as described and later turn the shaft about 10 revolutions - with water in the pump - but without adding pressure. Then pressure test the pump as normally done.

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When using soapy water on the shaft, the bellows will settle and seat in abt. 15 minutes, and until then tightness should not be expected. After start, check by viewing the leak hole that there are no leaks.

6.4 FITTING BEARING HOUSE

Place the O-ring (27) between rear cover (7) and bearing house (15) in the O-ring groove and hold it with a little soft soap or silicone grease. Please check the material of the O-ring first. As standard the material is EPDM, which will be damaged by mineral grease. Fit and fasten bearing house in the rear cover.

6.5 FITTING IMPELLER

Fit the sunk key in the shaft and lead the impeller towards the shoulder of the shaft. Secure the impeller (5) with washers (23) and Domed cap nut (24) .

6.6 FITTING REAR COVER

Place the O-ring (3) between pump casing and rear cover (7) in the O-ring groove and hold it with a little grease. However, check the material of the O-ring first. As standard the material is VITON, Fit and fasten rear cover in the pump casing.

6.7 FITTING COUPLING AND MOTOR

Fit the cooling fan (47) to the pump half coupling (38) with sunk screws (49). Then fit the pump half coupling to pump shaft and tighten the pointed screw slightly, Fit the motor half coupling to motor shaft, and tighten the pointed screw slightly, place pump and motor on baseplate (45) and tighten the set screw with washers (41, 42, 43,44) slightly. Add shims under bearing support (33) and motor feet, adjust the number of shims to ensure correct alignment of pump and motor. Tighten set screws (37). Check that the coupling alignment is within the limits indicated in the tables below. Adjust the coupling parts to have the required axial distance “s” and tighten the pointed screws (torque see below table) in the coupling parts.

The coupling point screw tightening torque*:

SIZE	28	32	38	42	48	55	60
Dimension G [mm]	M5	M8	M8	M8	M8	M8	M8
Pointed screw torque TA [Nm]	2	10	10	10	10	10	10

*Having set the coupling into operation, the tightening torque of the point screws and wear of elastomer ring have to be inspected in usual maintenance intervals.

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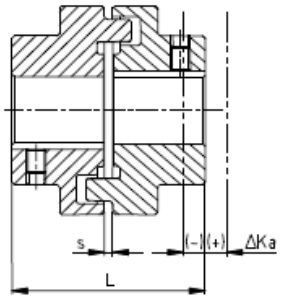
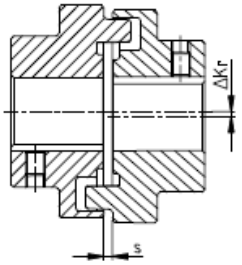
Alignment of the coupling

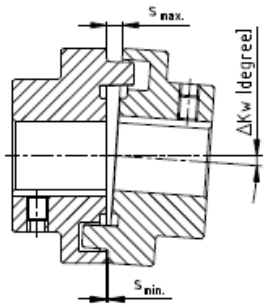


axial displacements

$L_{zul.} = L + \Delta K_a$ [mm]



radial displacements

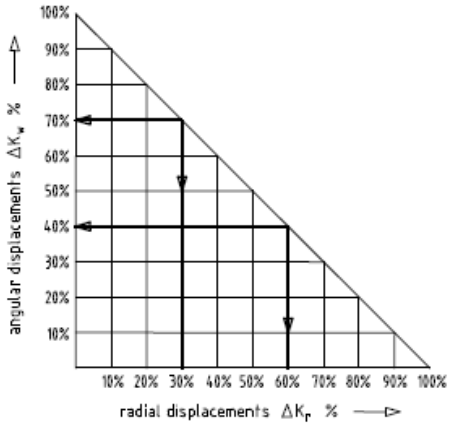


angular displacements

$\Delta K_w = s_{max.} - s_{min.}$ [mm]

Illustration 35: displacements

Illustration 36: combinations of displacement



Example for the misalignment combinations given in illustration 36:

Example 1:
$\Delta K_r = 30\%$
$\Delta K_w = 70\%$

Example 2:
$\Delta K_r = 60\%$
$\Delta K_w = 40\%$

$\Delta K_{total} = \Delta K_r + \Delta K_w \leq 100\ \%$

The displacement figures：

SIZE		28	32	38	42	48	55	60
Max. axial displacement △Ka [mm]		±1	±1	±1	±1	±1.5	±1.5	±1.5
Max. radial displacement △Kr [mm] with	1500 rpm	0.2	0.25	0.25	0.25	0.3	0.3	0.3
	3000 rpm	0.15	0.18	0.18	0.18	0.22	0.22	0.22
Max. angular displacement △Kw [mm]	1500 rpm (1 degree)	1.2	1.4	1.5	1.7	1.8	2.0	2.2
	3000 rpm (0.5 degree)	0.6	0.7	0.7	0.8	0.9	1.0	1.1
S [mm]		3	4	4	4	5	5	5
Coupling outer diameter [mm]		69	78	87	96	106	118	129

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6.8 SHAFT
When the pump has been assembled, check that the shaft rotates freely.

7. FROST PROTECTION

Pumps which are not in operation during frost periods are to be drained to avoid frost damage. Remove the plug at the bottom to empty the pump. Alternatively, it is possible to use anti-freeze liquids in normal constructions.

8. DISMANTLING

When removing the pump, first make sure that the pump has stopped. The pump is then drained of liquid before being dismantled from the piping system. If the pump has pumped dangerous liquids, be aware of this and protect against damage. In the case of hot liquids, care should be taken to ensure that the pump is emptied before removing the piping system.

9. START-UP

Please make sure the pump is filled with cold , clean water(room temperature) before first start-up and/or after pump has been drained.

ATTENTION

For safety reasons the pump is only allowed to operate against closed discharge valve for a short time (max. 5 minutes and at a max. temperature of 180°C). Otherwise there is a risk of damage to the pump and, at worst, of a steam explosion. If the pump is not monitored, the installation of a safety device is recommended.

Pumping water through a passive continuous pump is not recommended as it may damage the shaft seal due to lack of ventilation and/or too low speed due to current pressure and temperature at the shaft seal.

Check in the electric motor manual if the bearings in the actual motor shall be lubricated with grease before first start-up.

9.1 START-UP
Before starting the pump check that:

- the shaft rotates freely without jarring sounds.
- the pump casing, mechanical seal chamber and the suction line are filled with liquid.

Start the pump for a moment to check the direction of rotation. If the direction is correct (i.e. in the direction of the arrow) the pump may be started.

For the life of the shaft sealing, it is recommended that the pumps run at a speed of at least 450 rpm and that a maximum of 1 minute is spent on acceleration from 0 to 450 rpm and 1 minute deceleration from 450 to 0 rpm.

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In order to protect the shaft seal the pump must never run dry.

When the pump has been filled with cold and clean water(room temperature), the system can be started. Check the direction of rotation. If the direction is incorrect interchange of the power cords. The direction of rotation is indicated by an arrow. Make sure the bearings are running correctly and that they do not become warm.

10. SYSTEM BALANCING

It is often difficult to calculate a manometric delivery head in advance. It is, however, decisively important to the quantity of liquid delivered.

A considerably smaller delivery head than expected will increase the quantity of liquid delivered, causing increased power consumption and perhaps cavitation in pump and piping. In the pump the impeller may show signs of heavy erosion caused by cavitation (corrosion) which may at times render an impeller unfit for use in a very short time. Not unusually do similar erosions occur in pipe bends and valves elsewhere in the piping system.

Therefore, after start-up, it is necessary to check either the quantity of liquid delivered or the power consumption of the pump e.g. by measuring the current intensity of the connected motor. Together with a reading of the differential pressure the quantity of water delivered can be determined against the characteristics of the pump.

Should the pump not function as intended, please proceed according to the fault-finding list. Bear in mind, though, that the pump was carefully checked and tested at the factory and that the majority of faults stem from the piping system

FAULT	CAUSE	REMEDY
The pump has no or too low capacity	1. Wrong direction of rotation 2. Piping system choked 3. The pump is choked 4. Suction line leaks Pump takes air 5. Suction lift too high 6. Pump and piping system wrongly dimensioned	Change direction of rotation to clockwise when viewed from shaft end (the direction of the arrow) Clean or replace Clean the pump Find the leakage, repair the fault, non-return valve not submerged Check data sheet Q/H curve and NPSH or contact DESMI As
The pump uses too much power	1. Counter-pressure too low 2. The liquid is heavier than water 3. Foreign body in pump 4. Electric motor is running on 2 phases	Insert orifice plate or check valve/Contact DESMI Contact DESMI Dismantle the pump, remove the cause Check fuses, cable connection, and cable
The pump makes noise	1. Cavitation in pump	Suction lift too high/ Suction line wrongly dimensioned/Liquid temperature too high

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11. INSPECTION AND MAINTENANCE

Inspect the shaft seal for leaks at regular intervals.

- Before inspection of a pump without guard check that the pump cannot be started unintentionally.

- The system is to be without pressure and drained of liquid.

- The repairman must be familiar with the type of liquid which has been pumped as well as the safety measures he is to take when handling the liquid.

On pumps inoperative, the shaft must be rotated at least 2-3 rounds monthly to avoid standstill damage to shaft seal and bearings. If the pump is liquid-filled, it can alternatively be started up briefly.
In special applications, more frequent rotation or short-term start-up may be necessary to avoid solidification of the impeller and/or shaft seal.
In pressurized systems, the shaft seal is often seen to leak slightly during standstill – in most cases the leak stops shortly after the pump is started up.

11.1 DRAINING THE PUMP

When the piping system has been drained, note that there is still liquid in the pump. Remove the liquid by dismantling the pipe plug (2) at the bottom of the pump and shaft seal chamber.

12. REPAIRS

12.1 ORDERING SPARE PARTS

When ordering spare parts please always state pump type, serial No. (appears on the name plate of the pump), position No. on the assembly drawing and designation on the spare parts list.

The following parts are exposed to wear: Shaft seal (10), impeller (5), carbon bearing (4), O-rings (3 and 27), oil seal ring (11) and the ball bearing (13).

12.2 REPLACING THE IMPELLER

Close the valves on both sides of the pump. Draining the pump by dismantling pipe plug (2) at the bottom of the pump and shaft seal chamber. And dismantle the motor, Loosen the nuts (22) , set screws (37) and dismantle the rear cover with rotating parts from the pump casing. Remove the camp cap nut (24) and take off the impeller (5). Fit the new impeller.

12.3 REPLACING O-RINGS

When impeller and shaft have been separated, Remove the key (19) and loosen the nuts (18) and dismantle the bearing house with shaft and ball bearing unit from the rear cover. The O-ring (3 and 21) in the rear cover (7) and bearing house can be pulled out.

In order to replace the O-ring (21) it is necessary first to dismantle the impeller.

12.4 REPLACING SHAFT SEAL (22)

Dismantling as described in paragraph 5.

When the impeller has been dismantled, Remove the key (19) and loosen the nuts (18) and dismantle the bearing house with shaft and ball bearing unit from the rear cover. Loosen the point screw, then the sealing element itself can now be pulled off the shaft.

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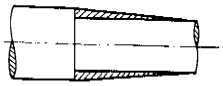
Dismantle the top piece from the ball bearing to permit pressing from the back with a pair of screwdrivers or the like under the collar off the seat.

Clean the bore for seat and shaft thoroughly of dirt and rust. Remove persistent coatings, if any, by grinding the shaft lightly with very fine emery cloth.

Grease the new seat ring and the inserted O-ring well with glycerine – not oil – and press it into place in the casing. Check that the seat is fitted correctly by knocking lightly with a piece of wood. The seat ring is to be treated very carefully to prevent the sliding surface from being scratched.

It is necessary to use a conical bush as shown below to prevent the rubber bellows from being damaged during mounting.



Grease the back of the carbon ring with glycerine to ensure that it stays in its correct place during the mounting. Grease the shaft, the conical bush and the rubber bellows amply with glycerine.

And If it is necessary to use plastic tape to help shaft seal get through the slide bearing rough surface area on the shaft.

Press the shaft seal on to the shaft until it resists. Press the driving ring only,

Finally It has to be made sure the length from shaft seal end to bearing house flange being within 44 +/- 0.5mm of the nominal length. And lock it with the pointed screw.

The ELK shaft seals must be turned after installation ... so O-rings, springs and sliding surfaces can slip into right placement before pressure testing. This is done by mounting the seal as described and later turn the shaft about 10 revolutions - with water in the pump - but without adding pressure. Then pressure test the pump as normally done.

12.5 REPLACING BALL BEARINGS

The bearings are dimensioned for a nominal life of 100,000 operating hours and is to be relubricated according to the following table. Bearings must be replaced in case of noise or bearing wear.
The bearings must be re-lubricated through the lubrication nipples (32) mounted on the outside of the bearing house console (15) according to the table below. When replaced, fill the bearings with grease and place a fat tumour on top of the shaft in a quantity corresponding to the chart below. The high-temperature grease SKF LGHP2 is recommended.

Pump	Assembly	Interval	Quantity
ESLHT25-180N	Ball bearing housing	4500 hours	10 g
ESLHT40-180N	Ball bearing housing	4900 hours	10 g

If the ball bearing is to be replaced, it is necessary to disassemble the pump and dismantle the pump shaft (as described in paragraph 5.1.3):

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When assembling the pump again, check the pump shaft for damages in the form of marks, burrs, or upsetting of the shaft end.

Damages, if any, are to be remedied by means of a file and fine emery cloth. This work has to be done very carefully. If this is not done carefully, the pump shaft will scratch the shaft seal when fitted.

13. OPERATING DATA

The following working pressures (pressure in piping incl. the pressure increase caused by the pump) and number of revolutions are allowed in standard pumps.

Pump	Max. working pressure[bar] SG-iron	Max. working pressure[bar] SS	Max.RPM
ESLHT25-180	14	16	3600
ESLHT40-180	14	16	3600

The above max. operating pressure is valid at 180°C water

The above-mentioned max. working pressure is a design value – delivered pumps are pressure tested according to actual application requirements and actual flange standards.

For instance the above-mentioned max. working pressure is **NOT** valid for pumps approved by a classification society. Pumps approved by classification societies have been pressure tested according to the requirements of these societies, i.e. a test pressure of 1.5 x the permissible working pressure. The test pressure is stated in the test certificate and stamped into the discharge flange of the pump.

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14. EU DECLARATION OF CONFORMITY

DESMI Pumping Technology A/S, hereby declare that our pumps of the ESLV and ESLH and ESLHT type are manufactured in conformity with the following essential safety and health requirements in the COUNCIL DIRECTIVE 2006/42/EC on machines, Annex 1.

The following harmonized standards have been used:

EN/ISO 13857:2008	Safety of machinery. Safety distances to prevent danger zones being reached by the upper limbs
EN 809:1998 + A1:2009	Pumps and pump units for liquids – Common safety requirements
EN12162:2001+A1:2009	Liquid pumps – Safety requirements – Procedure for hydrostatic testing
EN 60204-1:2006/A1:2009	Safety of machinery – Electrical equipment of machines (item 4, General requirements)
Ecodesign Directive (2009/125/EC)	Water pumps: Commission Regulation No 547/2012. Applies only to water pumps marked with the minimum efficiency index MEI. See pump nameplate.

Pumps delivered by us connected with prime movers are CE-marked and comply with the above requirements.

Pumps delivered by us without prime movers (as partly completed machinery) must only be used when the prime mover and the connection between prime mover and pump comply with the above requirements.

Nørresundby, March 05 2019

Henrik Mørkholt Sørensen
Managing Director

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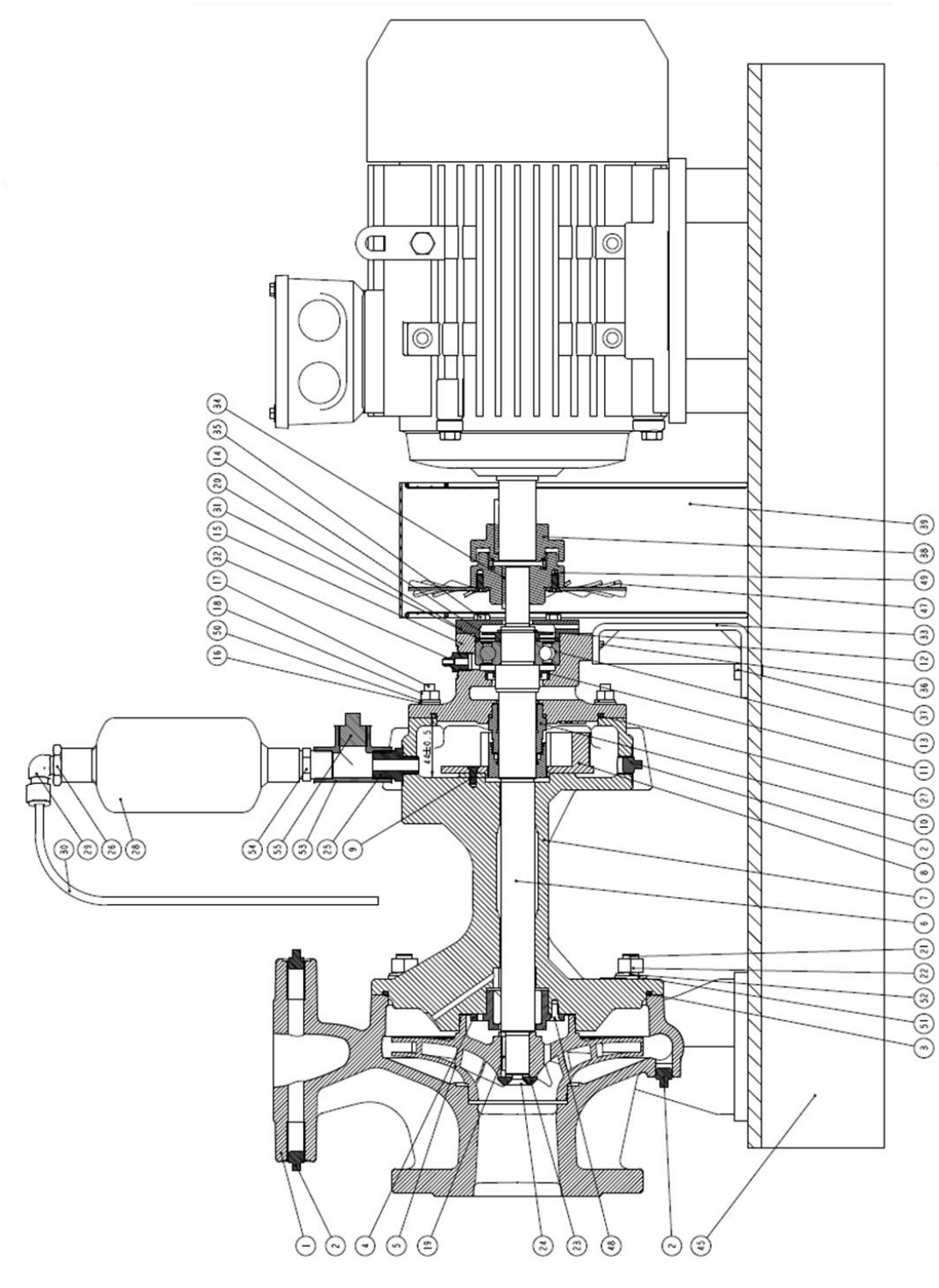
15. INFORMATION RELEVANT FOR DISASSEMBLY OR DISPOSAL AT END-OF-LIFE

No damage materials are used in DESMI pumps – please refer to DESMI Green Passport (can be sent on request – contact a DESMI sales office) – i.e. common recycling companies can handle the disposal at end-of-life. Alternatively the pump and motor can be returned to DESMI at end-of-life for safe recycling.

16. ASSEMBLY DRAWING ESLHT25-180N/-17 W180 / ESLHT40-180N/-17 W180



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1	Pump casing	15	Bearing house	29	Hexagon nipple	49	Sunk screw
2	Pipe Plug	16	Washer	30	Tube	50	Spring washer
3	O-ring	17	Stud	31	Orifice ring	51	Washer
4	Bearing	18	Nut	32	Grease nipple	52	Spring washer
5	Impeller	19	Key	33	Bearing support	53	Tee
6	Shaft	20	Bearing cover	34	Key	54	Hexagon nipple
7	Rear cover	21	Stud	35	Set screw	55	Pipe Plug
8	Vortex Break	22	Nut	36	Set screw		
9	Sunk screw	23	Washer	37	Set screw		
10	Mechanical seal	24	Cap nut	38	Coupling		
11	Oil seal ring	25	Washer	39	Coupling guard		
12	Snap ring	26	Bush	45	Baseplate		
13	Ball bearing	27	O-ring	47	Cooling fan		
14	Support disc	28	Air vent	48	Sunk screw		

17. DIMENSIONAL SKETCH

Please require a dimensional sketch of the actual pump from DESMI.

Connection holes on pump: Manometer: 1/4” BSP. Drain: 1/4” BSP.

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