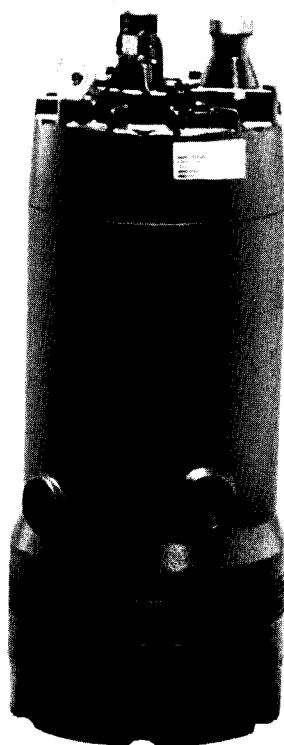
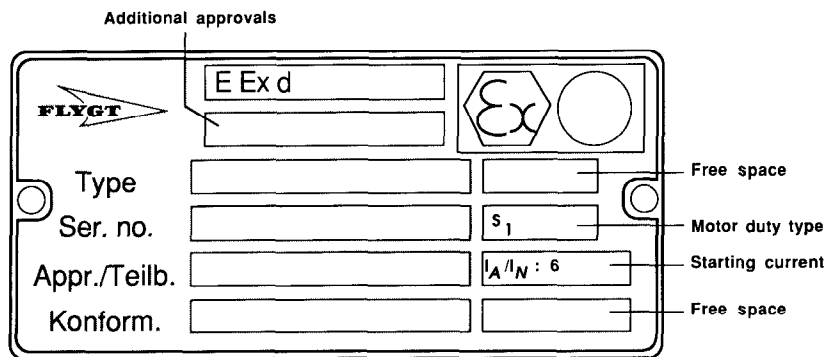
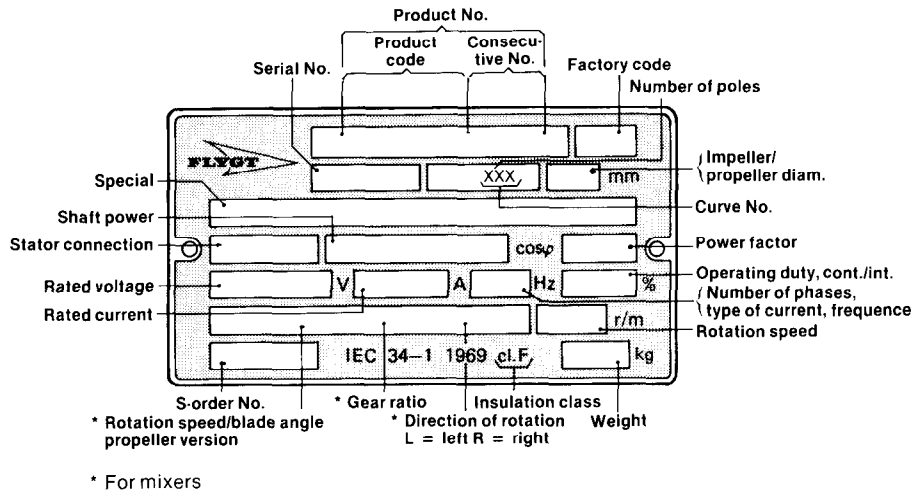


## INSTALLATION, CARE AND MAINTENANCE

EN: EEx de IIB T3  
EN: EEx de I  
MSHA  
EMR



# DATA PLATE INTERPRETATION



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# GUARANTEE

Flygt undertakes to remedy faults in products sold by Flygt provided:

- that the fault is due to defects in design, materials or workmanship;
- that the fault is reported to Flygt or Flygt's representative during the guarantee period;
- that the product is used only under conditions described in the care and maintenance instructions and in applications for which it is intended;
- that the monitoring equipment incorporated in the product is correctly connected;
- that all service and repair work is done by a workshop authorized by Flygt;
- that genuine Flygt parts are used.

Hence, the guarantee does not cover faults caused by deficient maintenance, improper installation, incorrectly executed repair work or normal wear and tear.

Flygt assumes no liability for either bodily injuries, material damages or economic losses beyond what is stated above.

## Official approval applies only providing:

- that the product is used under conditions described in the care and maintenance instructions and in applications for which it is intended;
- that the monitoring equipment incorporated in the product is correctly connected;
- that all service and repair work is done by a workshop authorized by Flygt;
- that genuine Flygt parts are used.

Flygt guarantees that a spare parts stock will be kept for 10 years after the manufacture of this product has been discontinued.

The manufacturer reserves the right to alter performance, specification or design without notice.

## "Caution statement" for MSHA

Federal Safety Regulations, as outlined in the applicable provisions of Title 30 of the Code of Federal Regulations, require that in order to maintain "permissibility" of this equipment the following conditions must be satisfied:

**1. General Safety.** Frequent inspections shall be made. All electrical parts, portable cable and wiring shall be kept in a safe condition. There shall be no openings into the casings of the electrical parts. The machine frame shall be effectively grounded. The power wires shall not be used for grounding. The operating voltage shall match the voltage rating of the motor.

**2. Service and Repair.** Inspections, service and repairs shall only be made when the portable cable is disconnected from the power supply. Work must be performed by trained personnel (preferably the manufacturer or his agent) to insure that the permissible pump is restored to its original state of safety in regard to all flame-arresting paths. Use replacement

parts exactly as those furnished by the manufacturer. When cable entries are disturbed on pump or permissible control, they shall be reassembled in the approved manner and with parts identical to the parts of the original certification.

**3. Fastenings.** All bolts, nuts, screws and threaded covers shall be properly tightened and secured.

**4. Cables.** A flame-resistant portable cable, bearing a MSHA assigned identification number, adequately protected by an automatic circuit-interrupting device shall be used. Special care shall be taken in handling the cable to guard against mechanical injury and wear.

**WARNING!** Failure to restore the permissible equipment to its original state of safety will void the MSHA APPROVAL. The creation of a safety hazard will subject the owner/operator of a mine to citations and penalties under the law.

The pump has MSHA No. 2G 3842 A-0 approval.  
Pumpen har godkännande MSHA No 2G 3482 A-0.  
Die Pumpe hat MSHA No. 2G 3842 A-0 Gutheissungen.  
La pompe a les approbation MSHA No. 2G 3842 A-0.

# PRODUCT DESCRIPTION

These care and maintenance instructions apply to an explosion proof and permissible (MSHA), submersible Flygt pump.

## Applications

2135.590 and 2135.690 are intended to be used for pumping of water which may contain abrasive particles.

The pump is designed for use in explosive environments in accordance with the following approval:

590/690: EEx de I  
590: EEx de IIB T3  
MSHA  
EMR

**Liquid temperature:** max. 40°C (105°F).

**Liquid density:** max. 1100 kg/m<sup>3</sup> (9.2 lb per US gal.)

The pumped liquid may contain particles up to a size which corresponds to the openings in the strainer.

**The pH of the pumped liquid:** 5—8.

**Depth of immersion:** max. 20 m (66 ft).

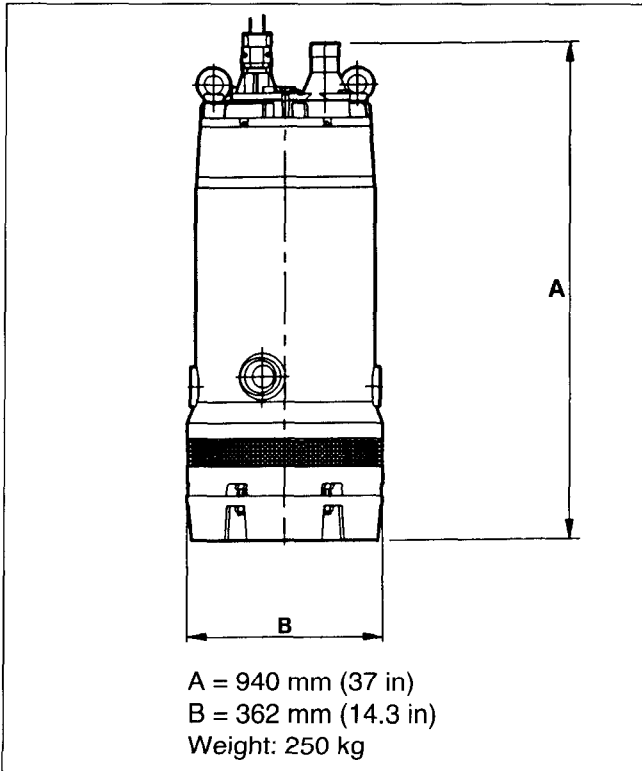
For other applications, contact your nearest Flygt representative for information.



### NOTE!

Make sure that the monitoring equipment incorporated in the product is correctly connected.

## Dimensions and weights



## Materials

		DIN	BS	AISI
Major Castings and Hydraulic Parts	Cast Iron	1691 GG25	1452: 1977 Grade 260	ASTM A48-76 Class 40B
Outer Casing Cooling Jacket and Lower Pump Housing	Spher.gra-phite Iron	1693 GGG40	2789 SNG 420/12	ASTM A536 60-40-18
Lifting Eye Bolts	Steel zinc-electro-plated	17100 1980 RST 37-2	4360 Grade 40B	A248 Grade D A 573 Grade 65
Shaft (friction welded)	Stainless Steel	X8CrNiMo 27 5 Wnrl. 4460		329
	Steel	17100 St 60-2	970 1971 part 1	
Impeller	Alloyed White Cast Iron L 102	1695 G-X260 Cr 27	4844 Grade 3E	ASTM 532-80 Alloy 111 A
	ALU Bronze	1714 CuAl 10 Ni	1400 1973	ASTM Cs 5500
Strainer	Stainless steel	X5 CrNi 18 9	EN 58A	ASTM TP 304
O-Rings	Nitrile Rubber 70° IRH			
Screws, Studs, and Nuts	Stainless Steel	X5CrNi 18 9	En 58A	304
Wear Parts	Nitrile Rubber 70° IRH			
Mechanical Face Seals:	Inner Stationary:	Tungsten carbide (Co bound)		
	Inner Rotating:	Carbon		
Mechanical Face Seals:	Outer Stationary:	Tungsten carbide (Nickel bound)		
	Outer Rotating:	Tungsten carbide (Nickel bound)		
Surface Treatments:	Priming of casting. Finishing coating of synthetic resin enamel in black color.			

## Motor data

**Rated output 13.5 kW**  
3 ~ 50 Hz, 2920 rpm

Voltage V	Rated Current A	Starting Current A
220	44	335
380	25	194
400	24	179
415	23	187
440	22	200
500	19	145
550	18	157
1000	9.7	71
1100	8.8	67

**Rated output 16.5 kW**  
3 ~ 60 Hz, 3525 rpm

Voltage V	Rated Current A	Starting Current A
440	27	220
460	26	200
550	22	139
575	21	142
600	20	154
1100	11	68

# Design

## 1. Motor

Squirrel-cage 3-phase induction motor for 50 Hz or 60 Hz.

The motor is started by means of direct on-line or star-delta start.

The motor can be run continuously or intermittently with a maximum of 15 evenly spaced starts per hour.

Flygt motors are tested in accordance with IEC 34-1.

The stator is insulated in accordance with class F (155°C, 310°F). The motor is designed to supply its rated output at  $\pm 5\%$  variation of the rated voltage. Without overheating the motor,  $\pm 10\%$  variation of the rated voltage can be accepted provided that the motor does not run continuously at full load. The motor is designed to operate with a voltage imbalance of up to 2% between the phases.

## 2. Bearings

The pump bearings are designed for at least 10 000 hours of operation.

The lower bearing of the rotor consists of a double row angular contact ball bearing.

The upper bearing of the rotor consists of a single row ball bearing.

## 3. Oil casing

The oil lubricates and cools the seals and acts as a buffer between the pump casing and the electric motor.

Pressure build-up within the oil casing is reduced by means of a built-in air volume.

## 4. Shaft seals

The pump has two mechanical seals.

Materials: Inner seal: tungsten carbide — carbon.

Outer seal: tungsten carbide — tungsten carbide.

## 5. Shaft

The shaft is delivered with the rotor as an integral part.

Shaft material: stainless and carbon steel.

## 6. Cooling

The stator is cooled by the pumped liquid passing through the space between the stator casing and the outer casing.

## 7. Impellers

The pumps are equipped with two radialflow impellers.

## 8. Monitoring equipment

The stator incorporates two thermal switches connected in series.

The thermal protectors opens at:

2135.590/690 EN: 110°C (230°F)

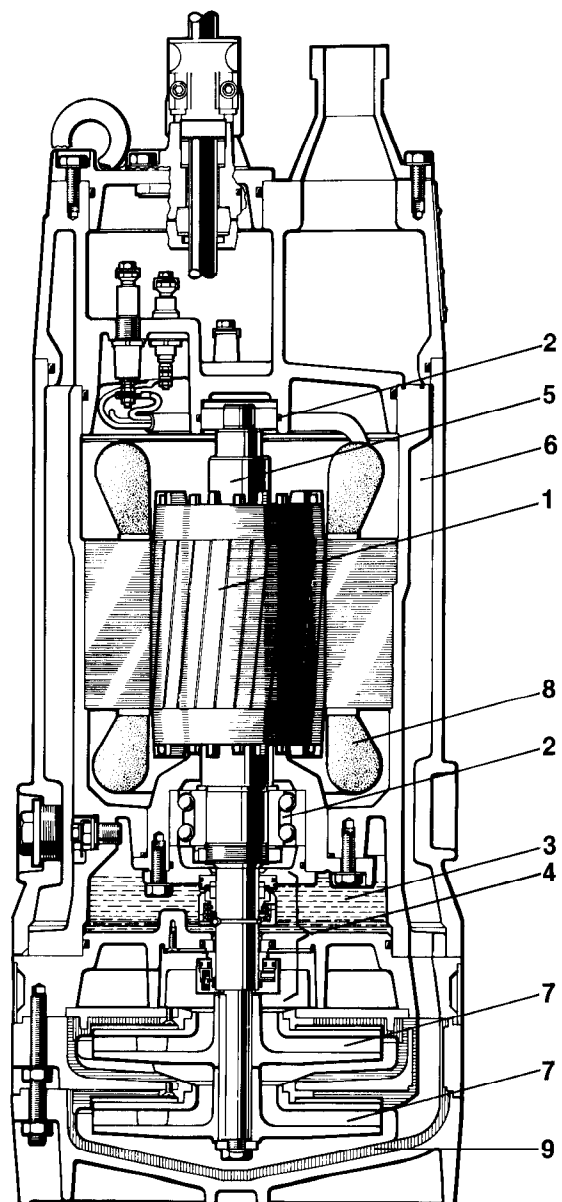
2135.590 MSHA/EMR: 125°C (260°F)

The monitoring equipment shall be of a design that makes automatic restart impossible.

See also "Electrical connections" and separate instructions for starter equipment/monitoring unit.

## 9. Wear parts

The pump's easily replaceable wear parts are rubber-covered.



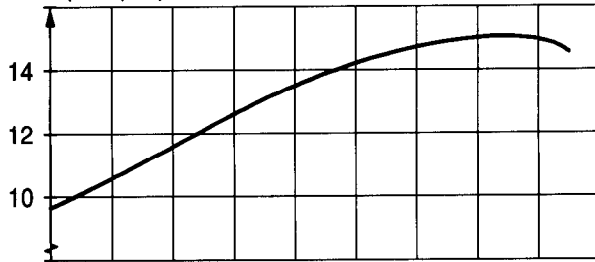
## Performance curves

└ = Best operating point

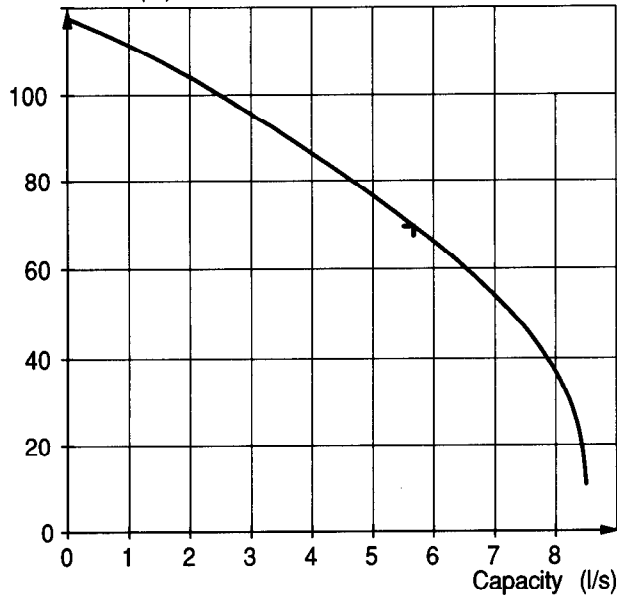
HT = high-head version

### 50 Hz, 3 ~ HT

Input (kW)

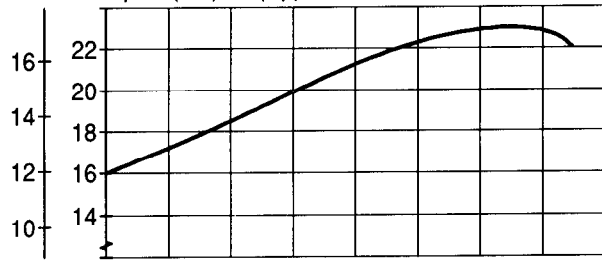


Head (m)

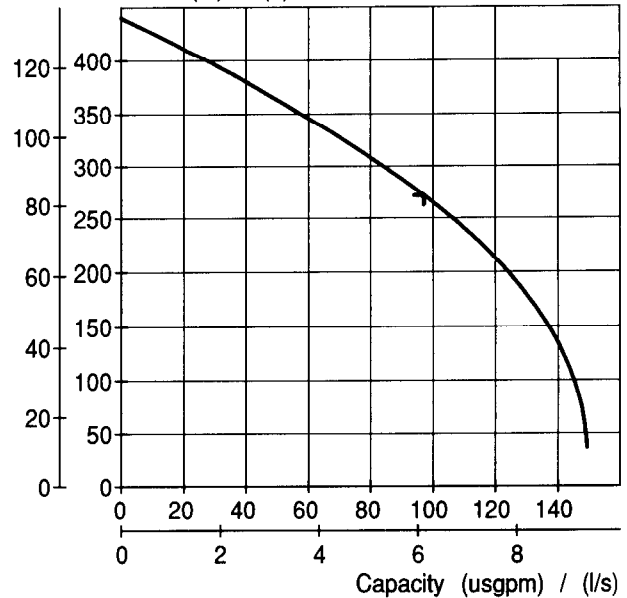


### 60 Hz, 3 ~ HT

Input (kW) / (Hp)



Head (m) / (ft)



## TRANSPORTATION AND STORAGE

The pump may be transported and stored in a vertical or horizontal position. Make sure that it cannot roll or fall over.

**Warning!**  
Always lift the pump by its lifting eye,  
never by the motor cable or  
the hose.

The pump is frostproof as long as it is operating or is immersed in the liquid. If the pump is taken up when the temperature is below freezing, the impeller may freeze. The pump shall be operated for a short period after being taken up in order to expel all remaining water.

A frozen impeller can be thawed by allowing the pump to stand immersed in the liquid for a short period before it is started. Never use a naked flame to thaw the pump.

For longer periods of storage, the pump must be protected against moisture and heat. The impeller should be rotated by hand occasionally (for example every other month) to prevent the seals from sticking together. If the pump is stored for more than 6 months, this rotation is mandatory.

After a long period of storage, the pump should be inspected before it is put into operation. Pay special attention to the seals and the cable entry.

Follow the instructions under the heading "Before starting".

# INSTALLATION

## Safety precautions

In order to minimize the risk of accidents in connection with the service and installation work, the following rules should be followed:

1. Make sure the lifting equipment is in good condition.
2. Be aware of the risk of electrical accidents.
3. Use a safety helmet, safety goggles and protective shoes.
4. Do not ignore the risk of drowning.
5. A first-aid kit must be available.

Follow all other health and safety rules and local codes and ordinances.

## Handling equipment

Lifting equipment will facilitate handling of the pump.

**WARNING!** Keep out from under suspended loads.

## Pump installation

Run the cables so that they do not have any sharp bends and are not pinched.

Connect the discharge connection and motor cable. See "Electrical connections".

Lower the pump into the sump.

Place the pump on a base which will prevent it from sinking down into the soft sump bottom.

Alternatively, the pump can be suspended by its lifting eye just above the sump bottom.

Consult your nearest Flygt representative regarding:

- choice of additional equipment.
- other problems in connection with installation.

# ELECTRICAL CONNECTIONS

All electrical work shall be carried out under the supervision of an authorized electrician.

Local codes and regulations shall be complied with.

### WARNING!

**All electrical equipment must be earthed. This applies to both pump equipment and any monitoring equipment.**

**Failure to heed this warning may cause a lethal accident. Make sure that the earth lead is correctly connected by testing it.**

### NOTE for Ex version

**All work on the explosion-proof motor section must be performed by authorized Flygt personnel or personnel authorized by Flygt.**



### NOTE!

**Make sure that the monitoring equipment incorporated in the product is correctly connected.**

Check that the mains voltage and frequency agree with the specifications on the pump data plate.

The motor can be connected for different voltages as shown on the data plate.

Under no circumstances may the starter equipment be installed in the pump pit.

Install the motor cable and the control cable as illustrated in the figure.

To avoid leakage into the pump, check:

- that the cable entry seal sleeve and washers conform to the outside diameter of the cable. See the parts list.
- that the outer jacket on the cable is not damaged. When refitting a cable which has been used before, always cut off a short piece of the cable so that the cable entry seal sleeve does not close around the cable at the same point again.

**NOTE!** For safety reasons, the earth lead should be approx. 100 mm (3.94") longer than the phase leads. If the motor cable is jerked loose by mistake, the earth lead should be the last lead to come loose from its terminal. This applies to both ends of the cable.

### Connection of stator and motor leads

Check on the data plate which connection, Y or  $\Delta$ , is valid for the voltage supply. Then, depending on voltage, arrange the connection to the terminal studs in accordance with Y or  $\Delta$ , see figure.

Connect the motor cable to the terminal stud connections L1, L2, L3, T1, T2 and earth.

Make sure that the pump is correctly earthed (grounded).

Install the cover (97).

Tighten the screws (1) so that the cable entry unit bottoms out.

Connect the motor cable to the starter equipment. Check the direction of rotation, see "Before starting".

If the direction of rotation is wrong, transpose two of the phase leads.

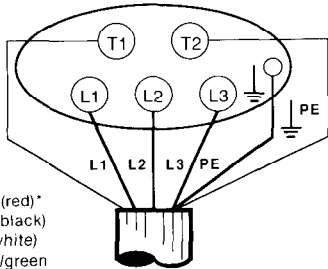
Remember that the starting surge with the direct-on line start can be up to six times higher than the rated current. Make sure that the fuses or circuit breakers are of the proper amperage.

The table gives rated current and starting current. Fuse amperage and cable shall be selected in accordance with local rules and regulations. Note that with long cables, the voltage drop in the cable must be

taken into consideration, since the motor's rated voltage is the voltage that is measured at the terminal board in the pump.

The overload protection (motor protection breaker) shall be set to the motor's operating current, but no higher than the motor's rated current as given on the data plate.

### Motor cable connection



- a = Brown (red)\*
- b = Black (black)
- c = Blue (white)
- d = Yellow/green

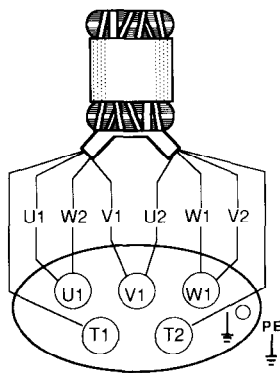
\* US colourmarking in brackets.

The stator leads are colourmarked as follows:

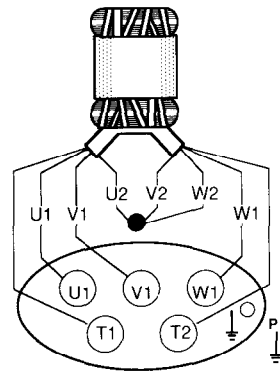
- U1 — red
- V1 — brown
- W1 — yellow
- U2 — green
- V2 — blue
- W2 — black
- U5 — red
- V5 — brown
- W5 — yellow
- U6 — green
- V6 — blue
- W6 — black

### Stator connection

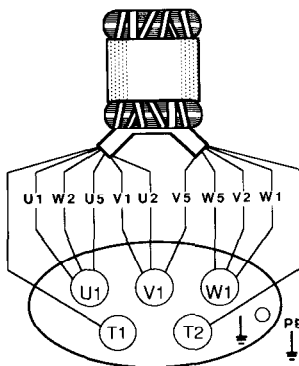
#### D connection



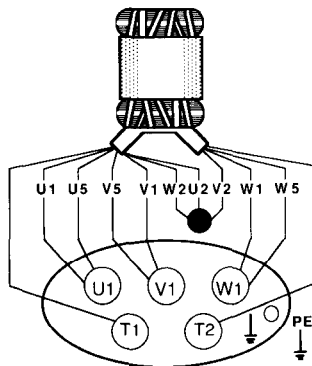
#### Y connection



D // connection  
500 - 550 V 50 Hz  
stator variant 56

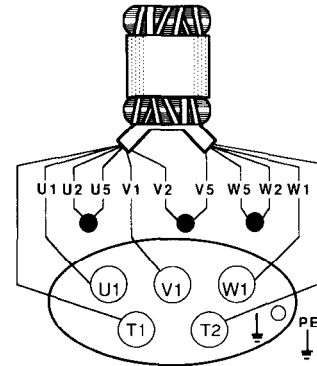


Y // connection  
500 V 50 Hz  
550 V 60 Hz  
stator variant 59



D ser. connection  
1000 - 1100 V 50 Hz  
stator variant 56

Y ser. connection  
1000 V 50 Hz  
1100 V 60 Hz  
stator variant 59





## Before starting

Check the oil level in the oil casing.

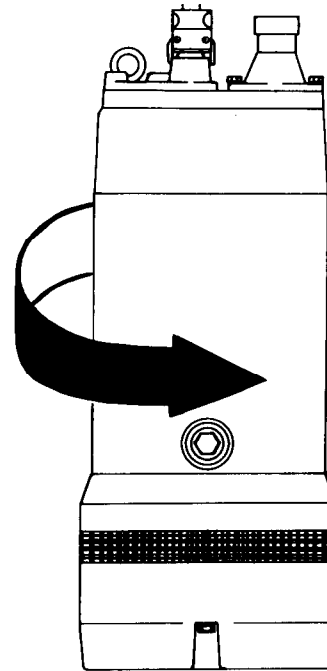
Remove the fuses or open the circuit breaker and check that the impeller can be rotated by hand.

Check that the monitoring equipment (if any) works.

Check the direction of rotation. See the figure. The impeller shall rotate clockwise, as viewed from above. When started, the pump will jerk in the opposite direction to the direction in which the impeller rotates.

**WARNING! Watch out for the starting jerk, which can be powerful.**

## Starting jerk



## OPERATION

In order to avoid sedimentation when the pumped liquid contains solid particles, the velocity of the medium in the discharge line should be:

Mixture	Min. velocity in discharge pipe/hose
1. Water + coarse gravel	4 m/s (13.2 ft/s)
2. Water + gravel	3.5 m/s (11.5 ft/s)
3. Water + sand	
Sand particles < 0.1 mm (0.004 in)	1.5 m/s (5.0 ft/s)
Sand particles < 0.6 mm (0.024 in)	2.5 m/s (8.2 ft/s)

Choose dimension of the discharge pipe/hose to give the pumped liquid at least this velocity.

The pump can be provided with level regulation in order to prevent unnecessary wear on the hydraulic components.

### Cleaning

If the pump has been running in very dirty water, let it run for a while in clean water, or flush it through the discharge connection. If clay, cement or other similar dirt is left in the pump it may clog the impeller and seal, preventing the pump from working.

During a longer period out of operation, the pump must be test run every other month to prevent the mechanical seals from sticking together.

# CARE AND MAINTENANCE

The figures in parentheses are item numbers and refer to the cutaway figure.

## Safety precautions

### WARNING!

**Before starting work on the pump, make sure that the pump is isolated from the power supply and cannot be energized.**

NOTE! This applies to the control circuit as well.

The following points are important in connection with work on the pump:

- make sure that the pump has been thoroughly cleaned.
- observe good personal hygiene.
- beware the risk of infection.
- follow local safety regulations.

### NOTE for Ex version

**All work on the explosion-proof motor section must be performed by authorized Flygt personnel or personnel authorized by Flygt.**

**Flygt renounces all responsibility for work done by untrained, unauthorized personnel.**

## Inspection

Regular inspection and preventive maintenance ensure more reliable operation.

The pump should be inspected twice a year, more frequently under severe operating conditions.

Under normal operating conditions, the pump should have a major overhaul in a service shop once a year.

This requires special tools and should be done by an authorized service shop.

When the pump is new or when the seals have been replaced, inspection is recommended after one week of operation.

### Service contract

Flygt or its agent offers service agreements in accordance with a preventive maintenance plan. For further information, please contact your Flygt representative.

## Recommended inspections:

Inspection of	Action
Visible parts on pump and installation	<p>Replace or fix worn and damaged parts.</p> <p>Make sure that all screws, bolts and nuts are tight.</p> <p>Check the condition of lifting eye, chains and wire ropes.</p>
Pump casing and impeller	<p>Replace worn parts if they impair function.</p> <p>Wear on the outlet flange on the pump casing usually causes corresponding wear on the discharge connection.</p> <p>Wear on the impeller and the parts around it necessitates fine adjustment of the impeller or replacement of worn parts. See "Removing the impeller".</p>
Oil quantity	<p><b>Oil casing</b></p> <p>WARNING. If the seal leaks, the oil casing may be under pressure. Hold a rag over the oil plug in order to prevent splatter. See "Safety precautions" for additional information.</p> <p>Check that the oil reaches up to the oil hole.</p>
Condition of the oil	<p>A check of the condition of the oil can show whether there has been an increased leakage. Note! Air/oil mixture can be confused with water/oil mixture.</p> <p>Insert a tube (or hose) into the oil hole. Cover the top end of the tube and take up a little oil from the bottom.</p> <p>Change the oil if it contains too much water, i.e., is heavily emulsified (cream-like), or if the oil housing contains separated water. See "Changing the oil". Check again one week after changing the oil.</p>

Inspection of	Action
	<p>If the oil contains too much water again, the fault may be:</p> <ul style="list-style-type: none"> <li>— that an oil screw (4, 90) is not sufficiently tight.</li> <li>— that the O-ring (23, 33) of an oil screw or its sealing surface is damaged.</li> <li>— that an O-ring (41) or its sealing surface is damaged.</li> <li>— that the lower mechanical seal (67) is damaged.</li> </ul> <p>Contact a Flygt service shop.</p>
Liquid in the stator casing	In order to ensure the explosion-proof (permissible) function, inspection may only be carried out by an authorized service shop or by Flygt personnel.
Cable entry	<p>Make sure that the cable clamps are tight. If the cable entry leaks:</p> <ul style="list-style-type: none"> <li>— check that the entry is firmly tightened into its bottom-most position.</li> <li>— cut a piece of the cable off so that the seal sleeve (51) closes around a new position on the cable.</li> <li>— replace the seal sleeve (51).</li> <li>— check that the seal sleeve (51) and the washers (20) conform to the outside diameter of the cables.</li> </ul>
Cables	Replace the cable if the outer jacket is damaged. Make sure that the cables do not have any sharp bends and are not pinched.
Level sensors or other level equipment	<p>Check function. Clean, adjust, replace or repair damaged level sensing equipment. Follow the instructions for the level sensing equipment in question.</p> <p>NOTE! The level sensor contains a mercury switch. Damaged sensors should therefore be disposed of in a proper manner.</p>
Starter equipment	If faulty, contact an electrician.
Rotation direction of pump (requires voltage)	Transpose two phase leads if the impeller does not rotate clockwise as viewed from above. Rotation in the wrong direction reduces the capacity of the pump and the motor may be overloaded. Check the direction of rotation, during <b>non-load</b> every time the pump is reconnected.
Pipes, valves and other peripheral equipment	Repair faults and notify supervisor of any faults or defects.
Insulation resistance in the stator	Use insulation tester. With a 1000 V-DC megger the insulation between the phases and between any phase and earth (ground) should be $> 1 \text{ M}\Omega$ .

## Changing the oil

### Oil casing

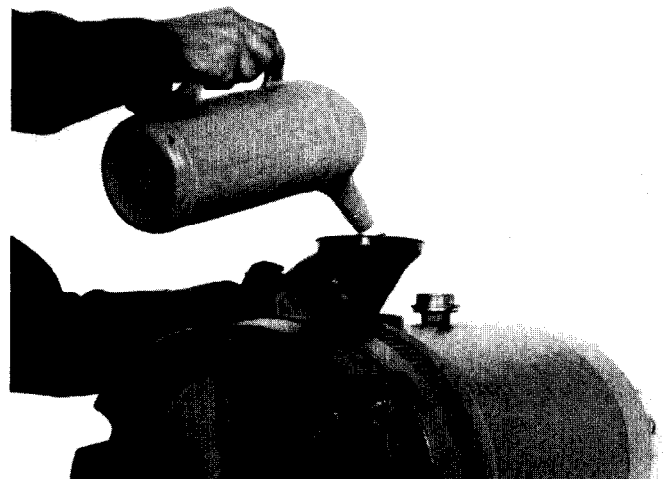
**WARNING.** If the seal leaks, the oil casing may be under pressure. Hold a rag over the oil plug to prevent splatter.

Lay the pump on its side on a bench or over two supports.

Remove the plug (30) and the oil casing screw (4, 90).

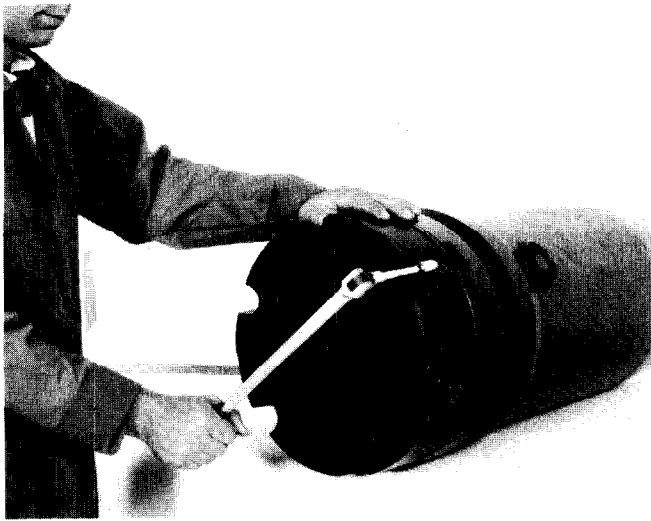
Turn the pump so that the oil hole faces downwards.

Fill up with 2.5 litres (2.6 US quarts) of new oil. Use an ordinary SAE 10W-30 motor oil.



## Removing the impeller

**WARNING!** Worn impellers often have very sharp edges.

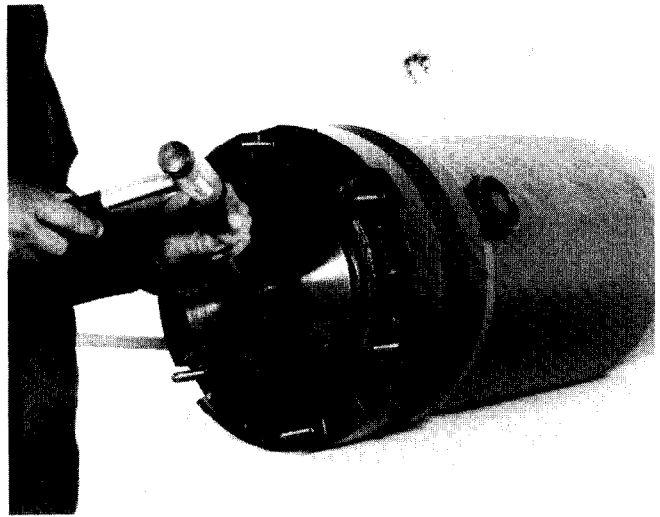


Lay the pump on its side.

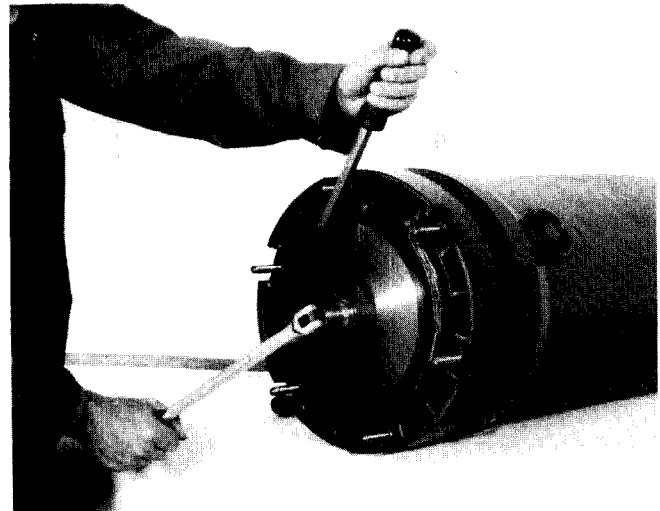
Remove nuts (13) and washers (22).



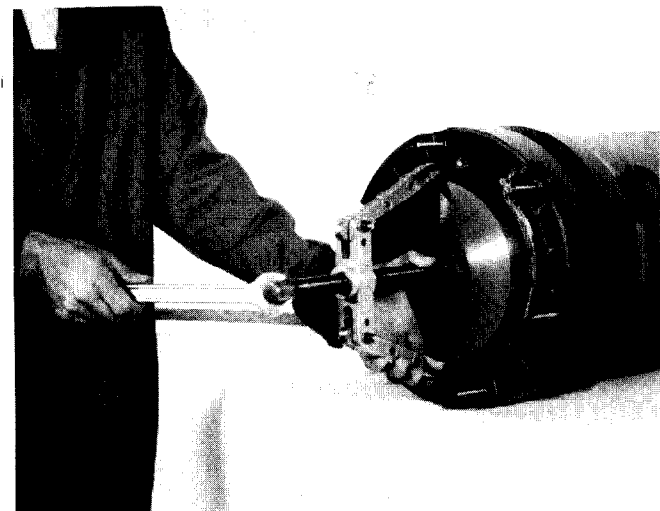
Pry of the lower diffuser with a pair of screwdrivers.



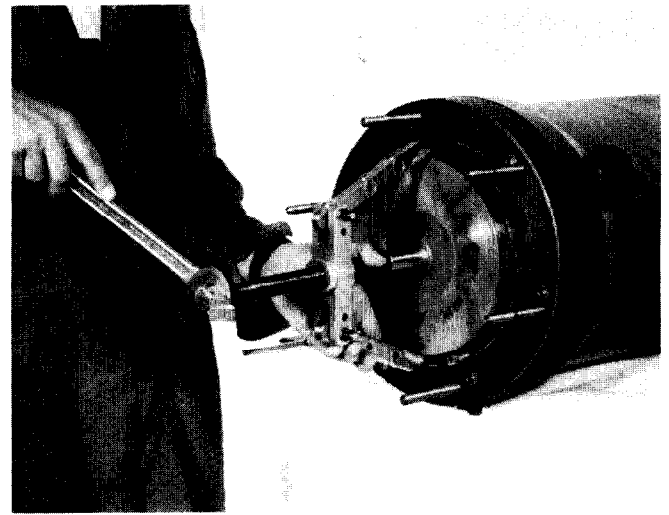
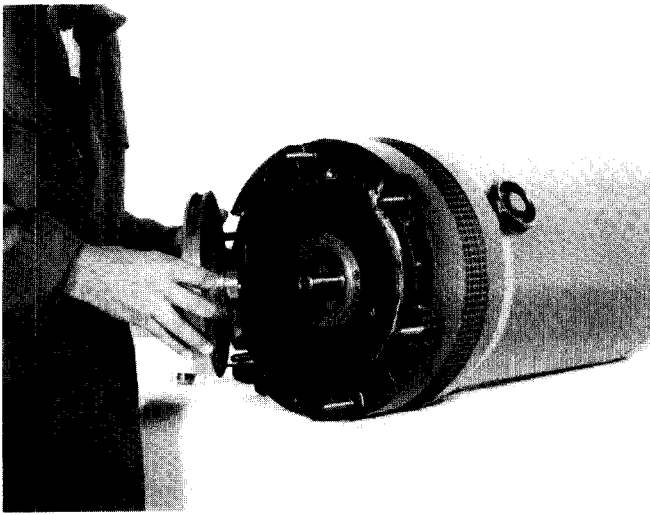
Knock back the folded washer (26).



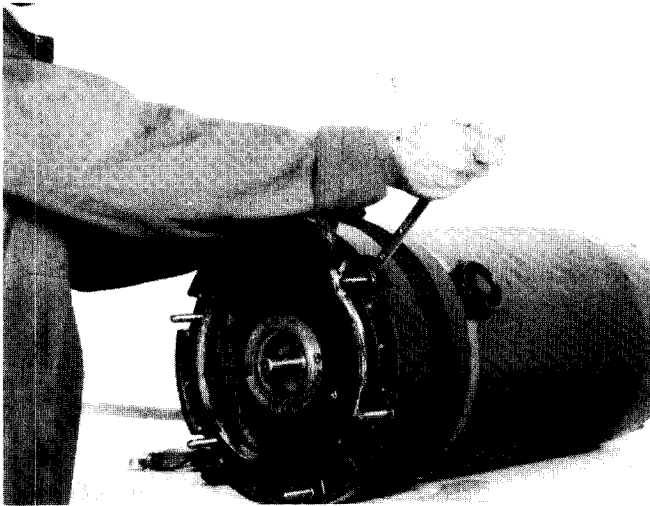
Remove the impeller bolt (2).



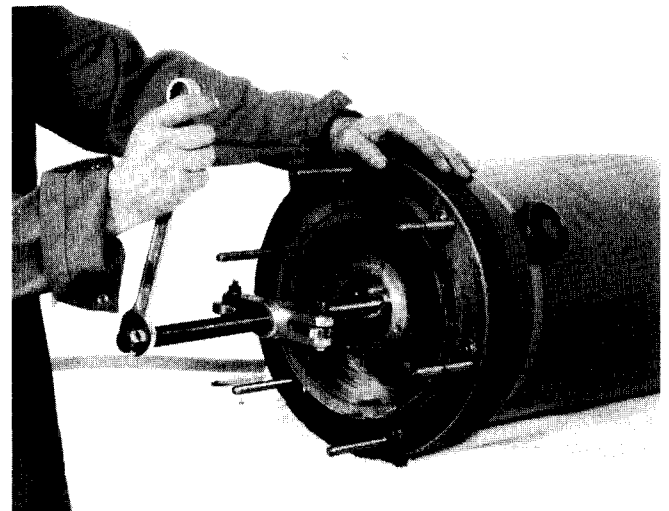
Pull of the impeller nr 1 with a puller.



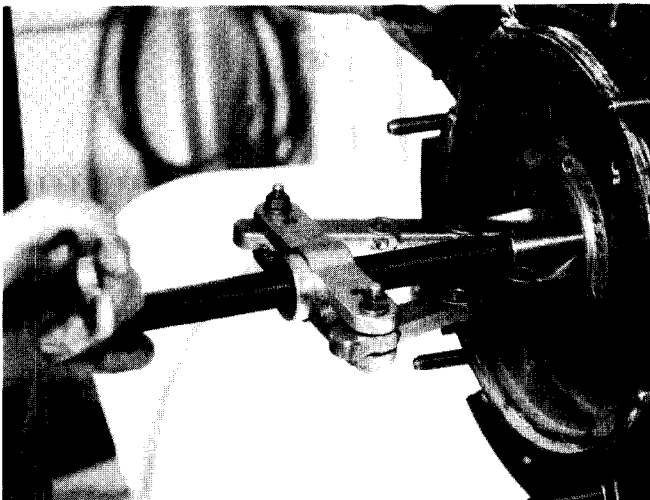
Pull of impeller nr 2.



Remove the nuts (13) from the stud (89).



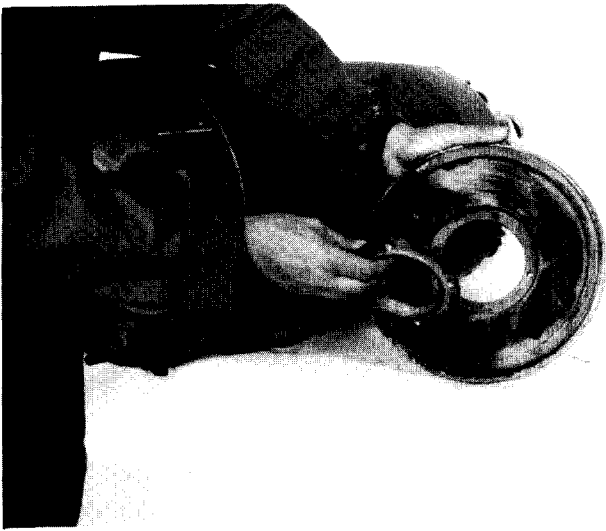
Pull of the diffuser disc (113) with a puller.



Pull of the upper diffuser (112) with puller.



After the four screws (5) have been removed the washer (106) can be knocked out.



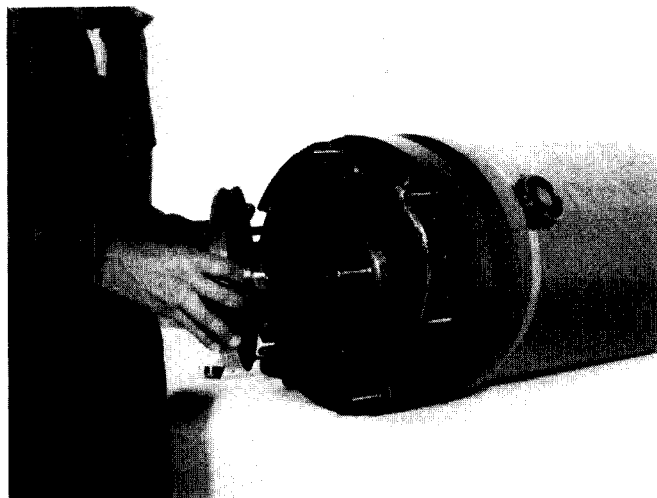
## Installing the impeller

Make sure that the end of the shaft is clean and free of burrs. Polish off any flaws with fine emery cloth.

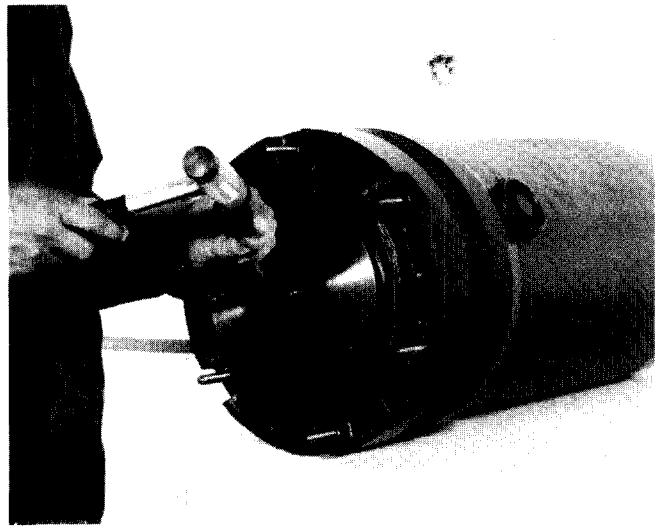


Install the diffuser disc (113), knock carefully with a rubber club.

Fit impeller nr 2 and the upper diffuser. Don't forget to put on washers (22) before the nuts.



Continue with impeller nr 1.



Fold back the washer (26) after tightning the impeller screw (2).

Check that the impeller can be rotated by hand.

# FAULT TRACING (TROUBLESHOOTING)

A universal instrument (VOM), a test lamp (continuity tester) and a wiring diagram are required in order to carry out fault tracing on the electrical equipment.

Fault tracing shall be done with the power supply disconnected and locked off, except for those checks which cannot be performed without voltage.

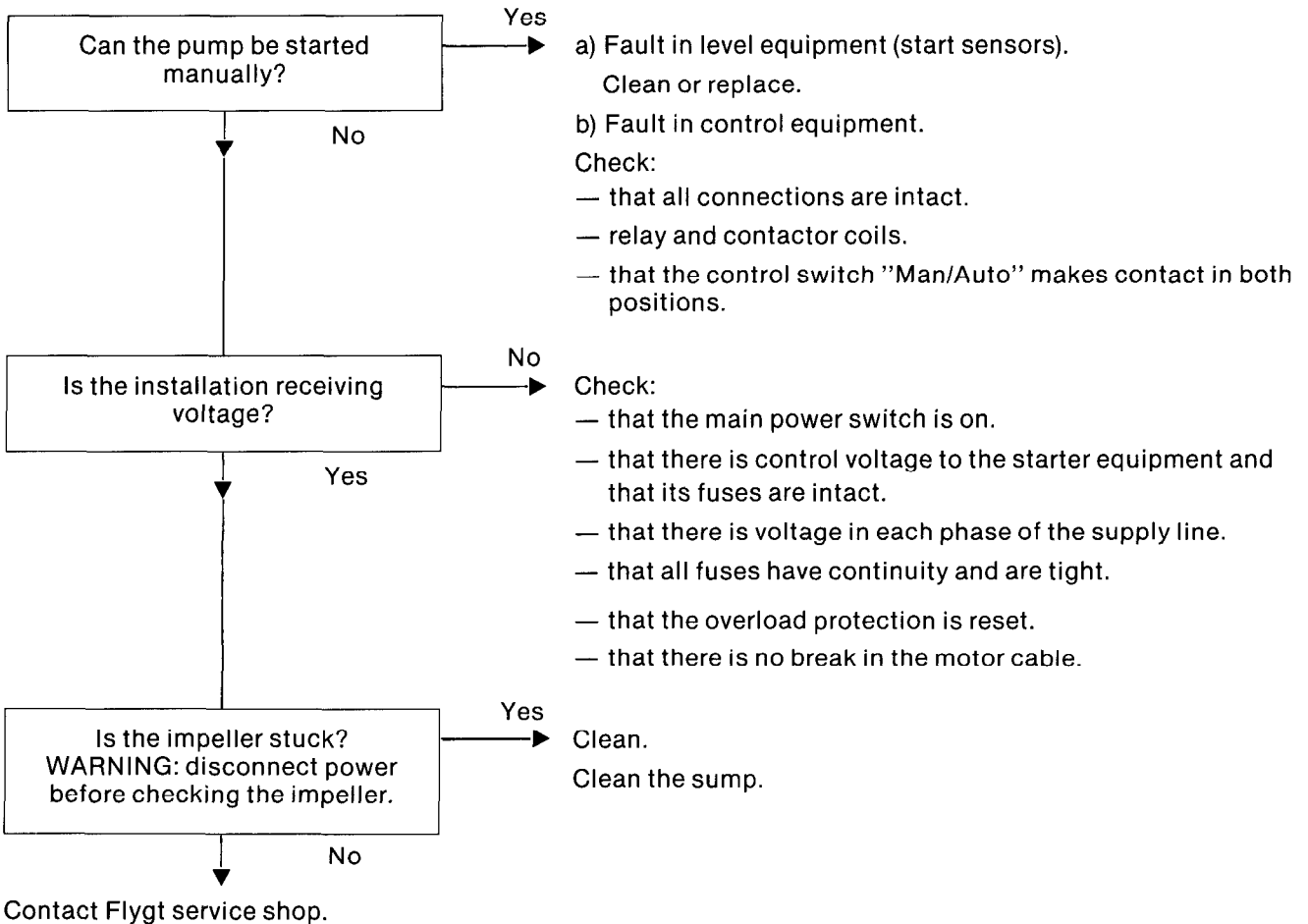
Always make sure that there is no one near the pump when the power supply is turned on.

Use the following checklist as an aid to fault tracing. It is assumed that the pump and installation have formerly functioned satisfactorily.

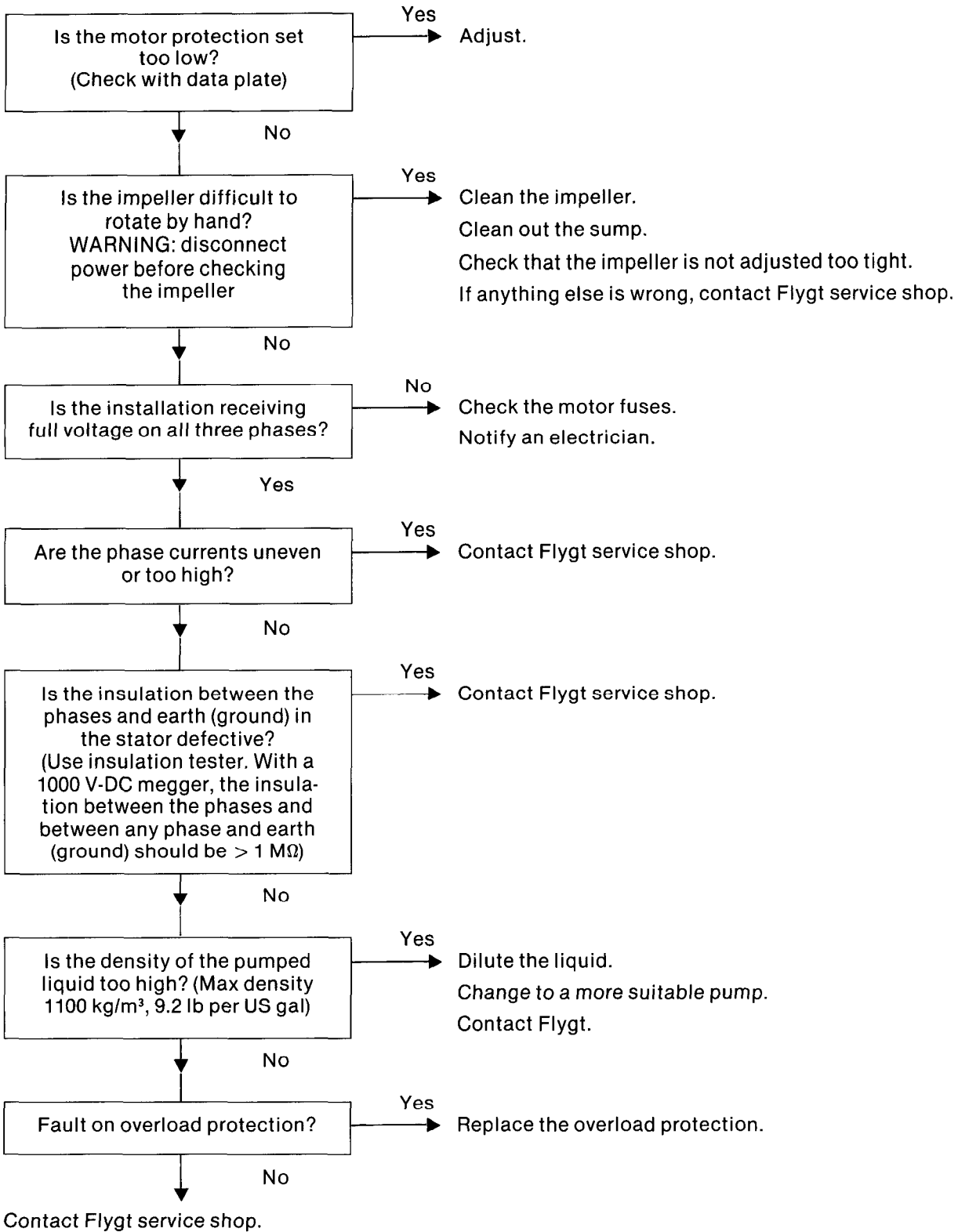
Electrical work shall be performed by an authorized electrician.

Follow local safety regulations and observe recommended safety precautions.

## 1. Pump fails to start

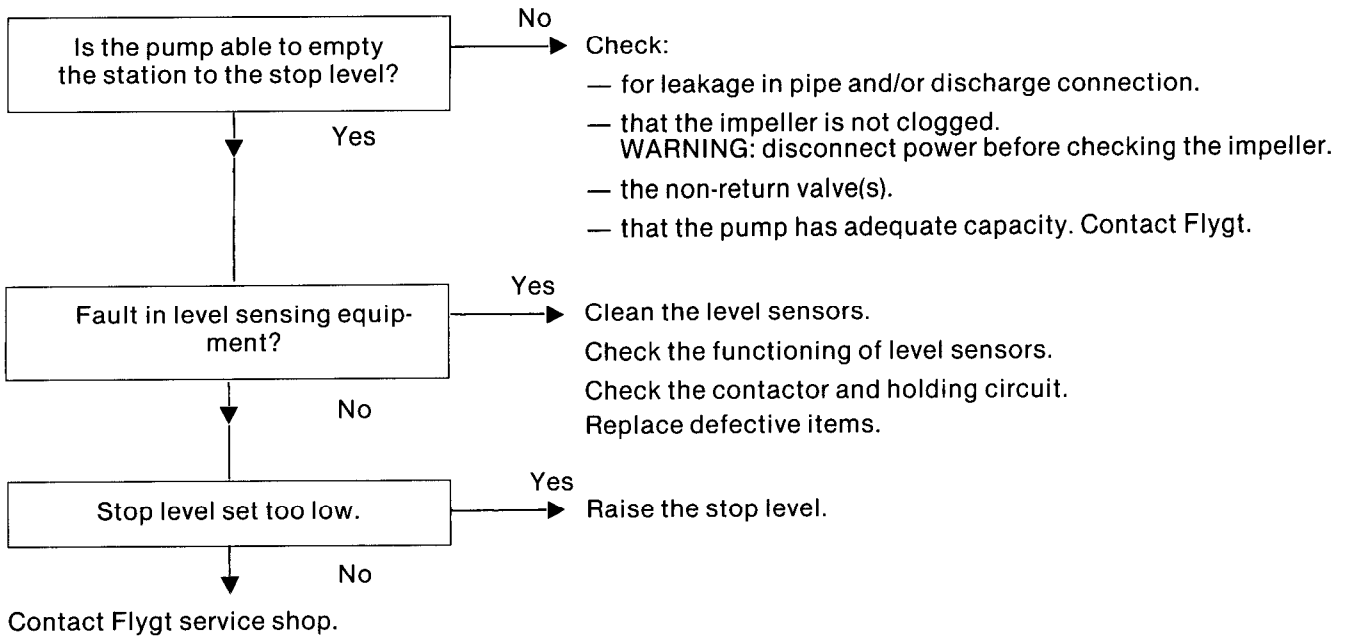


## 2. Pump starts but motor protection trips

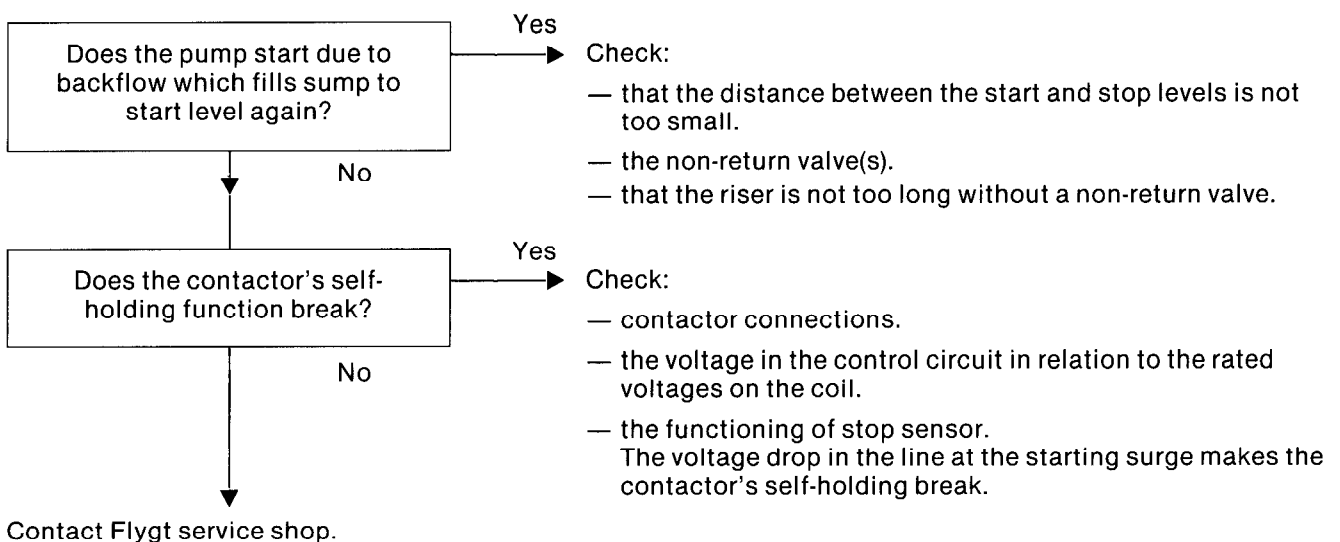




### 3. The pump does not stop (when level control is used)



### 4. The pump starts-stops-starts in rapid sequence



### 5. Pump runs but delivers too little or no water

- Check:
- direction of rotation of pump, see "Before starting".
  - that valves are open and intact.
  - that pipes/hoses, impeller and strainer are not clogged.
  - that the impeller rotates easily.
  - for leakage in the pump installation.

**Do not override the motor protection repeatedly if it has tripped.**

# ACCESSORIES AND TOOLS

## Level sensor

Flygt supplies level sensors suited for different liquid densities and with different cable lengths. See separate brochure.

## Start and control equipment

Flygt has suitable start and control equipment for the pump. Contact Flygt for further information.

## Tools

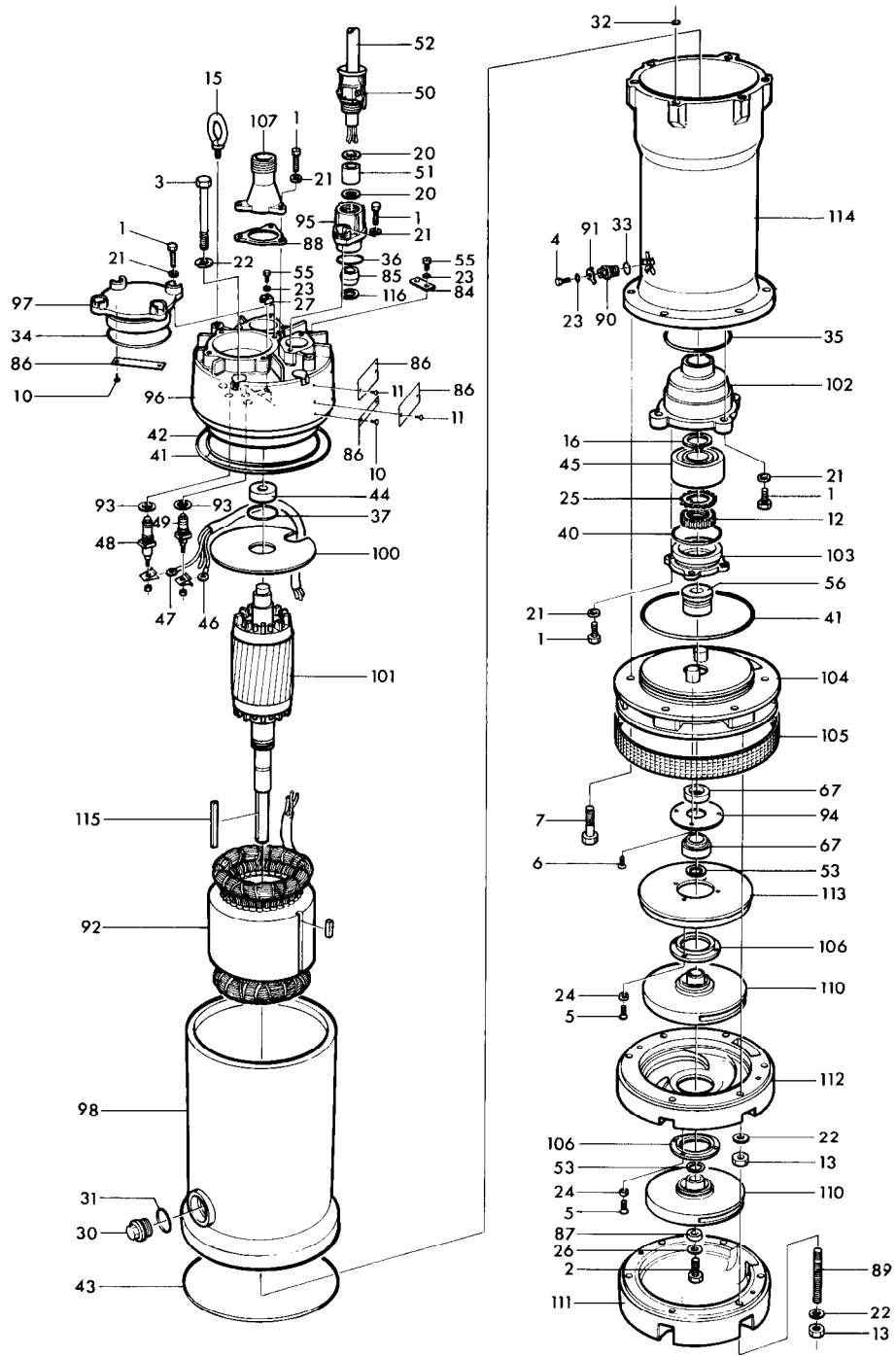
Besides ordinary standard tools, the following tools are required in order to perform the necessary care and maintenance of the pump:

Order No.	Description
84 13 60	Puller (impeller)
84 13 63	Puller (bearings)
84 15 14	Hook wrench

For further information on tools, see Flygt's Tool Catalogue.

# SERVICE LOG

Most recent service date	Pump No.	Hours of operation	Remarks	Sign.





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