SL1, SLV

1.1 - 11 kW, 50 Hz

Service instructions

Installation and operating instructions in English and other languages for 50 Hz

http://net.grundfos.com/qr/i/96771279

Original service instructions.

In this document there are references to the installation and operating instructions for the SL1, SLV (96771279). The installation and operating instructions are accessible via the QR code and link on the front of this document.

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1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

These instructions must be observed for explosion-proof pumps. We recommend that you also follow these instructions for standard pumps.

Caution — If these safety instructions are not observed, it may result in malfunction or damage to the equipment.

Note — Notes or instructions that make the job easier and ensure safe operation.

2. Safety

Warning

Installation of pumps in pits must be carried out by specially trained persons.

Work in or near pits must be carried out according to local regulations.

Warning

Persons must not enter the installation area when the atmosphere is explosive.

Warning

It must be possible to lock the mains switch in position 0. Type and requirements as specified in local codes.

For safety reasons, all work in pits must be supervised by a person outside the pump pit.

Note

We advise you to make all maintenance and service work when the pump is placed outside the pit.

Pits for submersible sewage and wastewater pumps may contain sewage or wastewater with toxic and/or disease-causing substances. Therefore, all persons involved must wear appropriate personal protective equipment and clothing, and all work on and near the pump must be carried out under strict observance of the hygiene regulations in force.

The following warnings and notes appear in a label delivered with the pump. Place the label near the control panel.

Warning

Risk of electric shock.

Do not remove power cable and cable relief. Do not connect a conduit to the pump.

Warning

Risk of electric shock.

This pump has not been approved for use in swimming pools or marine areas.

Warning

To reduce the risk of electric shock, see installation and operating instructions for guidance in proper installation.

Warning

To reduce risk of electric shock, install only on a circuit protected by an earth-leakage circuit breaker (ELCB).

Caution

Provide suitable motor protection based on the electric ratings.

Caution

Use with approved motor-protective circuit breaker matching the motor input in full-load amperes with overload element(s) selected or adjusted in accordance with control instructions.

3. Receiving the product

3.1 Transporting the product

You can transport the pump in vertical or horizontal position. Make sure that it cannot roll or fall over.

During long periods of storage, the pump must be protected against moisture and heat.

For further information, see the installation and operating instructions for SL1, SLV 1.1 - 11 kW. The installation and operating instructions are accessible via the QR code and link on the front page of this document.

3.2 Contaminated products

For further information, see the installation and operating instructions for SL1, SLV 1.1 - 11 kW. The installation and operating instructions are accessible via the QR code and link on the front page of this document.

4. Identification

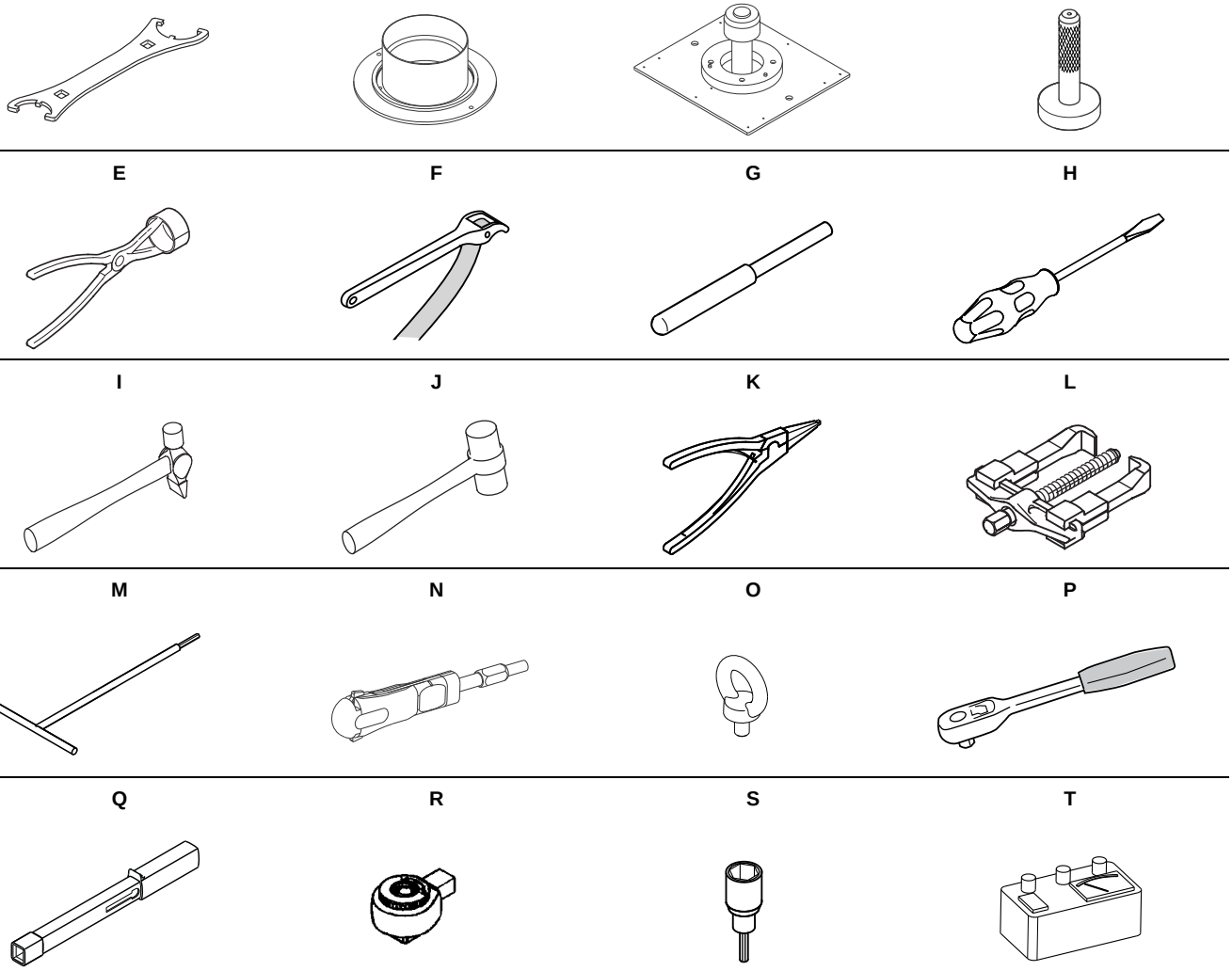
You can find an example of a nameplate and the explanation of the type key in the installation and operating instructions for SL1, SLV 1.1 - 11 kW.

The installation and operating instructions are accessible via the QR code and link on the front page of this document.

4.1 Approvals

The SL1 and SLV pumps have been tested by KEMA. For further information, see the installation and operating instructions for SL1, SLV 1.1 - 11 kW. The installation and operating instructions are accessible via the QR code and link on the front page of this document.

5. Service tools



5.1 Special tools

Pos.	Designation	For pos.[2)]	Description	Part number
A	Spanner for cable nut	181		95043464
B	Stator fixture, SL	48	Frame size B 135[1)]	98784159
			Frame size B 155[1)]	98760515
			Frame size C 155[1)]	98784332
			Frame size C 170[1)]	98760531
			Frame size C 210[1)]	98760534
			Frame size D 210[1)]	98784333
			Frame size D 245[1)]	98760537
C	Baseplate fixture, SL	48	Frame size B-C-D	98760538
D	Punch for neck ring	46	SL1.50	98764096
			SL1.80	98764150
			SL1.100	98764149
E	Multiplug pliers	176	7-pole or 10-pole	SV2118

1) To choose the right frame size, see section *16.1 Stator height and winding resistance*.

2) See position numbers in exploded drawings in section *15. Exploded views*.

5.2 Standard tools

Pos.	Designation	For pos.[2)]	Description	Part number
F	Strap wrench	49	48"	SV0853
G	Punch	46		
H	Screwdriver	49c, 155	Straight slot	
I	Bench hammer	46, 49c, 153	No 3	V0220016
J	Plastic hammer	50, 49c, 155	No 2	SV0349
K	Locking-ring pliers	102		
L	Puller for bearing	154, 155		
M	Tee key	182, 187, 188, 188a	M6 - 5 mm	SV0124
			M8 - 6 mm	SV0050
			M10 - 8 mm	SV0051
			M12 - 10 mm	SV0246
N	Molex plug removal tool	176		SV2117
O	Eyebolt	172		

5.3 Torque tools

Pos.	Designation	For pos.[2)]	Description	Part number
P	Ratchet handle	O, P	1/2" x 1/2"	96777072
Q	Torque wrench	O, P	9 x 12 mm, 4-20 Nm	SV0292
			9 x 12 mm, 20-100 Nm	SV0269
R	Ratchet insert tool	O, P	9 x 12, 1/2" x 1/2"	SV0295
S	Hexagon head driver	182, 187, 188, 188a	M6 - 5 mm	SV0296
			M8 - 6 mm	SV0297
			M10 - 8 mm	SV0298
			M12 - 10 mm	SV0299

5.4 Test tool

Pos.	Designation	Description	Part number
T	Test box		96628926

[2)] See position numbers in exploded drawings in section *15. Exploded views*.

5.5 Holding tool for stator housing

The holding tool cannot be ordered from Grundfos, it is to be produced locally. Use the drawing below when making a holding tool.

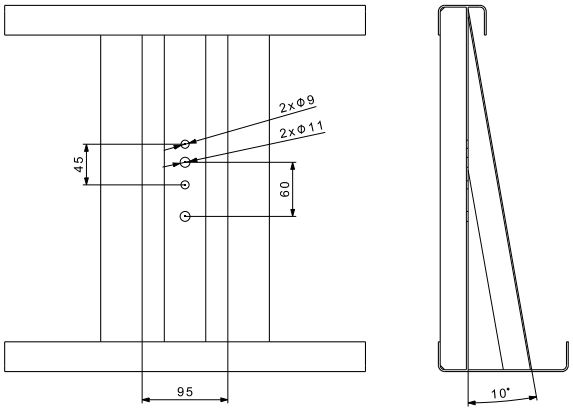


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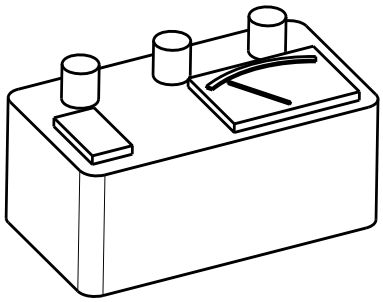
Fig. 1 Holding tool for stator housing

5.6 Test box

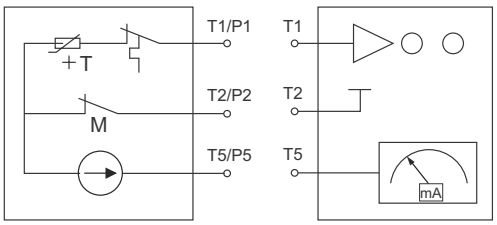


TM04 8000 2610

Fig. 2 Test box

Fault	LED	Out [mA]
None	Green	4-20
Moisture	Red	0
No pump	Red	0
Temperature	Red	4-20
WIO	Green	0
WIO - air (WIA)	Green	3.5
WIO - water	Green	22

Wiring diagram for test box:



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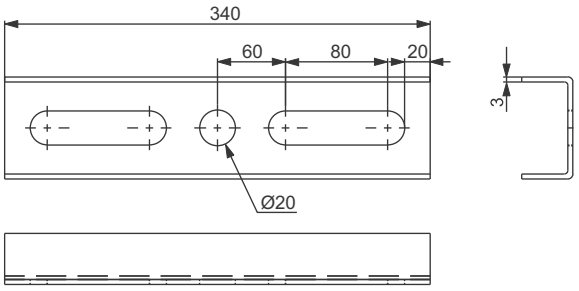
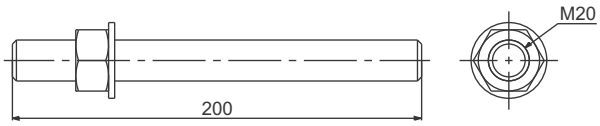
5.7 Seal ring mounting tool

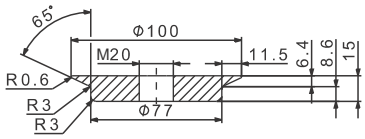
Puller beam



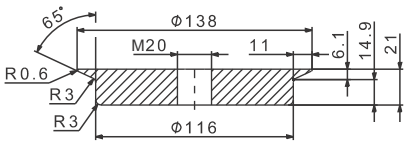
Threaded rod



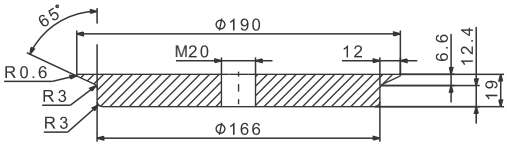
Puller tool DN 50



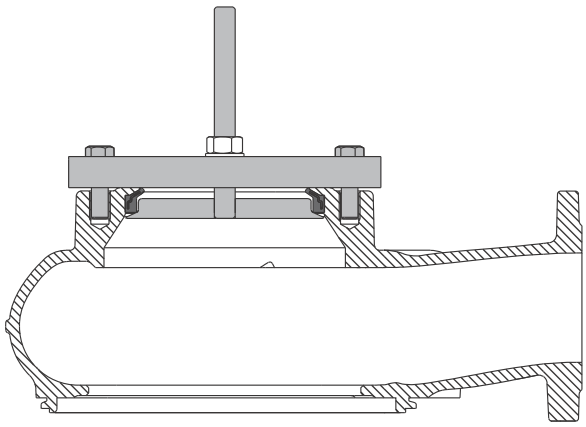
Puller tool DN 80



Puller tool DN 100



Mounting tool for seal ring



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6. Tightening torques and lubricants

Pos.[2)]	Designation	Quantity	Dimensions	Torque [Nm]	Lubricant
92a	Hexagon socket head cap screw	1		12 ± 2	
118a	Hexagon socket head cap screw	2	M8	20 ± 2	
			M10	30 ± 3	
174	Hexagon socket head cap screw	1		4 ± 1	
181	Union nut	1	7-pole	50 ± 5	
			10-pole	75 ± 5	
186	Hexagon socket head cap screw	2		7 + 2/- 0	
182	Hexagon socket head cap screw	4		20 ± 2	
187	Hexagon socket head cap screw	4		20 ± 2	
188	Hexagon socket head cap screw	2	M8	20 ± 2	
			M10	30 ± 3	
188a	Hexagon socket head cap screw	2	M10	50 + 5/- 0	
			M12	75 ± 5	
193	Oil plug	2		16 ± 2	
	O-rings	All			Rocol / Prolan

Rocol Sapphire Aqua-Sil, product number RM2924 (1 kg).
Alternative:
Prolan grease, product number RM6117

[2)] See position numbers in the exploded views in section *15. Exploded views*.

6.1 Tightening torques for inlet and outlet flanges

Grade 4.6 (5) galvanised steel bolts and nuts						Grade A2.50 (AISI 304) steel bolts and nuts				
	DN	DC	Screw	Specified tightening torques, rounded off by ± 5 [Nm]		DN	DC	Screw	Specified tightening torques, rounded off by ± 5 [Nm]	
				Slightly oiled	Well lubricated				Slightly oiled	Well lubricated
Flange	DN 65	145	4 x M16	70	60	DN 65	145	4 x M16	-	60
	DN 80	160	8 x M16	70	60	DN 80	160	8 x M16	-	60
	DN 100	180	8 x M16	70	60	DN 100	180	8 x M16	-	60
	DN 150	240	8 x M20	140	120	DN 150	240	8 x M20	-	120

7. Electrical connection

For further information, see the installation and operating instructions for SL1, SLV 1.1 - 11 kW. The installation and operating instructions are accessible via the QR code and link on the front page of this document.

8. Sensors

8.1 Thermal switch, Pt1000 and thermistor

All SL1 and SLV pumps have thermal protection incorporated in the stator windings.

Pumps without sensor

Pumps without sensor have a thermal switch. Via the pump controller safety circuit, the thermal switch will stop the pump by breaking the circuit in case of high temperature (approx. 150 °C). The thermal switch will reclose the circuit after cooling.

The maximum operating current of the thermal switch is 0.5 A at 500 VAC and cos φ 0.6. The switch must be able to break a coil in the supply circuit.

Pumps with sensor

Pumps with sensor have either a thermal switch and a Pt1000 sensor or a thermistor (PTC) in the windings, depending on the installation site.

Via the pump controller safety circuit, the thermal switch or the thermistor will stop the pump by breaking the circuit in case of high temperature approx. 150 °C. The thermal switch or the thermistor will reclose the circuit after cooling.

The maximum operating current of both the Pt1000 and the thermistor is 1 mA at 24 VDC.

8.2 WIO sensor (water-in-oil sensor)

The WIO sensor measures the water content in the oil and converts the value into an analog current signal. The two sensor wires are for power supply and for carrying the signal to IO 113. The sensor measures the water content from 0 to 20 %. It also sends a signal if the water content is outside the normal range (warning), or if there is air in the oil chamber (alarm). The sensor is fitted in a stainless steel tube for mechanical protection.

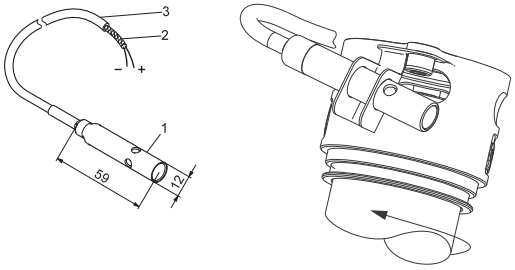

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Fig. 3 WIO sensor

8.2.1 Fitting the WIO sensor

Fit the sensor next to one of the shaft seal openings. See fig. 3. The sensor must be tilted into the motor's direction of rotation to ensure that oil is led into the sensor. Make sure that the sensor is submerged in the oil.

Technical data

Input voltage:	12-24 VDC
Output current:	3.4 - 22 mA
Power input:	0.6 W
Ambient temperature:	0-70 °C

Fault indication	Reaction
Water in oil	Warning/the pump keeps on running
Sensor not covered with oil	Alarm/the pump stops*

* Requires that the pump has been installed as described in the installation and operating instructions for IO 113.

8.3 Moisture switch

All motors are fitted with a moisture switch as standard where the moisture switch is connected via the supply cable and must be connected to a separate circuit breaker.

The moisture switch is positioned in the bottom of the motor. If there is moisture in the motor, the switch will break the circuit and send a signal to IO 113.

The moisture switch is non-reversing and must be replaced after use.

Note

Do not touch the expansion part (cardboard discs) of the moisture switch with moist or oily hands. The moisture switch must be stored in air-tight packaging in order to protect the expansion part against moisture. The switch is factory-set to 5 mm and requires no further setting.

9. Overhaul

Check pumps running normal operation every 3000 operating hours or at least once a year. If the pumped liquid is very muddy or sandy, check the pump at shorter intervals.

Check the following points:

- **Power consumption**
  See pump nameplate.
- **Oil level and oil condition**
  When the pump is new or after replacement of the shaft seal, check the oil level and water content after one week of operation.
  If the oil contains more than 20 % water, the shaft seal may be defective.
  The oil should be changed after 3000 operating hours or once a year.
  Use Shell Ondina X-420 oil (product No 96001442, 1 litre) or similar type. See section *10.3 Changing the oil*.
- **Cable entry**
  The cable is filled with filling compound to protect the motor against water ingress. Check that the casting is intact, and that the cable is not sharply bent and/or pinched.
  See section *10. Servicing the product* for replacement of cable.

Warning

The cable of Ex pump must only be replaced by Ex-approved service centres.

- **Pump parts**
  Check the impeller, pump housing, etc. for possible wear. Replace defective parts.
  See section *10. Servicing the product* for dismantling and assembly of the pump.
- **Ball bearings**
  Check the shaft for noisy or heavy operation by turning the shaft by hand. Replace defective ball bearings.
  See section *10. Servicing the product*.
  In case of defective ball bearings or poor motor function, a complete overhaul of the pump is usually required. This work must be carried out by Grundfos or an authorised service centre.

Warning

Defective bearings may reduce the Ex safety.

Warning

The ball bearings of Ex pumps must only be replaced by Ex-approved service centre.

- **O-rings and similar parts**
  During service or replacement, make sure that the grooves for O-rings and seal faces have been cleaned before the new parts are fitted.

Note Never reuse used rubber parts.

Warning

Ex pumps must be checked by an Ex-approved service centre once a year.

- **Measuring the insulation resistance**
  Megging must take place at a voltage of minimum 500 V. The insulation resistance measured must be minimum 50 kΩ.

10. Servicing the product

Service must be carried out by specially trained persons.

Before carrying out service, make sure that the pump has been thoroughly flushed with clean water. Rinse the pump parts in water after dismantling.

10.1 Servicing Grundfos pumps with explosion-proof motors

Only Ex-approved service centres are allowed to intervene in the flameproof enclosure of the pump.

Service not affecting the explosion protection of the pump and not violating the Ex regulations may be carried out by service persons who are not Ex-authorised.

Consequently, these persons are allowed to replace the following parts of explosion-proof pumps:

- pump housing
- impeller
- seal ring and wear ring
- shaft seal.

All other service work must be carried out by an Ex-approved service centre. Violation of this requirement will invalidate the Ex classification of the pump.

10.2 General information

Note Position numbers of parts (digits in brackets) refer to section *15. Exploded views*. Position numbers of tools (letters in brackets) refer to section *5. Service tools*.

Warning

Before starting work on the pump, make sure that the fuses have been removed or the mains switch has been switched off. Make sure that the power supply cannot be accidentally switched on.

All rotating parts must have stopped moving.

Warning

Except for replacement or dismantling of pump housing, shaft seal, impeller, seal ring and wear ring, all other service work must be carried out by an Ex-approved service centre.

Caution During service the paint on the outer surface may be damaged. Remember to apply new paint in order to keep the sealing effect of the paint intact.

10.3 Changing the oil

When the pump is new or after replacement of the shaft seal, check the oil level and water content after one week of operation.

Change the oil after 3000 operating hours or once a year. See description below.

After replacement of the shaft seal, change the oil.

Warning

When loosening the screws of the oil chamber, note that pressure may have built up in the chamber. Do not remove the screws until the pressure has been fully relieved.

10.3.1 Draining of oil

1. Place the pump on a plane surface with one oil plug (193) pointing upwards.
2. Remove the oil plugs.
3. While holding a container of minimum 2 litres under the lower oil plug, turn the pump to let the oil drain from the pump. As the flow of oil decreases, turn the pump a little until all oil has been drained.

   Water and oil separate almost immediately. If the oil in the container contains more than 20 % water, the shaft seal is defective. If so, replace the shaft seal.

Caution If a defective shaft seal is not replaced, the motor will be damaged within a short time.

If the quantity of oil deviates considerably from the quantity stated in the table below, the shaft seal is defective.

Note Dispose of used oil in accordance with local regulations.

4. Clean the faces for the gaskets for the oil plugs.

10.3.2 Oil quantities

The table shows the quantity of oil in the oil chamber of SL1 and SLV pumps.

	Power [kW]	Oil quantity [litres]
2-pole	2.2	0.7
	3.0	0.7
	4.0	1.0
	6.0	1.0
	7.5	1.0
	9.2	1.2
	11.0	1.2
4-pole	1.1	0.7
	1.3	0.7
	1.5	0.7
	2.2	0.7
	3.0	1.0
	4.0	1.0
	5.5	1.0
	7.5	1.2

Use Shell Ondina X-420 oil (product No 96586753, 1 litre)

Alternative:

Exxon Mobile Marcol 82 (product number 98703313, 1 litre)

JAX oil WMO 22 (product number 98836788, 1 litre)

Note Dispose of used oil in accordance with local regulations.

10.3.3 Oil filling

1. Turn the pump so that the oil filling holes are both pointing upwards.
2. Pour the oil quantity stated into the chamber.
3. Fit the oil plugs (193) with new gaskets (194) and tighten them. See section *6. Tightening torques and lubricants*.

10.4 Dismantling the pump

Before dismantling the pump

- Switch off the power supply.
- Close the isolating valves, if fitted, to avoid draining the piping system.
- Disconnect the power supply cable in accordance with local regulations.
- Note the centre of gravity of the pump to prevent it from overturning. This is especially important in the case of long pumps.

10.4.1 Removing the cable

1. Remove the union nut of the cable plug using spanner for cable nut (A).
2. Remove the female plug connector (181).

10.4.2 Removing the pump housing and impeller

1. Loosen the screw of the clamp (92a).
2. Open the clamp with a screwdriver (H) and remove it.
3. Remove the pump housing (50) by lifting the stator housing (55) by the lifting bracket (190) using a crane. If the pump housing sticks to the stator housing, loosen it with a few blows of a plastic hammer (J).
4. Hold the impeller with a strap wrench (F), and remove the screw (188a) of the impeller (49).
5. Loosen the impeller (49) with a light blow of a plastic hammer (J) on the edge. Remove the impeller.
6. Remove the key (9a) and the spring for the impeller (157).

10.4.3 Removing the seal ring and the wear ring

1. Turn the pump housing upside-down.
2. Remove the seal ring (46) from the pump housing by knocking it out with a punch (G) and a bench hammer (I), see fig. 4, or by prising it out with a screwdriver (H).

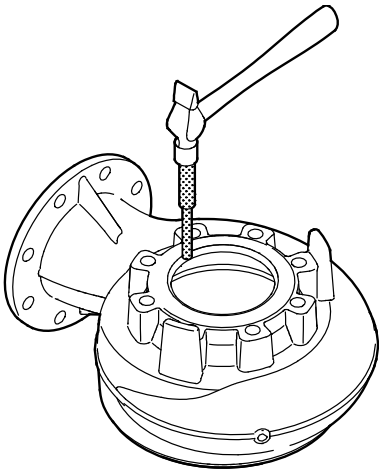

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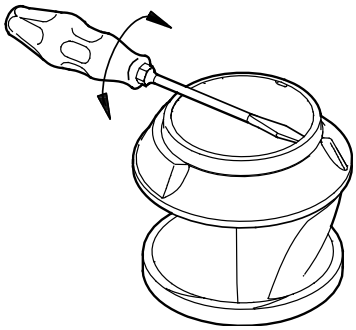
Fig. 4 Removing the seal ring

3. Clean the pump housing where the seal ring was fitted.
4. Remove the impeller wear ring (49c) with a screwdriver (H). See fig. 5.



TM02 8422 5103

Fig. 5 Removing the wear ring

5. Clean the impeller where the wear ring was fitted.

10.4.4 Removing the shaft seal

Sensor pump version

1. Drain the oil. See section *10.3.1 Draining of oil*.
2. Remove the screws (187) of the cover for oil chamber (58).
3. Remove the shaft seal driver and the O-ring (107).
4. Remove the screws (186) of the shaft seal (105).
   One of the screws also holds the bracket (522) of the water-in-oil sensor (521) (sensor version only).
5. Remove the bracket (522) from the water-in-oil sensor (521) and move the sensor aside (sensor version only).
6. Fit the screw (188a) in the shaft to protect the shaft end.
7. Remove the shaft seal (105) using a puller (L).
8. Remove the screw (188a) and the O-ring (153b) of the shaft.

Standard pump version

1. Drain the oil. See section *10.3.1 Draining of oil*.
2. Remove the screws (187) of the cover for oil chamber (58).
3. Remove the O-ring (107).
4. Remove the screws (186) of the shaft seal (105).
5. Fit the screw (188a) in the shaft to protect the shaft end.
6. Remove the shaft seal (105) using a puller (L).
7. Remove the screw (188a) and the O-ring (153b) of the shaft.

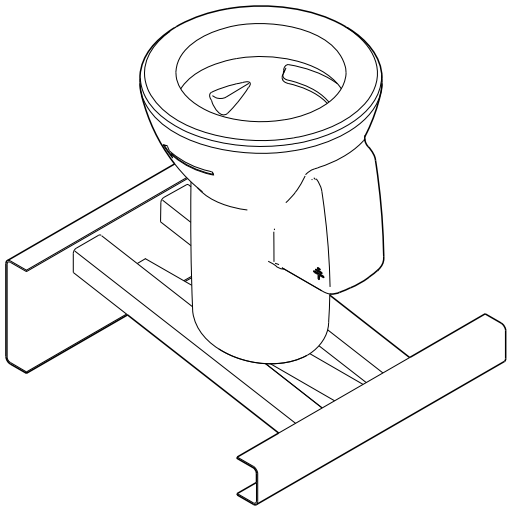
10.4.5 Removing the shaft with bearings and rotor

Warning

On Ex pumps, this work must be carried out by an Ex-approved service centre.

Sensor pump version

1. Remove the lifting bracket (190) by unscrewing its two screws (118a).
2. Fit an eyebolt (O) in the shaft, and lift the stator housing into vertical position by means of a crane.
   Place the stator housing upside down on a holding tool. See fig. 6. The holding tool cannot be ordered from Grundfos. Figure 1 shows an example of a suitable holding tool.
3. Remove the O-ring (37a) from the stator housing (55).



TM04 3851 5208

Fig. 6 Stator housing on a holding tool

4. Remove the screws (182) and the bearing cover (59).
5. Remove the O-ring (109) under the bearing cover.
6. Pull the cable of the water-in-oil sensor gently so that the conical washer and the cable grommet are free of the oil chamber (155).
   Pull the cable grommet and conical washer upwards towards the sensor.
7. Remove the screws (188) fixing the oil chamber (155) to the stator housing.
8. Lift the shaft with rotor (172) together with the oil chamber (155) carefully by means of a crane. If the rotor and the oil chamber stick to the stator housing, lift the stator housing a few centimetres and loosen the oil chamber from the stator housing using screwdrivers (H).
9. Lift the rotor carefully free of the stator housing. Disconnect the water-in-oil sensor (521) before lifting the stator out of the stator housing.
10. Remove the corrugated spring (158) from the stator housing (55).
11. Remove the O-ring (37b) from the oil chamber (155).

Standard pump version

1. Remove the lifting bracket (190) by unscrewing its two screws (118a).
2. Fit an eyebolt (O) in the shaft, and lift the stator housing into vertical position by means of a crane.
   Place the stator housing upside down on a holding tool. See fig. 6. The holding tool cannot be ordered from Grundfos. Figure 1 shows an example of a suitable holding tool.
3. Remove the O-ring (37a) from the stator housing (55).
4. Remove the screws (182) and the bearing cover (59).
5. Remove the O-ring (109) under the bearing cover.
6. Remove the screws (188) fixing the oil chamber (155) to the stator housing.
7. Lift shaft with rotor (172) together with the oil chamber (155) carefully by means of a crane. If the rotor and the oil chamber stick to the stator housing, lift the stator housing a few centimetres and loosen the oil chamber from the stator housing using screwdrivers (H).
8. Lift the rotor carefully out of the stator housing.
9. Remove the corrugated spring (158) from the stator housing (55).
10. Remove the O-rings (37b) from the oil chamber (155).

10.4.6 Removing the moisture switch and water-in-oil sensor

Warning

On Ex pumps, this work must be carried out by an Ex-approved service centre.

Moisture switch

1. Remove the screw and washer of the moisture switch (520). See fig. 7.

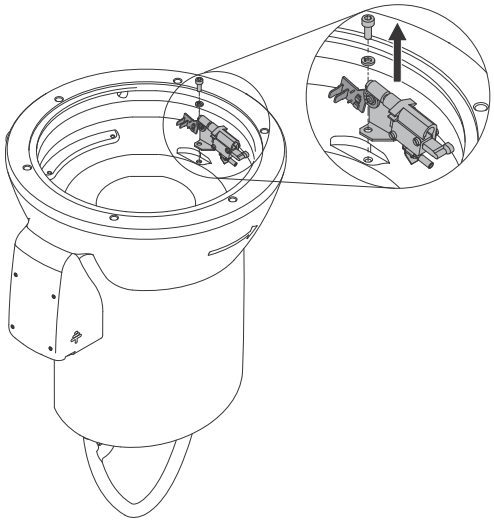


Fig. 7 Remove moisture switch

2. Pull the moisture switch together with the transient barrier (518) gently out and remove the cable terminals. If the cable is not long enough, you can cut the cable clips fixing the cable to the stator housing. See fig. 8.

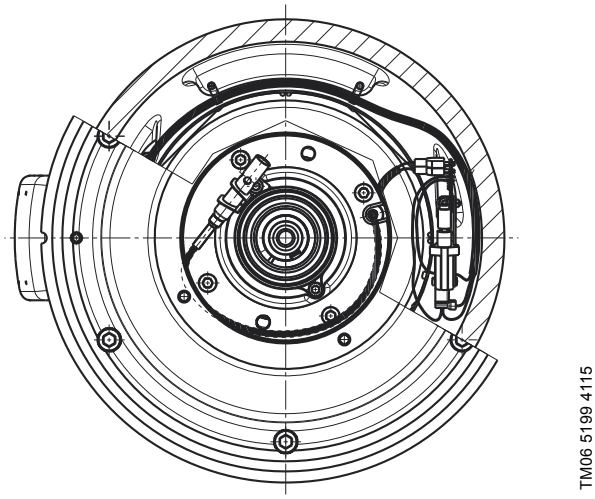


Fig. 8 Placement of sensor cables

Water in oil sensor

1. Cut off the cable terminals of the water-in-oil sensor cable (521).
2. Pull the cable of the water-in-oil sensor out of the oil chamber (155) and remove the four spring washers, the cable grommet and the conical washer from the cable.

10.4.7 Removing the bearings

1. Remove the circlip (102) using the circlip pliers (K).
2. Fit the screw (188a) in the shaft to protect the shaft end.
3. Remove the oil chamber (155) together with the drive-end bearing (153) using a puller (L).
4. Knock the drive-end bearing (153) out from the back of the oil chamber using a bench hammer (I) and a punch (G).
5. Pull off the non-drive end bearing (154) using a puller (L).
6. Remove the screw (188a).

10.4.8 Removing the stator

1. Push down the internal plug connector (176) using a small screwdriver.
2. Unplug the wires from the internal plug connector (176) using the molex plug removal tool (N). Remember to mark the position of the wires carefully.
3. Place the stator housing (55) on a stand at a height where the stator (48) can come out underneath.
4. Heat the stator housing with a powerful heat gun. Heating must take place so quickly that the stator is not heated too. If necessary, cool the stator at the same time, and pull it free using a hydraulic tool.

10.5 Assembling the pump

10.5.1 Fitting the stator

1. Assemble the baseplate fixture (C) with the correct size stator fixture (B) to form a stator guide. See fig. 9 and fig. 10.

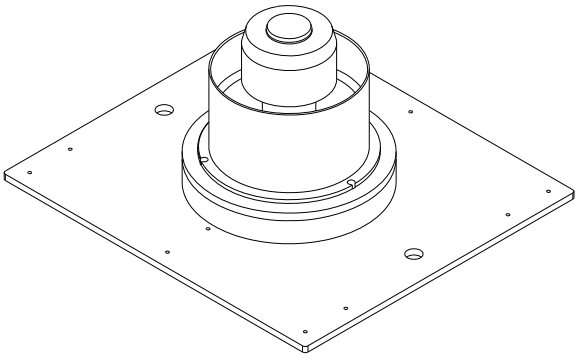


Fig. 9 Assembled stator guide

2. Place the stator (48) on the assembled stator guide.
3. Make sure the stator is inserted to the correct height according to fig. 10 and the table below.

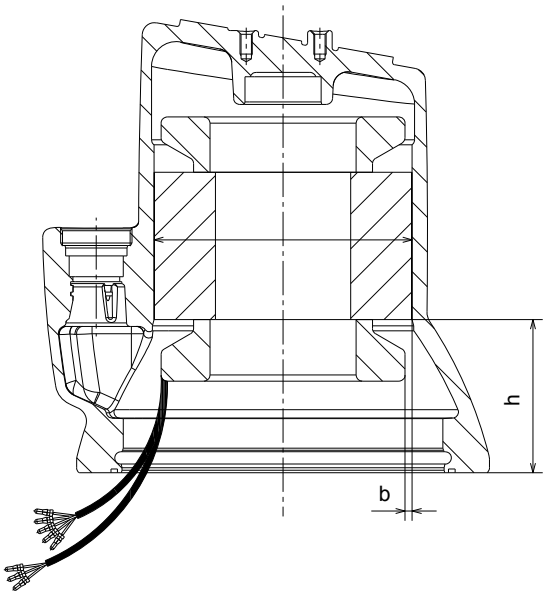


Fig. 10 Stator insertion height

Frame size	Stator diameter [mm]	h [mm]	b [mm]
B	∅135	116.0 ± 0.75	2.
	∅155	130.3 ± 0.75	2.4
C	∅155	117.0 ± 0.75	2.4
	∅170	131.8 ± 0.75	2.4
	∅210	124.5 ± 0.75	5.7
D	∅210	138.0 ± 0.75	5.7
	∅245	146.4 ± 0.75	5.7

4. Place the stator housing on top of the stator. Make sure that the cable entry is turned in same direction as where the wires leave the stator. See fig. 11.

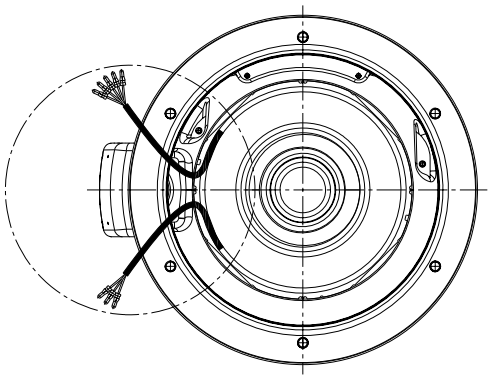


Fig. 11 Stator wire position inside stator housing

5. Heat up the stator housing to 205 °C ± 5 °C until the stator housing slides down over the stator. Heat the stator housing uniformly so that it is not deformed.

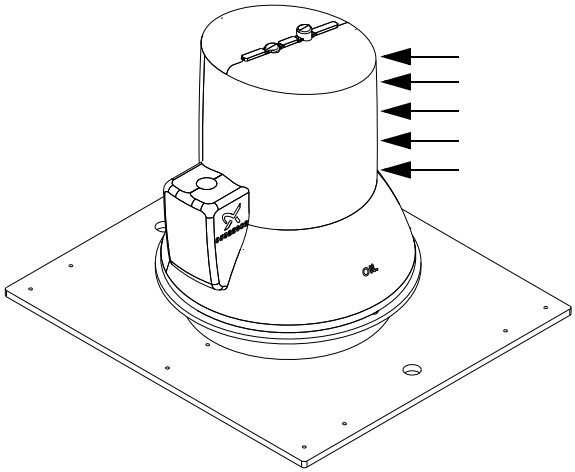


Fig. 12 Heating of stator

Note Measure the temperature on the side of the stator housing to achieve the best result of mounting the stator inside the stator housing

6. Make sure that the stator wires are not pinched, and that the bottom flange of the stator housing touches the stator guide.
7. Allow the stator housing to cool.
8. Make a control measurement according to fig. 10 and the table.
9. Run the stator wires to the cable entry and fit the earth conductor (green/yellow).
10. Connect and clamp the stator wires to the connector pins and mount the pins into the internal plug connector (176). See section *8. Sensors*. Use molex plug removal tool (pos. N), if necessary.

10.5.2 Fitting the bearings

1. Heat the new non-drive end bearing (154) to 120 °C and fit it on the rotor (172).
2. Place new drive-end bearing (153) in the oil chamber and press it home by pressing on the outer bearing ring.
3. Place the oil chamber with the drive-end bearing on the rotor and press the bearing home by pressing on the inner bearing ring.
4. Fit the circlip (102) using the circlip pliers (J).
5. Check that the drive-end bearing (153) and the oil chamber (155) can rotate freely.

10.5.3 Fitting the sensors

Sensor pump version

Warning
On Ex pumps, this work must be carried out by an Ex-approved service centre.

1. Fit the conical washer, the cable grommet and four spring washers on the cable of the water-in-oil sensor.
   They must always be replaced when they have been removed. Fit the spring washers so that they face each other. See fig. 13.

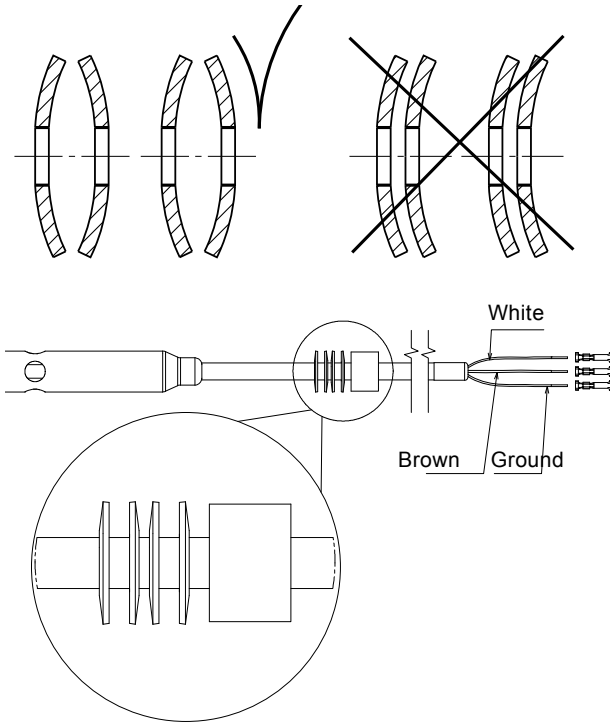


Fig. 13 Fitting the spring washers

2. Pull the cable of the water-in-oil sensor through the hole in the oil chamber (155).
   Take care not to pinch the sensor.
3. Connect the moisture switch, the transient barrier and the water-in-oil sensor wires to the internal plug connector (176) according to the wiring diagram. See section *8. Sensors*.
4. Click the internal plug connector (176), with all wires connected, into place.
5. Fit the moisture switch (520) and the transient barrier (518) by means of its screw and washer. See fig. 14.

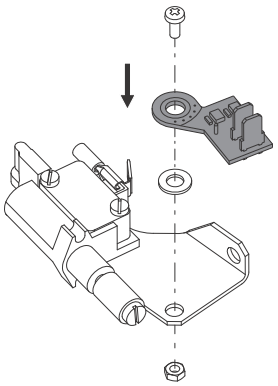


Fig. 14 Transient barrier

6. Fit the moisture switch to the stator housing (55). See fig. 15.

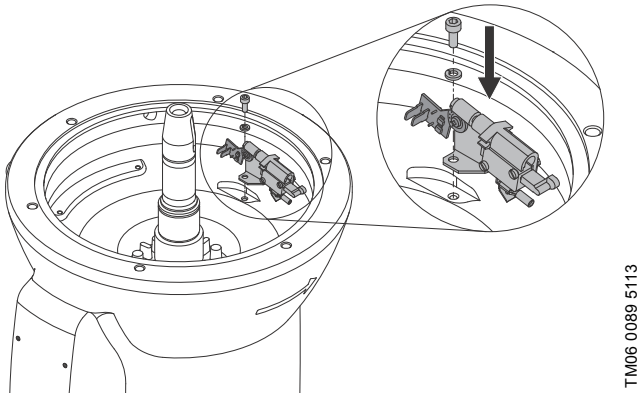


Fig. 15 Mounting the moisture switch

7. Fix the cables of the sensors to the stator housing (55) with cable clips. See fig. 16.

Standard pump version

1. Connect the moisture switch according to the wiring diagram. See section *8. Sensors*.
2. Fit the moisture switch (520) by means of its screw and washer to the stator housing. See fig. 15.
3. Fix the cable of the moisture switch to the stator housing (55) with cable clips. See fig. 16.

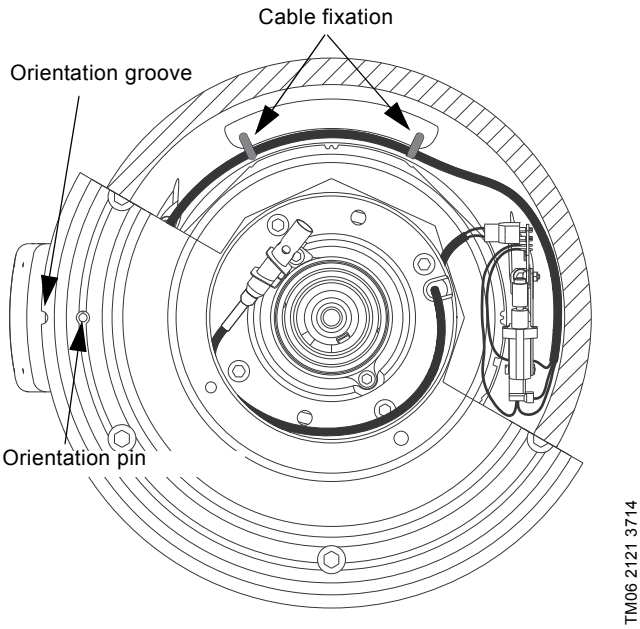


Fig. 16 Orientation markers and fixation of sensor cables

10.5.4 Fitting the shaft with bearings and rotor

Warning
On Ex pumps, this work must be carried out by an Ex-approved service centre.

Sensor pump version

1. Lubricate the O-rings (37a and 37b) with Rocol Sapphire Aqua-Sil and fit the O-ring (37b) on the oil chamber (155) and the O-ring (37a) on the stator housing (55).
2. Fit the corrugated spring (158) in the bottom of stator housing (55).
3. Lubricate the outer ring of the non-drive end bearing (154) with Rocol Sapphire Aqua-Sil.
4. Turn the oil chamber (155) so that the orientation groove in its circumference is next to the orientation pin of the stator housing. See fig. 16.
5. Lower the shaft with rotor (172) together with the oil chamber (155) carefully into the stator housing (55).
   Take care not to damage the stator windings.
   At the same time, pull the cable of the water-in-oil sensor through the hole in the oil chamber so that the cable is not pinched.
6. Fit the screws (188) in the oil chamber and cross-tighten them. See section *6. Tightening torques and lubricants*.
7. Lubricate the O-ring (109) with Rocol Sapphire Aqua-Sil and fit it on the oil chamber (155).
8. Pull the cable of the water-in-oil sensor a little to make sure it does not touch the rotor.
9. Fit the bearing cover (59) in such a way that the groove is placed above the cable entry of the oil chamber (155). See fig. 17.
10. Fit the screws (182) and cross-tighten them. See section *6. Tightening torques and lubricants*.

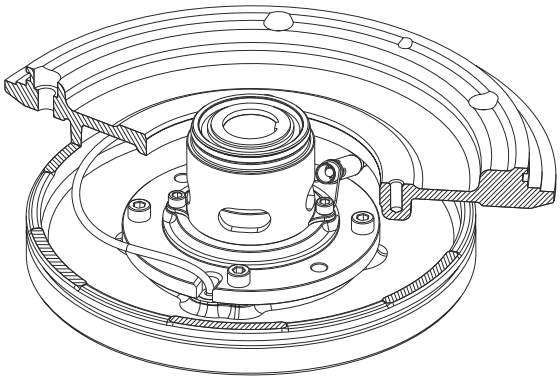


Fig. 17 Position of bearing cover

Standard pump version

1. Lubricate the O-rings (37a and 37b) with Rocol Sapphire Aqua-Sil and fit the O-ring (37b) on the oil chamber (155) and the O-ring (37a) on the stator housing (55).
2. Fit the corrugated spring (158) in the bottom of the stator housing (55).
3. Lubricate the outer ring of non-drive end bearing (154) with Rocol Sapphire Aqua-Sil.
4. Turn the oil chamber (155) so that the orientation groove in its circumference is next to the orientation pin of the stator housing.
5. Lower the shaft with rotor (172) together with the oil chamber (155) carefully into the stator housing (55).
   Take care not to damage the stator windings.
6. Fit the screws (188) in the oil chamber and cross-tighten them. See section *6. Tightening torques and lubricants*.
7. Lubricate the O-ring (109) with Rocol Sapphire Aqua-Sil and fit it on the oil chamber (155).
8. Fit the bearing cover (59) and the screws (182) and cross-tighten them. See section *6. Tightening torques and lubricants*.

10.5.5 Fitting the shaft seal

Sensor pump version

1. Lubricate the O-ring (153b) with Rocol Sapphire Aqua-Sil and fit it on the shaft.
2. Lubricate the two O-rings (106) of the shaft seal with Rocol Sapphire Aqua-Sil and fit them on the shaft seal (105).
3. Slide the shaft seal (105) gently over the shaft. The shaft seal driver must engage with the shaft keyway. See fig. 18.

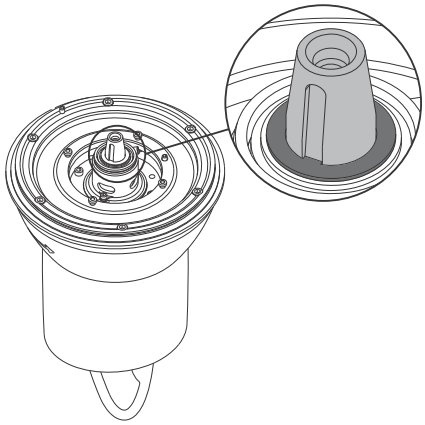


Fig. 18 Shaft seal engaged with shaft keyway

4. Fit the bracket (522) on the water-in-oil sensor (521). The bracket must be in front of the holes in the sensor. See fig. 19.
5. Fit one screw (186) through the bracket and one of the fixing holes of the shaft seal. To ensure that oil is led into the sensor, fit the bracket (522) so that the water-in-oil sensor (521) is positioned outside one of the holes in the shaft seal and pointing into the motor's direction of rotation. See fig. 19.

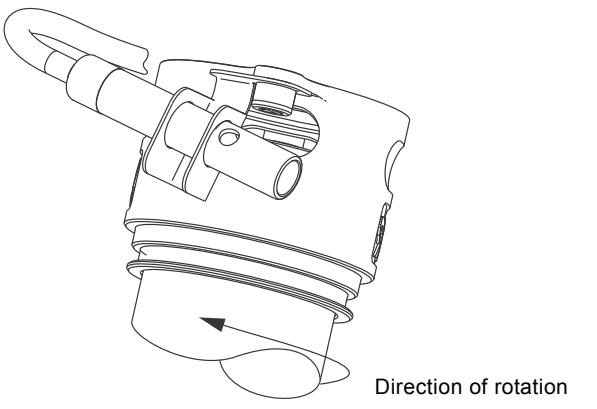


Fig. 19 Fitting the water-in-oil sensor

6. Fit the other screw (186) in the other fixing hole of the shaft seal and tighten both screws. See section *6. Tightening torques and lubricants*.
7. Lubricate the O-ring (107) with Rocol Sapphire Aqua-Sil and fit it on the oil chamber cover (58).
8. Fit the cover for oil chamber (58) according to the orientation pin, see fig. 20, and cross-tighten the screws (187). See section *6. Tightening torques and lubricants*.
9. Fill the oil chamber with oil. See section *10.3 Changing the oil*.

Standard pump version

1. Lubricate the O-ring (153b) with Rocol Sapphire Aqua-Sil and fit it on the shaft.
2. Lubricate the two O-rings (106) of the shaft seal with Rocol Sapphire Aqua-Sil and fit them on shaft seal (105).
3. Slide the shaft seal (105) gently over the shaft. The shaft seal driver must engage with the shaft keyway. See fig. 18.
4. Fit the screws (186) in the fixing holes of the shaft seal and tighten them. See section *6. Tightening torques and lubricants*.
5. Lubricate the O-ring (107) with Rocol Sapphire Aqua-Sil and fit it on the cover for oil chamber (58).
6. Fit the cover for oil chamber (58) according to the orientation pin (see fig. 20), and cross-tighten the screws (187). See section *6. Tightening torques and lubricants*.
7. Fill the oil chamber with oil. See section *10.3 Changing the oil*.

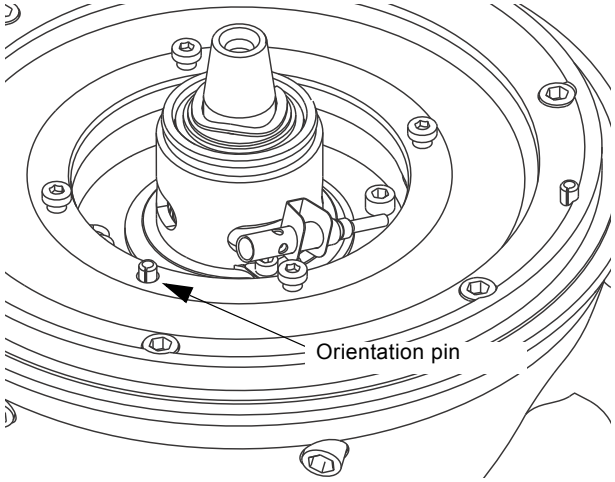


Fig. 20 Position of cover for oil chamber

10.5.6 Fitting the seal ring with a punch

1. Moisten the seal ring (46) with soapy water and fit it in the pump housing (50).
2. Knock the seal ring home in the pump housing using a punch (D). See fig. 21.
   Check on the outside of the pump housing that the seal ring has been knocked completely home in the housing.

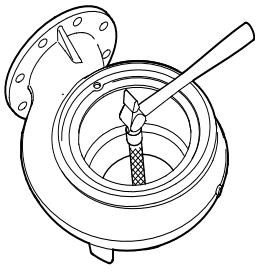


Fig. 21 Fitting the seal ring

10.5.7 Fitting the seal ring with a mounting tool

1. Moisten the seal ring (46) with soapy water and fit it in the pump housing (50).
2. Mount the tool on the pump housing. See fig. 22. See the tool dimensions in section *5.7 Seal ring mounting tool*.
3. Slowly tighten the nut on the threaded rod, and force the seal ring into place. Make sure that the tool gives an equal pull-force on to the seal ring.
4. Check on the outside of the pump housing that the seal ring has been pulled completely home in the housing.

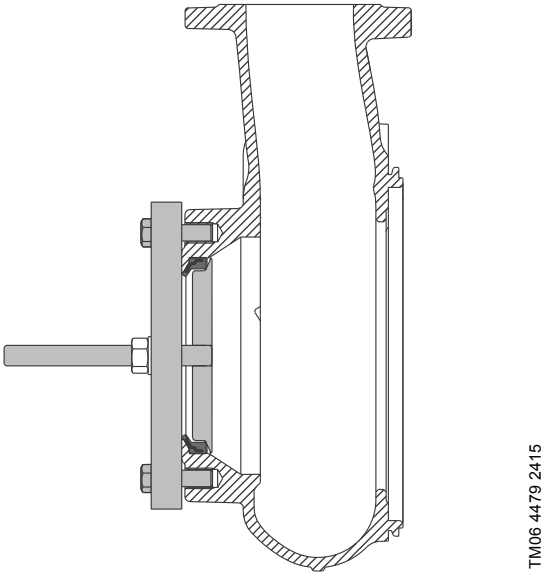


Fig. 22 Fitting the seal ring by means of a mounting tool

10.5.8 Fitting the wear ring on the impeller

5. Place the wear ring (49c) on the impeller (49).
6. Knock the wear ring home using a bench hammer () and a wooden block large enough for covering the wear ring. See fig. 23.

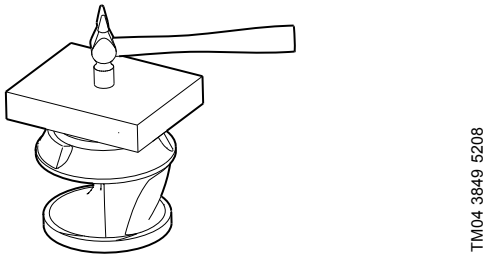


Fig. 23 Fitting the wear ring

10.5.9 Fitting the impeller and the pump housing

1. Fit an eyebolt (O) in the shaft.
2. Lift the stator housing by the eyebolt by means of a crane.
3. Remove the holding tool from the stator housing. See fig. 6.
4. Place the stator housing on the side on a table or on the floor.
5. Remove the eyebolt (O) from the shaft.
6. Fit the lifting bracket (190) in the correct direction (see fig. 24) and tighten the two screws (118a). See section *6. Tightening torques and lubricants*.

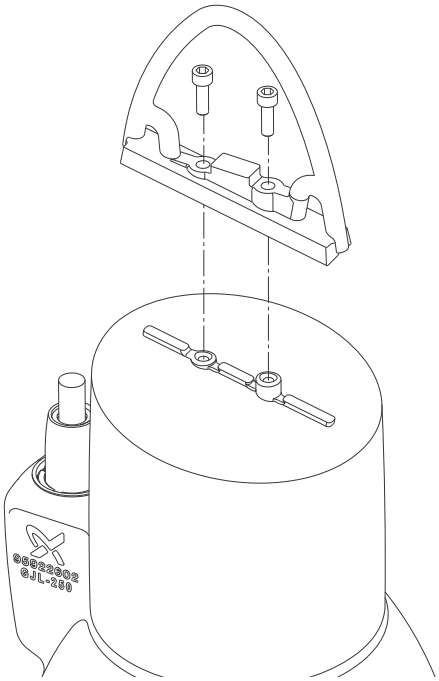


Fig. 24 Position of lifting bracket

7. Clean the conical part of the shaft and the inside of the impeller (49).
8. Fit the corrugated spring (157) and the key (9a) on the shaft.
9. Fit the impeller, the washer (66) and the screw (188a). See section *6. Tightening torques and lubricants*. Hold the impeller with a strap wrench (F).
10. Lubricate the O-ring (37) with Rocol Sapphire Aqua-Sil and fit it on the oil chamber (155).
11. Lift the pump by the lifting bracket and position it over the pump housing.
12. Lower the pump down on the pump housing. The groove in the circumference of the oil chamber must face the outlet flange so that the pin in the oil chamber fits into the hole in the pump housing.
13. Fit the clamp (92) and tighten the screw (92a). See section *6. Tightening torques and lubricants*.
14. Check that the impeller can rotate freely.
15. When the pump has been assembled, test the Pt1000, the moisture switch and the water-in-oil sensor by means of the test box (T). See section *5.6 Test box*.

10.5.10 Fitting the cable

1. Lubricate the O-ring (198) with Rocol Sapphire Aqua-Sil and fit it on the outer plug connector (181).
2. Fit the outer plug connector (181).
3. Fit the union nut of the plug connector and tighten it with the spanner for cable nut (A). See section *6. Tightening torques and lubricants*.

11. Startup

Warning

Do not start the pump if the atmosphere in the pit is potentially explosive.

11.1 General startup procedure

This procedure applies to pumps in new installations as well as to pumps being started up after service inspections, if startup takes place some time after the pump was placed in the pit.

1. Remove the fuses and check that the impeller can rotate freely. Turn the impeller by hand.

Warning

The impeller may have sharp edges - wear protective gloves.

2. Check the condition of the oil in the oil chamber. See also section *9. Overhaul*.
3. Check that the system, bolts, gaskets, pipework and valves etc. are in good condition.
4. Mount the pump in the system.
5. Switch on the power supply.
6. Check whether the monitoring units, if used, are operating satisfactorily.
7. **Pumps with sensor:** Switch on IO 113 and check that there are no alarms or warnings.
8. Check the setting of air bells, float switches or electrodes.
9. Check the direction of rotation. See section *11.2 Direction of rotation*.
10. Open the isolating valves, if fitted.
11. Check that the liquid level is above the motor for S1 operation and above the cable entry for S3 operation. If the liquid is not at the minimum level, do not start the pump.
12. Start the pump and let it run briefly, and check if the liquid level is falling.
13. Check that the outlet pressure and input current are normal. If not there might be air trapped inside the pump.

Note Remove trapped air from the pump housing by tilting the pump by means of the lifting chain when the pump is in operation.

Caution In case of abnormal noise or vibrations from the pump, other pump failure, power supply failure or water supply failure, stop the pump immediately. Do not attempt to restart the pump until the cause of the fault has been found and the fault corrected.

14. After one week of operation or after replacement of the shaft seal, check the condition of the oil in the oil chamber. For pumps without sensor, this is done by taking a sample of the oil.

Every time the pump has been removed from the pit, go through the above procedure when starting up again.

11.2 Direction of rotation

For further information, see the installation and operating instructions for SL1, SLV 1.1 - 11 kW. The installation and operating instructions are accessible via the QR code and link on the front page of this document.

12. Fault finding

For further information, see the installation and operating instructions for SL1, SLV 1.1 - 11 kW. The installation and operating instructions are accessible via the QR code and link on the front page of this document.

13. Wiring diagrams

The power supply to the pumps is via either a 7-wire cable or a 10-wire cable. For further information, see the installation and operating instructions for the selected control box or pump controller.

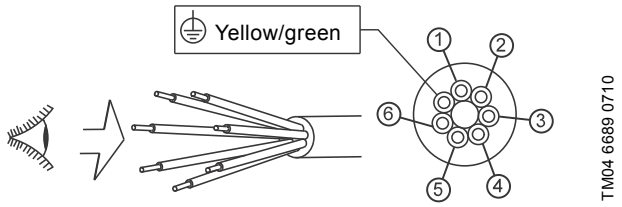


Fig. 25 Position of wires in 7-wire cable

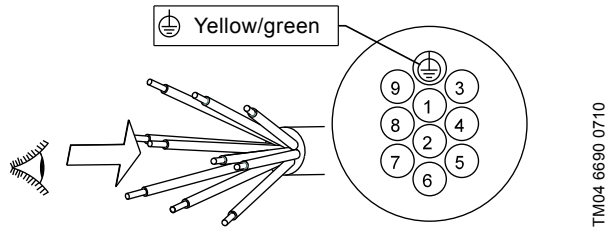


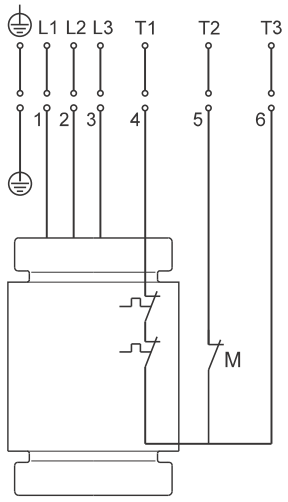
Fig. 26 Position of wires in 10-wire cable

13.1 Symbols used in the wiring diagrams

Symbol	Description
	Thermal switch
M	Moisture switch
+T	Pt1000 sensor
	Earth conductor
WIO	Water-in-oil sensor

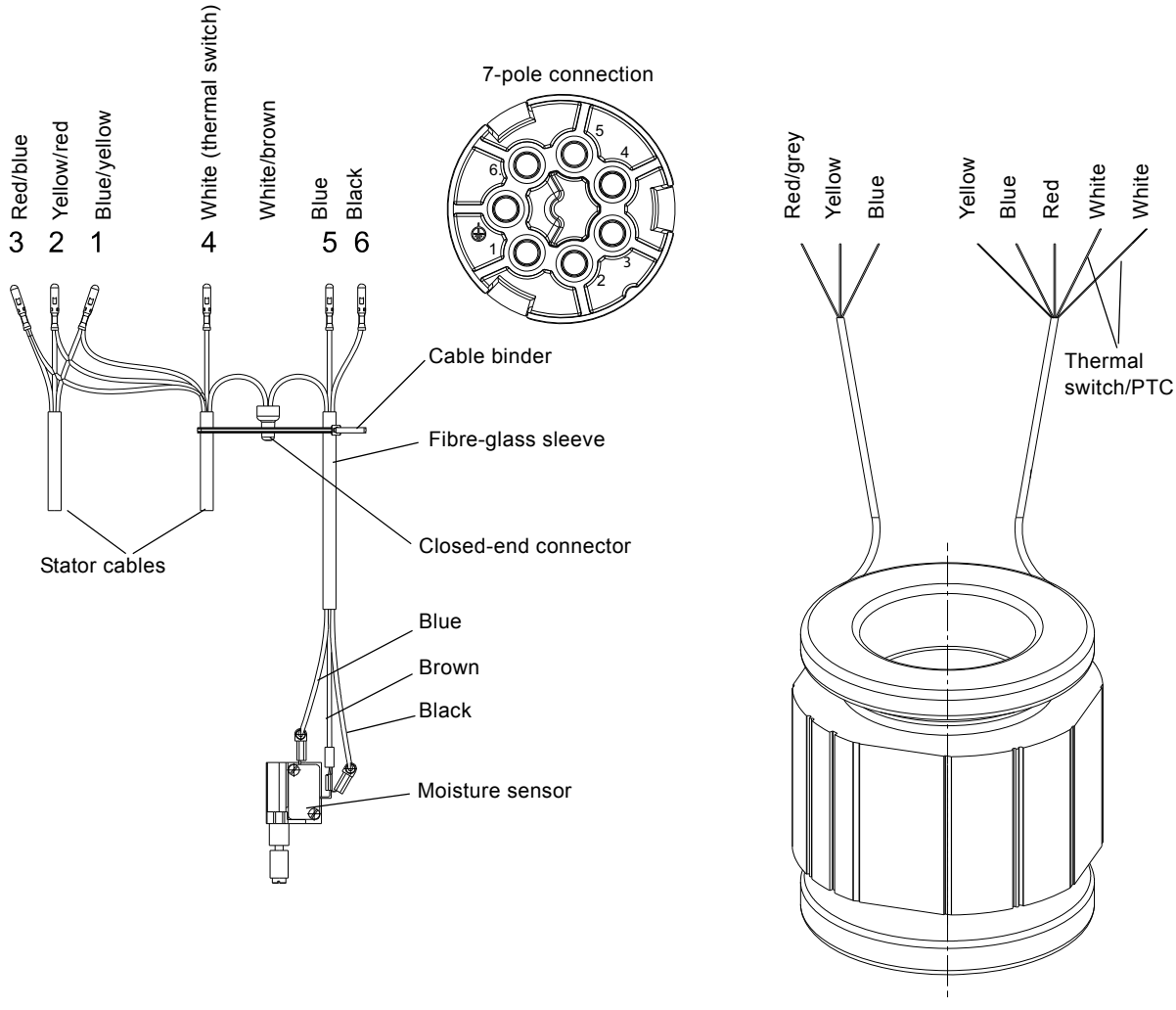
13.2 7-wire cable, standard version, DOL (direct online)

Voltage code 50 E (3 x 220-240 V)



TM04 6689 0710

Fig. 27 Main supply (standard version with thermal switches, moisture switch)

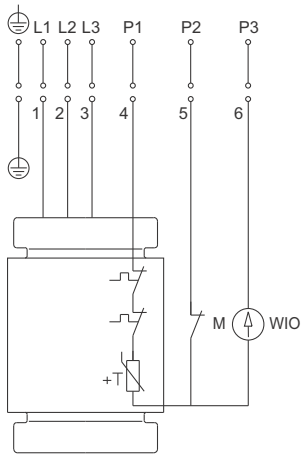


TM061957 3414 - TM06 1954 3414 - TM06 1951 3414

Fig. 28 Internal wiring, standard version, 7-pole connection, Δ connection

13.3 7-wire cable, sensor version, DOL (direct online)

Voltage code 50 E (3 x 220-240 V)



TM047884 2410

Fig. 29 Main supply (sensor version with thermal switch and PT1000, moisture switch and water-in-oil sensor)

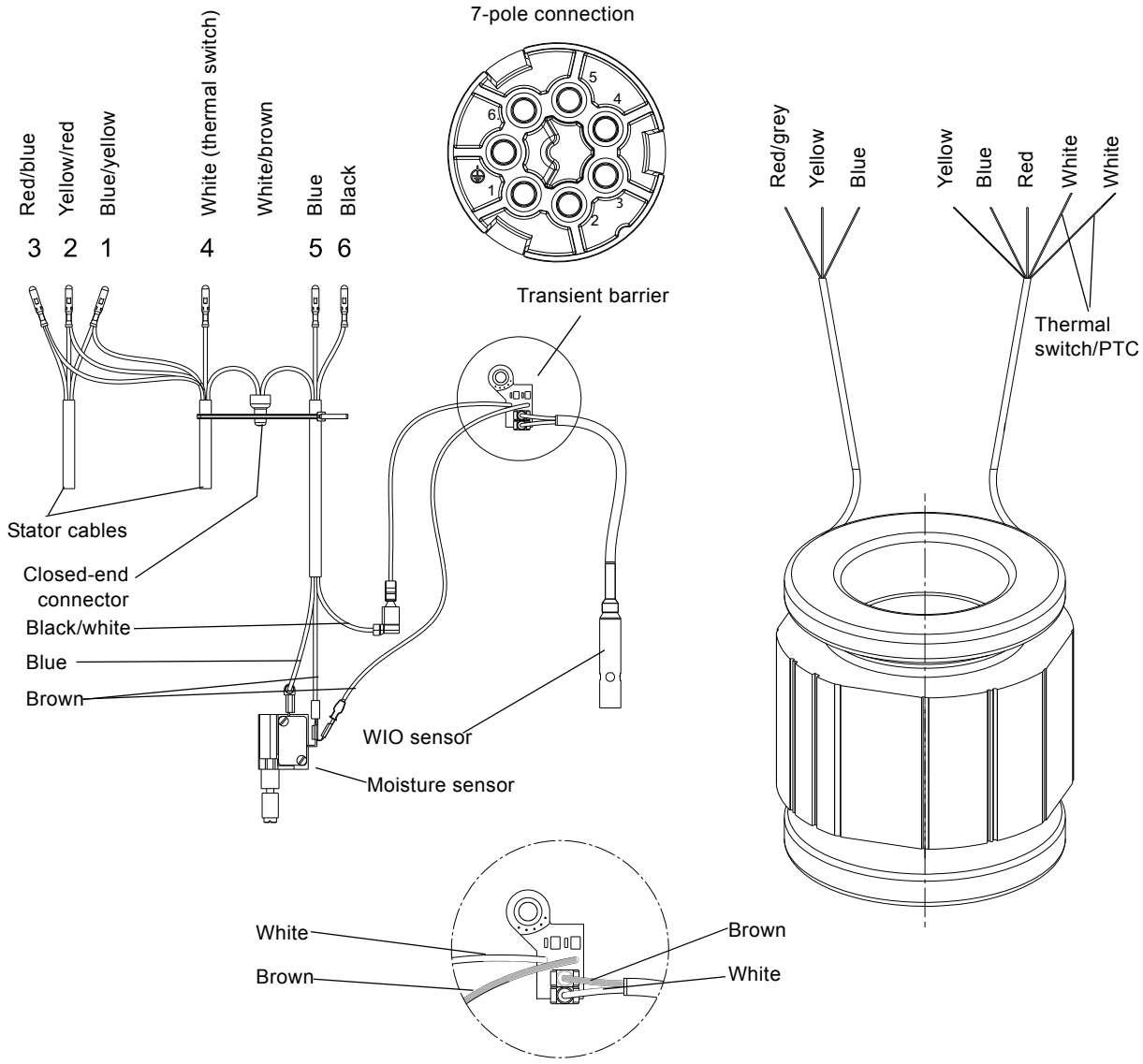
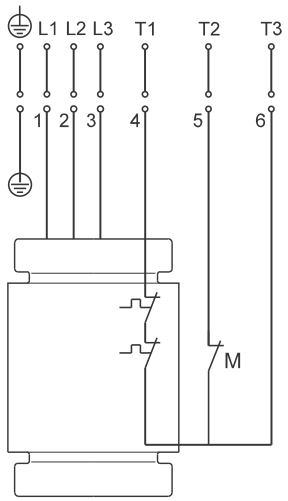


Fig. 30 Internal wiring, sensor version, 7-pole connection, Δ connection with WIO sensor

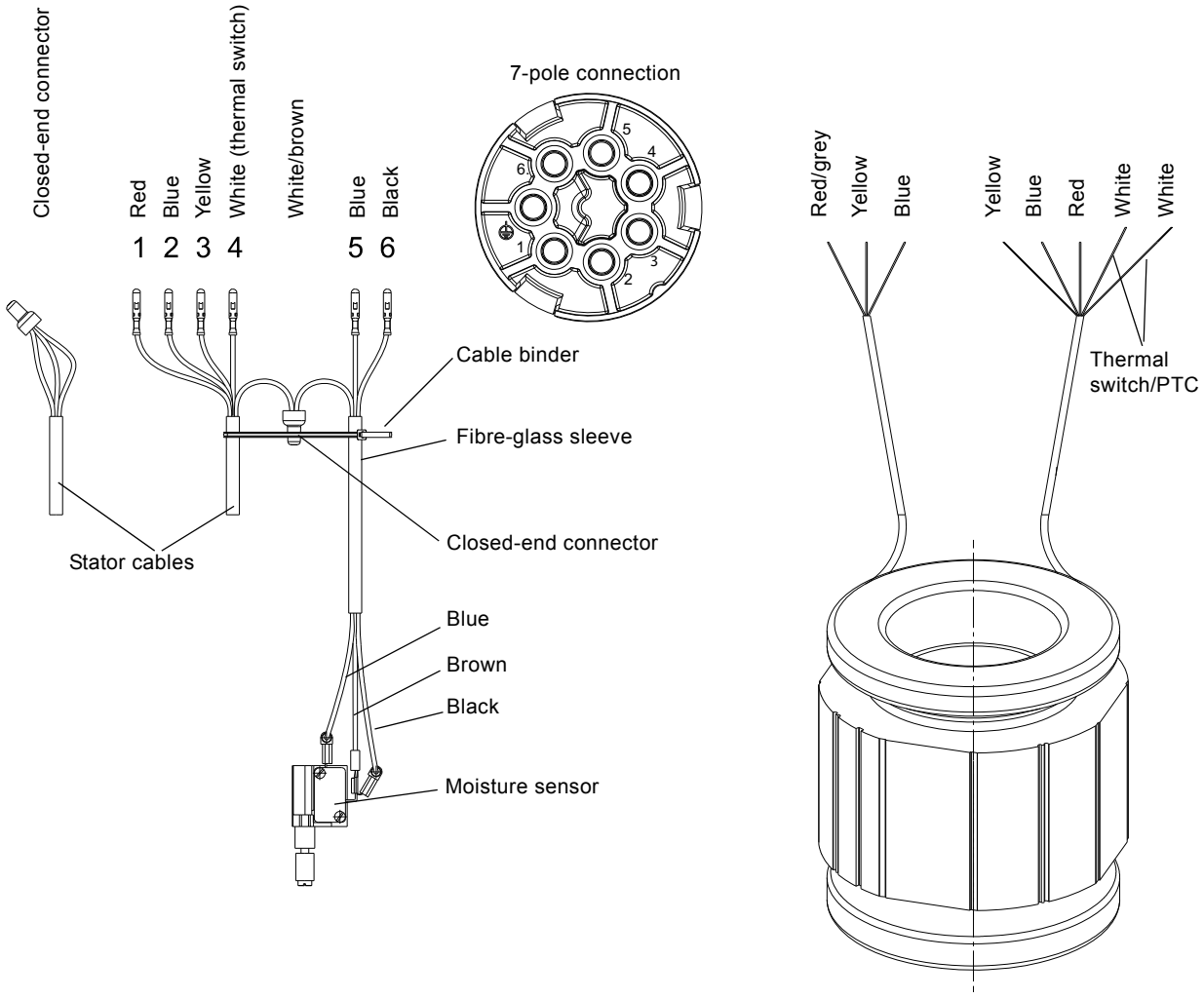
13.4 7-wire cable, standard version, DOL (direct online)

Voltage code 50 B (3 x 400-415 V) or 50 D (3 x 380-415 V)



TM04 6689 0710

Fig. 31 Main supply (standard version with thermal switches, moisture switch)

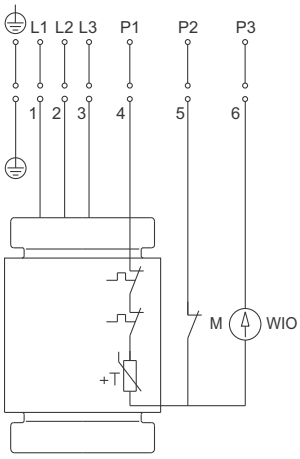


TM061957 3414 - TM06 1954 3414 - TM06 1951 3414

Fig. 32 Internal wiring, standard version, 7-pole connection, Y connection

13.5 7-wire cable, sensor version, DOL (direct online)

Voltage code 50 B (3 x 400-415 V) or 50 D (3 x 380-415 V)



TM047884 2410

Fig. 33 Main supply (sensor version with thermal switch and PT1000, moisture switch and water-in-oil sensor

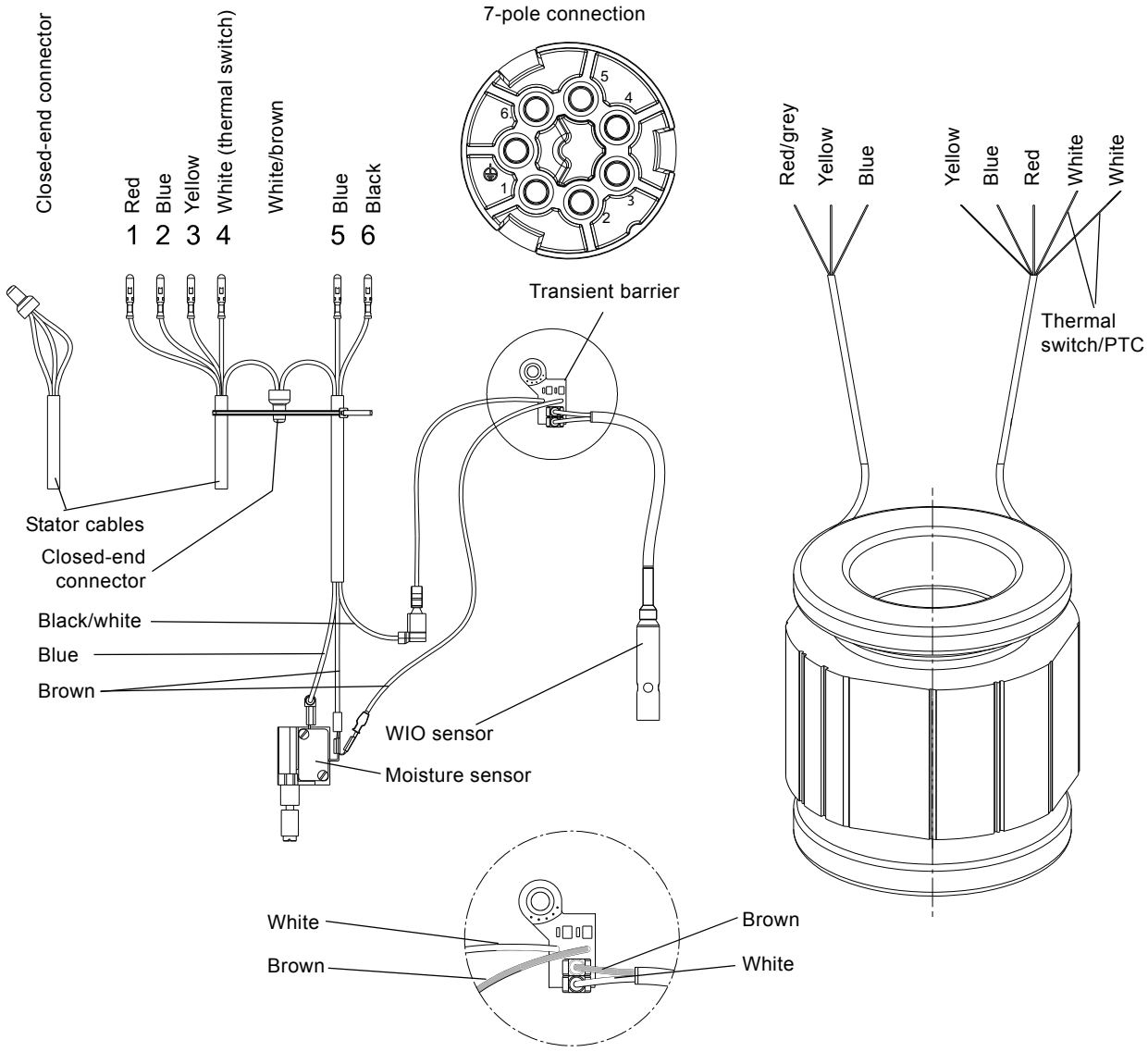
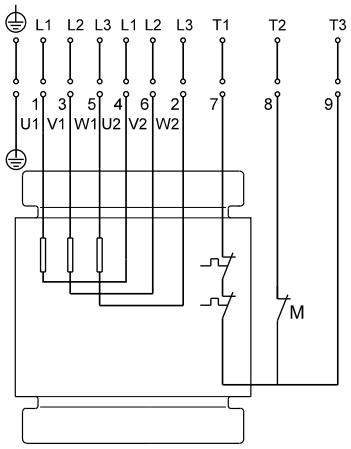


Fig. 34 Internal wiring, sensor version, 7-pole connection, Y connection with WIO sensor

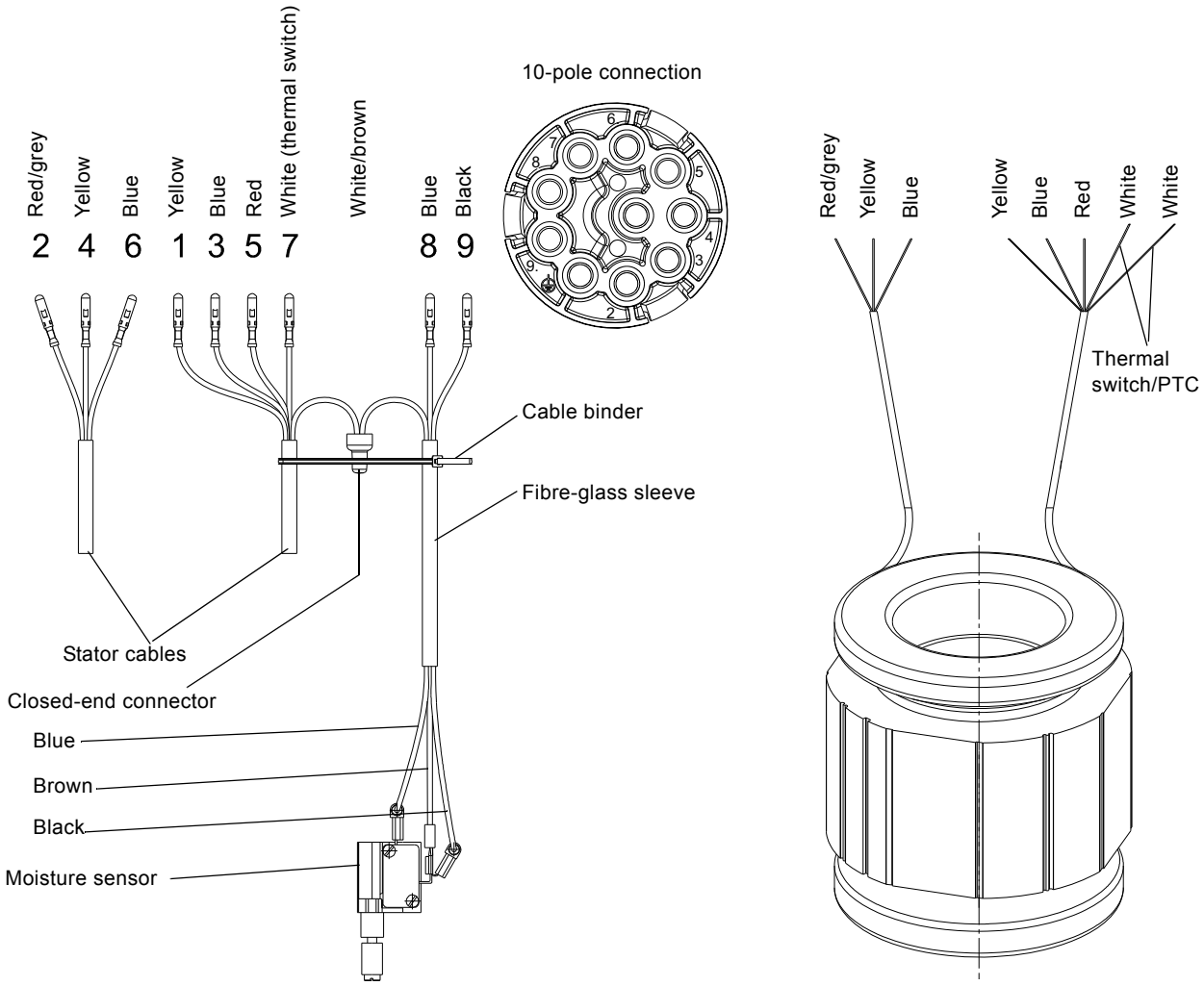
13.6 10-wire cable, standard version, star/delta connection (Y/D) DOL (direct online)

Voltage code 51 D (380-415 V) or 51 E (220-240 V)



TM04 6690 0710

Fig. 35 Main supply (standard version with thermal switches, moisture switch and CSA approval)

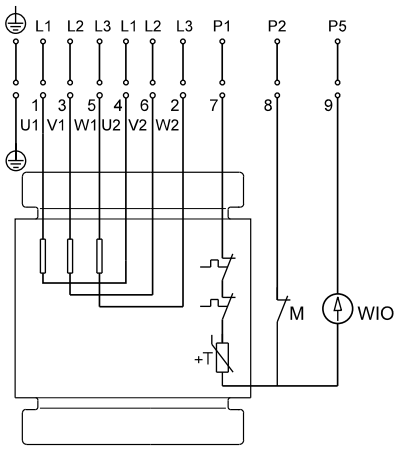


TM06 1958 3514

Fig. 36 Wiring diagram, standard version, 10-pole connection, Y/Δ connection, DOL

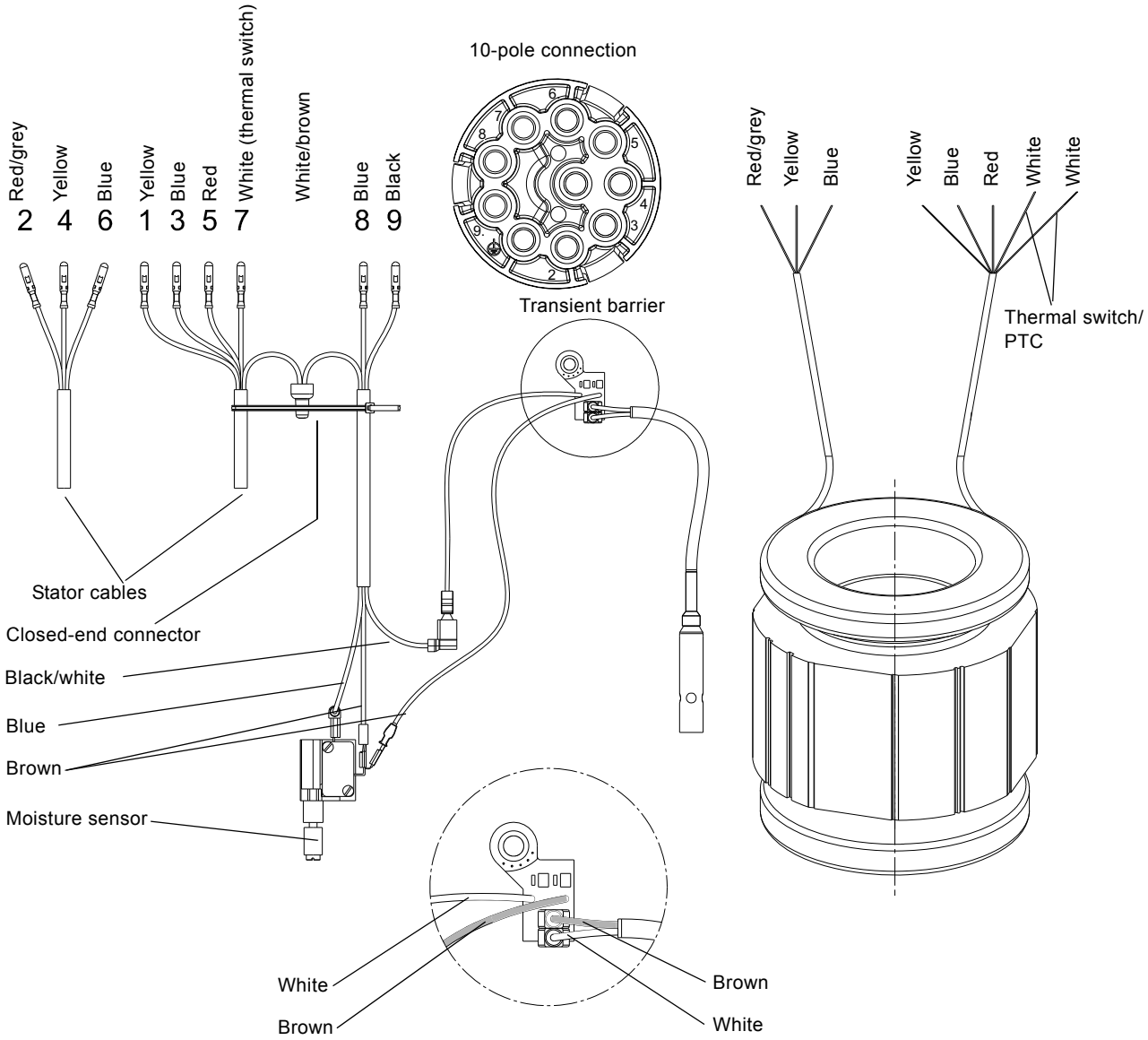
13.7 10-wire cable, sensor version, star/delta connection (Y/D)

Voltage code 51 D (380-415 V) or 51 E (220-240 V)



TM04 6690 0710

Fig. 37 Main supply (sensor version with thermal switch and PT1000, moisture switch and water-in-oil sensor)

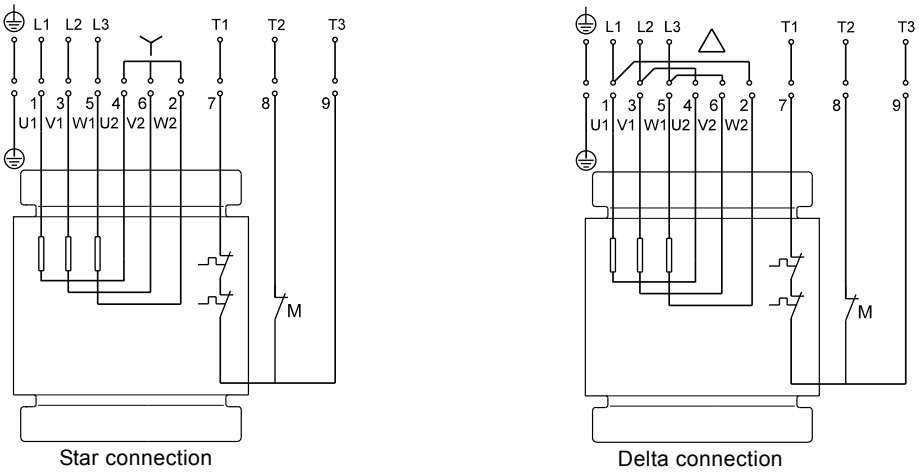


TM06 1956 3515 - TM06 1950 3514 - TM06 1954 3514 - TM06 1949 3514

Fig. 38 Wiring diagram, sensor version, 10-pole connection, Y/Δ connection, DOL

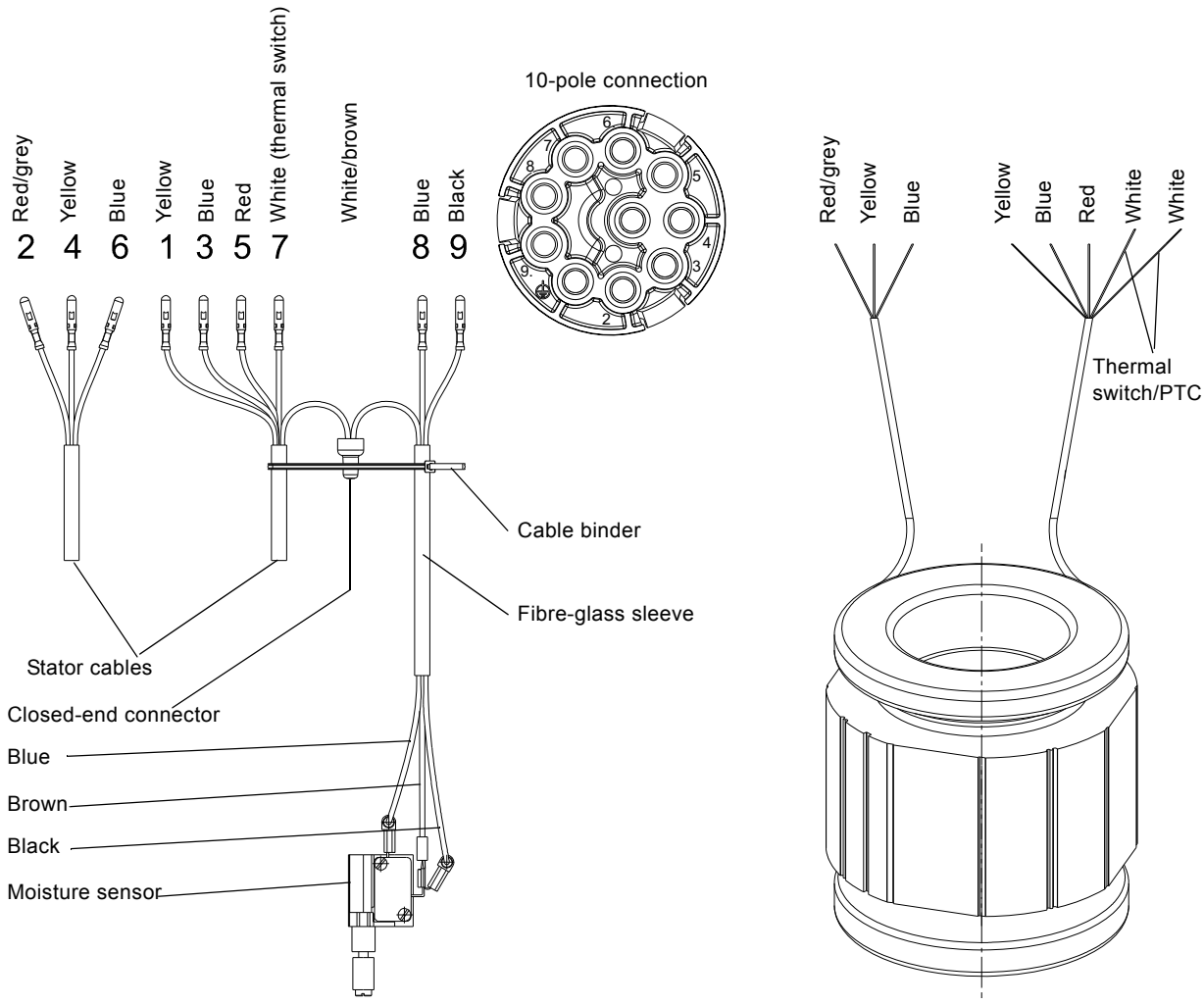
13.8 10-wire cable, standard version, star or delta connection

Voltage code 51 D (380-415 V) or 51 E (220-240 V)



TM04 6691 0710 - TM04 6692 0710

Fig. 39 Main supply (standard version with thermal switches, moisture switch)

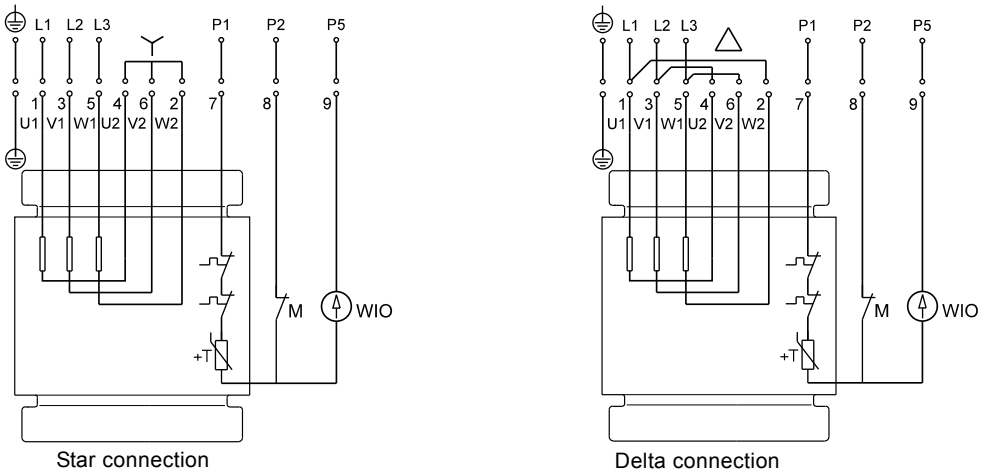


TM04 7900 2410

Fig. 40 Wiring diagram, standard version, 10-pole connection, Y or Δ connection, DOL

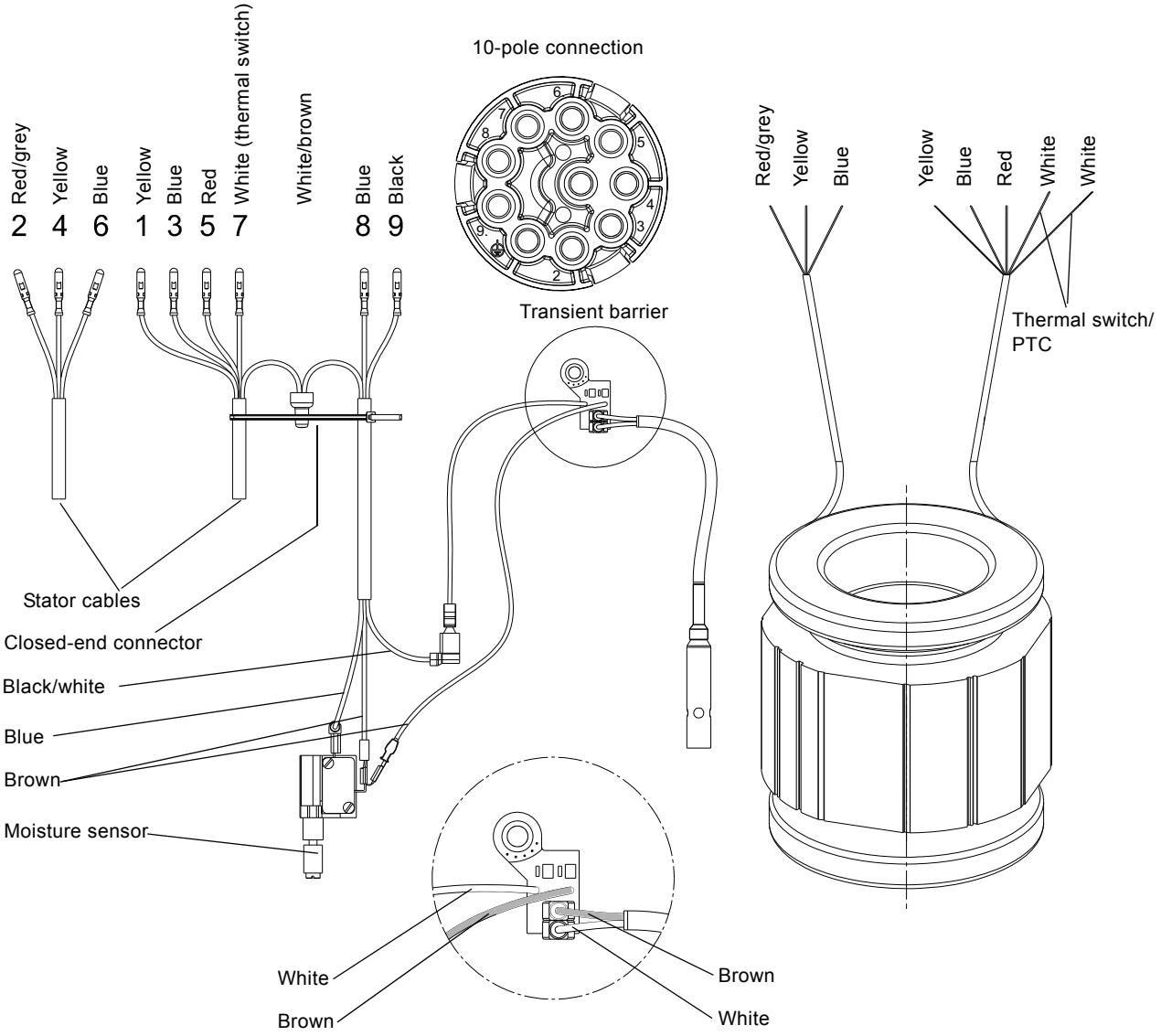
13.9 10-wire cable, sensor version, star or delta connection

Voltage code 51 D (380-415 V) or 51 E (220-240 V)



TM04 6691 0710 - TM04 6692 0710

Fig. 41 Main supply (sensor version with thermal switch and PT1000, moisture switch and CSA-approved water-in-oil sensor, with/ without FM approval)



TM06 1956 3515 - TM06 1950 3514 - TM06 1954 3514 - TM06 1949 3514

Fig. 42 Wiring diagram, sensor version, 10-pole connection, Y or Δ connection, DOL

14. Material specification, SL1 and SLV

Pos.	Component	Material	DIN W.-Nr. / EN standard	AISI/ASTM
6a	Tubular pin, D8 x 22 A2	Stainless steel	1.4301	304
7a	Blank rivet, 2.4 x 6 A2	Stainless steel	1.4301	304
9a	Key	Stainless steel	1.4301	304
37	O-ring	NBR rubber		
37a	O-ring	NBR rubber		
37b	O-ring	NBR rubber		
46	Seal ring	NBR rubber/stainless steel	1.4301	304
48	Stator			
49	SuperVortex impeller	Cast iron EN-GJL-250	5.1301	ASTM A48 Class 40B
	S-**tube**® impeller	Cast iron, EN-GJL-250	5.1301	ASTM A48 Class 40B
49c	Wear ring	Stainless steel	1.4301	304
50	Pump housing	Cast iron EN-GJL-250	5.1301	ASTM A48 Class 40B
55	Stator housing	Cast iron EN-GJL-250	5.1301	ASTM A48 Class 40B
58	Cover for oil chamber	Cast iron EN-GJL-250	5.1301	ASTM A48 Class 40B
59	Bearing cover	Cast iron EN-GJL-250	5.1301	ASTM A48 Class 40B
66	Washer	Stainless steel	1.4436	316
76	Nameplate	Stainless steel	1.4401	316
92	Clamp	Stainless steel	1.4401	316
92a	Hexagon socket head cap screw	Stainless steel	1.4436	316
102	Circlip			
105	Shaft seal complete (rotating part of MG1/25-G60 Q1Q1PGG, stationary part of MG1/25-G60 Q1Q1PGG; rotating part of BT-AR/25 BXPFF, stationary part of BT-AR/25 BXPFF)	Stainless steel, SiC/SiC Carbon/ceramic		
106	O-ring	NBR rubber		
107	O-ring	NBR rubber		
109	O-ring for bearing cover (D-end)	NBR rubber		
118a	Hexagon socket head cap screw	Stainless steel	1.4436	316
150a	Stator housing complete with stator			
153	Bearing (D-end)	Stainless steel		
153b	O-ring	NBR rubber		
154	Bearing (N-end)	Stainless steel		
155	Oil chamber	Cast iron EN-GJL-250	5.1301	ASTM A48 Class 40B
157	Corrugated spring (D-end bearing)	Stainless steel		
158	Corrugated spring (N-end bearing)	Stainless steel		
172	Shaft with rotor	Regular iron/stainless steel	1.0570 1.4401	316
174	Hexagon socket head cap screw	Stainless steel		
174a	Washer	Stainless steel		
176	Male plug connector			
181	Cable with female plug connector	7G2.5 + 3 x 1		
182	Hexagon socket head cap screw	Stainless steel	1.4436	316
186	Hexagon socket head cap screw	Stainless steel	1.4436	316
187	Hexagon socket head cap screw	Stainless steel	1.4436	316
188	Hexagon socket head cap screw	Stainless steel	1.4436	316
188a	Hexagon socket head cap screw	Stainless steel	1.4436	316
190	Lifting bracket	Stainless steel	1.4308	CF8
193	Plug	Stainless steel	1.4436	316
194	Gasket			
198	O-ring	NBR rubber		
518	Transient barrier (only sensor versions)			

Pos.	Component	Material	DIN W.-Nr. / EN standard	AISI/ASTM
518a	Hexagon socket head cap screw	Stainless steel	1.4436	316
518b	Lock washer	Stainless steel	1.4436	316
520	Moisture switch			
521	WIO sensor			
522	Bracket for moisture switch			

Material declaration:

Cast iron is manufactured according to EN 1561:1997.

Cast stainless steel is manufactured according to EN 10283:2010.

Conversion to other standards such as AISI/ASTM is normative, and products are not manufactured according to these.

15. Exploded views

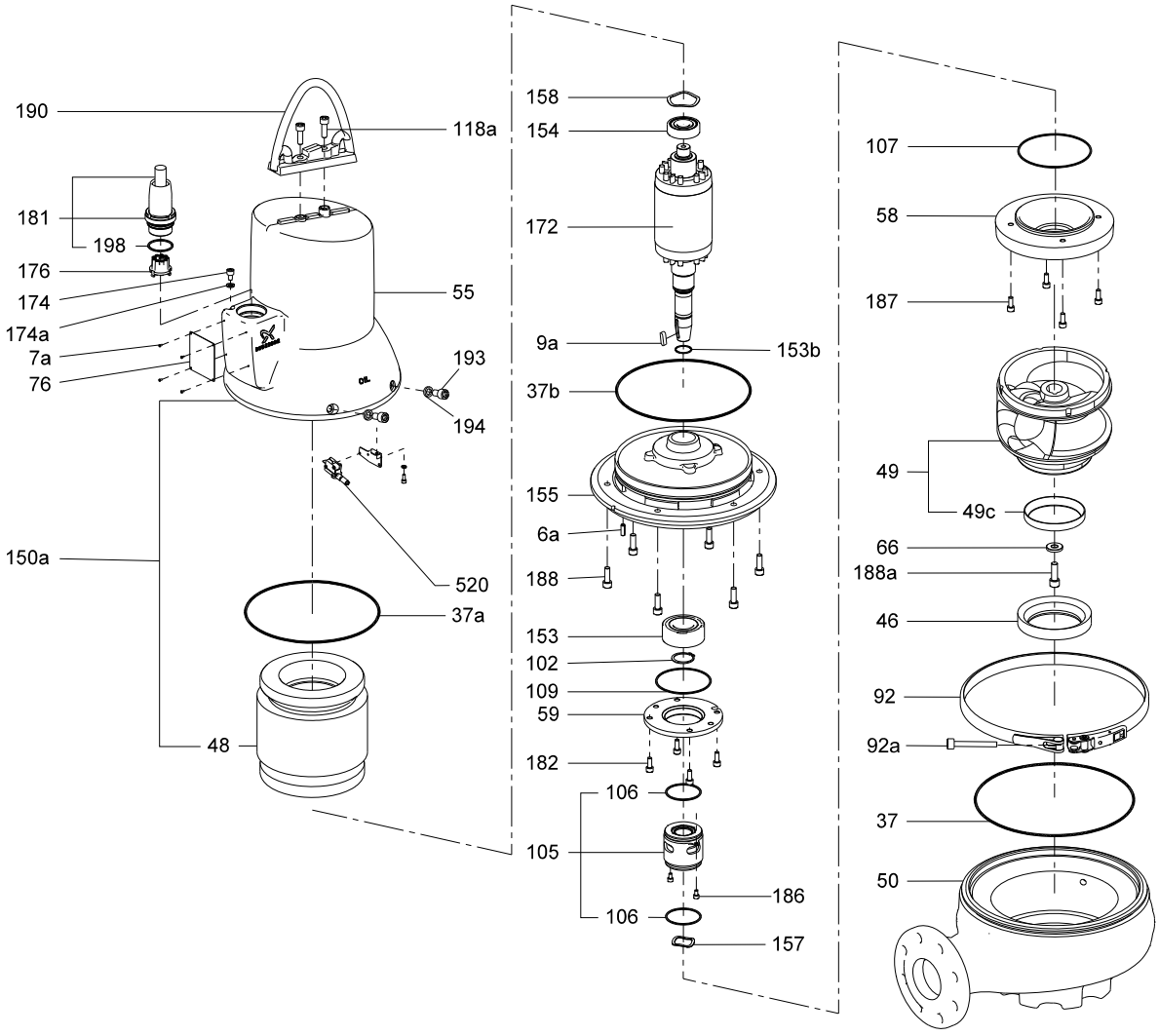


Fig. 43 SL1 pump, standard version

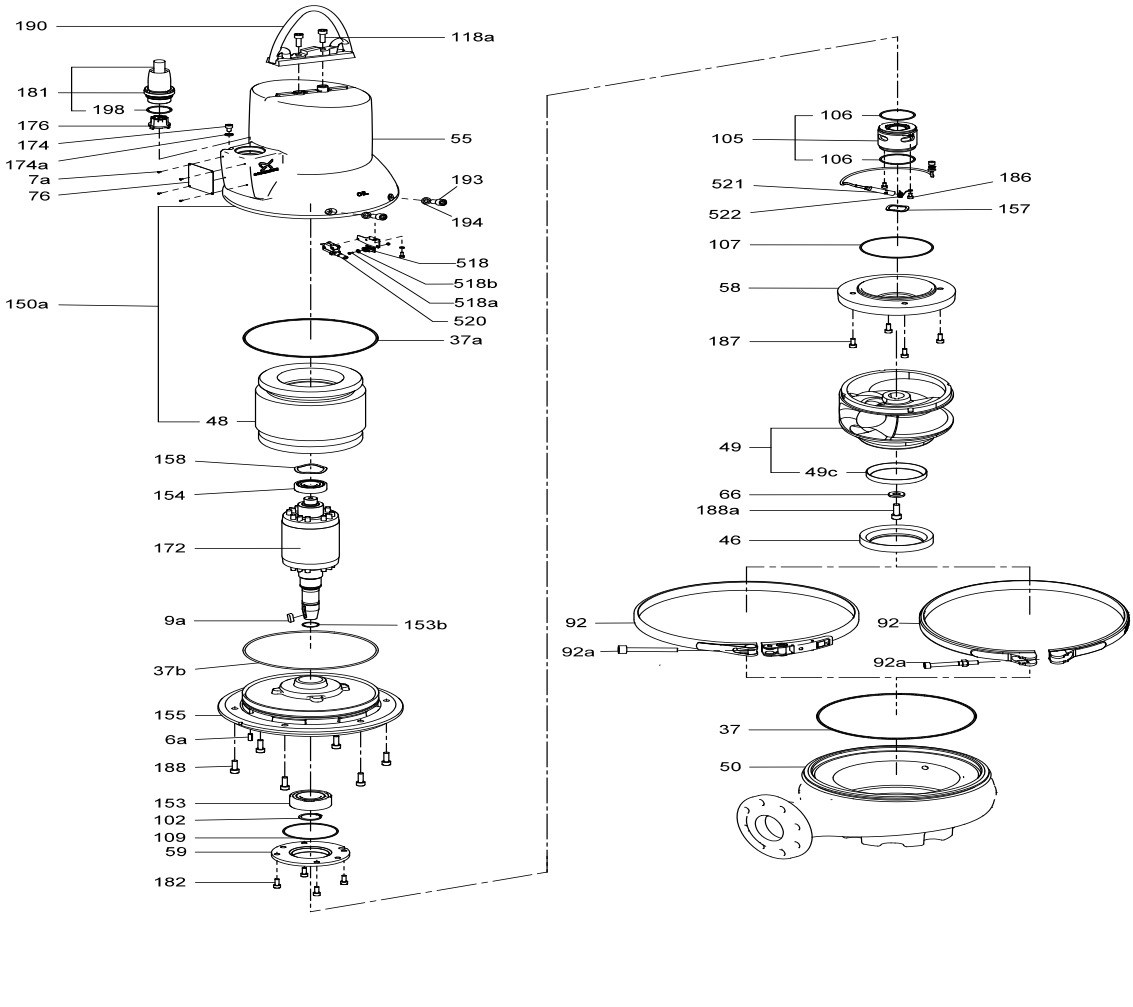


Fig. 44 SL1 pump, sensor version

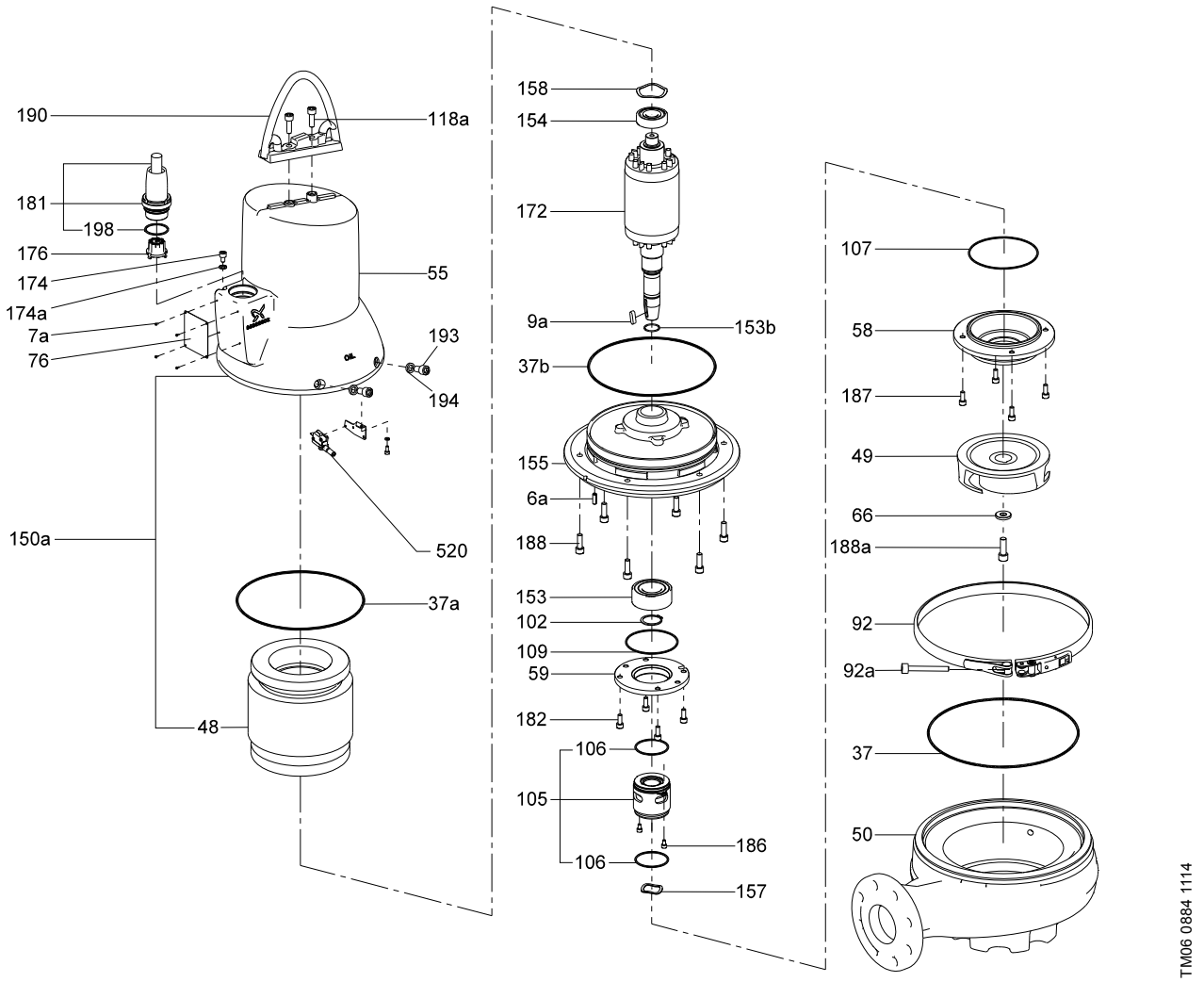


Fig. 45 SLV pump, standard version

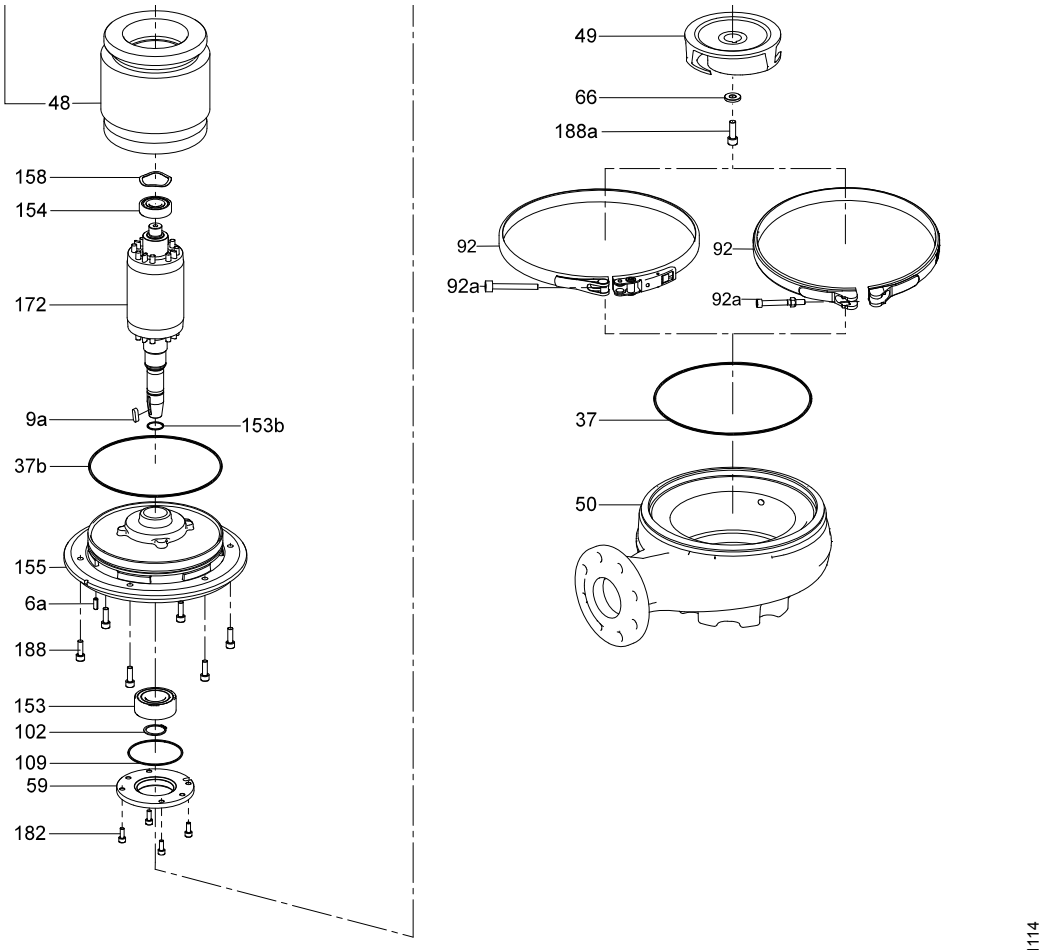


Fig. 46 SLV pump, sensor version

16. Electrical data

50 Hz

2-pole motor, 50 Hz					Cable connection	
Power (P_2) [kW]	**Power (P_1) [kW]**	**Voltage [V]**	**Starting method**	**Thermal protection**	**Cable cross-section [mm^2]**	**Wires/plug pins**
2.2	2.8	3 x 220-240	DOL	Thermal switch	1.5	7/7
2.2	2.8	3 x 220-240	Y/D	Thermal switch	2.5	10/10
2.2	2.8	3 x 380-415	DOL	Thermal switch	1.5	7/7
2.2	2.8	3 x 380-415	Y/D	Thermal switch	2.5	10/10
2.2	2.8	3 x 400-415	DOL	Thermal switch	1.5	7/7
3	3.8	3 x 220-240	DOL	Thermal switch	1.5	7/7
3	3.8	3 x 220-240	Y/D	Thermal switch	2.5	10/10
3	3.8	3 x 380-415	DOL	Thermal switch	1.5	7/7
3	3.8	3 x 380-415	Y/D	Thermal switch	2.5	10/10
3	3.8	3 x 400-415	DOL	Thermal switch	1.5	7/7
4	4.8	3 x 220-240	Y/D	Thermal switch	2.5	10/10
4	4.8	3 x 380-415	Y/D	Thermal switch	2.5	10/10
4	4.8	3 x 400-415	DOL	Thermistor	2.5	7/10
6.0	6.9	3 x 220-240	Y/D	Thermal switch	2.5	10/10
6.0	6.9	3 x 380-415	Y/D	Thermal switch	2.5	10/10
6.0	6.9	3 x 400-415	DOL	Thermistor	2.5	7/10
7.5	8.7	3 x 220-240	Y/D	Thermal switch	2.5	10/10
7.5	87	3 x 380-415	Y/D	Thermal switch	2.5	10/10
7.5	8.7	3 x 400-415	DOL	Thermistor	2.5	7/10
9.2	10.5	3 x 220-240	Y/D	Thermal switch	2.5	10/10
9.2	10.5	3 x 380-415	Y/D	Thermal switch	2.5	10/10
9.2	10.5	3 x 400-415	DOL	Thermistor	2.5	7/10
11	12.5	3 x 220-240	Y/D	Thermal switch	2.5	10/10
11	12.5	3 x 380-415	Y/D	Thermal switch	2.5	10/10
11	12.5	3 x 400-415	DOL	Thermistor	2.5	7/10

The supply cable resistance depends on the cable diameter.

Resistance per running metre of cable: 1.5 mm^2: 0.013 Ω.

Resistance per running metre of cable: 2.5 mm^2: 0.00830 Ω.

4-pole motor, 50 Hz					Cable connection	
Power P_2 [kW]	Power P_1 [kW]	Voltage [V]	Starting method	Thermal protection	Cable cross-section [mm^2]	Wires/plug pins
1.1	1.5	3 x 220-240	DOL	Thermal switch	1.5	7/7
1.1	1.5	3 x 380-415	DOL	Thermal switch	1.5	7/7
1.1	1.5	3 x 400-415	DOL	Thermal switch	1.5	7/7
1.3	1.8	3 x 220-240	DOL	Thermal switch	1.5	7/7
1.3	1.8	3 x 380-415	DOL	Thermal switch	1.5	7/7
1.3	1.8	3 x 400-415	DOL	Thermal switch	1.5	7/7
1.5	1.9	3 x 220-240	DOL	Thermal switch	1.5	7/7
1.5	1.9	3 x 380-415	DOL	Thermal switch	1.5	7/7
1.5	1.9	3 x 400-415	DOL	Thermal switch	1.5	7/7
2.2	2.7	3 x 220-240	DOL	Thermal switch	1.5	7/7
2.2	2.7	3 x 220-240	Y/D	Thermal switch	2.5	10/10
2.2	2.7	3 x 380-415	DOL	Thermal switch	1.5	7/7
2.2	2.7	3 x 380-415	Y/D	Thermal switch	2.5	10/10
2.2	2.7	3 x 400-415	DOL	Thermal switch	1.5	7/7
3	3.7	3 x 220-240	DOL	Thermal switch	1.5	7/7
3	3.7	3 x 220-240	Y/D	Thermal switch	2.5	10/10
3	3.7	3 x 380-415	DOL	Thermal switch	1.5	7/7
3	3.7	3 x 380-415	Y/D	Thermal switch	2.5	10/10
3	3.7	3 x 400-415	DOL	Thermal switch	1.5	7/7
4	4.8	3 x 220-240	Y/D	Thermal switch	2.5	10/10
4	4.8	3 x 380-415	Y/D	Thermal switch	2.5	10/10
4	4.8	3 x 400-415	DOL	Thermistor	2.5	7/10
5.5	6.4	3 x 220-240	Y/D	Thermal switch	2.5	10/10
5.5	6.4	3 x 380-415	Y/D	Thermal switch	2.5	10/10
5.5	6.4	3 x 400-415	DOL	Thermistor	2.5	7/10
7.5	8.6	3 x 220-240	Y/D	Thermal switch	2.5	10/10
7.5	8.6	3 x 380-415	Y/D	Thermal switch	2.5	10/10
7.5	8.6	3 x 100-415	DOL	Thermistor	2.5	7/10

The resistance in the supply cable depends on the cable diameter.

Resistance per metre of cable: 1.5 mm^2 = 0.012 Ω.

Resistance per metre of cable: 2.5 mm^2 = 0.007 Ω.

60 Hz

2-pole motor, 60 Hz					Cable connection	
Power P2 [kW]	**Power P1 [kW]**	**Voltage [V]**	**Starting method**	**Thermal protection**	**Cable cross-section [AWG (mm²)]**	**Wires/plug pins**
2.2	2.8	3 x 220-277	DOL	Thermal switch	1.5	7/7
2.2	2.8	3 x 220-277	Y/D	Thermal switch	1.5	10/10
2.2	2.8	3 x 380-480	DOL	Thermal switch	1.5	7/7
2.2	2.8	3 x 380-480	Y/D	Thermal switch	1.5	10/10
3	3.8	3 x 220-277	DOL	Thermal switch	1.5	7/7
3	3.8	3 x 220-277	Y/D	Thermal switch	1.5	10/10
3	3.8	3 x 380-480	DOL	Thermal switch	1.5	7/7
3	3.8	3 x 380-480	Y/D	Thermal switch	1.5	10/10
4	4.8	3 x 220-277	DOL	Thermal switch	2.5	7/7
4	4.8	3 x 220-277	Y/D	Thermal switch	2.5	10/10
4	4.8	3 x 380-480	DOL	Thermal switch	2.5	7/7
4	4.8	3 x 380-480	Y/D	Thermal switch	2.5	10/10
6.0	7.1	3 x 220-277	DOL	Thermal switch	2.5	7/7
6.0	7.1	3 x 220-277	Y/D	Thermal switch	2.5	10/10
6.0	7.1	3 x 380-480	DOL	Thermal switch	2.5	7/7
6.0	7.1	3 x 380-480	Y/D	Thermal switch	2.5	10/10
7.5	8.9	3 x 220-277	DOL	Thermal switch	2.5	7/7
7.5	8.9	3 x 220-277	Y/D	Thermal switch	2.5	10/10
7.5	8.9	3 x 380-480	DOL	Thermal switch	2.5	7/7
7.5	8.9	3 x 380-480	Y/D	Thermal switch	2.5	10/10
9.2	10.5	3 x 220-277	DOL	Thermal switch	2.5	7/7
9.2	10.5	3 x 220-277	Y/D	Thermal switch	2.5	10/10
9.2	10.5	3 x 380-480	DOL	Thermal switch	2.5	7/7
9.2	10.5	3 x 380-480	Y/D	Thermal switch	2.5	10/10
11	12.6	3 x 220-277	DOL	Thermal switch	2.5	7/7
11	12.6	3 x 220-277	Y/D	Thermal switch	2.5	10/10
11	12.6	3 x 380-480	DOL	Thermal switch	2.5	7/7
11	12.6	3 x 380-480	Y/D	Thermal switch	2.5	10/10

The supply cable resistance depends on the cable diameter.

Resistance per running metre of cable: 1.5 mm^2: 0.013 Ω.

Resistance per running metre of cable: 2.5 mm^2: 0.00830 Ω.

4-pole motor, 60 Hz					Cable connection	
Power P2 [kW]	Power P1 [kW]	Voltage [V]	Starting method	Thermal protection	Cable cross-section [AWG (mm^2)]	Wires/plug pins
1.1	1.5	3 x 220-277	DOL	Thermal switch	1.5	7/7
1.1	1.5	3 x 220-277	Y/D	Thermal switch	1.5	10/10
1.1	1.5	3 x 380-480	DOL	Thermal switch	1.5	7/7
1.1	1.5	3 x 380-480	Y/D	Thermal switch	1.5	10/10
1.3	1.8	3 x 220-277	DOL	Thermal switch	1.5	7/7
1.3	1.8	3 x 220-277	Y/D	Thermal switch	1.5	10/10
1.3	1.8	3 x 380-480	DOL	Thermal switch	1.5	7/7
1.3	1.8	3 x 380-480	Y/D	Thermal switch	1.5	10/10
1.5	2.1	3 x 220-277	DOL	Thermal switch	1.5	7/7
1.5	2.1	3 x 220-277	Y/D	Thermal switch	1.5	10/10
1.5	2.1	3 x 380-480	DOL	Thermal switch	1.5	7/7
1.5	2.1	3 x 380-480	Y/D	Thermal switch	1.5	10/10
2.2	2.9	3 x 220-277	DOL	Thermal switch	1.5	7/7
2.2	2.9	3 x 220-277	Y/D	Thermal switch	1.5	10/10
2.2	2.9	3 x 380-480	DOL	Thermal switch	1.5	7/7
2.2	2.9	3 x 380-480	Y/D	Thermal switch	1.5	10/10
3	3.7	3 x 220-277	DOL	Thermal switch	1.5	7/7
3	3.7	3 x 220-277	Y/D	Thermal switch	1.5	10/10
3	3.7	3 x 380-480	DOL	Thermal switch	1.5	7/7
3	3.7	3 x 380-480	Y/D	Thermal switch	1.5	10/10
4	4.9	3 x 220-277	DOL	Thermal switch	2.5	7/7
4	4.9	3 x 220-277	Y/D	Thermal switch	2.5	10/10
4	4.9	3 x 380-480	DOL	Thermal switch	2.5	7/7
4	4.9	3 x 380-480	Y/D	Thermal switch	2.5	10/10
5.5	6.5	3 x 220-277	DOL	Thermal switch	2.5	7/7
5.5	6.5	3 x 220-277	Y/D	Thermal switch	2.5	10/10
5.5	6.5	3 x 380-480	DOL	Thermal switch	2.5	7/7
5.5	6.5	3 x 380-480	Y/D	Thermal switch	2.5	10/10
7.5	9.0	3 x 220-277	DOL	Thermal switch	2.5	7/7
7.5	9.0	3 x 220-277	Y/D	Thermal switch	2.5	10/10
7.5	9.0	3 x 380-480	DOL	Thermal switch	2.5	7/7
7.5	9.0	3 x 380-480	Y/D	Thermal switch	2.5	10/10

The supply cable resistance depends on the cable diameter.

Resistance per running metre of cable: 1.5 mm^2: 0.013 Ω

Resistance per running metre of cable: 2.5 mm^2: 0.00830 Ω.

16.1 Stator height and winding resistance

Number of poles	Frame size	Power	Outer stator diameter	Inner stator diameter	Stator length	Stator height	Voltage variant	Phase resistance	Y-connection resistance	D-connection resistance
		[kW]	[mm]	[mm]	[mm]	[mm]		[Ω]	[Ω]	[Ω]
2-pole	B-135	2.2	135	75	140	129.0	50B, 50D, 50E	2.060	4.120	1.373
							51D	6.400	12.800	4.267
	B-155	3	155	85	110	130.3	50B, 50D, 50E	1.560	3.120	1.040
							51D	4.750	9.500	3.167
	C-170	4	170	95	140	131.8	51E	0.910	1.820	0.607
							50B, 50D, 51D	2.740	5.480	1.827
	C-210	6.0	210	110	120	124.5	51E	0.510	1.020	0.340
							50B, 50D, 51D	1.550	3.100	1.033
	C210	7.5	210	110	120	124.5	51E	0.510	1.020	0.340
							50B, 50D, 51D	1.550	3.100	1.033
	D-245	9.2	245	110	130	146.3	51E	0.275	0.550	0.183
							50B, 50D, 51D	0.930	1.860	0.620
	D-245	11	245	110	130	146.3	51E	0.275	0.550	0.183
							50B, 50D, 51D	0.930	1.860	0.620
4-pole	B-135	1.1	135	85	125	129.0	50B, 50D, 50E	4.750	9.500	3.167
	B-135	1.5	135	85	140	129.0	50B, 50D, 50E	3.300	6.600	2.200
	B-155	2.2	155	95	135	130.3	50B, 50D, 50E	1.680	3.360	1.120
							51D	5.000	10.000	3.333
	C-155	3	155	95	155	121.0	50B, 50D, 50E	1.390	2.780	0.927
							51D	3.960	7.920	2.640
	C-170	4	170	110	170	131.8	51E	0.920	1.840	0.613
							50B, 50D, 51D	2.910	5.820	1.940
	C-210	5.5	210	125	140	124.5	51E	0.630	1.260	0.420
							50B, 50D, 51D	1.860	3.720	1.240
	D-210	7.5	210	125	180	140.0	51E	0.426	0.852	0.284
							50B, 50D, 51D	1.320	2.640	0.880

Subject to alterations.

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Centro Industrial Garin
1619 Garín Pcia. de B.A.
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56, БЦ «Порт»
Тел.: +7 (375 17) 286 39 72/73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosna and Herzegovina
GRUNDFOS Sarajevo
Zmaja od Bosne 7-7A,
BH-71000 Sarajevo
Phone: +387 33 592 480
Telefax: +387 33 590 465
www.ba.grundfos.com
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
10F The Hub, No. 33 Suhong Road
Minhang District
Shanghai 201106
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

Croatia
GRUNDFOS CROATIA d.o.o.
Buzinski prilaz 38, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.hr.grundfos.com

Czech Republic
GRUNDFOS s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111
Telefax: +420-585-716 299

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Trukkikuja 1
FI-01360 Vantaa
Phone: +358-(0) 207 889 500
Telefax: +358-(0) 207 889 550

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Park u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT. GRUNDFOS POMPA
Graha Intirub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar,
Jakarta Timur
ID-Jakarta 13650
Phone: +62 21-469-51900
Telefax: +62 21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
Gotanda Metalion Bldg., 5F,
5-21-15, Higashi-gotanda
Shiagawa-ku, Tokyo
141-0022 Japan
Phone: +81 35 448 1391
Telefax: +81 35 448 9619

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос Россия
109544, г. Москва, ул. Школьная, 39-41, стр. 1
Тел. (+7) 495 564-88-00 (495) 737-30-00
Факс (+7) 495 564 88 11
E-mail grundfos.moscow@grundfos.com

Serbia
Grundfos Srbija d.o.o.
Omladinskih brigada 90b
11070 Novi Beograd
Phone: +381 11 2258 740
Telefax: +381 11 2281 769
www.rs.grundfos.com

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovakia
GRUNDFOS s.r.o.
Prievozská 4D
821 09 BRATISLAVA
Phona: +421 2 5020 1426
sk.grundfos.com

Slovenia
GRUNDFOS LJUBLJANA, d.o.o.
Leskoškova 9e, 1122 Ljubljana
Phone: +386 (0) 1 568 06 10
Telefax: +386 (0)1 568 06 19
E-mail: tehnika-si@grundfos.com

South Africa
GRUNDFOS (PTY) LTD
Corner Mountjoy and George Allen Roads
Wilbart Ext. 2
Bedfordview 2008
Phone: (+27) 11 579 4800
Fax: (+27) 11 455 6066
E-mail: lsmart@grundfos.com

Spain
Bombas GRUNDFOS Españ a S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-44-806 8111
Telefax: +41-44-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Телефон: (+38 044) 237 04 00
Факс.: (+38 044) 237 04 01
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

Uzbekistan
Grundfos Tashkent, Uzbekistan The Representative Office of Grundfos Kazakhstan in Uzbekistan
38a, Oybek street, Tashkent
Телефон: (+998) 71 150 3290 / 71 150 3291
Факс: (+998) 71 150 3292

Addresses Revised 25.01.2016

96932428 0316

ECM: 1172442