SE and SL 9-30 kW

Generation A

Service instructions

GRUNDFOS

SE and SL 9-30 kW

English (GB)

Original service instructions

Table of contents

1. General information

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.
-

WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.
-

CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.
-

The hazard statements are structured in the following way:

[N/A]
Description of hazard
Consequence of ignoring the warning.
- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

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

Tips and advice that make the work easier.

2. General safety instructions

Pump installation in pits must be carried out by trained persons.

All work in pits must be supervised by a person outside the pump pit.

CAUTION
Biological hazard
Minor or moderate personal injury
- Pits for sewage and wastewater may contain toxic and/or contagious substances. Persons must always wear appropriate personal protective equipment and clothing before entering the pit.

DANGER
Electric shock
Death or serious personal injury
- Before the installation, switch off the power supply and lock the main switch in position 0.

DANGER
Electric shock
Death or serious personal injury
- It must be possible to lock the main switch in position 0. Type and requirements are specified in EN 60204-1.

CAUTION
Hot surface
Minor or moderate personal injury
- Do not touch the pump or the cables during operation as the surface temperature may exceed 70 °C.

CAUTION
Sharp element
Minor or moderate personal injury
- Wear protective gloves when working on the pump.

Maintenance and service work must be carried out when the pump is outside the pit. For safety reasons, all work inside pits must be supervised by a person outside the pit.

Observe all safety regulations at the installation site.

WARNING
Crushing hazard
Death or serious personal injury
- Make sure the lifting bracket is tightened before lifting the pump.

3. Transportation

All lifting equipment must be rated for the purpose and checked for damage before lifting the pump. The lifting equipment rating must not be exceeded. The pump weight is stated on the nameplate.

CAUTION
Crushing hazard
Minor or moderate personal injury
- Make sure the pump cannot roll or fall over.

WARNING
Tipping hazard
Death or serious personal injury
- Use a service stand to support DN 100 and DN 150 (pressure ranges S and H) in vertical position.

WARNING
Crushing hazard
Death or serious personal injury
- Always lift the pump by its lifting bracket or use a forklift.

DANGER
Electric shock
Death or serious personal injury
- Never lift the pump by the power cable, hose or pipe.

Leave the cable-end protectors on the power cables until making the electrical connection. The free cable end must never be exposed to moisture or water.

3.1 Lifting the product

DANGER
Crushing hazard
Death or serious personal injury
- Make sure the lifting bracket or lifting eye bolts are tightened before lifting the pump. Torque: 70 ± 4 Nm.

DANGER
Crushing hazard
Death or serious personal injury
- Submersible pumps with and without cooling jacket and with pressure range S, H are delivered with a mounted lifting eye and an additional shackle, which must be used to attach the hook and the chain correctly.

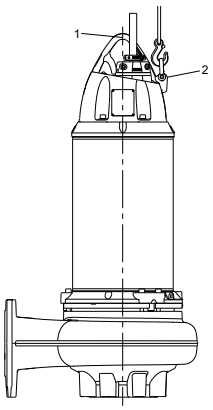
When lifting the pump, use the right lifting point to keep the pump balanced for proper installation. The table below shows the correct lifting point.

Installation type	Pressure range	Lifting bracket assembly	Lifting point
Submersible with and without cooling jacket	S, H	with lifting eye and shackle	See lifting points, vertical installation figure
	M, L, E	no lifting eye	See lifting points, vertical installation figure
Vertical, dry	S, H, M, L, E	no lifting eye	See lifting points, vertical installation figure
Horizontal, dry	S, H, M, L, E	no lifting eye	See lifting points, horizontal installation figure

The following installation types must be lifted at the lifting handle:
- submersible without cooling jacket with pressure range M, L and E
- submersible with cooling jacket with pressure range M, L and E
- vertical, dry.

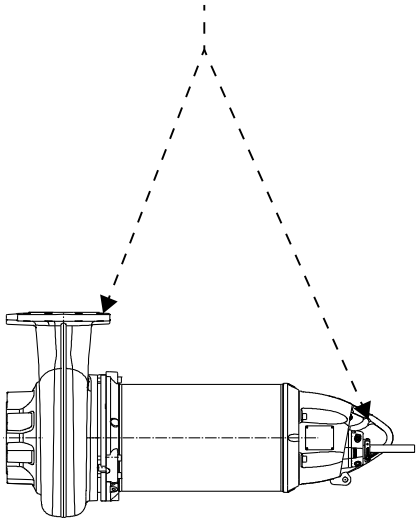
The following installation types must be lifted at the lifting eye with shackle (at the back of the lifting handle):
- submersible without cooling jacket with pressure range S and H
- submersible with cooling jacket with pressure range S and H.

Pumps with horizontal, dry installation can be lifted by a hole in the flange and the middle lifting point.



TM075107

Lifting points, vertical installation



TM075108

Lifting points, horizontal installation

Pos.	Description
1	Lifting handle
2	Lifting eye

4. Handling and storing the product

Protect the pump against moisture and heat during storage.

Transportation and storage temperature: -20 to +60 °C (-4 °F to +140 °F.

If the pump is not in operation or is being stored for more than one month, turn the impeller once a month.

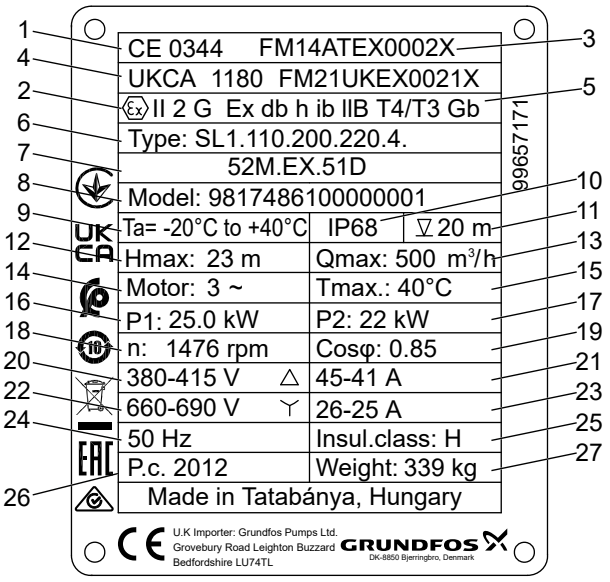
WARNING
Crushing hazard
Death or serious personal injury
- Do not turn the impeller by hand. Always use an appropriate tool.

After a period of storage, inspect the pump before putting it into operation. Make sure that the impeller can rotate freely. Pay attention to the condition of the shaft seals, O-rings and the cable entries.

5. Identification

5.1 Nameplate

The pumps can be identified by the nameplate on the motor top cover.



TM052533

Nameplate example for Ex-proof pump

Pos.	Description
1	EU Notified Body approving the Ex manufacturer
2	Explosion protection mark (ATEX)
3	EU Explosion protection certificate number
4	UK Approved Body approving the Ex manufacturer and UK Explosion protection certificate number
5	Explosion protection marking
6	Pump type designation
7	Pump type designation (line 2)
8	Model number
9	Ambient temperature
10	Enclosure class
11	Maximum installation depth
12	Maximum head
13	Maximum flow rate
14	Number of phases
15	Maximum liquid temperature
16	Rated power input P1
17	Rated power output P2
18	Rated speed
19	Cos φ, 1/1-load
20	Rated voltage, delta connection
21	Rated current, delta connection
22	Rated voltage, star connection
23	Rated current, star connection
24	Frequency
25	Insulation class
26	Production code (YYWW)
27	Weight

5.2 Type key

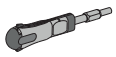
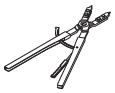
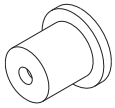
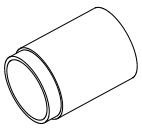
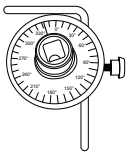
Example: **SL1.110.200.245.4.52M.EX.6.1G.A**

Code	Explanation	Designation
SE	Sewage pump with cooling jacket	Pump type
SL	Sewage pump without cooling jacket	
[ ]	Open S-tube® impeller (semi-open)	Impeller type
1	Closed single-channel S-tube® impeller	
2	Closed two-channel S-tube® impeller	
V	SuperVortex (free-flow) impeller	
[ ]	Maximum solids size [mm]	Pump free passage [mm]
75		
80		
85		
95		
110		
125		
200	Pump outlet nominal diameter	Pump outlet [mm]
245	24.5 kW: P2 / 10	Power [kW]
[ ]	Standard pump or standard Ex pump	Sensor version
A	Sensor version 1 or sensor version 1, Ex pump	
B	Sensor version 2 or sensor version 2, Ex pump	
2	2-pole motor	Number of poles
4	4-pole motor	
6	6-pole motor	
52	Frame size of the pump	Frame size
S	Super-high pressure	Pressure range
H	High pressure	
M	Medium pressure	
L	Low pressure	
E	Extra-low pressure	
[ ]	Cast iron pump housing, cast iron impeller, cast iron suction cover, cast iron motor housing	Material code for pump housing, impeller, suction cover and motor housing
Q	Cast iron pump housing, stainless-steel impeller, cast iron suction cover, cast iron motor housing	
W	Cast iron pump housing, white cast iron impeller and suction cover, cast iron motor housing	
N	Pump without EX approval	Pump version
EX	Pump with EX approval	
5	50 Hz	Frequency
6	60 Hz	
1D	3 × 380-415D, 660-690Y (Standard)	Voltage for 50 Hz
1E	3 × 220-240D, 380-415Y	
1N	3 × 500-550D	
1F	3 × 220-230D, 380-400Y	Voltage for 60 Hz
1G [1)]	3 × 380-480D, 660-690Y (Standard)	
1M	3 × 575-600D	
11 [2)]	3 × 460D (Standard)	
15 [2)]	3 × 380D, 660Y	
[ ]	1st generation	Generation code
A	2nd generation	
Z	Custom-built products	Customisation
[ ]	Thermal switches	Thermal protection
T	PTC thermistor	

1) Only for 2- and 4-pole motors.

2) Only for 6-pole motors.

6. Service tools

A	B	C	D	E	F
					

Standard tools

Pos.	Designation	Part number
A	Molex plug removal tool	SV2117

Special tools

Pos.	Designation	Description
B	Locking-ring pliers	Circlip range 122-400 mm
C	Refractometer	
D	Shaft Seal Protection Tool	PN 98564697
E	Lip Seal Assembly Tool	PN 92723555
F	Angle Measuring Gauge	

Related information

8.5 Inspecting and adjusting the impeller clearance

9. Disassembly

7. Tightening torques and lubricants

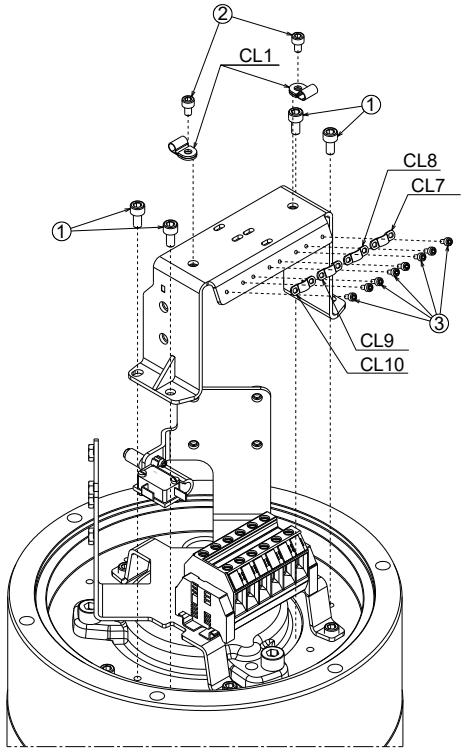
The shaft must be cleaned before the lubricant is applied. First use KEMA SSP-630 soap (or equivalent type) to clean the shaft, then use Valvoline Silicon Spray (or equivalent type) to lubricate the shaft.

Pump screws

Pos.	Designation	Quantity	Dimension	Torque [Nm (lb-ft)]	Lubricant
All	O-rings	All			Rocol Sapphire Aqua Sil
25	Plug N 3/8" ED	1	3/8"	40 ± 2 (29.5 ± 1.5)	
26	Hexagon socket head cap screw	6	M20	70 ± 4 (51.6 ± 3)	
46c	Hexagon socket head cap screw	3	M3	0.78 ± 0.1 (0.6 ± 0.1)	
67	Hexagon socket head cap screw	1	M16	170 ± 4 (125.4 ± 3)	Castrol Optimol
150d	Hexagon socket head cap screw	2	M6	8 ± 1 (5.9 ± 0.7)	
173e	Hexagon head screw	2	M6	8 ± 1 (5.9 ± 0.7)	
178	Hexagon socket head cap screw	6	M12	70 ± 4 (51.6 ± 3)	
181a	Hexagon socket head cap screw	2	M12	70 ± 4 (51.6 ± 3)	
182b	Hexagon head screw	3	M12	70 ± 4 (51.6 ± 3)	
182	Hexagon socket head cap screw	3	M10	40 ± 2 (29.5 ± 1.5)	
183	Hexagon socket head cap screw	3	M10	40 ± 2 (29.5 ± 1.5)	
184b	Hexagon socket head cap screw, (2- or 4-pole SL pump)	3	M8	20 ± 2 (14.8 ± 1.5)	
184b	Hexagon socket head cap screw, (6-pole SE pump)	6	M12	70 ± 4 (51.6 ± 3)	
185	Hexagon socket head cap screw	2	M12	70 ± 4 (51.6 ± 3)	
190b	Hexagon socket head cap screw	2	M12	70 ± 4 (51.6 ± 3)	
193	Plug N 3/8" ED	4	3/8"	40 ± 2 (29.5 ± 1.5)	
520a	Screw	1	M3	0.5 ± 0.2 (0.4 ± 0.1)	
520c	Screw	1	M5	3 ± 1 (2.2 ± 0.7)	
	Screw	1	M6	8 ± 1 (5.9 ± 0.7)	
521b	Hexagon socket head screw	1	M6	6 ± 1 (4.4 ± 0.7)	
705	Hexagon head screw, DN 250	8	M16	170 ± 8 (125.4 ± 3)	
705	Hexagon head screw, DN 300	12	M20	330 ± 8 (243.4 ± 3)	

7.1 Cable bracket screws

Dual-cable, EMC variant



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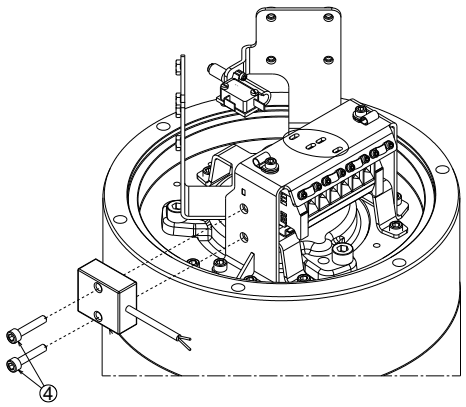
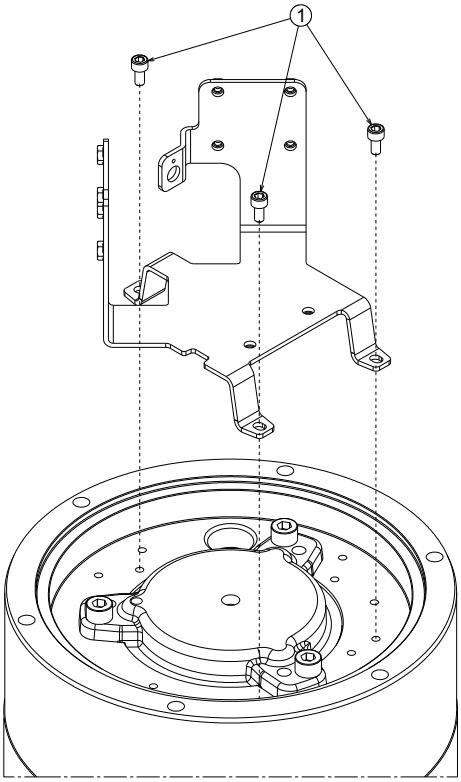


TM080010

Torque specifications				
Position no	Amount	Dimension	[Nm (lb-ft)]	Lubrication
1	4	M6	6 ± 0.9 (4.4 ± 0.7)	No
2	2	M5	4 ± 0.6 (3 ± 0.4)	Yes
3	8	M3	1 ± 0.15 (0.7 ± 0.1)	Yes
4	2	M6	6 ± 0.9 (4.4 ± 0.7)	Yes

Clamps	Use for fixing
Clamp 1	EMC screen on sensor bundle in EMC
Clamp 7	Vibration sensor wire
Clamp 8	Pt1000 lower bearing wire
Clamp 9	Pt1000 upper bearing wire
Clamp 10	Pt1000 wire from stator

Dual-cable, standard variant



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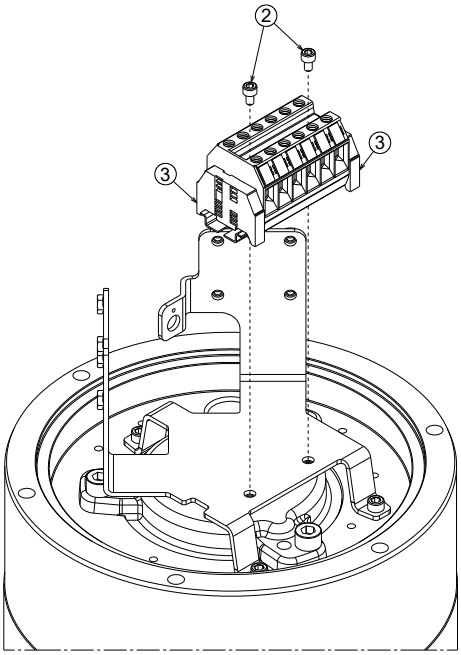

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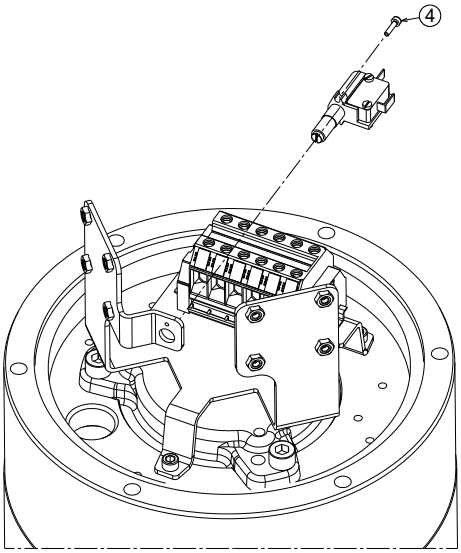
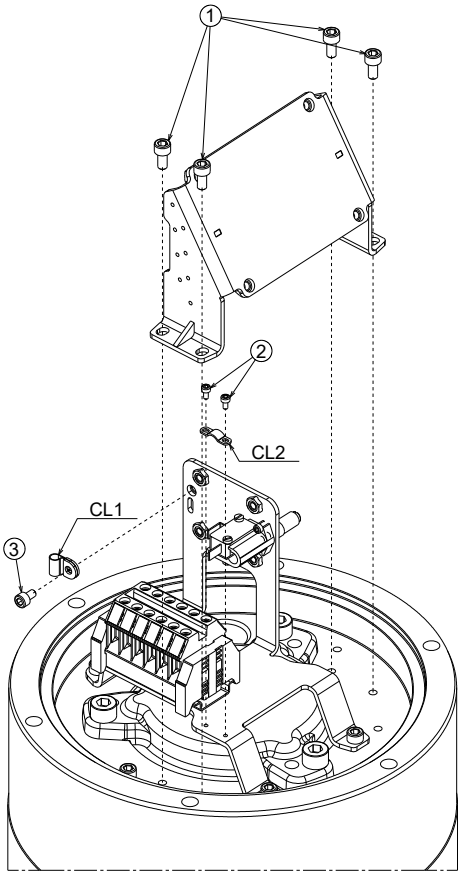


TM080013

Torque spec.				
Position no	Amount	Dimension	[Nm (lb-ft)]	Lubrication
1	3	M6	6 ± 0.9 (4.4 ± 0.7)	No
2	2	M5	4 ± 0.6 (3 ± 0.4)	Yes
3	2	M3	0.78 ± 0.1 (0.6 ± 0.1)	No
4	1	M3	0.5 ± 0.1 (0.4 ± 0.1)	Yes

Single-cable



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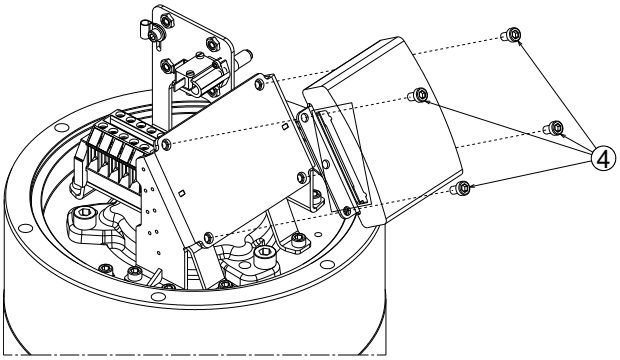

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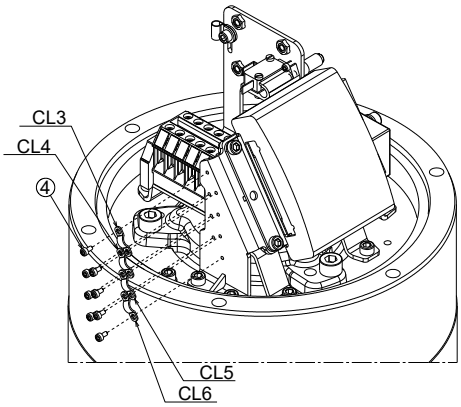

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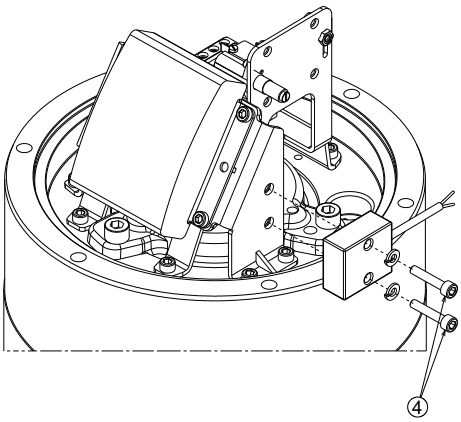


TM080009

Torque specifications				
Position no	Amount	Dimension	[Nm (lb-ft)]	Lubrication
1	1	M5	4 ± 0.6 (3 ± 0.4)	Yes
2	4	M6	6 ± 0.9 (4.4 ± 0.7)	No
3	4	M6	4 ± 0.4 (3 ± 0.3)	Yes
4	10	M3	1 ± 0.15 (0.7 ± 0.1)	Yes

Clamps	Use for fixing
Clamp 1	EMC screen on sensor bundle in EMC power cable
Clamp 2	Klixon or Pt1000 wire from stator
Clamp 3	Vibration sensor wire
Clamp 4	Pt1000 lower bearing wire
Clamp 5	Pt1000 upper bearing wire
Clamp 6	Pt1000 wire from stator

8. Maintenance schedule

WARNING
Crushing hazard
Death or serious personal injury
- During maintenance and service, including transportation to service workshop, always support the pump using lifting chains or place it in horizontal position to secure stability.

DANGER
Electric shock
Death or serious personal injury
- Before starting any work on the product, make sure that the power supply is switched off and that it cannot be switched on unintentionally.

DANGER
Electric shock
Death or serious personal injury
- Make sure the pump is earthed.

The maintenance and service work on explosion-proof pumps must be carried out by Grundfos or a Grundfos-authorised service workshop.

Do not open the pump if the ambient atmosphere is explosive or dusty.

Maintenance and service must be carried out by qualified persons.

Before carrying out maintenance and service, make sure that the pump is thoroughly flushed with clean water. Rinse the pump parts after dismantling.

Pumps running normal operation must be inspected every 2000 operating hours or at least once a year. If the pumped liquid is muddy or sandy, the pump must be inspected every 1000 operating hours or every six months.

Frequency converter operation may reduce the lifespan of the bearings and the shaft seal, depending on operating mode and other circumstances.

Check the following:

- **Power consumption**.
- **Motor liquid level**.

When the pump is new or after replacement of the shaft seals, check the motor liquid level and its water content after one week of operation. If the motor liquid level has dropped, the shaft seal may be defective.

Disposal of the motor liquid must comply with local regulations.

50 Hz					Quantity of Motor liquid	
Number of poles	Generation	Power (P2) [kW]	Head Class	Impeller Type	SE [l]	SL [l]
2	1st, 2nd	All	All	All	12.5	4.1
4	1st, 2nd	All	All	All	12.5	4.1
6	1st	All	All	Single S-tube®	13.8	5.1
	1st, 2nd	11, 13	All	Dual S-tube®	12.5	4.1
	1st, 2nd	16, 18	Extra low pressure	Dual S-tube®	13.8	5.1

60 Hz					Quantity of Motor Liquid	
Number of poles	Generation	Power (P2) [kW]	Head Class	Impeller Type	SE [l (qt)]	SL [l (qt)]
2	1st, 2nd	All	All	All	12.5 (13.2)	4.1 (4.3)
4	1st, 2nd	All	All	All	12.5 (13.2)	4.1 (4.3)
6	1st, 2nd	All	All	Dual S-tube®	12.5 (13.2)	4.1 (4.3)
	1st	All	All	Single S-tube®	13.8 (14.5)	5.1 (5.3)

- **Cable entries** Make sure that the cable entries are waterproof and that the cables are not sharply bent or pinched.
- **Impeller clearance** Check the impeller clearance and adjust if necessary.
- **Pump parts** Check the pump housing and other parts for possible wear. Replace defective parts.
- **Ball bearings** Check the shaft for noisy or heavy operation (turn the shaft by hand). Replace defective ball bearings. A general overhaul of the pump is usually required in case of defective ball bearings or poor motor function.

  Replace the ball bearings at least every 25.000 operating hours.

  Defective ball bearings may reduce Ex safety. On Ex-approved pumps, the ball bearings can only be replaced by an Ex-approved service workhop.

  .
- **Leakage chamber** The leakage chamber must be emptied every 2.000 operating hours or once a year.
  - For SL pumps, remove the leakage chamber plug (pos. 193a) to empty the chamber.
  - For SE pumps, remove the middle seal housing (pos. 58) to empty the chamber.
- **Measure insulation resistance** Measure the insulation resistance at 500 V minimal voltage, by a megger. The insulation resistance measured must be minimum 50 kΩ.
- **Mechanical tightness test**

Always lubricate O-rings before fitting.

Always lubricate the impeller screw with anti-seize paste.

Never reuse a worn shaft seal.

Never reuse rubber parts.

Related information

13. Components and material specification

8.1 Maintaining the explosion-proof SE, SL pumps

Overhauled and repaired explosion-proof pumps are marked with a repair plate providing the following information:

- repair symbol R
- name or registered trademark of the repairing workshop
- workshop reference number relating to the repair
- date of overhaul or repair.

In the event of subsequent repairs, the existing plate must be replaced by a new, updated one and earlier markings must be recorded.

The repair workshop must keep records of all the previously performed overhauls, repairs and possible modifications.

Copies of the detailed records of the repairing workshop must be filed by the owner or operator with the original type certificate of the explosion-proof motor.

8.1.1 Power cable

Use manufacturer-approved and compatible cables only.

8.1.2 Cable entry

Use only Ex cable entry parts corresponding to the cable diameter. The correct cable dimension marking is stamped on the inlet or the cable entry.

8.1.3 Spare parts

Damaged motor parts must always be replaced by new and approved parts. Motor parts must not be reconditioned.

8.2 Mechanical tightness test

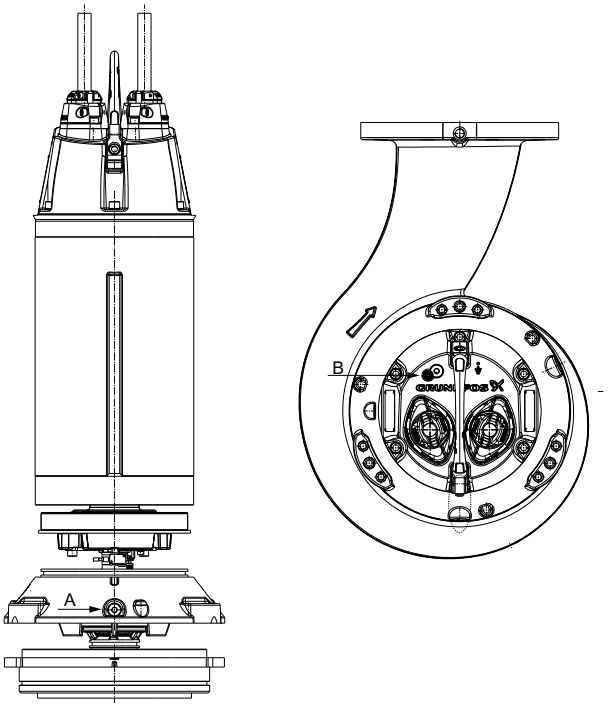
The purpose of the mechanical tightness test is to ensure that the seals in the seal housing are functioning properly after a motor reassembly. If a motor fails this test, water enters the motor compartment once the pump is back in operation. The test procedure is the same for both SE and SL, however, the inlet connection point for the pressurised gas is different with SE and SL.

This test is not able to determine the condition of the shaft seal.

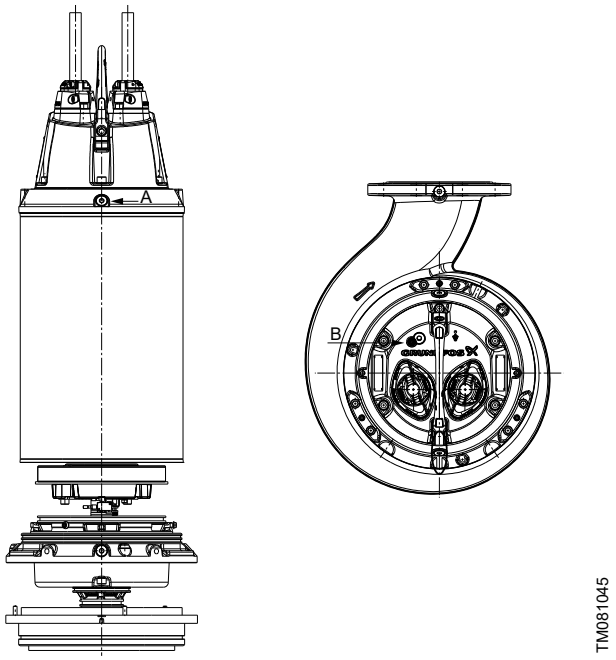
Attachments, hoses, etc, used to conduct this test need to be sourced locally.

Test procedure:

- Test the motor once it is assembled, but before the motor liquid is filled.
- Pressurize an inlet test pipe with dry pressurised air or nitrogen gas, 0.6 - 0.8 bar (8.7 - 11.6 psi) (max) connected to Connection Point A, and place the end of the outlet test pipe from Connection Point B slightly under water.
- Rotate the shaft manually a few times and carefully monitor for at least 2 minutes. If air bubbles are coming from the test outlet tube, it indicates leakage. In case of leakage, re-open the motor, and make sure the root-cause is identified and eliminated.



Mechanical tightness test connection points - SL



Mechanical tightness test connection points - SE

8.3 Motor liquid check and change

Clean the outside of the pump regularly to retain the heat conductivity.

Change the motor liquid once a year or after 2000 operating hours to prevent oxidation.

Lack of motor liquid may cause overheating and damage to the mechanical seals.

Use SML3 coolant for motor cooling.

8.3.1 Refractive index

The refractive index can indicate the leakage of the pumped liquid into the motor liquid (propylene glycol). Use a refractometer (product no 98676968) which shows the refractive index in percent. Always use the propylene glycol scale.

Measured freezing point	Liquid ingress percent (%)
-20 °C (-4 °F)	0
-18 °C (0.4 °F)	5
-17 °C (1.4 °F)	10
-15 °C (5 °F)	15
-14 °C (6.8 °F)	20

If the refractive index has a freezing point greater than, or equal to -14 °C (6.8 °F), the motor liquid must be changed. If the liquid ingress level is higher than 20 %, change the motor liquid.

Drain the leakage chamber of the pump after 2000 operating hours.

Check the freezing point of the new glycol prior to use, to ensure that the freezing point is -20 °C (-4 °F).

WARNING
Pressurised system
Death or serious personal injury
- The oil chamber may be under pressure. Loosen the screws carefully and do not remove them until the pressure has been fully relieved.

There must be minimum 10 % air in the seal housing due to the thermal expansion of the motor liquid during operation.

8.3.2 Motor liquid quantities

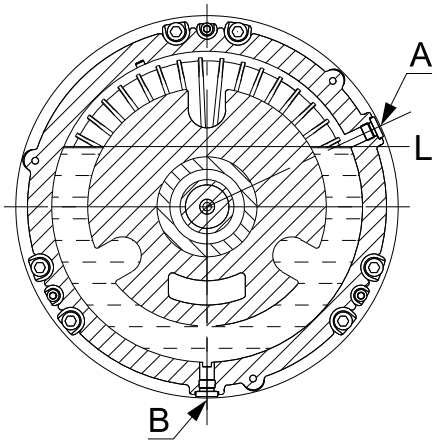
50 Hz	Generation	Power (P2) [kW]	Head Class	Impeller Type	Quantity of Motor liquid	
Number of poles					SE [l]	SL [l]
2	1st, 2nd	All	All	All	12.5	4.1
4	1st, 2nd	All	All	All	12.5	4.1
6	1st	All	All	Single S-tube	13.8	5.1
	1st, 2nd	11, 13	All	Dual S-tube	12.5	4.1
	1st, 2nd	16, 18	Extra low pressure	Dual S-tube	13.8	5.1

60 Hz	Generation	Power (P2) [kW]	Head Class	Impeller Type	Quantity of Motor Liquid	
Number of poles					SE [l]	SL [l]
2	1st, 2nd	All	All	All	12.5	4.1
4	1st, 2nd	All	All	All	12.5	4.1
6	1st, 2nd	All	All	Dual S-tube	12.5	4.1
	1st	All	All	Single S-tube	13.8	5.1

8.3.3 SL pumps

8.3.3.1 Drain motor liquid

1. Place a container under the pump which can hold at least 6 litres of motor liquid.
2. Place the pump horizontally on a plane surface with plug B pointing downwards.
3. Remove plug B.
4. Allow all motor liquid to drain from the seal housing into the container. Remove plug A to get a better flow of the motor liquid.



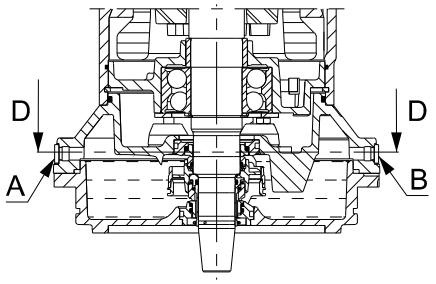
5. Replace the O-ring with a new ring on the plug.
6. Fit plug B and tighten it to the correct torque.

Related information

7. Tightening torques and lubricants

8.3.3.2 Fill motor liquid - vertical installation

1. Place the pump vertically.
2. Fill the shaft seal housing with motor liquid through hole A until the motor liquid reaches the level indicated by plug B. See the figure below.
3. Replace the O-ring with a new one.
4. Insert plugs A and B and tighten them to the correct torque.



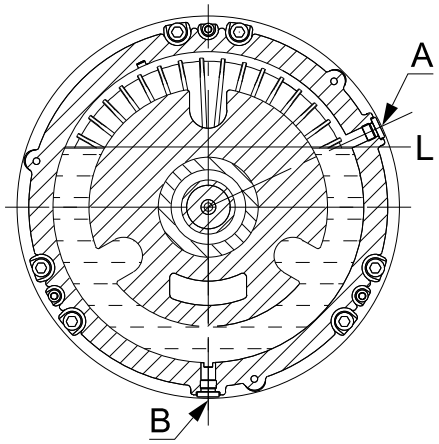
E

Related information

7. Tightening torques and lubricants

8.3.3.3 Fill motor liquid - horizontal installation

1. Place the pump horizontally with plug B mounted and facing downwards. Fill the shaft seal housing with motor liquid through hole A until the motor liquid reaches the level indicated (L) in the figure below.



2. Replace the O-ring with a new one.
3. Insert plug A and tighten it to the correct torque.

Related information

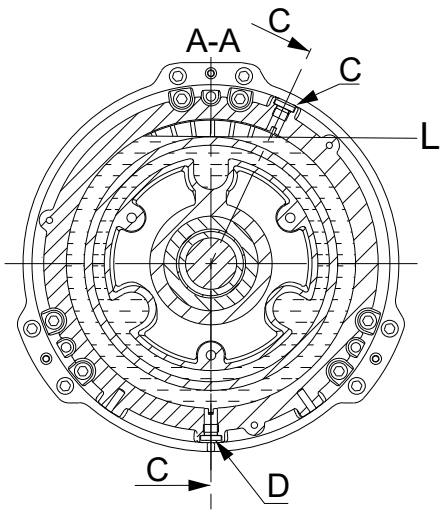
7. Tightening torques and lubricants

8.3.4 SE pumps

8.3.4.1 Drain motor liquid

1. Place a container under the pump which can contain at least 15 litres (15.8 qt) of motor liquid.
2. Place the pump horizontally on a plain surface with plug D pointing downwards.
3. Remove plug D. Remove plug C to get a better flow of the motor liquid.
4. Allow all motor liquid to drain from the seal housing into the container.
5. Replace the O-ring with a new ring on the plug.

6. Insert plug D and tighten it to the correct torque.

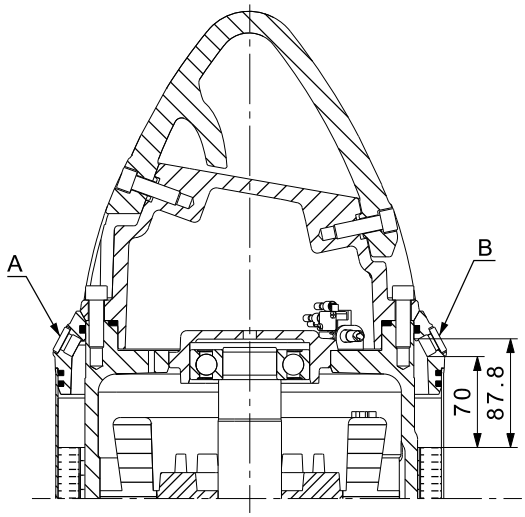


Related information

7. Tightening torques and lubricants

8.3.4.2 Fill motor liquid - vertical installation

1. Remove plug A and B on both sides to get the trapped air out while filling.
2. Fill the shaft seal housing with motor liquid through hole A until the motor liquid reaches the level indicated in the figure.



SE pump, vertical, top view

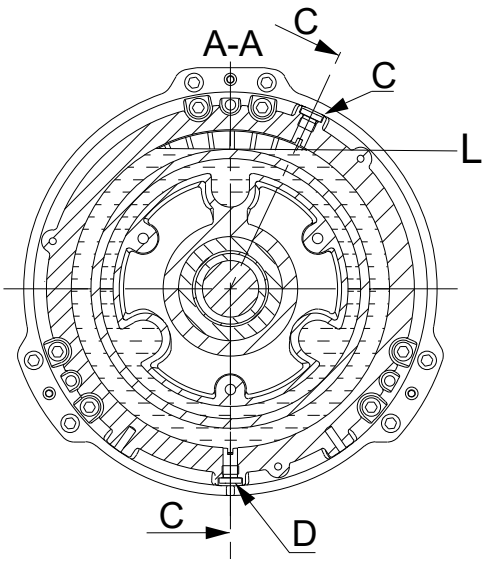
3. Replace the O-rings with new rings, insert the plugs and tighten to the correct torque.

Related information

7. Tightening torques and lubricants

8.3.4.3 Fill motor liquid - horizontal installation

1. Remove plug C.
2. Fill the shaft seal housing with motor liquid through hole C until the motor liquid reaches the level indicated (L) in the figure below.



TM052779

SE pump, horizontal view

3. Replace the O-ring with a new ring.
4. Insert plug C and tighten to the correct torque.

Related information

7. Tightening torques and lubricants

8.3.5 Contaminated pumps

The product is classified as contaminated if it is used with contagious or toxic liquid.

CAUTION
Biological hazard
Minor or moderate personal injury
- Flush the pump thoroughly with clean water and rinse the pump parts after dismantling.

8.4 Shaft seal inspection

8.4.1 Shaft seal condition assessment - SL pumps

Check shaft seal seal leakage by measuring the liquid volume in the upper seal housing chamber (58) during the 2000-hour or annual inspection

1. Place the pump in a horizontal position on a plane surface, with the drain plug (193a) pointing downwards.
2. Place a container under the drain plug (193a) and remove the plug (193a).
3. If less than 5 centilitres (cl) is drained, the shaft seal does not need replacement.

8.4.2 Shaft seal condition assessment - SL and SE pumps

Inspect the drained motor liquid to assess the condition of the shaft seal.

1. Drain all the motor liquid into a single clean, transparent container, and measure the volume of the drained liquid.
2. Leave the drained motor liquid in the container for 10-15 minutes.
3. Inspect the drained motor liquid
   - If there is discoloration or a significant amount of debris within the motor liquid, the shaft seal must be replaced.
   - If there is a significant change to the motor liquid volume, the shaft seal must be replaced.
   - If in doubt, repeat the inspection in 1 to 2 months.

8.4.3 How to avoid shaft seal damage

1. Improper assembly of the pump can lead to shaft seal failures.
   a. The O-ring in the shaft seal must be lubricated, with the lubricant placed on a cleaned shaft. Clean the shaft with soap prior to applying the silicon spray lubricant.

b. Once the shaft seal is on the shaft, the shaft seal must not be tilted.
   i. The shaft seal protection tool is required to prevent damage caused by accidentally hitting the shaft seal with the seal housing as it is lowered into place. Hitting the shaft seal with the seal housing may tilt and break the shaft seal.
   ii. Tighten the lower seal housing screws in a diagonal sequence, to avoid tilting the seal housing.
   A misaligned lower seal housing can press against the shaft seal causing the shaft seal to tilt.

2. Special wear-resistant shaft seals with tungsten-carbide sealing surfaces are available for purchase. These shaft seals can be used as a direct replacement of the current shaft seal. For further information, contact Grundfos.

Do not reuse a worn shaft seal.

Do not dismantle and reassemble the shaft seal.

Do not lift or move the pump by the shaft end.

Never rest a vertically tilted pump on its impeller.

8.5 Inspecting and adjusting the impeller clearance

For pumps with closed S-tube® impeller, the impeller clearance is the distance between the bottom of the impeller and stationary wear ring mounted in the bottom of the volute.

For pumps fitted with open S-tube®, the impeller clearance is the distance between the bottom of the impeller and the suction cover.

The correct impeller clearance is required to maintain the hydraulic performance of the pump and to prevent clogging.

Check the impeller clearance every time service is carried out to prevent hot surfaces in the hydraulic parts.

Clearance sizes for closed S-tube® impellers

Before determining the correct impeller clearance, check the pump nameplate for Production Code (P.c YYWW). Pumps manufactured before P.c 1440 have a different set of screws which require different turning angles than pumps manufactured during and after 1440.

For adjusting the impeller clearance and determining the turning angle, use an angle measuring gauge (F).

Pressure range	Impeller clearance [mm (in)]	Turning angle of set screw [°] before P.c. 1440	Turning angle of set screw [°] after P.c. 1440.
E = Extra-low pressure single-channel S-tube®	0.9 ± 0.1 (0.035 ± 0.003)	170°	260°
E = Extra-low pressure two-channel S-tube®	0.7 ± 0.1 (0.027 ± 0.003)	140°	220°
L = Low-pressure single-channel S-tube®	0.9 ± 0.1 (0.035 ± 0.003)	170°	260°
L = Low-pressure two-channel S-tube®	0.7 ± 0.1 (0.027 ± 0.003)	140°	220°
M = Medium pressure	0.6 ± 0.1 (0.023 ± 0.003)	125°	190°
H = High pressure	0.6 ± 0.1 (0.023 ± 0.003)	125°	190°
S = Super-high pressure	0.5 ± 0.1 (0.019 ± 0.003)	110°	170°

Tightening torques for fastening screws

Pump variant	Fastening crew torque [Nm (lb-ft)]
Pumps manufactured **before** 2014 week 40 (P.c 1440), M12 set screws.	**55 ± 4 Nm (40.6 ± 3)**
Pumps manufactured **during and after** 2014 week 40 (P.c 1440), M20 set screws	**70 ± 4 Nm (51.6 ± 3)**

Clearance sizes for open S-tube® impellers

Pressure range	Impeller clearance [mm (in)]	Turning angle of set screw (degrees)
H = High pressure	0.5 ± 0.1 (0.019 ± 0.003)	110°
S = Super-high pressure	0.5 ± 0.1 (0.019 ± 0.003)	110°

DANGER
Electric shock
Death or serious personal injury
- Before starting any work on the product, make sure that the power supply is switched off and that it cannot be switched on unintentionally.

The impeller clearance of submersible installations with and without cooling jacket can be inspected directly through the pump inlet.

The impeller clearance of dry, horizontal and vertical installations can be inspected and adjusted with the pump installed on the base stand and connected to the pipes.

Related information

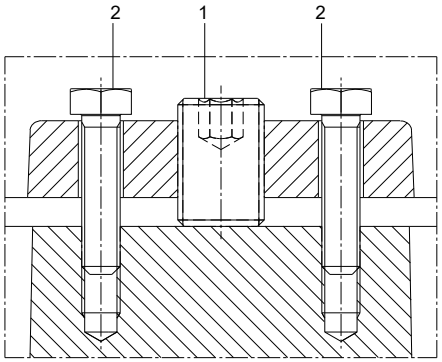
6. Service tools

11.24 Fitting the pump housing

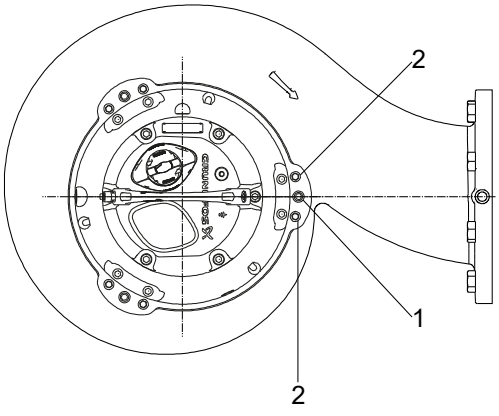
8.5.1 Adjusting the impeller clearance

Tighten the fastening screws carefully to avoid damage to the bearings.

The movement is 1 to 3 mm (0.039 to 0.118 in).



TM051916



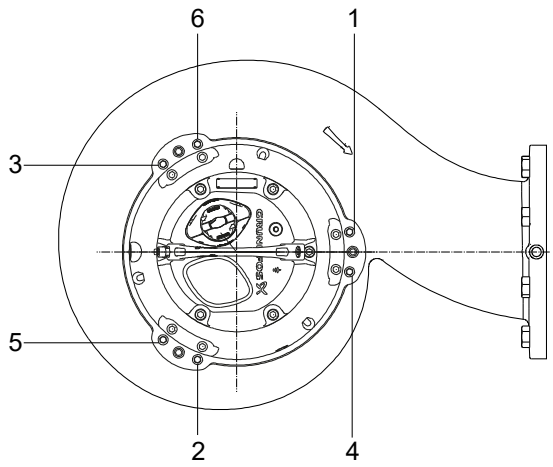
TM077793

Impeller adjusting screws

1	Set screw
2	Fastening screw

The following method is suitable for pumps in vertical position. Proceed as follows:

1. Loosen the fastening- and set screws so the impeller is sitting on the suction cover or stationary wear ring. In this position, the impeller clearance is zero.
2. Tighten the three set screws down by hand until they touch the top surface of the volute.
3. The impeller clearance is created by turning the set screws to a specific angle. Closed S-tube® and open S-tube® impellers, as well as the different head classes, have different impeller clearances. See the table in the chapter above to determine the correct impeller clearance and turning angle.
4. Once the correct angle is identified, turn the set screw clockwise by the specified angle. Use a turning gauge to ensure the set screw is tightened to the correct amount.
5. Tighten the fastening screws in two steps, according to the sequence below:
   - Tighten the screws one by one, from 1 to 6. Required torque: 40 ± 4 Nm (29.5 ± 3 lb-ft).
   - Repeat the previous sequence to the final torque of 70 ± 4 Nm (51.6 ± 3 lb-ft).



TM077792

Tightening sequence

Related information

11.24 Fitting the pump housing

9. Disassembly

Before disassembling the pump:

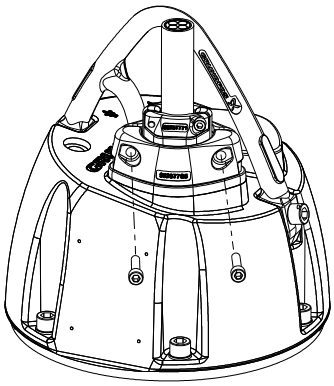
1. Switch off the power supply.
2. Close the isolating valves, if fitted, to avoid draining the piping system.
3. Disconnect the power supply cable.
4. Note the pump's centre of gravity to prevent it from overturning.

Related information

6. Service tools

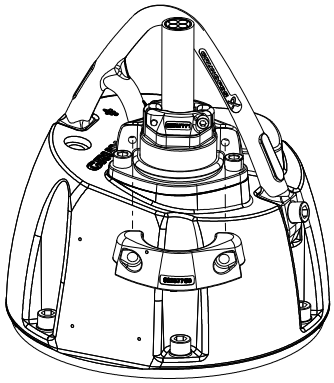
9.1 Removing the motor top

1. Remove the screws from the clamp of the upper cable entry (pos. 184b).

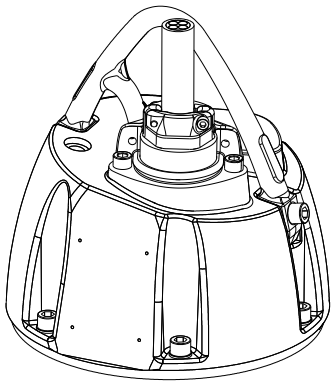


TM077597

2. Remove the clamp of the upper cable entry.

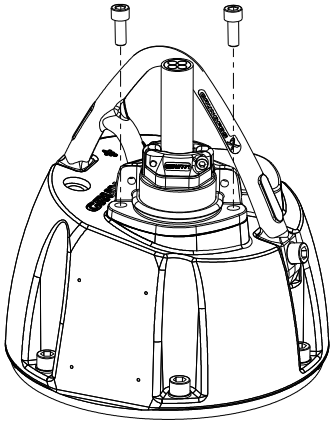


TM077616



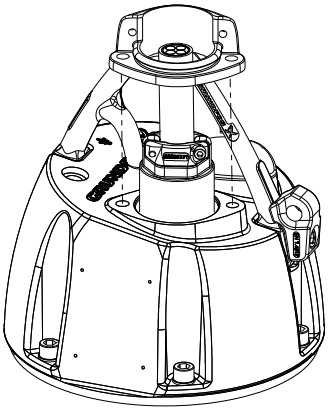
TM077599

3. Remove the screws from the clamp of the lower cable entry (pos. 181b).



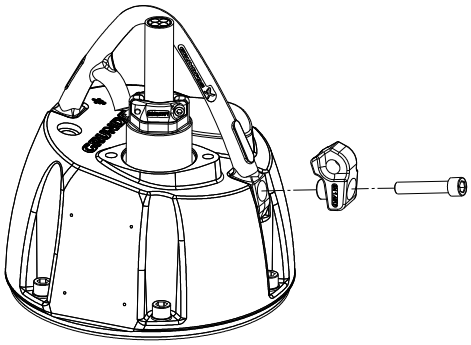
TM077600

4. Lift up the clamp of the upper cable entry (pos. 157b).



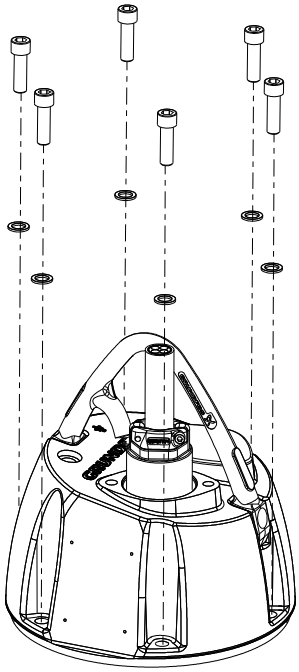
TM077601

5. If lifting eyes are present (pos. 190c) they need to be removed to access the screws of the motor top cover.



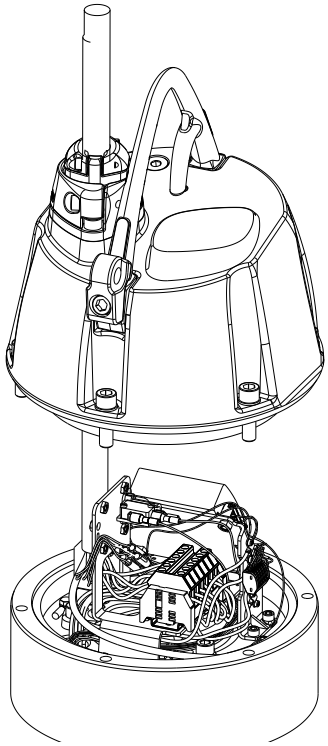
TM077618

6. Remove the screws holding the motor top to the stator housing.



TM077619

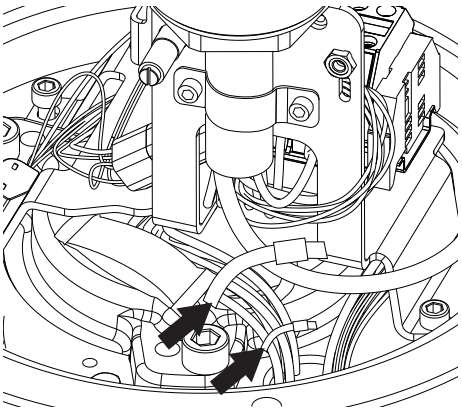
7. If lifting eyes (pos. 190c) are removed, they must be put back before lifting the pump.
8. Attach the lifting equipment to the designated lifting points, and lift the motor top up.

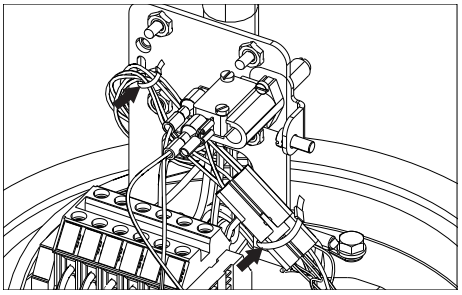


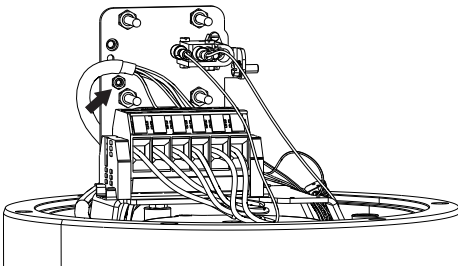
TM079157

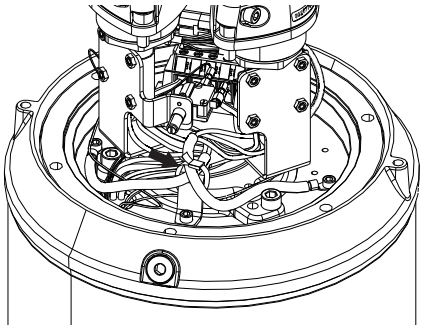
9.2 Removing the cable

1. Remove the cable ties holding cable wires in place. For EMC cable variants, the metallic clamp securing the cable screen to the cable bracket must be removed.

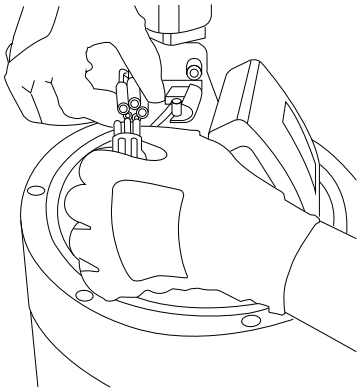

TM079622


TM079158


TM079168

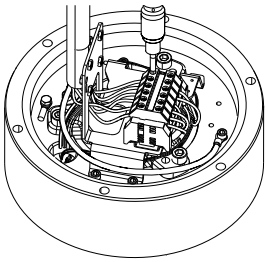

TM079171

2. Take apart the sensor wire connector.

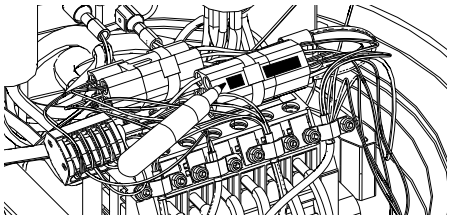

TM079257

The sensor wire connectors are MATE-N-LOK types. To remove the pins from the connectors, Extraction Tool 1804030-1 is required, which must be sourced locally.

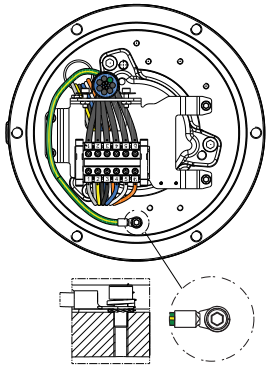
3. Remove all power wires from the terminal block by loosening the fastening screw and pulling the wire from the terminal block.


TM079205

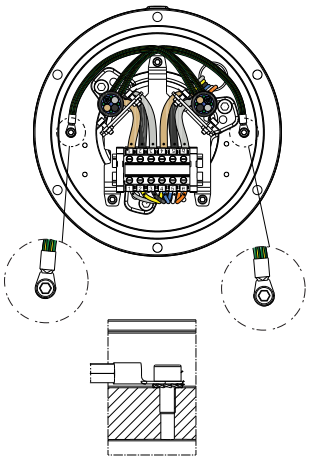
4. For dual-cable variants, always mark one set of connectors before taking them apart. The connectors with blue wire/wires belong to the Pt1000 sensors.


TM079201

5. Remove the earthing screw (pos. 173e) and the serrated washer (pos. 173f).

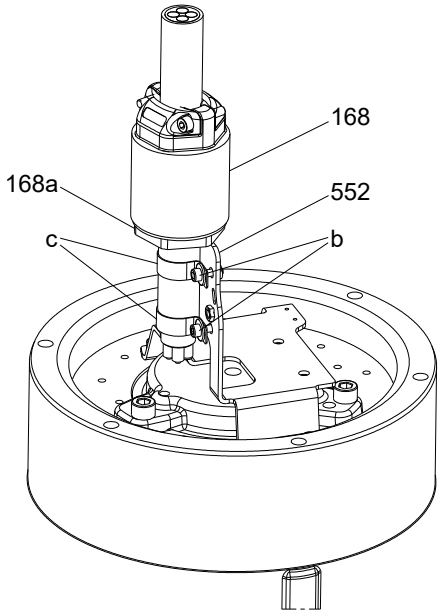

TM077921

Earthing screw, single cable


TM077926

Earthing screw, dual-cable EMC

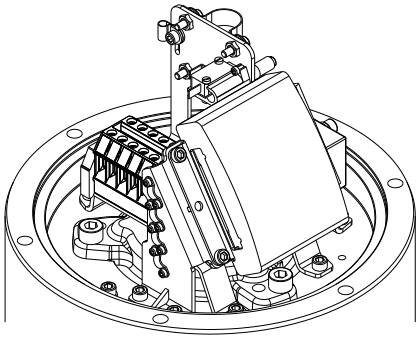
6. Remove the cable clamp fastening screws (b) and the cable clamp (c) first, then remove the cable.



TM079154

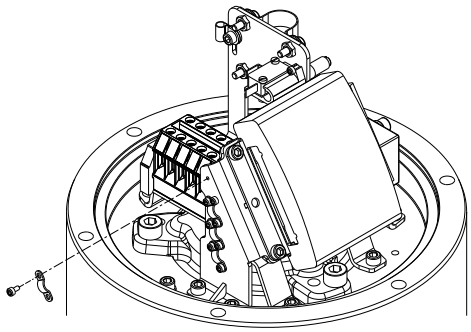
9.2.1 Removing the PVS-3 vibration sensor and SM 113 module

For variants with SM 113 module, the PVS-3 vibration sensor must be removed from the bracket.



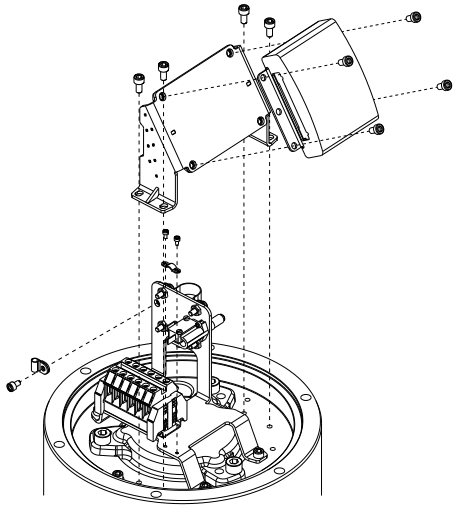
TM078014

1. Remove sensor wires from the SM 113 and the PVS-3 bracket.



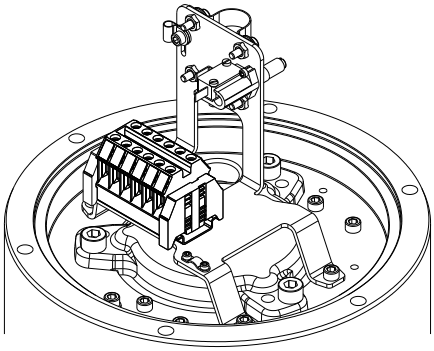
TM078015

2. Remove the PVS-3 vibration sensor from the bracket if the SM 113 module needs to be replaced.



TM078017

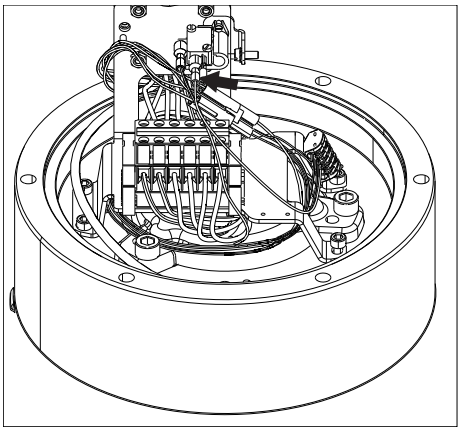
3. Remove the screws holding the feet of the PVS-3 bracket to the stator housing, then remove the bracket.



TM078016

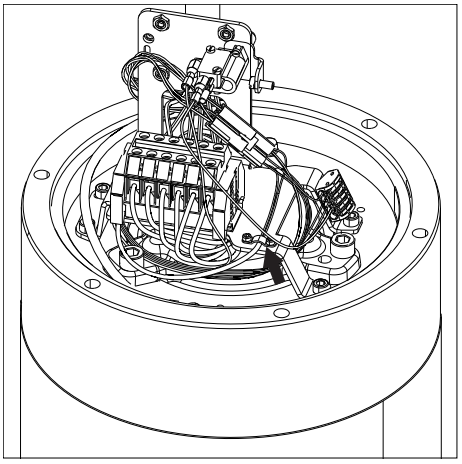
9.3 Removing the cable bracket

1. Remove all remaining cable ties. Remove the power wires coming from the stator to the terminal block. Remove screws securing the cable bracket to the stator housing.
2. Disconnect the wires inserted into the moisture switch (520).



TM079321

3. Remove the clamp securing the Pt1000 wires.

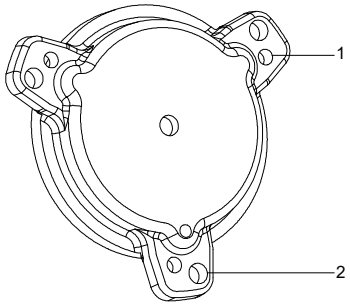


TM079289

4. Remove the screws holding the cable bracket to the stator housing.
5. Remove the cable bracket (522).

9.4 Removing the upper bearing bracket

1. Remove the screws (183).
2. Use 3 x M10 x 80 screws to lift up the bracket by the M10 ∅11 holes.
3. Remove the upper bearing bracket.



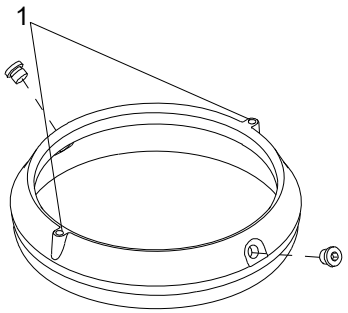
TM055624

Upper bearing bracket

Pos.	Description
1	M10
2	∅11

9.5 Removing the Cooling jacket ring on SE pumps

1. Remove the cooling jacket ring (754) with crowbars or by using the lifting points.
2. Remove the O-rings (157c and 157b).
3. Remove the outer cooling jacket (150c).



TM055625

Lifting points in cooling jacket ring

Pos.	Description
1	Lifting points

9.6 Removing the outer and inner cooling jacket on SE pumps

1. Remove the outer cooling jacket (150c).
2. Remove the O-ring (37a).
3. Remove the screws (150d).
4. Remove the inner cooling jacket (150b).

9.7 Removing the impeller

1. Remove the outer screws (26).
2. Lift the pump, including the impeller, out of the pump housing (50).
3. Remove the O-ring (37b).
4. Place the motor with impeller in horizontal position on a stable surface.
5. Bend down the tabs on the lock washer and loosen the impeller screw (67).
6. Remove the impeller screw (67).
7. Pull off the impeller (49) with a puller. Support the impeller with a hoist.

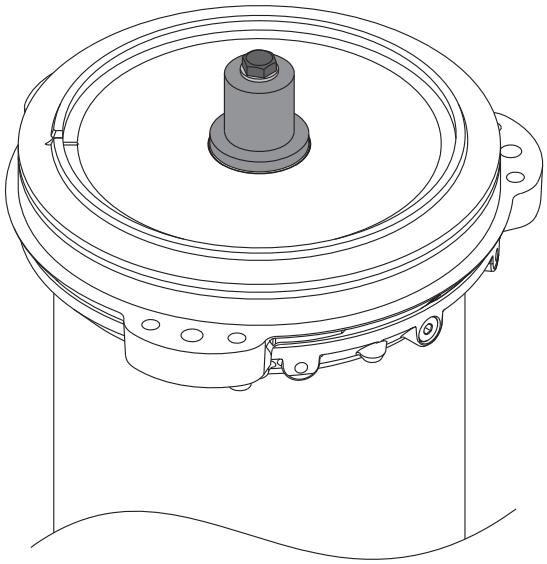
Protect the cone of the impeller shaft against scratches by taping the cone.

9.8 Removing the wear ring

1. Remove the screws (49b).
2. Push out the wear ring (49c) from the pump housing (50).

9.9 Removing the lower seal housing

1. Mount the Shaft Seal Protection Tool (D).



TM065453

Shaft seal protection tool

2. Remove the screws (184b).
3. Carefully remove the lower seal housing. Use crowbars and a soft hammer.

Related information

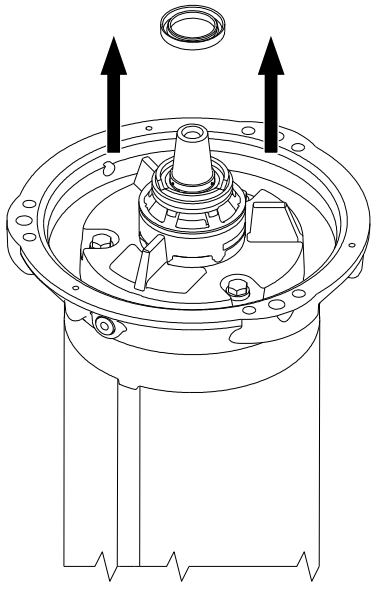
6. Service tools

9.10 Removing the intermediate seal housing on SE pumps

1. Remove the three screws (185).
2. Dismantle the intermediate seal housing (58). Use a soft hammer carefully if needed.
3. Remove the O-rings (37a and 107).

9.11 Removing the shaft seal cartridge

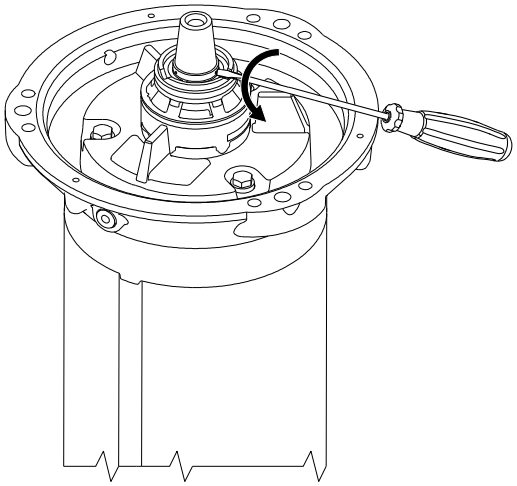
1. Loosen and remove the Shaft Seal Protection Tool (D).
2. Remove the Lip Seal (46b).



TM086289

Lip Seal removal

3. Loosen and remove the three screws (46c).



TM086290

Shaft seal screw removal

4. Withdraw the shaft seal cartridge from the shaft with a puller.

For more information on replacing shaft seal with lock ring, check the Service Kit Instructions below:

SE	SL
http://net.grundfos.com/qr/i/93108355	*http://net.grundfos.com/qr/i/92813883*

Related information

6. Service tools

9.12 Removing the upper seal housing on SL pumps

1. Remove the screws (182b).
2. Remove the upper seal housing (58). Use a soft hammer carefully.
3. Remove the O-ring (72a).

9.13 Removing the upper seal housing on SE pumps

1. Remove the screw (182b).
2. Remove the O-ring (72a).
3. Carefully remove the upper seal housing (58a). Use crowbars and a soft hammer.

9.14 Removing the shaft and rotor

1. Remove the circlip (55a) with the locking-ring pliers (B).
2. Insert an eyebolt into the shaft end.
3. Lift up the rotor and lower bearing housing slightly from the stator housing using the hoist.
4. Disconnect the plugs from the moisture switch and lower the bearing sensor, if fitted.
5. Remove the rotor.

9.15 Removing the bearing

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

1. Place the rotor in a vice with soft jaws.
2. Remove the screw and the washer of the level switch (521).
3. Remove the level switch (521).

4. Remove the circlip (187) and the washer (187a).
5. Remove the three screws (182) and the bearing bracket cover (59).
6. Remove the cable if the level switch (521) is fitted.
7. Pull off the lower bearing bracket (155) and the ball bearing (153) with a puller.
8. Knock out the bearing of the lower bearing bracket with a hammer and punch.
9. Remove the upper ball bearing (154) with a puller.
10. Remove the O-ring (72).

10. Electrical connection

10.1 Motor protection

Galvanic separation

Double-insulated sensors for high voltage measurements ensure the electrical safety. There is an additional galvanic separation inside the IO 113 module.

10.2 Sensors

The pumps can be equipped with various switches and sensors for protection. The specification table below indicates which switch and sensor types can be used.

Switch and sensor specification

	Standard pump	Sensor version 1	Sensor version 2	Standard Ex	Sensor version 1 Ex	Sensor version 2 Ex
Thermal switches or PTC	•	•	•	•	•	•
Moisture switch	•	•	•	•	•	•
Level switch in leakage chamber for standard and Ex motors	•	•	•	•	•	•
Pt1000 in stator winding		•	•		•	•
Pt1000 in upper bearing			•			•
Pt1000 in lower bearing			•			•
PVS-3 vibration sensor			•			•
SM 113 module [3]			•			•
IO 113 module [4]			•			•

[3] For pumps fitted with two power supply cables, the SM 113 module must be ordered separately and installed in the control cabinet. SM113 needs to be fitted with a resistor.

[4] The IO 113 with communication functionality must be chosen and ordered separately. In case of using Grundfos Dedicated Controls it must be the IO531B.

10.2.1 Sensor options

- Standard: moisture switch, level switch, Klixon or PTC in each winding.
- Sensor Set 1: moisture switch, level switch, Klixon or PTC in each winding, Pt1000 on the stator.
- Sensor Set 2: moisture switch, level switch, Klixon or PTC in each winding, vibration sensor (PVS-3), Pt1000 on the stator, lower- and upper bearing.

Note: As this pump range uses glycol (motor liquid SML3), it does not have Water-in-Oil (WIO) or Water-in-Air (WIA) sensors. The installation and operating instructions of the IO 113 and SM 113 modules refer to a WIA sensor, but there is no such sensor in this pump range.

In the standard range, only the standard sensor package is available. Pumps that require Sensor Set 1 or Sensor Set 2 are Factory Product Variants (FPVs).

Any pump with Sensor Set 2 requires an SM 113 module. For single-cable pumps, the SM 113 is mounted inside the motor top. For dual-cable pumps, there are enough sensor wires in the cable to allow the SM 113 to be mounted in the control box next to the IO 113.

Each cable has 5 sensor wires, which are connected to the sensor wiring in the pump by a set of connectors. The female connector on the cable side is plugged directly into the male connector on the motor side. These connectors have 6 sockets. Depending on the pump variant, each of these sockets can have a sensor wire from the pump connected into it. This means that one of the sockets in the male connector is not connected to any signal wire within the cable. There are redundant thermal protection switches in the stator. The unused set of thermal protection switches are not connected to the cable.

The wiring methods depend on the following:

- which sensor set is used
- number of power cables
- PTC or Klixon
- if the pump is an Ex version or not.

Please see the end of this document for the complete set of sensor wiring diagrams.

Related information

17. Wiring and sensor information

10.2.2 Thermal switches

Three bimetallic thermal switches are built into the stator windings. A contact opens in case of overtemperature (150 °C [302 °F]). The motor insulation class is H (180 °C [356 °F]).

The supply voltage to the thermal switches must be 12-24 V DC.

The thermal switches are connected to the control cable and must be connected to the safety circuit of the separate pump controller.

Use a multimeter to check whether the circuit resistance is maximum 3 Ω per thermal switch.

The motor-protective circuit breaker of the pump controller must include a circuit which automatically disconnects the power supply in case the protective circuit is opened.

In case the thermal switches or the moisture switches are not working, install an automatic circuit breaker.

10.2.2.1 Stator thermal switches

Every stator in this SE/SL pump range has both the Klixon and the PTC thermal switches wired into the stator. The only difference between a pump using PTC or Klixon switches is how the thermal switches are wired in the motor top, specifically in the 6-socket male connector. The wiring diagrams in Section 13 show the 6-socket connector.

The connector has 6 positions (sockets) that the sensor and switch wires are connected into. Because there is only 5 sensor wires in the cable, only the first 5 positions in the socket are connected to the signal cable. This means that position 6 in the socket is blank, it is not connected to any wire in the cable. As such, the unused set of thermal switches, are connected to cable socket position 6.

In the wiring diagrams, the wires ”TB” are for the Klixon and wires ”TP” are for the PTC switches. When PTC is used, 2TB1 is plugged into socket Position 6. When Klixon is used, 2TP1 is plugged into socket position 6.

PTC details

Grundfos part no	Thermik part no	Rated temperature [°C (°F)]
96577415	110546	150 ± 5 (302 ± 41 °F)
96650672	110363	150 (302 ± 41 °F)
98328968	113716	160 (302 ± 41 °F)

Klixon details

Grundfos part no	Thermik part no	Rated temperature [° C (°F)]	Reclosing temp. below rated temp. [°C (°F)]
96741587	111294	150 ± 5 (302 ± 41 °F)	35 ± 15 (95 ± 59)

Related information

17. Wiring and sensor information

10.2.3 Moisture and Level switches

Non-Ex version:

A moisture switch and a level switch are mounted in a non-Ex pump. The moisture switch is placed in the top cover and the level switch is in the leakage chamber above the shaft seal. See the Appendix.

Ex version:

A moisture switch and a level switch are mounted in an Ex pump. The moisture switch is placed in the top cover and the level switch is in the leakage chamber. See the Appendix.

All switches in both non-Ex and Ex versions are hardwired from the pump to IO 113. If moisture or a leakage is detected, they break the electric circuit. This generates both a hardware and a software alarm in IO 113, and the alarm relay opens. If the pump is connected to Dedicated Controls, the IO351B must be used.

Moisture- and level switches are motor protection devices protecting the motor from moisture or leakage. The moisture switch is non-reversing, and it must be replaced after being released. The level switch does not have to be replaced after being released.

The moisture- and level switches are connected in a separate circuit and to the control cable. See Appendix. They are also to be connected to the safety circuit of the separate pump controller.

Level switch[5)] must be installed with an Intrinsically Safe Apparatus and must meet the following:

- Apparatus must be Ex approved[6)]
- V_{max} or U_i[7)] > V_{oc},V_t, or U_o[8)]
- I_{max} or I_i[9)] ≥ I_{sc}, I_t, or I_o[10)]
- P_{max} or P_i[11)] ≥ P_o[12)]
- C_o[13)] ≥ C_i + C_{cable}[14)]
- L_o[15)] ≥ L_i + L_{cable}[16)]

6) The Ex approved barriers are either a multiple channel Ex approved barrier having parameters less then those quoted, or a combination of single channel Ex approved barriers for which the combinations of outputs are less than those quoted are nonignition capable for the Class, Division and Group or Class, Zone and Group of use.

7) V_{max} or U_i: Maximum voltage of the equipment in hazardous area

8) V_{oc},V_t, or U_o: Voltage of the associated equipment (barrier itself) located in safe area

9) I_{max} or I_i: Maximum current of the equipment in hazardous area

10) I_{sc}, I_t, or I_o: Current of the associated equipment (barrier itself) located in safe area

11) P_{max} or P_i: Maximum power of the equipment in hazardous area

12) P_o: Power of associated equipment (barrier itself) located in safe area

13) C_o: Capacitance of associated equipment (barrier itself) located in safe area

14) C_i + C_{cable}: Maximum capacitance of the equipment (together with cable) in hazardous area

15) L_o: Inductance of associated equipment (barrier itself) located in safe area

16) L_i + L_{cable}: Maximum inductance of the equipment (together with cable) in hazardous area

10.2.4 Thermistors

The standard pump range has Klixon switches; however, pumps with PTC thermistors are also available as Factory Product Variants (FPV).

The thermistors can be used as motor protection devices to monitor stator temperature instead of thermal switches, and must be connected to the thermistor relay in the control cabinet.

The operating voltage of PTC thermistors is 2.5 - 7.5 V.

10.2.5 Pump vibration sensor (PVS 3)

The PVS 3 sensor monitors the vibration level to protect the pump and the pipe network against damage.

A change in the vibration level indicates an abnormal situation. Make sure that a service inspection is carried out before the pump or the pipe network is damaged.

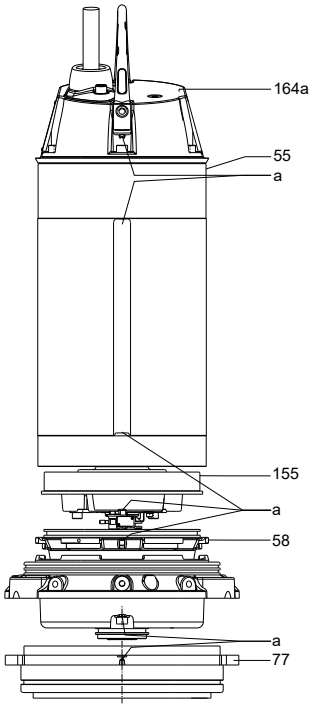
Pumps are fitted with S-tube® impellers. The S-tube® impellers are wet-balanced to reduce vibrations during operation. If these pumps are started with the pump housing containing air, the vibration level can be higher than in normal operation.

5) Level switch parameters: U_i = 18,5V; I_i = 1012mA; P_i = 10W

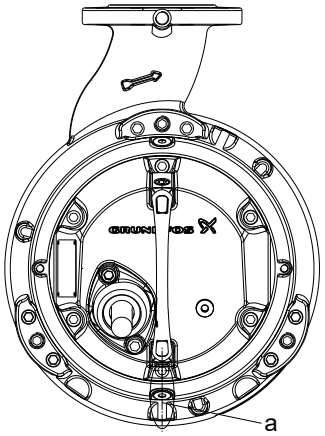
11. Assembly

11.1 Assembly alignment

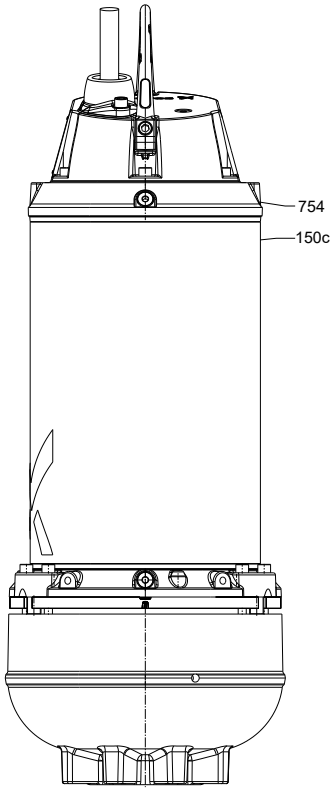
There are assembly grooves (**a**) located on the pump as shown in the images below. The grooves must be aligned for proper assembly.



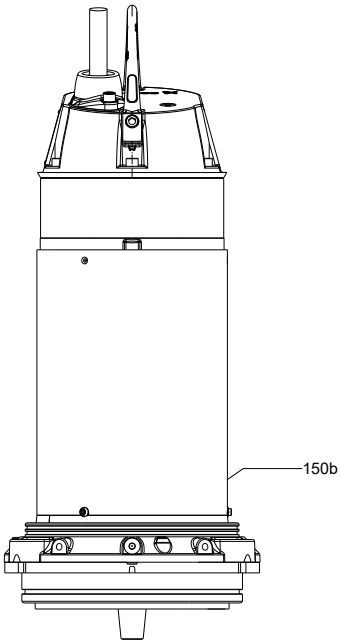
TM079065



TM079119



TM079117



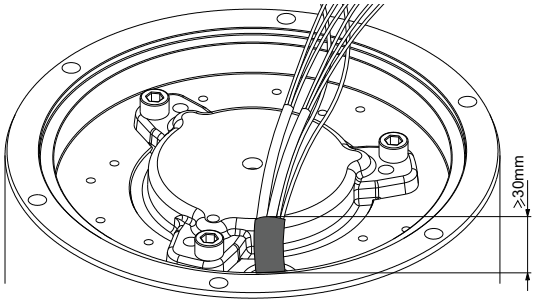
TM079118

Related information

13. Components and material specification

11.2 Mounting cable and PVS-3 bracket assembly

1. Check that the flex tube is in the current position. The flex tube should be sitting on the stator coil head and protruding at least 30 mm out of the stator housing.

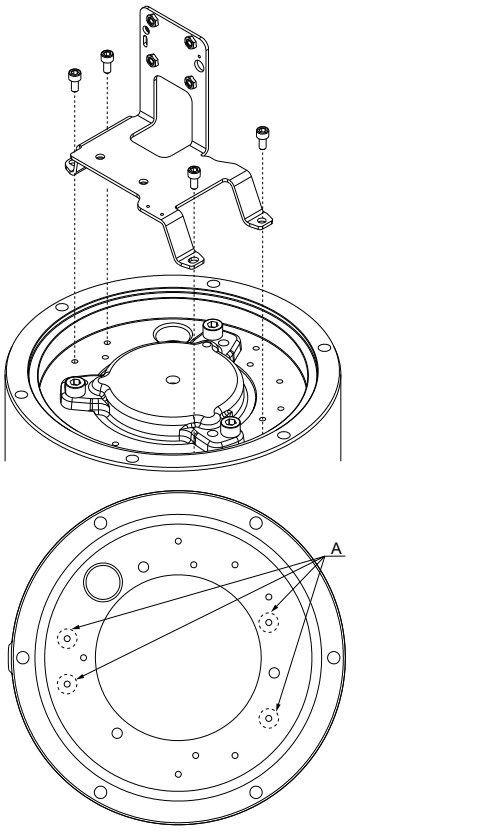


TM078655

2. Check that the stator power wires are in the correct order. Check that all power wires are terminated with a ferule. Keep the sensor wires to the left of the power wires. After the cable bracket is mounted on the stator housing, ensure that the position of the power and sensor wires look similar to the drawing below. The order is the following:

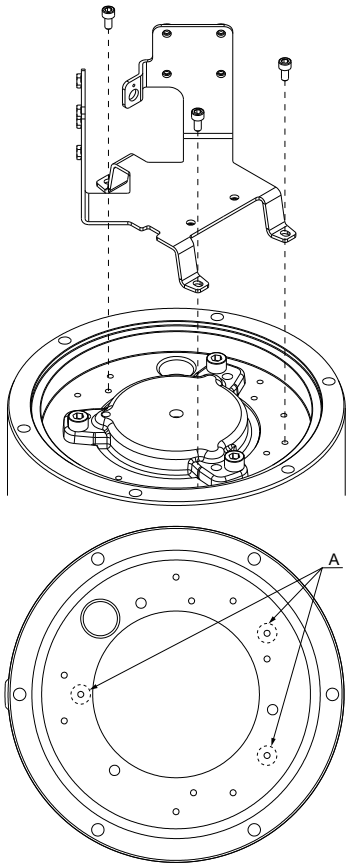
Stator wires	Grey	Yellow	Black	Blue	White	Orange
	U1	V1	W1	U2	V2	W2

3. Install the cable bracket and PVS-3 or SM 113 bracket (if necessary). Bracket feet positions are marked (A) on the drawing below.



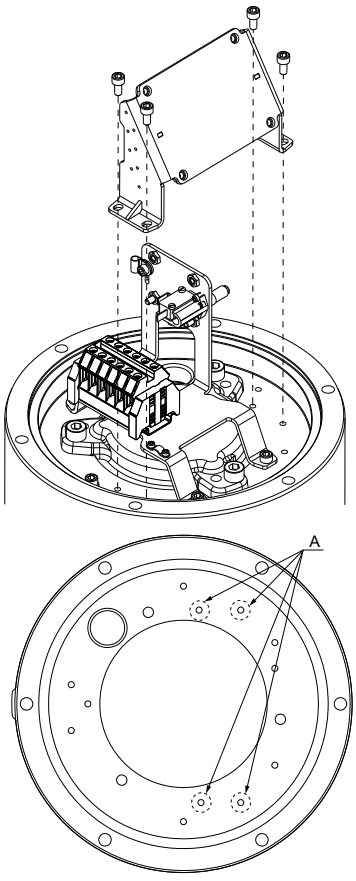
TM078657

Single-cable bracket



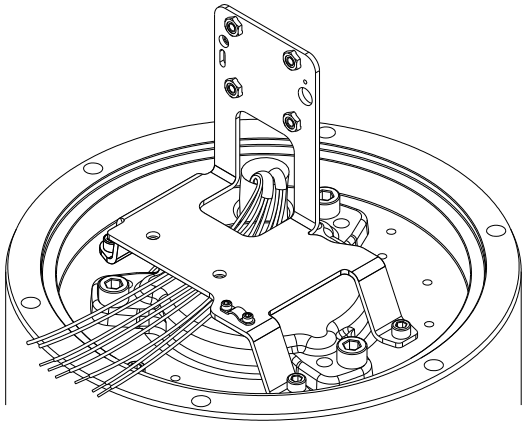
TM078659

Dual-cable bracket



TM078658

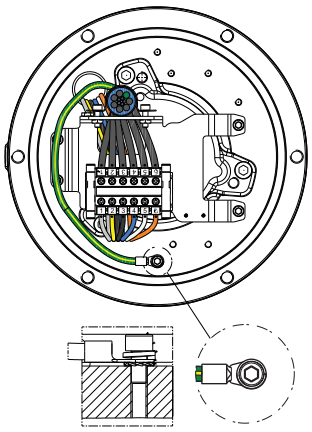
4. Check that each power wire is terminated with a ferule. Keep the sensor wires to the left of the power wires. After the cable bracket is mounted on the stator housing, ensure that the power wires and sensor/switch wires look the following:



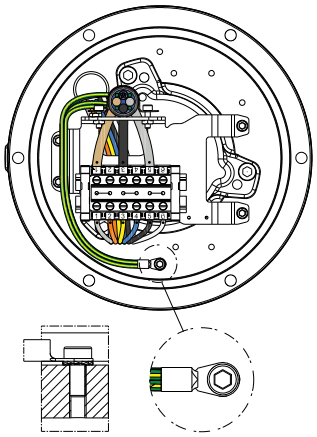
TM078656

11.3 Power wire connection, stator end

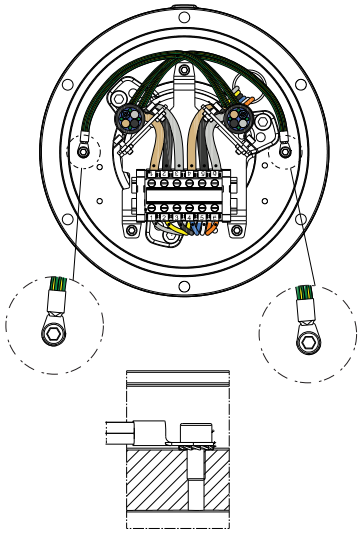
1. Mount the cable bracket to the stator housing. Ensure that the power wires and sensor switch wires are in the correct position under the cable bracket.



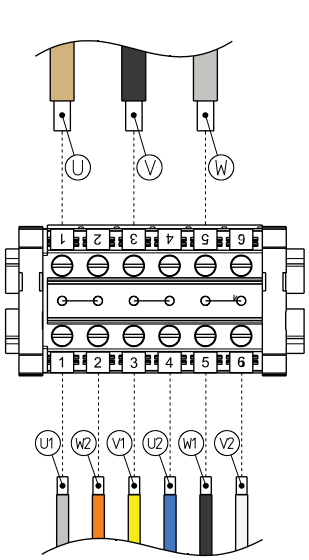
Earthing screw, single cable

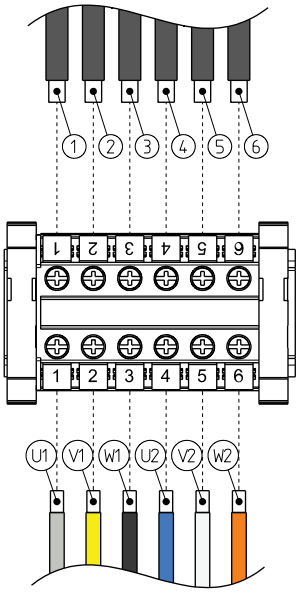


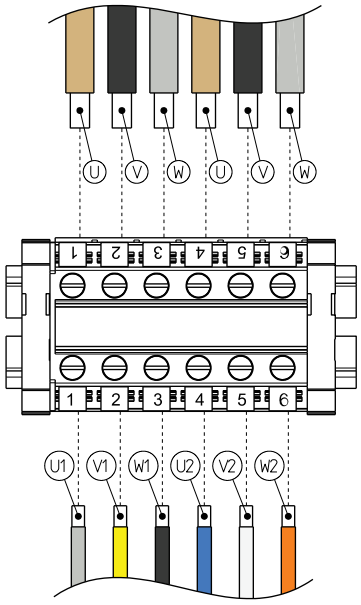
Earthing screw, single-cable EMC



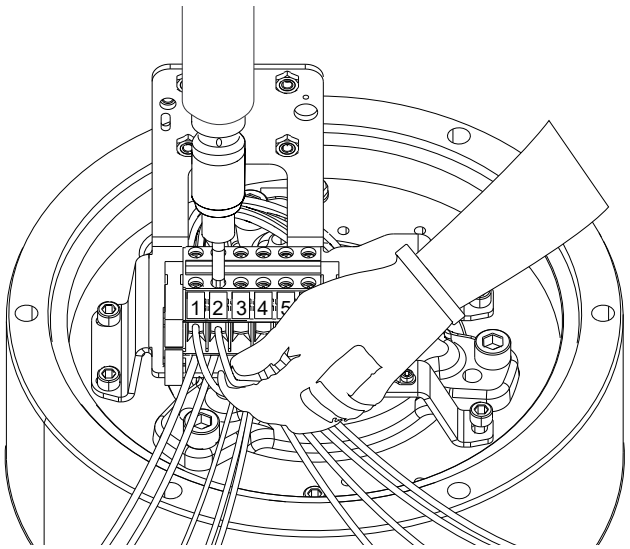
Earthing screw, dual-cable EMC







2. Insert the power wires from the stator into the terminal block, in accordance to the wiring diagram. Bend and push the power wires one-by-one into the terminal block, all the way to the back of the terminal. While holding the power wire in place, tighten the terminal screw to secure the power wire. The required torque is 1.3 ± 0.2 Nm (1 ± 0.1 lb-ft).



TM079414

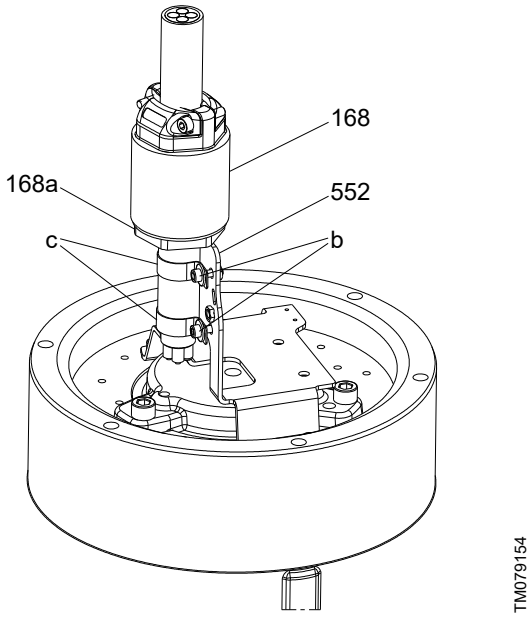
3. Insert the cable through the motor top. Make sure that the O-ring (157b) and the clamp for lower cable entry (181b) are on the cable.

Related information

17. Wiring and sensor information

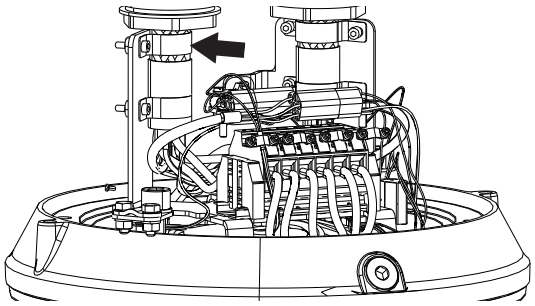
11.4 Power wire connection, cable end

1. Bend and mount the power cable with the bullet onto the bracket with the clamps (**c**). Ensure that the M5 washer is used with the M5 screw (**b**). Always use an appropriate anti-seize grease when securing the screws. The required torque is 4 ± 0.6 Nm (3 ± 0.4 lb-ft). Before tightening the screws to required torque, check that the cable is in the correct position.
2. The position of the cable entry mounted on the cable bracket is critical to the assembly.



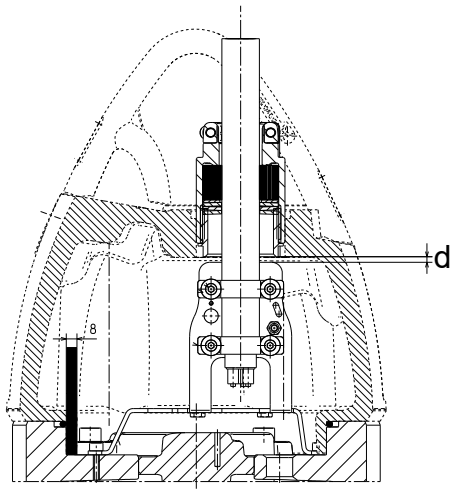
TM079154

- The cable entry is an assembly of many components, with the upper cable entry (168) housing; the seal ring, washer and disk springs. The assembly is held in place by the lower cable entry (168a).



TM079451

3. The distance (**d**) between the cable entry lower (168a) and the top of the cable bracket (522) must be 4.1 ± 0.3 mm (0.161 ± 0.011 in).



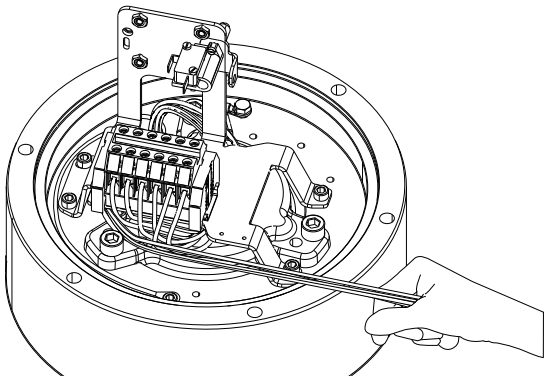
TM079156

EMC cable variant:

The positioning of the cable is as per Step 2. The cable shield is grounded with the cable clamp and the cable clamps used for the EMC cables are smaller than what is used with the standard cable. This is to ensure that a firm and secure contact is maintained between the cable shield and the mounting bracket. If the standard cable is replaced with an EMC cable the cable brackets also need to be replaced.

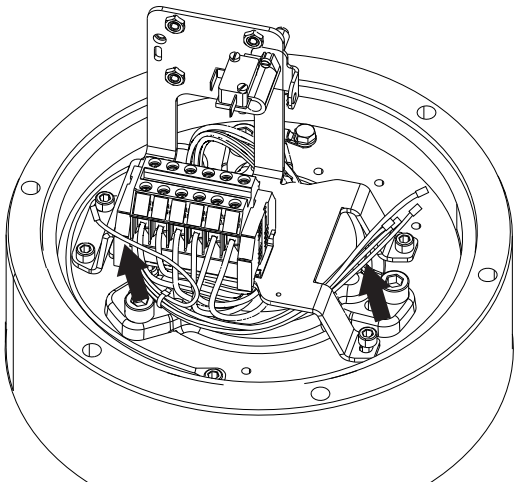
11.5 Sensor wire connection, standard cable with standard sensor set

1. Bundle the sensor wires from the motor together, and move the bundle to the right-hand side of the terminal block, in front of the mounting bracket.

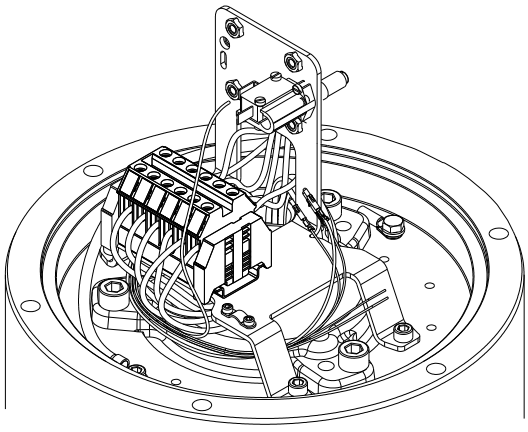


TM079467

2. Find the wire marked “MS1” and separate it from the bundle of wires. Push the bundle of wires underneath the bracket and through the right-hand side legs of the bracket. The MS1 wire should still be in front of the terminal block, as this wire is connected directly to the moisture sensor.

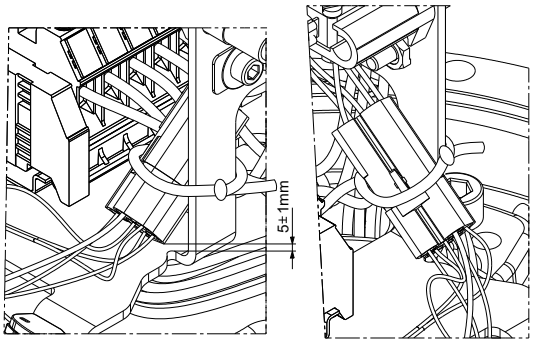


TM079477



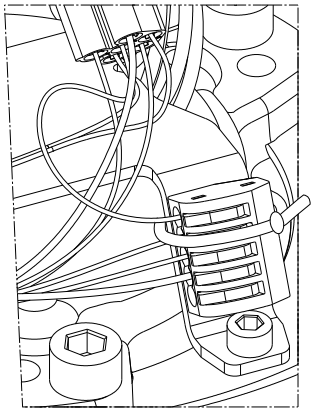
TM078660

3. Push the sensor wires into the the male connector or WAGO connector according to the wiring diagram. Close the connector and check the tightness of the connection by pulling the wires back.
4. Attach the two connectors.
5. Secure the joined connectors to the cable bracket with a cable tie. Keep 5 ± 1 mm (0.196 ± 0.039 in) in between the bottom of the connector and the bracket.



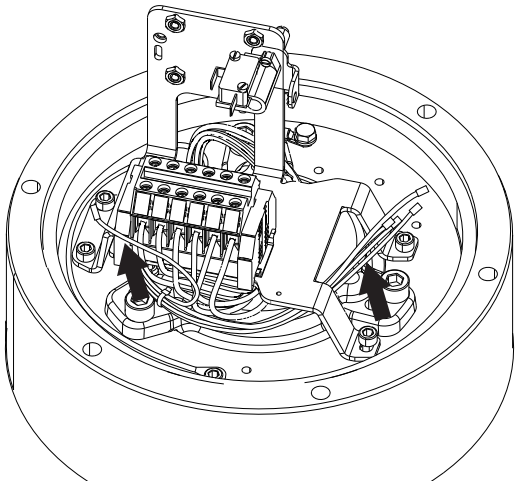
TM078661

6. Ensure that the connector is below the cable clamp screw.
7. Fix the sensor wires from the power cable onto the bracket with a cable tie. Use the dedicated cutout on the bracket.
8. Insert the sensor wires between the connector and the WAGO according to the wiring diagram.
9. Mount the WAGO onto the “leg” of the bracket by a cable tie. Position the wago connector as low as possible on the bracket leg.



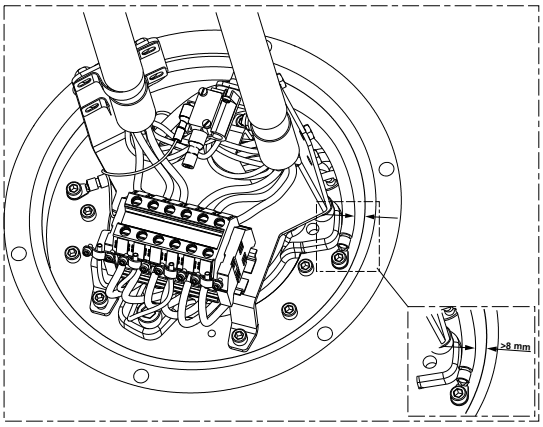
TM078662

10. Connect the sensor wires into the moisture switch. The MS2 wire is connected to the terminal at the back of the moisture switch. The MS1 wire is connected to the other terminal, see the wiring diagrams.



TM079477

11. Tighten the sensor wires from the motor in front of the bracket by a cable tie. The cable tie should be approximately in line with the end of the terminal block.
12. Tie the sensor wires from the motor together aside of the bracket with a cable tie. The cable tie should be approximately half way between the two legs of the brackets.
13. Secure the cable earth connection to the stator housing. Ensure that the serrated washer is underneath the cable lug. A minimum of 8 mm (0.314 in) distance is necessary between any wiring and the stator housing. Make sure that the earth cable is not within 8 mm (0.314 in) of the stator housing wall.



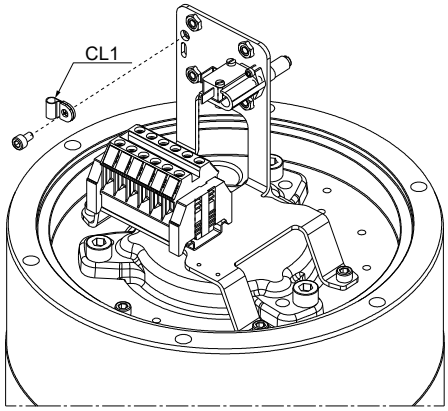
TM081097

Related information

17. Wiring and sensor information

11.6 Sensor wire connection, EMC cable with standard sensor set

With the EMC version, the sensor wires are not cable-tied to the cable bracket, but a P-clamp (CL1) is used to earth the cable shield. Place the P-clamp onto the shield of the signal wires, ensure that it is positioned 5 ± 2 mm (0.196 ± 0.078 in) from the end of the shield. Mount the clamp on the bracket. Ensure that a suitable anti-seize grease is used on the screw. The required torque is 4 ± 0.6 Nm (3 ± 0.4 lb-ft).

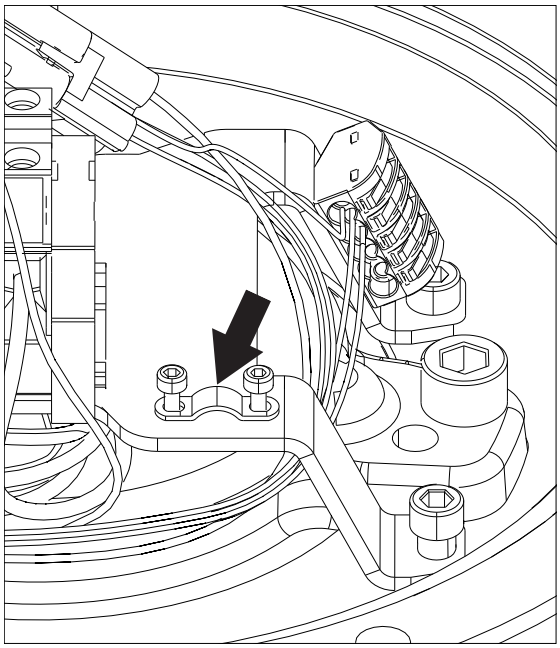


TM081059

11.7 Sensor wire connection, single cable with sensor set 1

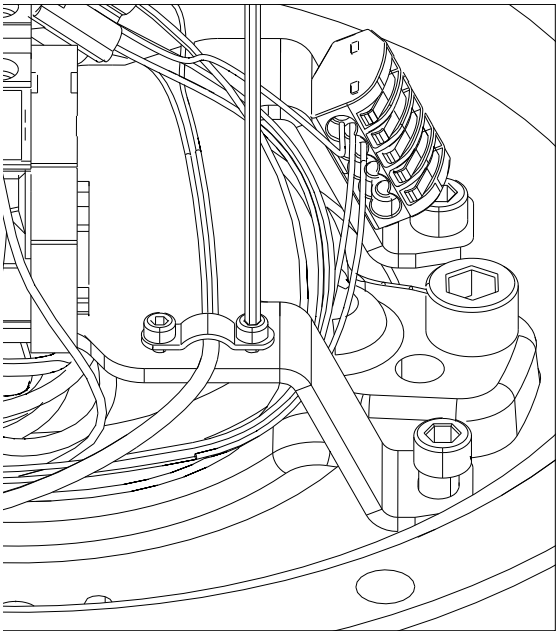
Sensor set 1 is different from the standard sensor set as it has a Pt1000 sensor mounted on the stator.

1. To complete the wiring of a single cable with sensor set 1, first complete all the wiring steps of the standard sensor set. Ensure that the wiring for the Pt1000 is kept in front of the cable bracket.
2. The wiring of the Pt1000 sensor is secured to the cable bracket by a clamp.



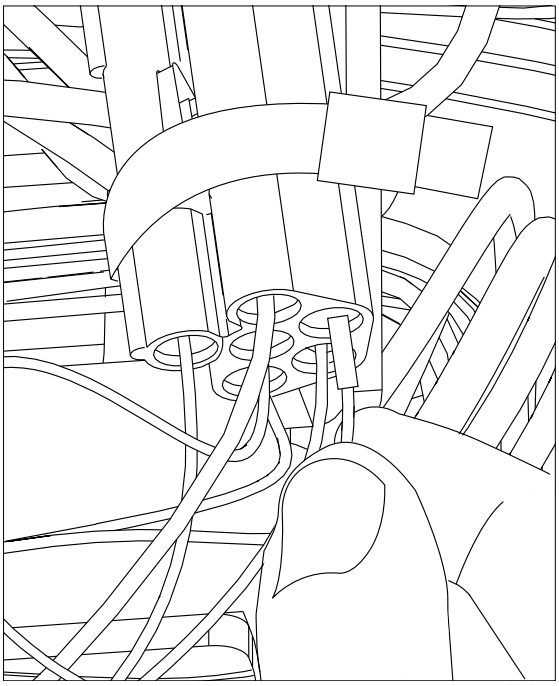
TM079489

3. Place the cable shield below the camp.
4. Secure the clamp. The required torque is 1 ± 0.15 Nm (0.7 ± 0.1 lb-ft). Use a suitable anti-seize grease on the screw thread.



TM079488

5. Place the Pt1000 connector pins into the male connector in accordance with the relevant wiring diagram. Check the connection with the male connector by pulling the wires backwards.



TM079490

Related information

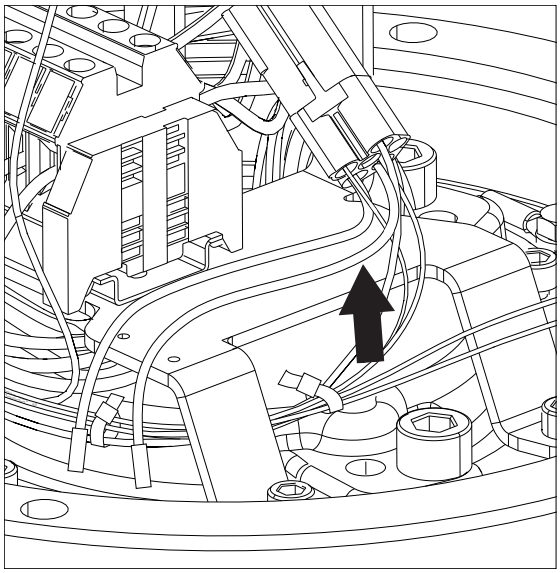
17. Wiring and sensor information

11.8 Sensor wire connection, single cable with sensor set 2

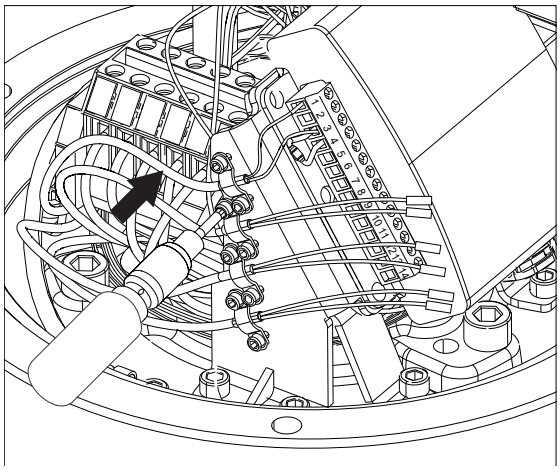
The wiring for sensor set 2 differs from the standard and sensor set 1. In addition, the SM 113 module is needed to be mounted in the motor top.

1. Complete all the steps as prescribed in the section above section, however:
   - Do not connect the Pt1000 sensor wires into the connector.
   - Do not mount the Pt1000 wires on the cable bracket.

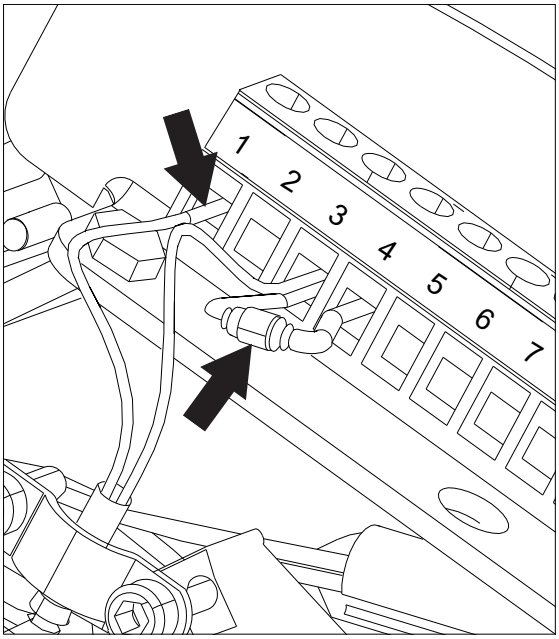
2. In accordance with the wiring diagram, insert the above two Pt1000 wires into the connector that will be inserted into the SM 113.



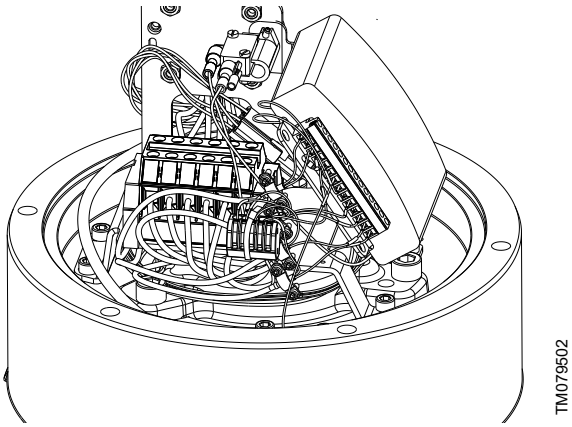
3. Mount the SM 113 to the PVS-3 bracket. Note the correct orientation of the SM 113 on the bracket. The required torque is 4 ± 0.4 Nm (3 ± 0.3 lb-ft). A suitable anti-seize grease is required on the screw thread.
4. Mount the PVS3 bracket to the stator housing.
5. Connect the SM113 earth wire to the foot of the PVS-3 during the mounting of the bracket.
6. Bring the sensor wires around in front of the power wires, and fix the sensor wires in the clamps (1 ± 0.15 Nm [0.7 ± 0.1 lb-ft), in accordance with the wiring diagram.



7. When mounting the sensor wires in the clamps, note that the wire shield must be in the middle of the clamp.
8. In accordance with the wiring diagram, insert the sensor wires into the SM 113.
9. The resistor needs to be inserted into the SM 113, as per the wiring diagram. As the pump uses glycol instead of oil, it does not have a WIO sensor. As such, the resistor simulates a WIO circuit. Note: The SM 113 is designed to be connected to a WIO sensor. If the resistor is not inserted, the IO113 indicates false alarms.



10. Insert wires into the WAGO connector.



11. Secure the WAGO connector to the PVS3 bracket with a cable tie.

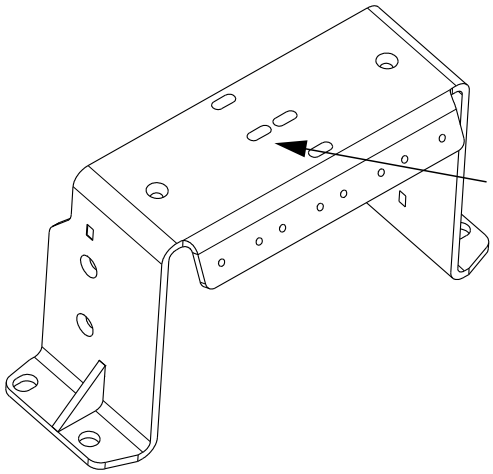
Related information

17. Wiring and sensor information

11.9 Sensor wire connection, dual cable (EMC cables only)

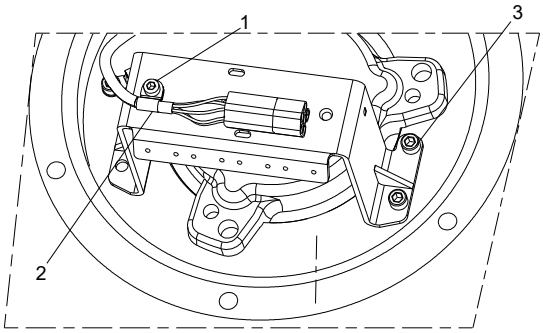
1. Prepare the PVS3 bracket with lacing cable ties through the cutouts, then mount the bracket on the stator housing. The required torque is 6 ± 0.6 Nm (4.4 ± 0.4 lb-ft).

   Note: This bracket is always used for dual cables, regardless if a PVS3 sensor is attached to it or not. This bracket is also used to secure the sensor connections from each cable.



TM081018

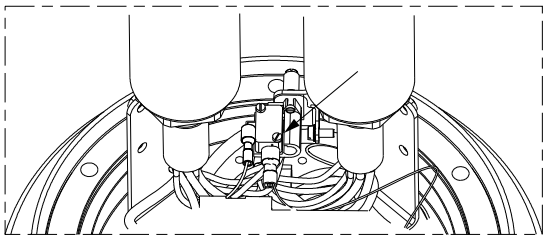
2. Mount the sensor wires from the power supply on the bracket with the P-clamp.



TM081019

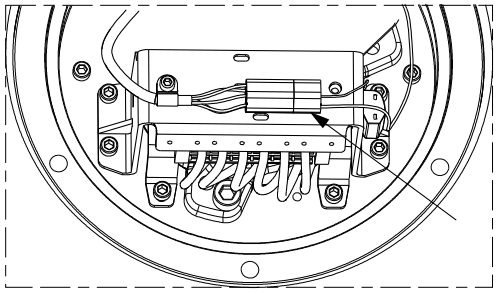
1	P-clamp screw, 6 ± 0.9 Nm (4.4 ± 0.7 lb-ft)
2	Sensor wire
3	Screw, 4 ± 0.6 (3 ± 0.4 lb-ft)

3. Connect sensor wires into the WAGO connector and into the connector, based on the wiring diagram.
4. Insert the wires into the moisture switch, based on the wiring diagram.



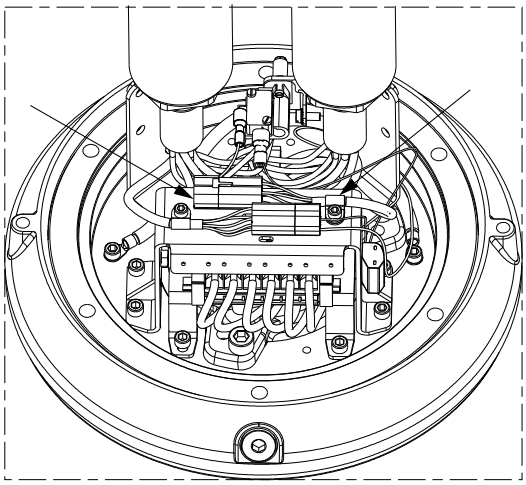
TM081021

5. Connect the two connectors together and cable tie to the PSV3 bracket.



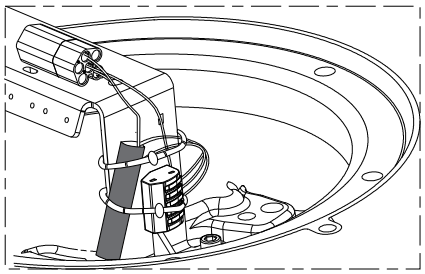
TM081022

6. Fix the sensor wires from cable No. 2 to the PVS-3 bracket with the P-Clamp, following the same procedure in step 2. Then cable tie the connector to the PVS-3 bracket.



TM081023

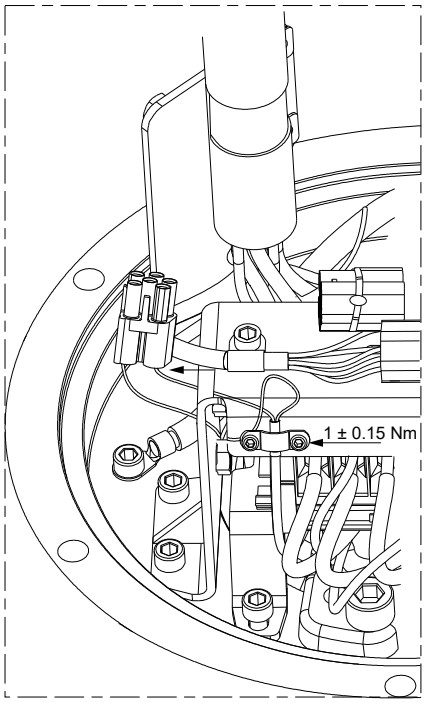
7. Cable tie the WAGO connector and the flex tube to the leg of the bracket.



TM081024

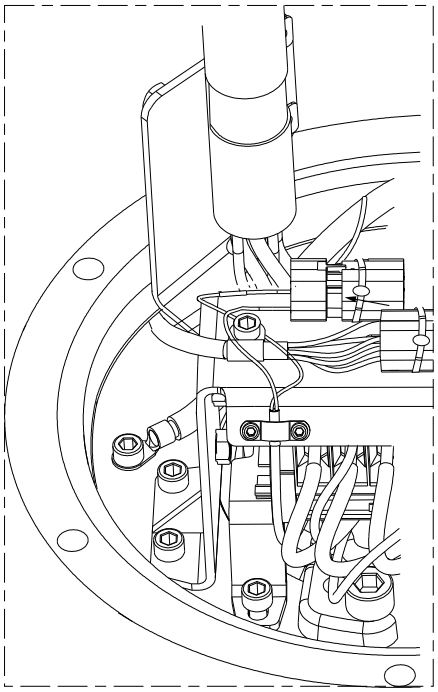
11.10 Sensor wire connection, dual cable, sensor set 1

1. Insert the Pt1000 cable into first P-clamp. The required torque is 1 ± 0.15 Nm (0.7 ± 0.1 lb-ft). Ensure that the wire in the P-clamp is fixed in place at the shield. Insert the Pt1000 wires into the connector as per the wiring diagram.

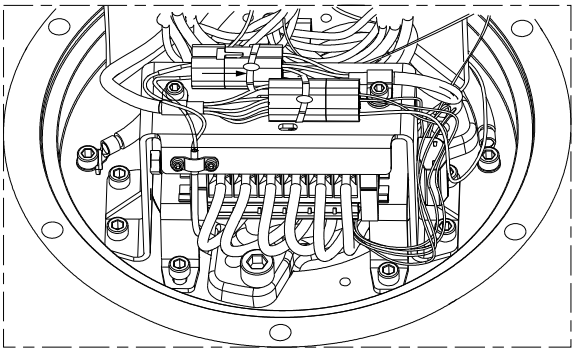


TM081040

2. Connect the socket into the sensor connector of cable No 2.

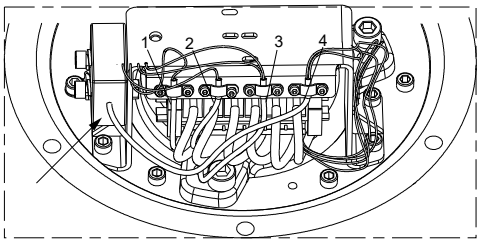


3. Ensure that the connectors are properly secured to the PVS-3 bracket with a cable tie.



11.11 Sensor wire connection, dual cable, sensor set 2

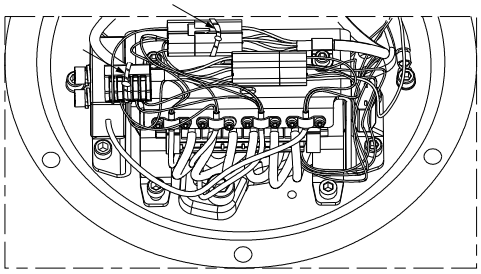
1. Mount the PSV-3 vibration sensor on the side to the bracket. The required torque is 6 ± 0.9 Nm (4.4 ± 0.7 lb-ft). Insert all the sensor wires into the P-clamps on the front side of the bracket.



TM081033

1	Pt1000 from stator
2	Pt1000 from upper bearing
3	Pt1000 from lower bearing
4	Vibration sensor wire

2. Insert the sensor wires into the WAGO and the connector, based on the wiring diagram. Then tie WAGO to the sensor wire of cable No. 1. Ensure that the connectors are properly secured to the PSV-3 bracket with a cable tie.



TM081034

11.12 Fitting the bearing

Clean the shaft and the shaft seal with soapy water before assembly.

1. Heat the new upper ball bearing (154) to 120 °C (248 °F), and fit it on the rotor (172).
2. Place the new lower ball bearing (153) in the lower bearing bracket (155), then press it home by pressing on the outer bearing ring.
3. Place the lower bearing bracket with the new lower bearing on the rotor, then press the bearing home by pressing on the inner bearing ring.

11.13 Fitting the level switch

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

1. Pull the cable of the level switch through the hole in the lower bearing bracket (155).

2. Fit the level switch (521) by screws and washers.
3. Place the bearing bracket cover (59), fit the screws (182) and tighten to 40 ± 2 Nm (29.5 ± 1.5 lb-ft).
4. Fit the washer (187a) and circlip (187) with locking-ring pliers.
5. Check that the bearings can rotate freely.

11.14 Fitting the shaft with bearings and motor

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

1. Lubricate the O-ring (72) with Rocol Sapphire Aqua-Sil and fit it into the stator housing (55).
2. Turn the lower bearing bracket (155) so that the groove in its circumference is opposite the cable plug of the stator housing.
3. Lower the rotor (172) with lower bearing bracket (155) down to the stator housing (55) with only a small gap left.
4. Fit the cable plugs to the correct sensors.
5. Lower the rotor into place.
6. Fit the circlip (55a) with locking-ring pliers (B).

11.15 Fitting the upper bearing bracket

1. Place the upper bearing bracket (61) on the upper bearing.
2. Fit the three screws (183) carefully and balanced. Tighten the screws so that the cover is pressed down over the bearing.
3. Tighten the screws (183) to 40 ± 2 Nm (29.5 ± 1.5 lb-ft).
4. Make sure the rotor can rotate freely.

11.16 Fitting the Upper seal housing cover on SE pumps

1. Lubricate the O-ring (72a) with Rocol Sapphire Aqua-Sil, and fit the upper seal housing cover (58a) into place.
2. Fit the screw (182b) with the washer (182c) and the O-rings (182d).
3. Lubricate the O-rings with Rocol Sapphire Aqua-Sil.
4. Tighten the screws to 70 ± 4 Nm (51.6 ± 3 lb-ft).

11.17 Fitting the upper seal housing on SL pumps

1. Lubricate the O-rings (72a and 107) with Rocol Sapphire Aqua-Sil and fit them on the upper seal housing.
2. Fit the screw (182b) with the washer (182c) and the O-rings (182d).
3. Lubricate the O-rings with Rocol Sapphire Aqua-Sil, then tighten the screws to 70 ± 4 Nm (51.6 ± 3 lb-ft).

11.18 Fitting the shaft seal

Prior to fitting the bearings and the shaft seal, clean the shaft with soapy water. Before fitting the shaft seal, apply a light coating of silicon spray to the part of the shaft where the shaft seal is located. It is required to lubricate the O-ring inside the shaft seal.

1. Make sure the O-rings are fitted on the shaft seal housing. If the seal is to be fitted on an SE pump, pay attention to the O ring (106).
2. Lubricate the O-rings with Rocol Sapphire Aqua Sil.
3. Spray soapy water on the shaft.
4. Push the seal onto the shaft.
5. Mount the shaft seal protection tool (D).
6. Press the shaft seal in place.

Protect the cone of the impeller shaft against scratches by taping in the cone.

7. Loosen and remove the shaft seal protection tool.
8. Fit the screws (46c) and tighten to 0.78 ± 0.1 Nm (0.6 ± 0.1 lb-ft).

For more information on replacing shaft seal with lock ring, check the Service Kit Instructions below:

SE	SL
http://net.grundfos.com/qr/i/93108355	*http://net.grundfos.com/qr/i/92813883*

11.19 Fitting the intermediate seal housing on SE pumps

1. Mount the shaft seal protection tool (D).
2. Lubricate the O-rings (37a and 107) with Rocol Sapphire Aqua-Sil, and fit them on the intermediate seal housing (58).
3. Fit the intermediate seal housing (58), then the screws (185) and tighten the screws to 70 ± 4 Nm (51.6 ± 3 lb-ft).

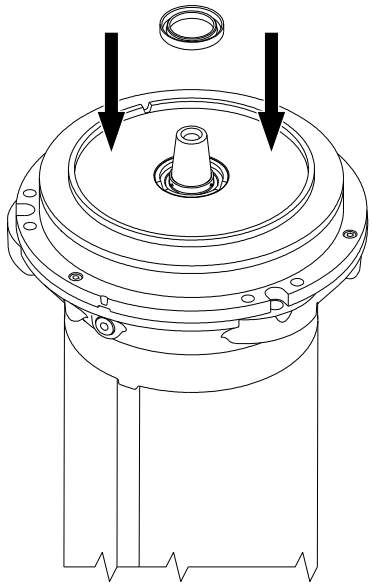
11.20 Fitting the jacket ring and inner or outer cooling jackets on SE pumps

1. Fit the inner cooling jacket (150b).
2. Fit the screws (150d).
3. Fit the outer cooling jacket (150c).
4. Lubricate the O-rings (157c) and (157b) with Rocol Sapphire Aqua-Sil and fit them on the cooling jacket ring (754).
5. Fit the cooling jacket ring (754).
6. Fit the screws (178) and tighten to torque 70 ± 4 Nm (51.6 ± 3 lb-ft).

11.21 Fitting the lower seal housing

1. Mount the shaft seal protection tool (D), if not fitted already.
2. Fit the lower seal housing (77) on the upper seal housing (58).
3. Fit the screws (184b) and tighten to 20 ± 2 Nm (14.8 ± 1.5 lb-ft).
4. Loosen and remove the shaft seal protection tool (D).

5. Fit the Lip Seal (46b).

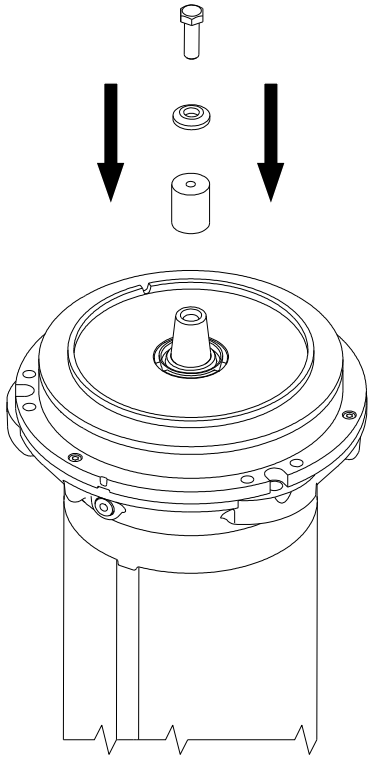


TM086291

Fitting the Lip Seal

Do not lubricate the Lip Seal (46b).

6. Mount the Lip Seal Assembly Tool (E).



TM086292

Mounting the Lip Seal Assembly Tool

The position is correct when the Lip Seal is in contact with the Driver Pipe.

7. Loosen and remove the Lip Seal Assembly Tool (E).

11.22 Fitting the wear ring

1. Fit the wear ring (49c) to the pump housing (50).
2. Fit the screws (49b).

11.23 Fitting the impeller

1. Fit an eyebolt in the shaft.
2. Lift the stator housing by the eyebolt with a hoist.
3. Lay the stator housing (55) on a stable surface.
4. Clean the tapered shaft end and the impeller (49) cone with soap.

The impeller cone must be completely free of debris and paint, to ensure the correct fit to the motor shaft.

5. Fit the impeller (49).
6. Lubricate the screw (67) and thread with Castrol Optimol Paste White T.
7. Fit the impeller washer (66) and screw (67), then tighten to 170 ± 4 Nm. Hold the impeller with a strap wrench.

Lubricate the bottom third of the impeller screw (67) with Castrol White Paste (or equivalent).

11.24 Fitting the pump housing

1. Lift the motor by a hoist.
2. Lubricate the O-ring (37b) with Rocol Sapphire Aqua-Sil, and fit it on the lower seal housing (77).
3. Carefully lower the pump into the pump housing (50).
4. Fit the screws (26) and the adjusting screws (12c).
5. Now make the adjustment of the impeller clearance. See section Inspecting and adjusting the impeller clearance.
6. Check that the impeller can rotate freely.
7. After impeller adjustment, place the pump vertically on a stable surface.

Related information

8.5 Inspecting and adjusting the impeller clearance
8.5.1 Adjusting the impeller clearance

11.25 Fitting the motor top cover

1. Fit the pressure test plug (25). In Ex models, the plug must be locked with the screw (25a) and the washer (25b).
2. Fit the O-ring (157).
3. Fit the moisture absorbing bag to the cables coming from the stator.

The pump must be closed within an hour after the new moisture absorbing bag is exposed to atmospheric humidity.

4. Fit the motor top cover (164a).
5. Fit the six screws (178).

12. Startup

DANGER
Electric shock
Death or serious personal injury
- Make sure the pump is grounded.

Pumps in dry installation must be vented.

Before the first startup and after a long standstill period, make sure that the pump is filled with the pumped liquid.

Make sure that the pump is filled with the pumped liquid. Dry-running is not allowed.

In case of abnormal noise or vibrations, stop the pump immediately. Do not restart the pump until the cause of the fault is identified and eliminated.

Proceed as follows:

1. Remove the fuses or switch off the main switch.
2. Check the motor liquid level in the cooling chamber.
3. Check if the impeller can rotate freely.
4. Check if the switches are closed, then replace them, if necessary.
5. Check whether the monitoring units, if used, are operating properly.
6. For pumps in a submerged installation, make sure that the pump is submerged in the liquid.
7. For pumps in dry installation, make sure that there is liquid in the pit.
8. Open the isolating valves, if fitted.
9. Check if the system is filled with liquid and vented.
10. Check the settings of the level switches in the pit.
11. Start the pump and check the operation for abnormal noise or vibrations.
12. After startup, the actual pump duty point must be established. Make sure the operating conditions are met.

    The pump may only be started for a short period without being submerged for checking the direction of rotation.

Always operate the pump in accordance with established routines and perform scheduled checks of monitoring equipment and accessories. Make sure that the pump and equipment settings cannot be changed by unauthorised persons.

12.1 Direction of rotation

The pump may be started for a short period of time without being submerged to check the direction of rotation.

For Ex pump, the check must be carried out outside of the Ex area.

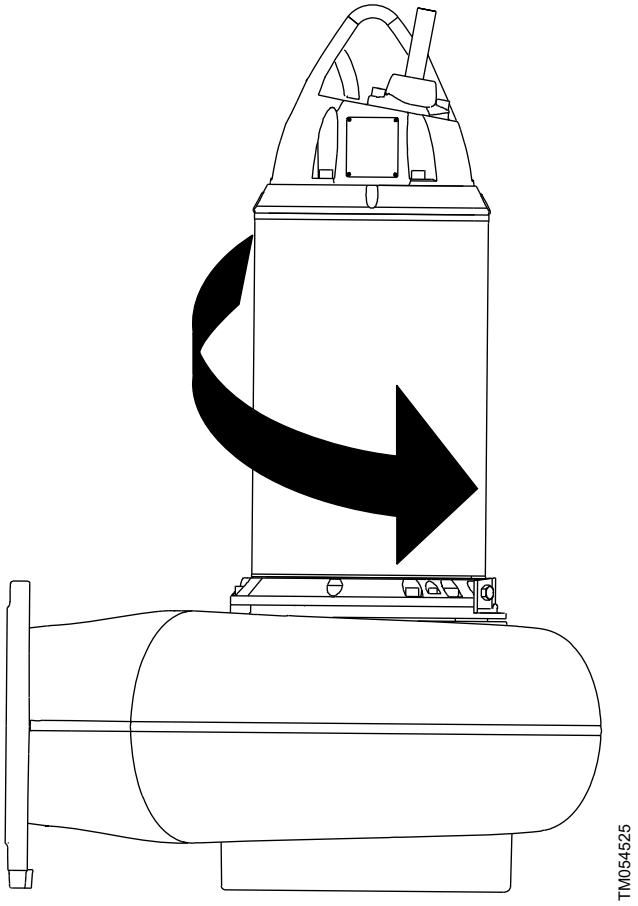
Check the direction of rotation before starting up the pump.

An arrow on the stator housing shows the correct direction of rotation. The correct direction of rotation is clockwise when viewed from above.

Check the direction of rotation

Check the direction of rotation in the following way every time the pump is connected to a new installation:

1. Let the pump hang from a lifting device, such as the hoist used for lowering the pump into the pit.
2. Start and stop the pump while observing its movement (jerk). If it is connected correctly, the impeller rotates clockwise, and the pump jerks counterclockwise.
3. If the direction of rotation is wrong, interchange any two of the phases in the power supply cable.



Direction of rotation

13. Components and material specification

Pos.	Component	Material
7a	Rivet	Stainless steel [17]
12c	Adjusting screw	Stainless steel [17]
25	Pressure test plug	Stainless steel [17]
25a	Hexagon socket head cap screw	Stainless steel [17]
25b	Lock washer	Stainless steel [17]
26	Hexagon socket head cap screw	Stainless steel [17]
37a	O-ring	Rubber [18]
37b	O-ring	Rubber [18]
46b	Lip Seal	
46c	Hexagon socket head cap screw	Stainless steel [17]
48	Stator lamination	
49	Impeller	Cast iron [19]
49b	Screw	
49c	Wear ring	
50	Pump housing	Cast iron [19]
55	Stator housing	Cast iron
55a	Circlip	DIN 472
58	Intermediate seal housing (SE install.) Upper seal housing (SL)	Cast iron
58a	Upper seal housing cover	Cast iron
59	Bearing bracket cover	Cast iron
61	Upper bearing bracket	Cast iron
66	Impeller washer	Stainless steel [17]
67	Hexagon socket head cap screw	Stainless steel [17]
72	O-ring	Rubber [18]
72a	O-ring	Rubber [18]
76	Nameplate	
77	Lower seal housing	
105	Shaft seal cartridge, complete	SiC/SiC or SiC/carbon
106	O-ring for shaft seal	
107	O-ring	Rubber [18]
150c	Outer cooling jacket	Stainless steel [17]
150b	Inner cooling jacket	
150d	Crosshead screw	
153	Ball bearing	Stainless steel
154	Ball bearing	Stainless steel
155	Lower bearing bracket	Cast iron
157c	O-ring	Rubber [18]
157b	O-ring	Rubber [18]
157	O-ring	Rubber [18]
157d	O-ring	Rubber [18]
164a	Motor top cover	Cast iron
168	Cable entry	Stainless steel [17]
168a	Lower cable entry	Stainless steel [17]
168b	Cover for connector	
172	Shaft with rotor	Stainless steel [20]
173e	Hexagon head screw	Stainless steel [17]
173f	Spring washer	Stainless steel [17]
173g	External earth connector	Stainless steel [17]
176a	Terminal block	

Pos.	Component	Material
176c	Plug housing	
178	Hexagon socket head cap screw	Stainless steel [17)]
181a	Hexagon socket head cap screw	Stainless steel [17)]
181	Cable	
181b	EMC cable/shield	
182	Hexagon socket head cap screw	Stainless steel [17)]
182b	Hexagon head screw	Stainless steel [17)]
182c	Washer	Stainless steel [17)]
182d	O-ring	Rubber [18)]
183	Hexagon socket head cap screw	Stainless steel [17)]
184b	Hexagon socket head cap screw	Stainless steel [17)]
185	Hexagon socket head cap screw	Stainless steel [17)]
187a	Washer	Stainless steel [17)]
187	Circlip	
190b	Hexagon socket head cap screw	Stainless steel [21)]
190	Lifting bracket	Stainless steel [21)]
193	Plug	Stainless steel [21)]
193a	Plug	Stainless steel [21)]
198	Rubber seal	
198b	Washer	
198a	Washer	
198c	Spring disc	
494	Plug	Stainless steel [17)]
520a	Slotted screw	Stainless steel [17)]
520	Moisture switch, top	
520c	Screw	
521	Level switch	
521a	Washer	Zn DIN 127
521b	Hexagon socket head cap screw	Stainless steel [17)]
522	Bracket	
522c	Screw	
524	Rubber bush	
524a	Disc spring	
703	Guide claw	Cast iron
704	Rubber seal	Neoprene 60
705	Hexagon head screw	Steel 8.8 DIN 933
754	Cooling jacket ring	

17) 1.4436/316

18) NBR

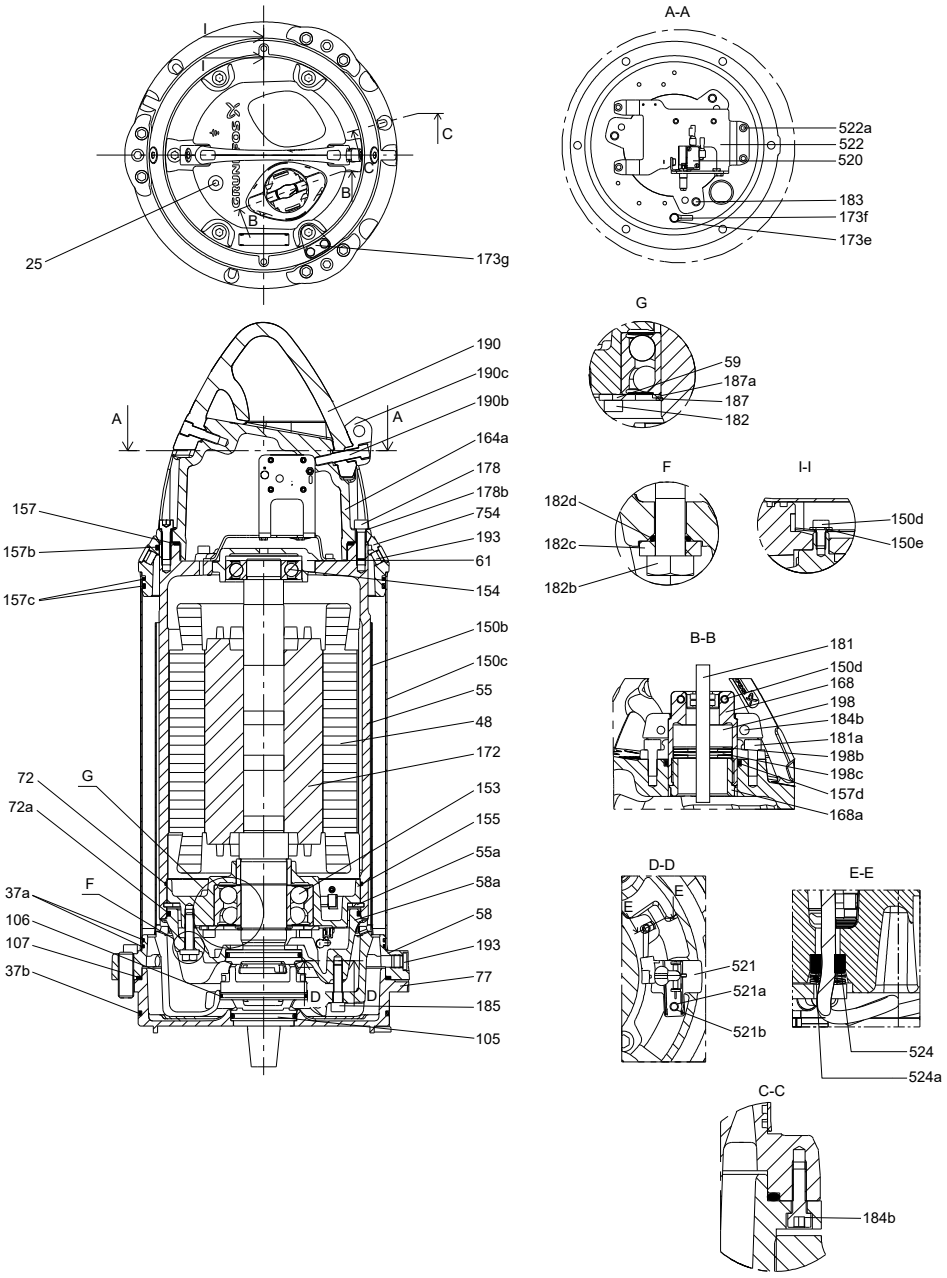
19) EN-JS 1050

20) 1.4462/329

21) 1.4408/316

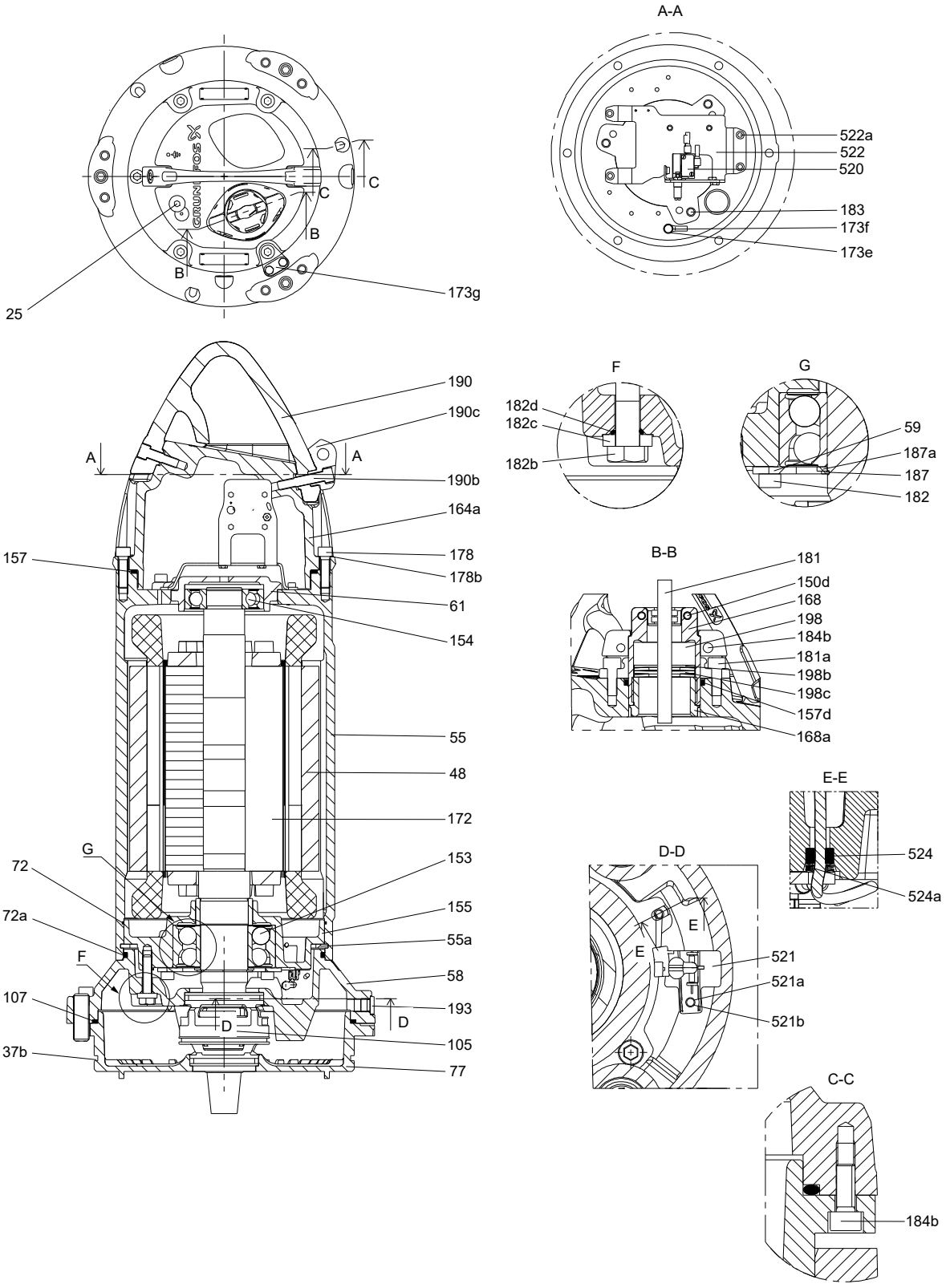
14. Sectional views

14.1 Sectional drawings, motors

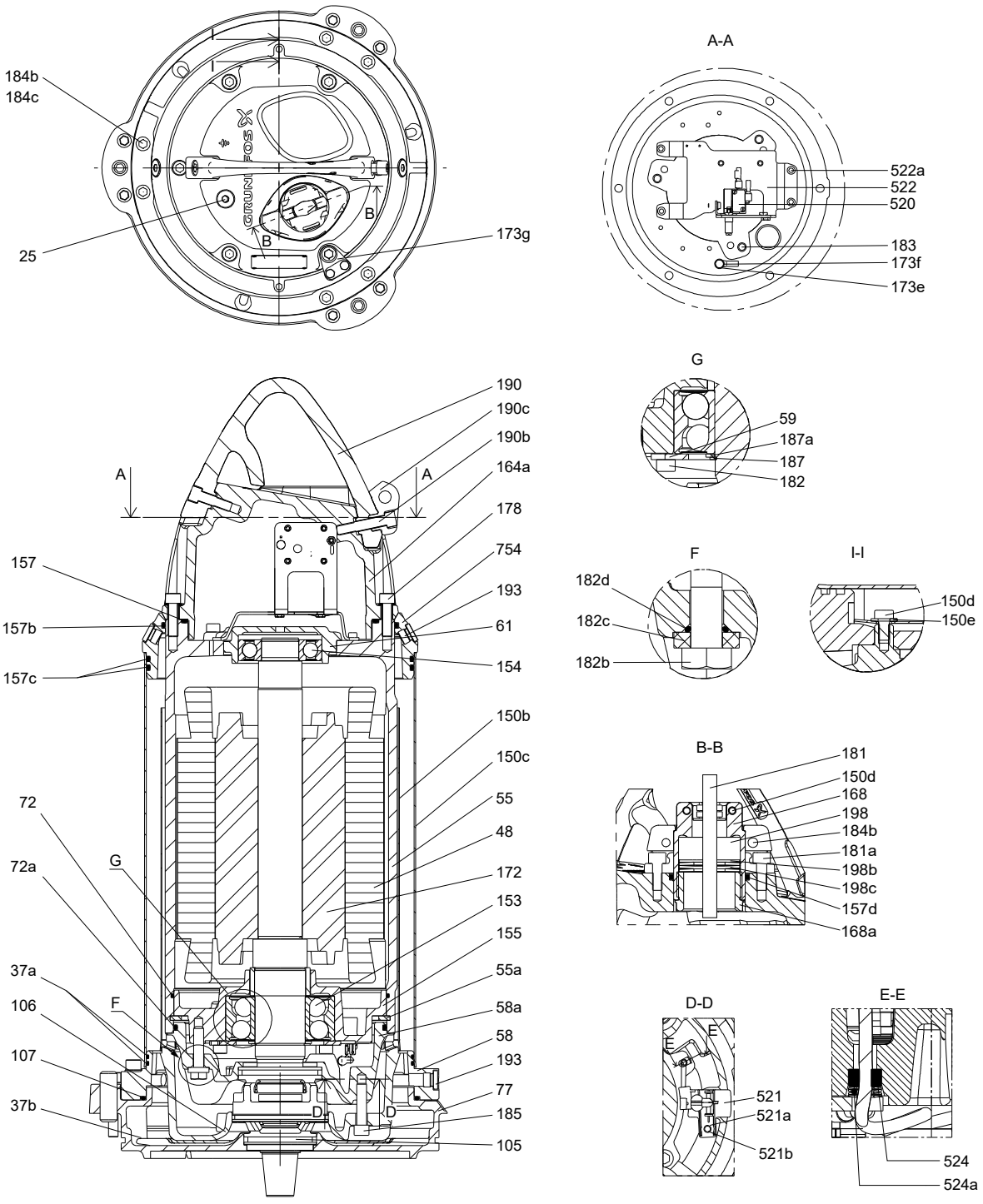


TM076053

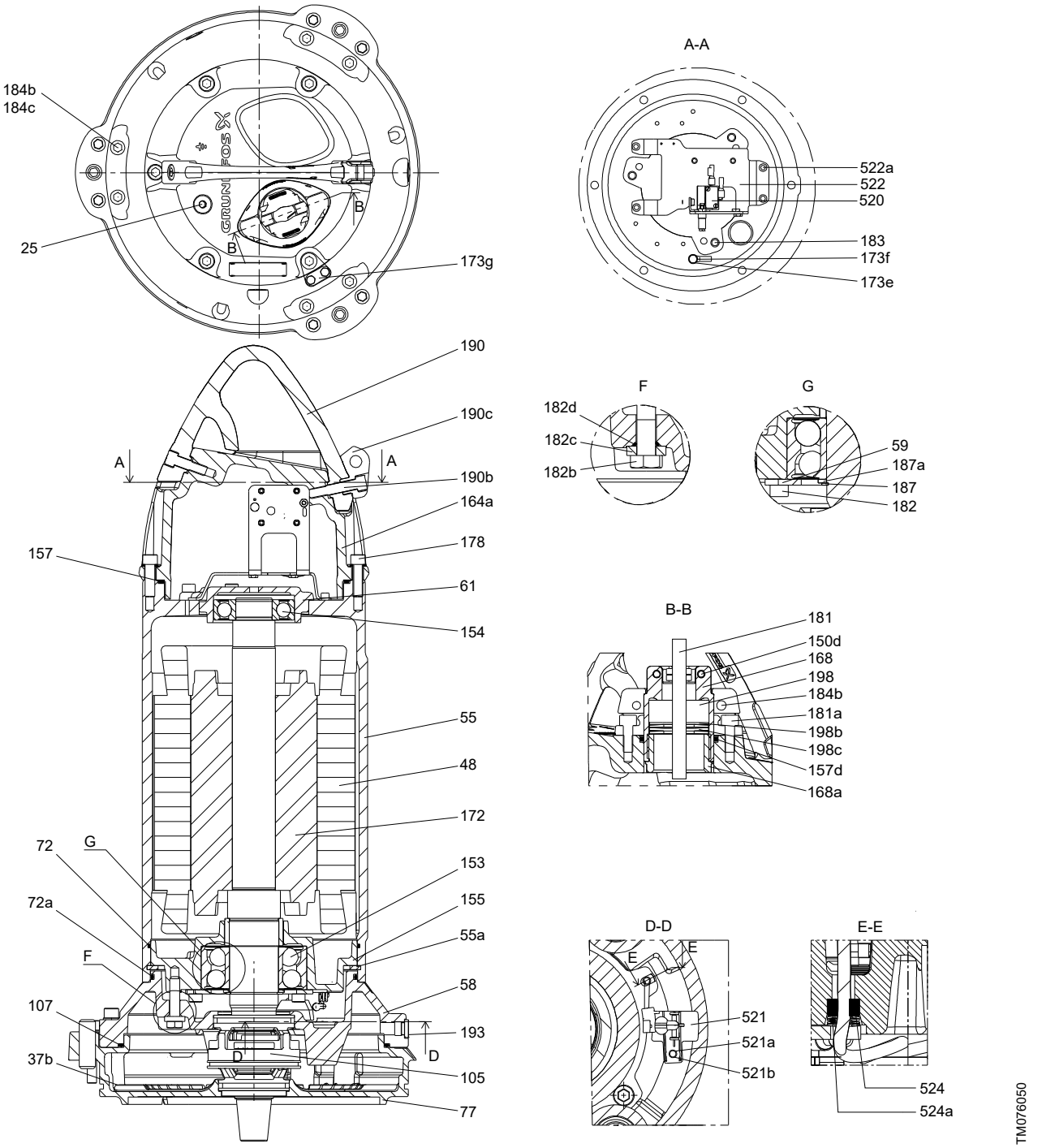
SE pump with cooling jacket (2- and 4-pole motors)



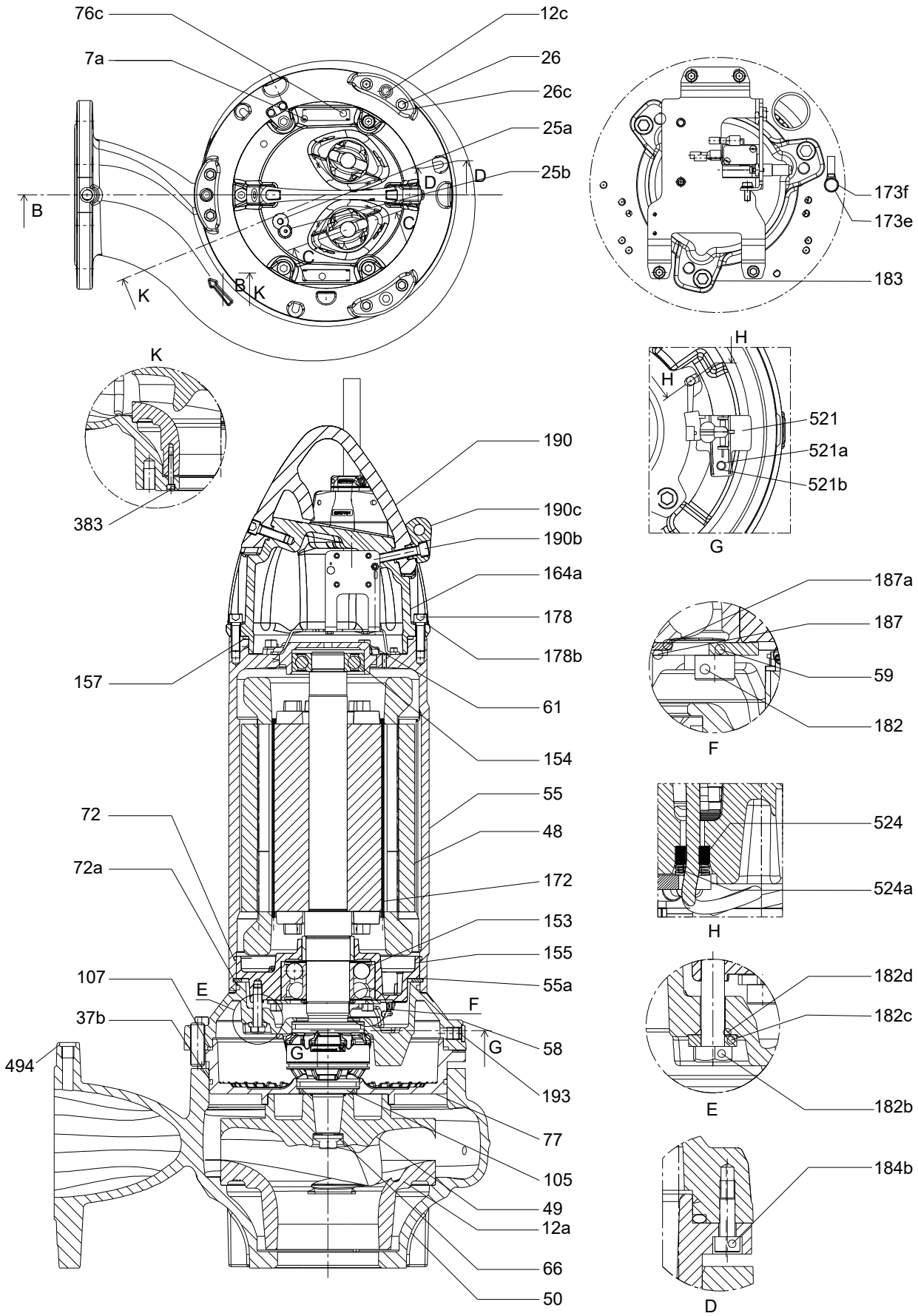
SL pump without cooling jacket (2- and 4-pole motors)



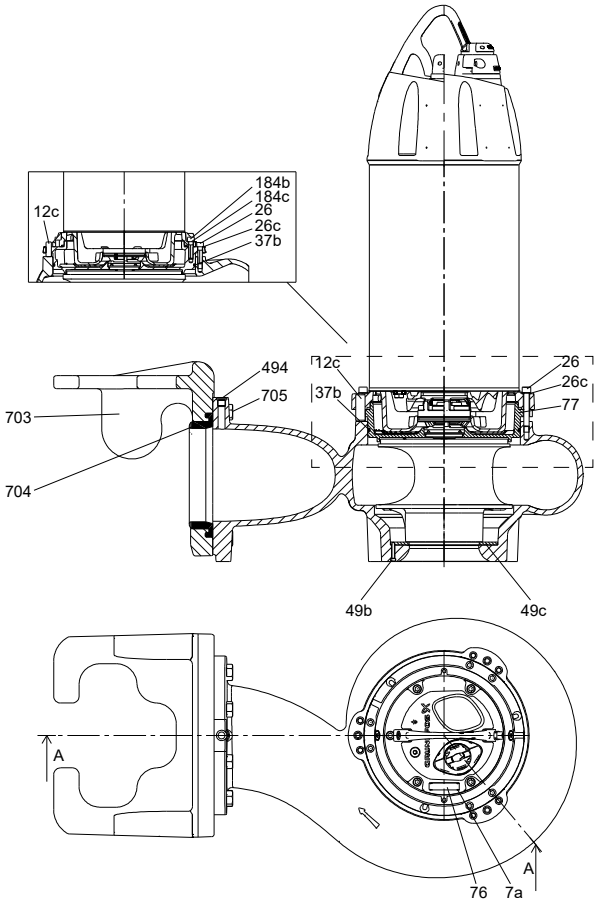
SE pump with cooling jacket (6-pole motors)



SL pump without cooling jacket (6-pole motors)

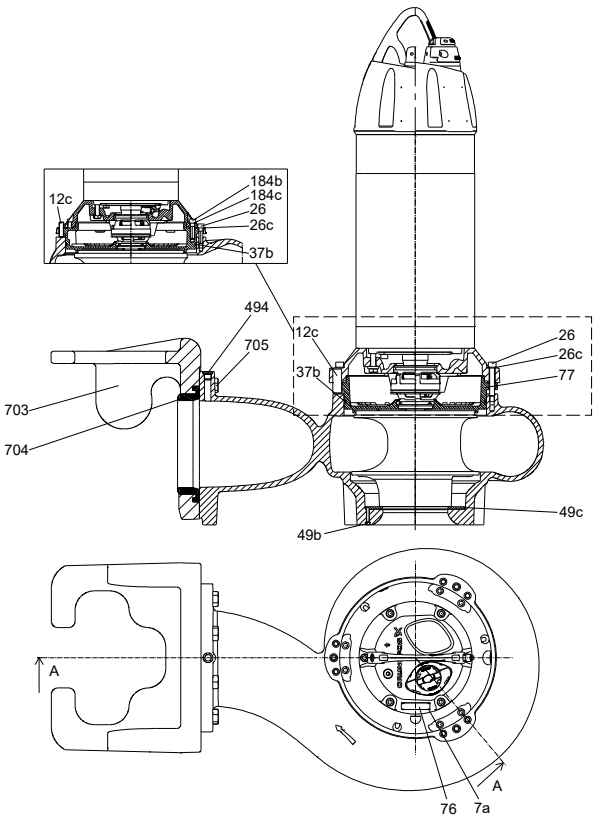


SL pump with Open S-tube® impeller



TM076051

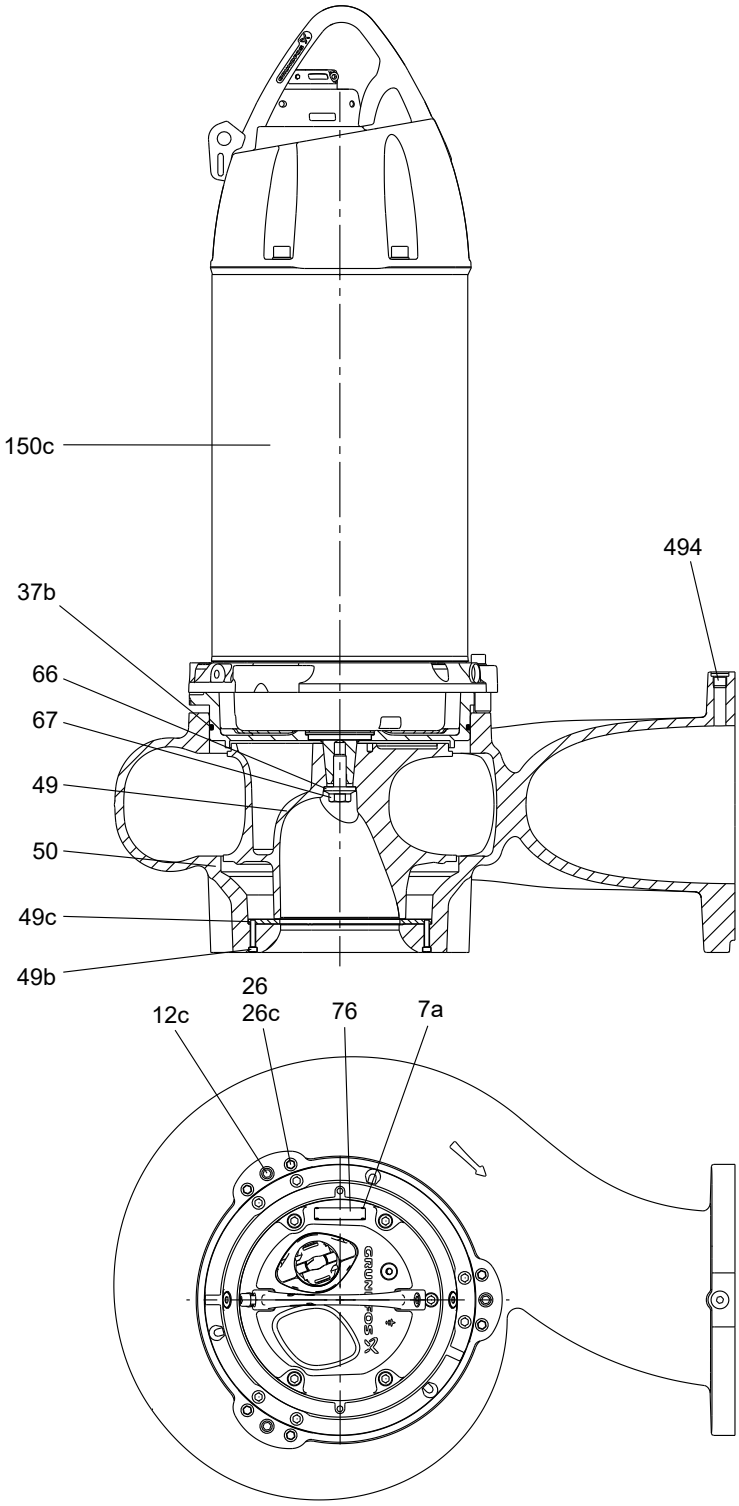
SE pump with guide claw (6-pole motors)



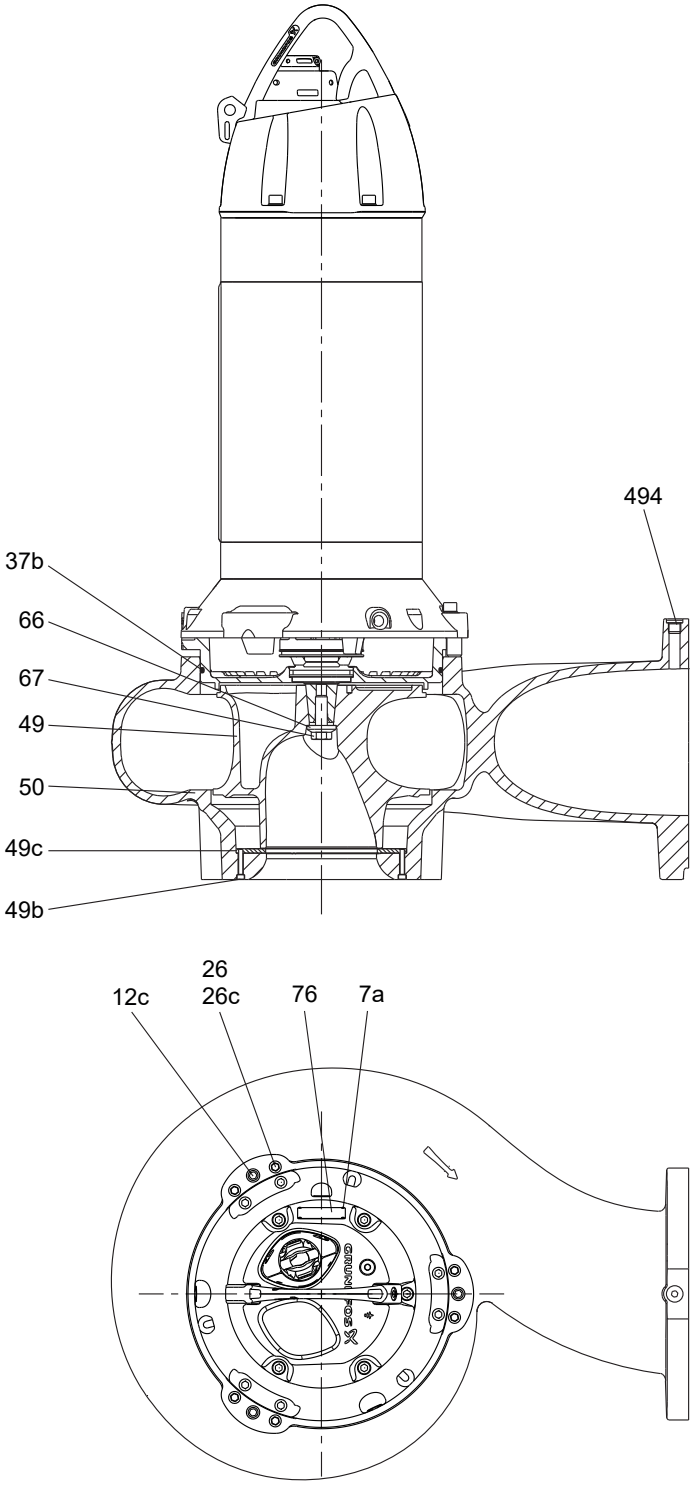
TM076052

SL pump with guide claw (6-pole motors)

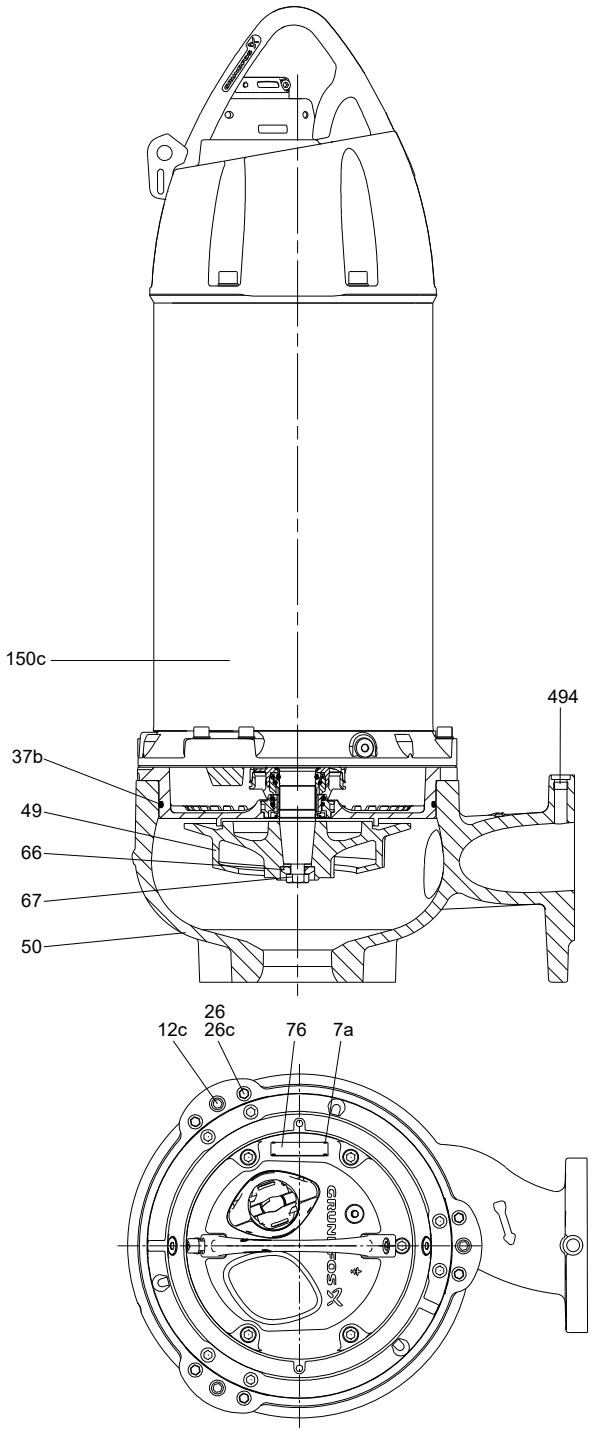
14.2 Sectional drawings, pumps



SE pump with closed S-tube® impeller

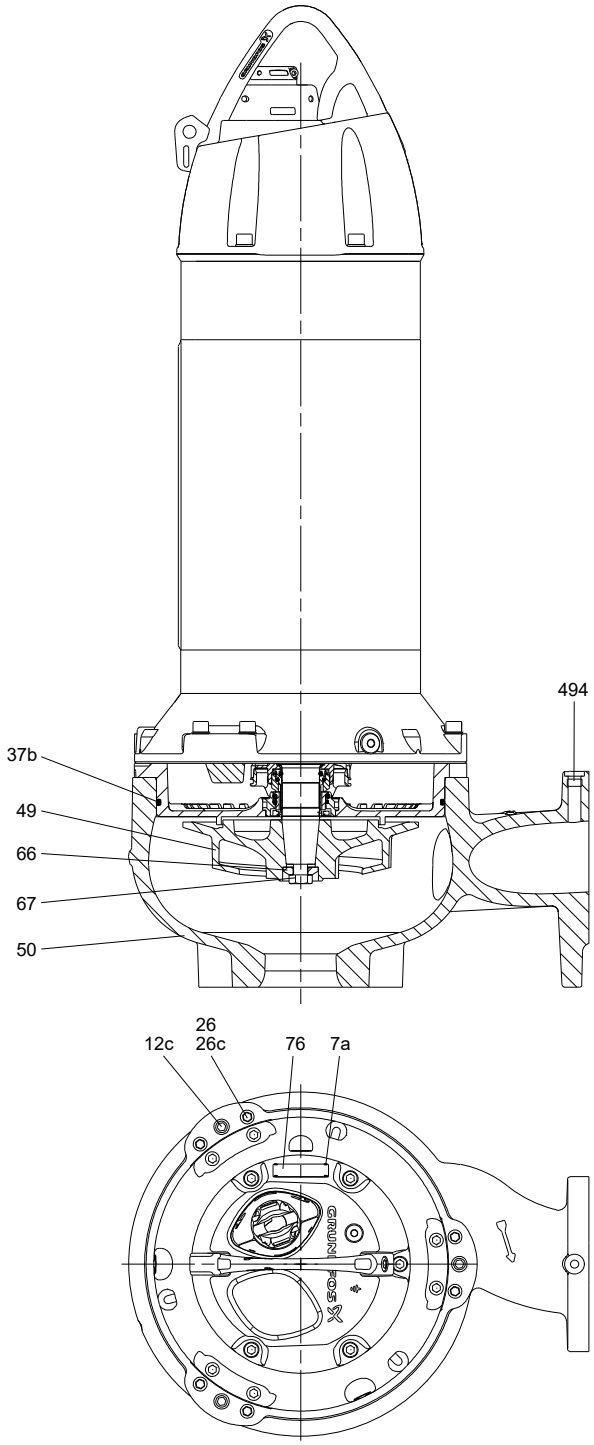


SL pump with closed S-tube® impeller



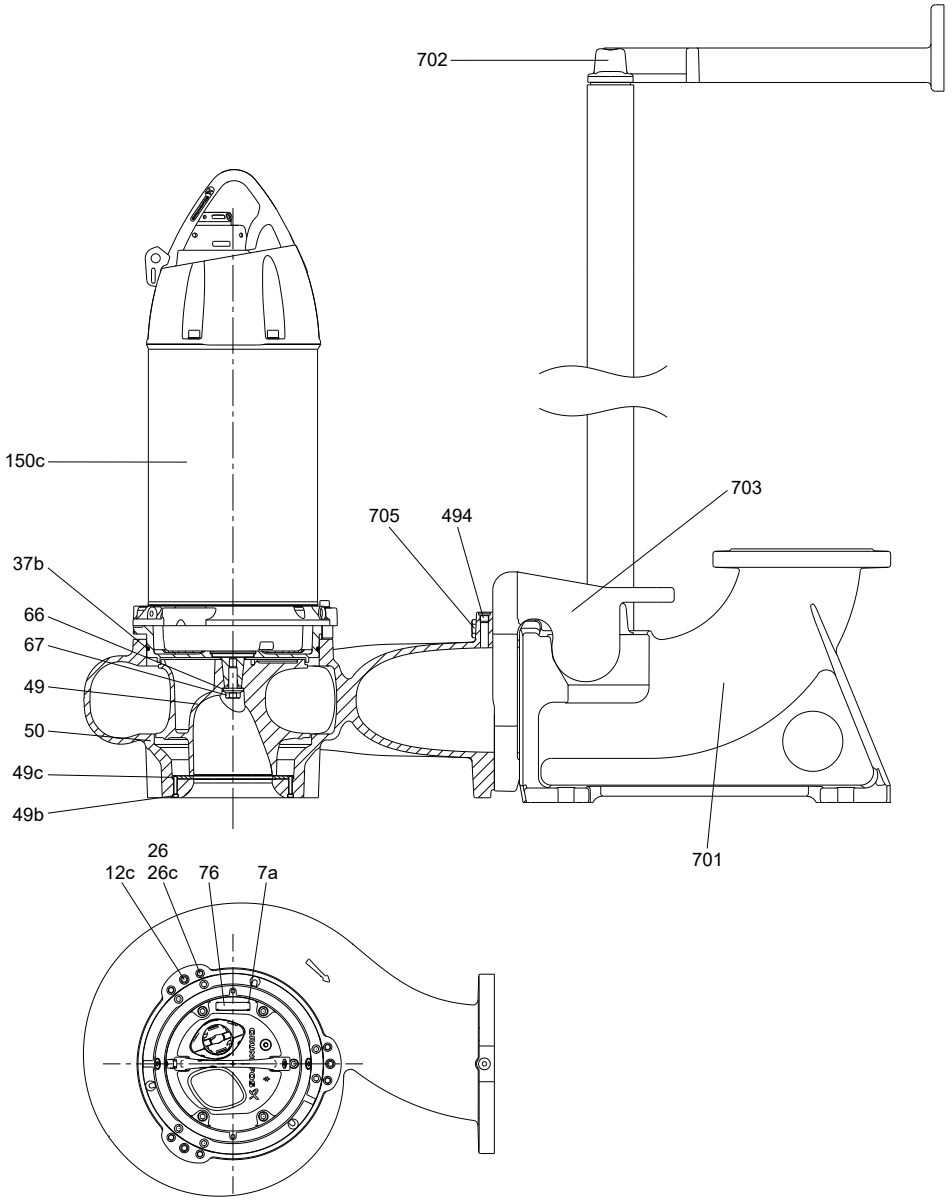
TM076042

SE pump with SuperVortex impeller

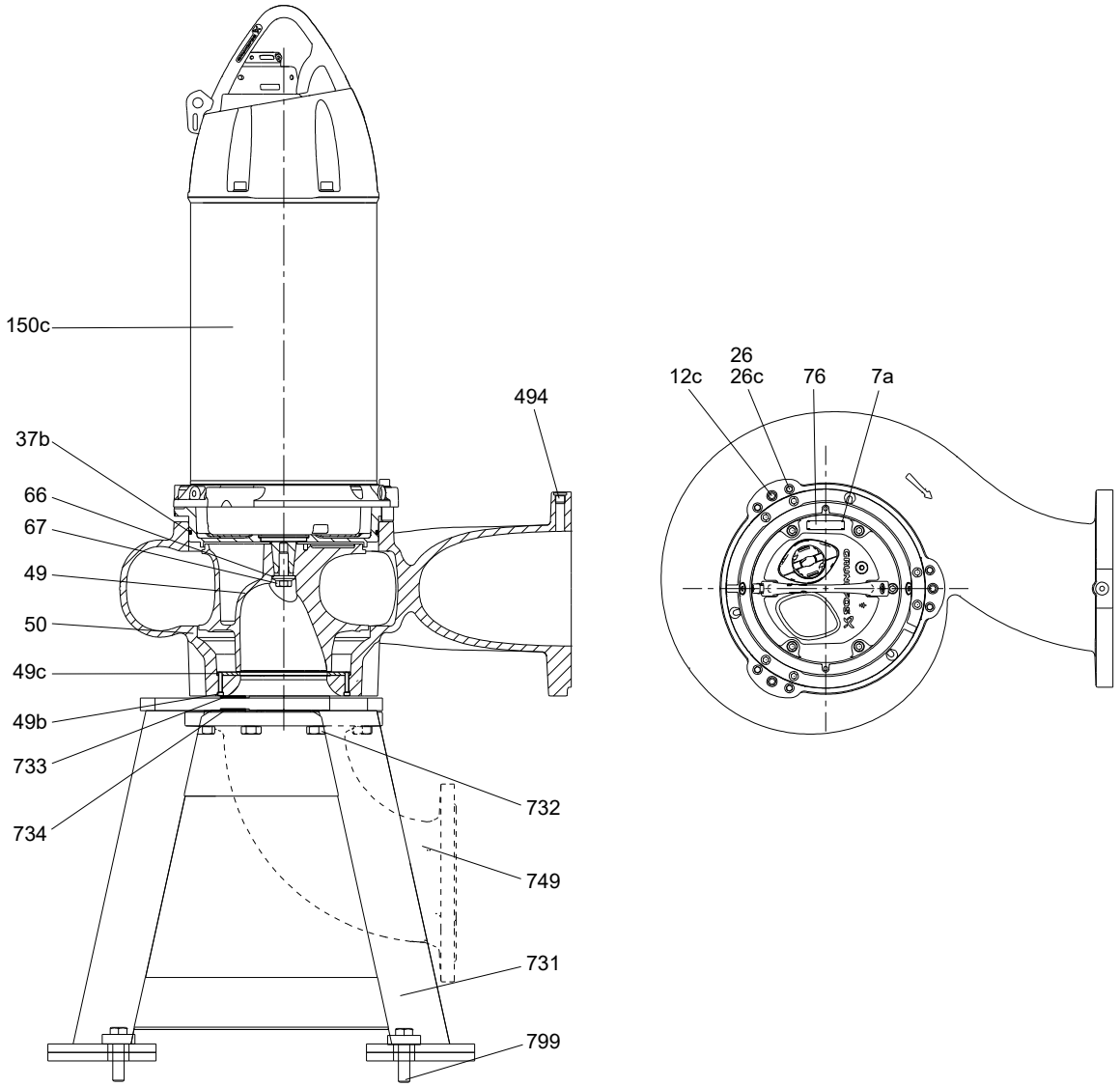


TM076043

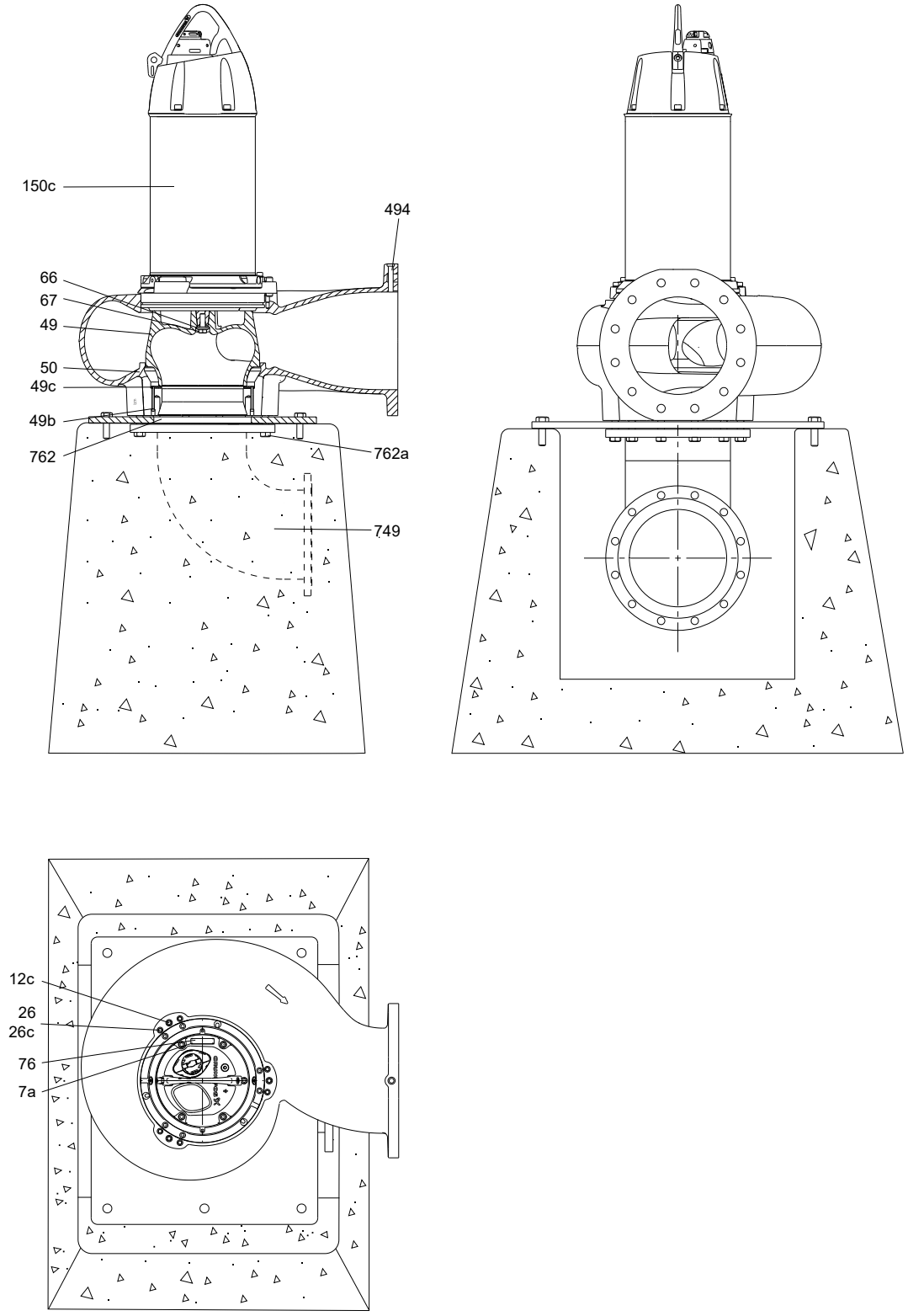
SL pump with SuperVortex impeller



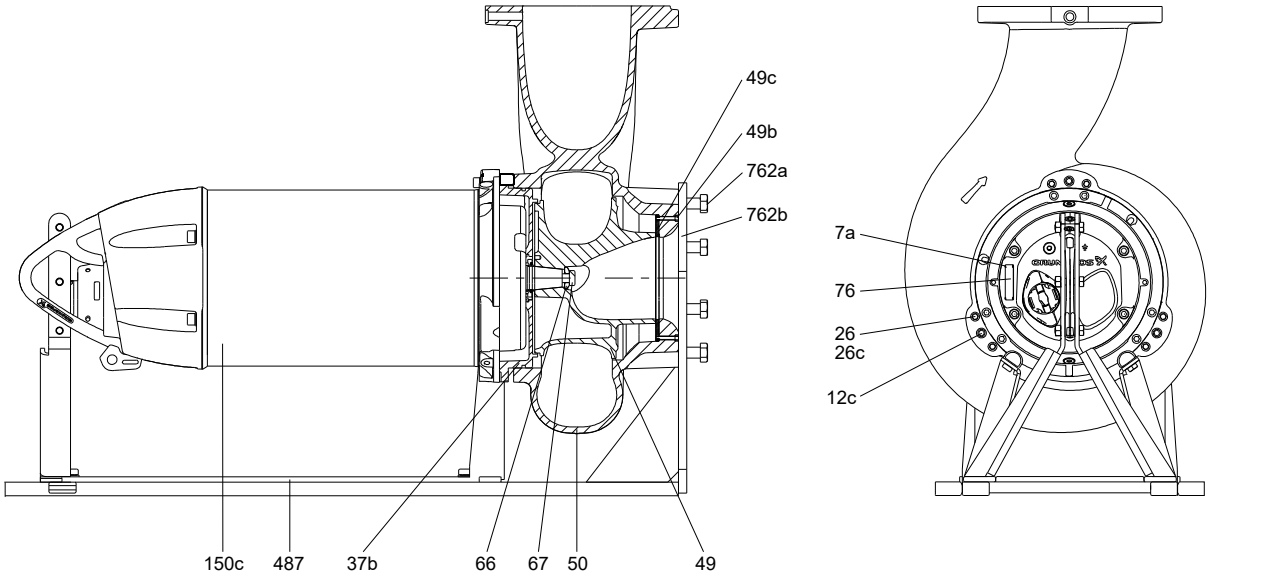
SE pump with guide claw for auto coupling



SE pump, dry installation on vertical base stand (recommended for SE pumps below 15 kW [20 hp])



SE pump, dry installation on concrete foundation (recommended for SE pumps from and above 15 kW [20 hp])



SE pump, dry installation on horizontal base stand

15. List of power cables

The following table contains the 10 and 15 metre cables for the standard pump Generation A range:

Cable sizes for DIN Ex 50 Hz pumps

Poles	Power [kW]	Frequency [Hz]	Voltage	Standard cable	EMC cable
2	13	50	1E	7 x 6 mm^2	3 x 6 mm^2
2	13	50	1D	7 x 4 mm^2	3 x 6 mm^2
2	13	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	15	50	1E	7 x 6 mm^2	3 x 10 mm^2
2	15	50	1D	7 x 4 mm^2	3 x 6 mm^2
2	15	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	17	50	1E	7 x 10 mm^2	3 x 10 mm^2
2	17	50	1D	7 x 4 mm^2	3 x 6 mm^2
2	17	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	18.5	50	1E	7 x 10 mm^2	3 x 10 mm^2
2	18.5	50	1D	7 x 4 mm^2	3 x 6 mm^2
2	18.5	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	20	50	1E	7 x 10 mm^2	3 x 16 mm^2
2	20	50	1D	7 x 4 mm^2	3 x 6 mm^2
2	20	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	22	50	1E	7 x 10 mm^2	3 x 16 mm^2
2	22	50	1D	7 x 4 mm^2	3 x 6 mm^2
2	22	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	24	50	1E	N/A	3 x 16 mm^2
2	24	50	1D	7 x 6 mm^2	3 x 10 mm^2
2	24	50	1N	7 x 4 mm^2	3 x 6 mm^2
2	26.5	50	1D	7 x 6 mm^2	3 x 10 mm^2
2	26.5	50	1N	7 x 4 mm^2	3 x 6 mm^2

Poles	Power [kW]	Frequency [Hz]	Voltage	Standard cable	EMC cable
2	13	60	1F	7 x 6 mm^2	3 x 6 mm^2
2	13	60	1R	7 x 6 mm^2	3 x 6 mm^2
2	13	60	1G	7 x 4 mm^2	3 x 6 mm^2
2	13	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	13	60	0S	7 x 6 mm^2	3 x 10 mm^2
2	15	60	1F	7 x 6 mm^2	3 x 10 mm^2
2	15	60	1R	7 x 6 mm^2	3 x 10 mm^2
2	15	60	1G	7 x 4 mm^2	3 x 6 mm^2
2	15	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	15	60	0S	7 x 6 mm^2	3 x 10 mm^2
2	17	60	1F	7 x 10 mm^2	3 x 10 mm^2
2	17	60	1R	7 x 10 mm^2	3 x 10 mm^2
2	17	60	1G	7 x 4 mm^2	3 x 6 mm^2
2	17	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	17	60	0S	7 x 10 mm^2	3 x 10 mm^2
2	18.5	60	1F	7 x 10 mm^2	3 x 10 mm^2
2	18.5	60	1R	7 x 10 mm^2	3 x 10 mm^2
2	18.5	60	1G	7 x 4 mm^2	3 x 6 mm^2
2	18.5	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	18.5	60	0S	7 x 10 mm^2	3 x 16 mm^2
2	22	60	1F	7 x 10 mm^2	3 x 16 mm^2
2	22	60	1G	7 x 6 mm^2	3 x 6 mm^2
2	22	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	22	60	0R	3 x 16 mm^2	3 x 16 mm^2
2	25	60	1G	7 x 6 mm^2	3 x 10 mm^2
2	25	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	25	60	0R	3 x 16 mm^2	3 x 16 mm^2
2	29	60	1G	7 x 10 mm^2	3 x 10 mm^2
2	29	60	1M	7 x 4 mm^2	3 x 6 mm^2
2	31	60	1G	7 x 10 mm^2	3 x 10 mm^2
2	31	60	1M	7 x 4 mm^2	3 x 6 mm^2

Cable sizes for DIN Ex 60 Hz pumps

Poles	Power [kW]	Frequency [Hz]	Voltage	Standard cable	EMC cable
4	10	50	1E	7 x 4 mm^2	3 x 6 mm^2
4	10	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	10	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	11	50	1E	7 x 4 mm^2	3 x 6 mm^2
4	11	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	11	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	13	50	1E	7 x 6 mm^2	3 x 6 mm^2
4	13	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	13	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	15	50	1E	7 x 6 mm^2	3 x 10 mm^2
4	15	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	15	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	17	50	1E	7 x 10 mm^2	3 x 16 mm^2
4	17	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	17	50	1N	7 x 4 mm^2	3 x 6 mm^2

Poles	Power [kW]	Frequency [Hz]	Voltage	Standard cable	EMC cable
4	18.5	50	1E	7 x 10 mm^2	3 x 16 mm^2
4	18.5	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	18.5	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	20	50	1E	7 x 10 mm^2	3 x 16 mm^2
4	20	50	1D	7 x 4 mm^2	3 x 6 mm^2
4	20	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	22	50	1E	N/A	3 x 16 mm^2
4	22	50	1D	7 x 6 mm^2	3 x 6 mm^2
4	22	50	1N	7 x 4 mm^2	3 x 6 mm^2
4	9	60	1F	7 x 4 mm^2	3 x 6 mm^2
4	9	60	1R	7 x 4 mm^2	3 x 6 mm^2
4	9	60	1G	7 x 4 mm^2	3 x 6 mm^2
4	9	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	9	60	0S	7 x 4 mm^2	3 x 6 mm^2
4	11	60	1F	7 x 4 mm^2	3 x 6 mm^2
4	11	60	1R	7 x 4 mm^2	3 x 6 mm^2
4	11	60	1G	7 x 4 mm^2	3 x 6 mm^2
4	11	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	11	60	0S	7 x 4 mm^2	3 x 6 mm^2
4	13	60	1F	7 x 6 mm^2	3 x 6 mm^2
4	13	60	1R	7 x 6 mm^2	3 x 6 mm^2
4	13	60	1G	7 x 4 mm^2	3 x 6 mm^2
4	13	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	13	60	0S	7 x 6 mm^2	3 x 10 mm^2
4	15	60	1F	7 x 6 mm^2	3 x 10 mm^2
4	15	60	1R	7 x 6 mm^2	3 x 10 mm^2
4	15	60	1G	7 x 4 mm^2	3 x 6 mm^2
4	15	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	15	60	0S	7 x 6 mm^2	3 x 10 mm^2
4	18	60	1F	7 x 10 mm^2	3 x 10 mm^2
4	18	60	1R	7 x 10 mm^2	3 x 10 mm^2
4	18	60	1G	7 x 4 mm^2	3 x 6 mm^2
4	18	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	20	60	1F	7 x 10 mm^2	3 x 16 mm^2
4	20	60	1R	7 x 10 mm^2	3 x 16 mm^2
4	20	60	1G	7 x 6 mm^2	3 x 6 mm^2
4	20	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	20	60	0S	7 x 10 mm^2	3 x 16 mm^2
4	22	60	1F	7 x 10 mm^2	3 x 16 mm^2
4	22	60	1R	N/A	3 x 16 mm^2
4	22	60	1G	7 x 6 mm^2	3 x 10 mm^2
4	22	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	22	60	0S	N/A	3 x 16 mm^2
4	22	60	0R	3 x 16 mm^2	3 x 16 mm^2
4	24.5	60	1F	N/A	3 x 16 mm^2
4	24.5	60	1R	N/A	3 x 16 mm^2
4	24.5	60	1G	7 x 6 mm^2	3 x 10 mm^2

Poles	Power [kW]	Frequency [Hz]	Voltage	Standard cable	EMC cable
4	24.5	60	1M	7 x 4 mm^2	3 x 6 mm^2
4	24.5	60	0S	N/A	3 x 16 mm^2
4	24.5	60	0R	3 x 16 mm^2	3 x 16 mm^2

Cable sizes for ANSI non-Ex 60 Hz pumps

Poles	Power [kW (hp)]	Frequency [Hz]	Voltage	Standard cable	EMC cable
6	11 (15)	50	1E	7 x 10 mm^2	3 x 10 mm^2
6	11 (15)	50	1D	7 x 4 mm^2	3 x 6 mm^2
6	11 (15)	50	1N	7 x 4 mm^2	3 x 6 mm^2
6	13 (17)	50	1E	7 x 10 mm^2	3 x 10 mm^2
6	13 (17)	50	1D	7 x 4 mm^2	3 x 6 mm^2
6	13 (17)	50	1N	7 x 4 mm^2	3 x 6 mm^2
6	16 (21)	50	1E	7 x 10 mm^2	3 x 16 mm^2
6	16 (21)	50	1D	7 x 4 mm^2	3 x 6 mm^2
6	16 (21)	50	1N	7 x 4 mm^2	3 x 6 mm^2
6	18 (24)	50	1E	7 x 10 mm^2	3 x 16 mm^2
6	18 (24)	50	1D	7 x 4 mm^2	3 x 6 mm^2
6	18 (24)	50	1N	7 x 4 mm^2	3 x 6 mm^2
6	8 (11)	60	1F	7 x 4 mm^2	3 x 6 mm^2
6	8 (11)	60	11	7 x 4 mm^2	3 x 6 mm^2
6	8 (11)	60	15	7 x 4 mm^2	3 x 6 mm^2
6	8 (11)	60	1M	7 x 4 mm^2	3 x 6 mm^2
6	8 (11)	60	0S	7 x 6 mm^2	3 x 6 mm^2
6	8 (11)	60	1R	7 x 4 mm^2	3 x 6 mm^2
6	10 (13)	60	1F	7 x 6 mm^2	3 x 6 mm^2
6	10 (13)	60	11	7 x 4 mm^2	3 x 6 mm^2
6	10 (13)	60	15	7 x 4 mm^2	3 x 6 mm^2
6	10 (13)	60	1M	7 x 4 mm^2	3 x 6 mm^2
6	10 (13)	60	0S	7 x 6 mm^2	3 x 10 mm^2
6	10 (13)	60	1R	7 x 4 mm^2	3 x 6 mm^2
6	12 (16)	60	1F	7 x 6 mm^2	3 x 10 mm^2
6	12 (16)	60	11	7 x 4 mm^2	3 x 6 mm^2
6	12 (16)	60	15	7 x 4 mm^2	3 x 6 mm^2
6	12 (16)	60	1M	7 x 4 mm^2	3 x 6 mm^2
6	12 (16)	60	0S	7 x 6 mm^2	3 x 10 mm^2
6	12 (16)	60	1R	7 x 6 mm^2	3 x 10 mm^2
6	14 (19)	60	1F	7 x 6 mm^2	3 x 10 mm^2
6	14 (19)	60	11	7 x 4 mm^2	3 x 6 mm^2
6	14 (19)	60	15	7 x 4 mm^2	3 x 6 mm^2
6	14 (19)	60	1M	7 x 4 mm^2	3 x 6 mm^2
6	14 (19)	60	0S	7 x 10 mm^2	3 x 10 mm^2
6	14 (19)	60	1R	7 x 6 mm^2	3 x 10 mm^2
6	16 (21)	60	1F	7 x 10 mm^2	3 x 10 mm^2
6	16 (21)	60	11	7 x 4 mm^2	3 x 6 mm^2
6	16 (21)	60	15	7 x 4 mm^2	3 x 6 mm^2
6	16 (21)	60	1M	7 x 4 mm^2	3 x 6 mm^2
6	16 (21)	60	0S	7 x 10 mm^2	3 x 16 mm^2
6	16 (21)	60	1R	7 x 10 mm^2	3 x 10 mm^2
6	19 (25)	60	1F	7 x 10 mm^2	3 x 16 mm^2

Poles	Power [kW (hp)]	Frequency [Hz]	Voltage	Standard cable	EMC cable
6	19 (25)	60	11	7 x 4 mm^2	3 x 6 mm^2
6	19 (25)	60	15	7 x 4 mm^2	3 x 6 mm^2
6	19 (25)	60	1M	7 x 4 mm^2	3 x 6 mm^2
6	19 (25)	60	0S	7 x 10 mm^2	3 x 16 mm^2
6	19 (25)	60	1R	7 x 10 mm^2	3 x 16 mm^2

The following table can be used to compare metric and US imperial cable dimensions:

Standard

Cable type [mm^2]	Outer cable diameter [in. (mm)]		Minimum bending radius [in. (mm)]
	Min.	Max.	
7 x 4 + 5 x 1.5	0.83 (21.2)	0.9 (22.8)	2.76 (70)
7 x 6 + 5 x 1.5	0.96 (24.5)	1.03 (26.1)	3.15 (80)
7 x 10 + 5 x 1.5	0.99 (25.2)	1.06 (26.8)	4.33 (110

EMC

Cable type [mm^2]	Outer cable diameter [in. (mm)]		Minimum bending radius [in. (mm)]
	Min.	Max.	
3 x 6 + 4 x 2.5 + 5 x 0.5	1.04 (26.3)	1.11 (28.3)	3.54 (90)
3 x 10 + 4 x 2.5 +5 x 0.5	1.04 (26.3)	1.11 (28.3)	4.72 (120)
3 x 16 +4 x 4 + 5 x 0.5	1.04 (26.3)	1.11 (28.3)	5.51 (140)

16. Conversion and modification of non-Ex pumps

Modifications of Ex pumps are prohibited without approval from Grundfos.

For non-Ex pumps, the modification is allowed for a variety of reasons, such as taking advantage of new Grundfos technology, or adapting the pump to a site-specific application. In all cases, modifications need to be properly recorded by the customer as the customer has to contact Grundfos directly when future service parts are required.

The most common after-sales modifications are:

- cable conversion
- change O-rings from NBR to FKM
- upgrade shaft seals and lower bearings
- conversion from Closed S-tube® hydraulics to Open S-tube® hydraulics
- conversion from Medium Head-class pump hydraulics to Sand Guard Rings version.

16.1 Cable conversion

Standard to EMC cable conversion

It is possible to convert a Model A pump from a standard cable to an EMC cable. Make sure that these conversions are completed by Grudfos as there are differences between the two assemblies.

Converting to a different cable length

In most cases, it is possible to converting a Model A pump to have a different cable length. Make sure that these conversions are completed by Grudfos.

Contact Grundfos to discuss cable conversion options.

16.2 O-ring material grade conversion

Model A pumps fitted with NBR O-rings can be changed to FKM O-rings. The O-ring for the lower seal housing (37b) is sold separately from the O-ring set used in the motor.

Motor O-rings

The motor O-ring set depends on the installation type, material grade, and the number of cables. There are eight different motor O-ring sets across the pump range, four NBR and four FKM. Contact Grundfos to obtain the kit numbers for the relevant motor O-ring set.

Description	Material grade	Installation type	No of cables
Motor O-rings	NBR	Submersible installation without cooling jacket	1
	FKM	Submersible installation without cooling jacket	1
	NBR	Submersible installation with cooling jacket; Dry vertical and horizontal installation	1
	FKM	Submersible installation with cooling jacket; Dry vertical and horizontal installation	1
	NBR	Submersible installation without cooling jacket	2
	FKM	Submersible installation without cooling jacket	2
	NBR	Submersible installation with cooling jacket; Dry vertical and horizontal installation	2
	FKM	Submersible installation with cooling jacket; Dry vertical and horizontal installation	2

Seal housing O-rings

There are two different sized O-rings for the lower seal housing. Only the 50 Hz 16 and 18 kW E Hydraulic pumps use the 359-sized O-ring. There are four different seal housing O-ring sets across the pump range, two NBR and two FKM. Contact Grundfos to obtain the spare numbers for the relevant O-ring.

Description	Material grade	Poles	Frequency (Hz)	Head class	Power (kW)	O-ring size
Seal housing O-ring	NBR	6	50	E	16, 18	359
	FKM	6	50	E	16,18	359
	NBR	6	50, 60	H, M, L, E	E 50 Hz: 11 and 13 kW E 60 Hz: all kW S, H, M, L: all kW	309
	FKM	6	50, 60	H, M, L, E	E 50 Hz: 11 and 13 kW E 60 Hz: all kW S, H, M, L: all kW	309

16.3 Shaft seal and lower bearing upgrade

Shaft Seals

The latest shaft seal version is the ”A” version. It is compatible with the previous version, and it comes in three different sizes and two different material grades. There are six different shaft seal types across the pump range. The "A" version shaft seal is more wear resistant, and can be purchased as a direct replacement of the previous shaft seal version. The 1.4517 grade shaft seal cartridges not only has higher grade stainless steel components, the primary seal is tungsten carbide.

Description	Poles	Material grade
Shaft seal cartridge "A"	6	1.4308
	4	
	2	
Shaft seal cartridge 1.4517 "A"	6	1.4517
	4	
	2	

Shaft seal kits can be found on Grundfos Product Center (GPC). For further information, contact Grundfos.

Lower bearing

All pumps in the SE/SL 9-30 kW / 12-42 Hp range use the same type of lower bearing, and the bearing comes in three different sizes. The latest version of the lower bearing is the doubled-sealed (2RS) version, that was introduced to the pump range in week 43, 2019. The 2RS bearing is compatible with the previous version. All kits containing the lower bearing have the 2RS-type bearing.

Description	Poles	Lower bearing seal
Lower bearing	6	2RS
	4	
	2	

Shaft seal and lower bearing

The 2RS lower bearing and 1.4308 material grade "A" version shaft seal can be found in a combined service kit on GPC. These kits are available in three different sizes.

Description	Poles	Shaft seal material grade	Lower bearing seal
Shaft seal "A" with 2RS lower bearing	6	1.4308	2RS
	4		
	2		

16.4 Closed S-tube® to Open S-tube® conversion

It is possible to convert Closed S-tube® to Open S-tube® for most super-high head, and high head-class pumps. Conversion kits are available on GPC.

On the same motor, pump performance curves of Open and Closed S-tube® hydraulics can be different. When comparing pump curves with the same duty point, the P2 of the pumps may be different. When converting a Closed S-tube® hydraulics to Open S-tube® hydraulics, the pairing of the new hydraulics to the existing motor is always based on the motor power. For some pumps, the duty point changes slightly after the conversion. For further information, contact Grundfos.

Super-high head (S) hydraulic head class					
50 Hz		60 Hz			
		60 Hz DIN		60 Hz ANSI	
Closed S-tube® hydraulics	Open S-tube® hydraulics with matching or better pump curves	Closed S-tube® hydraulics	Open S-tube® hydraulics with matching or better pump curves	Closed S-tube® hydraulics	Open S-tube® hydraulics with matching or better pump curves
26.5 kW	-	31 kW	31 kW	42 hp	42 hp
24 kW	26.5 kW	29 kW	29 kW	39 hp	39 hp
22 kW	24 kW	25 kW	25 kW	33.5 hp	33.5 hp
20 kW	20 kW	22 kW	22 kW	30 hp	30 hp
18.5 kW	18.5 kW	18.5 kW	18.5 kW	25 hp	25 hp
17 kW	18.5 kW	17 kW	17 kW	23 hp	23 hp
15 kW	15 kW	15 kW	15 kW	20 hp	20 hp
13 kW	13 kW	13 kW	13 kW	17.5 hp	17.5 hp

High-head (H) hydraulic head class					
50 Hz		60 Hz			
		60 Hz DIN		60 Hz ANSI	
Closed S-tube® hydraulics	Open S-tube® hydraulics with matching or better pump curves	Closed S-tube® hydraulics	Open S-tube® hydraulics with matching or better pump curves	Closed S-tube® hydraulics	Open S-tube® hydraulics with matching or better pump curves
22 kW	22 kW	24.5 kW	-	33 hp	-
20 kW	20 kW	22 kW	22 kW	30 hp	30 hp
18.5 kW	20 kW	20 kW	20 kW	27 hp	27 hp
17 kW	18.5 kW	18 kW	18 kW	24.5 hp	24.5 hp
15 kW	17 kW	15 kW	15 kW	20 hp	20 hp
13 kW	13 kW	13 kW	13 kW	17.5 hp	17.5 hp
11 kW	13 kW	11 kW	13 kW	15 hp	17.5 hp
10 kW	11 kW	9 kW	11 kW	12 hp	15 hp

16.5 Medium-head hydraulics with sand guard ring conversion

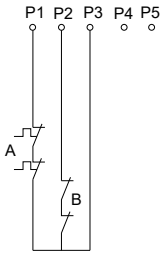
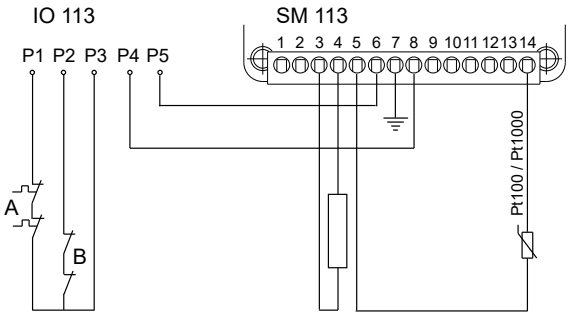
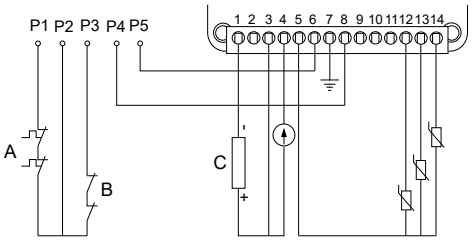
A version of the current medium-head S-tube® hydraulics with a sand guard ring is available and can be retrofitted onto existing medium head-class pumps. This type of hydraulics is for applications with high amounts of long fibres. A sand guard ring is permanently mounted in the volute of the pump, and the hydraulics use a modified impeller design.

For further information, contact Grundfos.

17. Wiring and sensor information

IO113 SM 113 information
IO113 pump configuration (DIP switches 1 and 2)

For further information see IO113 manual.

Sensors	IO113 pump variant configuration	DIP switch setting	Diagram
Standard: Level switch, moisture switch, Klixon/PTC in each winding.	"PA"	ON 1 2	 TM079855
Sensor Set 1: Level switch, moisture switch, Klixon/PTC in each winding, Pt1000 in the stator.	"PB"	ON 1 2	 TM079849
Sensor Set 2: Level switch, moisture switch, Klixon/PTC in each winding, vibration sensor (PVS3), Pt1000 in the stator, lower and upper bearing.	"PC"	ON 1 2	 TM079852

PA - IO 113 without WIO/WIA sensor

A: Moisture switch
B: Thermal switches

PB - With SM 113. Thermal switches, moisture switch, Pt100/Pt1000 sensors

A: Moisture switch
B: Thermal switches

A: Moisture switch
B: Thermal switches
C: Vibration sensor

- The SE/SL 9-30 kW / 12-42 Hp range does not have a Water-In-Air (WIA) or a Water-In-Oil (WIO) sensor. As such, position of DIP switches 11 and 12 must be ON (both in the upper position).
- When the Sensor Module (SM113) is used, ensure that the IO113 with communication functionality (98711370) is also used.
- As this pump range does not have a WIA or WIO sensor, the SM113 must be fitted with a 2.7 kΩ resistor (see wiring diagrams) to avoid false sensor alarms in the IO113.

Testing sensor circuits

- Klixon Circuit: The pass criteria for the Klixon circuit is that the circuit is connected.
- PTC Circuit: The pass criteria for the PTC circuit is between 100 ohms and 500 ohms.
- Moisture/Level Switch Circuit: The pass criteria for the moisture/level switch circuit is that the circuit is connected.

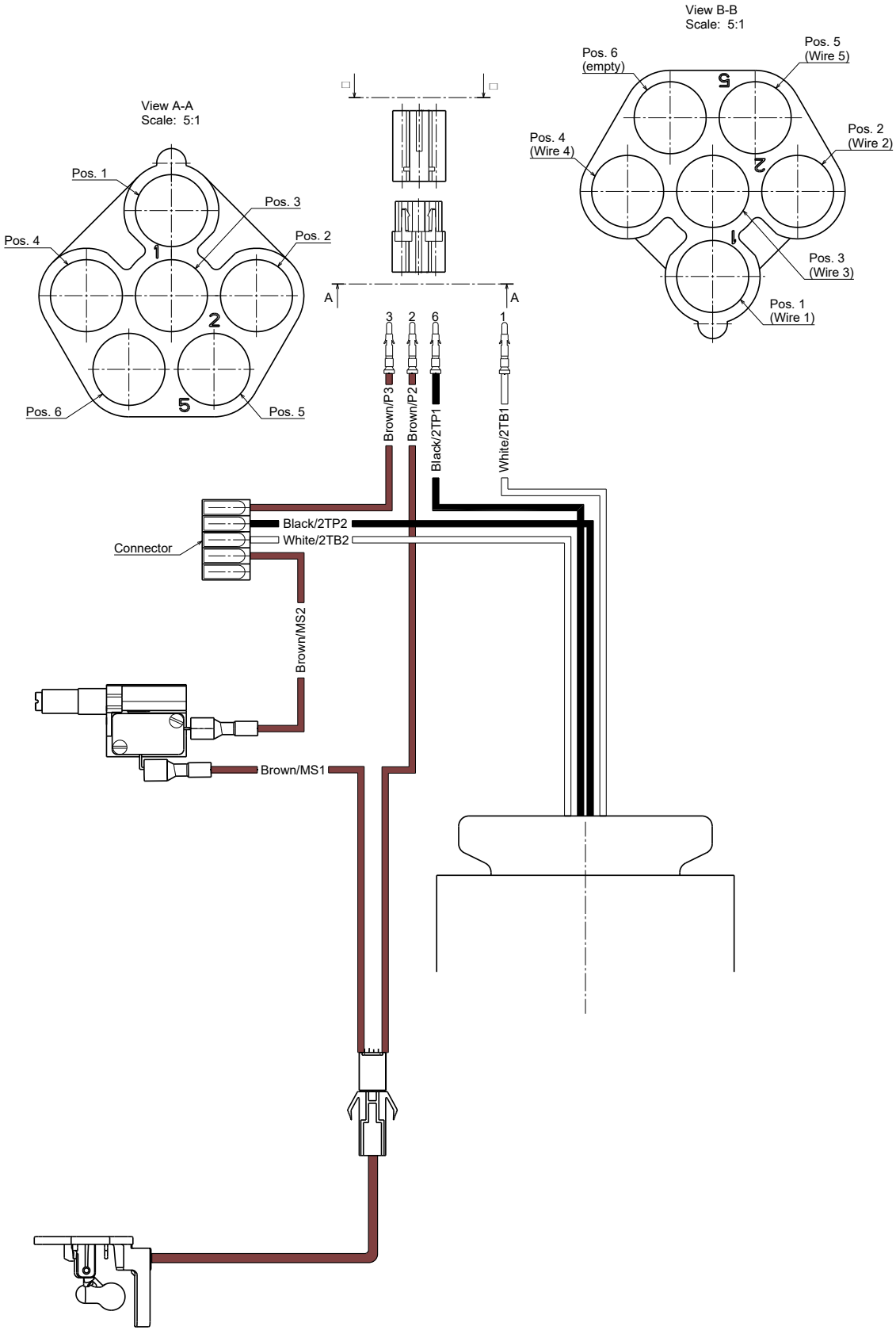
Generation A wiring diagrams

The sensor wiring methods depend on the following:

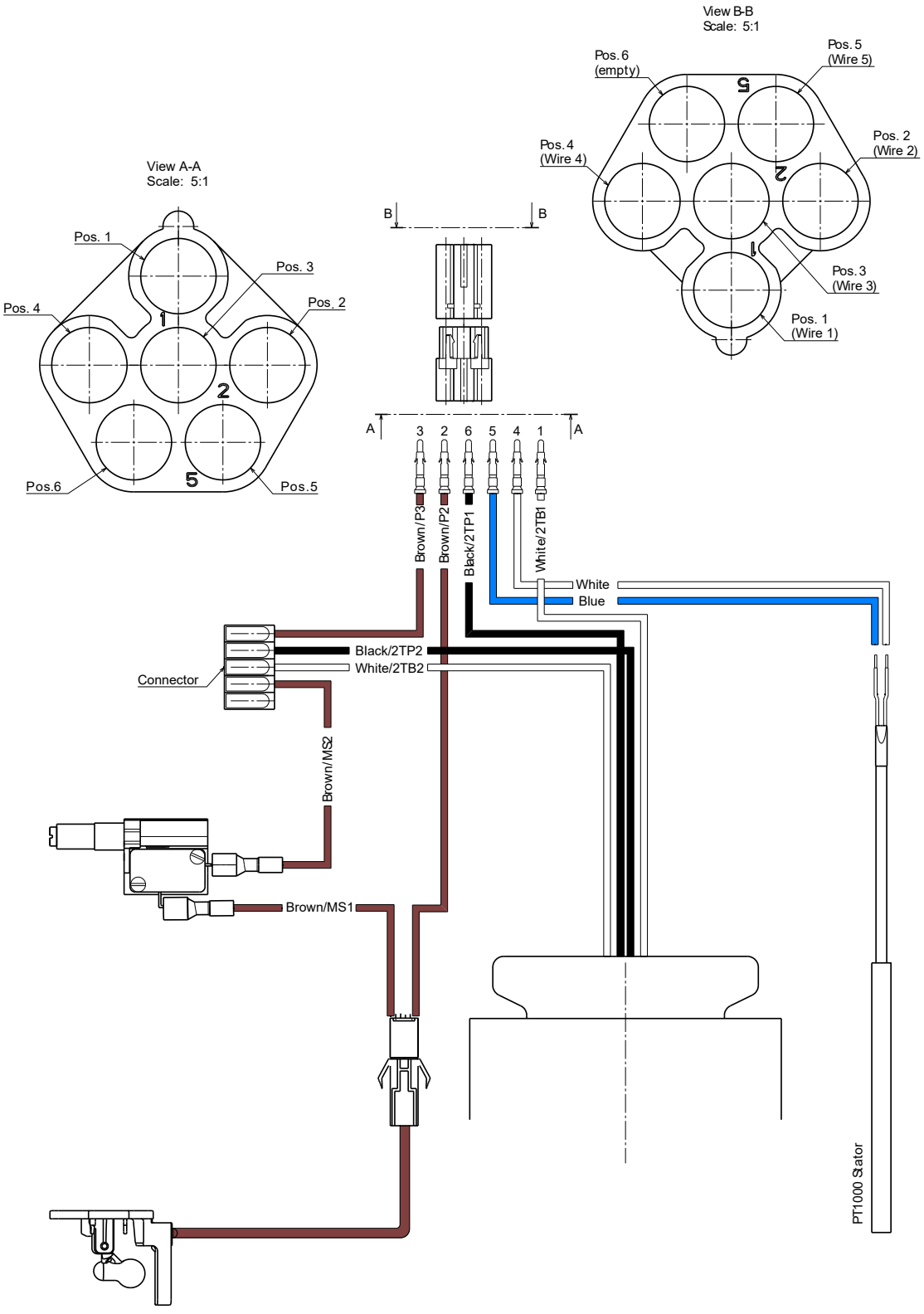
- sensor set in use
- number of power cable inlets
- PTC or Klixon
- Ex version or not.

Use the table below to identify the correct wiring diagram:

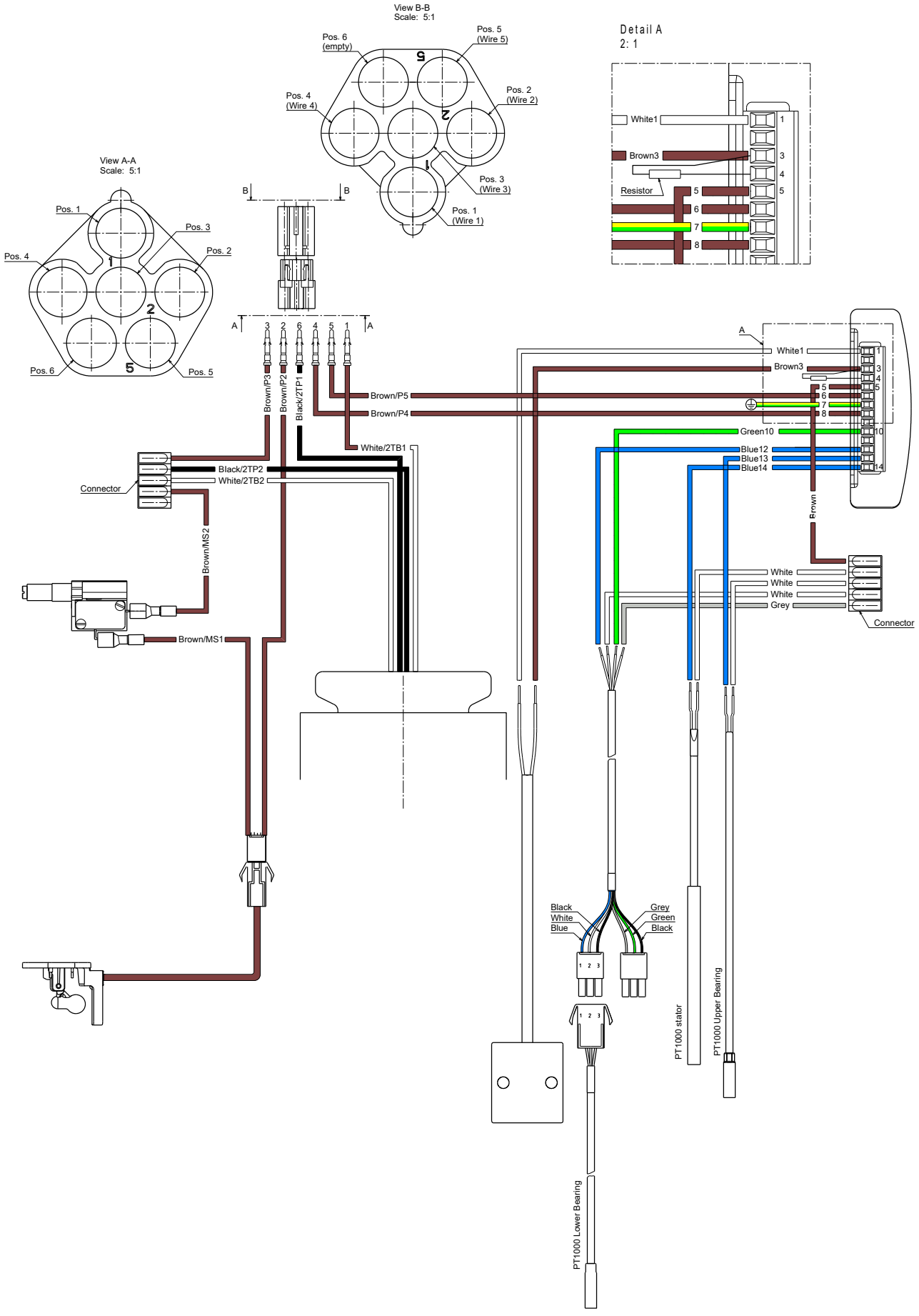
Description	Sensor set	Cable inlet	Stator protection	Ex
Diagram Std. Klixon single cable	Standard	1	Klixon	No
Diagram Sensor 1 Klixon single cable	A	1	Klixon	No
Diagram Sensor 2 Klixon single cable	B	1	Klixon	No
Diagram Std. Ex Klixon single cable	Standard	1	Klixon	Yes
Diagram Sensor 1 Ex Klixon single cable	A	1	Klixon	Yes
Diagram Sensor 2 Ex Klixon single cable	B	1	Klixon	Yes
Diagram Std. PTC single cable	Standard	1	PTC	No
Diagram Sensor 1 PTC single cable	A	1	PTC	No
Diagram Sensor 2 PTC single cable	B	1	PTC	No
Diagram Std. Ex PTC single cable	Standard	1	PTC	Yes
Diagram Sensor 1 Ex PTC single cable	A	1	PTC	Yes
Diagram Sensor 2 Ex PTC single cable	B	1	PTC	Yes
Diagram Std. Klixon double cable	Standard	2	Klixon	No
Diagram Sensor 1 Klixon double cable	A	2	Klixon	No
Diagram Sensor 2 Klixon double cable	B	2	Klixon	No
Diagram Std. Ex Klixon double cable	Standard	2	Klixon	Yes
Diagram Sensor 1 Ex Klixon double cable	A	2	Klixon	Yes
Diagram Sensor 2 Ex Klixon double cable	B	2	Klixon	Yes
Diagram Std. PTC double cable	Standard	2	PTC	No
Diagram Sensor 1 PTC dual cable	A	2	PTC	No
Diagram Sensor 2 PTC dual cable	B	2	PTC	No
Diagram Std. Ex PTC dual cable	Standard	2	PTC	Yes
Diagram Sensor 1 Ex PTC dual cable	A	2	PTC	Yes
Diagram Sensor 2 Ex PTC dual cable	B	2	PTC	Yes



Standard Klixon single cable



Sensor version 1 Klixon single cable



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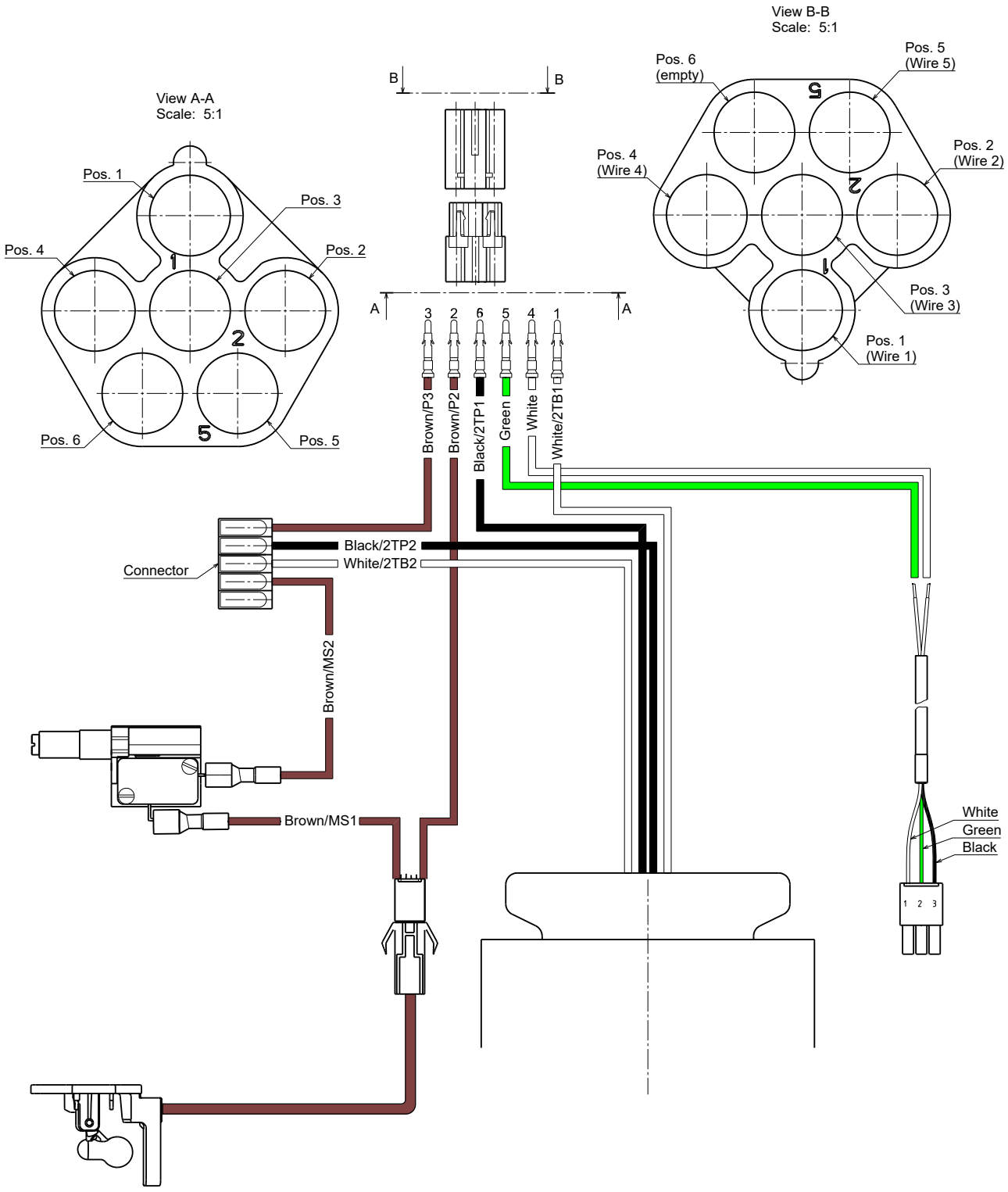
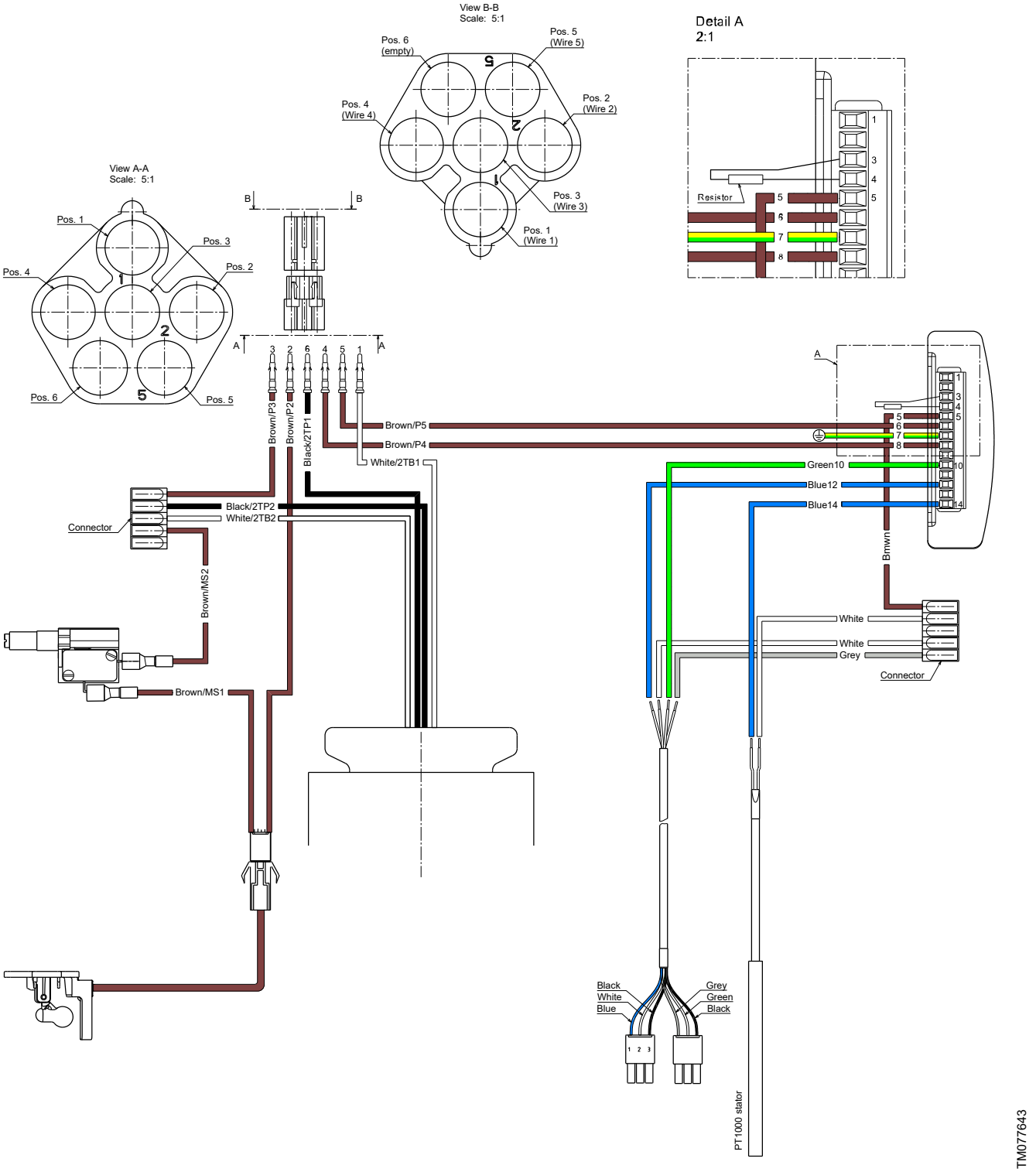


Standard Ex Klixon single cable



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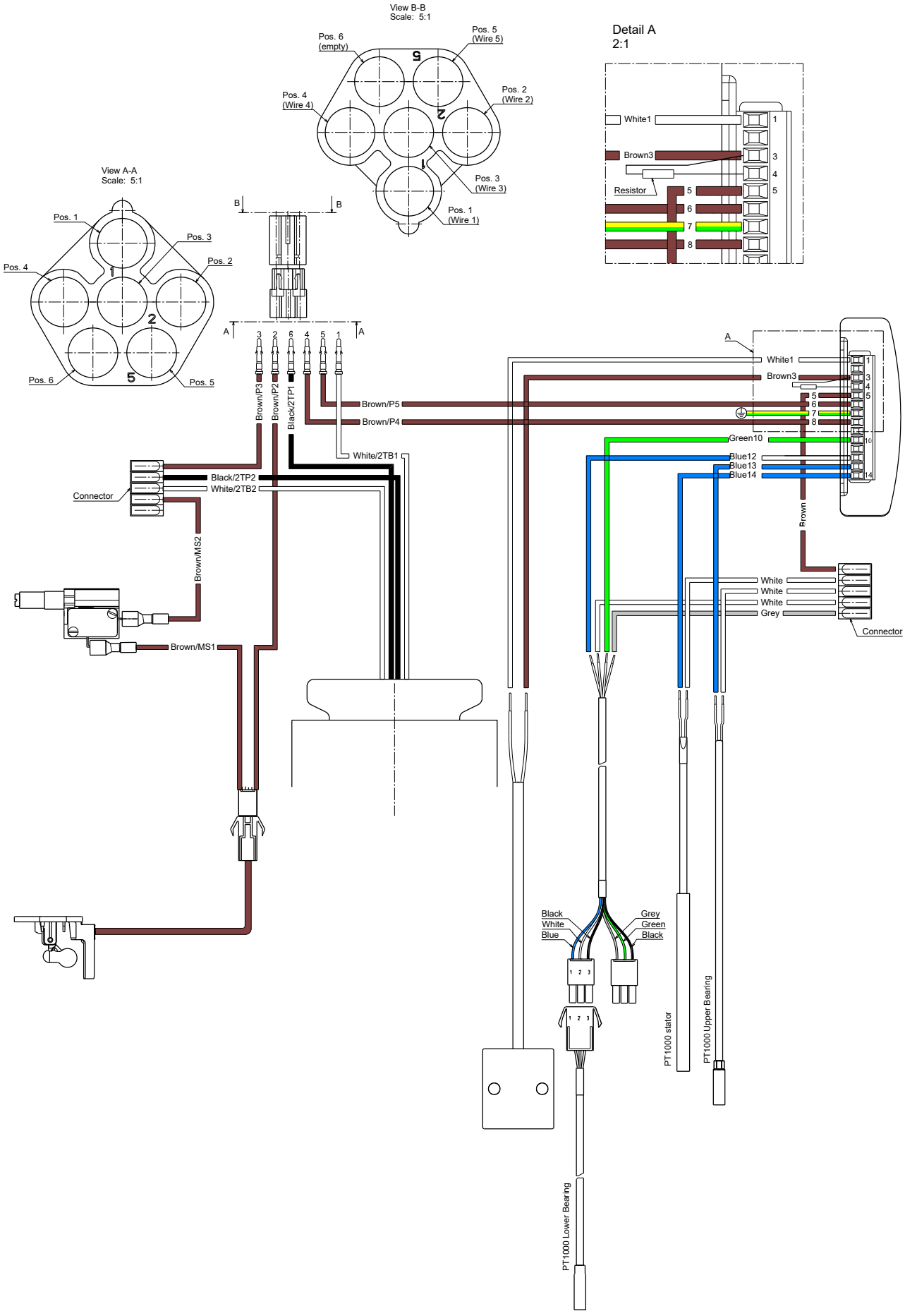

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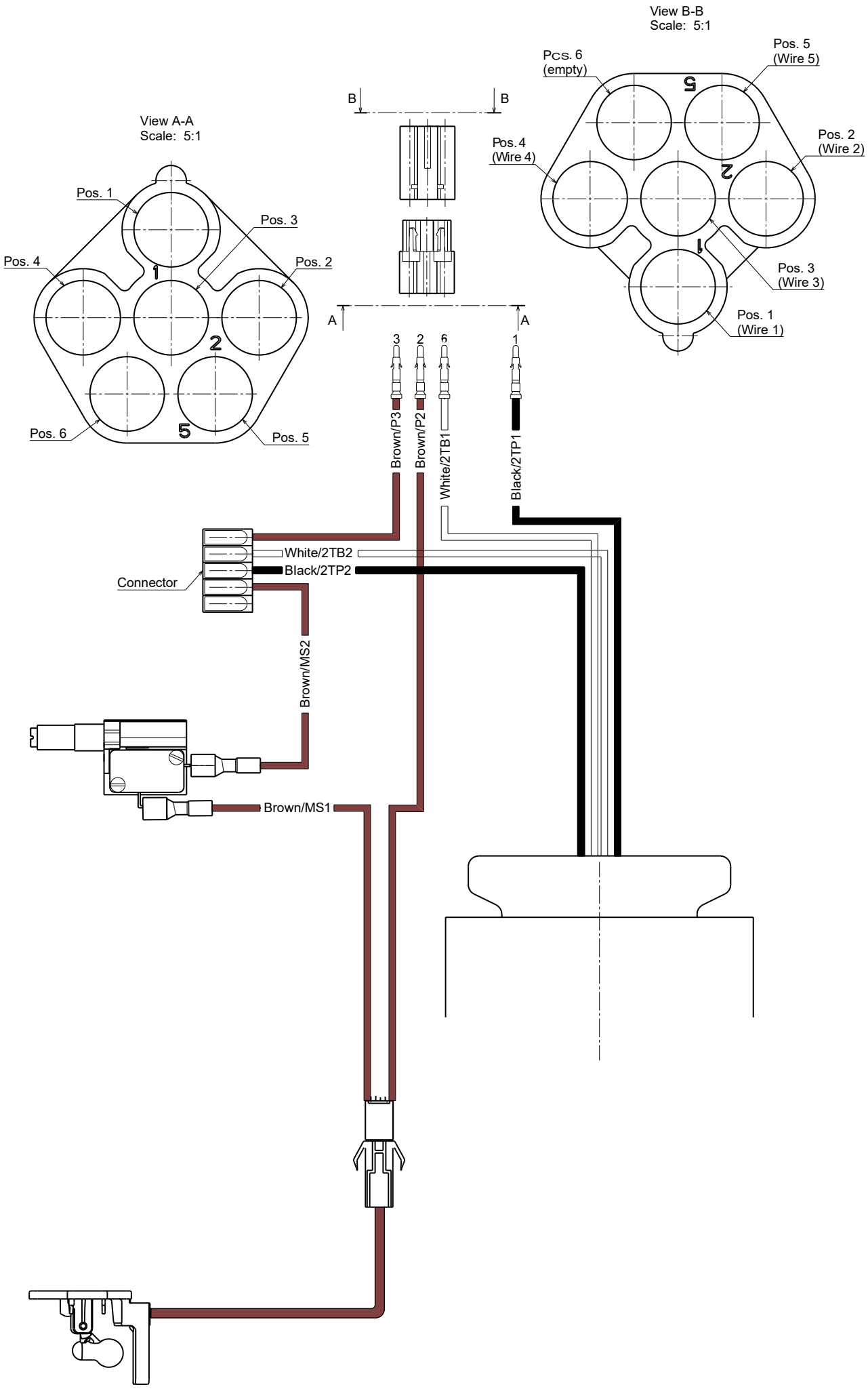
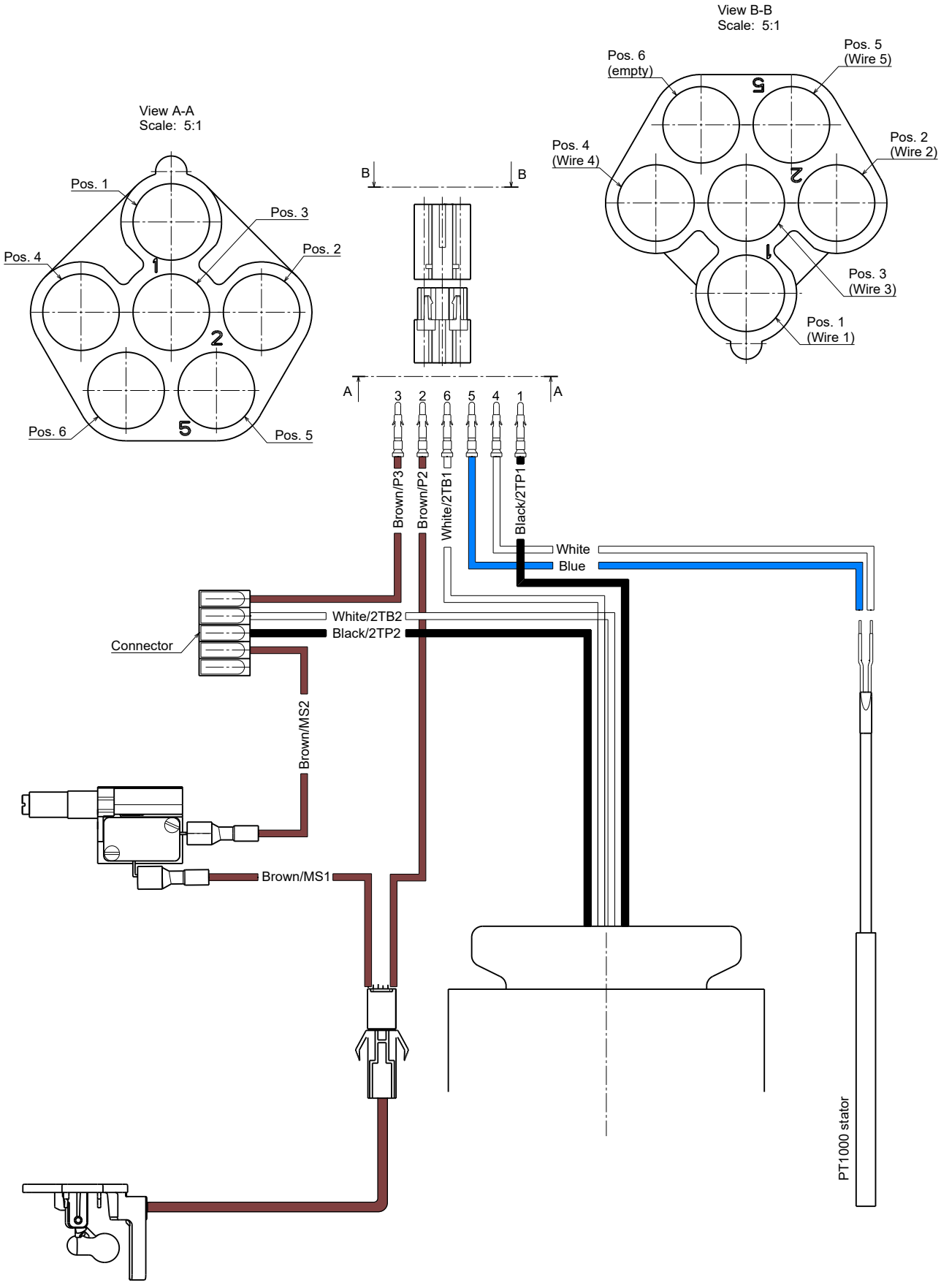

View B-B
Scale: 5:1
Pos. 5
(Wire 5)
Pcs. 6
(empty)
Pos. 4
(Wire 4)
Pos. 2
(Wire 2)
Pos. 3
(Wire 3)
Pos. 1
(Wire 1)
B
B
View A-A
Scale: 5:1
Pos. 1
Pos. 3
Pos. 4
Pos. 2
Pos. 6
Pos. 5
A
A
3
2
6
1
Brown/P3
Brown/P2
White/2TB1
Black/2TP1
White/2TB2
Black/2TP2
Connector
Brown/MS2
Brown/MS1

TM077645



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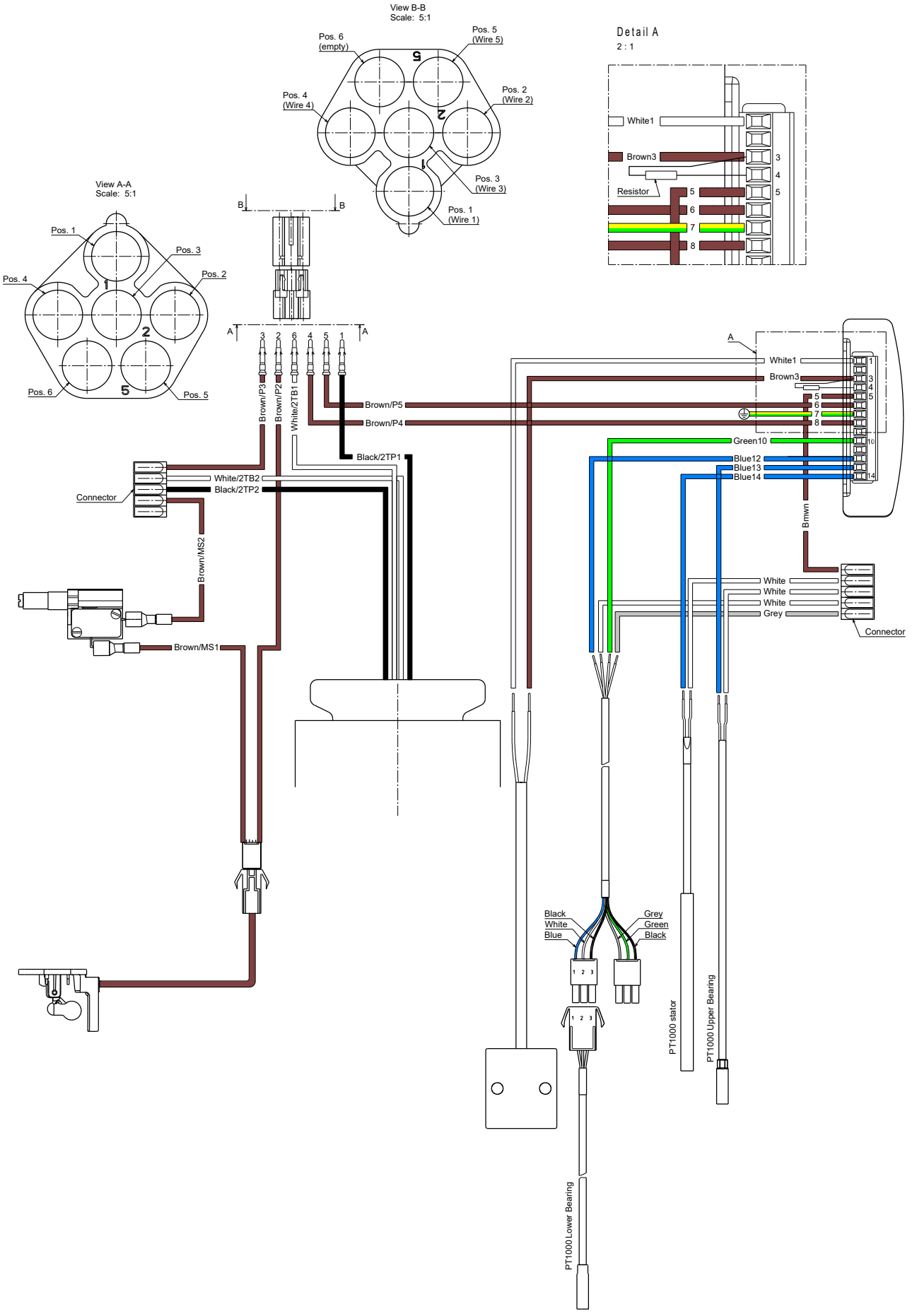

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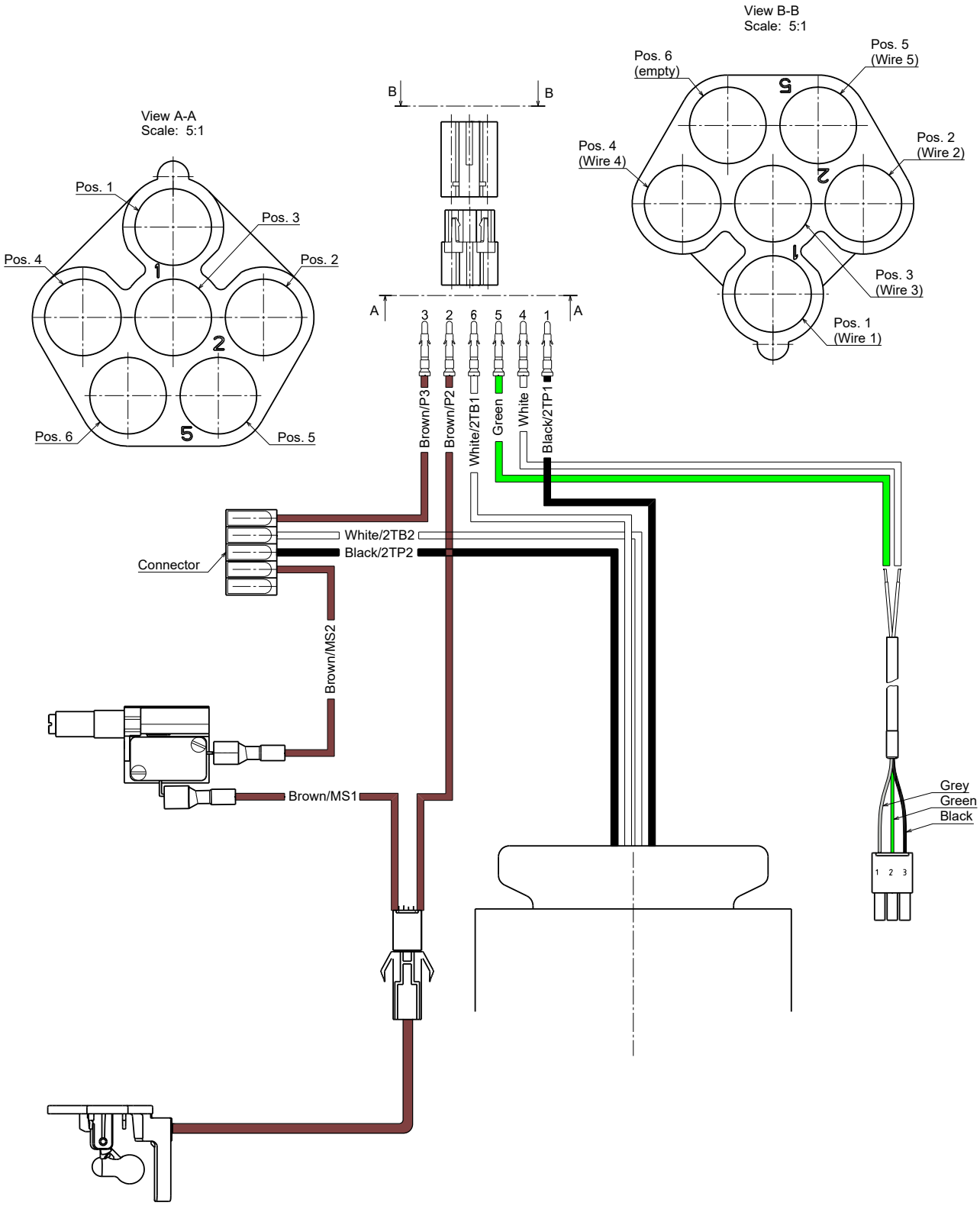

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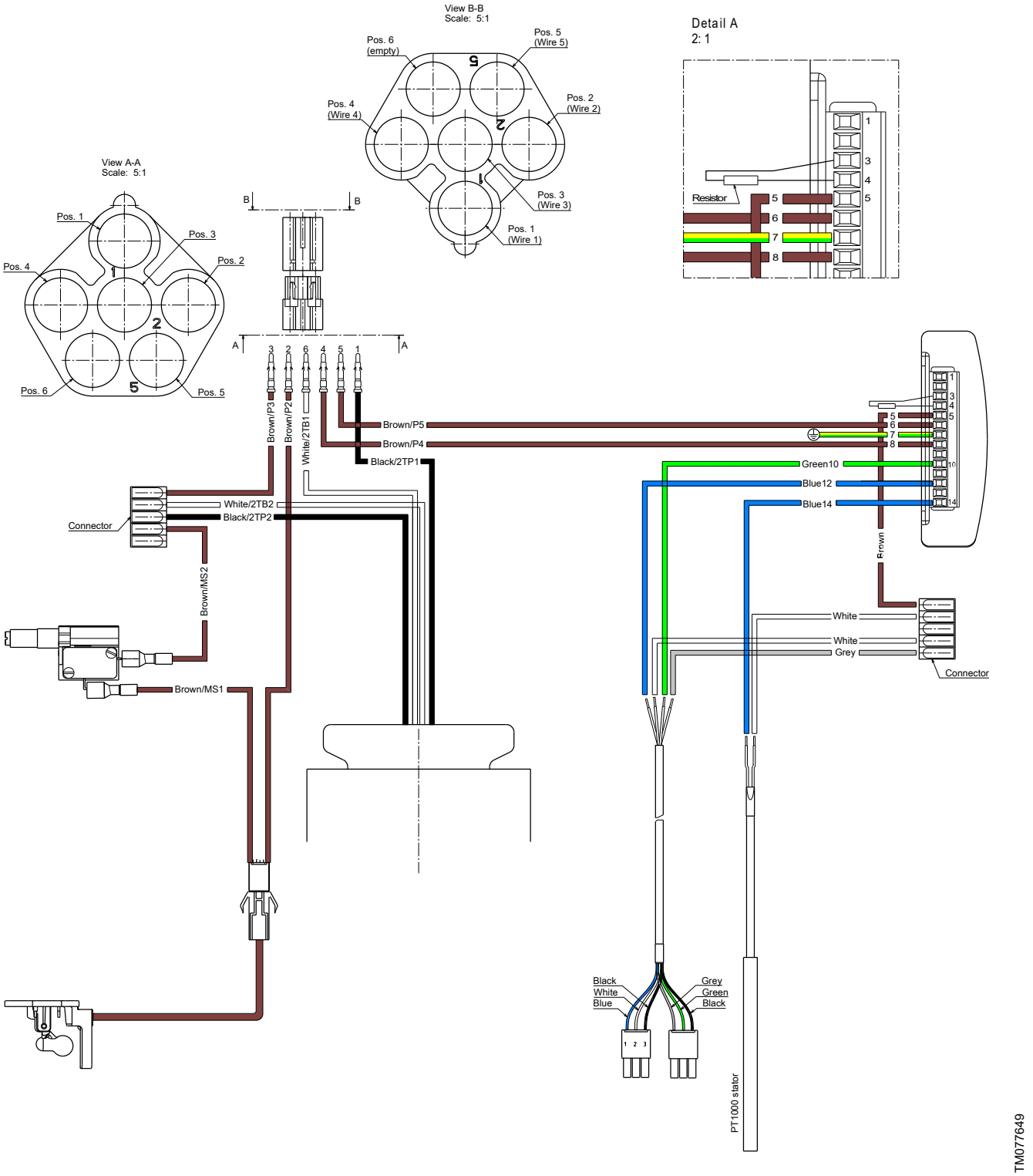

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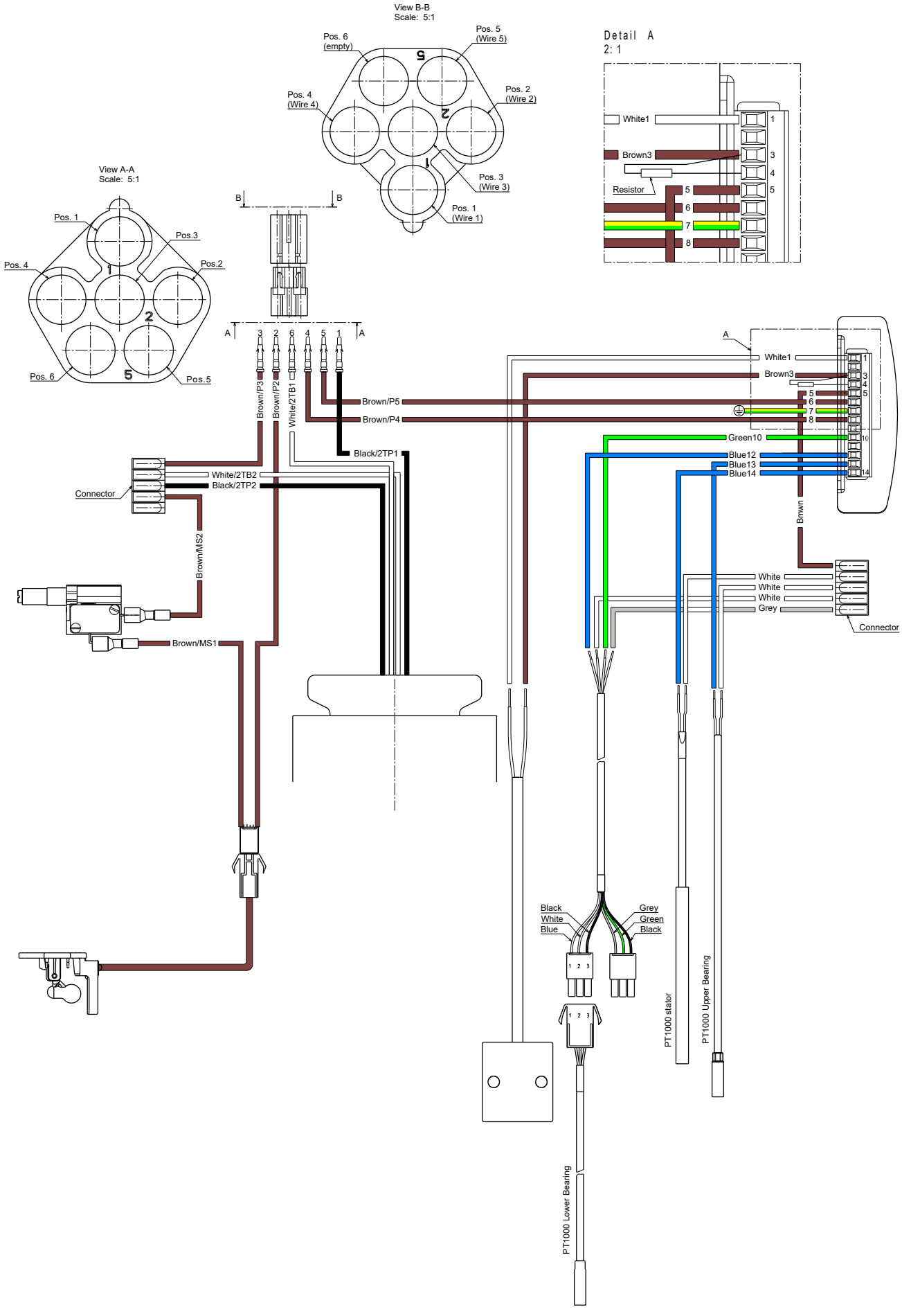

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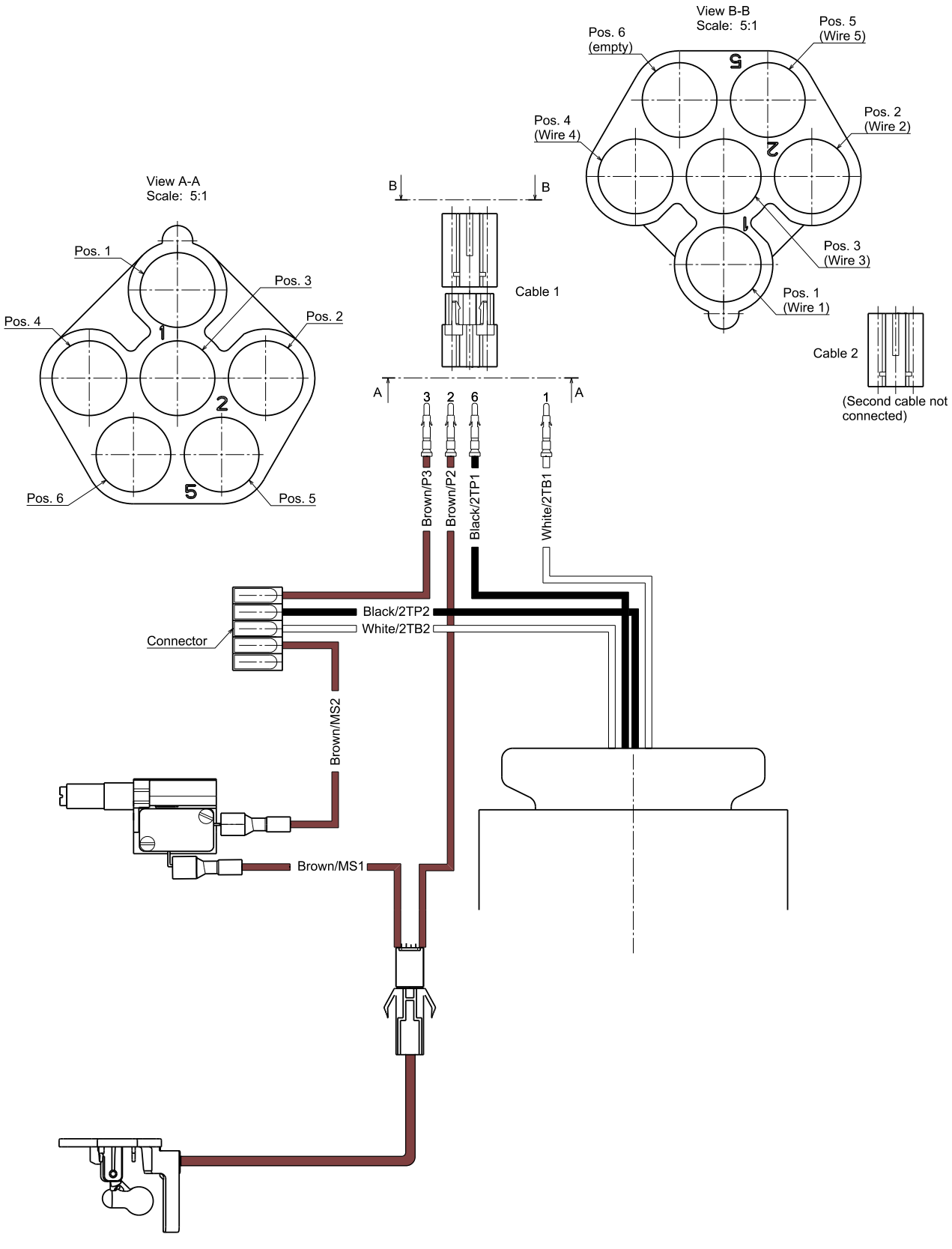
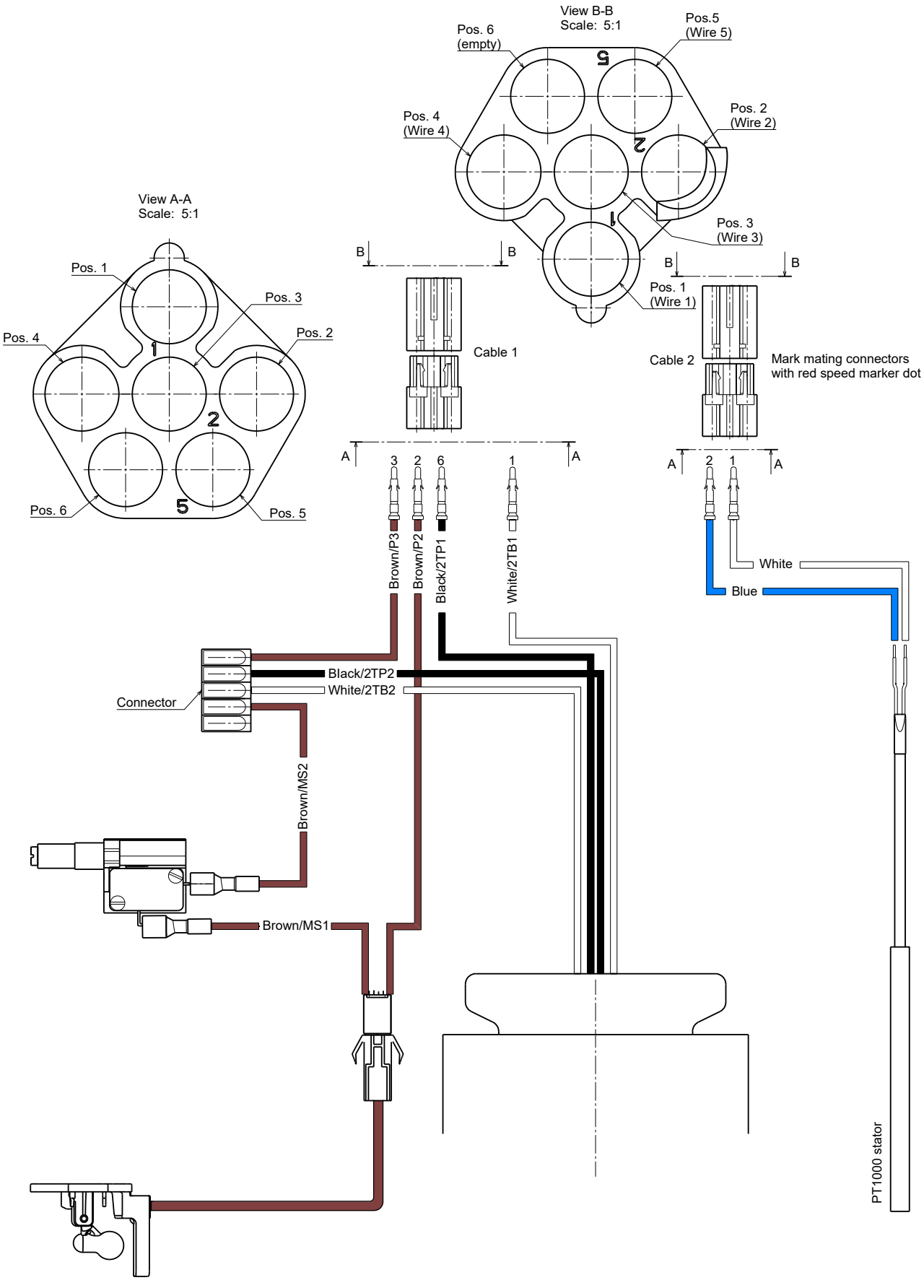
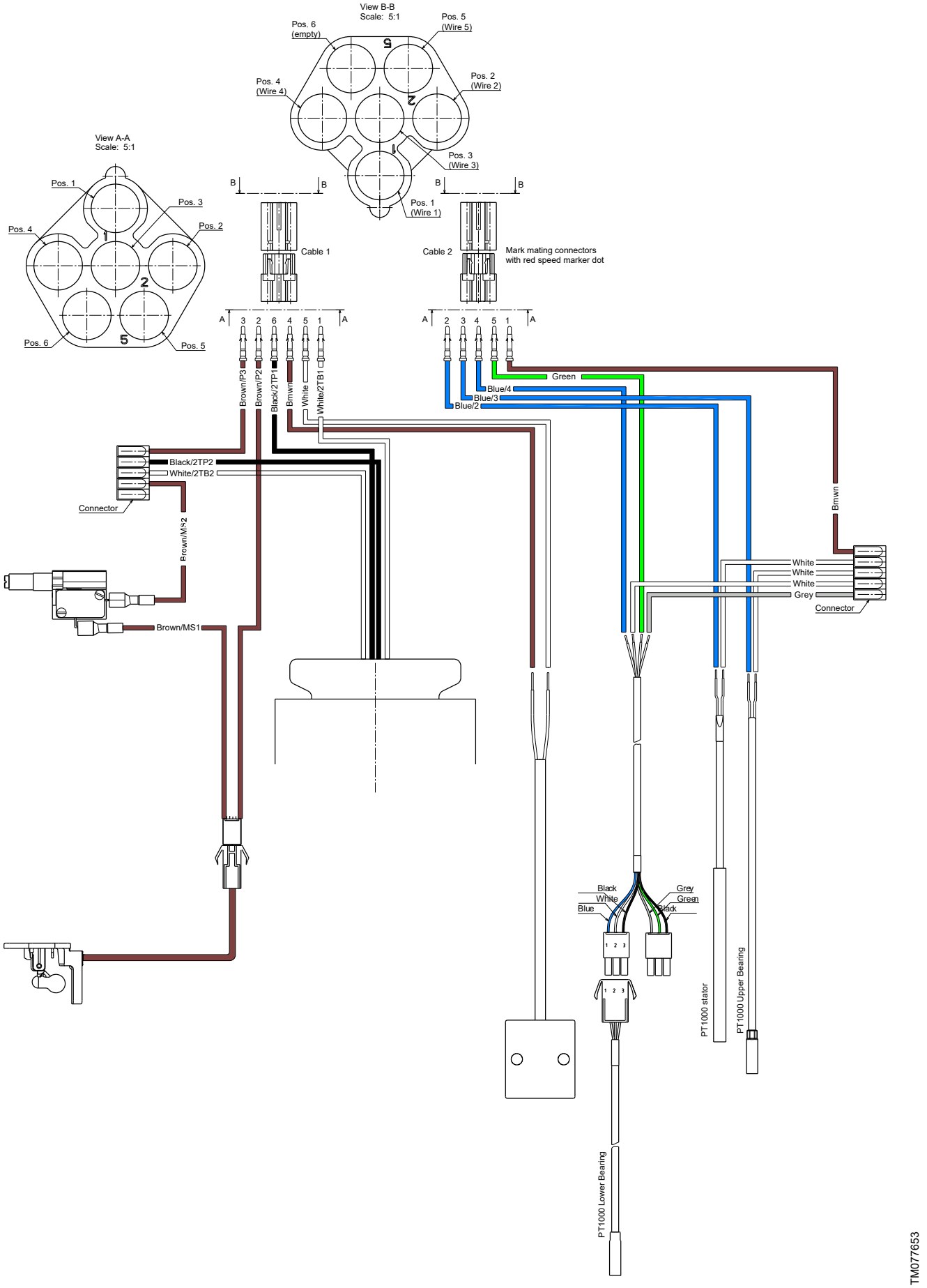


Standard Klixon dual cable



Sensor version 1 Klixon dual cable



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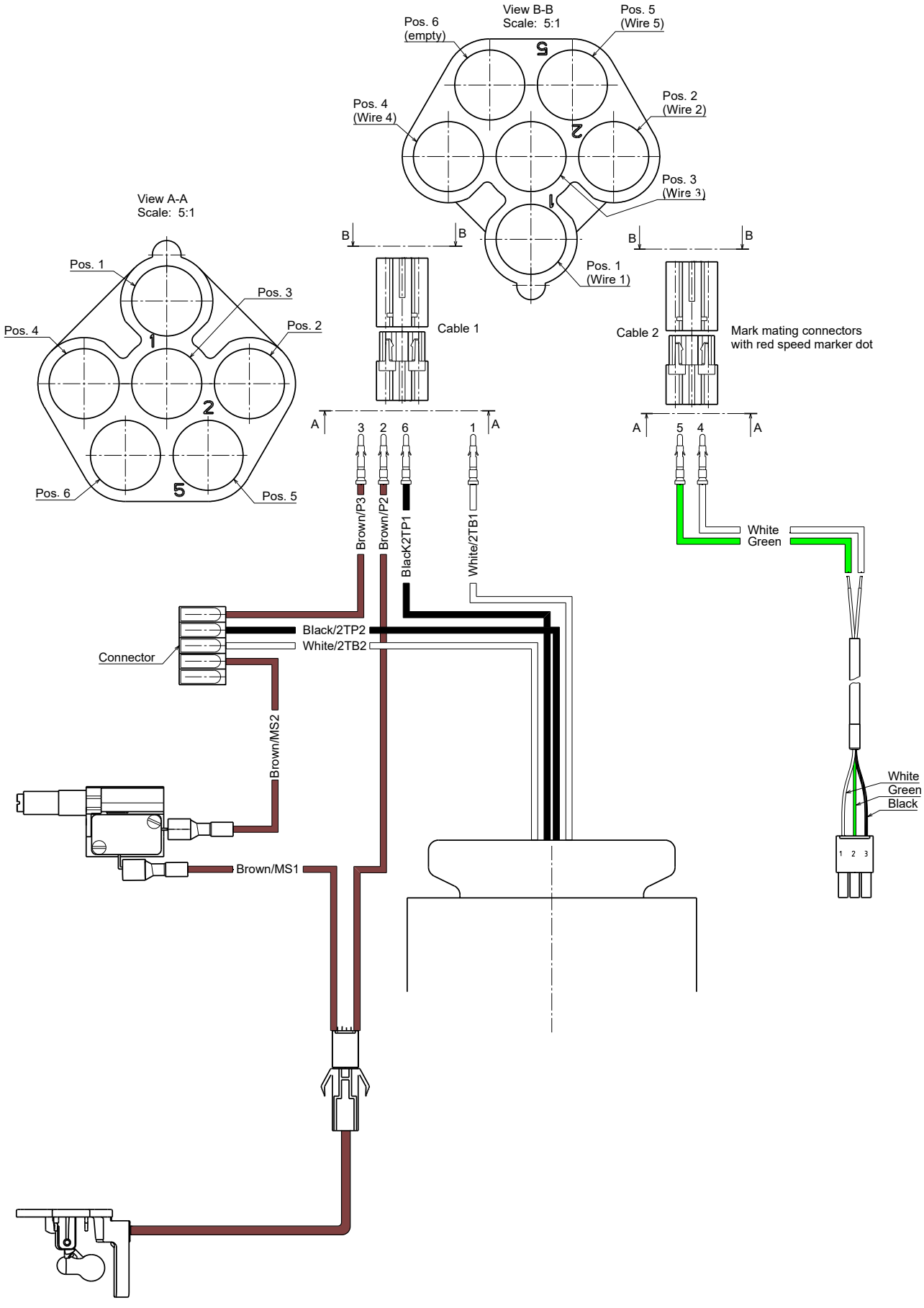

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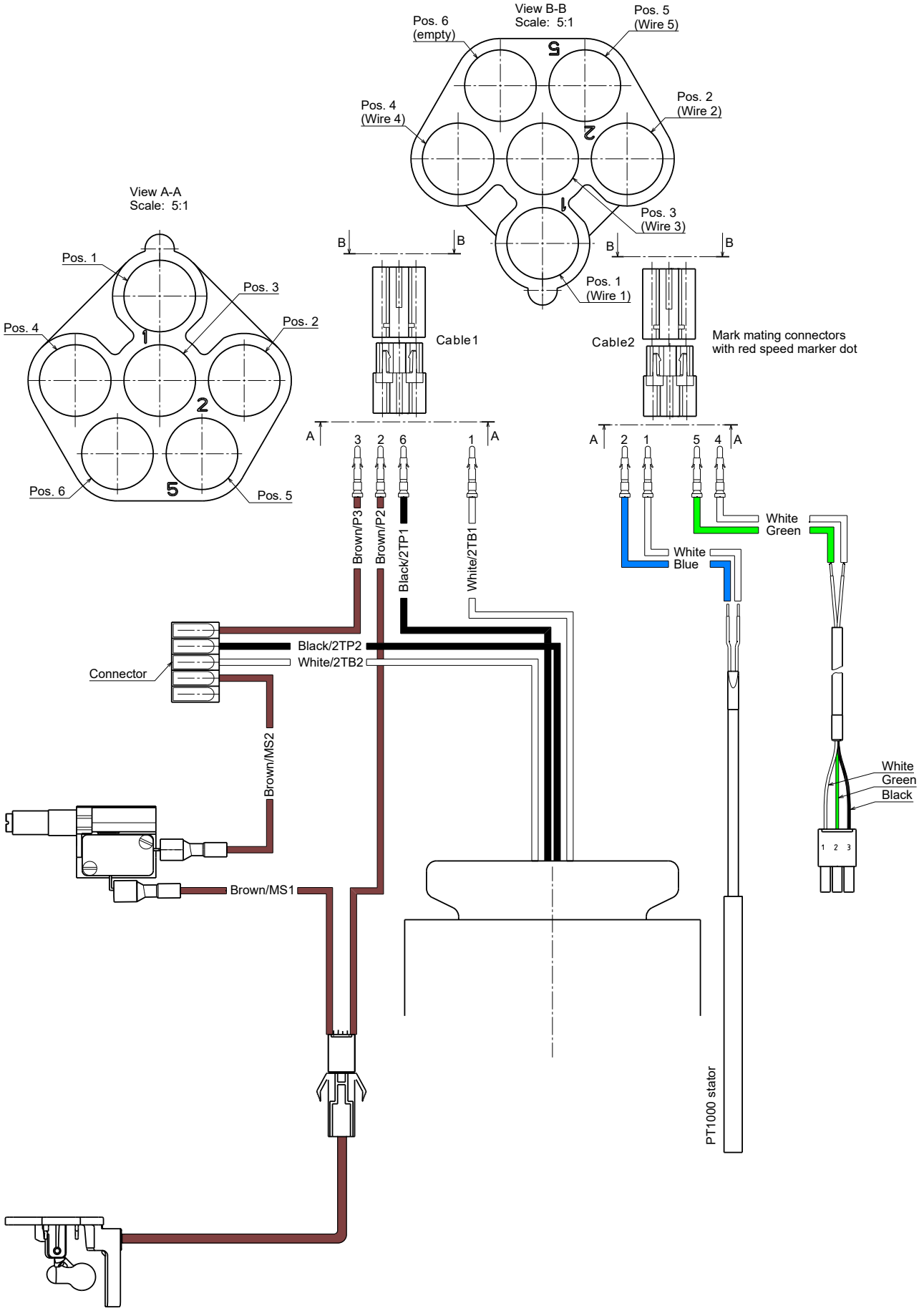

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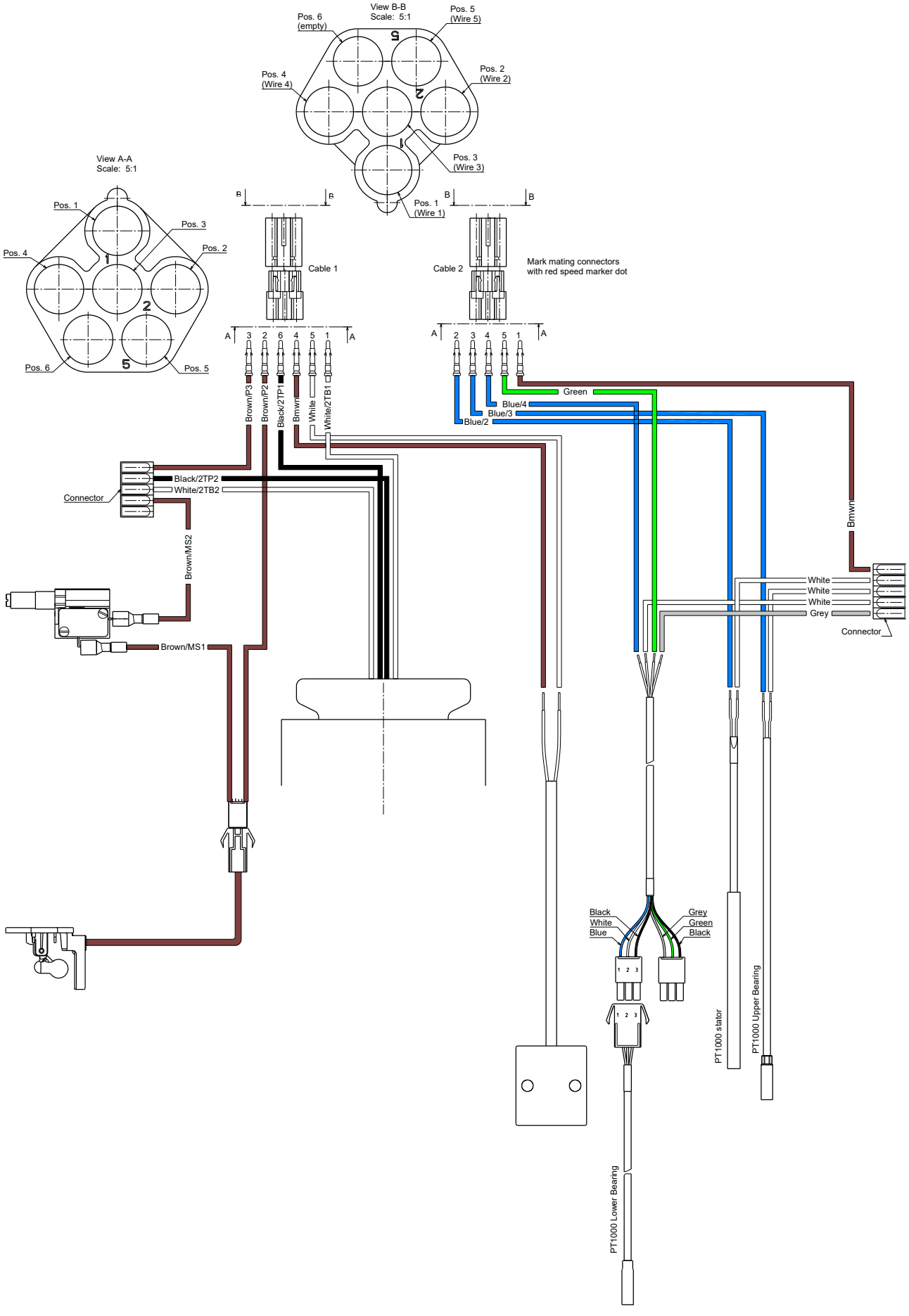

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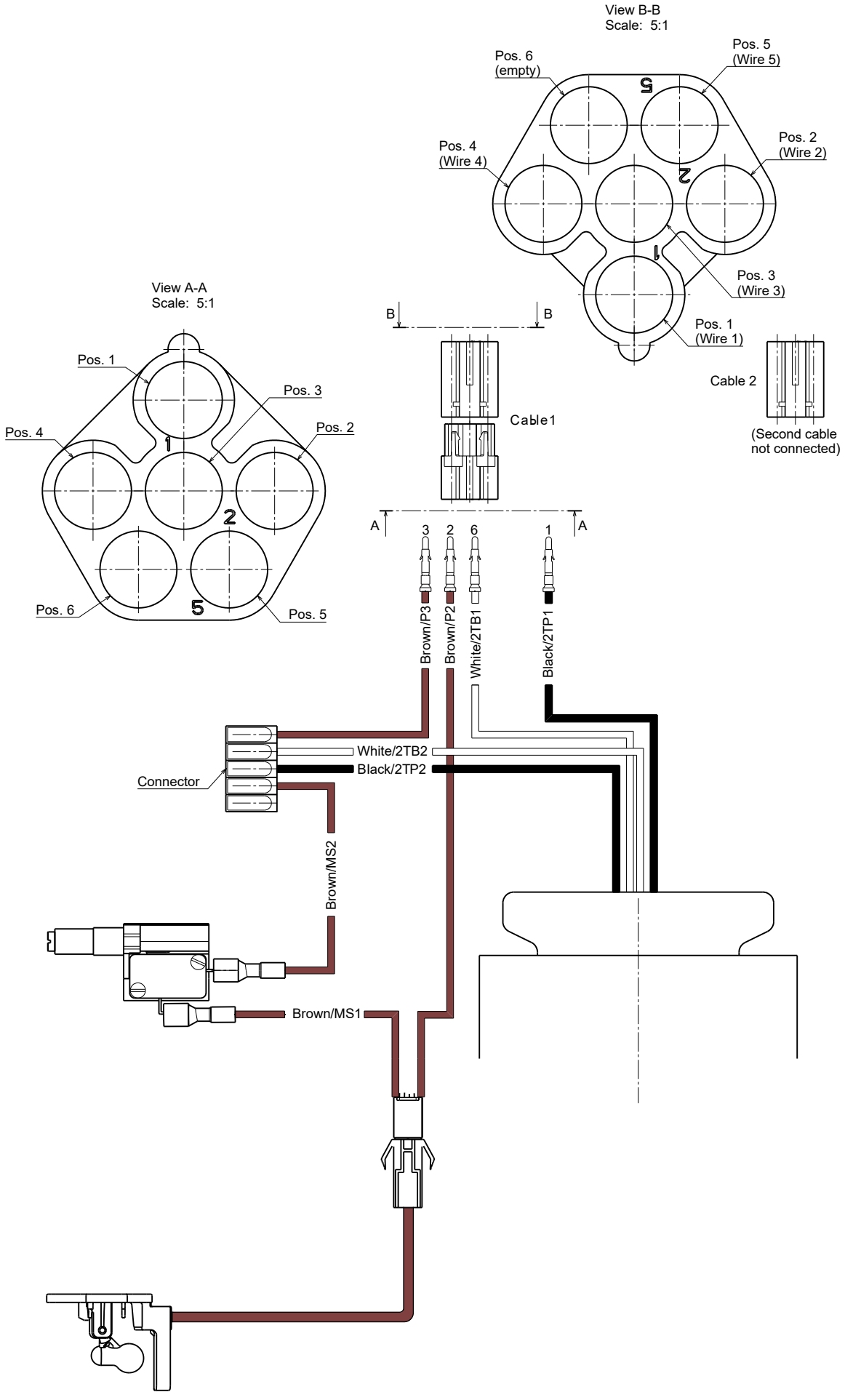
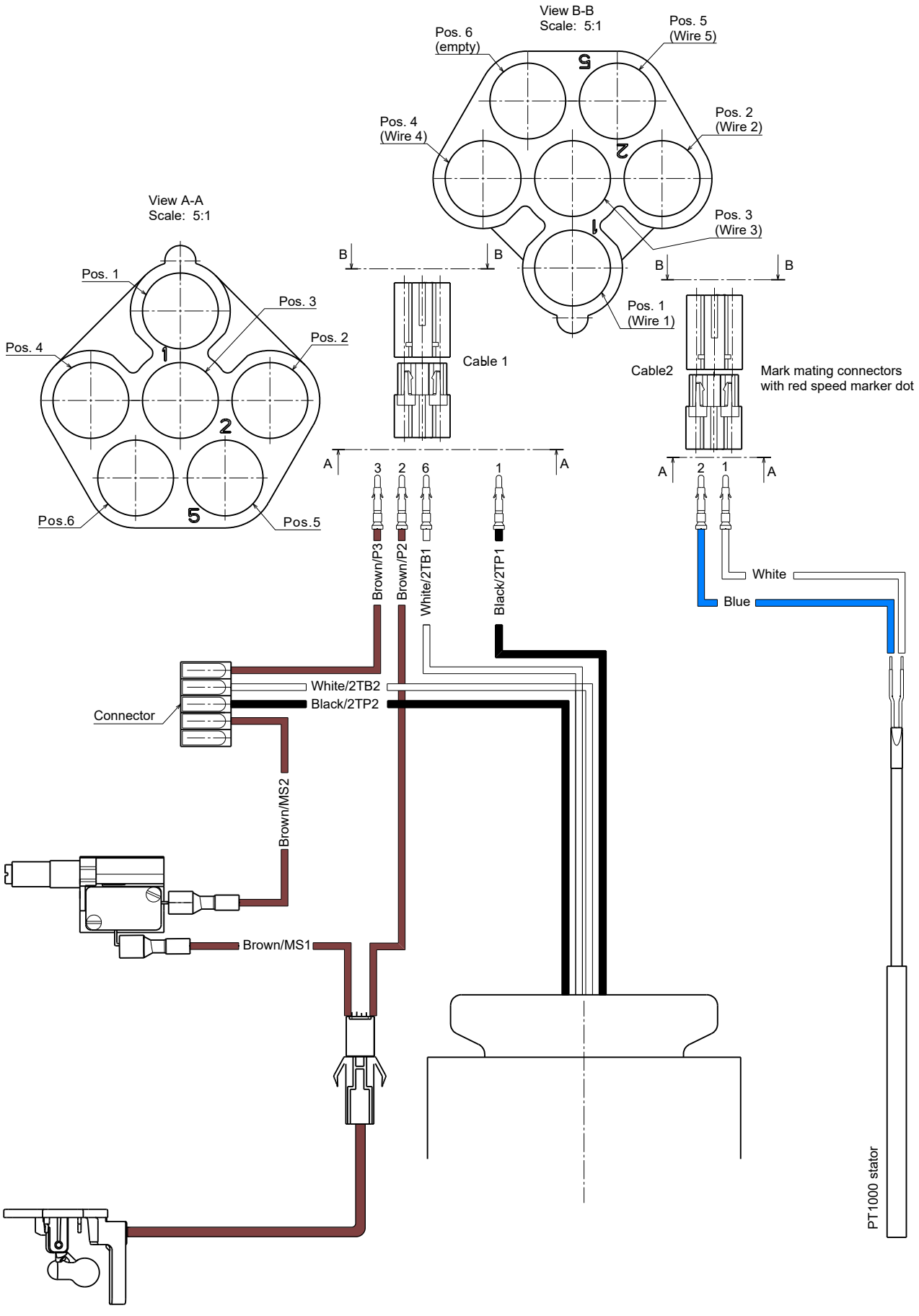
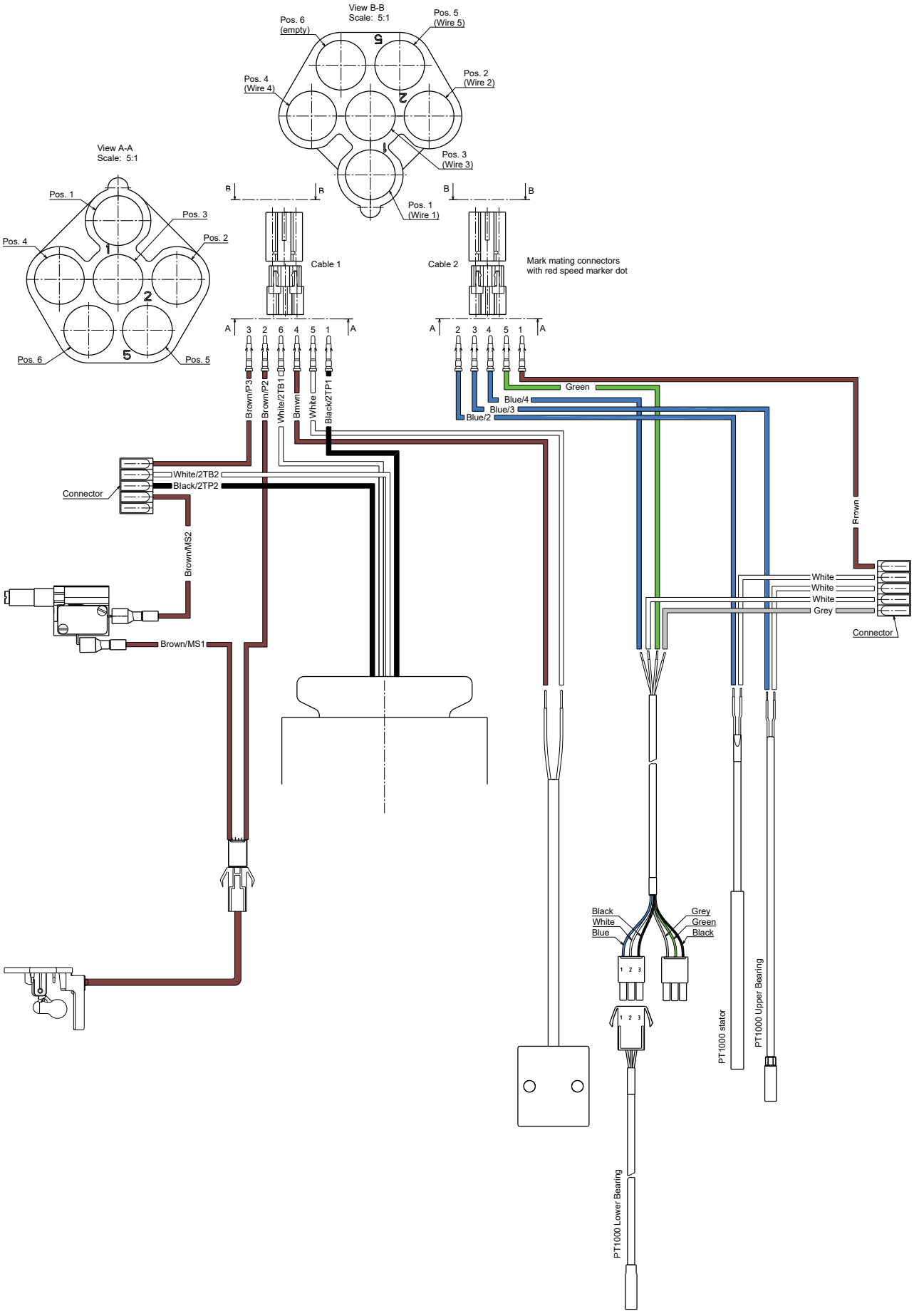


Standard PTC dual cable



Sensor version 1 PTC dual cable



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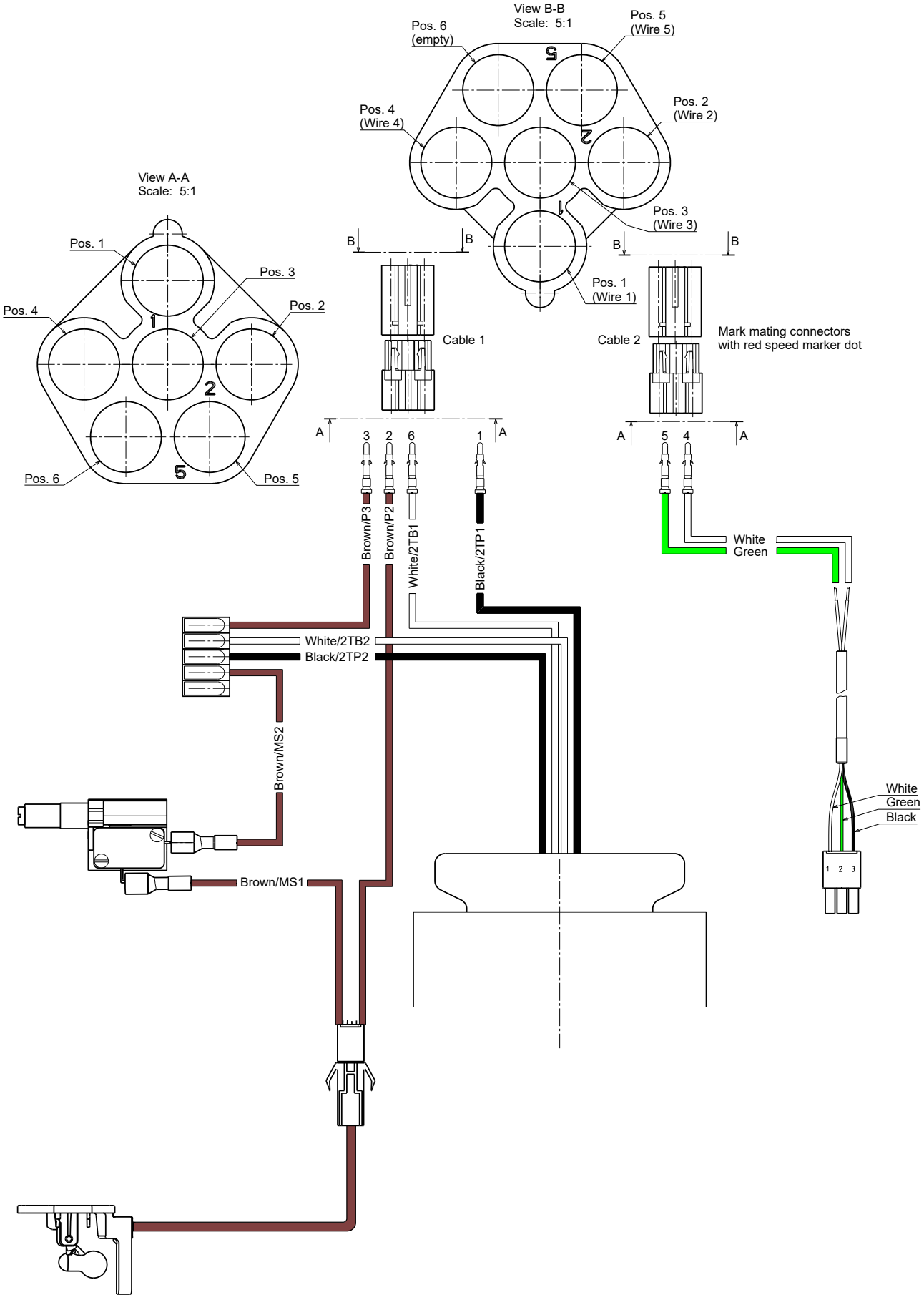
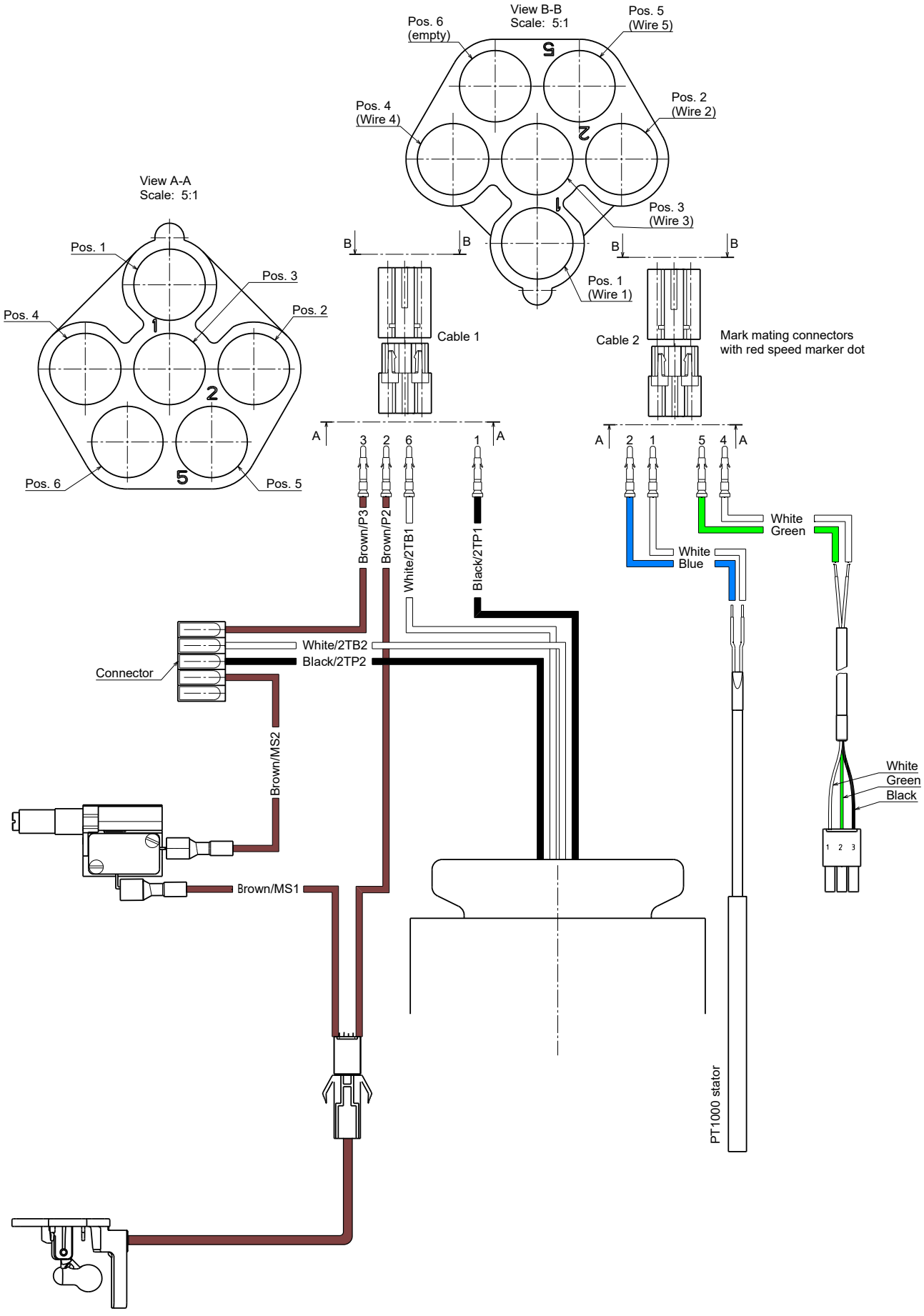
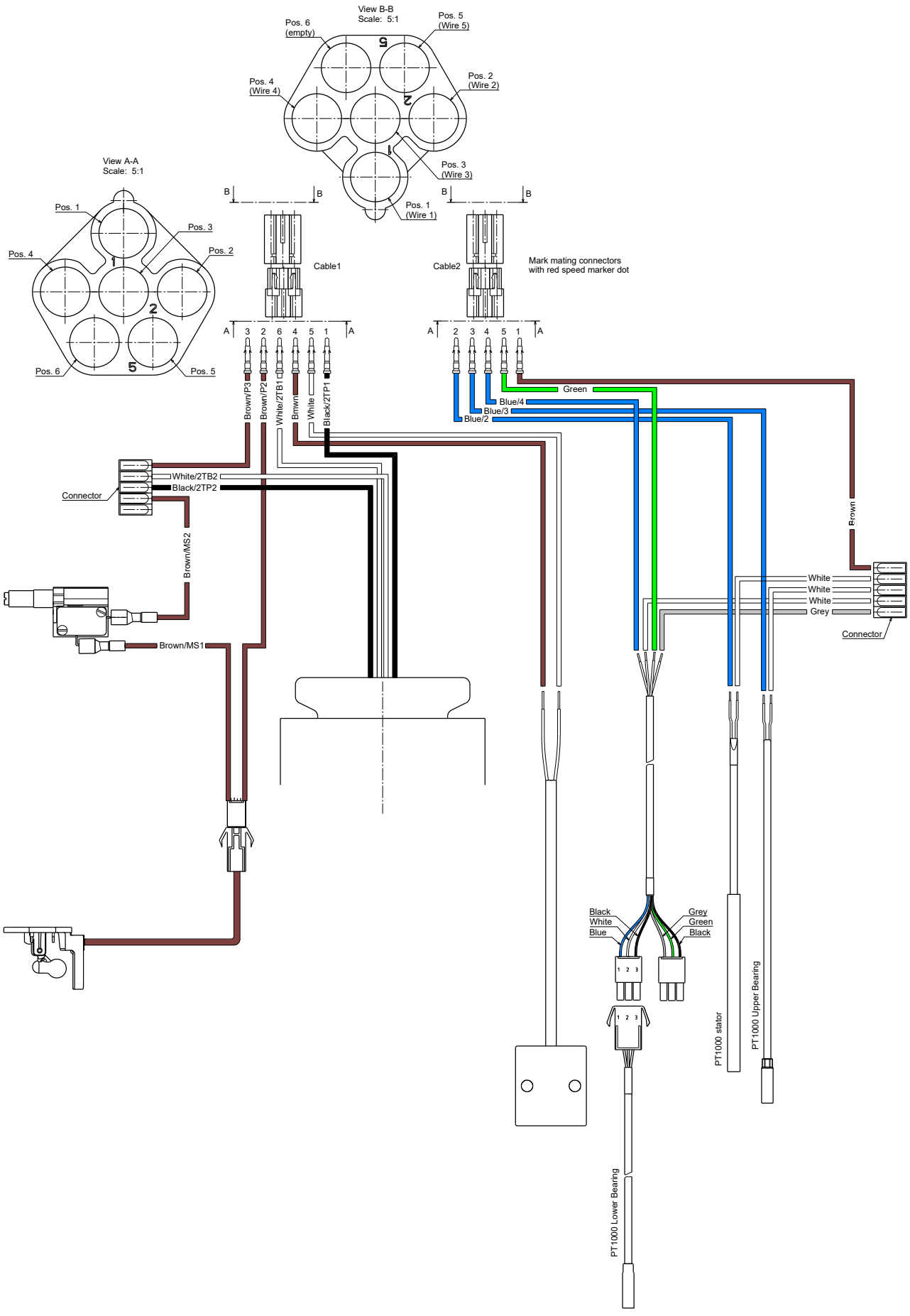


TM077660

Standard Ex PTC dual cable

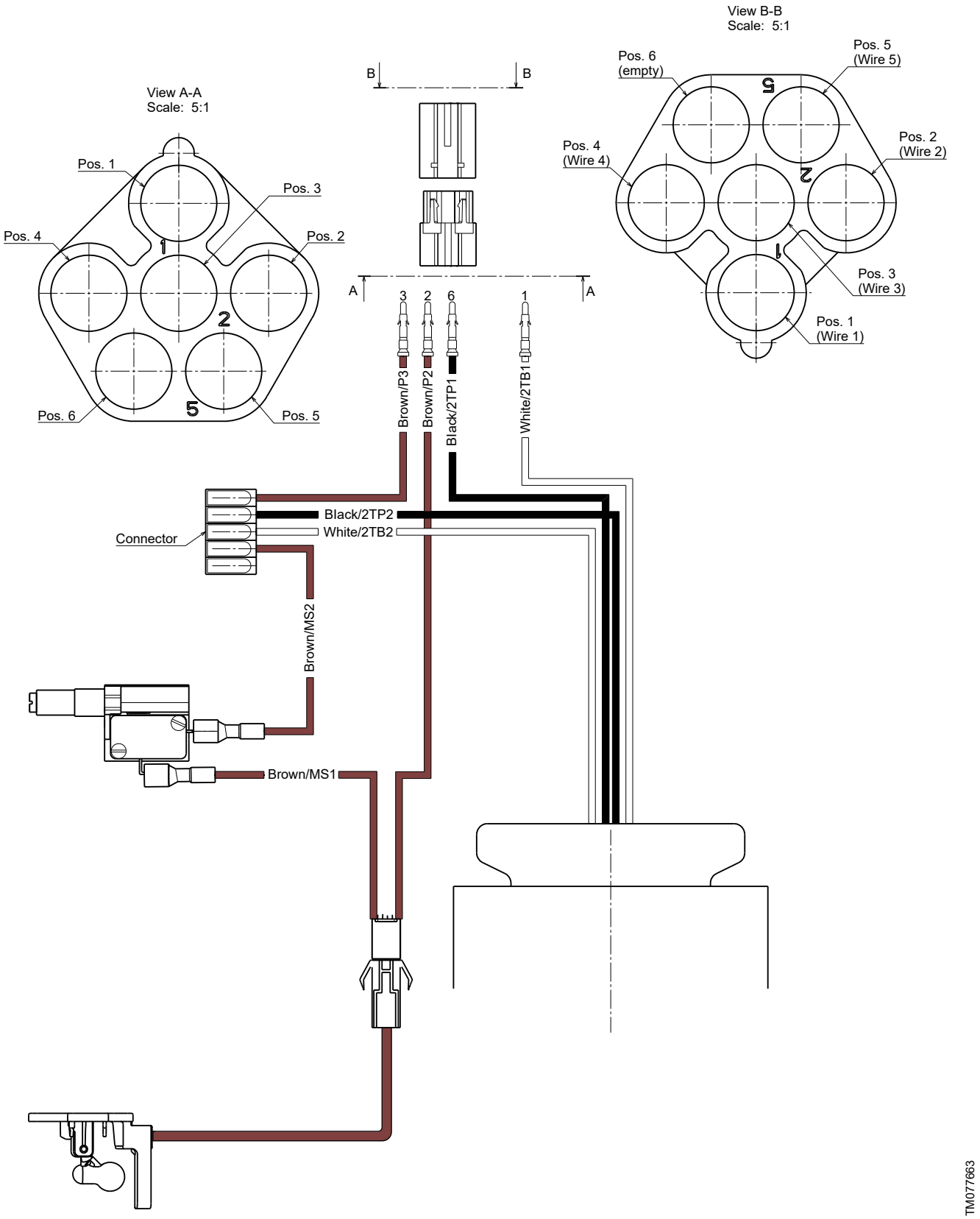


Sensor version 1 Ex PTC dual cable

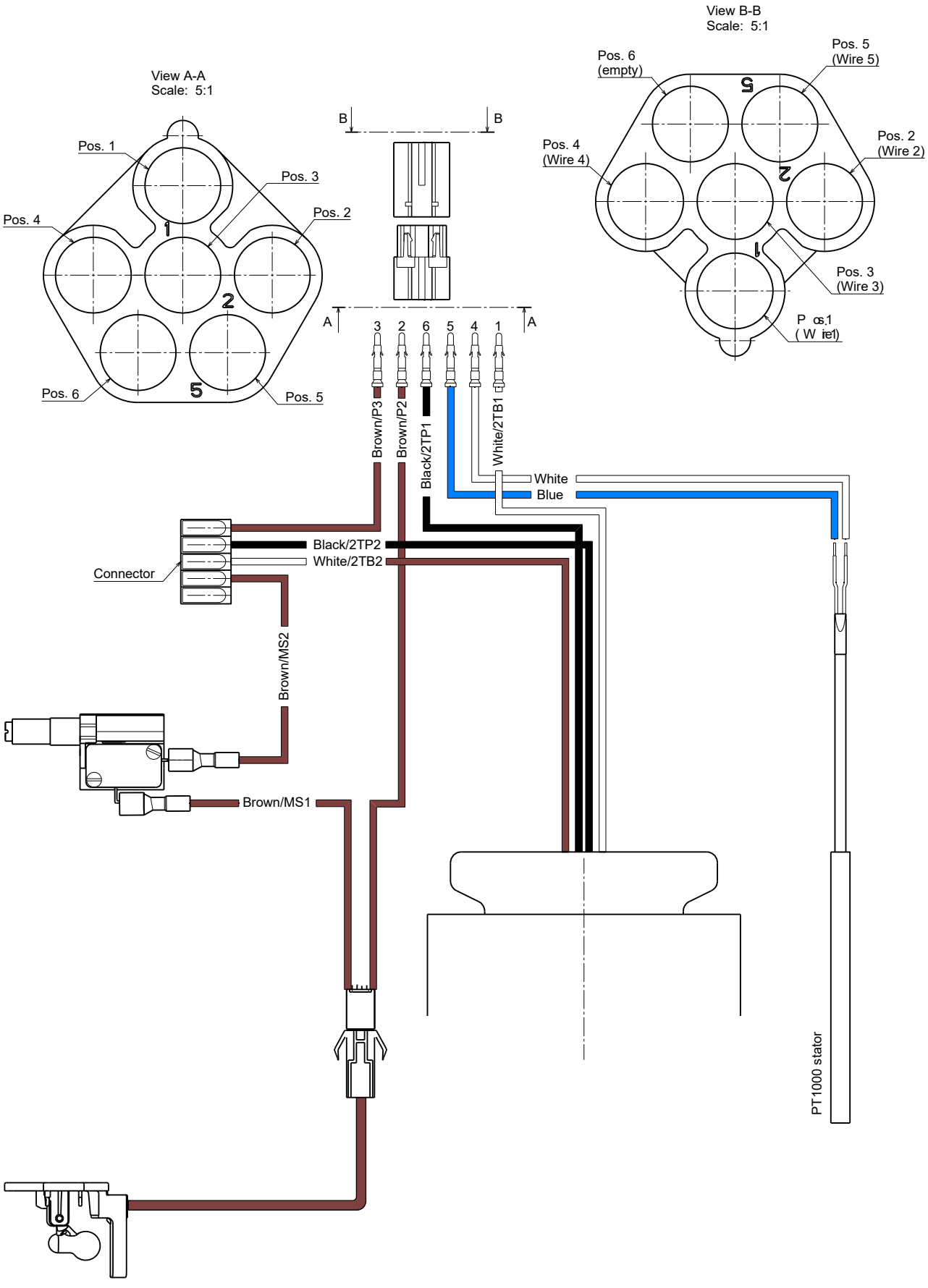


TM077662

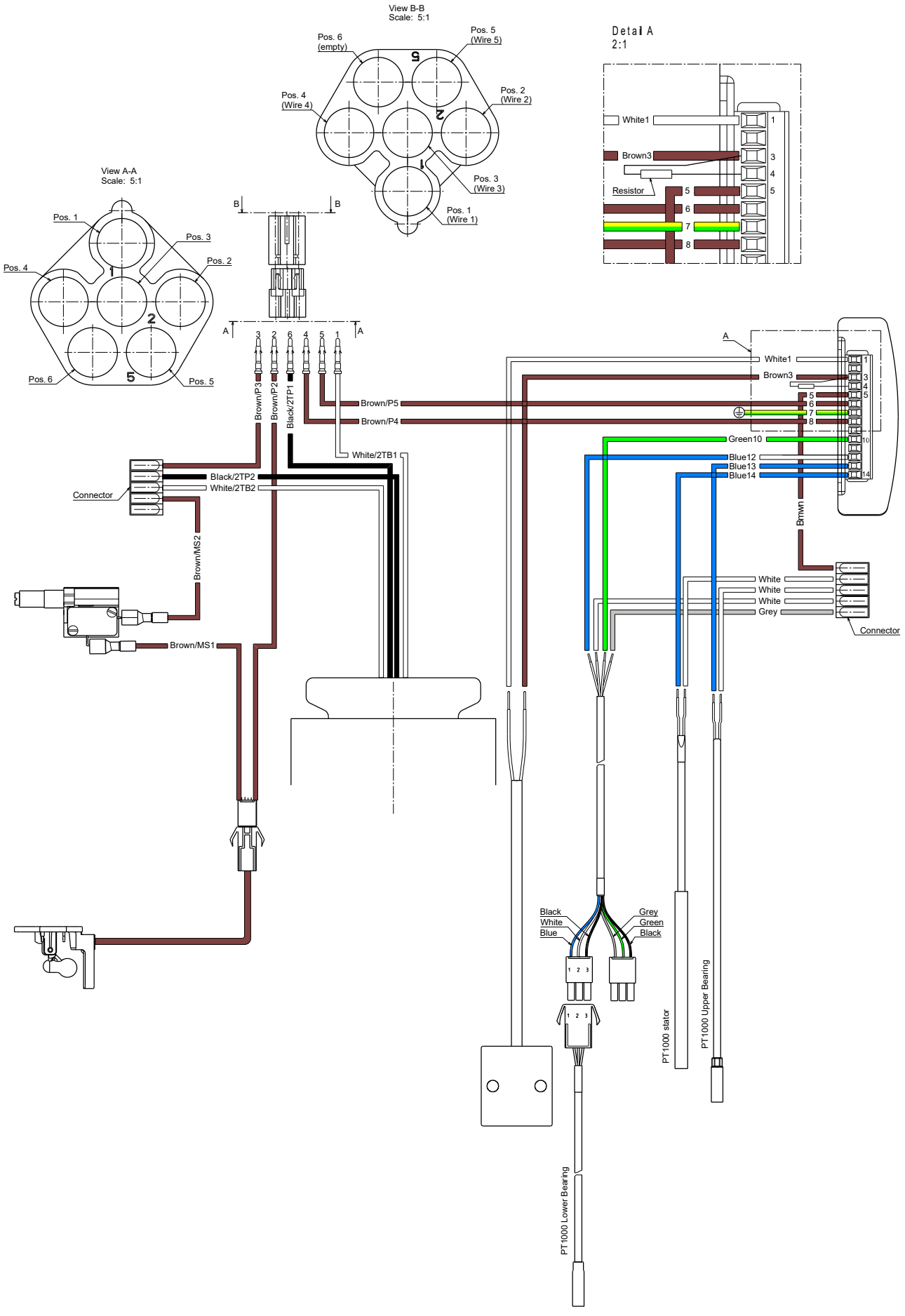
Sensor version 2 Ex PTC dual cable



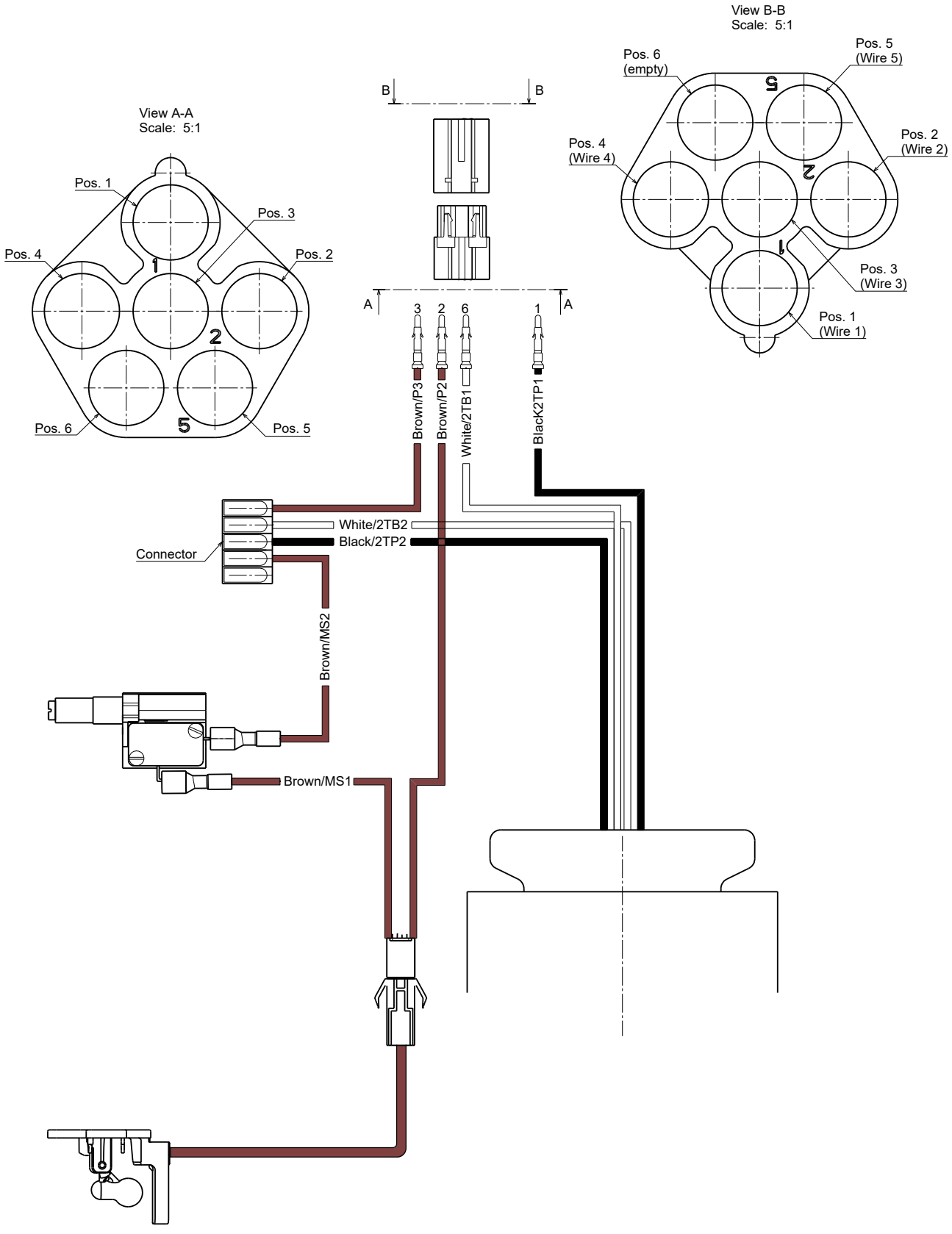
Standard Ex 2 Klixon single cable



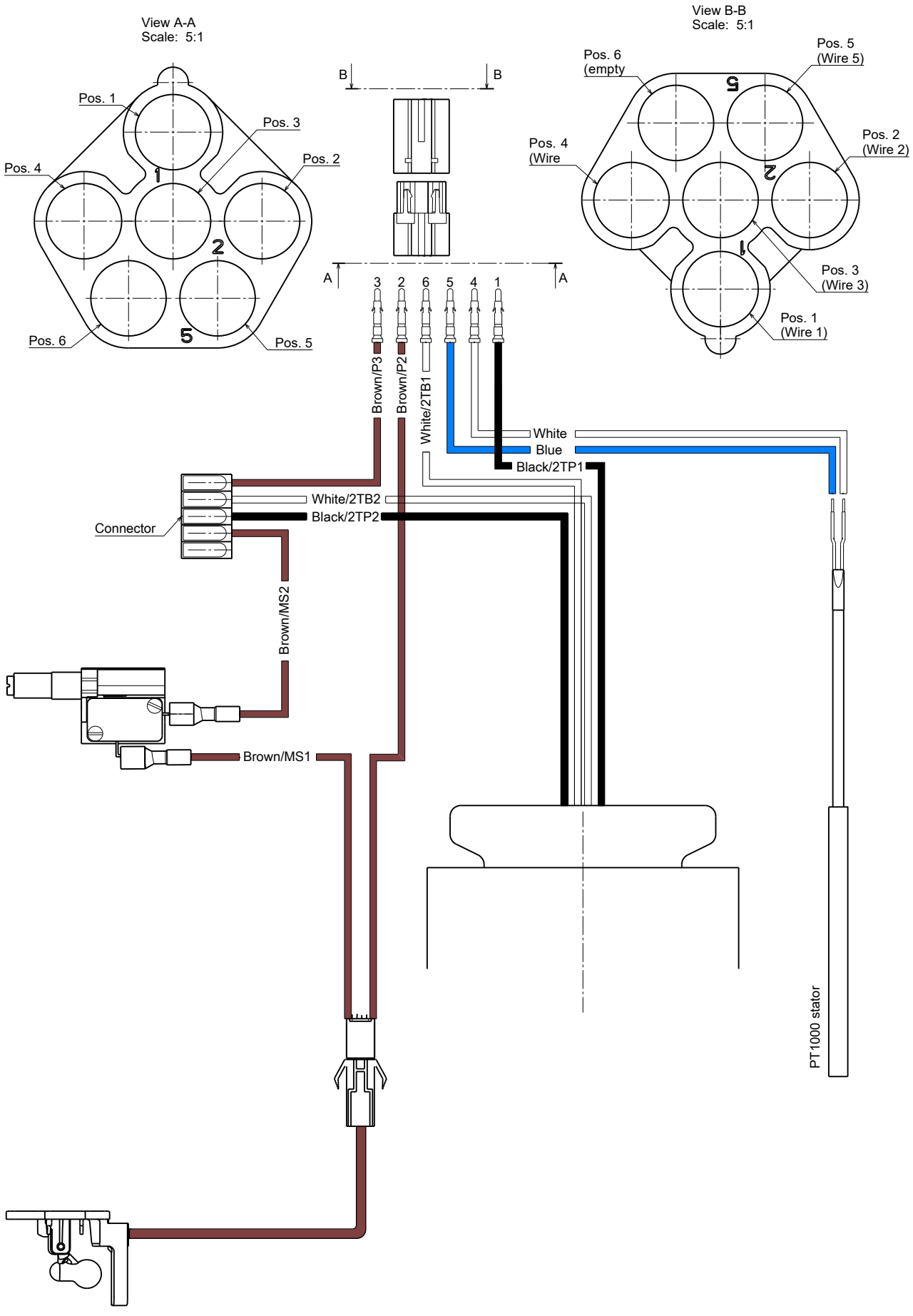
Sensor version 1 Ex 2 Klixon single cable



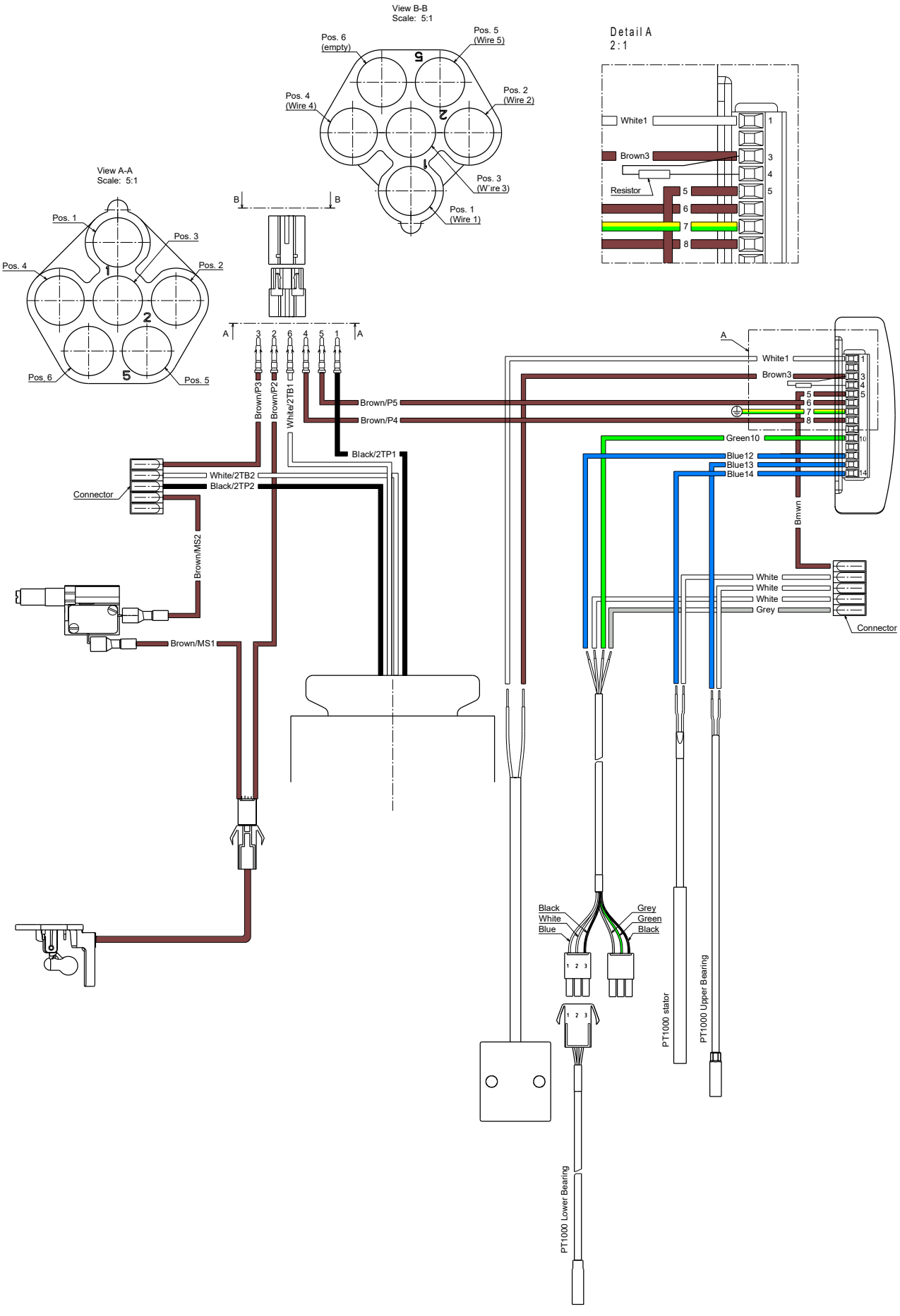
Sensor version 2 Ex 2 Klixon single cable



Standard Ex 2 PTC single cable



Sensor version 1 Ex 2 PTC single cable



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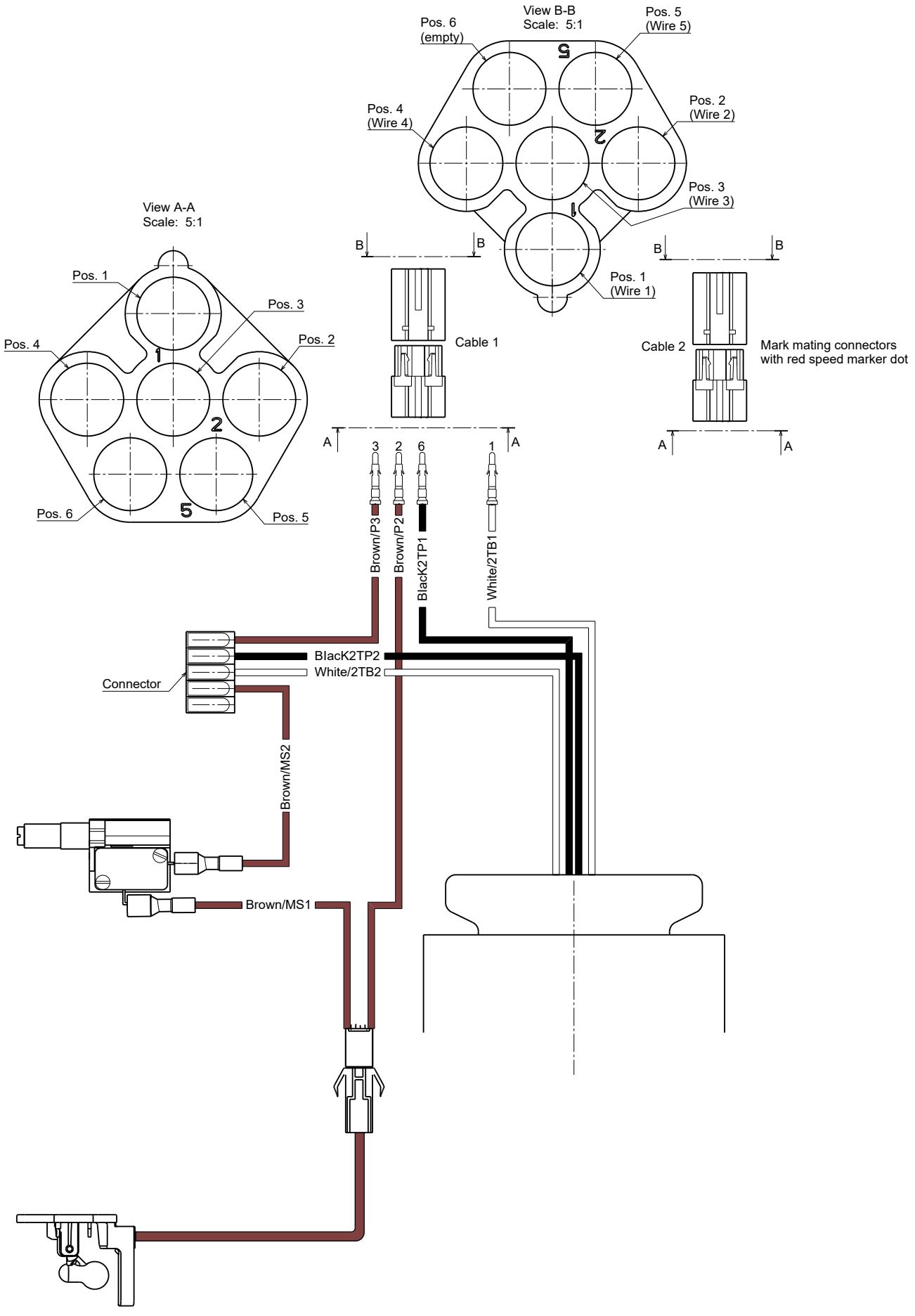
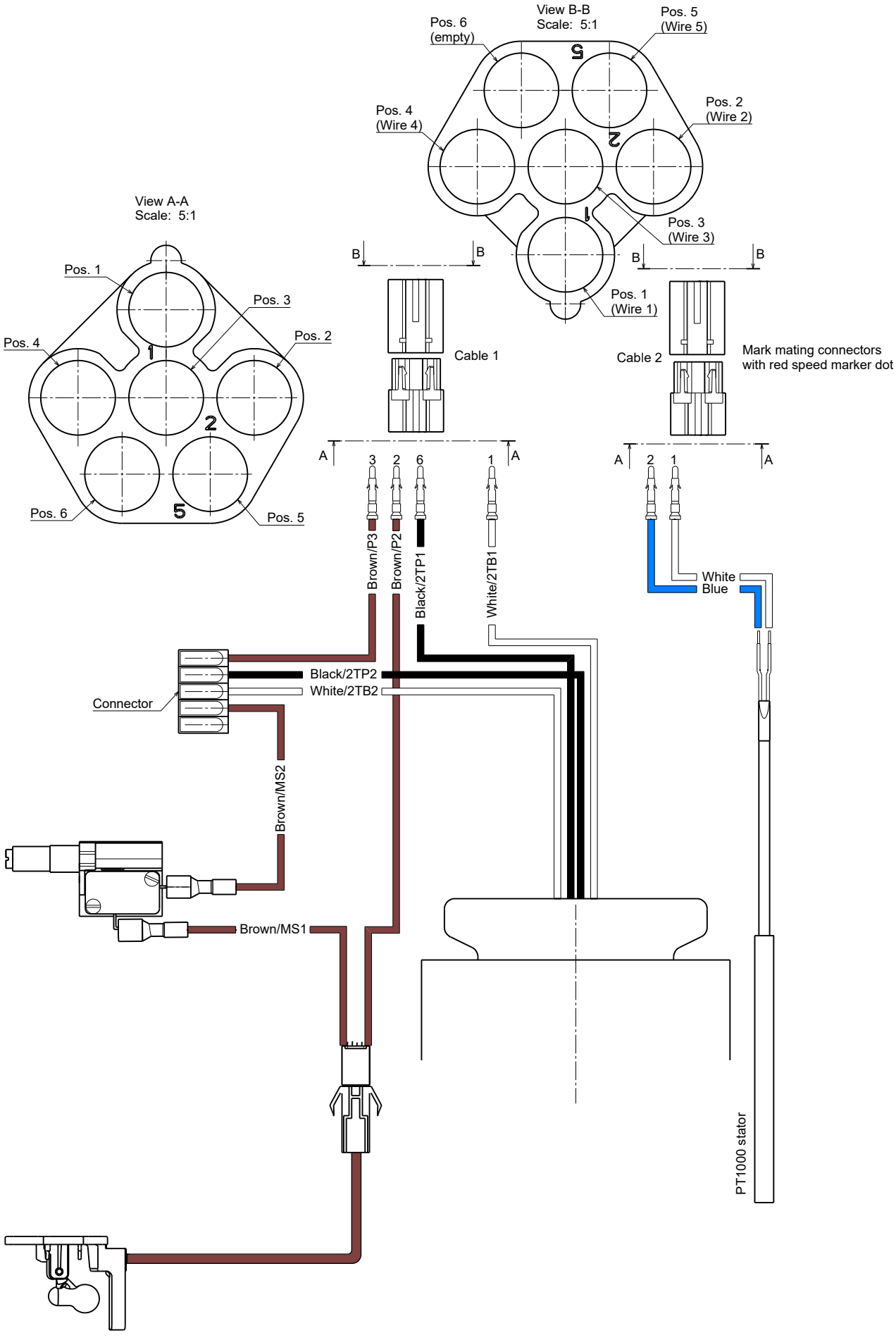
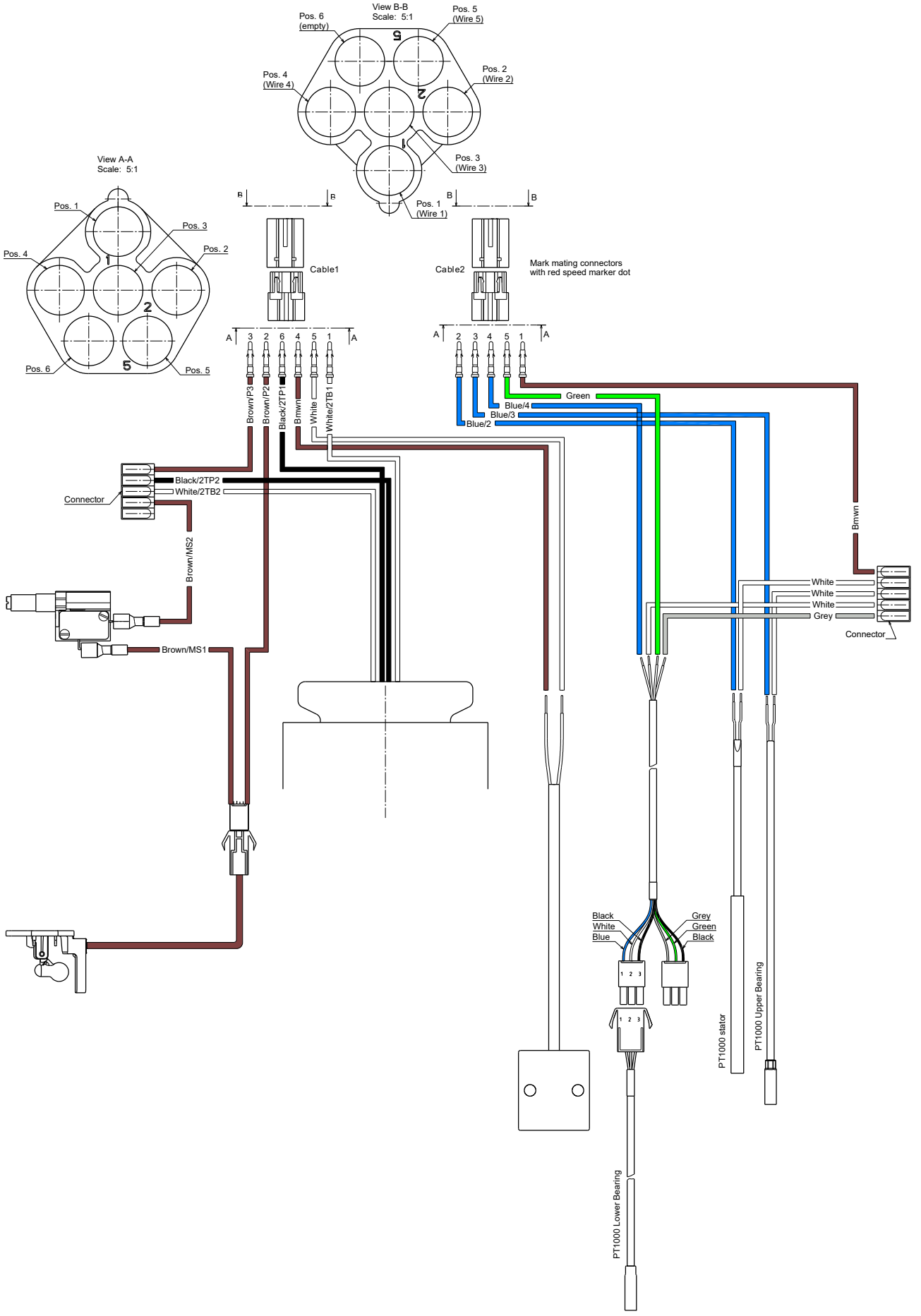


Standard Ex 2 Klixon dual cable



Sensor version 1 Ex 2 Klixon dual cable



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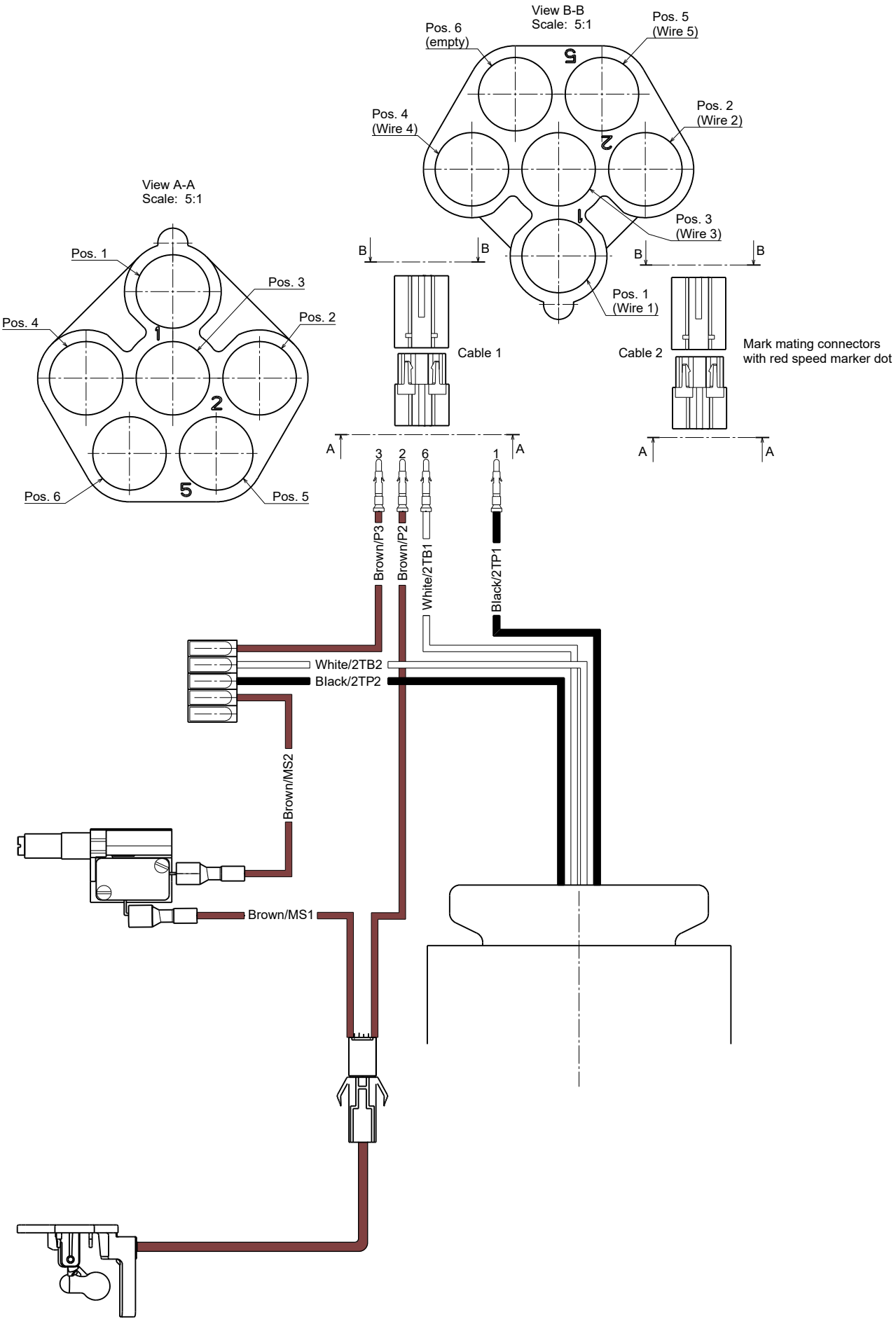
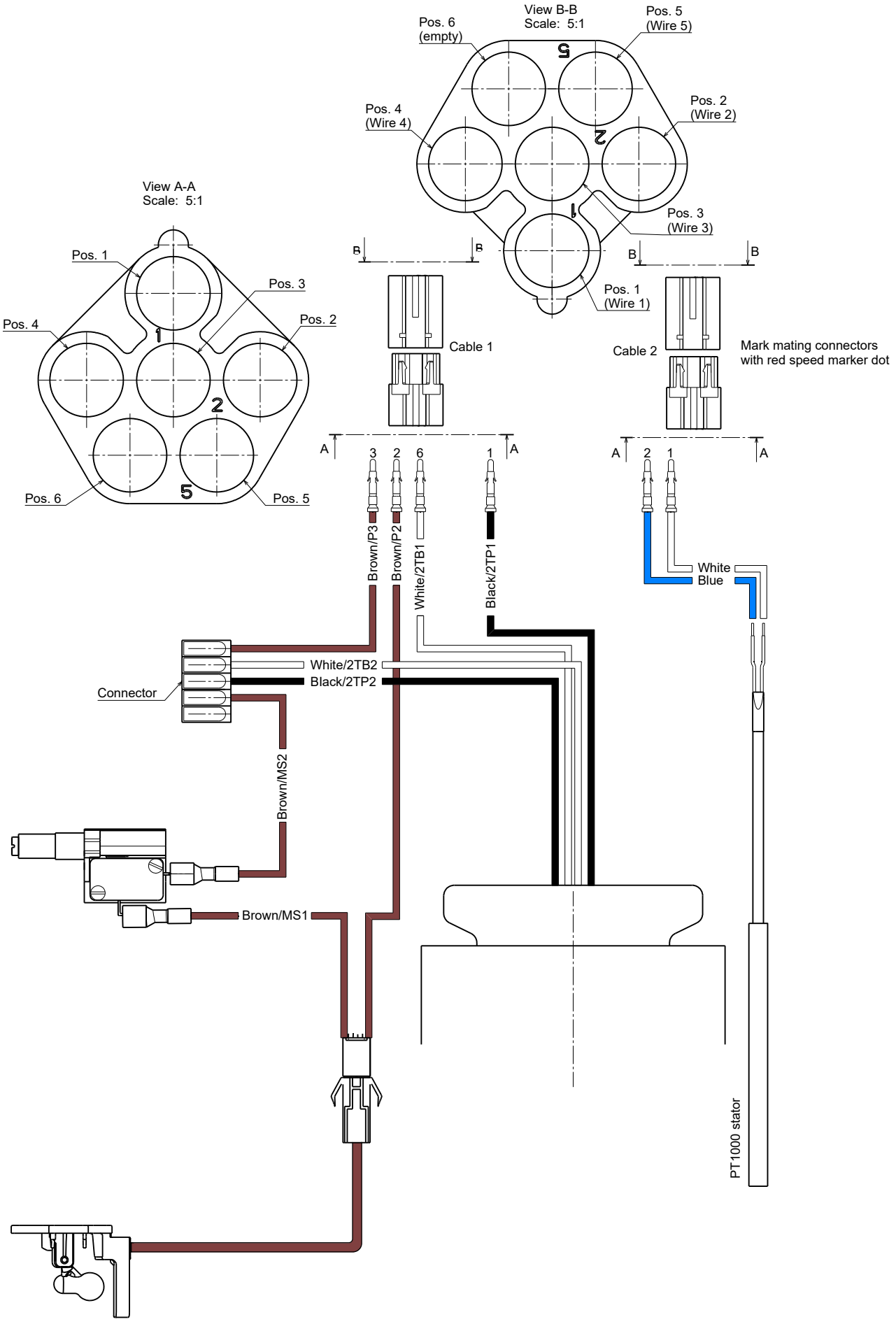


Standard Ex 2 PTC dual cable



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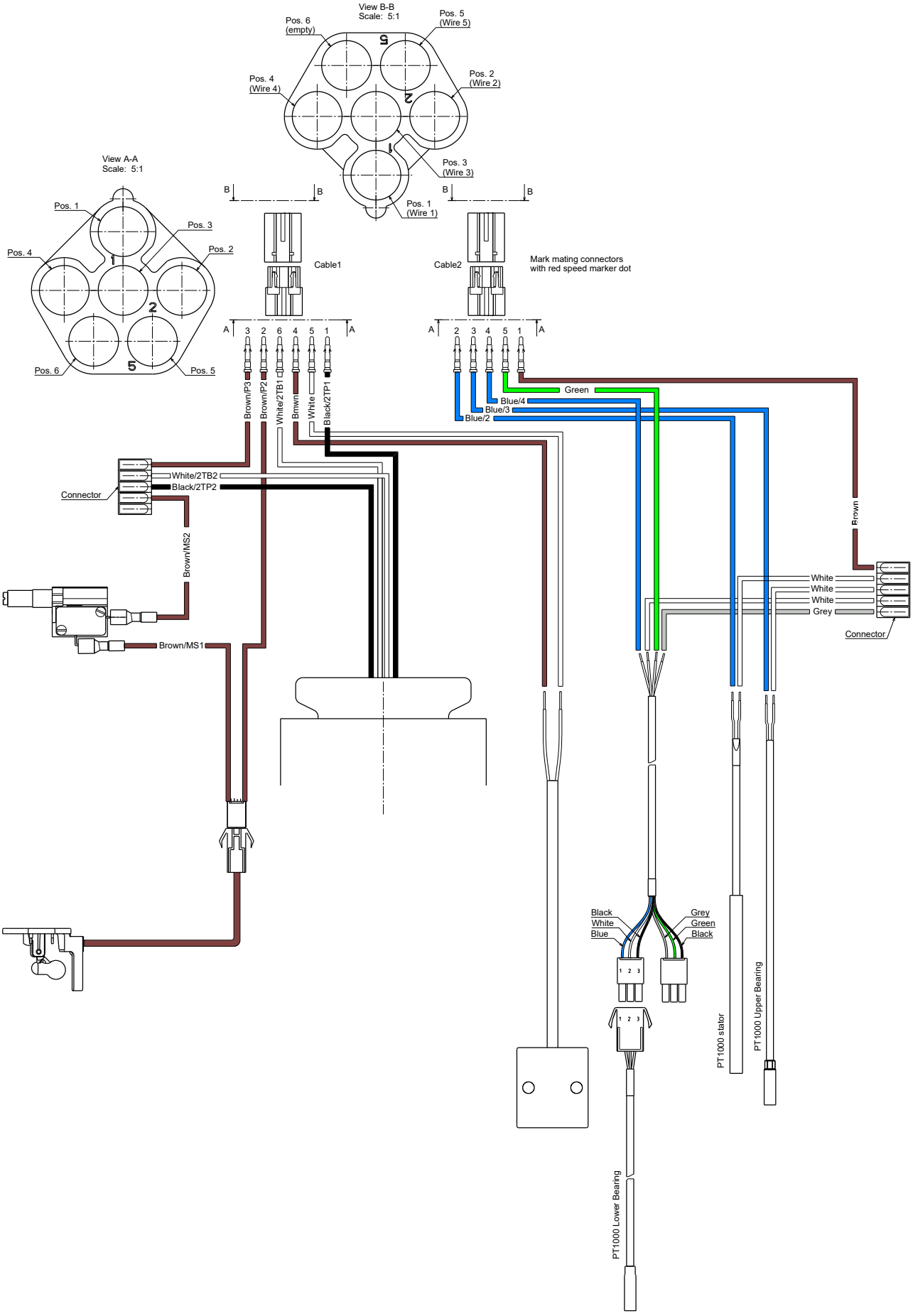

Sensor version 2 Ex 2 PTC dual cable

Related information

10.2.2.1 Stator thermal switches

11.3 Power wire connection, stator end

11.7 Sensor wire connection, single cable with sensor set 1

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