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1. Introductory Arrangement

Manufacturer reserves a right to adapt individual structural nodal points and possible substitution of materials in harmony with the development in this field. Any adaptations and substitutions of materials must not go at the expense of lifetime, reliability, and quality and they must not result in aggravated impact upon environment. The essential changes and substitutions of materials shall be consulted with customers and users.

2. Technical Data

rated speed	196	rpm
rated frequency	72	Hz
maximum speed	706	rpm
number of phases	3	
number of poles	44	
protection class	IP 55	
heat insulation class	H	
version	IM 9209	
cooling	IC 37 W	

cooling medium[1]	Fridex eko extra
Alternative coolants:	Selenia paraflu 11 formule
	Texaco havoline XLC
	Motul inugel expert ultra
	Castrol Radicool NF
	Total glacef MDX
	Glycocool longlife

amount of cooling medium	16	l / min
pressure loss at the rated flow rate	70	kPa
cooling medium temperature rise	5	K
minimum inlet coolant temperature	-40	°C
maximum inlet coolant temperature	70	°C
test voltage for a period of 60 s	3500	V
motor weight[2]	260	kg ± 3%
moment of inertia of the rotor without clutch	1.52	kgm^2
maximum noise acoustic power level[3]	86	dB ± 3dB
resistance to vibrations according to ČSN EN 61373		

Colour shade:	RAL 7043 (Traffic grey B)
Paint according to the Painting Code EdP3499/a.	document no. EdP0790

The character of the information in this document determines the activities necessary for the motor operation, maintenance and repair. Neither reception nor ownership of this document give a title to disclose partial data or the whole document to third parties without the written consent of ŠKODA ELECTRIC, a.s.

The Code is valid to its elaboration date. Manufacturer reserves the right to improve and enhance the product parameters after the elaboration date of this Code and the right to update this Code.

[1] The fluid will be mixed with distilled water in the ratio specified by the fluid manufacturer. Adherence to the correct fluid-water ratio in relation to the operating temperature range rests with the client. The fluid replacement intervals follow the regulation of the coolant manufacturer. Assessment of the ecological aspects as well as determination of the safety precautions for fluid handling is also fully in the client's competence. Before filling the system with different fluid type flush the entire cooling system thoroughly with distilled water. Mutual mixing of the fluids of various types and from different manufacturers is prohibited.

[2] In the basic version – with connector, without the clutch and without coolant.

[3] The noise examination methodology conforms to ČSN EN 60349-2

3. Safety

3.1. Explanation of Symbols

CAUTION
No entry into the motor assembly and disassembly area for cardiacs and wearers of pacemaker

DANGER
Information that must be pursued strictly to protect user and other persons against damages and injuries.

CAUTION
Information and instructions that must be pursued strictly to eliminate dangers to the health or lives of persons, the environment, and damages to the motor and further property.

Further useful information.

Information which pertain to the environment.

3.2. Safety Recommendations

- To avoid damage to health and maintain the proper and full functionality of motor, it is necessary that **each person** who comes into contact with the motor during repairs on facility is acquainted with the motor properties and this Maintenance Code.
- The interventions into motor that are carried out incorrectly or in a non-professional manner may cause motor failures and lead to jeopardising safety and health of persons, damages to property or environment for which manufacturer bears no responsibility whatsoever.
- All the activities associated with maintenance and repairs of the motor must be performed exclusively pursuant to this Code. These activities are allowed to be carried out by the personnel trained by ŠKODA ELECTRIC a.s. Manufacturer may deem non-observance of this Code as violation of the warranty conditions with all the consequences resulting thereof.
- Motor and its components must be protected against accidental fall or impact. Special attention must be paid to the bearings then.
- When motor is in operation, impurities must be prevented from entering the coolant inlet.
- Each procedure is prohibited that would influence safe operation of the motor.
- Only the tooling and instruments specified by this Code are allowed to be used for the activities associated with specific work procedures.
- No inadequate impacts, tools, and work procedures which could damage the bearings may be applied during handling, assembly, and disassembly.
- If, in terms of operation or technology, too hot or too cold motor components are found when working on the motor, use must be made of suitable protective gloves.

- In maintaining and cleaning the motor and its components with chemical agents with hazardous properties attention must be paid to the risks resulting from their use and the safety regulations imposed by their manufacturers in Material Safety Data Sheets relevant to such chemical agents. Application of the agents designated with C (Caustic) to clean the motor and its components is prohibited.

Observe the applicable regulations on environmental protection and occupational safety during each motor maintenance or repair process.

Before starting any works on the motor, the motor must be disconnected from the supply voltage and secured so that no electrical shock may take place!

- Assembly, disassembly as well as any handling have to be performed with regard to the local occupational safety regulations and their observance must be enforced.
- When performing maintenance or repair, tidiness of the working environment must also be taken into account, and the motor interior and its components must be protected from any contamination.
- If more motors are being disassembled at a time within a maintenance process, attention must be paid that the motor components and parts are not confused among these motors.
- The dedicated suspension hooks (eyes) and slings must be used when handling the motor. All persons must stay away from the motor suspended on a traversing crane.
- Bearing capacity of the handling equipment and its suspensions must be identical to the motor weight as minimum.

4. Emissions, Toxicity, Influence on the Environment

The materials chosen for the construction are fully recyclable, containing no halogen substances, asbestos, PVC, acids, and salts and they are not toxic. Anticorrosive coats contain neither chromium nor heavy metals.

The motor operation generates no harmful emissions and wastes dangerous to both health and environment.

The noise level of running motor does not exceed 86 dB ± 3dB

The assessment of toxicity and further properties of the materials and substances applied in the motor's construction conforms to the Act No. 350/2011 Coll. on chemical substances and preparations and the Act No. 258/2000 Coll. on public health protection as amended, and the (EC) European Parliament and Council's Legislation No. 1272/2008 on classification, labelling and packaging of substances and mixtures (known as CLP), amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending the European Parliament and Council (EC) Regulation No. 1907/2006 (known as REACH).

These Acts are in harmony with:

§ the European Parliament and Council Regulation 2004/10/EC on the harmonisation of laws, regulations and administrative provisions relating to the application of the principles of good laboratory practice and the verification of their applications for tests on chemical substances.

§ the European Parliament and Council Directive 2004/9/EC - on the inspection and verification of good laboratory practice.

5. Application

5.1. Sort, Type and Application

Three-phase synchronous traction motors with permanent magnets fitted to the rotor of 7HLU 3436 P/44-VA type are intended to drive and brake the low-floor tram car.

5.2. Location of Traction Motors on Car

Traction motor is mounted into the tram bogie to drive the tram wheel directly through the clutch. The motor and wheel axis are parallel, abaxial. With the empty car, the motor axis is above the wheel axis. Traction motor is located outside of the wheel. The motor is mounted to bogie with the flanges that protrude from the shields to the bogie frame brackets. Traction motors are in direct contact with ambient environment, their cooling takes place via the cooling medium (water and glycol) flowing through the chassis. This medium is consequently cooled down in the tram drive's heat exchanger.

6. Storage

Before starting any works on the motor, the motor must be disconnected from the supply voltage and secured so that no electrical shock may take place!

6.1. Storing Motor Before its Use

1) Motors must be stored in a dry environment free from mechanical shocks where temperature will not drop below 5°C and where abrupt temperature changes are prevented.

2) Entry of any impurities and living creatures must be prevented for they would impair proper operation of the motor and all of its components.

3) Motors must be protected against dust, namely the electrically conductive or chemically active dust, moisture and shocks. They must be stored on sufficiently strong support that transmits no vibrations or oscillations from the operated installed equipment.

4) When being stored and maintained the motor must be protected from complete or partial flooding with water.

5) Insulation resistance of windings must be measured and recorded before storing (see Chapter **8.2**)

6) After every 3 months of storing it is necessary to turn the machine rotor in the stator by one third of revolution. If motor's rotor is secured with rotorlock to eliminate motion, the rotorlock must be removed before turning. The actual motor turning can be performed on a pallet.

7) The preserved unpainted surfaces must be inspected for status after every 6 months of storing. If the preservation layer is impaired and uneven it is necessary to recover preservation of these surfaces.

8) In case of a long-term storage that exceeds 12 months, the steps must be taken according to Chap. 8.3. and the voltage test (Chap.8.3.4) and consequently the insulation state test (Chap. 8.3.3) must be included in the motor examination process, see Chap. 8.3, point 3.

9) Maximum motor storage time is 3 years. If this period is exceeded the motor cannot be operated and the lubricant level must be checked. It is recommended to send the motor to the manufacturer for this inspection, see the Manufacturer's Address, **Chap.17**.

10) Before using the motor after its storage period, the motor must be inspected for possible damage.

7. Description

This description is supplemented with **Ed611813 "DIMENSIONAL DRAWING“** and **Ed611812 „MOTOR CAVITY“** document **(for the connection of clutch).**

Three-phase synchronous traction motor with permanent magnets of 7HLU 3436 P/44-VA type Fig. 1 and Fig. 2.

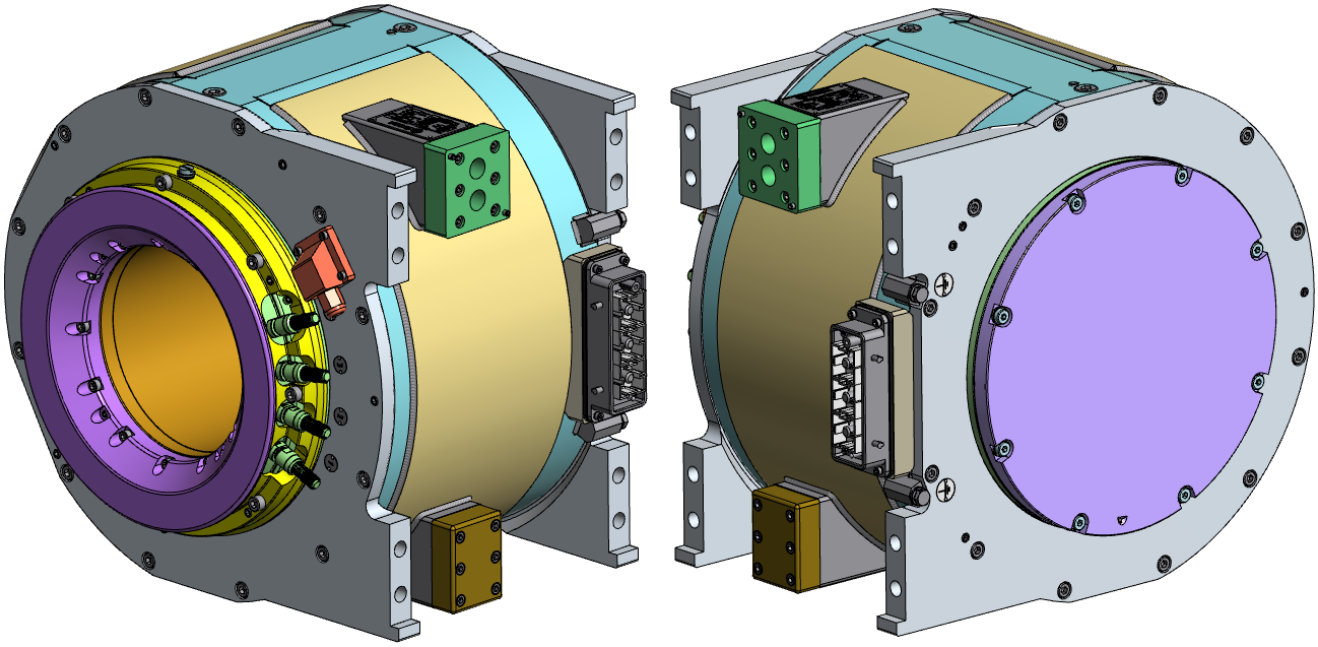

Fig. 1 – Motor **7HLU 3436 P/44-VA** - the front and rear side

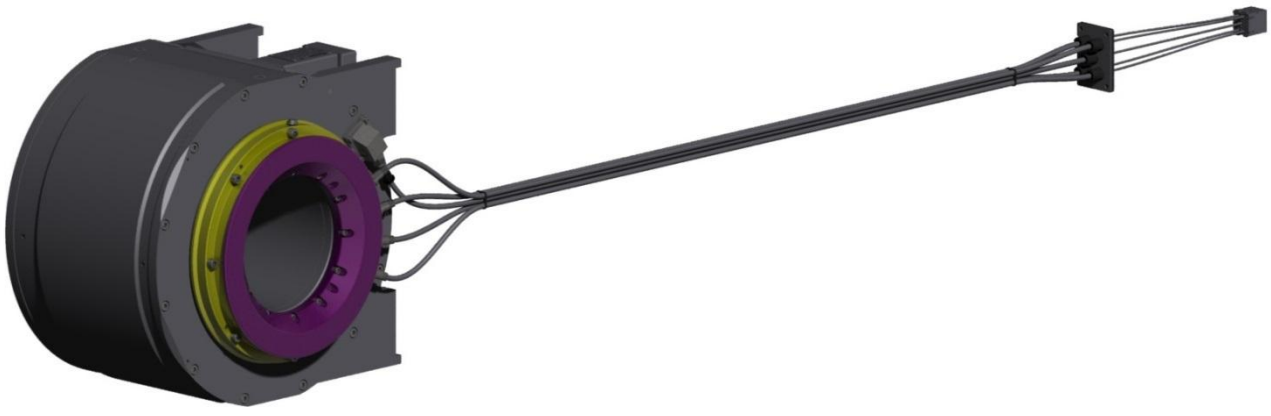

Fig. 2 – Motor **7HLU 3436 P/44-VA** – with wiring

7.1. Rotor (1)

Synchronous tram motors with permanent magnets are designed this way:

Rotor (**1**) is composed of hollow shaft (**1/1**), rotor harness (**1/2**) that consists of rotor stamping (**1/2/1**) and rotor side plates (**1/2/2**). Slip the rotor harness (**1/2**) with overlap, heated to 120°C - 140°C, onto shaft (**1/1**). The shaft is secured with spline (**1/3**) against turning and with safety ring (**1/6**) against extension. Individual poles are composed of the pairs of semi-poles that are assume a form of a system of magnets stuck to the thin ferromagnetic plates (**1/4**,**1/5**) mounted to the rotor harness' outer diameter using adhesive (**1/7**) and secured against release with a preloaded single-layer fibre-glass bandage (**1/8**)(**Fig. 4**).The rotor made this way is consequently balanced. For the position of the centre of gravity and values of the allowed unbalances see **Chyba! Nenalezen zdroj odkazů.**

PŘÍPUSTNÁ NEVYVÁŽENOST ALLOWED UNBALANCE	VYVAŽOVACÍ ROVINA BALANCING PLANE	
	I	II
PŘÍPUSTNÁ NEVYVÁŽENOST ALLOWED UNBALANCE gmm	588	580
HMOSTNOST PŘÍPUSTNÉHO NEVÝVAŽKU WEIGHT OF ALLOWED UNBALANCE g	3,92	3,87
NEJVYŠŠÍ PROVOZNÍ OTÁČKY MAXIMAL SERVICE SPEED mm−1	706	

VZÁLENOST VYVAŽOVACÍCH ROVIN,POLOMĚRY NEVÝVAŽKŮ A TĚŽIŠTĚ ROTORU
DISTANCE OF BALANCING PLANES, RADII OF UNBALANCES AND CENTER OF GRAVITY

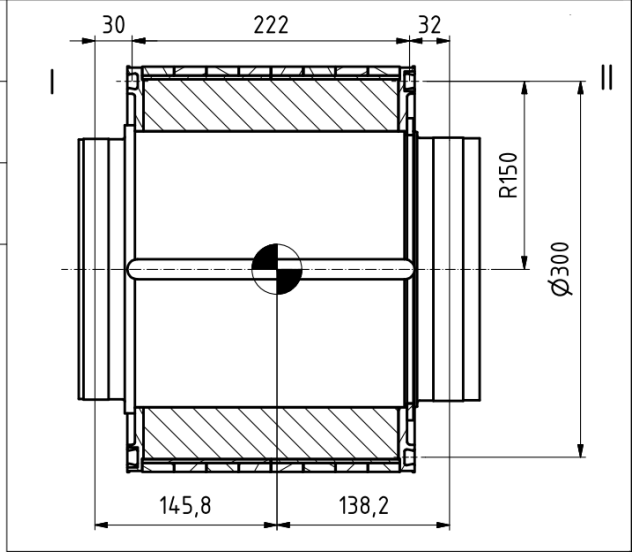

Fig. 3 – Rotor – position of the centre of gravity and values of unbalances

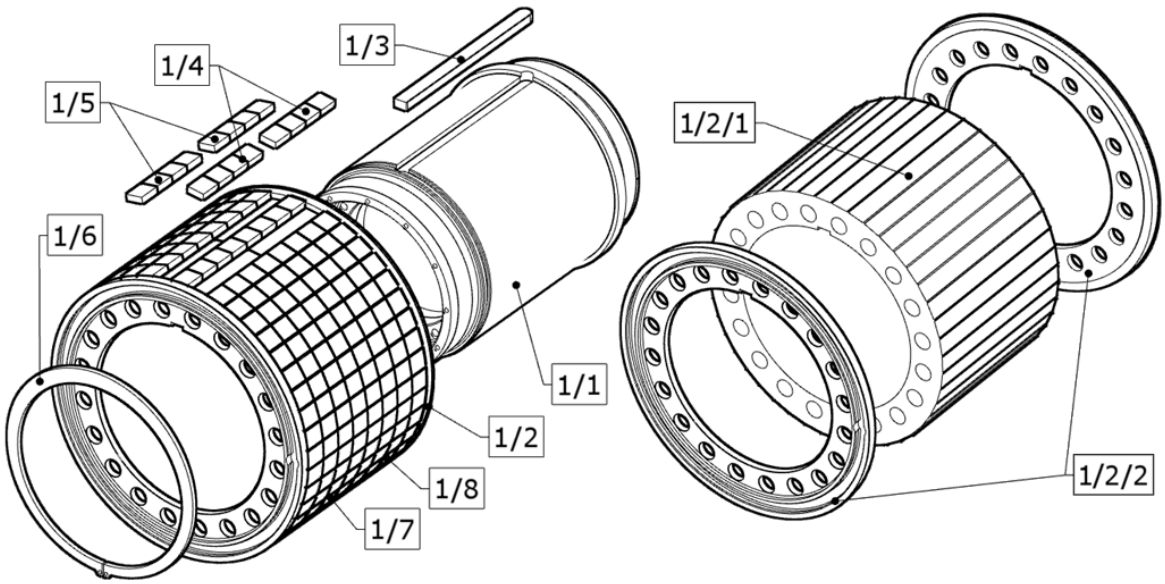

Fig. 4 – Rotor assembly (**1**)

7.2. Stator - Attaching Connector (2)

Stator – attachment of connector (**2**) is composed of the listed stator stack (**2/1/2/1**) that is composed of the stator laminations (**2/1/2/1/1**) and, on both the harness sides, with end stamping stack with insulation (**2/1/2/1/2**). This stack consists of two end stampings, each of 1 mm in thickness (**2/1/2/1/2/1**), and glass-textile insulation (**2/1/2/1/2/2**) of the same thickness (Fig. 5). Stator coils (**2/1/2/3**) secured with glass-textile wedges (**2/1/2/4**) in the slots between poles are inserted into the pair of slots (Fig. 6). After the impregnation process, the harness made this way and winding (**2/1/2**) are pressed into the machined steel chassis (**2/1/1**) with overlap. The position is secured by using a 8x14 pin (**2/1/7**) in the chassis and a guiding slot in the stator harness (**2/1/2/1**) (Fig. 7).

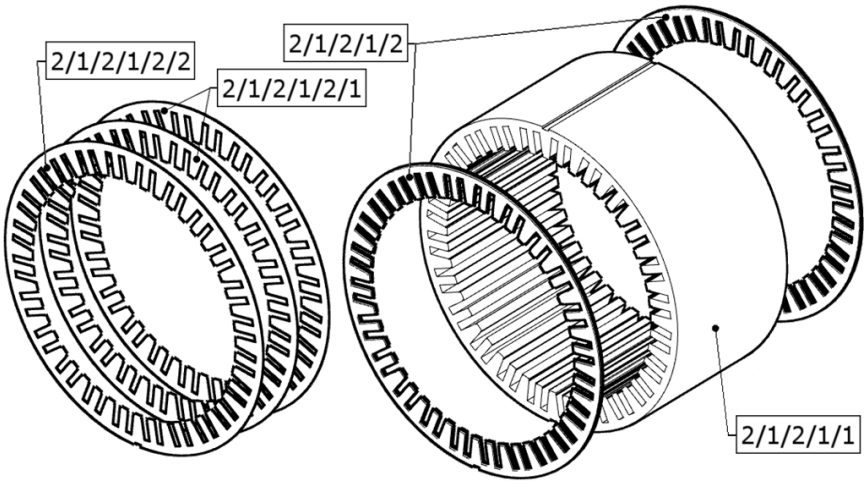

Fig. 5 – Stack of end lamination with insulation (**2/1/2/1/2**), stator stack (**2/1/2/1**)

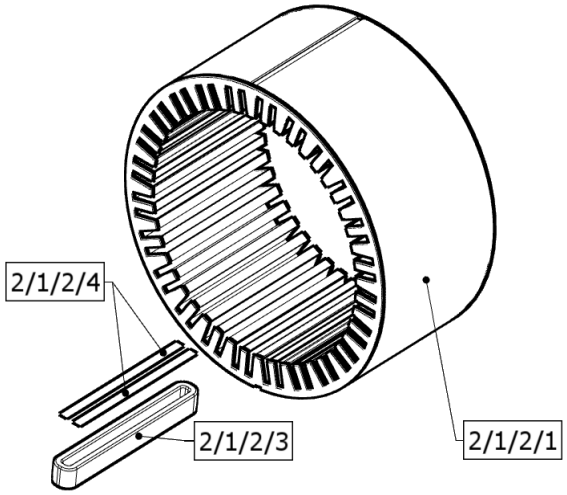

Fig. 6 – Stator stack (**2/1/2/1**), insertion of coils **(2/1/2/3**)

The machined chassis is composed of the welded chassis (**2/1/1/1**). This comprises the chassis YOKE (**2/1/1/1/1**) where channels are milled for a coolant flow. At their outer diameter, the channels are covered with a steel membrane (**2/1/1/1/2**) and, at their bottom side, with slats (**2/1/1/1/3**). On its side, the chassis is fitted with weldments (**2/1/1/1/4**, **2/1/1/1/5**) to ground the machine (Fig. 7). The winding is led out from the machine via connector (**2/1/15**) fixed with M4x16 screws (**2/1/9**) with washers (**2/1/11**) through the connector plate (**2/1/3**). The connector plate is screwed to chassis using M4x25 screws (**2/1/8**) with washers (**2/1/11**). See Fig. 8.

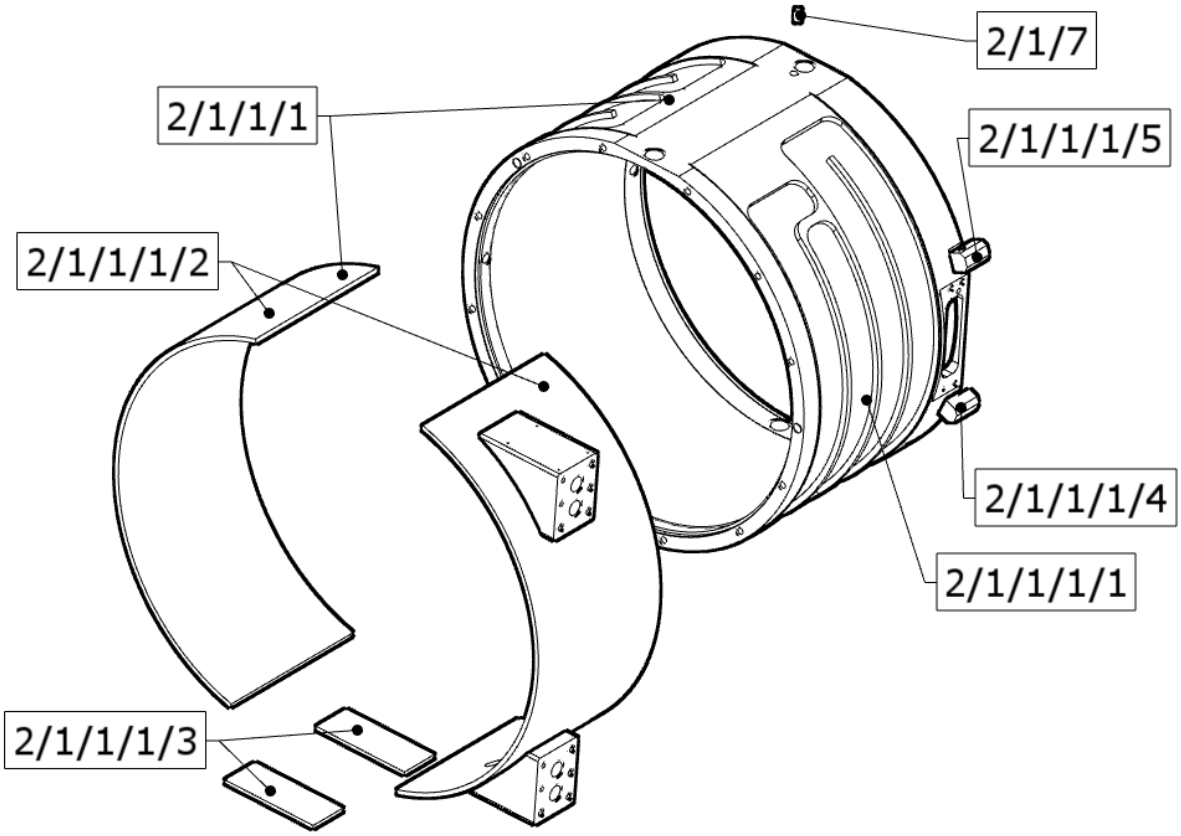

Fig. 7 – The machined chassis assembly (**2/1/1**)

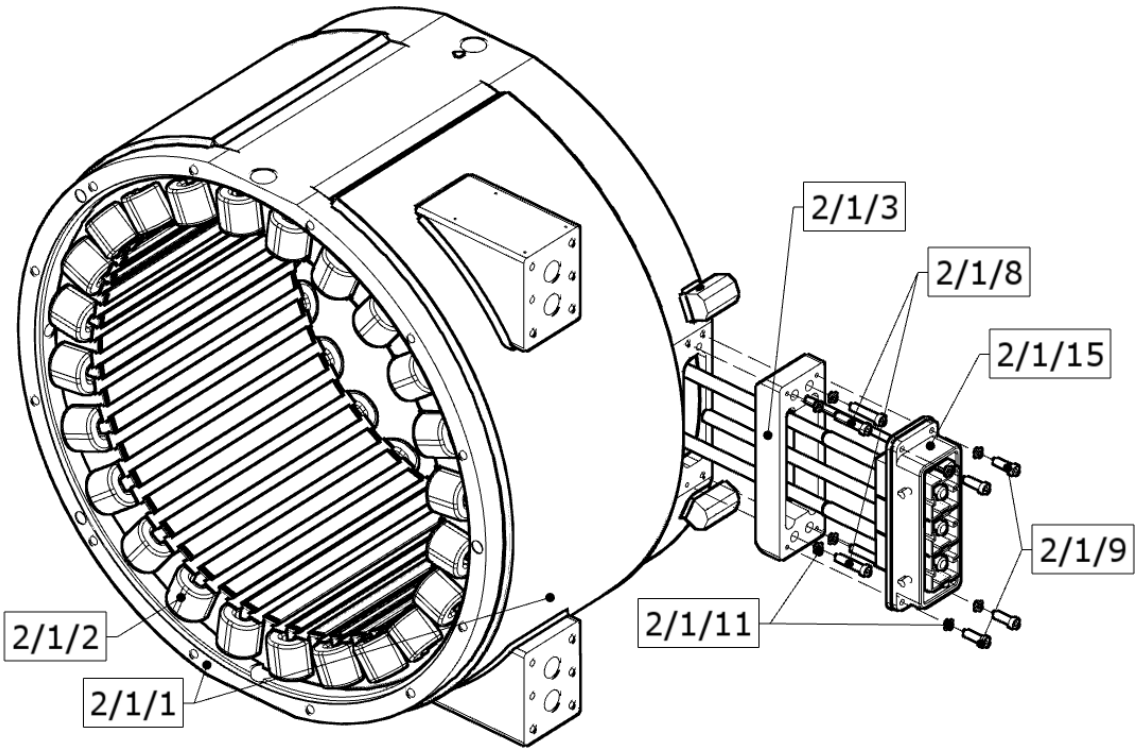

Fig. 8 – Winding led out through the power connector (**2/1/15**)

7.3. Shields A (3) and B (4)

Motor jacket is given its final shape by the flat steel shields. The shield A (**3**)(Fig. 9) and the shield B (**4**)(Fig. 10) that are laterally fitted with the protruding extended part with 4xM16 threads on each shield. They are used for fitting/mounting the motor into the tram.

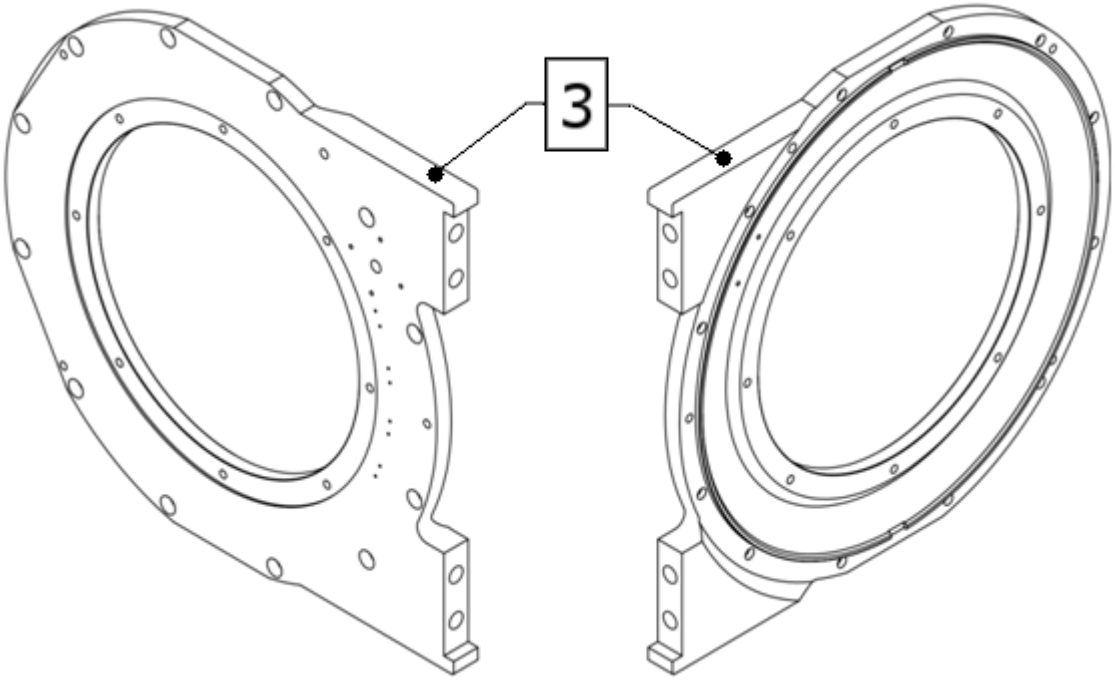

Fig. 9 – Shield A (**3**) – the front and rear side

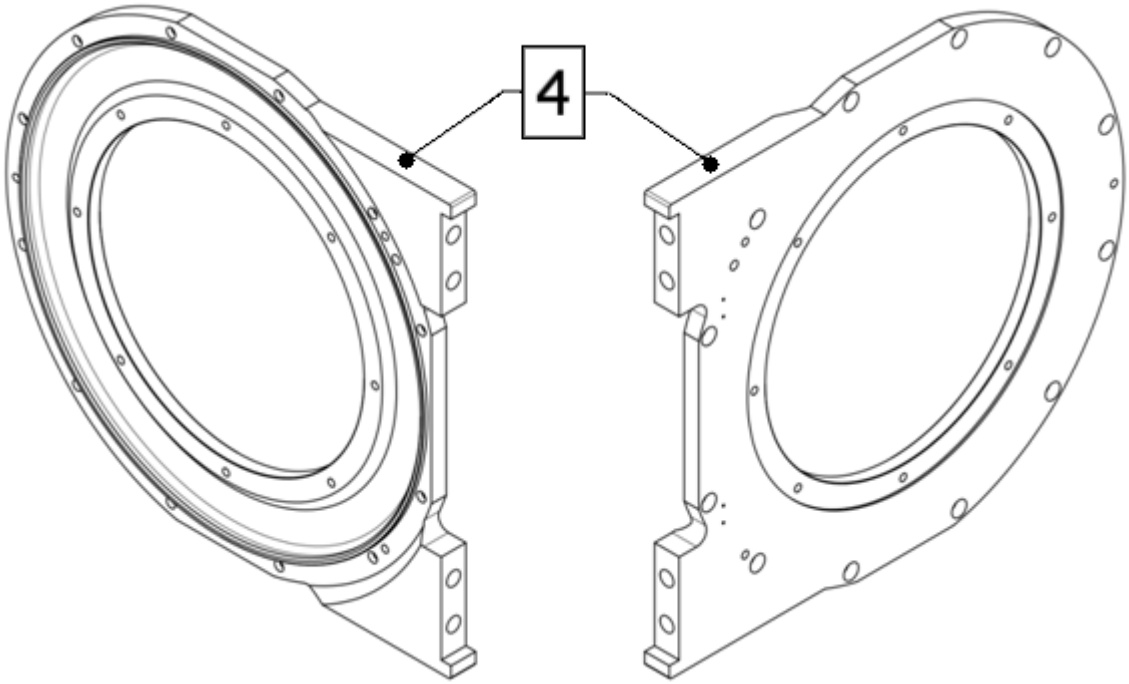

Fig. 10 – Shield B (**4**) – the front and rear side

7.4. Motor

Motor design:

Motors have a shape of IM9209 according to ČSN EN 60034-7:2001. It is therefore the machine with special assembly arrangement (the clamping holes laterally on the shields) in horizontal position and with the rotor's hollow shaft (2/1) extended from its cavity using recesses and holes for special clutch.

Bearing nodes are implemented as integral hybrid units (**11, 12**), including the labyrinth sealing. Being laterally attached to the tram wheel, it is the unit with the ceramic balls (**11**) and built-in position and speed sensor. The roller bearing unit (**12**) is located on the other side. Both units have ceramic elements. Sealing of the bearing unit with ball (**11**) is contactless. It is implemented with two parts. The labyrinth rotational (**5**) and static labyrinth (**51**) (Fig. 11).

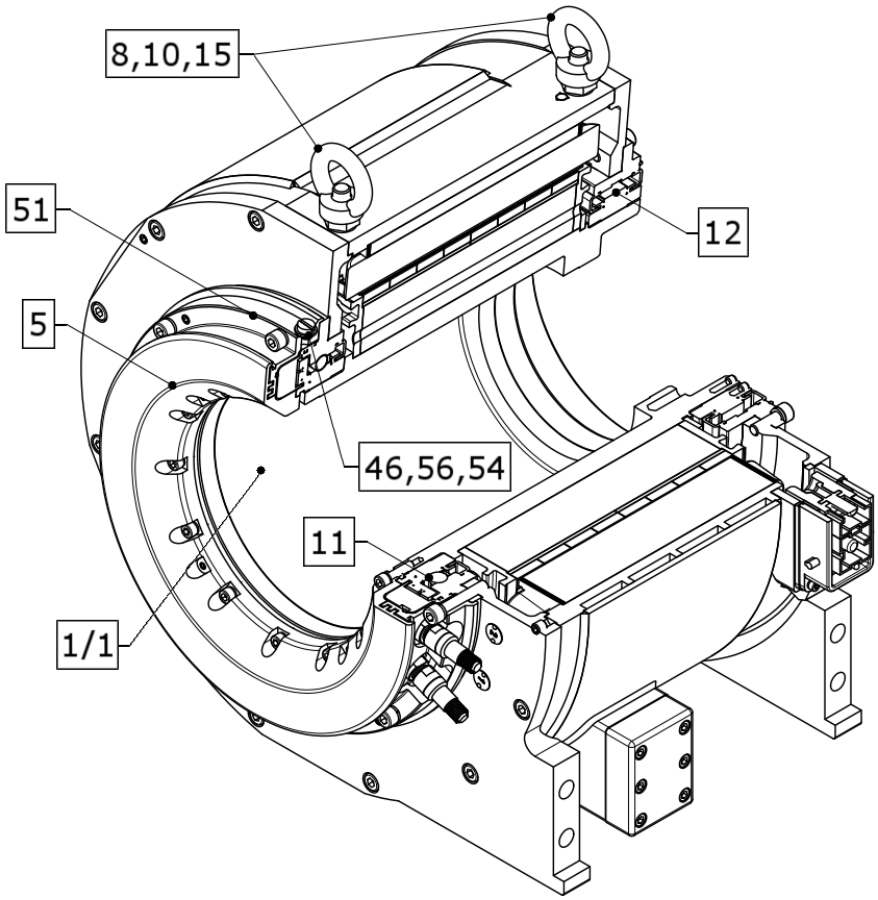

Fig. 11 – Section through the **7HLU 3436 P/44-VA** motor

The motors are designed in identical version for both wheels of one axle box. Uniform position of the mounting holes and electrical supplies for two paired motors is attained by lateral and height turning of one of the motors. To allow attachment of the cooling circuit to always be above the motors' horizontal axis, the cooling circuit is divided into two series branches interconnected under the motor horizontal axis with a special part sealed with O-ring (**28**). The part above the axis for coolant inlet and outlet is also sealed using O-rings (**27**).

The motors are supplied in the left-hand version and the right-hand version. This version differs with the location of components: spacer B (**6**), jumper (**7**), plugs – INBUS **(2/10)**, pintle (**10**), suspension loop nut M12 (**15**), cover (**56**) and washer (**46**) with O-ring (**54**). Plugs – INBUS **(2/10)** and cover (**56**) are secured with Loctite according to the assembly drawing Ed611811.

For illustration, the procedure is described in Section Chap.10.

In case of exchange of part (**6**) and part (**7**) it is necessary to check the seals for condition and, if necessary, replace the seals (**27**, **28**)(**Fig. 44**) and clean the contact surfaces. Pressure test must be carried out after the replacement. The test procedure is described in Section 9.2.1.9**.**

Use INBUS (Allen) key, size 8, to dismount the plugs **(2/10)**. Replace the damaged plugs with new part. When installing plugs, secure the joints with Loctite as depicted in the assembly drawing **Ed611811**. The plugs are screwed in flush with the external motor surface and consequently coated with external protective paint.

The correct assembly and motor functioning ALWAYS require replacement of all the parts specified in Section chap. 10!!!

Before and after the motor has been fitted into the bogie, it is of essence to check the installation of plug (2/10) on the motor top side once the handling lugs are removed. Then check the position of cover (56) with washer (46) and O-ring (54). It always has to be on the motor top side. The motor must not be operated without these plugs or when they are positioned incorrectly!!!

8. Maintenance Code

Before starting any works on the motor, the motor must be disconnected from the supply voltage and secured so that no electrical shock may take place.

8.1. Storing Motor Before its Use

See Chapter 6.1 Storing Motor Before its Use

8.2. ESD Protection Principles

The ESD protection principles must be followed when handling the broken down motor and especially the speed sensor and its supply cables.

The cables must be marked with self-adhesive tape with relevant symbol for work with ESD (sensitive equipment) (Fig. 12) and the sensor attachment connector must always be protected by ESD bag. (Fig. 13).

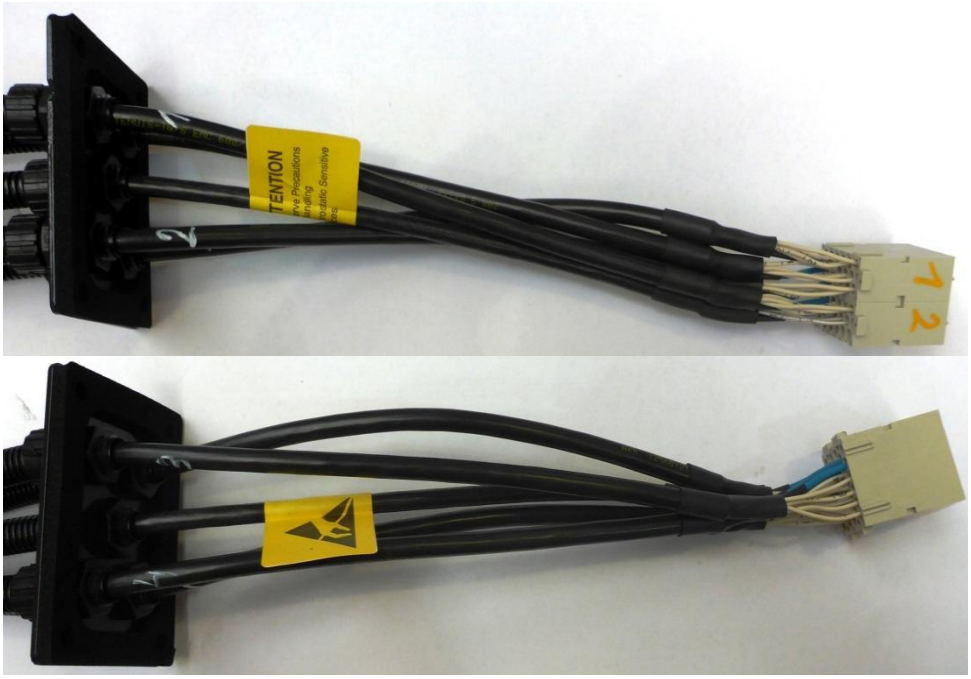

Fig. 12 – Cables marked with ESD label

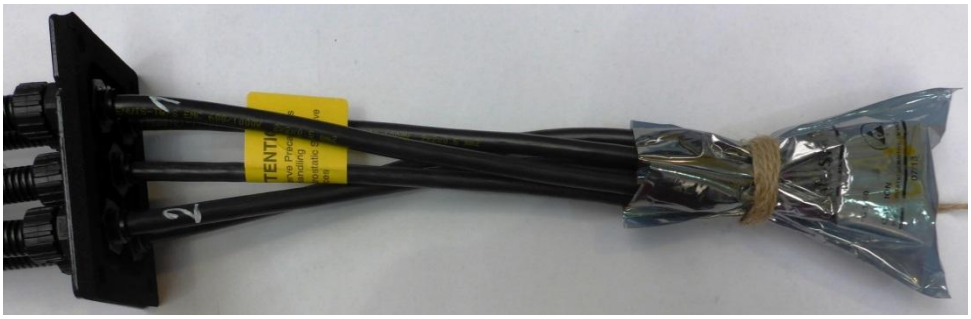

Fig. 13 – Connector protected with **ESD** bag

All the workers appointed to handle the speed sensor must be instructed and they have to adhere to the ESD protection principles. For the protection example see Fig. 14.

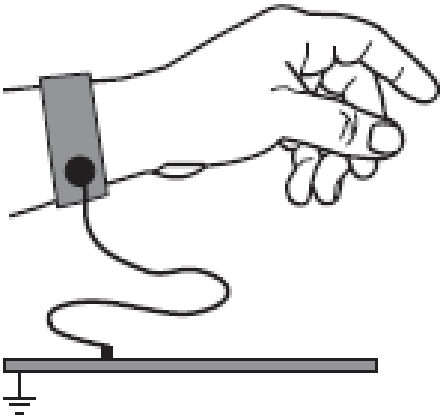

Fig. 14 – Protection against **ESD** with grounded wristband

In case of failure to adhere to the ESD protection principles the company's WARRANTY FOR THIS PART BECOMES NULL AND VOID!!!

8.3. Putting into Operation

Before starting any works on the motor, the motor must be disconnected from the supply voltage and secured so that no electrical shock may take place!!!

1. Once the motor was transported from the manufacturer or, if appropriate, after a short-term storage, check the machine visually for intact condition, tightening of screws and bolts, and verify if the motor's rotor rotates in the stator with regular resistance of adequate amount.
2. Afterwards, remove the preserving coat TECTYL 506 EH that protects the functional surfaces.
3. Motor is tested by following the points below:
   - checking the Ohmic resistance of winding (**Chap. 8.3.1**)
   - Checking the insulation resistance (**Chap. 8.3.3**)
   - checking the temperature sensors (**Chap. 8.3.2**)
4. Motor is mounted to the tram frame in the specified position (horizontal with mounting protrusions of shields on the machine side), mounting screws must be properly tightened and secured against loosening. A special clutch located in the motor cavity is linked to the tram wheel. M10x20 screws of the special clutch must also be tightened properly and secured against loosening.
5. The motor cooler (channels in the machine chassis) is connected to the tram's cooling circuit with flange surfaces. The contact surfaces are sealed with a soft gasket. As an alternative, O-rings can be used for sealing (this sealing performs correctly when the screws are fully tightened - metal to metal).
6. With the power connector connected electrically to the source, the temperature sensor to the protective circuit (the remaining temperature sensor is a reserve sensor), the cables of the monitored SKF bearing unit and the grounding wire to the protective boss on the motor chassis, it is of essence to take due care for reliability of the conductive contacts and the mechanical protection of the connector parts against damage under operation.

8.3.1. Checking the Ohmic Resistance of Winding

Given the fact the stator winding is star-connected, it is always measured between 2 outputs (U+V, U+W, V+W) and the reading is divided by two. Ohmic resistance depends on ambient temperature and the measured value is converted into **20°C** using the formula below:

measured value x ((235 + 20)/(235 + ambient temperature))

The established value must be within 0.252Ω ±5% (min. 0.2394Ω, max. 0.2646Ω).

We recommend to perform measurements of ohmic resistance by applying VA method ((controllable DC source (0 – 2 V/ 2 A) or ohmmeter with higher measured current (0-2 V / 2 A) is necessary).

In case the values range beyond the determined range, contact the manufacturer, see **Chap 17**.

8.3.2. Checking the Temperature Sensors

Measuring the ohmic resistance for all the Pt-cells in cold status (10°C to 40°C). The measured resistance must range within 103.9Ω/5V (10°C) to 115.4Ω/5V (40°C).

Remark: The winding temperature is established as $\mathbf{T_{vin}=(R_{PT100}-100) / 0.385}$ while $\mathbf{R_{PT100}}$ **= 107,7 Ω** is valid **for 20°C**

8.3.3. Checking the Insulation Resistance

New motor:

Stator winding to the chassis

- is carried out in cold state with the measuring voltage of 1000 V AC
- the insulation resistance must be >100 MΩ.

Temperature sensors to the chassis and to the stator winding

- is carried out in cold state with the measuring voltage of 500 V AC
- the insulation resistance must be >50 MΩ.

Motor from operation:

Stator winding to the chassis

- is carried out in cold state with the measuring voltage of 1000 V AC
- the insulation resistance must be >50 MΩ.

Temperature sensors to the chassis and to the stator winding

- is carried out in cold state with the measuring voltage of 500 V AC
- the insulation resistance must be >50 MΩ.

In case the values are lower that those defined above, stator drying must be performed according to **Chap. 8.3.3.1**.

8.3.3.1. Stator Drying

It is done at 80°C for 12 hours. Once finished the insulation states must be measured repeatedly, see **Chap. 8.3.3**. Drying can be repeated 3 times as maximum. If the insulation resistance fails to increase, contact the manufacturer, see **Chap 17**.

8.3.4. Voltage Test

New motor:

Stator winding to the chassis

- it is done using the applied voltage of 2800 V AC / 60 s

Temperature sensors to the chassis and to the stator winding

- it is done using the applied voltage of 500 V AC / 60 s

Motor from operation:

Stator winding to the chassis

- it is done using the applied voltage of 2450 V AC / 60 s

Temperature sensors to the chassis and to the stator winding

- it is done using the applied voltage of 500 V AC / 60 s

In case the tests fail to be met, see above, contact the manufacturer, see **Chap** 17.

8.3.5. Checking Vibrations

Measuring is done for the rms value of the speed of vibrations that occur at 400 rpm and 50 Hz. The maximum vibration value is 1.8 mm/s. Take 2 measurements for each shield.

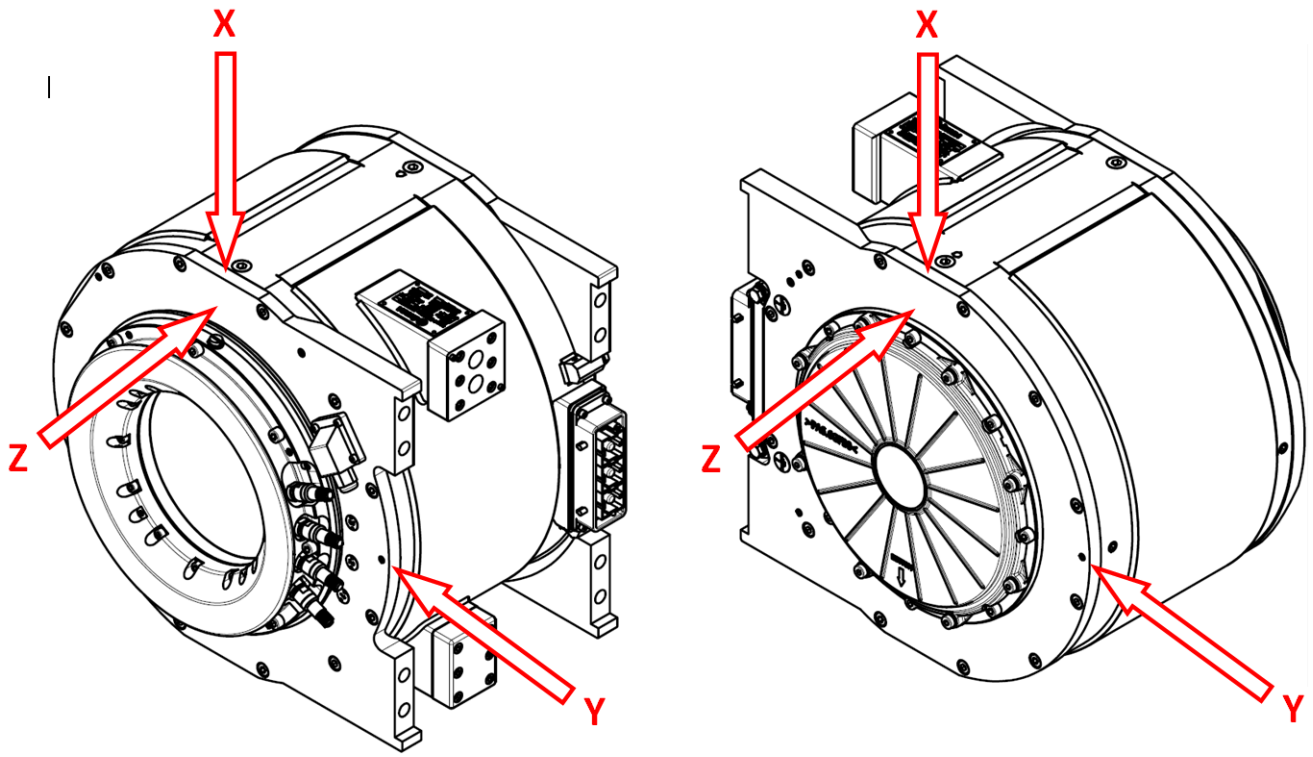

Fig. 15 – Graphical representation of the location of probes

Place the probes on the motor's shields A (**3**) and B (**4**), see **Fig. 15**

In case the test limit fails to be met, see above, contact the manufacturer, see **Chap. 17**.

8.3.6. Cooling Circuit Tightness Check

Before the actual test it is necessary to install the fixture **OXA31787** consisting of the plate (**1**), 4 pcs of M16x40 screw (**2**) according to DIN 933, sealing (**3**) and nipple (**4**).

Perform mounting to the side of spacer B (**6**) using 4 pcs of M16x40 screw (**2**) using a torque of 120 Nm. Connect the pressure air to the nipple (**4**) located on the fixture, see **Fig. 16**.

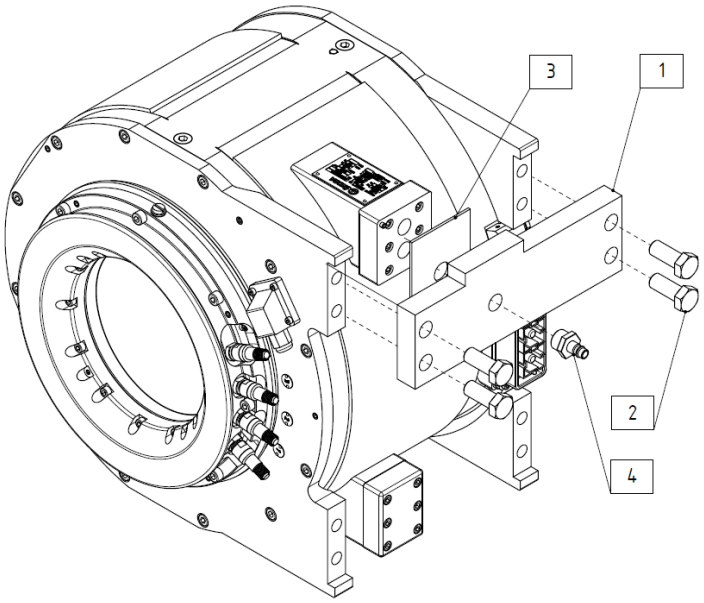

Fig. 16 – Mounting the fixture **OXA31787**

Tightness check is carried out by using the pressure air of 0.6 MPa for 10 minutes. Apply water and soap to the marked welds and joints: stator (**2/1**), spacer B (**6**) and stator (**2/1**), jumper (**7**) Fig. 17, to monitor pressure relief, if any. Pressure relief will be demonstrated by the formation of bubbles.

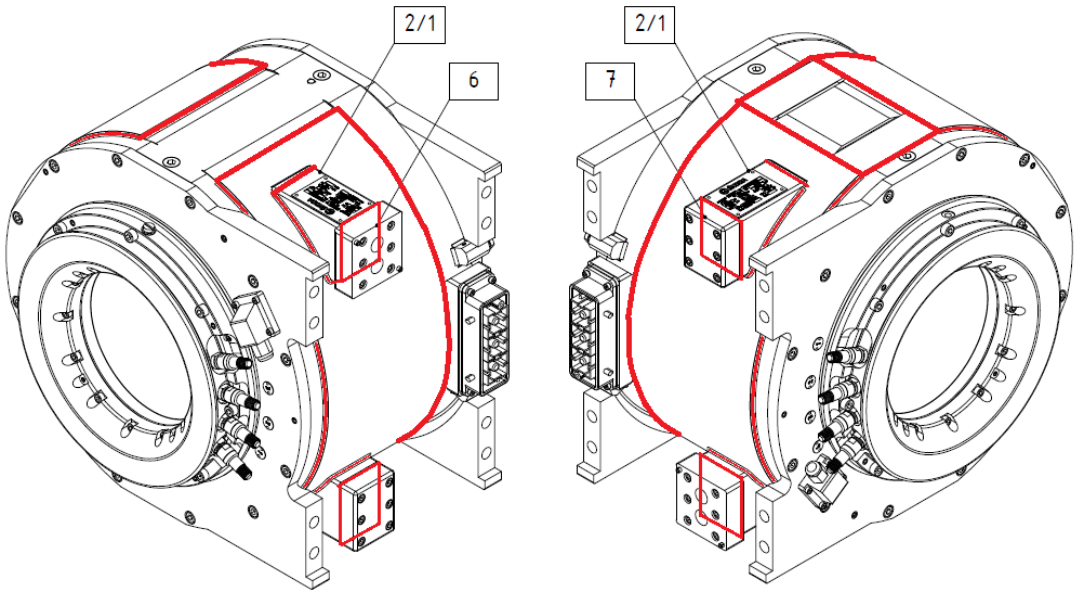

Fig. 17 – Graphical representation of the checked joints

In case the pressure drop takes place, contact the manufacturer, see **Chap 17.**

8.3.7. Voltage Constant Measuring

The value is established by measuring the induced voltage in cold state. The measuring is carried off-load in the generatoric operation at the rated speed. It is done immediately after coupling to the trial standstill before the running-in process is initiated.

The required values when measuring the induced voltage in cold state		
Speed [rpm]	Induced voltage [V]	Voltage constant at 20°C [V/1000 rpm]
196	200 ÷ 270	1131.3 ÷ 1319.85

Calculation of the voltage constant and its conversion into 20°C:

$$K_{e1000} = \frac{U_{induk}}{196} \qquad K_{e1000\ /\ 20°C} = \frac{100 * K_{e1000}}{(-0{,}0955 * (t - 20)) + 100}$$

Consequently calculate the voltage constant and compare this value with the initial value (Single-Part Test Report for the new motor). If the drop exceeds 5 % of the initial value, send the dismounted rotor to the manufacturer address. See **Chap. 17**.

8.3.8. Calibrating the Bearing Unit (11) Scanned by Sensor

In case the bearing unit scanned by sensor is decalibrated or in case of new calibration we recommend to break down the motor to send it to the manufacturer address, see **Chap. 17.**

The sensor position is verified **always** during the trial drive.

8.4. Recovery of Damaged Paint

Damaged paint (coat and shade) should be corrected according to the Painting Code **EdP0790**.

8.5. Maintenance, Examinations and Revisions

The motors require no special attendance. However, the trouble free operation requires that the principles for their installation above and the motor maintenance instructions below are adhered to. The maintenance consists of the **confirmatory examination KP, medium repair SO, major repair VO, and general overhaul GO**. The maintenance steps are repeated periodically each time when the specified mileage has been covered.

8.5.1. KP – Confirmatory Examination

(approximately after each 25.000 km ±20%, i.e. about 4 month interval)

Motor maintenance connected with its inspection and revision tasks conform to the procedure below:

Visual inspection:

1. Presence of all the visible screw connections, including the visual inspection of the cooling circuit and, if necessary, tightening of the screws.
2. Intactness of bushes (the bushes must not be damaged or cracked. Check the bushes by hand for their loosening. If they are loose tighten them!)
3. Presence of motor components, visible without motor, cable disassembly.
4. Cable must not have damaged insulation (incised, cracked or burnt surface, scores).

Based on good experience from operation, the examination interval may be eventually made longer upon the consent of the motor manufacturer.

8.5.2. SO – Medium Repair

(approximately after each 600 000 km ±20%, i.e. about 8 year interval)

Motor must not be washed using pressure water. Pressure water can penetrate into the inner parts of motor to make them corrode or alternatively their irreversible damage. It is recommended to clean the external motor surface by blowing with air and by using a brush with nylon bristles. Use wet cloth to perform final surface cleaning.

Sending to the manufacturer is recommended, see **Chap. 17** where the points below will be carried out.

Perform the following maintenance tasks together with the motor disassembly and its repair:

1. Motor dismounting from bogie and cooling circuit disconnection.
2. We recommend to measure the voltage constant (induced voltage) of the motor (**Chap. 8.3.7**)
3. The actual motor break-down into stator, rotor and shields with bearing units. Here, it is necessary to strictly adhere to the motor disassembly manual and utilize all the specified fixtures and jigs, and also **Chap. 8.2. ESD protection principles**.
4. Execute the following for the stator:
   - removal of possible impurities on the winding and terminals to the connector
   - examination of the stator winding for mechanical damage of the winding
   - if necessary, local repair of the surface layer of Elastosil N288 protective rubber – use brush to coat the place with damaged surface layer with a thinned Elastosil N288 rubber. Use white spirit or toluene to thin the rubber. Leave the stator repaired this way to cure in the air for a min. of 24 hours.
   - checking the Ohmic resistance of winding (**Chap. 8.3.1**)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - checking the temperature sensors (**Chap. 8.3.2**)
5. Execute the following for the rotor:
   - removal of potential impurities, including the axial ventilation channels in the rotor
   - check the rotor's outer diameter - max. 324.2 mm, its dimensions and mechanical intactness of the seating surfaces for the bearing units – 210n5 and 208n5.
   - careful visual inspection of the rotor's bandage for its colouring and intact state – if any deviation from the perfect condition is found send the rotor to the manufacturer's address. See **Chap. 17**.
6. Perform the following for the shields with bearing units:
   - removal of impurities and mechanical inspection of functional surfaces and their dimensions for intactness: ø412k6, ø210 +0/-0.022 and ø208 +0/-0.022
   - replacement of bearing units – send the old units for inspection and relubrication to SKF Praha
   - after installation, the bearing unit scanned by sensor must be calibrated (**Chap 8.3.8**)
7. Motor reassembly while adhering consistently to the motor assembly instructions (**Chap. 9.2.1**) and using all the specified fixtures and jigs, 8.2 ESD protection principles, and recovery of the machine's surface protection.
8. Examination of the motor according to the points below:
   - checking the Ohmic resistance of winding (**Chap. 8.3.1**)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - auditory check of motor operation for noise level
   - checking vibrations (**Chap. 8.3.5**)
   - voltage test (**Chap. 8.3.4**)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - checking the cooling circuit for tightness (**Chap. 8.3.6**)
   - checking the temperature sensors (**Chap. 8.3.2**)
9. Re-installation of the motor to the tram bogie plus attachment of the clutch and the sealed circuit for coolant.

8.5.3. GO – General Overhaul

(approximately after each 2 400 000 km ±20%, i.e. about 30 year interval)

Motor must not be washed using pressure water. Pressure water can penetrate into the inner parts of motor to make them corrode or alternatively their irreversible damage. It is recommended to clean the external motor surface by blowing with air and by using a brush with nylon bristles. Use wet cloth to perform final surface cleaning.

Sending to the manufacturer is recommended, see **Chap. 17** where the points below will be carried out.

Perform the following maintenance tasks together with the motor disassembly and its renovation:

1. Motor dismounting from bogie and cooling circuit disconnection.
2. We recommend to measure the voltage constant (induced voltage) of the motor (**Chap.** Chyba! Nenalezen zdroj odkazů.)
3. The actual motor break-down into stator, rotor and shields with bearing units. Here, it is necessary to strictly adhere to the motor disassembly manual and utilize all the specified fixtures and jigs, and also **Chap. 8.2** ESD protection principles.
4. Execute the following for the stator:
   - removal of possible impurities on the winding and terminals to the connector
   - examination of the stator winding for mechanical damage of the winding
   - if necessary, local repair of the surface layer of Elastosil N288 protective rubber – use brush to coat the place with damaged surface layer with a thinned Elastosil N288 rubber. Use white spirit or toluene to thin the rubber. Leave the stator repaired this way to wither in the air for 24 hours.
   - checking the power outputs (cable, pinning) and connector. In case the power outputs or the connector are damaged contact the manufacturer. See **Chap. 17**.
   - checking the Ohmic resistance of winding (**Chap.8.3.1**)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - voltage test (**Chap. 8.3.4**)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - checking the temperature sensors (**Chap. 8.3.2**)
5. Execute the following for the rotor:
   - rotor replacement. Send to the manufacturer's address. See **Chap. 17.**
6. Perform the following for the shields with bearing units:
   - removal of impurities and mechanical inspection of functional surfaces and their dimensions for intactness: ø412k6, ø210+0/-0.022 and ø208+0/-0.022
   - replacement of bearing units – send the old units for inspection and relubrication to SKF Praha
   - after installation, the bearing unit scanned by sensor must be calibrated (**Chap 8.3.8**)
7. Motor reassembly while adhering consistently to the motor assembly instructions and using all the specified fixtures and jigs, and recovery of the machine's surface protection.
8. Examination of the motor according to the points below:
   - checking the Ohmic resistance of winding (**Chap. 8.3.1**)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - auditory check of motor operation for noise level
   - checking vibrations (**Chap. 8.3.5**)
   - voltage test (8.3.4)
   - checking the insulation resistance (**Chap. 8.3.3**)
   - checking the cooling circuit for tightness (**Chap. 8.3.6**)
   - checking the temperature sensors (**Chap. 8.3.2**)
9. Re-installation of the motor to the streetcar bogie plus attachment of clutch and sealed circuit coolant.

9. Motor Assembly and Disassembly Instructions

The washer size 8 must be used for all the motors manufactured up to the serial number **0632565** where M8x20 screws (**17**) are used for the screw connections of shields A (**3**) and B (**4**) with the chassis (**2/1/1**). The tightening torque for the screws with washers is **6 Nm.**

9.1. Motor Break-Down and Handling:


CAUTION
No entry into the motor assembly and disassembly area for cardiacs and wearers of pacemaker

Suspension eyes, hooks and slings must be used when handling the motor.

This description is supplemented with the dimensional drawing **Ed611813** (**7HLU 3436 P/44-VA**)

Before starting any works on the motor, the motor must be disconnected from the supply voltage and secured so that no electrical shock may take place.

The modifications or works on motor that are carried out incorrectly or in a non-professional manner may lead to injuries of persons and material damages for which the manufacturer bears no responsibility whatsoever!

Standing under the suspended load is prohibited when motor is transported by crane.

Bearing capacity of the handling equipment and its suspensions must be identical to the motor weight as minimum (max. motor weight is **260kg ±3%**).

When transporting and handling the motor, treat the motor in such a way that it is not damaged mechanically.

Observe the applicable regulations on environmental protection and occupational safety during each motor maintenance or repair process.

No inadequate impacts, tools, and work procedures which could damage the bearings may be applied during handling, assembly, and disassembly.

When dismantling the motor, the motor must be adequately cleaned. Motor must not be washed using pressure water. Pressure water can penetrate into the inner parts of motor to make them corrode or alternatively their irreversible damage.
It is recommended to clean the external motor surface by blowing with air and by using a brush with nylon bristles. Use wet cloth to perform final surface cleaning.

When using force-off screws to press in or press out the components, **ALWAYS** tighten individual screws in the cross pattern.
Tighten to a fine tension (about ½ of the lead).

In principle, it is necessary that any motor failure or malfunction are handled and any interventions into the motor design are carried out by the competent worker, that is, worker with adequate qualification who is familiarized with the product.

The recommended solution that will ensure correct execution of all the tasks associated with maintenance and consequent trouble-free operation is to send the motor to the production plant. In case of failure please describe the failure as well. Remember to do so in case of the warranty and post-warranty repairs, see the manufacturer's address, **Chap. 17.**

Motor Break-Down and Handling:

The procedure allows use of the handling eyes (**15**) only, see **Fig. 18 -** Use of mounting eyes. These eyes are mounted to the motor's top side instead of plugs **(2/10)**. Firstly mount the pintle (**10**), then the suspension loop nut (**15**). Use the INBUS (Allen) key, size **8**, to dismount the plugs **(2/10)**.

After the motor has been reassembled into the bogie, it is necessary for the handling eyes or, if appropriate, Dismount the suspension lop nuts (**15**) (**M12**) and the pintle (**10**) to replace them with plugs **(2/10)**. The plugs are flush mounted with the external surface of the motor and subsequently coated with the top protective paint, see **"Paint Specification" EdP0790**. The plugs **(2/10)** must be secured with Loctite. See **Chap.10**.

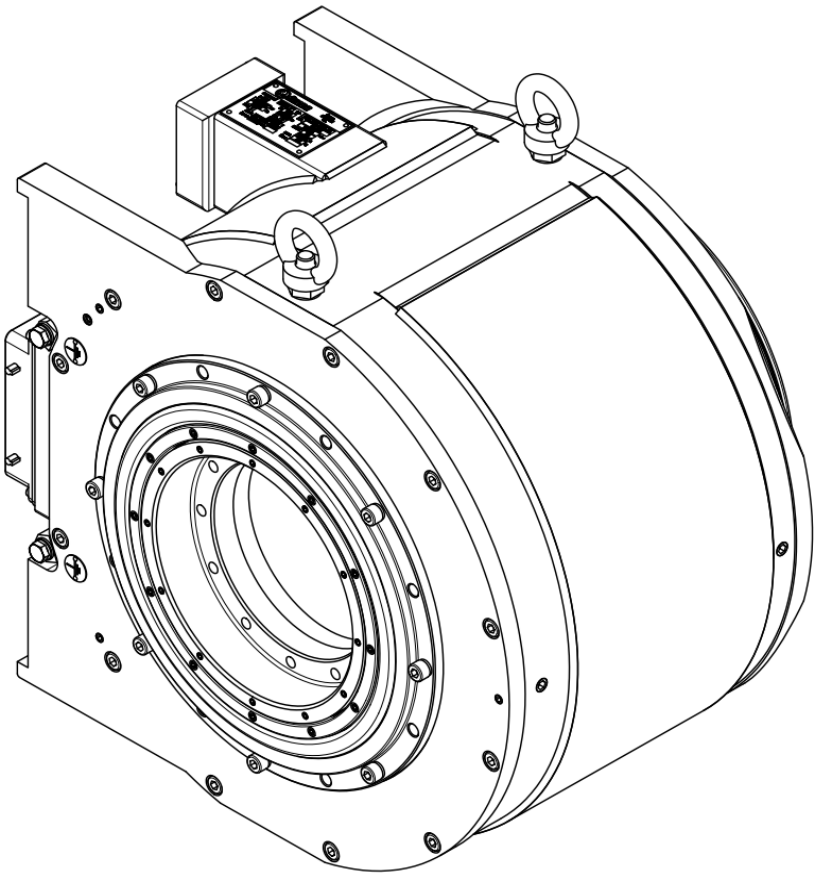

Fig. 18 – Use of mounting eyes

Tab. 1 - Disassembly fixture table

Part			Fixture	
Position	**Name**	**Identification**	**Designation**	**Description**
1 3	Rotor Shield A	Ed602067 Ed602071	OCS 31767	To position the assembly (rotor - Shield A) in the vertical position for assembly and disassembly
1 3 11	Rotor Shield A Bearing unit	Ed602067 Ed602071 63016693	OXA 31678	To position the rotor for assembly and disassembly of shield A with bearing unit
4 12	Shield B Bearing unit	Ed602073 63016694	OCS 31765	Fixture for assembly and disassembly of shield B with the bearing unit
2/1 1	Stator Rotor	Ed602064 Ed602067	OCS 32160	To disassemble the rotor from stator
2/1 1	Stator Rotor	Ed602064 Ed602067	OXA 32054	Winding protection inserts (4 to 6 pcs)
11	Bearing unit BMB-7509/ZMSTU	63016693	OCS 31764	Cramp for the ball bearing unit from the rotor shaft
	Tooling - HARTING		TB 09 99 000 0012	Extraction of contacts

9.1.1. Motor Disassembly

Procedure:

It is a disassembly into the main subassemblies, i.e. rotor (**1**), stator - attachment of connector (**2**), shield A (**3**) with the ball bearing unit (**11**), shield B (**4**) with the roller bearing unit (**12**).

9.1.1.1. Traction Motor Cabling Removal

The ESD protection principles must be followed when handling the broken down motor and especially the speed sensor and its supply cables.

The cables must be marked with self-adhesive tape with relevant symbol for work with ESD (sensitive equipment) (Fig. 12) and the sensor attachment connector must always be protected by ESD bag. (Fig. 13)

Use the contact poking tool, HARTING TB 09 99 000 0012, to extract contacts (**44/9**, **44/10**) from the contact insert (**44/8**). Then, loosen the nuts (**44/5**), remove washer (**44/2**) with seal (**44/3**) and snip the constriction tapes (**44/16**). See **Fig. 19** – Traction motor cabling removal .

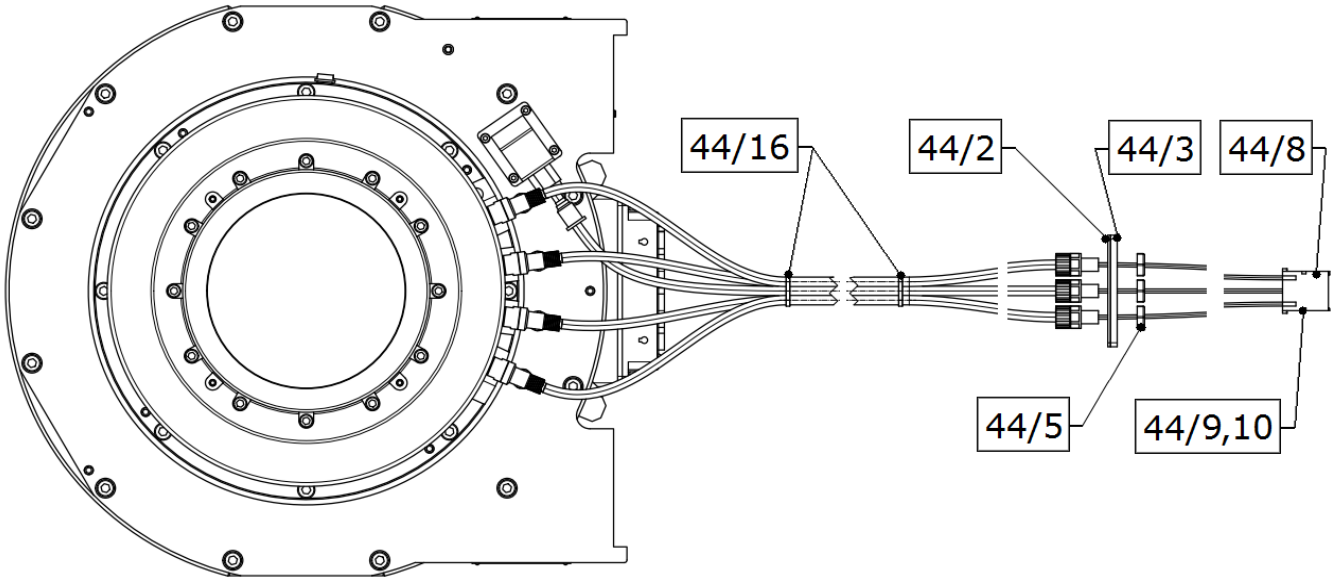

Fig. 19 – Traction motor cabling removal

9.1.1.2. Cable gland disassembly (14)

Place the motor to the horizontal position. Remove the screws (**20**), then the cable gland (**13, 14**) and disconnect or cut off the barrels (in the pressed joint) that connect the RADOX cable wires (**39**) with the Pt100 thermocouple outputs. See Fig. 20.

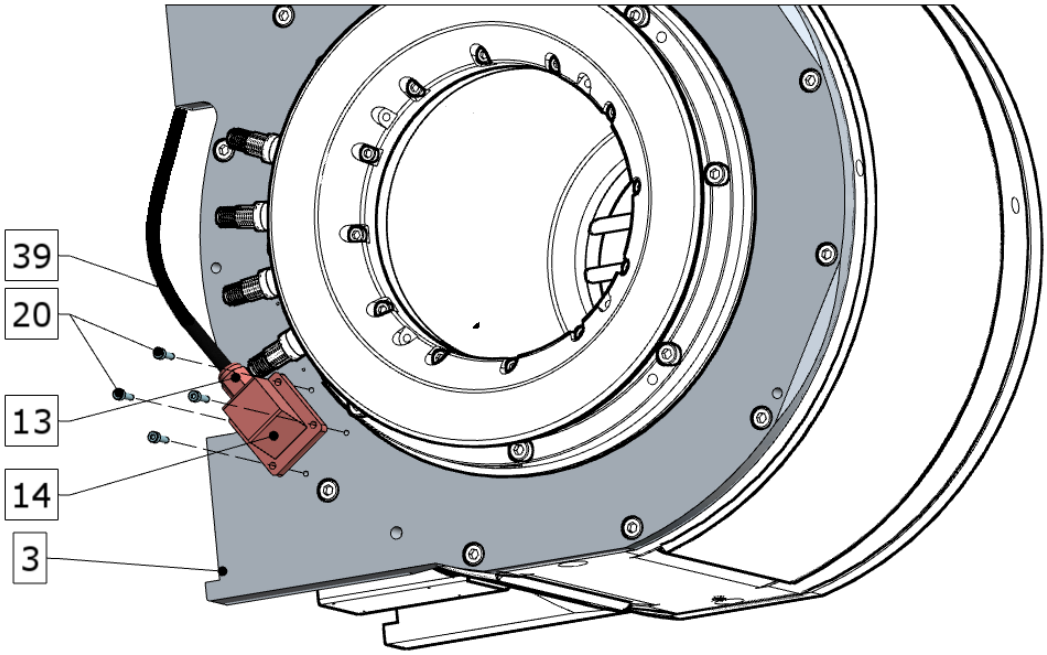

Fig. 20 – Cable gland disassembly (**13, 14**)

9.1.1.3. Disassembly of adjustment screws (49) and fixture installation

Remove the screws (**49**) from the inner race of bearing unit (**12**) and from the rotor shaft (**1/1**). Remove screws (**48**) from the shield B (**4**) and screws (**16**) from the bearing unit mount. Mount the **OCS31765** fixture to the ball bearing unit (**12**) by using 6 pcs of M6x25 screw (**513**) to the inner race and 8 pcs of M8x35 screw (**514**) to the outer race. By doing so, the positions of inner race and outer race of the bearing unit (**12**) are fixed to each other. **See Fig. 21** and **Fig. 22.**

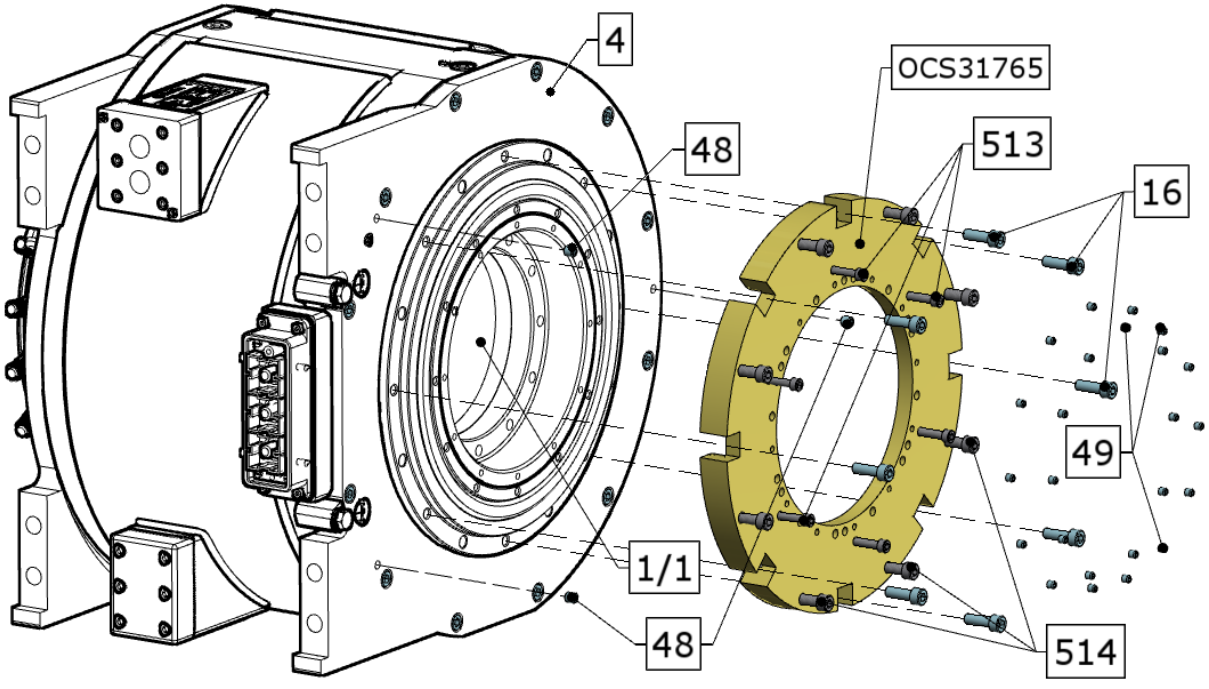

Fig. 21 – Disassembly of adjustment screws (**49**) and fixture installation

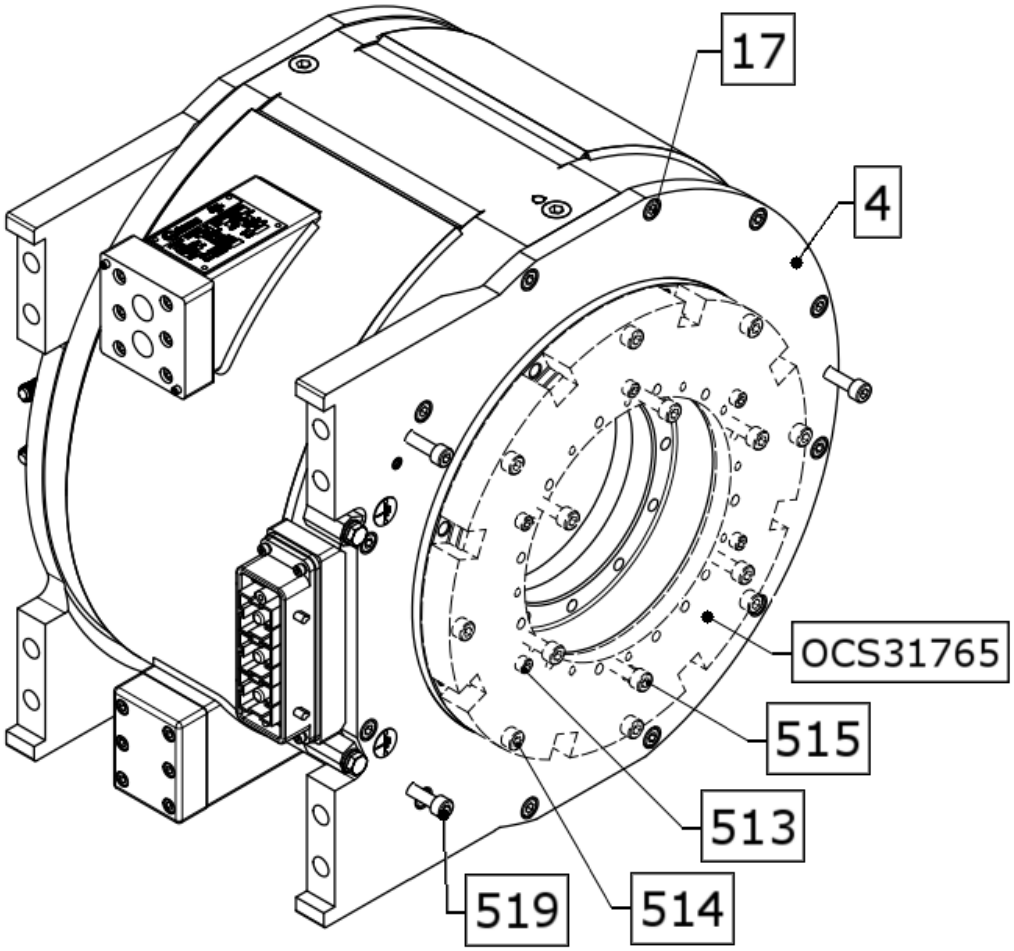

Fig. 22 – Fixture installation

9.1.1.4. Disassembly of the shield B (4)

Place the motor to the vertical position in **OCS31767** fixture (**Fig. 24)** with the ball bearing unit (**11**) downwards. Run the ball bearing unit's cables out from the fixture through the circular segment.

Remove the screws (**17**) that connect the shield B (**4**) with chassis (**2/1/1**). Extend the shield B (**4**) with the roller bearing unit (**12**) out from the chassis mount (**2/1/1**) and rotor shaft (**1/1**) by staggered tightening of the M6x40 force-off screws (**515**) in **OCS31765** fixture through the rotor face (**1/1**) and the M8x30 force-off screws (**519**) in the shield B (**4**). See **Fig. 24**.

Insert a minimum of 4 pcs of 0.5mm thick glass-textile insert, **OXA32054**, into the air gap along the perimeter. The inserts must be longer than the rotor (**1**) length so that damage to the bandage under the following operations is avoided. See **Fig. 23**.

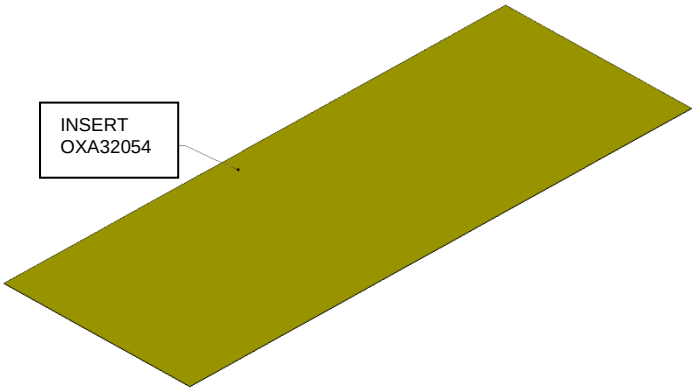

Fig. 23 – Insert for the stator and rotor disassembly

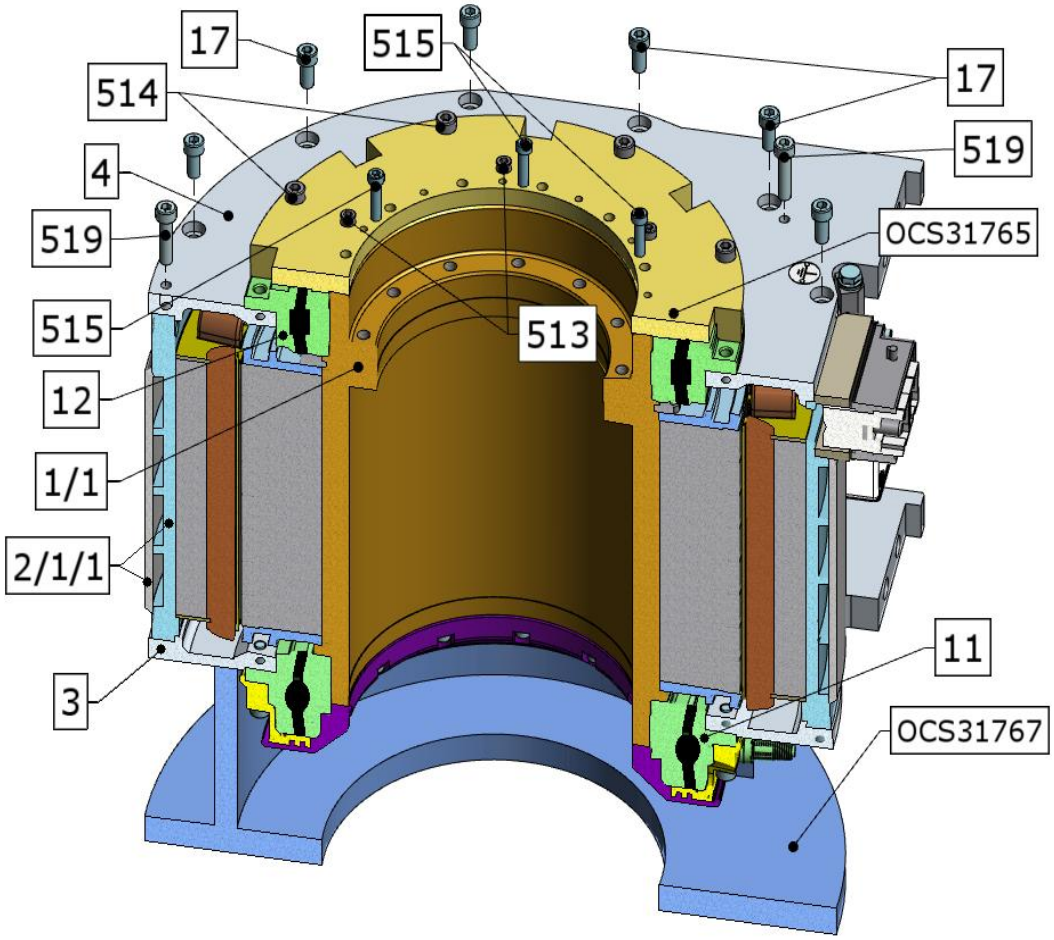

Fig. 24 – Disassembly of the shield B (**4**)

9.1.1.5. Disassembly of the shield A (3)

To dismount the shield A (**3**) from the rotor assembly (**1**) use the mounting fixture **OCS32160**. Position the fixture on the rotor (**1**) and secure it using nut. The bolt is screwed into the base (work bench, bench with T-slots, prism, etc.) and it runs through the cavity in rotor (**1**). Lean the clamp against the shaft face (**1/1**) and secure it with a nut on the bolt.

Remove the screws (**17**) on "A" side that mount the shield A (**3**) with chassis (**2/1/1**). Use the M8x30 force-off screws (**519**) and M8 threads in the shield A (**3**) to release the chassis (**2/1/1**). Use crane to extract carefully the chassis (**2/1/1**) out from the rotor (**1**). During this operation, hang the chassis (**2/1/1**) at four ropes of identical length and utilize the M8 threaded holes in the shield A (**3**). See **Fig. 25**.

Avoid placing the motor on the labyrinth system on side A of the shield A (3)!!! Motor may get damaged.

On the PT-cells side, screw 4 **M6** screws (by approx. 90°) into the stator (**2/1**) as legs for consequent positioning without causing any damage to the seating surfaces during storage.

During this operation, heavy magnetic forces are induced between rotor (**1**) and stator (**2/1**). In practice it means that the magnetic forces attract rotor (**1**) to stator (**2/1**) and no stator displacement in relation to rotor (**1**) occurs. See **Fig. 25**.

It is therefore necessary to prevent axial displacement of the rotor (**1**) in this operation. Preferably use bolt and clamp. The bolt is screwed into the base (work bench, bench with T-slots, etc.) and it runs through the cavity in rotor (**1**). Lean the clamp against the shaft face (**1/1**) and secure it with a nut on the bolt. See **Fig. 25**.

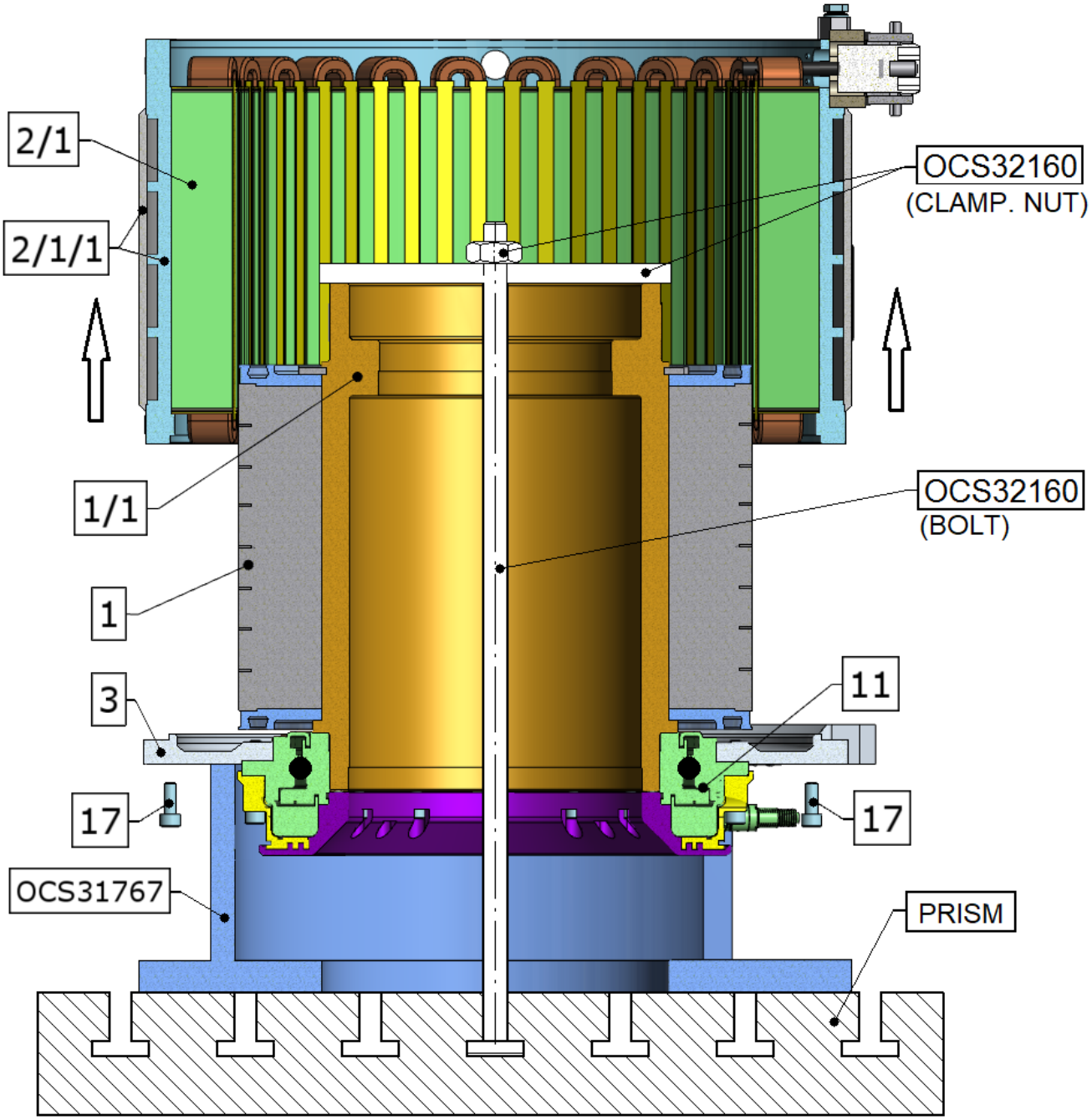

Fig. 25 – Disassembly of the shield A (**3**)

9.1.1.6. Disassembly of Labyrinth rotational (5) and Static Labyrinth (51) from the Ball Bearing Unit (11)

The works are performed in the horizontal position in **OXA31678** fixture.

First of all, dismount the labyrinth rotational (**5**) on the rear face of motor. Once the screws (**19**) and (**49**) are removed, the force-off threads in the labyrinth rotational (**5**) and 4 pcs of M6x25 screw can be used for gradual tightening in order to extract this labyrinth (**5**) axially from the mount of the ball bearing unit (**11**) and take it out freely. See **Fig. 26**.

Then, remove the screws (**48**) and (**55**) from the static labyrinth (**51**) by using the force-off threads in the static labyrinth (**51**) and 4 pcs of M8 screw. Tighten this labyrinth (**51**) gradually in order to extract this labyrinth axially from the mount of the ball bearing unit (**11**) together with O-ring (**52**) and take it out freely. See **Fig. 26**.

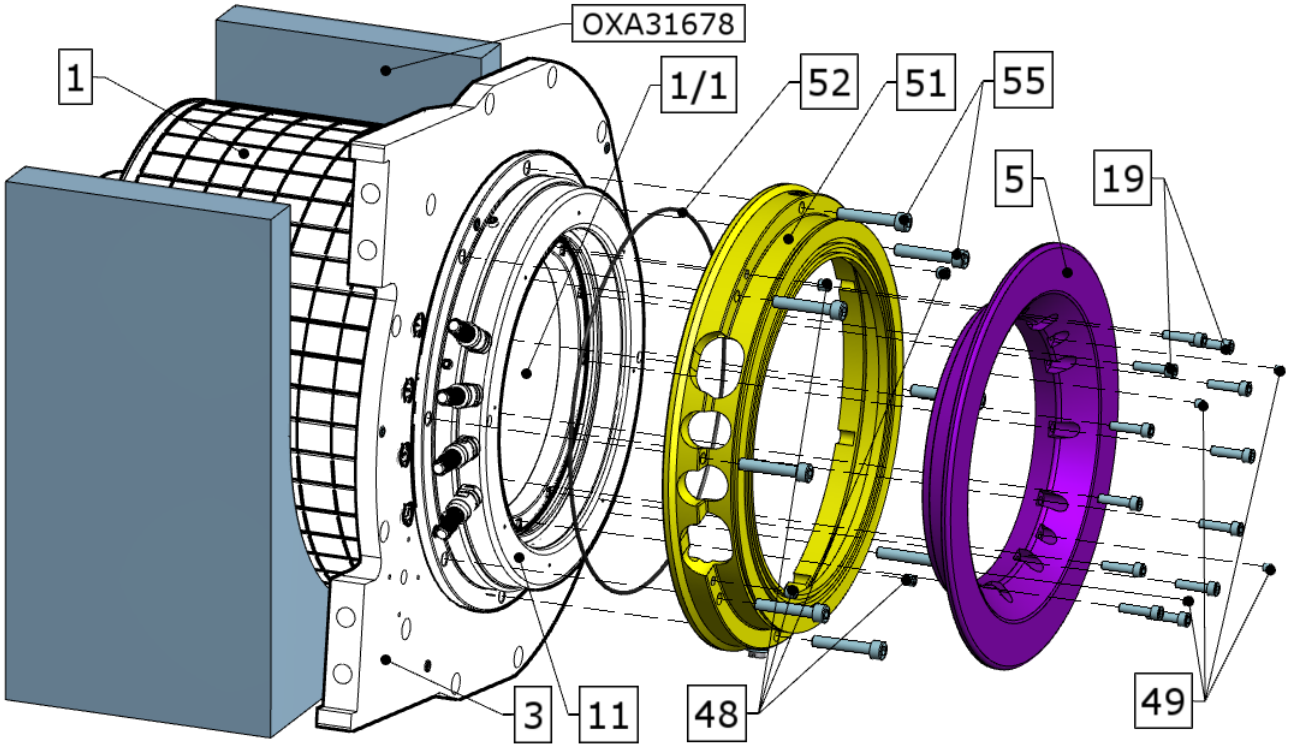

Fig. 26 – Mounting the static labyrinth (**51**) and labyrinth rotational (**5**)

9.1.1.7. Dismounting the Assembly of shield A (3) with Ball Bearing Unit (11) from Rotor (1)

Next, it is necessary to use the **OCS31764** disassembly fixture. Insert the fixture with one segment into the slot of inner race of the ball bearing unit (**11**). Then insert gradually the remaining segments and use M8 screws (**517**) to tighten them with the fixture's centring ring. Mount 12 pcs of M8x30 screw into the force-off threads of the fixture segments and tighten them gradually to force off the ball bearing unit (**11**) with shield A (3) in order to strip them axially from the rotor shaft (**1/1**). See **Fig. 27**and **Fig. 28**.

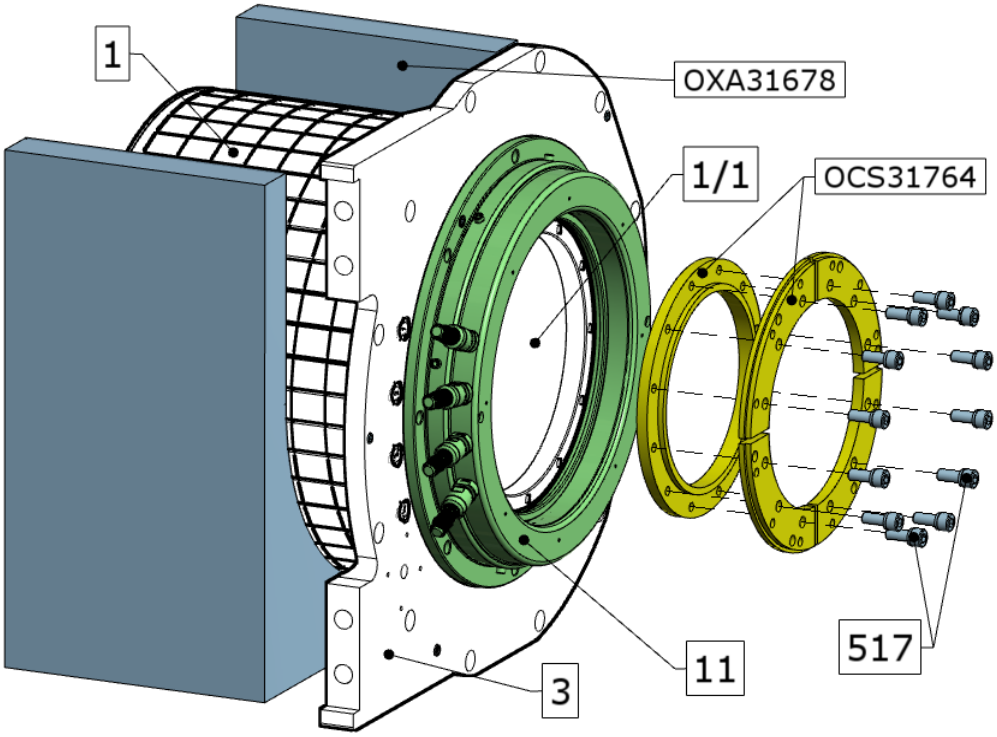

Fig. 27 – Dismounting the shield A (**3**) with ball bearing unit (**11**) from rotor (**1**) - preparation

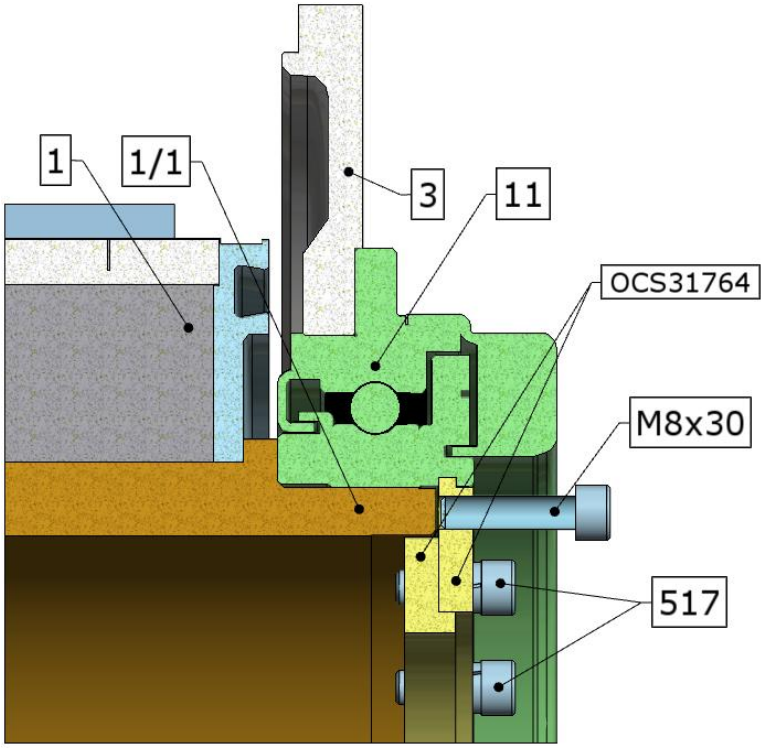

Fig. 28 – Dismounting the shield A (**3**) with ball bearing unit (**11**) from rotor (**1**)

9.1.1.8. Dismounting the Ball Bearing Unit (11) from shield A (3)

Dismount screws (**48**) and use the M8x25 force-off screws (through 4 pcs of M8 force-off thread in the bearing unit's flange (**11**)) to dismount the ball bearing unit (**11**) from the mount in the shield A (**3**). While performing this operation, adhere to the cross-pattern forcing-off of M8x25 screws (**by quarter turn**) because the bearing unit (**11**) is sensitive, and avoid exposing the bearing unit to excessive stress, namely when the bearing unit gets crossed – there is a risk of the bearing balls being pressed into the bearing race orbits. See **Fig. 29**.

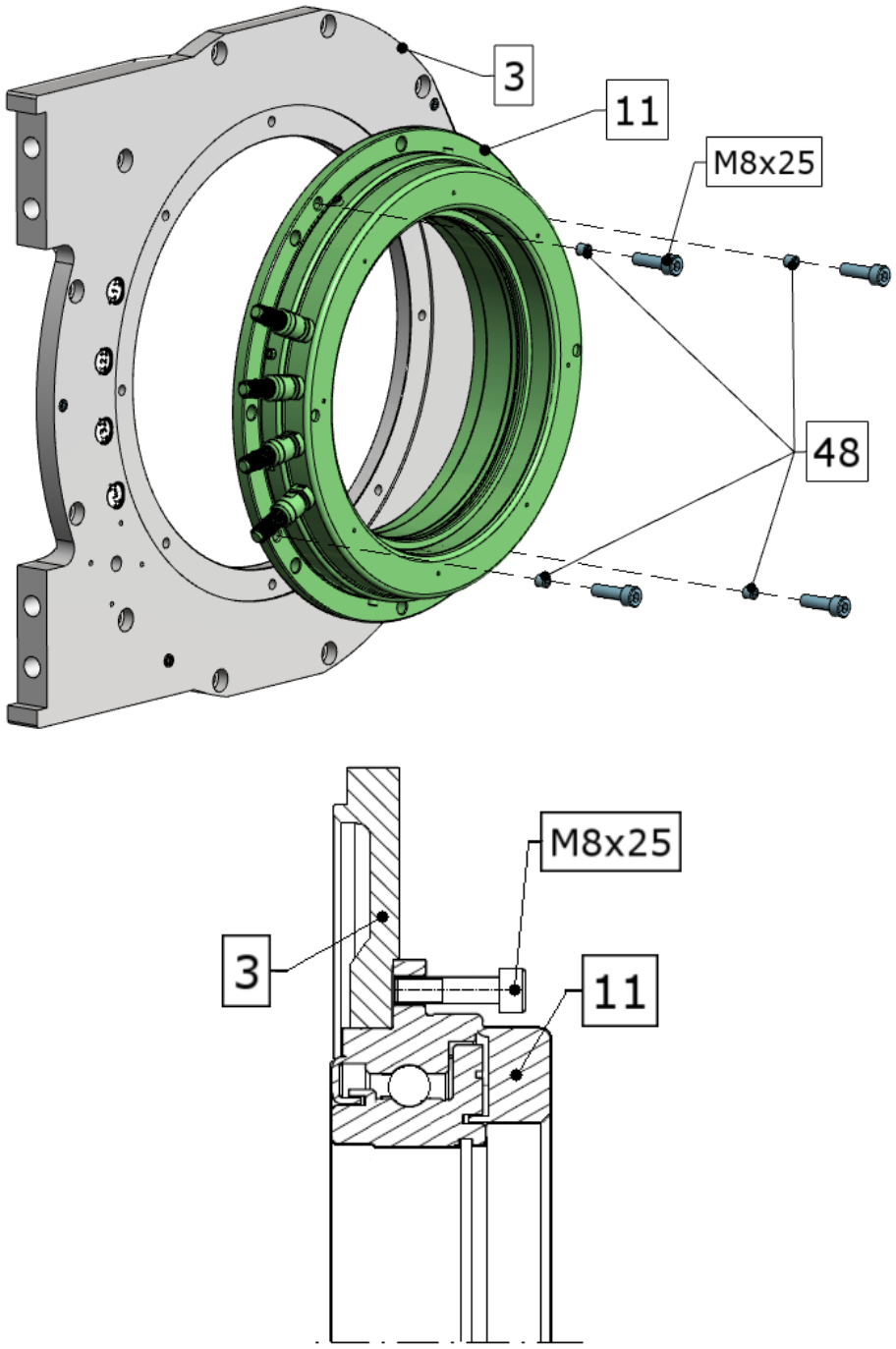

Fig. 29 – Dismounting the ball bearing unit (**11**) from shield A (**3**)

9.1.1.9. Dismounting the Roller Bearing Unit (12) from the shield B (4)

Use eight M8 force-off threads in the flange of roller bearing unit (**12**) and, while adhering to the cross-pattern forcing-off procedure (**by quarter turn**) using M8x35 screws (**514**), separate the bearing unit (**12**) from the shield B (**4**). When performing this operation, pay special attention to the fact that the bearing unit is sensitive and avoid exposing the bearing unit to excessive stress, namely when the bearing gets crossed – there is a risk of rollers being pressed into the bearing orbits of the inner and outer race, see **Fig. 30**.

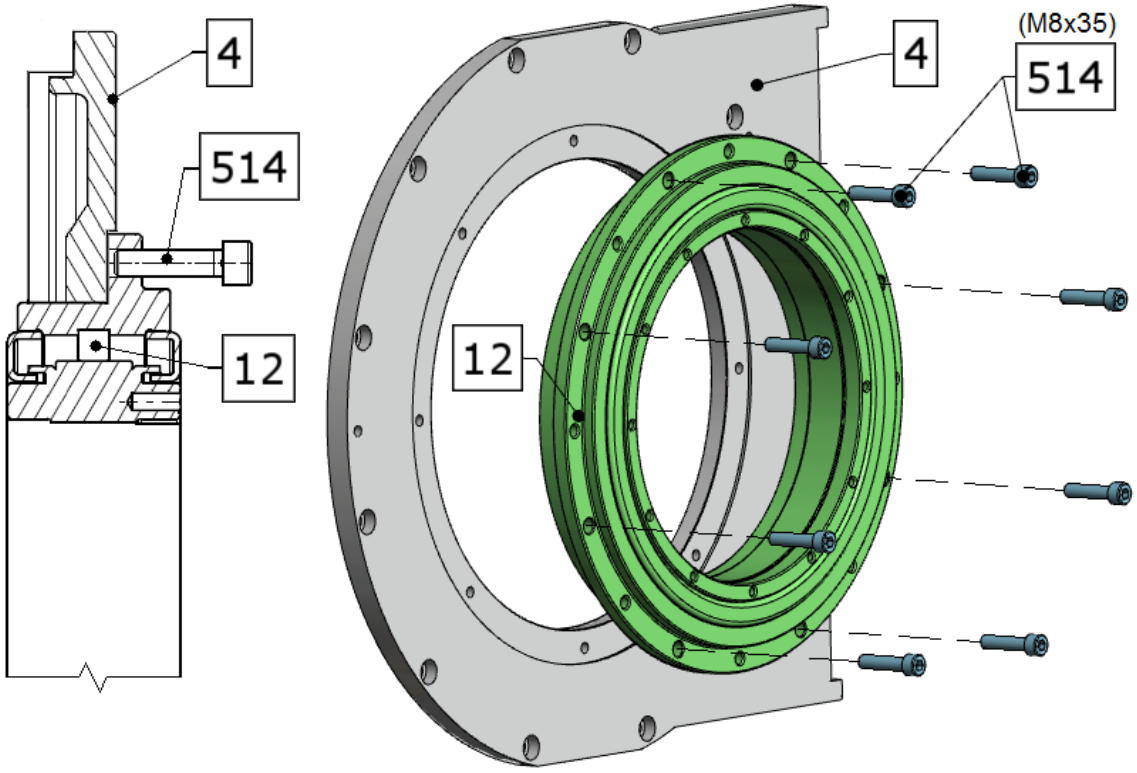

Fig. 30 – Dismounting the roller bearing unit (**12**) from the shield B (**4**)

Once the bearing unit (**12**) is released from the shield B (**4**), install immediately the transport security element (**Fig. 31**) to avoid mutual displacement of the inner and outer race of the bearing unit.

Fig. 31 – Transport security element (3 pcs of M6 screw and 4 pcs of M8 screw)

9.2. Handling and Preparing the Components for Installation

The ESD protection principles must be followed when the motor and especially the speed sensor and its supply cables are being handled in any manner.

The cables must be marked with self-adhesive tape with relevant symbol for the work with ESD sensitive equipment (Fig. 12)

All the workers appointed to handle the speed sensor must be instructed and they have to adhere to the ESD protection principles. For the protection example see Fig. 14.

1. What has to be done before assembly is proper cleaning of the interiors and recovery of the damaged paints.
2. Clean the surfaces that were sealed with silicon sealant and re-apply the sealant carefully.
3. All the screw connections must be tightened to adequate tightening torques in accordance with EN ISO 2320, if not stated otherwise.

Tab. 2 - Screw and nut tightening torque table

Thread	Position	Torque [Nm]
M8	**16, 17, 55**	**23**
M8 + washer 8	**17**	**6**
M8	**21**	**6**
M8	**47**	**according to EdP9683**
M6	**18, 19**	**10**
M4	**20**	**2**
Adjusting screws	**49** (M6), **48** (M8), **42** (M12)	**No torque** Flush mount with the motor surface
Plug M20	**8**	**No torque** Flush mount with the motor surface

4. Tighten all the screws to the specified tightening torque and secure them with Loctite in accordance with the **Ed611811 (7HLU 3436 P/44-VA)** assembly drawing.
5. Rotor's installation into the stator cavity must be carried out with the same caution as during disassembly. Care must be also taken to avoid damage to the insulation of stator winding.
6. No impacts which could damage the bearings may be applied during assembly.

Tab. 3 - Table of fixtures necessary for assembly

Part			Fixture	
Position	**Name**	**ID**	**Designation**	**Description**
1 3	Rotor Shield A	Ed602067 Ed602071	OCS 31767	To position the assembly (rotor - shield A) in the vertical position for assembly and disassembly
1 3 11	Rotor Shield A Bearing unit	Ed602067 Ed602071 63016693	OXA 31678	To position the rotor for assembly and disassembly of shield A with bearing unit
4 12	Shield B Bearing unit	Ed602073 63016694	OCS 31765	Fixture for the assembly and disassembly of the shield B and the ball bearing
3 11	Shield A Bearing unit	Ed602071 63016693	OCS 32132	To fully press the shield A with bearing unit onto the shaft shoulder
2/1 1	Stator Rotor	Ed602064 Ed602067	OXA 31703	Winding protection inserts (4 to 6 pcs)
2/1 1	Stator Rotor	Ed602064 Ed602067	OXA 31976	Guide protective cover of the winding while stator is mounted to rotor
12	Bearing unit	63016694	OCS 32191	To fully press the inner race of bearing unit
11	Bearing unit	63016693	OXA 32056	Template to mark the sealant application point on the bearing unit
5	Labyrinth rotational	Ed610015	OXA 32092	Gauge for application of Loctite 5188 to the labyrinth and shaft

9.2.1. Motor Assembly

The washer size 8 must be used for all the motors manufactured up to the serial number **0632565** where M8x20 screws (**17**) are used for the screw connections of shields A (**3**) and B (**4**) with the chassis (**2/1/1**). The tightening torque for the screws with washers is **6 Nm**.

Procedure:

The machine is reassembled in the exact reversed sequence of tasks of the machine's disassembly procedure.

9.2.1.1. Mounting the Ball Bearing Unit (with Sensor) (11) into the Shield (3)

First of all, assemble the rear shield A (**3**) with the ball bearing unit (**11**) to form one whole. The correct mutual position of the shield A (**3**) and the sensor outputs of bearing unit (**11**) is necessary here. Clean and degrease the seating surface of bearing unit (**11**). Then apply MS UNIFIX CLEAR (**43**) to the contact surface of bearing unit (**11**) and the shield A (**3**) at its entire perimeter. **Heat** the shield A **(3) inductively to 90° to 100°C** and assemble it with bearing unit (**11**). **Inductive heating permitted**.

Use the M8x25 auxiliary screws to tighten the bearing unit (**11**) gradually, uniformly and carefully in a cross-pattern manner (**by quarter turn**) to the shield A (**3**). While doing so, attention must be paid to the sensitivity of bearing unit (**11**). Avoid exposing this bearing unit to excessive stress, namely when the bearing unit gets crossed - there is a risk of balls being pressed into the bearing race orbits. See **Fig. 32**.

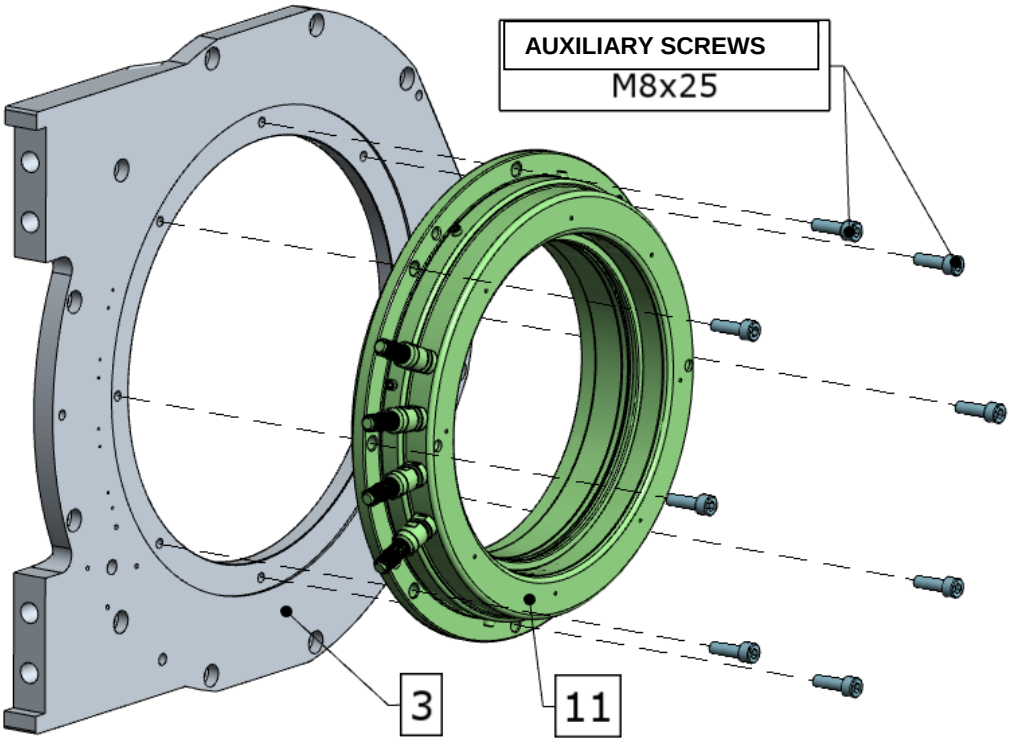

Fig. 32 – Mounting the ball bearing unit (**11**)

9.2.1.2. Mounting the Roller Bearing Unit (12) into the Shield B (4)

Before this operation, remove the transport security element from the bearing unit **Fig. 33** and the mutual position of inner race and outer race of the roller bearing unit (**12**) must be brought together using M6x25 screws (**513**) and M8x35 screws (**514**) using the **OCS31765** assembly fixture that employs threads made in these races for this purpose.

Clean and degrease the contact surface of the roller bearing unit (**12**) with the shield B (**4**). Apply MS UNIFIX CLEAR (**43**) to this surface at its entire perimeter. Heat the shield B (**4**) inductively to **90° to 100°C** and assemble it with the roller bearing unit (**12**). **Inductive heating permitted**.

Secure the mounted shield B (**4**) with screws (**16**) and secure them with Loctite to the specified tightening torque in accordance with the **Ed611811** assembly drawing (**7HLU 3436 P/44-VA** motor). See **Fig. 34**.

Fig. 33 – Transport security element (3 pcs of M6 screw and 4 pcs of M8 screw)

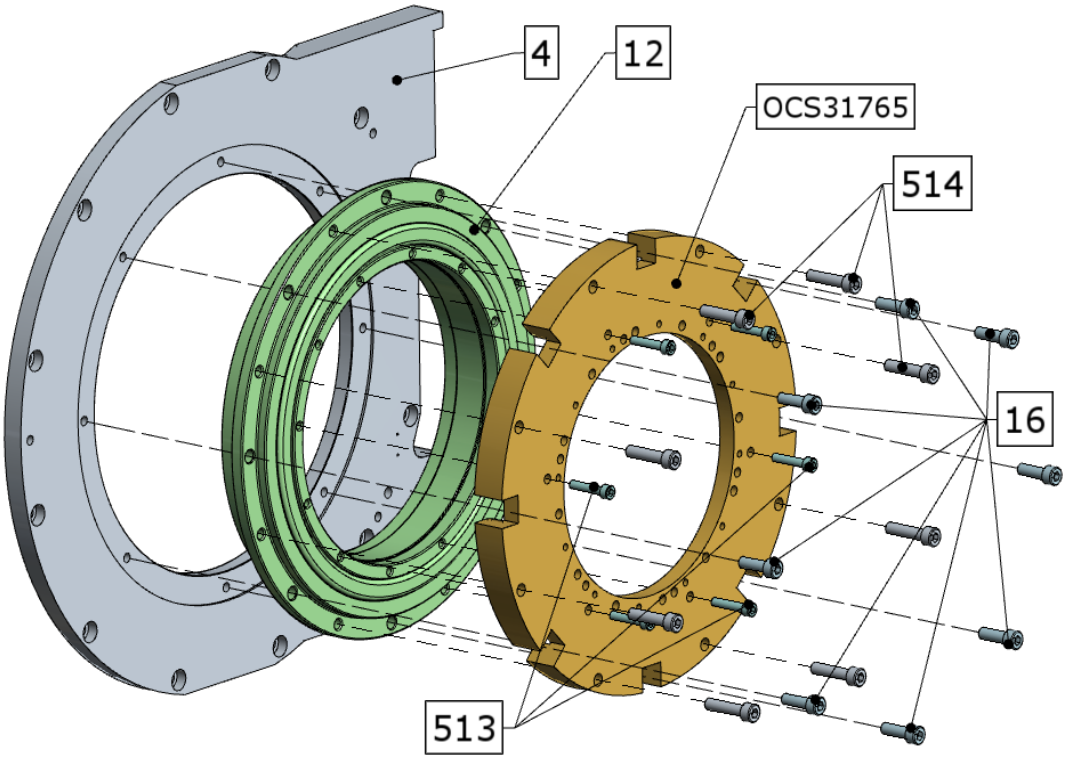

Fig. 34 – Assembly of the roller bearing unit (**12**)

9.2.1.3. Mounting the Rotor (1) and Assembly of the Ball Bearing Unit (with Sensors) (11) and the Shield A (3)

Use **OXA 31678** fixture to place the rotor (**1**) to horizontal position. Apply Rezistin and mounting paste to the rotor shaft (**1/1**). Heat the assembly - ball bearing unit (with sensors) (**11**), shield A (**3**) - **in furnace** to **80° to 90°C**. **Inductive heating IS NOT permitted.** Then mount the assembly to the rotor shaft (**1/1**) and drive it fully against the shaft shoulder using **OCS32132** fixture and screws (**19**). See **Fig. 35**.

!!! BEWARE !!!
Inductive heating is not admissible because it could damage the sensor in the bearing unit.

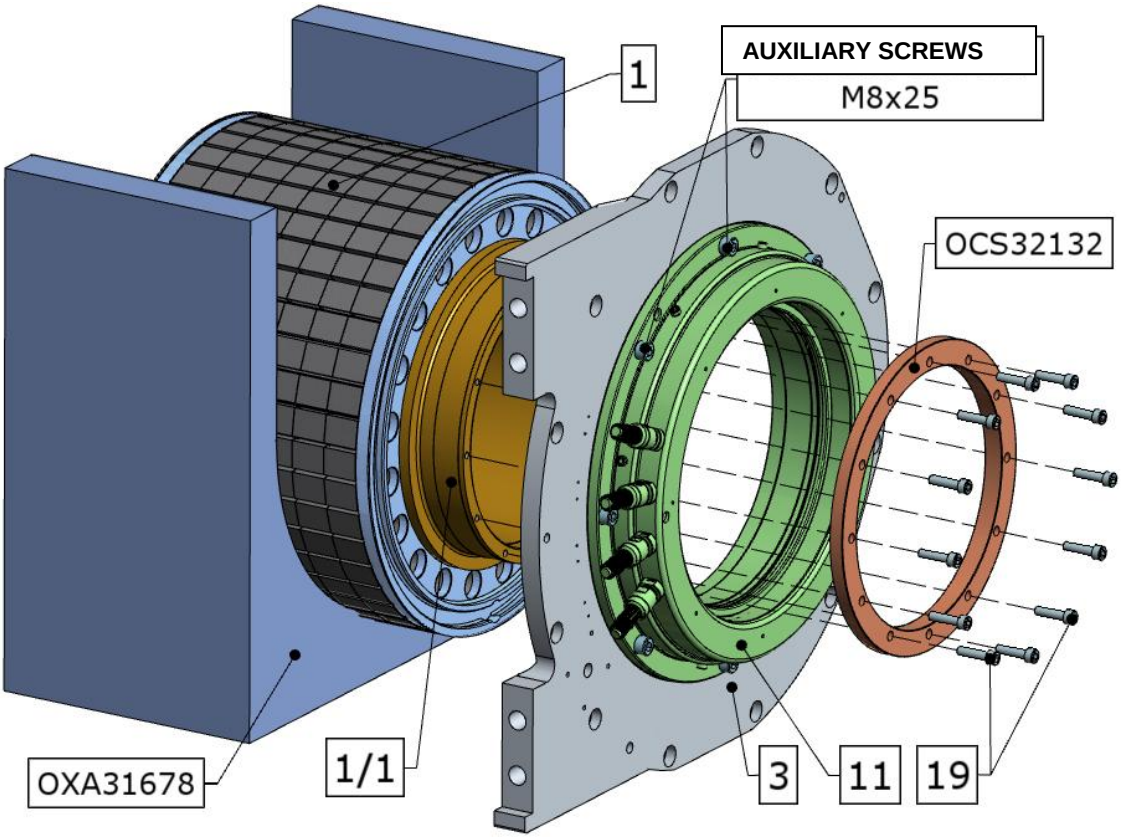

Fig. 35 – Assembly of rotor (**1**) and the assembly of components of the shield A (**3**) with the ball bearing unit (**11**)

9.2.1.4. Mounting the Stator to Assembly – Rotor (1), Shield (3), Ball Bearing Unit (11)

The washer size 8 must be used for all the motors manufactured up to the serial number **0632565** where M8x20 screws (**17**) are used for the screw connections of shields A (**3**) and B (**4**) with the chassis (**2/1/1**). The tightening torque for the screws with washers is **6 Nm.**

Bring this assembly (rotor (**1**), shield A (**3**), ball bearing unit (**11**)) to the vertical position in **OCS31767** fixture (**Fig. 37**) with the ball bearing unit (**11**) downwards. Run the ball bearing unit's (**11**) cables out from the fixture through the circular segment.

Apply MS UNIFIX CLEAR (**43**) to the entire perimeter of the contact surface of the shield A (**3**) and stator (**2/1**). Before slipping the stator (**2/1**) use 4-6 tapes (**OXA 31703**) made of glass-textite of 0.5 mm in thickness. (Fig. 36). These tapes must be inserted between stator (**2/1**) and rotor (**1**) for the entire slipping process. Mount the **OXA31976** Winding Cover guidance fixture to the rotor shaft (**2/1**). Adapt the stator (**2/1**) in such a way that it can be lifted by crane. Use the crane for consequent sliding of the stator (**2/1**) (**Fig. 37**).

If this procedure fails to be followed there is a risk of damage to stator as well as rotor!!!

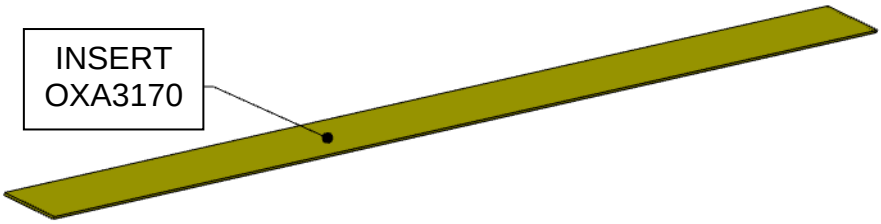

Fig. 36 – Stator to rotor mounting plate

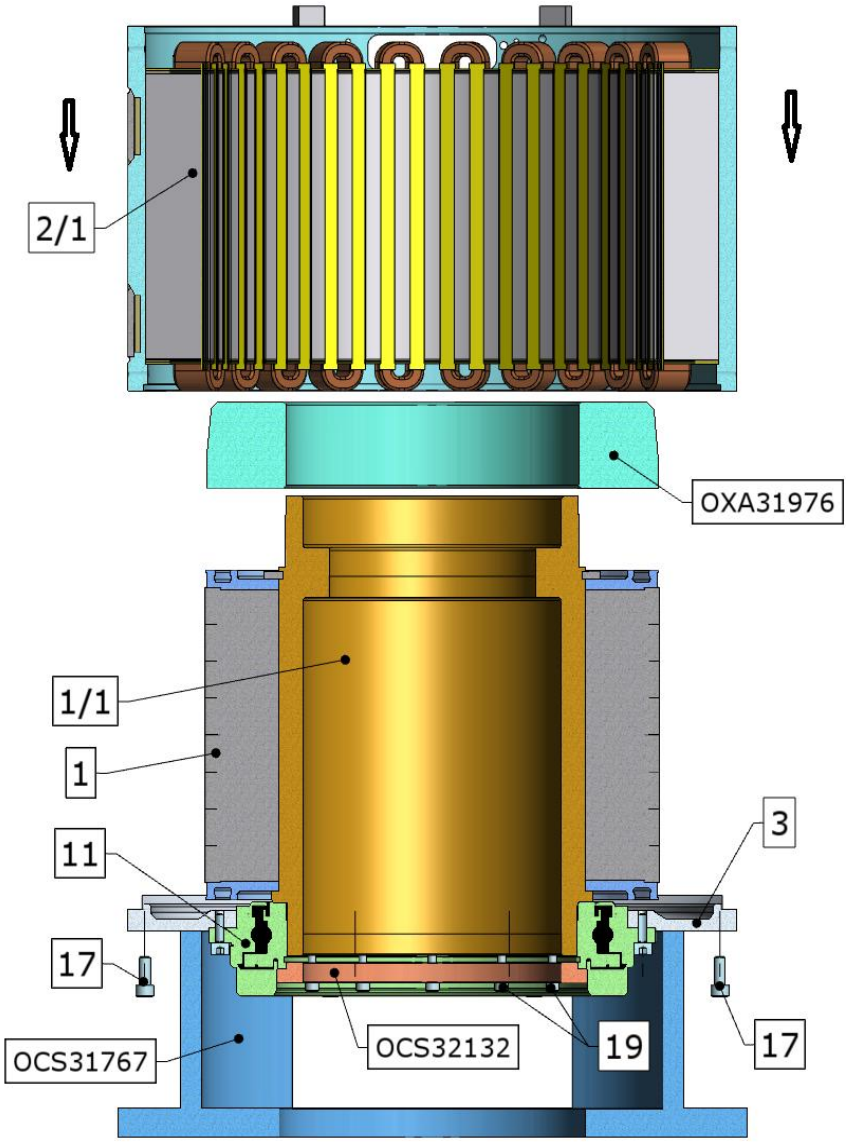

Fig. 37 – SECTION - Mounting stator (**2**) to the assembly of rotor (**1**), shield A (**3**) with the ball bearing unit (**11**)

!!! BEWARE !!!

Pay attention to the correct mutual position of the shield A (3) and stator (2/1).
Check against the Ed611811 (7HLU 3436P /44-VA) assembly drawing

While sliding the stator (**2/1**) onto rotor (**1**), pull 2+2 Pt100 thermocouple outputs protected by pairs in the insulation tubings (1 thermocouple = 1 tubing) through the **KR 10** hole (**Fig. 38**) in the shield A (**3**) and lead them out from the machine. Pay attention to the mutual position of the shield A (**3**) and stator (**2/1**). After the Stator (**2/1**) has been slid onto Rotor (**1**), loosen the galloon to extract the glass-textile tapes with inserts **OXA31703** (**Fig. 36**), remove the **OXA31976** Winding Cover guidance fixture from the rotor shaft (**1/1**) and pull the shield A (**3**) to the Stator (**2/1**) using screws (**17**). See **Fig. 38**.

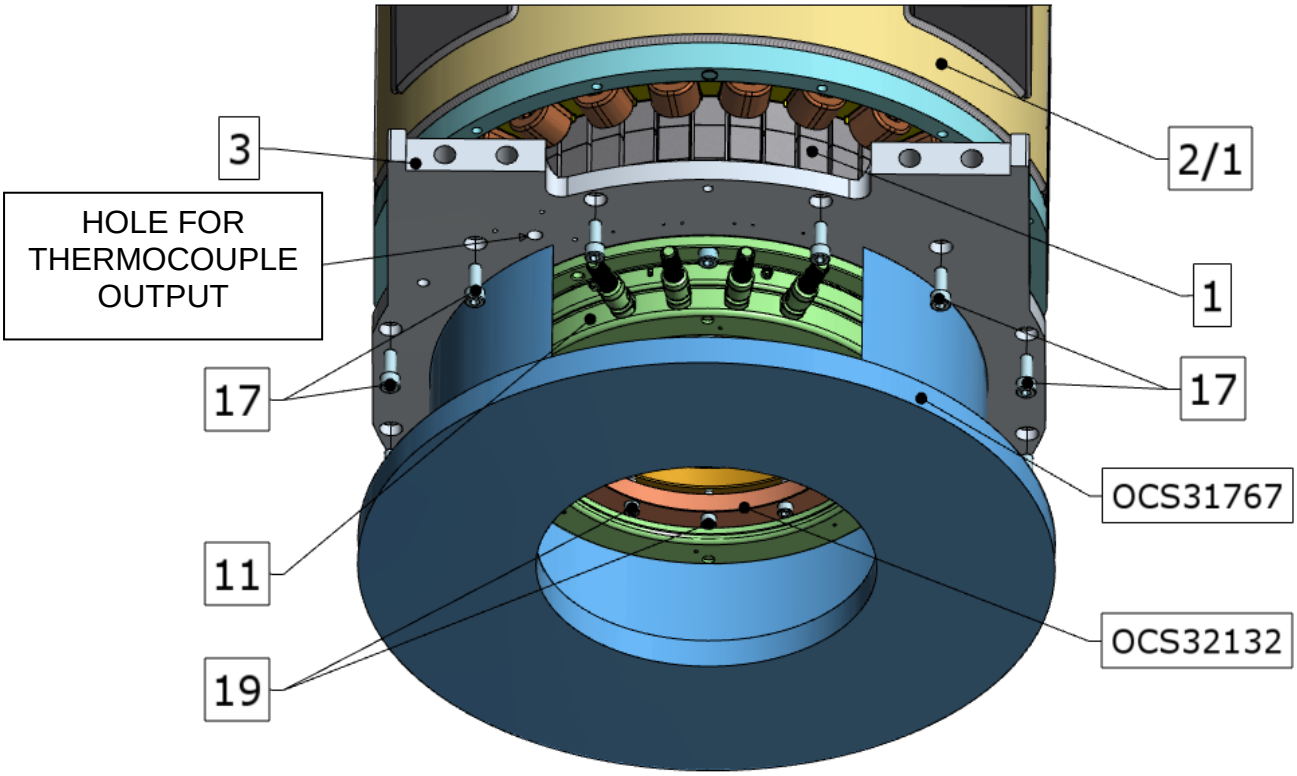

Fig. 38 – Mounting stator (**2**) to the assembly of rotor (**1**), shield A (**3**) with the ball bearing unit (**11**) - hole for the thermocouple

9.2.1.5. Mounting the Assembly of the Shield B (4) and the Roller Bearing Unit (12) onto the Assembly - Stator - Connecting the Connector (2), Rotor (1), Shield A (3), Ball Bearing Unit (11)

The washer size 8 must be used for all the motors manufactured up to the serial number **0632565** where M8x20 screws (**17**) are used for the screw connections of shields A (**3**) and B (**4**) with the chassis (**2/1/1**). The tightening torque for the screws with washers is **6 Nm.**

Place the assembly - stator (**2/1**), rotor (**1**), shield A (**3**), ball bearing unit (**11**) into vertical position.

Mount the assembly - shield B (**4**), roller bearing unit (**12**) and **OCS31765** assembly fixture to the rotor shaft (**1/1**) from the front side of motor (the side opposite to the ball bearing unit (**11**) and. finally, also into the motor frame (**2/1/1**).

Then apply MS UNIFIX CLEAR (**43**) to the contact surface of the shield B (**4**) and stator (**2/1**). Heat the shield B assembly (**4**) inductively to 80 to 90°C. **Inductive heating permitted.** The overlap of the roller bearing unit (**12**) on the rotor shaft (**1/1**) gets released and, at the same time, the overlap between the shield B (**4**) and the chassis (**2/1/1**) is not increased much. Slide the assembly onto the rotor shaft (**1/1**) and into stator (**2/1**). In doing so tighten the screws (**17**) gradually in staggered manner, see **Fig. 39**.

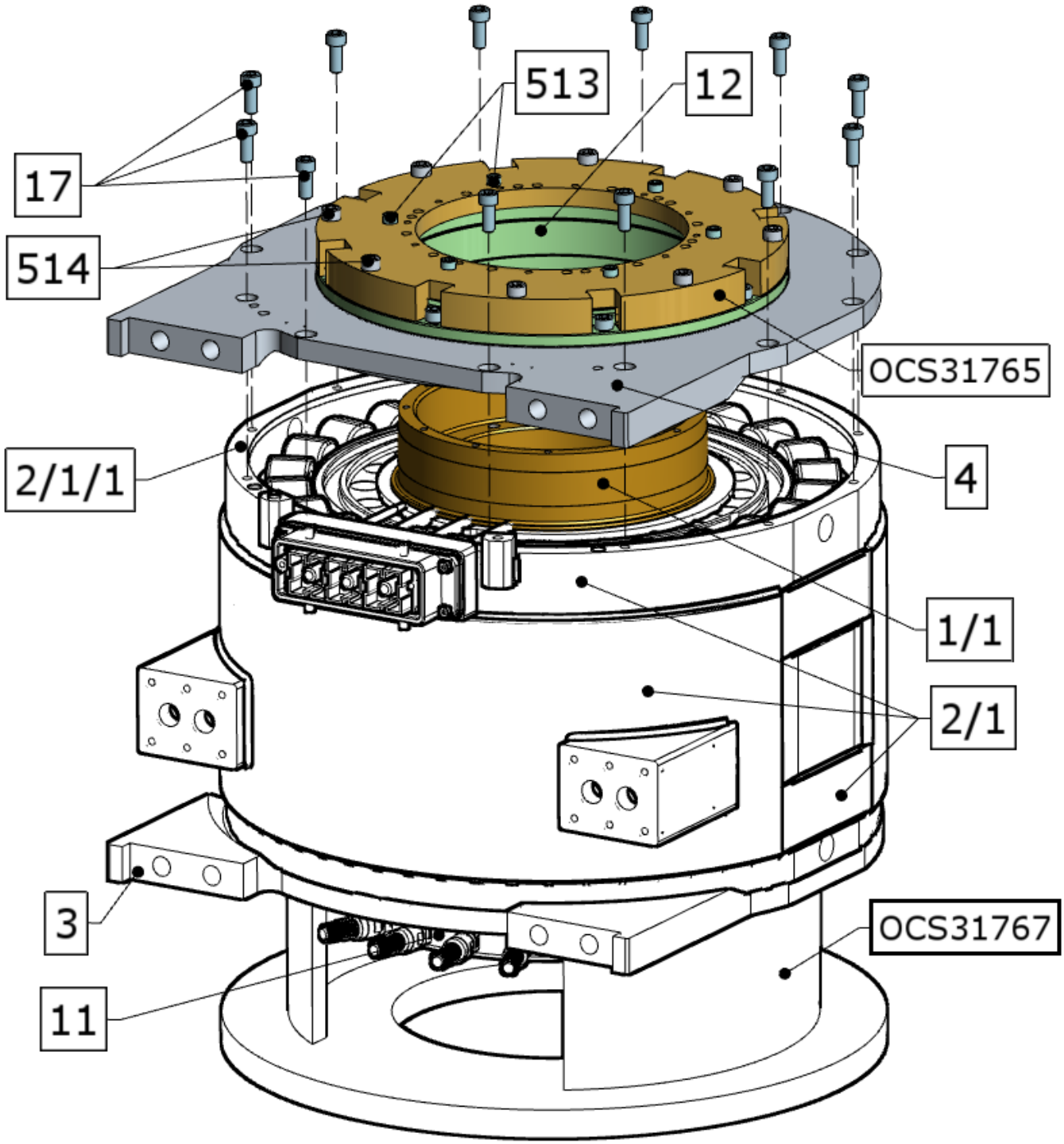

Fig. 39 – Mounting the assembly of the roller bearing unit (**12**), shield B (**4**) onto the assembly of stator (**2**), rotor (**1**), shield A (**3**), and ball bearing unit (**11**)

9.2.1.6. Final Pressing of the Inner Bearing Race

Before the actual assembly, apply REZISTIN to the surfaces on rotor (**1**) from the bearing surfaces to the side plate faces and the chassis surfaces for the shields.

Dismount the **OCS31765** fixture, release the **M6x25** screws (**513**) and **M8x35** screws (**514**), **Fig. 39** Mount the **OCS32191** fixture to the rotor shaft (**1/1**) and tighten with **M6** screws (M6 threads in the shaft face) to fully press the inner bearing race to the shaft face (**1/1**). With an eye to the sensitive bearing units with ceramic bodies, they must not be stressed excessively here as well so the staggered tightening of screws (**17**) and **M6** screws must be followed here, by a maximum of **270°**. Dismount the **OCS32191** fixture. See **Fig. 40**. Tighten all the screws to the specified tightening torque and secure them with Loctite in accordance with the **Ed611811**(**7HLU 3436 P/44-VA**) assembly drawing.

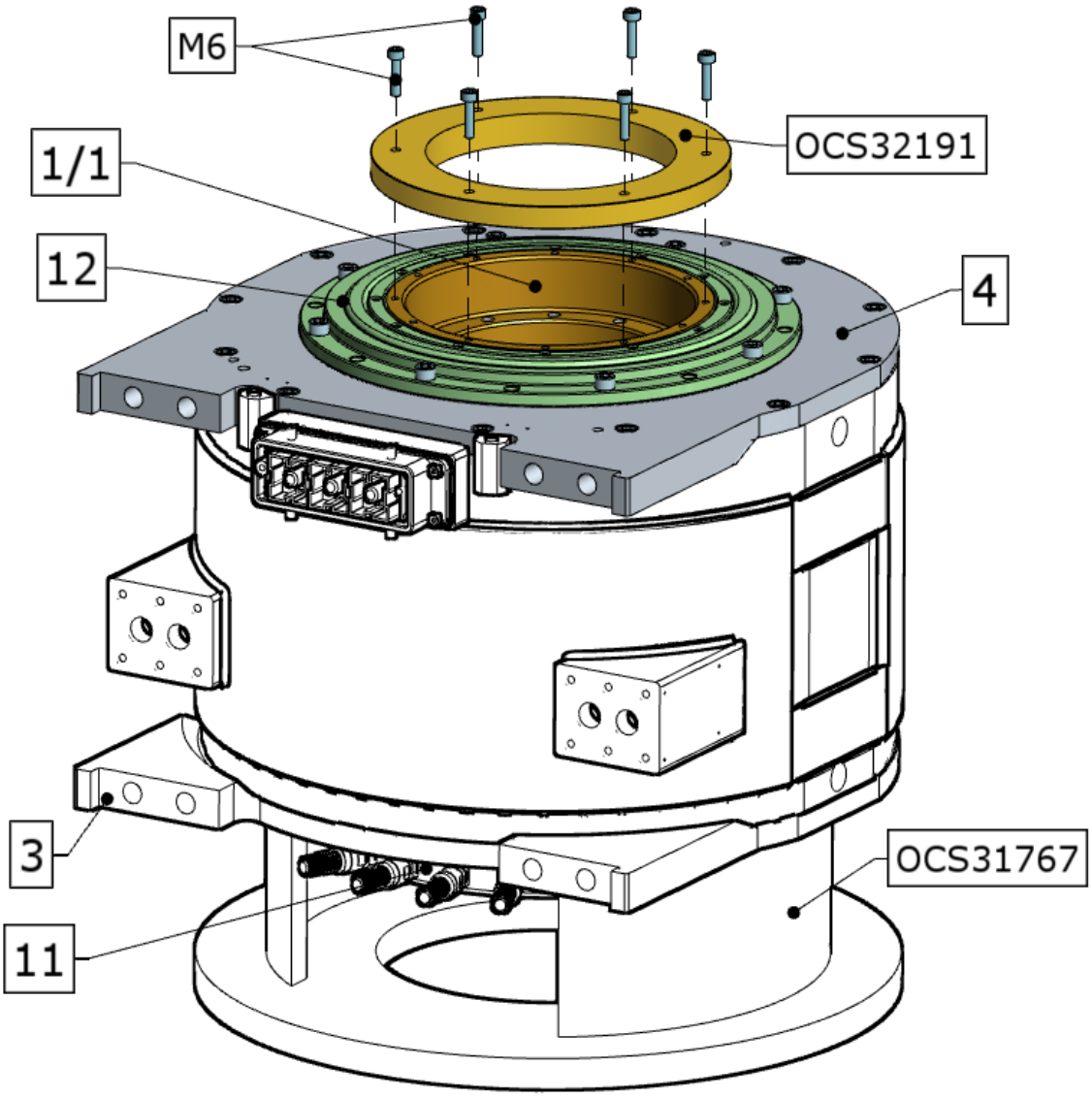

Fig. 40 – Final pressing of the inner bearing race

9.2.1.7. Assembly of Adjustment Screws (49) into Shaft (2/1) and Bearing Unit (12)

Finally, mount the M6x6 adjusting screws (**49**) into the rotor shaft (**1/1**) and into the bearing unit's inner race (**12**) (flush with the part surface). See **Fig. 41**.

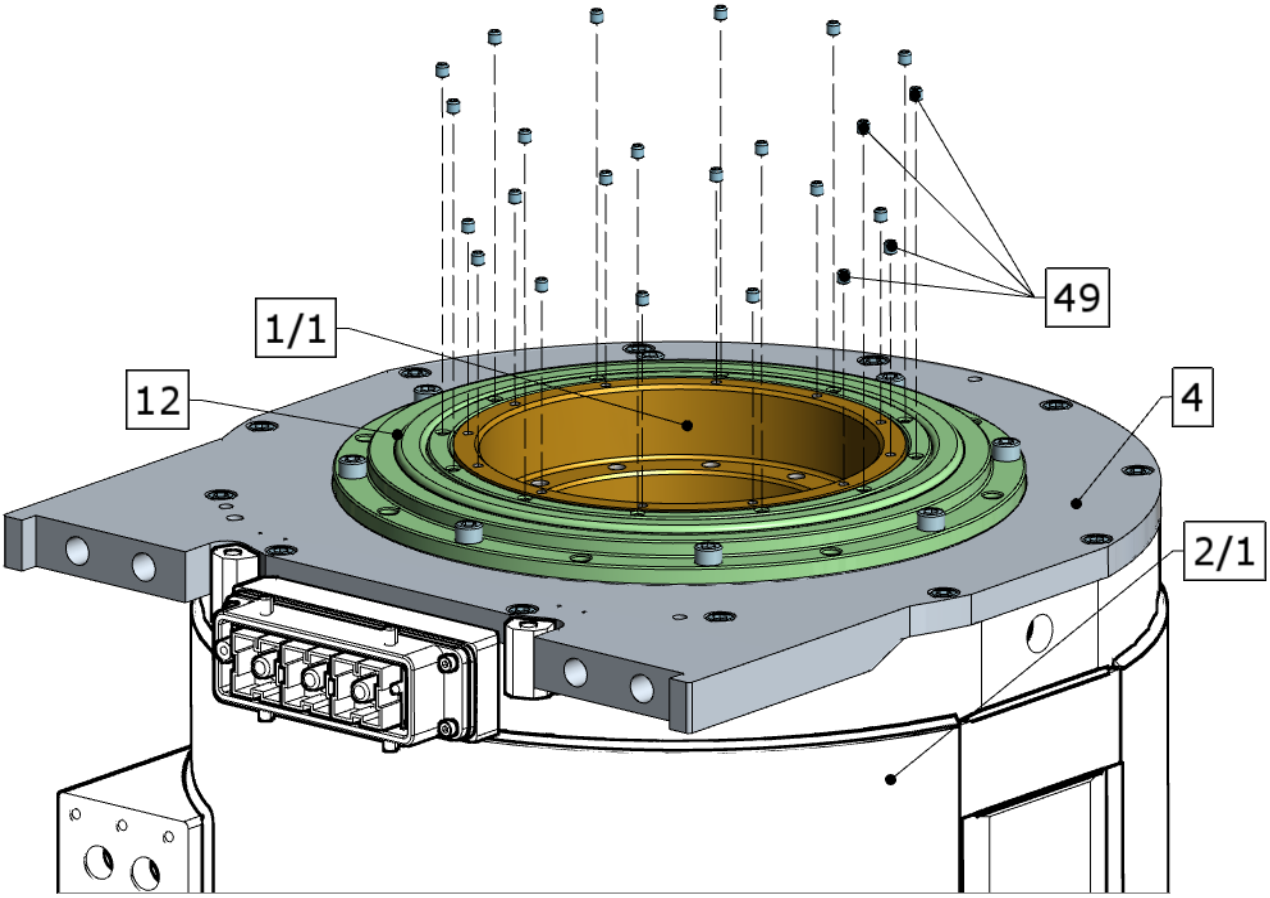

Fig. 41 – Assembly of adjustment screws (**49**) into shaft (**1/1**) and bearing unit (**12**)

9.2.1.8. Mounting the Static Labyrinth (51) and Labyrinth rotational (5)

Before the actual assembly, apply REZISTIN to the surfaces on rotor (**1**) from the bearing surfaces to the side plate faces and the chassis surfaces for the shields.

Place motor into the horizontal position. Clean the slots of the static labyrinth (**51**) and the slot for O-ring (**52**). Dismount the **M8x25** screws and clean the threads for screws (**55**) from silicone. Dismount the **OCS32132** fixture by releasing the screws (**19**) see **Fig. 35**.

Apply spots of MS UNIFIX CLEAR sealant (**43**) to the slot of static labyrinth (**51**) for O-ring (**52**). Use brush to apply Loctite 5188 uniformly to the seating surface of the bearing unit (**11**). Before applying the sealant (**43**), mark the application area of bearing unit (**11**) using the "**OXA32056** template" (**Fig. 42**) and alcohol-based marker. Apply the Sealant (**43**) to the bearing unit in a diameter of 6 mm along the gauge lines and the vicinity of sensor outputs. Place the O-ring (**52**) into the slot and press slightly. Mount the static labyrinth (**51**) with O-ring (**52**) to the assembly of bearing unit (**11**) and the shield A (**3**). Secure the static labyrinth (**51**) with screws (**55**). Wipe away the excessive sealant. Screw the M8x8 adjusting screws (**48**) into the free **M8** threads in the shield A (**3**) and static labyrinth (**51**). Flush them with the part surface. Secure all the screw joints with Loctite and tighten them to the torque specified in the **Ed611811** (**7HLU 3436 P/44-VA**) assembly drawing. See **Fig. 43**.

Use **OXA32092** gauge (**Fig. 42**) to apply Loctite 5188 to the contact surface of the labyrinth rotational (**5**) and shaft (**1/1**), and wipe away the excessive Loctite. Mount the labyrinth rotational (**5**) and use screws (**19**) to secure it. Use the M6x6 adjusting screws (**49**) to fix the labyrinth rotational (**5**) and secure with Loctite according to the **Ed611811** (**7HLU 3436 P/44-VA**) assembly drawing. Flush the adjusting screws with the external labyrinth surface, see **Fig. 43**.

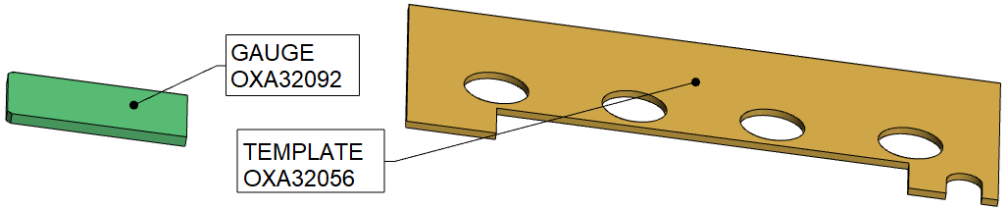

Fig. 42 – Sealant application template and gauge

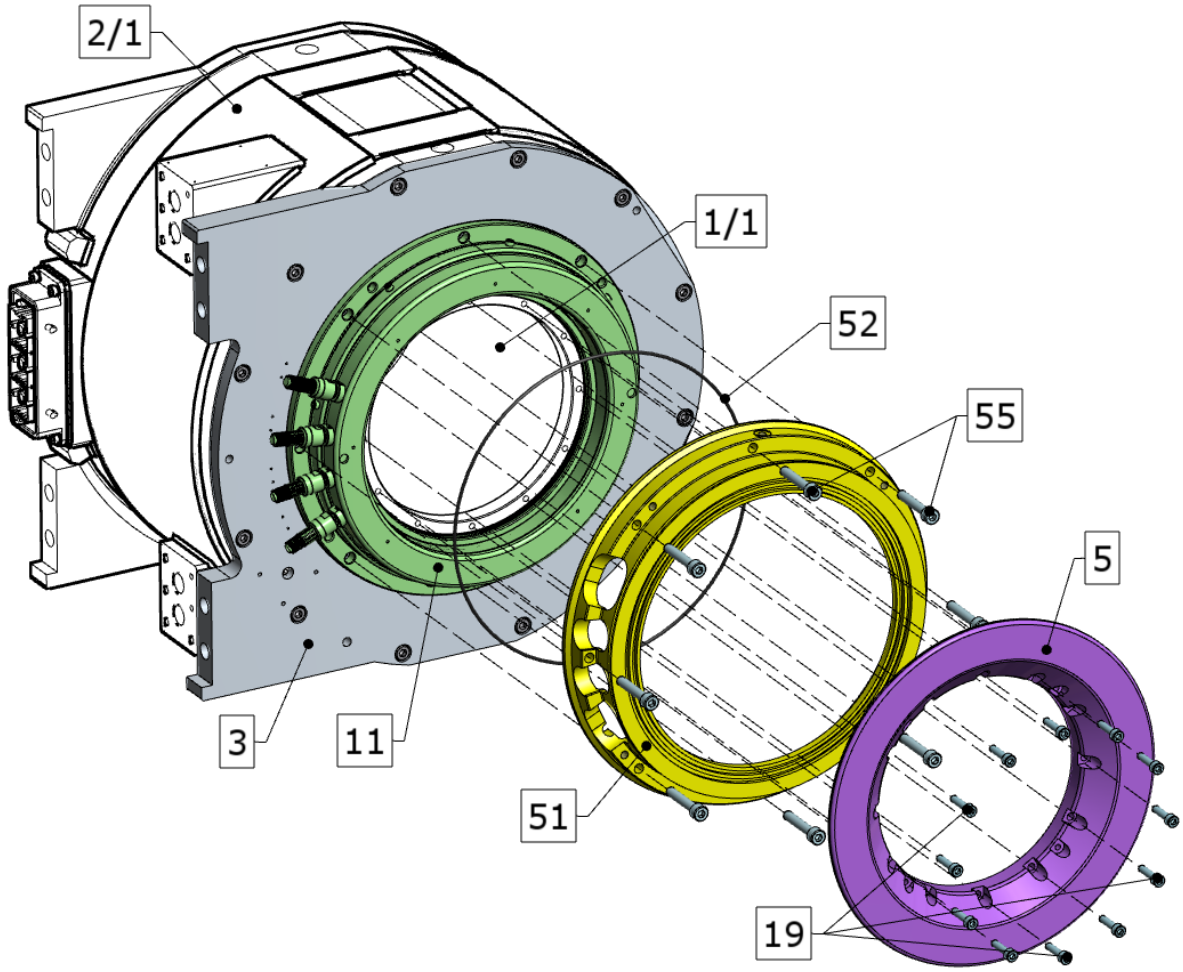

Fig. 43 – Mounting the static labyrinth (**51**) and labyrinth rotational (**5**)

9.2.1.9. Final Assembly

Place motor into the horizontal position. Install 2 plugs – INBUS **(2/10)** to the bottom side of motor into the M20x1.5 threads. Flush to level and secure with Loctite according to the **Ed611811** assembly drawing.

Screw the pintle (**10**), M12 suspension loop nut (**15**) into the top M20x1,5 threads. See **Fig. 44**.

Depending on the motor version, install the spacer B (**6**) using the screws (**18**) with O-ring (**27**), without pins (**32**). Secure with Loctite and tighten to the specified torque according to the **Ed611811** assembly drawing.

For measuring purposes, use the screws (**18**) and O-ring (**27**) without pins (**32**) to mount the spacer B (**6**) as well. Do not secure the screw joints.

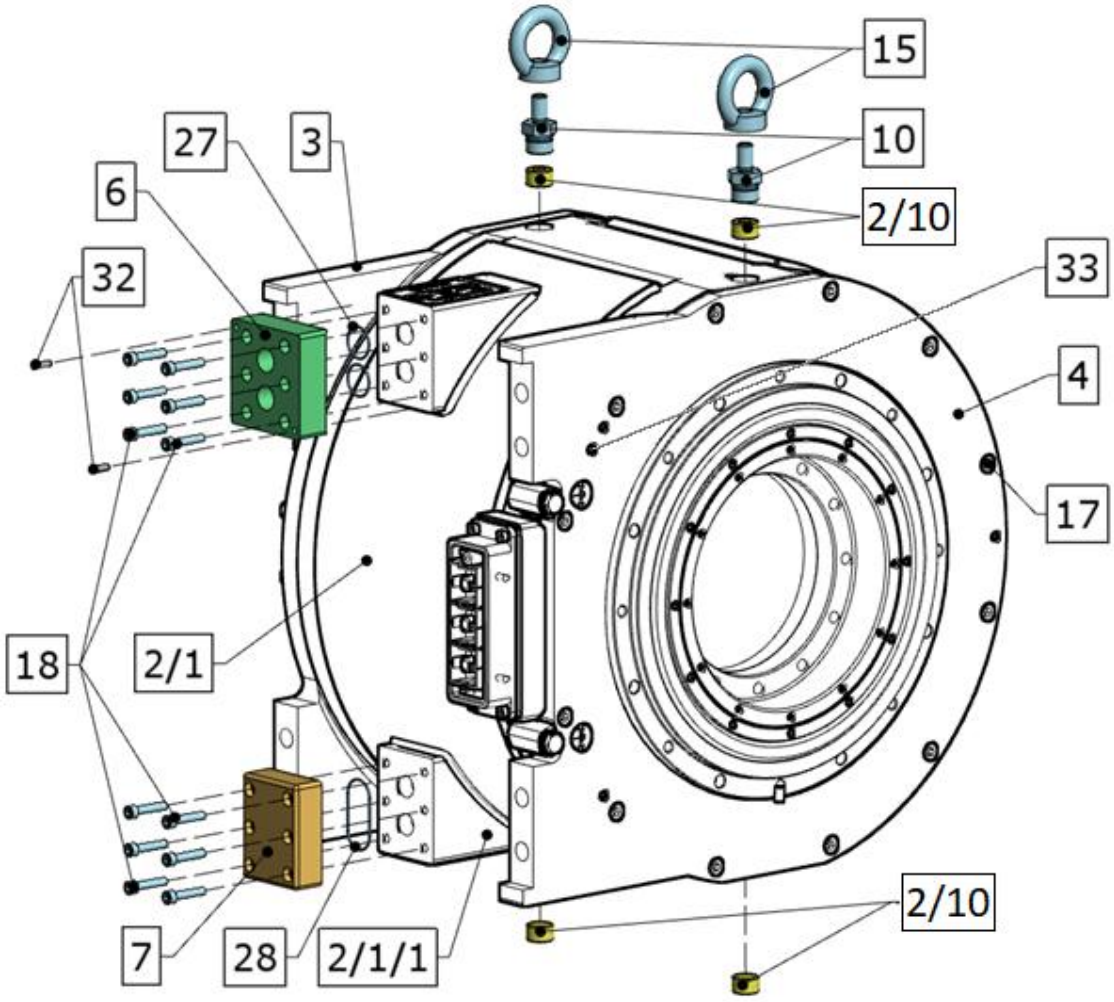

Fig. 44 – Final assembly of parts

Ensure that the clamping areas of the shield A (**3**) and B (**4**) with M16 threads (feet) are mutually in one plane and also the surface on the chassis (**2/1/1**) or, if appropriate, spacer B (**6**) for coolant connection is parallel to this plane.

Place the motor with its feet on shield A (**3**) and B (**4**) onto 4 ground prisms. Loosen the screws in shields (**17**). Use the altimeter to check if both the faces for the coolant inlet and outlet lie at the same distance from the measuring base. Take measurements through the mounted spacers B (**6**). Tighten the clamping screws (**17**) with washers (**24**) on the shield A (**3**) and B (**4**) to the required tightening torque as specified in the **Ed611811** assembly drawing. Consequently, place the pins (**33**) into the holes between stator (**2**) and shields A (**3**) and B (**4**).

Depending on the motor version, tap the pins (**32**) into spacer B (**6**). Consequently, depending on the motor version, dismount 1 spacer B (**6**) and install the jumper (**7**) using the screws (**18**) with washers (**25**),

including O-ring (**28**). Secure the screw joints with Loctite as specified in the **Ed611811** assembly drawing. Consequently, check the cooling circuit for tightness according to **Chap. 8.3.6**

All you need to do to finish the assembly is mounting the cable gland (**13**, **14**) using the screws (**20**) and earthing the cable shielding.

Pt sensor cable - cut open the top insulation at a distance of 80 mm, remove the insulation, strip off the shielding. Install cable gland (**13**) into the cable gland (**14**), mount the cable with the nut from cable gland (**13**), lace the cable through the cable gland (**13**). Slip the shielding over a part of the cable gland (**13**), mount the bushing nut and secure. Remove the overlapping shielding. Insulate four wire ends of the shielded output cable RADOX (**39**) for barrels (**40**). The detailed assembly procedure is specified in Document **EdP4722 - PT-Cell Wiring**.

Before commencing the sensor wiring process PERFORM THE FUNCTIONALITY TEST of Pt outputs; the range of measurable values on Pt sensors 100 ÷ 115.6 [Ω]: Take measurement also after the Pt cell has been wired. See **Fig. 45**.

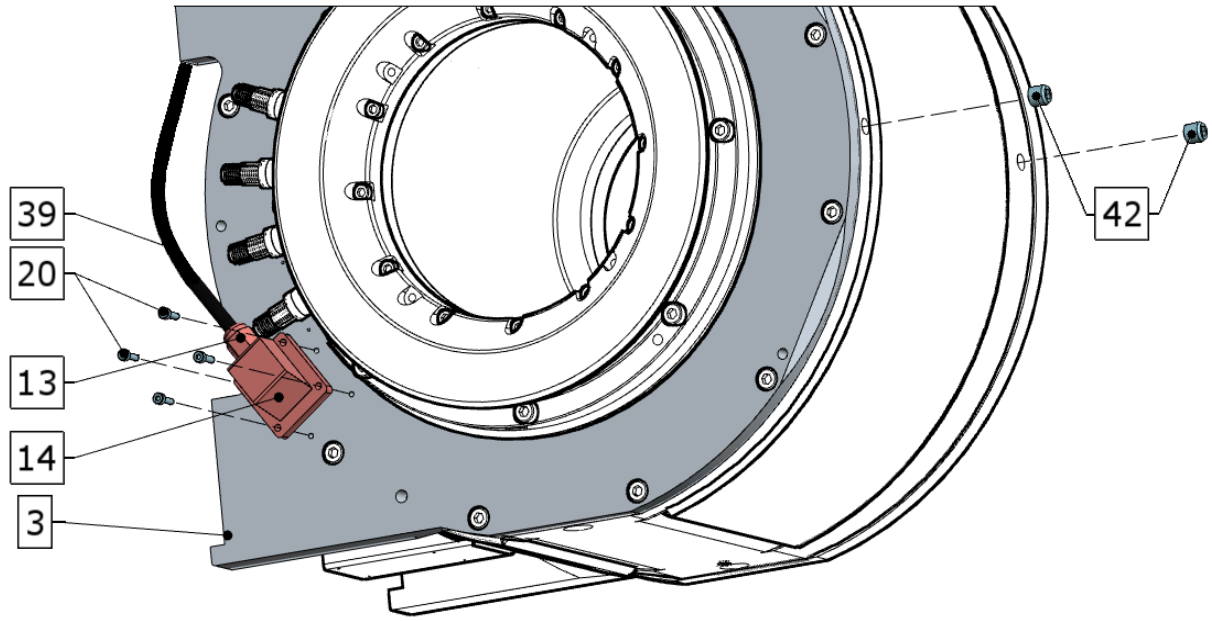

Fig. 45 – Mounting the angular connector (**13, 14**) and blind flanges (**42**)

Motor assembly:

From the stator chassis face (**2/1**), screw the adjusting screws into the technological holes as plugs (**42**) to secure them with LOCTITE 243. See **Fig. 45**.

Check all the free threads on the motor shields A, B (**3, 4**), rotor shaft (**1/1**) and bearing units (**11,12**) for the presence of M8x8 (**48**) and M6x6 (**49**) screws, except for the threads in the flange of roller bearing unit (**12**) that are used for fixation of cover (**45**). See **Chap. 9.2.1.12Chyba! Nenalezen zdroj odkazů.**, **Fig. 47**. Secure these screws with Loctite as specified in the **Ed611811** assembly drawing (motor **7HLU 3436 P/44-VA**) to flush them with the part surface they are mounted in.

After the assembly process has been finished, it is necessary to repair all the external surfaces and paints. The incoherent original paint must be removed. Grind off the paint transitions, clean and degrease. The paint can be applied by uniform spraying or with a brush. The paint system has three layers Contact the traction motor manufacturer for detailed specification of the paint and its repair, see the Manufacturer's Address, **Chap. 17.**

9.2.1.10. Wiring of Cables

Pull individual cables through the washer (**44/2**) with seal (**44/3**), tighten it consequently with the nuts (**44/5**), **Fig. 19**. Tighten this joint to the specified torque and secure with Loctite according to Drawing **Ed611826**. Constrict the cables with stripping tapes (**44/16**) and pin individual contacts (**44/9**,**44/10**) into the

insert for contacts (**44/8**) according to the diagram, see **Fig. 46**. For the complete wiring drawing see Annex "**Ed611826 - 15T+ Traction Motor Cabling**".

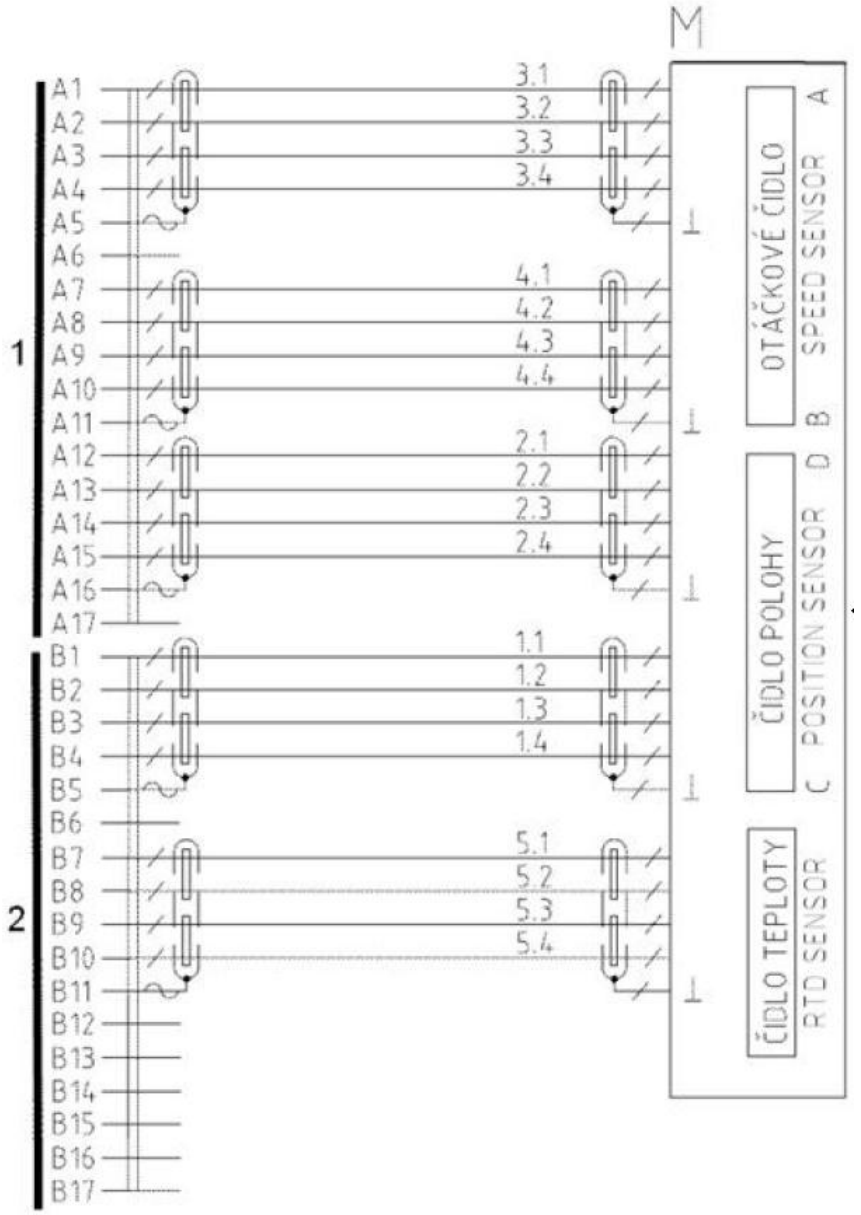

Fig. 46 – Diagram for wiring the contacts (**44/9, 44/10**) into the inserts for contacts (**44/8**)

Once the motor is installed perform the tests according to relevant paragraph in Chapter 8.

9.2.1.11. Coat System

Tab. 4 – Coat system

Layer	Coat type
1.	**Primer**
Rated thickness	90 µm
Colour	**ETOKAT AKTIV Primer**
Shade	**RAL 1002**
Manufacturer (Supplier):	Mäder Lacke
2.	**Interlayer**
Rated thickness	90 µm
Rated thickness of 2 layers	180 µm
Colour	**NUVOWERN Primer**
Shade	**RAL 9002**
Manufacturer (Supplier):	Mäder Lacke
3.	**Top coat**
Rated thickness (dry layer)	60 µm
Rated thickness of 3 layers	**240** µm
Colour	**NUVOVERN WR Emaillack**
Shade	**RAL 7043**
Manufacturer (Supplier):	Mäder Lacke

Protect the exposed surfaces, mainly the inlets (slots) between the labyrinth rotational (**5**) and static labyrinth (**51**) to avoid gluing and possible consequent damage to the motor. Avoid further coating of the slot on the static labyrinth (**51**). Protect cable harnesses. Use cloth to clean the surface tracks of corrosion on the exposed surfaces, and protect with REZISTIN.

9.2.1.12. Installation of Cover (45)

Once the motor is reinstalled into the tram bogie replace the john pin (**10**) and M12 suspension loop nut (**15**) with a plug – INBUS **(2/10)**. Flush to level and secure with Loctite according to the **Ed611811** assembly drawing.

Further, the external motor side needs to be fitted with cover (**45**), fixed with screws (**46**) and washers (**47**). See **Fig. 47**. You can find a detailed cover installation and handling procedure in the **EdP9683** document.

The motor dismounting from the bogie is possible in the reversed order of operations and it is also detailed in the document above. The cover position on the motor depends on the descriptor on the cover → it must be followed to ensure the correct function (the arrow on the motor cover face must always point to the top of rail, i.e. downwards).

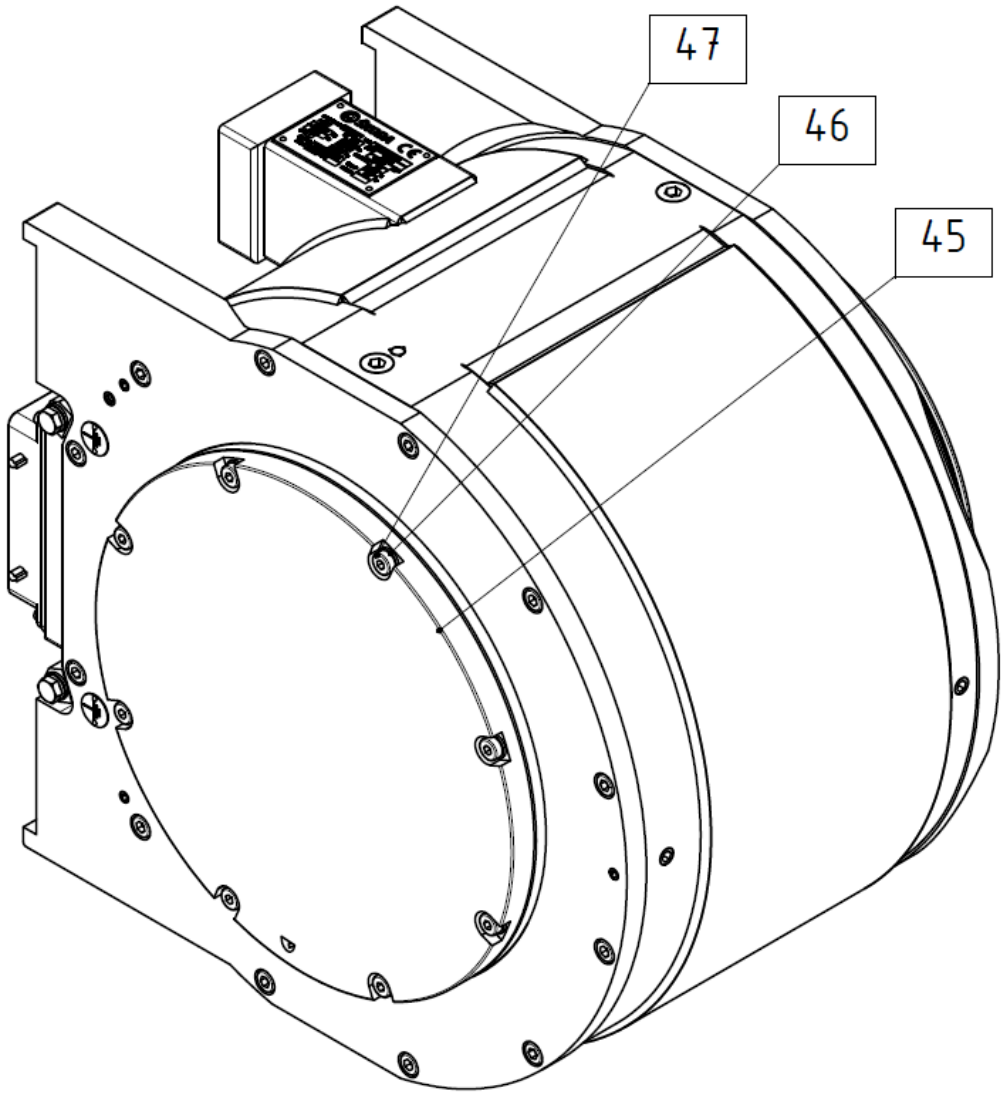

Fig. 47 – Installation of cover (**45**)

10. Change to Motor Version (Left-Hand x Right-Hand)

The 7HLU 3436 P/44-VA traction motor is designed as an exchangeable type - from the left-hand to the right-hand version. To ensure the correct operation of the motor, follow the steps below, otherwise the complete traction motor can be damaged irreversibly!!!

10.1. Cover (56) Replacement

Dismount cover (**56**) with washer (**46**) and O-ring (**54**) and screw it to the bottom part of static labyrinth (**51**). Screw in the plug fully, secure the joint with Loctite according to the **Ed611811** assembly drawing and repaint with the top coat. See **Fig. 48**

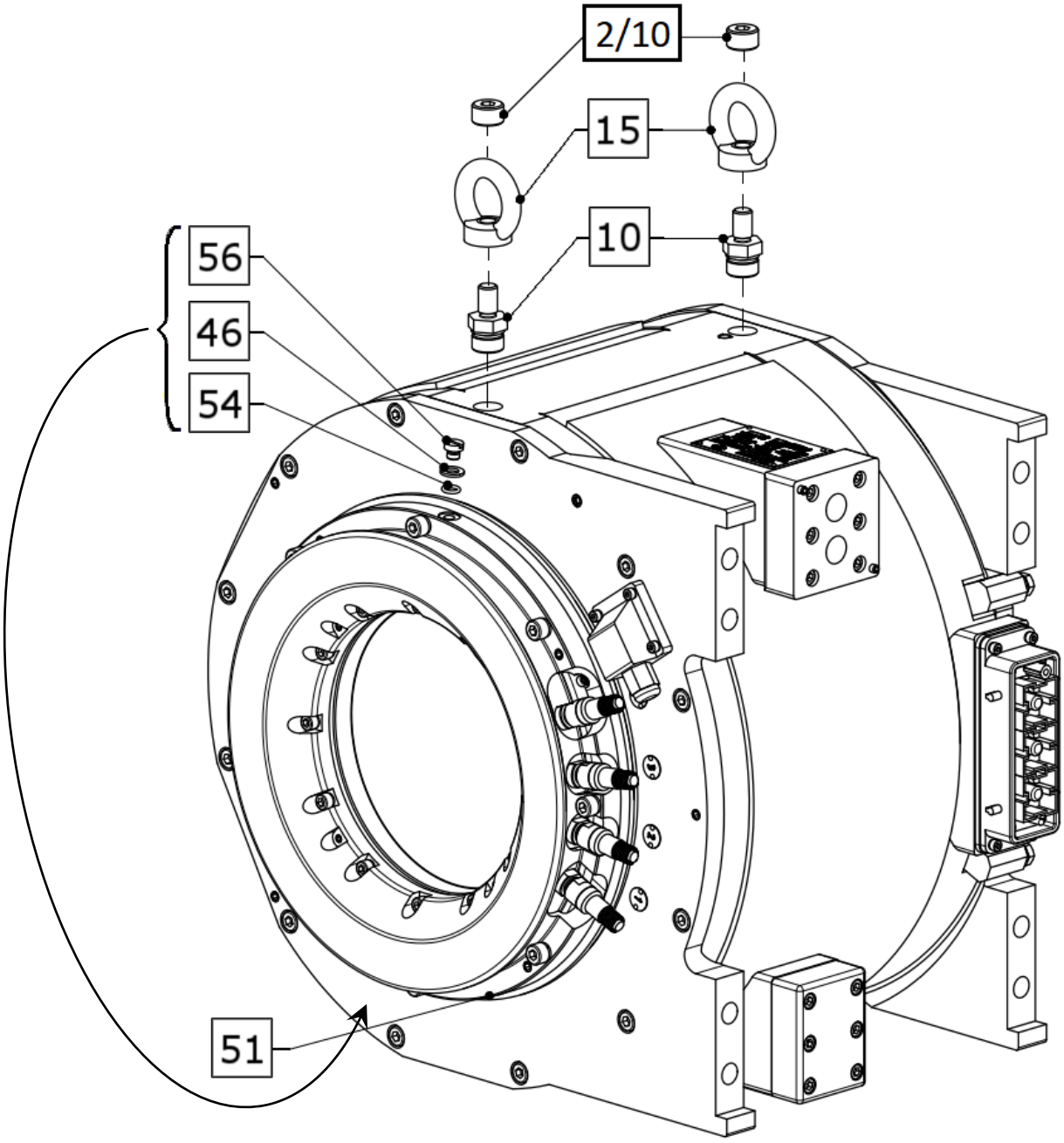

Fig. 48 – Exchange of cover (**56**), pintle (**10**) and suspension loop nut (**15**) while reconfiguring the left-hand motor into the right-hand motor

10.2. Using the Pintle (10) and M12 Suspension Loop Nut (15)

In case the motor reconfiguration from the left-hand type into the right-hand type, or vice versa, requires use of pintle (**10**) and M12 suspension loop nut (**15**), replace them with plugs - INBUS **(2/10)** - after the motor has been reinstalled to the tram bogie. Secure with Loctite, screw flush with the part (also after the reinstallation of plugs - INBUS **(2/10)**) according to the **Ed611811** assembly drawing. Consequently, repaint with the protective coat of TECTYL 506 EH. See **Fig. 48**.

10.3. Exchange of Adapter B (7) and Spacer B (6)

While reconfiguring the left-hand motor into the right-hand motor, or vice versa, exchange the adapter B (**7**), O-rings (**28**), screws (**18**) and washers (**28**) for spacer B (**6**), O-ring (**27**) and screws (**18**). See **Fig. 49**

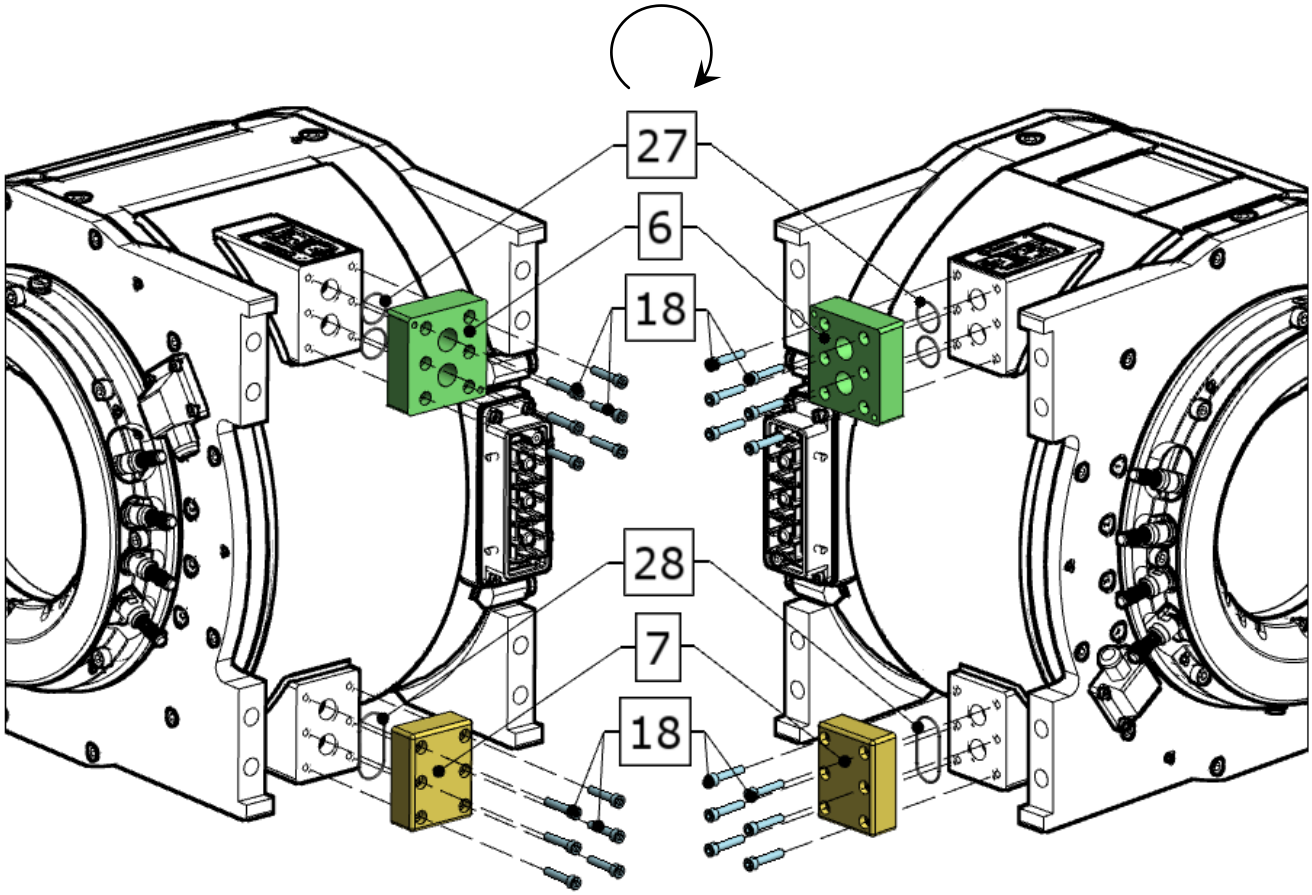

Fig. 49 – Exchange of spacer B (**6**) and jumper (**7**) while reconfiguring the LH motor into the RH motor and vice versa

To assure the correct motor version exchange and consequent correct function of the traction motor all of the steps above must be done, i.e. exchange of the cover (**56**), see **chap. 10.1** and **Fig. 48**, and exchange of spacer B (**6**) and jumper (**7**), see **Chap. 10.3** and **Fig. 49**. Checking the presence of all 4 plugs – INBUS **(2/10)** both after the application of pintle (**10**) and suspension loop nut (**15**) and after removal of any of them.

Checking all the steps for correct execution follows:

1) check all 4 plugs - INBUS **(2/10)** for presence
2) cover (**56**), washer (**46**) and O-ring (**54**) on the static labyrinth always on top of the motor
3) spacer B (**6**)(through part for the coolant distribution) always in the top part of the motor
4) perform the pressure test for the cooling circuit according to **Chap. 8.3.6.**

If any of the parts above is damaged please contact the service department ŠELC TRM, see the Manufacturer's Address, **chap. 17**.

10.4. Replacement of Power Connector Seal and Frame

10.4.1. Removal

Release 4 **M3x10** screws on the inner connector frame, pull out a bit the entire frame with the pin inserts outwards from the motor. Dismount the securing tapes on both sides of the pin inserts. Again, pull out a bit the inner frame of the connector and release the earthing cable by loosening the **M3x10** screw. Take off the inner connector frame. Remove the **M4x16** screws and dismount the power connector frame together with the seal from the connector board.

10.4.2. Assembly

Place the power connector frame with the seal for the connector board through the inserts for pins. Secure using 4 **M4x16** screws and tighten to the torque specified in **Ed611811** (**7HLU 3436 P/44-VA**). Place the inner connector frame through the inserts for pins. Fasten the earth wire using **M3x10** screw and tighten it to the torque according to **Ed609048**. Consequently, slide fully by the lock and fix with securing tapes on both sides. Insert the inner frame of the power connector plus the inserts for pins into the power connector frame and secure with 4 **M3x10** screws to tighten to the torque according to **Ed609048**, see **Fig. 50**.

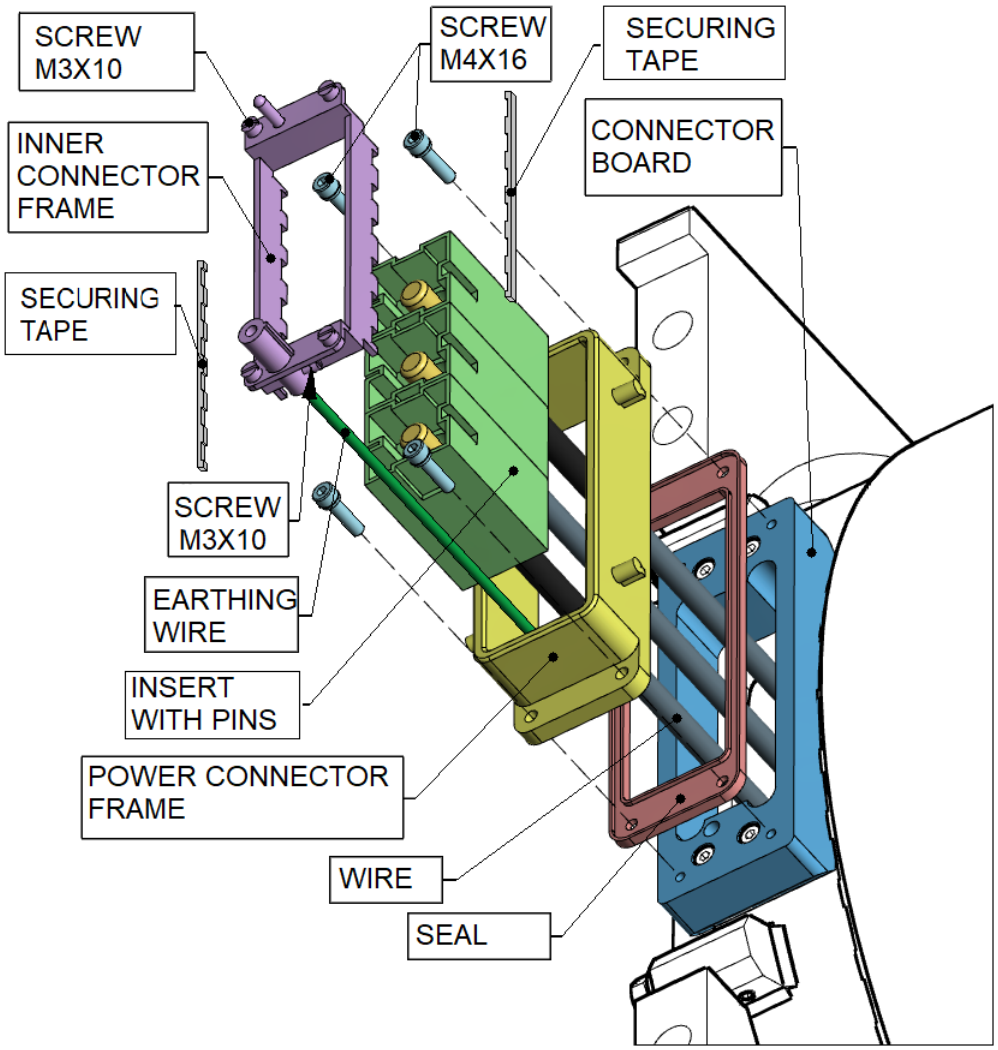

Fig. 50 – Exchange of the power connector seal and frame

11. Power Connector Wiring

Power connector (**2/1/15**) for the traction motor power supply is mounted to the stator (**2/1**). One of the prerequisites for the correct operation of the traction motor is the correct wiring with counterpart (the counterpart is a part of the tram). The connector type is designed so that it fully conforms to this purpose, i.e. a firm, safe and stable connection for the entire motor service life.

The whole traction motor must be handled in such a manner that the power connector (**2/1/15**) is not damaged externally from the mechanical or electrical viewpoint. **Fig. 51a),b)** depicts the status of the power connector (**2/1/15**) when traction motor is delivered from the manufacturer, i.e. the delivery includes the protective cap.

a) b)

Fig. 51 – Power connector protective cap
- a) metallic, b) plastic

Fig. 52 – Power connector after the removal of protective cap

When installing the motor into the tram and before connecting the counterpart to the power connector (**2/1/15**) dismount the power connector cap (see **Fig. 52**). Release the connector straps and remove the protective cap. Check the seal on the power connector for condition. It must not be damaged in any manner (scratches, scores, ruptures, etching, etc.).

Slide the counterpart axially onto the power connector (**2/1/15**). Once the counterpart seats against the power connector (**2/1/15**), secure the straps as the next step. Handle the straps so that they do not get distorted. The strap movement must take place along the unambiguously defined travel without seizing. Locking of the strap is accompanied by audible click. Once the strap is engaged, check all 4 strap pins of the power connector (**2/1/15**) for locking and the counterpart for tight seating against the seal of power connector (**2/1/15**). Any air gap between these parts **is inadmissible** (see **Fig. 54**). If any of the parts above is damaged or if any doubts exist of the correct connection please contact the motor manufacturer, see the Manufacturer's Address, **Chap. 17**.

Installation of the counterpart to the power connector by their decussation and drawing the counterpart by using the straps is prohibited. There is a risk of damage to both parts, including the straps. Secure the connector with straps only after both the connector counterparts sit against each other, see **Fig. 53**.

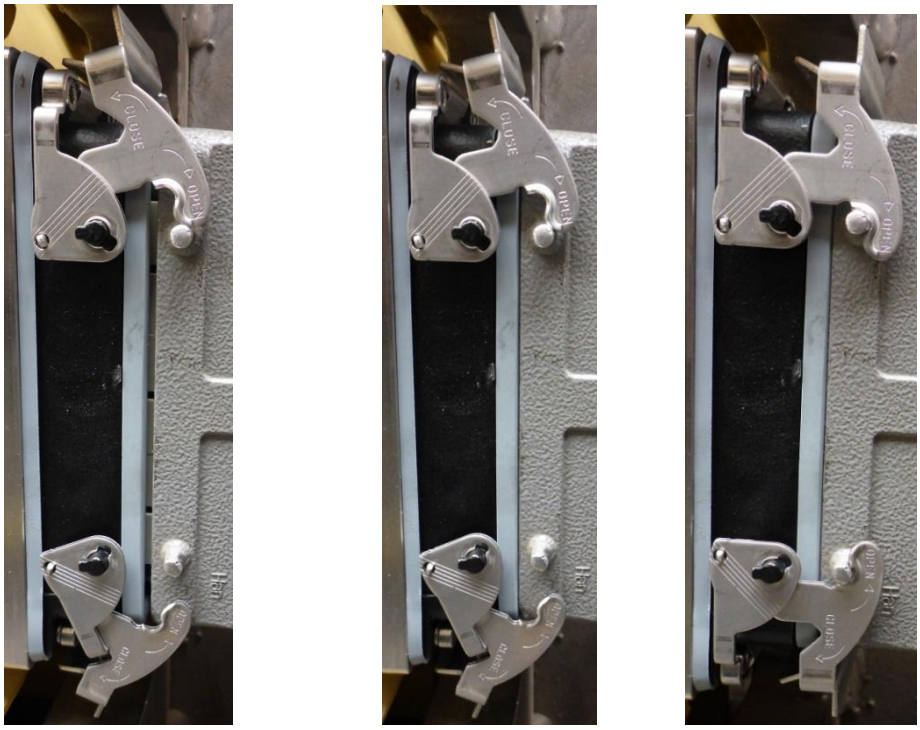

Fig. 53 – Power connector sliding and wiring

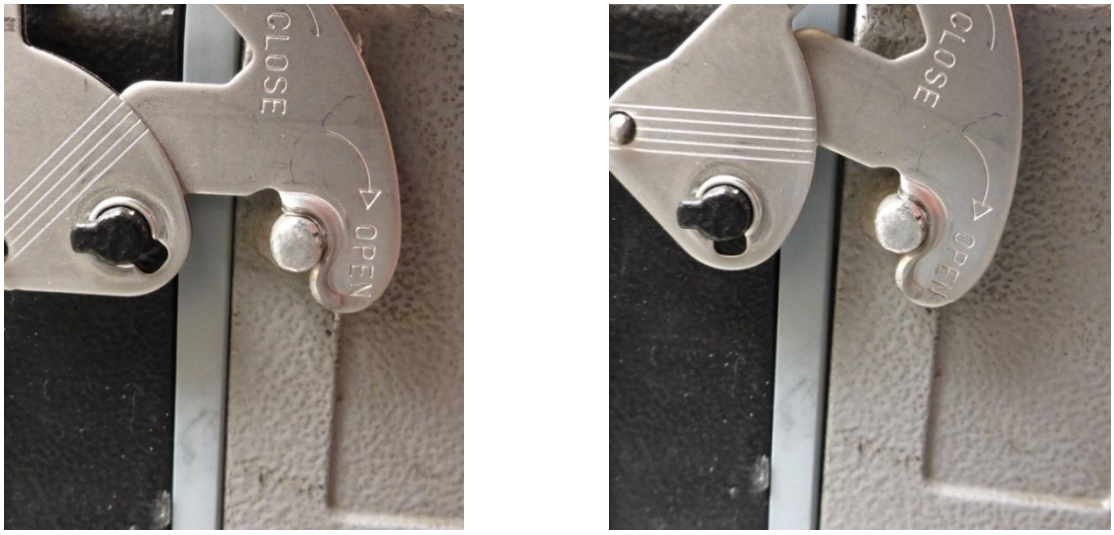

Fig. 54 – Tight seating of the power connector counterpart – GAP IS INADMISSIBLE

Checking the counterpart connection to the power connector (2/1/15) for correctness:

1) check the straps for clicking in place and locking
2) check the straps for deformities
3) check the counterpart seating against the power connector (**2/1/15**) for tightness

When disconnecting the connector from the tram or when handling the motor in any manner, cap must be installed onto the power connector (**2/1/15**) to protect the inner parts of the connector against ambient influences and mechanical damage.

12. Spare Parts List

Tab. 5 – Spare parts list

Position	Identification	Part name	Quantity	Unit
1	Ed602067	Rotor	1	pcs
2	Ed602096	Stator - connector attachment	1	pcs
3	Ed602071	Shield A	1	pcs
4	Ed602073	Shield B	1	pcs
5	Ed610015	Labyrinth rotational	1	pcs
6	63017737	Spacer B	1	pcs
7	63017736	Jumper	1	pcs
2/10	Ed610010	Plug - INBUS	4	pcs
10	Ed602086	Join pin	2	pcs
11	63016693	Bearing BMB-7509/ZMSTU	1	pcs
12	63016694	Bearing BC1-7308	1	pcs
13	63017688	Cable gland HSK-MS-E PG9	1	pcs
14	63017691	Cable gland WVF PG9	1	pcs
15	63011634	Suspension loop nut M12	2	pcs
16	63012767	Screw M8 x 25	8	pcs
17	63018522	Screw M8 x 20	24	pcs
18	63018523	Screw M6 x 30	12	pcs
19	63018524	Screw M6 x 25	12	pcs
20	63018525	Screw M4 x 16	4	pcs
21	63020721	Screw M8 x 12	2	pcs
22	63018513	Washer 8.4	2	pcs
23	63018514	Washer 8.4	2	pcs
27	63019040	O-ring 21.8 x 2.4	2	pcs
28	63019041	O-ring 39.6 x 2.4	1	pcs
32	63018518	Flexible pin 5x16	2	pcs
33	63017746	Pin 8x24	2	pcs
39	63017687	Cable RADOX	1.85	m
40	63018088	End sleeve 0.75/08	4	pcs
41	63012078	Tube SD 32F	0.34	m
42	63019538	Screw M12x12	2	pcs
43	63023520	MS Unifix clear	0.06	kg
45	Ed607715	Cover	1	pcs
46	63019482	Washer 8.4	9	pcs
47	63019483	Screw M8x20	8	pcs

Position	Identification	Part name	Quantity	Unit
48	63020164	Screw M8x8	10	pcs
49	63019735	Screw M6x6	22	pcs
50	63011789	Tube CGPT – 12.7/6.4-0	0.05	m
51	Ed610016	Labyrinth stationary	1	pcs
52	63019633	O-ring 265x3	1	pcs
54	63019634	O-ring 8x2	1	pcs
55	63019499	Screw M8x45	8	pcs
56	Ed608211	Cover	1	pcs
57	63019582	O-ring 270x3	1	pcs

13. List of Used Fixtures

Tab. 6 – List of used fixtures

Part			Fixture	
Position	**Name**	**ID**	**Designation**	**Description**
1 3	Rotor Shield A	Ed602067 Ed602071	OCS 31767 (Fs 307481)	To position assembly (rotor – Shield A) in the vertical position for assembly and disassembly
1 3 11	Rotor Shield A Bearing unit	Ed602067 Ed602071 63016693	OXA 31678 (FS 61107)	To position the rotor for assembly and disassembly of Shield A with bearing unit
4 12	Shield B Bearing unit	Ed602073 63016694	OCS 31765 (Fs 307474)	Fixture for assembly and disassembly of Shield B and bearing unit
3 11	Shield A Bearing unit	Ed602071 63016693	OCS 32132 (Fs 67544)	To fully press the Shield A with bearing unit onto the shaft shoulder
2/1 1	Stator Rotor	Ed602064 Ed602067	OXA 31703 (Fs 61019)	Winding protection inserts (4 to 6 pcs)
2/1 1	Stator Rotor	Ed602064 Ed602067	OXA 31976 (FS 66579)	Guide protective cover of the winding while stator is mounted to rotor
12	Bearing unit	63016694	OCS 32191 (FS 68473)	To fully press the inner race of bearing unit
11	Bearing unit	63016693	OXA 32056 (FS 68123)	Template to mark the sealant application point on the bearing unit
5	Labyrinth rotational	Ed610015	OXA 32092 (FS 68466)	Gauge for application of Loctite 5188 to the labyrinth and shaft
2/1 1	Stator Rotor	Ed602064 Ed602067	OCS 32160 (FS 68114)	For removal of rotor from stator
2/1 1	Stator Rotor	Ed602064 Ed602067	OXA 32054 (FS 68102)	Winding protection inserts (4 to 6 pcs)
11	Bearing unit BMB-7509/ZMSTU	63016693	OCS 31764 (FS 307460)	Cramp to strip the ball bearing unit from the rotor shaft
	Tooling - HARTING		TB 09 99 000 0012	Extraction of contacts

14. List of Used Materials

Tab. 7 – List of used materials

Material	Application	Manufacturer
LOCTITE, according to the Ed611811 assembly drawing	Securing the screws and surface sealing	HENKEL
NUVOVERN WR Emailacke	Top coat according to EdP0790	MÄDER LACKE
NOVALON ULTRA	Washing agent	NOVATO
TECTYL 506 EH	Non-greased parts	VALVOLINE
REZISTIN	Seating surfaces	PROXIM, s.r.o.
MS UNIFIX CLEAR	Tightening of seating surfaces	DEN BRAVEN
MOLYKOTE G-67	Mounting paste	DOW CORNING S.A.
FRIDEX EKO EXTRA **Alternatively:** Selenia paraflu 11 formule Texaco havoline XLC Motul inugel expert ultra Castrol Radicool NF Total glacef MDX Glycocool longlife	Cooling medium	Velvana **Alternatively:** Selenia Texaco Motul Castrol Total Shell
LOCTITE PERMABOND ESP110	Bonding of magnets	HENKEL
LOCTITE EA9505	Pairing of magnets	HENKEL

When handling specified chemical substances and preparations, instructions stated in the Safety Data Sheets and the equipment certificates must be adhered to.

Prefer use of the FRIDEX EKO EXTRA coolant, it can be diluted with distilled water. Alternative coolants can be used once the original coolant is drained completely from the entire cooling circuit of the tram. It is necessary to flush the circuit completely and thoroughly. Then, the alternative coolant can be used. It is recommended to record consistently each type of used coolant. NEVER mix the coolants. Topping, dilution and, if appropriate, disposal of the coolant conform to relevant equipment certificates and safety data sheets of the coolant manufacturer.

15. Disposal

Dispose of the motor according to the relevant legislation applicable in the country of use or, if appropriate, disposal.
In CR, dispose of the motor according to the applicable provisions of the Act No. 185/2001 Coll., on wastes and the implementation regulations to this Act, namely according to the Ordinance No. 93/2016 Coll. on the Waste Catalogue and the Ordinance No. 383/2001 Coll. on the waste handling details.

Traction motor contains:

1) recyclable materials (utilisable raw materials) which do not pose hazardous waste:

- Steel parts of stator, rotor, shields, bearings, etc.
- Copper conductors of the stator winding after the removal of insulation system
- Copper parts of cables
- Copper bars and rotor rings
- NdFeB permanent magnets

2) Materials and substances that are hazardous waste by virtue of law:

- Insulation system of the stator winding
- Cable insulations
- Oils and lubricants
- Adhesives and sealants

16. Transport

Pallet is used for transport and relocation. Motors are covered with polythene foil. The exposed metallic surfaces of the motor are protected with antirusting agents. If the speed sensor is handled in any way, the ESD protection principles must be adhered to, see **Chapter** Chyba! Nenalezen zdroj odkazů. ESD Protection Principles The cables must be marked with self-adhesive tape with relevant symbol for work with the ESD sensitive equipment (see **Fig. 12**) and the sensor attachment connector must always be protected by ESD bag. (see **Fig. 13**)

When transporting and handling the motor, treat the motor in such a way that it is not damaged mechanically. It is prohibited to handle the motor suspended at the rotor cavity.
Bearing capacity of the handling equipment and its suspensions must be identical to the motor weight as minimum (max. motor weight is 260 kg).

- When handling the motor, use the suspension eyes provided on the motor chassis. Use INBUS (Allen) key, size 8, to dismount the plugs **(2/10)**.
- Standing under the suspended load is prohibited when motor is transported by crane. Motor must be secured with wooden stops against its movement and held with straps to the pallet for any transport on a pallet. When in harness, the cabling from the bearing monitored by sensors must be pushed through the shaft and secured against untwisting. It is inadmissible to place the motor on cabling. The cabling may be damaged. For example of placement see **Fig. 55**.

Fig. 55 – Packaging method of **7HLU 3436 P/44-VA** motor

16.1. Protection of Bearings

The traction motor bearings must be protected against damage whenever the motor is not rotating, i.e. namely in transport, storage and when the vehicle is put out of service for a long period of time (that is, the time longer than the motor turning period according to the motor's "Maintenance Manual"). The motor must be protected during every transport regardless of whether or not it is transported separately or as a part of an assembly (motor mounted to the gearbox, bogie with installed motor, etc.) or of a vehicle.

In these cases, the rotor lock used for the motor can be used as the protection of the motor (bearings). If this lock in the assembled condition is impossible a different measure must be adopted. The person responsible for installation of the mechanical protection of bearings in such cases is the manufacturer of relevant assembly or vehicle and, consequently, the final customer. Before putting the motor or vehicle into operation, the motor lock must be dismounted.

If the vehicle or the unit containing a motor has been put out of service or if the motor has been stored for a prolonged period of time it is necessary to secure mechanical protection of bearings using a lock and provide that the rotor is turned according to the relevant instruction of the "Maintenance Manual" of the motor.

17. Motor Manufacturer Address

ŠKODA ELECTRIC, a.s.
DIVIZE TRAKČNÍ MOTORY
PRŮMYSLOVÁ 2A
301 00 PLZEŇ
CZECH REPUBLIC

Phone: +420 378 181 002
Fax: +420 378 181 368
E-mail: electric@skoda.cz
Service - phone: +420 378 181 075
Service - e-mail: servis.trm@skoda.cz

18. List of Annexes

"DIMENSIONAL DRAWING" of HLU 7HLU 3436 Motor ..... Drawing no. Ed611813
HLU 7HLU 3436 P/44-VA "MOTOR CAVITY" ..... Drawing no. Ed611812
"Example of Single-Part Test Report" ..... Document no. EdP7881
"ASSEMBLY FIXTURE A" of 7HLU 3436 P/44-VA Motor ..... Drawing no. Fs307460
"ASSEMBLY FIXTURE B" of 7HLU 3436 P/44-VA Motor ..... Drawing no. Fs307474
"DIS/ASSEMBLY FIXTURE“ of 7HLU 3436 P/44-VA Motor ..... Drawing no. Fs307481
"PRESSURE RING“ of 7HLU 3436 P/44-VA Motor ..... Drawing no. Fs67544
"TOOLING – HARTING“..... TB 09 99 000 0012
"GLASS-TEXTITE INSERTS“ ..... Drawing no. Fs61019
"SKF Assembly Instructions for TMBU Bearing Unit"..……..... Document no. EdP1365
7HLU 3436 P/44-VA "MOTOR ASSEMBLY" ..... Drawing no. Ed611811
7HLU 3436 P/44-VA "COAT SPECIFICATION" ..... Document no. EdP0790
"PT-CELL WIRING"..... Document no. EdP4722
"COVER INSTALLATION"..... Document no. EdP9683
„+15T TRACTION MOTOR CABLING". ..... Drawing no. Ed611826
"15T POWER CONNECTOR ASSEMBLY". ..... Drawing no. Ed609048

CAUTION!!!
Prior to each initiation of tasks specified in this Code ask the actual versions of drawings or documents which this Maintenance Code refers to from the motor manufacturer, see **Chap. 17**.

The motor manufacturer reserves the right to change the documents, that is, this Code and the attached documents and drawings in order to improve parameters of the product or its parts. This does not affect exchangeability and functionality of individual components.

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