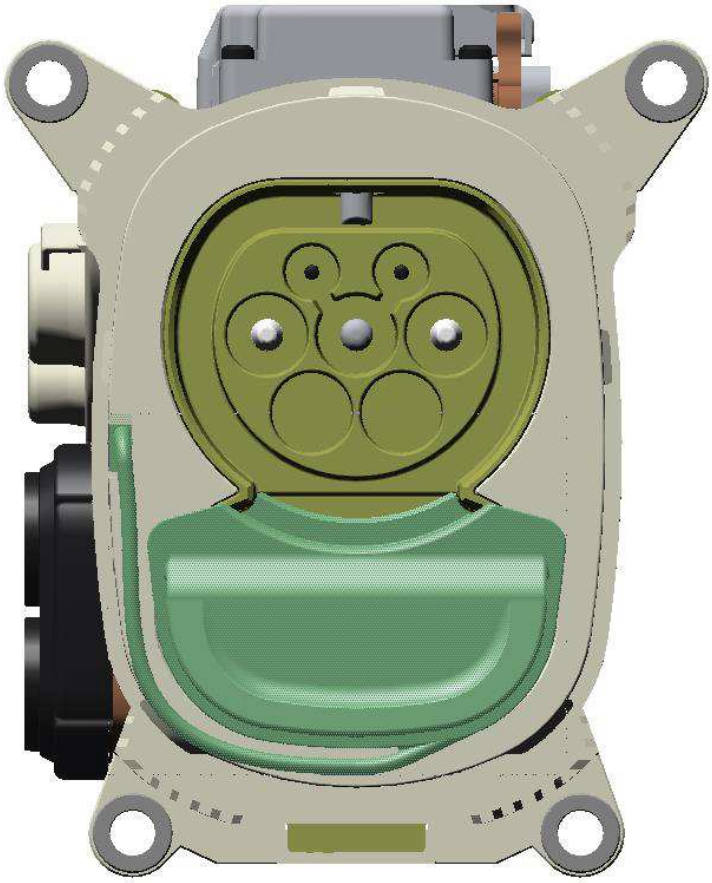
Class 1

EV Charge Inlet Combo 2



| Indicates Change

Content

1. SCOPE

1.1. Content

This specification describes the assembly and handling of the vehicle charge inlets Combo 2 acc. IEC62196-3 for conductive charging of electric vehicles with AC current and DC current for fast charging. This specification applies to manual assembly of the components in series production configuration.

1.2. Processing Note

The processor is responsible for the quality of the manufacturing process to ensure the correct function of the system. The warranty and liability is excluded if quality deficiency or damages occur due to non-compliance to this specification or use of not specified or not released tools, cables and components.

2. APPLICABLE DOCUMENTS

The following technical documents, if referred to, are part of this specification. In case of a contradiction between this specification and the product drawing or this specification and the specified documentation, the product specification has priority.

2.1. TE Connectivity Documents

a) Customer drawings for inlet type Combo 2

INLET HSG, COMBO 2, ASSY	2305973
CABLE EXIT, RECT, 90 DEG	2303200
FAMILY SEAL, AC	2296040
STRAIN RELIEF, AC	2296056
COVER, CABLE SEAL, AC	2296057
FAMILY SEAL, DC	2303206
COVER, CABLE SEAL, DC	2303237
MQS CAVITY PLUG	963143
PIN DIA 6.0mm, RIGID, PE	2293270
PIN DIA 6.0mm, RIGID, POWER AC, ASSY	2293269
PIN DIA 8,0mm, 90DEG, POWER DC, ASSY	2306177
SEALING	2120571
PROTECTION CAP, TE, WATER DRAIN	2292534
DC CAP, COMBO2	2310283
ACTUATOR RELEASE PULL CABLE, ASSY	2317394

b) Specifications / Spezifikationen

108-xxxxx	Product Spec. Vehicle Charge Inlets Combo 2
114-13000	Application Specification Micro Mate-N-Lock Connectors
114-94436	Application Specification 90 DEG Charger Inlet Contact System
108-94519	Product Spec. TE actuator for charge inlets

2.2. General Documentation

Cable Specifications of Prescribed Cables

AC-cable: cross-section 2 x 4,0mm²

Supplier	LEONI Silitherm
Outer Diameter	11.3 $^{-0,6}$ mm
Cable description	*FHLR2G2GCB2G 2x4.0mm²*
	similar LV216-2 Tab. A.5
Supplier Part No.:	FLHR2G2GCB2G 00002

DC-cable: cross-section 50mm²

Supplier	COROPLAST
Outer Diameter	15.8 $^{-0,6}$ mm
Cable description	*FHLR2GCB2G 50mm²*
	similar LV216-2 Tab. A.2
Supplier Part No.:	9-2611 FHLR2GCB2G 50mm²

DC-cable: cross-section 95mm²

Supplier	COROPLAST
Outer Diameter	*20,9 $^{-0.8}$* mm
Cable description	*FHLR2GCB2G 95mm²*
	similar LV216-2 Tab. A.2
Supplier Part No.:	9-2611 FHLR2GCB2G 95mm²

PE-cable: cross-section *25*mm²

Supplier	COFICAB
Outer Diameter	*8.45 $^{+0,25\ /\ -0,25}$ mm*
Cable description	*A42X-TCD* 25,0
Supplier Part No.:	A42X2500xxyy

Or:

Supplier	COFICAB
Outer Diameter	*8.45 $^{+0,25\ /\ -0,25}$ mm*
Cable description	*A42X-TBD* 25,0
Supplier Part No.:	A42XB2500xxyy

Signal-cable: cross-section 0,5mm²

Outer Diameter	1.6 $^{-0,2}$ mm
Cable description	*FLRY 0,5mm² acc. ISO6722-1*

3. APPLICATION TOOLS

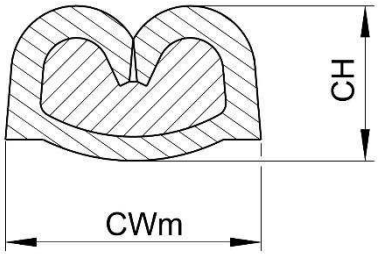
To produce a correct wire crimp, as validated by TE with the wires listed in this specification, following application tools are required.

Wire Size [mm²]	Stripping Length single wire for crimp [mm]	Crimp height CH_1 [mm]	Crimp width measurable CWm [mm]	Cable Specification	Supplier	Contact P/N	Geo-metry	Applicator	TE Crimp Validation is based on crimp press stroke / cycle time
4	13,0 ± 1	3,95 ± 0,1	5.6+0.5	FHLR2G2GCB2G 2x4.0mm²	Leoni	2293269-2	2W	4-528041-1	Hanke 971-200. Cycle time: 1.7 - 2.5s Stroke: 44mm
25	18,0 ± 1	5,6 ± 0,1	9,7+1,0	A42X-TCD 25.0 25mm² A42X-TBD 25.0 25mm²	COFICAB	2293270-5	2B	2454524-1*	
50	19,0 ± 1 / 28,0 ± 1	8,7 ± 0,15	-	FHLR2GCB2G 50mm²	Coroplast	2306177-1	F	541915-2	tbd
~~95~~	~~19,0 ± 1 / 28,0 ± 1~~	~~10,4±0.15~~	~~-~~	~~FHLR2GCB2G 95mm²~~	~~Coroplast~~	~~2306177-1~~	~~F~~	541915-2	tbd

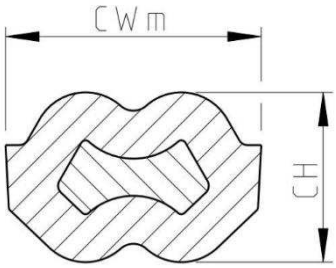
Table 1

**Conversion of the old applicator PN 2276149-6 possible by exchanging of spare parts.*

Crimp-Geometry: F



Crimp-Geometry: W / 2B



Crimp Die Sets are subject to wear and their condition and quality have to be monitored. Suspect and/or worn Die Sets have not to be used for the production of these crimps. Die Sets are available as spare parts.

4. WIRES

4.1. Assessment of the wires

To ensure the required electrical crimp contactability with stable crimp resistance a permissible maximum storage period of 8 months for unprocessed cable (referring to cable manufacturer production date) has to be respected.

4.2. Wire selection

The contact system is released for the application with wires specified in chapter 2.2
The released contact-wire-combinations and crimp parameters are given in table 1.

Other wires require the validation and approval of the TE engineering department.
The wires are applied as single wire terminations. Double terminations are not intended.

4.3. Wire preparation

The cable has to be cut accurately with a 90 deg. angle.

The cable insulation must be stripped before crimping. The stripping length of the outer insulation and shield is defined in the following Assembly Steps.
The insulation must be cut accurately and pulled off from the conductor. Offcut of insulation must not remain on the conductor. Single strands may not be damaged, fanned out, cut or pulled out. Furthermore the operator should avoid touching the bare single strands and the strands shall not be twisted. All single strands need to be caught in the crimp and not a single stand must remain outside the crimp.

5. REQUIREMENTS ON THE CRIMPED CONTACT WITH W-CRIMP SHAPE (CLOSED BARREL)

The following terms shown below are used in this specification, see figure 1.

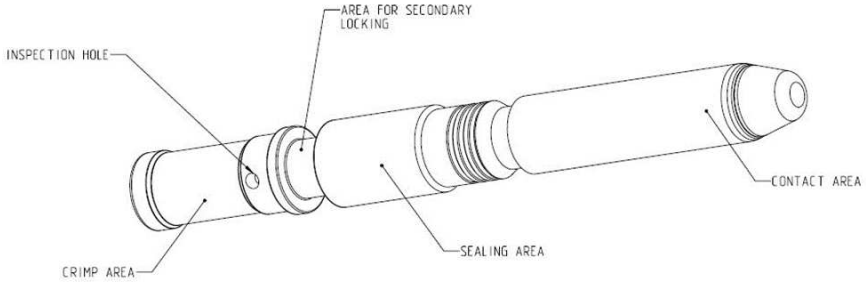


Figure 1

5.1. Conductor position

The single strands of the conductor are clamped inside the crimp area.
All single strands need to be caught in the crimp and not a single stand must remain outside the crimp.
The wire end must be fully inserted into the crimp area and has to be checked via the inspection hole after crimping. Insulation must not be inside of the crimping area, see figure 2

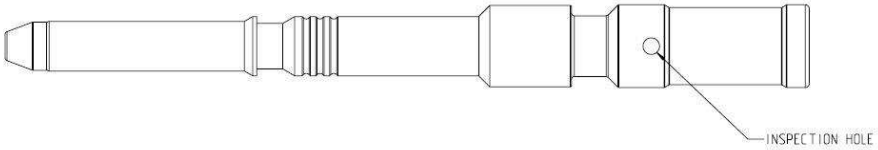


Figure 2

5.2. Crimp Geometry

The crimp geometry, crimp heights including their corresponding tolerances as well as wire sizes are given in table 1.

The crimp height is the key quality feature of a crimp connection. The measurement allows a non-destroying examination and a continuous process inspection. It is provided for every wire size and contact.
The crimp height is given in table 2.

Crimp height and width may also be measured in a cross section image. The mechanical operated measurement though is preferred.

During the application process the crimp height must be checked. This is valid for each batch and after every change or switchover of contact reel or wire bundle or applicator respective it's setup or components.

The crimp height has to be measured over both extensions in middle of the crimp, figure 3:

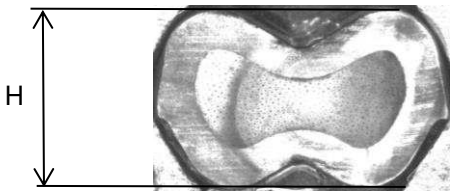


Figure 3 (pic exemplarily)

5.3. Cross Sections

When creating cross sections the correct grinding layer must be selected. The
Grinding layer had to be at middle of crimp area and may not be inside of serration, see figure 4.

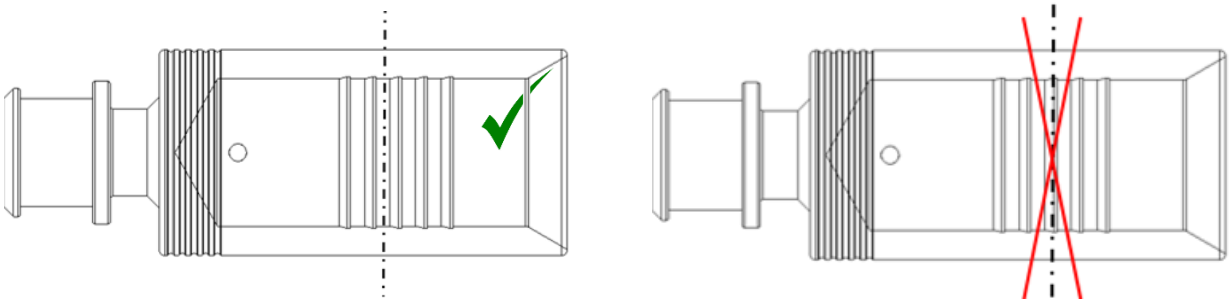


Figure 4 (pic exemplarily)

5.4. Wire pull-out forces

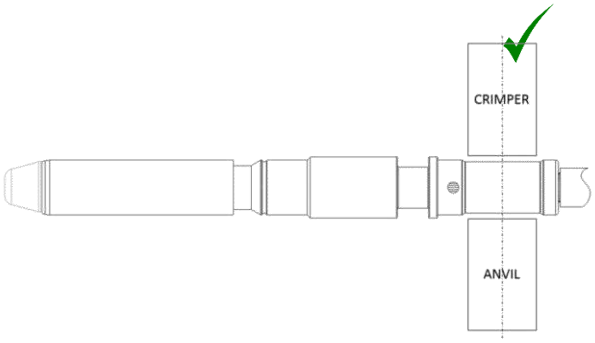
Measurement of wire pull-out forces from the wire crimp is a supporting manufacturing control.

The pull-out forces must fulfil the requirements according product specification 108-xxxxx

5.5. Crimp Position

The TE applicator positions the contacts in the crimping tool at middle position as shown, figure 5 and 6. Correct position and condition of applicator has to be checked for every production lot.

4mm² - AC cable



25mm² – PE cable

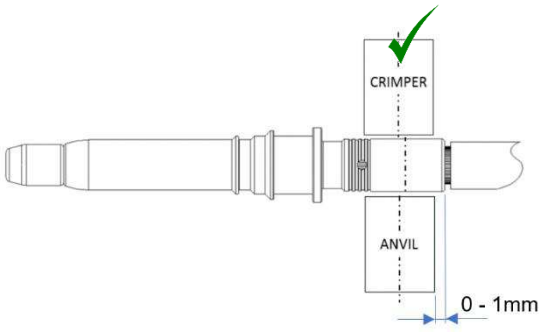


Figure 5 (pic exemplarily)

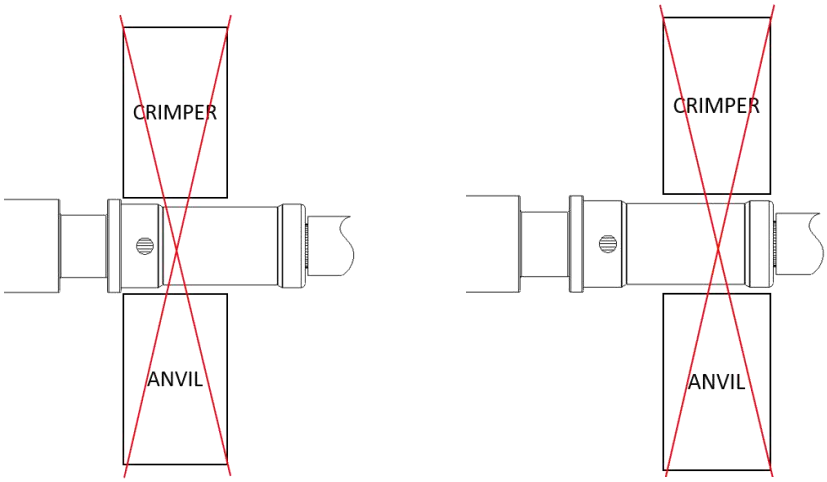


Figure 6 (pic exemplarily)

5.6. Contact area

During processing and following processing the contact area may not be damaged or bended.

5.7. Sealing area

During processing and following processing the sealing area may not be damaged or bended

5.8. Shape and position tolerances

Measuring the shape and position deviation is not always necessary, if the contact is obviously straight by eye. In case a measurement is required, the measurement equipment required at least a 10-time better measuring precision compared with the requirement tolerances, see figure 7 and 8.
Meeting the specific shape and position tolerances must be ensured before the contact is inserted into the housing.
If contacts are bent during the application process and exceed the specified tolerances these must not be bent back or reworked, but have to be scrapped.

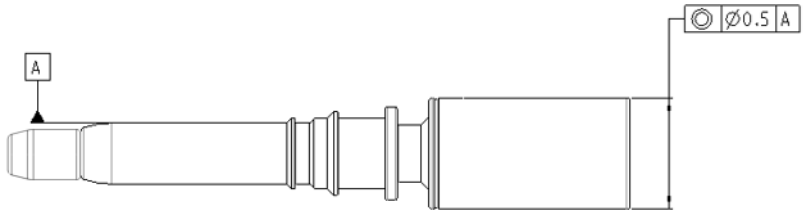


Figure 7 (pic exemplarily)

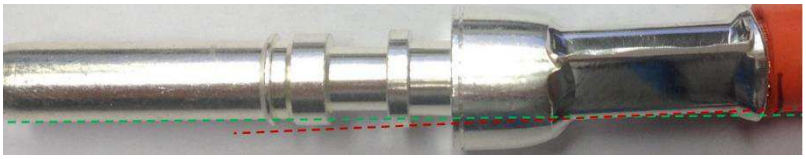


Figure 8 (pic exemplarily)

5.9. Measuring equipment and measuring position

As measuring equipment for measuring crimp height, a digital caliper with accuracy of measuring 0.01mm is the minimum requirement. Measuring of crimp height had to be done according as following always in middle of crimp area across whole crimp, see figure 9 and figure 3.

Figure 9 (pic exemplarily)

6. REQUIREMENTS ON THE CRIMPED CONTACT WITH F-CRIMP SHAPE

The crimp of the 50mm² cables on 90 DEG DC power contacts with F-shaped crimp geometry has to be processed according Application Specification 114-94436.

7. ASSEMBLY INSTRUCTIONS

7.1. Assembly overview Charge Inlet Combo2

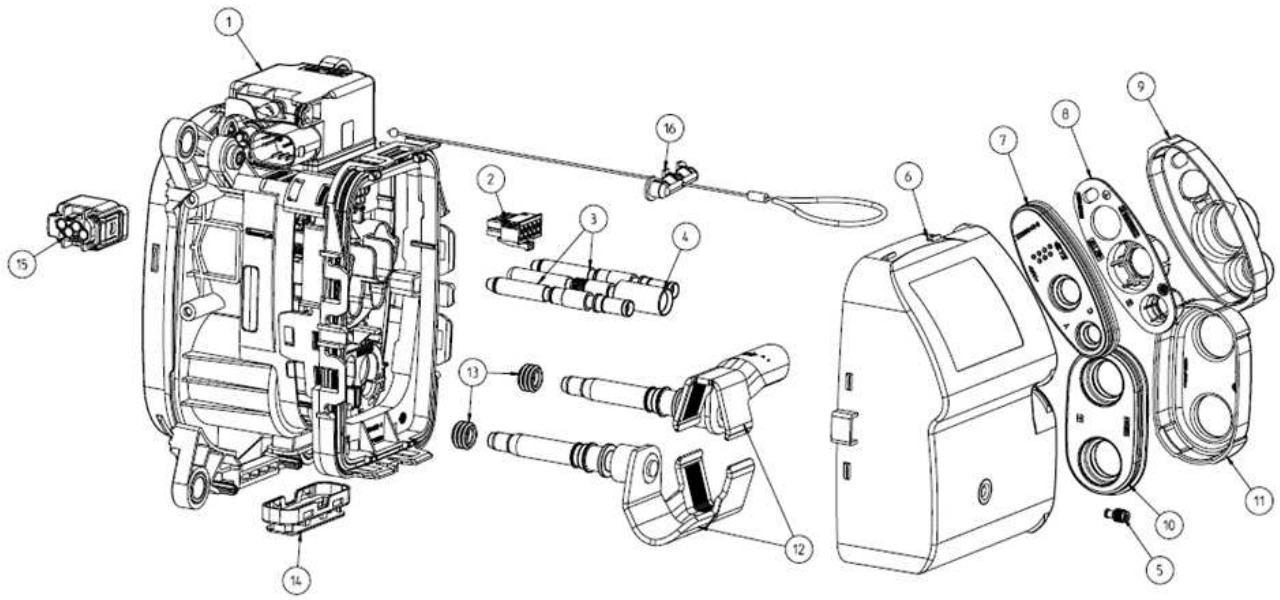


Figure 10

7.2. Parts to order

Charge inlet Combo 2 Variant / Part			1-phase AC 4mm² Ground 25mm² DC 50mm²
Pos.	**Qty.**	**Name / Bezeichnung**	**P/N**
1	1	INLET HSG, COMBO2, ASSY	2305973-1
2	1	10P MICRO MNL HSG	Additional part for charge inlet cabling: 1-794617-0
	7	CONTACT MICRO MNL	Additional part for charge inlet cabling: 0-794606-1
3	2	PIN DIA 6.0, RIGID, POWER AC, ASSY	2293269-2
4	1	PIN DIA 6.0, RIDIG, PE	2293270-5
5	1	MQS Cavity Plug	963143-1
6	1	CABLE EXIT, DC SIDE, COMBO	1-2303200-1
7	1	FAMILY SEAL, AC	2296040-6
8	1	STRAIN RELIEF, AC	2296056-5
9	1	COVER, CABLE SEAL, AC	2296057-2
10	1	FAMILY SEAL, DC SIDE, COMBO	2303206-4
11	1	COVER, CABLE SEAL, DC SIDE, COMBO	2303237-4
12	2	PIN DIA 8.0, 90 DEG, CONTACT, ASSY	2306177-1
13	2	SEALING	2120571-1
14	1	PROTECTION CAP, TE, WATER DRAIN	2292534-1
15	-	4POS MQS Connector HSG, Seals and Contacts	Additional part for Actuator cabling: p/n acc. Prod. Spec. 108-94519
16	1	Unlock Pull Cable Assy JLR X590	2317394-1 alternatively: 9-2317394-5

Table 2

7.3. Assembly Configurations Cable Exit

The inlet is designed for alternative cable exit directions to the left or right. Actually, only the version with exit direction to the right is tooled and available. This configuration is shown in figure 11.

In this specification the version with cable exit to the right is shown.

Configurations for cable exit sidewards:

To left side (currently not available)

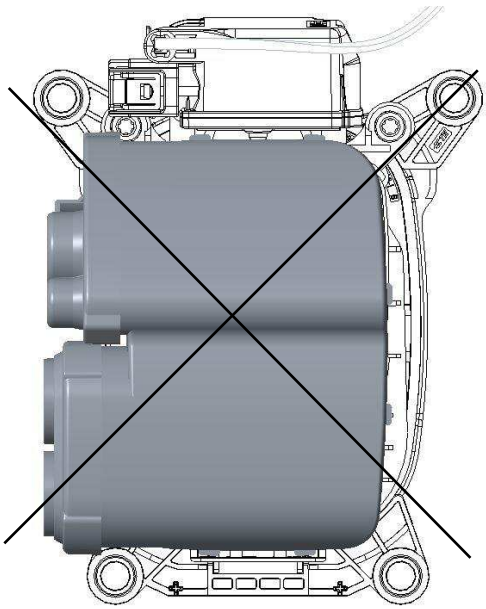


Figure 11a

To right side.

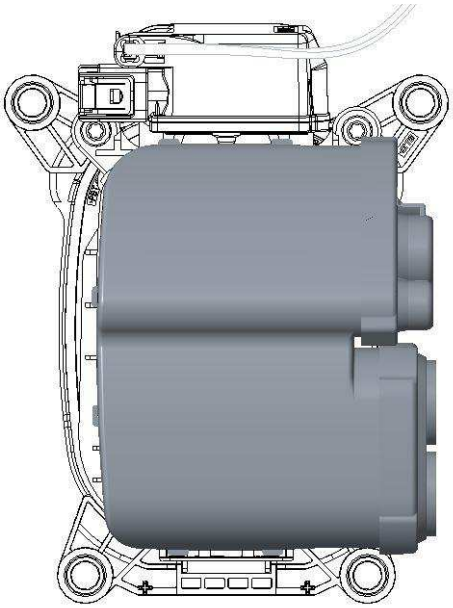
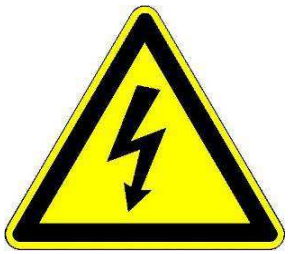


Figure 11b

7.4. Security Advice

ATTENTION!
- HIGH VOLTAGE APPLICATION -
CABLE INSULATION MUST NOT BE DAMAGED!



The assembly has only be performed by trained personnel.

Avoid prolonged or repeated skin contact with silver plated contacts (wear protective gloves)!

7.5. Assembly Steps

Step 1
The COVER CABLE SEAL AC 2296057-2, STRAIN RELIEF AC 2296056-5 and FAMILY SEAL AC 2296040-6 must be pushed over the signal wires, the ground wire and the AC-Multicore wire. Pay attention to place all wires at correct positions, figure 12. Especially ensure the correct position of the flange of the L-shaped FAMILY SEAL AC towards the STRAIN RELIEF, figure 12a

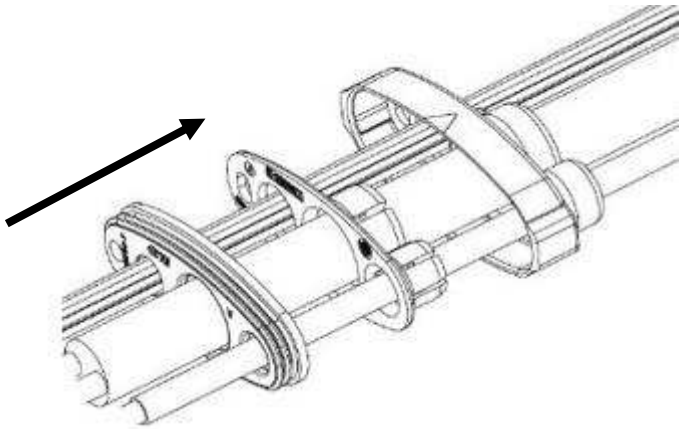


Figure 12

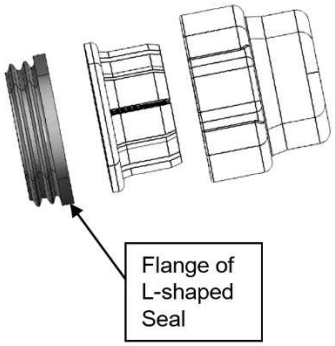


Figure 12a

Step 2

Dismantle the wires and crimp the contacts: **2x4 mm² AC-Multicore Cable**

Remove outer insolation, shield and filler of AC-multicore-cable acc. figure 13 and table 3.
The given length of the single wires ensures that the outer sheath of the multicore cable seals to the FAMILY SEAL AC 2296040. Alternatively, a marking on the outer sheath in a certain distance to the cut off position can be used to ensure the proper position of the outer sheath in the FAMILY SEAL AC.

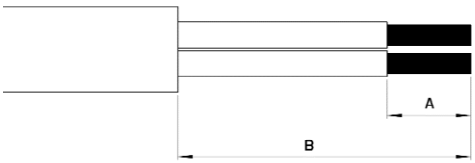


Figure 13

Wire Size	Removal of insulation dim. "A"	Length of single wires "B"
4 mm²	13 mm +/- 1mm	53 +/-2 mm

Table 3

Crimp the conductors to the PIN DIA6,0 RIGID CONTACTS 2293269 with the specified tools listed in table 1. The crimp has to fulfill the requirements acc. Chapter 5.

Step 3

Dismantle the wires and crimp the contact: **25 mm² PE (ground) single wire**

Remove outer insolation acc. Figure 14 and table 4.

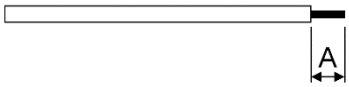


Figure 14

Wire Size	Removal of insulation dim. "A"
25 mm²	18 mm +/- 1mm

Table 4

Crimp the conductors to the PIN DIA 6,0 RIGID CONTACT 2293270 with the specified tools listed in table 1. The crimp has to fulfill the requirements acc. Chapter 5.

Step 4

Dismantle the wires and crimp the contacts: **Signal-Wires 0,5mm²**

Dismantle single wires acc. spec. 114-13000 and crimp the contacts 0-794606-1 acc. spec. 114-13000, see figure 15.

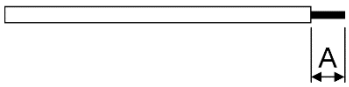


Figure 15

After Crimping the different cables, the subassembly of cables with cable exit components is in the condition shown in figure 16:

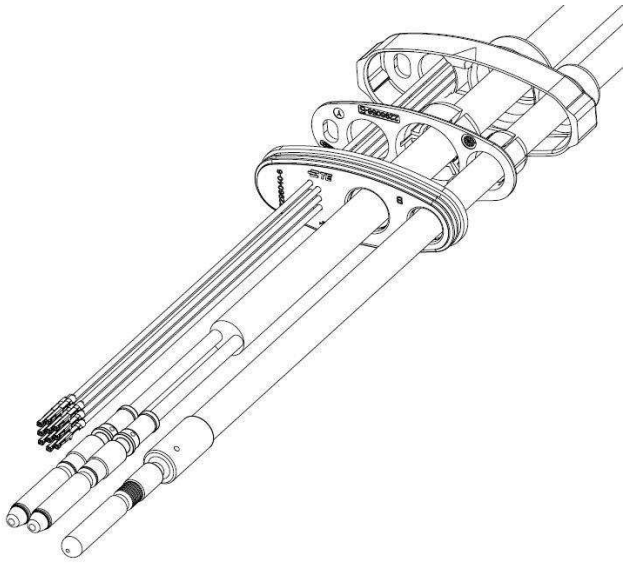


Figure 16 (schematic; crimp geometry not shown)

Step 5

Push signal terminals 0-794606-1 (Micro Mate'N'Lock) into the Connector Housing 1-794617-0 acc. application spec 114-13000. Pinning according figure 17:

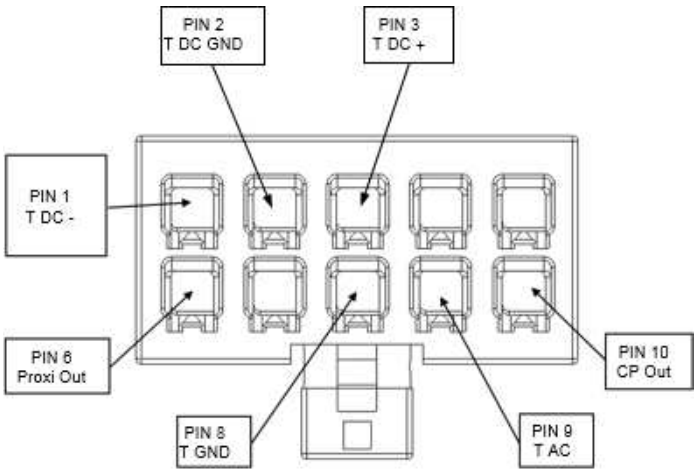


Figure 17

After Micro Mate'n'Lock connector housing assembly the subassembly of cables with cable exit components is complete, see figure 18:

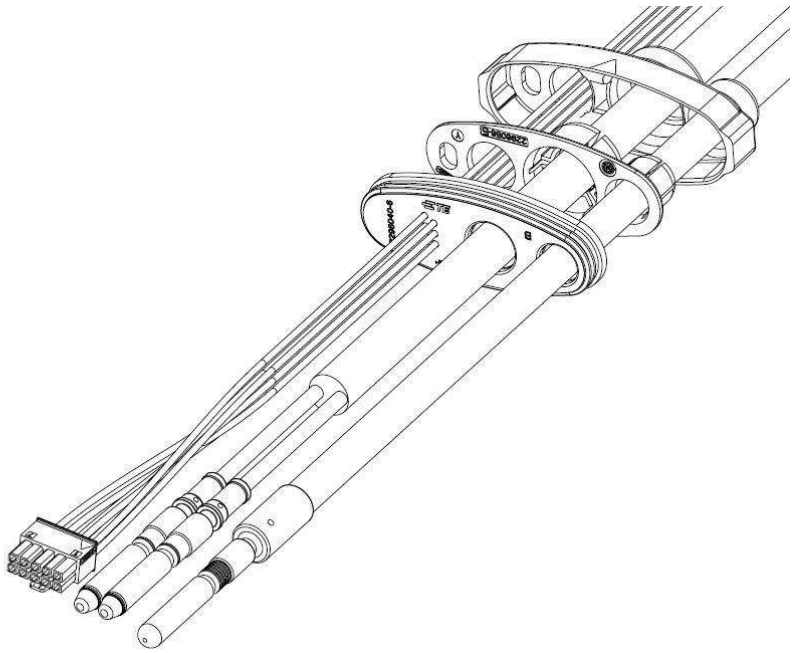


Figure 18(schematic; crimp geometry not shown)

Step 6
The COVER CABLE SEAL DC 2303237-4 and FAMILY SEAL DC 2303206-4 must be pushed over the 50mm² DC-Power wires, figure 19. Especially ensure the correct position of the flange of the L-shaped FAMILY SEAL AC towards the COVER CABLE SEAL, figure 19a

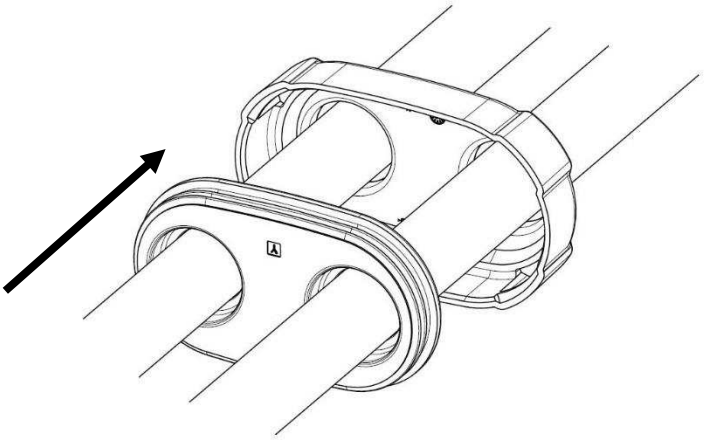


Figure 19

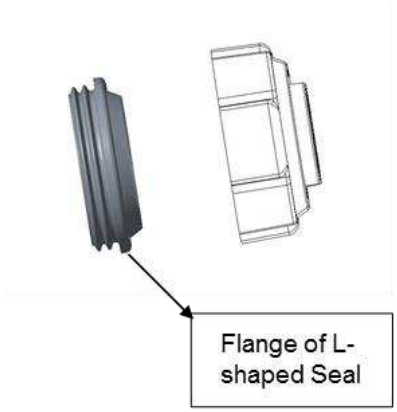


Figure 19a

Pass the cables through the DC area in the Cable Exit Combo 2303200-1 (figure 20).

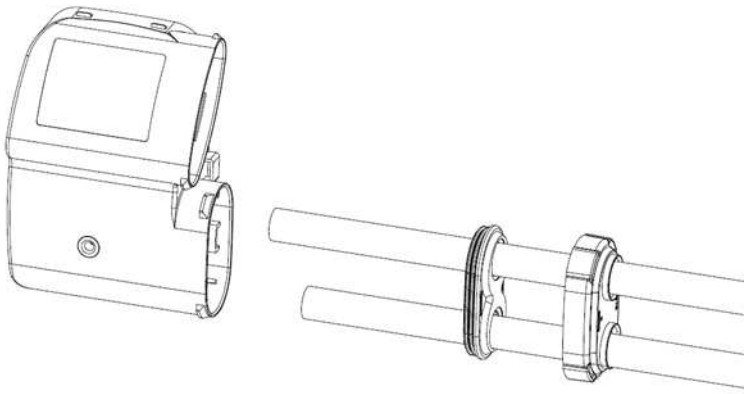


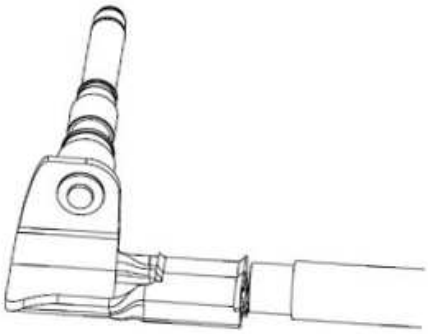
Figure 20

Step 7

Dismantle the wires and crimp the contacts: **50 mm² DC Power Cables.**

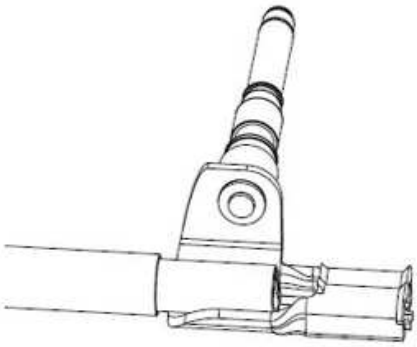
Dismantle single wires and crimp the contacts 2306177-1 according spec. 114-94436.

There is each one contact of these two configurations needed for each charge inlet, see figure 21.



Cable direction right

Figure 21



Cable direction left

Figure 21a

The cable configuration is different for the two cable exit versions acc. Chapter 7.3; for
- Cable direction RIGHT, figure 11b
- Cable direction LEFT figure 11a

see Figure 22 and Table 5

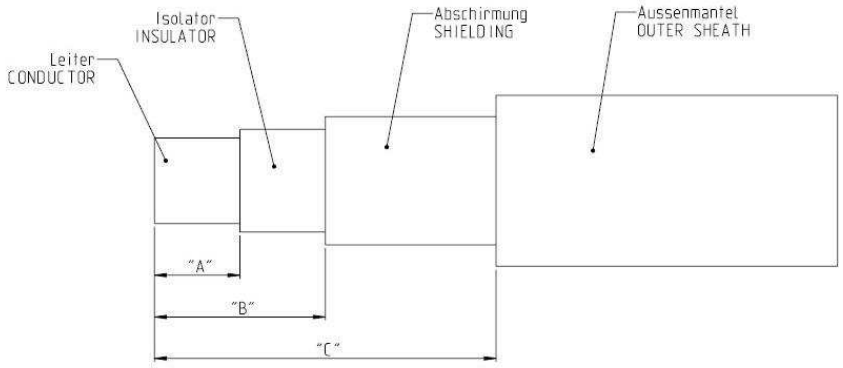


Figure 22

Dim	Cable direction RIGHT	Cable direction LEFT
Dim „A“	19 mm +/- 1mm	28 +/-1 mm
Dim „B“	29 mm +/- 1mm	63 +/-1 mm
Dim „C“	29 mm +/- 1mm	63 +/-1 mm

Table 5

For Charge Inlets with cable exit to the right (see figure 11), the crimps need to be arranged as shown in figure 23:

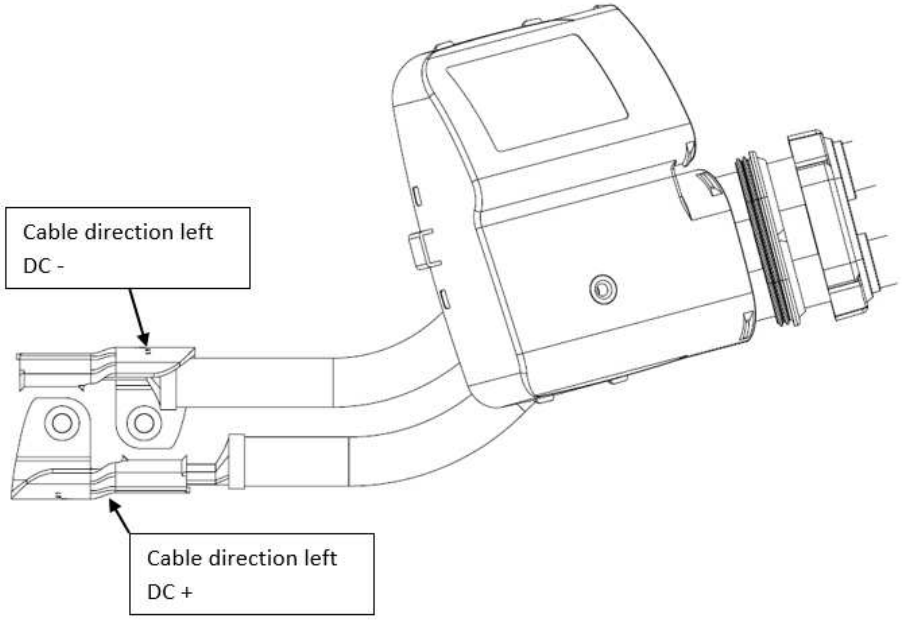


Figure 23

Step 8

Assemble the DC contact seals 2120571-1 on the DC contact assies. (figure 24). Pay attention to not damage the seal during handling. Make sure the seal does not twist or flip around, correct assembly is shown in figure 24a

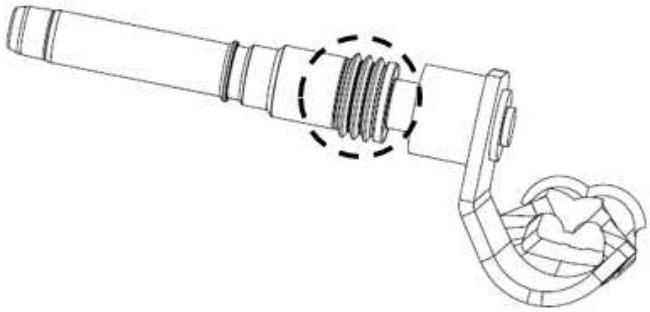


Figure 24

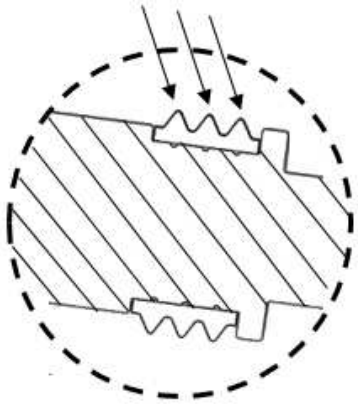


Figure 24a

Step 9

Pass the AC cable subassembly (figure 18) through the AC slot in Cable Exit 2303200-1 (figure 25).

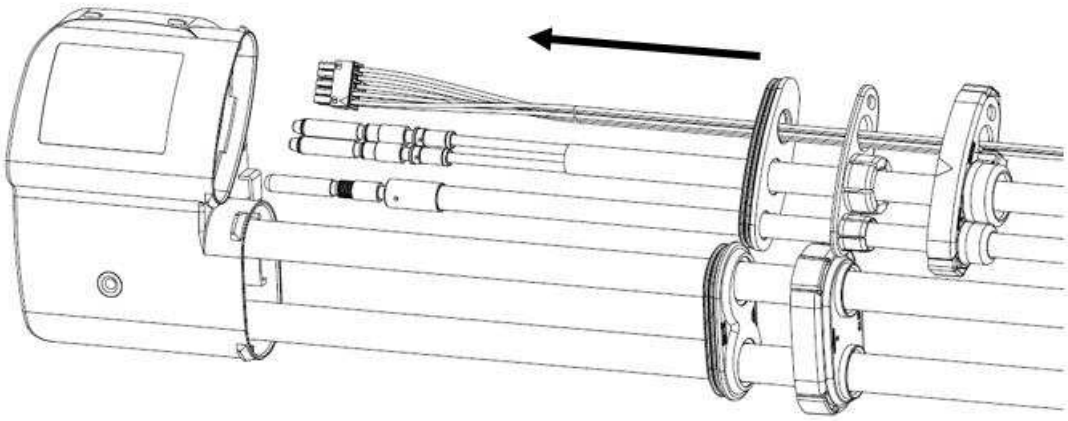


Figure 25

Step 10

Insert the Contacts from the backside into the Inlet Housing according the cavity description (see figure 26) into their locking position, see figure 27. To ensure that the contacts are correctly inserted, pull with a low force on the cables (max. 10N). Figure 27a shows contacts assembled in end position.

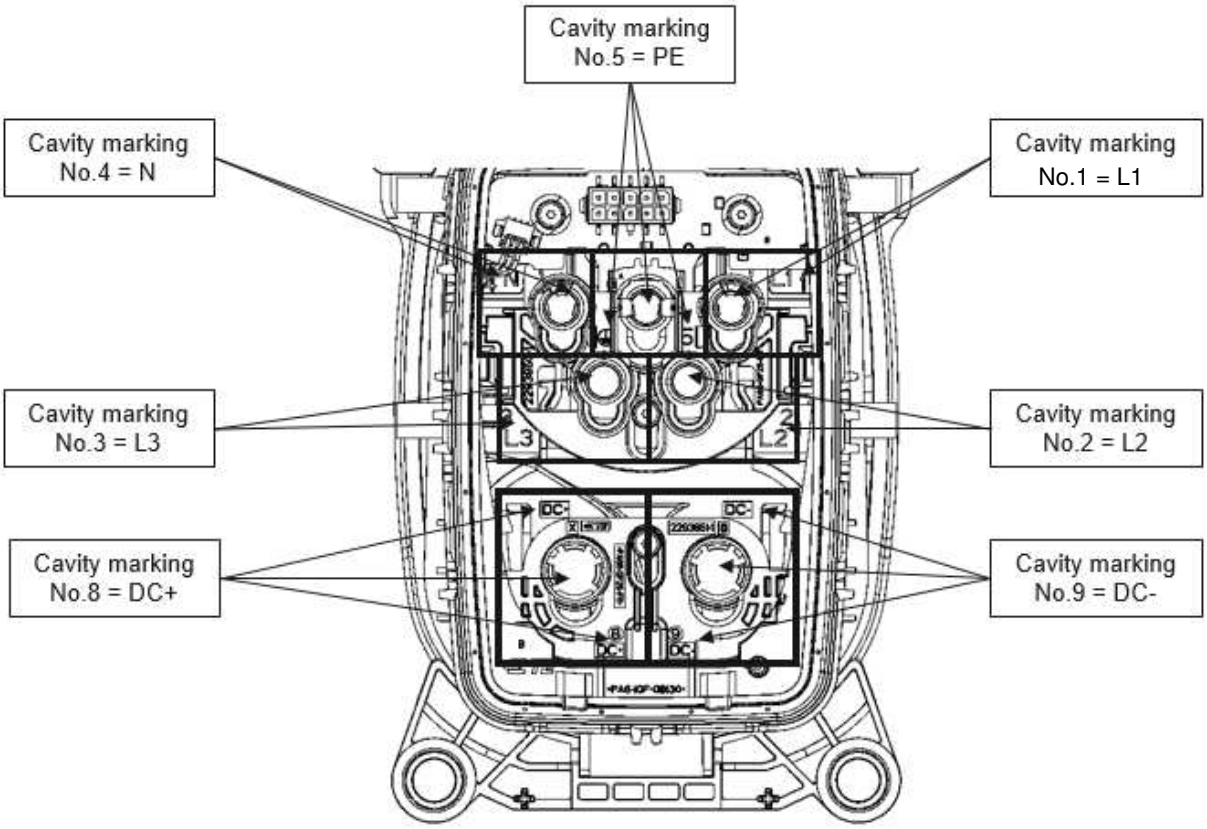


Figure 26

ATTENTION: The correct contact positions have to be ensured BEFORE pushing the contacts into locking their cavities in locking position.

In case of wrong positioning of the contacts the complete assembly has to be scrapped. There is no rework allowed (risk of damaging contacts and/or locking geometry in housing) !

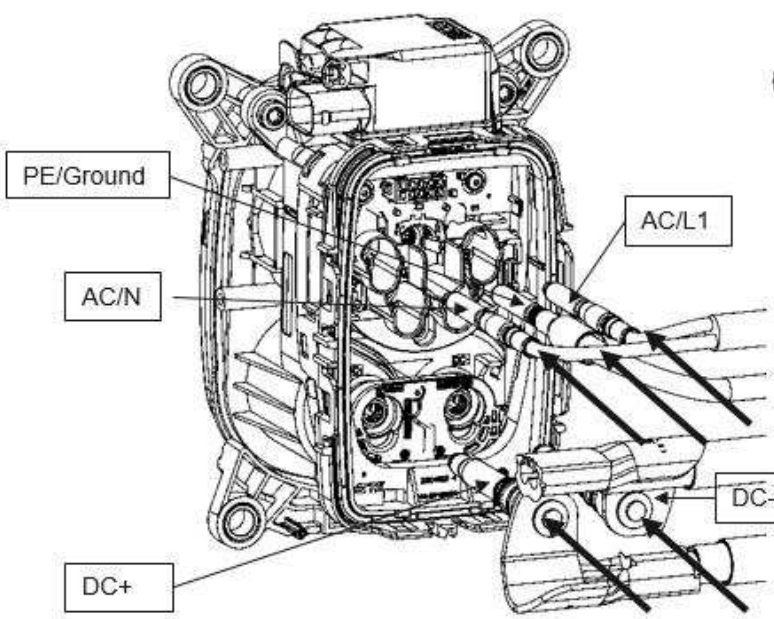


Figure 27

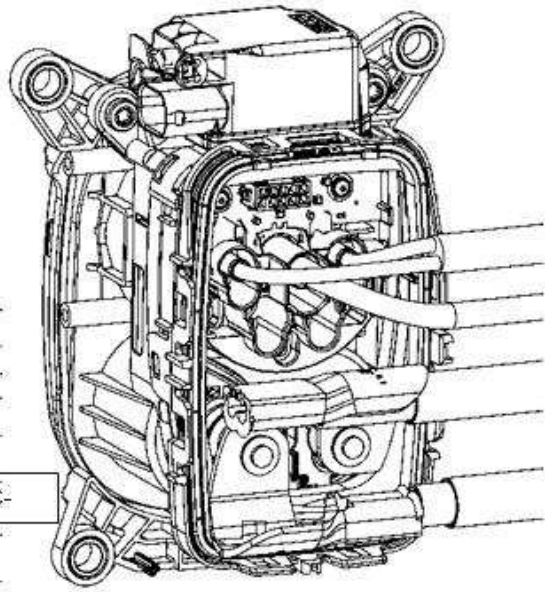


Figure 27a

Proposed sequence for contact insertion:
1.) 2x4mm² AC Power Cable with contacts into L2/N and L1 cavities
2.) 25mm² Ground Cable with contact into PE/ground cavity
3.) 2x 50mm² DC Power Cable with contacts into DC+ and DC- cavities

Step 11

After the contacts have been controlled for correct positioning and locking, both SECONDARY LOCKS have to be pushed upwards (Figure 28). Ensure that both latches are properly engaged with the inlet housing, which has to be controlled by the double audible click and by visible inspection. Secondary Locks in end position as shown in figure 29 and 29a

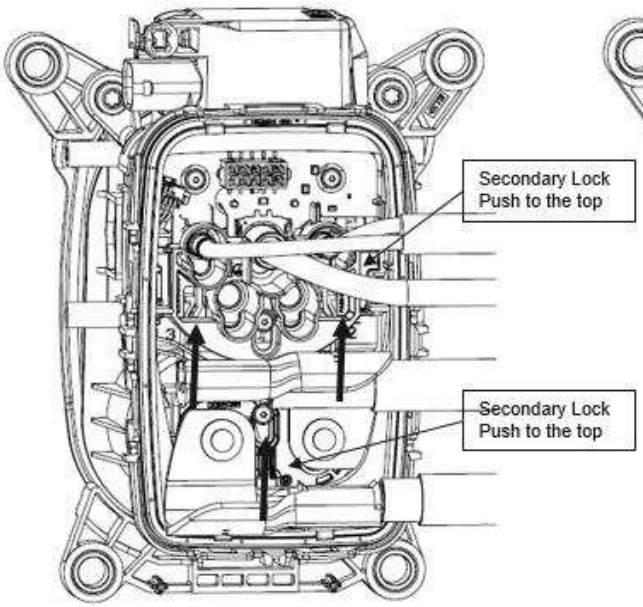


Figure 28

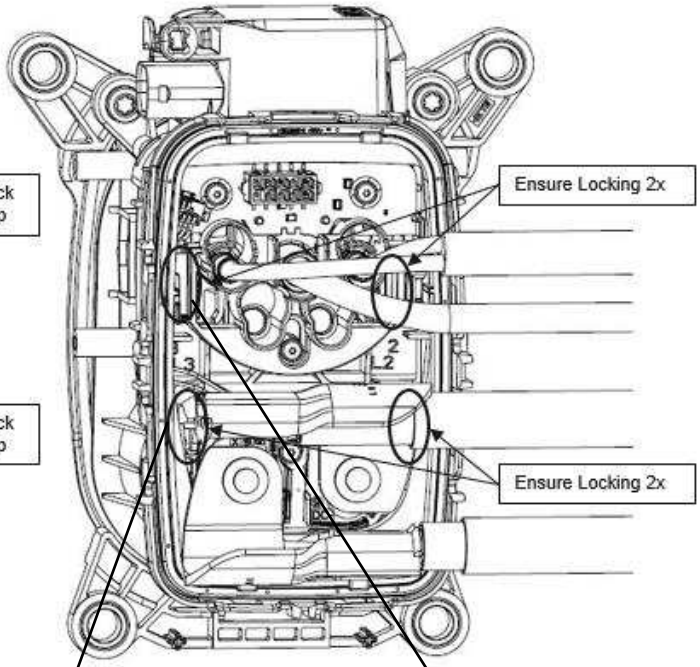


Figure 29

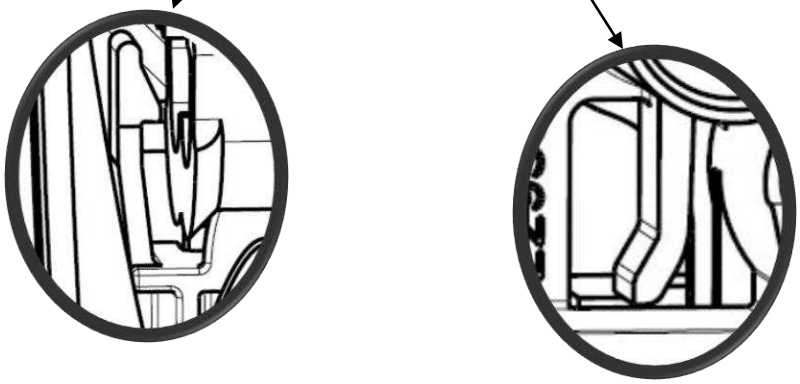


Figure 29a

Step 12

After the contacts have been locked with the SECONDARY LOCKS in both AC and DC area, the ADAPTER 2304812-1 with preassembled Peripheral Seals (1 seal rust red, 1 seal green) has to be pushed in lock position (Figure 30). The press force has to be applied on the marked locations on the surrounding collar to close the latches. Ensure that all 7 hooks are correctly engaged. (Figure 31).

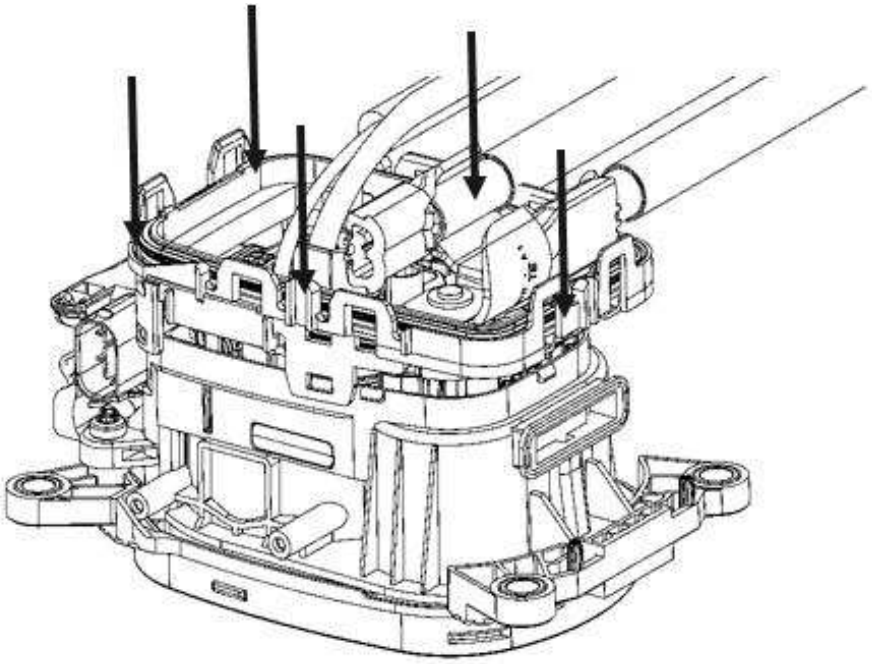


Figure 30

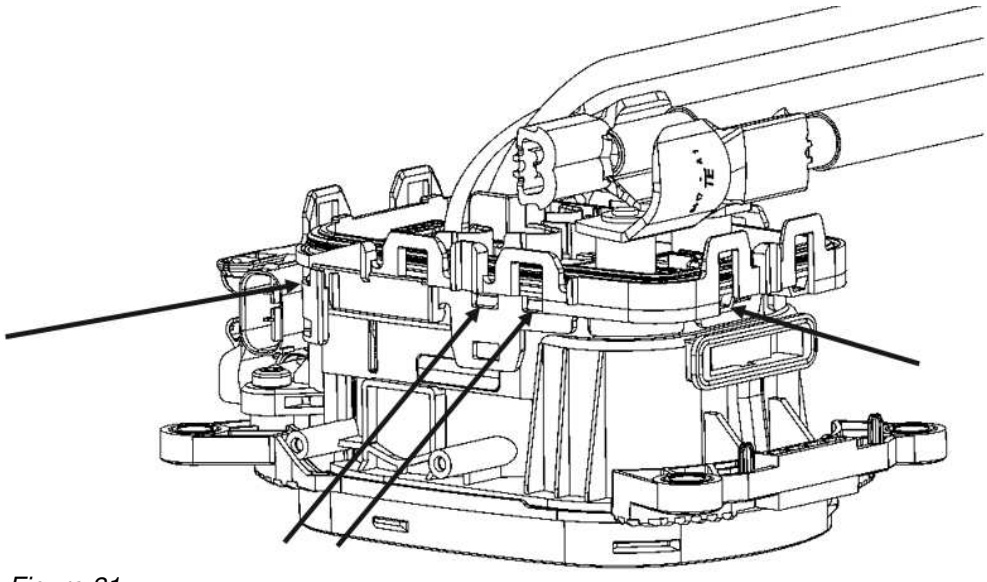


Figure 31

Step 13

Connect Micro Mate'N'Lock Connector to PCB-Header. Ensure the hook is properly engaged with the header, see figure 32.

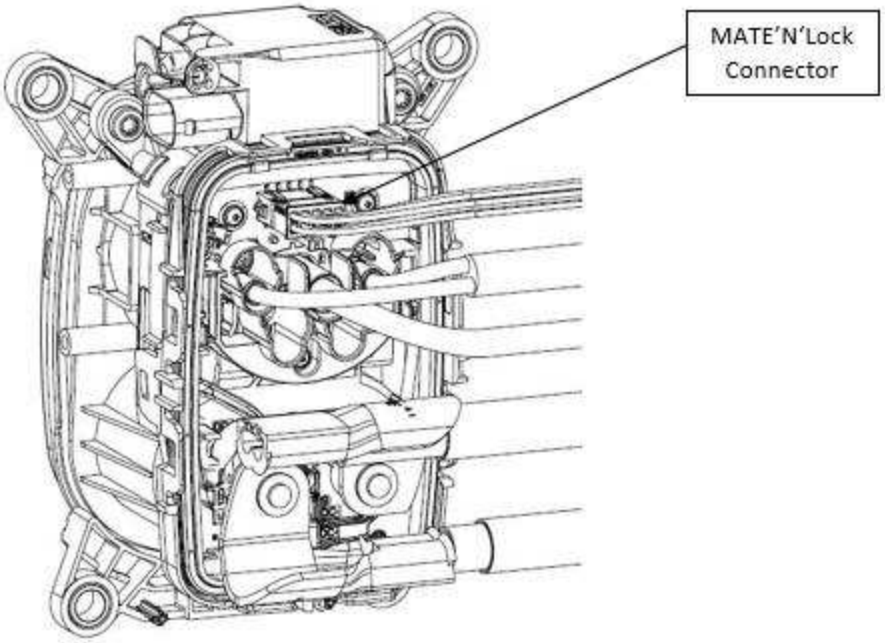


Figure 32

Step 14

Assemble the Cable Exit Cover 2302300-1 to the Inlet. Ensure that all 8 hooks are correctly engaged. (Figure 33). The press force has to be applied on the marked locations close to the latches, see figure 33a.
ATTENTION: The Cable Exit Cover 2303200-1 needs to be aligned properly over the inlet and pushed vertically into position to make sure the seal slips correctly into the seating all around (figure 34)

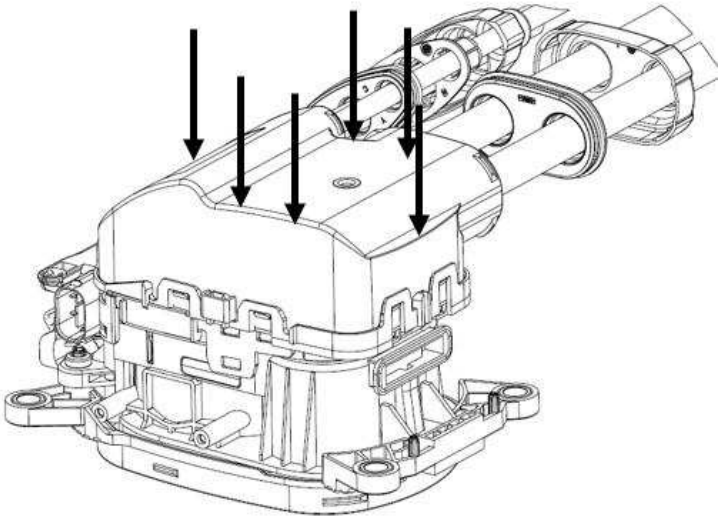


Figure 33

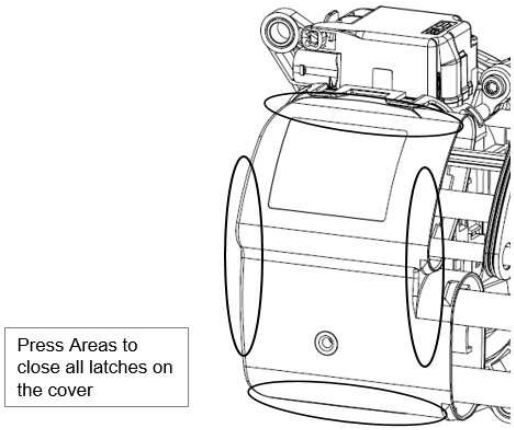


Figure 33a

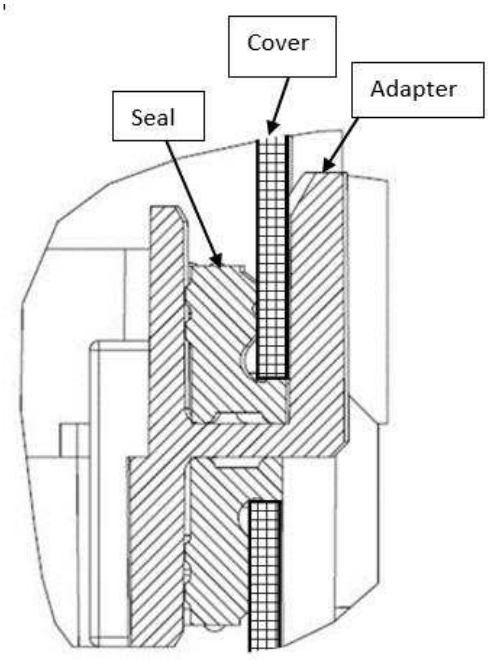


Figure 34

Step 15

Move the STRAIN RELIEF AC 2296056-5 together with FAMILY SEAL AC 2296040-6 into their position in the CABLE EXIT 2303200-1, see figure 35.

ATTENTION: Ensure that the AC-Multicore cable is well positioned in the FAMILY SEAL, that all seal lips are safely placed on the outer isolation of the cables. (Figure 36a)

Push the COVER CABLE SEAL AC 2296057-2 over it and snap it on the CABLE EXIT COVER 2303200-1. Ensure that both hooks are correctly engaged (double audible click), see figure 36a.

Move the FAMILY SEAL AC 2303206-4 into position in the CABLE EXIT 2303200-1 and snap the COVER CABLE SEAL DC 2303237-4 on the CABLE EXIT. Ensure that all hooks are correctly engaged (audible click), see figure 36b

ATTENTION: Ensure that the DC power cables are well positioned in the FAMILY SEAL, that all seal lips are safely placed on the outer isolation of the cables. (Figure 36b)

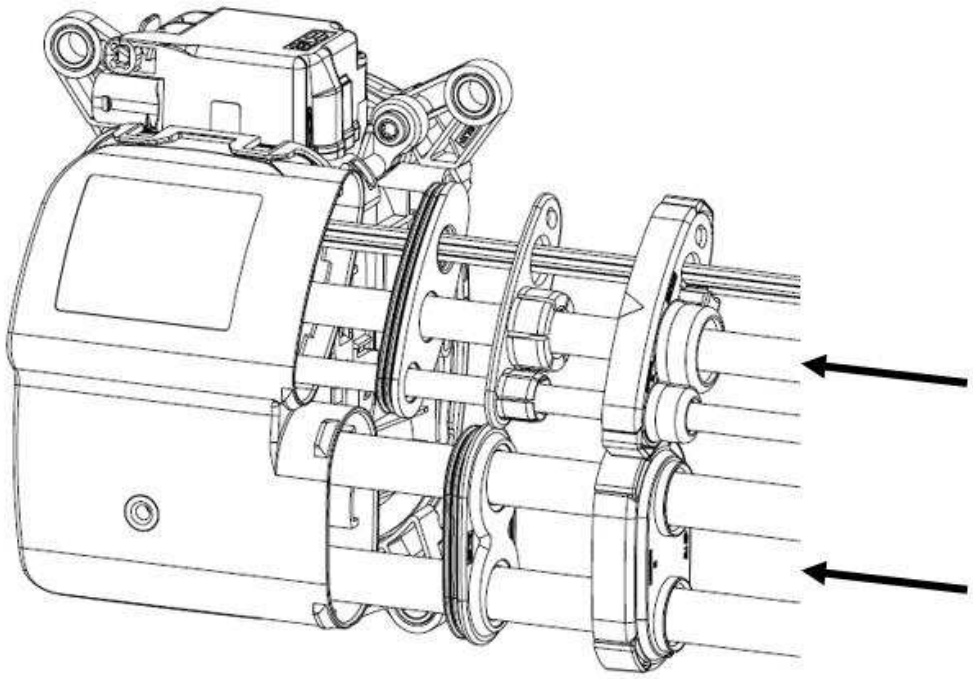


Figure 35

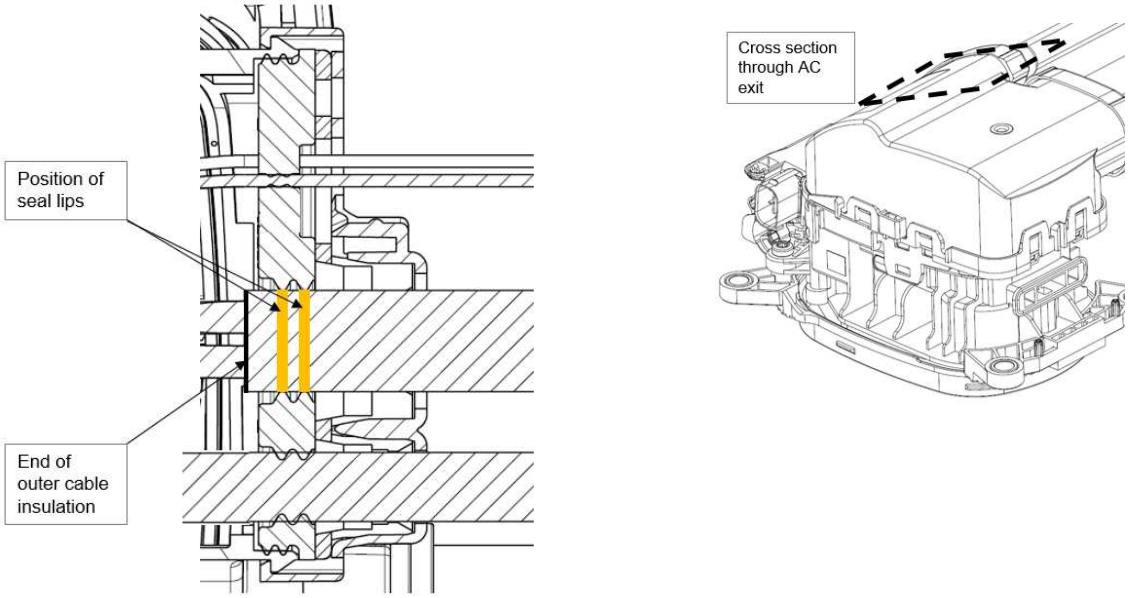


Figure 36a – AC seal lips

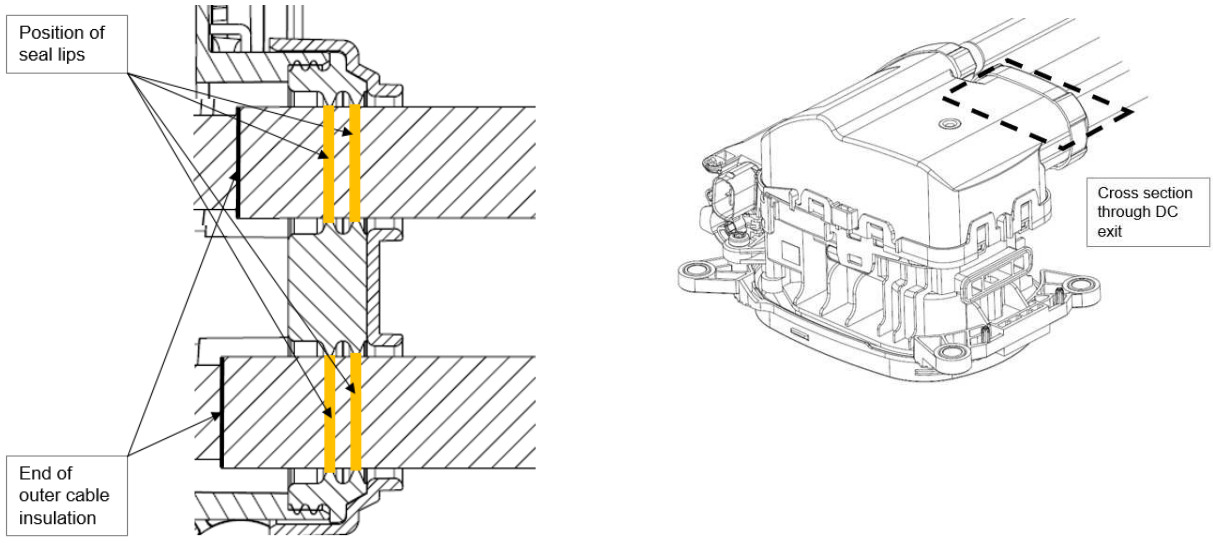


Figure 36b – DC seal lips

Step 16

Assemble Protection Cap 2292534-1 at Inlet Housing, see figure 37.

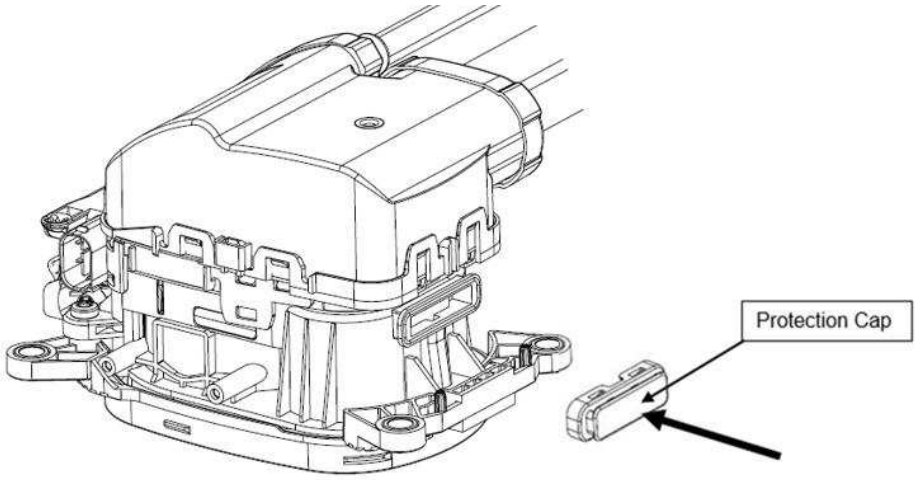


Figure 37

Step 17

Assemble the Pull Cable to the service unlock of the actuator. Move the metal ball through the centering hole on the actuator housing and snap it into the cylindric cavity of the service unlock, see figure 38

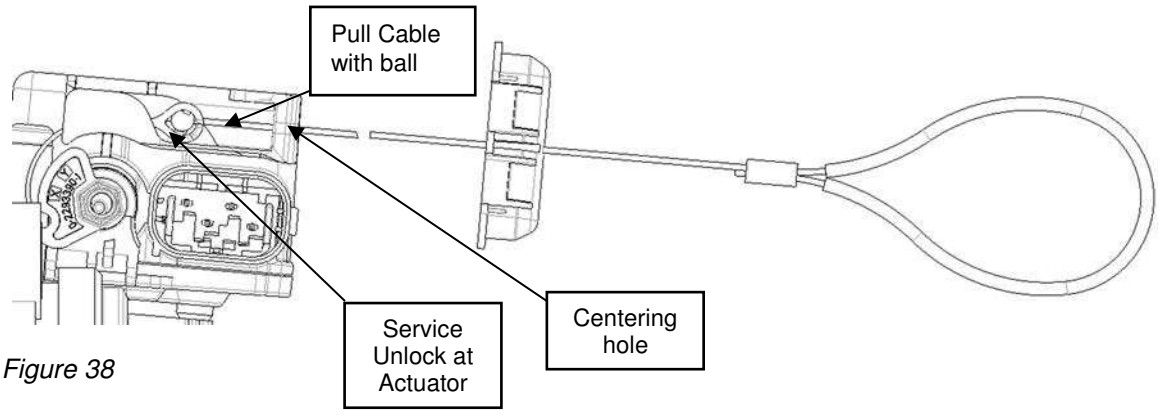


Figure 38

Step 18

As part of the End of Line Test as listed in Chapter 7.6), perform the tightness check of the fully assembled charge inlet. The pressure port on the rear of CABLE EXIT COVER 2303200-1(shown in figure 39) is designed to fit an elastic plastic tube (Polyurethan or similar) with an outer diameter of 4mm.

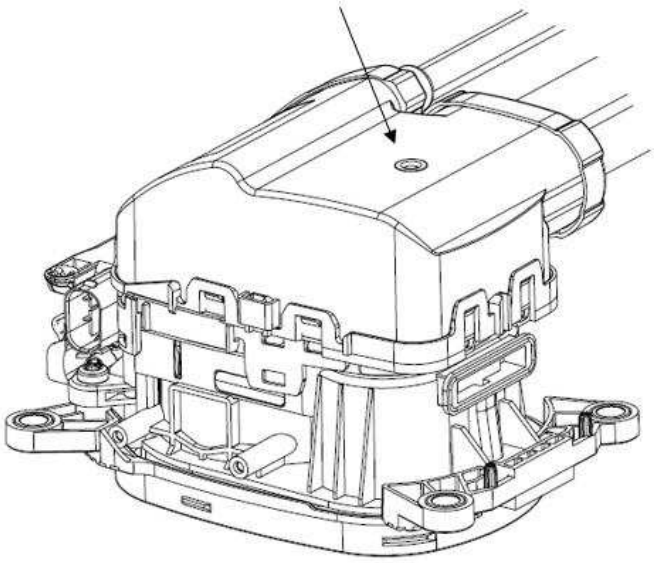


Figure 39

The tubular geometry of the pressure port has a reduced inner diameter towards the bottom to increase the pressure on the elastic tube when being inserted. The tube needs to be pushed that far into the pressure port that a sufficient air tightness can be achieved, see figure 40 for exemplarily inserted tube.

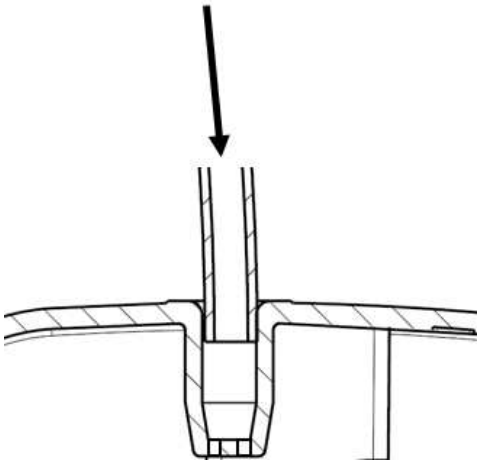


Figure 40

For the tightness check it is intended to perform an air differential pressure decay leak measurement test. Pressure profile is 0,1…0,15 bar, preferably under pressure. Acceptance criterion is pressure loss over time and has to be defined based on particularly prepared failure test samples

After successfully passed tightness check the pressure port needs to be closed with the MQS CAVITY PLUG The MQS CAVITY PLUG needs to be FULLY inserted into the pressure port, see figure 41. The bottom of the pressure port is closed with a cross geometry to avoid that the MQS Cavity Plug could be pushed through.

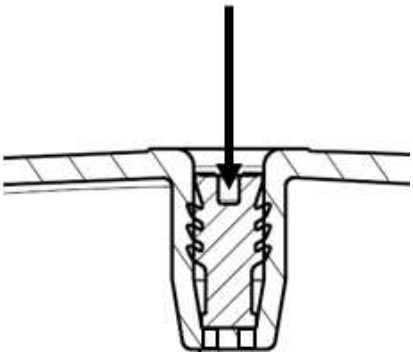


Figure 41

Step 19

For identification apply the label on this specified polished face on the CABLE EXIT, see figure 42. The label needs to include information acc. requirements of IEC 62196-x and IEC 61851. Also information acc. to customer requirements can be applied here.

Marking acc. IEC62196-3:

Manufacturer‘s name or trademark	XXXXX
Type reference or identification number	Art.: XXXXXXX
Rated Current(s), maximum Voltage(s) and Frequency	Max. 32A, 250V~ 50-60Hz / Max. 250A 650V
Number of Phases	3L / N / ⏚ / DC+ / DC- ⎓
Degree of protection	IP67, IP55 closed

There may apply additional national marking requirements, depending on the market/country the car will be configured for. Also information acc. to customer requirements can be applied here.
As a compatible label TE p/n 5-1768421-9 is recommended.

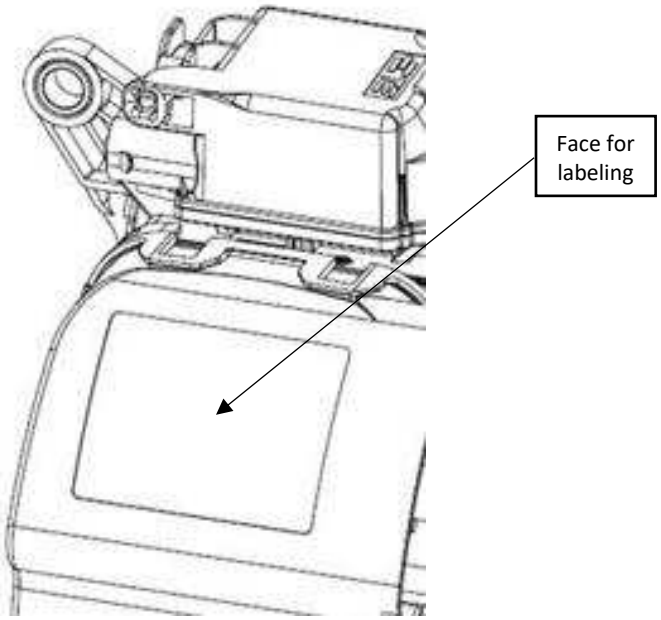


Figure 42

7.6. End of Line Test

The assembled Charge Inlet has to be tested electrically and mechanically to applicable requirements, including High Voltage test.

As a minimum, following tests have to be performed:

- Isolation Resistance:
  Test Voltage: 500VDC
  Inspection Duration: 1s
  min. Riso: 200MOhm
  pin-to-pin, excluding CP-to-Proxi and CP/Proxi-to-Ground
  a) L1 versus N
  b) L1+N versus Ground
  c) L1+N versus AC multicore shield

- Dielectric withstand voltage:
  Test Voltage: 2000VAC
  Inspection Duration: 1s
  max. Leakage current: 10mA
  pin-to-pin, excluding CP-to-Proxi and CP/Proxi-to-Ground
  a) L1 versus N
  b) L1+N versus Ground
  c) L1+N versus AC multicore shield

- Correct Pinning of all Contacts

- Check seals for correct seating by Tightness Check of completed Charge Inlet Harness Assy (Air pressure test)

- Check correct assembled MQS Cavity Plug in the pressure port after Tightness Check.

- Gauge check of geometrical interface acc. IEC62196-3.

- Functionality check of actuator. Drive (first) in lock and (second) in unlock position. During this operation, the actuator pull ring / pull cable becomes pulled back in end position.

LTR	REVISION RECORD	DWN	APP	DATE
1	INITIAL DOCUMENT	P. KOWARSCH	D. WEYRAUCH	31AUG2017
2	UPDATE DC CONTACT SEAL	D. WEYRAUCH	D. WEYRAUCH	15DEC2017
A	EXPLANATION OF EOL PRESSURE TEST AND ADDITION OF CAVITY PLUG. UPDATE TO LATEST DESIGN LEVEL	D. WEYRAUCH	F. WITTROCK	05JAN2018
A1	LABEL CONTET DEFINED ACC. IEC	M. STEIN	S. KUMAR	14SEP2020
A2	MODIFICATION OF CONTACT 25MM2 PE	J. NECAS	S. KUMAR	23AUG2022
B	MODIFICATION OF CONTACT 25MM2 PE UPDATED CHAPTER 3, TABLE 1. CRIMP IMAGE ADDED	R. VIGNESH	J. NECAS	02NOV2023

DRW P. KOWARSCH 31AUG2017	TE CONNECTIVITY GERMANY GMBH AMPÈRESTRAßE 12-14 D-64625 BENSHEIM GERMANY		
CHK D.WEYRAUCH 31AUG2017			
APP F. WITTROCK -	NO 114-94505	REV B	LOC AI
TITLE	Application Specification Vehicle Charge Inlet Type COMBO 2 acc. IEC62196-3		