



European Organization for Nuclear Research

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Assembly of the Ventilation System for ATLAS Racks

Abstract

This document defines the assembly procedure for the plastic tangential turbine ventilation chassis developed for the ATLAS rack cooling system. It includes component identification, required tools, consumables, orientation conventions, assembly and disassembly procedures, and inspection checkpoints.

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1 Purpose and Scope

1.1 Purpose

The purpose of this document is to define the assembly procedure for the tangential turbine ventilation chassis used in the ATLAS rack cooling system.

1.2 Scope

This document includes:

- Component identification;

- Required tools and consumables;
- Orientation convention for Case A, Case B, CW and CCW turbine wheels;
- Chassis preparation;
- Motor refurbishment procedure;
- Turbine assembly procedure;
- Final chassis assembly procedure;
- Inspection checklist;
- Disassembly procedure for existing units to be refurbished.

This document does not include detailed electrical schematics, procurement procedures, or final operational qualification.

2 Safety Considerations

Appropriate Personal Protective Equipment should be used throughout the procedure (e.g. gloves).

To minimize ergonomic risks during assembly and maintenance activities, operators should ensure that the workstation layout, working height, and body posture comply with Ergonomic Recommendations.

Personnel should perform a Risk-Assesment before starting any task and implement appropriate preventive measures, this hyperlink can be used to access a template.

Overall, all assembly and maintenance activities should be performed in accordance with CERN General Safety Fundamentals.

3 Component Identification

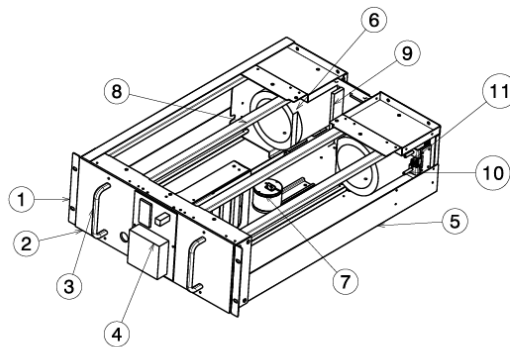
This section identifies the main components used for the assembly. All components shall be visually checked before starting the procedure.

Component	Description	Qty.	Supplier
Chassis	Main structural support of the ventilation assembly	1	Rack Peruzzi / Verotec
Plastic tangential turbine wheel, CW	Clockwise turbine wheel	1	Longwell: LW81*420/500-01
Plastic tangential turbine wheel, CCW	Counter-clockwise turbine wheel	1	Longwell: LW81*420/500-02
Motor/case assembly	Refurbished motor installed in turbine case	2	Reuse - Ziehl Abegg
6000ZZ bearing	Bearing installed on turbine shaft and motor lower side	4	CERN Store:23.01.07.210.6
608ZZ bearing	Bearing installed on motor upper side	2	CERN Store:23.01.01.231.5
Spring	Axial preload spring	2	Acxess Spring: PC032-390-6500-SST-0778-CG-N-IN
Washer	Washer installed above the spring	2	Bossard: 1964518
Starlock washer	Washer reused from existing motor	4	Reuse
Circlip	Retaining ring installed on motor shaft	2	Bossard: 1287176
Rubber bearing seal	Bearing support seal recovered from disassembled turbine assemblies	2	Reuse
Rubber damper	Vibration isolation element installed on the stand assemblies	16	Rack Peruzzi: Comes within stand assembly
Wieland male connector	Electrical connector installed on the connector plate assembly	2	Wieland
Front stand assembly with handle	Front support stand assembly equipped with handle and rubber dampers	4	Rack Peruzzi

Component	Description	Qty.	Supplier
Rear stand assembly	Rear support stand assembly equipped with rubber dampers	2	Rack Peruzzi
Rear stand assembly with connector plate	Rear support stand assembly equipped with connector plate, Wieland connector and rubber dampers	2	Rack Peruzzi
Motor shield	Protective cover for the motor assembly	2	-
Auxiliary card shield	Protective cover for the auxiliary card	1	-
Auxiliary card	Control electronics card	1	-
Capacitor	Capacitor recovered from disassembled units	2	Reuse
Cabling	Cable connections of the chassis	-	-
Various screws	Existing fasteners reused from original assemblies, replace if damaged.	-	Reuse

Assembly Configuration Note

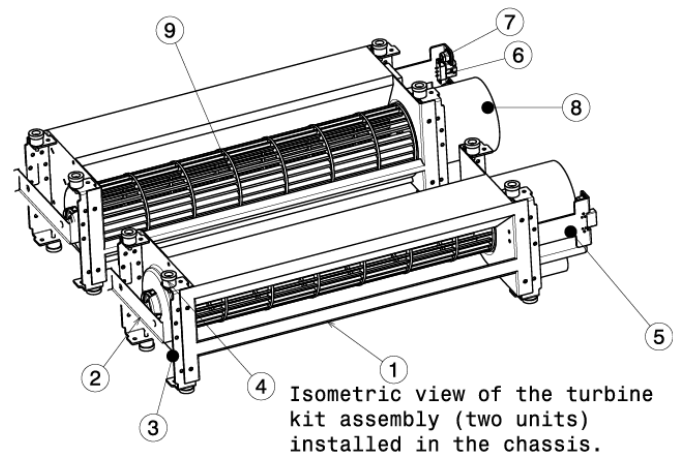
- Each turbine case is equipped with four stand assemblies.
- Each stand assembly is equipped with two rubber dampers.
- The front stand assemblies are supplied with pre-riveted handles.
- Rear stand assemblies are equipped with one rear stand assembly and one rear stand assembly with connector plate.
- For Case A, the rear stand assembly with connector plate shall be installed on the right side, when viewed from front.
- For Case B, the rear stand assembly with connector plate shall be installed on the left side, when viewed from front.
- The rubber bearing seals and capacitors are recovered from disassembled units and shall be visually inspected before reuse.
- The connector plate and Wieland male connector are assembled together prior to installation on the rear stand assembly.



Internal isometric view of the chassis assembly

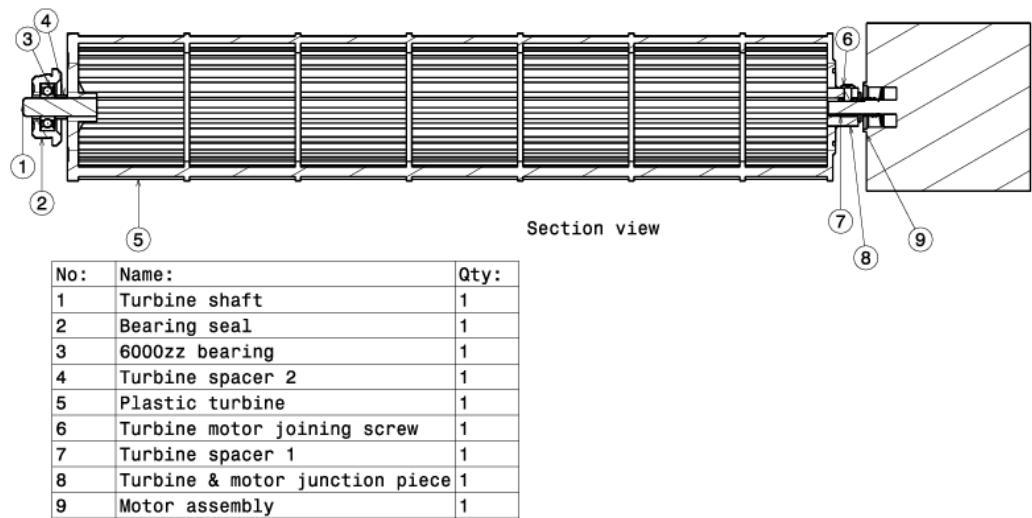
Chassis BOM (critical components only)		
No.	Name	Qty.
1	Rack installation panel	2
2	Front panel	1
3	Chassis handle	2
4	Monitoring card (MON Card)	1
5	Chassis (including sub-panels)	1
6	Shielding for the motor	2
7	Shielding for the Aux card	1
8	Rails for the turbine kit	8
9	Back card	1
10	Alignment pins for the turbine kit	4
11	Wieland female electrical connector	2

Figure 1: Overview of the main components. - Chassis



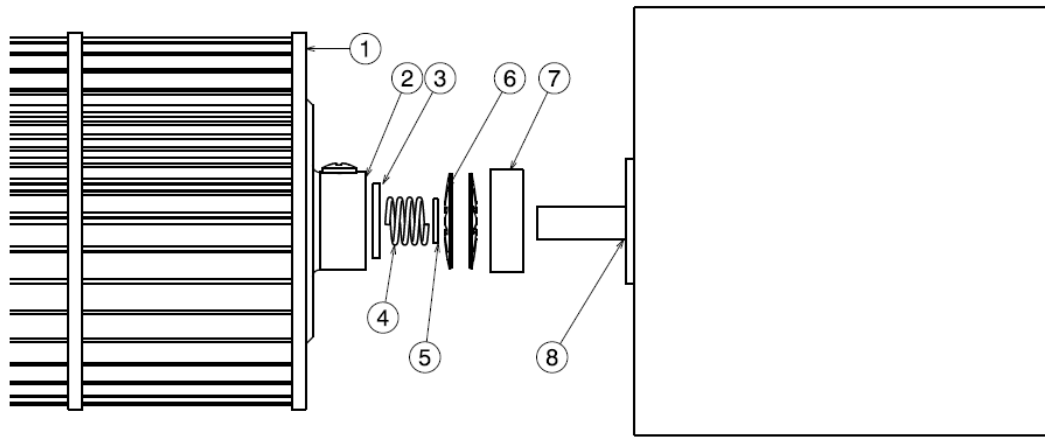
BOM for the turbine kit assembly of one chassis (excluding turbine & casing joining components)		
No:	Name:	Qty.:
1	Case of the turbines	2
2	Handle of the case	2
3	Stands	8
4	Vibration dampers	16
5	Mounting plate for Wieland male connector	2
6	Wieland male electrical connector	2
7	Bushing for alignment pins	4
8	Electric motor	2
9	Tangential turbine wheel	2

Figure 2: Overview of the main components - Turbine Kit.



No:	Name:	Qty:
1	Turbine shaft	1
2	Bearing seal	1
3	6000zz bearing	1
4	Turbine spacer 2	1
5	Plastic turbine	1
6	Turbine motor joining screw	1
7	Turbine spacer 1	1
8	Turbine & motor junction piece	1
9	Motor assembly	1

Figure 3: Overview of the main components - Turbine/Motor Interface



No:	Name:	Qty.:
1	Plastic turbine	1
2	Turbine & motor junction piece	1
3	Flat washer	1
4	Compression spring	1
5	Circlip	1
6	Starlock washer	2
7	608zz bearing	1
8	Motor	1

Figure 4: Overview of the main components - Motor

4 Required Tools

Tool / Equipment	Purpose	Supplier
Screwdriver set	Removal and installation of screws	-
Torque screwdriver	Controlled tightening at 0.5 Nm and 1.5 Nm	-
Bearing extractor kit	Extraction of used 608ZZ and 6000ZZ bearings from the motor	Mabeo: 1254733
Press	Pressing new 608ZZ and 6000ZZ bearings into position	Galaxus: 144-555
Special pressing bars	Bearing installation; use the smaller bar (21 mm ± 0.2 diameter) for 608ZZ and the larger bar (25 mm ± 0.2 diameter) for 6000ZZ	Custom made
Special hollow bar	Pressing the circlip into its groove on the motor shaft	Custom Made
Circlip pliers	Removal and installation of circlips	-
Drill	Removal of riveted stands from old turbine cases	-
Riveting gun	Installation of sheet metal parts to the turbine case	-
Soft-faced hammer	Gentle release or closure operations without damaging components	-
Pliers	Bending of the case clips	-
Cleaning cloth	Cleaning of reused parts	-

5 Consumables

Consumable	Use	Supplier
Loctite 638	Bonding of turbine spacers and 6000ZZ bearing to the turbine shaft	Mabeo: 126599D
Cleaning spray / degreasing agent	Cleaning of old motor and case components	RS:146-8383
Lubricant	Light lubrication of shaft and bearing contact surfaces	RS:339-123
Lint-free cloth	Cleaning without leaving fibers or debris	-
Spacer / shim material	Elimination of gaps between dampers and chassis, if required	-

6 Orientation Convention

Before assembly, the orientation of the turbine wheels and cases shall be confirmed. Identification of Case A and B is visible on the stickers of the cases as shown below:



Figure 5: Identification of Case A, Case B.

- Case A receives the CCW turbine assembly.
- Case B receives the CW turbine assembly.

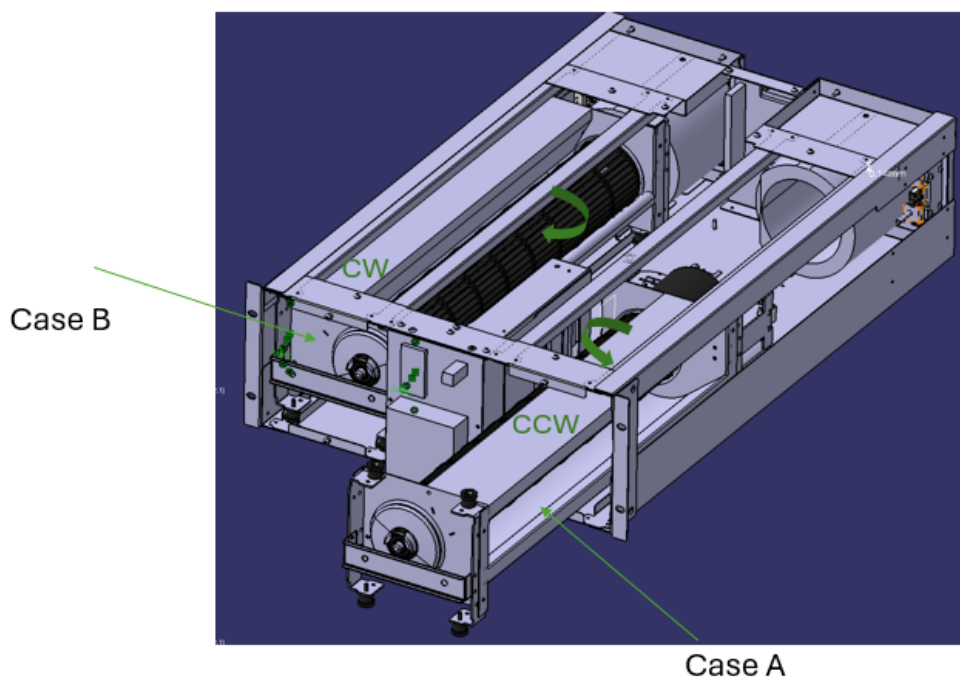


Figure 6: Case A, Case B, CW and CCW orientation convention.

7 Disassembly Procedure for Existing Units to be Refurbished

This procedure describes the recovery of reusable components from existing chassis units to be refurbished.

1. Place the chassis on its side and unscrew the indicated screws from the bottom plate.



Figure 7: Removal of bottom plate screws [1].

2. Place the chassis on its bottom and unscrew all screws from the top plate.

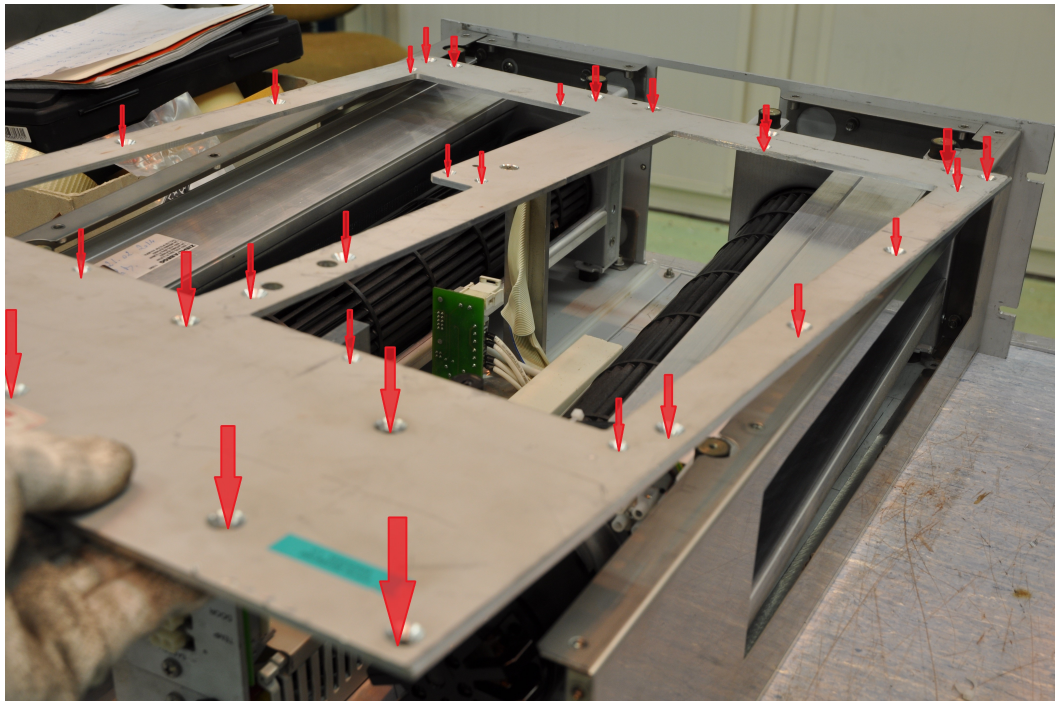


Figure 8: Removal of top plate screws [1].

3. Unscrew the grid screws at the rear end of the chassis and remove the grid.



Figure 9: Removal of rear grid screws [1].

4. Remove the motor shields.

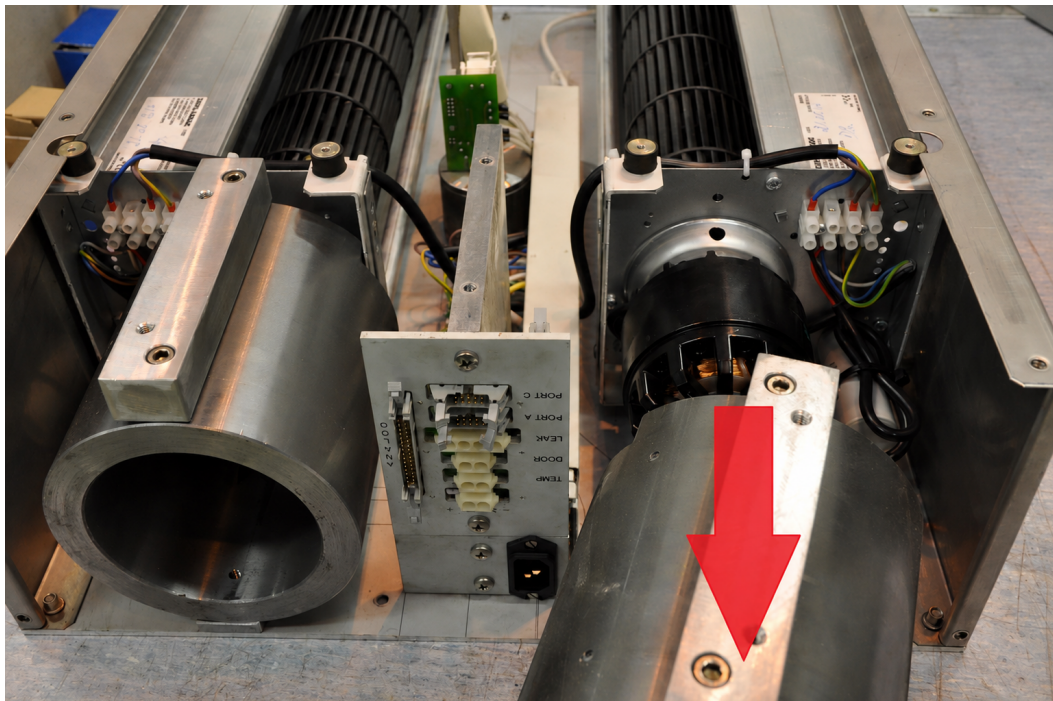


Figure 10: Removal of motor shields [1].

5. If the capacitors are attached to the chassis, remove them and set aside for reuse.

6. Disconnect the chassis-case cable connections and cut the present cable ties.

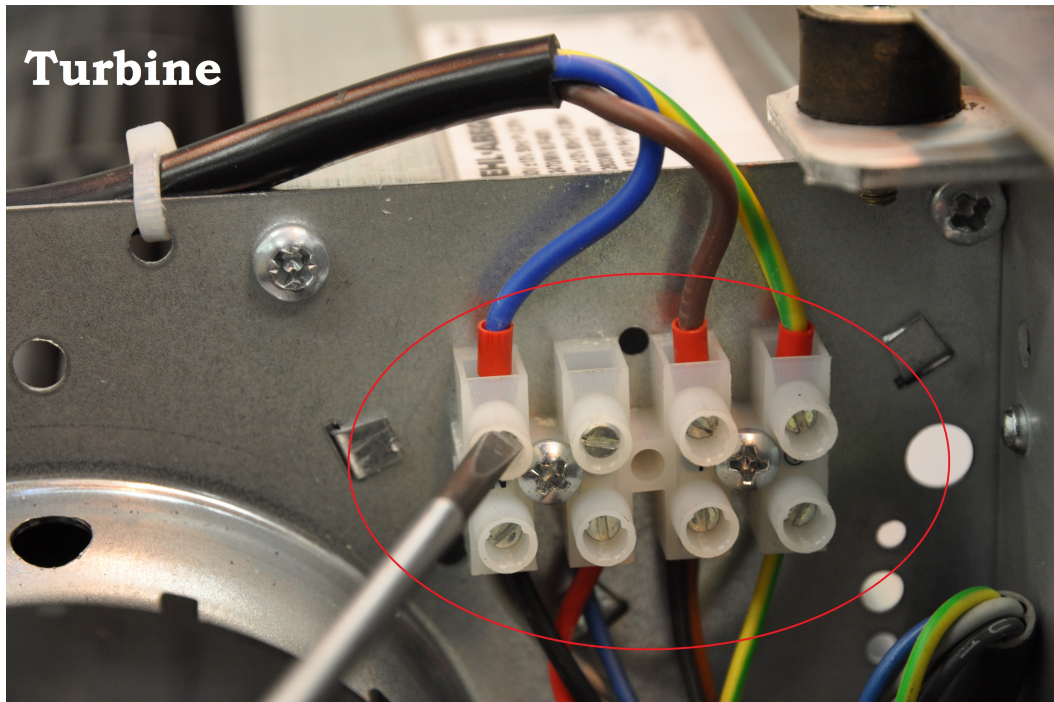


Figure 11: Removal of case-chassis cable connections [1].

7. Remove the individual turbine case assemblies from the chassis.

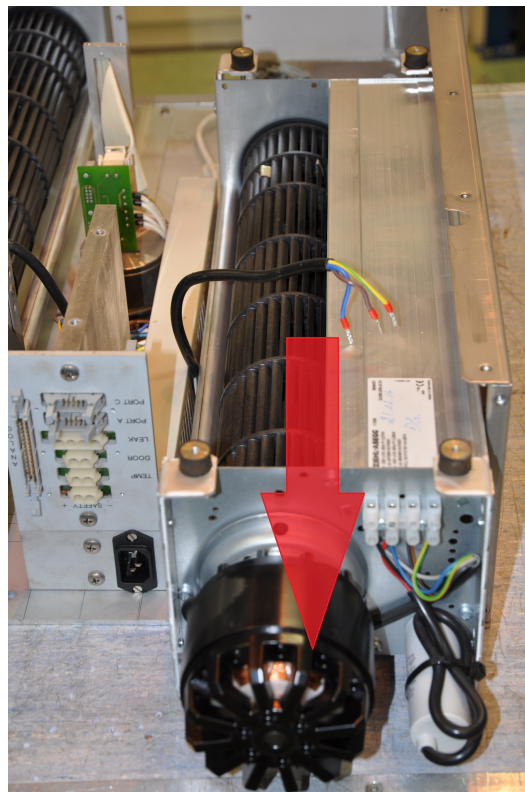


Figure 12: Removal of turbine case assemblies [1].

8. Drill out the rivets of the front-face stands on the turbine case, $\text{Ø}4.1\text{mm}$ drill tip, 4 per case. Do not drill out the motor-side stands at this stage to avoid damaging the motor.



Figure 13: Drilling out front-face stand rivets.

9. Using the shown hole on the case, unscrew the turbine joint screw from the motor shaft.

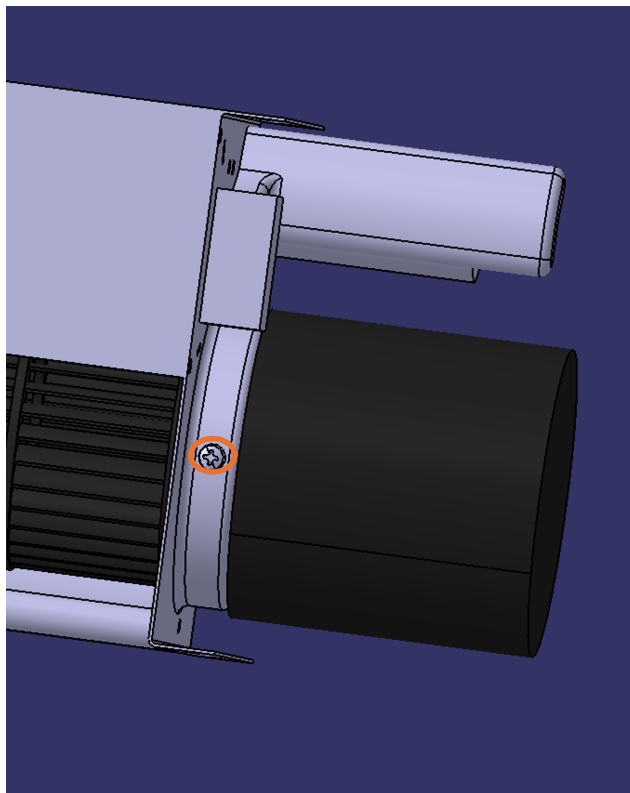


Figure 14: Removal of turbine-motor joint screw.

10. Remove the front face of the case by removing the 6 screws (illustrated in orange), and bend the closed clips(illustrated in green) open to approximately 90 degrees. Remove the front face of the case and set it aside for reuse. Remove the turbine from the case.

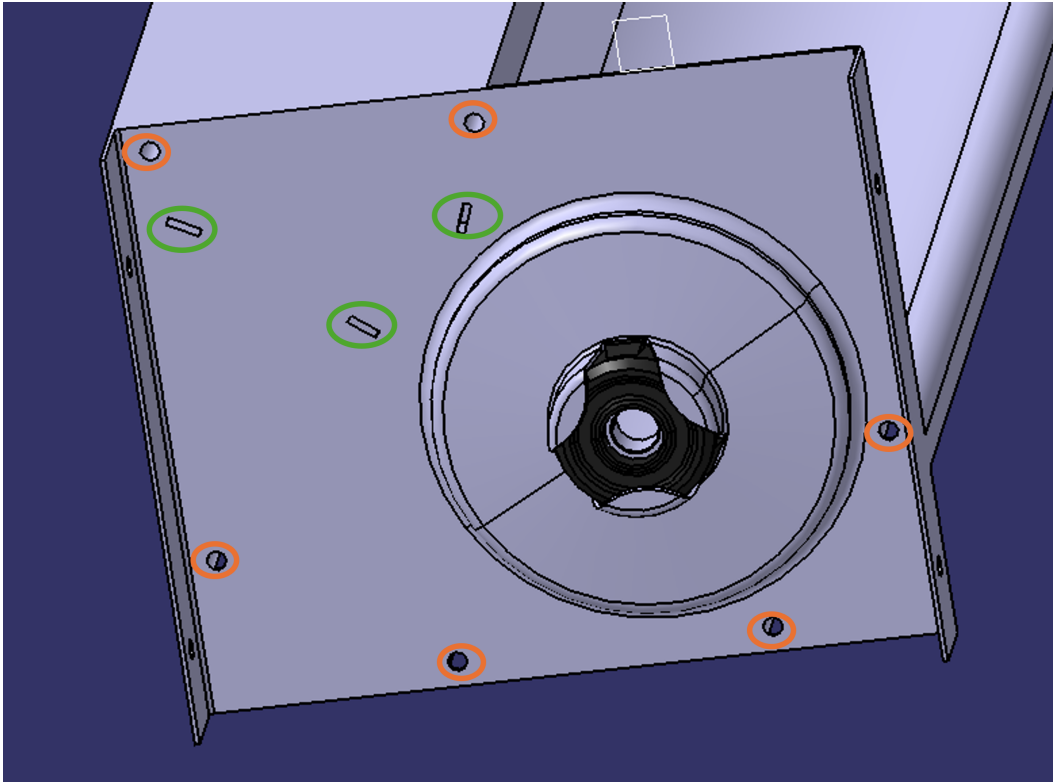


Figure 15: Removal of case's front face.

11. Remove the motor from the case by unscrewing the required screws (shown in orange) and set it aside for refurbishment. Remove the terminal block by unscrewing its 2 screws.

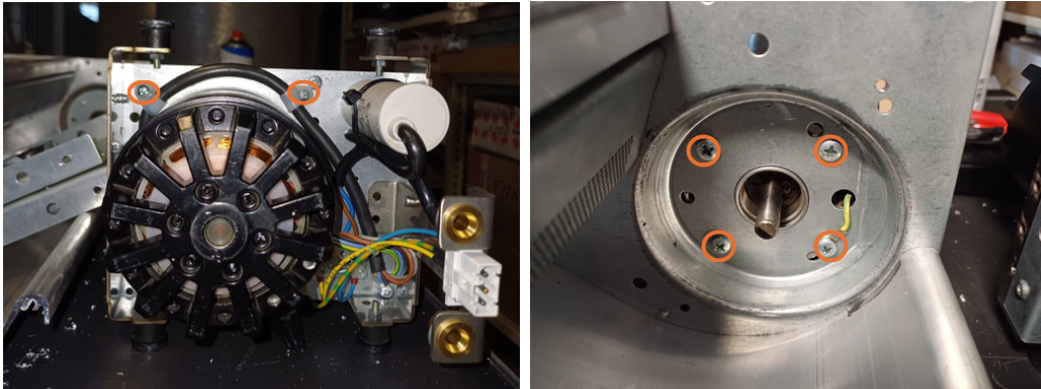


Figure 16: Removal of motor from existing case.

12. If the case has an attached capacitor remove it before drilling.
13. Drill out the rear-end stands after the motor has been removed, Ø4.1mm drill tip, 4 per case.

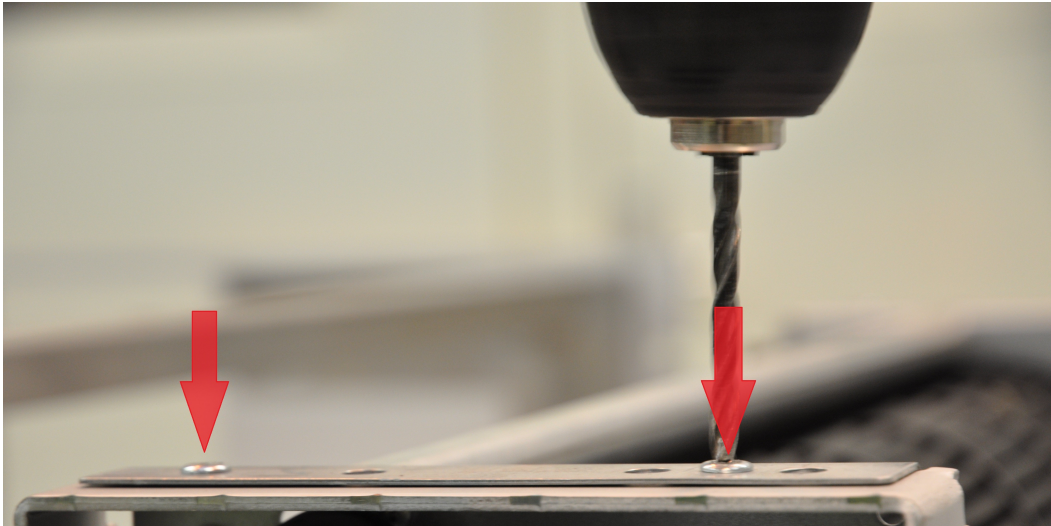


Figure 17: Drilling out rear-end stands [1].

14. Clean the case thoroughly using a cloth and a suitable cleaning agent. Set aside the cases for motor insertion.

8 Motor Refurbishment Procedure

1. Obtain two old motors and the corresponding capacitors extracted from the chassis/turbines to be refurbished.



Figure 18: Example old motor and capacitor to be refurbished.

2. From one motor, remove the spring and washer. Then remove the circlip using circlip pliers and remove the starlock washers. Clean and set aside the starlock washers for reuse.

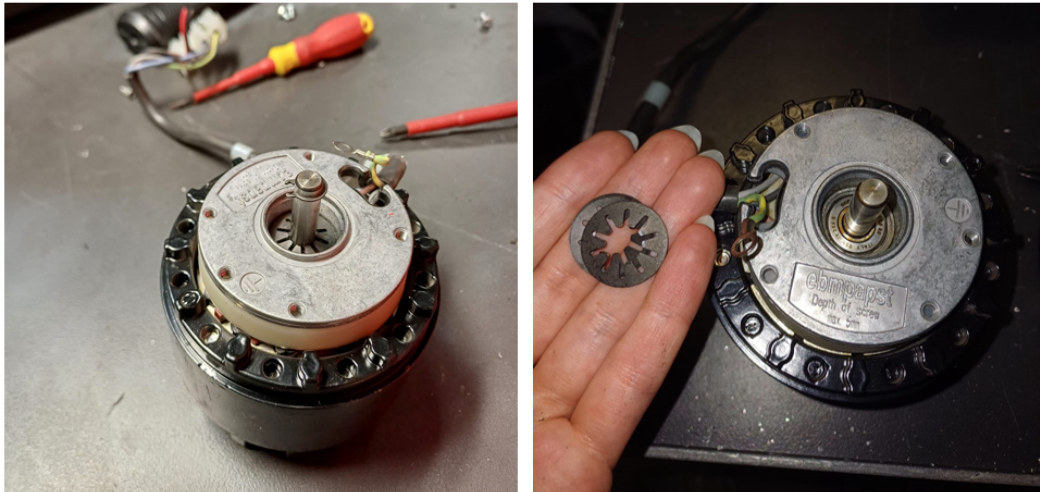


Figure 19: Removal of spring, washer, circlip and starlock washers.

3. Turn the motor upside down and try to pull out the inner motor assembly. If it cannot be removed manually, carefully tap the rear side of the black motor shell using a soft-faced hammer until the inner assembly is released.



Figure 20: Removal of the inner motor assembly from the black motor shell.

4. Once the inner motor assembly is removed, use the bearing extractor kit to remove the 608ZZ bearing from the upper side and the 6000ZZ bearing from the lower side.



Figure 21: Extraction of the 608ZZ (Upper side) bearing.

5. Clean the inner motor assembly using a lint-free cloth and a suitable cleaning spray or degreasing agent. Remove dirt, old lubricant residues, and debris before reassembly.
6. Obtain new 608ZZ and 6000ZZ bearings. Press them into their original positions using a press and the shown special bars. Use the smaller bar (21 mm diameter) for the 608ZZ bearing and the larger bar (25 mm diameter) for the 6000ZZ bearing.

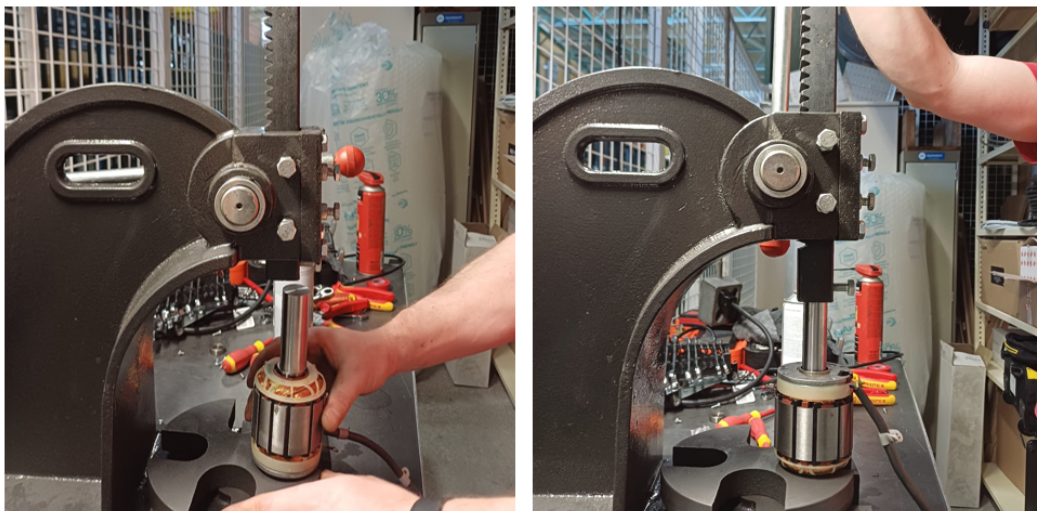


Figure 22: Pressing of the new 608ZZ and 6000ZZ bearings.

7. Clean the outer black motor shell. Apply a thin layer of lubricant to the shaft and bearing contact surfaces, then insert the refurbished inner motor assembly into the outer black motor shell.
8. Insert the two starlock washers onto the shaft above the 608ZZ bearing. Pay attention to their orientation the orientation should be as in Figure 4.

9. Using the circlip pliers, insert a circlip onto the shaft. Push until it is in its dedicated groove on the motor shaft.
10. Repeat the motor refurbishment procedure for the second motor.
11. Install the refurbished motors into their cases using the indicated screw points. The larger hole, shown in red, is for the small cable on top of the motor. Pass this cable through the case, insert a screw through its end clip then screw it into the closest hole (shown in orange), and then tighten the remaining 3 screws to 1.5 Nm in a cross sequence into their dedicated positions.

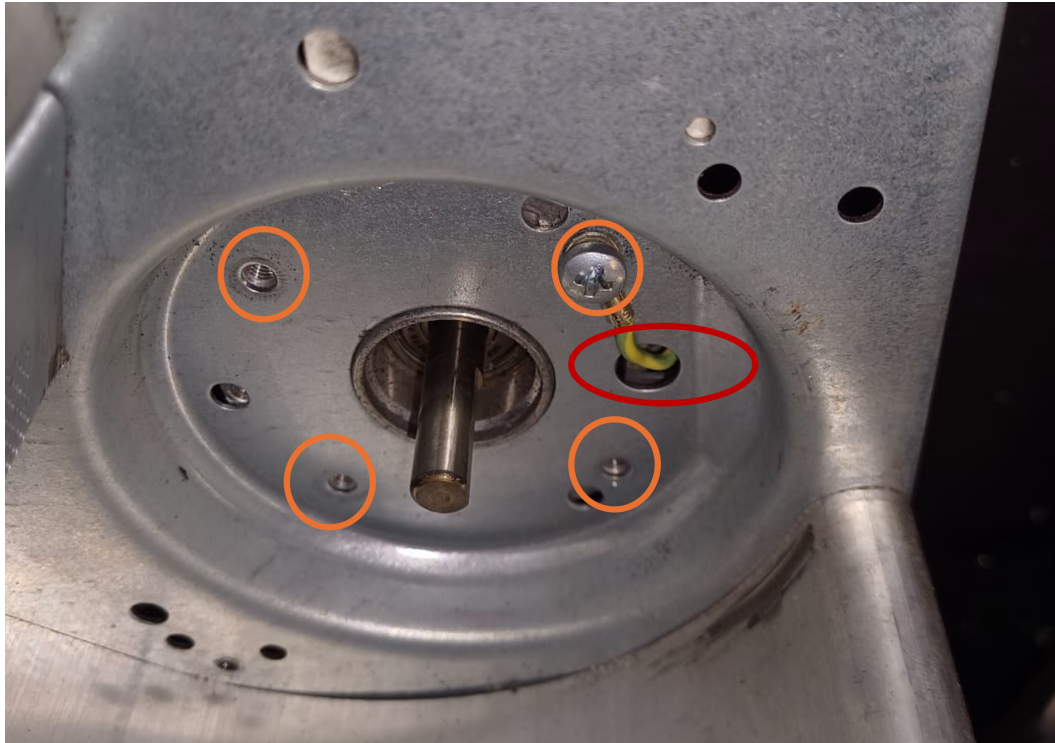


Figure 23: Installation of the refurbished motor into the case.

12. Insert the capacitor in the case using a suitable washer and a nut.

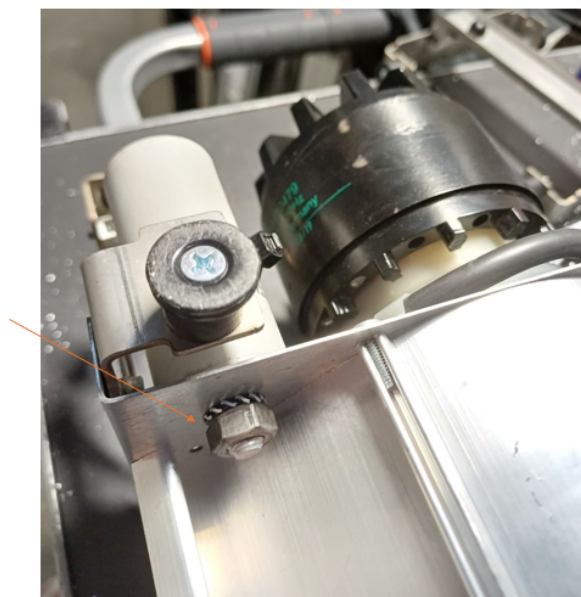


Figure 24: Installation of the capacitor into the case.

13. Screw in the terminal block. Connect the motor cables and capacitor cables to the terminal block. For Case B, follow the Case B terminal block connection figure. For Case A, follow the Case A terminal block connection figure.

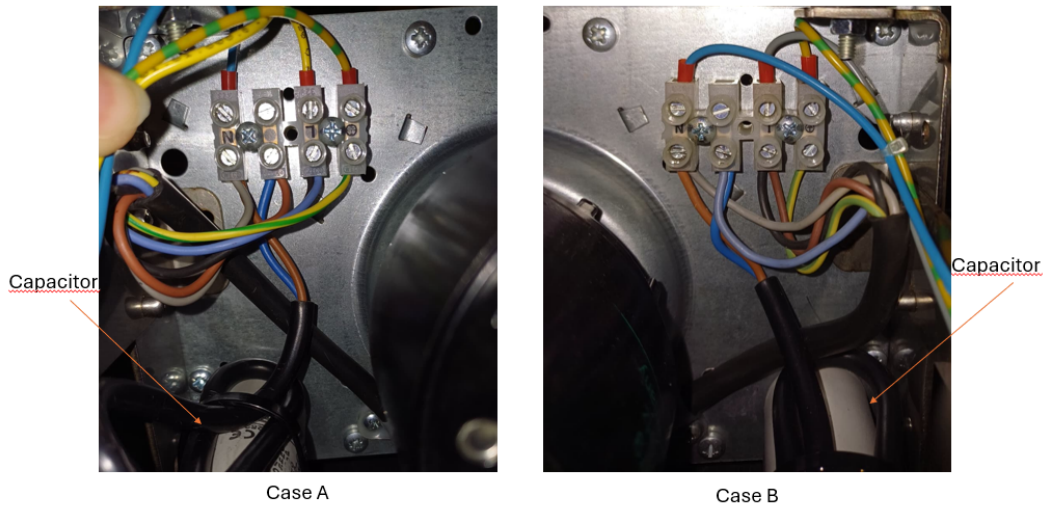


Figure 25: Terminal block connections for Case A and Case B. Ensure that all motor and capacitor wires are connected according to the indicated configuration.

14. Restrain the motor cable to the case as shown. Use cable ties where necessary.

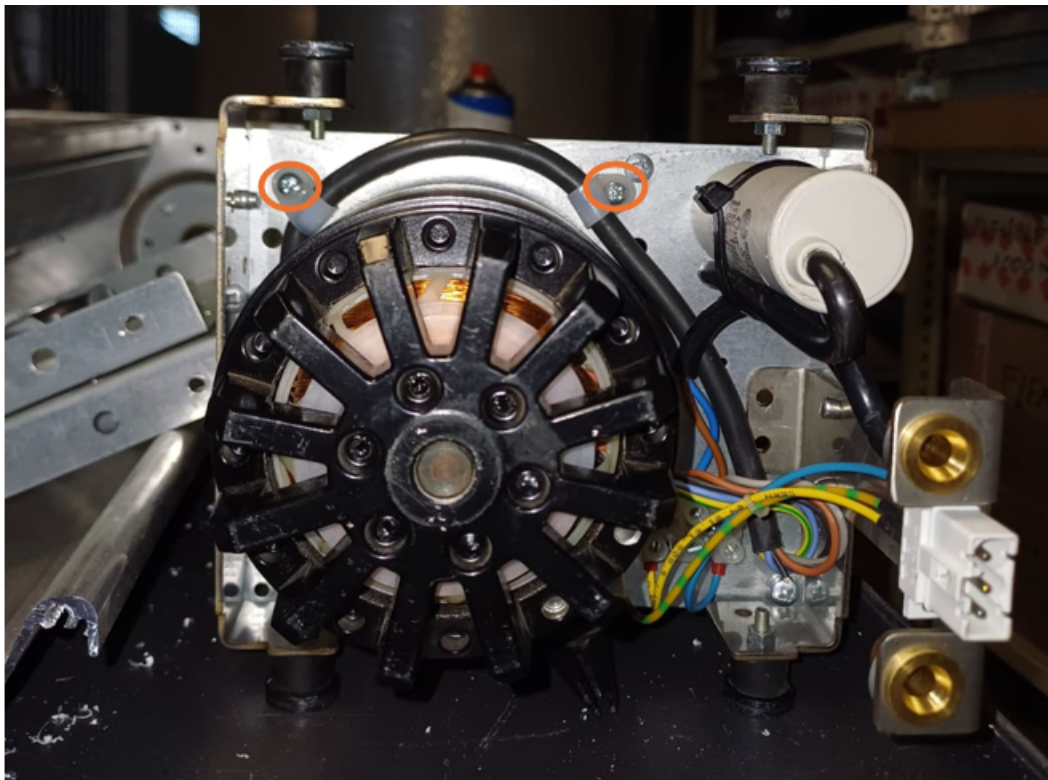


Figure 26: Motor cable restraint on the case.

15. Repeat the motor's case installation and cable connection steps for the second motor/case assembly. Set aside motor/case assemblies for turbine insertion.

9 Chassis Preparation

1. Take the empty chassis. Unscrew from the shown screws and set aside the top panel, then unscrew from the shown screws and set aside the front panel.

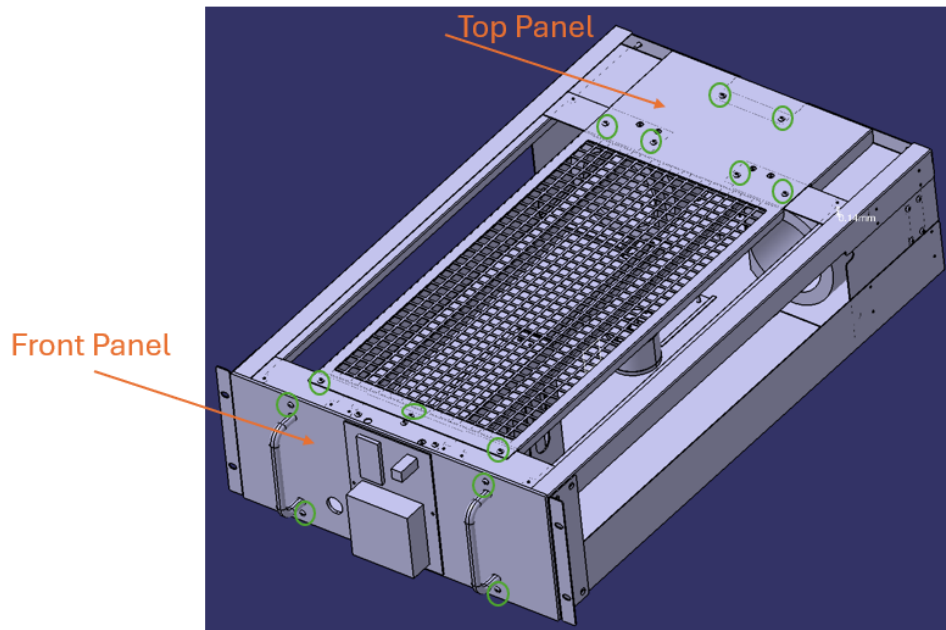


Figure 27: Removal of the chassis top and front panels.

2. Install the Wieland female connectors in position if absent, 2 per chassis.

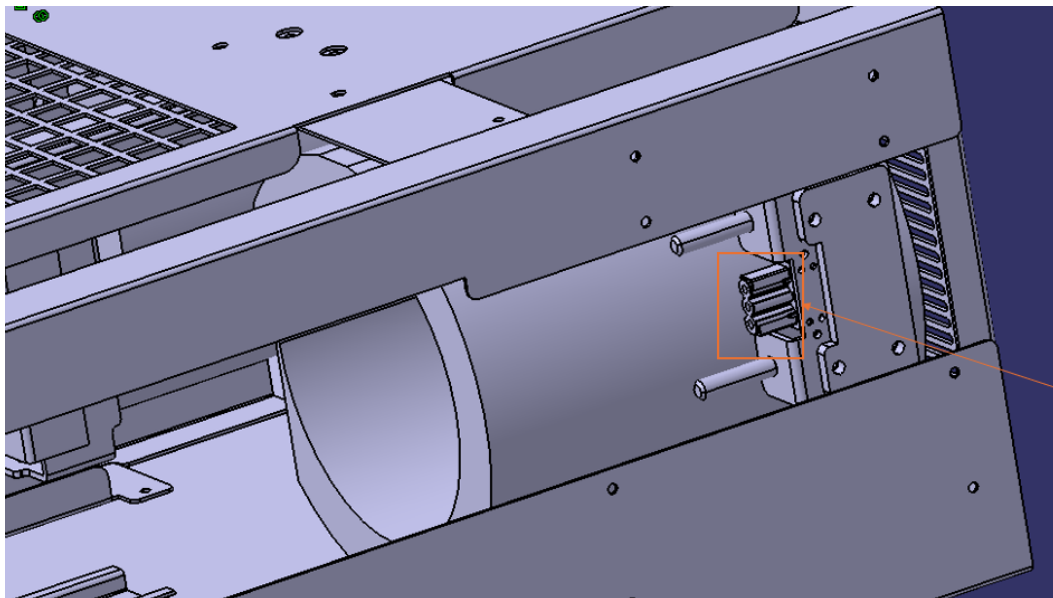


Figure 28: Installation of Wieland female connector.

3. Take the motor shields and install them on the chassis at the positions shown in the figure, also screw the other 4 holes at the opposite side of the chassis, in total 8 screws for 2 shields. Pay attention to shields orientation.

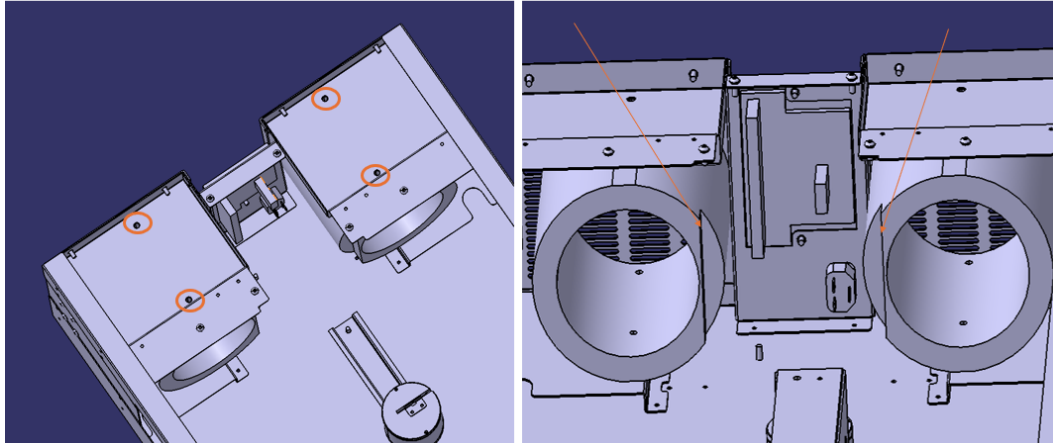


Figure 29: Installation of the motor shields.

4. Take the lower part of the small shield for the auxiliary card and install it inside the chassis.



Figure 30: Installation of the lower auxiliary-card shield.

5. Insert the auxiliary card into the small shield as shown, then close the shield and fasten its dedicated screws.



Figure 31: Auxiliary card installation and shield closure.

6. Make the chassis cable connections. Aux card connections should be as in the figure below.

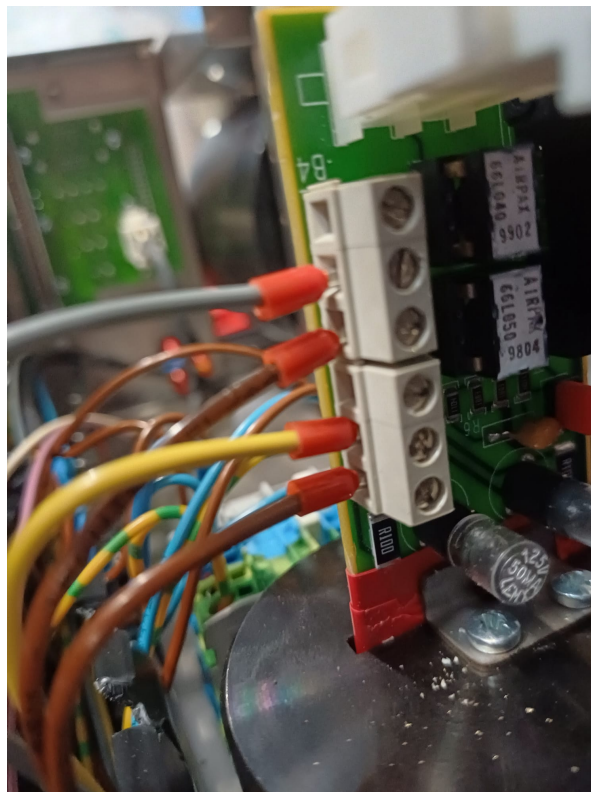


Figure 32: Aux card connections.

10 Turbine Assembly Procedure

1. Take two new turbine wheels, set aside their motor-joint screws for later use: one turbine should be CW and the other CCW. Bond the turbine spacers in their positions using Loctite 638 as shown. Subsequently, bond the 6000ZZ bearing onto the turbine shaft, positioning it immediately after Turbine Spacer 1. Make sure everything is flat and not tilted.

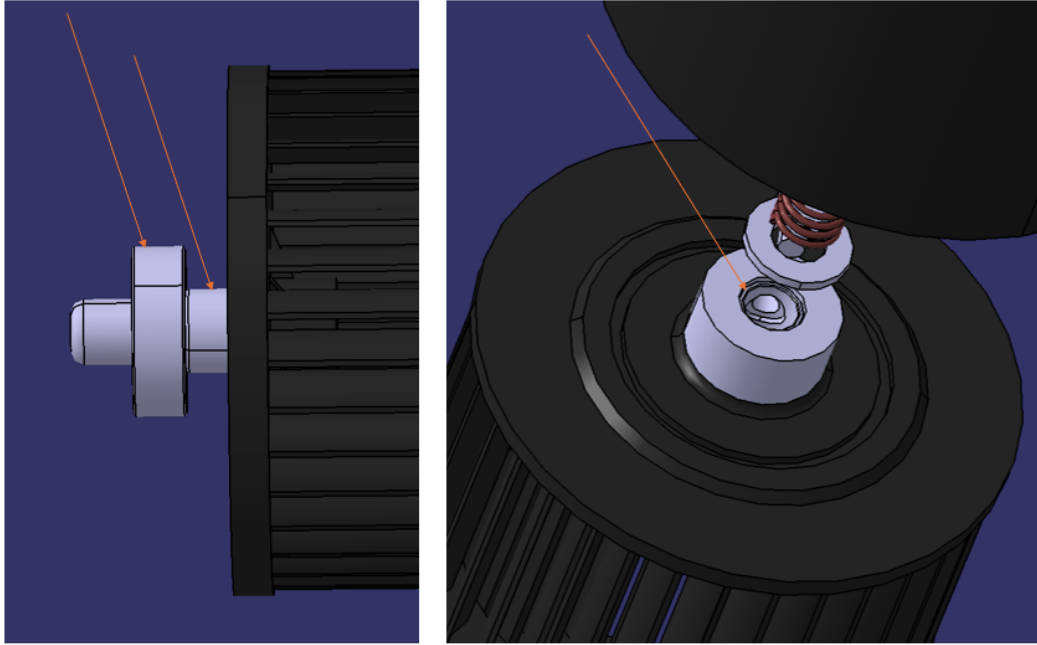


Figure 33: Bonding of turbine spacers and 6000ZZ bearing.

2. Insert bars into the turbine screw holes to ensure that Turbine Spacer 1 does not close the hole during curing. Place the assemblies carefully on a surface with the holes facing upward. Allow curing for 24 h at room temperature before further assembly.



Figure 34: Curing position of the turbine assemblies.

3. Take two flat washers and two long springs. Insert first the spring and then the washer into the motor's shaft, as shown.

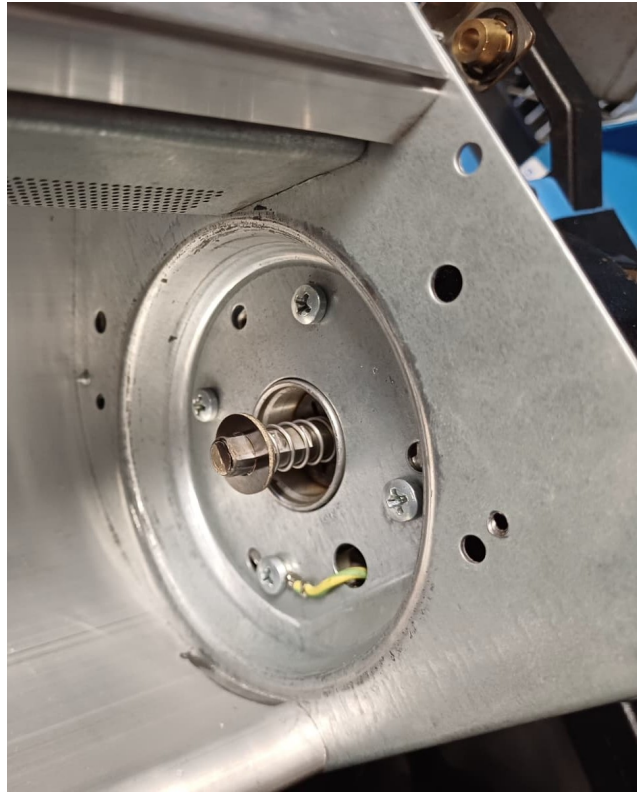


Figure 35: Installation of spring and washer on the motor shaft.

4. Take the refurbished motor/case assemblies and the two cured turbine assemblies. Insert the turbine motor joint screws without closing the hole where the motor shaft shall enter. Insert the CW turbine assembly into Case B and the CCW turbine assembly into Case A. Ensure that the flat face of the motor shaft is perpendicular to the turbine motor joint screw, as shown.



Figure 36: Insertion of CW and CCW turbine assemblies into Case B and Case A.

5. Close the front faces of the turbine cases using suitable screws. First, use the torque screwdriver set to 0.5 Nm and tighten the indicated screw positions (shown in orange) in a cross sequence. Slightly loosen the motor-side screws and retighten them to 0.5 Nm in a cross sequence. Finally, tighten both the motor-side case screws and the front-face case screws to 1.5 Nm in a cross sequence. Close the clips (shown in green) gently using a soft-faced hammer, avoiding impact on the case or any other component.

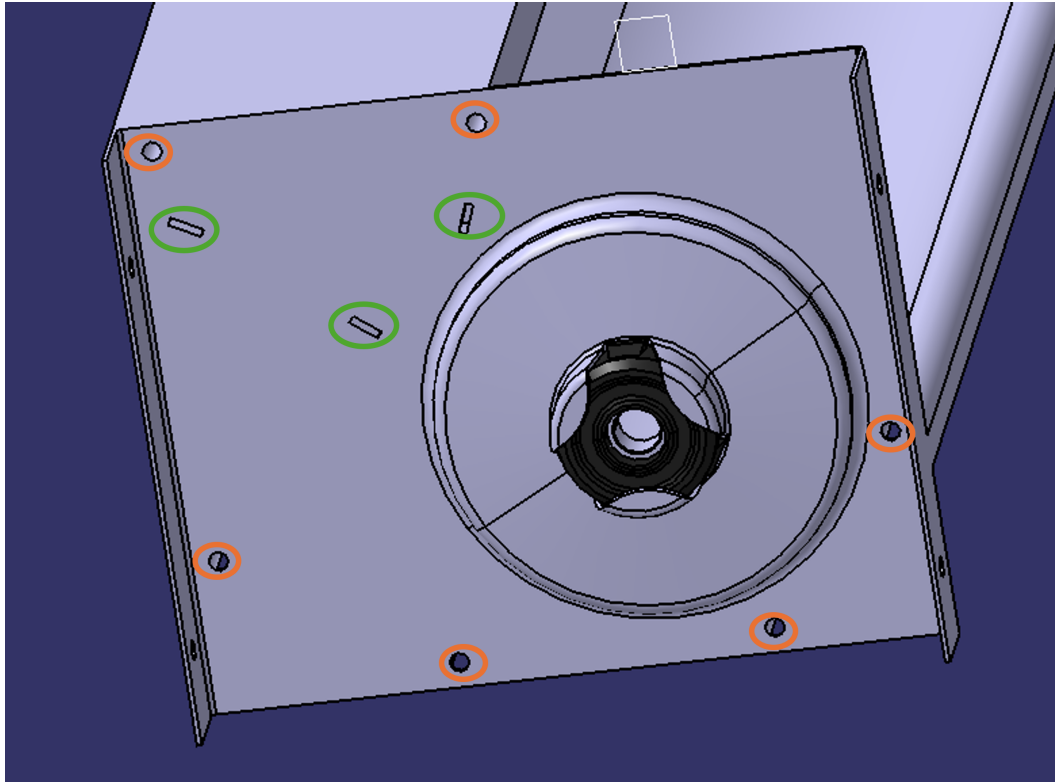


Figure 37: Closing and tightening sequence of the turbine case.

6. Push the turbines towards the front face of the case, ensuring that the turbine bearing is properly seated in the rubber bearing seal. Then tighten the turbine motor screw to the shaft, again ensuring that the flat face of the motor shaft is perpendicular to, and right below the joint screw.

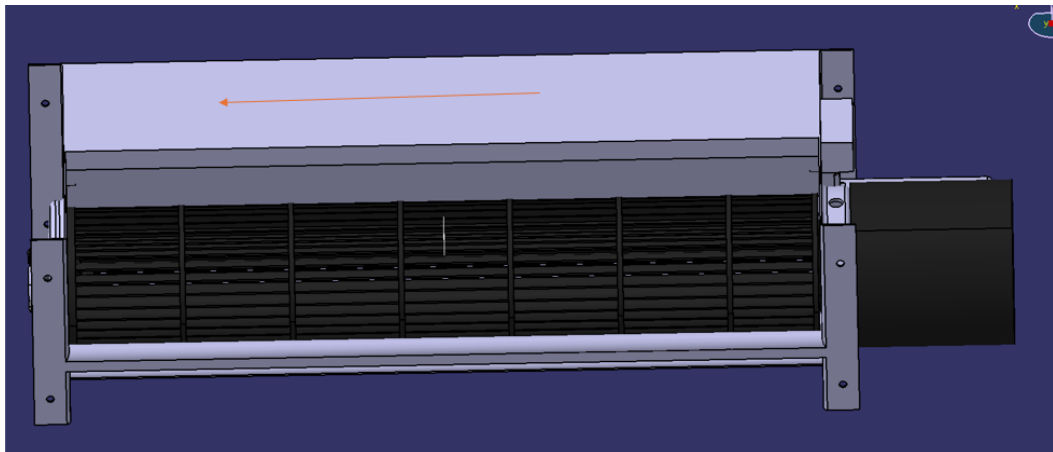


Figure 38: Final positioning of turbine bearing and motor joint screw.

7. Rotate the rotor by hand. Verify that the rotation is smooth and that there is no relative movement between the motor and the turbine assembly.

11 Final Chassis Assembly Procedure

1. Obtain the stands, handles, connector plate, and Wieland male connector. First, install the Wieland connector on the connector plate using the appropriate screws. Place all sheet metal parts on the case. Pay attention to the orientation of the dampers and sheet metal parts; they shall match the reference figures. Connector plate shall be right next to terminal block both for Case A and Case B.

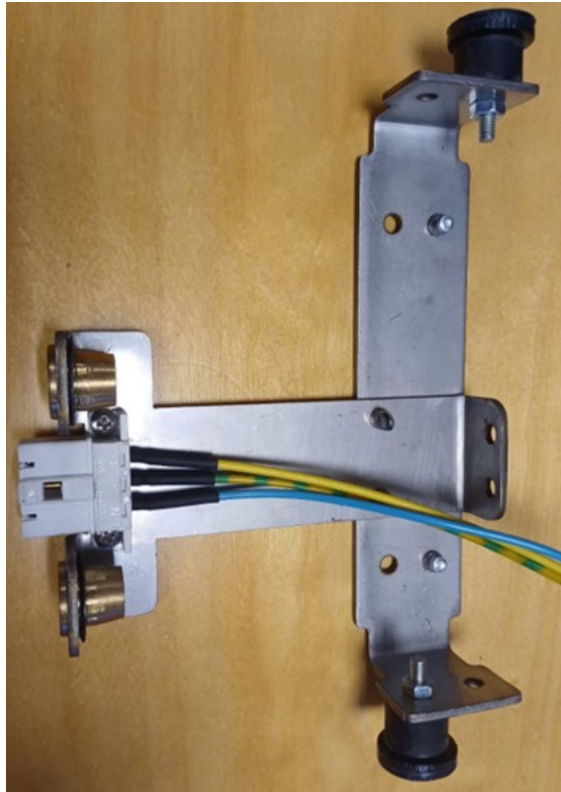


Figure 39: Wieland connector installation.

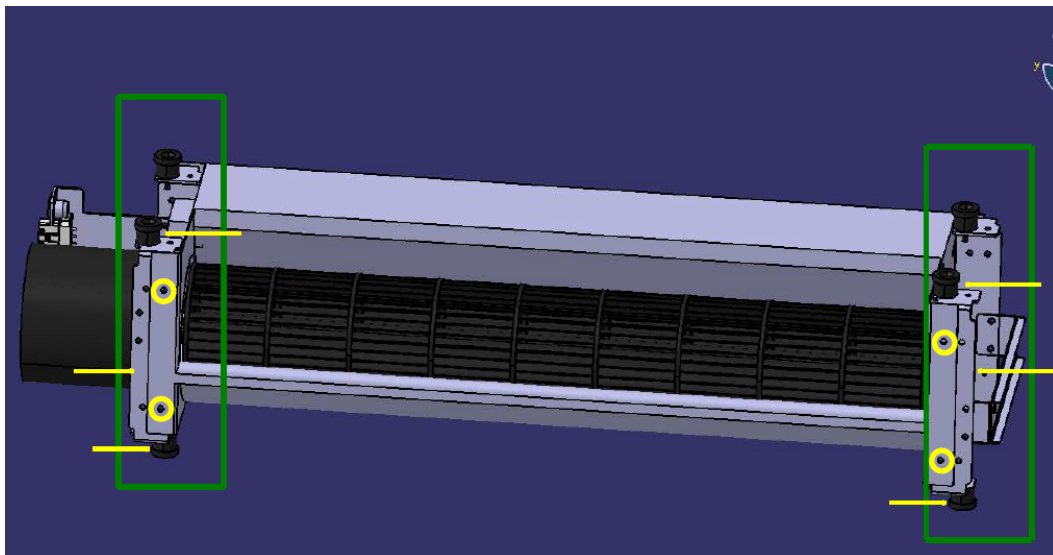


Figure 40: Positioning of stands, handles, connector plate and dampers for Case A - 1

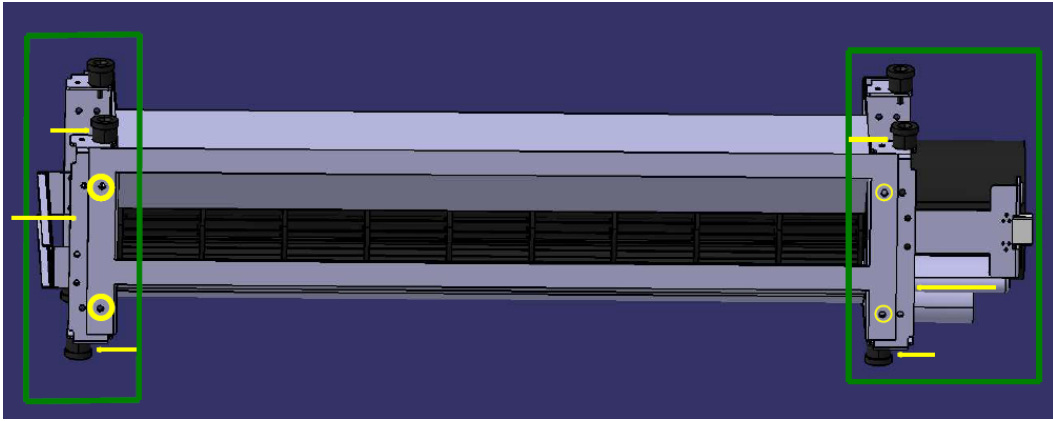


Figure 41: Positioning of stands, handles, connector plate and dampers for Case A - 2

2. Rivet all sheet metal parts to the case at the drilled out positions.
3. Connect the Wieland male connector to the terminal block as shown in the Figure 25.
4. Make sure every cable in the chassis and in the case is well connected and all are correct.
5. Insert the case assemblies into the chassis as shown. The case assemblies shall be in contact with the female connectors inside the chassis.

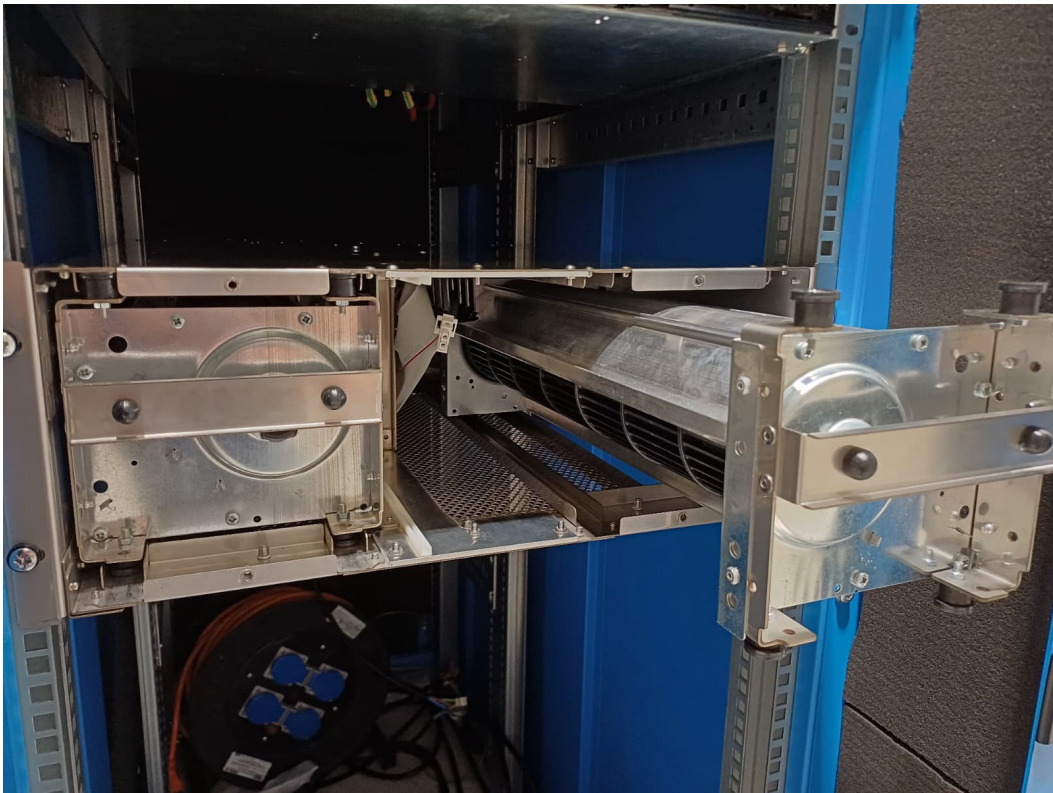


Figure 42: Insertion of case assemblies into the chassis.

6. If a gap is present between the dampers and the chassis, eliminate the gap using an appropriate sized spacer or shim restrained either on the damper or on the chassis.

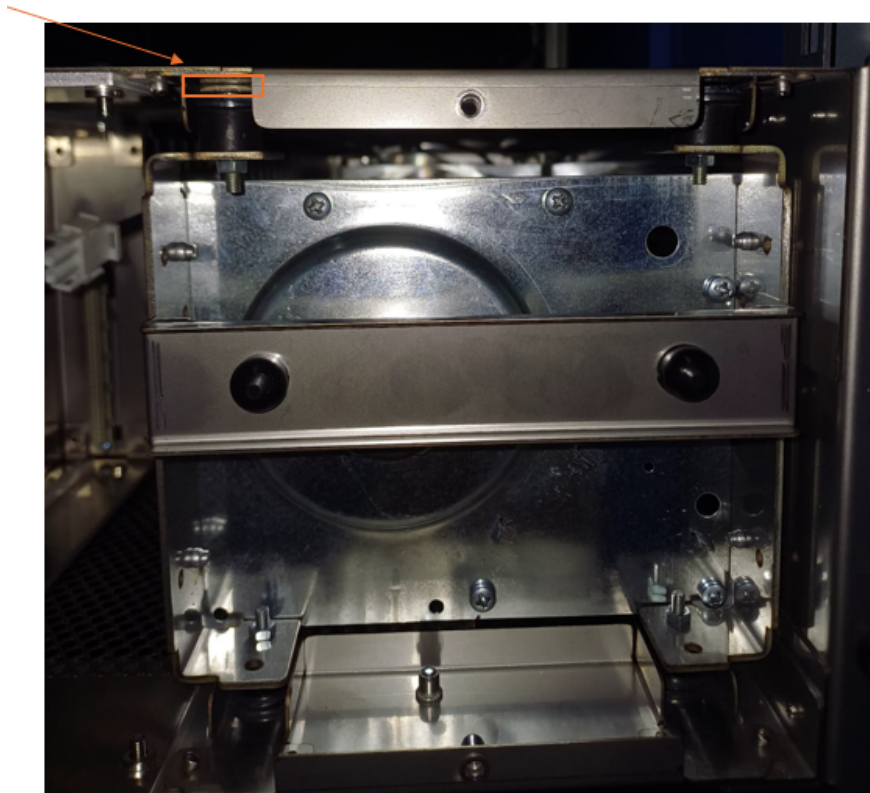


Figure 43: Gap correction between damper and chassis using spacer or shim.

7. Screw the top plate back onto the chassis. Screw the front plate back onto the chassis.
8. Finally, connect the light of the chassis.

12 Inspection Checklist

Inspection item	Acceptance criterion
Case screws	They should all be tightened to 1.5 Nm torque
Motor shields installed	Shields fixed in the correct positions
Auxiliary card installed	Auxiliary card positioned and shield closed
Cable connections completed	Chassis, motor, capacitor, and all connections match figures
Bearings installed	608ZZ and 6000ZZ bearings fully seated
Rotor rotation	Smooth manual rotation with no rubbing
Motor–turbine connection	No relative movement between motor shaft and turbine
Case A / Case B orientation	Case A has CCW turbine; Case B has CW turbine
Dampers installed	Correct orientation and no visible damage
Spacer/shim check	Verify that there is no gap between dampers and chassis
Fasteners and rivets	Installed and tightened/fixed correctly
Case insertion check	Cases fully engaged with chassis female connectors
Final readiness	Assembly ready for functional test

References

- [1] CERN. Rack turbine - edms no: 1365691, 2024.