

1. SCOPE

By performing a **maintenance program**, you ensure your electrical rotating machine operates as required, within safe conditions, both for the machine and the operators.

A maintenance program includes the scheduling of preventive and predictive maintenance tasks, for which the rules may vary depending on: the type and size of machine, the operating conditions, the duration of operation and rest periods, etc. The main difficulty is not to determine its content but the interval between each maintenance.

Evaluating the condition of brushes, brush-holders, commutators and slip rings, however, is a challenging task, and should be performed only by an experienced engineer or technician. Our brochure "How to maintain carbon-brushes, brush-holders, commutators and slip rings" gives main lines to put you on the way to such a diagnostic.

The present document only gives a **list of essential inspections and maintenance operations for optimal brush operation**, listed in a chronological order:

- inspection during operation and until machine stops,
- controls at standstill, including visual checks and measurements to be carried out,
- maintenance (machining, grinding, brushes replacement, etc...) and measurements to perform,
- inspection during operation.

In practical, it is easier to work with a checklist, which could then be attached to the machine follow-up file. It constitutes the level 1 of maintenance.

It is obvious that other maintenance operations not mentioned in this document may be required (e.g. insulation of windings, maintenance of bearings). In general, they are specified in the maintenance guide of the machine manufacturer.

2. CHECK-LIST OF MAINTENANCE

The checklist in following pages is intended to be as general as possible. It should therefore be adapted to the type of the machine.

Legend:

Y = Yes

N = No

N/A = Not applicable



VERY IMPORTANT:

All work carried out on rotating electrical machines is subject to a decommissioning procedure, even for visual inspection.

When the machine has just stopped, some parts may be very hot (brush shunts, brush-holders, sliding surface, etc.). It is recommended to wait until the temperature has decreased.

Note: Visual inspection is the primary means of inspection, so it may be useful to take pictures that can be included in a report, to document the observations.

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PREVENTIVE MAINTENANCE CHECK-LIST

Date:		Completed by:	
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General information on the machine

Plant		Machine reference		
OEM		Part number		
Date and comments of previous maintenance:				

Inspection before and during slow down

Check:	shaft	bearings	brushes	other parts	if yes, precise
Vibration level:	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N	
Noise:	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N	
Spark level (TDS-14) on each pole / phase arm, and per track, if applicable	Arm 1	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8		
	Arm 2	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8		
	Arm 3	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4	<input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8		
Any other remark:					

Inspection when stopped (see note page 1)

Just after stop	Commutator / rings Surface temperature (°C)	Track / ring 1	
		Track / ring 2	
		Track / ring 3	
Running time:	Real:	Since last stop:	

Brushes:

Wear assessment and brush aspect:							
Arm / phase	Brush number	Length (mm)		Wear (mm)	Wear rate (mm/1000h)		Aspect
		previous	current		Per brush	Average per group	

(add lines when necessary)



Positioning			
Any preferential position at stop?	<input type="checkbox"/> N/A	<input type="checkbox"/> Y	<input type="checkbox"/> N
If brush stagger (<i>see TDS-09</i>) is applied, is it correctly done?	<input type="checkbox"/> N/A	<input type="checkbox"/> Y	<input type="checkbox"/> N
Axial dimension parallel to the rotor axis		<input type="checkbox"/> Y	<input type="checkbox"/> N

Brush-holders

Visual inspection:	Integrity of all parts?		Any sign of vibration?		Any pollution?	
	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> Y	<input type="checkbox"/> N
Comments (if any):						

Measurements after brush removal (*add lines when necessary*)

Arm / pole number	Brush-holder number	Brush box dimensions (mm) – <i>see TDS-04</i>		Distance to the surface (mm)	Pressure – <i>see TDS-11</i>		Position to radial axis
		<i>t</i>	<i>a</i>		<input type="checkbox"/> kg <input type="checkbox"/> cN	<input type="checkbox"/> g/cm ² <input type="checkbox"/> kPa	

Visual inspection after brushes back into

Brush is correctly guided?	<input type="checkbox"/> O	<input type="checkbox"/> N
Correct position of pressure system?	<input type="checkbox"/> O	<input type="checkbox"/> N

Commutator / slip ring

Visual inspection:	Integrity of the rotor?		Any sign of vibration?		Any pollution?	
	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> Y	<input type="checkbox"/> N
Film	Film aspect description (<i>see TDS-13</i>)		Conform? ¹	Need for maintenance? ₁		
Track 1			<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N		
Track 2			<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N		
Track 3			<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N		

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Measurements	Concentricity / Runout		Roughness R_a (see TDS-02)		Number of peaks / cm R_{pc} (see TDS-02)	
	Value	Conform? ¹	Value	Conform? ¹	Value	Conform? ¹
Track 1		<input type="checkbox"/> Y <input type="checkbox"/> N		<input type="checkbox"/> Y <input type="checkbox"/> N		<input type="checkbox"/> Y <input type="checkbox"/> N
Track 2		<input type="checkbox"/> Y <input type="checkbox"/> N		<input type="checkbox"/> Y <input type="checkbox"/> N		<input type="checkbox"/> Y <input type="checkbox"/> N
Track 3		<input type="checkbox"/> Y <input type="checkbox"/> N		<input type="checkbox"/> Y <input type="checkbox"/> N		<input type="checkbox"/> Y <input type="checkbox"/> N
Specific						
Commutators: interbar aspect, chamfers (see TDS-03)...						
Slip rings: helical grooves aspect, chamfers (see TDS-03)...						
Other²						

(add lines when necessary)

¹ see Mersen documents, in particular Technical Guide on Maintenance and TDS.

² Other measurements may be performed to control the state of the machine, maybe at a higher maintenance step level: windings insulation resistance, neutral line (see TDS-06). We recommend you to refer to the O&M's manual.

Maintenance work

Activity	Done?	Measurements / Comments	Conformity?
Cleaning	<input type="checkbox"/> O <input type="checkbox"/> N		<input type="checkbox"/> O <input type="checkbox"/> N
Commutator / ring machining	<input type="checkbox"/> O <input type="checkbox"/> N	Out-of-round (μm):	<input type="checkbox"/> O <input type="checkbox"/> N
Commutator / ring grinding	<input type="checkbox"/> O <input type="checkbox"/> N	Roughness R_a (μm) : R_{pc} (pics/cm) :	<input type="checkbox"/> O <input type="checkbox"/> N
Brush-holders replacement / repair	<input type="checkbox"/> O <input type="checkbox"/> N		<input type="checkbox"/> O <input type="checkbox"/> N
Brush replacement	<input type="checkbox"/> O <input type="checkbox"/> N		<input type="checkbox"/> O <input type="checkbox"/> N
Other (precise)			

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Note:

If the machine is intended to be stored (not used after the maintenance operation), specific precautions shall be taken, in particular:

- protect the commutators or rings from damage and oil leaks (strips of cardboard, clean rag, covering, etc.),
- remove all brushes or insert a strip of insulating material between the brush and the sliding surface (see TDS-22).

Cited documents (available from Mersen website):

- *Mersen Technical Guides:*

Brushes for motors and generators.

How to maintain carbon-brushes, brush-holders, commutators and slip rings

- *Mersen PTT Technical data sheets (TDS):*

TDS-02: Surface condition of commutators and rings: Roughness

TDS-03: Bar edge chamfering – Machining of helical grooves

TDS-04: Dimensions of carbon brushes and brush-holders

TDS-06: Setting the neutral

TDS-09: Circumferential brush stagger

TDS-11: Pressure on carbon brushes

TDS-13: Aspect of commutator / slip-ring skins

TDS-14: Brush sparking

TDS-22: Ghost marking on slip rings

TDS-23: Silicones

MOTOR MAINTENANCE SERVICES
A COMPLETE OFFER
by MERSEN

<p>Visual Inspection</p> <ul style="list-style-type: none"> ✓ First findings with basic recommendations ✓ Check-list <p>Advice on preventive maintenance</p>	<p>Diagnostic</p> <ul style="list-style-type: none"> ✓ Visual Inspection + Measurement of the main mechanical motor parameters with recommendations + Inspection of the external environment + Technical report <p>Advice on curative maintenance</p>	<p>Expertise</p> <ul style="list-style-type: none"> ✓ Diagnostic + Mechanical expertise & measurement + Electrical expertise & measurement + Corrective prescriptions + Expertise report <p>In-depth analysis of the machine's parameters</p>	<p>Interventions</p> <ul style="list-style-type: none"> ✓ Expertise + Machining and refurbishment of slip ring assemblies and commutators + Expertise of Signal & Power Transfer Systems + Measurements before and after + Complete report <p>Execution of planned corrective actions</p>	<p>Emergency Management</p> <ul style="list-style-type: none"> ✓ Diagnostics NEW ✓ In-situ intervention ✓ Measurements before and after ✓ Complete report <p>Immediate corrective actions for quick production restart</p>
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