	Work Instruction	Generation Engineering
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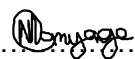
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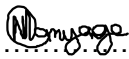
Compiled by



Marubini Manyage
Chief Engineer: Generation Engineering, Electrical Engineering

Date: 22/04/2025

Approved by



Marubini Manyage
Technology Principal: Motors

Date: 22/04/2025

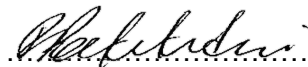
Authorised by



Phera Rakeketsi
Senior Manager: Generation Engineering, Electrical Engineering

Date: 2025-04-24

Supported by SCOT/SC/TC



Phera Rakeketsi
SCOT SC Chairperson

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EXECUTIVE SUMMARY

Motors perform critical functions throughout Eskom power plants and the failure of a motor could result in severe unplanned loss of generating capability at a Power Station. It is therefore of utmost importance that a motor be installed and commissioned correctly to prevent premature failure and ensure long term reliable operation.

This document stipulates the process to be followed for successful commissioning of electric motors. This includes details about the mechanical, electrical and instrumentation installation and commissioning. The document also stipulates checks to be conducted on the electrical protections of the motor before it is started for the first time. After the installation has been completed details are provided regarding the process to be followed when the motor is started for the first time - uncoupled and coupled.

The document contains check sheets which should be completed for the commissioning of all electric motors, Low and Medium Voltage. These check sheets should be stored in accordance with 32-6: Eskom document and records management procedure.

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1. INTRODUCTION

Electric motors fulfil a critical role at Power Stations throughout Eskom and the failure of MV motors can result in severe unplanned production load losses. Eskom incurs high costs with regards to the procurement and repair of MV motors. It is therefore of utmost importance to ensure that new and repaired motors are commissioned correctly and that the required checks and inspections are done to protect the motors from failing prematurely due to poor installation and commissioning practices.

2. SUPPORTING CLAUSES

2.1 SCOPE

This document outlines the procedure to be followed when preparing MV motors for operation at Power Stations throughout Eskom.

2.1.1 Purpose

This Work Instruction highlights effective actions to be executed when commissioning a new or refurbished MV Motor at the Power Station. Rotating Electrical Machines are running all over Eskom plants and severe injury to personnel and damage to the plant can be incurred as a result of improper installation, commissioning or handling of motors when taking the nature of their electrical and mechanical characteristics into account.

2.1.2 Applicability

This document shall apply to all Eskom Coal Fired and Peaking Power Stations.

2.2 NORMATIVE/INFORMATIVE REFERENCES

2.2.1 Normative

- [1] ISO 9001: *Quality Management Systems.*
- [2] SANS IEC 60034-8: *Rotating electrical machines – Part 8: Terminal markings and direction of rotation*
- [3] SANS IEC 60034-14: *Rotating electrical machines – Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher – Measurement, evaluation and limits of the vibration.*
- [4] SANS IEC 60034-18-1: *Rotating electrical machines – Part 18: Functional evaluation of insulation systems – Section 1: General guidelines.*
- [5] SANS IEC 60851: *Winding wires - Test methods Part 1-6*

2.2.2 Informative

N/A.

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2.3 DEFINITIONS

Definition	Description
Bearings	A stationary member or assembly of stationary members in which a shaft is supported and may rotate.
Commissioning	Putting into service an item of plant which has been safety cleared, successfully tested and optimised in accordance with the standards.
Critical Motors	Motors whose failure in service would have an appreciable probability of causing loss of availability of generating plants, or of causing unsafe conditions for personnel or plant.
Medium Voltage	Voltage ratings above 1000V
Overall Vibrations	The maximum vibration amplitude of unfiltered-time based vibration signals.
Polarization Index	Variation in the value of insulation resistance with time.

2.3.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
CID	Control & Instrument Department (Maintenance)
CT	Current Transformer
CW	Cooling Water
DE	Drive End
EMD	Electrical Maintenance Department
FAT	Factory Acceptance Test
IR	Insulation Resistance
LV	Low Voltage
MMD	Mechanical Maintenance Department
MΩ	Mega Ohms
MMS	Machinery Management Services
MV	Medium Voltage
NDE	Non-Drive End
OPS	Operating Department
O&M	Operating & Maintenance
PA	Primary Air
PI	Polarization Index
PTM	Protection, telecommunication and metering
PTW	Permit to Work
QIR	Quality Inspection Report

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Abbreviation	Description
RTD	Resistance Temperature Detector
SE	System Engineer

2.5 ROLES AND RESPONSIBILITIES

2.5.1 MV motors

The RACI chart in Table 1 is used to describe the functions for the installation and commissioning of MV electric motors:

- A – Means accountable for delivering on the activity.
- R – Means responsible and must be fully involved in the activity.
- C – Means must be consulted so as to provide input.
- I – Means to be informed only but not required to be involved in the activity.

Table 1: Roles and Responsibilities Chart

Role \ Activity	Engineering	Operating	Electrical Maintenance Department	Mechanical Maintenance Department	*Machinery Management Services	PTM Department	Controls and Instrumentation Dept.
A. Provide works instruction for MV motor commissioning	A	I	C	C	C	C	
B. Perform assessment on motor to be replaced	A	C	C	C	C		
C. Provide works information for motor to be changed	A	I	I	I	I	I	
D. Obtain HV permit to work on motor	I	R	A	A			
E. Obtain LV permit to work on motor	I	R	A	A			
F. Ensure safety of personnel working			R	R			
G. Perform pre-commissioning mechanical checks	I			A			
H. Perform pre-commissioning electrical checks	I		A				
I. Confirm electrical protections	I					A	
J. Instrumentation connection	I	C					A
K. Sanction for test to be taken on motor	I	R	A	A	I		
L. Make the motor standby	I	A	I	I	I		
M. Uncoupled motor run	R	A			R		
N. Isolate plant before coupling		A	R	R			

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O. Alignment & coupling motor to the load	I			A			
P. Clear all permits on motor	I	R	A	A			
Q. Store check sheets and records	A		R	R	R	R	R

*Note: For Peaking the function of Machinery Management Services are performed as follows:

- LV motors – Site maintenance
- Main bearings and main machine set – Turbine engineering.

2.6 PROCESS FOR MONITORING

- a. This Work Instruction will be implemented throughout Eskom and will be reviewed on a five yearly basis. Feedback from all stakeholders will be incorporated during the revision of this document.
- b. Stakeholders at the individual sites shall regularly conduct reviews to determine whether the Work Instruction is adhered to by all departments involved with the motor commissioning and whether the Work Instruction serves its intended purpose effectively.

2.7 RELATED/SUPPORTING DOCUMENTS

- [1] Eskom 32-6: Eskom document and records management procedure
- [2] Eskom 240-89217674: Refurbishment and Repair of Power Station Electric Motors Work Instruction.
- [3] Eskom 240-50237155: New MV Induction Motor Procurement Standard.
- [4] Eskom 240-54783039 New MV Induction Motor Technical Schedule AB Template.
- [5] Eskom 240-56361435: Transport of Power Station Electric Motors standard.
- [6] Eskom 240-56360387: Storage of Power Station Electric Motors standard.
- [7] Eskom 240-97049386 New MV Synchronous Motor Procurement Standard.
- [8] Eskom 240-138203748 MV Synchronous Motor Technical Schedule AB Template
- [9] Eskom 240-95138097 Electric Motor Test Certificate.

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3. MOTOR COMMISSIONING REQUIREMENTS

3.1 SAFETY

- a. Safety at the Power Station must always be the first priority. It must always be borne in mind that each person is responsible for his/her own safety, the safety of others and the safekeeping of the Plant.
- b. Safety should be an attitude, a way of doing things, which includes:
 - Adhering to the Life Saving Rules:
 - Open, isolate, test, earth, bond and/or insulate before touch.
 - Ensure a permit to work is in place.
 - Hook up at heights
 - Be sober.
 - Buckle Up
 - Awareness of potential dangers.
 - Knowledge of the necessary precautions.
 - The willingness to make the effort to apply the necessary precautions.
 - Application of the STAR principle – Stop, Think, Act, Review.
 - Conducting a risk assessment and pre-job briefing.
- c. It is imperative that only skilled persons (trained and authorised) on electric motors carry out the installation and commissioning of these motors.

3.2 MOTOR COMMISSIONING

3.2.1 Pre-commissioning checks

- a. Several pre-commissioning checks need to be performed before the motor is started for the first time. This includes Electrical and Mechanical checks. All checks are related to a Quality Inspection Report which should be completed for record keeping. The Quality Inspection Reports can be found in Appendix A. Each Power Station can customise their check sheets covering all the important checks described in this document. The supervisor for the relevant activity will sign the Quality Inspection Report. At this point, the assumption is that the motor is placed on its foundation / plinth and no other work has been carried out on it.
- b. The check sheets on this document are designed to be comprehensive and contain the majority of check points for a wide variety of motor designs. Some checkpoints will not be applicable on certain motor designs and should be marked as not applicable on the check sheet.
- c. It is recommended to assess motor condition, review new/refurbish data packs and conduct IR and PI tests before motors are taken from storage facility to the plant to confirm electrical condition of the windings.

3.2.1.1 Mechanical checks / installation – Quality Inspection Report 1

- a. Remove the transportation shaft locking device from the motor. Ensure that the motor is not damaged during this process and replace all bolts which were removed in order to remove the shaft locking device. If any paint was damaged during the process, it should be touched up to prevent corrosion. Clean the shaft extension of the anti-corrosive coating.

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- b. Ensure that the motor is properly anchored to the base. Inspect the general condition of the motor foundation and ensure that the foundation is not cracked. The tightness of the mounting bolts must also be checked (see Appendix B for torque specifications). The station may use their torque settings provided and verified by mechanical system engineer.
- c. It should be stressed that laser alignment is required on all MV motors. If it is not possible to perform laser alignment of a specific motor, the reason for not performing laser alignment should be stated and approved by the line manager and supported by the system engineer (preferably the mechanical system engineer). Each station must develop or have an alignment checksheet and keep records of each alignment.
- d. Additional checks:
 - Inspect the sleeve bearing oil reservoirs and ensure that all oil supply systems are filled with the recommended oil to the correct level.
 - Pipes for flood lubrication oil system (or water system) should be connected properly and ensure no damage is done to the pipes. Some motors have orifices on the bearing oil inlet, ensure it is replaced before securing the inlet pipe.
 - For motors with jacking oil system, ensure that the system is also connected properly and no damage is done to the pipework.
 - The lubrication oil system of motors with flood lube systems should be running before the rotor is turned. Inspect the connection of the oil or water pipes and check for leaks before and when the motor is running. Ensure that the lubrication oil pressure is within the specification.
 - Turn the rotor by hand (if possible) and listen for any abnormal sounds which could point towards mechanical or electrical glitches inside the motor.
 - Inspect the assembly of the main terminal box and cooling system (or heat exchanger bolts).
- e. For motors utilising water cooled heat exchangers (CACW), the cooling water system should be checked to ensure that:
 - The gaskets on all the flanged connections are replaced.
 - No leaks are present – It is recommended that the cooling water system be started before running the motor for the first time to check for any water leaks. Ensure leakage detectors are functioning to detect any leaks before starting the motor.
 - Ensure the drip tray water exit pipes are unplugged or the valves are open for those equipped with valves.

3.2.1.2 Electrical installation – Quality Inspection Report 2

- a. Perform a visual inspection on the motor. Check for any obvious physical damage, any carbon marks and any missing parts on the motor.
- b. Terminal boxes should be free of dirt, moisture and any foreign debris.
- c. Inspect the earthing to the motor for any discontinuity and ensure the earth is connected to the indicated earth studs on the motor. The machine frame, main terminal boxes, auxiliary terminal boxes must be connected to protective earth. For motors with grounding brushes, ensure the brushes are also connected to the protective earth.
- d. Phasing of cables should be done on motors using parallel supplies.
- e. Insulation resistance and Polarisation Index measurements must be taken before the motor is started for the first time. The power cables can be connected to the terminals in the main terminal box once

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these tests have been completed. Ensure that the earthing is carried out before connecting the main power supply.

- f. For Ex-rated motors, cable glands or cable bushings for supply cables must be Ex certified.
- g. In case of slip ring motors check that sliprings are clean. Check that brushes move freely in their holders and pigtailed do not touch each other.
- h. For motors with external blower motors, ensure the power supply to that motor is properly connected and no abnormalities are present on the external blower system.
- i. The power cables to the motor should be inspected to ensure that:
 - The cable insulation does not show any signs of deterioration (cracks, cable sweats, overheating).
 - The cable lug bolts are tightened with proper torque (see Appendix B).
 - The cables are suitably routed.
 - Cables are stress-relieved in a proper way.
 - All auxiliary equipment are connected and tested.
 - Surge arrestor cables:
 - Ensure that the surge arrestor cables are routed correctly and that it does not touch any metal parts on the terminal box.
 - Check that the connections of the surge arrestor cables are tight.
 - Check that the surge arrestor is in good condition with no cracks.

3.2.1.3 Electrical protections – Quality Inspection Report 3

- a. The relevant motor data should be used to calculate the protection settings for the motor. The protection settings should be implemented on the protection relays and recorded on the Quality Inspection Report. Some of the common protections to be noted are:
 - Thermal overload
 - Thermal re-start inhibit.
 - Instantaneous overcurrent
 - Earth fault protection
 - Differential protection
 - Negative phase sequence
 - Phase unbalance
 - Motor starting/stall protection.
- b. Polarity checks should be performed on the CTs at the motor to ensure that no nuisance trips occur when the motor is started for the first time.

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3.2.1.4 Instrumentation connection – Quality Inspection Report 4

3.2.1.4.1 Stator winding temperature

- a. Winding temperature detectors should be connected and checked that the correct signals are received at the control / equipment room. It should also be checked that the RTD entries are insulated from earth and the stator, check RTD cables, ensure they are clean and free of chafing and clean them if necessary. Ensure correct type RTD is installed.
- b. Should a motor utilise different winding temperature detectors, such as thermocouples, these should also be checked for any damage on the instrumentation cabling. The accuracy of these detectors at the motor should be verified against the readings at the control room.

3.2.1.4.2 Bearing temperature measurement

- a. Bearing temperature detectors should also be connected and checked for any damage on the instrumentation cabling. The accuracy of the readings at the motor should be verified against the readings at the control room. Ensure correct type thermocouples or RTDs are installed.
- b. If the bearing temperature measurement instrument is inserted into the bearing on site, and not factory fitted to an auxiliary junction box, then the bearing insulation resistance should be re-tested and compared to the bearing insulation resistance value measured during the FAT.

3.2.1.4.3 Other instrumentation (Cooling water leak detectors, air circuit temperature detectors, vibration monitoring, rotary encoders, speed sensors)

All other instrumentation should be verified to be in a working order before they are connected. Continuity of cables should be verified as far as reasonably possible and repaired if necessary. Readings obtained at the motor should be verified against readings at the control / equipment room.

3.2.2 Final commissioning

Final commissioning can commence once all the activities relating to QIRs 1-4 have been completed. Some items may not be applicable / relevant to some motors due to their nature of construction. In that case N/A must be written down in the applicable spaces on the Quality Inspection Report.

The final commissioning of the motor will consist of an uncoupled and coupled test runs. For safe test runs, ensure that proper work permits and/or permits to work are in place and / or revoked.

3.2.2.1 Uncoupled test run - Quality Inspection Report 5&6

3.2.2.1.1 First start (uncoupled, a few seconds only)

Note: Check that flood lubrication and/or water-cooling system is on, if applicable!

- a. When pre-commissioning checks are deemed satisfactory, the motor can be run and inspected for:
 - Any abnormal noises and detect their origin.
 - The shaft direction.
 - If the shaft direction is incorrect, exchange two phases of the motor cables to achieve the correct direction. For certain motors changing phases is done on the motor itself while for others it should be done in the switchgear room.
 - Mark each power cable to ensure correct direction is maintained in future connections and minimise uncoupled run to one.

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3.2.2.1.2 Second start (uncoupled)

Note: Check that flood lubrication and/or water-cooling system is on, if applicable!

- a. If the results of the first start were satisfactory, a second uncoupled test run should be done for preferably one hour, but not shorter than 30 minutes. The following checks should be done during the second uncoupled run:
 - Check for any abnormal noises.
 - Check for any abnormal vibrations on the motor and the bearings by taking bearing vibration measurements at intervals as per QIR 6.
 - Monitor the winding and bearing temperatures.
- b. Depending on the vibration results of the uncoupled run, it will be determined whether vibration readings should be taken again once the motor is on-load shortly after being coupled on start-up to re-capture the vibrations or alternatively prefer to measure the vibrations at a later stage during normal load conditions.
- c. After completion of the vibration measurements and confirmation that motor bearing and winding temperatures are satisfactory, the motor can be de-energised. The motor can now be coupled to the load and the coupling can be boxed up.

3.2.2.2 Coupled test run - Quality Inspection Report 5&6

- a. The coupled test run can be conducted after the motor has been coupled to the load and a sanction for testing has been taken. The coupled test run should be done for preferably one hour, but not shorter than 30 minutes. During the coupled test, the following checks should be done:
 - Monitor the % load. It is preferable to gradually load the motor to full load. During this period, current drawn, power input if possible, and speed of motor should be noted.
 - Monitor the winding and bearing temperatures.
 - Monitor the motor and bearing vibrations.
- b. When all the measurements have been completed and found to be within the specifications, the motor can be de-energised, allowing all parties to clear their permits. The motor is now fully commissioned and may be operated.
- c. If the motor is not required to be on standby, it may continue to operate once all the parameters are satisfactory.

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4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Brian Mokoena	Arnot Power Station – Motor Engineer
Bernie Jansen	Camden Power Station – Motor Engineer
Virginia Nama Mbe	Duvha Power Station – Motor Engineer
Kgotso Makweya	Grootvlei Power Station – Motor Engineer
Cedrick Mabelane	Hendrina Power Station – Motor Engineer
Mooiman Phetla	Kendal Power Station – Motor Engineer
Mhlengi Manqele	Kriel Power Station – Motor Engineer
Ernest Molefi	Lethabo Power Station – Motor Engineer
Gomotso Phokojoe	Kusile Power Station – Motor Engineer
Siyabonga Manana	Majuba Power Station – Motor Engineer
Boleo Lesejane	Matimba Power Station – Motor Engineer
Lindani Zwane	Matla Power Station – Motor Engineer
Thembehlele Majosi	Medupi Power Station – Motor Engineer
Sandile Madonsela	Tutuka Power Station – Motor Engineer
Oupa Mailula	RT&D – Chief Engineer
Samu Seleke	Generation Engineering Documentation Controller

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5. REVISIONS

Date	Rev.	Compiler	Remarks
Jun 2015	0	D.J. Dreyer	Document developed
Aug 2015	0.1	D.J. Dreyer	Internal review during development
Aug 2015	0.2	D.J. Dreyer	Reviewed by Work Group
Sep 2015	0.3	D.J. Dreyer	Reviewed by Care Group and Study Committee
Oct 2017	0.4	D.J. Dreyer	Final Draft Document for Comments Review Process
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6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

Name	Business Unit
DJ Dreyer	Kriel Power Station – Electrical Engineering
MJ Manyage	Gx Engineering - Electrical

7. ACKNOWLEDGEMENTS

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

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APPENDIX A: QUALITY INSPECTION REPORTS

QUALITY INSPECTION REPORT 1 – MECHANICAL CHECKS

Location/Unit Number		Serial Number	
Motor Type		Supply Voltage (V)	
Output Power (kW)		Insulation Class (F)	
Rated Current (A)		Frequency (Hz)	
Speed(rpm)		Other	

MMD activity	Outcome			Comments
General checks				
Transport locking device removed	Yes		No	
Motor foundation checked and in good condition	Yes		No	
Tightness of mounting bolts checked	Yes		No	Bolt size: _____ Torque: _____ Nm
Any abnormal noises detected when motor was turned by hand (if possible)	Yes		No	
Self-lubrication checks				
Bearing oil reservoirs checked – Recommended oil used	Yes		No	Manufacturer: _____ Type: _____
Bearing oil reservoirs checked – Correct level	Yes		No	Please mark sight glass level: DE  NDE 
Lubrication rings rotate freely	Yes		No	
Jacking oil pumps checked	Yes		No	
Flood lubrication checks				
Recommended oil used	Yes		No	Manufacturer: _____ Type: _____
Lubrication rings rotate freely	Yes		No	
Lubrication oil pressure correct	Yes		No	Pressure: _____ kPa
Lubrication oil flow correct	Yes		No	Oil flow: _____ L/min
Rotation of lubrication oil pumps checked	Yes		No	
Jacking oil pumps checked	Yes		No	
Oil/Water system running, pipe connections in order with no leaks	Yes		No	
Oil filters checked	Yes		No	
Cooling water system				
Cooling water system connected?	Yes		No	
Start CW system. Leaks detected?	Yes		No	
Cooling water pressure correct?	Yes		No	Pressure: _____ kPa
Cooling water flow correct?	Yes		No	Water flow: _____ L/min
Alignment Checks				
Was laser alignment performed?	Yes		No	If no, why? _____ Approved by line manager: _____
Is alignment within tolerances?	Yes		No	Note highest tolerance value recorded: _____ mm
Was the alignment checksheet used?	Yes		No	

Supervisor Name _____

Signature _____

Date _____

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QUALITY INSPECTION REPORT 2 – ELECTRICAL CHECKS

Location/Unit Number		Serial Number	
Motor Type		Supply Voltage (V)	
Output Power (kW)		Insulation Class (F)	
Rated Current (A)		Frequency (Hz)	
Speed(rpm)		Other	

EMD activity	Outcome			Comments
General checks				
Visual inspection performed	Yes		No	
Motor and earthing cables checked	Yes		No	
Phasing of motor cables done	Yes		No	
Termination Box and cable tightness checked	Yes		No	Torque: _____ Nm (Appendix B for specification)
Auxiliary cooling fans connected and direction checked	Yes		No	
Space heaters operating on automatic	Yes		No	
Check surge arrestor cable tightness	Yes		No	
Insulation resistance test				
Stator winding IR tested	Yes		No	Resistance: _____ MΩ Tested at: _____ kV Temperature: _____ °C Humidity: _____ g/m ³
Stator winding PI tested	Yes		No	PI= _____ Tested at: _____ kV
Space heater insulation resistance tested	Yes		No	Resistance: _____ MΩ To be tested at 500V
Non-drive end bearing insulation tested	Yes		No	Resistance: _____ MΩ To be tested at 500V
Accessories resistance test				
Stator 1 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 2 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 3 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 4 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 5 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 6 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 7 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 8 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 9 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 10 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 11 Pt 100:	Yes		No	Resistance: _____ Ω
Stator 12 Pt 100:	Yes		No	Resistance: _____ Ω
Bearing temperature detector tested Drive end	Yes		No	Type: <input type="checkbox"/> PT 100 <input type="checkbox"/> Thermocouple
Bearing temperature detector tested Non-Drive end	Yes		No	Type: <input type="checkbox"/> PT 100 <input type="checkbox"/> Thermocouple

Supervisor Name

Signature

Date

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QUALITY INSPECTION REPORT 3 – ELECTRICAL PROTECTION CHECKS

Location/Unit Number		Serial Number	
Motor Type		Supply Voltage (V)	
Output Power (kW)		Insulation Class (F)	
Rated Current (A)		Frequency (Hz)	
Speed(rpm)		Other	

PTM activity			
Description of protection	Value and time	Date checked	Name and signature
Thermal Overload (θt)			
Instantaneous Overload ($I >>$)			
Earth fault (I_0)			
Differential protection ($3\Delta I$)			
Negative phase sequence (I_2)			
Phase imbalance (ΔI)			
Polarity checks confirmed			
Stall protection			

Supervisor Name

Signature

Date

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QUALITY INSPECTION REPORT 4 – INSTRUMENTATION CHECKS

Location/Unit Number		Serial Number	
Motor Type		Supply Voltage (V)	
Output Power (kW)		Insulation Class (F)	
Rated Current (A)		Frequency (Hz)	
Speed(rpm)		Other	

CID activity	Outcome			Comments
Temperature monitoring				
Winding Pt 100's or thermocouples connected		Yes	No	Alarm: _____ °C
DE and NDE thermocouples or Pt 100's connected		Yes	No	Alarm: _____ °C Trip: _____ °C
Cooling water leak detectors connected		Yes	No	
Air circuit temperature detectors connected		Yes	No	Alarm: _____ °C Trip: _____ °C
Vibration monitors connected		Yes	No	Value at motor standstill DE: _____ mm/s NDE: _____ mm/s

Supervisor Name

Signature

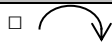

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QUALITY INSPECTION REPORT 5 – OPS CHECKS

Location/Unit Number		Serial Number	
Motor Type		Supply Voltage (V)	
Output Power (kW)		Insulation Class (F)	
Rated Current (A)		Frequency (Hz)	
Speed(rpm)		Other	

OPS, EMD and MMD activity	Outcome			Comments
First start (A few seconds only)				
Direction of the motor correct (viewed from Drive end)		Yes	No	<input type="checkbox"/>  Clockwise <input type="checkbox"/>  Anti-Clockwise
Are there any abnormal noises		Yes	No	
Second start (Uncoupled)				
Are there any abnormal noises		Yes	No	
Machine running OK		Yes	No	If no, why? _____

Uncoupled running checks:

Time	Bearing temperature(°C)		Stator winding temps.(°C)			Stator current (A)
	Drive end	N-Drive end	U	V	W	
00:00						
00:05						
00:10						
00:20						
00:30						
00:40						
00:50						
00:60						

Coupled test run

Time	Load (%)	Bearing temperature(°C)		Stator winding temps.(°C)			Stator current (A)
		Drive end	N-Drive end	U	V	W	
00:00							
00:05							
00:10							
00:20							
00:30							
00:40							
00:50							
00:60							

Supervisor Name

Signature

Date

CONTROLLED DISCLOSURE

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QUALITY INSPECTION REPORT 6 – MMS (MOTOR MONITORING SERVICES) CHECKS

Location/Unit Number		Serial Number	
Motor Type		Supply Voltage (V)	
Output Power (kW)		Insulation Class (F)	
Rated Current (A)		Frequency (Hz)	
Speed(rpm)		Other	

MMS activity	Outcome		Comments
Second start (Uncoupled)			
Does the machine vibrate abnormally?	Yes	No	Where: _____
Bearing vibrations measured	Yes	No	Drive end: _____ mm/s Non-drive end: _____ mm/s

Running Checks:

Time	Bearing vibration levels(mm/s)						Motor vibrations (mm/s)	
	Drive end			Non-drive end			Drive end foot	Non drive end foot
	Vertical	Horizontal	Axial	Vertical	Horizontal	Axial		
00:00								
00:05								
00:10								
00:20								
00:30								
00:40								
00:50								
00:60								

Coupled test run

Does the machine vibrate abnormally?	Yes	No	Where: _____
Bearing vibrations measured	Yes	No	Drive end: _____ mm/s Non-drive end: _____ mm/s

Running Checks:

Time	Bearing vibration levels(mm/s)						Motor vibrations (mm/s)	
	Drive end			Non-drive end			Drive end foot	Non drive end foot
	Vertical	Horizontal	Axial	Vertical	Horizontal	Axial		
00:00								
00:05								
00:10								
00:20								
00:30								
00:40								
00:50								
00:60								

Supervisor Name _____

Signature _____

Date _____

CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

APPENDIX B: TIGHTENING TORQUE SPECIFICATIONS**Table 2: Bolt tightening torque specifications**

	Tightening torques (in Nm with tolerance of 10% for specified thread sizes)							
	M5	M6	M8	M10	M12	M16	M20	M24
Case A	2.5	4.0	8.0	13	20	40	-	-
Case B	2.6	4.5	10	20	34	83	160	280
Case C	5.0	8.0	20	40	70	170	340	600

Case A tightening torques:

- For most electrical connections where the permissible torque is usually limited by the bolt materials and/or the load capability of the insulators (except for bus bar connections as per Case B).
- Bolts strengths below 5.6.

Case B tightening torques:

- For bolts with strengths class 5.6 and higher, or
- For bolts in components with low material strength (e.g. aluminium)

Case C tightening torques:

- For bolts with strength class 8.8 (or A4-70), but only for connecting components with high material strength (e.g. grey cast iron, steel or cast steel).

***Note on mechanical strength:**

The numbers stamped on the head of the bolt are referred to the grade of the bolt used in a certain application with the strength of a bolt. High-strength steel bolts usually have a hexagonal head with an ISO strength rating (called property class) stamped on the head. The absence of marking/number indicates a lower grade bolt with low strength. The property classes most often used are 5.8, 8.8, and 10.9. The number before the point is the ultimate tensile strength in MPa divided by 100. The number after the point is the multiplier ratio of yield strength to ultimate tensile strength. For example, a property class 5.8 bolt has a nominal (minimum) ultimate tensile strength of 500 MPa, and a tensile yield strength of 0.8 times ultimate tensile strength or $0.8(500) = 400$ MPa.

Ultimate tensile strength is the stress at which the bolt fails. Tensile yield strength is the stress at which the bolt will receive a permanent deformation (an elongation from which it will not recover when the force is removed) of 0.2% offset strain. When elongating a fastener prior to reaching the yield point, the fastener is said to be operating in the elastic region; whereas elongation beyond the yield point is referred to as operating in the plastic region, since the fastener has suffered permanent plastic deformation.

Mild steel bolts have property class 4.6. High-strength steel bolts have property class 8.8 or above.

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APPENDIX C: TYPICAL MOTOR LAYOUT

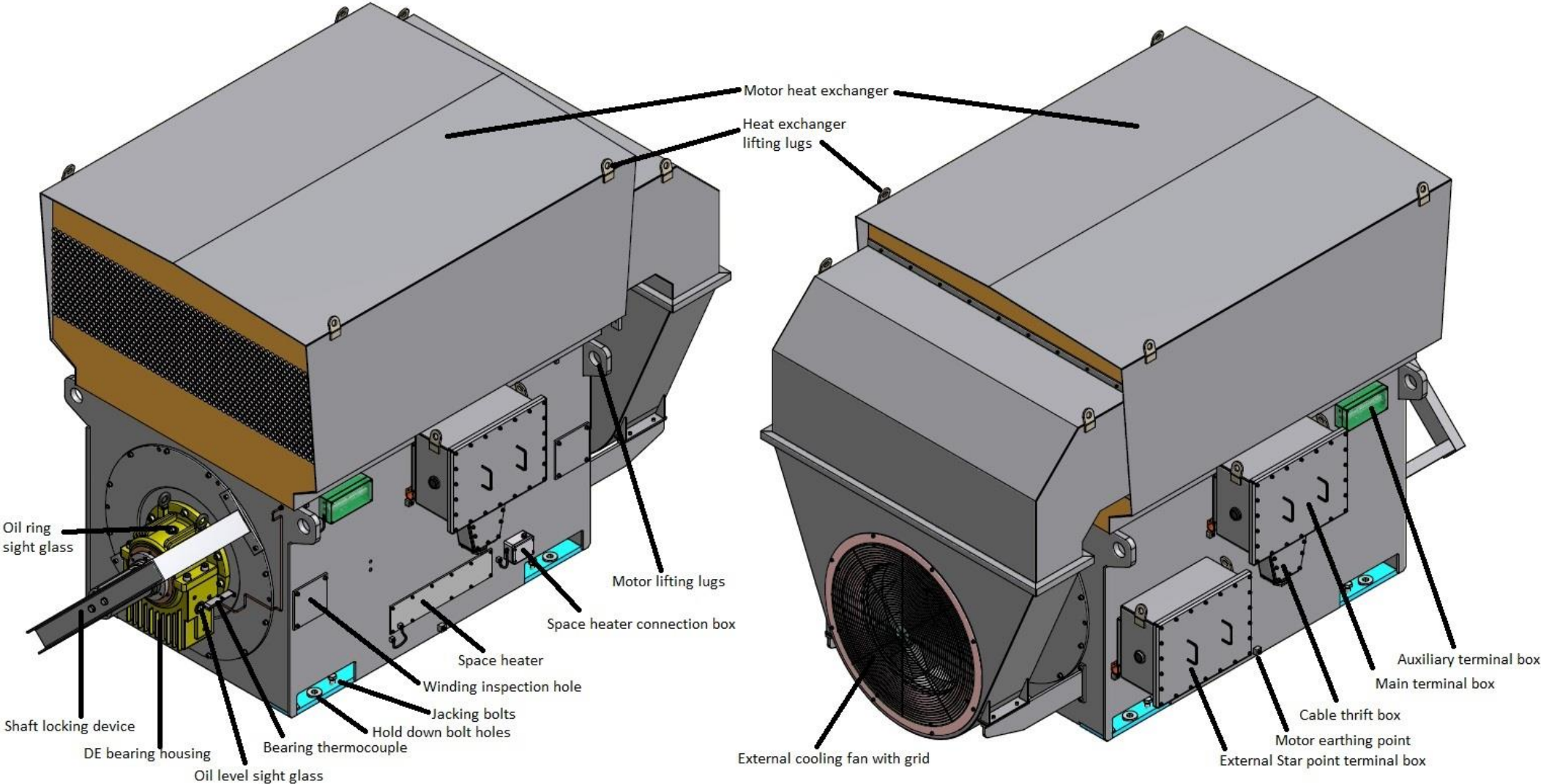


Figure 1: Typical Motor Layout