	Work Instruction	Risk & Sustainability Division/ Renewables Business Unit
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Title: **Crane, Hoist and Service Lift
Load Testing at Sere Wind Farm**

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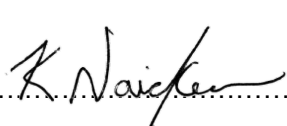
Compiled by



Gideon Van der Merwe
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Date: 7 September 2020


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Renewables Business Unit

Date: 7 September 2020

Authorised by



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Date: 7 September 2020

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1. Introduction

This document provides the Work Instruction for the statutory annual load test on cranes, hoists and Avanti lifts as per the requirements of OCCUPATION HEALTH AND SAFETY ACT (OHS ACT 85 OF 1993) with particular reference to the DRIVEN MACHINERY REGULATION 18 – LIFTING MACHINES AND LIFTING TACKLE –SUB-REGULATION 5 (a) at Sere Wind Farm.

1.1.1 Purpose

To specify the employer's requirements for the statutory annual load test on cranes, hoists and service lifts inside wind turbines.

1.1.2 Applicability

This document shall apply throughout Eskom Holdings SOC Ltd Risk & Sustainability Division.

1.1.3 Effective date

This Work Instruction shall be effective once signed by the authorising manager.

1.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

1.2.1 Normative

[1] ISO 9001 Quality Management Systems.

1.2.2 Informative

[2] Occupational Health and Safety Act No. 85 of 1993 and Regulations

1.3 Definitions

Definition	Description
Contractor	A LME that undertakes a task to perform Crane, Hoist and Service Lift Load Tests according to this Scope of Work and OHS ACT.
Employer	Eskom Holdings SOC Ltd
LME	"lifting machinery entity" means a legal entity approved and registered by the chief inspector in terms of regulation 19 of the DMR

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Definition	Description
LMI	"lifting machinery inspector" means a person who is employed by a Lifting Machinery Entity and who is registered by the Engineering Council of South Africa in terms of the Engineering Profession Act, 2000 (Act No. 46 of 2000);
Nacelle	Is a cover housing that houses all of the generating components in a wind turbine, including the generator, gearbox, drive train, and brake assembly.
Plant	Means WTG and includes the foundation bolts, service maintenance lifts, and electrical balance of plant and SCADA system.
Site	Lot 1862 Olifants River Settlement, Koekenaap, Western Cape, South Africa
Wind Turbine Generator or WTG	Means a wind turbine generator so described in this Scope of Work, including without limitation the nacelle, rotor(s), blades, controller(s), turbine switchgear and transformer(s), and all associated equipment (including the SCADA system), parts and components.

1.3.1 Disclosure Classification

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

1.4 Abbreviations

Abbreviation	Description
DMR	Driven Machinery Regulations
GPS	Global Positioning System
ISO	International Standards Organisation
LME	Lifting Machinery Entity
LMI	Lifting Machinery Inspector
m	meter
m/s	meters/second
MW	Megawatt
km	kilometer
kg	kilogram

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Abbreviation	Description
kV	kilovolt
OHS ACT	Occupational Health and Safety Act
O&M	Operation and Maintenance
PPE	Personal Protective
SHE	Safety Health & Environment
SOC	State Owned Company
WTG	Wind Turbine Generator

1.5 Roles and Responsibilities

It is the responsibility of the O&M Manager at Sere Wind Farm and the Renewables O&M manager to ensure that this document is implemented.

1.6 Process for Monitoring

N/A

1.7 Related/Supporting Documents

N/A

2. Crane, Hoist & Service Lift Load Testing at Sere Wind Farm

2.1 Location

Sere Wind Farm is located near Koekenaap in the Western Cape, South Africa. The Wind Farm's precise location is in Lot 1862 Olifants River Settlement as shown in Figure 1 below. GPS Co-ordinates (31.5288513S 18.1925658E). The nearest major town from the Wind Farm is Vredendal, which is located 55km away. The distance between Sere Wind Farm and Cape Town International Airport is 356km via the N7.

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Figure 1: Location of Sere Wind Farm

2.2 Description of Sere Wind Farm

Sere Wind Farm consists of 46 Wind Turbines (SWT 2.3-108) having a total capacity of 105.8MW. Each wind turbine has a 2.3MW asynchronous generator located in the nacelle and a converter located at the bottom of the tower. The 0.69/33kV transformer for each Wind Turbine Generator (WTG) is located on a plinth next to the tower. The 3-bladed horizontal, upwind rotor has a diameter of 108m. Each blade has a length of 53m consisting of glass fibre reinforced epoxy resin. The active yaw system consists of an externally geared slew bearing driven by eight braked electric motors. The Main bearing is of the spherical roller type. The 3-stage Winergy planetary gearbox has an inline and offline filter. The tapered tubular tower has a hub height of 115m.

2.3 Scope of Work

2.3.1 DMR 18 Subsection 5 (a) states “at intervals not exceeding 12 months: provided that, in the absence of a manufacturing standard or a standard incorporated under section 44(1) of the Act, the whole installation of the lifting machine shall be tested with 110% of the safe working load applied over the complete lifting range of such machine and in such a manner that every part of the installation is stressed accordingly”

2.3.2 DMR 18 Subsection 5 (b) states “The lifting machinery inspector of the lifting machinery entity referred to in paragraph (a) must have knowledge of the erection, load-testing and maintenance of the type of lifting machine or similar machinery involved.

2.3.3 The contractor shall provide a Load Test Certificate for each of the lifting machines in each Wind Tower located at Sere Windfarm. Each Load Test Certificate shall have all relevant information such as the manufacturer, serial number, safe working load, certificate number, customer name, site address, item location, description of item, overload applied, remarks, tested by, LMI Registration No, LME number, etc.

2.3.3 The LMI who is employed by a LME shall perform the load tests on the lifting machinery in each of the wind towers. There are 46 Wind Turbines at Sere Windfarm. The jib crane and chain hoist is located in the nacelle of the wind turbines.

The load tests per Wind Tower are for the following lifting machines:-

- 1) HMF Handy 265 Folding Hydraulic jib arm crane

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2) 250kg Liftket chain hoist

3) Avanti Lift

The jib crane is fitted with the 250kg Liftket electrical chain hoist. Appendix A shown a picture of the jib crane in the nacelle and the nameplate of the hoist. The Avanti Lift data is shown in Table 1 below.

Table 1

Name of Manufacturer	Avanti
Year of Installation	2014
Rated load	240kg
Total weight	405kg
Rated speed	0.3m/s
Travel Distance	101 -110 m

Refer to Appendix C, D and E for test methods on Avanti lift, HMF crane and Liftket chain hoist.

2.4 Safety

2.4.1 Access

2.4.1.1 Contractors are not allowed access to the Wind Turbines unless they are accompanied by an Eskom/Siemens Authorised person. The Authorised person is responsible for the safety of visitors. Authorised persons shall use the Permit to Work System to isolate plant so that work can be performed safely.

Always wear a helmet when:

- Work is in progress at more than one level, one or more persons work above you.
- Being on sites where turbines are erected or disassembled.
- Working with heavy objects, which may swing in your direction and accidentally hit you.
- Working on the outside of the turbine.
- Working with or near crane operations.

2.4.1.2 The Contractor shall provide his own helmet with chinstrap, safety boots and clothing.

2.4.1.3 The Employer shall provide the Safety harness, and ensure that the visitor has correctly adjusted the safety harness.

Always use harness when:

- Harness must be worn when ascending/descending towers equipped with ladders.
- Ascending / descending towers with service lift. If one person in the service lift; the harness must be brought - 2 persons in the service lift the harness must be worn.
- Harness must be worn when staying in tower, platforms, or nacelles at the risk of falling over the edge.

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- Harness must be worn whenever there is a risk of a fall likely to cause injury.

2.4.1.3 The Contractor shall at all times comply with all health and safety laws and statutory requirements relevant to the Site (including but not limited to, all national and international legal requirements, including but not limited to the Occupational Health and Safety Act 85 of 1993, the Mine Health and Safety Act 29 of 1996, and the National Environmental Management Act 107 of 1998), the Plant and the Services and take all reasonable precautions to maintain the health and safety of the Contractor's Personnel and such other persons authorised to be on the Site.

2.4.1.4 Without prejudice to the generality of the above, the Contractor shall itself and shall ensure that its employees, agents and Sub-Contractors comply with the Site Safety Rules and the Employer's Policies and Procedures.

2.4.2 Safety File

2.4.2.1 The minimum SHE file requirements are shown in Appendix B.

3. Acceptance

This document has been seen and accepted by:

Name	Designation
Lehlohonolo Tinte	Senior Manager Renewables
Kuben Naicker	Maintenance Manager - Renewables
Gideon Van Der Merwe	Maintenance – Sere Wind Farm

4. Revisions

Date	Rev.	Compiler	Remarks
September 2020	1	Gideon v/d Merwe	First Revision

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5. Appendix A



HOFFMANN Fördertechnik GmbH Wurzen Dresdener Straße 64-68 / Wurzen / Germany Tel. +49 3425 89240 / http://www.liftket.de			LIFTKET		
ELEKTROKETTENZUG / ELECTRIC CHAIN HOIST					
Typ/type 050/92		Fabrik-Nr./serial no.: D25036		Baujahr/fabr. year 2013	
Laststränge/load falls	1	KLOR 71G2		60% ED	240 S/h
Traglast/S.W.L. (kg)	250	690V; 50 // 60 Hz; 3 ph		FEM/ISO	3m/M6
Hub/speed (m/min)	24,0 // 28,8	1,1kW // 1,1kW		Klasse/class	F; IP55
Kette/chain (mm)	5,2x15	EN 818-7, T	1,6A // 1,7A	Steuerung/control 24 V AC	
FEM/ISO Kette/chain	1Bm/M3	2830U/min // 3380U/min		cos φ 0,76 // 0,82	
Prüf./cert08057		D8		Made in Germany	
					

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6. Appendix B

Minimum SHE File Requirements

1. Instruction to HS Plan
2. Principal & Sub contractor information
3. Management & Supervisor Training
4. Notification of Construction Work
5. Letter of good standing
6. Statutory appointments
7. List of appointments
8. HIRA- (Hazard Identification Risk Assessment)
9. Induction Training
10. Fall Protection Plan
11. Certificate of medical fitness
12. Tools, equipment inspection register
13. Certificate of Compliance, PPE register
14. Hazardous Chemical Substance Control
15. Certificate of competency- Training
16. Incident Records
17. Policy
18. NCR
19. Minutes of toolbox talks/ SHE Meetings
20. Audit report
21. Disciplinary records

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7. Appendix C

7.1 Avanti lift load test setup

1. Position lift in a suitable height above ground level platform.
2. Mount tool bar at bottom part of lift.



3. Mount elastic band in eye bolt



4. Mount shackle and load cell



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5. Mounting of shackles, load cell and sling
6. Dismount 2 of 3 cable bin straps
7. Pull aside the cable bin to get space to mount shackles, sling, and load cell
8. Lower sling through power cable opening in platform
9. Find best placed foundation bolt below cable bin



10. The bracket must fit center of cable bin best possible
11. Mount bracket and secure it with an extra nut. Just hand tighten nut.



12. Mount sling in bracket
13. Switch on load cell and prepare for test

7.2 Avanti lift load test procedure

1. Add load on lift cage and check of overload setting. **Caution: Stay clear of elastic band during test.**
2. Technician enter lift and drive up until lift stops - overload must activate and buzzer sound. The buzzer should sound between 300 - 320 kg - adjust setting, if not. Note: The overload must activate between 300 - 320 kg - buzzer should sound. Load cell readout includes weight of technician operating the service lift. Example: If technician weighs 80 kg, the load cell must display 220 - 240 kg. Repeat load test 3 times and calculate the average. If not between 300 - 320 kg adjust overload setting.

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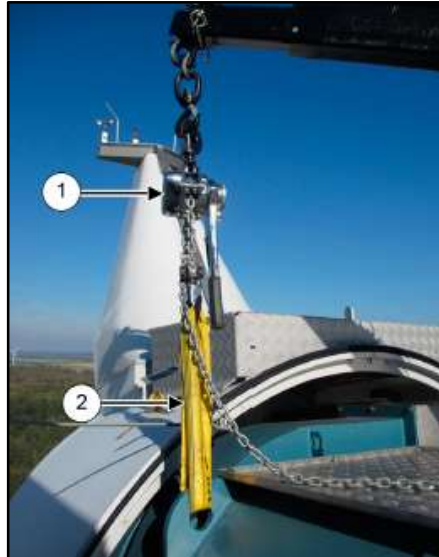
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8. Appendix D

8.1 HMF crane load test setup

Check load holding valve pressure setting

1. Rig up test assembly according to below picture and attach load cell.



- (1) Chain block (min. 1500 kg SWL)
- (2) Lifting strap (min. 2000 kg SWL)

2. Adjust crane boom to achieve a vertical pull through the strap and the chain hoist.
3. Connect a calibrated pressure gauge to the test port on the load-holding valve of the main boom cylinder.



- (1) Test port at load holding valve of main boom cylinder

4. Raise crane arm until the chain block and lifting strap is without slack.
5. Stop the hydraulic pump.
6. Reset pressure gauge

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7. Tighten the chain block until the pressure reaches the test pressure stated in the table below.

Crane type	Test pressure [bar]	Max. allowed pressure drop [bar]
HMF 250/252	170-175	15
HMF 260/262	175-180	15
HMF 265	190-195	15

8. After 10 seconds, note the start pressure setting in the checklist.
9. Wait for two minutes to allow pressure to drop, if any external leaks are present.
10. When two minutes has passes, note the final pressure setting in checklist.
11. The maximum pressure drop must not exceed 15 bar.
12. Keep the load for an additional 8 minutes.
13. Release tension.
14. Using the load cell and chain block perform the 110% load test.

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9. Appendix E

9.1 Liftket 250 clutch, brake and load test device setup

1. Configuring spring load test device (Certex)
 - Before initiating load test, make sure that the test device is adjusted to the correct load setting.
 - The test device consist of 3 springs, which can be configured in four different load cases.



- The spring load device configurations are indicated in table below.

Configuration	Load [kg]	Spring no. 1	Spring no. 2	Spring no. 3	Spring no. 3	Spring no. 2	Spring no. 1
1	175		X				X
2	200		X			X	
3	350	X	X			X	X
4	490			X	X		

- Each spring can be engaged/disengaged using thumbscrews.
- Configuration 3 is required for the Star Liftket 250 kg hoist.
- Engage springs 1 and 2. (both springs 1 and both springs 2) Note: Tighten thumbscrews fully before test.
- Disengage spring 3. (Both springs numbered 3)



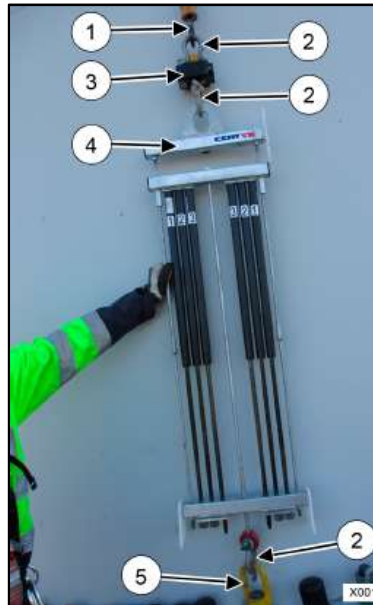
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9.2 Test set-up using spring load test device

1. Set up test clutch test.



- (1) Chain hoist hook
- (2) Enclosed shackle
- (3) Load cell
- (4) Spring load test device
- (5) Eye nut on foundation

2. Yaw the nacelle so that the chain hoist is in correct position in relation to the anchorage point on foundation. Note: Nacelle must not yaw automatically when turbine is stopped.
3. Use hand control to lower the chain to the foundation.
4. Check chain visually and listen for abnormal noise during movement.
5. Attach the chain hook to the upper enclosed shackle.
6. Attach lower enclosed shackle to lifting sling.
7. Hand tighten the M48 eye nut on the foundation bolt.



8. Attach lower enclosed shackle to eye nut.

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9.3 Test clutch

1. Switch on and reset load cell.
2. Test the overload protection by activating the chain hoist until the clutch slips at approximately 325 – 350 kg. Keep holding the 'Up' button until maximum value is displayed observing that clutch does not slip more than three seconds. Test load = (nominal load x dynamic factor), Nominal load = 250 kg, Dynamic factor = 1.3 – 1.4
Note: if the clutch setting is incorrect, follow procedure to adjust friction clutch.

9.4 Test brake retention

1. Switch on and reset load cell.
2. Activate the chain hoist until the clutch slips at approximately the set value according to the "Test clutch" procedure.
3. Make a mark on the chain to indicate stop position.



4. Hold the test load for 10 minutes.
5. After the 10 minutes has passed, check/measure that the chain has not moved according to the mark.
6. Check that load cell indicates at least 250 kg after the test and release the tension on the test set-up. Note: If the brake fails this test, replace brake.

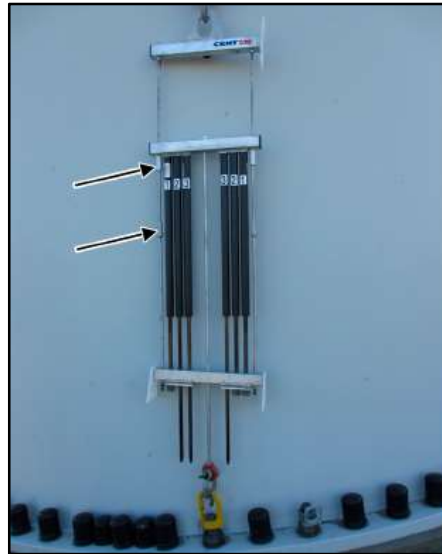
9.5 Dynamic test using spring load test device

1. Switch on and reset load cell.
2. Activate 'Up'/'Down' buttons three times, driving the chain between full load and no load.
Note: Do not hit end stops during test.
3. Notice and listen if the hoist is operating normal.
4. Activate 'Up' button until the clutch slips.
5. Activate 'Down' button and release immediately.
6. Check that the chain hoist brake stops the load within the length of approximately two chain link lengths.

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(1) Arrows indicating end stops

7. Check that load cell indicates at least 250 kg after the brake test. **Note:** This is to ensure brake has been tested at nominal load 250 kg. If load cell indicates less than 250 kg, do test again.
8. When braking the nominal load during lowering, the load must stop after approximately two chain link lengths. If not, replace brake.

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