DOCUMENT NO.: KP1/13D/4/1/TSP/09/090

Kenya Power

HORIZONTAL TENSILE TESTING MACHINE

— SPECIFICATION

A Document of the Kenya Power & Lighting Company Plc.

May 2024

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01. Circulation List

COPY NO.	COPY HOLDER
1	Manager, Standards
Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?fFolderId=23)	

REVISION OF KPLC STANDARDS

In order to keep abreast of progress in the industry, KPLC standards shall be regularly reviewed. Suggestions for improvements to approved standards, addressed to the Manager, Standards Department, are welcome.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2024-05-28	Date: 2024-05-28

02. Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 1 Rev 0	2024-05-28	New Issue	Rotich Benard	Dr. Eng. Peter Kimemia

FOREWORD

This specification has been prepared by the Standards Department in collaboration with Quality Control Section, Supply Chain, Logistics Department, both of the Kenya Power and Lighting Company Plc (Kenya Power) and it lays down requirements for Horizontal Tensile Testing Machine (servo-hydraulic type) herein called the 'machine'.

This machine shall be used for mechanical testing of insulators, stay rods, stay wire, stay insulators, conductors, etc., to determine their mechanical strengths e.g. Specified mechanical Load (SML), Tension Proof Load, , Breaking Strength, Failure Loads, etc.

The machine shall be designed to ascertain the mechanical properties of such materials to a load of 200kN. Information obtained from these tests shall be useful in quality control and mechanical property evaluations for line hardware items procured by Kenya Power.

The machine shall be supplied, installed, tested and commissioned at the Kenya Power's Materials Testing Facility located at Donholm in Nairobi, Kenya.

The specification stipulates the minimum requirements for Machine acceptable for use in KPLC. It shall be the responsibility of the supplier to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards, regulations and specifications in the manufacture of the Machine for Kenya Power and Lighting Company PLC.

Users of this KPLC specification are responsible for its correct interpretation and application.

The following are members of the team that developed this specification:

No	Name	Department
1.	Wesley Terer	Logistics, Supply Chain
2.	Rotich Benard	Standards, IESR

1. SCOPE

This specification covers Horizontal Tensile Testing Machine and covers the supply, delivery, installation and commissioning, and training on the operation and routine maintenance of the machine.

2. REFERENCES

2.1. NORMATIVE

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) shall apply.

ISO 376:	Metallic materials - Calibration of force-proving instruments used for the verification of uniaxial testing machines
ISO 6892:	Metallic materials - Tensile testing at ambient temperature
ISO 7500-1:	Metallic materials - Calibration and Verification of static uniaxial testing Machines, Part 1: Tension/compression testing machines — Calibration and Verification of the force-measuring system
ISO 9513:	Metallic materials - Calibration of extensometer systems used in uniaxial testing
IEC 60120	Dimensions of Ball and Socket Couplings of String Insulator Units
IEC61109:	Insulators for overhead lines - Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria
ASTM E4:	Practices for Force Verification of Testing Machines
ASTM E74:	Practice for Calibration of Force Measuring Instruments for Verifying the Force Indication of Testing Machines
ASTM E83:	Practice for Verification and Classification on Extensometer Systems
ASTM E1012:	Practice for Verification of Test Frame and Specimen Alignment under Tensile and Compressive Axial Force Application
ASTM E1856:	Standard Guide for Evaluating Computerized Data Acquisition Systems Used to Acquire Data from Universal Testing Machines

2.2. **INFORMATIVE**

ISO/IEC 17025: General Requirements for the Competence of Testing and Calibration Laboratories

ASTM E8 / E8M: Standard Test Methods for Tension Testing of Metallic Materials

International Vocabulary of Basic and General Terms in Metrology (VIM), BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2nd edition, 1993

International Organization of Legal Metrology (OIML) document, *Vocabulary of Legal Metrology — Fundamental Terms*, 2000

KP1/6C/4/1/TSP/09/98: Universal Testing Machine — Specification

3. TERMS AND DEFINITIONS

For the purpose of this specification, the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

The Horizontal Tensile Testing Machine shall be suitable for continuous operation indoors in tropical areas at:

a) Altitudes of up to 2200m above sea level;
b) Humidity of up to 95%;
c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C

4.2. DESIGN AND CONSTRUCTION

4.2.1. The Digital Horizontal Tensile Testing Machine shall be manufactured to ISO 7500-1and ISO 9513.

4.2.2. The machine shall be Class 0.5 as per ISO 7500-1 with a minimum load capacity of 200kN and shall be used for testing insulators, stay rods, stay wire, stay insulators, conductors, rope, slings, chains, belts or other large or long test pieces.

4.2.3. The machine shall be able to test line hardware and give the following mechanical strength measurements:

a) Specified mechanical Load (SML) as per ANSI C29.12
b) Tension Proof Load
c) Impact Strength

d) Ultimate breaking strength
e) Failure load

4.2.4. The machine shall be Servo Hydraulic type. The hydraulic cylinder and the servo system shall work together to apply a precise motion and force.

4.2.5. These test frames powered by hydraulics for high strength testing shall be adjustable in length to meet a variety of application requirements and with modifiable/changeable grips to accommodate different shaped specimens.

4.2.6. The machine frame shall be horizontal with heavy duty channels to sustain load and vibration for maintaining load capacity of up to 200 kN.

4.2.7. The machine shall be light weight, compact size, easy to operate and with noise free operation.

4.2.8. The machine shall have safety screens that are moveable to allow protection in relevant areas and a safety cage, as shown in Fig 1, to protect the operator during testing.

4.2.9. The Horizontal Tensile Testing Machine shall be Digital and also have the following minimum characteristics, features and ratings as shown in Table 1:

Table 1: Technical Details of the Horizontal Tensile Testing Machine

No	Description	Minimum Requirement
1.	Load Capacity	200 kN
2.	Load cell capacity (Tensile Mode)	200 kN (With Calibration Certificate ISO/IEC 17025 accredited testing facility)
	Accuracy of Load cells	1% or better
3.	**Dimensions and Features**	
	Machine Frame	Horizontal and sustain up to 200 kN
	Maximum length of the test piece	5000 mm
	Overall dimensions of the equipment	Supplier to state
4.	**Drive system**	
	Crosshead traverse Speed	1 mm to 500 mm/min (step less variable) or wider range with return option.
5.	**Force Measurement System** *(as per ISO 7500-1)*	
	Accuracy	± 0.5%
	Repeatability	0.5
	Reversibility	± 0.75
	Zero	± 0.05

No	Description	Minimum Requirement
	Relative resolution	0.25
6.	**Strain Measurement System (extensometer)**	
	Extensometer Measuring Range	At least 1200 mm
	Extensometer Accuracy	± 0.5% or 0.5 µm
	Extensometer Resolution/ Discrimination	0.1 µm or 0.0004% of range
7.	Data acquisition	As per ASTM E1856
8.	Power Supply	230V 50Hz Single Phase

4.3. CONTROL SYSTEMS AND SOFTWARE FEATURES

4.3.1. The machine shall have a control panel for conducting the tests specified in Clause 4.2.3.

4.3.2. The Control Panel shall display all operational data e.g. displays all crosshead traveling values in relation to actual load value vs elongation.

4.3.3. The control panel shall allow the selection of the available functions and control values by the operator

4.3.4. **Display and Output**

4.3.4.1. The machine shall offer real-time graphic display of the tests via the control panel or/and PC monitor.

4.3.4.2. The machine shall have USB-2, LAN and wireless connection interfaces to the latest PC and printer.

4.3.4.3. Selectable graphical display presentation shall be possible as the tests progress. Test parameters shall be displayed with graph simultaneously.

4.3.4.4. The machine shall have a memory function for test data to be stored for future reference, reports, certification or presentations.

4.3.4.5. The Control Panel shall display all operational data e.g. displays all crosshead traveling values in relation to actual load value vs elongation.

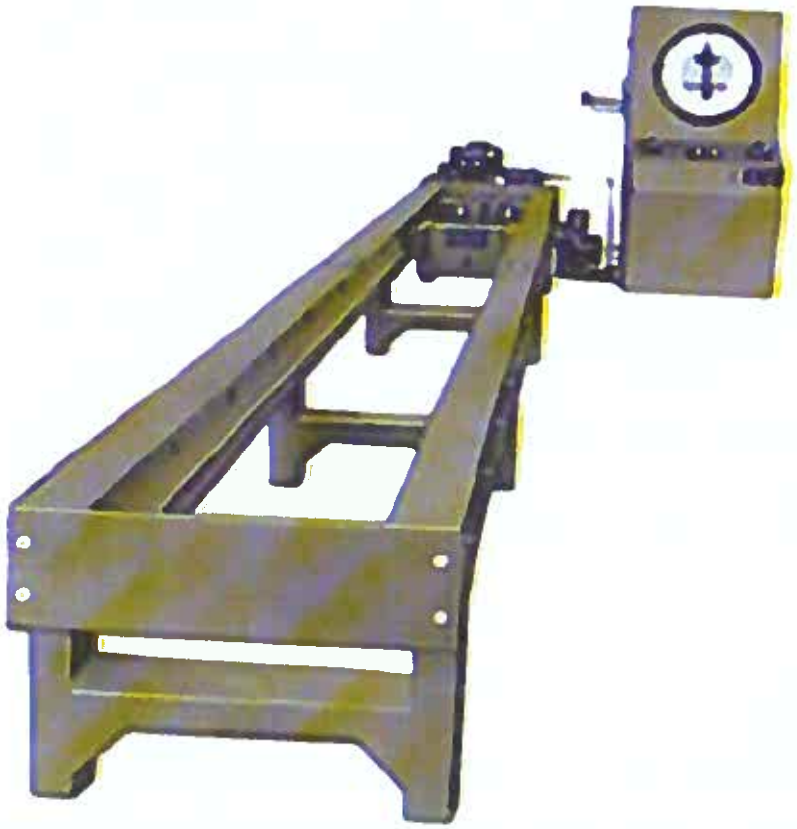

Figure 1: Horizontal Tensile Testing Machine

4.4. SPECIAL FEATURES

4.4.1. The following various measurement units shall be selectable on the control panel:

a) Load - kN, Kg, N

b) Stress - kN/mm^2, N/mm^2, MPa, Kg/mm^2

c) Displacement- mm

4.4.2. The operation shall have automatic Stop or Return following a sample break and auto shutdown on failure or on over-limit values.

4.4.3. The load cell used shall offer one-touch zero adjustment with load cell capacity discrimination to guarantee accuracy and speed during the setup process.

4.5. STANDARD ACCESSORIES

The machine shall be supplied complete with all components and accessories for intended applications including the following:

a) A full set of installation, commissioning and maintenance manuals for each unit, describing the settings and configuration of the controls.

b) A wide variety of grips and fixtures.

4.6. ACCURACY AND CALIBRATION

The machine shall be calibrated in accordance with the procedures laid out in ISO 7500-1:2018.

4.7. SPARES AND WARRANTY

4.7.1. All spares, labour, consumables and other costs required for proper functioning of the equipment including re-calibration during the **first twelve months (12)** after installation & commissioning shall be provided by the supplier at no cost to KPLC.

4.7.2. The minimum warranty and guarantee period required shall be a minimum of 24 months.

4.8. INSTALLATION AND COMMISSIONING

The contract shall include supply, installation, test and commissioning of the Horizontal Tensile Testing Machine. All parts and consumables required during installation and commissioning shall be provided by the supplier.

4.9. TRAINING

4.9.1. Following the delivery, installation and commissioning of the machine, the supplier shall conduct training for approximately 15 Kenya Power Engineers/Technicians, in Nairobi Kenya.

4.9.2. The Training shall include theory on how the equipment works followed by practical demonstrations. All the operational, protection and control features of the machine shall be exhaustively explained and demonstrated, including the operation of the interface software.

4.9.3. The Training shall be considered to have been successful once the engineers/ technicians can:

a) Competently carry out all the operations on the equipment.

b) Establish communication from computer to the control mechanism and carry out complete parameter settings and download and analyze data,

c) Trouble shoot, analyze and rectify any minor breakdowns that may occur.

4.9.4. Certificates shall be issued to participants on successful completion of the training.

4.9.5. All the costs of conducting the training including the spare parts and consumables shall be borne by the supplier.

5. TESTS AND INSPECTION

5.1 The Horizontal Tensile Testing Machine shall be inspected and tested in accordance with the requirements of this specification and applicable standards. It shall be the responsibility of the supplier to test or to have all the relevant tests performed.

5.2 After satisfactory installation and commissioning of the machine at the KPLC's Materials Testing Facility located at Donholm, performance evaluation and acceptance of the Digital Horizontal Tensile Testing Machine shall be done as per the procedure given in ASTM E1856 standard.

6. MARKING AND PACKING

6.1. MARKING

6.1.1. The following information shall be marked legibly and in a permanent manner on the machine and on each of the standard accessories:

a) The manufacturer's identity – name and trademark;

b) Model Number and serial number;

c) Month and year of manufacture;

d) Standard of manufacture;

e) Markings required by the applicable standard;

f) The words 'Property of **Kenya Power & Lighting Co. Plc.**'

6.2. PACKING

6.2.1. Each accessory for use with the machine shall be packaged in a manner to protect it from damage during transportation and storage.

APPENDICES

APPENDIX A: TESTS AND INSPECTION (Normative)

A.1. Copies of Type Test Certificates and Type Test Reports issued by a third-party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. A copy of the accreditation certificate for the testing laboratory shall be submitted with the tender (all in English Language). Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Authority.

A.2 Copies of Test Reports to be submitted shall include the tests stipulated in the relevant standards.

A.3. The Horizontal Tensile Testing Machine shall be subjected to acceptance tests at the manufacturer's premises before dispatch. The acceptance tests to be witnessed by two KPLC engineers.

A.4. On receipt of the Horizontal Tensile Testing Machine, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace/rectify without charge to KPLC, Horizontal Tensile Testing Machine that upon examination, test or use fail to meet any of the requirements in this specification.

APPENDIX B: QUALITY MANAGEMENT SYSTEM (Normative)

B.1. Supplier shall submit quality assurance plan (QAP) that shall be used to ensure that the Horizontal Tensile Testing Machine material, manufacture, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards, specifications and regulations.

B.2. The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2015 certificate (or the Diamond Mark of Quality from Kenya Bureau of Standards) shall be submitted with the tender for evaluation.

APPENDIX C: DOCUMENTATION AND DEMONSTRATION (Normative)

C.1 The bidder shall submit its tender complete with technical documents for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Fully filled clause by clause guaranteed technical particulars (GTP) signed by the manufacturer;

b) Copies of the Manufacturer's catalogues, brochures, drawings giving all relevant dimensions, Schematic Diagram and technical data;

c) Copies of required test/calibration reports of testing/calibrating laboratory accredited to ISO/IEC 17025;

d) Copy of accreditation certificate to ISO/IEC 17025 for the testing/calibrating laboratory;

e) Manufacturers letter of authorization, ISO 9001 certificate, and other technical documents required in the tender.

C.2. The successful bidder (supplier) may submit the following documents/details to KPLC for approval before manufacture:

a) Fully-filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacturer, specific values shall be filled in. Terms like "Yes", "Agree", "Complied" **shall not be acceptable;**

b) Quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations;

c) Test Program to be used after manufacture;

d) Marking details and method to be used in marking the 66kV Stay Insulators;

e) Manufacturer's undertaking to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards, regulations and specifications in the manufacture of the Horizontal Tensile Testing Machine for KPLC.

APPENDIX D: GUARANTEED TECHNICAL PARTICULARS (Normative)

(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, copies of complete type test reports and accreditation certificate to ISO/IEC 17025 for the third party testing laboratory for tender evaluation, all in English Language).

TENDER NO. ..... BIDDER'S NAME & ADDRESS .....

Clause	Description			Bidder's offer
	Manufacturer's Name			State
	Name of the item			State
	Type Reference/Model Number of item			State
	Country of manufacture			State
	List of components to be supplied (for one installation)			Specify
1.1	Scope of the work			State
1.2	Items that the machine can test			State
2	Applicable Standards			List
4.	**REQUIREMENTS**			
4.1	Service conditions			Specify
4.2.1	Manufacturing standards			State
4.2.2	Class of the machine and testing capacity			Specify
4.2.3	Mechanical measurements tested			Specify
4.2.4	Insulator end fittings compatible with the machine			State
4.2.8	The machine shall have safety screens and safety cage			Specify
4.2.9	**Machine characteristics**			
	1.	Load Capacity		Specify
	2.	Load cell capacity		Specify
	3.	Accuracy of Load cells		Specify
	4.	Dimensions and Features	Machine Frame	Specify
			Available test space, width-wise	Specify
			Overall dimensions of the equipment	State
	5.	Drive system	Crosshead traverse Speed	Specify
			Crosshead traverse distance	Specify
	6.	Force Measurement System	Accuracy	Specify
			Repeatability	Specify

Clause	Description			Bidder's offer
			Reversibility	Specify
			Zero	Specify
			Relative resolution	Specify
	7.	Strain Measurement System (extensometer)	Extensometer Measuring Range	Specify
			Extensometer Accuracy	Specify
			Extensometer Resolution/ Discrimination	Specify
	8.	Data acquisition		Specify
	9.	Power Supply		Specify
4.3.1	Machine have control panel			Specify
4.3.2	Operational data displayed on the control panel			State
4.3.3	Functions selectable from the control panel			State
4.3.4.1	Machine offering real time display via control panel/PC monitor			Specify
4.3.4.2	Connection interfaces			Specify
4.3.4.3	Selectable graphical display of test progress possible			State
4.3.4.4	Machine memory function capabilities			State
4.3.4.5	Control panel displays all operational data			Specify
4.4.1	Selectable measurement units on the monitor			Specify
4.4.2	Operation has automatic STOP and Return when sample breaks			Specify
4.4.3	Load cell offering one touch zero adjustment			State
4.5	**Standard accessories supplied with the machine**			
	a. Full set of manuals			State
	b. Grips and fixtures			State
4.6	Calibration Status			State
4.7.1	List of spares that accompanies the machine			State
4.7.2	Warranty Period			Specify
4.8	Contract includes installation and commissioning			Specify
4.9.1	Conduct training for KPLC engineers			State
4.9.2	Mode of training			State
4.9.3	Success of training			State
4.9.4	Certificates on successful completion of training			State
4.9.5	Training Costs			State
5.0	**Testing and inspection**			
5.1	Machine shall comply with the specification test requirements.			State

Clause	Description	Bidder's offer
5.2	Performance and evaluation as per ASTM E1856	State
6	**Marking & Packing**	
6.1	**Marking**	
6.1.1	Marking on the machine and standard accessories	Specify
6.2.	**Packing**	
6.2.1	Packing to protect from damage during transport, handling and storage	Specify
	APPENDICIES	
A	**TESTS AND INSPECTION (Normative)**	
A.1	Copies of Type Test Reports, Valid Accreditation Certificate of Testing laboratory	attach
A.2	Tests in the submitted test reports	List
A.3	Test to be witnessed by KPLC during FAT and equipment to carry out the tests	list
A.4	Inspection of Horizontal Tensile Testing Machine at KPLC stores and replacement of rejected stay insulators	Specify
B	**Quality Management System**	
B.1	Quality Management System (QAP) certificate	Attach
B.2	Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2015 certificate	Specify
C	**Documentation**	
C1	Documents submitted with tender documents for evaluation	State
C2	To be submitted for approval before manufacture	State
	Statement of Compliance to Specification (indicate deviation if any & supporting documents)	State Compliance

.....

Manufacturer's Name, Signature, Stamp and Date

***Note*

*All guaranteed values **MUST** be clearly stated. Words like 'agreed', Yes; 'confirmed', 'As per KPLC specifications', etc. shall not be accepted and shall be considered non-responsive.*

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2024-05-28	Date: 2024-05-28