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Kenya Power

LOW VOLTAGE MEASURING INSTRUMENTS -SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd

September 2016

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Standard Manager
2	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.

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0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2016-09-27	Cancels and replaces KP1/3CB/TSP/09/058-1, KP1/3CB/TSP/058-2 and KP1/3CB/TSP/058-3	Nancy Wairimu	Dr. Eng. Peter Kimemia

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FOREWORD

This specification has been prepared by the Standards Department in collaboration with Distribution Division, both of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for overhead line instruments for use on distribution and sub-transmission power lines. It is intended for use by KPLC in purchasing the tools and equipment.

The specification stipulates the minimum requirements for low voltage measuring instruments for overhead power lines acceptable for use in the company and it shall be the responsibility of the suppliers & manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the accessories for KPLC.

Most performance requirements of the low voltage measuring instruments are similar hence the need to consolidate them in one specification.

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

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1. SCOPE

1.1 This specification is for low voltage measuring and indicating instruments for use on distribution and sub-transmission power lines.

1.2 The specification covers the following categories of low voltage (600/1000 V) measurement instruments:

a) Phase Rotation Tester
b) Insulation Resistance Test Set
c) Earth Resistance Test Set
d) Digital Multimeter Test Set
e) Digital Clamp-On Multimeter
f) Cable height meter
g) Polarity tester/Earth leakage meter
h) Voltage tester

1.3 The specification also covers requirements, inspection and tests of the instruments and their accessories as well as schedule of Guaranteed Technical Particulars.

2. NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this specification. For dated editions the cited edition will apply; for undated editions the latest edition of the referenced document shall apply.

IEC 61010: Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements; --Part 2-033: Particular requirements for hand-held multimeters and other meters, for domestic and professional use, capable of measuring mains voltage,

IEC 61557: Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c - Equipment for testing, measuring or monitoring of protective measures -- Part 1: General requirements; -- Part 2: Insulation resistance; -- Part 3: Loop impedance; Part 4: Resistance of earth connection and equipotential bonding; --

Part 5: Resistance to earth; --Part 6: Effectiveness of residual current devices (RCD) in TT, TN and IT systems -- Part 7: Phase sequence; -- Part 10: Combined measuring equipment for testing,measuring or monitoring of protective measures

IEC 60695: Fire hazard testing- Part 2-11:Glowing/hotwire based test methods – Glow-wire flammability test methods for end products (GWEPT).

IEC 60068: Basic enviromental testing procedures – Part 2-17: tests-test Q : Sealing; –Part 2-27: Tests- Test Ea and guidance: Shock. –Part 2-30: Tests- Test Db : Damp heat, cyclic (12h +12h cycle);

IEC 61000: Electromagnetic Compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test; – Part 6-2: Generic standards – Immunity for Industrial environment.

IEC 61326: Electrical equipment for measurement, control and laboratory use - EMC requirements.

IEC 60417: Graphical symbols for use on equipment.

IEC 60529: Degrees of protection provided by enclosures (IP Code)

IEEE 43-2006: IEEE recommended practice for testing insulation of rotating machinery

OIML D 11: General Requirements for Measuring Instruments - Environmental Conditions

3. DEFINITIONS AND ABBREVIATIONS

For the purpose of this specification the definitions and abbreviations given in the reference standards shall apply and the following abbreviations:

3.1 ABBREVIATIONS

KPLC- Kenya Power and Lighting Company Limited

IEC – International Electrotechnical Commission

OIML – International Organization of legal metrology

ISO – International Organization for Standardization

IEEE – Institute of Electrical and Electronics Engineers

LCD – Liquid Crystal Display

rdg - Reading

dgt - Digit

ac – Alternating Current

DC – Direct Current

USB – Universal Serial Bus

RS - Recommended standard

BCD- Binary coded Decimal

D/A- Digital Analogue

IP – Ingress protection

r.m.s. – Root mean square

V – Volts

mV- Millivolts

kV - kilovolts

A – Amperes

mA – Miliamperes

m - Metre

mm- millimeter

mm^2 – square millimeter

sec - Second

h - hours

Ω- Ohms

kΩ - kilo ohms

mΩ - mega ohms

TΩ - tera ohm

nF – nano farad

µF- microfarad

kg - kilogram

Hz - Hertz

°**C** – degree Celsius

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

The equipment shall be designed and constructed for continuous outdoor use in tropical areas and harsh climatic conditions including areas exposed to:

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
d) Pollution: Design pollution level to be taken as "*Heavy*" (Pollution level III) for inland and "*Very Heavy*" (Pollution level IV) for coastal applications in accordance with IEC 60815.

4.2. Design and construction

4.2.1. Measuring instruments shall comply with IEC 61010-1 and IEC 61557-1 standards. When used for a designated purpose, they shall not endanger persons, livestock or property i.e. they shall be constructed in such a way that possibilities for unintentional, accidental, or intentional misuse are minimal.

4.2.2. The design shall also ensure that no hazardous touch voltages appear during the measurements. This shall be achieved by a suitable design of the source for the output voltage by:

a) Limiting the open-circuit value of the output voltage to an r.m.s. value of 50 V;
b) Limiting the r.m.s. (peak) value of the short-circuit current to 3.5 mA when the value of the voltage exceeds 50 V.

NOTE: *When no compliance with the above condition exists, then an automatic disconnection of the measurement process shall operate within a time period permissible according to Figure 1 of IEC 61010-1.*

4.2.3. If the measuring equipment indicates the voltage conditions at its measuring terminals, it shall also indicate if the system voltage exists and if the live conductor is exchanged with the protective conductor.

4.2.4. Measuring instruments shall also comply with OIML D 11 requirements such that:

a) Their errors do not exceed the maximum permissible errors under rated operating conditions.

b) When they are exposed to disturbances, either
   (i) Significant faults do not occur, or
   (ii) Significant faults are detected and acted upon by means of a checking facility.

4.2.5. Instruments powered by a battery (stand-alone, rechargeable auxiliary or back-up batteries) shall have the type (-s) and capacity (-ies) of the batteries allowed to be used in the applicable measuring instruments specified by the manufacturer. They shall also automatically check that the state of charge of these batteries will permit measurement with specification.

4.2.6. Instruments powered by the mains power and provided with a back-up battery for data-storage only, shall also comply with the requirements for mains powered instruments.

4.2.7. The terminals shall be designed so that the probe assembly can be connected to the measuring equipment reliably and accidental touching of any live parts is impossible.

4.2.8. Software controlled instruments that are complex in their functionality shall require that the user is guided for the correct use and for achieving correct measurement results.

4.2.9. The manufacturer shall specify the limiting conditions; storage and transport conditions for each specified influence quantity - quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement.

4.2.10. Measuring equipment shall have a valid calibration status prior to being confirmed, within a specified metrological requirement.

4.2.11. The manufacturer shall specify the warranty period which shall be at least 3 years

4.2.12. The measuring instruments shall be manufactured and tested in conformity with the safety and environmental design requirements shown in Annex A.

4.3. Specific Requirements

4.3.1. Phase Rotation Tester - LV

4.3.1.1. The phase rotation tester shall be designed, manufactured and tested in accordance with IEC 61557: Part 1 & 7 standard requirements. It shall also comply fully with the provisions of clause 4.2.1 of this specification.

4.3.1.2. The phase rotation tester shall be a handheld digital display type instrument designed to detect the rotational field of three-phase low voltage systems and determines motor-rotation direction. The indication of the phase sequence shall be visual and/or audible.

4.3.1.3. The indication shall be unambiguous between 85 % and 110 % of the nominal system voltage or within the range of the nominal voltage and between 95 % and 105 % of the nominal system frequency and shall also be unambiguously detectable in the presence of visual or audible interference.

4.3.1.4. Phase rotation meters (phase testers, phase rotation meters) shall be applicable in the testing of the phase sequence and phase orientation checks in three-phase electrical systems.

4.3.1.5. The phase rotation tester design shall have a correct phase matching between channels during energy metering applications; which may cause significant measurement errors at low power factors.

4.3.1.6. Bandwidth (frequency range over which current or voltage is measured), sampling rate (the frequency that a digital meter tests an analog signal and converts to a digital value), maximum channels, and operating temperature shall be specified by the bidder.

4.3.1.7. The tester shall be designed in such a manner that when either one or two measuring leads are connected to earth and the remaining measuring leads are connected to their corresponding phase conductors, the resulting total current to earth shall not exceed 3.5 mA r.m.s. The phase conductors shall be at 110 % of the maximum rated voltage for which the equipment is designed.

4.3.1.8. The tester shall be designed with color-coded test leads with insulated alligator clips for connecting to the system under test. The leads shall be permanently attached with live parts not accessible, whether plugged or unplugged (according to IEC 61010-3-031).

4.3.1.9. The following applies to leads

a) They shall have an outer diameter of at least 3.5 mm;
b) The copper cross-section shall be at least ≥ 0.75 mm^2;
c) They shall be made from individual wires with a diameter ≤ 0.07 mm;
d) They shall be provided with double or reinforced insulation.

4.3.1.10. **Features:**

The tester shall have the following features with the display design as per Fig. 1.

a) Phase rotation (L_1 L_2L_3, $L_2L_3L_1$ and $L_3L_1L_2$) LED indicators
b) Bright LED indication of Live or Open Phase (L_1, L_2, L_3)
c) Fuse protected inputs
d) Double insulated case
e) Color-coded 5 ft. leads and alligator clips
f) Permanently attached loss-proof leads
g) Tangle proof lead separators
h) Simple operation
i) Battery powered
j) Automatic shutdown after 5 minutes of non-use.
k) Low battery state and protective fuse blown indications.
l) Hold on to peak reading feature.

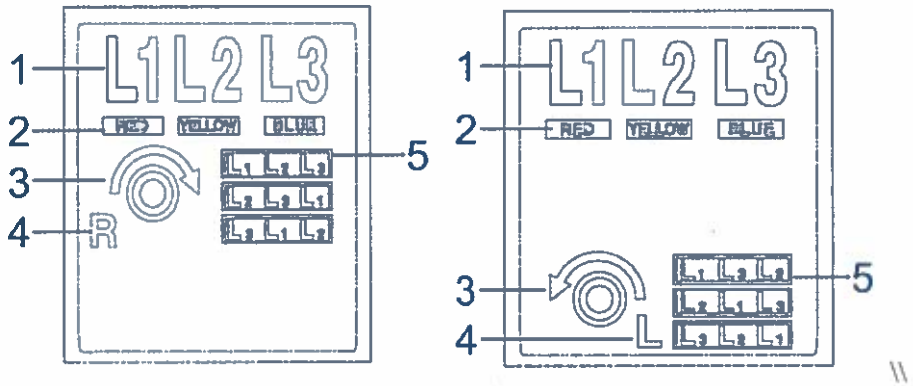

Fig. 1: Typical Low Voltage Phase Rotation Meter Display Screen

4.3.1.11. **Display Description**

1. Line designators (L1, L2, and L3)
2. Colour codes for test leads
3. Clockwise / Counter-Clockwise indicator
4. LEFT (L) or RIGHT (R) rotation direction
5. Phase Sequence grid

4.3.1.12. **The technical details**

a) Input power: chargeable internally housed batteries
b) Phase sequence (rotation) indicator (L_1 L_2L_3, $L_2L_3L_1$ and $L_3L_1L_2$)
c) Voltage range a.c: 200mV to 1000V (Auto ranging)
d) Resolution: 0.1 mV
e) Time limit for continuous use: 5 mins at 500V ac
f) Input impedance > 10 MΩ
g) Accuracy at least 0.5%
h) Battery life: more than 3000 tests of 5 s duration.

4.3.2. Insulation Resistance Test Set

4.3.2.1. The insulation resistance meter shall be designed, manufactured and tested in accordance with IEC 61557: Part 1, 4 & 5 standard requirements. It shall also comply fully with the provisions of clause 4.2.1 of this specification.

4.3.2.2. The meter shall be a direct reading portable electronic insulation resistance tester enclosed in the same casing as a dc to dc converter and shall have the ability to apply test voltage up to 5 kV, conforming to the requirements of IEEE 43:2006.

4.3.2.3. The meter shall be a multi-range tester with multi-voltage and multi-rated resistance ranges complete with a selector switch to change the range. The test voltages shall be 50 V to 1 kV in 10 V steps, 1 kV to 5 kV in 25 V steps; and the Insulation Resistance Range shall be 10 kΩ to 15 TΩ.

4.3.2.4. The insulation resistance meter in this specification shall be designed for testing the insulation resistance of low and high-voltage electric equipment including:

a) High-voltage power cables and high-voltage buses
b) Large motor/generator windings
c) Line and substation transformers

4.3.2.5. It shall be capable to perform automatic spot tests, step-voltage tests, dielectric discharge tests and dielectric absorption tests for the following applications:

a) Acceptance testing at installation to check conformance to specifications.
b) Routine preventive/predictive maintenance testing after installation.
c) Quality assurance testing as part of the manufacturing process.
d) Diagnostic testing to isolate faulty components for repair.

4.3.2.6. The minimum display functions and features shall be similar to those in Table 2 and Fig. 2

Table 2: Functions and test features for the IR tester.

No.	Feature	Function
1	Voltage at terminals	Displays amount of voltage present at the terminal.
2	Battery level	Indicates the level of battery operation available.
3	Breakdown indicator	Indicates that breakdown mode is in operation
4	High-voltage indicator	Indicates the presence of high voltage during operation.
5	Digital display	Displays the reading during a test.
6	Dielectric Absorption Ratio (DAR)	IR measurements taken after 30 seconds and 60 seconds
7	Polarization Index (PI)	IR measurements taken at 1 minute and 10 minutes
8	Dielectric Discharge Measurements (DD)	Dielectric Discharge = I (after 60 seconds) / Volts x Capacitance
8	Time constant	6 through 8 — Displays the ratio value or the resistance measured at the indicated time.
9	Capacitance display	Indicates the capacitance of the test sample.
10	Analog display	Unique; patented analog display shows resistance with real-time pointer movement.
11	Timer	Displays the elapsed time of test. Displayed constantly eliminating the need for a separate timer .
12	Data recording	Indicates if data is being recorded during the test.
13	Alarm	Indicates that alarm has been set.
14	Burn indicator	Indicates that burn mode is in operation.
15	Test modes	Shows which pre-programmed test is being run.



Fig. 2: Typical Insulation resistance digital display.

4.3.2.7. The insulation resistance test set shall have the technical particulars shown in table 3.

Table 3: Technical particulars for a 5 kV Insulation Tester.

Particulars	Requirement
Test Voltage	50 V to 1 kV in 10 V steps, 1 kV to 5 kV in 25 V steps
Insulation Resistance Range	Digital display: 10 kΩ to 15 TΩ
Accuracy (23° C)	±20% to 10 TΩ
Voltage Output Accuracy (0°C to 30°C)	0 to +4% ±1 V of nominal test voltage at 100 MΩ load ±25 V for test voltages less than 500 V
Short Circuit/Charge Current	3.5 mA
Current Measurement	Range: ±0.01 nA to ±5 mA Accuracy (23°C): ±5% ±0.2 nA at all voltages
Capacitance Measurement	Range: 10 nF to 50 μF (for voltages > 500 V) Accuracy (23°C): ±5% ±5 nF
Capacitor	Charge Time: 5 seconds per μF at 3 mA Discharge Time: 5 seconds per μF to discharge from:
Display	Digital - 3 digits

Particulars	Requirement
Dielectric Absorption Ratio (DAR)	Best criteria - 1.4 or more as per IEEE Std. 43-2006
Polarization Index (PI)	Best criteria – 4.0 or more as per IEEE Std. 43-2006
Dielectric Discharge Measurements (DD)	Good criteria – 2.0 or less as per IEEE Std. 43-2006
Timer Range	Count up to 99 minutes and 59 seconds from start of test
Industry-Standard Tests	Auto IR, PI, DAR, SV, and DD
Interference Rejection	2 mA rms at 200 V and above
Guard Terminal	2% error guarding 500 kΩ leakage with 100 mΩ load
Voltage Input Range	95 to 240 V, ±10% rms 50/60 Hz and dc
Battery Life	6 hours continuous testing at 5 kV

4.3.3. Earth Resistance Test Set (Electronic Type)

4.3.3.1. The earth resistance test set shall be electronic type, designed, manufactured and tested according to IEC 61557: Part 1 & 5.

4.3.3.2. The output voltage present across the terminals E and H shall be an a.c. voltage without a d.c component.

4.3.3.3. The frequency and the waveform shall be chosen so that electrical interference, particularly from installations operating with system frequency, will not adversely influence the measurement result to an excessive degree.

4.3.3.4. If the influence of interference voltages from distribution systems as a.c. currents or as d.c currents exceeds the requirements of the uncertainty values in IEC 61557-3 clause 4.3 and Annex A of this specification, this shall be stated by the manufacturer in the operating instructions.

4.3.3.5. The test set shall be capable of determining whether the maximum permissible resistances of the probes and auxiliary earth electrodes are exceeded.

4.3.3.6. The equipment shall be a fully automatic four terminal earth electrode resistances and soil resistivity meter with auto ranging from 20 Ω to 2000 Ω. The testing shall be conducted according to BS7671, BS7430 and BS6651

4.3.3.7. The earth resistance test set shall be suitable for taking several different measurements, including:

a) Grounding system resistance,
b) Insulation resistance,
c) Earth continuity,
d) Current leakage,
e) Ground bond.

4.3.3.8. The earth resistance test set shall have a digital display, with a liquid crystal display (LCD) indicator providing a numeric reading. LED indicator may be used to indicate that a test is occurring.

4.3.3.9. The earth resistance test set shall come with several different interfaces such as:

a) General-purpose interface bus (GPIB), designed to connect computers, peripherals, and laboratory equipment.
b) RS232 interfaces for ground resistance testers are used for serial communications between instruments and computers.
c) Printer port devices have a connector or port that is designed to interface with a printer.
d) Scanner ports designed to interface with a scanner.
e) USB, designed to connect computers, peripherals, and laboratory equipment.

4.3.3.10. The Earth resistance test set shall have the technical particulars shown in table 4.

Table 4: Technical particulars for Earth Resistance Test Set.

Characteristics	Description
Display	LCD 3 ½ with 2000 counts, maximum display count of 1999
Over-range Indication	"1" in the Most Significant Digit (MSD)
Operation Frequency of Ω current	820Hz to 1.6kHz at approx. 2mA.
Earth Resistance Range	20Ω/200Ω/2000Ω
Resistance resolution	0.00 - 19.99 (0.01Ω) 00.0 - 199.9 (0.1Ω) 000 – 1999 (1Ω or .001KΩ)
Earth Resistance Accuracy	±(2% reading + 2 digits) or± 0.1Ω
Max Earth Voltage	0-200V AC, 40-500Hz
Earth Voltage Accuracy	± (1% reading + 2 digits)
Power on/off	Switch only / No auto power off mode
Low Battery Indicator:	Symbol indicates low battery voltage

Characteristics	Description
Data Hold Indicator	Symbol indicates data hold
Power	8 x 1.5V AA Batteries (Alkaline preferred)
Weight:	Approximately 3.0 lbs. (1361g) including battery
Accessories included	Hard Case, Test Lead Set (red-33m, yellow- 33m, green 5m) Red 1m dual input jack to alligator clip adapter lead, 2 Auxiliary earth spikes, and Instruction Manual

4.3.3.11. The Earth resistance test set shall have the measurement characteristics shown in table 5.

Table 5: Measurement characteristics of Earth Resistance Test Set

RESISTANCE			
Range	**Measuring Range**	**Resolution**	**Accuracy**
20Ω	0.00Ω - 19.99Ω	0.01Ω	±(2% reading+ 2 digits)[1]
200Ω	00.0Ω - 199.9Ω	0.1Ω	±(2% reading + 2 digits)
2000 Ω	000Ω - 1999Ω	1Ω or 0.001KΩ	±(2% reading + 2 digits)
[1] Error is ± 2 digits or ± 0.1Ω, whichever is greater. Operation frequency of current is 820Hz to 1.6kHz at approx. 2mA.			
EARTH VOLTAGE POTENTIAL			
Range	**Measuring Range**	**Resolution**	**Accuracy**
0-200V AC	00.0 – 199.9V	.1mV	± 1.0% ± 2digits

4.3.4. Digital Multimeter

4.3.4.1. The digital multimeters (DMM) shall be designed, manufactured and tested in accordance with IEC 61557: Parts 1, 2, 3, 4, 6 & 10 standard requirements. It shall also comply fully with the provisions of clause 4.2.1 of this specification

4.3.4.2. The DMM shall have an auto-ranging dial for setting the function to be measured and the instrument count shall be a 3 ¾ - digit, 4,000 count display device with a DC Voltage accuracy of ± (0.5 % reading + 5 digits).

4.3.4.3. The provision of advanced multimeter functional features to make measurement of electrical systems and components easier shall be stated by the manufacturer and shall be accepted e.g. Direct Key Selection or Menu Selection.

4.3.4.4. Digital multimeters in this specification shall be handheld and shall be specifically designed to be used while holding, i.e. can be operated with one hand.

4.3.4.5. Devices with battery power shall have an option of being operated without plug-in power.

4.3.4.6. Specific measurements made by digital multimeters shall include:

a) DC & AC voltage,
b) DC & AC current,
c) Resistance,
d) Capacitance,
e) Frequency range,
f) Time period,
g) Special measurements that include:
   (i) Continuity check,
   (ii) Audible continuity,
   (iii) Diode test,
   (iv) Maximum or minimum or peak spike measurement,
   (v) RTD or Thermocouple temperature measurement,
   (vi) Transistor test.

4.3.4.7. Measurement characteristics shall be as shown in Annex B.

4.3.4.8. Output options for digital multimeters shall include :

a) GPIB,
b) USB
c) IEEE 488,
d) RS232,
e) BCD, and
f) D/A.

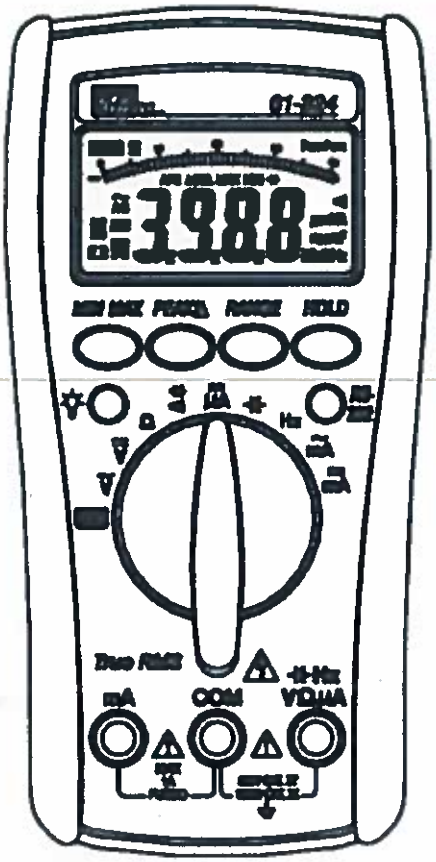

Fig. 3a: Typical design features of DMM

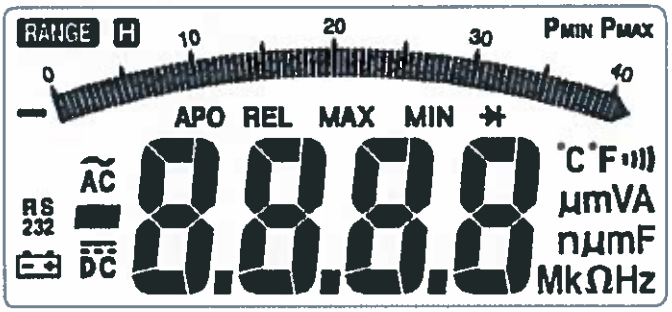

Fig. 3b: Typical LCD Display Window

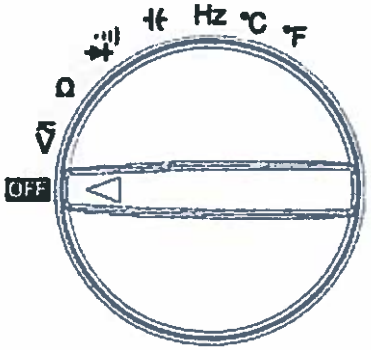

Fig. 3c: Typical Auto Ranging Meter

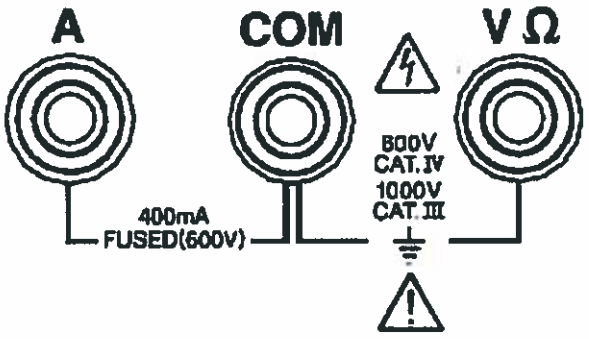

Fig. 3d: DMM Input Jacks or Ports

4.3.4.9. The digital multimeters shall have the following features:

Table 5: Functionalities and test features of digital multimeters.

Feature	Function
Audible continuity	Will give an indication to the user that a closed loop exists due to the probes touching each other through beeping
Diode test	will check to see if a diode is good or bad
Maximum or minimum or peak spike measurement	Measure and display when these events occur.
Resistance temperature detectors RTD or thermocouple probe.	Measure temperatures
Transistor test	Capable of examining a transistor and tell where the emitter, collector, and base is located
Battery level	Indicates the level of battery operation available.
Breakdown indicator	Indicates that breakdown mode is in operation
High-voltage indicator	Indicates the presence of high voltage during operation.
Digital display	Displays the reading during a test.
Digital bar graph	Displays measurement signals visually.
dB readings	Measure and display units of sound pressure
Auto-ranging	Automatically choose the measurement range
Adjustable sampling rate	Provide most comprehensive measuring ranges and features
Programmable, data acquisition, storage and logging	Operation using typed commands, by programming the remote system
Removable data storage and triggering	Continuously mounted backup storage media.

4.3.5. Digital Clamp-On Meter

4.3.5.1. The digital Clamp – On Meter shall be designed, manufactured and tested in accordance with IEC 61557: Parts 1, 2, 3, 4 & 10 standard requirements. It shall also comply fully with the provisions of clause 4.2.1 of this specification

4.3.5.2. It shall be a portable, 'single-hand operation' AC/DC digital clamp meter with an LCD display and back light for easy reading.

4.3.5.3. The general specification requirement for the clamp-on meter shall be as per Table 6:

Table 6: General specifications

Functionality	Description
Display	LCD , 3¾, digit (4000 counts), 9999 counts (Frequency mode), 40 segments analog bar graph and function units sign annunciators
Polarity	Automatic, positive implied, negative polarity indication.
Over range	"4000 "or" 4000" Most Significant Digit blinks.
Low battery indication	The " [battery] " is displayed when the battery voltage drops below the operating level.
Measurement rate	2/sec, nominal. 1/sec, Capacitance and Frequency mode. 20/sec, Analog display.
Accuracy	Stated accuracy at $23^0C + 5^0C$, <75% relative humidity.
Auto Power off	30minutes after rotary switch or mode changes.
Clamp jaw	According to EN61010-2-032 CAT IV 600V.
Power	Single standard 9 volt battery, as per IEC 6F22.
Battery life	150 hours typical with carbon zinc
Accessories	One pair of test 1eads, 9V battery (installed).

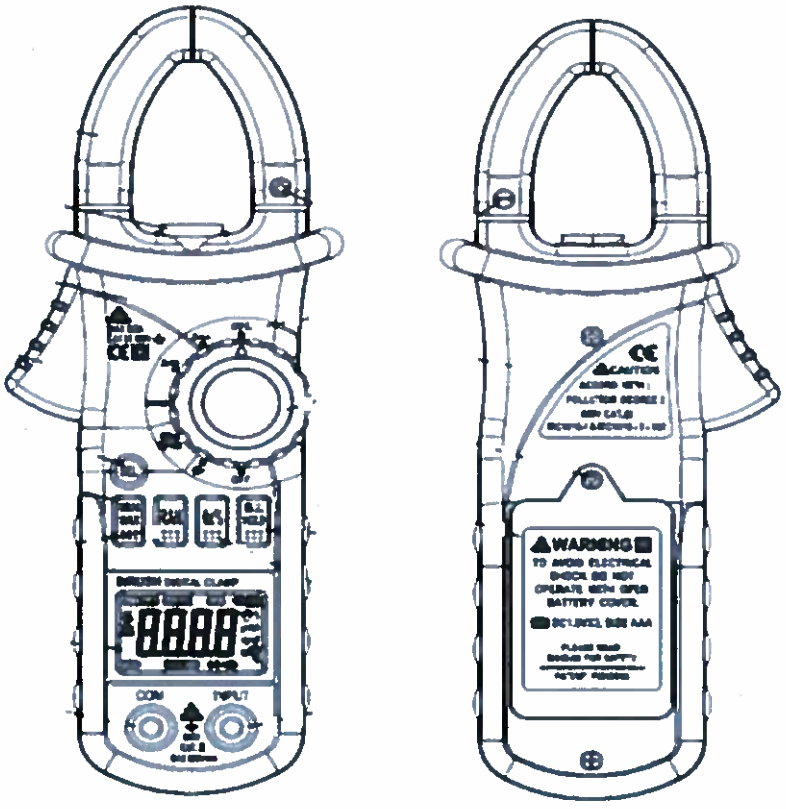

Fig. 4: Component parts of Clamp on Meter

4.3.5.4. The instrument shall be used to test both sinusoidal and non-sinusoidal waveforms by using the function True RMS. To ensure the precision of test result, input signal shall be as follows:

a) AC voltage: > 13 mV
b) AC current: > 1.3A

4.3.5.5. The electrical measurement characteristics of the digital clamp on meter shall be as per Annex B.

4.3.6. Cable Height meter

4.3.6.1. The cable height meter shall be designed, manufactured and tested in accordance with IEC 61557. It shall also comply fully with the provisions of clause 4.2.1 of this specification.

4.3.6.2. It shall be capable of measuring cable sag, cable height distance and overhead clearances

4.3.6.3. It shall utilize ultrasonic signals to determine the height of overhead cables of upto six overhead cables and wires.

4.3.6.4. It shall be robust, hand-held, light weight, easy to use and maintenance free.

4.3.6.5. It shall have battery condition indicator.

4.3.6.6. Cable height meter shall have the technical particulars shown in table 7.

Table 7: Technical particulars of a cable height meter

Characteristics	Requirement	
Accuracy	0.5 % ± 2 digits	
Resolution	Range< 10m	5mm
	Range > 10m	10mm
Power source	9V alkaline battery	
Battery life	>50000 measurements	
Display	LCD	
Measurement units	Metric (meters)	
Auto power off delay	3 minutes	
Weight	Approximately 0.5 kg	
Dimensions	Manufacturer to state	

4.3.6.7. The cable height measuring characteristics shall be as shown in table 8.

Table 8: Measuring characteristics of a cable height meter

Minimum cable size	Range
25mm cable	3- 15 m
12mm cable	3-15m
5.5 mm cable	3-12m
2.5 mm cable	3-10 m

4.3.7. Polarity tester/ Earth leakage meter

4.3.7.1. It shall be designed, manufactured and tested to IEC 61557: part 1 & 10. It shall also comply fully with the provisions of clause 4.2.1 of this specification.

4.3.7.2. It shall be capable of testing polarity and leakage current.

4.3.7.3. It shall be robust, hand-held, light weight, easy to use and maintenance free.

4.3.7.4. The polarity tester/earth leakage tester shall have the technical particulars shown in table 9:

Table 9: Technical particulars of polarity tester/ Earth leakage tester

Characteristic	Requirement
Rated tripping current	10mA, 15mA, 20mA,25mA, 30mA, 35mA
Operating voltage	230 V a.c
Resolution	1mA
Accuracy	±1% of full scale
Plug	13A, 3 pin plug to BS 1363
Cord length	300mm
Number of Wiring identifications	Correct wiring
	Live and Neutral reversed
	Earth and Neutral reversed
	No Live
	No Neutral
	No Earth
Display	LCD

4.3.8. Voltage tester

4.3.8.1. The voltage tester shall been designed, manufactured and tested in accordance with IEC 61557. It shall also comply fully with the provisions of clause 4.2.1 of this specification.

4.3.8.2. It shall be robust, hand-held, light weight, easy to use and maintenance free.

4.3.8.3. It shall have low battery status and protective fuse blown indications.

4.3.8.4. It shall be provided with appropriately rated leads.

4.3.8.5. It shall have hold on peak feature

4.3.8.6. It shall have the technical particulars as shown in table 10 below:

Table 10: Technical particulars of a voltage tester

Characteristic	Requirement
Voltage range d.c. and a.c.	200mV to 900 V auto ranging
Accuracy	0.5%
Resolution	0.1 mV
Input impedance	10 Mega Ohms
Power source	9V alkaline battery
Battery life	> 3000 tests of 5 seconds duration
Display	LCD

5. TESTS REQUIREMENTS

The low voltage measurement instruments shall be inspected and tested in accordance with the requirements of IEC 61010-2-030, IEC 61326-2-2, IEC 61557: Parts 1,2,3,4, 7 & 10 standards and provisions of clause 4.2.1 Annex A of this specification.

6. MARKING AND PACKING

6.1. Marking

6.1.1. Markings shall comply with IEC 61010-1 unless otherwise specified in other parts of IEC 61557.The measuring equipment shall carry the following marking which shall be clearly readable and indelible (in English Language).

a) Type of equipment.
b) Units of the measured quantity.
c) Ranges of measurement.
d) Type and current rating of the fuse in the case of exchangeable fuses.

e) Type of battery/accumulator and polarity of connection in the battery compartment.
f) Nominal voltage of the distribution system and the symbol for double insulation in accordance with IEC 61010-1 for measuring equipment with distribution system power supply.
g) Manufacturer's name and/or registered trade mark.
h) Model number, name or other means to identify the equipment (inside or outside).
i) The words "**PROPERTY OF KPLC**".
j) Reference to the operating instructions with the symbol as per Table 8 in accordance with IEC 61010-1.

Table 8: Safety symbols

	Caution, risk of danger (Important safety information - refer to the operation manual.)
	Application around and removal from HAZARDOUS LIVE conductors are permitted. IEC 60417- 5036
	Double insulation (Protection Class II) - IEC 60417- 5172
CAT III	Overvoltage (Installation) category III, Pollution Degree 2 per IEC 61010-1 refers to the level of Impulse Withstand Voltage protection provided.
	Conforms to European Union Directive
	Earth (ground) terminal – IEC 60417 - 5017

6.2. Packing

6.2.1. The low voltage measurement instruments shall be individually packed in a standard rugged heavy duty robust case with cushion grip handles and rubberized gripping surface for outdoor use (protection category IP X5) in such a manner to avoid damage during storage and transportation.

6.2.2. The instrument shall be portable, rugged and light weight. Its carrying case shall be shockproof, and impact resistant. Also shall be able to withstand a fall of one meter without damage to the equipment.

6.2.3. The housing shall be complete with a gasket to seals the lid when closed so as to protect the instrument against water and dirt while the instrument is carried through rainstorms or other hazardous conditions. The lid shall be secured by two latches and a handle for portability. A compartment shall also be provided for storage of test cables and line cord.

APPENDICIES

A. Safety and Environmental Design Requirements (Normative)

No	Particulars		Test Performance
1	Operating conditions	Operating temperature	0 ... +35 °C as per IEC 61557-1
		Storage temperature	-5 ... +50 °C
		Humidity range - Rel. humidity	5 ... 95 %, non-condensing
		Permissible percentage operating uncertainties	Shall not exceed ±30 % as per IEC 61557-1
		Supply voltage	85 % to 110 % of the nominal supply voltage for supply from the distribution systems as per IEC 60038
2	Environmental conditions	Shock (operating)	15 g / 11 ms half sine as per IEC 60068-2-27
		Vibration (operating)	IEC 61557-1 – direction: three mutually perpendicular axes; – amplitude: 1 mm; – frequency: 25 Hz; – duration: 20 min.
		Dry heat test	IEC 60068-2-2: Type A test (Test level 2) Temperature - $55^0C \pm 2^0C$ Duration of exposure – 2 h
		Damp heat test	IEC 60068-2-30: Test Db Test level 2 Temperature - $55^0C \pm 2^0C$ Relative humidity – 93 % Duration of exposure – 4 h
		Salt mist test	IEC 60068-2-11 – Test level 4 Saline solution – 5 % NaCl, pH value- 6.5 – 7.2 %, Temperature – 35^0C Duration – 96 h
		Flammability test	IEC 60695-2-11 – Needle flame test
3	EMC tests	Particular requirements test configurations, operational conditions and performance criteria	IEC 61326-2-2.
4	Safety	Rated Impulse Voltage for equipment -1.2/50µs	6000 V as per IEC 60664-1, table 1
		Overvoltage category	At least Class III, 600 V as per IEC 61010-1
		Pollution category	At least Degree 2 as per IEC 61010-1
		Insulation material group	At least Group II - 400≤CTI<600 (PLC=1) as per IEC 60112

No	Particulars		Test Performance
		Class of protection	Protection class II (reinforced insulation) as per 60664-1
		Protection against enclosures	
		Measuring category	At least category III as per IEC 61010-2-030
		Minimum clearances for equipment to withstand steady state voltages, temporary over-voltages and to avoid partial discharge	5.5 mm as per IEC 60664-1
		Creepage distance for	1.8 mm as per IEC 60664-1
		equipment subject to long term stresses, min	
		Minimum acceptable creepage distances on printed circuit boards	1.0 mm as per IEC 60664-1
		Maximum recurring peak voltage related to creepage distance on printed wiring boards	913 V as per IEC 60664-1
		Width of grooves by pollution degree on printed circuit boards	1.0 mm as per IEC 60664-1
		Partial discharge requirements	As per IEC 60664-1 Annex C
		Solid insulation design	Shall withstand short term and long term stresses as per IEC 60664-1 clause 3.3

* If the internal emission source(s) is operating at a frequency below 9 kHz then measurements need only to be performed up to 230 MHz

NOTE: The tests results shall be as per the Performance Criteria A specified in IEC 61326-1 for the respective tests.

B. Measurement characteristics of Multimeter and Clamp-on Meter (Normative)

DC VOLTS	
Ranges:	400 mV, 4 V, 40 V, 400 V, 600 V
Resolution:	100 µV
Accuracy (ranges):	±(0.25% rdg + 1dgt) on 400 mV to 400 V ±(0.25% rdg + 3dgts) on 600 V
Input impedance :	> 10 MΩ
Overload protection:	600 VDC or AC rms
AC VOLTS (True RMS) (50Hz - 500Hz)	
Ranges:	4 V, 40 V, 400 V, 600 V
Resolution:	1 mV
Accuracy:	± (0.75% rdg + 4dgts) on 50 - 60Hz ± (2.0% rdg + 4dgts) on 40 - 500Hz
Input impedance :	> 10 MΩ
Effect Reading:	100 – 3999
Overload protection:	600 VDC or 600 VAC rms
RESISTANCE	
Ranges:	400 Ω, 4 kΩ, 40 kΩ, 400 kΩ,4000 kΩ, 40 MΩ
Accuracy (ranges):	± (0.3% rdg + 5dgts) on 400 Ω ± (0.3% rdg + 1dgt) on 4 kV to 400 kΩ ± (0.5% rdg + 1dgt) on 4000 kΩ ± (2.0% rdg + 4dgts) on 40 MΩ
Open circuit volts:	0.4 Vdc
Overload protection:	600 VDC or AC rms
CONTINUITY	
Audible indication:	less than 40 Ω ± 20 Ω
Overload protection:	600 VDC or AC rms
DIODE TEST	
Test current:	1.0 mA + 0.6 mA
Accuracy:	+ (3.0% rdg + 3dgts)
Open circuit volts:	3.0 Vdc typical
Overload protection:	600 VDC or AC rms
FREQUENCY (Auto ranging)	
Ranges:	100 Hz, 1 kHz, 10 kHz, 100 kHz, 500 kHz
Resolution:	0.01 Hz
Accuracy:	+ (0.1% rdg + 2dgts)
Sensitivity:	2.0 Vrms min
Effect reading:	10 - 9999
Overload protection:	600 VDC or AC rms

CAPACITANCE	
Ranges:	4 nF, 40 nF, 400 nF, 4 mF, 40 mF
Accuracy:	± (3.0% rdg + 20dgts) on4 nF range (use DZERO) ± (3.0% rdg + 4dgts) on 40 nF to20 mF ranges ± (6.0% rdg + 4dgts) above 20 mF
Overload protection:	600 VDC or AC rms
DC CURRENT (Put conductor at the center of the jaws)	
Ranges:	400 A, 1200 A
Resolution:	100 mA
Accuracy: *700A to 1200A	± (1.5% rdg + 5dgts): ± (2.0% rdg + 5dgts)
Overload protection:	1200A dc maximum for 1 minute.
AC CURRENT (True RMS) (40 Hz – 500 Hz) (Put conductor at the center of the jaws in case of Clamp-on Multimeter)	
Ranges:	400 A, 1000 A
Resolution:	100 mA
Accuracy: *700A to 1000A: (50Hz/60Hz)	± (1.75% rdg + 5dgts) on 50 Hz/ 60 Hz ± (3.5% rdg + 5dgts) on 40 Hz – 500 Hz ±(2.5% rdg + 5dgts)
Overload protection:	1000 V maximum for 1 minute.

C. Tests and Inspections

C.1 It shall be the responsibility of the supplier to perform or to have performed the tests specified and whatever other tests he normally performs at works.

C.2 Copies of previous Type Tests 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. The accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender document (all in English Language).

Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated below:

Type tests for the instrument performance

(i) Electromagnetic compatibility (EMC)
(ii) Impulse overvoltage tests on the equipment -Clearances
(iii) Dielectric voltage withstand tests on the equipment - Controlled overvoltage
(iv) Functional tests of the equipment.

Type tests for printed circuit board coating performance

(i) Environmental, humidity and thermal conditioning tests
(ii) Dielectric voltage withstand tests
(iii) Comparative tracking index (CTI)
(iv) Resistance to soldering heat
(v) Coating adhesion
(vi) Insulation resistance between conductors

C.3 Routine and sample test reports for the low voltage measurement instruments to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers will witness tests at the factory before shipment.

C.4 On receipt of the goods KPLC will perform any of the tests specified in order to verify compliance with this specification.

C.5 The supplier shall replace without charge to KPLC the low voltage measurement instruments, which upon examination, test or use; fail to meet any of the requirements in the specification.

D. Quality Management System (Normative)

D.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the low voltage measurement instruments physical properties, tests and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

D.2 The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

D.3 The bidder shall indicate the delivery time of the items, manufacturer's monthly & annual production capacity and experience in the production of the type and size of items being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar type of the low voltage measurement instruments sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

E. Documentation (Normative)

E.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) 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 and technical data;
c) Sales records for the last five years and at least four customer reference letters;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
g) Manufacturers letter of authorization, ISO 9001:2008 certificate and other technical documents required in the tender.
h) Operating instructions:
The operating uncertainty, the intrinsic uncertainty and the variations $E1$ to $E10$ shall be provided in the operating instructions.

In addition, the operating instructions shall comprise the following details:

(i) Connection diagrams.
(ii) Instructions for measurements.
(iii) Brief description of the principle of measurement.
(iv) Diagrams or tables showing the maximum permissible indicated values taking into consideration the tolerances stated by the manufacturer (if necessary).
(v) Type of battery/rechargeable cells.
(vi) Information on the charging current, charging voltage and duration of charging for rechargeable cells.
(vii) Operational lifetime/runtime of the battery/rechargeable cells or the possible number of measurements.
(viii) Type of IP protection (IEC 60529).
(ix) Any necessary special guidance notes.

E.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Fully filled clause by clause guaranteed technical particulars (GTP) signed by the manufacturer;
b) Design Drawings with details of low voltage measurement instruments to be manufactured for KPLC.
c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008
d) Detailed test program to be used during factory testing;
e) All documentation necessary for safety of the equipment as specified in IEC 61010-1 clause 5.4 shall be provided with the equipment.

E.3 The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the low voltage measurement instruments to KPLC stores.

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F. 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, sales records for previous five years, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)*

Tender No ..... Bidder's Name & Address .....

Clause Number	Requirement		Bidder's Offer
Manufacturer's Name and address			Specify
Country of Manufacture			Specify
Bidder's Name and address			Specify
1.	Scope		
2.	Normative References		Specify
3.	Terms, Definitions and Abbreviations		
4.	Requirements		
4.1	Service condition		State
4.2	Design and Construction		State compliance
4.2.1-4.2.11			
4.3	Specific requirements		
4.3.1	Phase rotation tester		
	Brand name or designation		Specify
4.3.1.1 -4.3.1.10			State compliance
4.3.1.11	Features		List
4.3.1.12	Display Description		List
4.3.1.13	Technical details	Input power	State
		Phase sequence (rotation) indicator	
		Voltage range a.c	
		Resolution	
		Time limit for continuous use	
		Input impedance	
		Accuracy at	
		Battery life	
4.3.2	Insulation Resistance test set		
	Brand name or designation		Specify
4.3.2.1	Standards of manufacture		State
4.3.2.2	Maximum applied test voltage		State
4.3.2.3-4.3.2.5			State compliance
4.3.2.6	Functions and test features		List

4.3.2.7	Technical particulars	Test Voltage	State
		Insulation Resistance Range	
		Accuracy (23° C)	
		Voltage Output Accuracy (0°C to 30°C)	
		Short Circuit/Charge Current	
		Current Measurement	
		Capacitance Measurement	
		Capacitor	
		Display	
		Dielectric Absorption Ratio (DAR)	
		Polarization Index (PI)	
		Dielectric Discharge Measurements (DD)	
		Timer Range	
		Memory Capacity	
		Industry-Standard Tests	
		Interference Rejection	
		Guard Terminal	
		Voltage Input Range	
		Battery Life	
4.3.3	Earth resistance Test set (Electronic type)		
	Brand name or designation		Specify
4.3.3.1	Standard of manufacture		State
4.3.3.2-4.3.3.6			State compliance
4.3.3.7	Applications		State
4.3.3.8	LED indicator present?		State
4.3.3.9	Interface		State
4.3.3.10	Technical particulars	Display	State
		Over-range Indication	
		Operation Frequency of Ω current	
		Earth Resistance Range	
		Resistance resolution	
		Earth Resistance Accuracy	
		Max Earth Voltage	
		Earth Voltage Accuracy	
		Power on/off	
		Low Battery Indicator:	
		Data Hold Indicator	

		Power	
		Weight:	
		Accessories included	
4.3.3.11	Measurement characteristic	Resistance	State
		Earth voltage potential	
4.3.4	Digital Multimeter		
	Brand name or designation		Specify
4.3.4.1	Standard of manufacture		
4.3.4.2	Auto ranging dial present?		Specify
	Display		
4.3.4.3	Advanced multimeter functional feature present.		State
4.3.4.4	Weight		State
	Dimensions		
4.3.4.5	Devices with battery power shall have an option of being operated without plug-in power		State compliance
4.3.4.6	Specific measurement made by digital multimeter		List
4.3.4.7	Measurement characteristics		As per Annex B
4.3.4.8	Output interfaces present		State
4.3.4.9	Features		State
4.3.5	Digital clamp-on meter		
	Brand name or designation		Specify
4.3.5.1	Standards of manufacture		State
4.3.5.2	Weight		State
	size		
4.3.5.3	General specification	Display	Specify
		Polarity	
		Over range	
		Low battery indication	
		Measurement rate	
		Accuracy	
		Auto Power off	
		Clamp jaw	
		Power	
		Battery life	
		Accessories	
4.3.5.4	Input signal	A.C voltage	State
		A.C Current	
4.3.5.5	Measurement Characteristic		As per Annex B
4.3.6	Cable Height metre		

	Brand name or designation		Specify
4.3.6.1	Standard of manufacture		
4.3.6.2	Measuring capabilities		
4.3.6.3-4.3.6.5			State compliance
4.3.6.6	Technical particulars	Accuracy	Specify
		Resolution	
		Power source	
		Battery life	
		Display	
		Measurement units	
		Auto power off delay	
		Weight	
4.3.6.7	Measurement characteristics	**Minimum cable size**	Range
		25mm cable	Specify
		12mm cable	Specify
		5.5 mm cable	Specify
		2.5 mm cable	Specify
4.3.7	Polarity tester/ Earth leakage meter		
	Brand name or designation		Specify
4.3.7.1	Standard of manufacture		State
4.3.7.2	Capabilities		State
4.3.7.3	Weight		State
	Dimension		
4.3.7.4	Technical particulars	Rated tripping current	State
		Operating voltage	
		Resolution	
		Accuracy	
		Plug	
		Cord length	
		Number of Wiring identifications	
		Display	
4.3.8	Voltage Tester		
	Brand name or designation		Specify
4.3.8.1-4.3.8.5			State compliance
4.3.8.6	Technical particulars	Voltage range d.c. and a.c.	Specify
		Accuracy	
		Resolution	
		Input impedance	

		Power source	
		Battery life	
		Display	
5.	Test and Inspection		
6.	Marking and Packing		
6.1	Marking		Specify
6.2	Packing		Specify
A	Safety and Environmental Design Requirements		
1	Operating conditions	Operating temperature	Specify
		Storage temperature	Specify
		Humidity range - Rel. humidity	Specify
		Permissible percentage operating uncertainties	Specify
		Supply voltage	Specify
2	Environmental conditions	Shock (operating)	Specify
		Vibration (operating)	Specify
		Dry heat test	Specify
		Damp heat test	Specify
		Salt mist test	Specify
		Flammability test	Specify
3	EMC tests	Particular requirements test configurations, operational conditions and performance criteria	Specify
4	Safety	Rated Impulse Voltage for equipment -1.2/50µs	Specify
		Overvoltage category	Specify
		Pollution category	Specify
		Insulation material group	Specify
		Class of protection	Specify
		Protection against enclosures	Specify
		Measuring category	Specify
		Minimum clearances for equipment to withstand steady state voltages, temporary over-voltages and to avoid partial discharge	Specify
		Creepage distance for equipment subject to long term stresses, min	Specify
		Minimum acceptable creepage distances on printed circuit boards	Specify
		Maximum recurring peak voltage related to creepage distance on printed wiring boards	Specify

		Width of grooves by pollution degree on printed circuit boards	Specify
		Partial discharge requirements	Specify
		Solid insulation design	Specify
B.	Measurement characteristics of Multimeter and Clamp-on Meter		
	DC volts	Ranges	State
		Resolution	
		Accuracy	
		Input impedance	
		Overload protection	
	a.c Volts	Ranges	State
		Resolution	
		Accuracy	
		Input impedance	
		Effect reading	
		Overload protection	
	Resistance	Ranges	State
		Accuracy	
		Open circuit volts	
		Overload protection	
	Continuity	Audible indication:	State
		Overload protection:	
	Diode Test	Test current:	State
		Accuracy:	
		Open circuit volts:	
		Overload protection:	
	Frequency	Ranges:	State
		Resolution:	
		Accuracy:	
		Sensitivity:	
		Effect reading:	
		Overload protection:	
	Capacitance	Ranges:	State
		Accuracy:	
		Overload protection:	
	DC Current	Ranges:	State
		Resolution:	
		Accuracy:	

		Overload protection:	
	a.c Current	Ranges:	State
		Resolution:	
		Accuracy:	
		Overload protection:	
C	Test and Inspection		
C.1	Test standards and responsibility of carrying out tests		Provide
C.2	Copies of Type Test Reports submitted with tender		Provide
C.3	Acceptance tests to be witnessed by KPLC at factory before shipment		Provide
C.4	Test reports to be submitted by supplier to KPLC for approval before shipment		Provide
C.5	Replacement of rejected lux meters		State compliance
D	Quality Management System		State
D.1	Quality Assurance Plan		State
D.2	Copy of ISO 9001:2008 Certificate		Provide
D.3	Manufacturer's experience		State
	Manufacturing Capacity (units per month)		State
	List of previous customers		State
	Customer reference letters		Provide
E	Documentation		Provide
E.1	Documents submitted with tender		Provide
E.2	Documents to be submitted by supplier to KPLC for approval before manufacture		State
	Statement of compliance to specification		State

.....

Manufacturer's Name, Signature, Stamp and Date