KENYA STANDARD

DKS 1022:2015
ICS 29.035.01

Specification for 600/1000 V PVC insulated single-phase concentric cables with copper or aluminium conductors for electricity supply

COMMITTEE DRAFT, JULY 2015

Second Edition 2015

TECHNICAL COMMITTEE REPRESENTATION

The following organizations were represented on the Technical Committee:

Kenya Power and Lighting Co. Ltd.
Metsec Cables
Kenwest Cables Ltd.
Consumer Information Network
Jomo Kenyatta University of Science and Technology
SGS(K)
KIRDI
ASL Cables
Intertek
East African Cables
Nema
REA
Kenya Bureau of Standards — Secretariat

REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya standards shall be regularly reviewed. Suggestions for improvement to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

KENYA STANDARD **DKS 1022:2015**
ICS 29.035.01

Specification for 600/1000 V PVC insulated single-phase concentric cables with copper or aluminium conductors for electricity supply

KENYA BUREAU OF STANDARDS (KEBS)

Head Office: P.O. Box 54974, Nairobi-00200, Tel.: (+254 020) 605490, 69028000, 602350, Mobile: 0722202137/8, 0734600471/2;
Fax: (+254 020) 604031
E-Mail: info@kebs.org, Web:http://www.kebs.org

KEBSCoast Region
P.O. Box 99376, Mombasa 80100
Tel: (+254 041) 229563, 230939/40
Fax: (+254 041) 229448
E-mail: kebs-msa@swiftmombasa.com

KEBS Lake Region
P.O. Box 2949, Kisumu 40100
Tel: (+254 057) 23549,22396
Fax: (+254 057) 21814
E-mail: kebs-ksm@swiftkisumu.com

KEBS North Rift Region
P.O. Box 2138, Nakuru20100
Tel: (+254 051) 210553, 210555

FOREWORD

This Kenya Standard has been prepared by the Conductors and Cables Technical Committee, under the direct supervision of the Electrical Industry Standards Committee, and it is in accordance with the procedures of the Bureau.

The standard specifies requirements and dimensions for PVC-insulated single-phase concentric cables for operation to an earthed neutral system at nominal voltages up to and including 1 000 V between phases and 600 V to earth. It gives a tabulated schedule of test requirements designating each test under the category of routine test, regular sample test or type test. In addition, two annexeshave been added, Annex A giving recommendations for the selection and operation of cables and Annex B providing recommendations for the installation of cables.

In the preparation of this Kenya Standard, assistance was derived from BS 4553:1988. Acknowledgement is made for the assistance derived from this source.

Contents

SPECIFICATION FOR 600/1 000 V PVC INSULATED SINGLE-PHASE CONCENTRICCABLES WITH COPPER OR ALUMINIUM CONDUCTORS FOR ELECTRICITY SUPPLY

1 Scope

This Kenya Standard specifies requirements and dimensions for PVC-insulated single phase concentric cables for operation on an earthed neutral system at nominal voltages up-to and including 1 000 V between phases and 600 V to earth. The cables have a central phase conductor insulated with red PVC and a concentric layer comprising bare wires (neutral conductor). In any one cable both the phase and neutral conductors are of the same material i.e. both copper or both aluminium.

The cables are suitable for underground or general use in situations where the combination of ambient temperature and temperature-rise due to loading current results in a conductor temperature not exceeding 70 ^{0} C.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

KSIEC 60228

KS 04-188

KS 04-863

3 Definitions

For the purpose of this standard the definitions given in KS 04-178* shall apply together with the following:

3.1
rated voltage U_o
The nominal power-frequency voltage between phase conductor and earth, for which the cable is suitable.

3.2
rated voltage U
The nominal power-frequency voltage between phase conductors, for which the cable is suitable.

3.3
maximum voltage U_m
The maximum sustained power frequency voltage between phase conductors for which the cable is suitable.

3.4

* Glossary of terms related to cables, conductors and accessories for electrical supply.

nominal value
The value by which a quantity is designated which is often used in tables.

NOTE: In this standard, nominal values usually give rise to values to be checked by measurements checking into account specified tolerance.

3.5
approximate value
A value which is only indicative.

NOTE: In this standard, values described as 'approximate' do not constitute requirements to be checked by measurements.

3.6
type tests (symbol T)
tests required to be made before supplying, on general commercial basis, a type of cable covered by this standard, in order to demonstrate satisfactory performance characteristics to meet the intended application.

NOTE: These tests are of such nature that, after they have been made, they need not be repeated unless changes are made in the cable material, design or type of manufacturing process which might change the performance characteristics.

3.7
sample tests (symbol S)
testsmade on samples of completed cables or components taken from completed cable, adequate to verify that the finished product meets design specifications.

3.8
routine tests (symbol R)
tests made on all production lengths to demonstrate their integrity.

3.9
test after installation
tests intended to demonstrate the integrity of the cable and its accessories as installed.

4. VOLTAGE DESIGNATIONS

The cables shall be designated by the rated voltages U_o and U, expressed in the form U_o/U. For the purposes of this standard the voltage designation is 600/1 000 V. For the purposes of this standard, the maximum designated voltage, U_m is 1 200V.

NOTE: Guidance on the selection and operation of cables is given in Annex A.

5. PHASE CONDUCTOR

The phase conductor shall be either circular stranded or compacted stranded plain annealed copper (Class 2) or stranded annealed aluminium conduction (Class 2) and as given in Table 1 shall comply with KS IEC 60228 The phase conductor shall have a left hand direction of lay.

Where the manufacturer deems it necessary to use tinned copper conductors, they shall conform to the requirements of KS IEC 60228.

6. INSULATION

6.1 General

The insulation of the central phase conductor shall be red PVC compound type TI 1 complying with type KS 04 -188. It shall be applied by an extrusion process and shall be spark tested in accordance with 14.1.

6.2 Thickness of insulation

The thickness of insulation, determined by taking the average of a number of measurements as described in **15.1**, shall be not less than the value given in Tables 2 or 3 (as appropriate) and the smallest of the measured values shall not fall below the value given in tables by more than10 % + 0.1 mm.

6.3Spark testing of insulation

The core insulation shall conform to the requirements for spark testing specified in KS 04-863 when tested in accordance with the a.c or d.c test methods specified in that standard. See 14.1.

7. CONCENTRIC LAYER

7.1 **Neutral Conductor** —The neutral conductor shall be manufactured from plain annealed copper wires or plain annealed aluminium wires when measured in accordance with **14.5** the number of wires and the resistance of the neutral conductor shall comply with the values given in Tables 2 or 3 as appropriate.

7.2 **Application of Concentric Layer** — The concentric layer shall be applied with a right hand direction of lay.

The lay ratio in the outer layer shall not be less than 8 nor more than 16 times the mean outer diameter of that layer.

TABLE 2. 600/1000V SINGLE PHASE CONCENTRIC CABLES WITH STRANDED COPPER CONDUCTORS AND COPPER WIRE NEUTRAL CONDUCTORS

PHASE CONDUCTOR			CONCENTRIC NEUTRAL CONDUCTORS NUMBER AND APPROX. DIAMETER OF WIRES	LAY LENGTHS		THICKNESS OF OVER-SHEATH	APPROX. OVERALL DIAMETER OF CABLE	max. d.c. CONDUCTOR RESISTANCE PER 1 000 m OF CABLE AT 20 ^{0} C	
Nominal area	Number and approximate diameter of wires	Thickness of insulation						Phase	Neutral
mm^2	mm	mm	mm	min mm	max mm	mm	mm	Ω	Ω
4	7/0.85	1.55	24/0.85	59	118	1.4	9.75	4.61	1.343
6	7/1.04	1.55	26/0.85	63	127	1.4	10.72	3.08	1.240
10	7/1.35	1.55	29/0.85	71	142	1.4	11.73	1.83	1.151
16	7/1.70	1.55	26/1.13	84	167	1.4	12.78	1.15	1.007 4
25	7/2.14	1.60	29/1.13	95	190	1.5	14.88	0.727	0.629
35	19/1.53	1.65	28/1.35	109	218	1.6	16.75	0.524	0.473

TABLE 3. 600/1000V SINGLE PHASE CONCENTRIC CABLES WITH STRANDED ALUMINIUM CONDUCTORS AND ALUMINIUM WIRE NEUTRAL CONDUCTORS

PHASE CONDUCTOR			CONCENTRIC NEUTRAL CONDUCTORS NUMBER AND APPROX. DIAMETER OF WIRES	LAY LENGTHS		THICKNESS OF OVER-SHEATH	APPROX. OVERALL DIAMETER OF CABLE	max. d.c. CONDUCTOR RESISTANCE PER 1000 M OF CABLE AT 20^0 C.	
Nominal area	Number and approximate diameter of wires	Thickness of insulation						Phase	Neutral
mm^2	mm	mm	mm	min mm	max mm	mm	mm	Ω	Ω
10	7/1.35	1.55	23/1.13	75	151	1.4	12.21	3.08	1.335
16	7/1.70	1.55	26/1.13	84	167	1.4	13.34	1.91	1.808
25	7/2.14	1.60	29/1.13	95	190	1.5	14.88	1.20	1.058 6
35	19/1.53	1.65	27/1.35	109	218	1.6	16.75	0.868	1.796 6

8. OVER-SHEATH

The over-sheath shall be an extruded layer of black PVC compound as specified in KS 04-188. The over-sheath shall be spark tested in accordance with **14.2**.

9. THICKNESS OF OVER-SHEATH

When measured in accordance with **15.1**, the minimum thickness of the over-sheath shall not fall below the value given in Tables 2 or 3, as appropriate, by an amount more than (15 per cent + 0.1 mm).

10. CABLE MARKING

10.1 Embossing of Over-sheath

The external surface shall be legibly marked with the following elements:

	Element	Example of Marking
a	Electric cable	ELECTRIC CABLE
b	Voltage designation	**600/1 000 V**
c	Kenya Standard number[1]	KS 1022
d	Manufacturer's identification	XYZ
e	Number of cores, type and nominal area of phase conductor e.g 1. 1 X 25 AL shall indicate a single core cable with 25 mm^2 aluminium phase conductors. 2. 1 X 25 CU shall indicate a single core cable with 25 mm^2 copper phase conductors	

Marking of elements a) to d) shall be by embossing on the cable over-sheath. For cables with approximate tabulated overall diameter larger than 15mm, elements a), b) and c) shall appear, in any sequence that is deemed neither to confuse nor to conflict, on two or more primary lines along the axis of the cable, approximately equally spaced around the circumference of the cable. Elements d) and e) shall appear, together or separately, in any sequence that is deemed neither to confuse nor to conflict, either on one of the primary lines, or on a secondary line or lines.

For cables with approximate tabulated overall diameter lesser than 15mm, the elements shall be arranged as for cables of greater than 15mm diameter, except that the marking for elements a), b) and c) shall appear on one or more primary lines.

The letters and figures shall be raised and shall consist of upright block characters. The minimum size of characters shall be 15 per cent of the tabulated diameter of the cable, or 3 mm, whichever is the greater.

The distance between the end of one element of marking and the beginning of the next identical element shall not be greater than 550mm for elements a), b) and c, and not greater than 1100mm for elements d) and e).

Conformity shall be checked by visual examination and measurement.

10.2 Additional Markings- Additional markings such as a means of identifying the customer mark of quality or any other may be included throughout the length of the cable. If this is by means of embossing, this shall not affect the spacing between repetitions of legends as specified in **10.2.**

11. END SEALING

[1] Marking KS 1022 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity.

Both ends of every length of cable shall be sealed in such a manner that the sealing encloses the over sheath,preventing ingress of water.

NOTE: One example of end sealing is the use of close fitting plastic caps.

12. SCHEDULE OF TESTS

Table 1 lists the complete range of tests applicable to the cable covered by this standard, and refers to the relevant clauses of the standard specifying the requirements and test methods. The final column indicates, by means of the symbols R, and T, the category of each test.

TABLE 1. SCHEDULE OF TESTS

TEST	REQUIREMENT GIVEN IN CLAUSE OF THIS STANDARD	TEST METHOD	CATEGORY OF TEST (*see* CLAUSE **12**)

Test on components:			
Phase conductor material and construction	**4**	KS IEC 60228	RS
Insulation:			
(*a*) Material	**5**	KS 04-188	T
(*b*) Application	**5**	Visual examination	RS
(*c*) Spark test	**5**	KS 04-863	R
(*d*) Thickness	**6**	KS 04-188	RS
Concentric layer:	**7.1**	**14.5** of this standard	RS
Over sheath:			
(*a*) Material	**8**	KS 04-188	T
(*b*) Thickness	**9**	KS 04-188	RS
(c) Spark test	**8**	KS 04-863	R
Test on completed cables:			
Concentric construction	**7**	Visual examination	RS
Cable marking	**10**	Visual examination	R
Phase conductor resistance	**4**	**14.5** of this standard and KS IEC 60228	R
Neutral conductor resistance	**7.1**	**14.5** of this standard and KS IEC 60228	R
Voltage test	**14.3**	**14.3** of this standard	R
Insulation resistance	**14.4**	**14.4** of this standard	R

* Test methods for spark testing of electric cables.

13. TEST CONDITIONS

13.1 Ambient Temperature— Tests shall be made at ambient temperature of 20 ± 15 ^{0}C unless otherwise specified in the details of the particular tests.

13.2 Frequency and Waveform of Power Frequency Test Voltages —Unless otherwise specified in the relevant test method, the frequency of the alternating voltages shall be in the range of 49 Hz to 61 Hz. The waveform shall be substantially sinusoidal.

14. ROUTINE TESTS AT WORKS

14.1 Spark Test on Phase Core — A spark test shall be applied to the phase core at the insulation stage of manufacture in accordance with KS 04-863 and the test voltage shall be as given in Table 4.

TABLE 4. SPARK TEST VOLTAGES

NOMINAL CROSS-SECTIONAL AREA OF PHASE CONDUCTOR	TEST VOLTAGE	
	a.c. (r.m.s.)	d.c.
mm^2	kV	kV
4 to 16	6	9
25 and 35	10	15

14.2 Spark Test on PVC Over sheath— A spark test shall be applied to the PVC over sheath in accordance with KS 04-863.

14.3 Voltage Test on Completed Cables —A voltage of 3.5 kV r.m.s. shall be applied between the central phase conductor and all the wires comprising the concentric layer.

The voltage shall be increased gradually and maintained at the full value for 5 minutes. The insulation shall not break down.

14.4Insulation Resistance Test —After completion of the voltage test, the insulation resistance between the central phase conductor and all the wires comprising the concentric layer shall be measured and the value shall be not less than 5 M Ω/1 000 M at 20 ^{0}C.

The measurement of insulation resistance shall be made after application of d.c. voltage for 1 minute at not less than 500 V.

14.5 Conductor Resistance Test — The d.c. resistances of the central phase and neutral conductors shall be measured and when corrected to 20 ^{0}C, in accordance with KS IEC 60228, shall be not greater than the values given in Tables 2 and 3, as appropriate.

15. REGULAR SAMPLE TEST

15.1 Thickness Measurements of PVC

15.1.1 *Sampling*—Make the measurements of thickness of insulation and over sheath listed in the schedule of tests (*see* Table 1) on a sample taken from one end of each drum length of cable selected for the test, having discharged any portion which may have suffered damage. The measured value of the sample shall comply with the requirement of Clause **9**.

15.1.2 *Method*—Take measurements for each component by the method specified in KS 04-188, except that as an alternative to the equipment specified in KS 04-188, it is permissible to use a calibrated hand lens. Then determining an average thickness from several measurements, round the resultant value to the nearest 0.1 mm (0.05 mm being rounded upwards). In case of dispute or doubt, the method and equipment specified in KS 04-188 shall be used.

INFORMATIVE ANNEXES
ANNEX A

RECOMMENDATIONS FOR SELECTION AND OPERATION OF CABLES

A1. TYPE AND FINISH

PVC over-sheath provides protection against most corrosive and wet environments. In particularly onerous cases, reference should be made to the cable manufacturer.

A2. VOLTAGE RATING

The cables specified in this standard are rated at 600/1 000 V. They can be selected for use in systems which fall into either category A or B given below:

Category A— This category comprises those systems in which any phase conductor that comes into contact with earth or an earth conductor is automatically disconnected from the system.

Category B— This category comprises those systems which, under fault conditions, are operated for a short time, not exceeding 8 hours, on any occasion, with one phase earthed.

A3. CURRENT RATING

Reference should be made to the manufacturer's publications to obtain the current ratings of selected cable sizes.

ANNEX B

RECOMMENDATIONS FOR INSTALLATION OF CABLES

B1. COMPLIANCE WITH REGULATIONS

Attention is drawn to the Kenya Wiring Regulations(KS 04-662), when installing cables complying with this standard.

B2. MINIMUM TEMPERATURE DURING INSTALLATION

Attention is drawn to the fact that as the temperature decreases, PVC compounds becomes increasingly stiff and brittle, with the result that if the cable is bent too quickly to too small a radius or is struck at temperatures in the region of 0 ^{0}C or lower, there is a risk of shattering the PVC component. To avoid the risk of damage during handling therefore, it is desirable that the cable specified in this standard should be installed only when both the cable and the ambient temperature are above 0 ^{0}C and have been so for the previous 24hours or where special precautions taken to maintain the cable above this temperature.

B3. MINIMUM INSTALLATION RADIUS

None of the cables specified should be bent during installation to a radius smaller than 8 times the overall diameter given in Tables 2 or 3 as appropriate.

B4. PREVENTION OF MOISTURE INGRESS

Care should be exercised during installation to avoid any damage to cable coverings. This is important in wet or other aggressive environments. Unprotected open ends should not be exposed to moisture prior to final termination or jointing.

The possibility of damage to moisture seals during handling and installation of the cable should be borne in mind. Where such damage may have occurred, the seals should be inspected and remade if necessary.

B5. COMPOUND FILLING

Joints and sometimes terminations require filling with specified compounds to seal against wet or hazardous environments. When hot pouring compound is used, care should be taken that at the time of pouring, this temperature of the compound does not exceed 150 ^{0} C.

Any joint included should be of suitable design to provide a protective seal to prevent moisture gaining access to the insulation and ferrules or to the neutral.

B6. TESTS AFTER INSTALLATION

A voltage test after installation is not an essential requirement of this standard, but if a test is made, it should be carried out with a direct current, the value of the voltage being that specified below:

During the test, the voltage should be increased gradually to the full value of 3 500 V d.c. and maintained continuously for 15 minutes between phase conductor and the concentric conductor.

