KENYA STANDARD

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Specification for pvc-insulated cables for electricity supply

(Third Revision, 2018)

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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
Kengen
Taifa Cables
Cable Connect
East African cables
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REVISION OF KENYA STANDARDS

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

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Foreword

The third revision of this Kenya Standard was prepared by the Cables and Conductors Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

The first revision of this standard, was approved by the National Standards Council in 1987, had been based on various amendments which had been issued by the BSI to BS 6346: 1967, which the first issue of this Kenya Standard had been based on.

Towards the end of 1987, a newly revised edition of the British Standard, namely, BS 6346: 1987, was issued. It replaced the 1967 edition.

After studying this new edition, the Technical Committee decided that the first revision should be revised so as to be in line with the latest version of the British Standard. (It should be noted that IEC has so far not issued a similar standard.)

Requirements for cables with concentric neutral copper conductors, which had been covered by the previous two editions, are not specified in this second revision. These are now to be covered in another standard, which is under preparation.

Attention is drawn to the recommendations for the selection, installation and operation of PVC-insulated cables, given in Appendices A and B.

This third revision addresses requirements on embossing, and the gap specified between cable legends.

Acknowledgement is made for the assistance received from these sources.

C O N T E N T S

KENYA STANDARD

SPECIFICATION FOR PVC-INSULATED CABLES FOR ELECTRICITY SUPPLY

(SECOND REVISION, 1990)

1. SCOPE

This Kenya Standard gives requirements and dimensions for PVC-insulated cables for operation at voltage up to and including 1 900 V to armour or earth and 3 300 V between conductors.

The cables have been designed for general (including underground) use where the combination of ambient temperature and temperature rise due to load results in a conductor temperature not exceeding 70^0C.

The cables included in the standard are as follows:

1.1 600/1 000 V CABLES

1.1.1 Single-core Copper Conductor:

(a) Unarmoured, sheathed.

(b) Wire-armoured, sheathed.

1.1.2 Single-core Solid Aluminium Conductor:

(a) Unarmoured, sheathed.

(b) Wire-armoured, sheathed.

(c) Aluminium strip-armoured, sheathed.

1.1.3 Single-core Solid Sectional Aluminium Conductor:

(a) Unarmoured, sheathed.

(b) Wire-armoured, sheathed.

(c) Aluminium strip-armoured, sheathed.

1.1.4 Two-, Three- and Four-core Copper Conductor:

(a) Unarmoured, sheathed.

(b) Wire-armoured, sheathed.

1.1.5 Two-, Three- and Four-core Solid Aluminium Copper Conductor:

(a) Unarmoured, sheathed.

(b) Wire-armoured, sheathed.

(c) Aluminium strip-armoured, sheathed.

1.1.6 Multicore Auxiliary Copper Conductor:

(a) Wire-armoured, sheathed.

1.2 1 900/3 300 V CABLES

1.2.1 Single-core Copper Conductor:

(a) Wire-armoured, sheathed.

1.2.2 Single-core Solid Aluminium Conductor:

(a) Wire-armoured, sheathed.

(b) Aluminium strip-armoured, sheathed.

1.2.3 Single-core Solid Sectoral Aluminium Conductor:

(a) Wire-armoured, sheathed.

(b) Aluminium strip-armoured, sheathed.

1.2.4 Three-core Copper Conductor:

(a) Wire-armoured, sheathed.

1.2.5 Three-core Solid Aluminium Conductor:

(a) Wire-armoured, sheathed.

(b) Aluminium strip-armoured, sheathed.

NOTE: Appendix A gives recommendations for the selection and operation of cables, while recommendations for the installation of cables are given in Appendix B, and Appendix C lists information that should be given in any enquiry or order.

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.

KS 178:1980 Glossary of terms related to cables, conductors and accessories for electricity supply.

KS 188:1997 Specification for PVC insulations and sheaths of electric cables and cords

KS EAS 115:1999 Electric cables - Spark testing - Test method.

KS 187:1987
Specification for conductors of insulated cables (Second Edition).

KS 863:1988 Test methods for spark testing of electric cables.

KS 191-1:1987 Specification for test on electric cables under fire conditions - Part 1: Test on single vertical insulated wire or cable.

KS 662 Kenya wiring regulations

2. DEFINITIONS

For the purpose of this Kenya Standard the following definitions together with the relevant definitions given in KS 04-178*, shall apply:

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

2.1 Rated Voltage, U_o — The nominal power-frequency voltage earth for which the cable is suitable.

2.2 Rated Voltage — The nominal power-frequency voltage between phase conductors for which the cable is suitable.

2.3 Maximum Voltage, Um — The maximum sustained power-frequency voltage between phase conductors, for which the cable is suitable.

2.4 Nominal Value— The value by which a quantity is designated and which is often used in tables (of this standard).

NOTE: Usually, in this standard, nominal values give rise to values to be checked by measurements taking into account specified tolerances.

2.5 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. VOLTAGE DESIGNATION

The cables shall be designated by the rated voltages U_o and U, expressed in the form U_o/U.

The rated voltages recognized for the purposes of this standard are 600/1 000 V and 1 900/3 300 V.

The maximum designated voltages (Um) for the purposes of this standard for 600/1 000 V and 1 900/3 V cables are recognized as 1 100 V and 3 600 V respectively.

NOTE: Guidance on the selection of cables of appropriate voltage designations for particular systems is given in clause A2.

4. CONDUCTORS

The conductors shall be either annealed copper conductors or solid aluminium conductors, as indicated in Tables 11 to 25 inclusive, and shall comply with the requirements of KS 04-187*. It is permissible for the copper wire to be tinned at the manufacturer's discretion. The conductors shall be circular, circular sectoral or shaped solid (class 1), or circular, circular compacted or shaped stranded, (class 2), as indicated for the type and rated voltage of the cable in Cables 11 to 25 inclusive.

5. INSULATION

5.1 General — The insulation shall be a PVC compound complying with Type TI 1 of KS 04-188†. The insulation shall be applied by an extrusion process and shall form a compact and homogeneous body. Compliance shall be checked by visual examination.

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* Specification for conductors of insulated cables.

† Specification for PVC insulations and sheaths for electric cables and cords (First Revision). The insulation shall comply with the compatibility requirement of Clause 16.2.

5.2 Spark Testing of Insulation — The core insulation comply with the requirements for spark testing specified in KS EAS 115*, when tested in accordance with that standard.

5.3 Thickness of Insulation— The thickness of insulation, when determined by taking the average of a measurements in accordance with Clause 15.2, shall be not less than the value given in Tables 11 to 25, as appropriate, and the smallest of the measured values shall not fall below the value given in Tables 11 to 25, as appropriate, by more than (10 per cent +0.1 mm).

6. IDENTIFICATION OF CORES

The cores of all cables shall be identified by colours or by numbers, in accordance with the following sequence:

NUMBER OF CORES	NUMBERS	IDENTIFICATION
Single-core	-	Red or black
Two-core	-	Red, black
Three-core	-	Red, yellow, blue
Four-core	-	Red, yellow, blue, black
Five-core (Auxiliary cables)	1, 2, 3, 4, 5 and upwards	

The colours shall be either throughout the insulation or on its external surface.

The numbers shall be printed in a colour which contrasts with the cores. The intervals between adjacent numbers shall not exceed 70 mm.

Compliance with these requirements shall be verified by visual examination and by measurements.

NOTE: As per request of the customer, the harmonized color codes can be found in Annex F

7. LAYING-UP

The cores of cables having two or more cores up to and including seven cores shall be laid with a right-hand or right-hand left-hand alternating direction of lay. For multi-core auxiliary cables having seven or more cores, the direction of lay shall alternate for each successive layer. Compliance with these requirements shall be checked by visual examination. Where necessary, synthetic fillers, which may be applied integrally with either the bedding of armoured cable or the sheath of un-armoured cable, shall be used to form a compact and reasonably circular cable.

It is permissible for a synthetic binder tape to be used over the laid-up cores at the manufacturer's discretion. The suitability

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* Test methods for spark testing of electric cables.

of the fillers and binder tape, if used, shall be determined by compliance, of the cable, with the compatibility requirements given in Clause 16.2.

8. BEDDING

8.1 The bending shall be compatible with the insulating material. Compatibility shall be determined in accordance with Clause 16.2.

8.2 *Single-core cables* — The bedding of armoured 600/1 000 v cables shall consist of an extruded layer of polymeric compound having a tensile strength of not less than 4 N/mm^2 and an elongation at break of not less than 50 per cent, when the test is done in accordance with KS 188. The bedding of 1 900/3 300 v cables shall consist of an extruded layer of Type TM 1 or Type 6 PVC compound complying with KS 04-188.

8.3 *Multicore Cables* — The bedding of armoured 600/1 000 v cables shall consist of an extruded layer of polymeric compound having a tensile strength of not less than 4 N/mm^2 and an elongation at break of not less than 50 per cent. It is permissible for cables having a nominal conductor cross-sectional area of 10 mm^2 and above to have a taped bedding, as indicated in Tables 14 to 20, comprising two or more layers of PVC tape or other synthetic tape complying with Clause with Clause 8.4. The bedding of 1 900/3 300 v cables shall consist of an extruded layer of Type TM 1 or Type 6 PVC compound complying with KS 04-188.

Where the bedding is applied integrally with fillers, it shall be possible to strip it from the cable without damaging the insulation of the cores.

8.4 *Taped Bedding Gaps* — When taped bedding is used for 600/1 000 v cables, it shall be applied such that any gaps between adjacent of each tape are not coincident through the thickness of the bedding.

If there is a gap between adjacent edges of each tape, it shall not exceed 15 per cent of the tape width, as determined by measurement in accordance with Clause 15.3.

NOTE: The thickness of taped bedding (approximately 0.8 mm need not be checked by measurement).

8.5 *Thickness of Extruded Bedding* — The minimum thickness of extruded bedding measured in accordance with Clause 15.2 shall not fall below the value given in Tables 12 to 26, as appropriate, by an amount more than (15 per cent + 0.1 mm).

9. ARMOUR

9.1 *General* — For armoured cables, the armour shall consist of a single layer of wires or aluminium strips having nominal dimensions as given in Tables 11 to 25, as appropriate. The armour shall be applied helically with a left-hand lay for cables having up to and including seven cores. For multicore auxiliary cables having more than seven cores, the direction of lay shall be opposite to that of the final layer of cores. It is permissible for a binder tape to be applied between the armour and the oversheath at the discretion of the manufacturer.

9.2 *Wire Armour* — Wire armour for cables having two or more cores shall consist of a single layer of galvanized steel wires. Wire armour for single-core cables shall consist of a single layer of aluminium wires.

The armour wire shall comply with the following:

(a) The diameter of the round armour wire, whether of galvanized steel or plain aluminium, determined in accordance with Clause D1 shall fall within the minimum and the maximum wire diameters specified in Table 1.

(b) the mass of zinc coating of galvanized steel armour wire, determined in accordance with Clause D2 shall not be less than that given in Table 2.

(c) The mechanical characteristics of the galvanized steel armour wires shall be such that when

subjected to the test given in Clause D3, none of the wires shall break.

(d) The tensile strength of alumium armour wires when tested in accordance with Clause D4 shall be not less than 125 N/mm^2.

9.3 *Aluminium Strip Armour* — The thickness and width of individual strips of aluminium armour, determined in accordance with Clause D5, shall not differ from the values specified in Tables 12, 14, 16, 18, 21, or 23, as appropriate, by more than 10 per cent. The tensile strength of individual strips of aluminium armour, when tested in accordance with Clause D4 shall be not less than 145 N/mm^2.

9.4 *Joints* — Joints in steel wire armour shall be brazed or welded and any surface irregularity shall be removed. Joints in aluminium wire or strip shall be made by cold pressusre of fusion welding and all surface irregularities shall then be removed.

A joint in any wire or strip shall be not less than 1 m from the nearest joint in any other armour wire or strip in the complete cable.

9.5 *Armour Resistance* — The d.c. resistance of the armour of the complete cable, measured and corrected to 20^{0}C in accordance with Clause 15.4, shall not exceed the appropriate value given in Table 29 to 33 (see Appendix E).

TABLE 1. DIAMETER OF ARMOUR WIRE

NOMINAL WIRE DIAMETER	WIRE DIAMETER	
	Minimum	Maximum
mm	mm	mm
0.9	0.85	0.95
1.25	1.18	1.32
1.6	1.51	1.69
2.0	1.90	2.10
2.5	2.37	2.63
3.15	2.99	3.31

TABLE 2. MASS OF ZINC COATING

NOMINAL DIAMETER OF ARMOUR WIRE	MINIMUM GAS OF ZINC COATING
mm	g/m^2
0.9	112
1.25	150
1.6	172
2.0	180
2.5	195
3.15	206

10. OVERSHEATH

10.1 The oversheath of unarmoured or armoured cable shall be an extruded layer of black PVC compound complying with Type TM of KS 04-188.

The oversheath shall comply with the compatibility requirements given in clause 16.2.

The oversheath of all armoured cables shall comply with the spark testing specified in KS 04-863 when tested in accordance with that standard.

10.2 Thickness of Oversheath

10.2.1 *Unarmoured Cable* — The thickness of the oversheath on unarmoured cables, determined by taking the average of a number of measurements as described in Clause 15.2, shall be not less than the value given in Tables 11 to 19, as appropriate, and the smallest of the measured values shall not fell below the value in the table by more than (15 per cent + 0.1 mm).

10.2.2 *Armoured Cable* — The minimum thickness of the oversheath on armoured cables, measured in accordance with clause 15.2, shall not fall below the value given in Tables 11 to 25, as appropriate, by more than (20 per cent + 0.2 mm).

11. CABLE MARKING AND END SEALING

11.1 *End Marking* — The ends of each factory length of cable having three or more cores of conductor size 25 mm^2 and above, may be marked red or green. The end at which the sequence of core colours, as given in Clause 6, is clockwise may be marked red and other end may be marked green.

11.2 *Embossing of Oversheath* — The external surface of the PVC oversheath shall be embossed with an identification of the manufacturer and one of the following legends, as appropriate.

	VOLTAGE DESIGNATION	*LEGEND*
(i)	600/1 000	electric cable 600/1 000 V
(ii)	1 900/3 300	electric cable 3 300 V
(iii)	600/1 000 auxiliary cables (five-core And above)	electric cable 600/1 000 V aux.

For tabulated approximate overall diameters above 15 mm, the legend may be embossed along two or more lines approximately equally spaced around the circumference.

For tabulated approximate overall diameters of 15 mm and smaller, the legend shall be embossed along one or more lines.

The letters and figures shall be raised and shall consist of upright block characters. In the legend, the maximum size of the characters shall be 13 mm and the minimum size shall be 15 per cent of the tabulated approximate overall diameter of the cable or 3 mm, whichever is the greater. The gap between the end of one legend and the beginning of the next shall be not greater than 550 mm.

Compliance shall be checked by visual examination and by measurement.

11.3 Cable Size Marking

11.3.1 *Single-core Cables* — Single-core cables having a cross-sectional area of 4 mm^2 and above shall be marked with cable size in mm^2.

11.3.2 *Two-core, Three-core, Four-core and Multi-core Cables* — All these cables shall be marked with cable size in mm^2.

11.4 *Identification of Manufacturer* — A means of identifying the manufacturer shall be provided

throughout the length of the cable.

11.5 *End Sealing* — Both ends of every length of cable shall be sealed in such a manner that it includes the oversheath.

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

12. SCHEDULE OF TESTS

Table 3 lists the complete range of tests applicable to the cables 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*, *RS*, and *T*, the category of each test.

The categories and corresponding designations are as follows:

(a) *Routine tests (R)* — Tests made at the manufacturer's works, or elsewhere, on all cables in the finished state or, as appropriate (e.g. spark test), during manufacture

(b) *Regular sample tests (RS)* — Tests made at the manufacturer's works, or elsewhere, in representative samples selected regularly from the production line at an agreed interval.

(c) *Type tests (T)* — Tests made on one or more samples of cable, of the same type and size, made to the same specifications and having the same essential details, to show that they comply with the requirements of this standard. These tests, after they have been successfully completed, need not be repeated unless a repeat is deemed necessary by Kenya Bureau of Standards.

13. TEST CONDITIONS

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

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

TABLE 3. SCHEDULE OF TESTS

TEST	REQUIREMENT GIVEN IN CLAUSE (OF THIS STANDARD)	TEST METHOD	CATEGORY
Tests on components			
Conductor material and construction	4	KS 04-187	RS
Insulation:			
(a) Material	5.1	KS 04-188	T
(b) Application	5.1	Visual examination	RS
(c) Spark test	5.2	KS 04-863	R
(d) Thickness	5.3	Clause 15.2 of this standard and	RS

		KS 04-188	
Core identification	6	Visual examination and measurement	RS
Laid-up cores	7	Visual examination	RS
Bedding:			
(a) Taped bedding gap	8.4	Clause 15.3 of this standard	RS
(b) Extruded:			
(i) Material characteristics	8.2 and 8.3	KS 04-188	T
(ii) Thickness	8.5	Clause 15.2 of this standard and KS 04-188	RS
Armour:			
(a) Wire armour:			
(i) Diameter	9.2 (a)	Clause D1 of this standard	RS
(ii) Mass of zinc coating (galvanized steel wire only)	9.2 (b)	Clause D2 of this standard	RS
(iii) Wrapping test (galvanized steel wire only).	9.2 (c)	Clause D3 of this standard	RS

TABLE 3. SCHEDULE OF TESTS (Cont'd)

TEST	REQUIREMENT GIVEN IN CLAUSE (OF THIS STANDARD)	TEST METHOD	CATEGORY
(iv) Tensile test aluminium wire only)	9.2 (d)	Clause D3 of this standard	RS
(b) Aluminium strip armour:			
(i) Dimensions of individual strips	9.3	Clause D5 of this standard	RS
(ii) Tensile test	9.3	Clause D4 of this standard	RS
Oversheath:			
(a) Material	10.1	KS 04-188	T
(b) Thickness, unarmoured cable	10.2.1	Clause 15.2 of this standard and KS 04-188	RS
(c) Thickness, armoured cable	10.2.2	Clause 15.2 of this standard and KS 04-188	RS

(d) Spark test	10.1	KS EAS 115	R
Tests on complete cable			
Cable markings	11.1 to 11.5	Visual inspection and measurement, as appropriate	R
Conductor resistance	14.2	Clause 14.2 of this standard	R
Armour resistance	9.5	Clause 15.4 of this standard	RS
Voltage test	14.3.1	Clause 14.3.2 of this standard	R
Insulation resistance test	14.4.1	Clause 14.4.2 of this standard	R
Compatibility test	5.1 and 10	Clause 16.2 of this standard	T
Test under fire conditions	15.5	KS 04-191: Part 1*	RS

* Flame-retardant characteristics of electric cables.

14. ROUTINE TEST

14.1 *General* **—** Routine tests shall be as given in Table 4.

TABLE 4. ROUTINE TESTS

TEST	REQUIREMENT GIVEN IN CLAUSE (OF THIS STANDARD)	TEST METHOD
(i) Spark test on cores	5.2	KS 04-863
(ii) Spark test on oversheath	10.1	KS 04-863
(iii) Visual examination and measurement of cable markings	11.1 to 11.5	-
(iv) Conductor resistance	14.2	KS 04-187
(v) Voltage test on complete cable	14.3.1	Clause 14.3.2 of this standard
(vi) Insulation resistance	14.4.1	Clause 14.4.2 of this standard

14.2 *Conductor Resistance Test* **—** The d.c. resistance of each conductor shall comply with KS 04-187 when measured and corrected to 20^0C in accordance with that standard.

NOTE: For convenience, the maximum reistance values for annealed copper and aluminium conductors are given in Tables 29 to 33 (see Appendix E).

14.3 Voltage Test on Complete Cables

14.3.1 *Requirement* — For multicore armoured cables, apply the voltage between conductors.

Make the test at room temperature using an alternating voltage, the values of single-phase test voltage for the rated voltages being given in Table 5. If, for three-core cables rated at 1 900/3 V, the voltage test is carried out with a three-phase transformer, use a test voltage between the phases of 1.73 times the values given in Column 3 of Table 5. Increase the voltage gradually and maintain it as full value for 5 min.

TABLE 5. TEST VOLTAGE ON COMPLETE CABLES

VOLTAGE DESIGNATION	ALTERNATING TEST VOLTAGE (R.M.S.)	
	Between Conductors	Between Any Conductor and Earth
V	V	V
6000/1 000	3 500	3 500
1 900/3 300	10 000	5 800

14.4 Insulation Resistance Test

14.4.1 *Requirement* — After completion of the voltage test given in Clause 14.3, the insulation resistance between each conductor and the remaining conductors in the cable shall be measured in accordance with Clause 14.4.2, and shall be not less than the appropriate value given in Table 6.

14.4.2 *Method* — Connect the remaining conductors in the cable to the armour (if any). Measure the insulation resistance after electrification with direct current for 1 min at not less than 500 V.

NOTE: For multicore auxiliary cables, the cores may be connected in groups so that the insulation of each conductor is proved with respect to all others.

TABLE 6. MINIMUM INSULATION RESISTANCE VALUES

NOMINAL CROSS-SECTIONAL AREA OF CONDUCTOR	INSULATION RESISTANCE PER KILOMETER AT 20^0C	
	600/1 000 V	1 900/3 300 V
mm^2	MΩ	MΩ
1.5	10	-
2.5	9	-
4.0	8	-
6.0	7	-
10.0	7	-
16.0	6	10
25.0	5	8
35.0	5	7
50.0	5	6

TABLE 6. MINIMUM INSULATION RESISTANCE VALUES (Cont'd.)

NOMINAL CROSS-SECTIONAL AREA OF CONDUCTOR	INSULATION RESISTANCE PER KILOMETER AT 20^0C	
	600/1 000 V	1 900/3 300 V
mm^2	MΩ	MΩ
70.0	5	6
95 and above	5	5

15. REGULAR SAMPLE TESTS

15.1 *General* **—** Regular sample tests shall be as given in Table 7.

TABLE 7. REGULAR SAMPLE TESTS

TEST	REQUIREMENT GIVEN IN CLAUSE (OF THIS STANDARDS)	TEST METHOD
Conductor material and construction	4	KS 04-187
Insulation thickness	5.3	Clause 15.2 of this standard and KS 04-188
Core identification	6	-
Laid-up cores	7	-
Taped bedding gap	8.4	Clause 15.3 of this standard
Extruded bedding thickness	8.5	Clause 15.2 of this standard and KS 04-188
Armour resistance	9.5	Clause 15.4 of this standard
Oversheath thickness	10.2	Clause 15.2 of this standard and KS 04-188
Wire armour diameter	9.2 (a)	Clause D1 of this standard
Mass of zinc coating (galvanized steel wire only)	9.2 (b)	Clause D2 of this standard

TABLE 7. REGULAR SAMPLE TESTS (Cont'd)

TEST	REQUIREMENT GIVEN IN CLAUSE (OF THIS STANDARDS)	TEST METHOD
Wrapping test (galvanized steel wire only)	9.2 (c)	Clause D3 of this standard
Tensile test (aluminium wire and aluminium strip armour only)	9.2 (d)	Clause D4 of this standard
Dimensions of aluminium strip armour	9.3	Clause D5 of this standard
Fire test on single cables	15.5	KS 04-191: Part 1

15.2 Thickness Measurement

15.2.1 *Sampling* — Make the measurements of thickness of insulation, extruded bedding and oversheath listed in the schedule of the test requirements (see Table 3), on a sample taken from end of each drum length of cable selected for the test, having discarded any portion which may have suffered damage.

15.2.2 *Method* — Take measurements for each component by the method specified in Clause 6 of KS 04-188.

For multicore cables, take measurements of insulation thickness on each core up to a maximum of four.

When determining the average thickness from several measurements, round the resultant value to 0.1 mm, 0.05 mm being rounded upwards.

For the sample tests, make the measurements in accordance with KS 04-188, but it is permitted to use a calibrated hand lens, except in cases of dispute, when the equipment specified in KS 04-188

shall be used.

15.3 *Measurement of the Gap Between Tapes of Taped Bedding* — Measure the gap between the adjacent edges of each bedding tape at right angles to the tape, and also the tape width, on a sample of cable 300 mm long, taken not less than 150 mm from the end of a factory length.

Take the measurements by any suitable means in which error of determination does not exceed 0.5 mm. Measure the gaps at four positions approximately 50 mm apart along the length of the sample.

15.4 *Armour Resistance* — Determine the d.c. resistance of the armour by measuring the resistance of all the armour wires or strips of the completed cable connected together, and then correct the value from t^0C, the determination temperature, to 200C using the temperature correction multiplication factors given in Tables 8.

15.5 *Test Four Flame Propagation of Single Cable* — The finished cable shall comply with KS 04-191: Part 1 for tests under fire conditions when tested in accordance with that standard.

16. TYPE TESTS

16.1 *General* **—** Type tests shall be as given in Table 9.

16.2 Compatibility Test

16.2.1 *Requirement* — When tested in accordance with Clause 16.2.2, the material shall comply with the values given in Table 10.

NOTE: The test is intended to check that the insulation and oversheath are not liable to deteriorate due to contact with other components in the cable.

16.2.2 *Method* — Heat samples of completed cable in an oven for 7 days at 80 ± 2^0C using the procedure specified in Clause 8 of KS 04-188.

After ageing, measure the tensile strength and elongation at break fo rthe insulation, oversheath and bedding in accordance with Clause 7 of KS 04-188.

TABLE 8. TEMPERATURE CORRECTION MULTIPLICATION FACTORS

TEMPERATURE OF ARMOUR AT TIME OF MEASUREMENT, *t*	CORRECTION FACTOR, k_t	
	Galvanized Steel Wire Armour	Aluminium Wire or Strip Armour
0C		
5	1.072	1.064
6	1.067	1.059
7	1.062	1.055
8	1.057	0.050
9	1.052	1.046
10	1.047	1.042
11	1.042	1.037
12	1.037	1.033
13	1.033	1.029
14	1.028	1.025
15	1.023	1.020
16	1.018	1.016
17	0.014	1.012
18	1.009	1.008
19	1.005	1.004

TABLE 8. TEMPERATURE CORRECTION MULTIPLICATION FACTORS (Cont'd.)

TEMPERATURE OF ARMOUR AT TIME OF MEASUREMENT, *t*	CORRECTION FACTOR, k_t	
	Galvanized Steel Wire Armour	Aluminium Wire or Strip Armour
^{0}C		
20	1.000	1.000
21	0.996	0.996
22	0.991	0.992
23	0.987	0.984
24	0.982	0.980
25	0.978	0.977
26	0.974	0.973
27	0.969	0.969
28	0.965	0.965
29	0.961	
30	0.957	0.962
31	0.953	0.958
32	0.949	0.954
33	0.945	0.951
34	0.941	0.947
35	0.937	0.943

NOTE: The values of correction factor k_t are based on a resistance temperature coefficient at 20^{0}C of 0.004 5 per cent ^{0}C for galvanized steel wire and 0.004 0 per cent ^{0}C for aluminium wire or strip.

TABLE 9. TYPE TESTS

TEST	REQUIREMENT GIVEN IN CLAUSE (OF THIS STANDARD)	TEST METHOD
Insulation material	5	KS 04-188
Extruded bedding material	8.2 and 8.3	KS 04-288
Oversheath material	10.1	KS 04-188
Compatibility test	5.1 and 10	Clause 16.2 of this standard and KS 04-188

A P P E N D I X A

RECOMMENDATIONS FOR SELECTION AND OPERATION OF PVC INSULATED CABLES

1. TYPE OF FINISH

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

2. VOLTAGE RATINGS

The selection of standard cables of appropriate voltage designations for particular supply systems depends on the system voltage and the system earthing arrangements. To facilitate the selection of the cable, systems are divided into three categories.

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

(b) *Category B* — This category comprises those systems that, under fault conditions, are operated for a short time, not exceeding 8 h on any occasion, with one phase earthed.

NOTE: In a system where an earth fault is not automatically and promptly eliminated, the increased stresses on the insulation of cables during the earth fault are likely to affect the life of the cables to a certain degree. If the system is expected to be operated fairly often with a sustained earth fault, it may be preferable to use cables suitable for category C. In any case, for classification as category B the expected total duration of earth faults in any one year should not exceed 125.

(c) *Category C* — This comprises all systems that do not fall into categories A and B.

Table 26 gives the lowest rated voltage of cable which should be used for an a.c. system according to the system voltage and category.

TABLE 26. SELECTION OF CABLES FOR A.C. SYSTEMS

SYSTEM VOLTAGE		SYSTEM CATEGORY	MINIMUM RATED VOLTAGE OF CABLE, U_0/U
Nominal Voltage, U	Maximum Sustained Voltage, U_m		
kV	kV		kV
Up to 1.0	1.1	A, B or C	0.6/1
1.9 to 3.3	3.6	A or B	1.9/3.3

The nominal system voltage, *U,* given in Table 26 is the nominal voltage between phases.

The maximum sustained system voltage, U_m, is the highest voltage between phases which may be sustained under normal conditions at any time and at any point in the system. It excludes transient voltage variations, due, for example, to lightning impulses, fault conditions and rapid disconnection of loads.

Single-core 600/1 000 V cables are suitable for d.c. systems operating at up to 1 000 V to earth, and two-core 600/1 000 V cables are suitable for d.c. systems operating at up to 1 500 V between conductors. Single-core 1 900/3 300 V cables are suitable for d.c. systems operating at up to 3 000 V to earth. However, consideration should be given to the peak value when determining the voltage of a d.c. system derived from rectifiers, bearing in mind that smoothing does not modify the peak value when the rectifiers are operating on an open circuit.

3. CURRENT RATINGS

3.1 Cables installed in and around buildings — For the current ratings of cables installed in and around buildings, reference should be made to KS 04-662*.

3.2 *Other installations* — For current ratings of cables installed in situations other than those covered by Clause A3.1, the cable manufacturer should be consulted for any special advice.

APPENDIX B

RECOMMENDATIONS FOR INSTALLATION OF PVC-INSULATED CABLES

B1. COMPLIANCE WITH REGULATIONS

The cables specified in this standard should be installed in accordance with KS 04-662 or any other

applicable national regulations.

In special environments, the appropriate regulations and close of practice should be observed.

B2. MINIMUM INSTALLATION RADIUS

None of the cables specified in this standard should be bent during installation to a radius smaller than that recommended Table 27.

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* Kenya wiring regulations.

TABLE 27. MINIMUM INSTALLATION RADIUS

FINISH	OVERAL DIAMETER, *D*	MINIMUM INTERNAL RADIUS OF BEND
Circular copper conductor, unarmoured	Up to 10 mm Above 10 mm} Up to 25 mm } Above 25 mm	3*D* 4*D* *6D*
Circular copper conductor, armoured	Any	6*D*
Solid aluminium or shaped copper conductors, armoured or unarmoured	Any	8*D*

NOTE: Whether possible, larger installation radii should be used.

B3. MINIMUM TEMPERATURE DURING INSTALLATION

Attention is drawn to the fact that, as the temperature decreases, PVC compounds become 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 0^0C or lower, there is risk of shattering the PVC components.

To avoid the risk of damage during handling, therefore, it is desirable that the cables specified in this standard should be installed only when both the cable and the ambient temperature are above 00C and have been so for the previous 24 h or where special precautions have been taken to maintain the cables above this temperature.

B4. INSTALLATION PRACTICE

Care should be exercised during installation to avoid any damage to cable coverings. This is important in wet or other aggressive environments, especially for cables which do not have extruded

bedding. 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 re-made if necessary.

B5. EARTHING BONDS AND CLAMPS

Owing to the absence of a metal sheath, all earth fault currents will return through the armour unless there is a parallel bonding connection to relieve the armour of some of the fault current. In either event, it is necessary to ensure that there is no discontinuity in the return circuit via the armour, and there is no local spot of high resistance.

Careful attention, therefore, should be paid to the design of all bonding clamps in joints and terminations to ensure that each armour wire or strip contributes equally to the conductance of the bonding connection and that the resistance across a connector is not higher than that of the equivalent length of connected armour of the cable.

It is also important to ensure that all armour (wires or strips) and all faces of armour clamps or connections making contact with them are thoroughly cleaned during installation, and that the clamps are adequately tightened to ensure good electrical contact.

Bonding clamps in joints should be electrically connected with a bond having a conductance at least equal to that of an equal length of the complete armour of the cable, and with adequate thermal capacity to avoid excessive over-heating under short-circuit conditions. The shell of a cast iron box is normally sufficient for this purpose but an auxiliary metallic bond should be included if there are any doubts concerning its conductance.

B6. COMPOUND FILLING

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

B7. EARTHING OF ARMOUR

Provision should be made for earthing the armour to the main earth system at the supply end by means of a metallic bond of adequate conductance, the bonding connection being as short as possible. It is also desirable to earth the armour at additional positions such as at joints.

Special precautions may be necessary to eliminate the risk of corrosion due to the use of dissimilar metals.

B8. TEST AFTER INSTALLATION

A voltage test after installation is not a requirement of this Kenya Standard, but if a test is made, it should be carried out with a direct current, the value of the voltage being that specified in Table 28.. During the test, the voltage should be increased gradually to the full value and maintained continuously for 15 min between conductors and between each conductor and the armour. No breakdown should occur.

TABLE 28. TEST VOLTAGE AFTER INSTALLATION

CABLE VOLTAGE DESIGNATION	D.C. TEST VOLTAGE	
	Between Conductors	Between all Conductors and Armour
V	V	V
600/1 000	3 500	3 500
1 900/3 300	10 000	7 000

A P P E N D I X C

INFORMATION REQUIRED WITH ENQUIRY AND ORDER

NOTE: *See* Appendix A for recommendations for the selection of cables.

The following information should be given with an enquiry or order.

(a) The number of this Kenya Standard, i.e. KS 04-194.

(b) The length of cable required and, if important, individual drum lengths.

(c) the voltage designation (**see** Clause 3 and A2).

(d) The number of cores.

(e) The conductor size and, where applicable, the size of the reduced neutral conductor.

NOTE: These sizes depend upon various factors, details of which are given in KS 04-662.

(f) The conductor material, i.e. copper or aluminium.

(g) The type of finish, i.e.:

(i) Unarmoured.

(ii) Armoured with aluminium wire (single-core only), steel wire or aluminium strip.

(iii) Whether taped or extruded bedding (where applicable) is required for armoured cables.

NOTE: This will depend on the conditions of installation and in particular on whether the environment is especially onerous, e.g. aggressive or wet. In vases of doubt, advice should be sought from the cable manufacturers.

A P P E N D I X D

MECHANICAL TESTS

D1. MEASUREMENT OF DIAMETER OF ROUND WIRE

Take at random 10 per cent of the total number of wires from one sample of the completed cable. Determine the diameter of each wire with a micrometer by taking two measurements at right angles to each other. Take the average of all measurements to be the wire diameter.

D2. MASS OF ZINC COATING OF GALVANIZED STEEL WIRE

Take at random 10 per cent of the total number of wires from one sample of completed cable. Determine the mass of zinc by either a gravimetric or gas volumetric method as specified in KS 06-261*. Take the average of all the measurements to be the mass of zinc coating.

D3. WRAPPINF TEST FOR GALVANIZED STEEL WIRE

Take at random 10 per cent of the total number of wires from one sample of completed cable. Wrap each wire round a cylindrical mandrel for one complete turn. The mandrel shall have a diameter of approximately four times the specified wire diameter under test.

D4. TENSILE TEST FOR ALUMINIUM WIRES AND STRIPS

Take at random 10 per cent of the total number of wires or strips from one sample of completed cable. Measure the tensile strength of each wire or strip in accordance with Clause of KS 04-290†. Take the average of all the measurements to be the tensile strength.

D5. MEASUREMENT OF THE DIMENSIONS OF ALUMINIUM STRIP ARMOUR

Take at random 10 per cent of the total number of strips from one sample of completed cable. Measure the thickness and width of each strip using a dial micrometer or vernier caliper. Take the average of all the measurements to be the thickness of width of the strip, as appropriate.

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* Specification for steel wires and wire products used for fencing.

† Specification for galvanized steel wire for armouring of electric cables.

A P P E N D I X E

RESISTANCE OF CONDUCTOR AND ARMOUR, AND ARMOUR CROSS-SECTIONAL AREAS

E1. RESISTANCE OF CONDUCTOR AND ARMOUR

Tables 29 to 33 contain maximum values of the resistance of aluminium wire, aluminium strip and single, galvanized steel wire armour for single-core and multi-core cables with rated voltages of 600/1 000 V and 1 900/3 300 V as designated in Tables 11 to 25.

E2. GROSS CROSS-SECTIONAL AREA OF ARMOUR

Tables 29 to 37 contain gross cross-sectional areas of armour for use in calculating the maximum permissible fault current to comply with the relevant Clause of KS 04-662.

ANNEX F

TABLE 51 – Identification of conductors

Function	Alphanumeric	Colour
Protective conductors		Green-and-yellow
Functional earthing conductor		Cream
a.c. power circuit[1]		
Line of single-phase circuit	L	Brown
Neutral of single- or three-phase circuit	N	Blue
Line 1 of three-phase a.c. circuit	L1	Brown
Line 2 of three-phase a.c. circuit	L2	Black
Line 3 of three-phase a.c. circuit	L3	Grey
Two-wire unearthed d.c. power circuit		
Positive of two-wire circuit	L+	Brown
Negative of two-wire circuit	L-	Grey
Two-wire earthed d.c. power circuit		
Positive (of negative earthed) circuit	L+	Brown
Negative (of negative earthed) circuit[2]	M	Blue
Positive (of positive earthed) circuit[2]	M	Blue
Negative (of positive earthed) circuit	L-	Grey
Three-wire d.c. power circuit		
Outer positive of two-wire circuit derived from three-wire system	L+	Brown
Outer negative of two-wire circuit derived from three-wire system	L-	Grey
Positive of three-wire circuit	L+	Brown
Mid-wire of three-wire circuit[2][3]	M	Blue
Negative of three-wire circuit	L-	Grey
Control circuits, ELV and other applications		
Line conductor	L	Brown, Black, Red, Orange, Yellow, Violet, Grey, White, Pink or Turquoise
Neutral or mid-wire[4]	NorM	Blue

NOTES:

(1) Power circuits include lighting circuits.

(2) M identifies either the mid-wire of a three-wire d.c. circuit, or the earthed conductor of a two-wire earthed d.c. circuit.

(3) Only the middle wire of three-wire circuits may be earthed.

(4) An earthed PELV conductor is blue.