Iran-Transfo

ITS-MC28-01

Edition 1.1 2012-09

Cables for External Wiring

ITS

IRAN TRANSFO STANDARD
Research & Development Department

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Number of pages 8

FOREWORD

The Iran Transfo Standard (ITS) is a group of documents for standardization of Iran-Transfo Company requirements. Their preparation is entrusted to technical committees; any committee interested in the subject dealt with may participate in this preparatory work.
Preparation of this standard has been incepted in R&D Department and discussed in Electrical committee. Eventually, by approve of following members issued.

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All users should ensure that they have the latest edition of this publication.

CONTENTS

1 Scope

This technical terms of delivery specifies construction, dimension and test requirements of power and control cables with extruded solid insulation of rated voltages of 0.6/1 (1.2)kV[1] for fixed installations such as external wiring of power transformers used either inside metallic/plastic conduit or free at ambient conditions.

These cables are special PVC insulated and sheathed wiring conductor composed of copper conductor insulated with a layer of PVC compound according to IEC 60502.

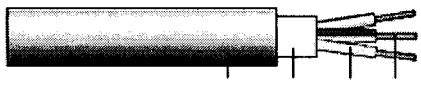
The cables have two or more cores, bunch stranded and covered with inner covering around which is a PVC protective jacket.

2 Technical Requirement

2.1 Cables without metallic screen (Type A)

These cables are used for fixed installations such as industrial installation. They can be used for indoor or outdoor in cable ducts and suitable for places without danger of mechanical damage. No screen is used in their construction.

2.1.1 Construction



1. Copper conductor: soft annealed copper stranded as per class 5 of IEC 60228, ISIRI 3084
2. Insulation: Polyvinyl chloride (PVC)
3. Inner covering: Extruded PVC compatible with the operating temperature of the conductor. (Thickness= 1 mm)
4. Outer sheath: Polyvinyl Chloride (PVC) type ST_2.

Core identification should be specified by separated colors. Earth conductor color should be specified by yellow/green color[2]. Other colors are arbitrary. (Proposed colors: 1-red, 2-blue, 3-black, 4-gray, 5-green, 6-yellow, 7-brown)

The outer sheath must be UV resistant.

Talc powder should be used in cable construction between insulation and inner covering in order to layers could be separated easily. Rather than talc powder Polyester band by 0.03 mm thickness approx can be used for detachment of two layers.

Detachment of second, third and fourth layer must be done easily and never stick together.

2.1.2 Technical data

Table 1: Main Properties of Cables (Type A)

Nominal voltage	0.6/1 (1.2) kV
Test voltage	3.5 kV(AC)
Insulating Compound	Thermoplastic (PVC/A)[1)]
Sheathing Compound	Thermoplastic (PVC) type ST_2
Min. operation temperature	-25 °C
Max. operation temperature	90°C for outer sheath and 70°C for insulation compound
Min. bending radius at minimum temperature	8 × cable diameter

1) Insulating and sheathing compound materials must be flexible materials.

[1] In the voltage designation of cables U_0/U (U_m):
U_0: is the rated power frequency voltage between conductor and earth or metallic screen for which the cable is designed.
U: is the rated power frequency voltage between conductors for which the cable is designed.
U_m: is the maximum value of the "highest system voltage" for which the equipment may be used.
[2] Except cables with 4 mm^2 cross section.

2.1.3 Cable size

Cable sizes and insulation thicknesses should be as following:

Table 2: Cable Sizes and insulation (Type A)

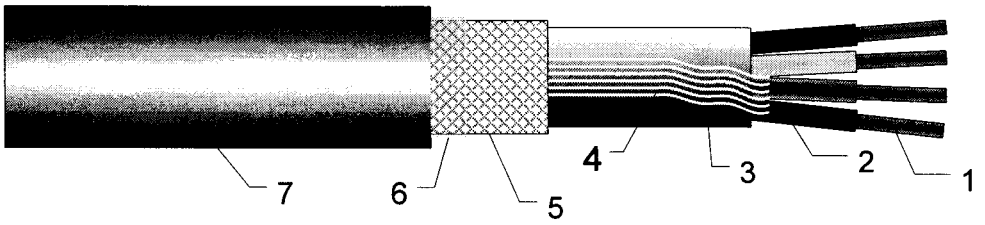
Size	Nominal Insulation thickness (mm)	Nominal Sheath thickness (mm)	Approx Overall diameter (mm)
2×1.5	0.8	1.8	11
2×2.5	0.8	1.8	12
2×4	1.0	1.8	13.5
2×6	1.0	1.8	14.4
2×10	1.0	1.8	16.7
3×1.5	0.8	1.8	11.5
3×2.5	0.8	1.8	12.5
3×4	1.0	1.8	13.5
3×6	1.0	1.8	14.4
3×10	1.0	1.8	17
4×1.5	0.8	1.8	12.3
4×2.5	0.8	1.8	13.3
4×4	1.0	1.8	15
4×6	1.0	1.8	16.3
4×10	1.0	1.8	18.5
5×1.5	0.8	1.8	13.5
5×2.5	0.8	1.8	15
5×4	1.0	1.8	17
5×6	1.0	1.8	18[2)]
5×10	1.0	1.8	19[2)]
6×1.5	0.8	1.8	14.5
7×1.5	0.8	1.8	16

2) Maximum permissible diameter is 20 mm.

2.2 Cables with metallic screen (Type B)

Application of these cables is similar to type A with additional requirements of earth conductor and protection against electromagnetic field.

2.2.1 Construction



1. Copper conductor: soft annealed copper stranded as class 5 of IEC 60228, ISIRI 3084
2. Insulation: Polyvinyl chloride (PVC)
3. Inner covering: Extruded PVC compatible with the operating temperature of the conductor. (Thickness= 1 mm)
4. Earth conductor: this conductor must be tinned copper and quantities of conductors are 7 with 0.55 mm diameter and conductors must be centered and pass through from one point of cable.
5. Screening: braiding of soft tinned copper wire with 70-80 % coverage. Taking back the screening occurs easily.
6. polyester band with 50% overlap
7. Outer sheath: Polyvinyl Chloride (PVC) type ST_2.

In cable construction between insulation and inner covering, talc powder should be used in order to separating layers easily. Rather than talc powder Polyester band with enough thickness can be used for detachment of two layers. The conductor's colors are similar to type A.

The outer sheath must be UV resistant.

Detachment of all layers must be done easily and never stick together.

Core identification should be specified by separated colors.

Inner covering should be circular and uniform thickness.

Detachment of cable should be such a way that 3rd, 5th and 7th layers could be separated without any damage at least up to 1 meter.

No discontinuity is allowed either for copper conductor or earth conductors.

2.2.2 Technical data

Table 3: Main Properties of Cables (Type B)

Nominal voltage	0.6/1 (1.2) kV
Test voltage	3.5 kV(AC)
Insulating compound	Thermoplastic (PVC/A) [1)]
Screening compound	tinned copper
Sheathing compound	Thermoplastic (PVC) type ST_2
Min. operation temperature	-25 °C
Max. operation temperature	90°C for outer sheath and 70°C for insulation compound
Min. bending at minimum temperature	8 × cable diameter /OD

1) For insulating and sheathing compound high flexible materials have to be used.

2.2.3 Cable size

Cable sizes are similar to table (2) with an increase up to 1 mm for approx overall diameter.

3 Designation

A cable with 4 cores without screening and conductor nominal cross section 2.5 mm² designated as:

ITS-MC28-01 - Cable - Type A - 4×2.5

4 Test method

All test methods according to IEC 60502-1.

4.1 Routine tests

The routine tests required by this standard are:

a) Measurement of the electrical resistance of conductors

b) Voltage test

4.2 Sample tests

The Sample tests required by this standard are:

a) Conductor examination: Compliance with the requirements of conductor construction according to IEC 60228 shall be checked.
b) Check of dimensions (according to clause 2.1.3 ITS-MC28-01)

4.2.1 Number of samples

Multicore cables	Number of samples
Up to 10 km	1
10 to 20 km	2
20 to 30 km	3

If any sample fails in one of the tests all consignment must be rejected.

4.3 Type tests

4.3.1 Electrical tests

A sample of completed cable 10 m to 15 m in length shall subjected to the following tests, Applied successively:

a) Insulation resistance measurement at ambient temperature according to clause 17.1 IEC 60502-1

b) Insulation resistance measurement at maximum temperature in normal operation according to clause 17.2 IEC 60502-1.

c) Voltage test for 4 hours according to clause 17.3 IEC 60502-1

4.3.2 Non-electrical tests

The non-electrical type tests required by this standard are given in below table.

	Cable Part	insulations	sheaths
1	**Dimensions**		
1a	Measurement of Thickness	*	*
2	**Mechanical properties (tensile strength and elongation-at-break)**		
2a	Without aging	*	*
2b	after aging in air oven	*	*
2c	after aging of pieces of complete cable	*	*
3	**Thermoplastic properties**		
3a	Hot pressure test	*	*
3b	Behavior at low temperature	*	*
4	**Miscellaneous**		
4a	Loss of mass in air oven		*
4b	Heat shock test (cracking)	*	*
4c	Flame retardance test (if required)		*
4d	Water absorption	*	
NOTE- * indicates that the type test is to be applied			

4.3.3 UV resistance test

Cables for outdoor use must be resistant to sunlight (UV resistant). The UV resistance is measured according to ISO 4892-2 meth.b. In this test, the material is exposed to 340nm UV-light during 500 hrs. After exposure, the variation in mechanical properties (tensile strength, elongation at break) is determined. A maximum decrease in mechanical properties of 25% is generally accepted.

5 Packing and Delivery

The cable must be delivered in wooden spool protected against mechanical damages for dispatching, transportation and lifting by lift truck. Length of cable in each wooden spool should be 500m to 1000 m and have following packing labels:

- Manufacturer name and mark
- Cable Type
- Cable size (Conductor quantities and cross section)
- Cable length
- Gross and net weight
- Production Serial number
- Manufacture standard

On each 1 meter of cable the following information must be indicated:

- Manufacturer name
- Cable size (Conductor quantities and cross section)
- Production Serial number
- Manufacture standard
- Meter gauge

6 Normative References

IEC 60502-1 (2009-11) Ed. 2.1

Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) - Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV)

ISIRI 607-3

Cables with PVC insulations

IEC 60228 (2004-11) Ed. 3.0

Conductors of insulated cables

ISIRI 3084 2nd. revision

Conductors of insulated cables

ISO 4892-2:2006 Edition: 2 2006-01-30

Plastics -- Methods of exposure to laboratory light sources -- Part 2: Xenon-arc lamps