



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 3410 : 2018

(JCMA/JSA)

**Cables and flexible cords for electrical
equipment of ships**

ICS 29.060.20 ; 47.020.60

Reference number : JIS C 3410 : 2018 (E)

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Date of Establishment: 1961-05-01

Date of Revision: 2018-10-25

Date of Public Notice in Official Gazette: 2018-10-25

Investigated by: Japanese Industrial Standards Committee
Standards Board for IEC area
Technical Committee on Electricity

JIS C 3410 : 2018, First English edition published in 2019-04

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

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Printed in Japan

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry and the Minister of Land, Infrastructure, Transport and Tourism through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japanese Electric Wire & Cable Maker's Association (JCMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS C 3410:2010** is replaced with this Standard.

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Cables and flexible cords for electrical equipment of ships

Introduction

This Japanese Industrial Standard has been prepared based on **IEC 60092-353** : 2011 (Edition 3), **IEC 60092-354** : 2014 (Edition 3), **IEC 60092-360** : 2014 (Edition 1) and **IEC 60092-376** : 2003 (Edition 2), in order to establish a standard for cables and flexible cords for ships reflecting the actual situations in Japan with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standards. A list of modifications with the explanations is given in Annex JD. Annex JA, Annex JB and Annex JC are unique to **JIS** and not given in the corresponding International Standards.

1 Scope

This Standard specifies cables, flexible cords and insulated wires used for electrical installations in ships.

NOTE The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60092-353 : 2011 *Electrical installations in ships — Part 353 : Power cables for rated voltages 1 kV and 3 kV*

IEC 60092-354 : 2014 *Electrical installations in ships — Part 354 : Single- and three-core power cables with extruded solid insulation for rated voltages 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)*

IEC 60092-360 : 2014 *Electrical installations in ships — Part 360 : Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables*

IEC 60092-376 : 2003 *Electrical installations in ships — Part 376 : Cables for control and instrumentation circuits 150/250 V (300 V) (overall evaluation : MOD)*

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards indicated below, only the editions of the indicated year shall be applied and any revisions (including amendments) made thereafter shall not be applied.

JIS C 3005 : 2014 *Test methods for rubber or plastic insulated wires and cables*

JIS C 3411 : 2018 *Electrical installations in ships — General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications*

NOTE Corresponding International Standard : IEC 60092-350 : 2014 *Electrical installations in ships — Part 350 : General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications* (IDT)

JIS G 4308 : 2013 *Stainless steel wire rods*

IEC 60331-1 : 2009 *Tests for electric cables under fire conditions — Circuit integrity — Part 1 : Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm*

IEC 60331-21 : 1999 *Tests for electric cables under fire conditions — Circuit integrity — Part 21 : Procedures and requirements — Cables of rated voltage up to and including 0,6/1,0 kV*

3 Types and symbols

The types and symbols of cables are as given in Table 1.

The meanings of the letters used in the symbols in this table are as given in Table 2 and Table 3.

Table 1 Types and symbols

Type of cable	Symbol	Table No.
0.6/1 kV Single core, EP rubber insulated, polyvinyl chloride (PVC) sheathed and stainless steel wire braid armoured cable with PVC protective covering	0.6/1 kV SPYC(SUS)Y	11
0.6/1 kV Single core, EP rubber insulated, PVC sheathed, stainless steel wire braid armoured and flame retardant cable with PVC protective covering	0.6/1 kV FA-SPYC(SUS)Y	
0.6/1 kV Double core, EP rubber insulated and PVC sheathed cable	0.6/1 kV DPY	12
0.6/1 kV Double core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable	0.6/1 kV DPYC	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering	0.6/1 kV DPYCY	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed and flame retardant cable	0.6/1 kV FA-DPY	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable	0.6/1 kV FA-DPYC	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering	0.6/1 kV FA-DPYCY	

Table 1 Types and symbols (continued)

Type of cable	Symbol	Table No.
0.6/1 kV Three core, EP rubber insulated and PVC sheathed cable	0.6/1 kV TPY	13
0.6/1 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable	0.6/1 kV TPYC	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering	0.6/1 kV TPYCY	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed and flame retardant cable	0.6/1 kV FA-TPY	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable	0.6/1 kV FA-TPYC	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering	0.6/1 kV FA-TPYCY	14
0.6/1 kV Double core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with common shield	0.6/1 kV DPYCSLA	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with common shield	0.6/1 kV TPYCSLA	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering and common shield	0.6/1 kV DPYCYSLA	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering and common shield	0.6/1 kV TPYCYSLA	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with common shield	0.6/1 kV FA-DPYCSLA	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with common shield	0.6/1 kV FA-TPYCSLA	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering and common shield	0.6/1 kV FA-DPYCYSLA	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering and common shield	0.6/1 kV FA-TPYCYSLA	
0.6/1 kV Double core, silicone rubber insulated, glass yarn and steel wire braid armoured cable	0.6/1 kV DSRC	15
0.6/1 kV Three core, silicone rubber insulated, glass yarn and steel wire braid armoured cable	0.6/1 kV TSRC	
0.6/1 kV Double core, silicone rubber insulated, glass yarn and steel wire braid armoured and flame retardant cable	0.6/1 kV FA-DSRC	
0.6/1 kV Three core, silicone rubber insulated, glass yarn and steel wire braid armoured and flame retardant cable	0.6/1 kV FA-TSRC	

Table 1 Types and symbols (continued)

Type of cable	Symbol	Table No.
150/250 V Multicore, EP rubber insulated and PVC sheathed cable	150/250 V MPY	16
150/250 V Multicore, EP rubber insulated, PVC sheathed and steel wire braid armoured cable	150/250 V MPYC	
150/250 V Multicore, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering	150/250 V MPYCY	
150/250 V Multicore, EP rubber insulated, PVC sheathed and flame retardant cable	150/250 V FA-MPY	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable	150/250 V FA-MPYC	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering	150/250 V FA-MPYCY	
150/250 V Multicore, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with common shield	150/250 V MPYCSLA	17
150/250 V Multicore, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering and common shield	150/250 V MPYCYSLA	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with common shield	150/250 V FA-MPYCSLA	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering and common shield	150/250 V FA-MPYCYSLA	
150/250 V Multicore, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with individual core shield	150/250 V MPYC-S	18
150/250 V Multicore, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering and individual core shield	150/250 V MPYCY-S	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with individual core shield	150/250 V FA-MPYC-S	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering and individual core shield	150/250 V FA-MPYCY-S	
150/250 V Multipair, EP rubber insulated and PVC sheathed cable	150/250 V TTPY	19
150/250 V Multipair, EP rubber insulated, PVC sheathed and steel wire braid armoured cable	150/250 V TTPYC	
150/250 V Multipair, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering	150/250 V TTPYCY	
150/250 V Multipair, EP rubber insulated, PVC sheathed, and flame retardant cable	150/250 V FA-TTPY	

Table 1 Types and symbols (continued)

Type of cable	Symbol	Table No.
150/250 V Multipair, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable	150/250 V FA-TTPYC	19
150/250 V Multipair, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering	150/250 V FA-TTPYCY	
150/250 V Multipair, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with common shield	150/250 V TTPYCSLA	20
150/250 V Multipair, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering and common shield	150/250 V TTPYCYSLA	
150/250 V Multipair, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with common shield	150/250 V FA-TTPYCSLA	
150/250 V Multipair, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering and common shield	150/250 V FA-TTPYCYSLA	
150/250 V Multipair, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with individual pair shield	150/250 V TTPYC-SLA	21
150/250 V Multipair, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering and individual pair shield	150/250 V TTPYCY-SLA	
150/250 V Multipair, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with individual pair shield	150/250 V FA-TTPYC-SLA	
150/250 V Multipair, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering and individual pair shield	150/250 V FA-TTPYCY-SLA	
0.6/1 kV Double core, EP rubber insulated and polychloroprene (PCP) sheathed flexible cord	0.6/1 kV DPNP	22
0.6/1 kV Three core, EP rubber insulated and PCP sheathed flexible cord	0.6/1 kV TPNP	
0.6/1 kV Four core, EP rubber insulated and PCP sheathed flexible cord	0.6/1 kV FPNP	
0.6/1 kV Single core, flame retardant cross-linked polyethylene (XLPE) insulated flexible switchboard wire	0.6/1 kV SCP	23
0.6/1 kV PVC insulated wire for control equipment wiring	0.6/1 kV SYP	24
0.6/1 kV Double core, EP rubber insulated, PVC sheathed and fire resistant cable	0.6/1 kV FR-DPY	25
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured and fire resistant cable	0.6/1 kV FR-DPYC	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured and fire resistant cable with PVC protective covering	0.6/1 kV FR-DPYCY	

Table 1 Types and symbols (continued)

Type of cable	Symbol	Table No.
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, flame retardant and fire resistant cable	0.6/1 kV FR-FA-DPY	25
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured, flame retardant and fire resistant cable	0.6/1 kV FR-FA-DPYC	
0.6/1 kV Double core, EP rubber insulated, PVC sheathed, steel wire braid armoured, flame retardant and fire resistant cable with PVC protective covering	0.6/1 kV FR-FA-DPYCY	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed and fire resistant cable	0.6/1 kV FR-TPY	26
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and fire resistant cable	0.6/1 kV FR-TPYC	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and fire resistant cable with PVC protective covering	0.6/1 kV FR-TPYCY	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, flame retardant and fire resistant cable	0.6/1 kV FR-FA-TPY	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured, flame retardant and fire resistant cable	0.6/1 kV FR-FA-TPYC	
0.6/1 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured, flame retardant and fire resistant cable with PVC protective covering	0.6/1 kV FR-FA-TPYCY	
150/250 V Multicore, EP rubber insulated, PVC sheathed and fire resistant cable	150/250 V FR-MPY	27
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and fire resistant cable	150/250 V FR-MPYC	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured and fire resistant cable with PVC protective covering	150/250 V FR-MPYCY	
150/250 V Multicore, EP rubber insulated, PVC sheathed, flame retardant and fire resistant cable	150/250 V FR-FA-MPY	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured, flame retardant and fire resistant cable	150/250 V FR-FA-MPYC	
150/250 V Multicore, EP rubber insulated, PVC sheathed, steel wire braid armoured, flame retardant and fire resistant cable with PVC protective covering	150/250 V FR-FA-MPYCY	
3.6/6 kV Single core, EP rubber insulated, PVC sheathed and stainless steel wire braid armoured cable with PVC protective covering	3.6/6 kV SPYC(SUS)Y	28
3.6/6 kV Single core, EP rubber insulated, PVC sheathed, stainless steel wire braid armoured and flame retardant cable with PVC protective covering	3.6/6 kV FA-SPYC(SUS)Y	

Table 1 Types and symbols (concluded)

Type of cable	Symbol	Table No.
3.6/6 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable	3.6/6 kV TPYC	29
3.6/6 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering	3.6/6 kV TPYCY	
3.6/6 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable	3.6/6 kV FA-TPYC	
3.6/6 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering	3.6/6 kV FA-TPYCY	
6/10 kV Single core, EP rubber insulated, PVC sheathed and stainless steel wire braid armoured cable with PVC protective covering	6/10 kV SPYC(SUS)Y	30
6/10 kV Single core, EP rubber insulated, PVC sheathed, stainless steel wire braid armoured and flame retardant cable with PVC protective covering	6/10 kV FA-SPYC(SUS)Y	
6/10 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable	6/10 kV TPYC	31
6/10 kV Three core, EP rubber insulated, PVC sheathed and steel wire braid armoured cable with PVC protective covering	6/10 kV TPYCY	
6/10 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable	6/10 kV FA-TPYC	
6/10 kV Three core, EP rubber insulated, PVC sheathed, steel wire braid armoured and flame retardant cable with PVC protective covering	6/10 kV FA-TPYCY	
NOTE 1 The rated voltages 150/250 V, 0.6/1 kV, 3.6/6 kV and 6/10 kV of cable indicate the following : — 150/250 V : 150 V means the rated power-frequency voltage (AC) between the conductor and earth or metallic screen, and 250 V means the rated power-frequency voltage (AC) between conductors for which the cable is designed. — 0.6/1 kV : 0.6 kV means the rated power-frequency voltage (AC) between the conductor and earth or metallic screen, and 1 kV means the rated power-frequency voltage (AC) between conductors for which the cable is designed. — 3.6/6 kV : 3.6 kV means the rated power-frequency voltage (AC) between the conductor and earth or metallic screen, and 6 kV means the rated power-frequency voltage (AC) between conductors for which the cable is designed. — 6/10 kV : 6 kV means the rated power-frequency voltage (AC) between the conductor and earth or metallic screen, and 10 kV means the rated power-frequency voltage (AC) between conductors for which the cable is designed.		
NOTE 2 “EP rubber” means ethylene propylene rubber.		

Table 2 Symbols denoting number of cores and principal use

Symbol	Number of cores and principal use
FA	Flame retardant
FR	Fire resistant
S	Single core for lighting and power
D	Double core for lighting and power
T	Three core for lighting and power
F	Four core for lighting and power
M	Multicore for control and signal
TT	Multipair for telephone and instrumentation
P	Portable or flexible

Table 3 Symbols denoting constituents

Constituent	Symbol	Meaning
Insulation	P	EP rubber
	SR	Silicon rubber
	Y	PVC (for SYP)
	C	Flame retardant XLPE (for SCP)
Sheath ^{a)}	Y	PVC
	N	PCP
Armour ^{b)}	C	Steel wire braid
	C (SUS)	Stainless steel wire braid
	CB	Copper alloy wire braid
Protective covering	Y	PVC
Others ^{c)}	-S	Individual core shield (braid)
	SLA	Common shield (aluminium laminated tape)
	-SLA	Individual pair shield (aluminium laminated tape)
	E	Earth conductor
Notes ^{a)} In the case of PCP sheath applied instead of PVC sheath, the symbol Y in Table 1 shall be changed to the symbol N. ^{b)} In the case of copper alloy wire braided armour instead of stainless steel wire braided armour, the symbol C (SUS) in Table 1 shall be changed to the symbol CB. ^{c)} In the case of cable with earth conductor, the letter E shall be suffixed to symbols in Table 1.		

4 Characteristics

When cables are tested in accordance with Clause 7, the characteristics shall be as given in Table 4,. The current rating and voltage drop of cables are shown in Annex JA to Annex JC for reference.

Table 4 Characteristics

Item	Characteristic	Applicable sub-clause for test method	Applicable cable
Construction	As specified in Clause 6 and Tables 11 to 31	7.1	Flame retardant cable, type FA cable, flexible cord, switchboard wire, wire for control equipment wiring
Conductor resistance	Not exceeding values in Tables 11 to 31 for cable conductors and Table 8 for earth conductors	7.2	Flame retardant cable, type FA cable, flexible cord, switchboard wire, wire for control equipment wiring
Dielectric strength	Capable of withstanding test voltage specified in Tables 11 to 31 for 5 min	7.3	Flame retardant cable, type FA cable, flexible cord, switchboard wire, wire for control equipment wiring
Insulation resistance	Not less than values in Tables 11 to 31	7.4	Flame retardant cable, type FA cable, flexible cord, switchboard wire, wire for control equipment wiring
Bending	No cracks in sheath, or the number of broken component wires in each conductor not exceeding 30 %	7.5	PCP sheathed flexible cord
Flame retardance of single wire or cable	Distance between lower edge of top support and onset of charring shall be 50 mm or more, and burning shall not extend downwards 540 mm or more from lower edge of top support.	7.6	Flame retardant cable, type FA cable, flexible cord, switchboard wire, wire for control equipment wiring
Flame retardance of bunched cables	Maximum extent of charred or affected portion measured on test sample shall not reach height exceeding 2.5 m from bottom edge of burner.	7.7	Type FA cable
Fire resistance	No fuse failure, no trip of circuit breaker or no turning off of indication showing conduction during test	7.8	Type FR cable
Material	As specified in Clause 5	7.9	Flame retardant cable, type FA cable, flexible cord, switchboard wire, wire for control equipment wiring

Table 4 Characteristics (concluded)

Item	Characteristic	Applicable sub-clause for test method	Applicable cable
Partial discharge	Discharge not exceeding 5 pC under the voltage of 1.73 times the rated voltage to ground	7.10	3.6/6 kV and 6/10 kV cables
Partial discharge after bending	Discharge not exceeding 5 pC under the voltage of 1.73 times the rated voltage to ground	7.11	3.6/6 kV and 6/10 kV cables
Tan δ measurement as function of voltage	Maximum tan δ under the rated voltage to ground shall not exceed 200×10^{-4} , or the maximum increment of tan δ between $0.5 U_0$ and $2.0 U_0$ shall not exceed 25×10^{-4} .	7.12	3.6/6 kV and 6/10 kV cables
Tan δ measurement as function of temperature	Maximum tan δ at ambient temperature shall not exceed 200×10^{-4} , or maximum tan δ at rated temperature (90 °C) shall not exceed 400×10^{-4} .	7.13	3.6/6 kV and 6/10 kV cables
Heating cycle plus partial discharge	Discharge not exceeding 5 pC under the voltage of 1.73 times the rated voltage to ground	7.14	3.6/6 kV and 6/10 kV cables
Power-frequency voltage after impulse withstand voltage	No dielectric breakdown	7.15	3.6/6 kV and 6/10 kV cables

5 Materials

5.1 Conductor

The conductor shall be of tinned or plain annealed copper wire as follows.

- When specimens of tinned annealed copper wire are taken from the finished cable and inspected visually, the wire surface shall appear smooth, uniform and lustrous, and the insulation shall be easily removable (peelable) from the conductor.
- After compatibility test is performed on a sample of plain annealed copper wire, the wire surface shall appear smooth, and the insulation shall be easily removable (peelable) from the conductor.

5.2 Insulation

The insulation shall be of EP rubber, silicone rubber, PVC (for SYP) or flame re-

tardant XLPE (for SCP). When specimens taken from the finished cable are tested in accordance with 7.9.2 or 7.9.3 and 7.9.5, the characteristics shall be as given in Table 5.

Table 5 Characteristics of insulation

Characteristic			Type of insulation (maximum permissible conductor temperature)			
			EP rubber (90 °C)	Silicon rubber (95 °C)	PVC (for SYP) (75 °C)	Flame re- tardant XLPE (for SCP) (90 °C)
Mechanical characteristics	Tensile strength MPa		4.2 min.	7.0 min.	15.0 min.	9.0 min.
	Elongation at break %		200 min.	150 min.	125 min.	120 min.
	After ageing in air oven	Temperature °C	135 ± 3	200 ± 3	100 ± 2	135 ± 2
		Duration h	168	240	240	168
		Tensile strength	—	5.5 min.	—	—
		Variation, maximum %	70 min. 130 max.	—	80 min. 120 max.	70 min. 130 max.
		Elongation at break	—	120 min.	—	100 min.
		Variation, maximum %	70 min. 130 max.	—	80 min. 120 max.	70 min. 130 max.
	After ageing in air oven with conductor	Temperature °C	135±3	—	—	—
		Duration h	168	—	—	—
		Tensile strength	70 min. 130 max.	—	—	—
		Elongation at break	70 min. 130 max.	—	—	—
	Compatibility (after ageing with copper conductor)	Temperature °C	100±2	105±2	—	100±2
		Duration h	168	168	—	168
		Tensile strength	—	4.0 min.	—	—
		Variation, maximum %	70 min. 130 max.	—	—	70 min. 130 max.
		Elongation at break	—	120 min.	—	—
		Variation, maximum %	70 min. 130 max.	—	—	70 min. 130 max.

Table 5 Characteristics of insulation (continued)

Characteristic				Type of insulation (maximum permissible conductor temperature)				
				EP rubber (90 °C)	Silicon rubber (95 °C)	PVC (for SYP) (75 °C)	Flame re- tardant XLPE (for SCP) (90 °C)	
Thermoplastic characteristics	Hot de- for- mation	Temperature °C		—	—	80 ± 2	—	
		Duration h				4		
		Permissible deformation %				50 max.		
	Behav- iour at low tem- perature	Bending test (Dia. ≤ 12.5 mm)	Tempera- ture °C	—	—	−15 ± 2	—	
			Duration h			16		
			Result of test			No cracks on cover- ing		
		Elongation test (Dia. > 12.5 mm)	Tempera- ture °C	—	—	−15 ± 2	—	
			Duration h			4		
			Elongation at break %			30 min.		
	Impact test	Temperature °C	—	—	−15 ± 2	—		
		Duration h			16			
		Result of test			No cracks on cover- ing			
	Electrical characteristics	High-volt age for 4 hours	Test voltage (0.6/1 kV) V		1 800	1 800	—	—
			Duration h		4	4		
Result of test			No break- break- down of insulation	No break- down of insulation				
Insula- tion re- sistance test at maxi- mum rated temper- ature		Temperature °C		90 ± 2	95 ± 2	75 ± 2	90 ± 2	
		Insulation resistance constant K_i		3.67 min.	1.85 min.	0.5 min.	0.35 min.	
Increase in AC capaci- tance		After immer- sion in distilled water at 50 °C	Between end of 1st and end of 14th day %	15 max.	15 max.	15 max.	15 max.	
			Between end of 7th and end of 14th day %	5 max.	5 max.	5 max.	5 max.	

Table 5 Characteristics of insulation (concluded)

Characteristic			Type of insulation (maximum permissible conductor temperature)			
			EP rubber (90 °C)	Silicon rubber (95 °C)	PVC (for SYP) (75 °C)	Flame re- tardant XLPE (for SCP) (90 °C)
Other characteristics	Loss of mass test	Temperature °C	—	—	100 ± 2	—
		Duration h			120	
		Loss of mass mg/cm ²			2 max.	
	Winding and heating test	Temperature °C	—	—	150 ± 3	—
		Duration h			1	
		Result of test			No cracks on covering	
	Ozone resistance test	Ozone concentration %	0.025 to 0.030	—	—	—
		Duration h				
		Result of test				
	Hot set test	Temperature °C	250 ± 3	250 ± 3	—	200 ± 3
		Mechanical stress N/cm ²	20	20		20
		Time under load min	15	15		15
		Elongation under load %	175 max.	175 max.		175 max.
		Permanent elongation %	15 max.	25 max.		15 max.

5.3 Glass yarn

Glass yarn shall be composed of long glass fibres for electric insulation.

5.4 Fire resistant tape

Fire resistant tape shall be composed mainly of mica.

5.5 Tape

Tape shall be made of paper, cotton yarn, synthetic fibre or plastic.

5.6 Glass tape

Glass tape shall be treated with a heat-resisting compound or varnish.

5.7 Aluminium laminated tape

Aluminium laminated tape shall be composed of plastic tape and an aluminium foil covering having a thickness of 0.02 mm or more.

5.8 Copper tape

Copper tape shall have a thickness of approximately 0.1 mm, and shall be tinned or plain annealed tape.

5.9 Filler

Filler shall be made of ~~jute, paper~~, rubber cord or plastic cord.

5.10 Sheath

Sheath shall be made from PCP or PVC. When specimens taken from the finished cable are tested in accordance with 7.9.2 or 7.9.3 and 7.9.5, the characteristics shall be as given in Table 6.

Table 6 Characteristics of sheath

Characteristic				Type of sheath	
				PCP	PVC
Mechanical characteristics	Tensile strength MPa			10.0 min.	12.5 min.
	Elongation at break %			300 min.	150 min.
	After ageing in air oven	Temperature °C		100 ± 2	100 ± 2
		Duration h		168	168
		Tensile strength	Minimum value MPa	—	12.5 min.
			Variation, maximum %	70 min. 130 max.	75 min. 125 max.
		Elongation at break	Minimum value %	250 min.	150 min.
			Variation, maximum %	60 min. 140 max.	75 min. 125 max.
	Compatibility test (after ageing with copper conductor)	Temperature °C		100 ± 2	100 ± 2
		Duration h		168	168
		Tensile strength	Minimum value MPa	—	12.5 min.
			Variation, maximum %	70 min. 130 max.	75 min. 125 max.
		Elongation at break	Minimum value %	250 min.	150 min.
			Variation, maximum %	60 min. 140 max.	75 min. 125 max.
	Oil resistance (after immersion in hot oil)	Temperature °C		100 ± 2	—
		Duration h		24	
		Variation of tensile strength %		60 min. 140 max.	
		Variation of elongation at break %		60 min. 140 max.	

Table 6 Characteristics of sheath (concluded)

Characteristic				Type of sheath	
				PCP	PVC
Thermoplastic characteristics	Hot de- for- mation	Temperature °C		—	80 ± 2
		Duration	Dia. ≤ 12.5 mm h		4
			Dia. > 12.5 mm h		6
		Permissible deformation %			50 max.
	Cold test (behav- iour at low tem- perature)	Bending test (Dia. ≤ 12.5 mm)	Temperature °C	—	−15 ± 2
			Duration h		16
			Result of test		No cracks on cover- ing
		Elonga- tion test (Dia. > 12.5 mm)	Temperature °C	—	−15 ± 2
			Duration h		4
			Elongation at break %		20 min.
		Impact test	Temperature °C	—	−15 ± 2
			Duration h		16
			Result of test		No cracks on cover- ing
	Other characteristics	Loss of mass test	Temperature °C	—	100 ± 2
			Duration h		168
			Loss of mass mg/cm ²		1.5 max.
Winding and heating test		Temperature °C	—	150 ± 3	
		Duration h		1	
		Result of test		No cracks on cover- ing	
Hot set test		Temperature °C	200 ± 3	—	
		Mechanical stress N/cm ²	20		
		Time under load min	15		
		Permissible elongation %	175 max.		
		Permanent elongation %	15 max.		

5.11 Armour

5.11.1 Galvanized steel wire

Galvanized steel wire shall comply with the following.

- Zinc coating** When specimens taken from the finished cable are tested in accordance with 7.9.4, coherent precipitation of copper shall not appear on the surface.
- Diameter of wire** The standard diameter of wires shall be 0.3 mm or 0.4 mm, and the tolerance on diameter shall be as given in Table 7.

Table 7 Tolerance on diameter of armoured wires

Unit: mm		
Standard	Maximum	Minimum
0.3	0.36	0.24
0.4	0.47	0.33

5.11.2 Stainless steel wire

Stainless steel wire shall be of SUS304 specified in **JIS G 4308** or equivalent. When specimens taken from the finished cable are tested, the standard diameter of wires shall be 0.3 mm or 0.4 mm, and the tolerance on diameter shall be as given in Table 7.

5.11.3 Copper alloy wire

Copper alloy wire shall be mainly composed of copper such as silicone bronze and phosphor bronze. When specimens taken from the finished cable are tested, the standard diameter of wires shall be 0.3 mm or 0.4 mm, and the tolerance on diameter shall be as given in Table 7.

5.12 Paint

Paint shall not peel off easily after being applied.

6 Construction

Construction shall be in accordance with Tables 11 to 31 and the following.

6.1 Conductor

The conductor shall be of stranded wires as specified in **5.1**. The surface shall be smooth and free from defects that may damage the insulation, such as cracks, projections or looseness of component wires.

6.1.1 Stranding

All stranded conductors shall have the component wires laid up in concentric layers with the adjacent layers laid up in the opposite direction. However, for the flexible conductors shown in Tables 22 to 24, other convenient means may be adopted, e.g. twisting the necessary number of wires in the same direction.

6.1.2 Splicing of stranded conductor

For stranded conductors, all component wires shall not be spliced at the same position.

6.2 Separator

The tape specified in **5.5** may be applied between the conductor and insulation as a separator.

6.3 Fire resistant layer

The fire resistant tape specified in **5.4** shall be applied between the conductor and insulation as a fire resistant layer.

6.4 Conductor screen

The conductor screen between the conductor and insulation shall consist of a semi-conducting tape or an extruded semi-conducting compound, which may be applied on top of the semi-conducting tape.

6.5 Insulation