ÜNTEL

Quality Through Experience

TECHNICAL DATA

MARINE CABLES

TECHNICAL DATA

MARINE CABLES STANDARDS

IEC 60092-350: Shipboard power cables - General construction and test requirements

IEC 60092-352: Electrical installation in ships - Choice and installation of electrical cables.

IEC 60092-353: Single and multicore non-radial field.Power cables with extruded solid insulation for rated voltages 1 kV and 3 kV

IEC 60092-354: Single and three-core power cables with extruded solid insulation for rated voltages 6 kV up to 30 kV.

IEC 60092-360: Insulating and sheathing meterials for shipboard and offshore units, power, control, instrumentation and telecommutication cables.

IEC 60092-376: Cables for control and instrumentation circuits 150/250 V (300 V).

IEC 60228: Conductors of insulated cables.

IEC 60287: (all parts), Electric cables - Calculation of the current rating.

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

IEC 60331-31: Tests for electric cables under fire conditions - Circuit integrity - Part 31: Procedures and requirements for fire with shock - Cables of rated voltage up to and including 0,6/1,0 kV

IEC 60331-1: Test method for fire with shock at a temperature of at least 830ºC for cables of rated voltage up to and including 0,6/1 kV and with an overall diameter exceeding 20mm.

IEC 60331-2: Test method for fire with shock at a temperature of at least 830ºC for cables of rated voltage up to and including 0,6/1 kV and with an overall diameter not exceeding 20mm.

IEC 60332-1-2: Test for vertical flame propagation for single insulated wire or cable.

IEC 60332-3-22: Test for vertical flame spread of vertically - mouted bunched wires or cables - Category A

IEC 60754-1: Test on gases evolved during combustion of meterials from cables. Part 1: Determination of the halogen acid gas content.

IEC 60754-2: Test on gases evolved during combustion of meterials from cables. Part 2: Determination of acidity (by pH measurement) and conductivity.

IEC 60811: Common test methods for insulating and sheating metarials of electric cables.

IEC 61034-1: Measurement of smoke density of cables burning under defined conditions - Part 1: Test apparatus.

IEC 61034-2: Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements.

BS-8491: This test serves to verify the integrity of cables (diameter >20mm) while exposed to fire, mechanical shock and water spray. A sample of cable is held on a flame at a temperature of roughly 830ºC, for a minumum of 120 minutes. The sample is also subjected to a mechanical shock, directly on the cable, every 10 minutes. Lastly, 5 minutes before the end of the test, the cable is sprayed by a strong jet of water for a period of 5 seconds, at intervals of 60 seconds.

EN 50200 Annex E: This test serves to verify circuit integrity of cables (diameter ≤20mm) while exposed to fire, mechanical shock and water spray. The cable is exposed to a flame 830ºC, mechanical shocks for 15 minutes and an additional 15 minutes to flame, mechanical shocks and water spray.

GENERAL INFORMATION ABOUT MARINE CABLES

Cables constructed in accordance with IEC 60092-350, IEC 60092-353, IEC 60092-354 and IEC 60092-376 are recommended for use on board ships. Cables (and their terminations) for use in special applications which are constructed in accordance with IEC 60702-1 and IEC 60702-2 are also acceptable provided that due consideration has been given to their intended application and use in a marine environment.

These cables are manufactured and tested in accordance to the standards being used for shipbuilding and repairing of ships and delivered to the end users together with the approvals of the requested classification societies.

Construction

Conductor: Conductors of marine cables are in accordance with the specifications defined in standard IEC 60228.

Insulation: For the insulation of marine cables, materials like SIR, HEPR, XLPE, HFX, HF90 and PVC are used according to related IEC construction standard.

Screening: One of the preferable ways to minimize either the effects of external electromagnetic fields or to prevent the cables creating electromagnetic fields is to apply screening to the cables. By earthing this screen, these effects are minimized and the screen strengthens the structure of the cable as well. In marine cables screening is made by metal wire braiding (mostly copper) or using metal tapes or aluminium foil in touch with drain wire.

Sheathing: For the sheathing of marine cables, materials like PVC (ST2), SHF1, SHF 2, Chloroprene are used according to related construction standard(s). Our SHF 1 sheathing compound is halogen free, flame retardant, low smoke and has very good abrasion resistance, good mechanical properties, low moisture absorption and high resistance to most of the chemicals.

Flame retardance: Flame retardant cables must be self-extinguishing when the source of flames dies out. The cables are tested according to IEC 60332-3-Cat A. Single, earth and bonding wires shall withstand the test specified in IEC 60332-1.

Fire resistance: During a fire it is vital that emergency circuits must continue to function. This could be communication circuits, emergency lights, alarms and fire pumps, etc. Fire resistant cables are tested in accordance with IEC 60331-21 and 31.

Content of halogen: Halogen-free cables will not cause corrosion to metals. When halogen - containing cables burn, the gases generated in combustion of the sheathing and insulation may cause corrosion. The secondary effects after a fire are often many times larger than the damages caused by the fire itself. The cables are tested to IEC 60754-1,2. Maximum content of halogen = 5 mg/g.

Smoke Emission: Smoke evolution has major significance in situations where escape routes are limited in case of fire. During the fire the light transmission is recommended to have a minimum value of 60% when tested in accordance with IEC 61034-2

Oil resistance: Although the cables with thermoplastic sheath material there are no requirements for oil resistance properties according to IEC 60092-360 our SHF 1 sheathing meets the criteria according to IEC 60811-2-1 for oil resistance to ASTM No.2 oil, 4 hours, 70 °C and our SHF2 sheathing meets oil resistivity in IRM oil no. 902 at 100°C for 24 hours.

UV resistance: Our halogen free sheathed marine cables have been tested and pass the requirements for UV resistivity and meet the criteria written in UL 1581 and ISO 4892-2

Mud resistance: In accordance with NEK 606 the mud resistant cables shall have a sheath (SHF Mud) that complies with the requirements in IEC 60092-360 for SHF2.

Rated Voltage

The rated voltages of cables are expressed as $U_0/U(U_m)$ where

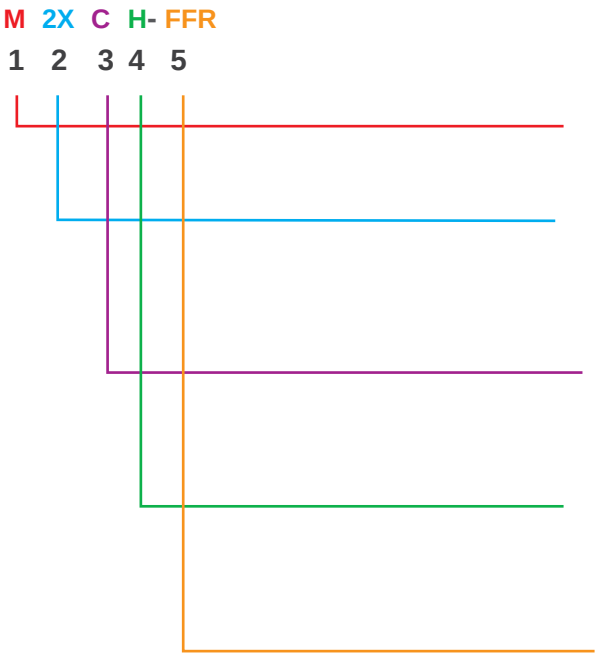
- U the rated voltage between the conductor and earth, or between the conductor and the metal screen
- U the rated voltage between the conductors
- U_m the highest system voltage

Installation Temperature: The minimum installation temperature for thermoplastic sheathed cables is -15ºC.

Maximum pulling tension: 50 N x total cross-section of conductors.

TECHNICAL DATA

CODING OF ÜNTEL MARINE CABLES



	CODE	DESCRIPTION
1	M	MARINE POWERCABLE
	FM	MARINE TELECOMMUNUCATION CABLE
2	G	HEPR INSULATION
	2X	XLPE INSULATION
	Y	FLAME RETARDANT PVC INSULATION
3	C	OVERALL COPPER BRAIDING SCREEN
	CC	INDIVIDUAL AND OVERALL COPPER BRAIDING SCREEN
	A	OVERALL ALUMINIUM TAPE SCREEN
	AA	INDIVIDUAL AND OVERALL ALL TAPE SCREEN
	S	STEEL WIRE BRAIDED SHIELD
4	G	CHLOROPRENE OUTER SHEATH
	Y	FLAME RETARDANT PVC (ST2) OUTER SHEATH
	H	HALOGEN-FREE SHF1 OUTER SHEATH
5	EMC	ENHANCED EMC PROTECTION
	FFR	FIRE RESISTANT
	FI	WITH INNER SHEATH
	NOFI	WITH SEPARATING FOIL

CORE IDENTIFICATION ACCORDING TO HD 308.S2

0,6/1 kv Power and Control Cables

N. of cores	Cores Colour					
1x...	-	-	-	Black	-	-
2x...	-	Blue	Brown	-	-	-
3G...	Green/Yellow	Blue	Brown	-	-	-
3x...	-	Brown	Black	Grey	-	-
4G...	Green/Yellow	Brown	Black	Grey	-	-
4x...	-	Blue	Brown	Black	Grey	-
5G...	Green/Yellow	Blue	Brown	Black	Grey	-
5x...	-	Blue	Brown	Black	Grey	Black
>5G... or > 5x...	White with black printed numbers, with or without Green/Yellow					

150/250 V Instumentation Cables

N. of cores	Cores Colour
Pairs on triples	White color black numbered on each core (eg 1,2 - 3,4 - 5,6)

3,6 up to 12/20kV Medium Voltage Cables

1x...: Natural colour of the compound
3x...: Natural colour of the compound + numbered tape(s) or coloured or thread

BENDING RADIUS

The internal bending radius for the installation of cables shall be as recommended by the manufacturer according to the type of cable chosen and shall not be less than the values given bellow tables

Bending radii for cables rated up to 1,8 / 3kV

Cable construction		Overal diameter of cable (D)	Minimum internal radius of bend
Insuiation	Covering		
Thermoplastic or thermosetting with circular copper conductors	Unarmoured or unbraided	≤25 mm	4 D [a]
		≤25 mm	6 D
	Metal braid screened or armoured	Any	6 D
	Metal wire armoured Metal tape armoured or metal - sheathed	Any	6 D
	composite polyester / metal laminate tape screened units or collective tape screening	Any	8 D
Mineral	Hard metal sheethed	Any	6 D
[a] 6D for defined circuit integrity			

Bending radii for cables rated at 3,6 /6,0 (7,2) kV and above

Cable construction	Overal diameter of cable (D)	Minimum internal radius of bend
Single Core Cable	Any	12 D
3 -Core Cables	Any	9 D

TOLERANCE OUTER DIAMETER OF THE LOW VOLTAGE MARINE CABLES (*)

Nominal Outer Diameter (mm)	Tolerance (+/- mm)
1 - 10	0.5
10.1 - 20	1.0
20.1 - 30	1.5
30.1 - 40	2.0
40.1 - 50	2.5
50.1 - 60	3.0
60.1 - 70	3.5
70.1 - 80	4.0

(*) Not applicable to MV cables and sector shaped cables. For OD tolerances of these cables, refer to their own catalogue page

PERMISSIBLE CURRENT CARRING CAPACITIES

Permissible current carrying capacities are stated by the rules of the vessel approval authority and in line with IEC 60092-352 and IEC 61892-4 standarts.

These values are applicable for DC and AC with a nominal frequency of 50 Hz or 60Hz.

The current to be carried by any conductor for sustained periods during normal operation shall be such that the appropriate conductor temperature limit is not exceeded.

This catalogue gives only an extract of IEC 60092-352 standard that selected 2 methods for the determination of current carriying capacities for continuous service.
Below methods are derived from experimental data and from IEC 60287 (Electric cables - Calculation of current rating.)

Annex A: a method for determination of current carrying capacities based upon those that have been accepted and established in other applicas of cable use. This method allows for greater choice of use in different installation configurations. The basis of the determination is on the following formula:

Where

$$I = A \times S^m - B \times S^n$$

I is the current carrying capacity (A);

S is the nominal cross-sectional area of conductor (mm2);

A and **B** are coefficients,
m and **n** are exponents according to cable type and method of installation.

Annex B: a method for determination of current carrying capacities as given in the second edition (1997) of IEC 60092-352. It is recommended that they are only used for refurbishment of ships or in conjuntion with other guidance information.

The formula on which they are based is:

$$I = \propto . A^{0,625}$$

Where
I is the current carrying capacity (A);

A is the nominal cross-sectional area of conductor (mm^2);

$\propto$ is a coefficient related to the maximum permissible service temperature of the conductor.

where $\propto$ is a coefficient related to the maximum permissible service temperature of the conductor as follows:

Maximum permissible temperature of the conductor		60 ^{0}C	70 ^{0}C	85 ^{0}C	90 ^{0}C	95 ^{0}C
Values of a for nominal Cross-sectional area	⩾ 2,5 mm^2	9,5	12	16	17	18
	< 2,5 mm^2	8	11,5	16	18	20

The selection of the method applicable to any particular installation is the responsibility of the appropriate approval authority or governing regulation.

Corection factors for cable grouping - IEC 60092-352

The current rating values may be considered appliable, without correction factor, for cables bunched together on cable trays, in cable conduit, pipe or trunking, unless more than 6 cables, which may be expected to operate simultaneously at their full rated current, are laid together in a cable bunch in such a way that there is an absence of free air circulation around them. In this case, a correction factor of 0,85 should be applied on current rating value.

CURRENT CARRYING CAPACITIES

Current Ratings in accordance with IEC 60092-352 based on ambient air temperature of 45ºC and a conductor temperature of the maximum rated temperature of the 90ºC insulation.

For more than 4-cores, the current ratings are given by the following formula;

I_1 = Current rating for 1-core

N = Number for cores

$$I_N = \frac{I_1}{\sqrt[3]{N}}$$

For class 2 conductor cables

Size / N	1	2	3	4	5	7	10	12	14	16	19	24	27	37
Factor, n	1	0,85	0,7	0,7	0,58	0,52	0,46	0,44	0,41	0,40	0,37	0,35	0,33	0,30
1,0 mm^2	18	15	13	13	10	9	8	8	7	7	7	6	6	5
1,5 mm^2	23	20	16	16	13	12	11	10	9	9	9	8	7	7
2,5 mm^2	30	26	21	21	17	16	14	13	12	12	11	11	10	9
4 mm^2	40	34	28	28	23									
6 mm^2	52	44	36	36	30									
10 mm^2	72	61	50	50	42									
16 mm^2	96	82	67	67	56									
25 mm^2	127	108	89	89	74									
35 mm^2	157	133	110	110	91									
50 mm^2	196	167	137	137										
70 mm^2	242	206	169	169										
95 mm^2	293	249	205	205										
120 mm^2	339	288	237	237										
150 mm^2	389	331	272	272										
185 mm^2	444	377	311	311										
240 mm^2	522	444	365	365										
300 mm^2	601	511	421	421										

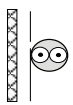
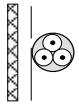
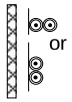
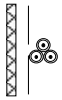
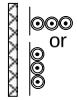
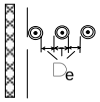
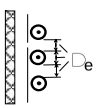
For class 5 conductor cables

Size / N	1	2	3	4	5	7	10	12	14	16	19	24	27	37
Factor, n	1	0,85	0,7	0,7	0,58	0,52	0,46	0,44	0,41	0,40	0,37	0,35	0,33	0,30
1,0 mm^2	16	14	12	12	10	9	8	7	7	6	6	6	5	5
1,5 mm^2	21	18	15	15	13	11	10	9	9	8	8	7	7	6
2,5 mm^2	29	25	21	21	17	15	13	13	12	12	11	10	9	9
4 mm^2	39	33	28	28	23									
6 mm^2	50	43	35	35	29									
10 mm^2	71	60	50	50	42									
16 mm^2	93	79	66	66	54									
25 mm^2	122	104	86	86	71									
35 mm^2	152	129	107	107	89									
50 mm^2	195	166	137	137										
70 mm^2	240	204	168	168										
95 mm^2	286	243	201	201										
120 mm^2	332	282	233	233										
150 mm^2	382	324	268	268										
185 mm^2	432	367	301	301										
240 mm^2	508	432	356	356										
300 mm^2	590	502	413	413										

Correction Factor for Various Ambient Air Temperatures

Ambient Temperature	35^0 C	40^0 C	45^0 C	50^0 C	55^0 C	60^0 C	65^0 C	70^0 C	75^0 C	80^0 C	85^0 C
Multiply Factor	1.10	1.05	1.00	0.94	0.88	0.82	0.74	0.67	0.58	0.47	-

Current carrying capacities in amperes
Copper conductors temperature: 90 ˚C and reference ambient air temperature: 45 ˚C

Nominal cross-sectional area of conductor	Installation Method												
	Method B1 Insulated conductors or single core cables in conduit on a bulkhead		Method B2 Multi-core cable in conduit on a bulkhead		Method C Multi-core cables on a bulkhead		Method E Multi-core cables in free air		Method F Single core cables, touching in free air			Method G Single core cables, spaced in free air	
	Two conductors	Three conductors	Two conductors	Three conductors	Two conductors	Three conductors	Two conductors	Three conductors	Two conductors	Three conductors trefoil	Three conductors	Horizontal	Vertical
mm²													
1,5	20	17,5	19	17	21	19	23	20					
2,5	27	24	26	23	29	26	31	28					
4	37	32	35	30	39	35	43	37					
6	47	42	44	38	50	45	55	47					
10	65	57	60	52	70	62	75	65					
16	87	77	79	70	93	84	100	87					
25	116	102	104	91	120	104	130	110	140	117	123	158	140
35	143	125	127	111	149	128	161	137	174	147	153	197	175
50	172	152	152	134	182	156	196	167	211	180	188	239	214
70	220	193	192	169	234	199	251	214	270	233	243	307	277
95	266	234	231	203	285	242	306	259	328	285	298	374	338
120	308	271	265	233	332	280	357	301	380	333	348	435	395
150					384	323	412	347	438	386	404	502	458
185					440	369	472	397	500	444	464	575	526
240					521	435	558	468	591	528	552	679	626
300					603	501	645	540	681	612	640	785	725
400									818	716	755	944	877
500									942	823	868	1 090	1 017
630									1 091	947	1 001	1 265	1 185

SHORT CIRCUIT CURRENT RATINGS

The following short current ratins are for cables normally operating at a maximum conductor temperature of 90 ºC

The theoretical temperature that arises in the conductor during a short circuit, which is used as a basis of the calculation, is 250 ºC in accordance with IEC 60724.

EPR and XLPE insulation are capable of with starding of short term temperature up to 250 ºC

zThe short circuit current ratings for copper conductors given in the table are values for one second for other duration the current may be calculated from the following formula ;

$$I_k = 226 x \frac{S}{\sqrt{t}} x \sqrt{\ln \frac{234+T_k}{234+T_b}}$$

I_k = Short Circuit Current (A)

S = Cross Section (mm^2)

t = Duration of the Short Circuit (s)

T_k = Max. Rated Conductor Temp. (ºC) at Short Circuit

T_b = Max. Conductor Temp.(ºC)

Cross-section mm^2	Short Circut Current A(1s)
1	142
1.5	213
2.5	358
4	572
6	589
10	1,430
16	2,280
25	3,570
35	5,005
50	7,150
70	10,016
95	13,593
120	17,170
150	21,462
185	26,468
240	34,338
300	42,922

REACTANCE - INDUCTANCE AND IMPEDANCE

The reactance of a cable operating in a A.C. system depends on the axial spacing between conductors. The values specified in cable construction details are for cables with circular conductors. The value for a sector-shaped conductor should be taken as 90% of the calculated value.

Inductance for 2-, 3- and 4- cores cables is given by the formula;

$$L = 0{,}2 \times \left(\ln \left(\frac{2a}{d} \right) + 0{,}25 \right) \times 10^{-6}$$

L = Induction in H/m and phease,
d = Conductor diameter in mm.
a = Axial space between conductors in mm.

Reactance for 2-, 3- and 4- core cables is given by the formula;

$$X = 2 x \pi x f x L x I$$

X = Reactance in ohm pr. Phase,

I = Conductor lengeht in meter.

f = Frequency in Hz,

L= Inductor in H/m and pahse

TECHNICAL DATA

Impedance for 2-, 3 and 4-core cables is given by the formula;

$$\mathbf{Z} = \sqrt{R^2 + X^2}$$

Z = Impedance in ohm pr. phase,

X = Rectance in ohm pr. phase.

R = Resistance at operating temperature in ohm pr. phase,

CONSTRUCTION AND RESISTANCE OF CONDUCTOR

Resistance Formula;

$$\mathbf{R} = \rho \frac{L}{A}$$

R = resistance in ohm per phase

ρ = specific resistance, $\Omega \cdot mm^2/m$

A = Conductor area, mm^2

Resistance as a function of temperature

$$R_{20} = R_t \times k_t \times \frac{1000}{L}$$

$\mathbf{k_t}$ = is the temperature correction factor from below table or from below formula

$\mathbf{k_{20}}$ = is the conductor resistance at 20 ºC, in Ω/km;

$\mathbf{R_t}$ = is the mensured conductor resistance, in Ω;

L = is the length of cable, in m.

Correction factors are applied as bellow:

Temperature [ºC]	5	10	15	20	25	30	35	40	45	50
Kt	1.064	1.042	1.020	1.000	0.980	0.962	0.943	0.926	0.909	0.893
Temperature [ºC]	55	60	65	70	75	80	85	90	95	
Kt	0.877	0.862	0.847	0.833	0.820	0.806	0.794	0.781	0.769	

Formula for Temperature Correction factor of copper conductors.

$$k_{t,Cu} = \frac{254,5}{254,5 + t} = \frac{1}{1+0,00393(t-20)}$$

Electrial Paramenters for Instrumentation Cables

Nominal cross section	mm^2	0,5	0,75	1	1,5	2,5
Conductor resistance at 20 ºC, max	Ω/km	40,4	26,0	19,2	12,8	7,86
Loop resistance of pair at 20 ºC, max	Ω/km	80,8	52	38,4	25,6	15,72
Mutual Capacitance at 1 kHz, max	nF/km	150	150	150	150	150
Loop inductance at 1 kHz, max	mH/km	1,0	1,0	1,0	1,0	1,0
Inductance to resistance ratio (L/R)	$\mu H/\Omega$	25	25	25	40	60

CONDUCTOR RESISTANCE

Power Cables

Nominal Cross-section of conductor	Class 2				Class 5			
	Bare copper		Tinned copper		Bare copper		Tinned copper	
	Maximum resistance at 20 °	Maximum resistance at 90 °	Maximum resistance at 20 °	Maximum resistance at 90 °	Maximum resistance at 20 °	Maximum resistance at 90 °	Maximum resistance at 20 °	Maximum resistance at 90 °
mm²	**Ω/km**							
1	18,1	23,1	18,2	23,2	19,5	24,9	20,0	25,5
1,5	12,1	15,4	12,2	15,6	13,3	17,0	13,7	17,5
2,5	7,41	9,45	7,6	9,64	7,98	10,2	8,21	10,47
4	4,61	5,88	4,70	5,99	4,95	6,3	5,09	6,49
6	3,08	3,93	3,11	3,97	3,30	4,2	3,39	4,32
10	1,83	2,33	1,84	2,35	1,91	2,4	1,95	2,49
16	1,15	1,47	1,16	1,48	1,21	1,5	1,24	1,58
25	0,727	0,927	0,734	0,936	0,78	0,995	0,795	1,014
35	0,524	0,668	0,529	0,675	0,554	0,706	0,565	0,720
50	0,387	0,493	0,391	0,499	0,386	0,492	0,393	0,501
70	0,368	0,342	0,270	0,344	0,272	0,347	0,277	0,353
95	0,193	0,249	0,195	0,249	0,206	0,263	0,210	0,268
120	0,153	0,195	0,154	0,196	0,161	0,205	0,164	0,209
150	0,124	0,158	0,126	0,161	0,129	0,164	0,132	0,168
185	0,0991	0,1264	0,100	0,128	0,106	0,135	0,108	0,138
240	0,0754	0,0961	0,0762	0,0972	0,0801	0,1021	0,0817	0,1042
300	0,0601	0,0766	0,0607	0,0774	0,0641	0,0817	0,0654	0,0834

Instrumentation, control and communications cables

	Class 2		**Class 5**	
Nominal cross-sectional of conductor	Resistance of plain copper conductors at 20 ° C	DC resistance of tinned copper conductors at 20 ° C	DC resistance of plain copper conductors at 20 ° C	DC resistance of tinned copper conductors at 20 ° C
mm²	**Ω/km**			
0,5	40,4	41,6	41,4	42,5
0,75	26,0	26,3	27,6	28,3
1	19,2	19,3	20,7	21,2
1,5	12,8	12,9	14,1	14,5
2,5	7,86	8,02	8,47	8,71

VOLTAGE DROP

In the absence of specific design limits set by a regulatory body, the cross-sectional areas of conductors shall be so determined that when the conductors are carrying tha maximum current under normal conditions of service, the drop in voltage from the main or emergency switchboard bus-bars to any and every point on the installation does not exceed the limitation given in Clause 36 of IEC 60092-201

Current carrying in cable core(s) induce(s) a voltage drop and value of this voltage drope is the difference between the measured voltages at booth ends of the cable

Generally accepted values are 3% for lighting and 5% for motors and other applications.

Voltage drop depends on:

- Type of current (DC) or (AC)
- Single or tri-phased systems.
- Length of the cable
- Carrying current capacity and power factor.
- Electrical resistance and inductance.

In DC system

$Vd = 2 \times I \times L \times R$

In AC Single Phase System

$Vd = 2 \times I \times L (R.\cos \varnothing + X. \sin \varnothing)$ I = Conductor lenght (m)

In AC Three Phase System

$V d = \sqrt{3} \times I \times L \times (R.\cos \varnothing + X. \sin \varnothing)$

Where

Vdrop	Voltage drop (V)
R	D. C. conductor resistance at max rated conductor temperature (Ω /km)
L	Cable length (km)
I	Current rating value (A)
Cos Ø	Power factor if no details, power factor is Cos ∅ = 0.8 and Sin ∅ = 0.6.
X	Reactance (Ω / km)

VOLTAGE DROP

For Class 5 Conductors

	Conductor Resistance			App. Voltage Drop at 90 °C		
Cross Section mm^2	Resistance at +20 °C ohm/km	Resistance at +45 °C ohm/km	Resistance at +90 °C ohm/km	DC mV/Am	Single Phase mV/Am (*)	Three Phase mV/Am (*)
1,5	13,3	14,607	16,959	33,92	27,13	23,50
2,5	7,98	8,765	10,176	20,35	16,28	14,10
4	4,95	5,437	6,312	12,62	10,10	8,75
6	3,3	3,625	4,208	8,42	6,73	5,83
10	1,91	2,098	2,436	4,87	3,90	3,38
16	1,21	1,329	1,543	3,09	2,47	2,14
25	0,78	0,857	0,995	1,99	1,59	1,38
35	0,554	0,609	0,707	1,41	1,13	0,98
50	0,386	0,424	0,493	0,986	0,789	0,683
70	0,272	0,299	0,347	0,694	0,555	0,481
95	0,206	0,227	0,263	0,526	0,421	0,364
120	0,161	0,177	0,206	0,412	0,330	0,285
150	0,129	0,142	0,165	0,330	0,264	0,229
185	0,106	0,117	0,136	0,272	0,218	0,188
240	0,0801	0,088	0,103	0,206	0,165	0,143

(*) : At Cos Ø = 0,8 and at 50 Hz

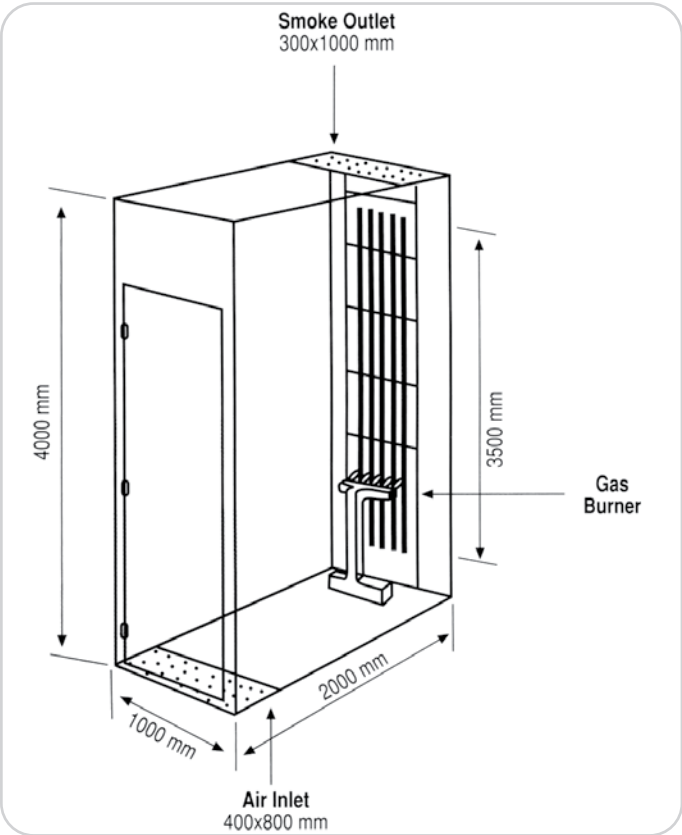
For Class 2 Conductors

	Conductor Resistance			App. Voltage Drop at 90 °C		
Cross Section mm^2	Resistance at +20 °C ohm/km	Resistance at +45 °C ohm/km	Resistance at +90 °C ohm/km	DC mV/Am	Single Phase mV/Am (*)	Three Phase mV/Am (*)
1,5	12,1	13,289	15,429	30,86	24,69	21,38
2,5	7,41	8,139	9,449	18,90	15,12	13,09
4	4,61	5,063	5,879	11,76	9,41	8,15
6	3,08	3,383	3,928	7,86	6,28	5,44
10	1,83	2,010	2,334	4,67	3,73	3,23
16	1,15	1,263	1,467	2,93	2,35	2,03
25	0,727	0,799	0,927	1,85	1,48	1,28
35	0,524	0,576	0,669	1,34	1,07	0,93
50	0,387	0,426	0,494	0,988	0,79	0,685
70	0,268	0,295	0,342	0,684	0,55	0,474
95	0,193	0,212	0,247	0,494	0,40	0,342
120	0,153	0,169	0,196	0,392	0,31	0,272
150	0,124	0,137	0,159	0,318	0,25	0,220
185	0,0991	0,109	0,127	0,254	0,20	0,176
240	0,0754	0,083	0,097	0,194	0,16	0,134

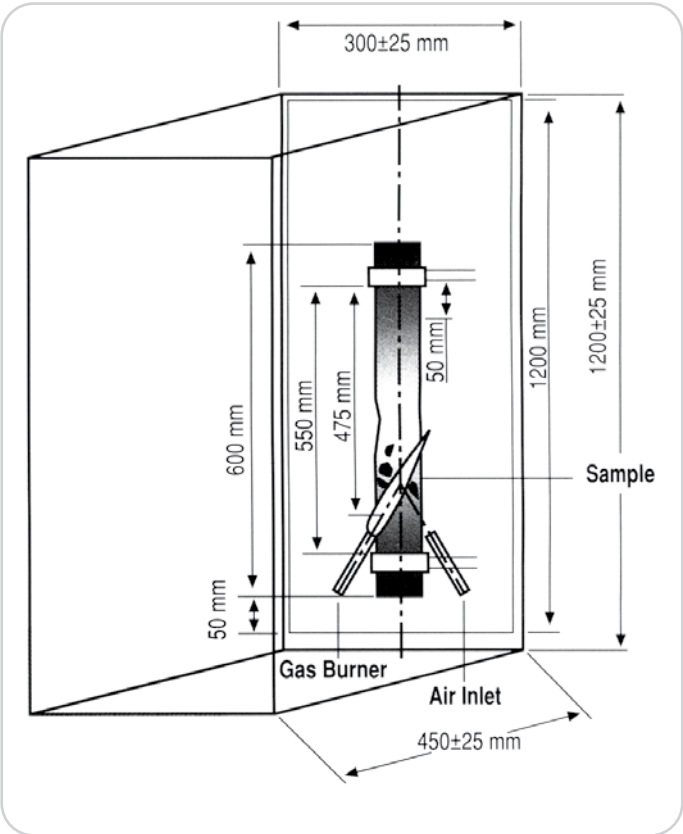
(*) : At Cos Ø = 0,8 and at 50 Hz

TESTS ON ELECTRIC CABLES UNDER FIRE CONDITIONS

IEC 60332/3 Fire test on bunched and vertical laid cables.
Test chamber



IEC 60332/1 Fire test on a vertical laid single cable.Test chamber



Flame application time

Required volume of combustible material
per 1 m of cable bunch (lt) : V

Flame application time

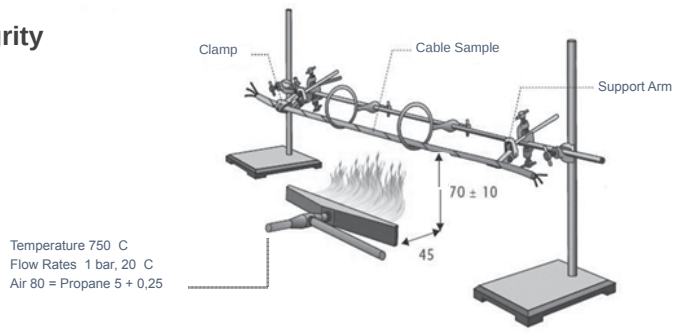
Weight of test piece (kg) : m
Flame application time (s) = 60+m/25

IEC 60332/3 CATEGORY	V	MINIMUM BURNING TIME
A	7lt.	40 minutes
B	3.5lt.	40 minutes
C	1.5lt	20 minutes

Test Conditions of IEC 60332/3

This test is to determine the fire propagation characteristics of a bunch of cables. The test should be carried out if the external wind speed measured by an anemometer fitted on the top of the test rig is not greater than 5 m/s and the temperature of the walls of the test chamber is in between 5 ºC and 40 ºC. The temperature inside of the chamber should be 23±5 ºC before the test

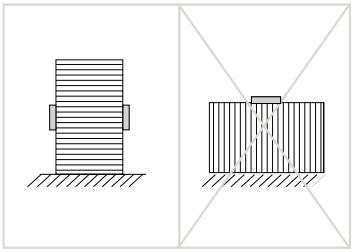
IEC 60331 - 21
Fire Test for circuit integrity



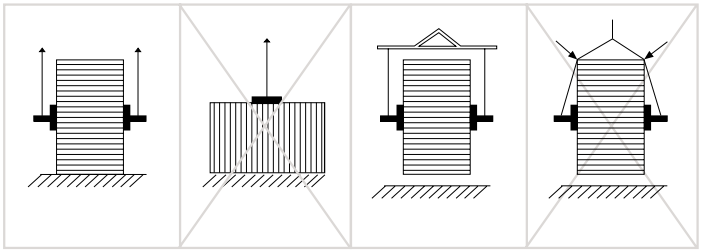

CERTIFICATE
ÜNTEL KABLOLARI SAN. VE TİC. A.Ş.
ISO/IEC 27001:2013
TS EN ISO 14001:2004
TS EN ISO 9001:2008
TS 18001:2014
TSE
ÇEVRE YÖNETİM SİSTEMİ BELGESİ
KALİTE YÖNETİM SİSTEMİ BELGESİ
TÜRK LOYDU
ABS
DET NORSKE

Cables and Drums User Guide Drums Handling

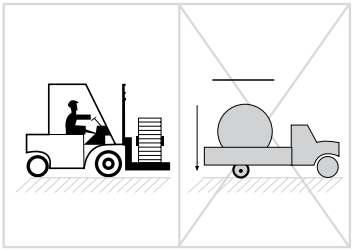
1.1.Position of Drums



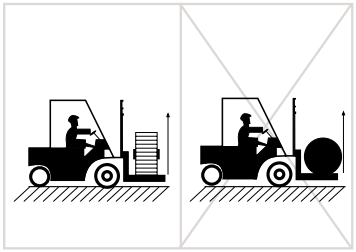
1.2.Loading



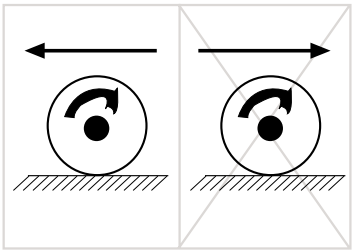
1.3.Unloading



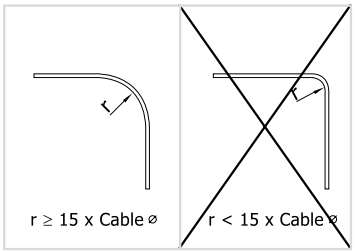
1.4.Handling by forklift

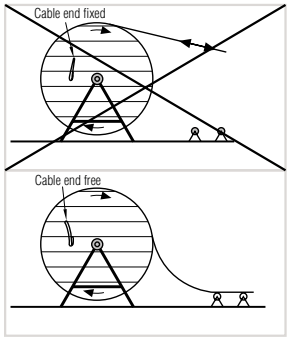


1.5.Rolling



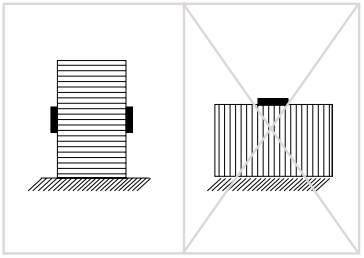
1.6.Paying-off the Cable



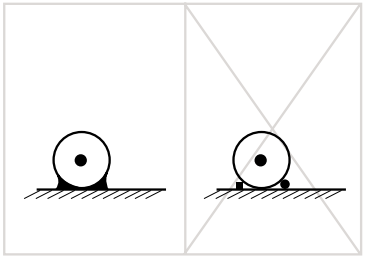


TransportRequirements

2.1.Position of the Drums

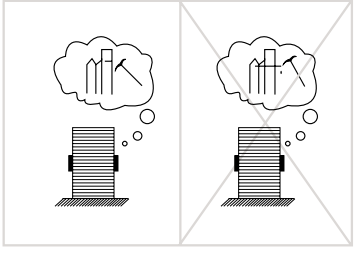


2.2.Fastening Drums

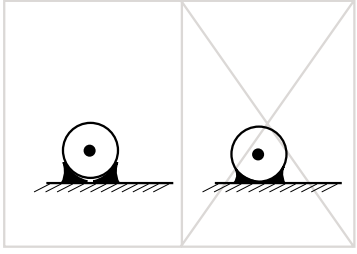


Cables and Drums User Guide

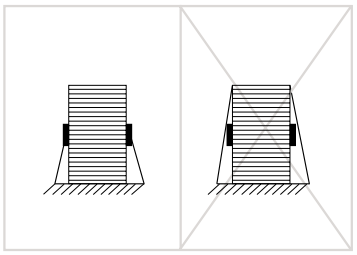
2.3.Use of nails



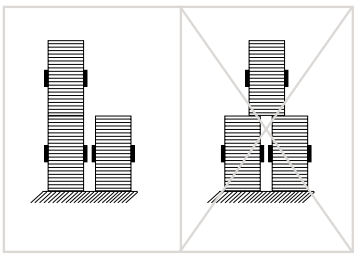
2.4.Bigger Drums



2.5.Binding of the Drums

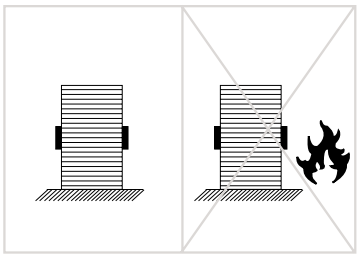


2.6.Multiple Drum Storage

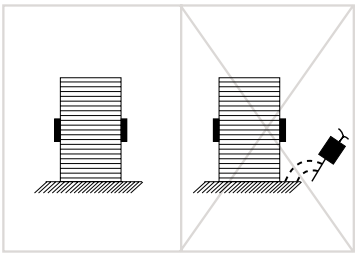


Storage Requirements

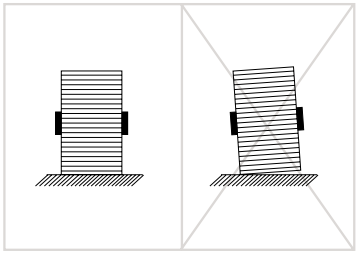
3.1.Do not store near heat sources



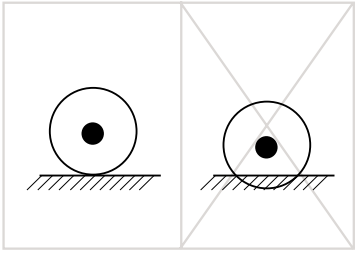
3.2. Do not store on vibrating surfaces. (Ship engine room etc.)



3.3.Do not store on irregular surfaces.



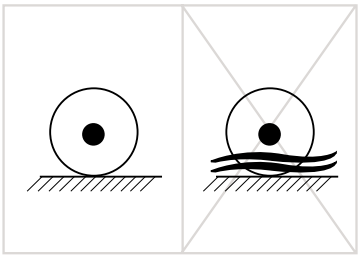
3.4.Do not store on soft surfaces

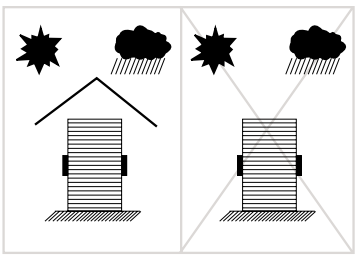


Cables and Drums User Guide

3.5. Do not store on areas liable of flooding. All cable ends must be fully sealed at all times to prevent the ingress of water. It is preferable to store reels off the ground on timbers or other supports. In damp locations, it is advisable to allow at least 3 inches between reels to permit circulation of air.

3.6. If storage is likely to last more than 6 months, drums should be stored in order to be protected from effects like rain, sunlight etc.





NOTES

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OFFSHORE CABLES

AIRPORT CABLES

CRANE CABLES

MINING CABLES

DEFENSE INDUSTRY CABLES

MARINE CABLES

RAILWAY CABLES

INDUSTRIAL CABLES

TUNNELLING CABLES

INSTRUMENTATION CABLES

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