



Quality Through Experience

# INSTRUMENTATION CABLES

**TECHNICAL DATA**





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## NOMINATIVE REFERENCE STANDARDS

**EN 50288-7:** Sectional specification for instrumentation and control cables

**PAS 5308-1:** Control and Instrumentation Cables Part 1 : Specification for polyethylene insulated cables

**PAS 5308-2:** Control and Instrumentation Cables Part 2 : Specification for PVC insulated cables

**IEC 60228:** Conductors of insulated cables.

**BS EN 50288-1:** Multi-element metallic cables used in analogue and digital communication and control. Generic specification

**EN 50289 Series:** Communication cables - Specifications for test methods

**EN 50290 Series:** Communication cables

**EN 50307:** Lead and lead alloy sheath and sleeves of electric cables

**EN 60708:** Low-frequency cables with polyolefin insulation and moisture barrier polyolefin sheath (IEC 60708)

**EN 60811-1-1:** Insulating and sheathing materials of electric and optical cables. Common test methods. Part 1-1: General application Measurement of thickness and overall dimensions. Tests for determining the mechanical properties (IEC 60811-1-1)

**HD 383 S2 :** Conductors of insulated cables First supplement: Guide to the dimensional limits of circular conductors (IEC 60228 + IEC 60228A, mod.)

**HD 446.3 S1:** Thermocouples - Part 3: Extension and compensating cables tolerances and identification system (IEC 60584-3, mod.)

**IEC 60189-2 :** Low-frequency cables and wires with PVC insulation and PVC sheath - Part 2: Cables in pairs, triples, quads and quintuples for inside installations

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

**IEC 60332-3-24:** Test for vertical flame spread of vertically - mouted bunched wires or cables - Category C

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

**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.

**EN 10218-1:** Steel wire and wire products . General . Part 1: Test methods

**EN 10244-2:** Steel wire and wire products . Non-ferrous metallic coatings on steel wire . Part 2: Zinc or zinc alloy coatings

**EN 10257-1:** Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunications cables . Part 1: Land cables

# TECHNICAL DATA

## GENERAL INFORMATION AND BASIC CABLE DESIGN CRITERIA

**Conductor:** Conductors in accordance with the specifications defined in standard IEC 60228 and conductors shall be solid, stranded or flexible plain or metal coated copper in accordance with Class 1, 2 or 5 of HD 383 in the range of 0,5 mm<sup>2</sup> to 2,5 mm. For finished multi-pair, multi-triple and multi-quad cables the maximum resistance of HD 383 shall be increased by 2 %.

**Insulation:** The insulating material shall be applied to comply with the requirements of EN 50288-1. The insulation materials are to be selected according to electrical properties, temperature ratings, flame/fire behaviour and environmental conditions.

Insulating materials have to comply:

- a) PVC EN 50290-2-21
- b) Polyethylene EN 50290-2-23
- c) Polypropylene EN 50290-2-25
- d) Halogen free flame retardant compound EN 50290-2-26
- e) Cross-linked polyethylene EN 50290-2-29

**Cabling elements:** Instrumentation cables can be laid-up in cores, pairs, triples, quads. The lay length of a pair, triple or quad shall not exceed 100 mm for cables with conductor cross section  $\leq 1,5 \text{ mm}^2$ , nor 150 mm for cables with conductor cross-section  $2,5 \text{ mm}^2$ .

**Screening:** Screens are mainly used in instrumentation cables to prevent or reduce possible interference in cables that can be caused by Cross-talk from adjacent pairs or triples or interference induced by external source like electrical equipment, rotating machinery, power lines or other power cables.

Screening can be individually and / or overall screening.

Screening elements can be:

- Aluminium laminated polyester tape in contact with a tinned copper drain wire
- Braiding of tinned copper wires or plain copper wires
- Combination of aluminium laminated polyester tape and braiding of tinned copper wires
- Copper tape

**Cable make-up:** The cable elements shall be assembled together in concentric layers or in unit construction to form the cable core.

Moisture barriers: The moisture barrier materials can be

- Water swellable tapes
- Cords
- Swellable non-toxic powder
- Petro-jelly filling compound
- Laminated sheathings consisting of longitudinal overlapped metallic foil

**Inner sheath material:** When an additional inner sheath is applied under a metallic sheath or armouring it should comply with the requirements of EN 50288-1:

Inner sheath materials have to comply:

- a) PVC to EN 50290-2-22;
- b) Polyethylene to EN 50290-2-24;
- c) Halogen free flame retardant compound to EN 50290-2-27

# TECHNICAL DATA

**Chemical protection:** Used mainly for protection against aggressive petrochemicals. Due to environmental regulations we prefer to use new developed multi-layer sheathing consisting of AL/HDPE/PA layers - aluminium tape and high density polyethylene HDPE sheath with a covering of polyamide PA (Nylon)- instead of Lead Sheath The multi-layer sheath cables have smaller diameter and lighter than the lead sheath cables and offers the advantage of easy handling and installation compare to Lead Sheath.

**Armouring:** Metallic armour are used when cables have to be installed direct buried, or if mechanical protection, protection against rodent, protection against accidental damages are required.

Armouring shall be done by

- R / SWA - Single layer of galvanized steel wires, coverage min. 90%.
- B / STA - Single or double layer of steel or brass tape
- Q / SWB - Metal braiding

**Outer sheath material:** Outer sheath material has to comply with the requirements of EN 50288-1. Outer sheath material should be selected according to climatic conditions, like moisture, temperature ratings (arctic, cold, high temperatures), flame behaviour, installation and connection methods, environmental conditions, chemicals, UV, sunlight, oil resistant, direct burials, anti-rodent or termite.

Outer sheath materials have to comply:

- a) PVC to EN 50290-2-22;
- b) Polyethylene to EN 50290-2-24;
- c) Halogen free flame retardant compound to EN 50290-2-27

Outer sheath colours:

Black: UV resistant and/or non-intrinsically safe cables and circuits

Blue: For intrinsically safe cables and circuits

Red or Orange: For fire resistance cables

Grey: For indoor applications

**Flame retardant:** Flame retardant cables must be self-extinguishing when the source of flame dies out. The cables are tested according to IEC 60332-3-24 Cat C. Single, earth and bonding wires shall withstand the test specified in IEC 60332-1-2.

**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. Fire resistant cables are tested in accordance with IEC 60331-21, 31 and IEC 60331-1 or 2.

**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:** Oil resistant cables has to meets the criteria according to IEC 60811-2-1 for oil resistance to ASTM No.2 oil, 4 hours, 70 °C and ICEA S-82-552

**UV resistance:** Halogen free cables have been tested and pass the requirements for UV resistivity and meet the criteria written in UL 1581 section 1200 and ISO 4892-2

**Hydrocarbon resistance:** Hydrocarbon resistant cables has to meets the criteria according to UIC 895OR

**Minimum installation temperature:** -5 °C for PVC cables, -15 °C for LSZH cables

# TECHNICAL DATA

## CODING OF INSTRUMENTATION CABLES

### Cable Type

RE- Instrumentation and Instrumentation Control Cable resp.  
RT- Thermocouple Extension or Compensating Cable

### Metal cladding of conductor

-v Copper conductor, tinned

### Insulation materials

Y Polyvinylchloride (PVC)  
Yw Heat resistant Polyvinylchloride (PVCw)  
2Y Polyethylene (PE)  
9Y Polypropylene  
2X Cross-linked Polyethylene (XLPE)  
2G Silicone rubber (SiR)  
3G Ethylene propylene rubber (EPR)

### Screening

(ST) Static screen of Aluminium laminated plastic tape  
C Braid of tinned or untinned copper wires over cable core  
(St)C Aluminium laminated polyester tape with brading of tinned copper wires  
(L) Longitudinally applied Aluminium foil, one or both sides plastic coated  
K / CuB Wrapping of copper foils

PiMF Pair in Metal Foil

TiMF Triple in Metal Foil

QIMF Quad in Metal Foil

(C) Braid of tinned or untinned copper wires over single cabling element

### Chemical protection

M Sheath of lead

Mz Sheath of lead alloy

(L)2Y4Y Multi-layer consisting of AL/HDPE/PA

### Armour

R / SWA Galvanized round steel wires

FG / SFA Galvanized flat steel wires with galvanized steel tape

B / STA Double layer of galvanized steel tapes

Q / SWB Braid of galvanized round steel wires

### Inner and outer sheath materials

Y Polyvinylchloride (PVC)  
Yw Heat resistant Polyvinylchloride (PVCw)  
Yv Polyvinylchloride(PVC) of increased thickness  
Yö Oil resistant PVC  
H Halogen-free, flame retardant (LSZH)  
Hö Oil resistant LSZH  
Hx Cross-linked halogen-free, flame retardant LSZH  
4Y Polyamide (Nylon-PA)  
11Y Thermoplastic polyurethane (TPU)

### Other properties

..CI Circuit Integrity (Fire resistant)  
-fl Flame retardant; requirements for IEC 60332-3-24 (cat.C)  
F Cable core petro-jelly filled  
-AR Anti rodent type  
-AT Anti termit type  
UV UV resistant

# TECHNICAL DATA

## Electrical test

Parameter	test method	Requirement	
Conductor resistance	EN 50289-1-2	HD 383 for multicore cables and maximum shall be increased by 2% for multi-pair, multi-triple and multi-quad cables.	
Conductor resistance unbalance	EN 50289-1-2	N/A	
Dialectric strength	EN 50289-1-3	Duration 1 minute For 90 V rating $\geq 0,75 \text{ kV}_{ac}$ or $\geq 1,5 \text{ kV}_{ac}$ For 300 V rating $\geq 1,0 \text{ kV}_{ac}$ or $\geq 2,0 \text{ kV}_{ac}$ For 500 V rating $\geq 2,0 \text{ kV}_{ac}$ or $\geq 3,0 \text{ kV}_{ac}$	
Insulation resistance	EN 50289-1-4	Material	Resistance $M\Omega/km$
		PVC	10
		Polyethylene	1.000
		Polypropolene	1.000
		HFFR	10
XPLE	1.000		
Mutual capacitance	EN 50289-1-5	Polyolefin	< 150 nf/km
		Others	< 250 nf/km
Capasitance Unbalance (pairs/quads)	EN 50289-1-5	Polyolefin	500 pf/500 m
Inductance	EN 50289-1-12	Only to be used for L7R	
Inductance to resistance ratio (L/R)	EN 50289-1-2	< 25 $\mu H/\Omega$ for up to 1 mm <sup>2</sup> < 40 $\mu H/\Omega$ for 1,5 mm <sup>2</sup> < 60 $\mu H/\Omega$ for 2,5 mm <sup>2</sup>	

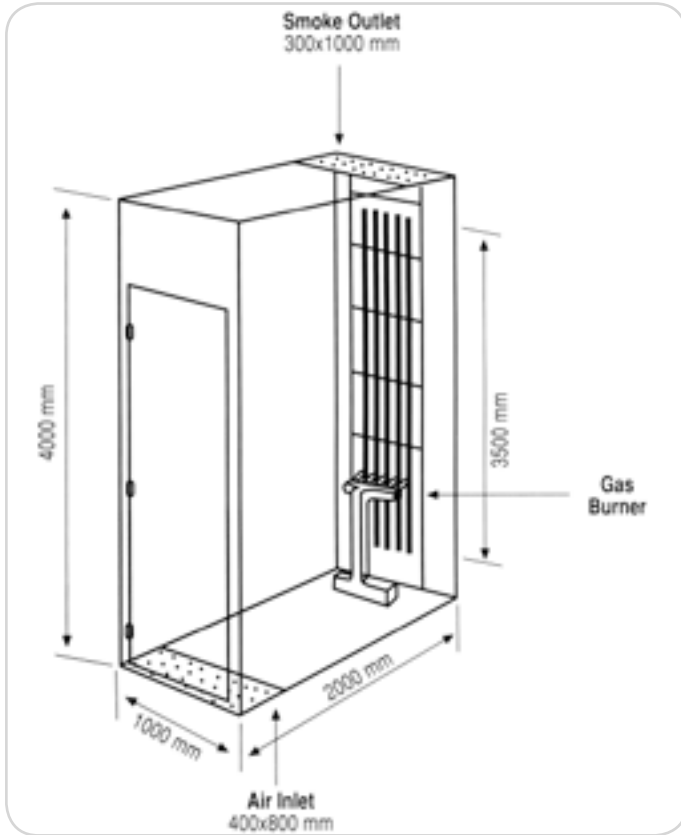
## Mechanical tests

Parameter	test method	Requirement
Conductor relongation at break	EN 50289-3-2	> 10%
Shrinkage of insulation	EN 50289-3-4	EN 50288-1
Crush resistance of the cable	EN 50289-3-5	N/A
Impact resistance of the cable	EN 50289-3-6	N/A
Abrasion resistance of the sheath marking	EN 50289-3-8	N/A
Simultane installation testing of the cable	EN 50289-3-7	N/A
Tensile performance of the cable	EN 50289-3-16	N/A

# TECHNICAL DATA

## TESTS ON ELECTRIC CABLES UNDER FIRE CONDITIONS

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



### Flame application time

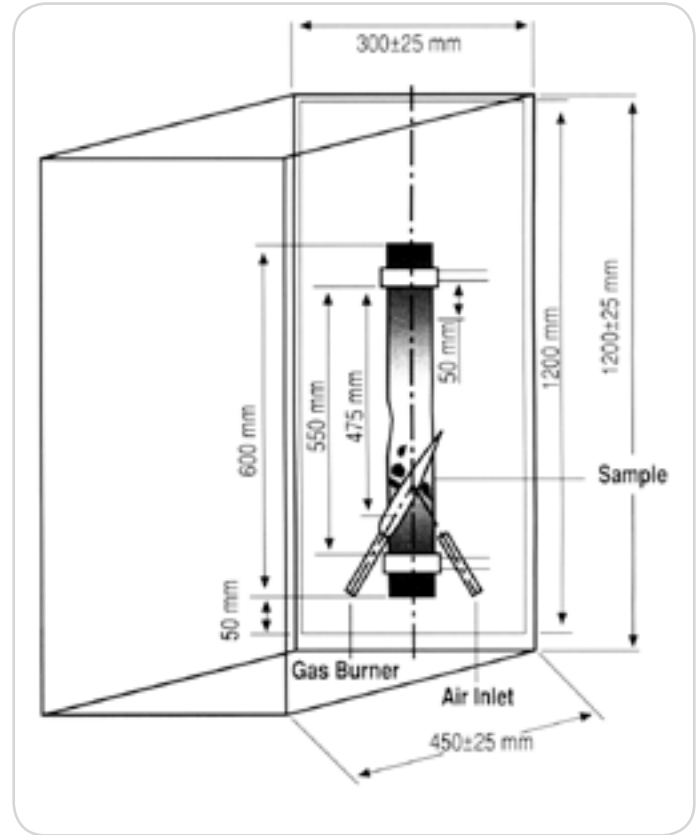
Required volume of combustible material  
per 1 m of cable bunch (lt) : V

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 °C and 40 °C. The temperature inside of the chamber should be 23±5 °C before the test

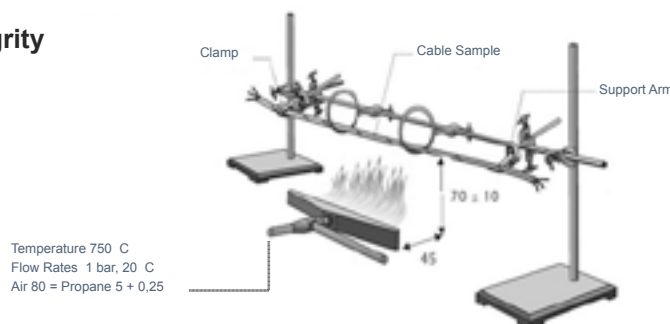
**IEC 60332/1** Fire test on a vertical laid single cable. Test chamber



### Flame application time

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

## IEC 60331 - 21 Fire Test for circuit integrity



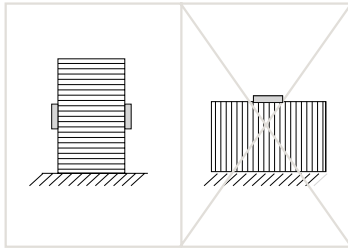
Temperature 750 °C  
Flow Rates 1 bar, 20 °C  
Air 80 = Propane 5 + 0,25



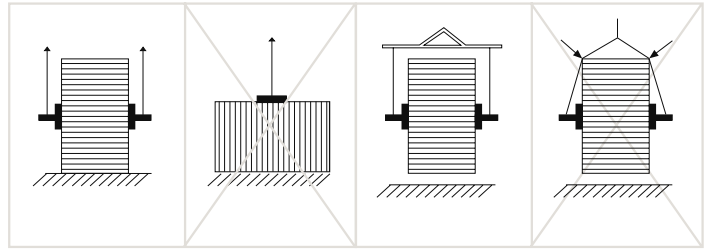
# TECHNICAL DATA

## Cables and Drums User Guide Drums Handling

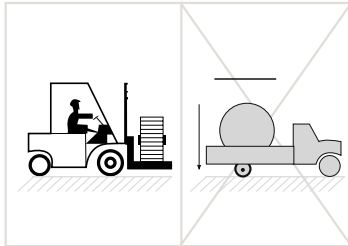
### 1.1.Position of Drums



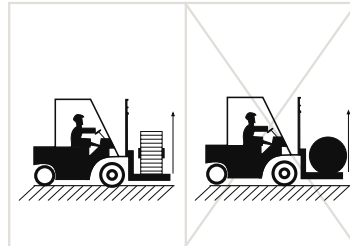
### 1.2.Loading



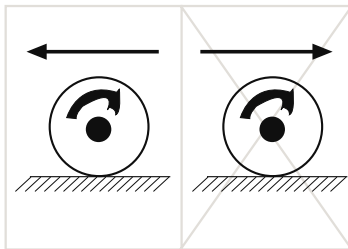
### 1.3.Unloading



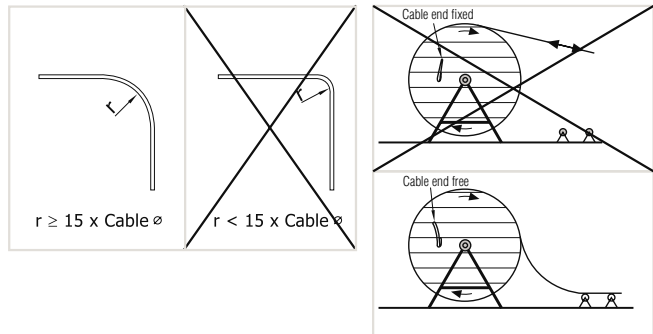
### 1.4.Handling by forklift



### 1.5.Rolling

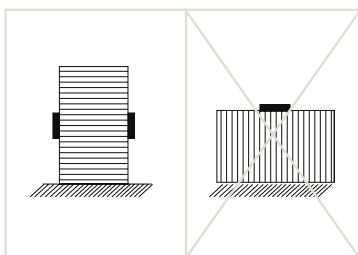


### 1.6.Paying-off the Cable

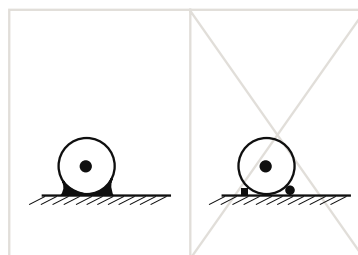


## Transport Requirements

### 2.1.Position of the Drums

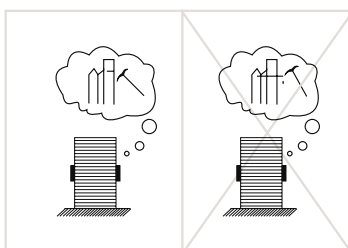


### 2.2.Fastening Drums

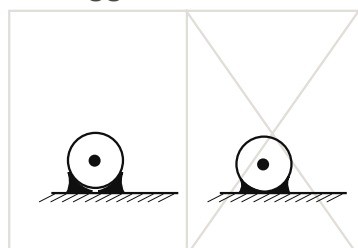


## Cables and Drums User Guide

### 2.3.Use of nails

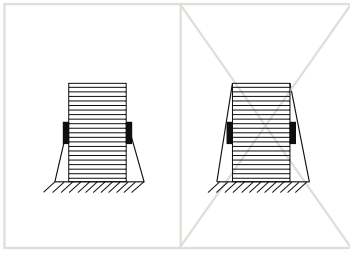


### 2.4.Bigger Drums

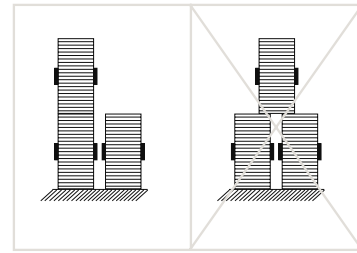


# TECHNICAL DATA

## 2.5. Binding of the Drums

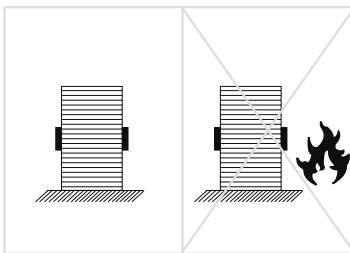


## 2.6. Multiple Drum Storage

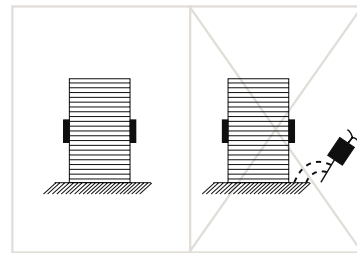


## Storage Requirements

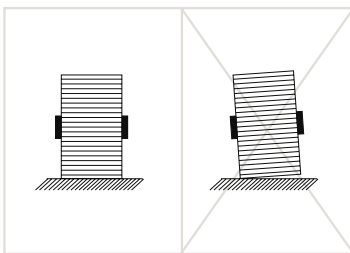
### 3.1. Do not store near heat sources



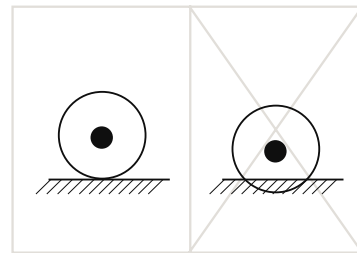
### 3.2. Do not store on vibrating surfaces. (Ship engine room etc.)



### 3.3. Do not store on irregular surfaces.



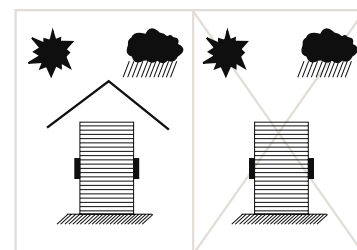
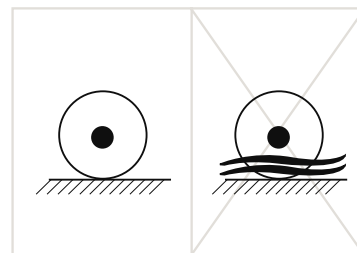
### 3.4. Do not store on soft surfaces



## 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.







**OFFSHORE  
CABLES**



**AIRPORT  
CABLES**



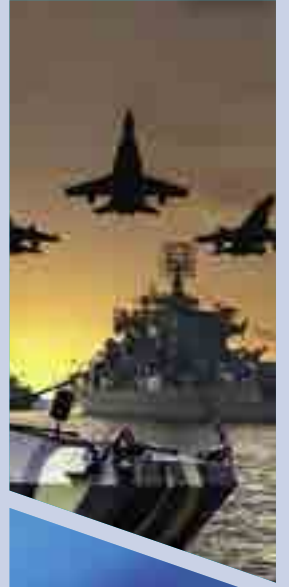
**CRANE  
CABLES**



**MINING  
CABLES**



**DEFENSE  
INDUSTRY  
CABLES**



**MARINE  
CABLES**

**RAILWAY  
CABLES**

**INDUSTRIAL  
CABLES**

**TUNNELLING  
CABLES**

**INSTRUMENTATION  
CABLES**

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