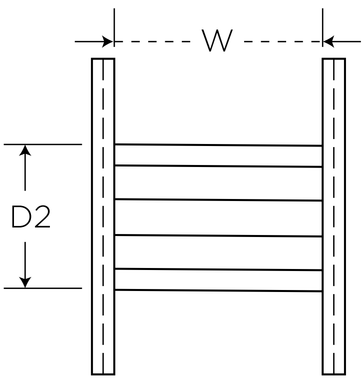
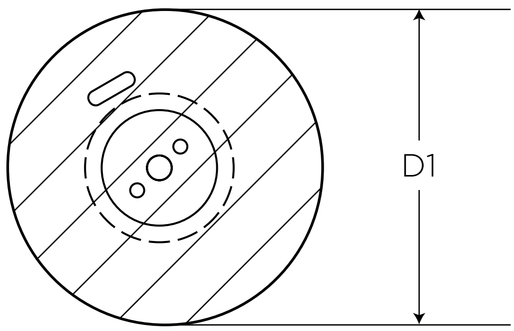
HANDLING AND INSTALLATION INSTRUCTIONS

Drum Capacity

Drum* / Cable Diameter	D1=1400mm W=800 mm D2=600 mm w=160 kg	D1=1600mm W=1000 mm D2=1000mm w=220 kg	D1=1800mm W=1000 mm D2=1000mm w=350 kg	D1=2000mm W=1000 mm D2=1000mm w=400 kg	D1=2200mm W=1200 mm D2=1200mm w=500 kg	D1=2400mm W=1200mm D2=1200mm w=600 kg	D1=2600mm W=1200mm D2=1300mm w=700 kg	D1=2800mm W=1200 mm D2=1600mm w=800 kg	D1=3000mm W=1400 mm D2=1600mm w=900 kg
Approximate Capacity in Meters									
10	9450	11500							
5	4000	4500							
0	2200	2500	3800						
5	1350	1700	2400	3300					
30	900	1200	1500	2200					
35	650	900	1100	1500	2200				
40	480	580	880	1200	1600	2100			
45			650	900	1200	1600	1900	2000	
50				700	1000	1300	1500	1600	
55				550	800	1000	1200	1300	1900
60					650	850	1000	1080	1600
65					550	700	850	910	1300
70					450	600	700	760	1100
75						500	600	650	950
80						450	540	560	830
85							450	480	730
90								420	640
95								370	560
100									500
105									440
110									390

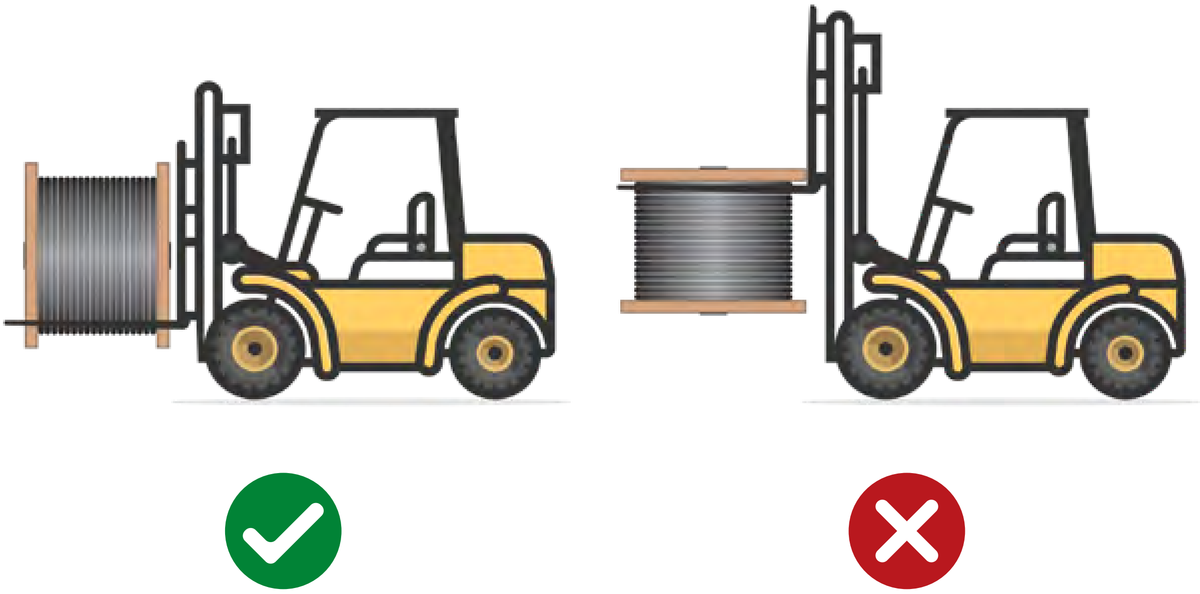
*D1: Flange diameter
*W: Inner width
*D2: Barrel diameter
*w: Approximate empty weight



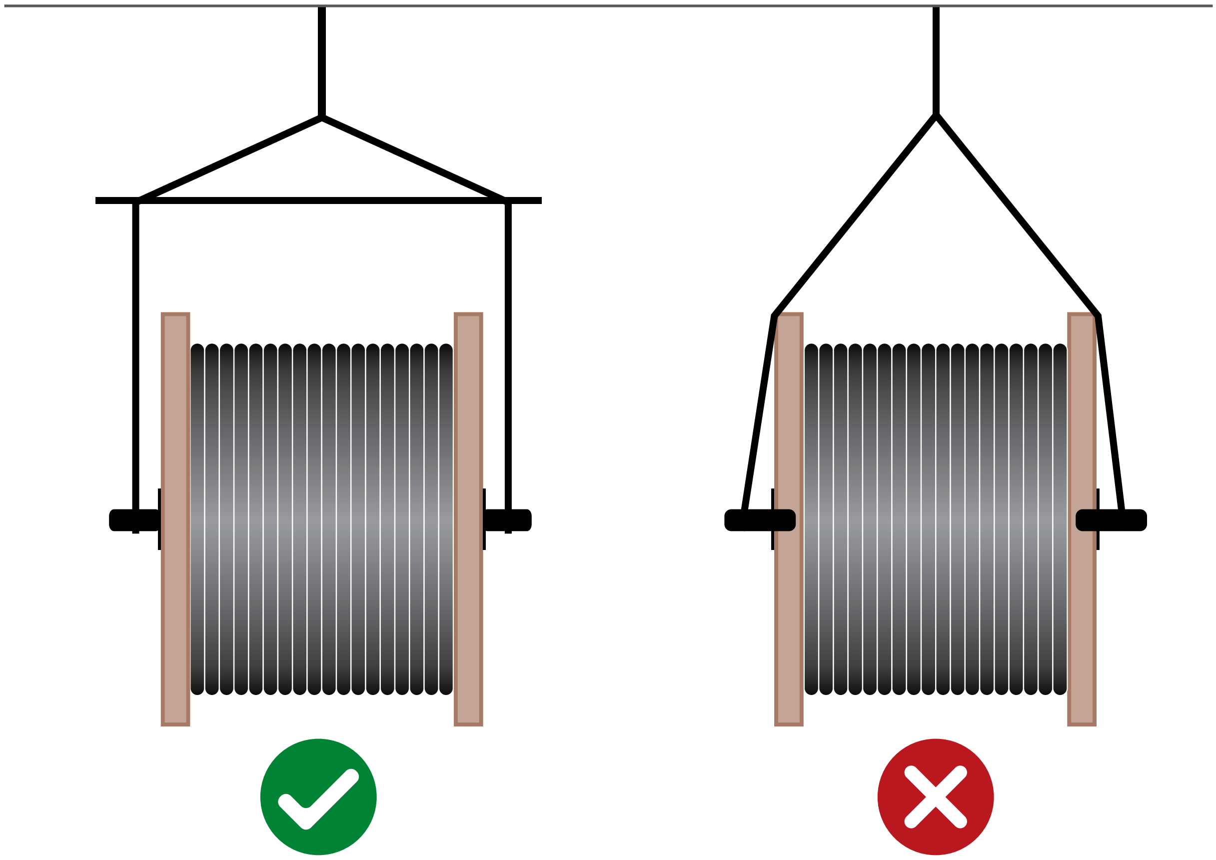


HANDLING AND INSTALLATION INSTRUCTIONS

Drum Handling



Do not allow forks to touch cable or reel wrap.



Use a shaft through the center of the drum and a spreader beam.

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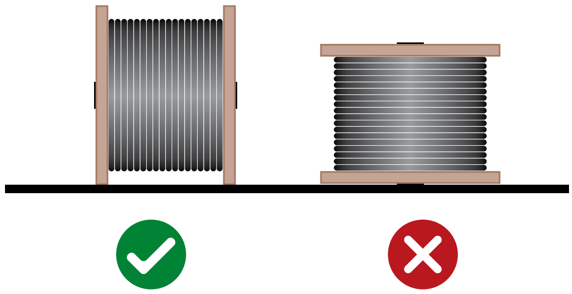
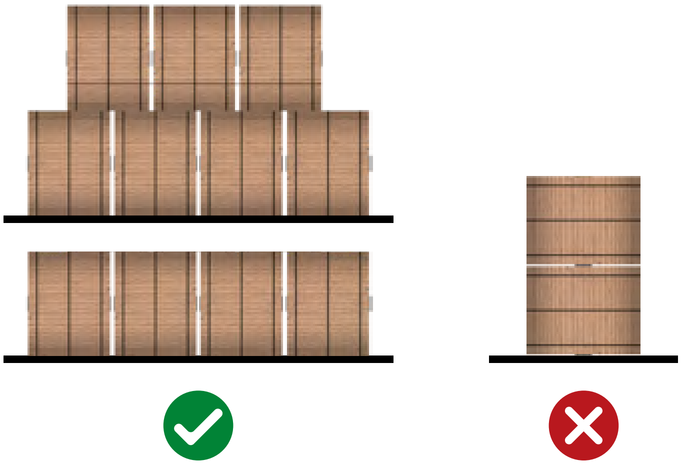
HANDLING AND INSTALLATION INSTRUCTIONS

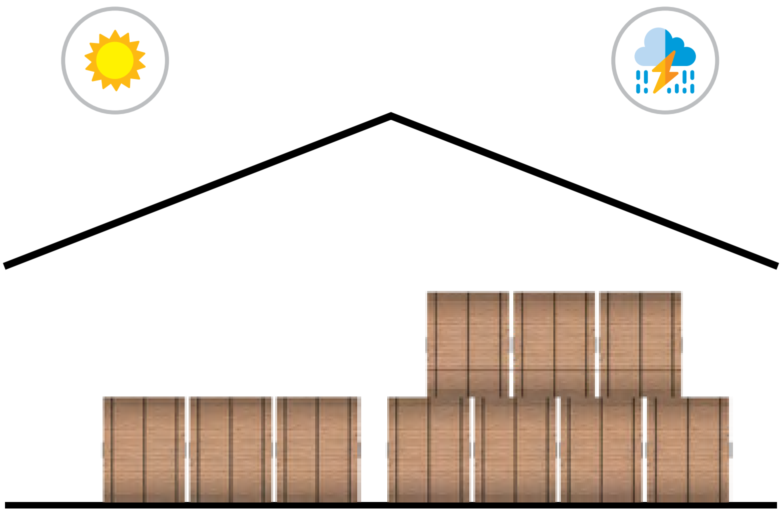
Drum Storage



Store drums on a level and firm surface on flange edges
(not with the flange flat on the ground).



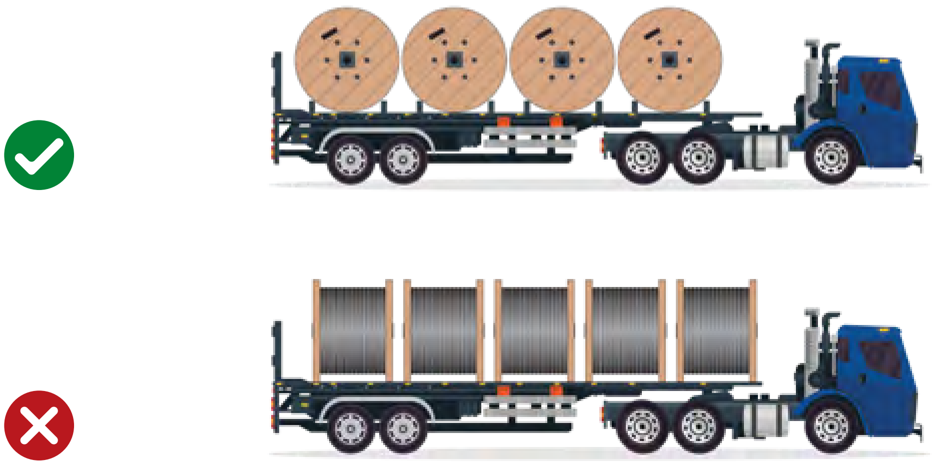
Stack the completely wrapped drums on their flanges. Stacking is allowed only for the drums whose flange diameter is 1250 mm or less. Do not store drums on flat flanges.



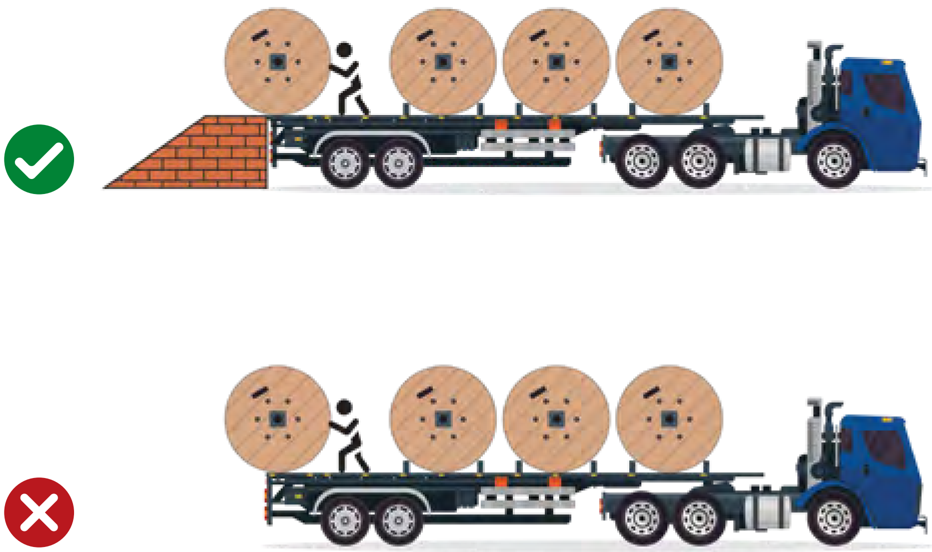
Store drums in a completely safe place to avoid environmental factors.

HANDLING AND INSTALLATION INSTRUCTIONS

Drum Loading and Unloading



Place the drums parallel to the lorry axis.

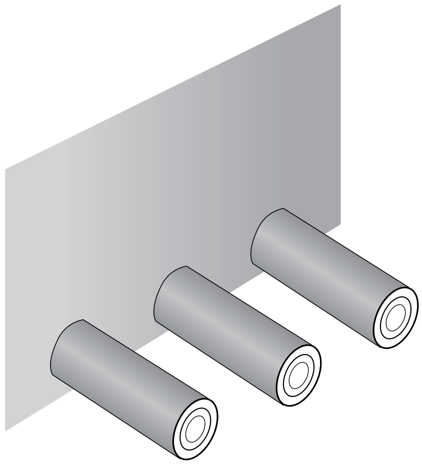


Use forklift or roll the drum from truck on to receiving platform.

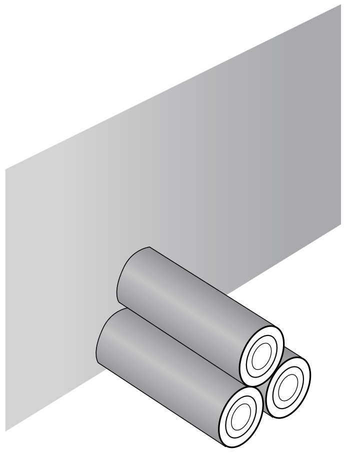
HANDLING AND INSTALLATION INSTRUCTIONS

Cable Installation Instructions

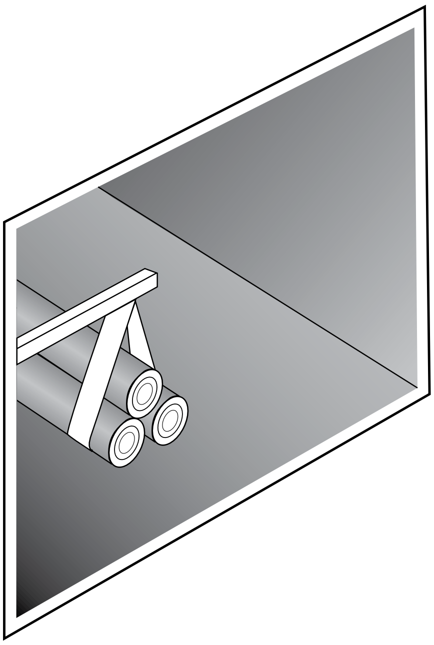
1- Cable Laying Formation:



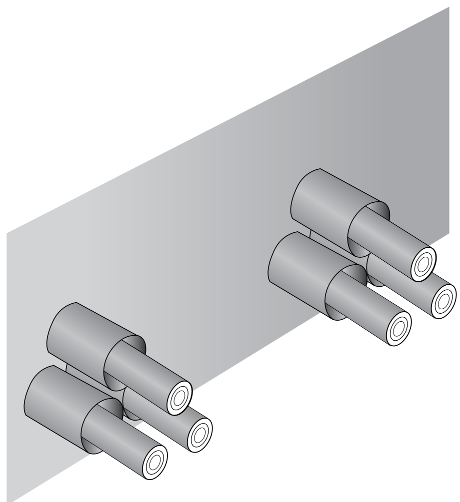
Cables directly buried in flat formation



Cables directly buried in trefoil formation



Cables in the air inside a gallery in touching trefoil formation



Cables buried in plastic ducts in tight trefoil formation

HANDLING AND INSTALLATION INSTRUCTIONS

2- Cable Pulling & Laying:

Cable pulling is a critical process in the installation of power cables. It must be ensured that they are properly routed and secured during laying in ground/ducts & within various infrastructure setups such as buildings, tunnels, and bridges. This process should be done by skilled, trained & certified people who are familiar with cable installation. Although there are many criteria that should be adopted for successful installation, two of the most important is the bending radius of cables during laying & the pulling force allowed to avoid cable damage. While the pulling force depends on the type of conductor, the bending radius depends on the cable construction & the remaining cable layers.

Tools and Equipment:

- **Cable Pulling Winch (Mechanical Drive):**

  Cable pulling winches with mechanical drives are pivotal tools for controlled cable installation, featuring variable speed and directional control for precise operation. They excel in long cable runs, conduit installations, trenching, and vertical pulling tasks, making them versatile for various infrastructure projects. Considerations include selecting the appropriate capacity winch, ensuring compatibility with cable types, and prioritizing operator safety through proper training and adherence to safety protocols.

- **Cable Feeders for Reels:**

  Using cable feeders for reels in cable pulling operations, ensuring smooth and consistent feeding of cables onto pulling equipment. They assist in maintaining controlled tension, preventing tangles, twists, and potential damage to the cable during installation. Manual and motorized variants offer flexibility, catering to different pulling requirements, while adjustable tension control allows fine-tuning for specific cable types and environments.

- **Cable Rollers:**

  Cable rollers guide cables during pulling operations, minimize friction and preserve the integrity of the cable's outer sheath. They come in various types, including single, double, corner, and adjustable rollers, catering to different installation needs. Key considerations include proper placement, compatibility with cable types, equipment and regular maintenance to ensure optimal performance of the rollers.

- **Cable Laying by Hand:**

  Laying cables by hand involves the manual handling, routing, and securing of cables without specialized equipment. While labor-intensive, it is suitable for small-scale installations, temporary setups, or locations where access to machinery is limited. Careful planning, attention to detail, and adherence to safety protocols are essential for successful manual cable laying operations.

HANDLING AND INSTALLATION INSTRUCTIONS

Cable Installation Instructions

3- Minimum Bending Radius During Installation:

Type of Screen, Cores, and Outer Covering	Minimum Bending Radius During Installation (Expressed as Multiple of The Cable Overall Diameter D)
For Low Voltage Cables	
PVC outer covering	15 X D
LLDPE/HDPE outer covering	20 X D
For Medium and High Voltage Cables	
Copper wire screen, or lead sheathed, three core	16 X D
Copper wire screen, single core	20 X D
Lead sheath, single core	24 X D
Aluminium foil laminated, single core	24 X D
MDPE/HDPE Outer Covering	20 X D

4- Maximum Permissible Pulling Force:

To ensure the mechanical integrity of the cables during installation, it's important to ensure that the tensile force applied during pulling from conductor is compatible with the cables' mechanical strength.

$$P = K.A$$

** P: Maximum pulling force (N)

** K: Maximum stress (N/mm^2)

$K = 50\ N/mm^2$ for Copper conductors

$K = 30\ N/mm^2$ for Aluminium conductors

** A: Total cross-sectional area of conductor (mm^2)

In case of multicore cables, the cross-sectional area of all cores should be considered.

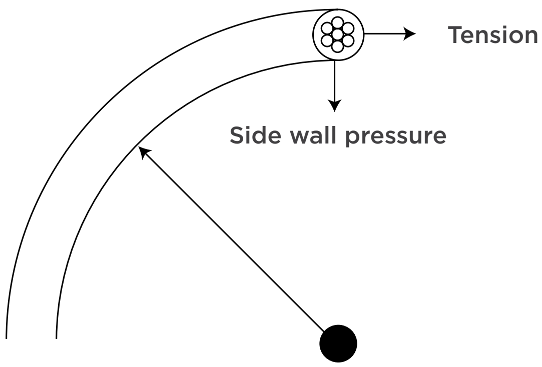
Side wall pressure:

Sidewall pressure refers to the radial force exerted on a cable's insulation and sheath at a bend point while under tension.

Sidewall pressure to cable =

$$\frac{\text{Tension (daN)}}{\text{Bending radius (m)}}$$

Permissible maximum sidewall pressure to the cable at bending point during installation is ≤ 1000 daN/m.



HANDLING AND INSTALLATION INSTRUCTIONS

Cable Installation Instructions

Purpose of Cable Sheath Bonding

Medium and High voltage power cables are provided with an outer concentric conductor in the form of a metal screen and/or a metal sheath which surrounds the main conductor and insulation layer. Metal screens and metal sheaths are collectively referred to as the sheath. The sheath also includes any metallic armor layer(s) in the cable. The purposes of a cable metal sheath include to provide fault current return path, return path for the induced capacitive charge currents, earth potential for human safety, and moisture barrier for cable insulation.

Sheath bonding arrangements are implemented to reduce sheath current losses. Whilst the bonding arrangements come with an additional cost for equipment and maintenance, they will often result in considerably smaller cable sizes to be used for supplying the same load currents. The metal sheath bonding arrangement selected for high-voltage cable systems has the second highest impact on cable current ratings, second only to the external thermal resistance (the installed environment) to the cables.

A sheath bonding system is used for protecting the insulation of various cable system components during normal operation as well as from transient overvoltage from lightning, switching and fault surges. Moreover, the sheath bonding arrangement is also important from a safety point of view.

In the following we explain the following types: both end bonding, single point bonding, and cross-bonding.

** Sectionized cross-bonding is the most common special bonding arrangement for HV and EHV transmission lines except if the line length is short then single-point bonding is mostly used.

Losses in The Cable Sheath

The magnetic field that is generated from the current flow in the main conductors of cables creates a “transformer” effect that induces a current in the sheath. Due to these induced currents in the sheath two types of losses can occur; circulating current losses and eddy current losses. The presence of current losses in the sheath causes additional heating inside the cable resulting in reduced current-carrying capacity of the cable’s conductor.

The eddy currents circulate radially and longitudinally of the cable sheaths, and are generated on similar principles of skin and proximity effects. The eddy currents are generally of smaller magnitude compared with circulating current and they are generated in the cable sheath irrespective of the bonding system of single core cables.

If circulating currents are present in the sheath (depending on the sheath bonding arrangement) their current magnitude is generally much greater than that of the eddy currents.

Circulating currents occur in the sheath for solid bonding of single core cables and multicore cables where an individual sheath surrounds each conductor core. For sheaths that are single-point or cross-bonded there are no circulating currents, however, eddy current losses still occur.

HANDLING AND INSTALLATION INSTRUCTIONS

Both End Bonding

Method

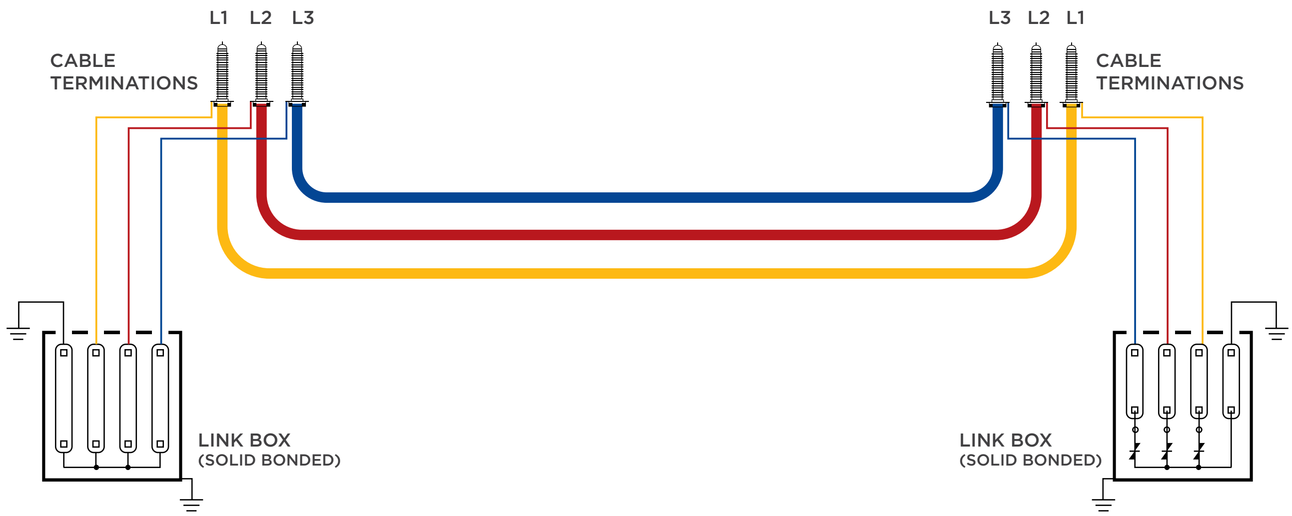
With this bonding arrangement, the sheaths, screens, and armour (if present) are solidly earthed at both ends of the cable system.

Advantages

- Simple and low-cost solution.
- External magnetic fields around the cable are minimized due to opposing sheath currents compared to conductor currents.
- Minimal maintenance is required.
- The sheath's voltage is maintained at earth's potential at all points.

Disadvantages

- The cable conductors' current induces circulating currents in the sheaths, up to 80% of the conductor current.
- Heat generated by joule losses from circulating current flow can lead to additional heating, necessitating larger cable sizes for solid bonding arrangements and de-rating the cable system.



HANDLING AND INSTALLATION INSTRUCTIONS

Bonding Methods

Single-Point Bonding

Method

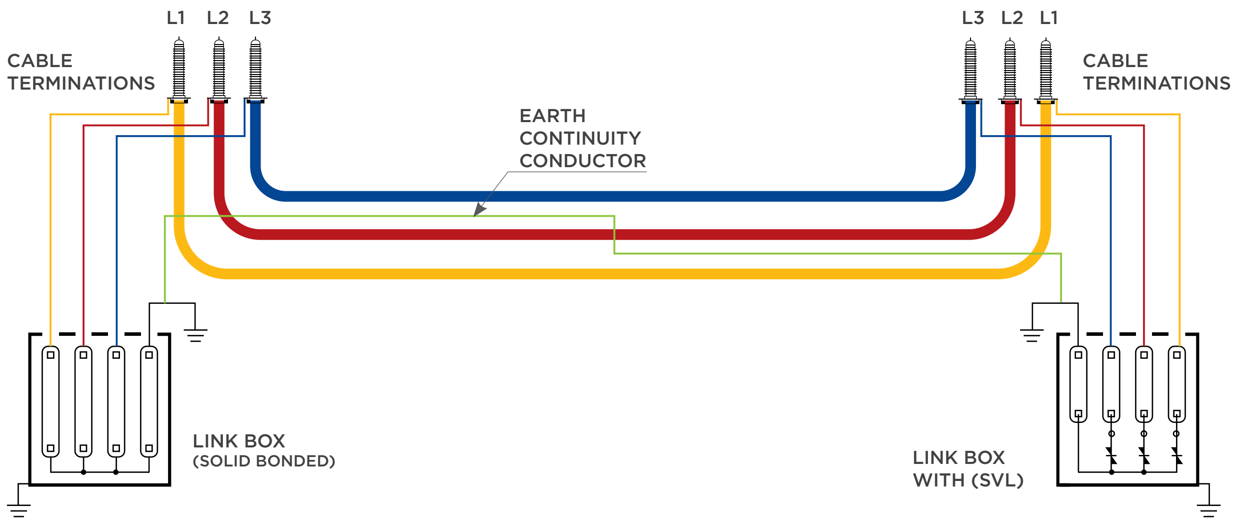
In a single-point bonded cable system the cable sheaths of all three phases are solidly bonded together and earthed at one point only whilst the other end is isolated from ground by SVL (Sheathing Voltage Limiter).

Advantages

- Single-point bonding improves cable current ratings by eliminating induced circulating current losses in the sheath.
- Single-point bonding is cost-effective as it requires only one length of cable.
- Single-point bonding eliminates sheath circulating current losses since there's no continuous closed loop electrical path along the sheaths. However, sheath eddy losses may persist.

Disadvantages

- Voltage along the cable rises with conductor current and length, particularly noticeable in single-core cables due to phase spacing.
- An ECC running parallel to the cables reduces voltage rise but adds significant cost to the system.
- Insulating the sheath at the free end is essential to avoid dangers posed by induced voltages.



HANDLING AND INSTALLATION INSTRUCTIONS

Bonding Methods

Cross-Bonding

Method

Cross-bonding minimizes power loss over cable sheaths by exploiting the vector summation of three phase induced voltages, each 120 degrees out of phase. This reduces the resultant voltage close to zero, significantly reducing undesired current flow and losses. Minor sheath sections are cross-connected to neutralize voltage in three successive sections, forming a major section.

Advantages

- Compared to single-point bonding, a cross-bonded configuration has the advantage of not being length limited.
- Circulating currents are significantly reduced, resulting in lower sheath losses and higher cable current ratings.
- Besides inhibiting sheath currents during the normal balanced load operation, the sheaths do form a continuous path from end to end of the cable circuit and are grounded at both ends. Therefore, during ground faults, sheath currents can flow across the length, thus eliminating the need for a separate ECC.
- Cross-bonded systems save costs by eliminating the need for an ECC and provide more effective screening during earth faults compared to systems with a parallel ECC. This reduces induced voltages in parallel cables, communication lines, pipelines, and fences, making cross-bonded systems preferable to single-point bonded ones.

Disadvantages

- Costly and complicated.
- Cross-bonding sheaths reduces circulating current, but ensuring uniform section length presents a challenge.