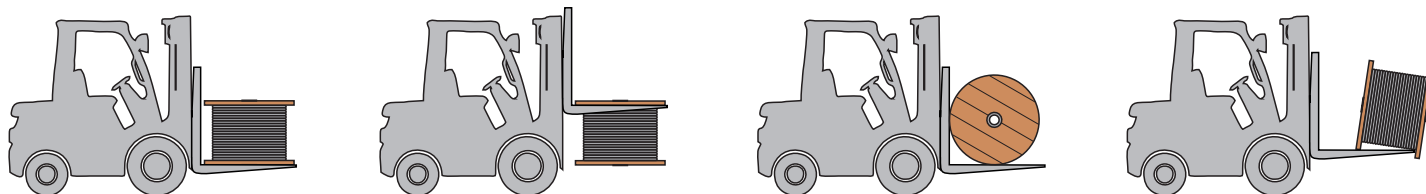


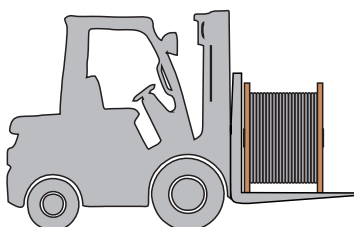
Appendix P. Cables' transportation, storage and handling

P.1 Transportation and storage

Reasonable precautions must be taken in consideration to avoid damage to the cable and injury to people. Lifting and moving operations must be carried out in accordance with the relevant local regulations or codes of practice. Always pay attention to the weight of the drum, the method and direction of rolling and the method of handling and lifting. All reels or drums must be transported on their sides and are not allowed to lie on the flange.

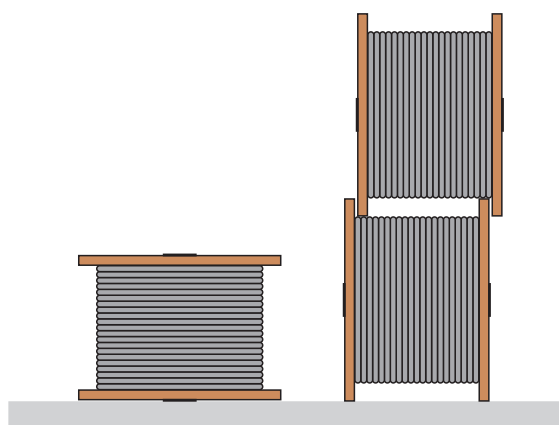


Wrong

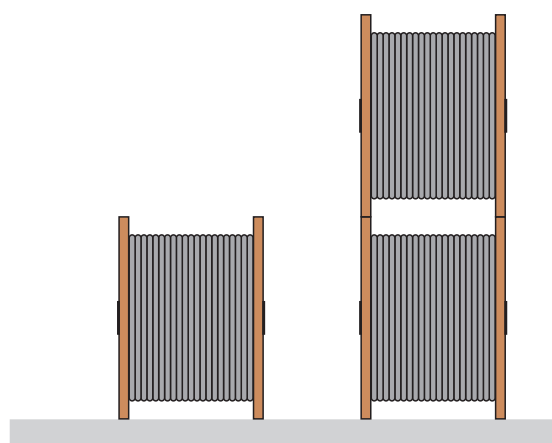


Correct

Cable drums should be stored so that the drum flanges do not contact cable on another drum. Drums should be stored on a level surface, on the flange edges (not with the flange flat on the ground) and restricted from rolling.



Wrong



Correct

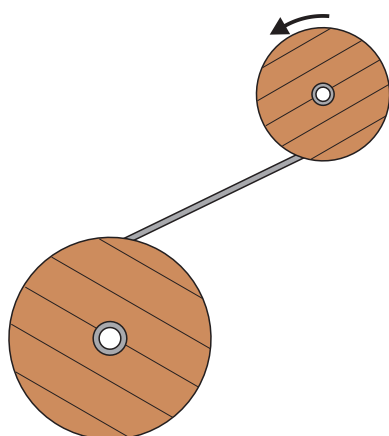
Cables should not be exposed to large temperature fluctuations and wherever possible must be stored indoor. Cables stored in wet location must be protected by sealing the exposed end with heat shrinkable end caps. Cables stored at temperatures below the ones recommended for installation, should not be subject to any mechanical stress, impacts, bending or torsions. Cables should be stored in a dry and frost-free locations. Cables with colored outer jacket should not be stored in direct sunlight to prevent damages and fading of the color. Cables should be protected against direct sun light with suitable protection package such as black plastic lagging. The cables must not be placed in contact with chemicals and corrosive media.

P.2 Handling

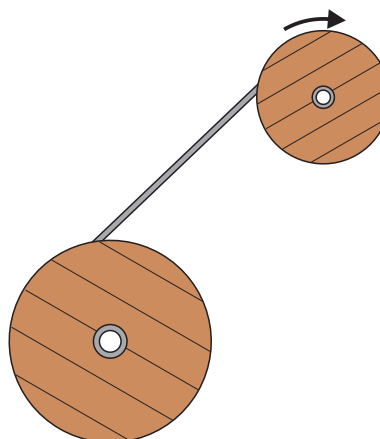
Prior to installation, the cables must be kept in-house storage for at least 24 hours to reach the temperature recommended for installation. Cables should be operated on clean floor without metal or wooden parts, nails, etc. to avoid any damage.

At very cold temperatures the material stiffens and becomes inflexible and irreparable damage can occur. Since the mechanical strain on the cable in its laid form is significantly less than the one during laying and use, the permissible minimum temperature is lower than the temperature valid for the installation period. Unless otherwise specified, minimum laying temperature is -5°C for PVC jacketed cables, -20°C for PE jacketed cables and it is $+5^{\circ}\text{C}$ for winding/unwinding process.

Spooling from the top of one reel to the bottom of the other will induce a twist in the cable. Always maintain direction of cable wraps throughout spooling system. Unless otherwise specified, the maximum tensile stress of the copper conductors during installation should be 50 N/mm^2 which as to be considered as the sum of the static and dynamic stress; residual stress after installation for fixed application should be 10 N/mm^2 . Cables must never be bend to a radius tighter than the minimum bending radius specified in the technical datasheets.

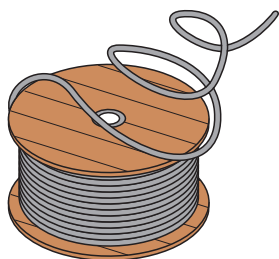


Wrong

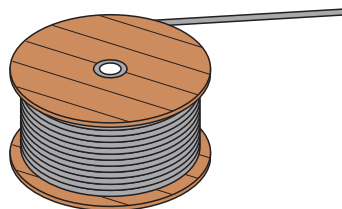


Correct

During unwinding, a straight torsion-free guiding has to be observed and the cable has to be fixed and connected torsion-free. Cables must never be unwound off over the drum flange, this will causes kinks and may results in cable damages.



Wrong



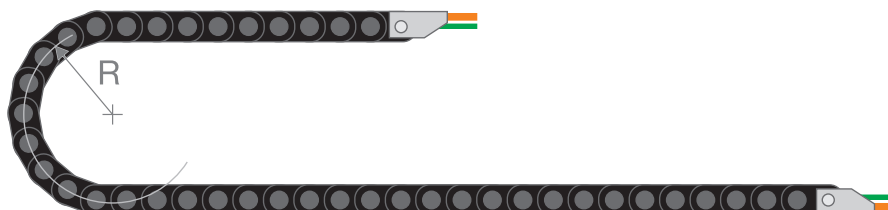
Correct

P.3 Use of cables in drag-chain

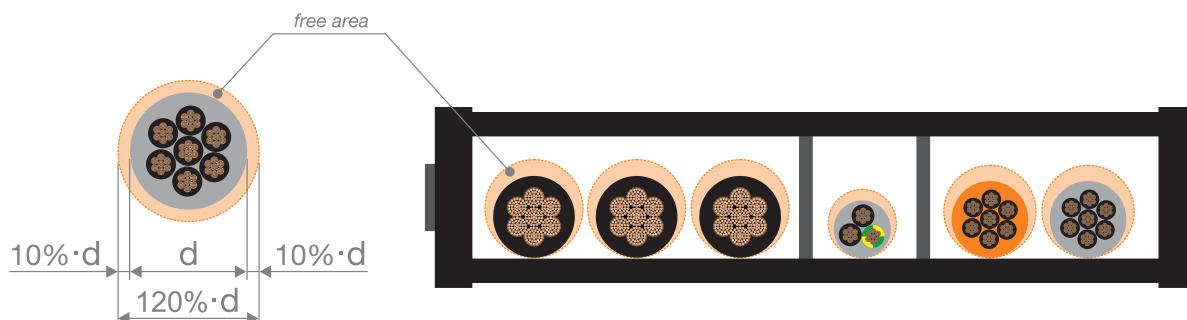
For dynamic applications, cables in drag-chain (also called energy chain, cable track, cable carrier) can be used. A drag-chain is a mechanical system designed to carry, protect and guide power, control, signal cables and hydraulic or pneumatic hoses in dynamic applications to transfer power and signal between two points in relative movement (translation, rotation or both) to each other.

Following instructions are suggested for a proper installation of cables in drag-chain.

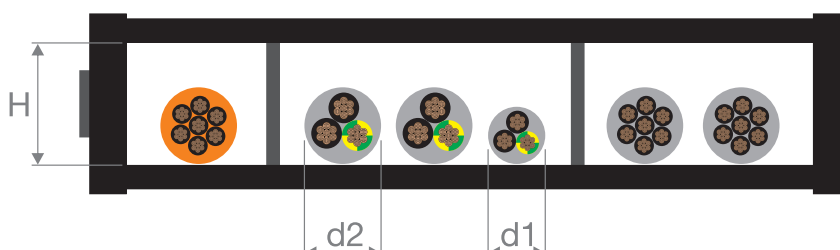
- The cables must be selected extremely carefully. Always use only cables which are suitable for the specific drag-chain application.
- Cables should be stored in closed space and within the temperature range given in the technical datasheet. The cable temperature should not be below +5°C during installation.
- The minimum bending radius R must always be respected. The cable with the largest diameter must be used for dimensioning the minimum bending radius of the drag-chain.



- The total cross-section of the drag-chain should be filled not more than 80%. Allow a free space around the cable of at least 10% of the diameter.



- The cable must not cross another and must not be placed on top of another. Single layer of cables should be preferred over multi-layer arrangement. Dividing bars should be installed between the layers of multi-layer cable arrangement. Cables with different diameters, jacket material or conducting material should be installed separately with dividing bars (separators). If this is not possible verify that the internal space of the drag-chain does not allow cables to be twisted ($H < d1 + d2$).

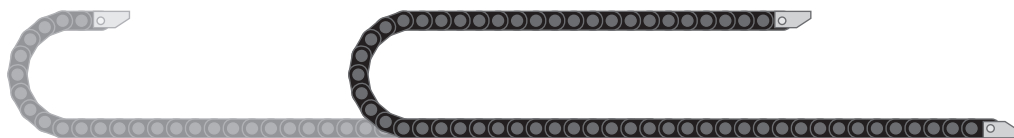


- Cables must be able to move freely also around the bending radius. The cables must never be fixed or tied together in the chain.
- Cables must be laid in drag chains without any inducted torsion (twisting) or load. It is suggested to lay or, better, hang the cables before use in order to release any possible twist.
- Before and after fixing cables, it is suggested to operate the drag-chain for few cycles in order to verify free movements, spaces around the cables and to bring the cables in a neutral position.
- A certain amount of loose cable (reserve) must be guaranteed on both ends of the drag-chain. Avoid keeping the movement up to the utility. Install cable fixation devices (cable clamps, cable ties, fixation profiles) at the moving end and at the fixed point.
- Verify periodically the cables: check overlaps, torsions or stretching. Replace all the cables after failure of a drag-chain.

The drag-chain configurations are depending on the travel distance, the fill weight, the drag-chain type and the applications.

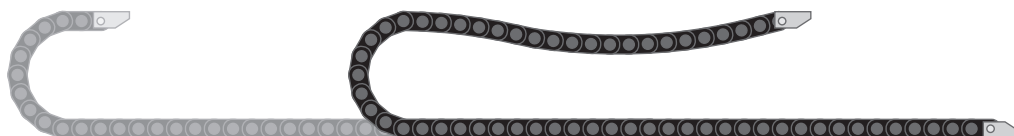
Unsupported (or self-supported).

When the upper run of the drag-chain operates without touching the lower run along the entire travel. This configuration allow higher speed and acceleration and less cable and drag-chain stress, lifetime is longer.



Unsupported with sag (or self-supported with sag).

When the upper run of the drag-chain operates with a sag. This configuration allow longer travel distances but must be operated with lower speed and acceleration and the lifetime is reduced.



Gliding (or sliding).

In the case of long travel lengths, the upper run of the drag-chain glides on its lower run. Beyond the fixed point the drag-chain glides on the sliding surface (support) of the guide channel which is required to prevent the upper run from slipping off the lower run.

