Cable Installation in C-Tracks Manual

Systematic Technology

Content

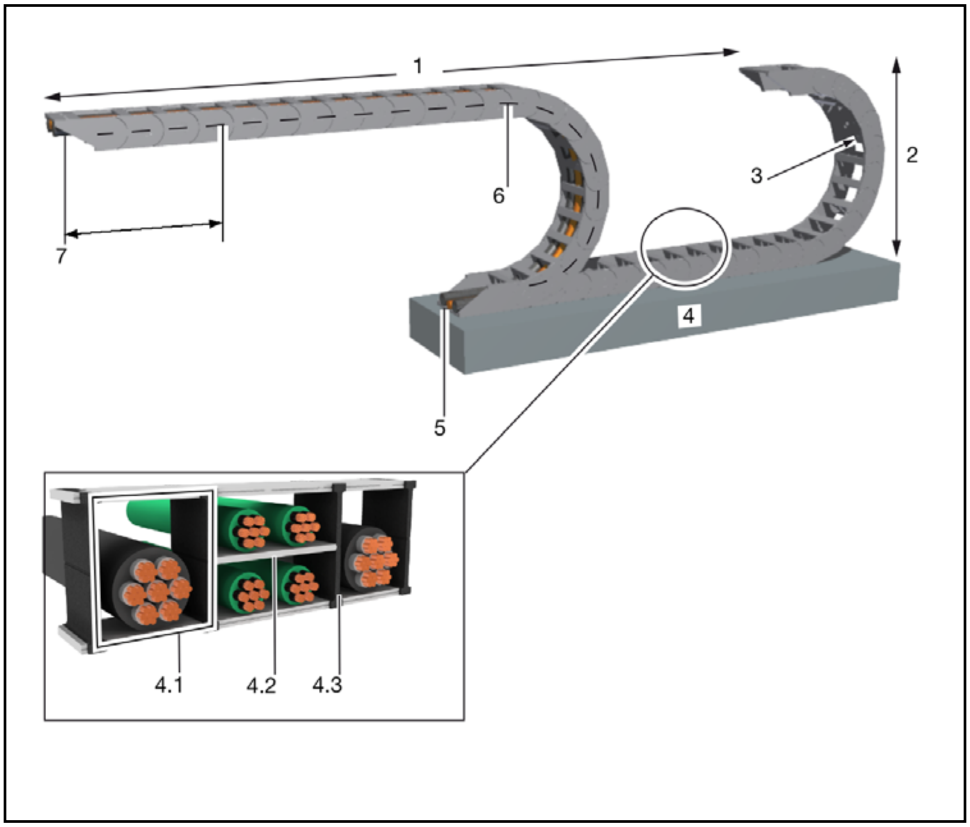
1 General Information

NOTICE **Only cables suitable for continuous moving applications should be used in c-tracks.** Standard control cables are not recommended for use in c-tracks.

- All Lutze Superflex® cable is proven to be compatible with all major brands of C-tracks.
- Superflex® N PVC is designed for moderate flexing in short to medium length C-tracks.
- Superflex® Plus PUR is designed for high performance flexing or longer C-tracks.

NOTICE **High flexing, such as Lutze Superflex® cables require special handling techniques, different from standard control cables.** To ensure the longest possible life span for your cable, it is crucial to follow installation procedures precisely.

2 Overview

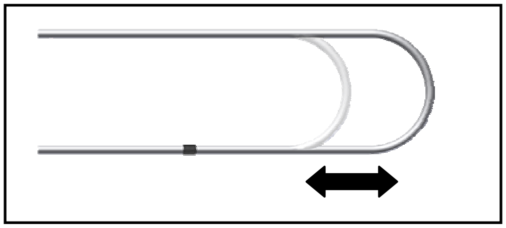


1) Travel Distance
2) Mounting Height
3) Bend Radius
4) C-Track - Element
    4.1) Single Cavity
    4.2) Horizontal Divider
    4.3) Vertical Divider
5) Fixed End
6) Neutral Zone
7) Moving End including Relaxation Zone

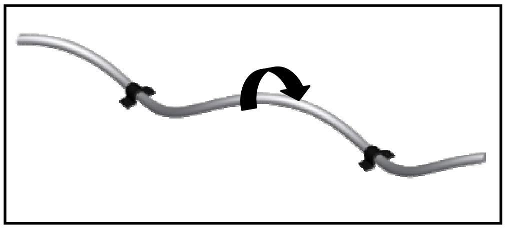
3 Cable Information

There are different kinds of moving applications and it is important to use the right cable for each application to avoid premature failures.

- **Linear (continuous rolling back and forward motion)**
  This is a typical load in c-tracks.

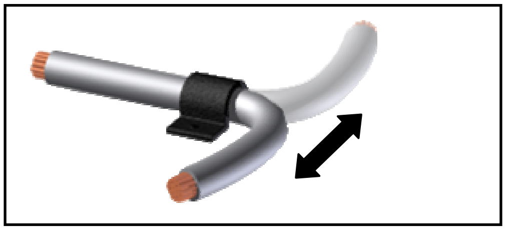


- **Torsion**
  This is a typical load in robotic applications.



NOTICE **The use of Lutze Superflex® cables for torsion load is limited.** Recommended are Robotic cables, such as Lutze Superflex® Robot cables which are especially made for torsion loads.

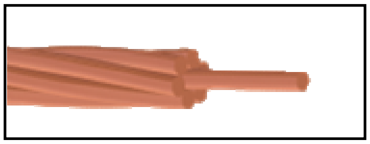
- **Bending**
  This is a typical load which can appear in continuous moving applications as well as in robotic applications.



NOTICE **Do not use standard flexible cables in c-track applications!** The use of a standard flexible cables can cause cork-screwing or knots. It is necessary to use a high flexing cable such as Lutze Superflex® cable.

The difference between flexing and high flexing cables is shown on the next page.

Standard Flexible Cable

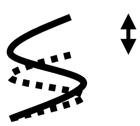


- low numbers of strands per conductor

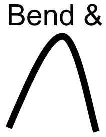
- longer pitch layering
- is designed as a pliable cable for easy routing and installation:

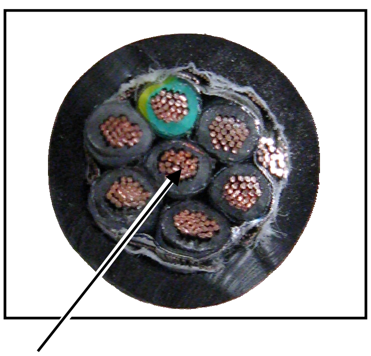
Static:

Periodical Free Flexing:



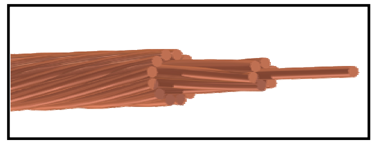
Bend & Route:





- no central core
- mostly PVC as insulation material
- foil shield or braid shield
- jacket material depends on application

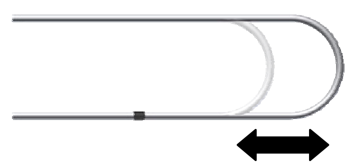
High Flexing Cable – Lutze Superflex®

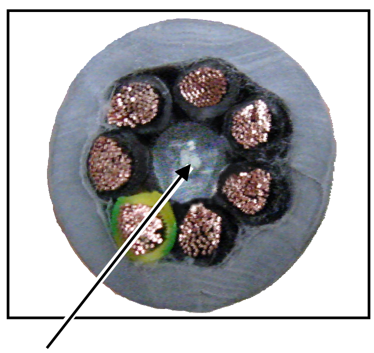


- high numbers of strands per conductor (superfine)

- short pitch layering
- higher quality of materials
- conductors are designed without back twist
- slower and more complex manufacturing process on high- and equipment
- designed for:

Linear Constant Motion:





- central core for single layer construction
- PVC or TPE as insulation material
- tinned copper braid shield
- jacket material is high abrasion resistant such as PUR

3.1 Choosing Cables

In consideration to the c-track dimensions and the operating environment the cable must be chosen. When choosing cables make sure:

- The operating temperature matches the temperature the cable is rated for.

°F

- The cable gauge size is sized correctly to the required amperage in order to assure the maximum heat dissipation.

AWG

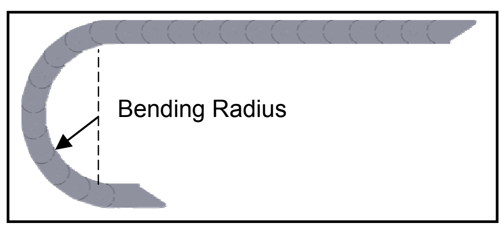
- The speed of the application is not too fast.

m/s

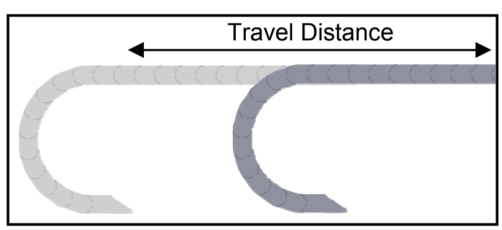
- The acceleration is chosen right (recommended is max. $10 m/s^2$).

m/s^2

- The bending radius of the c-track is big enough (See technical data for each cable).

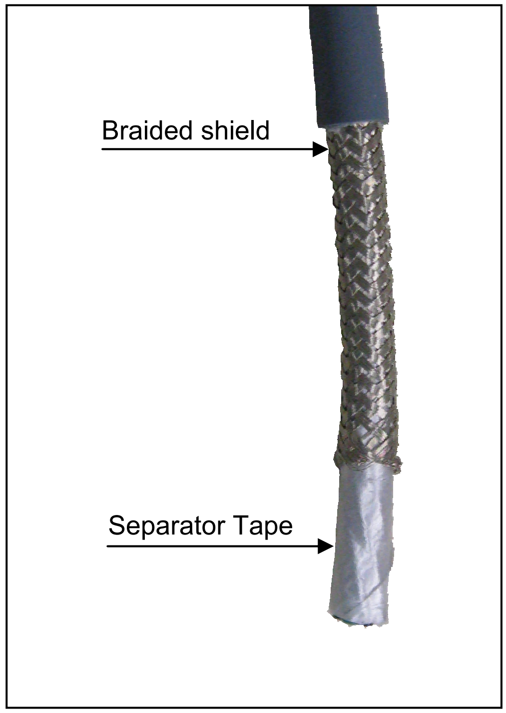


- The longer the travel distance the better the cable must be constructed (We recommend Lutze Superflex® Plus for long c-tracks).

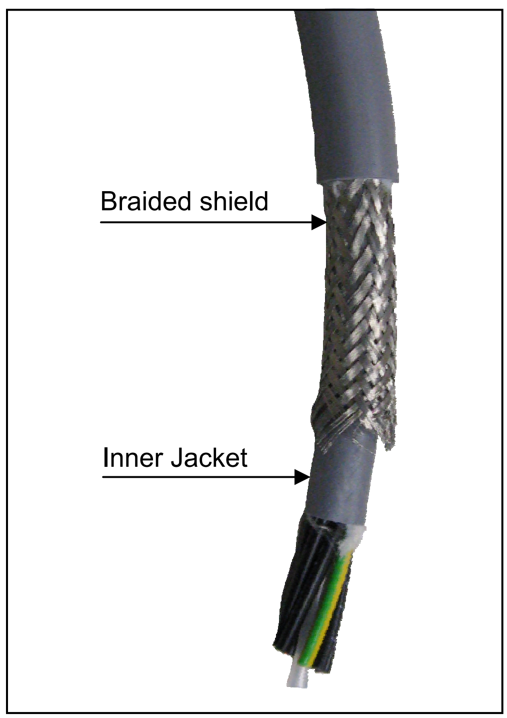


3.1.1 Shielded Cables

- When using shielded cables in c-tracks a cable with a braided shield is recommended. Foil shields can shift and ultimately break apart.
  Also drain wires are not recommended. The shield has to be separated from the cable core.



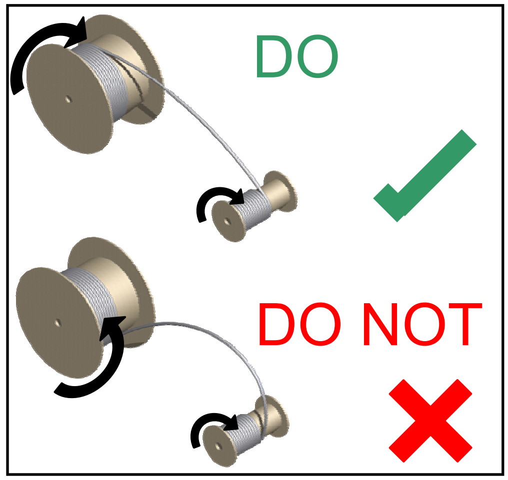
- In c-tracks with long travel distances it is recommended to use a cable with a braided shield and a inner jacket (sub jacket).
  Inner jackets offer the best protective barrier between cable core and shield.



4 Handling of Cables

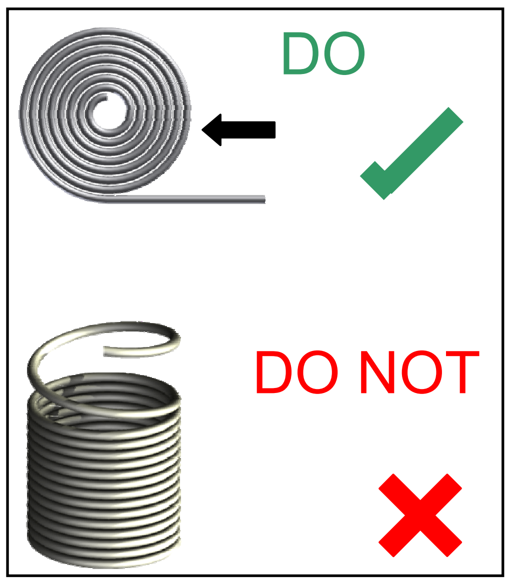
It is recommended to use special handling techniques. The cable can be damaged if unreeled or installed in the c-track:

1) When unreeling the cable, do not change the bend direction. The cable has to go on the reel in the same direction it came off the reel. Low and equal tensile force during spooling.



2) Ring put ups require careful uncoiling by rolling the ring upright over the floor.

3) Do not twist the cable when unwinding. Always unwind straight from spool

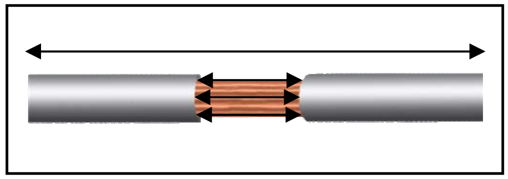


5 Installation of Cables

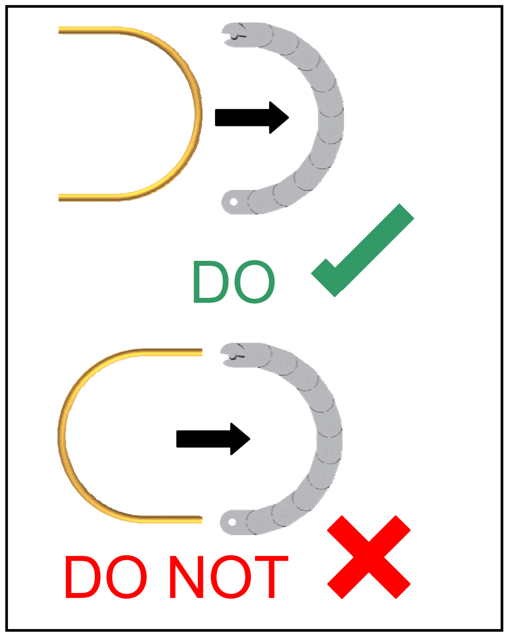
The installation requires the highest degree of accuracy to ensure long lifetime and to reduce stress on the cable.

5.1 Laying the Cables in the C-Track

NOTICE **Cables should not be pulled through the track.**
The inner layering, of the cable can be damaged if the cable is stretched too much.
If necessary pull the cable with equal tensile force on conductors, shield and jacket.

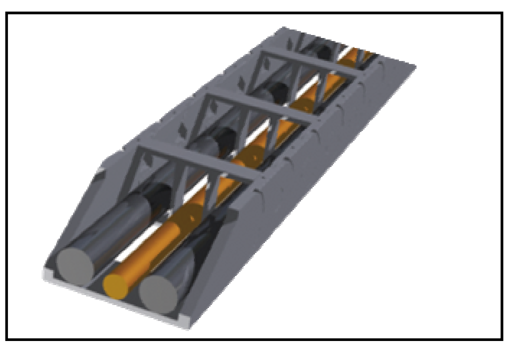


- Cables which come from a reel retain a bend direction. Do not flex the cable against this bend. The cable should be laid in the track in accordance with the same curve of the track. Otherwise the cables should be cut to the required length and laid flat for 24 hours before installation.



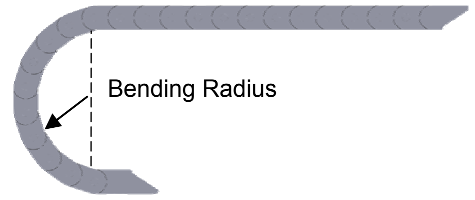
- Install the cables parallel in the c-track.

- Try to ensure balanced weight distribution. If you have more than one heavy cable, we recommend installing the heavy cables evenly to each side of the track.

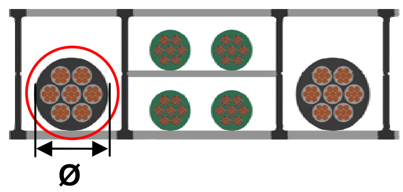


5.2 Bending Radius

The largest cable in the c-track will determine the required bending radius of the c-track.
Example to determine the bending radius:



1) Multiply the largest cable diameter by the recommended standard bending multiplier.



Cable Type	Standard Bending Multiplier
Unshielded Cable	7.5
Shielded Cable	12

Ø of cable x Standard Bending Multiplier = Bending Radius

If the bending radius is too small, the cables may fail prematurely (see next page)

.

Ø of cable x Standard Bending Multiplier = Bending Radius

Example for an unshielded cable with the outer diameter of 12 mm:

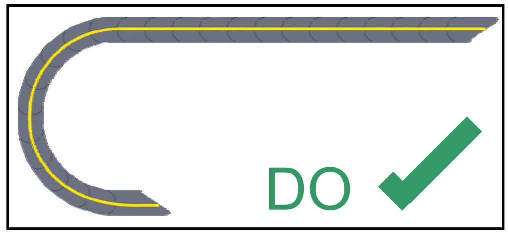
12 mm x 7.5 = 90 mm

The bending radius should be 90 mm.

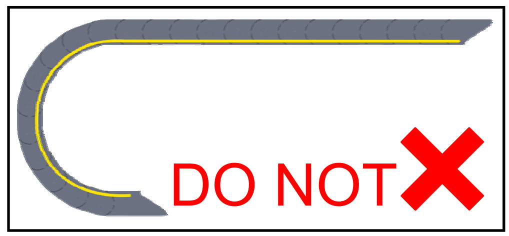
NOTICE **A smaller bending radius of the c-track may be possible in some cases, but it shortens the life span of the cable.**

5.2.1 Optimal length adjustment

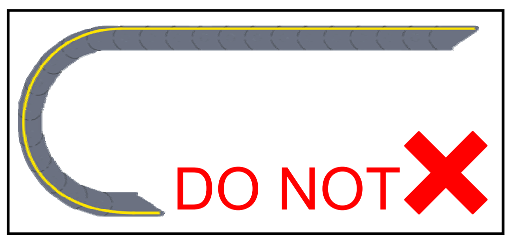
The cables should run in the neutral zone of the c-track. It is the center line as shown in the picture for single layer installation.
Space to the top and the bottom of the c-track is required: (see calculating cavity space)



- If a cable is installed too short it will be stretched against the inner wall of the track which can causes abrasion of the jacket.



- If a cable is installed too long the cable will be compressed on the outer wall of the track.



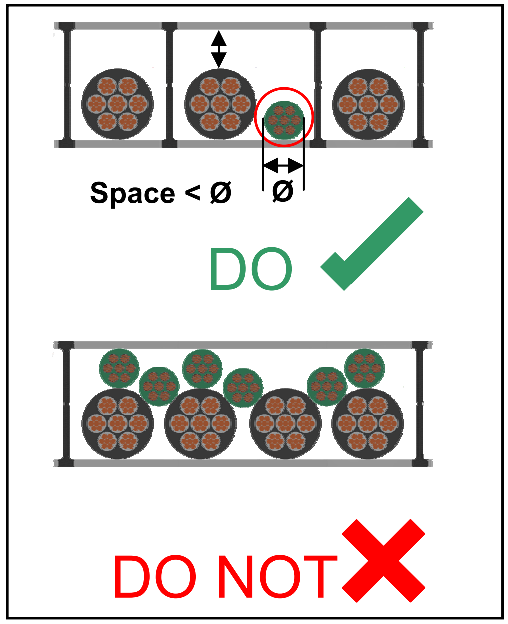
5.3 Placing the Cables in C-Track Cavities

Use dividers horizontally and vertically to divide the c-track into separate cavities according to your application requirements.

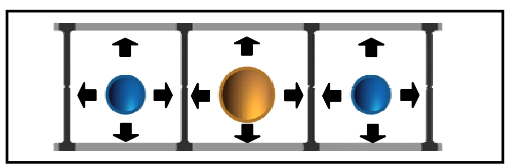
NOTICE

Do not lay cables directly on top of each other!
Without dividers the cables can otherwise be tangled up with one another.

- Install just one cable per cavity. If necessary, two small cables or a big and a small cable can be installed in the same cavity. If cables can not be separated from each other and have to be laid in the same cavity, the remaining space to the top must be smaller than the outer diameter of the smallest cable. This way the cables will not wind around each other.



- Pneumatic and hydraulic lines must be laid in their own separate cavities. When pneumatic or hydraulic lines are pressurized they expand in diameter and may move uncontrollably from side to side.



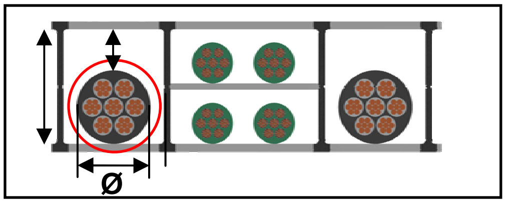
5.3.1 Calculating the Cavity Space

To ensure that the cables have enough space inside the cavity, calculate the height and the width of each cavity based on the outer diameters of the cable. The travel distance and the Safety Factor are needed to calculate the space.

Travel Distance	Safety Factor
Shorter than 10 m	Add 15 % to the outer diameter
10-30 m	Add 50 % to the outer diameter
Longer than 30 m	Add 100 % to the outer diameter

Calculating the height of the cavity

1)
For two cables in one cavity: Choose the biggest cable outer diameter which is used.



For one cable in one cavity: Just choose the outer diameter of this cable.

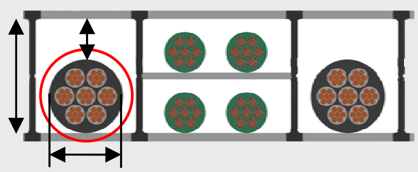
2) Add the outer diameter to the Safety Factor. This equals the required minimum height of the cavity.

Ø + Safety Factor = minimum height

OD + Safety Factor (50%) = minimum height

Example for a cable with the length of 20 m:

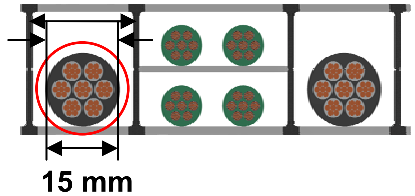
15 mm + 7.5 = 22.5 mm



The minimum cavity height should be 22.5 mm.

Calculating the width of the cavity

1)
For two cables in one cavity:
Choose the biggest cable outer diameter which is used.



For one cable in one cavity:
Just choose the outer diameter of this cable.

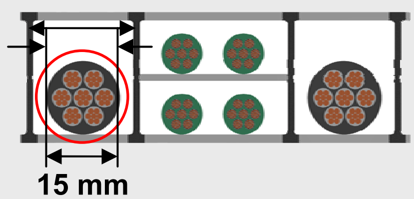
2) Add 10 % to the outer diameter. This equals the required minimum width of the cavity.

Ø + 10% = width

Outer diameter + 10% = width

Example for cable with the outer diameter of 15 mm:

15 mm + 1.5 = 16.5 mm

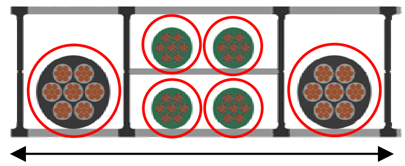


The wide of the cavity should be 16.5 mm.

Calculating the minimum width of the c-track

1) Calculate the outer diameter plus the safety factor for each cable.

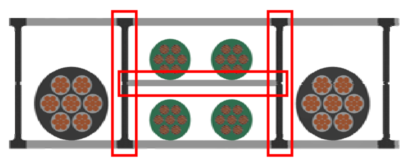
2) Add these sums up.



1)
(Ø of cable 1 + 50%) =∑ cable 1
(Ø of cable 2 + 50%) =∑ cable 2
…

2)
∑ cable 1 + ∑ cable 2 =
∑ All cables

3) Calculate the number of dividers.



(divider) + (divider) +…. =

1) Add the sums of step 2 and 3 together.

∑ALL cables + dividers = width

Example for 6 cables with the length of 15 m and 4 dividers:

1) (8mm + 4) = ∑ 12 (15 mm + 7.5) = ∑ 22.5
(8mm + 4) = ∑ 12 (15 mm + 7.5) = ∑ 22.5
(8mm + 4) = ∑ 12
(8mm + 4) = ∑ 12

2) ∑ 22.5 + ∑ 22.5 + ∑ 12 + ∑ 12 + ∑ 12 + ∑ 12 = ∑ 93

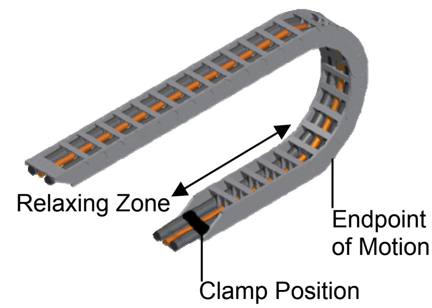
3) 1 + 1 + 1 = 3

4) ∑ 93 + 3 = 96

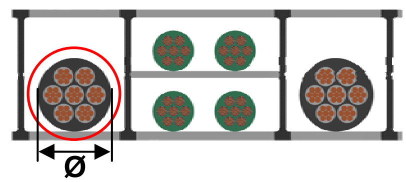
The minimum width of the cavity should be 96 mm.

5.4 Securing the Cables

- The correct clamping position on the moving as well as on the fixed end depends on the outer diameter of the biggest cable. Please leave enough relaxing zone distance in the track, between the last driving chain link of the track and the clamping position.



- For best performance, the length of the relaxing zone must be 50 times the outer diameter of the largest cable in the track.



Outer Diameter Ø of largest cable x 50 = Relaxing Zone

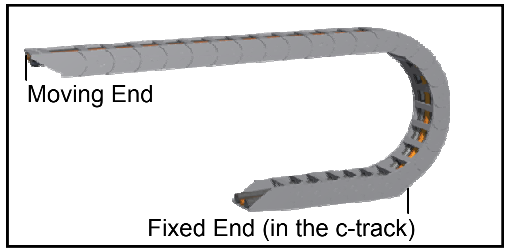
Ø of cable x Standard Bending Multiplier = Bending Radius

Example for a cable with the outer diameter of 12 mm:

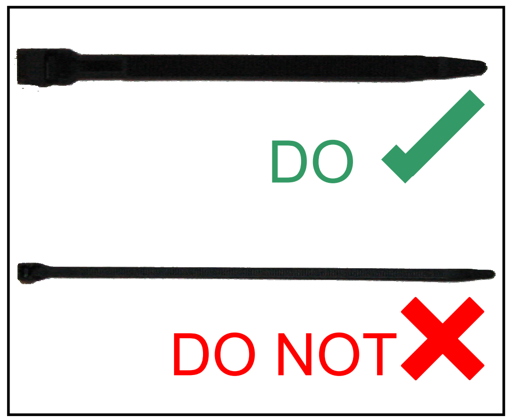
12 mm x 50 = 600 mm

The relaxing zone should be 600 mm long.

- The cables should be clamped at the fixed anchor point as well as the moving end.



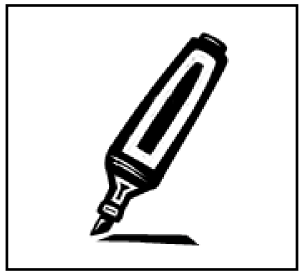
NOTICE **If using cable ties do not pull too firmly.**
The cable can be damaged! Use cable clamps which are clamping a wide area.



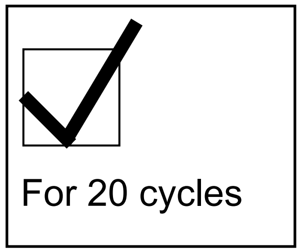
NOTICE **Only fix the cable at the ends of the c-track**.
Make sure that a relaxing zone on both ends is given.

6 Checking

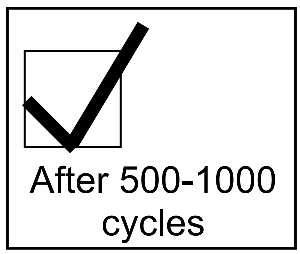
1) The cable should be marked at the moving and fixed end. This will help to determine later if the cable has shifted or elongated during application.



2) Check the free movement of all cables after final assembly. Run a test with at least 20 cycles over the whole travel distance. Adjust the cable length if needed.



3) Check for free movement again after 500-1000 cycles and adjust the cable length if needed.

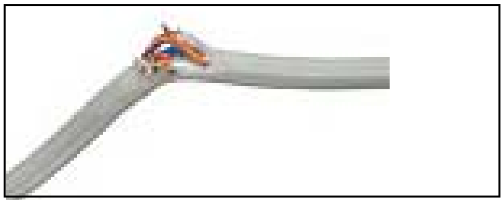


7 Common Failures

Incorrect handling and installation can cause failures. Some of those are listed below:

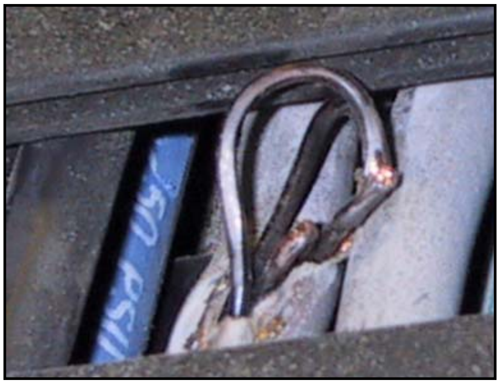
- **Breaking of cable conductors**

  The loss of conductivity due to mechanic overload of each conductor at continuous moving load.



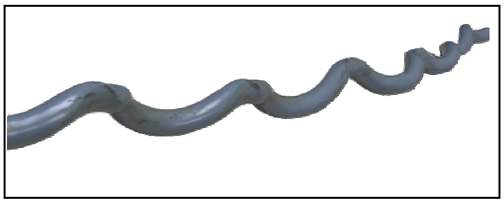
- **Damaged Insulation**

  The damage of the insulation of the conductor can cause short-circuits.
  Broken conductors or shields can also puncture the insulation.

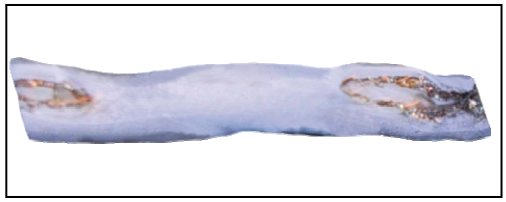


- **"Corkscrewing"**

  Deformation of the whole cable.
  Corkscrewing is a sign that the cable is about to fail very soon. Corkscrewing can also be caused if the cable is twisted during the install or not properly strain relieved. Corkscrewing may also be caused by using cable that is not designed for c-track applications.

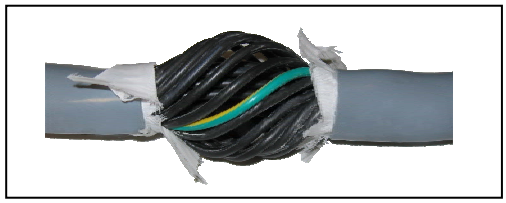


- **Abrasion of the Jacket**



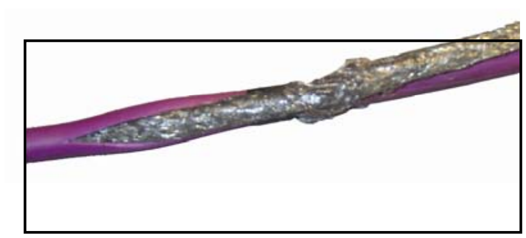
The jacket is wearing off to expose till the shield or stranding.
Abrasion is caused by rubbing against the links of the c-track. This is a result of improper length adjustment and improper strain relief or overcrowding the C-track.

- **Bird-nesting**



Bird-nesting can causes knots under the jacket that are very visible. Bird-nesting is a sign that the cable is about to fail very soon.
Bird-nesting can occur if the conductors retain a back-twist inside the cable or if the cable is pulled and not laid into the c-track. Bird-nesting may also be caused by using cable that is not designed for c-track applications.

- **Loosing of shield**



Using a cable with an incorrect shield can causes a breakage or shifting of the shield.

Reasons:

- Installation procedure not followed.
- The speed of the application is too high.
- The travel Path of the application is too long.
- The acceleration of the application is too high.
- The bending radius of the c-track is too small.
- The temperature of the application is too high.
- Wrong cable design was chosen.