Foreword

In the following pages, you will find some major technical information organized in handling/installation and Electrical.

Our goal is provide you with all the easy, most common information in order to deal correctly with all our cables (from the project to the final handling).

Obviously we prefer if you would contact us for any specific, as our sales department and our technicians can act together in order to help you best in this way.

HANDLING AND INSTALLATION

Cable reels

Cable life and performances is tightly connected to the reeling design.
A well designed reeling system, combined with the correct choice of the cables, secures optimal performances of the whole system and also can assure a long lasting operative cables, increasing their life and reliability.
Today's market uses a wide range of cable reels that can be summarized in three main types: you can find herewith a brief description of each one with some hints about their advantages and disadvantages.

Mono-Spiral reel

It is one of the most diffused. It has a simple guide route that gives - as a result - an extension to the cable's own life in comparison to the other types.
Moreover on these cable reels (due to the improved heat dissipation), the conductor size for the power cables are generally smaller in comparison to the other kind of reels. The cable diameter and length are main factors to be considered for the application on mono-spiral reels: the good balance between reel's inner and outer diameter, will be critical for determining and controlling the cable tension.

Random Wound reel

It is the simplest type amongst the existing cable reels: it operates without guides so the random layering can create severe operational difficulties such as slippage of coils, abrupt tensile forces, torsion, abrasions and abnormal build-ups.
For these main reasons this application can support only small cable diameters and short runs: 250m maximum run, and a weight approx. < 4 kg/m.

Multi-spiral reel

It is indicated for large cable diameters and long lengths.
The main advantage on using this type of reel is its ability to carry large amount of cable (even with large diameters) at a constant reeling tension and for long distances.
On the other hand, normally due to the reel location, is also difficult to reduce the number of guides and changes of direction on this type of installation.

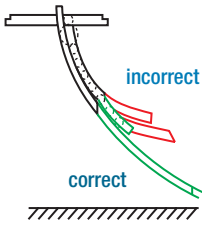
Cable guides

After considering the correct reeling system, the cable guides became the next step to be looked at properly.
Some misuse of the handling of these guides lead to some major reeling system problems. Amongst the various guide types the best are the radius types as they provide generous bending radii with minimum cable deflection. Our last mandatory recommendation is to keep the guide exactly aligned with the payout plane of the cable: every misalignment can lead to an increase of torsion on the cable itself.

One way or two ways guides

A one way guide often appears even on two directions payout as it seems the most economic solution.
However a considerable increase in cable life is obtained if a two way guide is used: in fact the net torsional and "massaging" effects imparted by the guide to the cables are balanced using a symmetrical two way one.
This problem doesn't occur if the reeling system is end fed. In this case the one-directional guide is in contact with the cable regardless of the direction of travel of the machine.

A part from this, the two-way guide or the multi roller systems, this is the preferred one. Multi roller or two-way guide should be designed to continue the arc beyond the angle of deflection. In this way the minimum bending radii is always maintained.



As a general note, you have to absolutely avoid any abrupt changes of the bending radius (often this is due to a not enough long angle of deflection of the roller guide arc). These changes lead to a punctual overpressure that results into a cable breakage.

Over and under tension protection

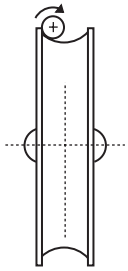
It is highly recommended that cable guiding systems include both under and over tension protection systems. Even a short exposure to over tension caused by mechanical failure or accidents can render a cable inoperable due to permanent conductor deformation or breakage. Conversely, under tension protection is desirable to ensure that cable cannot free spool from the reel and sustain damage. This protection is particularly important for high mounted cable reels. All over tension protection devices should be set to the maximum continuous safe working tension defined for each cable section.

Sheaves

Comparing them with the previously described guide types, some difficulties are clear. The sheaves' weight increases inertia, so more torque is needed to compensate it giving a final increase on cable tension so reducing its life. Another disadvantage to be considered from using a sheaved guide is the detrimental effect onto the cable outer jacket that is directly in contact with the sheave circumference. This contact area should increase if a hollow internal sheave shape is used. This becomes a particularly significant condition that will lead to a considerable reducing of the cable life and this is why we suggest to use a correct sheave profile as shown in the below image.

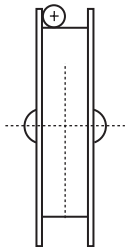
Incorrect sheaved profile

Torsion is induced on the cable due to rolling effect leading to a reducing in cable life.



Correct sheaved profile

This design minimizes torsion applied on the cable.



Change of direction

At the designing stage of a cable winding system, please keep an eye on leaving enough distance between any changes of direction. The best and recommended distance should be at least 20 times the cable OD (even longer for high speed systems). This behavior will leave the cable to regain its starting shape before suffering another bending.

Anchoring systems

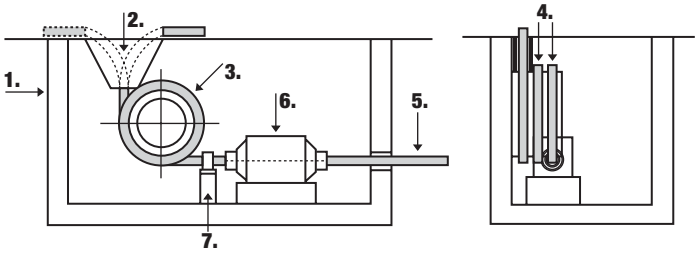
Correct cable anchoring is important in establishing reliable operation of a cable handling system. According to the cable handling system typology, different methods may be used, but all of them share the same basic intent: spread the tensile forces over a sufficient large cable jacket area in order to avoid damage or failures at the anchoring point.

The most common mobile anchor points are performed using the ordinary terminals or “cable grips”.
In these cases it is recommended that the tensile load would be distributed over an end length of the cable equal to 20/25 times its OD, and that a slack loop of cable will be left before entry into the terminal box in order to allow the operating movements.

When an underground centre point attachment is installed, the vertical distance between the entry bell and the crane’s payout guide should not be less than 15 times the cable OD or 1m, whichever is larger. At least 21/2 cable turns should be wound around the fixed stress relief drum to ensure sufficient contact area for an adequate stress relief.

Dynamic tensile stress on the cable can lead to premature failure, especially in high travel speed applications. In order to minimize this, several solutions are at hand, as the most important - according to our experience - is a travel speed reduction device. This system can be incorporated with most reel drive designs. It reduces the travel speed before reaching the centre point, and then re-accelerates once the centre point has been passed and the reel direction of rotation has been reversed.

Anchoring system for center crossover



1. Cable support
2. Entry bell
3. Stress bearing drum
4. Cable wound twice (2 1/2) around stress bearing drum
5. Supply cable
6. Cable termination box
6. Clamp

BENDING RADII

Table 1

OPERATING VOLTAGE (V)	CABLE'S OVERALL DIAMETER (mm^2)	TYPE OF USE: FIXED INSTALLATION	ANCHORING REEL	FESTOONS	CABLE WINDING REELS	BASKET	CABLE CARRIER CHAINS	CABLE TENDER SYSTEMS	GUIDE PULLEY SYSTEMS
≤ 1000	< 8.0	3x0D	3x0D		5x0D	-	8x0D		7.5x0D
	< 12.0	3x0D	4x0D		5x0D	-	9x0D		7.5x0D
	≤ 20.0	4x0D	5x0D		5x0D	-	10x0D		7.5x0D
	> 20.0	4x0D	5x0D		6x0D	15x0D	11x0D		7.5x0D
> 1000		6x0D	10x0D		12x0D	-	10x0D		15x0D

The above table gives the recommended minimum bending radii for different cable uses. Observance of these recommendations and a precise calculation of the bending radius is important as one of the most important factors of reliability. Increase on minimum bending radius has a more than proportional effect on the life of a cable because it causes stretching and internal torsions due to increased mechanical stresses in the conductors.

As the frequency of movements is important, a tighter bending radius may be considered where movement is slow and occasional.

Care must also be taken and limits imposed on design where pulleys or guide rollers (same radii as for collection reels) are present or where there is a flexion and torsional stress due to reel being parallel to the line of travel of the machine.

Handling and installation

For optimum long life service, laying operations must be carried out by expert personnel. In addition to the normal measures to be observed when laying cables, the following recommendations, specific to the operating conditions for mobile cables, must be strictly adhered to.

It's always a good practice to test the installation a few times as soon as the cable as been laid to check operation and immediately correct any eventual defects or faults.

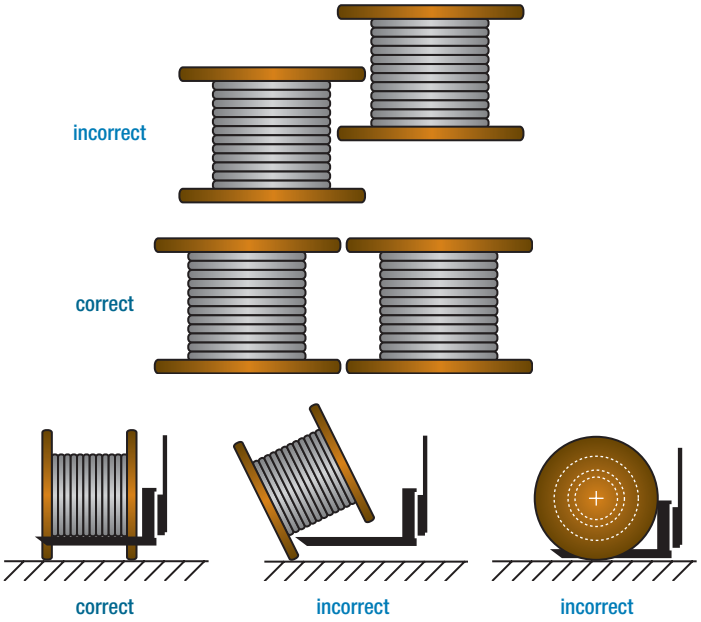
Handling of cable

Storing and handling of cables on the original drums is recommended in order to prevent the formation of defects caused by loose coils.

If possible avoid, or at least minimize, to roll the drums on its flanges: on the other hand, use a fork-lifter or crane to move the reel. If you cannot avoid to roll the drum, do it against the coiling direction not following. This small suggestion will keep the cable coiled tight to the reel and will prevent any torsion or abrupt tensions given by loose coil action.

A further recommendation regards storage.
Spare cables have to remain on their original drums (it prevents coils slumping); moreover - even you consider either a short or long cable storage - the cables' drums must be kept in a cool, dry and shaded location and the cable's ends must be sealed (as done on first delivery) in order to prevent the entrance of moisture and dirt.

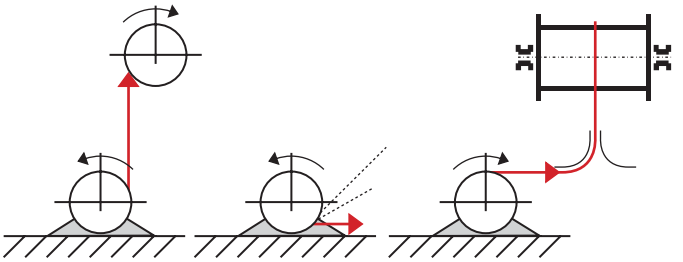
Fork lifting operating



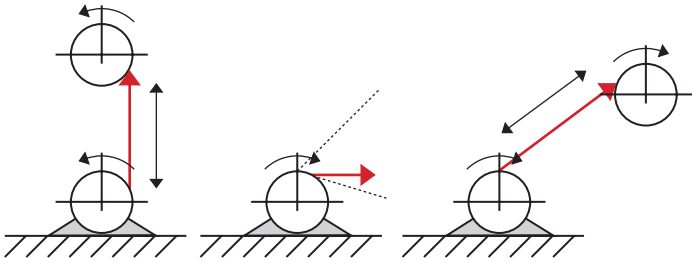
Cable installation

Generally, when a cable is installed onto a force guidance system as the reeler, festoons, gravity-fed (spreader) basket, the transport drum should be jacked up above ground level.
The preferred method to operate a cable installation on site consist first of all in jacking up the original drum then unwinding the cable all along the entire machine's travel route. You can use conventional cable pulling equipment and rollers to perform this action.
Sometimes these procedures cannot be used due to the environment or site conditions so you can act transferring it directly from the drum to the reel. It is also a recommended method when reel location and/or cable runaway are not accessible.
In this case you must avoid to introduce "S" bending between the drum and the reel. Whenever possible the cable should be transferred directly without passing through or over any rollers or change of directions.
The directly transferring from the transport drum to the final reel must be done slowly and with a minimum tension: this behavior would avoid any torsional influence during cable installation.

The below pictures show how to proceed generally when unreeling the cable from the original drum and transferring it directly to the final operating system.



incorrect



correct

The spiral will be rolled to the free end of the cable in order to remove any twisting. This action must be performed again for each founded twisting. Then re-anchor the cable to start operation.
If during the first test-running of the equipment you still find a slight or residual twisting, lead the machine to the end run then un-anchor the cable (eventually cutting 25/50cm of cable) and eliminate the torsion. After this, re-anchor the cable and have a final check.
Please keep in mind that a cable correctly installed, if no torsions are introduced by guides or unnatural bending, it cannot twist (for an evident physical law).
For this reason we suggest that during the final check, you draw some marks on the cable than let the machine run in order to can easily determinate if the cable starts to twist.
If yes the whole system has to be stopped in order to find and eliminate the external cause of the torsion.

Note: the cable marking can show a natural slight spiral effect (more evident on long cable lengths), but this aspect is totally not related to any kind of twisting problem.

Twist removal

If, during the above procedure, the cable has become twisted, we strongly recommend to eliminate it. Normally two methods are foreseen to perform this action.

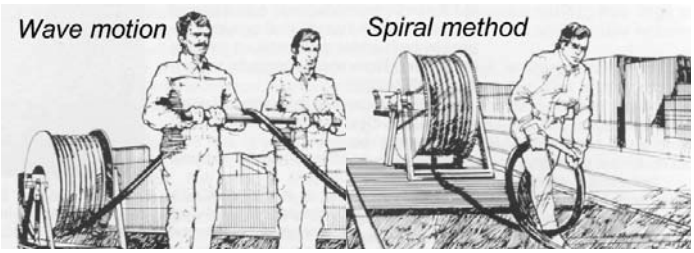
Wave Motion

Insert a cylinder roller (the diameter of which should be between 15/20 cm) underneath the cable near to the twisting. At this point two people should walk handling the roller and pushing the “wave” towards the end of the cable.

You can perform this action until the detected twist is removed.

Spiral Method

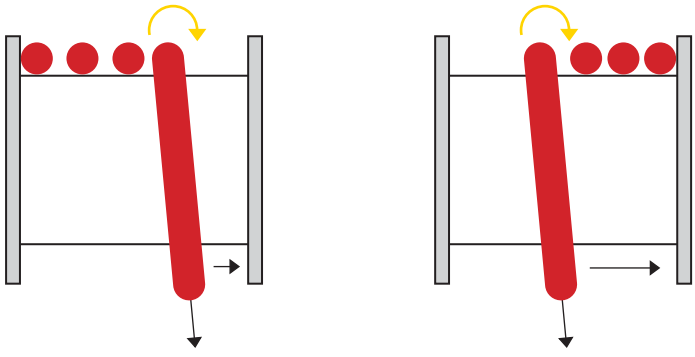
This could be carried out by one person only and will reach the same effect described above. Allow enough cable from the fixed end of the cable (better from the drum jacked on) in order to obtain a spiral. This should be a right side or a left side one according to the direction of the detected twist.



Cable installation on multi-spire reels

PANZERFLEX® crane cables are manufactured with right hand lay-up of the conductors (power and control cable) and therefore when winding onto multi-spiral reels, the first turn must be with the cable against the right flange of the reel.

This will have the effect of exploiting the natural tendency of the cable under traction to move to the right, keeping subsequent turns close together.



incorrect correct

To assist the movement of the cable over guide rollers, sheaves, etc. a dry lubricant or a silicone based grease may be used as these types of lubricants avoid dust and dirt from adhering to the lubricated surface.

Cables installation for vertical application (BASKETHEAVYFLEX, PANZERFLEX-VS, PANZERLITE)

Anchoring systems

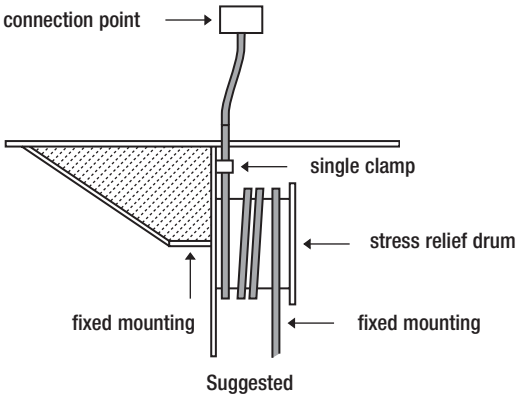
Cables installation on a spreader or other kind of vertical application, needs to follow some major attention, mainly due to the specific kind of application.

Main recommendations given in the previous paragraphs (wound the cable from the original drum; avoid to subject the cable to unnecessary loops, torsion or twisting; eliminate any eventual torsion, etc.) must be followed also for these cables.

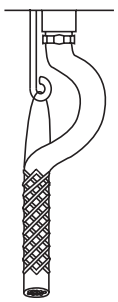
Moreover the installation has to go after all the topics given herewith.

The best anchoring is achieved with a stress relief drum as shown on the below picture. The open ended construction facilitates installation and replacement while affording better stress relieve and sheath protection than cable grips. In this case at least 2 1/2 cable turns should be wound around the drum. The table “Bending radii” show the minimum bending radii of stress relief.

If, on the other hand, the anchoring would be made with a grip, a recommended length of coverage over the cable is 20/25 times the cable OD. This will aid in spreading the dynamic stresses over a sufficient sheath surface area to inhibit cable damage.



Suggested

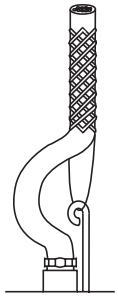


Typical cable anchoring method using a Kellems Grip®

PANZERFLEX-VS, PANZERLITE

Fix the bottom

When necessary, the bottom of these cables would be fixed by a suitable grip. The sheath coverage is the same of the anchoring system (20/25 OD of the cable). The distance from the end of anchoring device to the end of the machine travel should be at least 40 x cable OD. If frequent dynamic stresses near the anchor point are anticipated a spring may be used.



Typical cable anchoring method using a Kellems Grip®

BASKETHEAVYFLEX

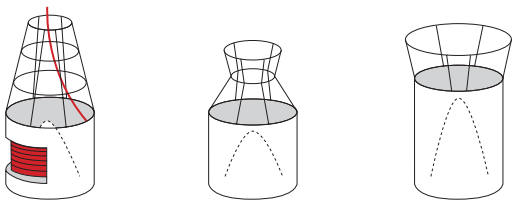
Suggested cable coiling

Even if the Basketheavyflex cable has been especially designed for this type of application, the correct design of the basket is important not only as far as cable life is concerned, but also to avoid operating malfunction.

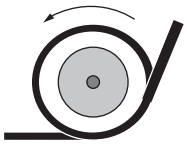
High stress applications will be typically involve long vertical lengths, high speed combined ascent and descent with movement and, often, the presence of strong winds.

In these cases care must be taken to ensure that coiling diameter is not less than 1.5 m. A centrally guide cone centrally placed into the basket is recommended for even coiling the cable correctly.

The shape of the basket and of the opening are also important operating factors: with high lift and high speed a height of at least 2 m and a conical opening are recommended.



Good cable coiling Less controlled coiling Poor coiling control



The cable has to be laid, from the bottom of the basket, in anticlockwise direction starting from the outer layer of the original cable drum.

Scope of the information given herewith is to assure the **PALAZZO PRYSMIAN's** deep commitment to giving the customer the best support for a perfect use of our products.

Life and performance of our **PANZERFLEX®**, depend directly on all the recommendations and figures stated in this technical section. Furthermore we would like to underline that the main topics that must be regularly and carefully checked are:

- the perfect alignment of all equipments such as: lyres, reels,sheaves, etc.
- all the protection devices in order to avoid over and under tensions.
- any twisting induced (and not released) during installation or test-run activities.

The misuse of even one the above instructions will surely lead to premature cable failures.

ELECTRICAL

Electrical parameters

Voltages

For therated,operating and test voltages of cables, the definitions given in DIN VDE 0298, Part3, apply. Some of these are mentioned in table 4/3 below.
AC - alternating current
DC - direct current

Rated voltage

The rated voltage of an insulated electric cable is the voltage which is used as the basis for the design and the testing of the cable with regard to its electrical characteristics.
The rated voltage is expressed by the two values of power frequency voltage U_0/U in V.

- U_0 rms value between one conductor and "earth"
- U rms value between two conductors of a multi-core cable or of a system of single-core cables

In a system with AC voltage, the rated voltage of a cable must be at least equal to the rated voltage of the system for which it is used. This requirement applies both to the value U_0 and the value U.
In a system with DC voltage, its rated voltage must not be more than 1.5 times the value of the rated voltage of the cable.

Operating voltage

The operating voltage is the voltage applied between the conductors and earth of a power installation with respect to time and place with trouble-free operation.

- *I Cables with a rated voltage U_0/U up to 0.6/1 kV*
  These cables are suitable for use in three-phase AC, single-phase AC and DC installations, the maximum continuously permissible operating voltage of which does not exceed the rated voltage of the cables by more than 10% for cables with a rated voltage U_0/U up to and including 450/750 V 20% for cables with a rated voltge U_0/U = 0.6/1 kV.
- *I Cables with a rated voltage U_0/U greater than 0.6/1 kV*
  These cables are suitable for use in three-phase and single-phase AC installations, the maximum operating voltage of which does not exceed the rated voltage of the cable by more than 20%.
- *Cables in DC installations*

  If the cables are used in DC installations, the continuously permissible DC operating voltage between the conductors must not exceed 1.5 times the value of the permissible AC operating voltage. In single-phase earthed DC installations, this value should be multiplied by a factor of 0.5.

Test voltage

Regarding the test voltage of flexible cables, the values given in the corresponding parts of DIN VDE 0250 apply.