

AMPACITY DERATING FACTORS FOR MINE TRAILING CABLES COILED ON REELS

DERATING FACTORS

The environmental and thermal conditions where a trailing cable is used and the thermal resistance of its insulation determine a cable's ampacity rating. Cables used on reels on mobile machinery also have a derating factor applied to account for the heating effects of having one or more layers consistently on the reel. The more layers on the reel, the less amperage a cable can handle due to the effects caused by the buildup of heat.

Local regulations regarding to the electrical requirements for trailing cables always must be considered. If there are not specific regulations, is strongly suggested to follow international requirements like those published by recognized associations like the Insulated Cable Engineers Association/National Electrical Manufacturers Association Standards, Office of Mine Safety and Health Research (OMSHR-NIOSH) or the VDE association for electrical, electronic & information technologies, among other.

Each cable standard inform the ampacity ratings based on specific ambient and conductor temperatures, and apply to cables suspended in still air. Most common temperatures are 40°C (ambient) and 90°C (EPR insulated conductors)

Ampacity ratings must be corrected for ambient temperatures different from the standard 40°C, and for different numbers of layers of cables on the reels. These corrections must be achieved using multiplying factors known as *derating factors*.

This technical guide is focused on the derating factors for round mining cables coiled on reels.

HAZARD OF STORING CABLE ON THE CABLE REEL

Electrical current flowing through the conductors of a trailing cable generates heat. When more heat is generated in the conductor than can be dissipated to the surrounding environment, namely the conductor insulation, cable outer jacket and the surrounding air or

other solid material of the cable reel, the temperature of the conductor increases as well as the other components parts of the trailing cable. As the conductor temperature increases and exceeds the normal operating temperature rating of the insulation, 90° C for most modern trailing cables, the insulating properties of the insulation begin to degrade and the plastics materials could be melted if the temperature reaches extreme values.

After withstanding repeated exposure to temperatures exceeding the normal operating temperature rating of the insulation, breakdown or deterioration of the conductor's insulation and the overall jacket will result. Degraded cable insulation can result in a short circuit that may cause a fire or explosive release of energy.



Fig. 1. Cores deterioration in a trailing cable.



Fig. 2. Polyurethane jacket melted by overheating.

CABLE REEL TYPES

Depends on the machinery specification and its applications, there are several cable reel types. In the next pictures appear some common cable reels.



Fig. 3. Monospiral reel or radial drum (Ventilated)

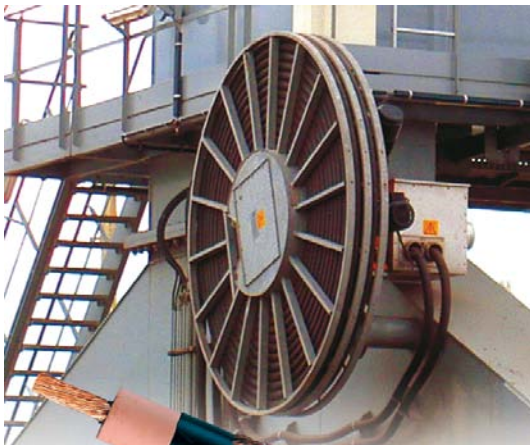


Fig. 4. Monospiral reel or radial drum (Unventilated)



Fig. 5. Multi-spiral reel or cylindrical drum.



Fig. 6. Multi-spiral and multi-layer reel or cylindrical drum.

CAUSES OF HEATING AND DAMAGE TO CABLES ON REELS

Cable heating can occur when a cable is layered on a permissible mining machine’s cable reel and stays wound on the reel for extended periods of time. This heating is most noticeable when three to four layers of cable are left on the cable reel for extended periods and are only removed from the reel when the mining equipment is used at the farthest working places from the cable’s anchor point. This may cause internal heating and cable jacket melting and cracking. This condition may be detected by odors emitted from the over heated cable or by regular thermal infrared inspection.

The increased demands on cable reeled equipment, caused by higher duty cycles necessitated by longer runs from the face area to the dump point, increases the duration of peak electrical current through the equipment’s trailing cable. The longer duration of peak current generates additional heat in the layers of cable on the cable reel. This additional heat generation contributes to the increasing occurrences of trailing cable deterioration on the cable reel.

A thermal IR image of a SHD cable coiled in several layers is shown in Fig. 7, the brightest area of the image shows jacket surfaces of inner cable layers with temperatures higher than 83°C which means that copper conductors reach temperatures about 110°C (20°C more than the maximum operating temperature).

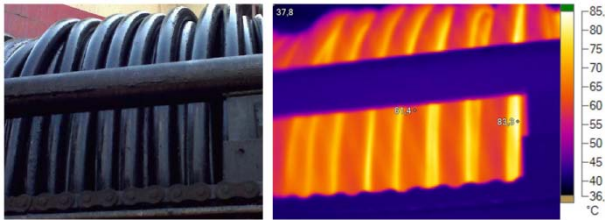


Fig. 7. Visible and thermal IR images of a cable coiled on several layers.

When a section of cable jacket is found to be melted or cracked due to excessive heating, the entire length of cable should be replaced and the techniques to minimize cable heating should be considered.

ALTERNATIVES TO MINIMIZE CABLE HEATING

Effective techniques to minimize cable overheating on standard equipment include:

1. Increasing the equipment’s trailing cable size to the largest size covered by the equipment’s approval documentation.
2. Modifying the equipment to utilize a higher operating voltage such that equal or greater power can be achieved at a lower electrical current flowing through the existing trailing cable size.
3. Removing all but the last layer of the unwound cable from the reel and tying it off near the cable’s anchor point. With the excess cable tied off the reel, the entire length of cable should have the opportunity to cool.
4. Implementing the ampacity derating factors for cables layered on cable reels. Nexans strongly recommend using the more conservative factors according to the Office of Mine Safety and Health Research (MSHR)

STANDARD	NUMBER OF LAYERS					
	1	2	3	4	5	6
OMSHR / NIOSH	0,67	0,49	0,39	0,31	0,26	0,23
DIN/VDE	0,80	0,61	0,49	0,42	0,38	-
ICEA/NEMA	0,85	0,65	0,45	0,35	-	-

Table 1. Ampacity derating factors for round cables coiled on cylindrical drums.

	Correction factor for less than 10 layers
Ventilated reel	0,8
Unventilated reel	0,7

Table 2. Ampacity derating factors for round cables coiled on radial drums.

Using a trailing cable of the proper size to preclude the generation of excessive conductor temperatures is the ideal method to eliminate cable overheating. This magnitude of ampacity derating would require, for example, that a 1/0 AWG trailing cable be replaced with a 500 MCM size cable when 4 layers are used on the reel.

REFERENCES

Trailing cable overheating on equipment cable reels. MSHA Program Information Bulletin NO. P10-20. 2010. Available in <<http://www.msha.gov/regs/compliance/PIB/2010/pib10-20.pdf>>

Investigation of ampacity derating factors for shuttle cars using fiber optics technology. Office of Mine Safety and Health Research (OMSHR)

Derating factors for round and flat mine trailing cables. Office of Mine Safety and Health Research (OMSHR). Available in <<http://www.cdc.gov/niosh/mining/content/deratingfactors.html>>

ANSI/NEMA WC58/ICEA S-75-381-2008 Portable and Power Feeder Cables for Use in Mines and Similar Applications.

DIN VDE 0298-4. Application of cables and cords in power installations –Part 4: Recommended current-carrying capacity for sheathed and nonsheathed cables for fixed wirings in and around buildings and for flexible cables and cords.