
Cranes — Wire ropes — Care and maintenance, inspection and discard

*Appareils de levage à charge suspendue — Câbles en acier —
Entretien et maintenance, inspection et dépose*

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Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions	2
4 Care and maintenance	4
4.1 General	4
4.2 Rope replacement	4
4.3 Offloading and storing the rope	6
4.4 Condition of the rope prior to installation	6
4.5 Installing the rope	7
4.6 Running-in the new rope	10
4.7 Maintaining the rope	11
4.8 Maintenance of rope-related parts of the crane	11
5 Inspection	12
5.1 General	12
5.2 Daily visual inspections	12
5.3 Periodic inspections	12
5.3.1 General	12
5.3.2 Frequency	13
5.3.3 Extent of inspection	13
5.3.4 Inspection at, or in the vicinity of, a termination	14
5.3.5 Inspection record	14
5.4 Inspection following an incident	15
5.5 Inspection following period with crane out of operation	15
5.6 Inspection by magnetic rope test method	15
6 Discard criteria	15
6.1 General	15
6.2 Visible broken wires	16
6.2.1 Criteria for visible broken wires	16
6.2.2 Use of Tables 3 and 4 and rope category number	16
6.2.3 Wire breaks other than those resulting from service	16
6.2.4 Single-layer and parallel-closed ropes	17
6.2.5 Rotation-resistant ropes	19
6.3 Magnetic rope test (MRT)	19
6.4 Decrease in rope diameter	20
6.4.1 Uniform decrease along the rope	20
6.4.2 Calculation to determine actual uniform decrease in diameter and expression as percentage of nominal rope diameter	21
6.4.3 Local decrease	21
6.5 Fracture of strands	21
6.6 Corrosion	21
6.7 Deformation and damage	22
6.7.1 General	22
6.7.2 Waviness	22
6.7.3 Basket deformation	23
6.7.4 Core or strand protrusion or distortion	23
6.7.5 Protruding wires in loops	23
6.7.6 Local increase in rope diameter	23
6.7.7 Flattened portion	23
6.7.8 Kink or tightened loop	24
6.7.9 Bend in rope	24

6.7.10 Damage due to heat or electric arcing.....	24
Annex A (normative) Key areas requiring particularly close inspection.....	25
Annex B (informative) Typical modes of deterioration.....	27
Annex C (informative) Discard criteria for MRT.....	37
Annex D (informative) Internal examination of rope by use of clamps	39
Annex E (informative) Typical examples of inspection records.....	42
Annex F (informative) Useful information on rope deterioration and discard criteria.....	45
Annex G (informative) Combined effect assessment of rope condition and severity rating — One method.....	48
Annex H (informative) Examples of cross-sections of ropes and corresponding rope category number (RCN).....	51
Annex I (informative) External corrosion.....	57
Bibliography	59

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 3, *Ropes*.

This fifth edition cancels and replaces the fourth edition (ISO 4309:2010), which has been technically revised and contains the following changes:

- magnetic rope test (MRT) methodology and discard criteria are introduced, as an aid to the internal inspection of wire ropes;
- guidance is given on when to use magnetic rope testing and how to combine its results with other inspection results;
- an example of an MRT report is provided.

Introduction

A wire rope on a crane is regarded as an expendable component, requiring replacement when the results of inspection indicate that its condition has diminished to the point where further use might be unsafe.

By following well-established principles such as those detailed in this document, along with any additional specific instructions provided by the manufacturer of the crane or hoist and/or by the manufacturer of the rope, this point should never be exceeded.

When correctly applied, the discard criteria given in this document are aimed at retaining an adequate safety margin. Failure to recognize them can be extremely harmful, dangerous and damaging.

To assist those who are responsible for “care and maintenance” as distinct from those who are responsible for “inspection and discard”, the procedures are conveniently separated.

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Cranes — Wire ropes — Care and maintenance, inspection and discard

1 Scope

This document establishes general principles for the care and maintenance, and inspection and discard of steel wire ropes used on cranes and hoists.

In addition to guidance on storage, handling, installation and maintenance, this document provides discard criteria for those running ropes which are subjected to multi-layer spooling, where both field experience and testing demonstrate that deterioration is significantly greater at the crossover zones on the drum than at any other section of rope in the system.

It also provides more realistic discard criteria covering decreases in rope diameter and corrosion, and gives a method for assessing the combined effect of deterioration at any position in the rope.

This document is applicable to those ropes used on the following types of cranes, the majority of which are defined in ISO 4306-1:

- a) cable and portal cable cranes;
- b) cantilever cranes (pillar jib, wall or walking);
- c) deck cranes;
- d) derrick and guy derrick cranes;
- e) derrick cranes with rigid bracing;
- f) floating cranes;
- g) mobile cranes;
- h) overhead travelling cranes;
- i) portal or semi-portal bridge cranes;
- j) portal or semi-portal cranes;
- k) railway cranes;
- l) tower cranes;
- m) offshore cranes, i.e. cranes mounted on a fixed structure supported by the sea bed or on a floating unit supported by buoyancy forces.

This document applies to rope on cranes, winches and hoists used for hook, grabbing, magnet, ladle, excavator or stacking duties, whether operated manually, electrically or hydraulically.

It also applies to rope used on hoists and hoist blocks.

NOTE In view of the fact that the exclusive use of synthetic sheaves or metal sheaves incorporating synthetic linings is not recommended when single-layer spooling at the drum, due to the inevitability of wire breaks occurring internally in large numbers before there is any visible evidence of any wire breaks or signs of substantial wear on the periphery of the rope, no discard criteria are given for this combination.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4301-1:1986,¹⁾ *Cranes and lifting appliances — Classification — Part 1: General*

ISO 17893, *Steel wire ropes — Vocabulary, designation and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17893 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

3.1
nominal diameter
 d
diameter by which the rope is designated

3.2
measured diameter
actual diameter
 d_m
average of two measurements, taken at right angles to one another, of the diameter that circumscribes the rope cross-section

3.3
reference diameter
 d_{ref}
measured diameter (3.2) of a section of rope that is not subject to bending, taken directly after running in the new rope

3.4
crossover zone
that portion of rope coincident with a crossing over of one wrap by another as the rope traverses the drum or rises from one layer to the next at the drum flange

3.5
wrap
one revolution of rope around a drum

3.6
reel
flanged spool on which rope is wound for shipment or storage

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Note 1 to entry: This diameter is used as the baseline for uniform change in diameter.

1) This edition of ISO 4301-1 has been provisionally retained.

3.7**wire rope periodic inspection**

in-depth visual inspection of the rope plus measurement of the rope and, if practicable, an assessment of its internal condition

Note 1 to entry: If required, this may include an *MRT* (3.11) performed by a person competent in the operation of MRT equipment and interpretation of trace data.

3.8**competent person**

person having such knowledge and experience of wire ropes on cranes and hoists as is necessary for that person to assess the condition of the rope, make a judgement as to whether it may remain in service and stipulate the maximum time interval between inspections

Note 1 to entry: If an *MRT* (3.11) is required, it has to be performed by a competent person in that discipline.

3.9**valley wire break**

wire break that occurs at the inter-strand contact point or valley area between two outer strands

Note 1 to entry: Outer wire breaks that also occur within the rope anywhere between one valley area and the next — see [Figure 1](#) — including any strand-core breaks, may also be regarded as valley wire breaks. The red lines indicate the contact points and the location of the valley breaks.

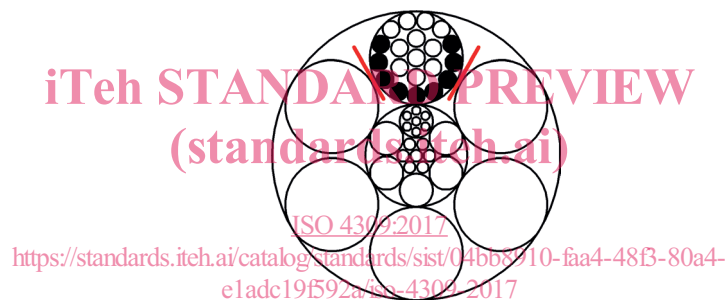


Figure 1 — Position of valley breaks

3.10**severity rating**

amount of deterioration expressed as a percentage towards discard

Note 1 to entry: The rating may relate to either an individual mode of deterioration [e.g. broken wires, decrease in diameter or loss of metallic area as detected by *MRT* (3.11)] or the combined effect of more than one mode of deterioration, e.g. broken wires and decrease in diameter.

3.11**magnetic rope test****MRT**

non-destructive testing (NDT) based on the measurement of the magnetic flux leakage of a magnetized rope

3.12**test head**

device on that part of the *MRT* (3.11) instrument positioned around the rope during testing which generates the magnetizing field and contains the detecting or sensing elements

3.13

base trace

signals on the *MRT* (3.11) recording display as the rope travels through the test head on the first occasion that it is tested

Note 1 to entry: The trace is the datum against which future in-service deterioration effects are compared. The trace reflects the construction of the rope and changes in magnetic characteristics of the rope along its length, e.g. magnetic permeability differences.

3.14

local fault

local flaw

LF

short discontinuity in the wire rope, such as a wire break, welded wire, corrosion pit or inter-strand nicking

3.15

loss of metallic area

LMA

change in metallic cross-sectional area expressed as percentage of nominal metallic cross-sectional area of the new rope

Note 1 to entry: Loss of metallic area is normally associated with damage such as uniform corrosion, wear, abrasion/mechanical damage or wire breaks.

4 Care and maintenance

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4.1 General

In the absence of any instructions provided by the manufacturer of the crane in the operator's manual and/or provided by the manufacturer or supplier of the rope, the general principles given in 4.2 to 4.7 shall be followed.

4.2 Rope replacement

Unless an alternative rope has been approved by the crane manufacturer, rope manufacturer or other competent person, only a rope of the correct length, diameter, construction, type and direction of lay and strength (i.e. minimum breaking force), as specified by the crane manufacturer, shall be installed on the crane. A record of the rope change shall be placed on file.

In the case of larger-diameter, rotation-resistant ropes, it may be necessary to apply additional means of securing the rope ends, e.g. through the use of steel straps or servings, particularly when preparing samples for testing.

If the length of rope required for use is to be cut from a longer length, such as a bulk-manufactured reel of rope, servings shall be applied at both sides of the intended cutting point to prevent the rope from unlaying (i.e. unravelling) after the cut has been made.

Figure 2 shows an example of how a single-layer rope should be served before cutting. For rotation-resistant and parallel-closed ropes, multiple-length servings may be necessary. An alternative method for larger-diameter, rotation-resistant ropes is shown in Figure 3. Ropes that are only lightly preformed are more likely to unlay/unravel after cutting, if inadequate or insufficient servings are applied.

NOTE Serving is sometimes referred to as "seizing".

Unless an alternative rope termination has been approved by the crane manufacturer, rope manufacturer or other competent person, only one of a type, as specified by the crane manufacturer in the operator's manual, shall be used to attach a rope to a drum, hook block or anchor point on the machinery structure.

It is beneficial to take a base trace for the MRT by testing the rope before installation or as soon as practical after installation.

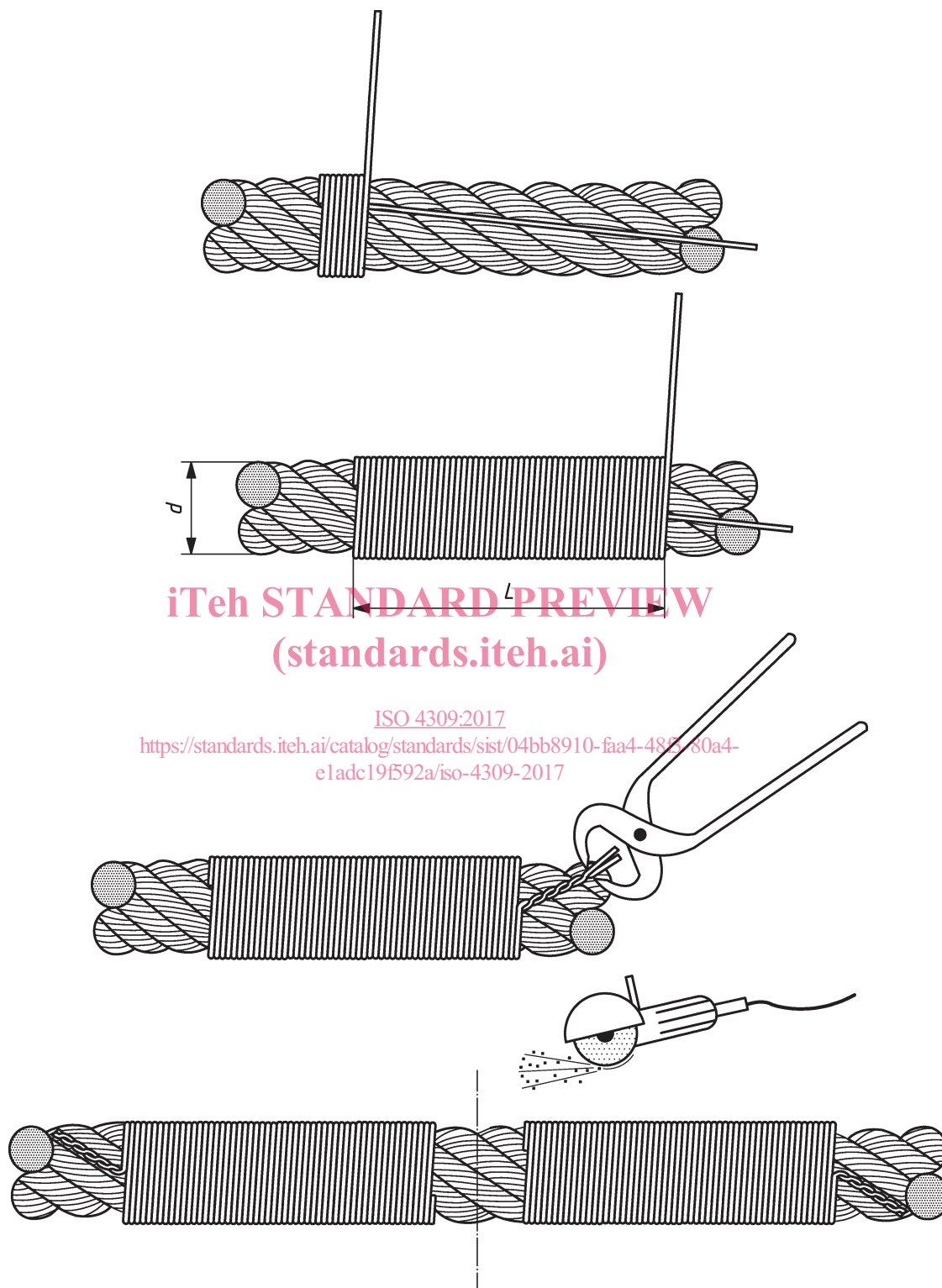


Figure 2 — Application of serving prior to cutting of single-layer type rope



Figure 3 — Alternative serving and cutting method for large diameter rotation-resistant rope

4.3 Offloading and storing the rope

To avoid accidents and/or damage to the rope, it should be offloaded with care.

Reels or coils of rope shall not be dropped, neither shall they be struck by a metal hook or fork of a lift truck or any other external force that could damage or deform the rope.

Ropes should be stored in a cool, dry building and should not be allowed to be in contact with the floor. They should not be stored where they are likely to be affected by chemicals, chemical fumes, steam or other corrosive agents.

If outdoor storage cannot be avoided, ropes should be covered so that moisture cannot induce corrosion.

Ropes in storage shall be checked periodically for any signs of deterioration such as surface corrosion and, if deemed necessary by a competent person, dressed with a suitable preservative or lubricant which is compatible with the rope manufacturing lubricant.

In warm environments, the reel should be periodically rotated one half-turn to prevent drainage of lubricant from the rope.

4.4 Condition of the rope prior to installation

Before installing the rope, and preferably on receipt, the rope and its certificate should be checked to ensure that the rope is in accordance with that ordered.

The minimum breaking force of the rope to be installed shall not be lower than that specified by the crane manufacturer.

The diameter of the new rope shall be measured in a straight section with the rope under no tension and the value (d_m) recorded.

Where a wire rope has been kept in storage for a period of time during which corrosion might have occurred, it may be advantageous to perform visual inspection and an MRT.

Check the condition of all sheave and drum grooves to ensure that they are capable of accepting the size of the new rope, do not contain any irregularities, such as corrugations, and have sufficient remaining thickness to safely support the rope.

The sheave groove diameter should be between 5 % and 10 % larger than the nominal rope diameter. For optimal performance the groove diameter should be at least 1 % greater than the actual diameter of the new rope.

4.5 Installing the rope

When uncoiling and/or installing a wire rope, every precaution shall be taken to avoid inducing turn into, or out of, the rope. Allowing this to occur can result in the formation of loops, kinks or bends in the rope, rendering it unfit for use.

In order to prevent any of these developing, the rope should be paid out in a straight line with a minimum of slack being allowed to occur (see [Figure 4](#)).

Rope supplied in a coil should be placed on a turntable and paid out straight; however, where the coiled length is short, the outer rope end may be made free and the remainder of the rope rolled along the ground [see [Figure 4 a](#)].

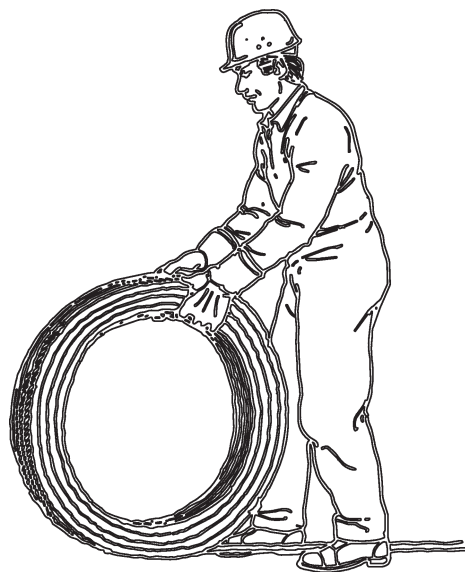
A rope shall never be paid out by throwing off wraps when the coil or reel is flat on the ground or by rolling the reel along the ground (see [Figure 5](#)).

For those lengths of rope supplied on a reel, place the supply reel and its supporting stand or cradle as far away from the crane or hoist as possible, in order to limit any fleet angle effects to an absolute minimum and thus avoid any undesirable rotational effects.

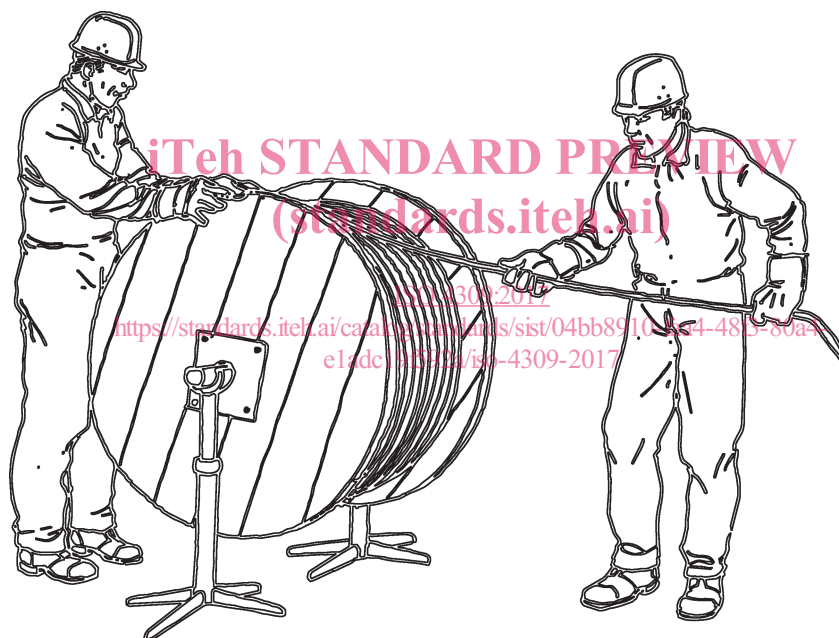
Protect the rope from any potential ingress of grit or other contaminants by running it on suitable matting (e.g. used conveyor belting), rather than allowing it to run directly on the ground.

Be aware that a revolving reel of rope can have a high inertia, in which case it needs to be controlled in order to slowly pay out the rope. For smaller reels, this is usually achieved by employing a single brake (see [Figure 6](#)). Larger reels have significant inertia once they start to revolve and might need to be substantially braked.

As far as is practicable, ensure that the rope always bends in the same direction during installation, i.e. pay out the rope from the top of the supply reel to the top of the drum on the crane or hoist (referred to as “top-to-top”), or from the underneath of the supply reel to the underneath of the drum on the crane or hoist (referred to as “bottom-to-bottom”). For an example of “bottom-to-bottom”, see [Figure 6](#).

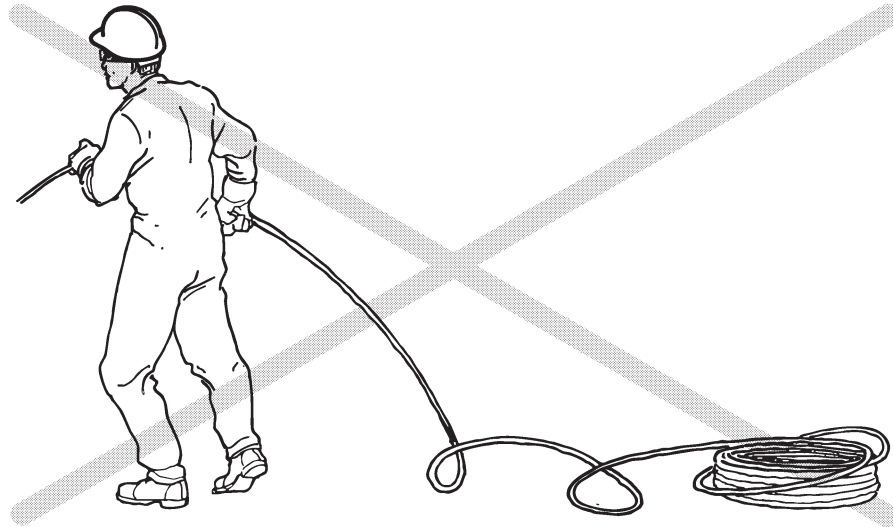


a) From coil



b) From reel

Figure 4 — *Correct procedures for uncoiling wire rope*



a) From coil

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b) From reel