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

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Health, Labour and Welfare and the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Crane Association (JCA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS B 8836:2007** is replaced with this Standard.

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

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 4309:2017**, Edition 5, with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard establishes general principles for the care and maintenance, inspection and discard of steel wire ropes used on cranes specified in **JIS B 0146-1** (hereafter referred to as ropes).

In addition to guidance on care, maintenance and inspection, this Standard 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 Standard is applicable to those ropes used on hoists and hoist blocks.

NOTE 1 In view of the fact that when using synthetic sheaves or metal sheaves incorporating synthetic linings, wire breaks may occur internally in large numbers before there is any visible evidence of any wire breaks or signs of substantial wear on the rope, use of discard criteria for this case is not recommended.

NOTE 2 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 4309:2017 *Cranes—Wire ropes—Care and maintenance, inspection and discard* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0146-1 *Cranes—Vocabulary—Part 1: General*

JIS B 8835-1 *Cranes and lifting appliances—Selection of wire ropes—Part 1: General*

JIS G 3525 *Wire ropes*

JIS G 3546 *Wire ropes with profile wires*

ISO 2408 *Steel wire ropes—Requirements*

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

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS B 0146-1**, **JIS B 8835-1**, **JIS G 3525**, **JIS G 3546**, **ISO 17893** and the followings apply.

3.1

nominal diameter, d

diameter by which the rope is designated

3.2

measured diameter, actual diameter, d_m

average of two or three measurements, taken in two or three different directions, of the diameter that circumscribes the same cross-section of the rope according to the method appropriate to the number of outer strands of the rope (see Annex JA)

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

NOTE This diameter is used as the baseline for severity rating.

3.4

crossover zone

that portion of rope that winds in different direction than normal winding direction such as when the rope rises from one layer to the next at the drum flange, due to the type of drum groove or condition of the underlayer rope

3.5

wrap

one revolution of rope around a drum

3.6

reel

flanged spool on which rope is wound for shipment or storage

NOTE A reel can be of wooden or steel construction depending on the mass of rope wound.

3.7

wire rope periodic inspection

in-depth visual inspection of the rope plus measurement of the rope actual diameter (3.2) and, if practicable, an assessment of its internal condition

NOTE 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 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

3.9

valley wire break

wire break that occurs at the inter-strand contact point or valley area between two outer strands (black-filled circles in Figure 1)

NOTE 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.

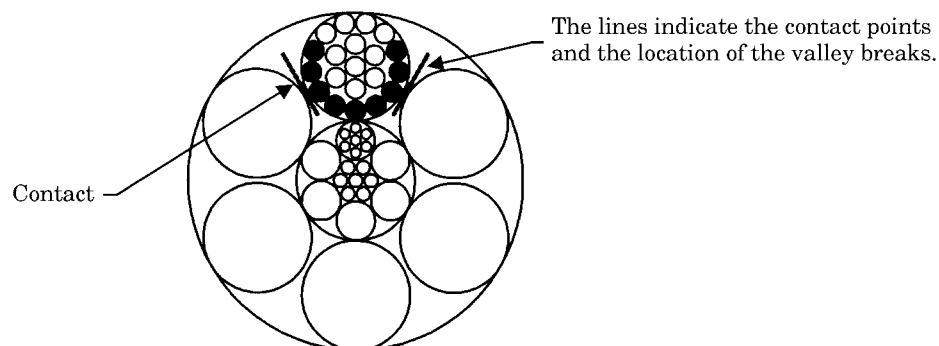


Figure 1 Position of valley wire breaks

3.10

severity rating

amount of deterioration expressed as a percentage towards discard

NOTE 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, normally performed by a competent person

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 element

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 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 difference.

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 metallic of area, LMA

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

NOTE Loss of metallic area is normally associated with damage such as uniform corrosion, wear, abrasion/mechanical damage or wire breaks.

3.16

seizing

securing of the rope end by winding a thin wire or strand adequate times around the rope in vicinity of the rope end

4 Care and maintenance

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 4.8 shall be followed.

4.2 Replacement

Only a rope of the correct length, diameter, construction, type and direction of lay and strength, as specified by the crane manufacturer, shall be installed on the crane. Provided it is approved by the crane manufacturer, rope manufacturer or other competent person, however, an alternative rope may be used.

The rope length shall be such that at least two wraps would remain on the drum when the lifted load or the jib is at the lowest position.

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.

If the length of rope required for use is to be cut from a longer length, such as a bulk-manufactured reel of rope, seizing shall be performed 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 a) to d) show an example of how a single-layer rope should be seized before cutting. For rotation-resistant and parallel-closed ropes, greater-length seizing may be necessary. An alternative method for larger-diameter, rotation-resistant ropes is shown in Figure 3. Ropes are more likely to unlay/unravel after cutting, if inadequate or insufficient seizing is applied.

Unless an alternative rope seizing 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.

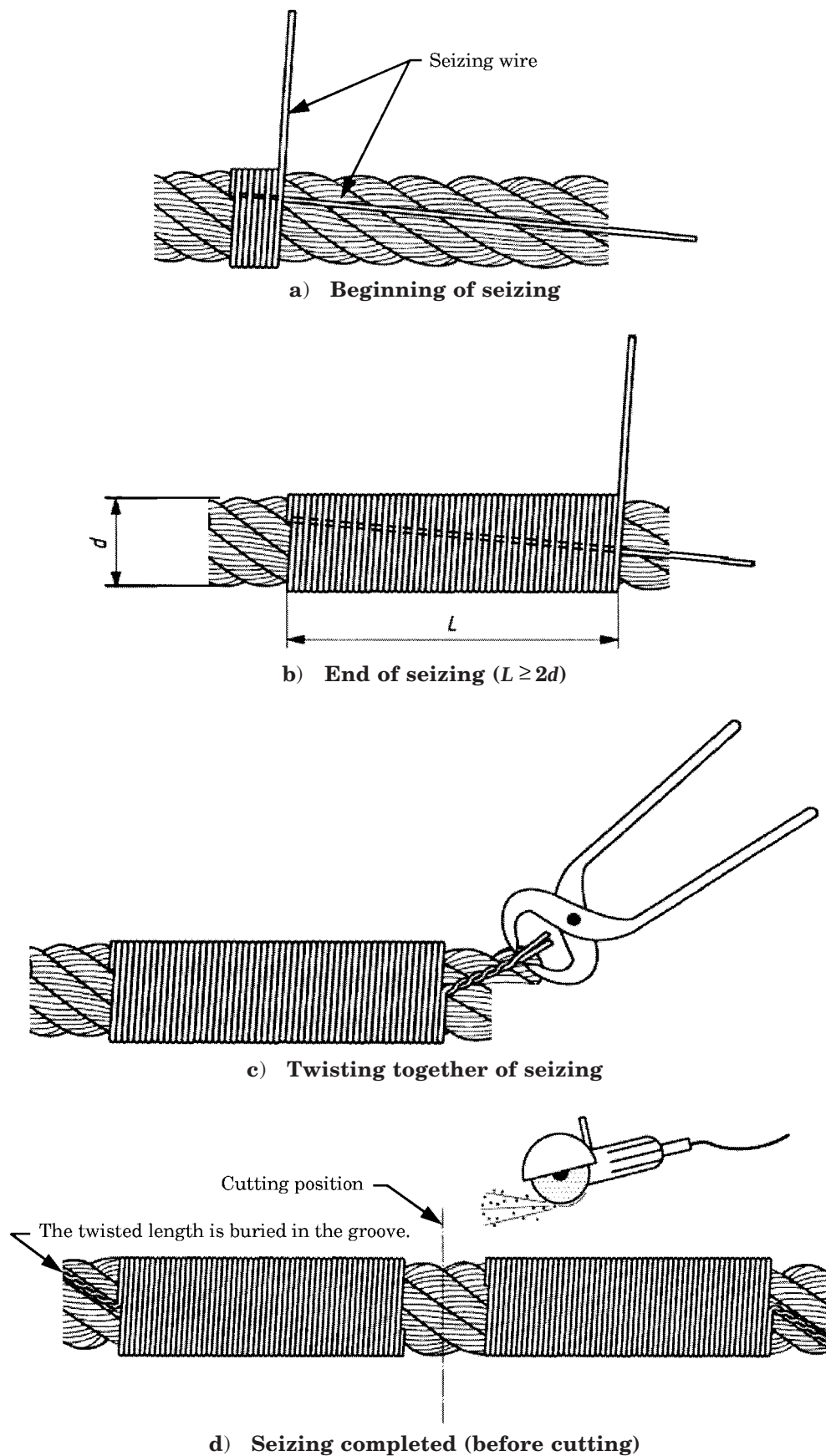


Figure 2 Application of seizing prior to cutting of single-layer type rope



Figure 3 Alternative seizing 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, the rope 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.

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 7 % and 10 % larger than the nominal rope diameter.

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 development of these defects, 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).

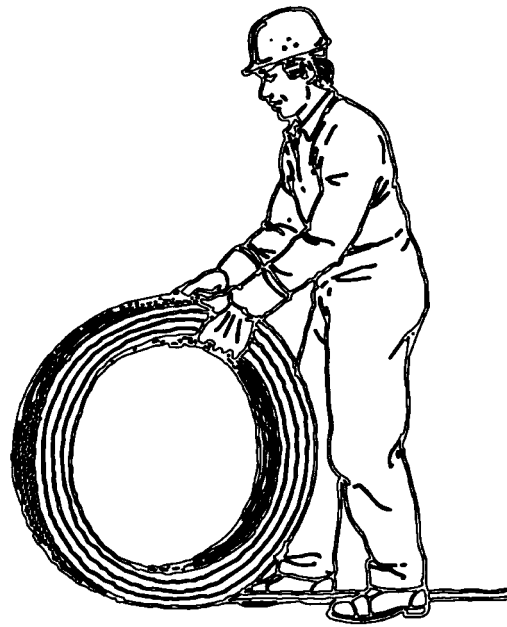
For those lengths of rope supplied on a reel, place the supply reel and its supporting stand or cradle as far away from the crane or hoist as possible, in order to limit any fleet angle effects to an absolute minimum and thus avoid any undesirable rotational effects.

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.

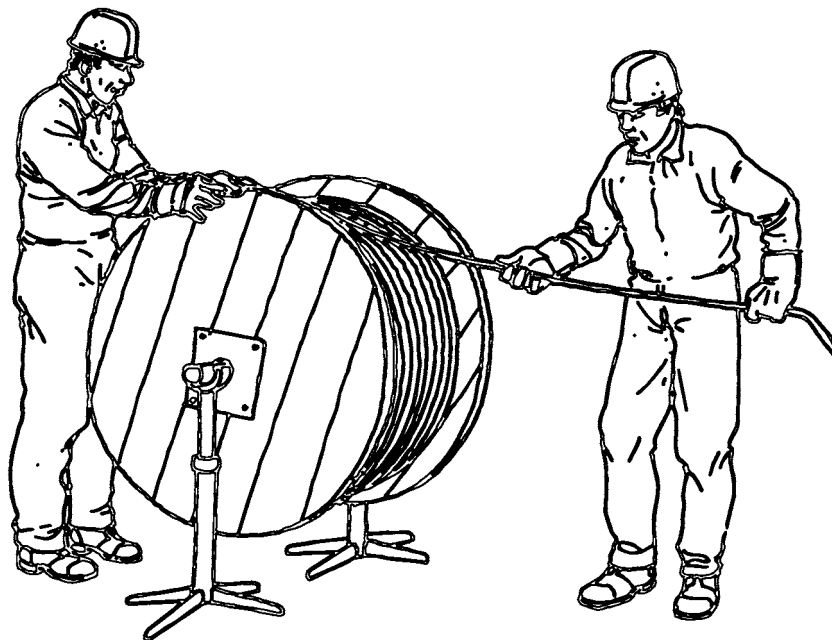
Be aware that a revolving reel of rope can have a high inertia, in which case it needs to be controlled in order to slowly pay out the rope. For smaller reels, this is usually achieved by employing a single brake (see Figure 6).

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”) (see Figure 6).

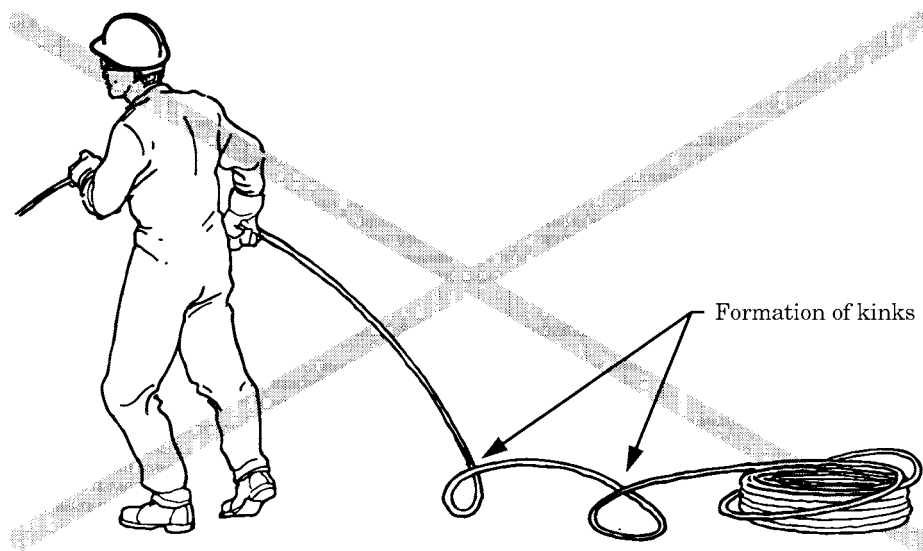


a) From coil



b) From reel

Figure 4 Correct procedures for uncoiling wire rope

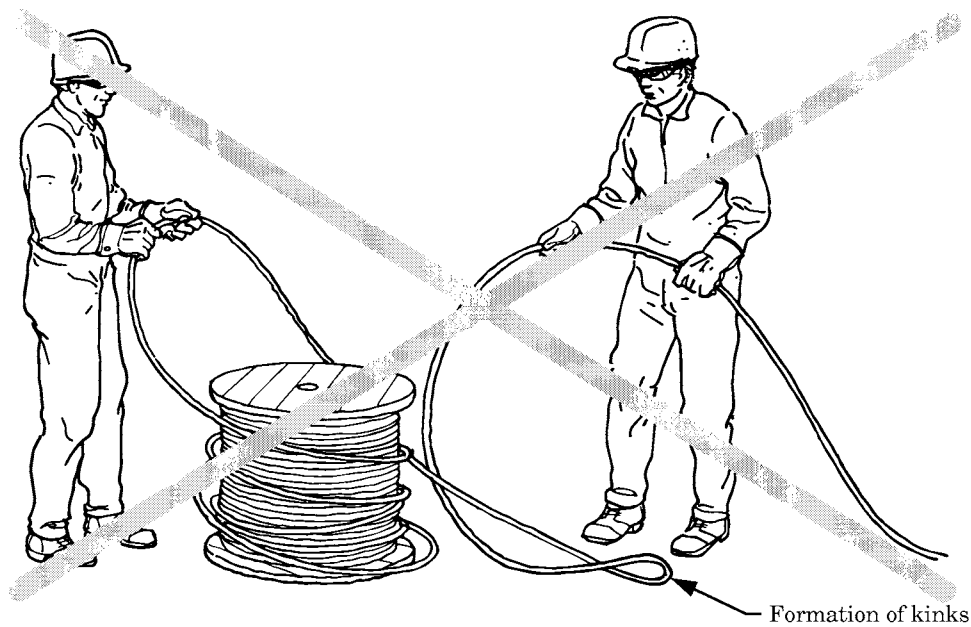


a) From coil



b) From reel

Figure 5 Incorrect procedures for uncoiling wire rope



c) From reel

Figure 5 (concluded)

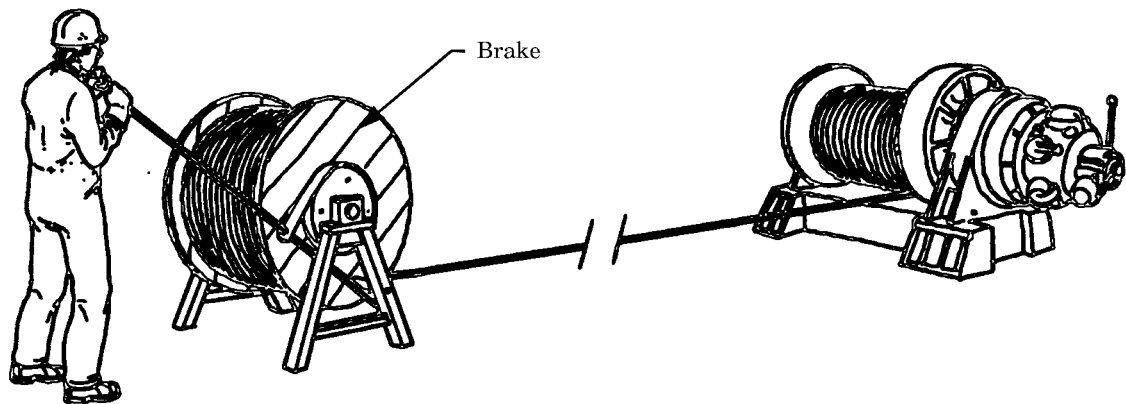


Figure 6 Example of transfer of wire rope from bottom of reel to bottom of drum with control of rope tension

For those ropes that are subjected to multi-layer spooling, apply a back-tension to the rope during installation equivalent to about 2.5 % to 5 % of the minimum breaking force of the rope. This helps ensure that the rope on the bottom layer is tightly wound, forming a firm base for succeeding layers.

Follow the crane manufacturer's instructions for the securing of the ends of the rope at the drum and outboard anchorages.

Protect the rope from rubbing against any part of the crane or hoist during installation.

4.6 Running-in the new rope

Before bringing the rope into full operation on the crane, ensure that all hoisting limiting and indicating devices associated with the operation of the crane are correctly functioning.

In order to allow the components of the rope to better adjust to the normal operating conditions, the crane should be operated at reduced speed and loading [i.e. down to at least 10 % of the working load limit (WLL)] for a number of operational cycle.

4.7 Maintaining the rope

Maintenance of the rope shall be carried out relative to the type of crane, its frequency of use, the environmental conditions and the type of rope.

During the life of the rope, and before it shows any signs of dryness or corrosion — particularly over those lengths which travel through sheaves and enter and exit the drum and those sections which are coincident with a compensating sheave — the rope shall be dressed from time to time, as determined by a competent person. In some cases, it may be necessary to clean the rope before applying the dressing in order for it to be effective.

The rope dressing shall be compatible with the original lubricant applied by the rope manufacturer and shall have penetrating characteristics. If the type of rope dressing is not identified in the crane manual, the user shall seek guidance from the crane manufacturer or the wire rope manufacturer.

A shorter rope life is likely to result from a lack of maintenance, particularly if the crane or hoist is used in a corrosive environment or, for whatever reason, no rope dressing can be applied. In such cases, the period between inspections shall be reduced accordingly.

In order to avoid any localized deterioration, which might otherwise originate from a broken wire protruding excessively from the rope and overlying others when that portion travels through a sheave, it may be removed by gripping the protruding end(s) and bending the wire backwards and forwards (see Figure 7), until it eventually breaks (invariably in the valley position between the strands). When a broken wire is removed from the rope as part of a maintenance exercise, its location should be recorded for the information of the rope inspector. If such action is taken, this shall be counted as a broken wire and taken into account when assessing the condition of the rope in relation to the discard criteria for broken wires.

When broken wires are evidently close to or at the termination, but the rope is unaffected elsewhere along its length, the rope may be shortened and the terminal fitting refitted. Before this is done, the remaining length of wire rope shall be checked to ensure that the two or more wraps would remain on the drum with the crane at its most extreme operating limit.

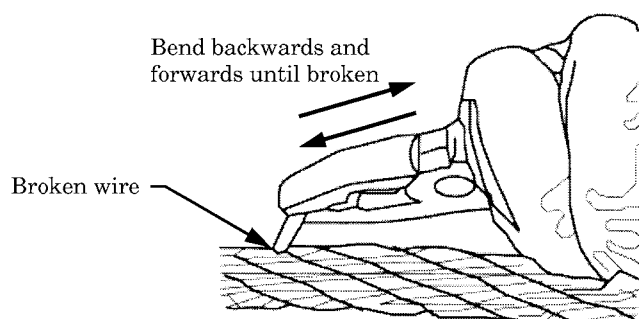


Figure 7 Removal of protruding wire

4.8 Maintenance of rope-related parts of the crane

In addition to following the instructions contained in the crane manual, winding drums and sheaves shall be periodically checked to ensure that they rotate freely in their bearings.

NOTE Stiff or jammed sheaves or rollers wear heavily and unevenly, causing severe abrasion of the rope. Ineffective compensating sheaves can give rise to loosening of the rope which causes unequal loading in the rope reeving.

5 Inspection

5.1 General

In the absence of any particular instructions regarding inspection provided by the manufacturer of the crane in the operator's manual and/or by the manufacturer or supplier of the rope, the general principles for inspection given in **5.2** to **5.6** shall be followed.

5.2 Daily visual inspections

At least the intended working section of rope for that particular day shall be observed with the objective of detecting any general deterioration or mechanical damage. This shall include the points of attachment of the rope to the crane shown in Annex A.

The rope shall also be checked to ensure that it is sitting correctly on the drum and over the sheave(s) and has not been displaced from its normal operating position.

Any appreciable change in condition shall be reported and the rope examined by a competent person in accordance with **5.3**.

If, at any time, the rigging arrangement is modified, such as when the crane has been moved to a new site and re-rigged, the rope shall be subjected to a visual inspection as described in this subclause.

The driver/operator of the crane may be appointed to carry out daily checks to the extent that the driver/operator is sufficiently trained and considered competent to carry out this action.

5.3 Periodic inspections

5.3.1 General

Periodic inspections shall be carried out by a competent person.

The information gained from a periodic inspection is to be used to assist in deciding whether a crane rope

- a) can safely remain in service until it shall undergo its next periodic inspection, or
- b) needs to be withdrawn immediately or within a specified timeframe.

Through an appropriate assessment method, i.e. by visual means and/or measurement, or with an MRT, the severity of deterioration shall be assessed and expressed either as a percentage (e.g. 20 %, 40 %, 60 %, 80 % or 100 %) of the particular individual discard criteria or in words (e.g. "Slight", "Medium", "High", "Very high" or "Discard").

Any damage that might have occurred to the rope prior to it being run in and entering service shall be assessed by a competent person and observations shall be recorded.

A list of the more common modes of deterioration and assessment methods is given in Table 1.

Table 1 Modes of deterioration and assessment methods

Mode of deterioration	Assessment method
Number of visible broken wires (including those which are randomly distributed, localized groupings, valley wire breaks and those that are at, or in the vicinity of, the termination)	By counting
Loss of metallic area caused by broken wire	Visual, MRT
Decrease in rope diameter (resulting from external wear/abrasion, internal wear and core deterioration)	By measurement
Loss of metallic area caused by mechanism other than broken wires e.g. corrosion, wear, etc.	Visual, MRT
Fracture of strand(s)	Visual
Corrosion (external and internal)	Visual, MRT
Deformation	Visual and by measurement (wave only)
Mechanical damage	Visual
Heat damage (including electric arcing)	Visual

For some examples of typical modes of deterioration, see Annex B.

5.3.2 Frequency

The frequency of the periodic inspection shall be determined by the competent person, who shall take account of at least the following:

- the statutory requirements covering the application in the country of use;
- the type of crane and the environmental conditions in which it operates;
- the classification group of the mechanism;
- the results of previous inspection(s);
- experience gained from inspecting ropes on comparable cranes;
- the length of time the rope has been in service;
- the frequency of use;
- the crane manufacturer's recommendations.

As determined by a competent person, the ropes shall be subject to inspection at least once a month.

The competent person can find it prudent to initiate or recommend more frequent periodic inspections than those required by legislation. This decision can be influenced by the type and frequency of operation. Also, depending on the condition of the rope at any time and/or whether there is any change in circumstances, such as an incident or change in operating conditions, the competent person can deem it necessary to reduce or recommend the reduction of the interval between periodic inspections.

NOTE Generally, ropes develop broken wires at a greater rate later in the life of the rope than in its early stages.

5.3.3 Extent of inspection

Each rope shall be inspected over its entire length.

However, in the case of a long length, and at the discretion of the competent person, only the working length plus at least five wraps on the drum may be inspected. In such a case, and where a greater working length is subsequently observed after the previous inspection and prior to the next one, that additional length plus five wraps on the drum should also be inspected before the additional length of rope is used. Particular care shall nevertheless be taken at the following critical areas and locations:

- a) drum anchorage;
- b) any section at, and in the vicinity of, a rope termination;
- c) any section that travels through one or more sheaves;
- d) any section that travels through a safe load indicator which incorporates sheaves;
- e) any section that travels through the hook block;
- f) in the case of cranes performing a repetitive operation, any part of the rope that lies over a sheave while the crane is in a loaded condition;
- g) that part of the rope which lies over a compensating sheave;
- h) any section that travels through a spooling device;
- i) those sections that spool on the drum, particularly crossover zones that are associated with multilayer spooling;
- j) any section that is subjected to abrasion by external features (e.g. hatch combings);
- k) any part of rope that is exposed to heat.

Key areas requiring particularly close inspection are described in Annex A.

In this regard, an MRT can provide an additional source of useful information (see **5.6**) for a competent person to judge whether or not the rope has internal deterioration.

5.3.4 Inspection at, or in the vicinity of, a termination

Termination and its vicinity is vulnerable to the onset of wire breaks due to vibration and other dynamic effects and, depending on the state of the environment, corrosion. Some probing with a spike may be carried out to establish if there is looseness in any of the wires, suggesting the existence of a broken wire within the termination. The termination itself should also be inspected for any excessive amounts of distortion and wear.

Additionally, ferrules used in the securing of eyes or loops shall be visually inspected for any cracks in the material and for evidence of any possible slippage between the ferrule and the rope.

Detachable terminations such as symmetrical wedge sockets shall be inspected for evidence of any broken wires in the vicinity of the entry of the rope into the termination and checked to see that the termination has been correctly assembled.

Eye splices shall be checked to see that the seizing is only over the tapered section of the splice, thus allowing the remainder of the splice to be visually inspected for broken wires.

5.3.5 Inspection record

After each periodic inspection, the competent person shall provide a rope inspection record (for typical examples, see Annex D), and state the maximum time interval that is not to be exceeded before the next periodic inspection takes place.

Preferably, a running record (see **D.2**) should be maintained.

5.4 Inspection following an incident

If an incident has occurred that might have caused damage to a rope and/or its termination, the rope and/or its termination shall be inspected as for a periodic inspection (see **5.3**), prior to recommencement of work or as required by the competent person.

Where a twin rope hoisting system is employed, it is often necessary to replace both ropes even if only one has reached discard criteria defined in Clause **6**, because the new rope is larger than the one remaining and has a different elongation property, which can both have an effect on the respective amounts of rope being paid out from the drum.

5.5 Inspection following period with crane out of operation

If the crane has been out of operation for three months or longer, the rope(s) shall undergo a periodic inspection, as described in **5.3**, prior to recommencement of work.

5.6 Inspection by magnetic rope test method

An MRT may be used as an aid to periodic inspection to determine the location of those sections of rope that could be subject to deterioration.

If it is intended to carry out an MRT as an element in periodic inspection, the rope should be subjected to an initial examination (base trace) as soon as possible in its lifetime to serve as a “datum” reference point for future comparison.

An MRT should be used where defects might exist which might not be identified by visual inspection alone and shall be performed together with a visual inspection.

6 Discard criteria

6.1 General

In the absence of any instructions provided by the manufacturer of the crane in the operator’s manual or provided by the supplier or manufacturer of the rope, the individual discard criteria given in **6.2** to **6.7** shall apply (for useful information in support of these criteria, see Annex E).

As deterioration often results from a combination of different modes at the same position in the rope, the competent person shall assess the “combined effect”, one method of which is described in Annex F.

If, for whatever reason, there is a noticeable change in the rate of deterioration of the rope, the reason for this shall be investigated and, wherever possible, corrective action taken. In extreme cases, the competent person may decide to discard the rope,

reduce the time for the next periodic inspection, or amend the discard criteria, for example by reducing the allowable number of visible broken wires.

In those instances where a rope of long length has suffered deterioration over a relatively short section, the competent person may decide that it is not necessary to discard the whole length of rope, provided that the affected section can be satisfactorily removed and the remaining length is in a serviceable condition.

6.2 Visible broken wires

6.2.1 General

Discard criteria for broken wires shall be regarded as being met when the number of broken wires in a rope is found to be 10 % or more of the total number of wires (excluding filler wires or steel cores of ropes with a steel core) in a rope lay length (approximately equivalent to a length of $6d$). Criteria for visible broken wires, given in 6.2.2 to 6.2.4, may be applied.

6.2.2 Criteria for visible broken wires

The discard criteria for the various natures of visible broken wire shall be as specified in Table 2.

Table 2 Discard criteria for visible broken wires

	Nature of visible broken wire	Discard criteria
1	Wire breaks occurring randomly in sections of rope which run through one or more metal sheaves and spool on and off the drum when single-layer spooling or occurring at sections of rope which are coincident with cross-over zones when multi-layer spooling ^{a)}	See Table 3 for single-layer and parallel-closed ropes and Table 4 for rotation-resistant ropes.
2	Localized grouping of wire breaks in sections of rope which do not spool on and off the drum	If grouping is concentrated in one or two neighbouring strands it might be necessary to discard the rope, even if the number is lower than the values over a length of $6d$, which are given in Tables 3 and 4.
3	Valley wire breaks ^{b)}	Two or more wire breaks in a rope lay length (approximately equivalent to a length of $6d$)
4	Wire breaks at a termination	Two or more wire breaks
Notes ^{a)} For a typical example, see Figure B.2. ^{b)} For a typical example, see Figure 8 and Figure B.3.		

6.2.3 Use of Tables 3 and 4 and rope category number

If the rope is a single-layer or parallel-closed rope, as shown in Annex G, apply the corresponding rope category number (RCN) and read off the discard values in Table 3 for broken wires over a length of $6d$ and $30d$. If the construction is not shown in Annex G, determine the total number of load-bearing wires in the rope (by adding together all of the wires in the outer layer of strands except for any filler wires) and read off the discard values in Table 3 for broken wires over a length of $6d$ and $30d$ for the appropriate conditions.