

## Product Safety: Instructions and Warnings on the use of steel wire rope

The following Instructions and Warnings combine to form guidance on Product Safety and are intended for use by those with a working knowledge of wire as well as the new user. They should be read, followed and passed on to others.

Failure to read, understand and follow these instructions could result in harmful and damaging consequences.

A "Warning ⚠️" statement indicates a potential hazardous situation which could result in a significant reduction in rope performance and/or put at risk, either directly or indirectly, the safety or health of those persons within the danger zone of the rope and its associated equipment.

### STORAGE

Unwrap the rope and examine immediately after delivery to verify that it is in accordance with the details on delivery documents.

Measurement of rope diameter should be carried out as shown in Fig 1.

Select a clean, well ventilated, dry area for storage, cover with waterproof material if conditions preclude inside

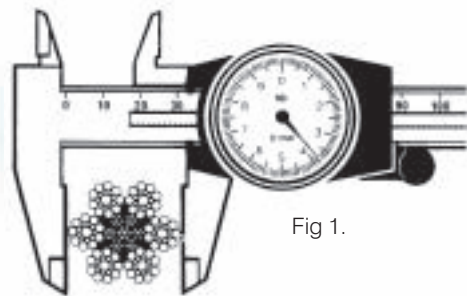


Fig 1.

storage. Rotate the reel periodically during long periods of storage, particularly in warm environments, to prevent migration of lubricant from the rope.

**Warning ⚠️** Never store wire rope in areas subject to elevated temperatures as this may seriously affect its future performance. In extreme cases its original as-manufactured strength may be severely reduced rendering it unfit for safe use

Support the reel clear of the floor so that there is a clear passage of air under the reel. Ensure that the rope is stored where it is not likely to be affected by chemical fumes, steam or other corrosive agents.

**Warning ⚠️** Failure to do so may result in the rope becoming contaminated with foreign matter and start the onset of corrosion before the rope is put to work.

Ensure the rope is stored and protected in such a way that it will not be exposed to accidental damage either during storage or in placing the rope into or taking it out of storage.

### HANDLING AND INSTALLATION

Handling and installation of the rope should be carried out in accordance with a detailed plan and should be

supervised by a competent person. Suitable protective clothing and equipment should be worn.

**Warning ⚠️** Incorrectly supervised handling and installation procedures may result in serious injury to persons in the vicinity of the operation as well as those directly involved in the process.

### Before Installation

Examine the rope visually to ensure that no damage or deterioration has occurred during storage or transportation. Check the working area for potential hazards that may affect the safe installation of the rope. Check the condition of the rope related equipment on the vessel. Include the following:

#### Drum

Check the general condition of the winch drum to ensure that it is in good condition with no damage or areas that will cause damage to the rope.

#### Sheaves (Pulleys)

Ensure that the groove is the correct shape and size for the new rope. Check that sheaves are free to rotate and in good condition. When a new rope is fitted a variation in size compared with the old worn rope will be apparent. The new rope may not fit correctly into the previously worn groove profile and unnecessary wear and rope damage may occur. This may be remedied by machining out the grooves before the new rope is fitted. Before this is done care should be taken to ensure that sufficient material is present to maintain strength in the sheave after machining.

#### Structure

Ensure that no part of the vessel's steelwork is positioned such that it will lie in the path of the rope between the installation drum and winch

**Warning ⚠️** Failure to carry out any of the above could result in unsatisfactory and unsafe rope performance.

### Installation

Installation of the rope should be carried out in the following manner:

Pass a shaft through the reel and place the reel in a suitable stand that allows it to rotate and be braked to avoid overrun during installation. The rope must be transferred from reel to winch drum in the correct manner, top to top or bottom to bottom. Fig 2

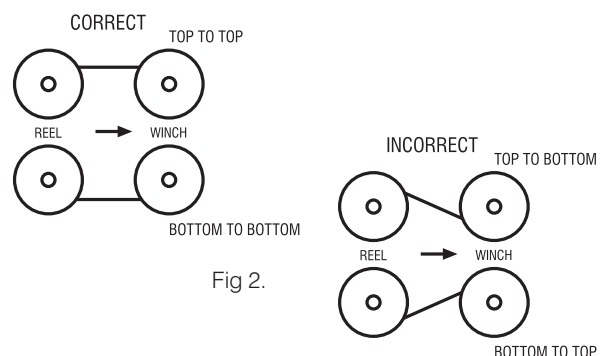
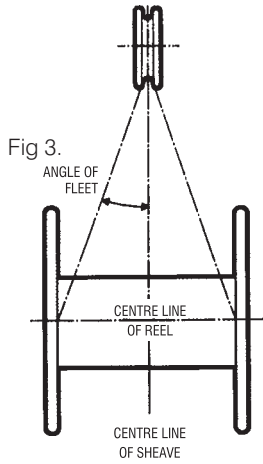
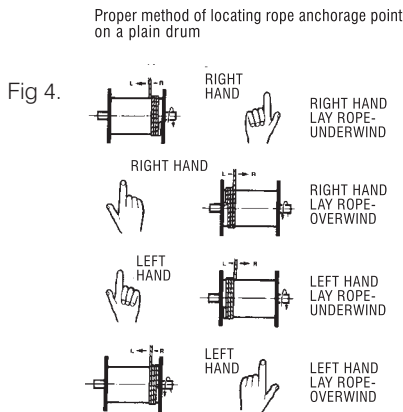


Fig 2.

The reel stand should be positioned to maintain a maximum fleet angle of 1.5 degrees. Correct block alignment and control of fleet angle is essential to avoid inducing "turn" in the rope **Fig 3**



The direction of coiling on the drum is important and should be related to the direction of lay of the rope to ensure close coiling. The correct method of locating the rope anchorage point on the winch drum is shown in **Fig 4**

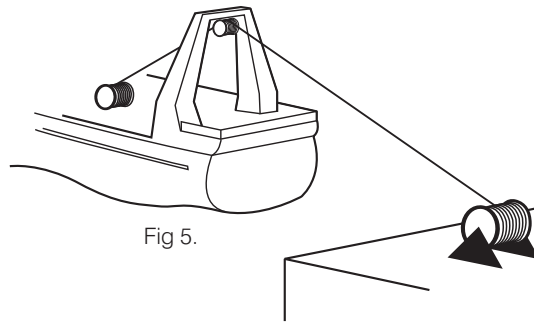


**Warning** ⚠ Any looseness or uneven winding will result in excessive wear, crushing and distortion of the rope. Ensure that the as-manufactured condition of the rope is maintained throughout the whole of the handling and installation operation.

**Warning** ⚠ Irregular coiling usually results in severe surface wear and rope malformation, which in turn is likely to cause premature rope failure

### Larger Vessels

For larger vessels with auto trawl systems and longer rope lengths the rope must be installed under as much tension as is safe and practical to ensure that the "under layers" are wound tightly on the drum. Bridon would recommend applying 5-10% of the M.B.L of the rope as back tension, when installing the rope onto the winch. A suitably anchored spooling machine may be used. **Fig 5**



**Warning** ⚠ Failure to carry out this procedure will allow movement and crushing of the rope on the drum.

### Smaller Vessels

Smaller vessels with simple winch systems and shorter rope lengths may install ropes using a braked reel, go to sea shoot the gear and use the tension generated to achieve good spooling. NB Twin rigged vessels with three drums on one shaft must ensure that all three ropes are installed and tensioned simultaneously to avoid spooling irregularities.

Ensure that the outboard end of the rope is released from the reel in a controlled manner. On release of the bindings used for packaging the rope will want to straighten, unless controlled this could be a violent action. Stand clear.

**Warning** ⚠ Failure to control could result in injury

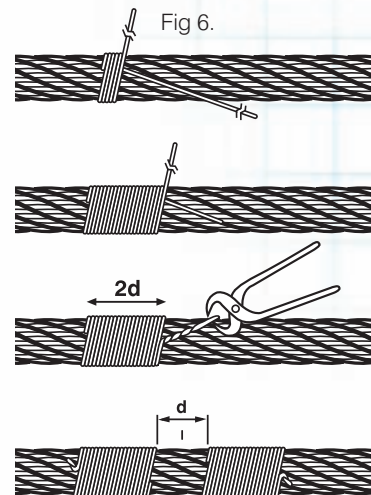
Care must be taken to avoid free end rotation of the rope end, which may cause un-laying or elongation.

Take particular care when the rope has to be cut. Apply secure servings on both sides of the cut mark using wireor strong twine. Each serving should be at least two rope diameters. Arrange and position the rope in such a manner that when cut the rope ends will remain in position, avoiding any backlash or other undesirable movement. **Fig 6**

**Warning** ⚠ Rope produced from carbon steel wires in the form shipped is not considered a health hazard. During subsequent processing (e.g. cutting, grinding and cleaning) dust and fumes may be produced which contain elements which may affect exposed workers.

Ideally cut the rope with an abrasive disc cutter, other suitable mechanical and hydraulic shearing equipment may be used if necessary. Ensure adequate ventilation during cutting to avoid any build up of fumes from the rope or any of its constituents.

**Warning** ⚠ Some special ropes contain synthetic material which, when heated to temperatures above normal processing temperatures may decompose and give off toxic fumes.



**d = rope diameter**

## Troubleshooting Guide

### Typical examples of Wire Rope deterioration

- 1 Mechanical damage due to rope movement over sharp edge projection whilst under load.



- 2 Localised wear due to abrasion on supporting structure.



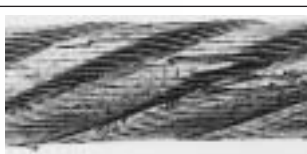
- 3 Narrow path of wear resulting in fatigue fractures, caused by working in a grossly oversize groove, or over small support rollers.



- 4 Two parallel paths of broken wires indicative of bending through an undersize groove in the sheave.



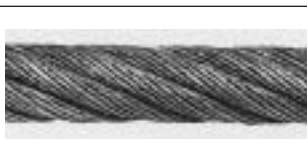
- 5 Severe wear, associated with high tread pressure.



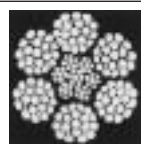
- 6 Severe wear in Lang's Lay, caused by abrasion.



- 7 Severe corrosion.



- 8 Internal corrosion whilst external surface shows little evidence of deterioration.



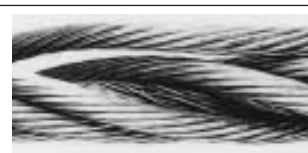
- 9 Typical wire fractures as a result of bend fatigue.



- 10 Wire fractures at the strand, or core interface, as distinct from 'crown' fractures.



- 11 Break up of IWRC resulting from high stress application.



- 12 Looped wires as a result of torsional imbalance and/or shock loading.



- 13 Typical example of localised wear and deformation.



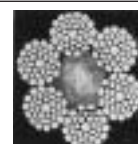
- 14 Multi strand rope 'bird caged' due to torsional imbalance.



- 15 Protrusion of rope centre resulting from build up of turn.







- 16 Substantial wear and severe internal corrosion.








## Troubleshooting Guide





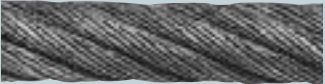

The following is a simplified guide to common wire rope problems. More detailed advice can be obtained from any Bridon distributor. In the event of no other standard being applicable, Bridon recommends that ropes are inspected/examined in accordance with ISO 4309.

Problem	Cause/Action
<p>Mechanical damage caused by the rope contacting the structure of the installation on which it is operating or an external structure - usually of a localised nature.</p> 	<ul style="list-style-type: none"> <li>• Generally results from operational conditions.</li> <li>• Check sheave guards and support/guide sheaves to ensure that the rope has not "jumped out" of the intended reeving system.</li> <li>• Review operating conditions.</li> </ul>
<p>Opening of strands in rotation resistant, low rotation and parallel closed ropes - in extreme circumstances the rope may develop a "birdcage distortion" or protrusion of inner strands.</p> <p><b>Note - rotation resistant and low rotation ropes are designed with a specific strand gap which may be apparent on delivery in an off tension condition. These gaps will close under load and will have no effect on the operational performance of the rope.</b></p> 	<ul style="list-style-type: none"> <li>• Check sheave and drum groove radii using sheave gauge to ensure that they are no smaller than nominal rope radius +5% - Bridon recommends that the sheave and drum groove radii are checked prior to any rope installation.</li> <li>• Repair or replace drum/sheaves if necessary.</li> <li>• Check fleet angles in the reeving system - a fleet angle in excess of 1.5 degrees may cause distortion.</li> <li>• Check installation method - turn induced during installation can cause excessive rope rotation resulting in distortion.</li> <li>• Check if the rope has been cut "on site" prior to installation or cut to remove a damaged portion from the end of the rope. If so, was the correct cutting procedure used? Incorrect cutting of rotation resistant, low rotation and parallel closed ropes can cause distortion in operation.</li> <li>• Rope may have experienced a shock load.</li> </ul>
<p>Broken wires or crushed or flattened rope on lower layers at crossover points in multi - layer coiling situations.</p> <p>Wire breaks usually resulting from crushing or abrasion.</p> 	<ul style="list-style-type: none"> <li>• Check tension on underlying layers. Bridon recommends an installation tension of between 2% and 10% of the minimum breaking force of the wire rope. Care should be taken to ensure that tension is retained in service. Insufficient tension will result in these lower layers being more prone to crushing damage.</li> <li>• Review wire rope construction. Dyform wire ropes are more resistant to crushing on underlying layers than conventional rope constructions.</li> <li>• Do not use more rope than necessary.</li> <li>• Check drum diameter. Insufficient bending ratio increases tread pressure.</li> </ul>
<p>Wires looping from strands.</p> 	<ul style="list-style-type: none"> <li>• Insufficient service dressing.</li> <li>• Consider alternative rope construction.</li> <li>• If wires are looping out of the rope underneath a crossover point, there may be insufficient tension on the lower wraps on the drum.</li> <li>• Check for areas of rope crushing or distortion.</li> </ul>

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<p>"Pigtail" or severe spiralling in rope.</p> 	<ul style="list-style-type: none"> <li>• Check that the sheave and drum diameter is large enough - Bridon recommends a minimum ratio of the drum/sheave to nominal rope diameter of 18:1.</li> <li>• Indicates that the rope has run over a small radius or sharp edge.</li> <li>• Check to see if the rope has "jumped off" a sheave and has run over a shaft.</li> </ul>
<p>Two single axial lines of broken wires running along the length of the rope approximately 120 degrees apart indicating that the rope is being "nipped" in a tight sheave.</p> 	<ul style="list-style-type: none"> <li>• Check sheave and drum groove radii using sheave gauge to ensure that they are no smaller than nominal rope radius + 5% - Bridon would recommend that the sheave/drum groove radii are checked prior to any rope installation.</li> <li>• Repair or replace drum/sheaves if necessary.</li> </ul>
<p>One line of broken wires running along the length of the rope indicating insufficient support for the rope, generally caused by oversize sheave or drum grooving.</p> 	<ul style="list-style-type: none"> <li>• Check to see if the groove diameter is no greater than 15% greater than the nominal rope diameter.</li> <li>• Repair or replace drum/sheaves if necessary.</li> <li>• Check for contact damage.</li> </ul>
<p>Short rope life resulting from evenly/randomly distributed bend fatigue wire breaks caused by bending through the reeving system.</p> <p>Fatigue induced wire breaks are characterised by flat ends on the broken wires.</p> 	<ul style="list-style-type: none"> <li>• Bending fatigue is accelerated as the load increases and as the bending radius decreases. Consider whether either factor can be improved.</li> <li>• Check wire rope construction - Dyform ropes are capable of doubling the bending fatigue life of a conventional steel wire rope.</li> </ul>
<p>Short rope life resulting from localised bend fatigue wire breaks.</p> <p>Fatigue induced wire breaks are characterised by flat ends on the broken wires.</p> 	<ul style="list-style-type: none"> <li>• Bending fatigue is accelerated as the load increases and as the bending radius decreases. Consider whether either factor can be improved.</li> <li>• Check wire rope construction - Dyform ropes are capable of doubling the bending fatigue life of a conventional steel wire rope.</li> <li>• Localised fatigue breaks indicate continuous repetitive bends over a short length. Consider whether it is economic to periodically shorten the rope in order to move the rope through the system and progressively expose fresh rope to the severe bending zone. In order to facilitate this procedure it may be necessary to begin operating with a slightly longer length of rope.</li> </ul>

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Problem	Cause/Action
<p>Core protrusion or broken core in single layer six or eight strand rope.</p> 	<ul style="list-style-type: none"> <li>• Caused by repetitive shock loading - review operating conditions.</li> </ul>
<p>Rope accumulating or "stacking" at drum flange - due to insufficient fleet angle.</p> 	<ul style="list-style-type: none"> <li>• Review drum design with original equipment manufacturer - consider adding rope kicker, fleet sheave etc.</li> </ul>
<p>Sunken wraps of rope on the drum normally associated with insufficient support from lower layers of rope or grooving.</p> 	<ul style="list-style-type: none"> <li>• Check correct rope diameter.</li> <li>• If grooved drum check groove pitch.</li> <li>• Check tension on underlying layers - Bridon recommend an installation tension of between 2% and 10% of the minimum breaking force of the wire rope - Care should be taken to ensure that tension is retained in service. Insufficient tension will result in these lower layers being more prone to crushing damage.</li> <li>• Make sure that the correct rope length is being used. Too much rope (which may not be necessary) may aggravate the problem.</li> </ul>
<p>Short rope life induced by excessive wear and abrasion.</p> 	<ul style="list-style-type: none"> <li>• Check fleet angle to drum.</li> <li>• Check general alignment of sheaves in the reeving system.</li> <li>• Check that all sheaves are free to rotate.</li> <li>• Review rope selection. The smooth surface of Dyform wire ropes gives better contact with drum and sheaves and offers improved resistance to "interference" between adjacent laps of rope.</li> </ul>
<p>External corrosion.</p> 	<ul style="list-style-type: none"> <li>• Consider selection of galvanised rope.</li> <li>• Review level and type of service dressing.</li> </ul>
<p>Internal corrosion.</p> 	<ul style="list-style-type: none"> <li>• Consider selection of galvanised rope.</li> <li>• Review frequency amount and type of service dressing.</li> <li>• Consider selection of plastic impregnated (PI) wire rope.</li> </ul>

