Guidance
In-Service Inspection Procedures

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Reference: Wire Rope Discard Criteria as detailed within BS ISO 4309:2017 Cranes – wire ropes – Care and maintenance, inspection and discard.

1. INTRODUCTION

Steel wire ropes are fitted on a vast array of lifting equipment, ranging from small portable hoisting units to large complex mobile cranes. Current regulations stipulate a requirement for periodic thorough examinations on lifting equipment by a Competent Person (CP). Steel wire ropes fitted to lifting equipment as a means for lifting are safety critical and a failure of such could present significant risks.

The regulations state that thorough examinations should be carried out, either at the maximum interval between thorough examinations as stated (depending on the application), or as an exception varied in accordance with an examination scheme (UK). The in-service thorough examination is intended to ensure that any deterioration that could compromise health and safety conditions is identified and rectified in good time.

Historically, the thorough examination of a steel wire ropes working exclusively in synthetic (non-metallic) or synthetic lined sheaves presented a problem for the CP carrying out the thorough examination. The issue was due to the potential lack of external visual broken wires (other wear indicators are still detectable, such as diameter reduction or twist); however, any damage as a result of a dynamic (shock) loading may not be visually evident. This may result in a possible scenario arising whereby the internal condition of the rope deteriorates significantly without any evidence of the work done or resultant deterioration being visible on the external surface of the steel wire rope.

This information is accurate for all steel wire ropes (single-layer and multi-layer). The issue presents additional challenges with multi-layer steel wire ropes, as the deterioration typically occurs on the internal rope layers, due to the relative movement of the rope layers / strands. Consequently, when utilised with non-metallic sheaves there is no external indication of this internal wear mechanism, reducing the overall load carrying capability of the rope.

2. SCOPE

In the absence of specific manufacturer direction, this document is intended to provide guidance for the CP if a situation arises where the discard criteria within *BS ISO 4309:2017 Cranes – Wire ropes – Care and maintenance, inspection and discard* is not applicable or cannot be applied, due to the conditions, as presented on site.

i.e. – specifically where steel wire ropes are working within non-metallic sheaves and single layer spooling, as this is currently not within the scope of BS ISO 4309:2017.

3. TECHNICAL EVALUATION

Typically the thorough examination is underpinned and supported by standards which provide well established principles and discard criteria. *BS ISO 4309:2017* provides information which the CP can apply when completing the thorough examination, with respect to discard criteria.

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One scenario not specifically addressed by *BS ISO 4309:2017* is steel wire ropes working in non-metallic sheaves and single layer spooling. Such criteria are difficult to quantify, principally due to the variation of properties in the parent material of the non-metallic sheaves. Non-metallic sheaves do not abrade the outer surface of the steel wire rope in the same manner as metallic sheaves and the majority of the deterioration will occur internally.

One design method adopted by manufacturers used to address this aspect is to place at least one metallic sheave in the critical load path of the system, which helps to compensate for the lack of external visual wear indication of the steel wire rope. Such metallic sheaves are typically positioned where there is greatest likelihood of contact with the steel wire rope, during normal duties. A further method utilised is the definition of a limiting number of cycles or operating hours, defining the point of discard of the rope.

Consequently, in the absence of any manufacturer specific direction or metallic sheaves within a pulley system, the following is intended to provide guidance for the CP completing the thorough examination. This information is applicable and most relevant to a situation where a steel wire rope is identified to be working in non-metallic sheaves with single layer spooling.

Within the course of the thorough examination, in addition to all other usual inspection steps the CP should undertake a review of:

- Any available manufacturer's specification / recommendations / instructions regarding any prescribed discard criteria.
- The reeving arrangement, no of cycles or running hours, if available.

This may support a decision by the CP to call for rope replacement.

In the absence of the above noted information the discard detailed below may be applied.

It should be noted - in all cases where it is appropriate, the discard criteria as detailed within Section 6 of *BS IS0 4309:2017* should all be applied.

Steel wire ropes working in non-metallic sheaves and single layer spooling should be treated as an exception and the following discard for visible broken wires may be applied at the discretion of the competent person.

For steel wire ropes working in non-metallic sheaves with single layer spooling, the discard for visible broken wires stated in Tables 3 and 4 of *BS ISO 4309:2017* should be reduced by 50%.

Note 1: This reduction in the number of visible broken wires before discard represents a reasoned engineering judgement approach.
Note 2: Where the 50% numerical value does not equal a whole number, this value should be rounded up.

For example:

In the absence of specific manufacturer's guidance, an ordinary lay steel wire rope which has a Rope Category Number (RCN) of 09 with a total number of load bearing wires in the outer layer of strands in the rope between 201 and 220 working in non-metallic sheaves and/or single layer spooling. From *BS ISO 4309:*2017 the maximum permissible visible broken wires for steel wire ropes working in metallic sheaves and/or single layer spooling (for machine Classes M1 to M4) is 9 over a length of 6 diameters. Applying a 50% reduction due to non-metallic sheaves and single layer spooling would represent a maximum permissible visible broken wires of 9/2 = 4.5, rounded up giving discard as 5 visible broken wires over 6 diameters.