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Terminations for steel wire ropes - Safety - Part 3: Ferrules and ferrule-securing

Endverbindungen für Drahtseile aus Stahldraht - Sicherheit - Teil 3: Pressklemmen und Verpressen

Terminaisons pour câbles en acier - Sécurité - Partie 3 : Manchons et boucles manchonnées

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Terminations for steel wire ropes - Safety - Part 3: Ferrules and ferrule-securing

Terminaisons pour câbles en acier - Sécurité - Partie 3 : Manchons et boucles manchonnées

Endverbindungen für Drahtseile aus Stahldraht - Sicherheit - Teil 3: Pressklemmen und Verpressen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 168.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 13411-3:2022) has been prepared by Technical Committee CEN/TC 168 “Chains, ropes, webbing, slings and accessories - Safety”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13411-3:2004+A1:2008.

This document has been modified by the removal of Annexes ZA and ZB in accordance with the standard being de-harmonized.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive(s).

Annex A is informative.

The other parts of EN 13411 are:

Part 1: Thimbles for steel wire rope slings

Part 2: Splicing of eyes for wire rope slings

Part 3: Ferrules and ferrule-securing

Part 4: Metal and resin socketing

Part 5: U-bolt wire rope grips

Part 6: Asymmetric wedge socket

Part 7: Symmetric wedge socket

Part 8: Swage terminals and swaging

Part 9: Solid Thimbles

Introduction

This document is a Type C standard as stated in EN ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

It is understood that type testing of a ferrule-secured eye termination system is the responsibility of the ferrule-secured eye termination system designer.

It is also understood that the ferrule supplier is responsible for ensuring that the material, design, and quality of the ferrule is in accordance with the ferrule-secured eye system designer's specification.

Ferrule-secured eyes manufactured by the ferrule-secured eye termination producer in accordance with this document are permitted for use as rope terminations in the production of steel wire rope slings. They are also used as terminations for steel wire rope assemblies for raising, lowering, and supporting loads.

The steel wire rope terminations concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for steel wire rope terminations that have been designed and produced according to the provisions of this type C standard.

1 Scope

This document deals with the requirements for the ferrule-securing of eyes and endless loops.

It also deals with the requirements for ferrules for the ferrule-securing of eyes and endless loops.

This document applies to the ferrule-securing of eye terminations formed either by a Flemish eye or turn-back eye and covers ferrules made of non alloy carbon steel and aluminium.

This document applies to slings and assemblies using steel wire ropes for general lifting applications up to and including 60 mm diameter conforming to EN 12385-4, lift ropes conforming to EN 12385-5 and spiral strand ropes conforming to EN 12385-10. It is approved for use on rope grades up to 1960. For use on rope grades higher than 1960, the designer/ manufacturer must satisfy the testing requirements of this document.

Type testing of ferrule-secured systems and manufacturing quality control requirements are also specified.

This document deals with all significant hazards, hazardous situations, and events relevant to this particular steel wire rope termination when used as intended and under conditions of use which are foreseeable by the manufacturer.

This document applies to terminations of steel wire ropes with ferrules and ferrule-securing which are manufactured after the date of this publication.

NOTE One design of ferrule-secured turn-back eye termination using an oval aluminium ferule which satisfies the requirements of this document is given for information in Annex A.

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.

EN 515:2017, *Aluminium and aluminium alloys — Wrought products — Temper designations*

EN 12385-1:2002+A1:2008, *Steel wire ropes — Safety — Part 1: General requirements*

EN 12385-2:2002+A1:2008, *Steel wire ropes — Safety — Part 2: Definitions, designation and classification*

EN 12385-4:2002+A1:2008, *Steel wire ropes — Safety — Part 4: Stranded ropes for general lifting applications*

EN 12385-5:2021, *Steel wire ropes — Safety — Part 5: Stranded ropes for lifts*

EN 12385-10:2003+A1:2008, *Steel wire ropes — Safety — Part 10: Spiral ropes for general structural applications*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

3 Terms and definitions

For the purposes of this document, the terms and definitions in EN 12385-2 apply together with the following:

3.1
ferrule-secured eye termination (FSET)
eye formed at a rope end secured by means of a ferrule pressed on the rope

3.2
Flemish eye ferrule-secured termination
eye formed at a rope end secured by means of a ferrule pressed on the main body of the rope and the tail ends of the strands from the Flemish eye

3.3
turn-back eye ferrule-secured termination
eye formed at a rope end secured by means of a ferrule pressed onto the main body of the rope and the tail end

3.4
ferrule-secured endless loop
loop secured by ferrules pressed on the overlapping rope ends resulting in an endless rope assembly

3.5
competent person
designated person, suitably qualified by knowledge and experience, and with the necessary instruction to ensure that the required operations are correctly carried out

3.6
ferrule-secured system designer
person or organization that designs the ferrule-secured eye termination or ferrule-secured endless loop and assumes responsibility for type testing

3.7
ferrule manufacturer
person or organization that manufactures ferrules for a ferrule-secured eye termination or ferrule-secured endless loop system

3.8
ferrule-secured termination manufacturer
person or organization that manufactures the FSET and/or ferrule secured endless loop in accordance with the ferrule-secured termination system designer's instructions

4 List of hazards

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this standard, identified by risk assessment as significant for this type of steel wire rope termination and which require action to eliminate or reduce the risk.

Accidental release of a load due to failure of a FSET puts at risk either directly or indirectly the safety or health of those persons within the danger zone.

Table 1 contains those hazards that require action to minimize risk identified by risk assessment as being specific and significant for ferrule-secured eyes and endless loops.

Table 1 — Hazards and associated requirements

Hazards relevant to this standard identified by reference to EN ISO 12100:2010	Relevant clause of this standard
Inadequate mechanical strength	5.1.2 5.2 Annex A
Inadequate dimensional tolerances	5.3.2 Annex A
Inadequate information about the selection of ropes and accessories and their inadequate integration into the machine	5.1.3 5.3 6.8 7
Inadequate information about abnormal conditions of assembly/ testing/ use and maintenance	6 7
Inadequate information for the selection of ropes suitable for the particular application	Annex A
Exposure to puncture hazard	5.3.4 5.3.5
NOTE For the purposes of this Part of EN 13411, inadequate strength of parts means failure to achieve 90 % of the minimum breaking force of the rope.	

5 Safety requirements and/or measures

5.1 Ferrule-secured system

5.1.1 General

The ferrule-secured system shall comply with the safety requirements and/or protection measures of this clause.

In addition, the ferrule-secured systems shall be designed according to the principles of EN ISO 12100 for relevant hazards but not significant, which are not dealt with in this document.

The ferrule-secured system designer shall carry out type testing in accordance with 5.1.2.

The ferrule-secured termination system designer shall provide instructions on how to produce the ferrule-secured termination and/or the ferrule-secured endless loop.

The instructions shall at least cover those items given in 5.1.3 and be supported with a written declaration that the system has passed the type testing requirements of 5.1.2.

In the particular case of oval ferrules with tapered ends used in the securing of the turn-back eye or endless loop where the rope end is contained within the ferrule, the ferrule-secured system designer shall provide means whereby the position of the rope end before and after pressing can be ascertained. This shall not include verification by marking the rope. Only the parallel portion of a ferrule shall be considered load bearing.

5.1.2 Type testing

5.1.2.1 Sampling

Where the ferrule design follows a mathematical progression throughout a given size range, rope diameter shall be selected for testing to represent the lower and upper quartiles of that range.

Where the ferrule design does not follow a mathematical progression throughout a given size range, each rope diameter within that range for which the system is designed shall be selected for testing.

For each rope diameter selected as above, the rope grade shall be the highest for which the system is designed and at least three FSETs or three ferrule secured endless loops, whichever is the case, shall be tested.

NOTE 1 In the case of the FSET the number of tests is regarded as two when the test lengths have a FSET at both ends.

Additionally, sampling shall take into account whether the type of ferrule-secured termination is a turn-back eye or Flemish eye or whether it is an endless loop, as follows:

a) Turn-back eye ferrule secured-termination

Testing shall be carried out on each of the basic rope types for which the system is designed. For each basic rope type, testing shall be carried out on ropes having the lowest and highest metallic cross-sectional area factors for which the system is designed.

NOTE 2 For the purposes of this standard there are four basic rope types, namely single layer rope, rotation-resistant rope, parallel-closed rope, and spiral strand rope, refer EN 12385-2 for definitions.

b) Flemish-eye ferrule-secured termination

Testing shall be carried out on single layer rope having the lowest and highest metallic cross-sectional area factors for which the system is designed.

c) Ferule-secured endless loop

Testing shall be carried out on single layer rope having the lowest and highest metallic cross-sectional factor for which the system is designed.

5.1.2.2 Tensile test

When tested in accordance with 6.2 the FSET shall sustain a force of at least 90 % of the minimum breaking force of the rope.

NOTE A terminal efficiency of 90 % is equivalent to a termination efficiency factor, K_T, of 0,9 which is used in the calculation of WLL for slings

When tested in accordance with 6.2 the ferrule-secured endless loop shall sustain a force of at least 90 % of twice the minimum breaking force of the rope.

5.1.2.3 Fatigue test

When tested in accordance with 6.3 for 75 000 cycles followed by a tensile test in accordance with 6.2 the FSET and endless loop shall sustain a force of at least 80 % of the minimum breaking force of the rope.

Additionally for Flemish eye ferrule-secured terminations of crane hoist ropes a further fatigue test shall be performed on an assembly comprising a solid thimble having a peripheral length equivalent to at least four rope lay lengths. When tested in accordance with 6.4 the ferrule-secured termination shall withstand a minimum of $1x10^6$ cycles and not exhibit a complete strand fracture.

5.1.3 Instructions to be provided by the ferrule-secured system designer

The ferrule-secured system designer shall provide instructions on at least the following:

a) preparation of the rope end;

b) details of the rope(s) for which the system is designed;

c) matching of the ferrule material and size to the rope diameter and type;

d) positioning of the rope end;

e) procedure for ferrule-securing, i.e. pressing the ferrule;

f) alignment, condition and maintenance of the tooling;

g) procedure for removal of fins;

h) dimensional requirements of the pressed ferrule;

i) marking limitations of the ferrule; and

j) temperature limits of the ferrule secured system.

5.2 Ferrules

5.2.1 Material

The material selected by the ferrule manufacturer shall be non-alloy carbon steel or aluminium and shall conform to the same specification as that used by the ferrule-secured system designer when satisfying the type tests.

Non-alloy carbon steel shall be a fully-killed non-ageing normalized steel.

Aluminium shall be in condition ‘F’ according to EN 515.

5.2.2 Dimensions

The dimensions of the ferrule shall be in accordance with those used by the ferrule-secured system designer when satisfying the type tests.

5.2.3 Manufacture and quality control of ferrule

The tube from which ferrules are made shall be free from any cracks, folds and surface defects.

With the exception of steel ferrules for Flemish eyes, ferrules shall be produced to provide a seam-free hollow product. Extrusion over mandrels with a bridge shall not be used. Electric resistance welding of steel tubes may only take place steel ferrules for Flemish eyes and shall be carried out prior to the tube drawing and normalizing processes.

For each batch of steel ferrules produced from the same cast of steel and heat treatment a sample ferrule shall be selected and close flattened at ambient temperature, see Figure 1. If the sample fails this test a further ten (10) or 3 % of the batch of ferrules, whichever is the greater, shall be randomly selected, and all shall pass the flattening test otherwise the whole batch shall be rejected.