

Terminations for steel wire ropes — Safety —

Part 5: U-bolt wire rope grips

The European Standard EN 13411-5:2003 has the status of a
British Standard

ICS 21.060.70; 53.020.30

National foreword

This British Standard is the official English language version of EN 13411-5:2003.

The UK participation in its preparation was entrusted to Technical Committee MHE/2, Wire ropes, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 4 June 2003

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 19 and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments

English version

Terminations for steel wire ropes - Safety - Part 5: U-bolt wire rope grips

Terminaisons pour câbles en acier - Sécurité - Partie 5:
Serre-câbles pour terminaisons à oeil de câbles en acier

Endverbindungen für Drahtseile aus Stahldraht - Sicherheit
- Teil 5: Drahtseilklemmen mit U-förmigem klemmbügel

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Foreword

This document (EN 13411-5:2003) has been prepared by Technical Committee CEN /TC 168 "Chains, ropes, webbings, slings and accessories - Safety" the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2003, and conflicting national standards shall be withdrawn at the latest by November 2003.

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 EC Directive(s).

For relationship with EC Directive(s), see informative annex ZA, which is an integral part of this document.

Annexes A and B are informative.

This European Standard also contains a Bibliography.

The other Parts of this European Standard 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 6: Asymmetric wedge socket

Part 7: Symmetric wedge socket

This is the first edition of this Part of this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard has been prepared to provide a means of conforming with the essential safety requirements of the Machinery Directive and associated EFTA Regulations.

Purchasers ordering to this standard are advised to specify in their purchasing contract that the supplier operates a quality assurance system applicable to the relevant part of this standard (e.g. EN ISO 9001) to ensure themselves that products claimed to comply consistently achieve the required level of quality.

1 Scope

This European Standard specifies the minimum requirements for U-bolt wire rope grips manufactured from ferrous materials and the safe behaviour of eye terminations secured by U-bolt wire rope grips for use as intended by the manufacturer.

Suitable uses include suspending static loads and single use lifting operations which have been assessed by a competent person taking into account appropriate safety factors.

U-bolt wire rope grips are not suitable for use with spiral ropes.

This standard does not cover U-bolt wire rope grips as the primary securing devices on mine hoists, crane hoists or eye terminations for slings for general lifting service.

Examples of grips together with fitting instructions are given in informative annexes A and B.

The hazards covered by this standard are identified in clause 4.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 292-2:1991, *Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles and specifications*

EN 1050:1996, *Safety of machinery – Principles for risk assessment*.

EN 1562, *Founding – Malleable cast irons*

EN 12385-1:2002, *Steel wire ropes – Safety – Part 1: General requirements*.

EN 12385-2:2003, *Steel wire ropes – Safety – Part 2: Definitions, designation and classification*.

EN 20898-2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values – Coarse thread (ISO 898-2:1992)*

EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs (ISO 898-1:1999)*

EN ISO 4759-1, *Tolerances for fasteners Part 1: Bolts, screws, studs and nuts - Product grades A, B and C (ISO 4759-1:2000)*.

EN ISO 7500-1, *Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines (ISO 7500-1:1999)*

3 Terms and definitions

For the purposes of this European Standard the terms and definitions given in EN 12385-2:2003 and the following apply:

3.1

U-bolt wire rope grip

U-bolt wire rope grip: assembly consisting of a U-bolt, bridge and nuts that allow for two parts of rope to be pressed together when the nuts are tightened'

3.2

grip-secured eye termination

grip-secured eye termination: eye termination secured by wire rope grips fitted in accordance with the manufacturer's instructions'

4 List of hazards

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

Temperature hazard is not covered as in use temperature is limited by the wire rope.

Table 1 contains those hazards that require action to reduce risk identified by risk assessment as being specific and significant for wire rope grips.

Table 1 — Hazards and associated requirements

Hazards identified in annex A of EN 1050:1996		Relevant clause of annex A of EN 292-2:1991	Relevant clause/subclause of this standard
1	Mechanical hazard due to inadequacy of strength	1.3.2 4.1.2.3 4.1.2.5 4.2.4 1.7.3 4.3.1 4.2.4	5 5 6 6
1.7	Puncture hazard	1.3	5
10.4	Errors of fitting hazard	1.5.4	7

5 Safety requirements and/or measures

5.1 Materials

5.1.1 U-bolt

Carbon steel with at least property class 5.8 but not more than property class 8.8 in accordance with EN ISO 898-1.

5.1.2 Bridge

Malleable cast iron grade W40-05 or B35-10 in accordance with EN 1562; or forged non-ageing carbon steel.

5.1.3 Nut

Carbon steel with at least property class 5 in accordance with EN 20898-2 and product grade A in accordance with EN ISO 4759-1.

5.2 Mechanical properties

5.2.1 Grip security/tensile efficiency of grip-secured eye termination

When tested in accordance with 6.2.2 the grip-secured eye termination shall withstand a force of at least 80% of the minimum breaking force of the rope held for 5 minutes without the rope slipping more than 1 mm at the grip-secured eye termination.

5.2.2 Pulsatory fatigue behaviour of grip-secured eye termination

When tested in accordance with 6.2.3 the grip-secured eye termination shall withstand a minimum of 20 000 cycles.

The same grip-secured eye termination subjected to the pulsatory test above shall then be tested in accordance with 6.2.2, after which the grips shall not exhibit any visible cracks, deformation or other damage.

6 Verification of safety requirements

6.1 Qualification of personnel

All testing and examination shall be carried out by a competent person.

6.2 Type testing

6.2.1 General

In order to prove the design, material and method of manufacture, testing shall be carried out on each class of rope for which the grips are designed. The grade of the rope shall be the highest for which the grips are designed.

Where grips are intended for use with single layer ropes with a fibre core and a steel core, testing shall be carried out on both.

At least three assemblies having a grip-secured eye termination at one end shall be tested.

NOTE The number of tests is regarded as two for assemblies having grip-secured eye terminations at both ends.

For both tests described below, the applied force shall be transmitted to the grip-secured eye termination via a round pin(s). The angle subtended by the eye shall not exceed 30°.

The minimum length of free rope between the outer grips for assemblies having grip-secured eye terminations at each end shall be at least $30d$, where d is the nominal rope diameter.

The test machines used in the tests specified in 6.2.2 and 6.2.3 shall conform to EN ISO 7500-1.

Any change of design, specification of material, method of manufacture or any dimension outside normal manufacturing tolerances that may lead to a modification of the mechanical properties shall require that the type testing specified in 6.2.2 and 6.2.3 are carried out on the modified components.

6.2.2 Grip security and tensile test

The test procedure shall generally be in accordance with that described in 6.4.1 of EN 12385-1:2002 except that after a force equivalent to 20 % of the minimum breaking force of the rope has been applied it may be necessary to re-tighten the grips in accordance with the manufacturer's instructions.

The test may be discontinued when the applied force reaches a value equivalent to 80 % of the minimum breaking force of the rope.

6.2.3 Pulsatory fatigue test

Apply a force equivalent to 20 % of the minimum breaking force of the rope and if required by the manufacturer's instructions re-tighten the grips.

Subject each assembly to a cyclic tension along the rope axis of between 15 % and 30 % of the relevant minimum breaking force of the rope. Re-tightening of the grips shall be in accordance with the manufacturer's instructions.

Ensure that the frequency of force application does not exceed 5 Hz.

6.2.4 Acceptance criteria for type tests

If all three assemblies pass all of the above tests, the component of the size submitted for type testing shall be deemed to conform to this part of EN 13411.

If one assembly fails any one of the above tests, two further assemblies shall be tested and both shall pass all of the tests in order for the component of the size submitted for testing to be deemed to conform to this part of EN 13411.

If two or three assemblies fail any one of the above tests, the component of the size submitted for type testing shall be deemed not to conform to this part of EN 13411.

7 Information for use

1.1 Identification marking

The grip size is indicated by the nominal rope diameter(s) for which the grip is intended.

Grips shall be marked permanently by the manufacturer with the grip size and manufacturer's identification.

7.2 Fitting instructions

The manufacturer of the grips shall provide fitting instructions which shall include advice on the diameter, class and grade of rope for which each grip is suitable, the number, material and dimensions of grips to be used, their spacing and orientation and the required torque value.

The manufacturer's instructions shall include information on the following:

- a) temperature range for use;
- b) greasing of screw threads and any other surfaces;
- c) re-tightening and the subsequent frequency of re-tightening.

7.3 Certificate

The manufacturer or supplier shall, on request, provide a certificate giving the following information:

- a) a statement of conformance to this European Standard;
- b) name and address of manufacturer;
- c) nominal size of wire rope grip (rope diameter);
- d) a means of referencing the certificate to the wire rope grip.

Annex A (informative)

Specification for construction and sizes for one design of grip - 1

A.1 General

This annex specifies the materials, dimensions and construction requirements for one design of wire rope grip, suitable for rope grades up to and including 1960, which meets the performance requirements of this standard.

A.2 Material

A.2.1 U-bolt

The material, finish and testing of the U-bolt are to be as follows:

Property class 6.8 in accordance with EN ISO 898-1.

Finish in accordance with EN ISO 4042, zinc electroplated and yellow chromatinized.

Testing in accordance with EN ISO 898-1.

A.2.2 Bridge

The material, finish and testing of the bridge are to be as follows:

Malleable cast iron grade W40-05 or B35-10 in accordance with ISO 5922.

Finish in accordance with EN ISO 4042 zinc electroplated and chromatinized.

Testing in accordance with EN 1562.

A.2.3 Collar nut

The material, finish and testing of the collar nut are to be as follows:

Property class 6 in accordance with EN 20898-2.

Product grade 'A' in accordance with EN ISO 4759-1.

Finish in accordance with EN ISO 4042 zinc electroplated and yellow chromatinized.

Testing in accordance with EN 20898-2.

A.3 Dimensions

Dimensions are to be in accordance with Table A.1.

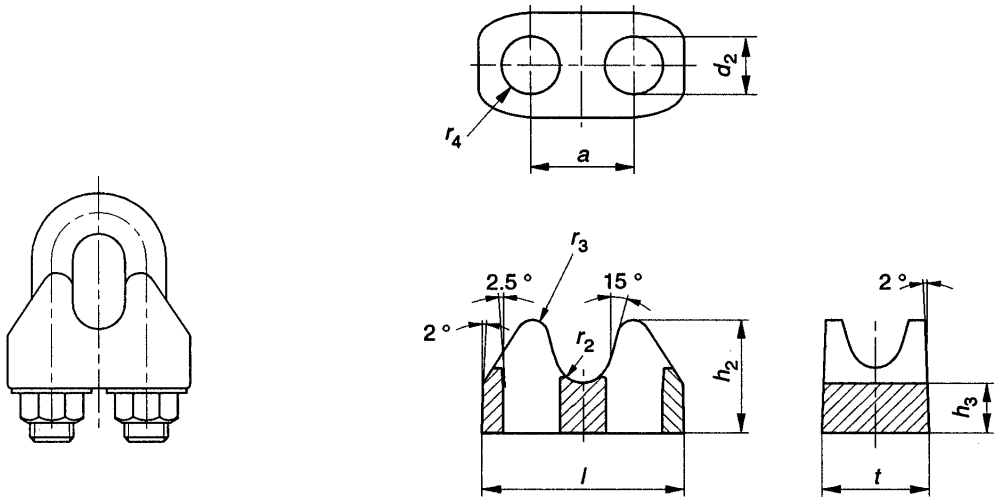


Figure A.1 — Wire rope grip

Figure A.2 — Bridge

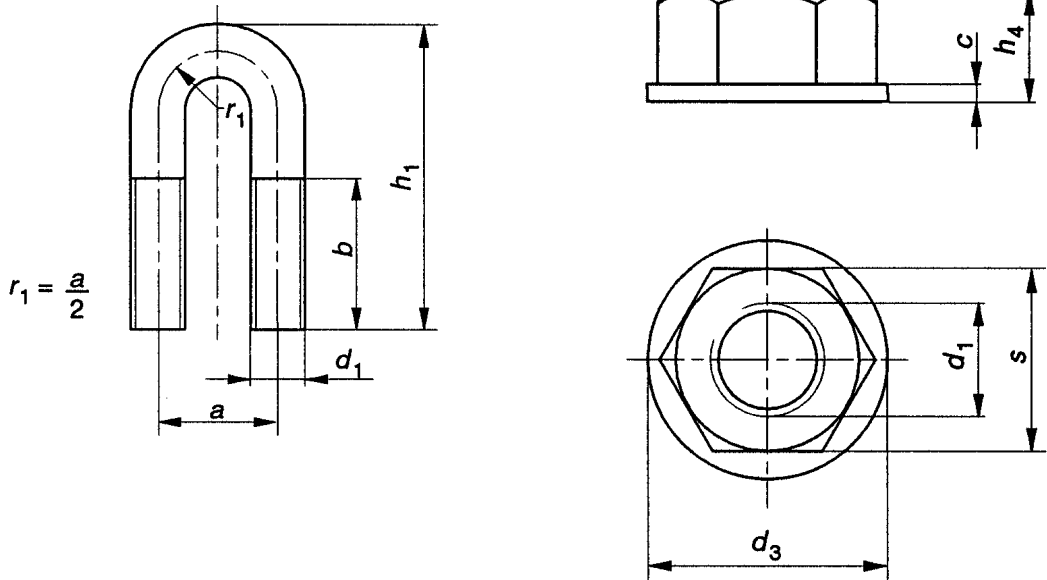


Figure A.3 — U-bolt

Figure A.4 — Collar nut

Note: All edges are to be rounded

Table A.1 —Dimensions (see Figures A1, A2, A3 and A4)

Nominal size of grip ^a	U-bolt				Bridge ^c									Collar nut				
	mm				Mm									mm				
	a ^b	b	d ₁	h ₁ ^b	a	d ₂	h ₂	h ₃	1	r ₂	r ₃	r ₄	t	c	d ₁	d ₃	h ₄	s
5	12	13	M5	25	12	5.8	13	5	25	2,5	2	6,5	13	1	M5	10	5	8
6.5	14	17	M6	32	14	7	14	6	30	3,5	2	8	16	1,6	M6	12,5	6	10
8	18	20	M8	41	18	10	18	8,5	39	4	3	10	20	1,6	M8	17	8	13
10	20	24	M8	46	20	10	21	9	40	5	3	10	20	1,6	M8	17	8	13
12	24	28	M10	56	24	12	25	11	50	6	3	12	24	1,9	M10	20	10,5	16
14	28	31	M12	66	28	15	30	13	59	7	4	14	28	2,5	M12	24	12,5	18
16	32	35	M14	76	32	17	35	16	64	8	4	16	32	2,5	M14	28	13,5	21
19	36	36	M14	83	36	17	40	17	68	9,5	4	16	32	2,5	M14	28	13,5	21
22	40	40	M16	96	40	19	44	20	74	11	4	17	34	3	M16	30	16	24
26	46	50	M20	118	46	24	51	22	84	12	5	19	38	5	M20	37	24	30
30	54	55	M20	131	54	24	59	27	95	15	5	20,5	41	5	M20	37	24	30
34	60	60	M22	150	60	26	67	30	105	17	5	22,5	45	7	M22	45	30	34
40	68	65	M24	167	68	28	77	33	117	20	5	24,5	49	7	M24	45	30	34

^a This equates with the maximum nominal diameter of rope. For intermediate nominal diameters of rope, use the next larger grip size.

Nominal size 5 applies only to nominal rope diameter 5 mm.

^b Tolerances in accordance with EN 22768-1, grade C.

^c Tolerances in accordance with ISO 8062, grade CT10.

A.4 Fitting instructions

The distance between grips 'e' (see Figure A.5) should be at least 1,5 *t* and not more than 3 *t* where *t* is the width of the bridge (see Figure A.2)

When using a thimble in the eye assembly, the first wire rope grip should be placed immediately against the thimble. The bridge should always be placed on the load bearing part of the rope.

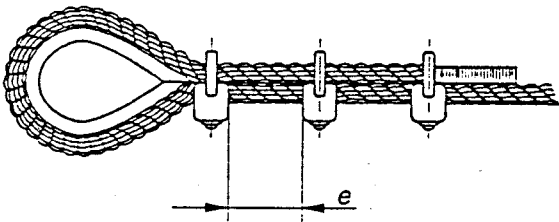


Figure A.5 — Spacing for grips

When making the assembly and before bringing into service, the collar nuts should be tightened to the torque given in Table A.2.

The recommended tightening torques are for grips with greased bearing surfaces and nut threads.

After load is applied for the first time the torque should be checked again and, if necessary, corrected.

The wire rope end termination should be inspected by a competent person.

Table A.2 gives the recommended number of grips to be used relative to rope size.

Table A.2 —Torque and number of wire rope grips

Nominal size of grip ^a	Tightening torque Nm	Number of grips
5	2,0	3
6,5	3,5	3
8	6,0	4
10	9,0	4
12	20	4
14	33	4
16	49	4
19	68	4
22	107	5
26	147	5
30	212	6
34	296	6
40	363	6
^a See footnote a of Table A.1.		

Annex B (informative)

Specification for construction and sizes for one design of grip – 2

B.1 General

This annex states the materials, dimensions and construction requirements for one design of wire rope grip, suitable for rope grades up to and including 1960 N/mm², which meets the performance requirements of this standard.

B.2 Material

B.2.1 U-bolt

The material, finish and testing of the U-bolt are to be as follows:

Material: Carbon steel, the properties of which are to withstand, without distortion the recommended torque load.

Finish: Plate (in accordance with EN 12329), mechanical (in accordance with ASTM B-695) or hot dip galvanized (in accordance with ASTM A-153).

Testing: Sample magnetic particle inspection in accordance with EN 1677-1.

B.2.2 Bridge

The material and finish of the bridge are to be as follows:

Material: forged from carbon steel, the properties of which are to withstand, without distortion the recommended torque load.

Finish: Plate (in accordance with EN 12329), mechanical (in accordance with ASTM B-695) or hot dip galvanized (in accordance with ASTM A-153).

Markings: Manufacturers identification and size are to be legible. Distinctive roddles are to be present.

B.2.3 Nuts

The material, finish and testing of the nut are to be as follows:

Material: ASTM A563 G-a or better

Finish: Galvanized in accordance with ASTM A-153

B.3 Dimensions

Dimensions are to be in accordance with Table B.1.

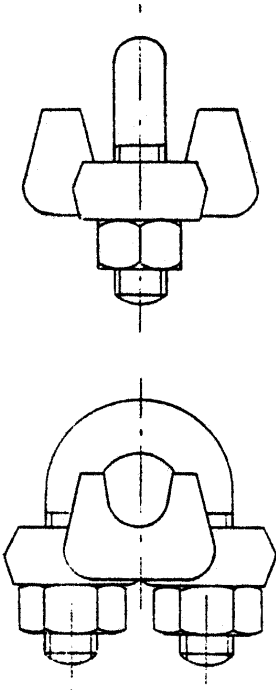


Figure B.1 — Wire rope grip

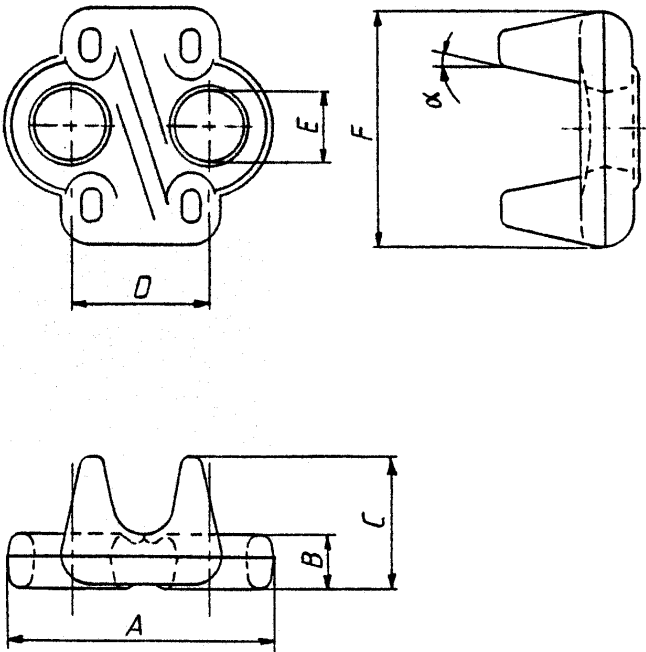


Figure B.2 — Bridge

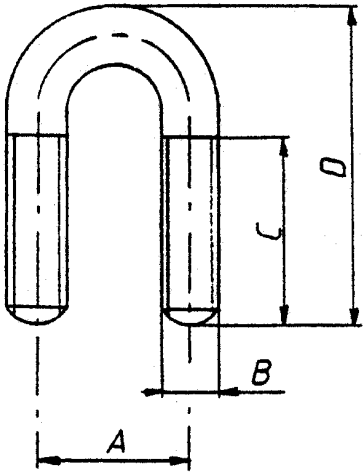


Figure B.3 — U-bolt

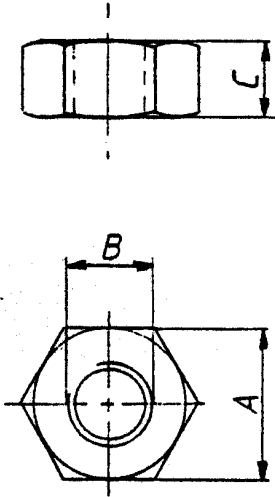


Figure B.4 — Nut

Table B.1 — Dimensions (see Figures B.1, B.2, B.3 and B.4)

Nominal size of		Nominal rope size	Bridge						U-bolt				Nut			
grip	mm		A	B	C	D	E	F	α	A	B	C	D	A	B	C
1/8	3-4		25	4,3	9,4	12	7,2	20,5	12°	12 #12-24 UNC		11	23	9,4 #12-24 UNC		4,7
3/16	5		30	5,6	12,7	15	8,3	24	12°	15 1/4-20 UNC		14	30	11 1/4-20 UNC		5,6
1/4	6-7		36,5	7,1	16,8	19	9,9	30	12°	19 5/16-18 UNC		12,5	31	14,1 5/16-18 UNC		7,5
5/16	8		42	7,9	18,5	22,5	11,6	33,5	12°	22,5 3/8-16 UNC		19	43	17,2 3/8-16 UNC		9,1
3/8	9-10		49	9,5	23	25,5	13,3	41,5	12°	25,5 7/16-14 UNC		19	47,5	18,8 7/16-14 UNC		10,7
7/16	11		58	11	28,5	30	15,2	48,5	11°	30 1/2-13 UNC		25,5	58,5	21,9 1/2-13 UNC		12,3
1/2	12-13		58	11	28,5	30	15,2	48,5	11°	30 1/2-13 UNC		25,5	58,5	21,9 1/2-13 UNC		12,3
9/16	14-15		63,5	12	34	33,5	16,8	52,5	10°	33,5 9/16-12 UNC		32	69,5	23,4 9/16-12 UNC		13,9
5/8	16		63,5	12	34	33,5	16,8	52,5	10°	33,5 9/16-12 UNC		32	69,5	23,4 9/16-12 UNC		13,9
3/4	18-20		72	12	35,5	38	18,7	57	10°	38 5/8-11 UNC		36,5	84	26,6 5/8-11 UNC		15,5
7/8	22		80,5	13	40	44,5	22	62	10°	44,5 3/4-10 UNC		41	96	31,3 3/4-10 UNC		18,6
1	24-26		88	14,2	45	48	22	66,5	10°	48 3/4-10 UNC		46	106	31,3 3/4-10 UNC		18,6
1 1/8	28-30		91	14,2	48,5	51	22	71,5	10°	51 3/4-10 UNC		51	115	31,3 3/4-10 UNC		18,6
1 1/4	32-34		105	17,5	55	58,5	25,5	79,5	10°	59 7/8-9 UNC		56	133	36 7/8-9 UNC		21,8
1 3/8	36		106	17,5	59	60,5	25,5	79,5	10°	59 7/8-9 UNC		56	133	36 7/8-9 UNC		21,8
1 1/2	38-40		113	19	62	65,5	25,5	86,5	10°	65,5 7/8-9 UNC		60,5	145	36 7/8-9 UNC		21,8
1 5/8	41-42		121	19	67,5	70	28,5	92	10°	70 1-8 UNC		66,5	160	40,6 1-8 UNC		25
1 3/4	44-46		135	22,5	74	77,5	32,5	97	10°	77,5 1 1/8-7 UNC		70	174	45,3 1 1/8-7 UNC		28,5
2	48-52		149	24	83	86	36	113	10°	86 1 1/4-7 UNC		76	195	50 1 1/4-7 UNC		31
2 1/4	56-58		162	28,5	81	99	36	116	9°	98,5 1 1/4-7 UNC		81	213	50 1 1/4-7 UNC		31
2 1/2	62-65		168	28,5	94	105	36	119	9°	105 1 1/4-7 UNC		87,5	227	50 1 1/4-7 UNC		31
2 3/4	68-72		175	33	124	111	36	127	9°	111 1 1/4-7 UNC		90,5	243	50 1 1/4-7 UNC		31
3	75-78		194	40	113	121	41,5	135	9°	121 1 1/2-6 UNC		99	272	59,5 1 1/2-6 UNC		37,3
NOTE # 12-24 Unc:number size thread indicates a nominal diameter of 0.2078/0.2150 inches with a pitch of 24 threads per inch																

NOTE # 12-24 Unc: number size thread indicates a nominal diameter of 0.2078/0.2150 inches with a pitch of 24 threads per inch

B.4 Fitting instructions

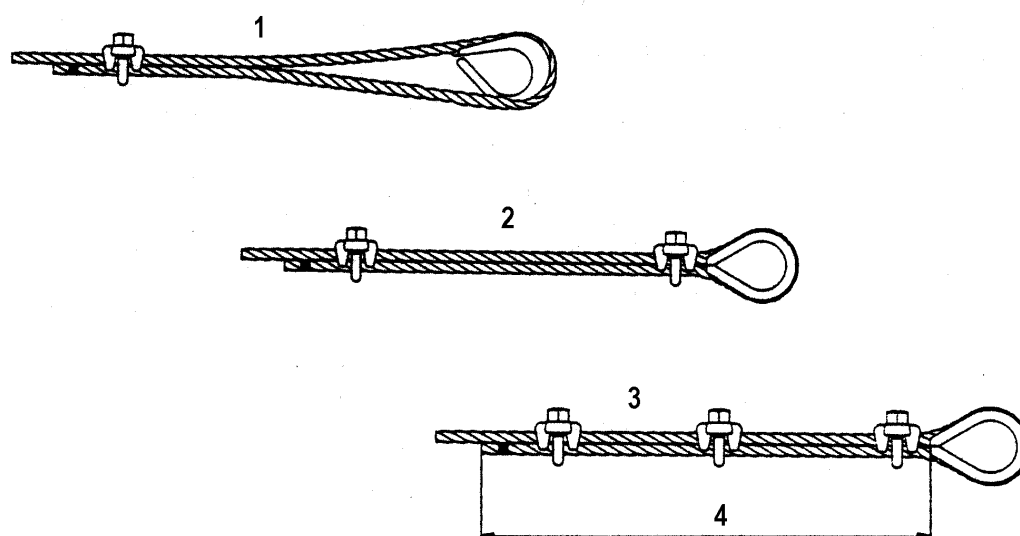
This grip is for use with 6 stranded right hand lay ropes in 6×19 and 6×36 classes.

Refer to Table B.2 in following these instructions. Turn back specified amount of rope from thimble or loop. Apply first grip one bridge width from dead end of rope. Apply U-bolt over dead end of wire rope – live end rests in saddle. Tighten nuts evenly, alternate from one nut to the other until reaching the recommended torque.

When two grips are required, apply the second grip as near the loop or thimble as possible. Tighten nuts evenly, alternating until reaching the recommended torque.

When more than two grips are required, apply the second grip as near the loop or thimble as possible, turn nuts on second grip firmly, but do not tighten. Proceed to next step.

When three or more grips are required, space additional grips equally between first two – take up rope slack – tighten nuts on each U-bolt evenly, alternating from one nut to the other until reaching recommended torque.



Key

- 1 Location of first grip
- 2 Location of second grip
- 3 Location of third/other grips
- 4 Turnback

Figure B.5 — Sequence of fitting grips

Apply the U-bolt over the dead end of the wire rope, the live end rests in the saddle.

The number of clips shown in Table B.2 is based upon using RRL or RLL wire rope, 6×19 or 6×37 Class, FC or IWRC; IPS or XIP. If Seale construction or similar large outer wire type construction in the 6×19 Class is to be used for sizes 1 inch and larger, add one additional clip.

The number of clips shown also applies to rotation – resistant RRL wire rope, 8×19 Class, IPS, XIP, sizes 1 - 1/2 inch and smaller; and to rotation – resistant RRL wire rope, 19×7 Class, IPS, XIP, sizes 1 - 3/4 inch and smaller.

Apply first load to test the assembly. This load should be of equal or greater weight than loads expected in use. Next, check and retighten nuts to recommended torque.

Periodically re-tightening of the nuts can be at 10 000 cycles (heavy usage), 20 000 cycles (moderate usage) or 50 000 cycles (light usage). If cycles are unknown, a time period could be used, e.g. every 3 months, 6 months, annually.

The wire rope end termination should be inspected periodically for wear, abuse, and general adequacy.

Table B.2. – Torque and number of grips

Nominal size of grip	Nominal diameter (mm)	Minimum No. of Grips	Amount of Rope to Turn Back (mm)	^a Torque Nm
1/8	3-4	2	85	6.1
3/16	5	2	95	10.2
¼	6 - 7	2	120	20.3
5/16	8	3	133	40.7
3/8	9 - 10	3	165	61.0
7/16	11 - 12	3	178	88
1/2	13	3	292	88
9/16	14 - 15	3	305	129
5/8	16	3	305	129
3/4	18 - 20	4	460	176
7/8	22	4	480	305
1	24 - 25	5	660	305
1-1/8	28 - 30	6	860	305
1-1/4	32 - 34	7	1120	488
1-3/8	36	7	1120	488
1-1/2	38 - 40	8	1370	488
1-5/8	41 - 42	8	1470	583
1-3/4	44 - 46	8	1550	800
2	48 - 52	8	1800	1017
2-1/4	56 - 58	8	1850	1017
2-1/2	62 - 65	9	2130	1017
2-3/4	68 - 72	10	2540	1017
3	75 - 78	10	2690	1627
NOTE If a greater number of grips are used than shown in the table, the amount of turnback should be increased proportionately.				
^a The tightening torque values shown are based upon the threads being clean, dry and free of lubrication.				

Annex ZA (informative)

Relationship of this document with EC Directives

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

Machinery Directive 98/37/EC, amended by Directive 98/79/EC

Compliance with this document provides one means of conforming with the specific essential requirements of the Directive concerned, and associated EFTA regulations.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this document.

Bibliography

EN 1677-1	<i>Components for slings – Safety – Part 1: Forged steel components, Grade 8</i>
EN 12329	<i>Corrosion protection of metals - Electrodeposited coatings of zinc with supplementary treatment on iron or steel</i>
EN 22768-1	<i>General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (ISO 2768-1:1989)</i>
EN ISO 4042	<i>Fasteners — Electroplated coatings (ISO 4042:1999)</i>
ISO 5922	<i>Malleable cast iron</i>
ISO 8062	<i>Castings — System of dimensional tolerances and machining allowances</i>
ASTM B-695	<i>Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel</i>
ASTM A-153	<i>Standard Specification for Zinc Coating (Hot-Dip) of Iron and Steel Hardware</i>
ASTM A-563 Ga	<i>Standard Specification for Carbon and Alloy Steel Nuts</i>

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