BRITISH STANDARD

BS EN
1677-5:2001

Components for slings — Safety —

Part 5: Forged steel lifting hooks with latch — Grade 4

The European Standard EN 1677-5:2001 has the status of a British Standard

ICS 53.020.30

National foreword

This British Standard is the official English language version of EN 1677-5:2001. It supersedes BS 2903:1980 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/1, Chains and fittings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible 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.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 June 2001

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

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Foreword

This European Standard 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 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of an identical text or by endorsement, at the latest by October 2001, and conflicting national standards shall be withdrawn at the latest by October 2001.

This European Standard 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 Directives, see informative annex ZA, which is an integral part of this standard.

The other parts of EN 1677 for components for slings are:

Part 1: Forged steel components — Grade 8;
Part 2: Forged steel lifting hooks with latch — Grade 8;
Part 3: Forged steel self-locking hooks — Grade 8;
Part 4: Links — Grade 8;
Part 6: Links — Grade 4.

Annexes A and B of this European Standard are informative.

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard has been prepared to be a harmonized standard providing one means of complying with the essential safety requirements of the Machinery Directive and associated EFTA regulations.

The hooks covered by this part of EN 1677 are normally supplied to be part of a sling, but they may also be used for other applications. In such instances it is important that the hook design is checked to ensure its fitness for the intended use.

The extent to which hazards are covered is indicated in the scope. In addition, lifting equipment shall conform as appropriate to EN 292 for hazards that are not covered by this standard.

1 Scope

This part of EN 1677 specifies requirements for forged steel lifting hooks of grade 4 having latch and eye up to 31,5 t WLL, mainly for use in:

- chain slings according to EN 818-5;
- steel wire rope slings according to prEN 13414-1:1998;
- textile slings according to EN 1492-1, EN 1492-2;

intended for lifting objects, materials or goods.

This part of EN 1677 does not apply to hand forged hooks.

The hazards covered by this part of EN 1677 are identified in clause 4.

Annex A gives the bases for calculation of hook dimensions.

Annex B gives an example of a designation system for hooks of grade 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 292-1	*Safety of machinery — Basic Concepts — General principles for design — Part 1: Basic Terminology, methodology.*
EN 292-2:1991 +A1:1995	*Safety of machinery — Basic concepts — General principles for design — Part 2: Technical principles and specifications (Amendment A1:1995).*
EN 818-5	*Short-link chain for lifting purposes — Safety — Part 5: Chain slings — Grade 4.*
EN 818-6	*Short link chain for lifting purposes — Safety — Part 6: Chain slings — Specification for information for use and maintenance to be provided by the manufacturer.*
EN 1050:1996	*Safety of machinery — Principles for risk assessment.*
EN 1492-1	*Textile slings — Safety — Part 1: Flat woven webbing slings made of man-made fibres.*
EN 1492-2	*Textile slings — Safety — Part 2: Round slings made of man-made fibres.*
EN 10002-2:1991	*Metallic materials — Tensile testing — Part 2: Verification of the force measuring system of the tensile testing machines.*
EN 10025:1990 +A1:1993	*Hot rolled products of non-alloy structural steels — Technical delivery conditions.*
prEN 13414-1:1998	*Steel wire ropes for slings — Safety — Part 1: Wire rope slings.*
EN 45012	*General requirements for bodies operating assessment and certification/registration of quallity systems (ISO/IEC Guide 62:1996).*
EN ISO 9002:1994	*Quality systems — Model for quality assurance in production, installation and servicing.*
ISO 643:1983	*Steels — Micrographic determination of the ferritic or austenitic grain size.*

3 Terms and definitions

For the purposes of this part of EN 1677, the following terms and definitions apply.

3.1
working load limit (WLL)
maximum mass that a hook is authorized to sustain in general lifting service, expressed as a code

NOTE This term has the same meaning as the term maximum working load used in annex A of EN 292-2:1991+A1:1995.

3.2
manufacturing proof force (MPF)
force applied to the hook during the manufacturing proof test

3.3
breaking force (BF)
maximum force reached during the static tensile test of the hook, at which the hook fails to retain the load

3.4
traceability code
series of letters and/or numbers marked on a hook that enables its manufacturing history, including the identity of the cast of steel used, to be traced

3.5
competent person
designated person, suitably trained, qualified by knowledge and practical experience, and with the necessary instruction to enable the required test and examination to be carried out

NOTE 4.18 of EN ISO 9002:1994 gives guidance on training.

3.6
lot
specified number of hooks from which samples are selected for testing purposes, and that have been manufactured from the same cast of steel and subjected to the same heat treatment process

4 Hazards

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

In order to provide the necessary strength and durability of hooks, this part of EN 1677 gives requirements for the design, manufacture and testing to ensure that specified levels of performance are met.

Fatigue failure has not been identified as a hazard when grade 4 hooks having the specified levels of performance given in this standard are used for general lifting purposes.

Since failure can be caused by the incorrect choice of grade and specification of hook, this part of EN 1677 also gives requirements for marking and the manufacturer's certificate.

Errors of fitting can also lead to failure and this part of EN 1677 contains dimensional requirements to allow correct fit.

Risk of injury due to sharp edges, sharp angles or rough surfaces when handling is also covered by this standard.

Those aspects of safe use associated with good practice are given in EN 818-6.

Table 1 contains those hazards, that require action to reduce risk identified by risk assessment as being specific and significant for forged steel hooks of grade 4.

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+A1:1995	Relevant clause/subclause of this part of EN 1677
1.e	Mechanical hazard due to inadequacy of strength	1.3.2 4.1.2.3 4.1.2.5 4.2.4 1.7.3	5 5 5 5 7
1.3	Cutting hazard	1.3.4	5.4
1.8	Friction or abrasion hazard	1.3.4	5.4
15	Errors of fitting hazard	1.5.4	5.2
17	Falling objects hazard	1.3.3	5.6

5 Safety requirements

5.1 Design

The form of the upper end shall be of the eye type as indicated in Figure 1.

The dimensions shall be such as to ensure articulation so that the force imposed is transmitted in the intended direction.

NOTE The form of the hook is not specified in detail. For example, a minimum value of dimension F (see Figure 1) as measured in any direction is specified so that the eye of the hook can accommodate a pin, but the eye of the hook need not be circular.

Each hook shall have a spring-loaded latch conforming to 5.6 to ensure that the load cannot become accidentally unhooked.

5.2 Dimensions

The principal dimensions of the hooks shall conform to Table 2, in which the hook dimensions are related to the working load limit.

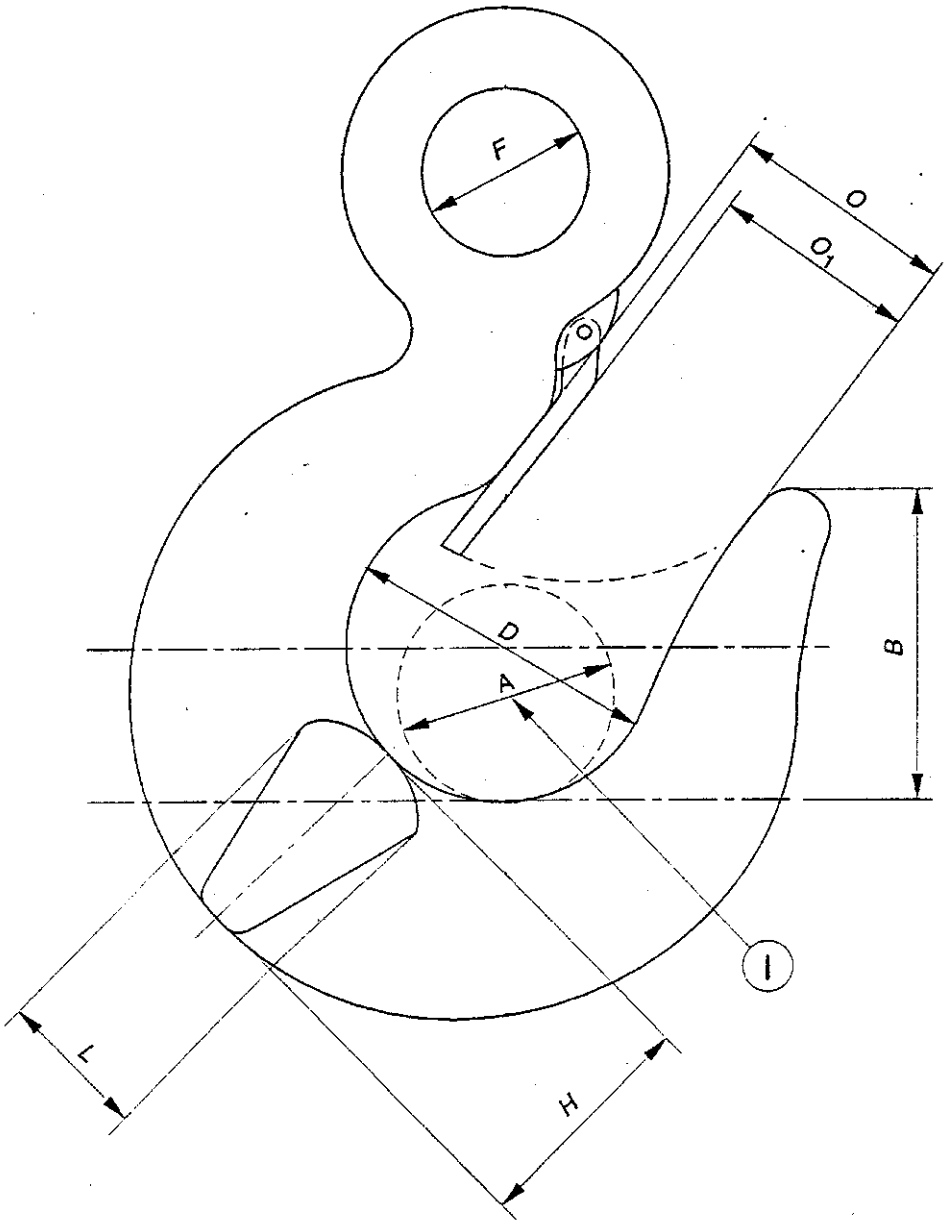
NOTE For direct use in wire rope slings and/or textile slings, dimension F should be larger than the minimum value given in Table 2.

In addition, the following requirements shall be met:

a) the actual point height B shall be equal to or greater than the full throat opening, O, (see Figure 1);

b) the full throat opening O shall not exceed 95 % of the actual seat diameter D;

c) the hook latch shall be capable of closing over the maximum diameter of bar A, as indicated in Figure 1, that can be admitted through the actual throat opening O_1.



Key

1 Maximum diameter of bar

Figure 1 — Dimensions of hook

Table 2 — Dimensions of hooks (see Figure 1)

Code number	Working load limit (WLL) t	*D* min. mm	*O* min. mm	O_1 min. mm	*F* min. mm	*H* max. mm	*L* max. mm
6	0,56	22	17	16	12	25	17
7	0,75	26	20	18	14	29	20
8	1	30	23	21	16	35	23
9	1,25	34	26	24	18	38	26
10	1,6	38	29	27	20	43	29
11	2	42	32	30	23	48	32
13	2,65	49	37	35	26	55	37
14	3	52	40	37	28	59	40
16	4	60	46	43	32	68	46
18	5	67	51	48	36	76	51
19	5,6	71	54	51	38	80	54
20	6,3	75	57	53	40	85	57
22	7,5	82	63	58	44	93	63
23	8	85	65	60	46	96	65
25	10	95	72	68	51	107	72
26	10,6	98	75	70	52	111	75
28	12,5	106	81	76	57	120	81
32	16	119	91	85	64	135	91
36	20	134	102	96	72	152	102
40	25	150	115	107	80	170	115
45	31,5	168	129	120	90	190	129

5.3 Materials and heat treatment

5.3.1 Quality of material

5.3.1.1 General

Within the limitations given in 5.3.1.2 to 5.3.1.4, the manufacturer shall select the type of steel to be used so that the hooks, when suitably heat-treated, conform to the mechanical properties specified in this part of EN 1677.

5.3.1.2 Type of steel

The steel shall be produced by an electric process or by an oxygen blown process.

5.3.1.3 Deoxidation

The steel shall be fully killed as defined in EN 10025:1990+A1:1993, stabilized against strain age embrittlement, and have an austenitic grain size of 5 or finer when tested in accordance with ISO 643:1983.

5.3.1.4 Chemical composition

To ensure that hooks are stabilized against strain age embrittlement during service, the steel shall contain at least 0,025 % aluminium.

The steel shall contain no more sulfur and phosphorus than the limits given in Table 3.

Table 3 — Sulfur and phosphorus content

Element	Maximum mass content as determined by	
	Cast analysis %	Check analysis %
Sulfur	0,025	0,030
Phosphorus	0,025	0,030

The silicon content of the steel shall be as specified in Table 4.

NOTE The purpose of this requirement is to limit the detrimental effect on the hook as part of a chain sling when used for lifting in galvanizing baths.

Table 4 — Silicon content

Element	Mass content as determined by	
	Cast analysis %	Check analysis %
Silicon	0,12 to 0,30	0,15 to 0,35

5.3.2 Heat Treatment

Each hook shall either be hardened from a temperature above the AC_3 point and tempered, or normalized from a temperature above the AC_3 point, before being subjected to the manufacturing proof force. The tempering temperature shall be at least 475 °C.

The normalizing or tempering conditions shall be at least as effective as a temperature of 475 °C maintained for a period of 1 h.

NOTE A method of verification is as follows. After the hooks have been reheated to and maintained for 1 h at 475 °C and then cooled to room temperature they should conform in the finished condition to 5.5.2 and 5.5.3.

5.4 Manufacturing methods and workmanship

5.4.1 Manufacture

Each hook body shall be forged hot in one piece. Excess metal from the forging operation shall be removed cleanly leaving the surface free from sharp edges. After heat-treatment, furnace scale shall be removed and the hook body shall be free from harmful surface defects, including cracks.

Welding shall not be used during the manufacture of hooks unless:

a) none of the parts to be welded are load bearing; or

b) the welded part is not to be subjected to load under normal operating conditions or under any foreseeable misuse of the hook.

NOTE Care should be taken during welding to ensure that the mechanical properties of the hook are not adversely affected.

All welds shall be smoothly finished.

5.4.2 Surface finish

The finished condition of hooks shall include any surface finish.

NOTE Hooks are supplied in various surface finishes, e.g. descaled, electroplated or painted.

5.5 Mechanical properties

5.5.1 General

The mechanical properties of hooks shall be as specified in 5.5.2 and 5.5.3.

5.5.2 Manufacturing proof force (MPF)

The manufacturing proof force shall be the force calculated by multiplying the appropriate working load limit given in Table 2 by a factor of 2,0 and taking account of acceleration due to gravity (g).

Hooks shall be able to sustain the manufacturing proof force without deviating from the manufacturer's dimensions of the drawing after removal of the force.

The proof force shall be applied in the finished condition (see 5.4.2). Where processes are used that involve risk of hook embrittlement, e.g. acid cleaning or electroplating, the manufacturing proof force shall be reapplied in the finished condition.

5.5.3 Breaking force (BF)

Hooks shall have a breaking force at least equal to the force calculated by multiplying the appropriate working load limit given in Table 2 by a factor of 4,0 and taking account of acceleration due to gravity (g). On completion of the test, the hook shall show evidence of deformation.

NOTE In this context, breaking means failure by deformation to retain the load.

5.6 Hook latches

The latch shall engage in the point of the hook to form a complete closure of mating surfaces. With the hook in any orientation, the spring shall ensure that the latch is held positively in the closed position. Latches operated solely by gravity shall not be permitted.

NOTE The force required to open the latch should not exceed that which can be applied manually. Table 5 contains guidance on the minimum initial torque and maximum torque during latch opening necessary to fulfil these requirements.

Table 5 — Torque values for latches — Guidance

Code number		Minimum initial torque	Maximum torque during opening
from	up to and including	Nm	Nm
6	7	0,1	0,2
8	10	0,2	0,4
11	14	0,3	0,6
16	18	0,75	1,5
19	23	1	2
25	28	2	4
32	45	3,5	7

The spring shall be constructed from corrosion protected material and shall be able to withstand at least 10 000 complete openings of the latch without fracture.

The latch shall be able to withstand forces f_1 applied across the width of the latch, equidistant between the point of the hook and the centre of rotation of the latch, and force f_2 which shall be applied across the thickness of the latch laterally to f_1 (see Figure 2). Both f_1 and f_2 shall be equivalent to 300 kg or 10 % of the working load limit of the hook, whichever is the greater, but f_2 shall not exceed 20 kN.

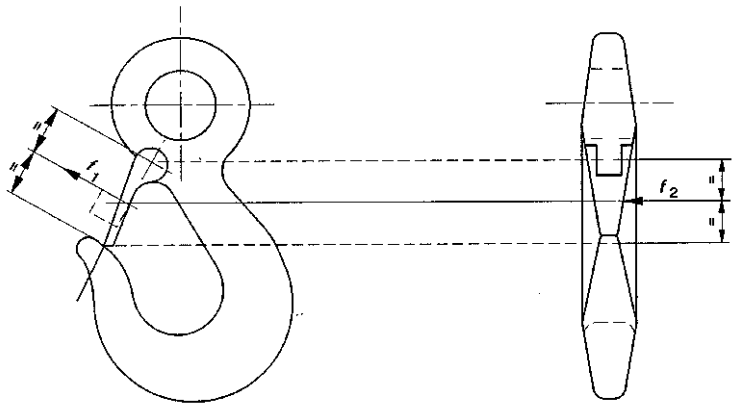


Figure 2 — Application of forces for type testing of the latch

6 Verification of safety requirements

6.1 Qualification of personnel

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

6.2 Type tests

6.2.1 General

In order to prove the design, material, heat treatment and method of manufacture, each size of hook in the finished condition shall be type tested to demonstrate that the hooks possess the mechanical properties specified in this part of EN 1677.

Any change of design, specification of material, heat treatment, method of manufacture or any dimension outside normal manufacturing tolerances that may lead to a modification of the mechanical properties defined in 5.5, shall require that the type tests specified in 6.2.2 to 6.2.3 are carried out as appropriate on the modified hooks.

The tests specified in 6.2.2 and 6.2.3 shall be carried out on three samples of each size of hook of each design, material, heat treatment and method of manufacture.

In the tests specified in 6.2.2 and 6.2.3, the force shall be applied to the hook axially without shock, using a test fixture of diameter not greater than 60 % of the seat diameter, D, of the hook.

The test machine used in the tests specified in 6.2.2 and 6.2.3 shall conform to EN 10002-2:1991, Class 1.

6.2.2 Test for deformation

Three samples shall be tested, and each shall be able to sustain the manufacturing proof force specified for the hook in 5.5.2. Following the removal of the force, the dimensions shall be within the tolerances specified on the hook manufacturer's drawings. In no case shall any dimension alter by more than 1,0 % of the initial dimension after the manufacturing proof force has been applied and removed.

6.2.3 Static tensile test

Three samples shall be tested and each shall have a breaking force at least equal to the minimum value specified for the hooks in 5.5.3.

NOTE 1 This test may be carried out on the same hooks subjected to the deformation test.

NOTE 2 It is not necessary to test the hook up to its actual breaking force for the specified mechanical properties to be demonstrated. It is sufficient that the minimum breaking force is reached and that the hook shows evidence of deformation.

6.2.4 Acceptance criteria for type tests

6.2.4.1 Test for deformation

If any of the three samples fails the test for deformation, the hook of the size submitted for type testing shall be deemed not to conform to this part of EN 1677.

6.2.4.2 Static tensile test

If all three samples pass the static tensile test, the hook of the size submitted for type testing shall be deemed to conform to this part of EN 1677.

If one sample fails, two further samples shall be tested and both shall pass the test in order for the hook of the size submitted for testing to be deemed to conform to this part of EN 1677.

If two or three samples fail the test, the hook of the size submitted for type testing shall be deemed not to conform to this part of EN 1677.

6.3 Manufacturing proof tests

For the manufacturing proof test, the equipment used shall apply a force of at least equal to the manufacturing proof force specified.

After heat treatment hooks shall sustain the appropriate manufacturing proof force specified in 5.5.2.

After removal of the force there shall be no visible defect, and the dimensions shall be within the tolerances specified on the manufacturer's drawings.

6.4 Manufacturing test regime and acceptance criteria

6.4.1 General

The manufacturing test regime shall depend on whether the manufacturer has a quality system conforming to EN ISO 9002 and certified by a certification body accredited to EN 45012.

NOTE A quality system conforming to EN ISO 9001 automatically conforms to EN ISO 9002.

If such a system is in place and operating, the manufacturer's test regime shall conform to 6.4.2. If no such system is in place or operating the manufacturer's test regime shall conform to 6.4.3.

The maximum size of the lot shall be as given in Table 6 for the ranges of code numbers indicated.

Table 6 — Number of hooks in a lot

Code number	Maximum number in a lot
up to 13	1 000
over 13 to 25	500
over 25	200

6.4.2 Manufacturing test regime and acceptance criteria when a quality system conforming to EN ISO 9002 is in place and operating

If a quality system conforming to EN ISO 9002 is in place and operating, the manufacturer shall apply the manufacturing proof test to all hooks supplied in accordance with 6.3. Any hook failing the manufacturing proof test shall not conform to this part of EN 1677.

6.4.3 Manufacturing test regime and acceptance criteria when a quality system conforming to EN ISO 9002 is not in place or not operating

If a quality system conforming to EN ISO 9002 is not in place or not operating, the manufacturer shall carry out a manufacturing proof test in accordance with 6.3. Any hook failing the manufacturing proof test shall not conform to this part of EN 1677.

All hooks that pass the manufacturing proof test shall conform to this part of EN 1677.

In addition, the manufacturer shall subject one sample per lot to the static tensile test as defined in 6.2.3. If the sample meets the appropriate requirements then the lot shall be deemed to conform to this part of EN 1677.

If the sample fails to meet the requirements then two further samples shall be taken from the same lot. Both of these samples shall be subjected to the static tensile test. If one or both of these samples fail to meet the appropriate requirements the entire lot shall be deemed not to conform to this part of EN 1677.

6.5 Hook latches

A type test to verify the conformity to 5.6 shall be carried out on 3 sample latches for each size of hook. The test shall be carried out with the latches in situ or in a test fixture that accurately simulates the location of the latch and hook point. Forces f_1 and f_2 shall be separately applied as indicated in Figure 2. The latch shall show no permanent deformation following removal of the forces. If any of the three samples fails the test, the latch of the size submitted for type testing shall not be deemed to conform to this part of EN 1677.

7 Marking

Each hook shall be legibly and indelibly marked in a place where the marking will not be removed by use and in a manner that will not impair the mechanical properties. This marking shall include at least the following information:

a) code number;

b) the grade number “4”;

c) the manufacturer’s name, symbol or mark;

d) the traceability code.

NOTE Item a) is the code number which identifies WLL of the hook (see Table 2).

8 Manufacturer’s certificate

After all the testing as specified in clause 6 has been carried out with satisfactory results, the manufacturer shall issue a certificate for hooks that conform to this part of EN 1677.

The certificate shall include at least the following information:

a) the name and address of the manufacturer or authorized representative, including the date of issue of the certificate and authentication;

b) the number and relevant part of this European Standard(s), i.e. EN 1677-5;

c) code number;

d) the quantity and description of the hook;

e) the grade number “4”;

f) the working load limit, in tonnes;

g) the manufacturing proof force, in kilonewtons;

h) confirmation that the specified minimum breaking force was met or exceeded;

i) an identification of the quality system to EN ISO 9002 when in place and operating.

The manufacturer shall keep a record, for at least 10 years after the last certificate has been issued, of the material specification, heat treatment, dimensions, test results, quality system in use and all relevant data concerning the hooks that have satisfied the type tests, including records of sampling. This record shall also include the manufacturing specifications that shall apply to subsequent production.

9 Instructions for use

Instructions for use shall accompany the hooks and shall conform to the relevant clauses of EN 818-6.

Annex A
(informative)

Bases for the calculation of hook dimensions

The dimensions given in Table 2 are derived from the following formulae:

$D = 21{,}2\sqrt{2 \cdot \text{WLL}}$;

$O = 16{,}2\sqrt{2 \cdot \text{WLL}}$;

$O_1 = 15{,}1\sqrt{2 \cdot \text{WLL}}$;

$F = 11{,}4\sqrt{2 \cdot \text{WLL}}$;

$H = 24\sqrt{2 \cdot \text{WLL}}$;

$L = 16{,}2\sqrt{2 \cdot \text{WLL}}$.

The dimensions (in millimetres) have been calculated using the WLL given in Table 2 and rounded to the nearest whole number.

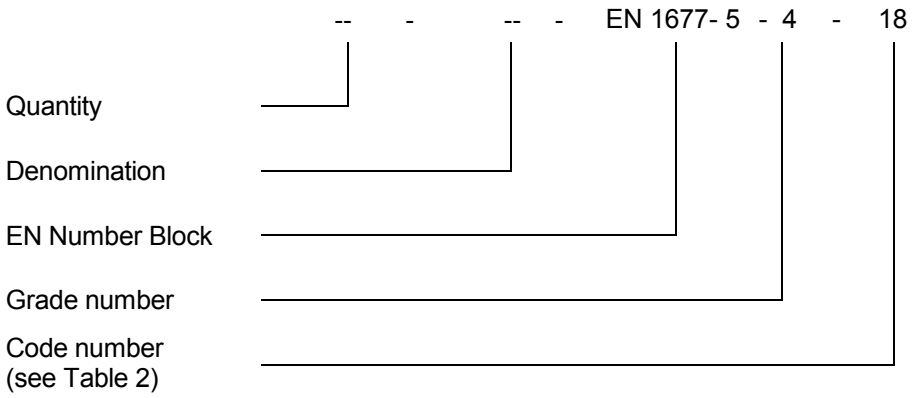
Annex B
(informative)

Designation system for hooks — Grade 4

B.1 Designation

Designation of hooks should be in accordance with the general format given in B.2. The denomination of a hook should be determined by the manufacturer.

B.2 General format



Annex ZA
(informative)

Relationship of this document with EC Directives

This European Standard 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 Directives:

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

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

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

Bibliography

EN ISO 9001 *Quality management systems — Requirements (ISO 9002:2000)*.

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