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**Forged shackles for general lifting  
purposes — Dee shackles and bow  
shackles**

*Manilles forgées pour levage — Manilles droites et manilles lyres*

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# Contents

	Page
Foreword.....	iv
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Form and dimensions</b> .....	<b>3</b>
4.1 Dee shackles.....	3
4.2 Bow shackles.....	3
4.3 Hole diameter.....	5
4.4 Types of shackle pin.....	5
<b>5 Mechanical properties</b> .....	<b>7</b>
5.1 General.....	7
5.2 Deformation resistance test.....	7
5.3 Breaking force.....	8
5.4 Fatigue resistance.....	8
<b>6 Material</b> .....	<b>8</b>
6.1 General.....	8
6.2 Grade.....	9
6.3 Specific requirements.....	9
6.4 Charpy impact test.....	9
<b>7 Heat treatment</b> .....	<b>10</b>
7.1 Grades 6, 8 and 10.....	10
<b>8 Workmanship</b> .....	<b>10</b>
8.1 Manufacture.....	10
<b>9 Screw threads</b> .....	<b>11</b>
<b>10 Type testing</b> .....	<b>11</b>
10.1 General.....	11
10.2 Deformation resistance test.....	12
10.3 Breaking force test.....	12
10.4 Fatigue test.....	12
10.5 Charpy impact test.....	12
10.6 Acceptance criteria for type testing.....	12
10.6.1 Deformation resistance test.....	12
10.6.2 Static strength test and fatigue test.....	12
10.6.3 Charpy impact test.....	13
<b>11 Manufacturing testing</b> .....	<b>13</b>
11.1 Visual examination.....	13
11.2 Proof force test.....	13
11.3 Hardness testing.....	13
11.4 Non-destructive testing.....	13
<b>12 Marking</b> .....	<b>14</b>
12.1 Shackle body.....	14
12.2 Shackle pins.....	14
<b>13 Manufacturer's certificate</b> .....	<b>14</b>
<b>14 Instructions for use</b> .....	<b>15</b>
<b>Annex A (informative) Designation</b> .....	<b>16</b>
<b>Annex B (informative) Safe use of shackles</b> .....	<b>17</b>
<b>Bibliography</b> .....	<b>24</b>

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 111, *Round steel link chains, chain slings, components and accessories*, Subcommittee SC 3, *Components and accessories*.

This fourth edition cancels and replaces the third edition (ISO 2415:2004), which has been technically revised.

The main changes are as follows:

- modification of the grades to 6, 8 and 10;
- corresponding adaption of preferred dimensions, heat treatment and mechanical requirements;
- selective method to ensure product material toughness; and
- including the guidance for safe use of shackles in [Annex B](#).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Forged shackles for general lifting purposes — Dee shackles and bow shackles

## 1 Scope

This document specifies the general characteristics of forged dee and bow shackles in a range of sizes having working load limits from 0,5 t to 120 t and in grades 6, 8 and 10, and presents their performance and preferred dimensions necessary for their interchangeability and compatibility with other components for use in the temperature range of -20 °C to 200 °C.

## 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.

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 261, *ISO general purpose metric screw threads — General plan*

ISO 263, *ISO inch screw threads — General plan and selection for screws, bolts and nuts — Diameter range 0,06 to 6 in*

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

EN 10228-1, *Non-destructive testing of steel forgings - Part 1: Magnetic particle inspection*

EN 10228-2, *Non-destructive testing of steel forgings - Part 2: Penetrant testing*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **shackle**

component consisting of two readily separable parts, the *body* (3.2) and the *pin* (3.5)

### 3.2

#### **body**

one of the two parts of a *shackle* (3.1), consisting of a bar of suitable cross section formed or forged to the appropriate shape and terminating in coaxial *eyes* (3.4)

### 3.3

#### **crown**

part of the *shackle* (3.1) body opposite the *pin* (3.5)

### 3.4

#### **eye**

boss on each end of the *body* (3.2) with coaxial holes through which the *pin* (3.5) passes

### 3.5

#### **pin**

straight bar of circular cross section which passes through the *eye* (3.4) holes and secured in a manner that can be readily disassembled

Note 1 to entry: Some types may have additional components, for example: a nut.

### 3.6

#### **dee shackle**

*shackle* (3.1), the *crown* (3.3) of which forms a semicircle with an inner radius of half the width between the *eyes* (3.4)

Note 1 to entry: See [Figure 1](#).

### 3.7

#### **bow shackle**

*shackle* (3.1), the *crown* (3.3) of which forms more than a semicircle with an inner radius of more than half the width between the *eyes* (3.4)

Note 1 to entry: See [Figure 2](#).

### 3.8

#### **breaking force**

$F_b$   
maximum force reached during a static tensile test before the assembly being tested fails to retain the load

### 3.9

#### **proof force**

$F_e$   
force applied as a test to a finished *shackle* (3.1)

Note 1 to entry: See [Table 2](#).

### 3.10

#### **working load limit**

##### **WLL**

maximum mass a *shackle* (3.1) is designed to sustain in general service

### 3.11

#### **working load**

##### **WL**

maximum mass a *shackle* (3.1) may sustain in a particular stated service

### 3.12

#### **finished condition**

state of the surface after forging, heat treatment, machining and surface treatment

Note 1 to entry: Examples of surface treatment are descaling, electroplating, hot dip galvanizing, painting, etc.

### 3.13

#### **lot**

specified number of *shackles* (3.1) from which samples are selected for testing purposes, and which have been manufactured from the same cast of steel and subjected to the same heat treatment process

### 3.14 grade

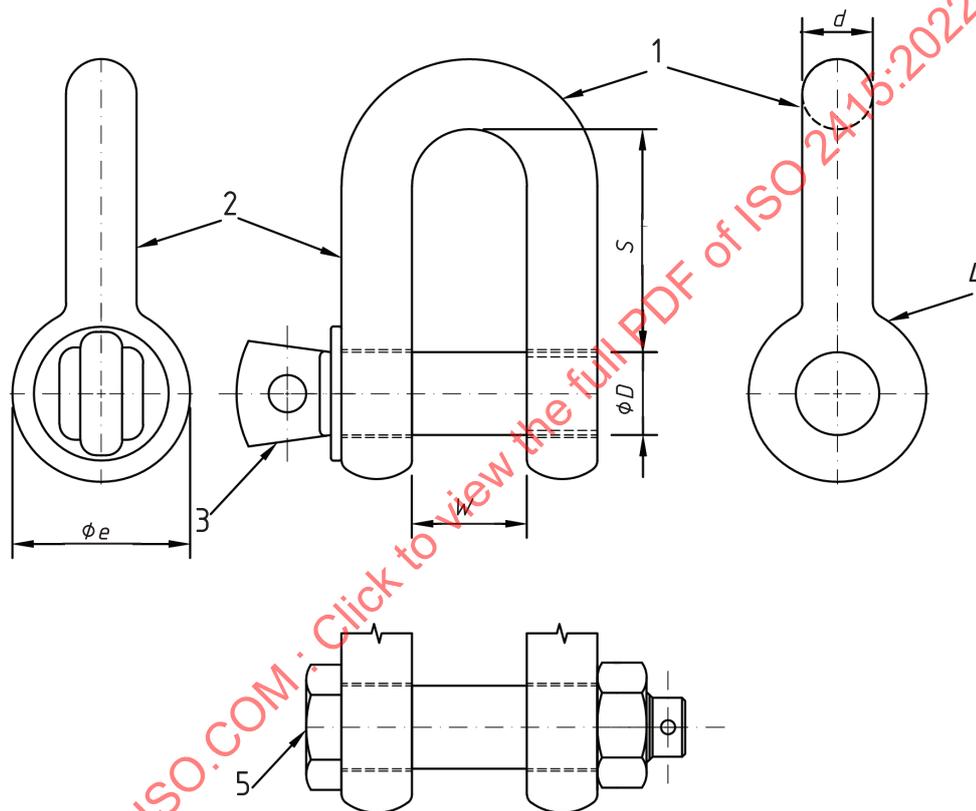
minimum ultimate tensile strength of the material

Note 1 to entry: See [Table 4](#).

## 4 Form and dimensions

### 4.1 Dee shackles

The dimensions of dee shackles shall be in accordance with [Figure 1](#) and [Table 1](#).



#### Key

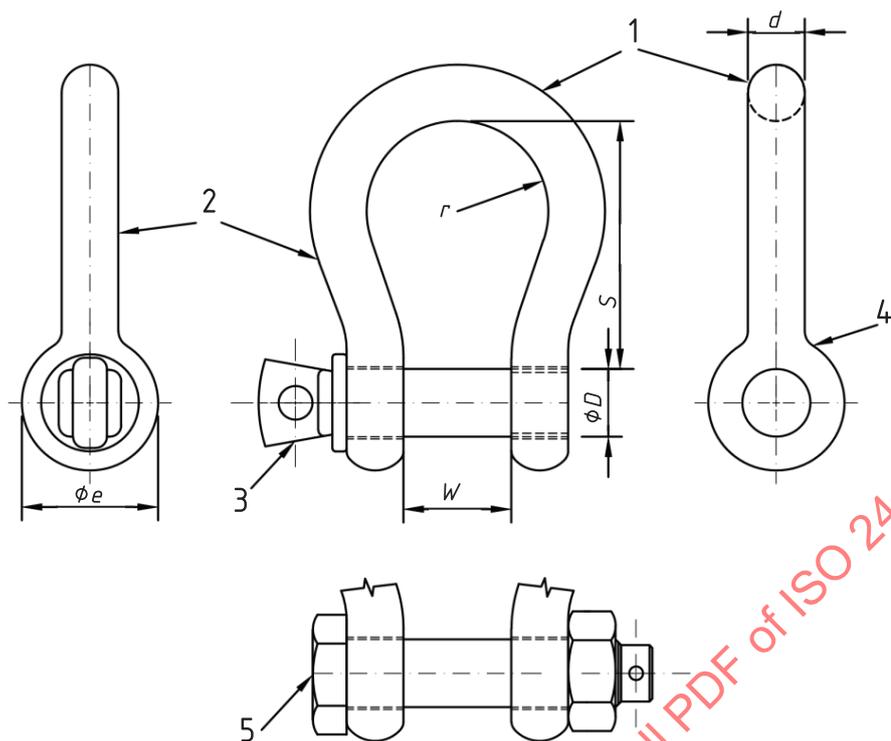
- 1 crown
- 2 body
- 3 screwed pin with eye and collar — Type W (see [Figure 3](#))
- 4 eye
- 5 bolt-type pin with hexagon head, hexagon nut and split cotter pin — Type X (see [Figure 3](#))

NOTE This figure is intended only to show where dimensions are measured. It does not purport to indicate any detailed design of any part of the shackle.

**Figure 1 — Dimensions of dee shackles**

### 4.2 Bow shackles

The dimensions of bow shackles shall be in accordance with [Figure 2](#) and [Table 1](#).



**Key**

- 1 crown
- 2 body
- 3 screwed pin with eye and collar — Type W (see [Figure 3](#))
- 4 eye
- 5 bolt-type pin with hexagon head, hexagon nut and split cotter pin — Type X (see [Figure 3](#))

NOTE This figure is intended only to show where dimensions are measured. It does not purport to indicate any detailed design of any part of the shackle.

**Figure 2 — Dimensions of bow shackles**

Dimensions in millimetres

**Table 1 — Preferred dimensions of dee and bow shackles**

Working load limit (WLL) [t]			<i>d</i>			<i>D</i>			<i>W</i>			<i>e</i>			<i>S</i>		<i>2r</i>
Grade 6	Grade 8	Grade 10	min.	typ.	max.	min.	typ.	min.									
0,5	0,75		5,5	7	8	7	8	9	9,5	12	14,5	15,5	17	18,5	20	27	19
0,75	1		7	9	10	8,5	9,5	10,5	11	13,5	16	18,5	20	21,5	25	29	20
1	1,5	2	9	10	11,5	10	11	12	14	16,5	19	22	23,5	25	27	32	24
1,5	2	2,5	10,2	11	12,7	11,2	12,2	13,2	16,5	19	21,5	25	26,5	28	33	39	27
2	2,5	3,3	12,5	13,5	15	15	16	17	19	21,5	24	29,5	32	34,5	38	44	30
3,25	4	5	14	16	19	17	19	21	24	27	30	38	40	43	47	57	39
4,75	6,3	7	17,5	19	22,5	20	22	24	28,5	31,5	34,5	44	46	49	52	65	48
6,5	8,5	9,5	20,5	22	25,5	23	25	27	33,5	36,5	39,5	50	52	55	65	76	55
8,5	9,5	12,5	23	25	28	26	28	30	40	43	46	56	59	62	74	88	64
9,5	12	15	26,5	28	31,5	30	32	34	43,5	46,5	49,5	64	67	70	83	101	70
12	13,5	18	30,5	32	35,5	33	35	37	47,5	51,5	55,5	70	73	76	87	108	78
13,5	17	21	33,5	35	39,5	36	38	40	53	57	61	76	80	84	104	126	85
17	25	30	36,5	38	42,5	40	42	44	56	60	64	84	88	92	115	139	94
25	35	40	43	45	49	49	51	53	70	74	78	100	104	108	139	168	119
35	42,5	50	48	50	52	56	58	60	79	83	87	108	112	116	155	182	130
42,5	50	55	55	57	59	63	65	67	90	95	100	126	130	134	170	205	150
55	70	85	62	65	68	68	70	72	100	105	110	140	145	150	185	240	170
85	100	120	72	75	78	80	83	86	122	127	132	157	162	167	205	300	180
120			87	90	95	92	95	98	142	147	152	205	210	215	250	370	225

NOTE Sizes, tolerances and loads in other standards are not specifically excluded by this table and can be deemed compliant.

**4.3 Hole diameter**

The maximum diameter of the unthreaded hole or holes in the body of the shackle shall be either  $1,1 \times D$  or  $D + 1,5$  mm, whichever is greater, where  $D$  is the actual pin diameter.

Holes in shackle bodies shall be generally aligned coaxially with each other and concentric to the outside diameter of the eyes. Centre of the shackle eye and centre of the hole to be the concentric within a tolerance of  $\pm 5$  % of the nominal diameter of the shackle pin.

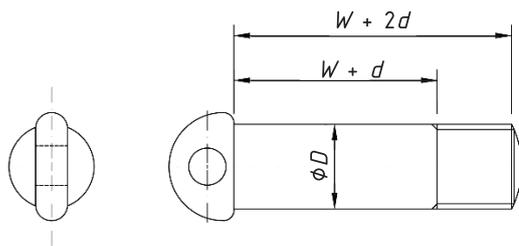
**4.4 Types of shackle pin**

The threaded shackle pins shown in [Figure 3](#) illustrate only typical examples of pins; other suitable forms of pins are acceptable.

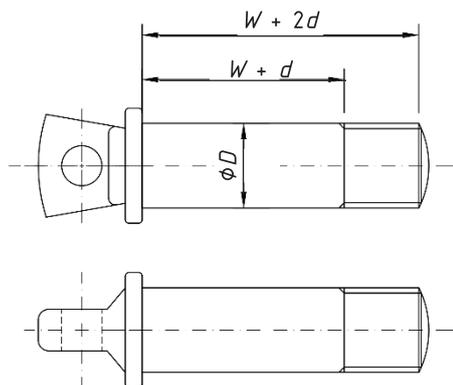
The pins illustrated are of the following types:

- a) Type V: screwed with eye;
- b) Type W: screwed with eye and collar;
- c) Type X: bolt with hexagon head, hexagon nut and a retainer, for example a split pin;
- d) Type Y: countersunk and slotted head.

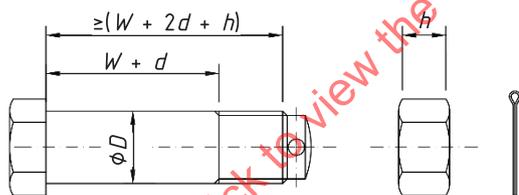
For the purpose of the designation system (see [Annex A](#)), all other types of pins are designated as being of Type Z.



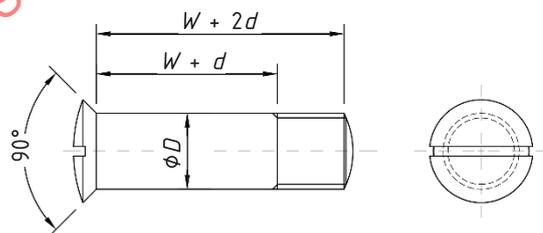
a) Type V: screwed with eye



b) Type W: screwed with eye and collar



c) Type X: bolt with hexagon head, hexagon nut and a retainer: for example, a split pin



d) Type Y: countersunk and slotted head

Figure 3 — Typical examples of shackle pin types

## 5 Mechanical properties

### 5.1 General

The mechanical properties of the shackles in terms of proof force and breaking force shall be as specified in [Table 2](#).

**Table 2 — Mechanical properties**

Working load limit (WLL) [t]			Proof force $F_e$ [kN]			Breaking force $F_b$ [kN]		
Grade 6	Grade 8	Grade 10	Grade 6	Grade 8	Grade 10	Grade 6	Grade 8	Grade 10
See <a href="#">Table 1</a>			Min. 2 times WLL			Min. number of times WLL		
						5 or 6	5	5

For grade 6 the breaking force shall be a minimum of 5 or 6 times WLL with the factor as classified in [Table 5](#).

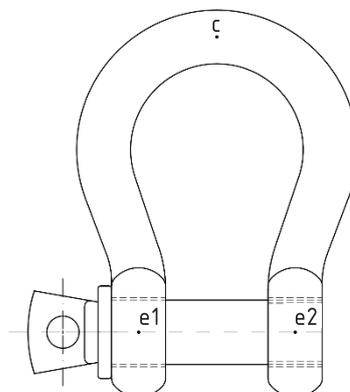
In the tests specified in [5.2](#) to [5.4](#), the force shall be applied to the shackle axially without shock to the crown of the body, using a test machine fixture having a dimension not greater than 60 % of the maximum internal width of the shackle, and to the centre of the shackle pin, using a testing machine fixture having a width not exceeding the diameter of the pin. The fixtures that are used for the deformation resistance test, breaking force test and fatigue test shall be the same configuration.

The test machine used in the tests specified in [5.2](#) to [5.4](#) shall comply with ISO 7500-1 Class 1.

### 5.2 Deformation resistance test

Each shackle, when tested in accordance with [10.2](#), shall be capable of sustaining the manufacturing proof force to  $2 \times$  WLL without exceeding the deformation requirement, as measured between e1 and c, e2 and c, e1 and e2, i.e. no dimension shall alter by more than 2 % (or 0,5 mm whichever is greater), of the initial dimension after the proof force has been applied. After removal of the test force, the pin, when loosened, shall turn freely (see [Figure 4](#)). Small indents from the test tools are allowed.

To remove deformation due to “setting” from a real deformation result, it is allowed to apply an initial load equal to the WLL of the shackle being tested and measure initial dimensions after release of this first load.



**Figure 4 — Positions for measuring deformation**

### 5.3 Breaking force

Each shackle, when tested in accordance with 10.3, shall have a breaking force at least equal to that specified in Table 2.

On completion of the breaking force test, the shackle shall show evidence of ductility. Dee shackles shall have a minimum inside length increase of 5 % for grade 6 and 8, and 2 % for grade 10. Bow shackles shall have a minimum inside length increase of 10 % for grade 6 and 8, and 5 % for grade 10. Measurements are taken from bearing point to bearing point.

If the pin breaks, it shall show a permanent bend of not less than 20° for grades 6 and 8, and grade 10 shall show a permanent bend of not less than 10°. A shackle bow shall show a diameter reduction (contraction) after breaking and there shall be a fine-grained structure in the fracture area.

NOTE 1 This test can be carried out on the same shackles that have been subjected to the deformation test.

NOTE 2 It is not necessary to test the shackle up to its actual breaking force for the mechanical properties specified to be demonstrated.

### 5.4 Fatigue resistance

Each shackle of grade 6, 8 and 10 with a working load limit up to and including 32 t, when tested in accordance with 10.4, shall, after at least 20 000 cycles, be capable of retaining the load.

Fatigue resistance testing may be conducted on shackles that have passed a proof load test.

## 6 Material

### 6.1 General

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

In its finished state, as supplied to the shackle manufacturer, the steel shall comply with the requirements specified in 6.2, as determined by a cast or check analysis on the bar or on the finished shackle.

The steel shall be fully killed, shall be suitable for forming or forging and shall be capable of being heat treated to obtain the mechanical properties required by this document. Its content of sulfur and phosphorus shall be restricted in accordance with Table 3.

**Table 3 — Maximum sulfur and phosphorus content**

Element	Maximum mass content	
	[%]	
	Cast analysis	Check analysis
Sulfur	0,025	0,030
Phosphorus	0,025	0,030

The steel shall be made in conformity with fine-grain practice in order to obtain an austenitic grain size of 5 or finer when tested in accordance with ISO 643.

NOTE This could be achieved, for example, by ensuring that the steel contains sufficient aluminium or an equivalent element to permit the manufacture of shackles stabilized against strain-age-embrittlement during service; a minimum value of 0,020 % of total aluminium is given for guidance.

Within the limitations specified above, it is the responsibility of the shackle manufacturer to select steel such that the finished shackle, suitably heat-treated, complies with the requirements of the mechanical properties specified in this document.

## 6.2 Grade

Definition of grade:

**Table 4 — Material strength**

Grade	Minimum ultimate tensile strength of the material
	[MPa]
6	600
8	800
10	1 000

Shackles comply with this document if the minimum ultimate tensile strength of the material in finished condition is met in [Table 4](#) as combined with the basic requirements of this document.

NOTE The shackle grade designation system describes the minimum required material ultimate strength in the finished condition and does not reflect the strength of grade 6, grade 8 and grade 10 chain and chain components of equivalent sizes (see [Table 1](#) for shackles' WLL).

## 6.3 Specific requirements

Manufacturers shall use one of three methods to insure design robustness; increased factor, a minimum Charpy value, or alloying elements. See [Table 5](#).

**Table 5 — Specific requirements**

Grade	Factor	Charpy V-notch impact test at -20 °C minimum energy [J]	Minimum mass content (in percent by mass) of alloy elements as determined by cast analysis [%]		
			Ni	Cr	Mo
			0,4	0,4	0,15
6	6	-	-	-	-
	5	-	At least two of the above elements contained.		
	5	20	-	-	-
8	5	-	Ni and at least one of the other elements contained.		
	5	27	-	-	-
10	5	-	Ni and at least one of the other elements contained.		
	5	30	-	-	-

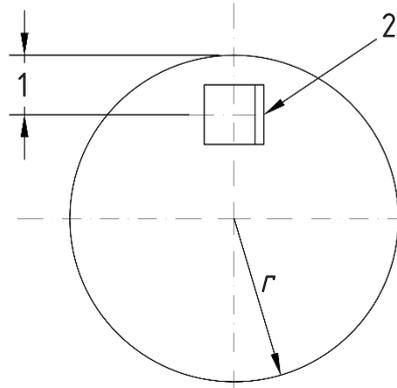
NOTE Regardless of which method is used to increase product robustness, nothing precludes a manufacturer from using Charpy testing to ensure their products material toughness and/or production control.

## 6.4 Charpy impact test

If Charpy test is used to insure product robustness, samples shall be tested from both shackle pins and bodies at a temperature of -20 °C. The test temperature shall conform to the lowest application temperature. They shall have a minimum impact value as stated in [Table 5](#).

The Charpy V-notch impact test shall be carried out in accordance with ISO 148-1 on shackles of all sizes  $\geq 13$  mm. The position of the notched specimen in the sample shall be as indicated in [Figure 5](#) for the small diameters sampled from the centre of the bar.

For tests where the size of shackle is too small to provide a suitable test piece, tests may be carried out on sample material which shall be of the same cast and heat treatment.



**Key**

- 1 approximately  $1/3 r$
- 2 notch

**Figure 5 — Position and orientation of the notched specimen in a sample**

**7 Heat treatment**

**7.1 Grades 6, 8 and 10**

Shackles that are quenched and tempered shall be hardened from a temperature above the AC3 point and tempered before being subjected to the manufacturing proof force. The tempering temperature shall be a minimum of 400 °C.

The tempering conditions shall be at least as effective as a temperature of 400 °C maintained for a period of 1 h.

A method of verification is that after the shackles have been re-heated to, and maintained for 1 h at a minimum 400 °C and then cooled to room temperature, they shall conform to the mechanical properties of [Table 2](#).

If an alternative heat treatment method is used, the mechanical properties of [Table 2](#) shall be proven by performance testing on sample shackles after they have been heated to a minimum 400 °C for 1 h and then cooling in air to room temperature.

Surface hardening of shackles shall not be permitted.

**8 Workmanship**

**8.1 Manufacture**

The shackle body shall be forged in one piece without welding. Neither the shackle body nor the pin shall be cast or welded. Welding shall not be used during the manufacturing of the components unless:

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

- b) the area affected by the weld is not to be subjected to load under normal operating conditions or under any foreseeable misuse of the shackle;
- c) the welding is completed before heat treatment;
- d) care should be taken during welding to ensure that the mechanical properties of any load bearing parts of the finished shackle are not affected; or
- e) all welds shall be smoothly finished.

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.

Edges of machined surfaces shall be rounded to eliminate cutting edges and to ensure attainment of mechanical properties of the shackle.

The pin shall be either forged or machine-finished. The collar or head of the pin shall fit closely against the body of the shackle.

When a threaded pin is fully tightened, the length of thread which remains visible between the jaws of the shackle shall not be greater than one and a half threads.

In all cases when the pin is correctly fitted in the body of the shackle, the jaw width,  $W$  (see [Figures 1](#) and [2](#)), shall not be significantly reduced.

For pin Type X (see [Figure 3](#)), the bolt should not have threads visible between the shackle eyes.

The finished shackle body and pin shall be free from any harmful surface defects, including cracks.

Due to the risk of hydrogen embrittlement, care should be taken during electroplating or galvanizing to ensure that the mechanical properties of any load bearing parts of the finished shackle are not affected.

If shackles are to be hot dip galvanized or subjected to similar processes, such processing should only be carried out under the control of the shackle manufacturer.

## 9 Screw threads

Screw threads shall conform to either ISO 261 minimum class 7H/8g or to ISO 263 minimum class 1A/1B.

Alternative forms of thread may be used, provided that the performance of the shackle is not impaired.

NOTE It is allowed to use undercutting the threads for male and/or overcutting threads for female to make a hot dipped galvanizing or other coating possible.

## 10 Type testing

### 10.1 General

Type tests demonstrate that shackles certified by the manufacturer complying with the requirements laid down in this document possess the mechanical properties specified in this document. The purpose of these tests is to prove the performance of the design, material, heat treatment and method of manufacture of each size of finished shackle, including protective coating (if applied). Any modification of the design, material specification, heat treatment or method of manufacture — including protective coating (if applied) — or in any dimension outside normal manufacturing tolerances that could lead to a change of the mechanical properties according to [Clause 5](#), shall require that the type tests specified in [10.2](#) to [10.4](#) ([10.5](#) only applicable if this option from [Table 5](#) is chosen by the manufacturer) be carried out on the modified shackle.

All shackles to be type tested shall comply with all the other requirements laid down in this document. The tests specified in [10.2](#) to [10.4](#) ([10.5](#) only applicable if this option from [Table 5](#) is chosen by the manufacturer) shall be carried out on each shackle size, design, material, heat treatment and method of manufacture, in its finished condition. This includes protective coating if applied.

In the tests specified in [10.2](#) to [10.4](#), the force shall be applied as stated in [5.1](#).

## 10.2 Deformation resistance test

Three samples shall be tested and each shall be capable of sustaining the proof force specified for the shackle in [Table 2](#).

The requirements for the state of deformation shall be as stated in [5.2](#).

NOTE See also [Clause 11](#) for proof testing of shackles, where required.

## 10.3 Breaking force test

Three samples shall be tested. Each shackle shall reach the minimum value specified in [Table 2](#). This test may be carried out on the same shackles that have been submitted to the deformation resistance test.

## 10.4 Fatigue test

Shackles with a working load limit of up to and including 32 t shall be subjected to the fatigue test.

Three samples shall be tested and each shall be capable of sustaining at least 20 000 cycles of the force range specified below without failing to retain the load.

The force range applied during each cycle shall be equal to 1,5 times the working load limit specified in [Table 1](#). The minimum force in each cycle shall be positive and less than or equal to 3 kN. The frequency of force application shall be maximum 25 Hz.

## 10.5 Charpy impact test

Three samples shall be tested from both shackle pins and bodies at a temperature of -20 °C. The test temperature shall conform to the lowest application temperature. They shall have a minimum impact value as stated in [Table 5](#).

## 10.6 Acceptance criteria for type testing

### 10.6.1 Deformation resistance test

If all three samples pass the test, the shackle of the size submitted for type testing may be deemed to conform to this document.

### 10.6.2 Static strength test and fatigue test

If all three samples pass the test, the shackle of the size submitted for type testing may be deemed to conform to this document.

If one of the samples fails, two further samples shall be tested and both shall pass the test in order for the shackle of the size submitted for type testing to comply with this document. If two or three samples fail the test, the shackle of the size submitted for type testing shall not be deemed to conform with this document.

### 10.6.3 Charpy impact test

All three samples, for both body and pin, shall have a minimum impact value as stated in [Table 5](#) in order for the shackle of the size submitted for type testing to conform to this document.

## 11 Manufacturing testing

The manufacturer shall carry out manufacturing testing for each produced batch of shackles in their finished condition.

### 11.1 Visual examination

All shackles shall be visually examined for conformity. Any shackle failing the visual examination shall be deemed not to conform to this document.

### 11.2 Proof force test

**11.2.1** Proof force test sample sizes are stated in [Table 6](#). The proof force test shall be done on each production batch of shackles in their finished condition, i.e. after manufacture, heat treatment and machining, including protective coating (if applied). It is allowed to apply the coating after proof force testing, only if during the type testing evidence is presented that the surface finish does not adversely influence the product. The proof force is specified in [Table 2](#).

If any shackle fails the manufacturing proof force test then the whole lot shall be subject to this test. Any shackle failing the manufacturing proof force test shall be deemed not to conform to this document.

**Table 6 — Sampling regime**

Lot size	Sample size [%]
1 – 3 000	3 (minimum 5 pieces)
3 001 – 5 000	2
> 5 000	1
Or 2 % independent of the lot size, with a minimum of 5 pieces for small batches.	

After the proof force has been removed, there shall be no visible defect, and the dimensions shall be within the tolerances specified on the manufacturer's drawings.

### 11.3 Hardness testing

Hardness testing for verification of correct heat treatment shall be done on each heat treatment batch. Results shall be within the manufacturing specifications.

### 11.4 Non-destructive testing

After heat treatment and de-scaling, the surfaces of both the body and pin shall be subjected to non-destructive testing in accordance with ISO 9934-1 and ISO 3452-1 or EN 10228-1 and EN 10228-2 in the sampling regime of [Table 6](#).

Indications greater than 2 mm in length shall not be permitted in areas of the shackle subjected to tensile stresses, in all foreseeable service conditions.

If grinding is required to remove indications, the shackle shall afterwards conform to the dimensions and tolerances specified by the manufacturer. A final examination shall show no indications greater than 2 mm in length.

Care should be taken to ensure that the direction and roughness of grinding does not create starting points for fatigue failure and cause excessive heating, which may have a local effect on the heat-treated condition or may cause cracks.

## 12 Marking

### 12.1 Shackle body

Each shackle shall be legibly and indelibly marked in a manner which will not impair its mechanical properties. This marking shall include at least the following information placed on the shackle by the manufacturer:

- a) manufacturer's identification mark or symbol;
- b) grade number, i.e. 6, 8 or 10;
- c) working load limit in tonnes, e.g. WLL 10 t;
- d) traceability code, enabling any particular shackle or batch of shackles in the consignment to be identified.

### 12.2 Shackle pins

All shackle pins of a diameter greater than, or equal to, 13 mm shall be legibly and indelibly marked with the relevant grade number, traceability code and manufacturer's symbol such that this marking does not impair the mechanical properties of the pin.

Traceability code of shackle pins and shackle bodies are not necessarily the same, they may be different.

Pins of less than 13 mm diameter shall be marked with at least the grade number.

For grade 8 pins the grade identification marking can be either: 8 or HS.

## 13 Manufacturer's certificate

**13.1** When the type testing as specified in [Clause 10](#) has been carried out with satisfactory results, the manufacturer may issue certificates of conformity for shackles of the same nominal dimensions, size, material, heat treatment and method of manufacture — including protective coating (if applied) — as the shackles tested.

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 and all relevant data concerning the shackles that have satisfied the type tests. This record shall also include the manufacturing specifications that shall apply to subsequent production.

Any modification in material specification, in method of manufacture — including protective coating (if applied) — in heat treatment, or in any dimension outside normal manufacturing tolerances which may lead to a change of the mechanical properties as specified in [Clause 5](#), shall be considered as a design modification. Tests in accordance with [Clause 10](#) are required before the manufacture is permitted to issue certificates of conformity for any modified design.

**13.2** The manufacturer shall provide a certificate with each consignment of shackles, giving the following information for each consignment:

- a) quantity and description of shackle, including type, shape and type of pin;
- b) grade number, i.e. 6, 8 or 10;

- c) traceability code, for both shackle body and pin, enabling any particular shackle or batch of shackles in the consignment to be identified;
- d) proof force specified;
- e) the working load limit in tonnes, e.g. WLL 10 t;
- f) minimum breaking force.

The certificate shall declare that each shackle complies with this document and is within the manufacturer's specification of the type tested shackle(s).

The manufacturer should issue certificates that are compliant with ISO 10474.

## 14 Instructions for use

Documented information shall be provided covering the subjects listed below. [Annex B](#) contains guidance to assist in the preparation of this information:

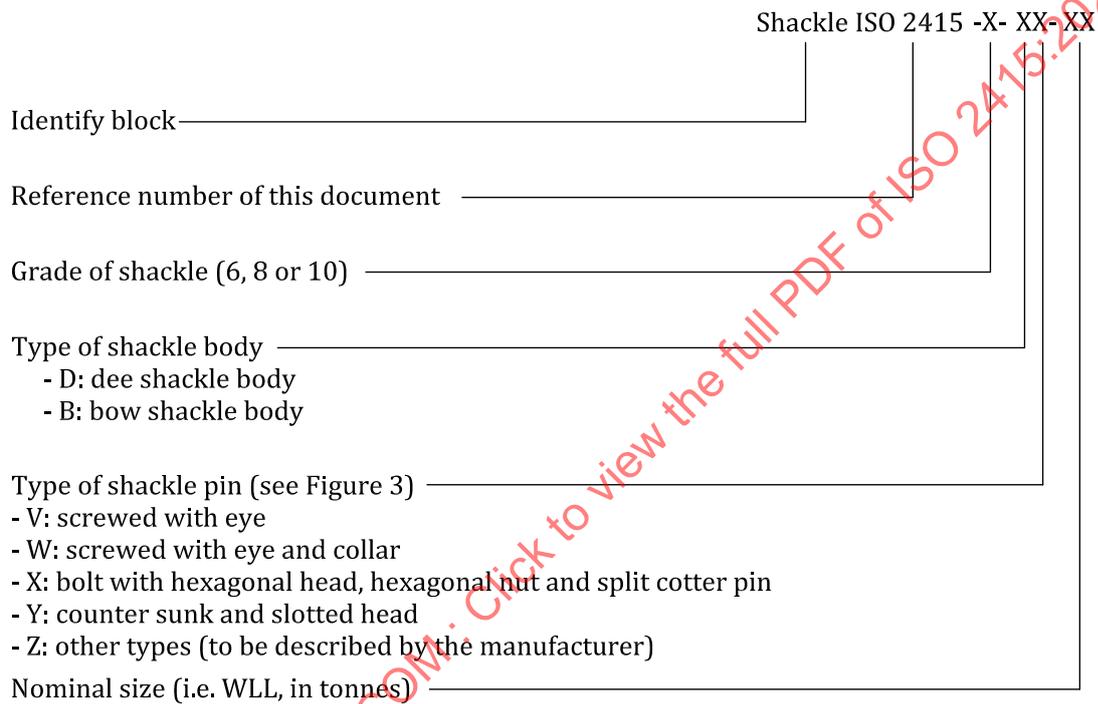
- a) selection of the correct shackle size, type, grade, shape and type of pin for the particular application;
- b) precautions to avoid the pin unscrewing;
- c) any restriction on altering the finished condition of the shackle;
- d) any limitations on the use of the shackle due to temperature, adverse environmental conditions or other hazardous conditions;
- e) inspection of the shackle before use and rejection criteria;
- f) replacement of a lost or damaged shackle pin;
- g) correct alignment of the shackle with the line of loading;
- h) correct fitting of the shackle pin;
- i) use of shackles with multi leg slings and the effect of leg angle on the loading of the shackle;
- j) avoidance of applications where the load is unstable;
- k) periodic thorough examination by a competent person.

## Annex A (informative)

### Designation

For reference and ordering purposes, shackles complying with this document may be designated using the following system.

The following elements should be used in the order given.



EXAMPLE 1 A dee shackle, complying with this document, with pin of Type W, of nominal size 20 t, and of grade 6, should be designated as follows:

**Shackle ISO 2415 - 6 - DW 20**

EXAMPLE 2 A bow shackle complying with this document, with pin of Type X, of nominal size 10 t, and of grade 8, should be designated as follows:

**Shackle ISO 2415 - 8 - BX 10**

## Annex B (informative)

### Safe use of shackles

#### B.1 Assembly

##### B.1.1 General

Shackles should be inspected before use to ensure that:

- a) the body and the pin of the shackle are both identifiable as being of the same size, at least the same type and make;
- b) all markings are readable;
- c) the threads of the pin and the body are undamaged;
- d) the body and pin are not unduly distorted;
- e) the body and pin are not unduly worn;
- f) the body and pin are free from nicks, gouges, cracks and corrosion.

**B.1.2** Ensure, where appropriate, that the pin is correctly screwed into the eye of the shackle body, i.e. tighten finger tight, then lock using a small tommy bar or suitable tool so that the collar of the pin is seated on the shackle eye. Ensure that the pin is of the correct length so that it penetrates the full depth of the screwed eye and allows the collar of the pin to bed on the surface of the eye.

In all cases, when the pin is correctly fitted in the body of the shackle, the jaw width  $W$  should not be significantly reduced.

**B.1.3** Incorrect seating of the pin may be due to a bent pin, the thread fitting too tightly or misalignment of pin holes. Do not use the shackle under these circumstances.

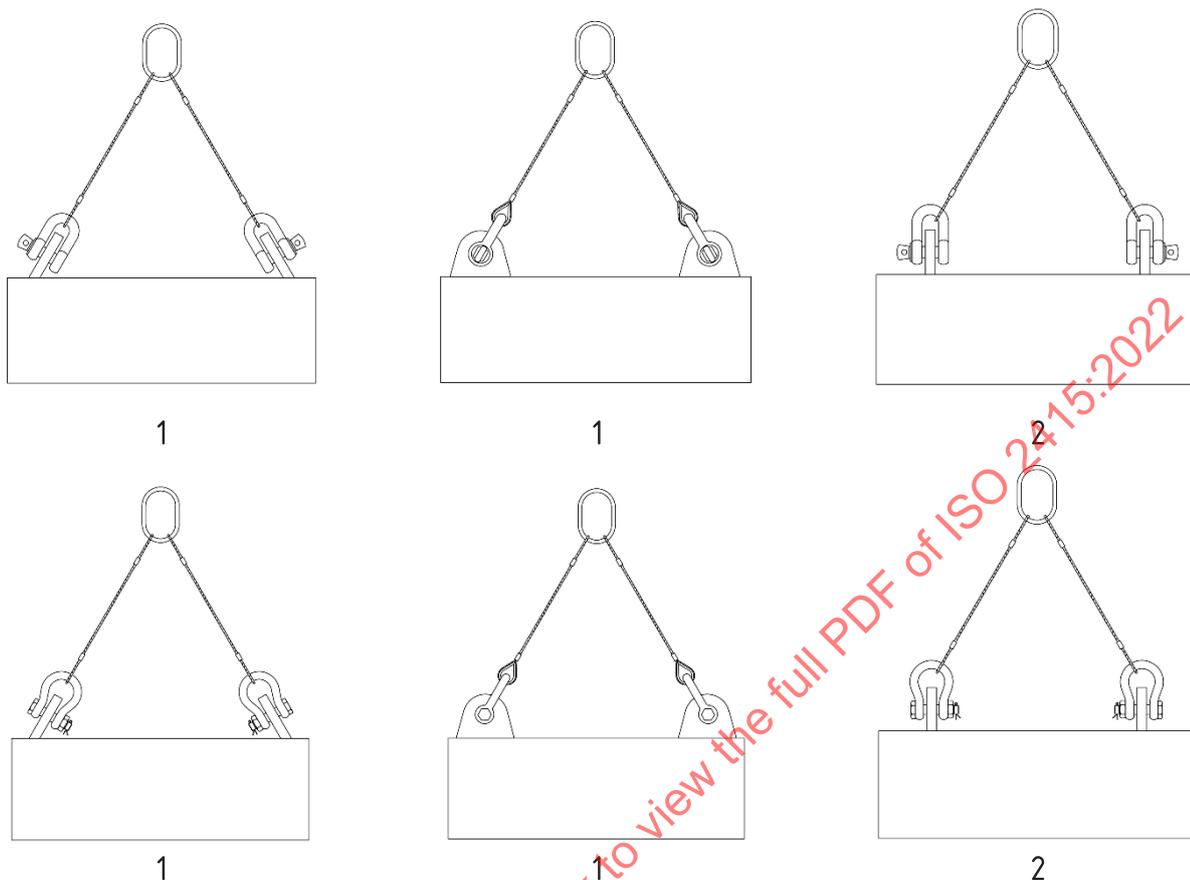
**B.1.4** Never replace a shackle pin except with one of the same size, at least the same type and make as it may not be suitable for the loads imposed.

#### B.2 Usage

**B.2.1** Select the correct type of shackle for a particular application from the information given in [B.2.2](#) to [B.2.8](#) inclusive.

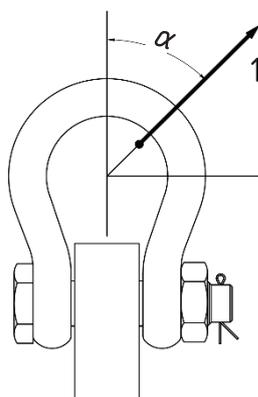
**B.2.2** It is important that pad eyes are positioned in the correct location and orientation to avoid side loading as much as possible. In general, this means that the shackle body should take the load along the

axis of its centreline (see [Figure B.1](#)). If side loads on a shackle on a pad eye (see [Figure B.2](#)) cannot be avoided, a working load (WL) should be applied as shown in [Table B.1](#).



- Key**
- 1 correct
  - 2 correct with WLL reduction

**Figure B.1 — Correct use of shackles and correct use with WLL reduction**



- Key**
- 1 load

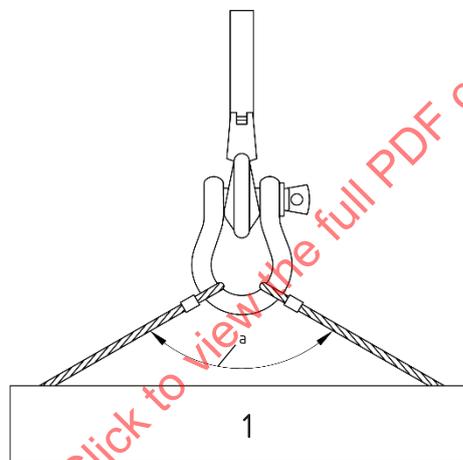
**Figure B.2 — Side load**

**Table B.1 — WLL angled reduction rate**

Angle $\alpha$ [°]	WL percentage at side load angle $\alpha$ (shackle on pad eye) [%]
0 - 5	100
5 - 45	70
45 - 90	50

**B.2.3** When using shackles in conjunction with multi-leg slings, due consideration should be given to the effect of the angle between the legs of the sling. As the angle increases so does the load in the sling leg and consequently in any shackle attached to the leg.

**B.2.4** When a shackle is used to connect two slings to the hook of a lifting machine, it should be a bow type shackle assembled with the slings in the shackle body and the hook engaged with the shackle pin. The included angle between the slings should not exceed 120° (see [Figure B.3](#)).

**Key**

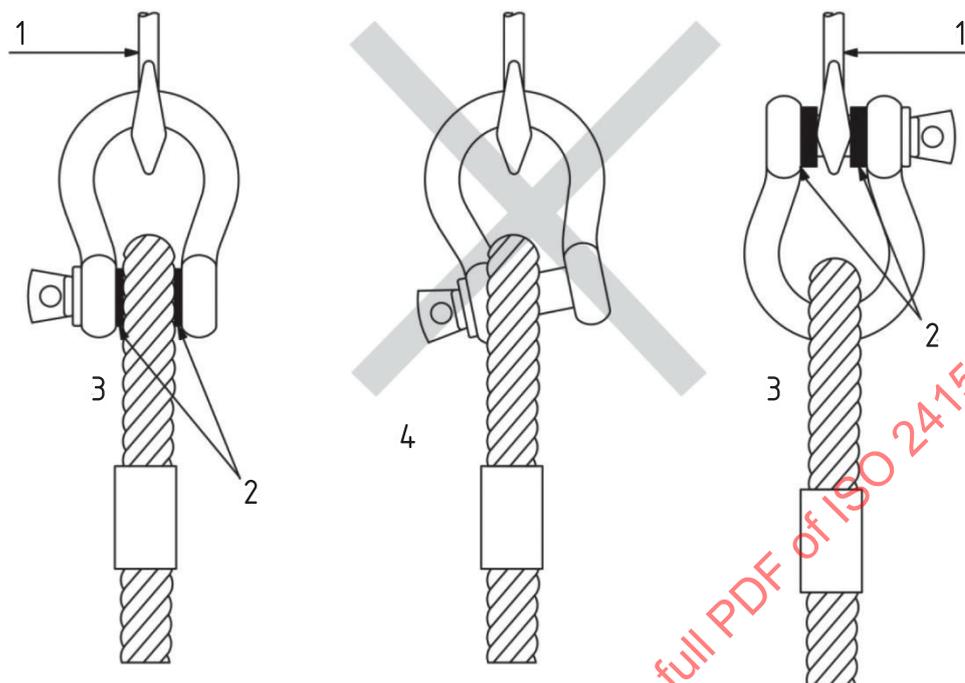
- 1 load
- a 120° maximum.

**Figure B.3 — Recommended angle between the slings**

**B.2.5** Generally, a load bearing component that is in connection with a shackle is of a rounded shape. Point loading of shackles is allowed but the minimum diameter of a rounded component should be equal or larger than the diameter of the bow at contact point of the shackle being used. Larger diameters and or flat parts (at shackle pin side) to increase contact area can be beneficial. Sharp edges should be avoided.

**B.2.6** To avoid eccentric loading of the shackle a loose spacer may be used on either end of the shackle pin (see [Figure B.4](#)). Do not reduce the width between the shackle jaws by welding washers or spacers

to the inside faces of the eyes or by closing the jaws, as this will have an adverse effect on the properties of the shackle.



**Key**

- 1 hook
- 2 spacers
- 3 correct
- 4 incorrect

**Figure B.4 — Use of loose spacers on shackle pin**

**B.2.7** When a shackle is used to secure the top block of a set of rope blocks the load on this shackle is increased by the value of the hoisting effect.