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Cranes — Training of slingers and signallers

Appareils de levage à charge suspendue — Formation des élingueurs et des signaleurs

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Foreword

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This document was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 5, *Use, operation and maintenance*.

This third edition cancels and replaces the second edition (ISO 23853:2018), which has been technically revised.

The main changes are as follows:

— Clause 4 "Prerequisite aptitudes and knowledge" has been modified to "Training requirements".

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.

Introduction

The objective of this document is to achieve uniform methods of training, verification and authorization of slingers and signallers involved in crane operations.

Cranes — Training of slingers and signallers

1 Scope

This document specifies the minimum training to be given to trainee crane slingers and crane signallers to develop the basic slinging skills and to impart the requisite knowledge for competency required for slingers and signallers as defined in ISO 15513.

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 15513:2000, *Cranes — Competency requirements for crane drivers (operators), slingers, signallers and assessors*

ISO 16715, *Cranes — Hand signals used with cranes*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Training requirements

Slingers and signallers shall be trained in accordance with ISO 15513:2000, 5.3 and 5.4 respectively.

5 Training objectives

The objectives of slinger/signaller training are to:

— provide knowledge about cranes;

— provide knowledge about slinging equipment;

— teach safe slinging methods;

— teach signalling methods;

— impart safe slinging techniques;

— provide knowledge regarding job planning, hazard identification and load control.

6 Training procedures

The duration and contents of the training procedures shall be sufficient to attain the objectives.

The training shall include both a theoretical programme and a practical programme. In particular, it is important that trainees are taught safe slinging work through case studies of accidents that have occurred during slinging work.

The practical training shall be carried out for a group of trainees, sufficiently small to allow for individual hands-on attention, according to the following procedures:

— The training instructor shall demonstrate the aspects of basic slinging work, i.e. preparation of a lift plan, identification of site hazards, determination of the centre of gravity, estimation of the mass of a load, attaching slinging equipment on the load, lifting, conveying and lowering the load.

— The trainee shall then perform the slinging work according to the demonstration by the instructor and repeat it until he or she becomes skilled. In particular, he or she shall learn safe procedures for slinging work.

— The trainee acts as a slinger (or signaller) and one or two other trainees act as assistant(s).

Upon completion of training, assessment of the results of the theoretical and practical programmes shall be conducted to confirm whether or not a trainee has achieved the training objectives.

7 Contents of training programme

7.1 Theoretical programme

7.1.1 Knowledge of cranes

The following knowledge of cranes shall be included in the training programme:

a) cranes in general:

— vocabulary;

— crane motions;

— lifting capacity, rated capacity chart;

b) types, outline of structure, purpose of use:

— mobile cranes;

— tower cranes;

— jib cranes;

— bridge and gantry cranes;

c) hook, load block and below-the-hook lifting attachments;

d) load control.

7.1.2 Slinging equipment

The following knowledge of slinging equipment shall be included in the training programme:

a) wire rope slings:

— rope construction;

— rope lay;

— working load limit;

— proper use, maintenance and storage;

b) chain slings:

— types of chain slings;

— working load limit;

— proper use, maintenance and storage;

c) fibre slings:

— types;

— working load limits;

— proper use, maintenance and storage;

d) rigging hardware and accessories:

— pulley (reeving) block;

— slinging gear (clamps, lifting hooks, shackles, lifting beams, lifting nets, eye pieces);

— softeners and dunnage.

7.1.3 Inspection of slinging equipment

The following knowledge of the inspection of slinging equipment shall be included in the training programme:

a) wire rope slings:

— inspection of items (number of broken wires, reduction of rope diameter, wear, kink, deformation, corrosion, lubrication, abnormality at connecting part or end fitting, etc.);

— discard criteria;

b) chain slings:

— inspection of items (elongation, deformation, twist, crack, abnormality at joint section, etc.);

— discard criteria;

c) fibre slings:

— fibre rope slings:

1) inspection of items (wear, scratch, cut, corrosion, loose lay, etc.);

2) discard criteria;

— fibre webbing slings:

1) damage (wear, scratch, cut of sewing strings);

2) outer abnormality (change of colour, colouring, melt, dirt);

3) metal fitting (deformation, scratch, crack, corrosion);

4) discard criteria;

d) lifting clamps:

— abnormality of clamp body or lifting ring;

— abnormality of throat opening;

— damage, wear or clogging at teeth (knurled part) of cam or jaw;

— function of clamp;

— function of safety latch;

— maintenance;

— discard criteria.

7.1.4 Slinging methods

The following knowledge of slinging methods shall be included in the training programme:

a) determination of the centre of gravity and estimation of the mass of loads;

b) choice of slinging method corresponding to characteristics of the load:

— direct lifting;

— basket hitch;

— choke hitch;

— clamp lifting;

— non-symmetrical loads;

— lifting by a lifting beam (spreader);

c) selection of slinging equipment with consideration of load weight, centre of gravity, load characteristics and sling geometry;

d) loads that require special handling methods.

7.1.5 Signalling

The following knowledge of signalling shall be included in the training programme:

a) hand signals in accordance with ISO 16715;

b) radio communication (voice communications).

7.1.6 Safety rules

The following knowledge of safety rules shall be included in the training programme:

a) general operational guidelines and restrictions;

b) guidelines and restrictions that are applicable to a specific worksite or industry;

c) applicable national or local regulations.

7.1.7 Job planning

The following knowledge of job planning shall be included in the training programme:

a) job sequence;

b) path of travel and control of the load;

c) restrictions of the work area to minimize hazards to personnel, pedestrians and traffic;

d) pick and landing zones: locations and adequacy;

e) location of personnel involved in slinging work;

f) coordination with other site personnel.

7.1.8 Hazard identification and control procedures

The following knowledge of hazard identification and control procedures shall be included in the training programme:

a) hazards associated with the use of cranes and slinging practices:

— crushing hazards, such as falling load, load collapse, caught between moving load and other objects;

— cutting hazards, such as broken wire rope, sharp edged load;

— impact hazards, such as load sway, load collapse, falling objects;

— entanglement hazards, such as with wire rope sling, tagline;

b) potential hazards to be taken into consideration at lifting operation site:

— overhead power lines;

— overhead service lines, such as steam, gas, telephone;

— trees;

— uneven and/or unstable ground;

— allowable floor loading as appropriate;

— surrounding buildings/vessels/structures/equipment;

— hazardous materials;

— corrosive substances;

— barricades;

— inadequate lighting;

— radio interference;

— inclement weather, including wind acting on the crane and the suspended load;

— other cranes, equipment or vehicles;

c) load control:

— use of tagline;

— selection and application of 'No-Touch' tools;

— stable conveyance of the lifted load from pick to landing;

— trapped or caught loads.

7.2 Practical programme

7.2.1 General

The practical programme shall include various steps for slinging work, such as safe procedures for slinging work, signalling, determination of the centre of gravity, estimation of the mass of loads, selection of slinging equipment, checking (inspection) of slinging equipment, attaching slinging equipment on the load and the hook, lifting, transporting and lowering the load. With regard to the slinging methods, trainees shall learn at least the techniques required for basket-hitch lifting, choke hitch lifting, clamp lifting and lifting of unevenly shaped loads.

Mass estimation of actual loads and selection of wire rope sling is provided in Annex A. The training procedure for double wrap basket hitch lifting and for clamp lifting is provided in Annex B.

7.2.2 Safe procedures for slinging work

Practice in the following procedures for slinging work shall be included in the training programme:

a) proper clothing, use of personal protective equipment;

b) safety confirmation by pointing and calling;

c) regularly scheduled safety and coordination meetings among personnel involved in controlling the crane and load handling.

7.2.3 Signalling

Practice in the following procedures for signalling shall be included in the training programme:

a) hand signals in accordance with ISO 16715;

b) radio communication (voice communications).

7.2.4 Determination of the centre of gravity and estimation of the mass of loads

Practice in the determination of the centre of gravity and estimation of the mass of loads shall be included in the training programme.

7.2.5 Selection of slinging equipment

Practice in the selection of slinging equipment shall be included in the training programme.

7.2.6 Checking (inspection) of slinging equipment

Practice in the checking (inspection) of slinging equipment shall be included in the training programme.

7.2.7 Slinging

7.2.7.1 Attaching slinging equipment

Practice in the following procedures for attaching slinging equipment shall be included in the training programme:

a) determination of the centre of gravity and lifting points that are adequate to stabilize and balance the lifted load, and that can safely sustain the slinging forces;

b) guiding the hook above the load and lowering the hook;

c) attaching slinging equipment on the load and the hook;

d) confirmation of the safety of slinging condition;

e) proper use of rigging hardware.

7.2.7.2 Trial lift and lifting the load

Practice in the following procedures for trial lift and lifting the load shall be included in the training programme:

a) precision lifting and stop;

b) monitoring the load at the commencement of the pick to ensure that rigging is properly engaged and aligned;

c) monitoring the load as it is being picked to ensure that the load is balanced, and that it is not distressed or excessively deformed.

7.2.7.3 Transporting the load

Practice in the following procedures for transporting the load shall be included in the training programme:

a) planning the path of travel of the load;

b) cross over (space shared with other cranes);

c) signalling the load path and lowering position to a crane operator;

d) guiding the load.

7.2.7.4 Lowering the load

Practice in the following procedures for lowering the load shall be included in the training programme:

a) evaluating ground or supporting structure surface condition;

b) guiding the load to the lowering place and preparing dunnage;

c) lowering the load and stop lowering;

d) precision lowering, grounding the load and confirmation of the stability;

e) removing the slinging equipment from the hook and the load;

f) checking the slinging equipment and storing it at a designated place.

8 Assessment

8.1 General

After the completion of the training programme, the knowledge and practical competence of the trainee shall be assessed in accordance with ISO 15513. Any trainee who has been determined not to meet the competency standard shall undergo further training prior to reassessment.

The assessment shall be completed by a third party, independent of the training provider. This is to avoid training that only includes content to pass the assessment.

8.2 Knowledge assessment

The knowledge assessment shall evaluate the competence of the trainee on 7.1.1 to 7.1.8. In order to demonstrate an acceptable level of competence, the trainee shall score at least 50 % of the marks possible for each topic and 60 % of the total marks. Further training shall be undertaken if these marks are not achieved.

8.3 Practical assessment

The practical assessment shall determine whether the trainee has acquired the skill to perform procedures in 7.2.2 to 7.2.7. The pass mark shall be 70 % of the total marks possible. Further training shall be undertaken if these marks are not achieved.

Annex A
(informative)

Practical training aids

A.1 Mass estimation of actual loads

For practical training in mass estimation, trainees estimate the mass of actual loads using the theoretical techniques in 7.1.4. Trainees are required to calculate the mass by measuring the dimension of the loads and calculating its volume, then multiplying the volume by the specific gravity using information such as the one illustrated in Table A.1. Initially, trainees measure the dimensions with a tape measure, but the final goal is for them to acquire the technique for estimating the volume correctly by measuring the dimension of the loads using only their hands (hand span, arm span), feet (stride length), etc.

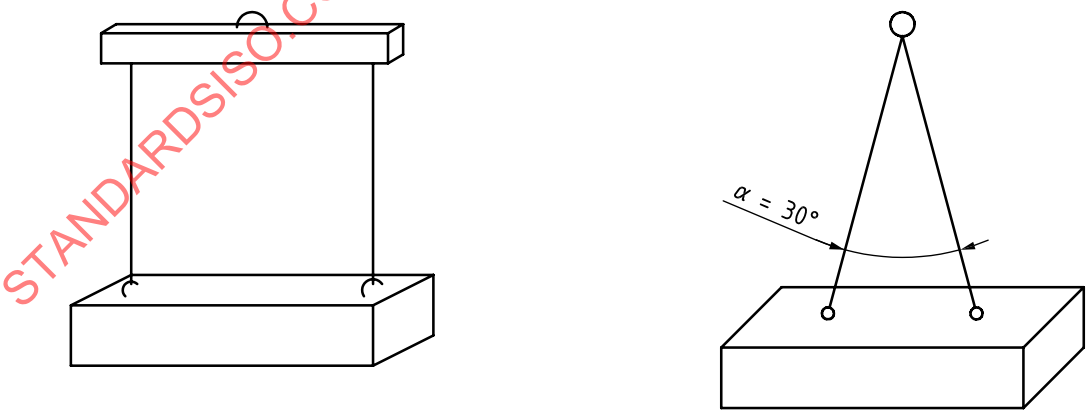
A.2 Selection of wire rope sling

A.2.1 General

Through practical training in the selection of wire rope slings, trainees learn to select the wire rope slings appropriate to the lifting conditions, such as the mass of the load, number of legs of the wire rope slings and the lifting angle.

A.2.2 Two-legged slinging

For lifting a load by two-legged slinging as shown in Figure A.1, trainees are required to determine the appropriate wire rope diameter for the given mass and lifting angle, according to Table A.2 and Table A.3, and select the proper one from a random selection of actual wire ropes, as shown in Table A.4. The objective of this practical training is to teach the trainees to visually select the target diameter of the wire rope sling.



a) Lifting angle 0° (mass = 5 t) **b) Lifting angle 30°** (mass = 7 t)

Figure A.1 — Two-legged slinging

Table A.1 — Example of estimation of the mass

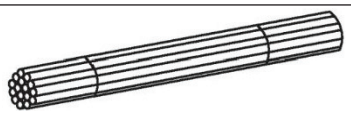
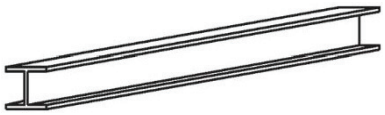
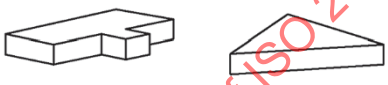
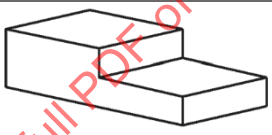
Load	Mass t	Density kg/m^3	Shape
Steel bar	W 0,5	7,8	
Bundle of steel bars	W 0,5	7,8	
H-section steel	W 0,5	7,8	
Steel plate	W 0,5	7,8	
T-shaped steel and triangular steel	W 0,5	7,8	
Non-symmetric load	W 0,5	Steel: 7,8 Concrete: 2,3	
Wheel or cylindrical load	W 0,5	Steel: 7,8 Concrete: 2,3	

Table A.2 — Factor for calculating the working-load limit (WLL) for two-legged slings

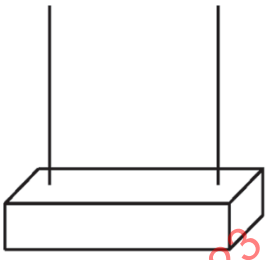
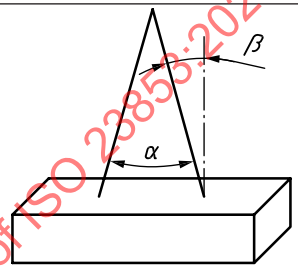
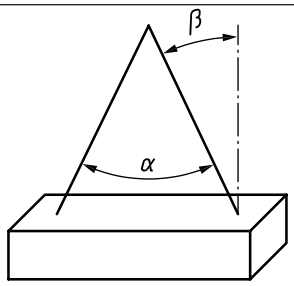
Lifting angle °	Calculation factor for WLL	Two-legged slings
$\alpha = 0$	2,0	
$0 < \alpha \leq 30$ $0 < \beta \leq 15$	1,9	
$30 < \alpha \leq 60$ $15 < \beta \leq 30$	1,7	

Table A.3 — Working-load limit (WLL) of two-legged slings

Rope diameter mm	WLL t					
	Lifting angle					
	$\alpha = 0°$		$0° < \alpha \leq 30°$		$30° < \alpha \leq 60°$	
	Wire rope construction					
	6 × 24	6 × 37	6 × 24	6 × 37	6 × 24	6 × 37
10	1,4	1,8	1,3	1,7	1,2	1,5
12	2,0	2,6	1,9	2,5	1,7	2,2
14	2,8	3,6	2,7	3,4	2,4	3,1
16	3,6	4,8	3,4	4,6	3,1	4,1
18	4,6	6,0	4,4	5,7	3,9	5,1
20	5,6	7,4	5,3	7,0	4,8	6,3
22	6,8	9,0	6,5	8,6	5,8	7,7
24	8,2	10,8	7,8	10,2	7,0	9,2
28	11,0	14,6	10,5	13,9	9,4	12,4

NOTE The values of WLL are derived from the formula in ISO 7531:1987, 4.4.[5] The minimum breaking force is assumed to be that of the 6 × 24 and 6 × 37 fibre core groups, equivalent to 1 570 N/mm^2 and 1 770 N/mm^2 nominal tensile strengths respectively, as given in ISO 2408.

A.2.3 Three-legged slinging

For lifting a load by three-legged slinging as shown in Figure A.2, trainees are required to determine the appropriate wire rope diameter for the given mass and lifting angle, according to Table A.5 and Table A.6, and select the proper one from a random selection of actual wire ropes, as shown in Table A.4. The objective of this practical training is to teach the trainees to visually select the target diameter of the wire rope sling.

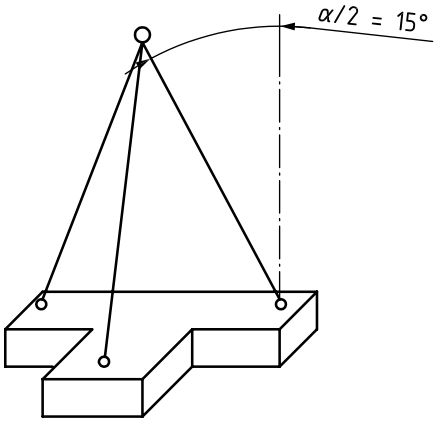
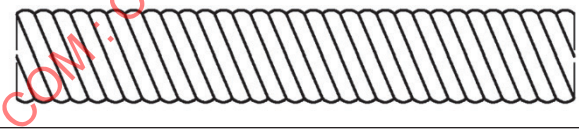
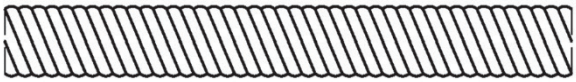
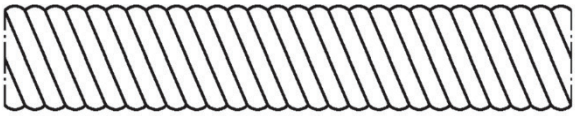
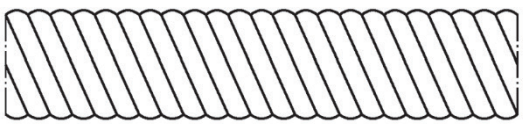
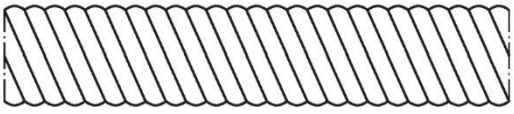


Figure A.2 — Three-legged slinging (lifting angle 30°)

Table A.4 — Examples of wire rope used in slings

Symbol	Randomly arranged wire ropes used in slings
C	
D	
A	
B	
E	
G	
F	

NOTE The diameters of the wire ropes are: A = 10 mm, B = 12 mm, C = 14 mm, D = 16 mm, E = 18 mm, F = 20 mm, G = 22 mm, H = 24 mm, J = 28 mm.

Table A.4 *(continued)*

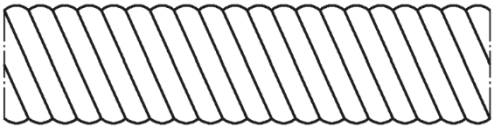
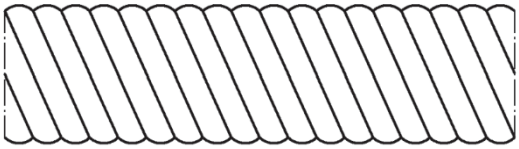
Symbol	Randomly arranged wire ropes used in slings
H	
J	
NOTE The diameters of the wire ropes are: A = 10 mm, B = 12 mm, C = 14 mm, D = 16 mm, E = 18 mm, F = 20 mm, G = 22 mm, H = 24 mm, J = 28 mm.	

Table A.5 — Working load limit (WLL) of single-legged sling with eye splices

Rope diameter mm	WLL t	
	Rope construction	
	6 × 24	6 × 37
10	0,7	0,9
12	1,0	1,3
14	1,4	1,8
16	1,8	2,4
18	2,3	3,0
20	2,8	3,7
22	3,4	4,5
24	4,1	5,4
28	5,5	7,3

Table A.6 — Factor for calculating WLL for three-legged sling

Lifting angle, α °	Calculation factor for WLL
30	2,9
NOTE See Figure A.2.	

Annex B
(informative)

Training sheet

B.1 General

For practical training in slinging work, several types of load are provided, such as a steel bar, a bundle of steel bars, a steel plate, a T-shaped steel, etc., with individual mass of about 0,5 t, as well as necessary slinging equipment such as wire rope slings, shackles, clamps, sleepers, etc. The slinging method and the load transport course are indicated. The training instructor demonstrates the aspects of basic slinging work, i.e. confirming or identifying the mass of the load, determining the centre of gravity, checking the slinging equipment, attaching wire rope slings to the load and hook, trial lift and lifting, transporting and lowering the load, and putting the slinging equipment in order upon completion.

After the demonstration, trainees perform each step of the operation one at a time, under the instructor's supervision, until they master each operation. During training, trainees learn not only how to perform sling work safely, but also safe working practice such as giving hand signals correctly, finger pointing and calling-out actions, etc. When they have become proficient in each step, they perform all the steps combined, i.e. start-to-finish slinging work. The training may be performed by a team of three trainees, i.e. one acts as trainee slinger and other two act as his or her assistants. Tables B.1 and B.2 give examples of slinging procedures.

B.2 Training sheet for double-wrap basket-hitch lifting

B.2.1 Training materials

The following materials are needed for the training:

a) load to be used: steel bar, bundle of steel bars, steel pipe or bundle of steel pipes, about 3 m in length and of mass 0,5 t to 1 t;

b) slinging method: four-legged lifting with double wrap basket hitch;

c) slinging equipment: wire rope slings with eyes at both ends (two pieces, nominal diameter 10 mm, length 5 m), and sleepers (four pieces, profile 150 mm × 250 mm, length 1 m).

B.2.2 Example of a training procedure for double-wrap basket-hitch lifting