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**Cranes — Bridge and gantry cranes —  
International Standards for design and  
manufacturing requirements and  
recommendations**

*Appareils de levage à charge suspendue — Ponts roulants et ponts  
portiques — Normes Internationales sur les exigences de conception et  
de fabrication*



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## Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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.

ISO/TR 16880 was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 9, *Bridge and gantry cranes*.



# Cranes — Bridge and gantry cranes — International Standards for design and manufacturing requirements and recommendations

## 1 Scope

This Technical Report collects the design and manufacturing requirements and recommendations for bridge and gantry cranes in ISO and IEC International Standards.

## 2 Requirements

### 2.1 Particular ISO International Standards for bridge and gantry cranes

The International Standards marked with an x are also applicable for cranes in use. Units and symbols can be found in ISO 31<sup>1)</sup> (all parts).

#### ISO 4301-1

##### *Cranes and lifting appliances — Classification — Part 1: General*

Abstract: Establishes a general classification of cranes based on the number of operating cycles to be carried out during the expected life of the crane and a load spectrum factor which represents a nominal state of loading. Classification considers only the operating conditions which are independent of the type of crane and the way it is driven.

#### ISO 4301-5

##### *Cranes — Classification — Part 5: Overhead travelling and portal bridge cranes*

Abstract: Establishes the classification of cranes based on the number of operating cycles to be carried out during the expected life of the appliance and its mechanisms, and a load spectrum factor which represents the nominal state of loading.

#### ISO 4302

##### *Cranes — Wind load assessment*

Abstract: Gives a simplified method of calculation and assumes that the wind blows horizontally from any direction, that the wind blows at a constant velocity and that there is a static reaction to the loadings applying to the crane structure. It includes built-in allowances for the effects of gusting (rapid changes in wind velocity) and for dynamic response.

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1) ISO 31, *Quantities and units*

- ISO 4304** *Cranes other than mobile and floating cranes — General requirements for stability*
- Abstract: Specifies the conditions to be met when verifying, by calculation, the stability of all crane types defined in ISO 4306-1 that are subject to tilting. It assumes that they are standing on a firm, level supporting surface or track. The sliding of cranes on their tracks is not covered.
- ISO 4306-1** *Cranes — Vocabulary — Part 1: General*
- Abstract: Defines terms concerning the main types of cranes, parameters, general concepts and component parts in English, French and Russian.
- ISO 4306-5** *Cranes — Vocabulary — Part 5: Bridge and gantry cranes*
- Abstract: Establishes a vocabulary and defines the terms relating to bridge and gantry cranes.
- ISO 4308-1** x *Cranes and lifting appliances — Selection of wire ropes — Part 1: General*
- Abstract: Specifies two methods for the selection of wire rope to be used on lifting appliances as designated in ISO 4306-1, one based on the value of the rope selection factor  $C$  and the other based on the value of the coefficient of utilization  $Z_p$ . ISO 4308-1 establishes the minimum requirements for acceptable strength and performance levels of wire ropes with respect to the design, application and maintenance of the lifting appliance. ISO 4308-1 establishes the minimum requirements for the diameters of drums and sheaves that are to be associated with the selected wire rope.
- ISO 4309** x *Cranes — Wire ropes — Care, maintenance (including installation), inspection*
- Abstract: Details the essential guidelines for examination of wire ropes in service on a lifting appliance, and enumerates discard criteria relating to wire breaks, wear, corrosion and deformation which are to be applied to ensure the efficient and safe usage of the equipment.
- ISO 4310** *Cranes — Test code and procedures*
- Abstract: Specifies the tests and procedures to be followed in order to verify that a crane conforms to its operational specifications and is capable of lifting rated loads. Where rated loads are determined by stability, a test procedure and test load are specified that permit stability margins to be easily verified. Defines test procedures such as conformity tests, visual inspection and load lifting competence testing.
- ISO 7296-1 plus  
ISO 7296-1:1991/  
Amd.1:1996** *Cranes — Graphic symbols — Part 1: General*  
*Cranes — Graphic symbols — Part 1: General — Amendment 1*
- Abstract: Gives 67 symbols and defines the various colours to be used with cranes. Contains the alphabetical indexes in English, French and Russian.

- ISO 7363**      *Cranes and lifting appliances — Technical characteristics and acceptance documents*
- Abstract: Establishes the form of presentation and content of the documents which a manufacturer should provide with the equipment. Documents give technical information and include acceptance documents for the equipment to facilitate its installation, testing and use. Specimen acceptance documents are given in the annex. Applies to all types defined in ISO 4306-1.
- ISO 7595**      *Socketing procedures for wire ropes — Molten metal socketing*
- Abstract: Provides guidance on recommended practices for metal socketing. When socketing ropes have wire tensile grades greater than 1 960 MPa, special precautions may be necessary and the rope supplier should be consulted. Rope terminations specified in ISO 7595 may be used for determining the breaking load of wire ropes in accordance with ISO 3108.
- ISO 7752-1**      *Lifting appliances — Controls — Layout and characteristics — Part 1: General principles*
- Abstract: Deals with the arrangement of those crane controls which are used in positioning loads and serves as a general basis for the elaboration of detailed International Standards for particular types. It defines basic requirements of these controls, safe crane operation conditions and criteria for the layout of control levers and pedals.
- ISO 7752-5**      *Lifting appliances — Controls — Layout and characteristics — Part 5: Overhead travelling cranes and portal bridge cranes*
- Abstract: Establishes the arrangement, requirements and direction of movement of the basic crane controls for travelling, traversing, slewing, cab driving, lifting, hoisting and lowering operations for these cranes as defined in ISO 4306-1.
- ISO 8306**      *Cranes — Overhead travelling cranes and portal bridge cranes — Tolerances for cranes and tracks*
- Abstract: Specifies the manufacturing tolerances for cranes and trucks at a standard temperature of 20 °C. These tolerances apply to a lifting appliance loaded solely by its own mass. Tolerances take no account of elastic deformation during operation.
- ISO 8566-1**      *Cranes — Cabins — Part 1: General*
- Abstract: Establishes the general requirements for cabin construction, driver's seat, visibility, control elements, information, noise, vibration, heating and air-conditioning for cranes as defined in ISO 4306-1.
- ISO 8566-5**      *Cranes — Cabins — Part 5: Overhead travelling and portal bridge cranes*
- Abstract: Establishes the requirements for cabin construction, driver's seat, control elements, heating and cooling for cranes as defined in ISO 4306-1.

- ISO 8686-1**                      *Cranes — Design principles for loads and load combinations — Part 1: General*
- Abstract: Establishes general methods for calculating loads and principles to be used to select load combinations for proof of competence for the structural and mechanical components for cranes as defined in ISO 4306-1. It is based on rigid-body kinetic analysis and elasto-static analysis. It provides the general form, content and range of parameter values for more specific standards and also a framework for agreement on loads and load combinations between manufacturer and purchaser.
- ISO 8686-5**                      *Cranes — Design principles for loads and load combinations — Part 5: Overhead travelling and portal bridge cranes*
- Abstract: Establishes the application of ISO 8686-1 to overhead travelling and portal bridge cranes as defined in ISO 4306-1, and gives specific values for the factors to be used.
- ISO 9373**                      x    *Cranes and related equipment — Accuracy requirements for measuring parameters during testing*
- Abstract: Specifies the principal requirements for instruments and measurement systems of test loads, distances, time and other relevant parameters for cranes and related equipment. It gives recommended limit values of relative errors in measurement during testing.
- ISO 9374-1**                      *Cranes — Information to be provided — Part 1: General*
- Abstract: Specifies in general the information to be provided by the purchaser and the manufacturer so that the most suitable crane can be supplied for the duty requirements and service conditions. Refers to ISO 4301-1 and ISO 7363.
- ISO 9374-5**                      *Cranes — Information to be provided — Part 5: Overhead travelling cranes and portal bridge cranes*
- Abstract: Specifies information to be provided by a purchaser in enquiring about or ordering a crane and a manufacturer in tendering for or supplying a crane.
- ISO 9926-1**                      x    *Cranes — Training of drivers — Part 1: General*
- Abstract: Specifies the minimum training to be given to trainee drivers of cranes, to develop basic operational skills and to impart the requisite knowledge for the proper use of those skills. Does not specify any procedure for evaluating capabilities or qualifications of the trainees.
- ISO 9927-1**                      x    *Cranes — Inspections — Part 1: General*
- Abstract: Specifies the regular inspections to be carried out on cranes as defined in ISO 4306-1, ISO 4306-2 and ISO 4306-3.
- ISO 9928-1**                      x    *Cranes — Crane driving manual — Part 1: General*
- Abstract: Gives guidance on the contents and the presentation of a crane driving manual which include: technical data, special safety advice, driver's aids and controls, driver's instructions, load diagrams and load tables, safety devices and environmental conditions.



- ISO 9942-1**                      *Cranes — Information labels — Part 1: General*
- Abstract: Specifies the minimum requirements for labels for the identification and operation of cranes.
- ISO 10245-1**                      *Cranes — Limiting and indicating devices — Part 1: General*
- Abstract: Specifies general requirements for limiting and indicating devices for lifting appliances that are applicable to loads and motions, performance and environment. These devices restrict operation and/or provide the driver or other persons with operational information.
- ISO 10245-5**                      *Cranes — Limiting and indicating devices — Part 5: Overhead travelling and portal bridge cranes*
- Abstract: Specifies the requirements for limiting and indicating devices of bridges and gantry cranes for loads, motions, performance and environment. General requirements for limiting and indicating devices for cranes are given in ISO 10245-1.
- ISO 10972-1**                      *Cranes — Requirements for mechanisms — Part 1: General*
- Abstract: Establishes requirements which apply generally to mechanisms and related components of cranes and lifting appliances as described in ISO 4306-1, ISO 4306-2 and ISO 4306-3.
- ISO 10973**                         *Cranes — Spare parts manual*
- Abstract: Provides guidelines on the general requirements necessary for the preparation and presentation of spare parts manuals for cranes.
- ISO 11630**                      x *Cranes — Measurement of wheel alignment*
- Abstract: Establishes requirements for methods of measuring the alignment of crane wheels in accordance with ISO 4310, ISO 9373 and ISO 12488-1.
- ISO 11660-1**                      *Cranes — Access, guards and restraints — Part 1: General*
- Abstract: Establishes the general requirements for access to control stations and other installations of cranes as defined in ISO 4306-1, during normal operation, maintenance inspection, erection and dismantling. Guards and restraints are also dealt with in general, regarding the protection of persons on or near the crane as related to moving parts, falling objects or live parts.
- ISO 11660-5**                      *Cranes — Access, guards and restraints — Part 5: Bridge and gantry cranes*
- Abstract: Establishes the particular requirements relating to the access, guards and restraints for bridge and gantry cranes as defined in ISO 4306-1 and gives criteria for the selection of the appropriate equipment under the various conditions of use expected of the crane.
- ISO 11994**                         *Cranes — Availability — Vocabulary*
- Abstract: Establishes the generally accepted terms and definitions relating to availability of all types of cranes as defined in ISO 4306-1, with the aim of making contracts and mutual understanding easier. The terms and definitions are to be used by crane designers, manufacturers, inspecting authorities, users and others.

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- ISO 12210-1**                    *Cranes — Anchoring devices for in-service and out-of-service conditions — Part 1: General*
- Abstract: Establishes the general criteria for the provisions of anchoring devices for cranes and crane parts for in-service and out-of-service conditions.
- ISO 12478-1**                    *Cranes — Maintenance manual — Part 1: General*
- Abstract: Establishes guidelines on the general requirements necessary for the preparation and presentation of maintenance manuals for cranes.
- ISO 12480-1**                    x *Cranes — Safe use — Part 1: General*
- Abstract: Establishes required practices for the safe use of cranes, including safe systems of work, management, planning, selection, erection and dismantling, operation and maintenance of cranes and the selection of drivers, slingers and signallers.
- ISO 12482-1**                    x *Cranes — Condition monitoring — Part 1: General*
- Abstract: Ensures that the design constraints of the intended use of a crane are clearly identified and defines actions to be taken when the crane has been used over a period of time and has approached these constraints, to ensure a new safe working period. A description is given of the special assessment required to monitor the condition of a crane.
- ISO 13200**                      *Cranes — Safety signs and hazard pictorials — General principles*
- Abstract: Establishes general principles for the design and application of safety signs and hazard pictorials permanently affixed to cranes. It describes the basic safety sign formats, specifies colours for safety signs and provides guidance on developing the various panels that together constitute a safety sign.
- ISO 13202**                      *Cranes — Measurement of velocity and time parameters*
- Abstract: Establishes guidelines for the measurement of the velocity and time parameters of cranes as defined in ISO 7363. ISO 13202 is complementary to ISO 4310 and covers the types of crane specified therein.
- ISO/TS 15696**                    *Cranes — List of equivalent terms*
- Abstract: Establishes a list of equivalent terms in English, French and Russian of the most commonly used terms in the field of cranes and defined or listed in International Standards developed by ISO Technical Committee ISO/TC 96. This Technical Specification contains terms concerning the main types of crane, parameters, general concepts and component parts.

## 2.2 Additional International Standards for bridge and gantry cranes

### 2.2.1 Manufacturing

ISO 5817                      *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

Abstract: Provides quality levels of imperfections in fusion-welded joints (except for beam welding) in all types of steel, nickel, titanium and their alloys. It applies to material thickness above 0,5 mm. Three quality levels are given in order to permit application to a wide range of welded fabrication. They are designated by the symbols B, C and D. Quality level B corresponds to the highest requirement on the finished weld. The quality levels refer to production quality and not to the fitness-for-purpose of the product manufactured.

### 2.2.2 IEC standards for electrical requirements

IEC 60204-32                *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines*

Abstract: Applies to equipment or parts of equipment not exceeding 1 000 V a.c. or 1 500 V d.c. between lines, and with nominal frequencies not exceeding 200 Hz. Additional and special requirements can apply to the electrical equipment of hoisting machines that are used in potentially explosive and/or flammable atmospheres. It does not cover individual items of electrical equipment other than their selection for use and their erection.

## 3 Additional recommendations

### 3.1 Structural steels

Structural steels in accordance with national standards may be used. Increased elastic deformations and prolonged dampening times of vibrations might limit the serviceability of bridge and gantry cranes, when higher stress levels, permitted by the use of high-strength steels, are used.

Other areas of concern regarding the use of high-strength steels (yield point > 400 N/mm<sup>2</sup>) are as follows:

- reduced number of cycles to failure with large stress ranges;
- higher requirements for straightness of plates and columns to achieve higher compressive strength;
- higher requirements for weld quality to achieve equal strength with the parent steel.

### 3.2 Welding

The acceptance quality levels of welds should be defined in the drawings or other manufacturing documents according to ISO 5817.

In general, with mild structural steels (yield point < 400 N/mm<sup>2</sup>) quality level C is acceptable when the maximum design stresses are limited by yielding. Quality level D is acceptable in non-critical joints only. Quality level B and other established methods (e.g. grinding, Tungsten-Inert Gas (TIG)-remelting, shot

peening, etc.) can be used to achieve improved fatigue life. Different quality requirements can apply in a structure dependant upon the actual stress condition in the joint under consideration. The manufacturer of the structures should use appropriate welding procedures to achieve the specified quality levels. Appropriate non-destructive testing should be used to ensure compliance with the quality level requirement.

### **3.3 Verification of structures by calculation**

ISO 8686-5 specifies the loads and factors to be applied in calculations. Until a complete set of International Standards for proof of strength of the structures is available, the limit states of the materials, joints, components, and elements with risk of elastic instability shall be taken from national standards or recognized design literature. Also, the calculation rules or formulae related to certain limit states shall be selected from the same source as the limit state.

The  $\gamma_m$  and  $\gamma_f$  factors specified in ISO 8686-5 apply to the yield strength of steel as the limit state. For other types of limit states, different factors may be necessary to establish the same level of safety.

### **3.4 Mechanical components**

General requirements for mechanisms are given in ISO 10972-1.

Until a complete set of International Standards for the calculation of mechanical components is available, limit states and corresponding calculation formulae should be taken from the national standards or recognized design literature.



