International Standard

ISO 10972-1

Cranes — Requirements for mechanisms —

Part 1: General

Appareils de levage à charge suspendue — Prescriptions pour les mécanismes —

Partie 1: Généralités

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Contents

Page

Foreword

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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 document 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).

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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.

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

This second edition cancels and replaces the first edition (ISO 10972-1:1998), which has been technically revised.

The main changes are as follows:

— in 4.4, the requirement for cranes intended for transportation of molten metals or similar hazardous materials has been moved to a new Clause 5;

— in 4.8, the requirement of rope drives has been revised according to ISO 16625;

— in 4.11, the requirement of load lifting attachment has been revised according to EN 13135:2013+A1:2018;

— a new Clause 5 on high-risk applications has been added.

A list of all parts in the ISO 10972 series can be found on the ISO website.

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

This document establishes design requirements and guidance that reflect the present state of the art in the field of crane machine design. This document enables cranes to fulfil the essential safety requirements and ensures adequate service of their components. It is acknowledged that new technologies, materials, etc. can bring about new solutions that result in equal or improved safety and durability.

Cranes — Requirements for mechanisms —

Part 1: General

1 Scope

This document establishes requirements for mechanisms and related components of cranes as described in ISO 4306 series, concerning:

a) general layout and design of mechanisms;

b) selection and/or design requirements of components.

This document does not provide requirements for proof of competence calculation regarding different limit states (yield strength, fatigue, wear).

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 3077, *Short-link chain for lifting purposes — Grade T, (types T, DAT and DT), fine-tolerance hoist chain*

ISO 4301-1, *Cranes — Classification — Part 1: General*

ISO 4306 (all parts), *Cranes — Vocabulary*

ISO 16625, *Cranes and hoists —Selection of wire ropes, drums and sheaves*

ISO 4302, *Cranes — Wind load assessment*

ISO 4310, *Cranes — Test code and procedures*

ISO 4347, *Leaf chains, clevises and sheaves — Dimensions, measuring forces, tensile strengths and dynamic strengths*

ISO 4413, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 4779, *Chain components for lifting purposes — Forged eye hook with point and latch — Grade 4, stainless steel, solution annealed*

ISO 6336-1, *Calculation of load capacity of spur and helical gears — Part 1: Basic principles, introduction and general influence factors*

ISO 6336-2, *Calculation of load capacity of spur and helical gears — Part 2: Calculation of surface durability (pitting)*

ISO 6336-3, *Calculation of load capacity of spur and helical gears — Part 3: Calculation of tooth bending strength*

ISO 6336-5, *Calculation of load capacity of spur and helical gears — Part 5: Strength and quality of materials*

ISO 7752-1, *Cranes — Control layout and characteristics — Part 1: General principles*

ISO 7752-2, *Cranes — Control layout and characteristics — Part 2: Basic arrangement and requirements for mobile cranes*

ISO 7752-4, *Cranes — Controls — Layout and characteristics — Part 4: Jib cranes*

ISO 7597, *Forged steel lifting hooks with latch, grade 8*

ISO 8686 (all parts), *Cranes — Design principles for loads and load combinations*

ISO 10300-1, *Calculation of load capacity of bevel gears — Part 1: Introduction and general influence factors*

ISO 10300-2, *Calculation of load capacity of bevel gears — Part 2: Calculation of surface durability (macropitting)*

ISO 10300-3, *Calculation of load capacity of bevel gears — Part 3: Calculation of tooth root strength*

ISO 12210, *Cranes — Anchoring devices for in-service and out-of-service conditions*

ISO/TS 14521, *Gears — Calculation of load capacity of worm gears*

ISO 17440, *Cranes — General design — Limit states and proof of competence of forged steel hooks*

ISO 20332, *Cranes — Proof of competence of steel structures*

ISO 21940-11, *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour*

ISO 23778, *Proof of competence of hydraulic cylinders in crane applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the ISO 4306 series and the following 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
in-service braking
stopping or slowing the crane motion with the motor disconnected, through an immediate and easy control by the operator from the normal working position

3.2
out-of-service braking
avoiding unwanted starts for indefinite periods of time

Note 1 to entry: Actuation may be automatic or manual.

3.3
emergency braking
backup braking
safety braking
stopping the crane motion in case of loss of power or pressure supply through engagement with a limiting device or the activation of an emergency stop switch

3.4
control braking
maintaining a desired speed, automatically or by the operator, with the motor engaged

3.5
chain drive
device for supporting and moving loads via chain and roller arrangement

3.6
rope drive
device for supporting and moving loads via rope, sheave and drum arrangement

4 General

4.1 Design criteria

4.1.1 General design and layout

The general design and layout of a crane mechanism shall take into consideration:

— requirements of the user;

— specific function of the mechanism and its use;

— reliability of the mechanism, considering the consequences of failure;

— displacement of the structure supporting the mechanism;

— avoidance of uncontrolled motions considering the limits of transmission of force or moments, when provided, for example, by motors, clutches, brakes;

— avoidance of undesirable or excessive vibrations;

— avoidance of excessive noise emissions;

— protective measures for rotating parts;

— ease of use and controls of the mechanism with adequate space and motion limiters and indicators;

— recommendations of the component supplier for the selection and installations of component parts;

— serviceability, i.e. easy accessibility for maintenance of components (see ISO 11660-1);

— interchangeability of components;

— availability of lifting lugs or lifting points for handling;

— access for operator or maintenance personnel (see ISO 11660-1);

— environmental conditions and hazards.

4.1.2 Criteria for strength of components

When selecting the components of the mechanisms, it shall be verified that the applicable loading conditions in terms of maximum loading, load spectrum and number of load cycles conform to the corresponding rated characteristics of the components. The loadings shall be in accordance with the ISO 8686 series.

References for the proof of competence calculations may be given for the mechanical components in 4.3 to 4.11.

4.2 Power

The power mechanism shall be an electrical, hydraulic or pneumatic motor or an internal combustion engine.

The crane mechanism or mechanisms shall have a force and torque equal to or greater than the force and torque values required to properly control the crane under the specified design conditions. Gravitational, inertial, in-service wind, friction forces and mechanism efficiency shall be taken into account.

a) The average distance per work cycle of each motion (see ISO 4301-1) shall be taken into account, when determining an appropriate rating type of the motor duty and thermal power rating requirement.

b) The loads to be applied shall be in accordance with the ISO 8686 series, setting all the dynamic factors to $\phi_i = 1$ and the partial safety factors to $\gamma_p = 1$. The hoisted load shall be applied with the value of the rated load, unless otherwise specified. The wind state for an outdoor crane shall be that specified for the crane and applied in calculation of wind forces in accordance with ISO 4302. Travel resistance shall be taken into account as an external load action.

For the thermal capacity calculation, the load combinations A of the ISO 8686 series shall be applied, with the addition of in-service wind force during controlled movement (see ISO 4302) into each load combination.

For the torque calculations, the load combinations B of the ISO 8686 series shall be applied, applying the in-service wind force required for starting drive forces (see ISO 8686-1).

4.3 Couplings

4.3.1 General

The type of coupling shall be selected based on the general design of the mechanism, its use and the performance required in order to avoid vibrations and unwanted reactions. Alignment shall be in accordance with the supplier's instructions.

When necessary, rotating parts shall be statically or dynamically balanced.

4.3.2 Clutches

When sprag-type clutches are used in hoist and derricking systems, they shall incorporate a positive mechanical lock against failure or be designed to transmit twice the maximum torque imposed by the maximum line pull.

Dry friction clutches shall be protected against rain and other liquids such as oil and lubricants. Clutches shall be arranged to permit adjustments where necessary to compensate for wear.

The maximum permissible torque of the clutch shall be at least as high at any operating temperature as the torque impulses occurring during operations, taking into account the impulse frequency and the permissible wear.

4.4 Brakes

4.4.1 General

Braking can be divided into four types: in-service braking, out-of-service braking, emergency braking and control braking.

Means shall be provided for arresting each motion of the crane.

The restraining torque of the brakes shall consider the operating environment.

Emergency braking shall be performed using brakes which are automatically applied in case of power failure. The emergency brakes shall provide a deceleration rate consistent with the design parameters for a fully loaded mechanism.

The force to apply a manual in-service brake by hand or foot shall comply with the requirements of ISO 7752-1, ISO 7752-2 and ISO 7752-4.