TECHNICAL REPORT

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Cranes — Safety code on mobile cranes

Appareils de levage à charge suspendue — Code de sécurité sur les grues mobiles

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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.

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is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.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 19961 was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 6, *Mobile cranes*.

Cranes — Safety code on mobile cranes

1 Scope

This Technical Report provides a guide to International Standards applicable to mobile cranes — crawler cranes, railway cranes, wheel-mounted cranes and any variations thereof that retain the same fundamental characteristics — and a summary of related provisions. Special adaptations of the general types of machine covered, where applicable, also fall within its scope.

NOTE According to the ISO Directives, Part 2, the verbal forms used to identify provisions in an International Standard are

— "shall" or "shall not", used to indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted,

— "should" or "should not" for recommendations, indicating that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited, and

— "may" or "need not", used to indicate a course of action permissible within the limits of the document.

2 Purpose

The purpose of this Technical Report is to

a) identify the many International Standards relevant to mobile cranes and their safety (see Bibliography for a complete listing),

b) summarize the content of those documents,

c) promote mobile crane safety by the delineation of these standards, so that the incorporation of their provisions into the design and use of mobile cranes will guard against, and minimize, injury to workers and damage to equipment,

d) facilitate the work of all those working in the field of mobile cranes (designers, supervisors and others either directly or indirectly responsible for the safe use and maintenance of the machines) with a need to consult the current standards relating to mobile cranes, and

e) contribute to further international harmonization of mobile crane standards.

3 Terms and definitions

ISO 4306-1 defines terms concerning the main types of cranes, parameters, general concepts and component parts.

ISO 4306-2 defines the terms relating to the basic types of self-powered mobile cranes.

4 Construction and characteristics

4.1 Load rating

4.1.1 Crane stability (backward/forward)

ISO 4305 specifies the conditions to be taken into consideration when verifying the stability of a mobile crane by calculation, assuming that the crane is operating on a firm and level surface (up to 1 % gradient).

It applies to mobile cranes defined in ISO 4306-2 mounted on wheels or crawlers with or without outriggers.

4.1.2 Crane structural competence

ISO 8686-1 establishes general methods for calculating loads and principles to be used to select load combinations for proofs of competence for the structural and mechanical components of cranes.

Based on rigid-body kinetic analysis and elasto-static analysis, it expressly permits the use of more advanced methods (calculations or tests) to evaluate the effects of loads and load combinations, and the value of dynamic load factors, where it can be demonstrated that these provide at least equivalent levels of competence.

It provides the general form, content and ranges of parameter values for more specific standards to be developed for individual lifting appliance types.

It provides a framework for agreement on loads and load combinations between a designer or manufacturer and an appliance purchaser for those types of lifting appliances where specific standards do not exist.

ISO 8686-2 applies the principles set forth in ISO 8686-1 to mobile cranes, as defined in ISO 4306-2, and presents loads and load combinations appropriate for use in proof of competence calculations for the steel structures of mobile cranes. It applies to mobile cranes used for normal service and for duty cycle service.

ISO 11662 specifies a test method that provides a systematic, non-destructive procedure for determining the stresses induced in crane structures under specified conditions of static loading through the use of resistance type electronic strain gages and to specify appropriate acceptable criteria for specified loading conditions.

4.1.3 Wind load

ISO 4302 relates to wind loads on cranes. It gives a simplified method of calculation and assumes that the wind can blow horizontally from any direction, that the wind blows at a constant velocity and that there is a static reaction to the loading it applies to the crane structure. It includes built-in allowances for the effects of gusting and for dynamic response.

4.1.4 Crane rating manuals

ISO 11661 specifies a standard presentation or format for mobile crane rated capacities on rated capacity charts. It applies to mobile cranes fitted with booms as defined in ISO 4306-2, when used in lifting mode.

4.2 Boom hoist, load hoist and telescoping boom mechanisms

4.2.1 Boom hoist

4.2.1.1 Mechanism

The boom hoist may use a rope drum for its drive or hydraulic cylinder(s), and the supporting structure may be a gantry or the same hydraulic cylinder(s) used to elevate the boom.

The boom hoist shall be capable of elevating and controlling the boom with its rated load (for rope boom hoists, when reeved according to the manufacturer's specifications), and shall be capable of supporting the boom and rated load without action by the operator.

In a rope supporting and elevating arrangement, boom lowering shall be done only under power control. Free-fall lowering of the boom shall not be permitted.

4.2.1.2 Boom hoist drum

The boom hoist drum shall have sufficient rope capacity to operate the boom in all positions, from the lowest permissible to the highest recommended, when using the manufacturer's recommended reeving and rope size. No less than two full wraps of rope shall remain on the drum with the boom point lowered to the level of the crane-supporting surface. The end of the rope shall be anchored to the drum by an arrangement specified by the winch manufacturer.

The drum shall provide a first layer rope pitch diameter in accordance with ISO 8087.

4.2.1.3 Boom hoist brake/holding device

On machines with rope-supported booms, a braking mechanism and an additional holding device, with a braking moment of 1,5 times the maximum drive moment of the winch, shall be provided to prevent inadvertent lowering of the boom.

An integrally mounted holding device (such as a load check valve) shall be provided with boom support hydraulic cylinder(s) to prevent uncontrolled lowering of the boom in the event of a hydraulic system failure (e.g. supply hose rupture).

4.2.2 Load hoist

4.2.2.1 Mechanism

The hoist mechanism may consist of a drum or hydraulic cylinder(s) with necessary rope reeving.

The load hoist drum assemblies shall have power and operational characteristics sufficient to perform all load lifting and lowering functions required in crane service when operated under recommended conditions.

Where brakes and clutches are used to control the motion of the load hoist drums, they shall be of a size and thermal capacity sufficient to control all rated crane loads with minimum recommended reeving (where maximum rated loads are being lowered with near maximum boom length or operations involving long lowering distances, power-controlled lowering is recommended to reduce demand on the load brake). Brakes and clutches shall be provided with adjustments where necessary to compensate for lining wear and to maintain force in springs, where used. Freefall lowering shall not be used where prohibited by national legislation. If freefall is provided, a means controllable from the operator's station shall be provided to hold the drum from rotating in the lowering direction and be capable of holding the rated load without further action by the operator. Foot-operated brakes having a continuous mechanical linkage between the actuating and braking means, capable of transmitting full braking force and equipped with a positive mechanical means to hold the linkage in the applied position meet this requirement.

4.2.2.2 Load hoist drums

Load hoist drums shall have rope capacity with the recommended rope size and reeving sufficient to perform crane service within the range of boom lengths, operating radii, and vertical lifts specified by the manufacturer.

No less than two full wraps of rope shall remain on the drum when the hook is in the extreme low position.

The drum end of the rope shall be anchored to the drum by an arrangement specified by the crane or rope manufacturer.

The drum flange shall extend a minimum of 1,5 times the rope diameter over the top layer of rope at all time.

The load hoist drums shall provide a first layer rope pitch diameter in accordance with ISO 8087.

Drum rotation indicators should be provided and located to afford sensing by the operator.

4.2.2.3 Load hoist brakes

When power-operated brakes having no continuous mechanical linkage between the actuating and braking means are used for controlling loads, an automatic means shall be provided to set the brake to prevent the load from falling in the event of loss of brake control power.

Foot-operated brake pedals shall be constructed so that the operator's feet, when in proper position, will not slip off, and a means shall be provided for holding the brakes in the applied position without further action by the operator.

4.2.2.4 Power-controlled lowering

When provided, a power-controlled lowering system shall be capable of handling rated loads and speeds as specified by the manufacturer. Such a system is recommended to assist in precision lowering and to reduce demand on the load brake.

4.2.2.5 Cylinders with rope reeving

Cranes using a load hoist mechanism with hydraulic cylinder(s) and rope reeving shall have power and operational characteristics sufficient to perform all load lifting and lowering functions required in crane service when operated under recommended conditions. Sheaves used in multiple rope reeving shall have a pitch diameter and grooves in accordance with ISO 4308-1 and ISO 4308-2.

4.2.3 Telescoping boom

Extension and retraction of boom sections may be accomplished through hydraulic, mechanical, or manual means.

The powered retract function shall be capable of controlling any rated load which can be retracted.

An integrally mounted holding device (such as a load hold check valve) shall be provided with the telescopic hydraulic cylinder(s) to prevent uncontrolled retraction of the boom in the event of a hydraulic system failure (e.g. supply hose rupture).

4.2.4 General

Sheaves in multiple rope reeving shall have pitch diameters and grooves in accordance with ISO 4301-2.

4.3 Swing mechanism

4.3.1 Swing control

The swing mechanism shall start and stop with controlled acceleration and deceleration.

4.3.2 Swing braking means and locking device

A braking means with holding power in both directions shall be provided to restrict movement of the rotating superstructure, when desired during normal operation. The braking means shall be capable of being set in the holding position and remaining so without further action by the operator.

A device or boom support shall be provided to prevent the boom and super structure from rotating when in transit. It shall be constructed to prevent inadvertent engagement or disengagement.

4.4 Crane travel

4.4.1 Travel controls

On all crane types with a single control station, the controls for the travel function shall be located at the operator's station.

On all wheel-mounted multiple control station cranes, the travel controls shall be located in the carrier cab. Auxiliary travel controls may also be provided in the crane cab. If there is an operator in the crane cab when the crane is travelling, communication shall be provided between the cabs. Use of audible signalling devices shall meet this requirement.

4.4.2 Travel mechanism

On **railway cranes**, when the travel mechanism must be temporarily deactivated in the normal course of the requirements of the user, provision shall be made to disengage the travel mechanism from the cab or outside the crane body.

On **crawler cranes**, the travel and steering mechanism shall be arranged so that it is not possible for both crawlers to freewheel without operator control. Control shall be effected from the operator's position on the revolving superstructure.

4.4.3 Travel brakes and locks

On **crawler cranes**, brakes or other locking means shall be provided to hold the machine stationary during working cycles on a level grade or while the machine is standing on the maximum gradient recommended for travel. Such brakes or locks shall be arranged to remain in engagement in the event of loss of operating pressure or power.

On **railway cranes**, brakes shall be provided to bring the crane to a stop while descending the maximum grade recommended for travel. In addition, manual brake engagement means shall be provided to hold the machine stationary on the maximum grade recommended for travel. Such means shall be arranged to remain in engagement in the event of loss of operation air pressure.

On **wheel-mounted cranes**, means shall be provided to control completely the crane carrier travel when descending maximum gradient specified by the manufacturer under maximum loading conditions. Brakes shall be provided to bring the machine to a stop on level ground within a distance specified from a specified speed according to national regulations. Where long or steep gradients are to be negotiated, a retarder or similar device should be provided. Means shall be provided to hold the machine stationary on the maximum grade for travel recommended by the manufacturer. Where travel brakes are operated by air pressure, means shall be provided for manually or automatically stopping the vehicle when the operating pressure falls below the specified minimum level.

4.5 Controls

ISO 7752-1 establishes principles and requirements for the controls of lifting appliances. It deals with the arrangement of those controls which are used in positioning loads and serves as a general basis for the elaboration of detailed standards covering controls for particular types of lifting appliances.

ISO 7752-2 establishes the arrangement, requirements and direction of movement of the basic controls for slewing, load hoisting and lowering and jib luffing and telescoping. Section 1 deals with bi-directional controls, while Section 2 (see Addendum 1 to ISO 7752-2:1985) covers the basic arrangement and requirements for cross-shift levers (joysticks).