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Mobilna dvigala - Ugotavljanje stabilnosti

Mobile cranes - Determination of stability

Grues mobiles - Détermination de la stabilité

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Mobile cranes — Determination of stability

Grues mobiles — Détermination de la stabilité

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 96, *Cranes*, Subcommittee SC 6, *Mobile cranes*.

This third edition cancels and replaces the second edition (ISO 4305:1991), which has been technically revised.

Mobile cranes — Determination of stability

1 Scope

This International Standard 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 as defined in ISO 4306-2, i.e. appliances mounted on wheels (tires) or crawlers, with or without outriggers with the exception of loader cranes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4302, *Cranes — Wind load assessment*

ISO 4306-1, *Cranes — Vocabulary — Part 1: General*

ISO 4306-2, *Cranes — Vocabulary — Part 2: Mobile cranes*

ISO 4310:2009, *Cranes — Test code and procedures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4306-2 (except for boom, fly jib and mast mounted boom) apply.

3.1
fixed-length boom
boom of fixed operating length, the length of which can be varied by the addition or removal of inserts, but cannot be varied during the operating cycle

[SOURCE: ISO 4306-2:2012, 4.1, modified — The phrase “which length” has been changed to read “the length of which”.]

3.2
lattice boom
fixed-length boom of trussed construction

[SOURCE: ISO 4306-2:2012, 4.1.1]

3.3
telescoping boom
boom consisting of a base section from which one or more boom sections are telescoped for additional length

[SOURCE: ISO 4306-2:2012, 4.2]

3.4
mast-mounted boom
assembly comprising a boom mounted at or near the top of a vertical or almost vertical mast member

Note 1 to entry: The angle of the boom to mast may be changed during operation.

[SOURCE: ISO 4306-2:2012, 4.3]

3.5
fly jib
extension attached at or near the boom point or mast-mounted boom to provide additional boom length and an auxiliary hoisting means

Note 1 to entry: A fly jib is configured with a fixed angle to the boom.

[SOURCE: ISO 4306-2:2012, 4.4]

3.6
tipping angle
angle formed between the vertical plane through the tipping line (fulcrum) and the plane through the tipping line and the centre of gravity of the crane

Note 1 to entry: See Figures B.1 to B.6.

Note 2 to entry: Take into consideration the lifted load at the centre of the boom point or jib point sheaves to calculate the machine centre of gravity plus the load centre of gravity.

4 Calculations of stability

4.1 General

The calculations shall verify that the crane is stable under the following conditions:

a) the criteria specified in Table 1;

b) the criteria specified in Table 2;

c) the criteria specified in Table 3;

d) backward stability (see 4.3);

e) stability with out-of-service wind (see 4.4).

4.2 Criteria for stability

4.2.1 See Tables 1, 2 and 3.

4.2.2 Based on the criteria specified in Table 1, Table 2, and Table 3, it is intended that the stability-limited crane ratings shall be usable in a minimum wind speed of 8,3 m/s. Under special conditions where this requirement imposes a restriction on rated capacity, the manufacturer shall clearly specify the maximum wind speed included in the stability calculation.

Table 1 — Machine configuration stability calculation for applied load

Machine configuration/condition	Loading	Value to be taken into consideration[a]
On outriggers/crawlers[b]	Applied load	$1{,}25P + 0{,}1 \cdot F$
On wheels (tyres)[b]	Applied load	$1{,}33P + 0{,}1 \cdot F$
On crawlers with travel speed up to 0,1 m/s	Applied load	$1{,}25P + 0{,}1 \cdot F$
On crawlers with travel speed greater than 0,1 and less than or equal to 0,4 m/s	Applied load	$1{,}33P + 0{,}1 \cdot F$
On wheels (tyres) with travel speed up to 0,4 m/s	Applied load	$1{,}33P + 0{,}1 \cdot F$
On crawlers/wheels (tyres) with travel speed greater than 0,4 m/s	Applied load	$1{,}50P + 0{,}1 \cdot F$

[a] In these formulae:

P is the rated capacity (hoist medium load) as specified by the crane manufacturer for the various configurations of the crane. It shall be for the hoist medium load of the crane as defined by ISO 4306-1:2007, 6.1.5;

F is the load from the mass of the boom and fly jib referred to the boom head or fly jib head. (The determination of F is given in ISO 4310.)

The value to be taken into consideration is intended to simulate the dynamic forces arising during normal controlled operation.

[b] These configurations take into consideration a non-travelling crane, which performs crane operations similar to luffing (booming), hoisting, telescoping and slewing.

Table 2 — Machine configuration stability calculation with wind load and dynamic effects

Machine configuration/condition	Loading	Value to be taken into consideration[a]
On outriggers/crawlers[b]	Applied load	$1{,}1 \cdot P$
	Wind load	$S \cdot W$
	Inertia forces	D
On wheels (tyres)[b]	Applied load	$1{,}17 \cdot P$
	Wind load	$S \cdot W$
	Inertia forces	D
On crawlers with travel speed up to 0,1 m/s	Applied load	$1{,}1 \cdot P$
	Wind load	$S \cdot W$
	Inertia forces	D
On crawlers with travel speed greater than 0,1 m/s and less than or equal to 0,4 m/s	Applied load	$1{,}17 \cdot P$
	Wind load	$S \cdot W$
	Inertia forces	D
On wheels (tyres) with travel speed up to 0,4 m/s	Applied load	$1{,}17 \cdot P$
	Wind load	$S \cdot W$
	Inertia forces	D
On crawlers/wheels (tyres) with travel speed greater than 0,4 m/s	Applied load	$1{,}33 \cdot P$
	Wind load	$S \cdot W$
	Inertia forces	D
With travel speed greater than 0,1 m/s, the total load on the support base on the side or end of the undercarriage supporting the least load [wheels (tyres), crawlers] shall be not less than 15 % of the total mass of the crane.		

[a] In this column:

D is the inertia force due to hoisting, telescoping, slewing, luffing or travel. For cranes having stepped controls, the actual values from inertia forces shall be used. For cranes having infinitely variable controls, the value of D shall be taken as 0.

S is a partial safety factor:

S = 1,0 for wind load on the suspended load P;

S = 1,2 for wind load on the crane structure(boom, jib, mast, etc.);

P is as defined in Table 1;

W is the effect of the in-service wind and shall be calculated in accordance with ISO 4302.

[b] These configurations take into consideration a non-travelling crane, which performs crane operations similar to luffing (booming), hoisting, telescoping and slewing.

Table 3 — Minimum values of tipping angle

Machine configuration/condition	Minimum tipping angle[a]
On outriggers/crawlers and crawlers with travel speed up to 0,1 m/s	4,0°
On wheels (tyres) without travelling	4,5°
On crawlers with travel speed greater than 0,1 m/s and equal to or less than 0,4 m/s	4,5°
On wheels (tyres) with travel speed equal to or less than 0,4 m/s	4,5°/5,5°[b]
On crawlers with travel speed greater than 0,4 m/s	5,0°
On wheels (tyres) with travel speed greater than 0,4 m/s	5,0°/6,0°[b]
Accelerations caused by the sudden start or the sudden stop of movements of the crane and/or the load could result in unintentional movements of the crane and/or the load (kinetic energy). In order to avoid tipping of the crane by such a cause, there shall be sufficient potential energy available. These dynamic effects have to be covered by a calculation. It is possible to use as an alternative the simplified calculation method with tipping angle. The verification shall be carried out for all capacities of the crane for the worst position in the most unfavourable direction.	

[a] The given minimum tipping angle values are valid for slopes of less than 1 %. Any inclination of the ground larger than 1 % shall be considered in the tipping calculations (method with tipping angle) and the slope angle used shall be stated in the load chart. The application point of the mass (of the load) shall be set at the height of the axis of the pulley head.

[b] If the flexibility of the wheels (tyres) is taken into account, the smaller values may be used.

4.3 Backward stability (with and without boom)

4.3.1 General

To retain a reasonable margin, counterweighting shall be limited by the mass distribution given below (in this subclause), application being under the following conditions:

— placed on a firm, level supporting surface (up to 1 % gradient);

— equipped with the shortest specified boom, set at its maximum recommended boom angle for that boom length;

— with hook, hook-block or other load-handling equipment resting on the ground;

— with boom removed from the crane;

— with outriggers free of the bearing surface for on-wheels (tyres) calculations;

— equipped with the longest specified boom, or boom and fly-jib combination set at its maximum recommended boom angle for that combination, and subjected to an in-service wind acting from the least-favourable direction.

The specified mass distribution criteria shall be satisfied for each counterweight condition with the crane rotated to the least-stable positions permitted by the manufacturer.