INTERNATIONAL STANDARD

ISO 15818

First edition
2017-03

Earth-moving machinery — Lifting and tying-down attachment points — Performance requirements

Engins de terrassement — Points d'ancrage pour le levage et l'arrimage — Exigences de performance

Reference number
ISO 15818:2017(E)

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Foreword

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This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 3, *Machine characteristics, electrical and electronic systems, operation and maintenance*.

Introduction

This document has been developed to define the performance requirements of lifting and tying-down attachment points fitted on, or incorporated into, earth-moving machinery for the purposes of its effective and safe transportation.

Although manufacturers of machines do not have direct responsibility for such transportation, the method and precautions necessary for lifting, tying down and disassembling for transportation are described in informative annexes which can be used by the manufacturer as guidance when preparing the operator's manual.

The tying-down requirements and recommendations given in this document are intended to match with widely applied practices such as those described in IMO/ILO/UNECE guidelines. However, where this is not the case, another or other supplemental methods for securing the machine can be provided in the operator's manual.

Earth-moving machinery — Lifting and tying-down attachment points — Performance requirements

1 Scope

This document specifies the performance requirements for the lifting and tying-down attachment points of earth-moving machinery as defined in ISO 6165.

This document also applies to components and subassemblies of earth-moving machinery which the manufacturer intends to be lifted or tied down separately by using lifting or tying-down attachment points.

NOTE 1 Some components (e.g. tyres, tyres with wheels, track shoe assemblies, hydraulic cylinders) can be securely tied down without specific tying-down attachment points.

This document applies to the following modes of transport:

— lifting with cranes (e.g. mobile cranes, gantry cranes);

— road transport (e.g. truck, trailer);

— rail transport, including combined transport (e.g. wagons with containers, swap-bodies, semi-trailers, trucks);

— sea transport.

It is not applicable to

— airlift or transport by air, or

— rail transport of machines on wagons subject to shunting.

NOTE 2 National or local regulations can be more stringent.

This document does not include requirements for attaching the machine to a platform of the rail car, boat, etc., from which the machine is intended to work.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for 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 2867, *Earth-moving machinery — Access systems*

ISO 6165, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 6405-1, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6165 and the following apply.

3.1
lifting attachment point
device fitted on, or incorporated into, an earth-moving machine, used for lifting the machine or disassembled unit

Note 1 to entry: The attachment point can be a hole, a lifting eye or any specific part of the machine as specified by the manufacturer.

3.2
lifting accessory
combination of materials (e.g. shackles, wire ropes, slings, chains) used for lifting the machine or disassembled unit

3.3
tying-down attachment point
device fitted on, or incorporated into, an earth-moving machine, used for tying down when transporting the machine or disassembled unit

Note 1 to entry: The attachment point can be a hole, a tying-down eye or any specific part of the machine as specified by the manufacturer.

3.4
tying-down accessory
combination of materials (e.g. chains, wire ropes, shackles, bracing, wheel chocks) used for tying down and fastening when transporting a machine or disassembled unit

3.5
sling
assembly of slinging components, such as chains, wire ropes or textile material joined to upper or lower terminals, suitable for attaching to a *lifting attachment point* (3.1)

3.6
machine lifting configuration
manufacturer's recommended position of the machine for lifting

3.7
machine tying-down configuration
manufacturer's recommended position of the machine for transport

3.8 Masses for calculation

3.8.1
mass of each disassembled unit
mass of each unit of a machine (e.g. component, subassembly, base machine) that is disassembled for transport

Note 1 to entry: It is used for calculating forces exerted on *lifting attachment points* (3.1) or *tying-down attachment points* (3.3) of the unit.

3.8.2
whole machine mass for calculation
mass of the machine, including the heaviest combination of cab, canopy, operator-protective structures, if any, with all their components and mountings, and any combination of equipment and attachment approved by the manufacturer of the machine, including full-liquid systems excluding payloads

Note 1 to entry: It is used for calculating forces exerted on *lifting attachment points* (3.1) or *tying-down attachment points* (3.3) of the whole machine.

3.9
distributed lifting force
force applied onto each *lifting attachment point* (3.1) from lifting equipment through *lifting accessories* (3.2) during lifting

Note 1 to entry: The distributed lifting force magnitude and direction can be different for each lifting attachment point due to unequal distribution of loads and non-vertical lifting accessories.

3.10
distributed tying-down force
restraining force
force potentially applied onto each *tying-down attachment point* (3.3) from transport vehicle through *tying-down accessories* (3.4) during transport

3.11
working load limit
WLL
maximum load (mass) that the *lifting accessory* (3.2) is designed to lift under the conditions specified by the manufacturer

3.12
lashing capacity
LC
maximum allowable direct force that a *tying-down accessory* (3.4) can sustain in use

3.13
transport vehicle
vehicle to which the earth-moving machine is tied down for transportation purposes

3.14
proof force
calculated force including proof factor for *distributed lifting force* (3.9) or *distributed tying-down force* (3.10)

3.15
breaking force
calculated force including safety factor for *distributed lifting force* (3.9) or *distributed tying-down force* (3.10)

3.16
number of effective tying-down attachment points
n
number of *tying-down attachment points* (3.3) used simultaneously in the same direction of force

3.17
number of effective lifting attachment points
n
number of *lifting attachment points* (3.1) used simultaneously

3.18
lashing
restraining (as cargo) of earth-moving machine movement in relation to the *transport vehicle* (3.13) against forces applied on the machine during transport by means of the appropriate use of *tying-down accessories* (3.4)

3.19
resultant force
F_{Rx}, F_{Ry}
force acting on *the tying-down attachment point* (3.3) due to the direction of force relative to the *transport vehicle* (3.13) actuated on the load in either the x- or y- direction during transport

4 Lifting attachment points

4.1 Location and number

Sufficient number of lifting attachment points shall be placed so that the lifting force derived from the machine mass is relatively well distributed and balanced during lifting with a lifting accessory or accessories.

Where there is no appropriate central lifting attachment point (see Figure B.2), lifting attachment points shall be spaced the maximum practical distance for appropriate stability and balance.

A lifting attachment point or points should be designed to hold the terminal fittings of the lifting accessories in the foreseen position to avoid slipping.

4.2 Strength

Dependent on transport procedure, the lifting attachment points shall fulfil the strength requirements to lift the whole machine or to lift the disassembled unit. Table 1 shall be used to define strength requirements for symmetric loadings.

Alternatively, taking uneven loadings into account, the strength requirement for each lifting attachment point shall be calculated individually using the mass of each disassembled unit or (3.8.1) the whole machine mass for calculation (3.8.2) and the location of the lifting points relative to the centre of the mass. A proof factor of 1,5 for the proof force and a safety factor of 4 for the breaking force shall be used in the calculations.

The strength of each lifting point shall be verified according to Clause 9.

Open-end lifting attachment points, such as hooks, shall have a safety latch or other device to prevent unintended disengagement of the mating lifting accessory.

Table 1 — Lifting attachment points — Strength requirements — Symmetric loadings

Distributed lifting force N	Strength requirement	
	Proof force N	Breaking force N
$\frac{m \times g}{n \times \cos\theta}$	$\frac{m \times g \times 1{,}5}{n \times \cos\theta}$	$\frac{m \times g \times 4{,}0}{n \times \cos\theta}$
m	is the whole machine mass for calculation or mass of each disassembled unit (kg)	
g	is the acceleration due to the force of gravity (g = 9,8 m/s^2)	
n	is the number of effective lifting attachment points, for calculation of symmetric loadings as defined below: 1 with one lifting attachment point and 2 with two lifting attachment points that are symmetrically located about the centre of the machine mass, with equal chain lengths and angles; 2 with four or more lifting attachment points that are symmetrically located about the centre of the machine mass, with equal chain lengths and angles for rigid load; 3 with three lifting attachment points that are symmetrically located about the centre of the machine mass, with equal chain lengths and angles; 3 with four lifting attachment points that are symmetrically located about the centre of the machine mass, with equal chain lengths and angles for non-rigid load; 4 with four lifting attachment points that are symmetrically located about the centre of the machine mass, with equal chain lengths and angles for the case where adequate load balancing is ensured for non-rigid load (e.g. frame oscillation, axle oscillation, lifting accessories with balancing capability).	
θ	is the angle between the vertical line and the sling leg at the lifting attachment point (see Figure 1). It is generally limited to prevent damage to the machine, for example, operator station, engine cover. The angle used for calculation shall be 60° or the maximum possible angle needed to prevent the machine from being damaged by the lifting devices as determined by the manufacturer. For single-leg slings, the lift angle is equal to 0°.	

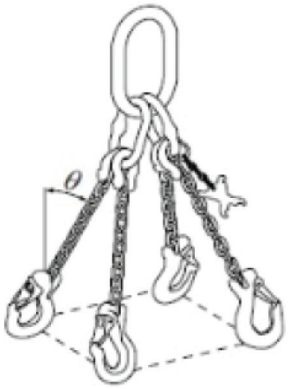

Figure 1 — Lifting attachment points — Angle between vertical line and sling leg