INTERNATIONAL STANDARD

ISO 10567

Second edition
2007-10-01

Earth-moving machinery — Hydraulic excavators — Lift capacity

Engins de terrassement — Pelles hydrauliques — Capacité de levage

Reference number
ISO 10567:2007(E)

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Published in Switzerland

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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.

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 10567 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 1, *Test methods relating to machine performance*.

This second edition cancels and replaces the first edition (ISO 10567:1992), which has been technically revised.

Earth-moving machinery — Hydraulic excavators — Lift capacity

1 Scope

This International Standard provides a uniform method for calculating the lift capacity of hydraulic excavators and specifies a procedure for verifying the calculations. It is applicable to the limits of both hydraulic lift capacity and machine-tipping, and establishes the rated lift capacity for hydraulic excavators as defined in ISO 7135.

2 Normative references

The following referenced documents are indispensable for the application 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 7135, *Earth-moving machinery — Hydraulic excavators — Terminology and commercial specifications*

ISO 9248, *Earth-moving machinery — Units for dimensions, performance and capacities, and their measurement accuracies*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
load
external mass, including the mass of the attached equipment and attachment if applicable, applied at the lift point

3.2
lift point
LP
⟨condition 1⟩ location on the bucket or the attachment bracket, as specified by the manufacturer, to which a load may be attached

See Figure 1 a).

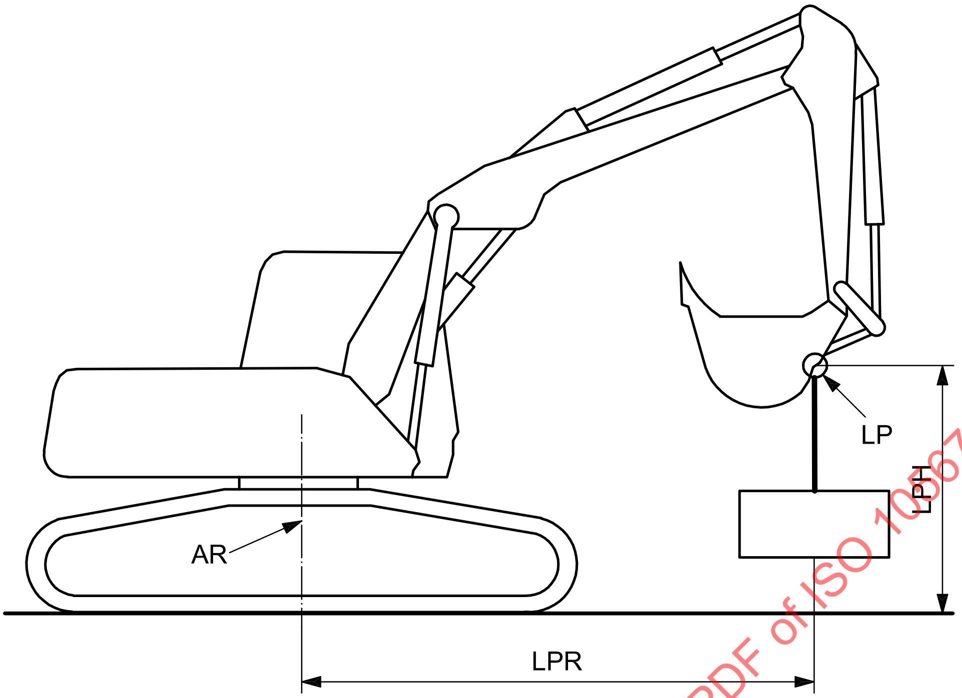
NOTE For attaching the bucket or attachment bracket load, the bucket cylinder need not be fully extended.

3.3
lift point
LP
⟨condition 2⟩ centreline of the bucket pivot mounting pin on the arm

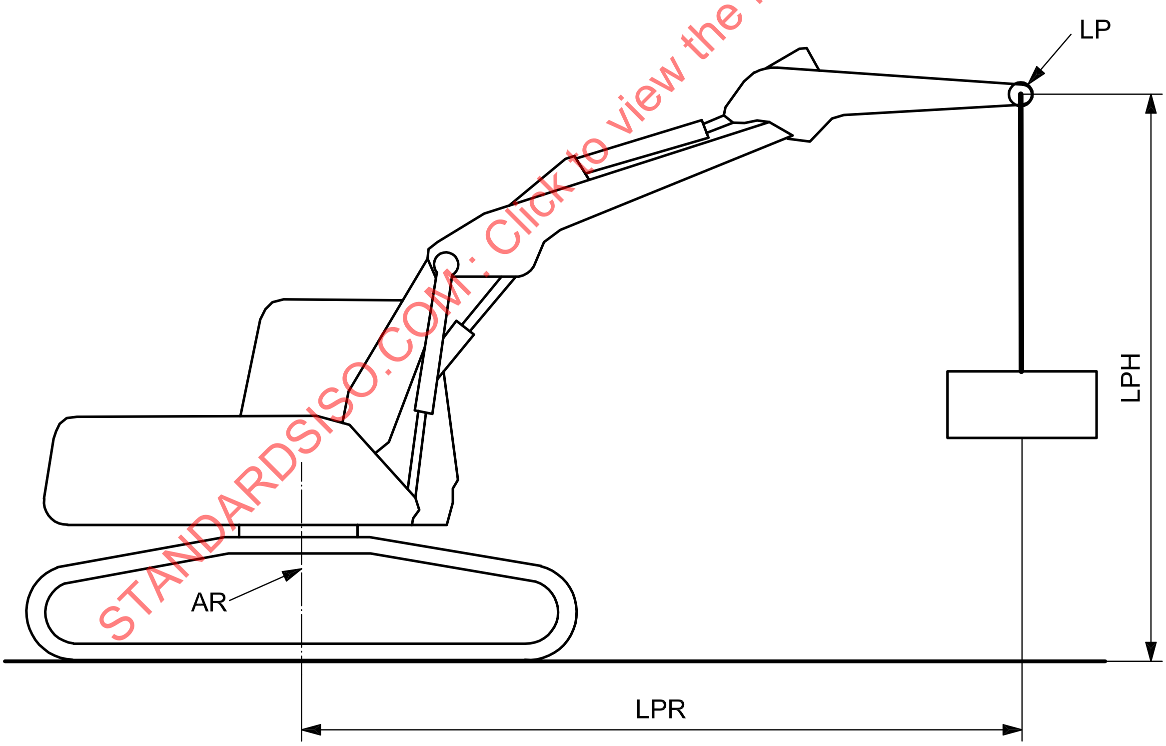
See Figure 1 b).

3.4
lift-point height
LPH
vertical distance from the ground reference plane (GRP) to the lift point

See Figure 1.



a) **Condition 1**



Key

AR axis of rotation

LP lift point

LPH lift-point height

LPR lift-point radius

b) **Condition 2**

Figure 1 — Lift point

3.5
lift-point radius
LPR
horizontal distance from the axis of rotation to the vertical hoist line or tackle

See Figure 1.

3.6
balance point
moment acting to overturn the machine with a specific load and lift-point radius, which is equal to the moment of the machine available to resist overturning

3.7
tipping load
static load at the balance point

3.8
rated tipping load
75 % of the tipping load

3.9
working circuit pressure
nominal hydraulic pressure applied to the specific circuit by the pump(s)

3.10
holding circuit pressure
maximum static hydraulic pressure in a specific circuit, limited by a relief valve at a flow no greater than 10 % of rated circuit flow

3.11
hydraulic lift capacity
load that can be lifted from the lift point by the boom, arm or bucket cylinders with the excavator physically restrained from tipping

3.11.1
boom cylinder hydraulic lift capacity
load that can be lifted by applying working circuit pressure to the boom cylinder(s) without exceeding holding circuit pressure in any other circuit

3.11.2
arm cylinder hydraulic lift capacity
load that can be lifted by applying working circuit pressure to the arm cylinder(s) without exceeding the holding circuit pressure in any other circuit

3.11.3
bucket cylinder hydraulic lift capacity
load that can be lifted by applying working circuit pressure to bucket cylinder without exceeding the holding circuit pressure in any other circuit

3.12
rated hydraulic lift capacity
87 % of the smaller of boom or arm hydraulic lift capacity at specific lift-point positions

3.13
rated lift capacity
smaller of either the rated tipping load or the rated hydraulic lift capacity

3.14
maximum radius
maximum lift-point radius at a given lift-point height

3.15
maximum radius rated lift capacity
rated lift capacity at the maximum radius

3.16
adjustable intermediate boom
hydraulically adjustable intermediate boom consisting of stub, intermediate boom and hydraulic cylinder(s)

3.17
minimum radius
minimum lift-point radius at a given lift-point height

3.18
minimum radius lift capacity
rated lift capacity at the minimum radius determined in the same manner as the rated lift capacity

4 Calculations

4.1 Tipping load calculations

4.1.1 General

Tipping load calculations shall be made at each grid line intersection of a 0,5 m, 1 m or 2 m vertically and horizontally spaced grid placed over the excavator's working range. The origin of the grid shall be at the intersection of the ground reference plane (GRP) and the axis of rotation. The tipping load calculations shall be made to determine the load that can be lifted with the machine at its balance point (3.6). Tipping load calculations shall be made over the side and over the end of the excavator undercarriage. When the undercarriage is not symmetrical about the axis of rotation from front to rear, the tipping load calculations shall be made in the least favourable position. Maximum and minimum radii lift capacity positions may be calculated for each horizontal grid line at the excavator manufacturer's discretion.

4.1.2 Machine configuration for calculations

4.1.2.1 The tipping loads shall be calculated with the machine on a firm, level supporting surface.

4.1.2.2 Tipping load calculations are not to be published for equipment positions in which a vertical line projected downward from the lift point would pass through the bucket.

4.1.2.3 The operating mass shall consist of the base machine and equipment, with empty attachment or attachment bracket if the lift point as defined in 3.2 is specified by the manufacturer, and with the operator (75 kg), full fuel tank and with all fluid systems at the levels specified by the manufacturer.

4.1.2.4 Tipping loads for machines equipped with an adjustable intermediate boom shall be calculated with the intermediate boom positioned at maximum length. See Figure 1.

4.1.2.5 If the equipment has additional adjustable positions, calculations shall be made in the most unfavourable position.

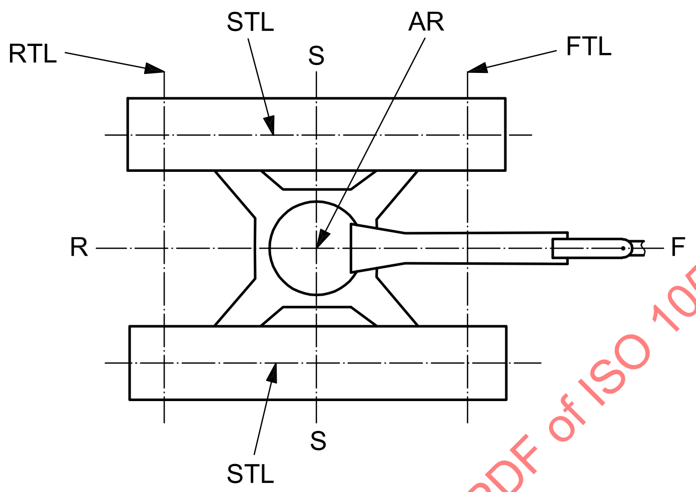
4.1.2.6 For tipping load calculations when a bucket is installed, the bucket attitude shall have a vertical line projected from the lift point, tangent, or as near tangent as the bucket linkage allows, to the back side of the bucket. When the bucket linkage does not allow the load line to be tangent, the line may

a) hang free of the back of the bucket, regardless of the bucket cylinder extension, with the load line adequately retained to the lift point (see Figure 1 a), or

b) wrap smoothly around the back of the bucket, regardless of the bucket cylinder extension, without allowing the load line to come in contact with any sharp projection on the back of the bucket or edge of the bucket lip.

4.1.3 Calculations for balance point for end tipping line

4.1.3.1 The tipping line used for balance point calculations over the front/rear of machines with track-type undercarriage shall be a line connecting the centreline of support idlers or sprockets (see Figure 2). The equipment shall be positioned over the front/rear in the least stable position for these calculations.



Key

F front
R rear
S side
AR axis of rotation
FTL front tipping line
RTL rear tipping line
STL side tipping line

Figure 2 — Tipping conditions for track-type undercarriage

4.1.3.2 The tipping line to be used for balance point calculations over the front/rear of machines with a rubber-tyred undercarriage shall be the axle centreline, the bogie axle centreline, or a line connecting the outrigger pads as shown in Figure 3.

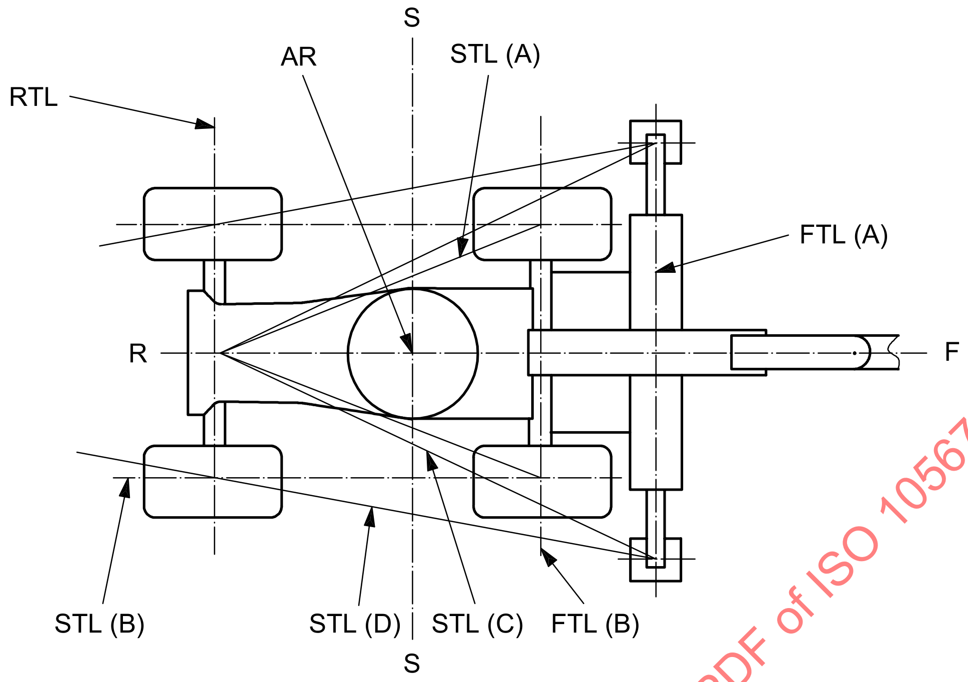
4.1.3.3 The tipping line for pivoted outrigger pads shall be a line at the GRP, connecting the point on the pads directly below the centreline of the pivot. For rigid outrigger pads, the tipping line shall be a line connecting the centroid of the contact area between the pads and the GRP. See Figure 3 a).

4.1.3.4 A blade, properly attached to the machine and capable of supporting the machine as an outrigger, may be considered an outrigger. The location of the blade tipping line shall be a line at the GRP where the blade contacts that plane. See Figure 3 b).

4.1.3.5 For machines equipped with outriggers and/or blade, calculations shall be made both without the outriggers and/or blade applied and with the outriggers and/or blade applied in their most favourable position.

4.1.4 Calculations for balance point for side tipping line

4.1.4.1 The tipping line used for side-tipping balance point calculations on machines with track-type undercarriages shall be defined by the pivot points between support rollers and track elements (such as links or guides) as shown in Figures 2 and 4.

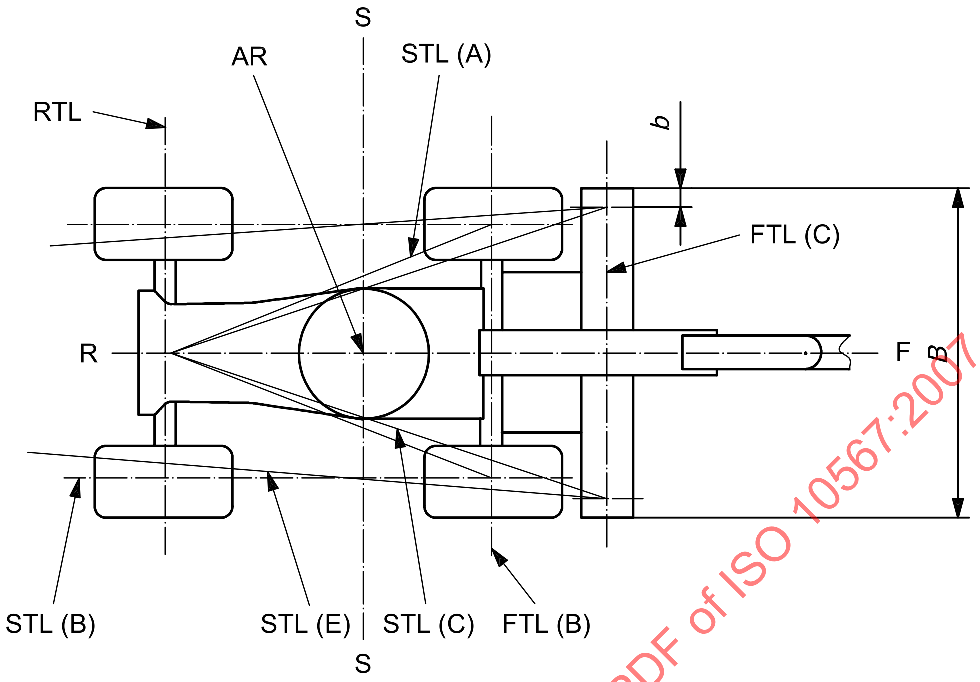


Key

F	front
R	rear
S	side
AR	axis of rotation
FTL (A)	front tipping line with outriggers
FTL (B)	front tipping line at axle centreline
RTL	rear tipping line at axle centreline
STL (A)	side tipping line with oscillating axle
STL (B)	side tipping line without blade, without outriggers and with non-oscillating axle
STL (C)	side tipping line with outriggers or blade with oscillating axle
STL (D)	side tipping line with outriggers and non-oscillating axle

a) Undercarriage with outriggers

Figure 3 — Tipping conditions for rubber-tyred undercarriage



Key

F front

R rear

S side

AR axis of rotation

FTL (B) front tipping line at axle centreline

FTL (C) front tipping line with blade

RTL rear tipping line at axle centreline

STL (A) side tipping line with oscillating axle

STL (B) side tipping line without blade, without outriggers and with non-oscillating axle

STL (C) side tipping line with outriggers or blade with oscillating axle

STL (E) side tipping line with blade and non-oscillating axle

B overall length of blade in contact with GRP

b $= 0{,}025 \times B$

b) Undercarriage with blade

Figure 3 — Tipping conditions for rubber-tyred undercarriage *(continued)*

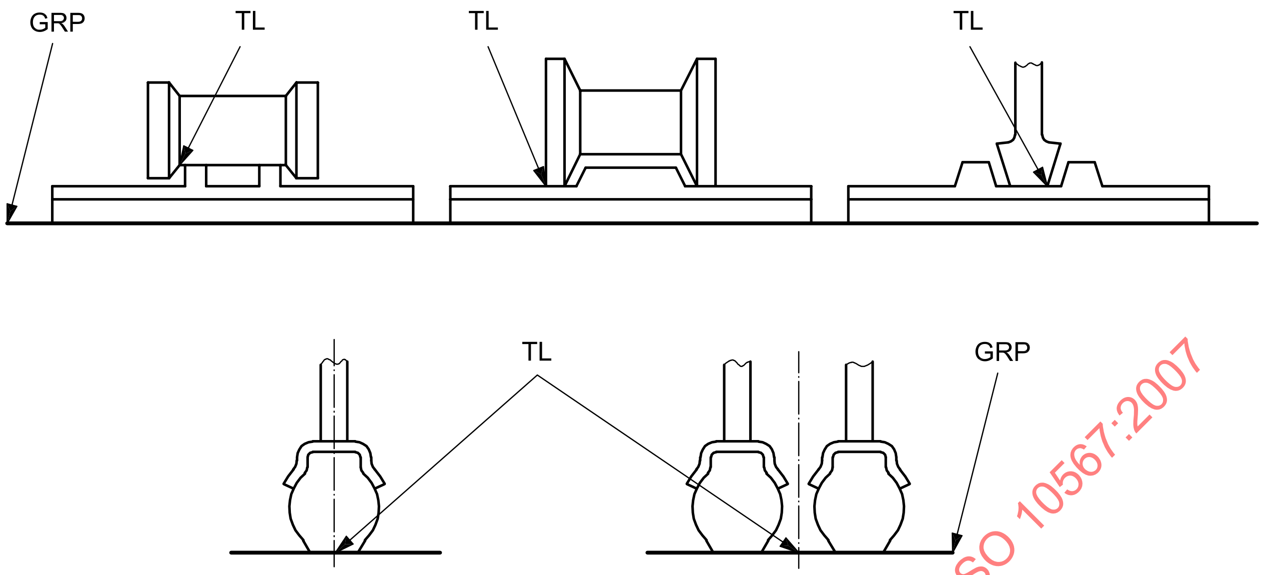
4.1.4.2 The tipping line to be used for calculations for the balance point of machines with a rubber-tyred undercarriage with blocked or non-oscillating axles shall be a line connecting the centre of contact of the tyres (midpoint between dual tyres) on the same side of the machine, at the GRP, see Figures 3 and 4.

4.1.4.3 The tipping line for an excavator with an oscillating axle shall be a line through the axle pivot point and one other rigid support point (see Figure 3).

4.1.4.4 If ratings are based upon a blocked or non-oscillating axle, this condition shall be clearly defined on the load rating charts and diagrams.

4.1.4.5 When outriggers are used, the position of the tipping line shall be as specified in 4.1.3.2 and 4.1.3.3.

4.1.4.6 When the blade is used, the side tipping line shall be as specified in 4.1.3.4.



Key

GRP ground reference plane

TL tipping line (located on side of machine nearest load line)

Figure 4 — Tipping lines

4.2 Hydraulic lift capacity calculations

Hydraulic lift capacity calculations shall be made at each grid line intersection of a 0,5 m, 1 m or 2 m vertically and horizontally spaced grid placed over the excavator's working range. The origin of the grid shall be at the intersection of the GRP and the axis of rotation. The hydraulic lift capacity calculations shall be made to determine the load that can be lifted with the force generated by the boom, arm and bucket cylinders, as defined in 3.11.1, 3.11.2 and 3.11.3. Maximum and minimum radii lift capacity positions may be calculated for each horizontal grid line at the excavator manufacturer's discretion.

5 Verification testing

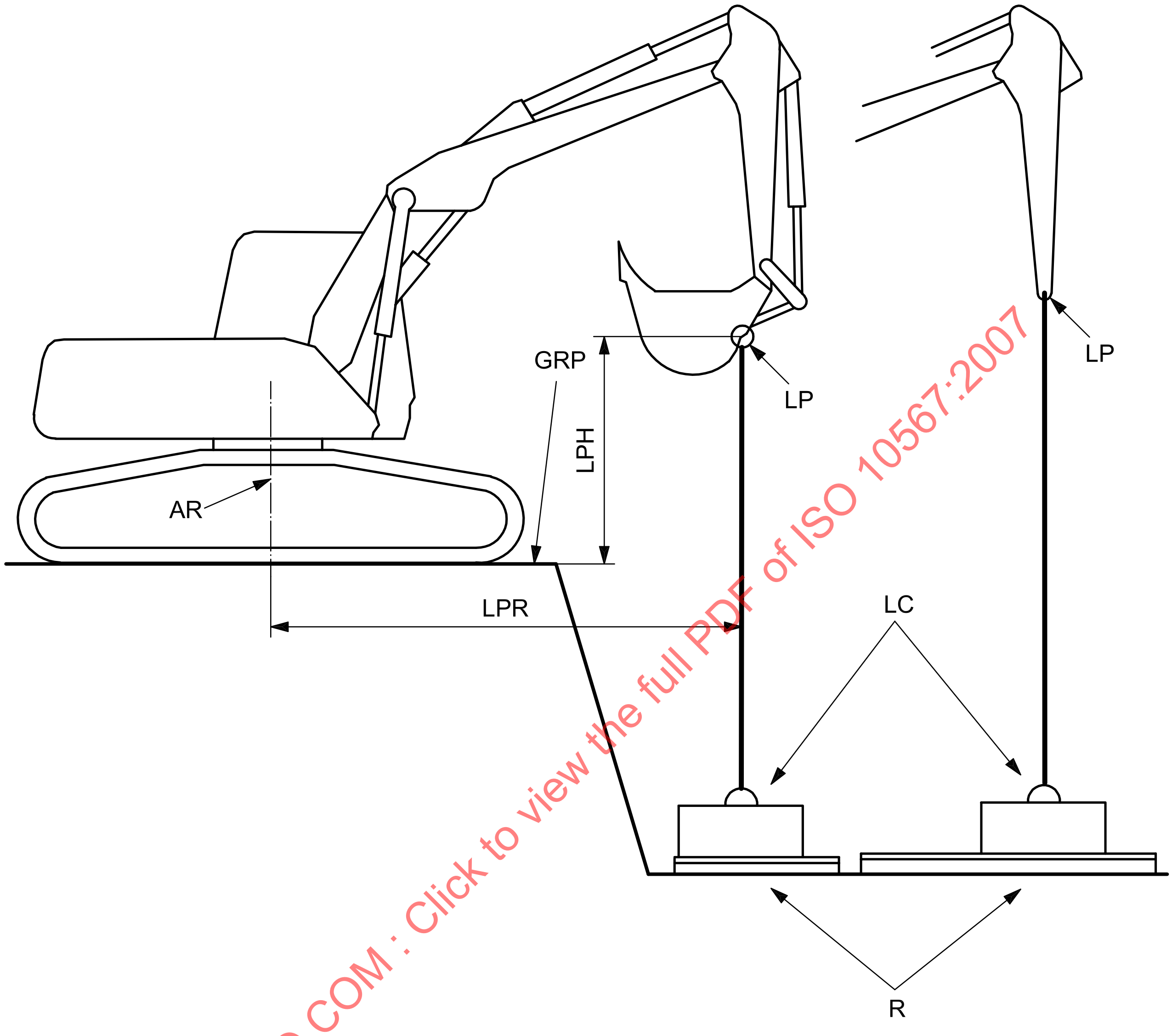
5.1 Test site

5.1.1 Dead-weight test site (immovable weight)

A dead-weight test site shall consist of a firm and level horizontal surface arranged so that a load cell can be connected between the lift point and the dead weight. The dead weight may be either a horizontal rail with a movable attachment device or a fixed-point dead weight with the excavator moving to obtain the various lift points (see Figures 5 and 6).

5.1.2 Live-weight test site (movable weight)

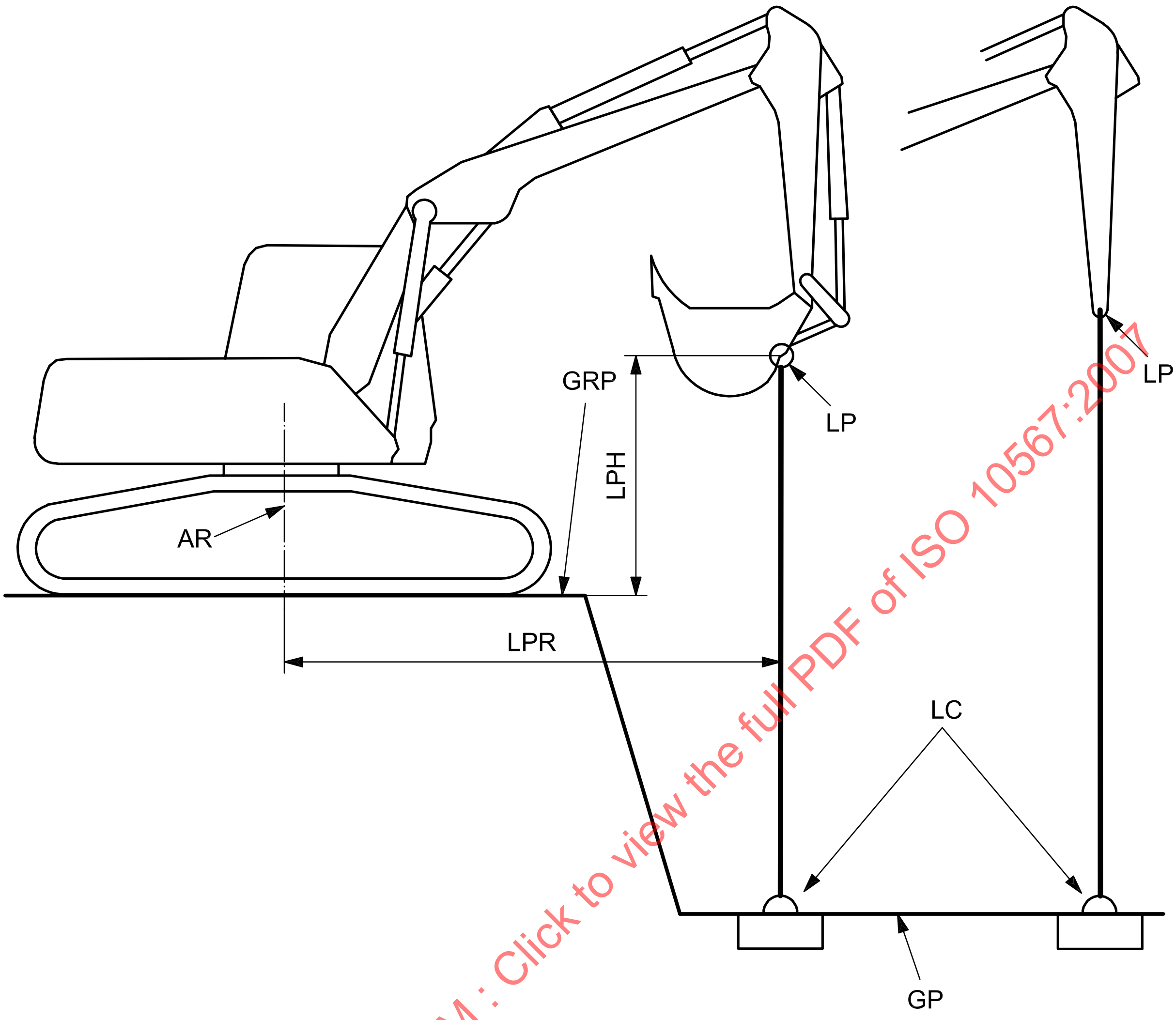
A live-weight test site shall consist of a firm and level horizontal surface arranged so that a weight attached to the lift point can be moved without obstructing the limit of the excavator's tipping load or hydraulic capacity. See Figure 7 for a typical test arrangement. The live weight should be kept within 0,5 m of the surface from which it was raised, in order to minimize the possibility of the machine overturning.



Key

AR axis of rotation
GRP ground reference plane
LC load cell
LP lift point
LPH lift-point height
LPR lift-point radius
R rails

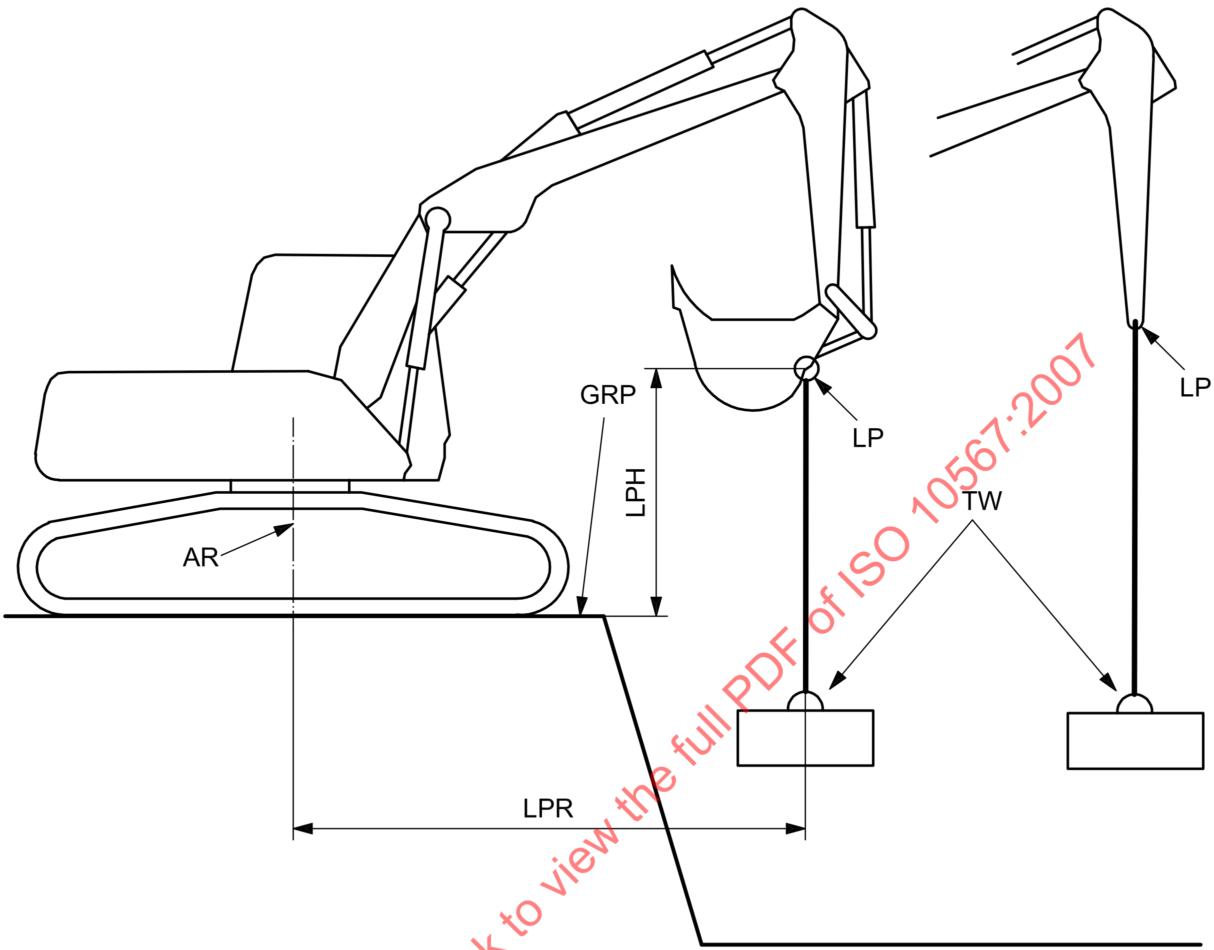
Figure 5 — Self-aligning dead weight



Key

AR axis of rotation
GP ground plane
GRP ground reference plane
LC load cell
LP lift point
LPH lift-point height
LPR lift-point radius

Figure 6 — Fixed dead weight



Key

AR axis of rotation
GRP ground reference plane
LP lift point
LPH lift-point height
LPR lift-point radius
TW test weight

Figure 7 — Live weight

5.2 Test equipment

Instrumentation accuracy shall be in accordance with ISO 9248.

5.2.1 Load cell, of sufficient capacity (if a dead-weight test site is used).

5.2.2 Weights of known mass (if a live-weight test site is used).

5.2.3 Means of measuring the lift-point position relative to the axis of rotation of the excavator.

5.2.4 Means of measuring perpendicularity between the load line and the GRP when using the dead-weight test site.

5.2.5 Means of monitoring pressure in all hydraulic circuits that will be under pressure during the actual lift capacity verification tests.

5.3 Test conditions and procedure

5.3.1 The excavator shall be thoroughly cleaned and in normal working condition with fuel tanks filled to capacity and all other fluids at their prescribed levels and at normal operating temperature.

5.3.2 The excavator shall be fitted with hoe equipment and a counterweight as specified by the manufacturer for the calculated lift capacity chart being verified.

5.3.3 Tyres on rubber-tyred undercarriage machines shall be inflated to the manufacturer's recommended values.

5.3.4 Track tension on machines with a track-type undercarriage shall be adjusted to the manufacturer's recommended values.

5.3.5 The hydraulic pressure shall be checked, including the working- and holding-circuit pressures, to ensure that the system is set at the manufacturer's recommended nominal published value.

5.3.6 A means shall be provided for preventing the excavator from overturning during the test procedure.

5.3.7 Carry out tipping load measurements at specific lift points to determine the force that achieves the balance point.

Tests for machines with outriggers and/or blade shall be conducted both without the outriggers and/or blade applied and with the outriggers and/or blade applied in their most favourable position.

5.3.8 Carry out hydraulic lift capacity measurements at specific lift points to verify hydraulic lift capacity calculations — without exceeding the working circuit pressure in any cylinder or the holding circuit pressure in any other circuit.

5.3.9 The number of verifying points obtained shall include at least the following:

a) tipping over the end and the side — position the equipment over the end and the side to obtain the tipping load;

b) hydraulic limited lift capacity above and below the GRP.

5.4 Recording test results

Measured lift forces, lift-point heights and lift-point radii for tipping loads and hydraulic lift capacities shall be recorded.

6 Validation of calculated values

The measured values should be 95 % or more of the calculated values. If not, the lift capacity chart shall be adjusted, based on the correction factor determined by the required values.

7 Rated lift capacity chart

7.1 Two suggested formats for the rated lift capacity chart are presented in Tables A.1 and A.2. Other regional formats that meet the requirements of 7.2 to 7.6 are also acceptable.

7.2 The rated lift capacity chart shall show the lift capacity at specific lift-point radii and at lift-point height. If the values are limited by hydraulic lift capacity, this shall be noted in the chart.

7.3 Rated lift capacity values shall be tabulated for intersections of the lift point with a 0,5 m, 1 m, 1,5 m or 2 m vertically and horizontally spaced grid placed over the excavator's working range. The maximum and minimum lift radii capacities may, at the manufacturer's discretion, also be included. The origin of the grid shall be at the intersection of the GRP and the axis of rotation.

7.4 The rated lift capacity chart shall be mounted in a location where it is protected from damage or premature deterioration and shall be legible from the control position.

7.5 Because of the large number of attachment options and machine variations available, the manufacturer shall publish revised lift capacity charts if these variations would decrease the machine rated lift capacity by more than 5 %.

7.6 For machines equipped with hydraulic circuits capable of providing momentary increases in lift capacity, such as *power boost* or *heavy lift*, the manufacturer shall state on the lift capacity chart that the capacities are with or without this feature.