

Issued 1975-02
Cancelled 2008-04

Superseded by ISO 10567

Hydraulic Excavator Lift Capacity Calculation and Test Procedure

1. **Scope**—This standard applies to hydraulic excavators as defined in SAE J1057 and J1193.
 - 1.1 **Purpose**—This standard provides a uniform method to calculate and a test procedure to validate hydraulic excavator lift capacity. It establishes definitions and specifies machine conditions for calculations in Section 1 and identifies the validating test procedure in Section 2.
 - 1.2 **Rationale**—Superseded with ISO 10567.
2. **References**
 - 2.1 **Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.
 - 2.1.1 **SAE PUBLICATIONS**—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1057—Identification Terminology of Earthmoving Machines
SAE J1193—Nomenclature and Dimensions for Hydraulic Excavators
3. **Definitions**
 - 3.1 **Load**—The external weight including the weight of the attaching equipment kilograms (pounds) applied at the lift point.
 - 3.2 **Lift Point**—The location on the bucket or bucket linkage, specified by the manufacturer, to which a load may be attached for lifting purposes. If more than one lift point is provided, the one having greatest lift point radius shall be used for determining lift capacities. The lift point location(s) shall be identified on the rated lift capacity chart. See Figures 1 and 2.

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- 3.3 Lift Point Height**—The vertical distance from the ground reference plane to the lift point. See Figures 1 and 2.
- 3.4 Lift Point Radius**—The horizontal distance from the axis of rotation to the vertical hoist line or tackle. See Figures 1 and 2.
- 3.5 Rated Lift Bucket Position**—The bucket attitude having a vertical line projected from the lift point, tangent, or as near tangent as the linkage allows, to the backside of the bucket. When the bucket linkage does not allow the load line to be tangent, the line may:
- Hang free of the back of the bucket if the bucket cylinder is fully extended and the load line is adequately retained to the lift point. See Figure 1.
 - Wrap the back of the bucket if the bucket cylinder is fully retracted and the load line of tackle does not come in contact with any sharp projection or edge. See Figure 2.
- 3.6 Balance Point**—When the moment acting to overturn the machine at a specific linkage position is equal to the moment of the machine available to resist overturning.
- 3.7 Tipping Load**—When the load supported from the lift point at a specific linkage position achieves the balance point.
- 3.8 Rated Tipping Load**—75% of the tipping load at any specific linkage position.
- 3.9 Hydraulic Pressure**
- Working Circuit Pressure—That nominal pressure applied to the specific circuit by the pump(s).
 - Holding Circuit Pressure—The maximum static pressure in a specific circuit, limited by a relief valve at a flow no greater than 10% of rated circuit flow.
- 3.10 Hydraulic Lift Capacity**—The load that can be lifted from the lift point by the boom or arm cylinders with the bucket in the rated lift bucket position (3.5) and the excavator physically restrained from tipping.
- 3.10.1 BOOM HYDRAULIC LIFT CAPACITY—The load that can be lifted by applying working circuit pressure to the boom cylinder(s) without exceeding holding circuit pressure in any other circuit.
- 3.10.2 ARM HYDRAULIC LIFT CAPACITY—The load that can be lifted by applying working circuit pressure to the arm cylinder(s) without exceeding holding circuit pressure in any other circuit.
- 3.11 Rated Hydraulic Lift Capacity**—87% of the lesser of boom or arm hydraulic lift capacity at a specific linkage position (identified by lift point height and lift point radius).
- 3.12 Rated Lift Capacity**—The smaller of either rated tipping load (3.8) or rated hydraulic lift capacity (3.11).
- 3.13 Maximum Radius Lift Capacity**—The lift capacity determined in the same manner as rated lift capacity except that the bucket is positioned with the cutting edge vertical or as near vertical as the linkage allows. See Figure 2. (Note: The hoist line or tackle is permitted to wrap smoothly round but should not be allowed to come in contact with any sharp projection on the back of the bucket.)

4. Section 1 - Lift Capacity Calculations

4.1 Tipping Load Calculations—A series of calculations at various linkage positions to determine the force generated by the boom and arm hydraulic lift capacities (as defined in 3.10.1 and 3.10.2) that achieves the balance point. Sufficient excavator linkage position calculations above and below the ground reference plane, over the ends and over the sides in the least stable position with the bucket in the rated lift bucket position must be obtained to develop a lift capacity chart. See Figure 11.

NOTE—Tipping load calculations will use a “balance point” definition that includes the total moment of the machine available to resist overturning to achieve consistency in calculations. Previous definitions for tipping load such as:

“when all of the rollers leave the track”

“when the rollers on the opposite side leave the track”

“when one wheel leaves the ground”

shall not be used. These definitions are more test related, and since all tests measure the maximum overturning resisting force, the definitions should not be required.

4.1.1 MACHINE CONFIGURATION FOR CALCULATIONS

4.1.1.1 Operating Mass—The mass of the base machine with standard equipment, or equipment specified by the manufacturer, operator (75 kg/165 lb), full fuel tank, full lubricating, hydraulic and cooling systems, and where provided, with empty bucket. This same mass is to be used for tool forces, range diagrams, and other standard specifications.

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

4.1.1.3 Lift capacities shall be calculated with the machine on a firm level supporting surface.

4.1.2 CALCULATIONS FOR THE BALANCE POINT FOR THE END TIPPING LINE

4.1.2.1 The tipping line to be used for balance point calculations over the front/rear of machines with crawler undercarriages shall be the centerline of support idlers or sprockets. See Figure 4. (Note: The linkage shall be positioned over the front/rear in the least stable position for these calculations.)

4.1.2.2 The tipping line to be used for calculations over front/rear of machine with rubber-tired carrier mountings shall be the axle centerline, bogie axle centerline, or centerline of outrigger pad as shown in Figures 5, 6, and 7.

4.1.2.3 Calculations shall be developed once with permanently mounted stabilizing devices in the retracted position and once with them applied in the most favorable position.

4.1.3 CALCULATIONS FOR BALANCE POINT POINT FOR SIDE TIPPING LINE

4.1.3.1 The tipping line to be used for side tipping balance point calculations on machines with crawler undercarriages shall be defined by the pivot points between support rollers and track elements (such as links or guides) as shown in Figure 3.

4.1.3.2 The tipping line to be used for calculations for the balance point of machines with rubber-tired carrier mountings shall be the center line of the tires at ground plane or midpoint between dual tires at ground reference plane when so equipped. See Figures 3, 5, 6, and 7.