SAE International™

SURFACE VEHICLE STANDARD

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Hydraulic Backhoe Lift Capacity

RATIONALE

This revision of existing SAE J31 has been expanded to include a calculated method of determining lift capacities. This is a common practice in the industry and is also used on similar equipment such as hydraulic excavators.

1. SCOPE

This standard applies to hydraulically operated backhoes (as defined in SAE J1116)

This standard describes a uniform "over end" and "full swing arc" lifting capacity rating for backhoes. It is based on the actual capacity of the machine to lift and support a load under stable conditions.

Rated lift capacities will be specified for both the boom and the dipperstick and will be shown on a lift capacity chart Figure 1.

1.1 Purpose

The purpose of this standard is to provide a uniform method of rating hydraulic backhoe lift capacities.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue 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 J49 Specification Definitions—Hydraulic Backhoes

SAEJ326 Nomenclature—Hydraulic Backhoes

SAEJ1116 Categories of Off-Road Self-Propelled Work Machines

2.1.2 ISO Publication

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 6016 Earth-moving machinery—Methods of measuring the masses of whole machines their equipment and components

3. DEFINITIONS

3.1 Hydraulic Lift Capacity

The actual vertical load measured at hinge pin of bucket that can be lifted at a specified position under specific conditions.

3.1.1 Lift Capacity, Over End

The load that can be lifted anywhere within an angle of 45 deg either side of a line through the swing pivot centerline and parallel to the prime mover centerline.

3.1.2 Lift Capacity, Swing Arc

The load that can be lifted and swung anywhere within the full swing arc.

3.1.3 Boom Lift Capacity

The load that can be lifted by actuating the boom cylinder(s) and can be held by the dipperstick cylinder(s).

3.1.4 Dipperstick Lift Capacity

The load that can be lifted by actuating the dipperstick cylinder(s) and can be held by the boom cylinder(s).

3.2 Tipping Capacity

The load that will cause tipping at a specified position under specified conditions. If unit is hydraulically limited, auxiliary means should be used to measure tipping.

3.2.1 Tipping Condition

A backhoe is considered to be at the point of tipping when all supports on the unloaded side leave the ground, or when rollers leave the trackrail of crawlers.

3.2.2 Tipping Capacity, Over End

The minimum load that will place the unit in a tipping condition anywhere within an angle of 45 deg either side of a line through the swing pivot centerline and parallel to the machine centerline.

3.2.3 Tipping Capacity, Swing Arc

The minimum load that will place the unit in a tipping condition at any point within the full swing arc.

3.3 Rated Boom and Dipperstick Lift Capacity

The lift capacity shall be: 87% of the hydraulic lift capacity; not to exceed 75% of the tipping load, measured at hinge pin of bucket.

3.4 Lift Height

The vertical distance of the bucket hinge pin to the GRP (Ground Reference Plane).

3.5 Lift Radius

The horizontal distance from the intersection of the swing pivot centerline with the supporting surface to the center of the vertical load line, through the bucket hinge pin.

3.6 Balance Point

The 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.

4. CONDITIONS

4.1 The equipment on the machine shall be as specified in SAE J49.

4.2 Sideshift backhoes shall be positioned with the swing pivot centerline on the centerline of the machine, and also in the least stable offset position. (This position must be stated.)

4.3 If the machine is equipped with any extendible or adjustable members, their position shall be stated.

4.4 If optional equipment such as stabilizer pads, buckets, or counterweights are used, this shall be stated.

4.5 The specifications are to be determined with the machine on a hard level surface. On rubber-tired machines, down pressure is to be applied to the stabilizers so that the adjacent tires are tangent to the surface. If the opposite end of the machine is equipped with a working tool such as a loader bucket, blade or stabilizer, down pressure shall be applied so that the adjacent tires are tangent to the surface. The tangent condition is met when the distance from the axle centerline to the surface is equal to the tire unloaded or free radius. On track units, the full length of the track is to be on the surface with all rollers contacting the track.

4.6 The load shall be exerted vertically at the bucket hinge pin with the specified bucket attached and the bucket fully dumped.

4.7 Unless otherwise specified, the backhoe boom must be in the transport position when the dipperstick lift capacity is determined.

4.8 The dipperstick must be fully rotated outward when the boom lift capacity is determined.

4.9 Machines equipped with extendible dipperstick feature should be rated in fully retracted and fully extended positions.

4.10 Shut-off valves or lockouts cannot be used in the boom or dipperstick circuits to obtain the standard lift capacities, but may be used in the stabilizer circuits. Additional defined lift capacities using shut-off valves or lockouts may be given.Lift capacities are to be arrived at without the aid of momentum.

4.11 The machine is not to be anchored in any way that will affect tip capacity results. The machine may be tethered to prevent over turning to determine hydraulic capacity beyond tip point.

4.12 Lift and tipping capacities shall be verified by test.

4.13 The hydraulic system shall be as specified per SAE J49.

5. CALCULATIONS

5.1 Tipping Load Calculations

A series of calculations at various lift radii is made to determine the load required to achieve the balance point as defined in 3.6. Sufficient lift points shall be considered to develop the rated lift capacity chart (see Figure 1). Lift point positions shall be included above and below the ground reference plane, over end and over swing arc of the machine, and with the machine in the configuration that results in the lowest moment available to resist overturning.

5.1.1 Machine Configuration for Calculations

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

5.1.1.2 The operating mass of the base machine shall be as defined in ISO 6016 and shall consist of its equipment and empty attachment as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all systems at the levels specified by the manufacturer. When a bucket is included it shall be empty.

5.1.1.3 If the attachment has additional adjustable positions calculations shall be done in the most unfavorable position.

5.1.2 Calculations for Balance Point for End Tipping Line

5.1.2.1 The tipping line to be used for balance point calculations over the end of machines with track-type undercarriage shall be a line connecting the center-line of support idlers or sprockets or a line connecting the stabilizer pads as shown in Figure 2.

5.1.2.2 The tipping line to be used for calculations over the end of machines with rubber-tired undercarriage shall be a line connecting the stabilizer pads as shown in Figure 2.

5.1.2.3 For machines equipped with stabilizers, calculations shall be made with the outriggers applied in their most favorable position.

5.1.3 Calculations for Balance Point for Swing Arc Tipping Line

5.1.3.1 The tipping line to be used for swing arc 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 show in Figure 3.

5.1.3.2 The tipping line to be used for calculations for the balance point of machines with rubber-tired undercarriage with blocked or non-oscillating axles shall be a line connecting the center of contact of the tires (midpoint between dual tires) on the same side of the machine, at the ground reference plane (see Figures 2 and 3).

5.1.3.3 The tipping line for a backhoe with an oscillating axle shall be a line through the axle pivot point and one other rigid support point (see Figure 2).

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

5.1.3.5 When stabilizers are used, the position of the tipping line shall be as specified in Figure 2.

5.1.3.6 A loader bucket or blade, properly attached to the machine and capable of supporting the machine as a stabilizer, may be considered a stabilizer.

5.1.3.7 When the loader bucket or blade, is used to provide additional stability the side tipping line shall be located as shown in Figure 2.

5.2 Hydraulic Lift Capacity Calculations

A series of calculations at various lift points is made to determine the load that can be lifted with the force generated by the boom or the dipperstick hydraulic lift capacity (as defined in 3.1.3 and 3.1.4). Sufficient calculations shall be made, including lift points above and below the ground reference plane, to develop the rated lift capacity chart shown in Figure 1.

6. RATED LIFT CAPACITY CHART

The following rated lift capacities shall be stated to the nearest 5 kg (10 lb) and tabulated and located on the machine, available to the operator, at the operator's station:

6.1 The rated lift capacities shall be tabulated for intersections of the bucket hinge pin with each horizontal grid line placed over the backhoe's operating area. A grid for SI units shall be specified in increments of 0.5 m and the grid for U.S. customary units shall be specified in increments of 2 ft. The origin of the grid shall be at the intersection of the supporting surface and the swing pivot centerline.

6.2 The rated lift capacity over end shall be shown above the grid point and the rated lift capacity, swing arc shall be shown below the grid point.

6.3 The rated boom lift capacity points shall be shown on the arc traveled by the bucket hinge pin as the boom cylinder moves through its stroke with the dipperstick fully rotated outward. The points shall be shown where the arc intersects horizontal grid lines. Grid lines must extend to two-thirds of the maximum digging depth (Figure 1).

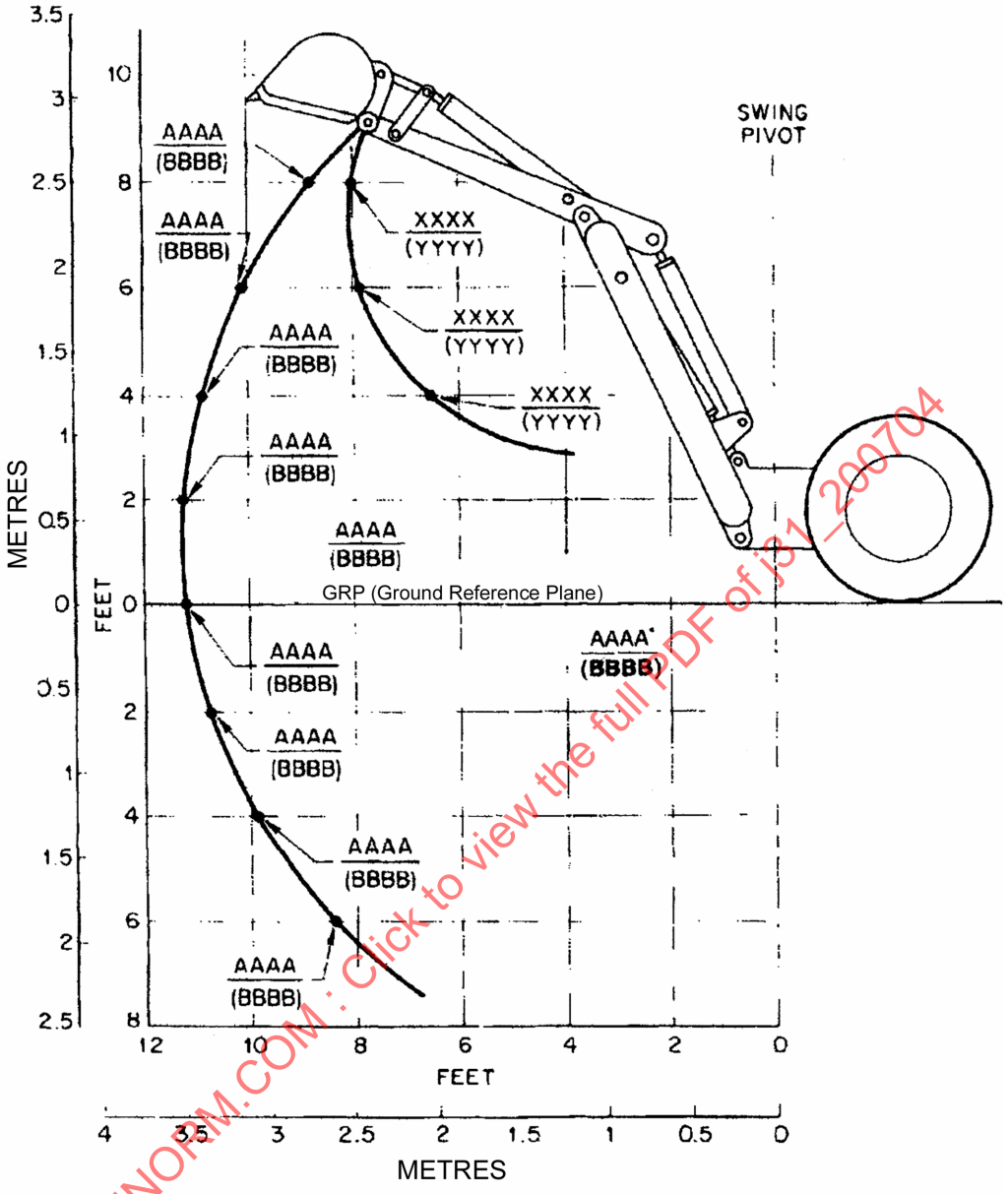
6.4 The rated dipperstick lift capacity points shall be shown on the arc traveled by the bucket hinge pin as the dipperstick cylinder moves through its full stroke, with the boom as positioned in 4.7. The points shall be shown where the arc intersects horizontal grid lines (Figure 1).

6.5 Additional boom lifting points inside the backhoe's working area may be shown in addition to those previously specified. They are to be arrived at by using the conditions in Section 4, with the exception of 4.8.

6.6 Stability limited rated lift capacities shall be identified.

6.7 The weight of the bucket used in test or calculations shall be stated on the lift chart.

6.8 Include a statement that capacities are with stabilizers down and tires are tangent to ground.



AAAA Rated Boom Lift Capacity (over end)
BBBB Rated Boom Lift Capacity (swing arc)
XXXX Rated Dipperstick Lift Capacity (over end)
YYYY Rated Dipperstick Lift Capacity (swing arc)
* Indicates capacity is stability limited (use light face type)
Hydraulic limited (use bold face type)
Bucket Weight - ____ Kg (____ lbs)
Lift Capacities are with stabilizers down and tires tangent to ground

FIGURE 1 - HYDRAULIC BACKHOE LIFT CAPACITY