SURFACE VEHICLE STANDARD

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Lift Capacity Calculation Method Knuckle-Boom Log Loaders and Certain Forestry Equipment

RATIONALE

SAE J2417 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Standard provides a uniform method to calculate the lift capacity of knuckle-boom log loaders and certain forestry equipment. It establishes definitions and specifies machine conditions for calculations. This document applies to knuckle-boom log loaders as defined in ISO 6814 and ISO 17591 and certain forestry equipment defined in ISO 6814 that have a rotating upper-structure such as feller bunchers, forwarders, harvesters, and behind the cab or rear-mounted knuckle-boom log loaders not having their own power supply. It does not apply to harvesters that are incapable of lifting a tree or log completely off the ground. This document applies to those machines that are crawler, rubber-tired, and pedestal or stationary mounted.

1.1 Purpose

The purpose of the SAE document is to establish a consistent, repeatable means of determining the lift capacity for the types of equipment contained therein.

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1.2 Applicability

Lift capacity calculations and the resulting rated lift capacity chart are developed by the equipment manufacturer or the entity that assembles and or modifies basic components to produce the complete machine for each machine model that is produced. These charts are developed solely for comparative purposes.

2. REFERENCES

2.1 Applicable Documents

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.

2.1.1SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

J1254 Component Nomenclature - Feller Buncher

2.1.2ISO Publication

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

ISO 6814 Machinery for forestry-mobile and self propelled machinery - Identification vocabulary

ISO 17591 Machinery for forestry – Knuckleboom log loaders – Identification terminology, classification and component nomenclature

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1ISO Publication

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

ISO 10567 Earth-moving machinery - Hydraulic excavators - Lift capacity

ISO 13862 Machinery for forestry – Feller-bunchers – Terms, definitions and commercial specifications

3. DEFINITIONS

3.1 ATTACHMENT

That portion of the machine that is unique and dedicated to the machine's primary purpose, i.e., log and material handling and the processing of trees and logs.

NOTE: The attachment, depending upon the type of machine, can be called working equipment, boom set, front linkage, or front.

3.2 BALANCE POINT

The theoretical location on the machine at which the forward moment produced by the attachment and load is equal to the rearward moment produced by the weight of the machine.

3.3 FORESTRY PROCESSING HEAD

The component of a forestry attachment that processes the tree or log, e.g., felling, delimbing, slashing, bucking, and piling.

3.4 GROUND REFERENCE PLANE

For crawler and rubber-tired mounted machines, the ground reference plane is that firm level supporting surface that the machine sits on, see Figures 1, 2, 3, 4, and 5. For pedestal or other stationery-mounted machines, the ground reference plane may be either the firm, level supporting surface the entire machine and structure sits on or an arbitrary but easily distinguished physical feature selected by the manufacturer. See Figure 6. For those machines supplied without a crawler, rubber-tired, or pedestal mounting, it is the responsibility of the manufacturer to select and define the ground reference plane.

3.5 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.

3.6 HYDRAULIC LIFT CAPACITY

The load that can be supported from the lift point at a specific lift point position by applying working circuit pressure to any cylinder(s) without exceeding holding circuit pressure in any other circuit.

3.7 LIFT POINT

The location on the attachment specified by the manufacturer, to which a load may be attached for lifting purposes.

NOTE: If more than one lift point is provided, the one having the greatest lift point radius shall be used for determining lift capacities. See Figures 1 through 6. The lift point's location shall be identified on the rated capacity chart.

3.8 LIFT POINT HEIGHT

The vertical distance from the ground reference plane to the lift point. See Figures 1 through 6.

3.9 LIFT POINT POSITION

The location of the lift point as defined by the lift point height and radius.

3.10 LIFT POINT RADIUS

The horizontal distance from the axis of rotation to the lift point. See Figures 1 through 6.

3.11 LOAD

The external weight including the weight of the grapple, processing head, and attaching equipment, (kilograms) applied at the lift point.

3.12 MAXIMUM RADIUS (RATED) LIFT CAPACITY

The lift capacity, determined in the same manner as the (rated) lift capacity, except that the lift point position is at the maximum radius for a given lift point height.

3.13 MINIMUM RADIUS (RATED) LIFT CAPACITY

The lift capacity determined in the same manner as the (rated) lift capacity, except that the lift point position is at the minimum radius for a given lift point height.

3.14 RATED HYDRAULIC LIFT CAPACITY

87% of the lesser of the hydraulic lift capacities at a specific lift point position.

3.15 RATED LIFT CAPACITY

The smaller of either the rated tipping lift capacity or rated hydraulic lift capacity.

3.16 RATED TIPPING LIFT CAPACITY

75% of the tipping load at the specific lift point position.

3.17 TIPPING LINE

A theoretical line about which the machine is assumed to tip. In most instances, the tipping line moves as increased tipping occurs.

NOTE: For calculation purposes, the tipping line is assumed fixed relative to the machine. See Figures 1 through 6.

3.18 TIPPING LIFT CAPACITY

The load that can be supported from the lift point at a specific lift point position with the machine at its balance point.

3.19 WORKING CIRCUIT PRESSURE

The nominal pressure produced in the specific circuit by resistance to flow from the pump(s).

4. LIFT CAPACITY CALCULATIONS

4.1 Machine Configuration for Calculations

4.1.1 Operating Mass

The mass of the base machine with standard equipment, or equipment specified by the manufacturer, operator (75 kg), full fuel tank, full lubricating, hydraulic, and cooling systems. The weight of grapples and forestry processing heads shall not be included in the operating mass.

4.1.2 Permissible Variations

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%.

4.1.3 Machine configuration for calculations

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

4.1.3.2 For machines equipped with oscillating axles, the axle(s) shall be positioned perpendicular to the longitudinal axis of the machine.

4.2 Hydraulic Load Calculations

At various lift point positions, to determine the load that can be supported at the lift point by the force generated by each hydraulic cylinder(s). Sufficient lift point positions shall be considered to develop the rated lift capacity chart throughout the machines operating range as defined in 5.3.

4.3 Tipping Load Calculations

At various lift point positions, to determine the load required to achieve the balance point as defined in 3.2. Lift point positions shall encompass those that are over both the ends and sides of the machine. Sufficient lift point positions shall be considered to develop the rated lift capacity chart throughout the machines operating range as defined in 5.3. Over-end tipping may be either over the front and/or over the rear of the machine; but shall be defined and identified by the manufacturer. For the purposes of this document, the two over-side tipping conditions are assumed to be equal. The over-side tipping calculations shall be done in the least stable condition.

4.4 Over-End Tipping

The tipping line to be used for balance point calculations over the front and rear of crawler-mounted machines shall be the centerline of the support idlers or drive sprockets. See Figure 1. The rear of the crawler mount is the end that contains the drive sprocket. The front of the crawler mount contains the support idler. The tipping line to be used for calculations over the front and rear of rubber-tired mounted machines shall be the axle centerline, bogie axle centerline, or the centerline of the outrigger pads as shown in Figures 2 through 5. For machines equipped with outriggers, the calculations shall be developed for the outriggers fully applied in the manufacturers' recommended position and also with the outriggers fully retracted. See 4.6 and Figures 2, 4, and 5.

4.5 Over-Side Tipping

The tipping line to be used for balance point calculations over the side of crawler-mounted machines shall be the theoretical tipping point between the support rollers and the track links as shown in Figure 7. The tipping line to be used for balance point calculations over the side of rubber-tired mounted machines shall be the distance to the centerline of the tires at the ground reference plane, the midpoint between dual tires at the ground reference plane, or the tipping line of outrigger pads as defined in 4.6. See Figures 2, 4, 5, and 8. For machines equipped with outriggers, calculations shall be developed for the outriggers fully applied in the manufacturers' recommended position and also with the outriggers fully retracted. For calculations with the outriggers fully applied, the rubber-tired mounting shall be free of the ground with the machine fully supported by the outriggers. See Figure 2. For calculations with the outriggers fully retracted, the tipping line shall be defined through the wheel tipping line.

4.6 Outrigger Pads

When defined through oscillating, (ball and socket), or pivoting outrigger pads, the tipping line shall be at the ground reference plane directly below the centerlines of the outrigger pad oscillation points or pivots. When defined through rigid outrigger pads, the tipping line shall be at the ground reference plane throughout the centroids of the pad ground contact areas. See Figures 2, 4, and 5.

4.7 Blades

For machines equipped with dozer or back-fill blades, the blade may be used to increase the over-front and over-side tipping capability of the machine. The tipping line is the intersection of the blade and the ground reference plane. See Figure 3. When the blade is used to increase the machine's tipping capability, the manufacturer shall ensure that the blades hydraulic system and its structural integrity are sufficient to withstand the loads imposed by the tipping condition. For machines equipped with blades, calculations shall be developed with and without the influence of the blade.

4.8 Pedestal-Mounted Machines

For pedestal- or stationary-mounted machines where tipping conditions do not exist, the manufacturer shall ensure that the structural integrity of the machine is sufficient to withstand the calculated hydraulic lift capacities. Derating the lift capacity chart to compensate for structural inadequacies is not permissible.

4.9 Machines Without Mountings

For machines supplied without mountings, such as trailer-mounted and truck-mounted log loaders and for loaders that are to be pedestal mounted by a third party, the manufacturer shall base the lift capacities solely on the machines hydraulic capacity. The provisions of 4.8 shall apply.

5. RATED LIFT CAPACITY CHART

5.1 The rated lift capacity chart shall show the rated lift capacity at specific lift point positions. The chart shall note if the values are limited by hydraulic lift capacity.

5.2 Two acceptable formats for the rated lift capacity chart are shown in Figures 9 and 10.

5.3 Rated lift capacity values shall be tabulated for intersections of the lift point with 1.5 m or 3.0 m vertically and horizontally spaced grid placed over the machine's operating range. The maximum and minimum lift radii may also be included even though not located at a grid point. The origin of the grid shall be at the intersection of the ground reference plane and the axis of rotation. Rated lift capacity values shall be stated to the nearest 50 kg.

5.4 Due to the wide variety of field-operating conditions, rated lift capacity charts need not be placed in the operator's cab of log loaders, forwarders, feller bunchers, and other forestry equipment. For machines supplied without mountings, the manufacturer's rated lift capacity chart shall be based solely on the machine's hydraulic capacity. It is at the manufacturer's discretion to include the lift capacities at maximum and minimum lift point radius on the lift capacity chart.

5.5 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. See Figures 9 and 10.

5.6 A rated lift capacity chart is required for each machine variation in which any one rated lift capacity value differs by more than 5% from the corresponding value on an existing chart.

6. NOTES

6.1 Marginal Indicia

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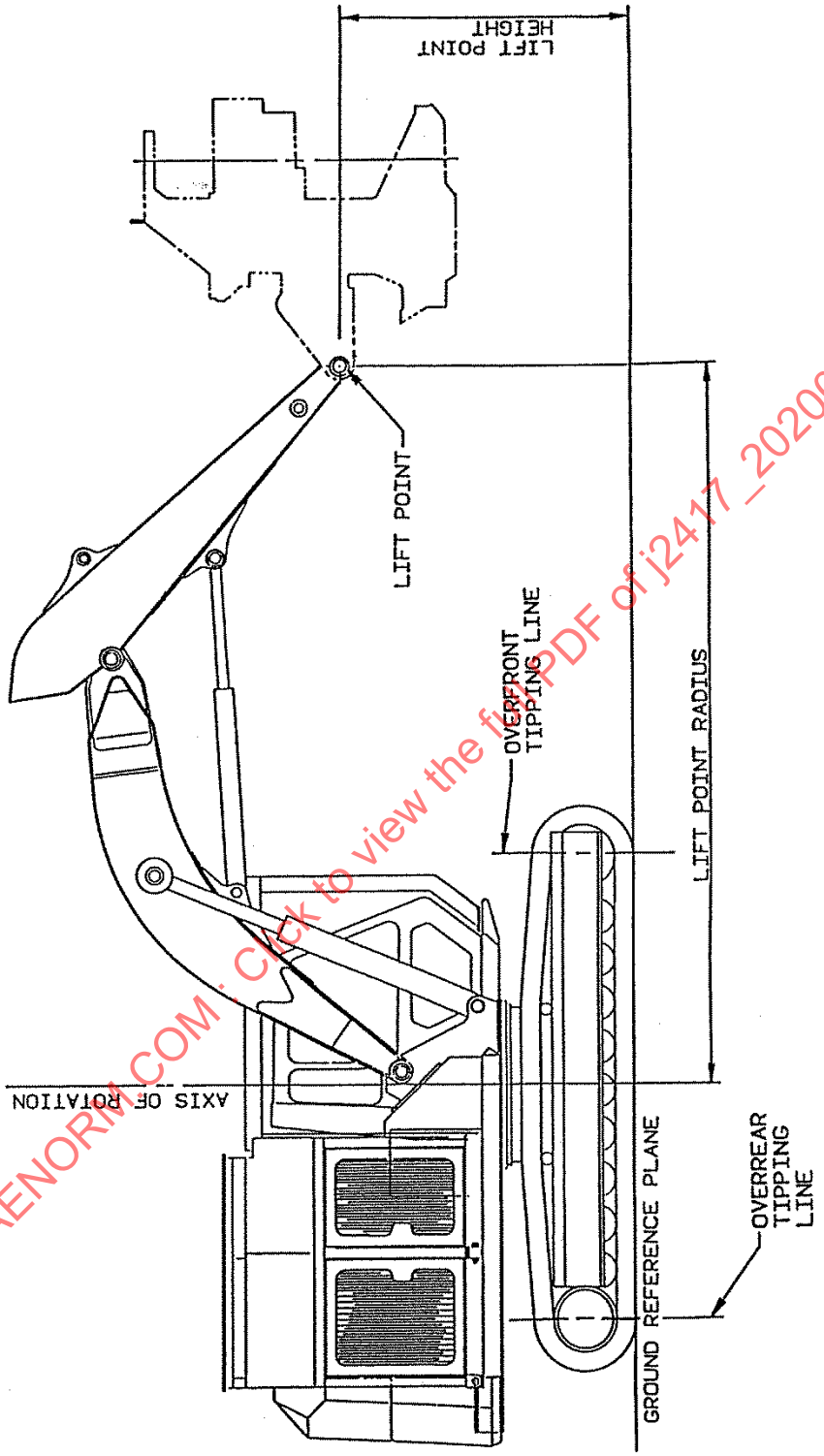

FIGURE 1 - CRAWLER-MOUNTED FELLER BUNCHER

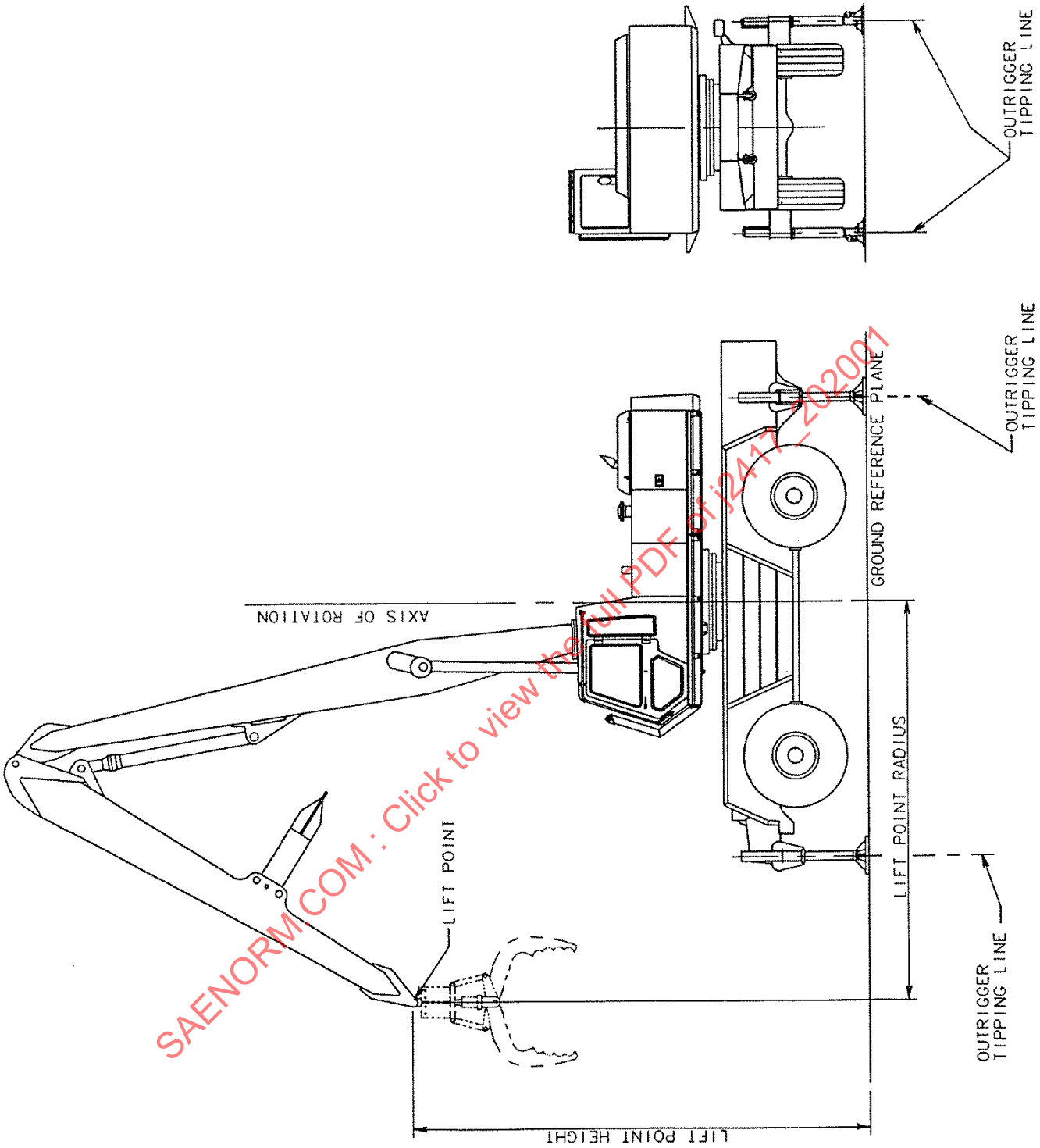

FIGURE 2 - WHEEL-MOUNTED LOG LOADER

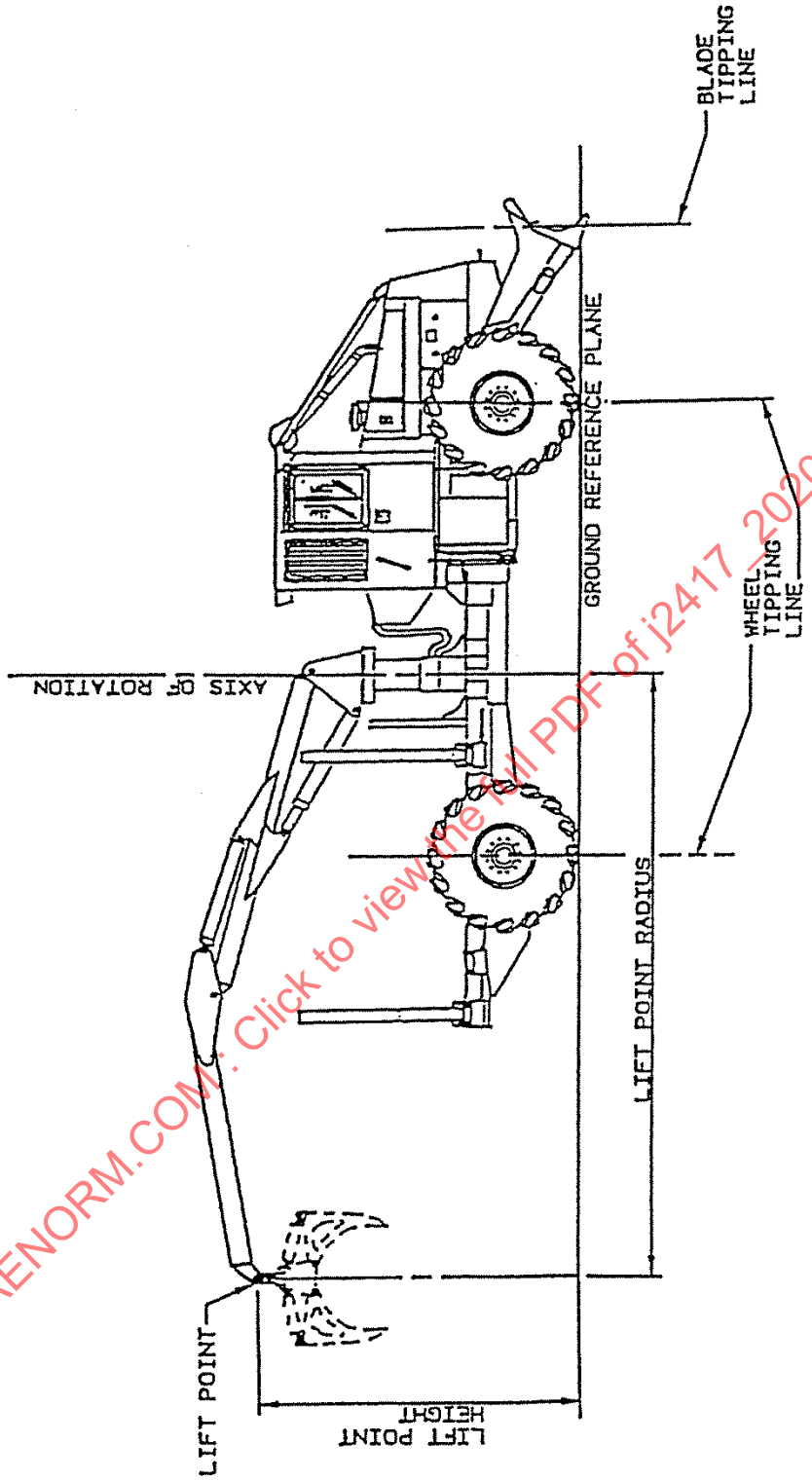

FIGURE 3 - WHEEL-MOUNTED FORWARDER

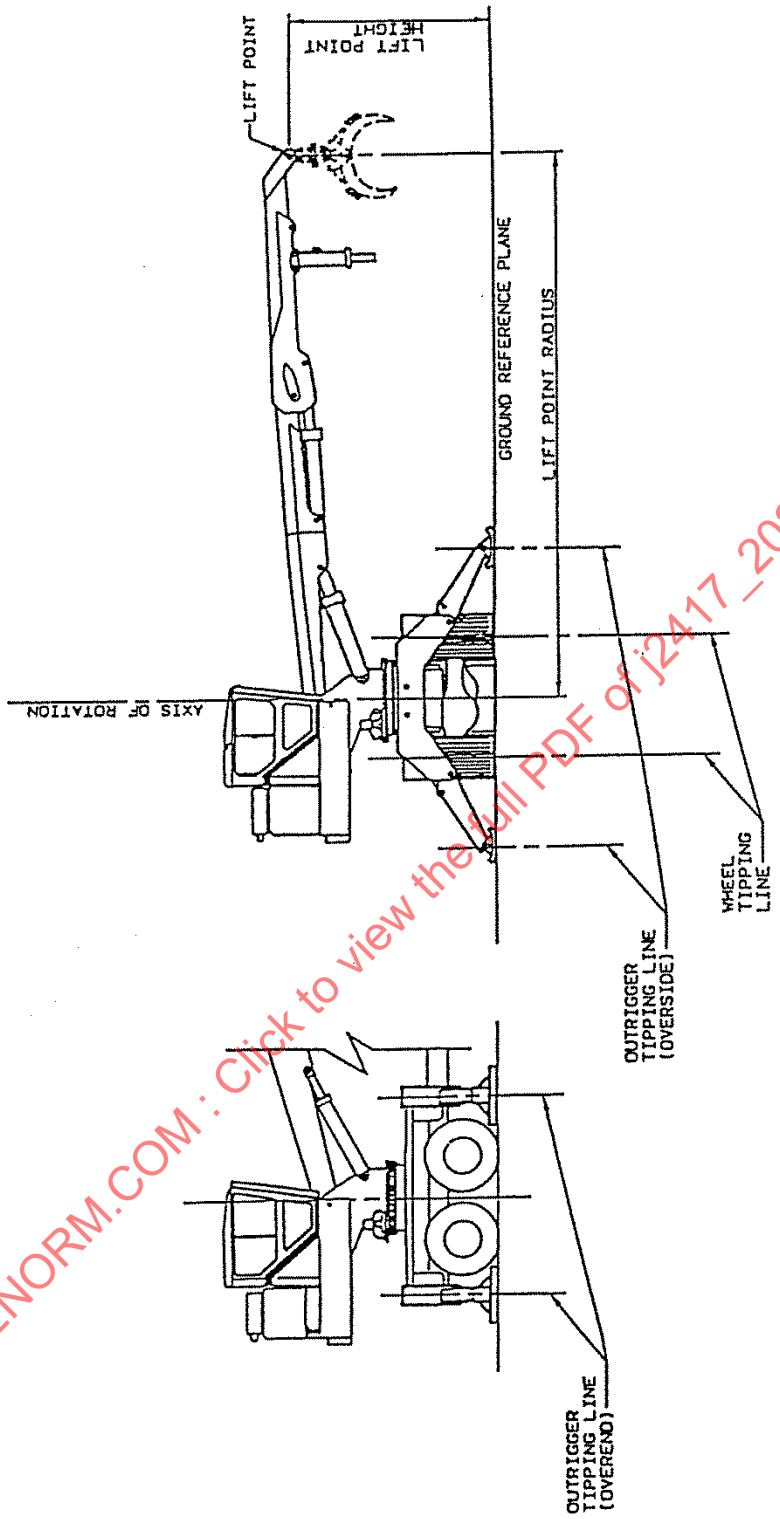

FIGURE 4 - TRUCK/TRAILER-MOUNTED LOG LOADER

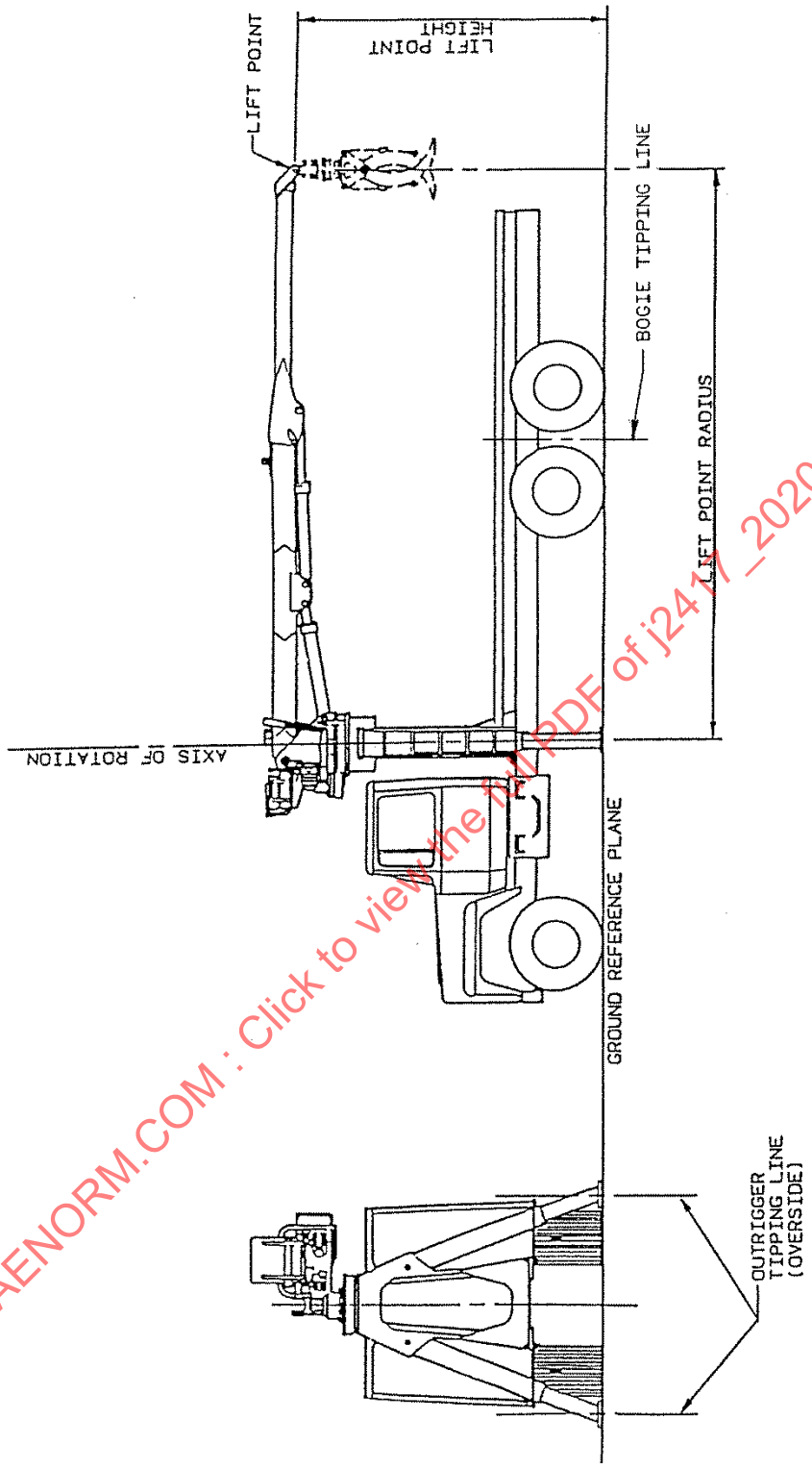

FIGURE 5 - BEHIND THE CAB KNUCKLE-BOOM LOG LOADER

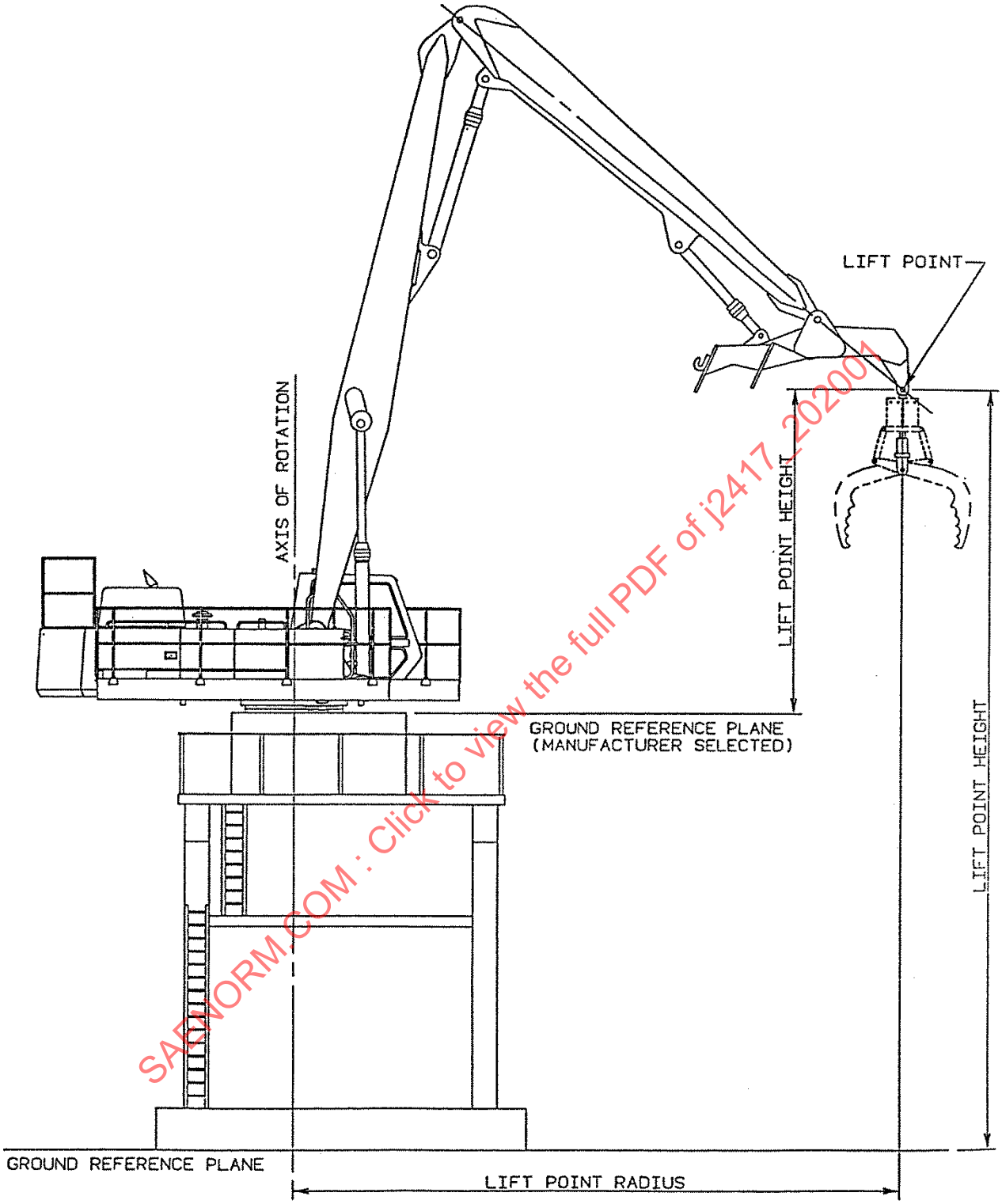

FIGURE 6 - PEDESTAL-MOUNTED LOG LOADER