SAE International™

SURFACE VEHICLE STANDARD

SAE J2518

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Lift Capacity Calculation Method Scrap and Material Handlers

1. ***Scope—***This SAE Standard provides a uniform method to calculate the lift capacity of scrap and material handlers, establishes definitions and specifies machine conditions for the calculations. This document applies to scrap and material handlers as defined in SAE J2506 that have a 360 degrees continuous rotating upper structure. It does not apply to equipment that is incapable of lifting a load completely off the ground. This document applies to those machines that are crawler, wheel, rail and pedestal or stationary mounted.

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

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.

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 issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2506—Material Handler Nomenclature

2.2 **Related Publications—**The following publications are provided for information purposes only and are not a required part of this specification.

2.2.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2417—Lift Capacity Calculation Method—Knuckle Boom Log Loaders and Certain Forestry Equipment

2.2.2 ASME PUBLICATION—Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900.

ASME B30.25, Scrap and Materials Handlers

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2.2.3 ISO PUBLICATION—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

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

3. Definitions

3.1 Attachment—The magnet or grapple that is affixed to the second or third member of a front.

3.2 Balance Point—The theoretical location on the machine at which the forward moment produced by the front, attachment and load is equal to the rearward moment produced by the weight of the machine.

3.3 Front—That portion of the machine that is unique and dedicated to the machine's primary purpose, i.e., scrap and material handling. The front, depending upon the type of machine, may also be called working equipment, boom set or front linkage. The front consists of two or three structural members actuated by hydraulic cylinders that are affixed to the upper structure.

3.4 Ground Reference Plane—For crawler, rail and wheel mounted machines the ground reference plane is that firm level supporting surface that the machine sits on, See Figures 1 through 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 5. For those machines supplied without a crawler, wheel, rail 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 front specified by the manufacturer, to which a load may be attached for lifting purposes. Normally the magnet or grapple pivot on the second or third member is the lift point. 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 5. The lift point's location shall be identified on the rated lift capacity chart.

3.8 Lift Point Height—The vertical distance from the ground reference plane to the lift point. See Figures 1 through 5.

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 5.

3.11 Load—The external weight that includes the weight of the grapple or magnet 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.

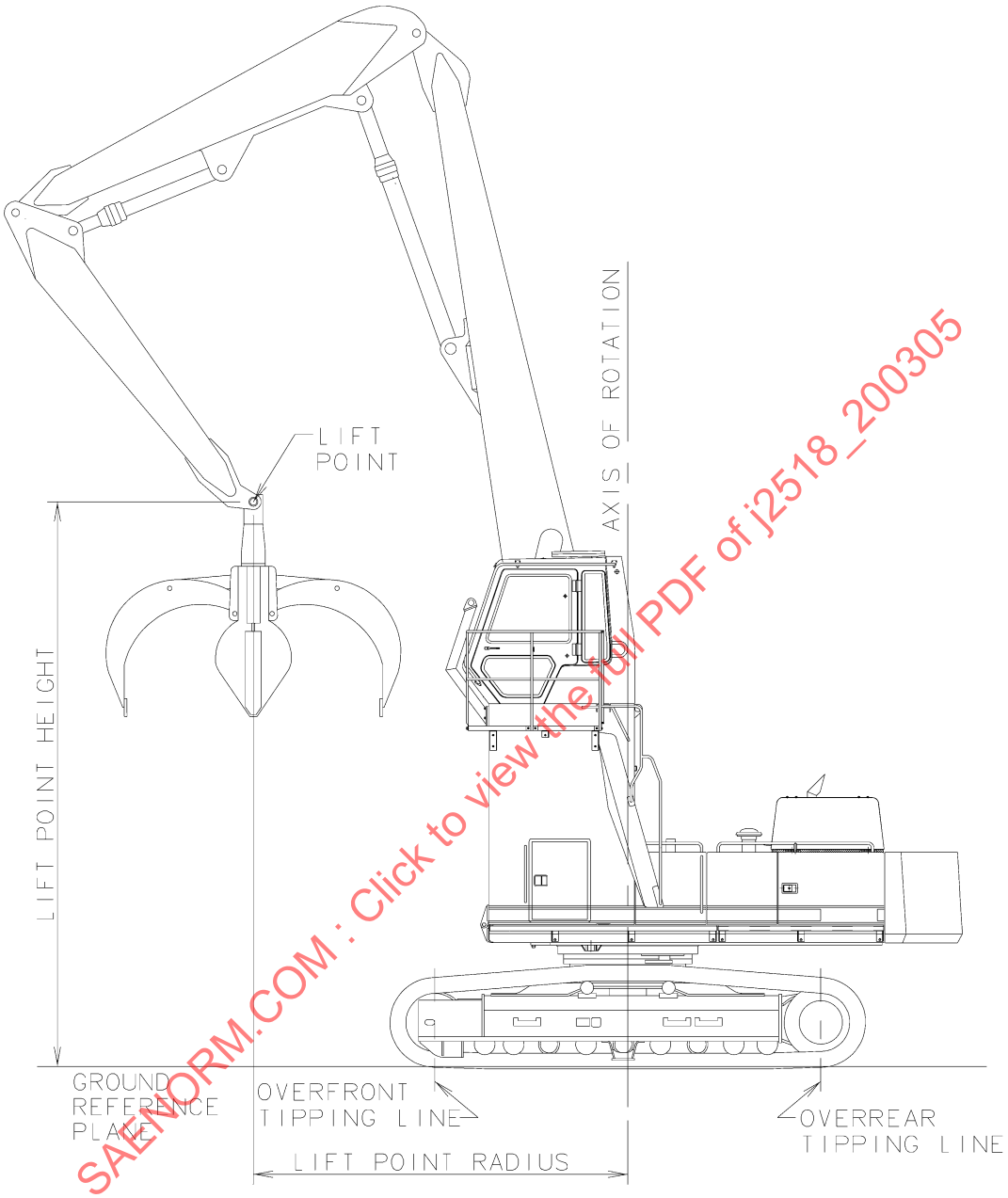

FIGURE 1—CRAWLER MOUNTED HANDLER

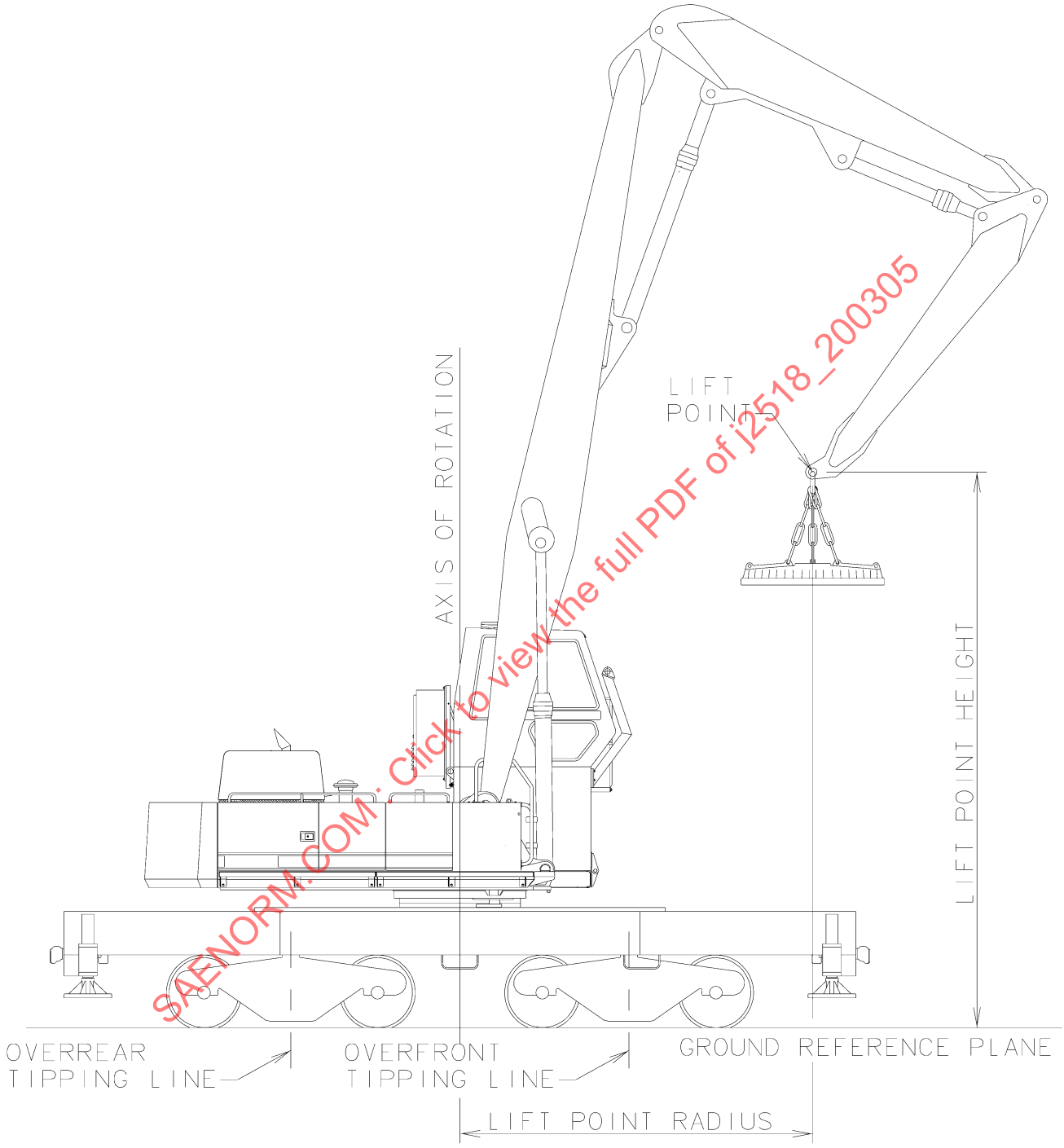

FIGURE 2—RAIL MOUNTED HANDLER

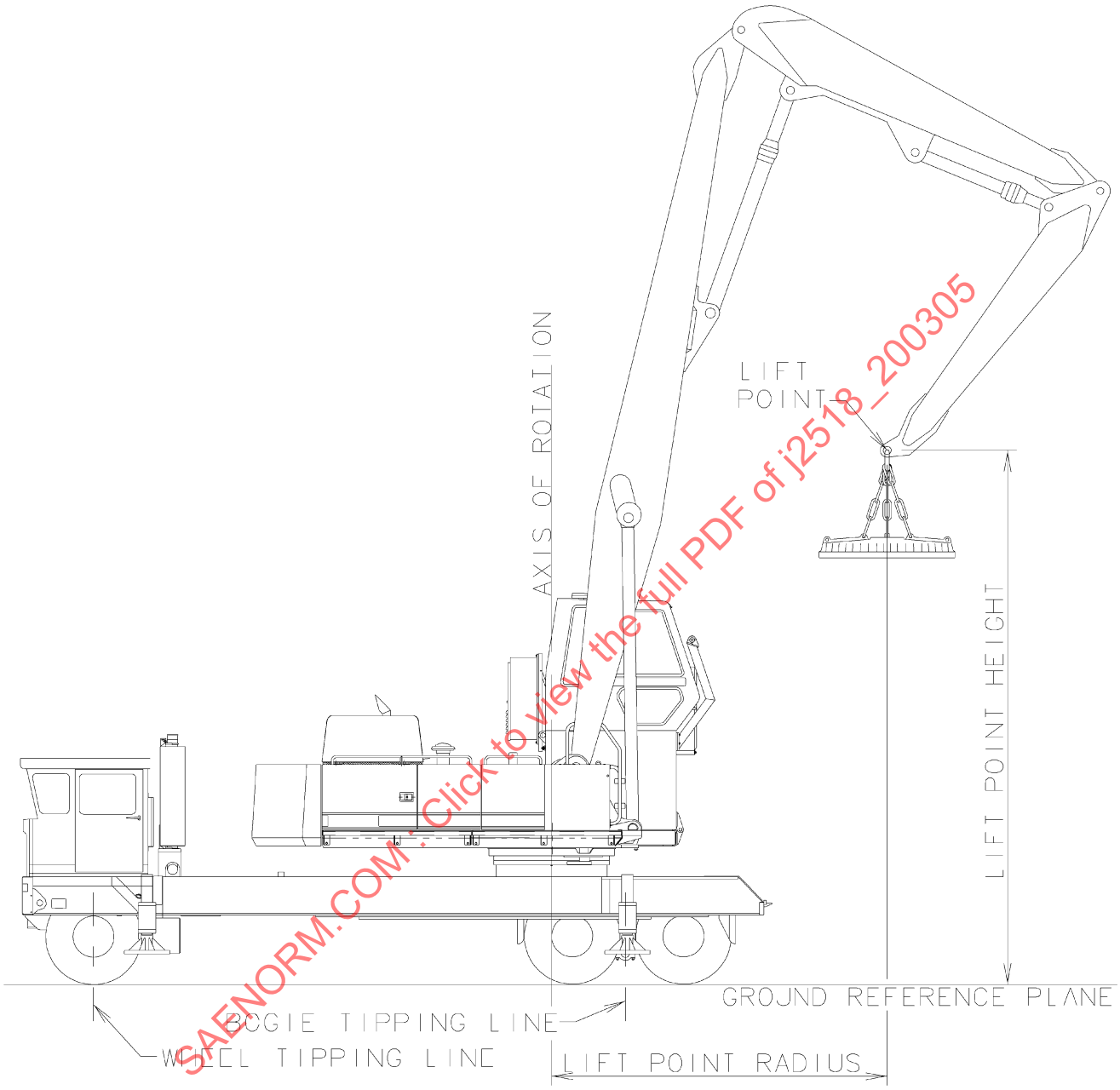

FIGURE 3—WHEEL-MOUNTED HANDLER

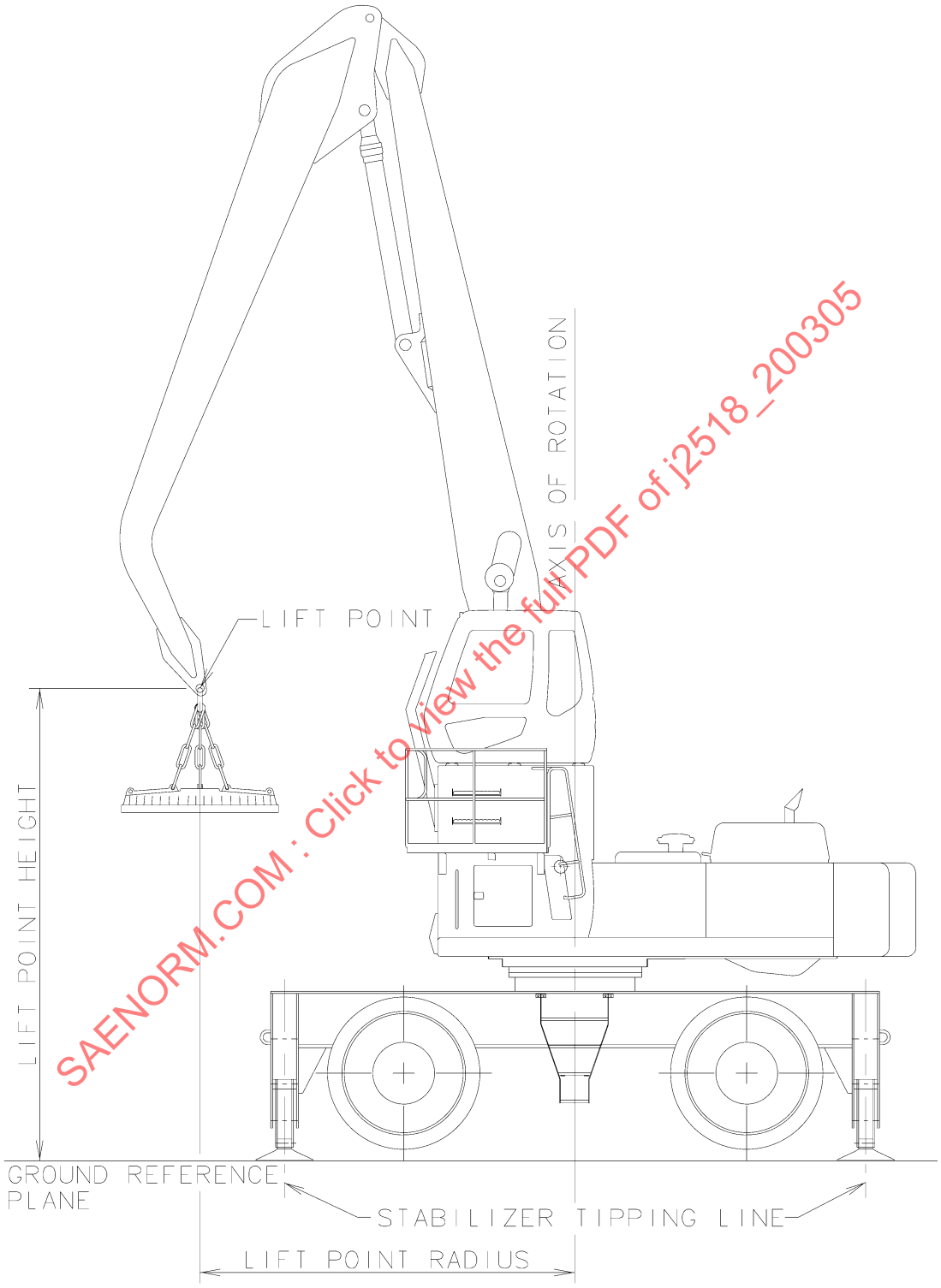

FIGURE 4—WHEEL MOUNTED HANDLER

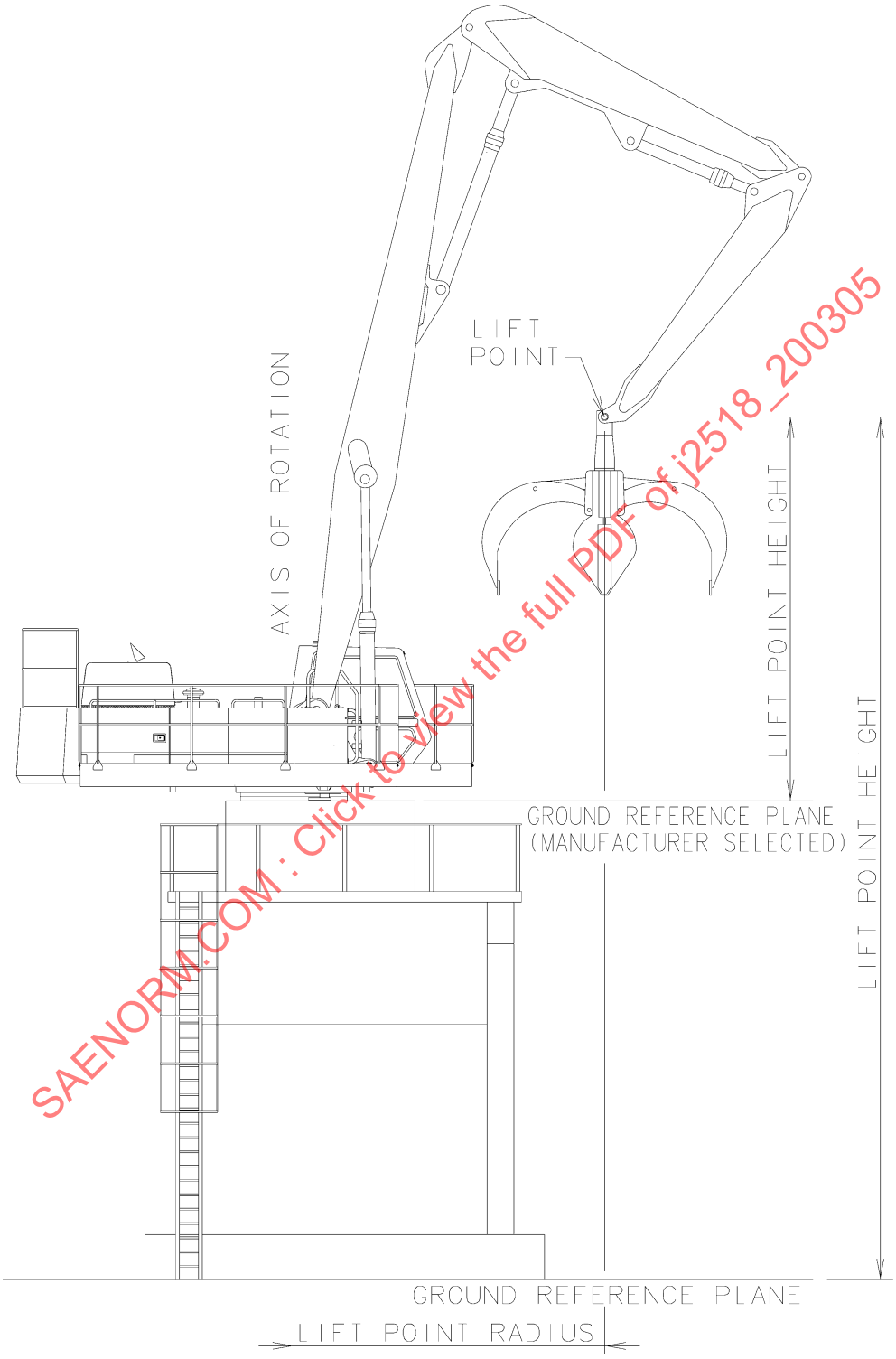

FIGURE 5—PEDESTAL MOUNTED HANDLER

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 for crawler and wheel mounted handlers. For rail mounted handlers without stabilizers fully extended 80% of the tipping load shall be used.

3.17 Tipping Line—A theoretical line about which the machine is assumed to tip. In most instances the tipping line will move as increased tipping occurs. For calculation purposes, the tipping line is assumed fixed relative to the machine. See Figures 1 through 4, 6, 7 and 8.

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 as specified by the manufacturer, operator (75 kg), full fuel tank, full lubricating, hydraulic and cooling systems. The weight of grapples, magnets and other auxiliary equipment, will not be included in the operating mass.

4.1.2 PERMISSIBLE VARIATIONS—Because of the large number of front 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%.

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

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

4.2 Hydraulic Load Calculations—A series of 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 will be considered to develop the rated lift capacity chart throughout the machines operating range as defined in 5.3.

4.3 Tipping Load Calculations—A series of calculations at various lift point positions, to determine the load required to achieve the balance point as defined in 3.2. Lift point positions will encompass those that are over both the ends and sides of the machine. Sufficient lift point positions will 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 standard 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/or rear of crawler mounted machines shall be the centerline of the line to be used for calculations over the front and/or rear of wheel and rail mounted machines shall be the axle centerline, bogie axle centerline, or the centerline of the stabilizer pads as shown in Figures 2 through 4. For machines equipped with stabilizers the calculations shall be developed for the stabilizers fully applied in the manufacturer's recommended position and also with the stabilizers fully retracted. See 4.6 and Figure 4.

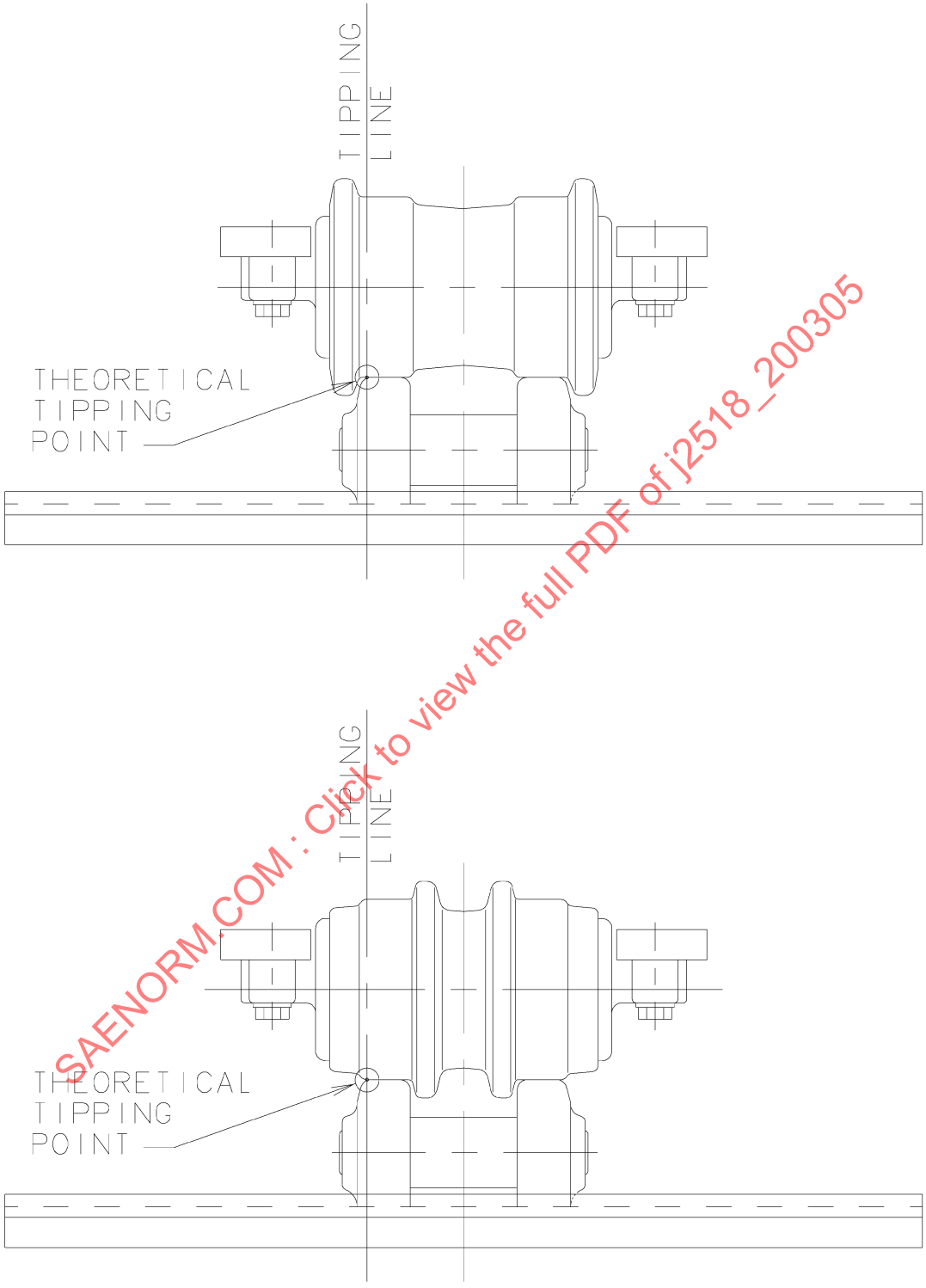

FIGURE 6—TIPPING LINE
CRAWLER MOUNTED MACHINES

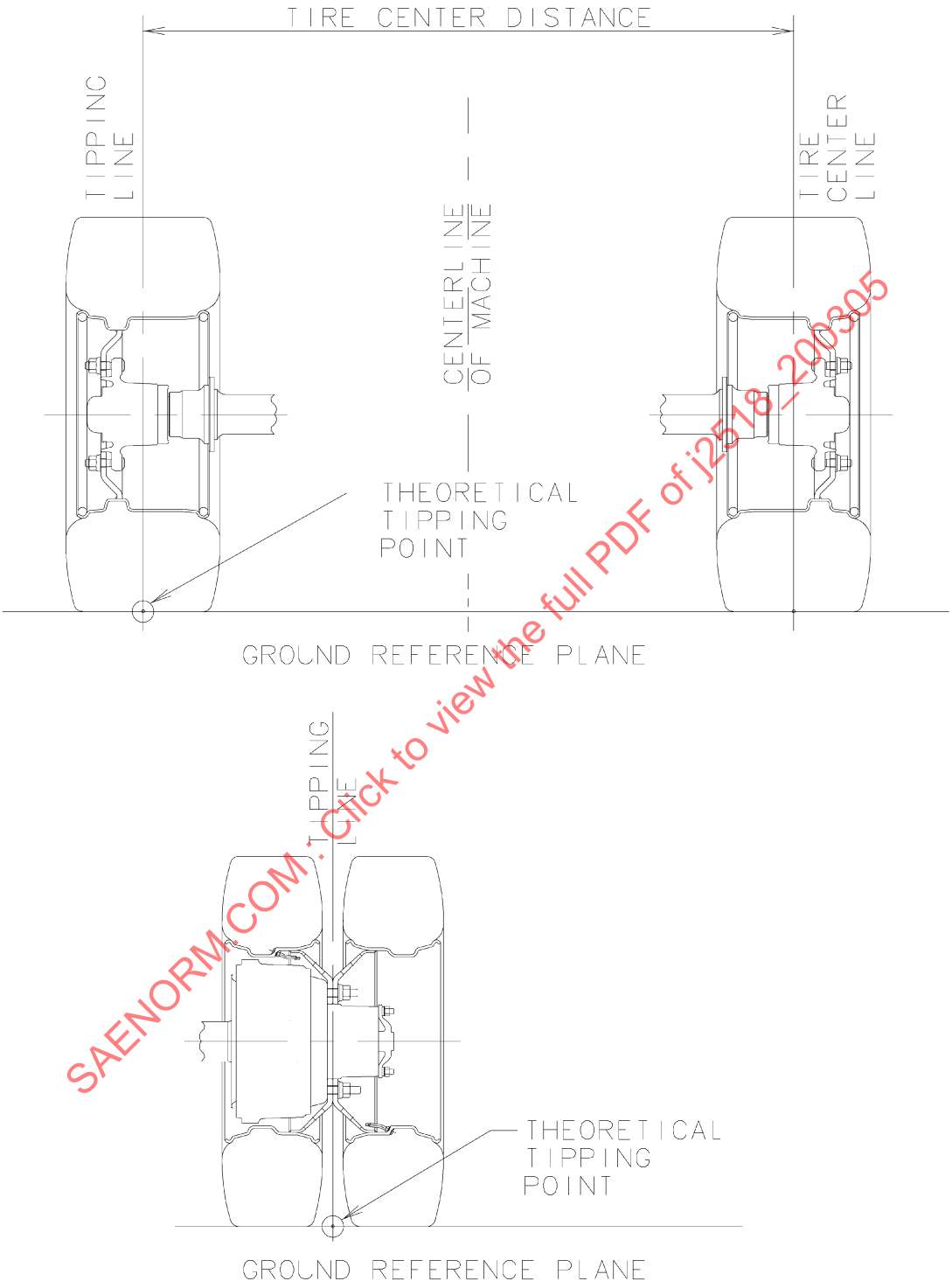

FIGURE 7—SIDE TIPPING LINE
RUBBER TIRE MOUNTED MACHINES

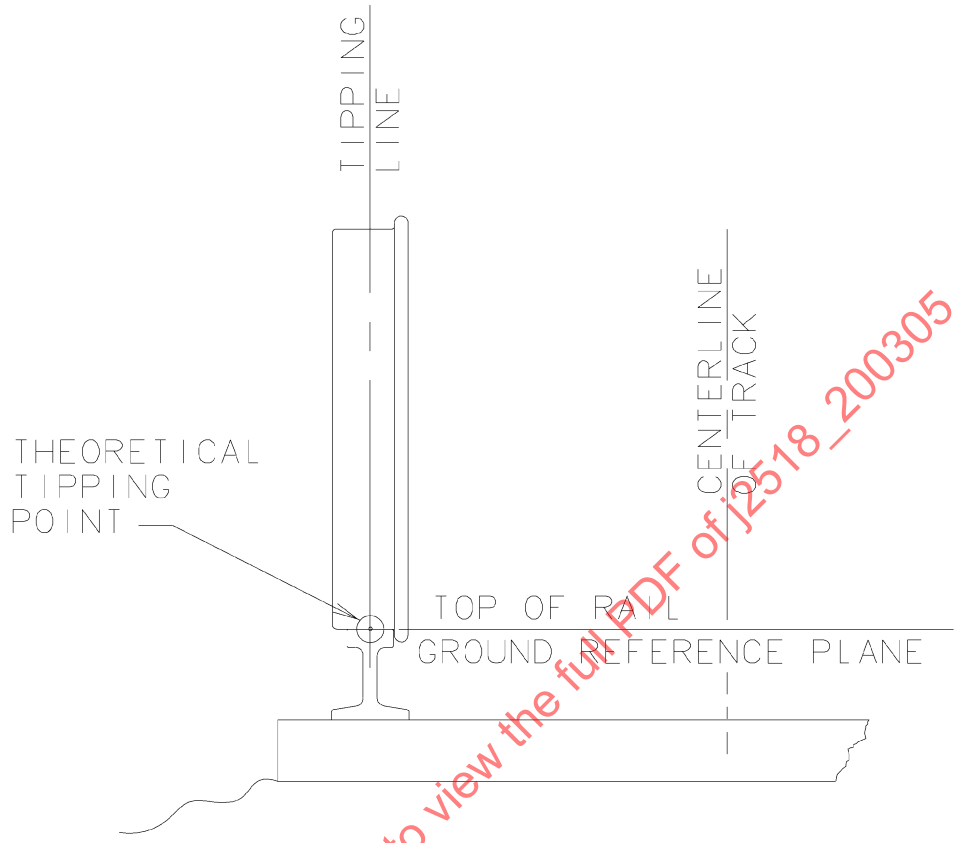

FIGURE 8—SIDE TIPPING LINE
RAIL MOUNTED MACHINES

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 6. The tipping line to be used for balance point calculations over the side of wheel and rail mounted machines shall be the distance to the center line of the wheels at the ground reference plane, the midpoint between dual wheels at the ground reference plane or the tipping line of stabilizer pads as defined in 4.6. See Figures 7 and 8. For machines equipped with stabilizers calculations shall be developed for the stabilizers fully applied in the manufacturers' recommended position and also with the stabilizers fully retracted. For calculations with the stabilizers fully applied the wheel mounting will be free of the ground with the machine fully supported by the stabilizers. See Figure 4. For calculations with the stabilizers fully retracted the tipping line will be defined through the wheel tipping line.

4.6 Stabilizer Pads—When defined through oscillating, (ball and socket), or pivoting stabilizer pads, the tipping line shall be at the ground reference plane directly below the centerlines of the stabilizer pad oscillation points or pivots. When defined through rigid stabilizer pads the tipping line shall be at the ground reference plane through the centroids of the pad ground contact areas.

4.7 Pedestal Mounted Machines—For pedestal or stationary mounted machines where tipping conditions do not exist the manufacturer will 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.

4.8 **Three Piece Fronts—**For three piece fronts there is no unique orientation of the primary structural members for each lift point location as there is for two piece fronts. For a three piece front an infinite number of orientations of the boom, arm and jib are possible for each lift point position. In these cases it is necessary to perform iterative repetitive calculations to determine a set of all lift capacities possible for hydraulic and tipping capacities. From this set of calculations the largest value obtained is selected for each of the hydraulic and tipping capacities. The final or selected hydraulic and tipping lift capacities are then compared and the rated lift capacity determined.

4.9 **Wheel Mounted Machines—**For wheel mounted machines, without the stabilizers engaged, the manufacturer will ensure that the structural integrity of the tires, either pneumatic, foam filled or solid, is sufficient to withstand the calculated lift capacities. Derating the lift capacity chart to compensate for tire inadequacies is not permissible.

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 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 must state on the lift capacity chart that the capacities are with or without this feature. See Figures 9 and 10.

5.6 For machines equipped with multiple work modes the manufacturer must state on the lift capacity chart which work mode has been used.

5.7 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.

5.8 The lift capacity chart shall be placed in a location accessible to the operator while at the controls.