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Front End Loader Bucket Rating — SAE J742b

SAE STANDARD
EDITORIAL CHANGE JUNE 1975

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SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
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Report of Construction and Industrial Machinery
Technical Committee approved May 1957 and last revised
March 1969. Editorial change June 1975.

1. This standard describes a method for determining the average volume of an average material carried by the bucket of a front end loader. The calculations used result in a realistically conservative heaped volume. They are based on physical dimensions of the bucket only without regard to bucket action provided by any specific machine. It has been determined that for rating purposes, a nominal heaped load will have a 2:1 angle of repose when the bucket is oriented as shown in Figs. 1 and 2. This in no way implies that the loader linkage must carry the bucket oriented in this attitude, or that all materials will naturally have a 2:1 angle of repose.

2. Rated capacity shall be expressed in cubic metres (cubic yards) for all sizes 0.57m^3 ($3/4$ cu yd) or over, and in cubic metres (cubic feet) for all sizes under 0.57m^3 ($3/4$ cu yd). It shall be stated as the "SAE Rating (Nominally Heaped)".

3. Rated capacities shall be stated in intervals of 0.03m^3 (1 cu ft) for buckets under 0.57m^3 ($3/4$ cu yd), 0.10m^3 ($1/8$ cu yd) for buckets from 0.57m^3 ($3/4$ cu yd) to 2.29m^3 (3 cu yd), and 0.18m^3 ($1/4$ cu yd) for buckets over 2.29m^3 (3 cu yd).

4. Measurements and calculations are outlined in the figs. 1 and 2. All linear measurements are millimetres (inches) and the resulting volumes are in cubic millimetres (cubic inches). These are to be converted to cubic metres (cubic feet or yards) as specified above. If the calculated value falls below a given rating interval by more than 2% the next lowest interval shall be deemed to be the rating.

EXAMPLE:

A calculated value 1.49m^3 (1.95 cu yd) is under 1.53m^3 (2 cu yd) by more than 2%, and therefore, the proper rating on the basis of the measurements and calculations is 1.43m^3 ($1-7/8$ cu yd).

5. To determine the rated capacity it is necessary to first determine the struck capacity. It is defined as the volume of

material retained in the bucket after a heaped load is struck by drawing a straight edge across the width of the bucket with one end of the straight edge resting on the cutting edge and the other end resting on the uppermost portion of the bucket back sheet or spill guard. (See SAE J731). For buckets with spill guards the struck capacity can be expressed by the following equation:

$$V_s = AW - \frac{2}{3} a^2 b$$

where

A=cross sectional area at the center of the bucket, mm^2 (in^2).

W=average inside width of the bucket, mm (in).

a=height of the spill guard at the center of the bucket normal to the strike line, mm (in).

b=length of opening at the center of the bucket, mm (in).

For buckets without spill guards, the struck capacity is expressed as follows:

$$V' = A'W$$

where:

A'=cross sectional area at the center of the bucket, mm^2 (in^2).

If struck capacity is shown in addition to the SAE rating, it should be shown decimally to three significant figures.

NOTE: Where the terms A or A' occur, they may be determined on an accurately drawn layout by use of a planimeter or by accurately cutting a template to fit the bucket profile. The template must be placed in a plane normal to the bucket back sheet and equidistant from corresponding points of the bucket side sheets.

6. Using the 2:1 angle of repose of the heaped material, the rated capacity is expressed as follows:

$$V_r = V_s + \frac{b^2 W}{8} \frac{b^2}{6} (a + c)$$

where c is the length on a normal to the strike line. On one end it is terminated by the assumed crest of the material. On

the other end it is terminated by the intersection with a line from the bit or cutting edge tip to the base of the spill guard.

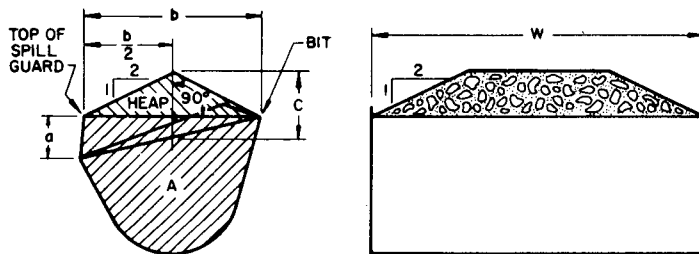
For buckets without spill guards, the rated capacity is expressed as follows:

$$V_r = V_s + \frac{b^2 W}{8} - \frac{b^3}{24}$$

7. This method applies primarily to

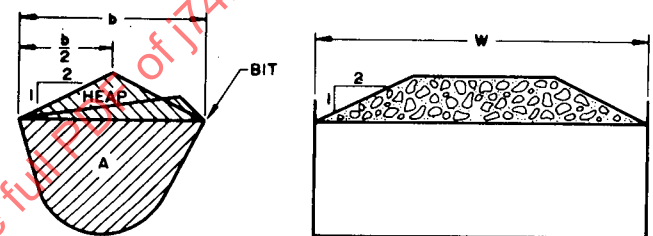
regular buckets have parallel sides and a cutting edge parallel to the edge of the spill guard or back sheet. Moderately clipped spill guard corners will introduce no appreciable errors.

8. The addition of any auxiliary guard to protect against spillage of material which might injure the operator will not be included in bucket capacity calculations. It is recommended that such a guard be of "see through" construction.



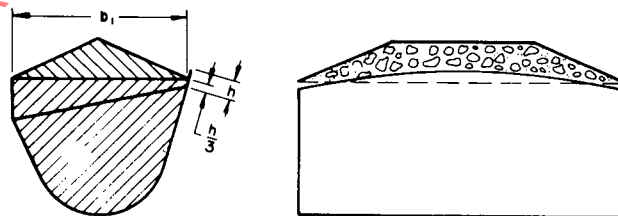
AVERAGE BUCKET INSIDE WIDTH = W
 PLANIMETER AREA A
 BUCKET CAPACITY WITH 2:1 ANGLE OF REPOSE
 STRUCK CAPACITY $V_s = AW - \frac{2}{3} \cdot \frac{a^2 b}{2}$
 RATED CAPACITY $V_r = V_s + \frac{b^2 W}{8} - \frac{b^3}{24} (a+c)$

FIG. 1 - RATED BUCKET CAPACITY FOR BUCKETS WITH SPILL GUARDS



AVERAGE BUCKET INSIDE WIDTH = W
 PLANIMETER AREA A
 BUCKET CAPACITY WITH 2:1 ANGLE OF REPOSE
 STRUCK CAPACITY $V_s = AW$
 RATED CAPACITY $V_r = V_s + \frac{b^2 W}{8} - \frac{b^3}{24}$

FIG. 2 - RATED BUCKET CAPACITY FOR BUCKETS WITHOUT SPILL GUARDS



h = DISTANCE FROM SIDE CUTTING BARS TO FORWARD POINT OF CUTTING EDGE.

BUCKET CALCULATIONS MADE AS IN FIGURES 1 AND 2 WITH CENTER CROSS SECTION AREA CORRECTED FOR IRREGULAR CUTTING EDGE AS SHOWN, THUS:

$$V_r = V_s + \frac{b_1^2 W}{8} - \frac{b_1^3}{24} (a+c) \text{ OR } V_r = V_s + \frac{b_1^2 W}{8} - \frac{b_1^3}{24}$$

THIS METHOD IS NOT ALTERED FOR OTHER SIMILAR SHAPES SUCH AS A MORE POINTED CUTTING EDGE.

FIG. 3 - RATED BUCKET CAPACITY FOR BUCKETS WITH IRREGULAR SHAPED CUTTING EDGES