

Submitted for recognition as an American National Standard

(R) HYDRAULIC EXCAVATOR AND BACKHOE DIGGING FORCES

1. **Scope**—This document applies to all hydraulic excavators and backhoes that are either crawler mounted or rubber tire mounted, with or without outrigger members, identified in SAE J1116 as earthmoving machines and defined in SAE J1057.
- 1.1 **Purpose**—This document is to provide a uniform method of determining digging forces for hydraulic excavators and backhoes.
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.
- SAE J1057 SEP88—Identification Terminology of Earthmoving Machines
SAE J1116 JUN86—Categories of Off-Road Self-Propelled Work Machines
3. **Definitions**
- 3.1 **Working Circuit Pressure**—That nominal pressure applied to the specific circuit by the pump(s).
- 3.2 **Holding Circuit Pressure**—The maximum static pressure in a specific circuit, limited by a relief valve at a flow no greater than 10% of the circuit rated flow.
- 3.3 **Maximum Digging Forces**—The maximum digging forces are the digging forces that can be exerted at the outermost cutting point. These forces are calculated by applying working circuit pressure to the cylinder(s) providing the digging force without exceeding holding circuit pressure in any other circuit. Weight of components and friction are to be excluded from these force calculations.
- 3.3.1 **MAXIMUM BUCKET TANGENTIAL FORCE**—The maximum bucket tangential force, “V”, Figure 1, is the digging force generated by the bucket cylinder(s) and tangent to the arc of radius “C”, Figure 1. The bucket shall be positioned to obtain the maximum output moment from the bucket cylinder(s) and connecting linkage.

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- 3.3.2 MAXIMUM ARM/DIPPERSTICK FORCE—The maximum arm/dipperstick force, “W”, Figure 2 is the digging force generated by the arm/dipperstick cylinder(s) and tangent to the arc of the radius “B”, Figure 2. The arm/dipperstick shall be positioned to obtain the maximum output moment from the arm/dipperstick cylinder(s) and the bucket positioned as in 3.3.1.
- 3.3.3 MAXIMUM TELESCOPING BOOM CROWD FORCE—The maximum telescoping boom crowd force “U”, Figure 3, is the digging force generated by the telescoping boom cylinder acting on a line parallel to the boom. Force “U” is independent of bucket position. This definition applies to telescoping booms only, not extendable arms/dipperstick.

4. Conditions

- 4.1 Specified bucket linkage configuration must be used unless otherwise noted.
- 4.2 Maximum digging forces will be with the specified bucket.
- 4.3 Adjustable arm/dippersticks must be in the minimum extension position unless otherwise noted.
- 4.4 Published digging forces are to be in Newtons (lb).
- 4.5 Additional digging forces may be specified separately for available buckets or equipment.
- 4.6 The manufacturer must be able to verify published hydraulic digging forces by actual tests. Test values for any new machine must exceed 95% of published digging force values. Boom, arm/dipperstick, and bucket are to be positioned to minimize the effect of component weight on force measurements.

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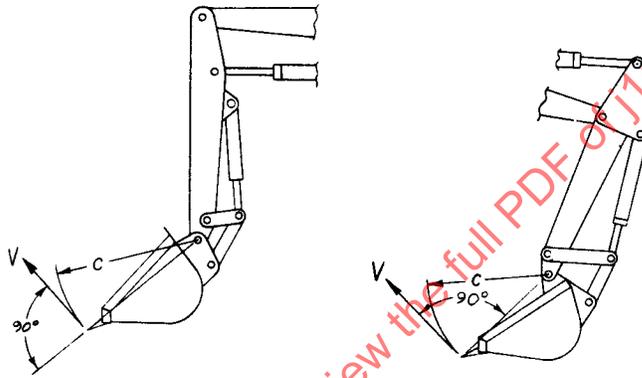
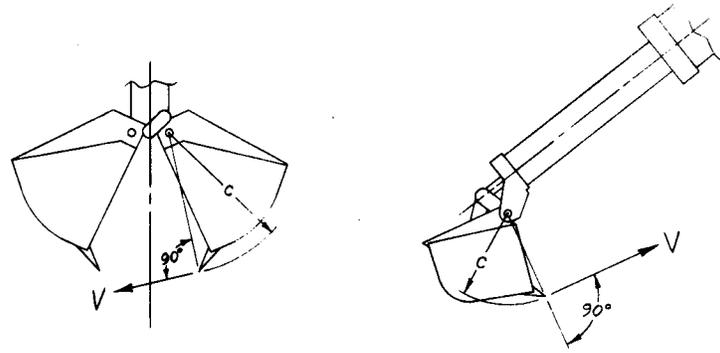


FIGURE 1—MAXIMUM BUCKET TANGENTIAL FORCE

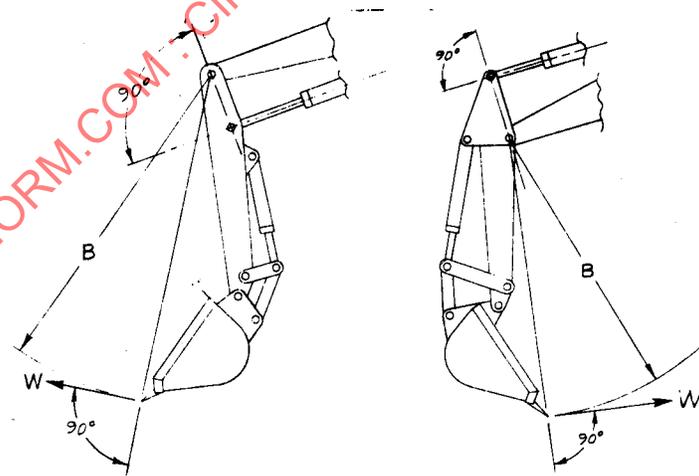


FIGURE 2—MAXIMUM ARM/DIPPERSTICK FORCE

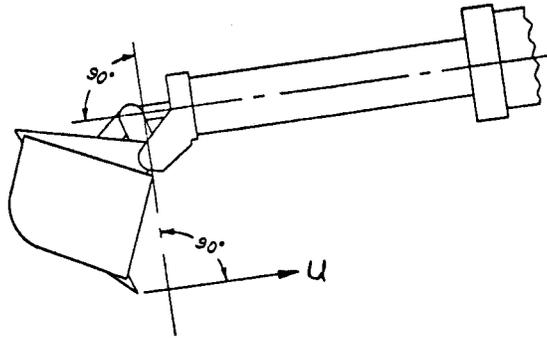


FIGURE 3—MAXIMUM TELESCOPING BOOM CROWD FORCE

5. **Notes**

- 5.1 **Marginal Indicia**—The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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