SAE International™ SURFACE VEHICLE STANDARD

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Swing Performance And Rating Procedure, Material Handlers, Knuckle Boom Log Loaders And Certain Forestry Equipment

1. ***Scope—***This SAE Standard describes a uniform method to calculate and specify swing performance characteristics of material handlers, knuckle boom log loaders, delimbers, feller bunchers, harvesters, processors, and other knuckle boom material handlers. It establishes definitions and specifies machine conditions for calculations and tests. This document applies to knuckle boom log loaders as defined in SAE J1209 and SAE J2055 and to certain forestry equipment defined in SAE J1209 and ISO 6814 that have rotating upper-structures such as feller bunchers, harvesters, processors, and forwarders. Included in the definition of knuckle boom log loaders are behind the cab and rear-mounted log loaders not having their own power supply.

1.1 **Purpose—**The purpose of this SAE Standard is to establish a consistent, repeatable means of determining and specifying the swing performance for the types of equipment contained therein.

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 J745—Hydraulic Power—Pump Test Procedure
SAE J746—Hydraulic Motor Test Procedure
SAE 1209—Identification Terminology of Mobile Forestry Machines
SAE J1349—Engine Power Test Code—Spark Ignition and Compression Ignition Net Power Rating
SAE J2055—Identification Terminology and Component Nomenclature—Knuckle Boom Log Loader

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

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

2.2 **Related Publication—**The following publications is provided for information purposes only and is not a required part of this document.

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

SAE J1371—Hydraulic Excavator Swing Performance and Rating Procedure

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3. *Definitions*

3.1 Swing—The rotation of the upper-structure with respect to the undercarriage.

3.2 Rated Engine Speed, Nr—As defined in SAE J1349 and specified in revolutions per minute.

3.3 Swing Reduction Ratio, Pr—The total gear ratio between the swing gear and the swing pinion. It shall be determined by using Equation 1:

$$Pr = \frac{\text{Number of teeth of swing bearing gear}}{\text{Number of teeth of swing drive pinion}} \quad \text{(Eq. 1)}$$

3.4 Swing Motor Speed, Sm—The output shaft rotational velocity, in revolutions per minute, as determined according to SAE J746 at the hydraulic pressure differential required to sustain swing motion on a level surface.

3.5 Swing Motor Torque, Tm—The maximum output torque, in Newton Meters, of the hydraulic drive motor(s), at stall pressure and determined according to SAE J746.

3.6 Hydraulic Pump delivery, Qp—The output flow in liters per minute, with the engine at rated engine speed, Nr, of the pump supplying oil or the flow limit of the swing control valve to the hydraulic swing motor(s) as determined according to SAE J745 and at the hydraulic pressure differential required to sustain swing on a level surface.

3.7 Swing Control Valve—The valve or valve section that controls the flow of hydraulic oil to operate the swing motor(s). The valve controls clockwise and counterclockwise swing operation.

3.8 Gear Reduction Ratio, Rg—The total gear reduction ratio between the swing motor and the swing pinion.

3.9 Gear Efficiency, Eg—That proportion of power expressed as a percentage, transmitted through the total gear system. For the purpose of developing uniform ratings within this document, an efficiency no greater than 98% should be used for each spur gear mesh or planetary set. Eg is the multiple of all individual gear set efficiencies.

3.10 Swing Control—The control that activates the pump or the swing control valve to swing or rotate the upper-structure in either a clockwise or counterclockwise direction.

3.11 Operating Mass, M—The total mass specified in kilograms, of an upper-structure and attachment equipped ready to perform its intended function, in standard configuration as defined by the manufacturer. Included in the operating mass is a 75 kg allowance for the operator, full fuel tank, the mass of all oils and greases necessary to fill oil reservoirs, and lubrication compartments to the specified levels and the mass of the standard bucket, magnet, grapple, or processing head.

3.12 Operating Weight, W—The weight of the upper-structure and attachment specified in units of force, Newtons, where:

$$W = 9.807M$$

3.13 Rated Swing Speed, Sn—The swing speed at Rated Engine Speed, Nr, determined using Equation 2 and specified in revolutions per minute.

$$Sn = \frac{Sm}{(Pr)(Rg)} \quad \text{(Eq. 2)}$$

3.14 Rated Swing Torque, Ts—The Rated Swing Torque determined using Equation 3 and specified in Newton Meters.

$$Ts = (Tm)(Rg)(Pr)(Eg) \quad \text{(Eq. 3)}$$

3.15 Time-to-Swing 90 Degrees—The time in seconds from the start of the swing control movement for the upper-structure to rotate through 90 degrees starting from a stop.

3.16 Swing Angle of Deceleration—The angle, measured in degrees, of rotation when the swing motion is decelerated from rated swing speed to zero.

3.17 Swing Brake—A device or system to bring the rotation of the upper-structure to a stop in any position. The brake may be a mechanical brake or the machine's hydraulic system.

3.18 Swing Parking Brake—A device or system to hold the upper-structure for an indefinite period of time after stopping in any position.

3.19 Swing Lock—A mechanical device not dependent on friction to hold the upper-structure in a fixed position with respect to the undercarriage.

4. Rating Procedure and Performance Requirements

4.1 Rated Swing Speed and Swing Torque—The manufacturer must be able to verify the published Rated Swing Speed and Rated Swing Torque specifications by actual tests with resulting values determined from tests exceeding 95% of published values.

4.2 Time-to-Swing 90 Degrees—A measured value starting at the time of swing control movement. The time-to-swing 90 degrees is to be established with the engine speed control set at maximum. Test results to verify Rated Time-to-Swing 90 Degrees must not exceed published values by more than 5%.

4.3 Swing Angle Deceleration—A measured angle starting at the point of swing control movement to neutral until the upper-structure comes to a complete stop. Use of the swing brake or reversing the control level is acceptable, if it is a normal operating procedure recommended by the manufacturer. Test results to verify Rated Swing Angle Deceleration must not exceed published values by more than 5%.

4.4 Swing Brake

4.4.1 All machines shall have a swing brake.

4.4.2 The swing brake shall be capable of bringing the upper-structure to a complete stop from rated speed 10times without the swing angle of deceleration increasing more than 20% of the measured angle in 4.3. These 10 actuations are to be applied sequentially as rapidly as the upper-structure can be accelerated to the rated swing speed and decelerated to a full stop.

4.4.3 If the swing brake will not hold the upper-structure from rotating after stopping in any position, a swing parking brake is required. The swing parking brake must have a torque capacity of at least 105% of the maximum swing motor torque and be capable of preventing upper-structure rotation regardless of the attachment position. The swing parking brake may be either manually or automatically applied and be capable of being applied without the engine running.

4.4.4 If the machine is not equipped with a swing parking brake, the swing brake must apply or be capable of being applied without the engine running.

4.5 Swing Lock

4.5.1 A swing lock is not mandatory.

4.5.2 The swing torque capacity of the swing lock shall be such that if the swing control lever is fully engaged with the swing lock in the locked position and engine at full throttle, the swing lock mechanism will not be damaged.

4.6 Swing Control Lock—A means shall be provided to lock or prevent the movement of the swing control lever or to make the movement of the swing control ineffective when the operator leaves the operator's station.

5. Test Conditions

5.1 The basic machine and attachments shall be specified by the manufacturer and shall be as defined in 3.11. For test purposes, other than testing on slopes, the machine must be level within 1%.

5.2 When measuring the Time-to-Swing 90 Degrees and Swing Angle of Deceleration, the attachment must be extended to maximum reach with the grapple pivot or processing head pivot at boom foot height.

5.3 Because of the large number of attachment options and other machine variations available, the manufacturer must publish additional specifications for other machine configurations if these variations would increase the Time-to-Swing 90 Degrees and the Swing Angle of Deceleration by more than 5% or the manufacturer must specifically state which machine configurations are included in or excluded form the specifications.

PREPARED BY THE SAE MACHINERY TECHNICAL COMMITTEE SC4—
FORESTRY AND LOGGING EQUIPMENT