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**Braking Performance
— Roller/Compactors**

**SAE Recommended Practice
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BRAKING PERFORMANCE - ROLLER/COMPACTORS

1. SCOPE: Minimum performance criteria for service braking systems, secondary stopping systems, and parking systems for all self-propelled vibratory and static roller/compactors are provided in this SAE Recommended Practice.
2. PURPOSE:
 - 2.1 To define minimum braking system performance for in-service machines.
 - 2.2 To provide test criteria by which machine braking system performance may be verified.
3. BRAKING SYSTEMS:
 - 3.1 Service Braking System: The primary system used for stopping and holding the machine.
 - 3.2 Secondary Stopping System: The system used for stopping the machine in the event of any single failure in the service braking system.
 - 3.3 Parking System: The system used to hold a stopped machine stationary.

NOTE: The above systems may use common components. A common component is defined as a component that performs a function in two or more braking systems. In general, a failure of a common component should not reduce the effectiveness of the machine's stopping capability below the secondary stopping performance as defined in 4.2.1. Exceptions to this requirement are the following common components: input braking systems on final drive, tires, wheels, and compactor drums.

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4. BRAKING SYSTEMS PERFORMANCE:

4.1 Service Braking System: All machines shall be equipped with a service braking system capable of being applied from the operator's position.

4.1.1 Stopping Performance: The service braking system, when tested in accordance with Section 5, shall stop the machine within the distance specified in Table 1.

TABLE 1 - BRAKE PERFORMANCE REQUIREMENTS
SI (Metric) Units

Machine Mass, kg	Machine Speed, km/h					
	3	6	9	12	16	18
	Service Brake Maximum Stopping Distance - m (Secondary Brake Maximum Stopping Distance - m)					
Up to 5400	0.6 (0.9)	1.5 (2.9)	2.8 (5.9)	4.5 (10.0)	7.2 (17.0)	8.8 (21.3)
Over 5400 to 13 600	0.8 (1.1)	1.9 (3.3)	3.4 (6.6)	5.3 (10.8)	8.3 (18.2)	10.0 (22.5)
Over 13 600	1.0 (1.3)	2.4 (3.7)	4.1 (7.2)	6.1 (11.7)	9.4 (19.3)	11.3 (23.8)

English Units

Machine Weight, lb	Machine Speed, mph					
	2	4	6	8	10	12
	Service Brake Maximum Stopping Distance - ft (Secondary Brake Maximum Stopping Distance - ft)					
Up to 12 000	2.1 (3.5)	5.6 (10.8)	10.3 (22.1)	16.4 (37.3)	23.7 (56.5)	32.4 (79.6)
Over 12 000 to 30 000	2.9 (4.2)	7.0 (12.3)	12.5 (24.3)	19.3 (40.3)	27.4 (60.2)	36.8 (84.0)
Over 30 000	3.6 (4.9)	8.5 (13.7)	14.7 (26.5)	22.2 (43.2)	31.1 (63.9)	41.2 (88.4)

- 4.1.2 Holding Performance: The service braking system shall have capability equivalent to holding the machine on a 20% grade or maximum grade the machine can climb if less than 20% under all conditions of loading. The test surface shall be as specified in 5.1.1 except for grade. This criterion shall apply to both the forward and reverse directions.
- 4.1.3 System Recovery (If Applicable): With the machine stationary, the service braking system's primary power source shall have capability of delivering at least 70% of maximum brake pressure measured at the brakes when the brakes are fully applied 20 times at the rate of six (6) applications per minute with the engine at maximum governed rpm.
- 4.1.4 Warning Device: The service braking system using stored energy shall be equipped with a warning device which actuates before system energy drops below 50% of the manufacturer's specified maximum operating energy level. The device shall be readily visible and/or audible to the operator, and provide a continuous warning. Gages indicating pressure or vacuum shall not be acceptable to meet these requirements.
- 4.2 Secondary Stopping System: All machines shall be equipped with a secondary stopping system.
- 4.2.1 Stopping Performance: The secondary stopping system, when tested in accordance with Section 5, shall stop the machine within the distance specified in Table 1.

4.2.2 Application: The secondary system shall be capable of being applied from the operator's position. The system shall be arranged so that it cannot be released by the operator unless immediate reapplication can be made to stop the machine.

4.2.2.1 In addition to the manual control, the secondary stopping system may also be applied automatically. If an automatic secondary stopping system is used, the automatic application should occur after a warning device, if present, is actuated.

4.3 Parking System: All machines shall be equipped with a parking system capable of being applied from the operator's position.

4.3.1 Parking System Performance: The parking system shall have capability equivalent to holding the machine stationary on a 15% grade under all conditions of loading. The test surface shall be as specified in 5.1.1 except for grade. This criterion shall apply to both the forward and reverse directions.

4.3.2 Remain Applied: The parking system when applied shall maintain the parking performance in compliance with paragraph 4.3.1 despite any contraction of the brake parts, exhaustion of energy, or leakage of any kind.

5. BRAKE TEST CRITERION:

5.1 Facilities and Instrumentation:

5.1.1 The test course shall consist of a hard, dry surface (ground moisture may be present to the extent that it does not adversely affect the braking surface) with a well-compacted base. The approach will be of sufficient length, smoothness, and uniformity of grade to assure stabilized travel speed of the machine. The braking surface shall not have over 1% grade in the direction of travel, or more than 3% grade at right angles to the direction of travel.

5.1.2 A means to measure the stopping distance with an accuracy of $\pm 1\%$.

5.1.3 A means to measure the machine test speed with an accuracy of $\pm 5\%$.

5.1.4 A means for determining the machine mass (weight) with an accuracy of $\pm 5\%$.

5.1.5 A means for measuring the braking system pressure level, where applicable, to an accuracy in accord with industry standard component tolerance.

5.1.6 A means for measuring the braking system actuation effort with an accuracy of $\pm 5\%$.

5.2 Test Requirements:

5.2.1 All tests to be conducted with the applicable braking system fully charged, as per the manufacturer.

- 5.2.2 Machine to be tested with maximum fuel, oil and sprinkler system water, and with ballast as actually in use when operating.
- 5.2.3 Stopping distance to be measured in meters (feet) from the point at which the machine's operator initiates brake control to the point at which the machine is stopped.
- 5.2.4 Stopping tests to be conducted from a machine speed of not less than 16 km/h (10 mph) or maximum speed if less than 16 km/h (10 mph).
- 5.2.5 Stopping tests shall be conducted with the transmission in the gear commensurate with the speed required in paragraph 5.2.4 where applicable. The power train may be disengaged prior to completing the stop.
- 5.2.5.1 On Machines Using Hydrostatic Drives: Secondary brake stopping tests shall be conducted with the drive train disengaged to eliminate the retarding torque of a hydrostatic transmission. An acceptable alternate static test is to apply the brake and to stall the hydrostatic transmission under maximum torque. If the secondary brake fails to stall the hydrostatic drive, the secondary stopping distances shall be used to demonstrate secondary stopping performance.
- 5.2.6 Auxiliary retarders shall not be used in the tests unless the retarder is automatically actuated by the applicable brake system control.
- 5.2.7 Maximum allowable efforts to actuate braking systems as defined in Section 3 are 890 N (200 lbf) for a foot-operated system, and 540 N (120 lbf) for a hand-operated system.
- 5.2.8 On machines where hydrostatic braking is used as the service brake, the stopping and holding performance of this system shall be conducted with the engine running.
- 5.2.9 When testing a vibratory machine, all tests shall be conducted without vibration.