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SURFACE VEHICLE STANDARD

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Submitted for recognition as an American National Standard

Braking Performance—Rubber-Tired Asphalt Pavers

Foreword—This reaffirmed document has been changed only to reflect the new SAE Technical Standards Board format. Definitions have been changed to Section 3. All other Section numbers have changed accordingly.

1. Scope—This SAE Standard specifies brake system performance and test criteria to enable uniform evaluation of the braking capability of self-propelled, rubber-tired asphalt pavers. Service, secondary, and parking brakes are included.

1.1 Application—This document applies to self-propelled, rubber-tired asphalt pavers as defined in 3.1 and to these same machines while in service.

2. References

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein.

2.1.1 ISO PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 9248—Earthmoving machinery—Units for dimensions, performance, and capacities and their measurement accuracies

3. Definitions

3.1 Rubber-Tired Asphalt Paver—A self-propelled, rubber-tired construction machine specifically designed to receive, convey, distribute, profile, and compact paving material by the free-floating screed method.

3.2 Machine Mass

3.2.1 For stopping performance tests, the operating mass of the machine with the heaviest combination of screed (without any fixed screed extensions) and options approved by the manufacturer, with an operator of 75 kg, with the machine fully fueled and serviced, and with the hopper and feeder system empty.

3.2.2 For holding performance tests, the mass is the same as 3.2.1 except the machine hopper is to be filled with a volume of 1600 kg/m^3 minimum density material equal to 67% of the hopper-struck capacity.

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3.3 Brake Systems—All the components which combine together to stop and/or hold the machine. Such systems consist of the control(s), means of brake actuation, the brake(s), and all parts connecting the brake(s) to the tires.

3.3.1 SERVICE BRAKE SYSTEM—The primary system used for stopping and holding the machine.

3.3.2 SECONDARY BRAKE SYSTEM—The system used for stopping the machine in the event of any single failure in the service brake system.

3.3.3 PARKING BRAKE SYSTEM—The system used to hold a stopped machine stationary.

3.4 Common Component—A component that performs a function in two or more brake systems.

4. General Brake System Requirements

4.1 Required Brake Systems—Machines shall be equipped with:

4.1.1 A service brake system.

4.1.2 A secondary brake system.

4.1.3 A parking brake system.

4.2 No brake system shall contain a disconnect such as a clutch or shiftable gear box which allows disabling the brake(s).

4.2.1 Brake disconnects designed to allow movement of disabled machines shall be located outside the operator's station unless they can be reapplied immediately.

4.2.2 A power-source disconnect designed for cold-weather starting which also disables a brake system shall require application of the parking brake prior to disconnection.

4.3 Service Brake System—All machines shall meet the service brake performance requirements specified in 6.4.1 and 6.5.1.

4.3.1 If other systems are provided with power from the service brake system, any failure in these systems shall be considered the same as a failure in the service brake system.

4.4 Secondary Brake System—All machines shall meet the secondary brake performance requirements specified in 6.5.2.

4.5 Parking Brake System—All machines shall meet the parking brake performance requirements of 6.4.2.

4.5.1 After being applied, this system shall maintain the required parking performance despite any contraction of the brake parts or leakage of any kind. This system shall not be dependent upon an exhaustible energy source.

4.6 The previous systems may use common components. However, a failure of any single component shall not reduce the effectiveness of the machine's stopping capability to less than the secondary stopping performance, as defined in 6.5.2.

4.7 Brake System Controls—All brake system controls shall be capable of being applied from the operator's station. The secondary and parking brake system(s) control(s) shall be arranged so that they cannot be released from the operator's station after any application unless immediate reapplication can be made from the operator's station.

4.8 Warning Device (Stored Energy Sources)—If stored energy is used for the service brake system, that system shall be equipped with a warning device which activates before system energy drops below the greater of 50% of the manufacturer's specified maximum operating energy level or the level required to meet the secondary stopping requirements. The device shall readily attract the operator's attention by providing a continuing visual or audible warning. Gauges indicating pressure or vacuum do not meet this requirement.

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 test course shall not have more than 3% grade at right angles to the direction of travel. Grade in the direction of travel shall be as specified for the test being conducted.

5.1.2 A means shall be provided to measure and record these parameters within the specified accuracy as shown in Table 1 (reference ISO 9248).

TABLE 1—INSTRUMENT ACCURACY LEVELS

Parameter	Instrument Accuracy
Brake System Pressure	±2.0%
Machine Speed	±2.0%
Machine Mass	±2.0%
Stopping Distance	±0.5%
Brake-Control Actuating Force	±1.0%
Grade	±1.0%

5.2 Test Requirements

5.2.1 Manufacturer's precautions shall be observed while conducting performance tests.

5.2.2 All parameters related to brake systems shall be within the machine manufacturer's specifications; that is, tire size and pressure, brake adjustment, warning-device actuation point, etc. All power-assist pressures shall be within the machine manufacturer's specification range. No manual adjustment(s) shall be made to the brake system during any one performance test.

5.2.3 MACHINE MASS—Machine is to be tested at the machine mass defined in 3.2.

5.2.4 Stopping distance is to be measured in meters from the point at which the brake control application begins to the point at which the machine is at rest.

5.2.5 Stopping performance tests are to be conducted from maximum level surface machine speed per the machine manufacturer's specifications.

5.2.6 When the machine transmission provides a selection of gear ratios, the stopping tests shall be conducted with the transmission in the gear commensurate with the test speed specified. The powertrain may be disengaged prior to completing the stop.

5.2.7 The screed shall be carried in the transport position recommended by the manufacturer.

5.2.8 Immediately prior to a test, the machine shall be operated until the engine, transmission, and machine fluids are at normal operating temperature.

6. Performance Tests

6.1 Control Forces—Control forces needed by the operator to meet the required braking performance for the systems defined in Section 4 shall not exceed the values in Table 2:

TABLE 2—CONTROL FORCES

Control Type	Force
Finger Grasp (flip levers and switches)	20 N
Hand Grasp	
Upwards	400 N
Downwards	300 N
Fore-Aft	300 N
Sideways	300 N
Foot Pedal (leg control)	700 N
Foot Treadle (ankle control)	350 N

6.2 System Recovery (if applicable)—With the machine stationary, the service brake system's primary power source shall have capability of delivering at least 70% of maximum brake pressure measured at the brakes when brakes are fully applied 20 times at 10 s intervals with the engine at maximum governed rpm.

6.3 Warning Device (Stored Energy System)—The service brake system energy shall be reduced by any suitable means. The warning device (see 4.6) shall activate before system energy drops below the greater of 50% of the manufacturer's specified maximum stored energy level required to meet the secondary stopping requirements (see 6.5.2). The warning device shall activate prior to any automatic application of a secondary brake system.

6.4 Holding Performance—All machines shall be tested in both the forward and reverse directions on a test course as described in 5.1.1 with grade as specified as follows:

6.4.1 The service brake system shall be capable of holding the machine on a 20% grade.

6.4.2 The parking brake system shall be capable of holding the machine on a 15% grade. The drivetrain(s) shall be disengaged.

6.4.3 If the tests in 6.4.1 and 6.4.2 are impractical, the tests may be carried out either:

6.4.3.1 On a tilt platform (a skid-resistant surface that may be inclined); or

6.4.3.2 By applying a pulling force to the machine with the transmission in neutral on a test course as described in 5.1.1 with no more than 1% grade in the direction of travel. the pulling force shall be applied horizontally near the ground to achieve a minimum force equivalent to the grades specified in 6.4.1 and 6.4.2. The equivalent force in Newtons s 1.92 times machine mass in kilograms for 20% grade; and 1.46 times machine mass in kilograms for a 15% grade.

6.5 Stopping Performance—All machines shall be tested on a test course as described in 5.1.1 with no more than 1% grade in the direction of travel. Tests shall be conducted in accordance with the conditions specified in 5.2. Stopping distance tests shall be conducted two times while travelling forward, once in each direction of the course. Stopping distance and machine speed used in reporting the test results shall be the average of the two tests.

6.5.1 The service brake system shall stop the machine within the distance specified in Table 3.

TABLE 3—STOPPING PERFORMANCE REQUIREMENTS

Machine Type and Mass	Service Brake System Stopping Distance in Meters (m)	Secondary Brake System Stopping Distance in Meters (m)
All Machines	$V^2/36$	$V^2/21$
V = Maximum level surface machine speed in kilometers per hour (km/h)		

6.5.2 The secondary brake system shall stop the machine within the distance specified in Table 3. On machines using hydrostatic drives, the braking force of the hydrostatic motors must be removed from the drivetrain during stopping performance tests prior to engaging the secondary brake.

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