

**DEPARTMENT OF TRANSPORTATION****National Highway Traffic Safety Administration****49 CFR Part 571**

[Docket No. NHTSA-2008-0150]

RIN 2127-AK16

**Federal Motor Vehicle Safety Standards; Motorcycle Brake Systems**

**AGENCY:** National Highway Traffic Safety Administration, Department of Transportation (NHTSA).

**ACTION:** Notice of proposed rulemaking (NPRM).

**SUMMARY:** We are proposing to amend the Federal motor vehicle safety standard on motorcycle brake systems, in order to add and update requirements and test procedures and to harmonize with a global technical regulation for motorcycle brakes. If adopted, today's proposal would specify an additional dry brake test procedure to test each service brake control individually and with the motorcycle in the fully loaded condition, provide a new test procedure for assessing performance of motorcycle brakes from high speeds, provide a new wet brake test that better simulates in-service conditions, provide an improved test procedure for evaluating heat fade, add test procedures and performance requirements for antilock brake systems, if fitted, and add a power-assisted braking system failure test, if equipped.

**DATES:** *Comment closing date:* You should submit your comments early enough to ensure that Document Management receives them not later than November 17, 2008.

**ADDRESSES:** You may submit comments, identified by the docket number in the heading of this document, by any of the following methods:

- *Federal eRulemaking Portal:* Go to <http://www.regulations.gov>. Follow the online instructions for submitting comments.
- *Mail:* Docket Management Facility, U.S. Department of Transportation, 1200 New Jersey Avenue, SE., West Building Ground Floor, Room W12-140, Washington, DC 20590-0001.
- *Hand Delivery:* 1200 New Jersey Avenue, SE., West Building Ground Floor, Room W12-140, between 9 a.m. and 5 p.m. ET, Monday through Friday, except Federal holidays.

• *Fax:* 202-493-2251.

*Instructions:* All submissions must include the agency name and docket number or Regulatory Identification Number (RIN) for this rulemaking. Note that all comments received will be

posted without change to <http://www.regulations.gov>, including any personal information provided. Please see the discussion of the Privacy Act below. For detailed instructions on submitting comments and additional information on the rulemaking process, see the Public Participation heading of the Supplementary Information section of this document.

*Privacy Act:* Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477-78) or you may visit <http://DocketInfo.dot.gov>.

*Docket:* For access to the docket to read background documents or comments received, go to <http://www.regulations.gov>, or the street address listed above. Follow the online instructions for accessing the dockets.

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You may send mail to these officials at National Highway Traffic Safety Administration, 1200 New Jersey Avenue, SE., Washington, DC 20590.

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**I. Executive Summary**

Currently, motorcycle brake systems must comply with a series of performance requirements established in Federal Motor Vehicle Safety Standard (FMVSS) No. 122, *Motorcycle Brake Systems*, in the early 1970s. While the motorcycle brake performance requirements have ensured a minimum level of braking performance, they have not kept pace with the advancement of modern technologies. The National Highway Traffic Safety Administration (NHTSA) seeks to keep its standards up to date. This document proposes to update FMVSS No. 122 based on the Motorcycle Brake Systems Global Technical Regulation (GTR), which reflects the capabilities of current technologies. Updating the standard to reflect modern technologies would help prevent the introduction of unsafe motorcycle brake systems on the road. Moreover, benefits from harmonization including decreased testing costs and ease of market entry would accrue to current and new manufacturers, and would in turn get passed on to consumers. While there is not necessarily any quantifiable safety benefit for this proposal since virtually all motorcycles sold in the U.S. can currently meet the proposed requirements, the agency is planning on taking several other actions to decrease motorcycle fatalities.<sup>1</sup>

<sup>1</sup> See U.S. Department of Transportation, "Action Plan to Reduce Motorcycle Fatalities," at 8 (October

The substantive performance tests and requirements of FMVSS No. 122 have not been updated since their adoption in 1972. Since that time, motorcycle brake system technology has significantly changed and improved such that FMVSS No. 122 no longer reflects the current performance of motorcycle brake system technologies. In order to address modern braking technologies, the agency sought to improve the requirements and test procedures of FMVSS No. 122. These efforts coincided with the 2002 adoption of the initial Program of Work under the 1998 United Nations' Economic Commission for Europe (UNECE) Agreement Concerning the Establishment of Global and Technical Regulations for Wheeled Vehicles, Equipment and Parts Which Can Be Fitted And/or Be Used On Wheeled Vehicles (1998 Agreement).<sup>2</sup> That program included motorcycle brake systems as one of the promising areas for the establishment of a GTR. The agency sought to work collaboratively on modernizing motorcycle brake regulations with other Contracting Parties to the 1998 Agreement (Contracting Parties), particularly Canada, the European Union and Japan. Through the exchange of information on ongoing research and testing and through the leveraging of resources for testing and evaluations, the agency participated in successful efforts that culminated in the establishment of the Motorcycle Brake Systems GTR under the 1998 Agreement. We believe that the provisions of the GTR would improve the current requirements and test procedures of FMVSS No. 122 by updating them to more closely reflect the capabilities of modern technologies.

The U.S., as a Contracting Party of the 1998 Agreement that voted in favor of establishing this GTR at the November 15, 2006 Session of the Executive

2007), available at <http://www.nhtsa.gov/motorcycles/index.cfm> (hereinafter "Action Plan to Reduce Motorcycle Fatalities"); National Highway Traffic Safety Administration (NHTSA), "2006 Motorcycle Safety Program Plan," at 26 (2006), available at <http://www.nhtsa.gov/portal/site/nhtsa/menuitem.d7975d55e8abbe089ca8e410dba046a0/> (hereinafter "2006 Motorcycle Safety Program Plan").

<sup>2</sup> The 1998 UNECE Agreement Concerning the Establishment of Global and Technical Regulations for Wheeled Vehicles, Equipment and Parts Which Can Be Fitted And/or Be Used On Wheeled Vehicles (1998 Agreement) was concluded under the auspices of the United Nations and provides for the establishment of globally harmonized vehicle regulations. This 1998 Agreement, whose conclusion was spearheaded by the United States, entered into force in 2000 and is administered by the UNECE's World Forum for the Harmonization of Vehicle Regulations (WP.29). See <http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29age.html>.

Committee of the 1998 Agreement, is obligated under the Agreement to initiate the process for adopting the provisions of the GTR.<sup>3</sup> This proposal is based on the Motorcycle Brake Systems GTR. If NHTSA decides to adopt amendments to FMVSS No. 122 that differ from the requirements of the GTR, the agency will first seek to amend the GTR by submitting a formal proposal to the Executive Committee of the 1998 Agreement, in accordance with the Agreement.

This proposal, if made final, would improve the current FMVSS No. 122 requirements in several areas. First, it would make the dry brake test requirement more stringent by specifying testing of each service brake control individually, with the motorcycle in the fully loaded condition. Second, the proposal would establish a more stringent high speed test requirement by specifying a slightly higher rate of deceleration. Third, the proposal would replace the existing wet brake test with one that better simulates actual in-service conditions, by spraying water onto the brake disc, instead of submerging the brake system before testing. Fourth, the proposal would specify an improved heat fade test procedure based on European and Japanese national regulations, which share the same test procedure and performance requirements. Fifth, the proposal would specify performance requirements for antilock brake systems, if present. Finally, the proposal would establish a new test requirement to evaluate the motorcycle's performance in the event of a failure in the power-assisted braking system, if so equipped.

Besides updating requirements and test procedures to help ensure the safety of motorcycle brake systems, the proposal also provides benefits from harmonization. Motorcycle manufacturers, and ultimately, consumers, both here and abroad, can expect to achieve cost savings through the formal harmonization of differing sets of standards when the Contracting Parties implement the new GTR. Motorcycles are vehicles that are prepared for the world market. It would be more economically efficient to have manufacturers using the same test procedures and meeting the same performance requirements worldwide. This proposal would help achieve these benefits and thus reduce the amount of resources utilized to test motorcycles. Moreover, this GTR sets the stage for

<sup>3</sup> While the 1998 Agreement obligates such Contracting Parties to initiate rulemaking within one year of the establishment of the GTR, it leaves the ultimate decision of whether to adopt the GTR into their domestic law to the parties themselves.

further cooperative efforts with other countries facing similar problems at the same or even greater exposure rates, learning from their experience, and leveraging resources to jointly research and implement more effective vehicle related interventions.<sup>4</sup>

Although this proposal would add and update FMVSS No. 122 performance requirements and provide benefits from harmonization, we anticipate that virtually all motorcycles sold in the U.S. can meet the requirements as proposed. The proposal includes several tests that would enhance the safe operation of a motorcycle: tests both at gross vehicle weight rating (GVWR) and lightly loaded vehicle weight, which ensure adequate braking performance at the two extremes of the loading conditions; a wet brake test that is more representative of the manner in which brakes are wetted during real world riding in wet conditions; a variety of ABS performance tests to ensure that motorcycles equipped with ABS have adequate antilock performance during emergency braking or on slippery road conditions; and a new requirement that addresses failure in the power-assisted braking system.

Given the sources and magnitude of the overall safety problem posed by increased motorcycle fatalities, the agency intends to address the problem of motorcycle safety comprehensively, focusing on regulatory as well as behavioral countermeasure strategies. In October 2007, the Secretary of Transportation announced the Action Plan to Reduce Motorcycle Fatalities which will help reduce motorcycle fatalities with new national safety and training standards, curb the use of counterfeit helmet labelling, place a new focus on motorcycle-specific road improvements, provide training for law enforcement officers on how to spot unsafe motorcyclists, and create a broad public awareness campaign on rider safety. *Id.* at 1.

## II. Background

FMVSS No. 122, *Motorcycle brake systems*, (49 CFR 571.122) took effect on January 1, 1974 (37 FR 1973, June 16, 1972). FMVSS No. 122 specifies performance requirements for motorcycle brake systems. The purpose of the standard is to provide safe motorcycle brake performance under normal and emergency conditions. The safety afforded by a motorcycle's braking system is determined by several factors, including stopping distance,

<sup>4</sup> "Action Plan to Reduce Motorcycle Fatalities," *supra* note 1, at 8.

linear stability while stopping, fade resistance, and fade recovery. A safe system should have features that both guard against malfunction and stop the motorcycle if a malfunction should occur in the normal service system. FMVSS No. 122 was originally conceived to cover each of these aspects of brake safety by specifying equipment and performance requirements appropriate for both two-wheeled and three-wheeled motorcycles. Because motorcycles differ significantly in configuration from other motor vehicles, the agency established a separate brake standard applicable only to this vehicle category. Many of the FMVSS No. 122 test procedures are, however, similar to those for passenger cars.<sup>5</sup>

Only a few changes have been made to the regulation since it was established. In response to petitions, a 1974 final rule changed the application of FMVSS No. 122 requirements for low-speed motor-driven cycles (motorcycles with 5-brake horsepower or less whose speed attainable in one mile is 30 miles per hour or less) (39 FR 32914, Sept. 12, 1974). In 1978, NHTSA amended the FMVSS No. 122 parking brake test to clarify the test conditions and incorporate an interpretation applicable to three-wheeled motorcycles (43 FR 46547, Oct. 10, 1978). In 2001, the minimum hand lever force requirements for the heat fade test and water recovery test were decreased to facilitate the manufacture of motorcycles with combined braking systems (66 FR 42613, Aug. 14, 2001). Except for the above changes, FMVSS No. 122 has not been amended to keep pace with the advancement of modern brake technologies.

### III. Current Requirements of FMVSS No. 122

FMVSS No. 122 applies to both two-wheeled and three-wheeled motorcycles. Among other requirements, the motorcycle manufacturer must ensure that each motorcycle can meet performance requirements under conditions specified in paragraph S6, *Test conditions*, and as specified in paragraph S7, *Test procedures*. The tests in S7 include pre- and post-burnishment effectiveness tests, a fade and recovery test, a partial failure test, a water recovery test, and parking brake test. At the end of the test procedure sequence, the brake system must pass a durability inspection. All stops must be made without lockup of any wheel.

<sup>5</sup> See Brake Systems on Motorcycles Proposed Motor Vehicle Safety Standard, 36 FR 5516 (Mar. 24, 1971).

*Equipment.* Each motorcycle is required to have either a split service brake system or two independently actuated brake systems. The former system encompasses a service brake system combined with a hand operated parking brake system for three-wheeled motorcycles. If a motorcycle has a hydraulic service brake system, it must also have a reservoir for each master cylinder, and a master cylinder reservoir label advising the proper grade of brake fluid. If the service brake system is a split hydraulic type, a failure indicator lamp is required. Additionally, three-wheeled motorcycles must be equipped with a friction type parking brake with a solely mechanical means to retain engagement. The service brake system must be installed so that the lining thickness of the drum brake shoes may be visually inspected, either directly or by using a mirror without removing the drums, and so that disc brake friction lining thickness may be visually inspected without removing the pads.

*Pre- and post-burnish tests.* The service brake system and each independently actuated service brake system on each motorcycle must be capable of stopping within specified distances from 30 miles per hour (mph) and 60 mph. The brakes are then burnished by making 200 stops from 30 mph at 12 feet per second per second (fps<sup>2</sup>). The service brake system must then be capable of stopping at specified distances from 80 mph and from a speed divisible by 5 mph that is 4 mph to 8 mph less than the maximum motorcycle speed. The post-burnish tests are conducted in the same way as the pre-burnish stops, and the service brakes must be capable of stopping the motorcycle within the post-burnish specified stopping distances.

*Fade and recovery test.* The fade and recovery test compares the braking performance of the motorcycle before and after ten 60-mph stops at a deceleration of not less than 15 fps<sup>2</sup>. As a check test, three baseline stops<sup>6</sup> are conducted from 30 mph at 10 to 11 fps<sup>2</sup>, with the maximum brake lever and maximum pedal forces recorded during each stop, and averaged over the three baseline stops. Ten 60-mph stops are then conducted at a deceleration rate of not less than 15 fps<sup>2</sup>, followed immediately by five fade recovery stops from 30 mph at a deceleration rate of 10 to 11 fps<sup>2</sup>. The maximum brake pedal and lever forces measured during the

<sup>6</sup> The baseline check is used to establish a specific motorcycle's pre-test performance to provide a basis for comparison with post-test performance. This comparison is intended to ensure adequate brake performance, at reasonable lever and pedal forces, after numerous high-speed or wet brake stops.

fifth recovery stop must be within plus 20 pounds and minus 10 pounds of the baseline average maximum brake pedal and lever forces.

*Partial failure test.* In the event of a pressure component leakage failure, the remaining portion of the service brake system must continue to operate and shall be capable of stopping the motorcycle from 30 mph and 60 mph within specified stopping distances. The brake failure indicator light must activate when the master cylinder fluid level decreases below the minimum specified level.

*Water recovery test.* The water recovery test compares the braking performance of the motorcycle before and after the motorcycle brakes are immersed in water for two minutes. Three baseline stops are conducted from 30 mph at 10 to 11 fps<sup>2</sup>, with the maximum brake lever and pedal forces recorded during each stop, and averaged over the three baseline stops. The motorcycle brakes are then immersed in water for two minutes, followed immediately by five water recovery stops from 30 mph at a deceleration rate of 10 to 11 fps<sup>2</sup>. The maximum brake pedal and lever forces measured during the fifth recovery stop must be within plus 20 pounds and minus 10 pounds of the baseline average maximum brake pedal force and the lever force.

*Parking brake test.* For motorcycles required to be equipped with a parking brake system, such system must be able to hold the motorcycle on a 30 percent grade, in both forward and reverse directions, for 5 minutes. A parking brake indicator lamp must be provided.

### IV. Harmonization Efforts

Globally, there are several existing regulations, directives, and standards that pertain to motorcycle brake systems. As all share similarities, the Contracting Parties to the 1998 Agreement under WP.29 tentatively determined that the development of a GTR under the 1998 Agreement would be beneficial. During the 126th session of WP.29 of March 2002, the Executive Committee of the 1998 Agreement adopted a Program of Work, which included the development of a GTR on motorcycle brake systems. Subsequently, Canada offered to sponsor the GTR on motorcycle braking requirements at the 52nd session of the Working Party for Brakes and Running Gear (GRRF), in September 2002.<sup>7</sup> To

<sup>7</sup> The Working Party for Brakes and Running Gear (GRRF) is made up of delegates from many countries around the world, and who have voting privileges. Representatives from manufacturing and consumer groups also attend and participate in the GRRF and informal working groups that are

proceed with the development of the GTR, the Executive Committee endorsed Canada's request to establish and chair an informal group on motorcycle brakes, at the 130th session of WP.29 in June 2003.

In an effort to select the best of existing performance requirements for a GTR, the U.S. and Canada conducted analyses of the relative stringency of three national motorcycle brake system regulations. These were the UNECE Regulation No. 78, FMVSS No. 122, and the Japanese Safety Standard JSS 12-61. The subsequent reports, along with proposed provisions of a GTR, were presented at GRRF meetings, and will be available in the docket. While using different methodologies, the results from the U.S./Canada report were similar to an industry-led report that examined the issue under the GRRF. These studies completed by the U.S., Canada, and the industry provided the basis for the development of the technical requirements of the GTR.

The following regulations, directives and international voluntary standards were considered and used as the basis for the development of the GTR:

- UNECE Regulation No. 78—Uniform provisions concerning the approval of vehicles of category L with regard to braking.

- FMVSS No.122, *Motorcycle brake systems*.

- Canada Motor Vehicle Safety Regulation No. 122—Motorcycle brake systems. (CMVSS No. 122).

**Note:** FMVSS and CMVSS No. 122 are substantially similar.

- Japan Safety Standard JSS12-61.
- Australian Design Rule 33/00—Brake systems for motorcycles and mopeds.
- International Organization for Standardization (ISO) 8710:1995, *Motorcycles—Brakes and braking devices—tests and measurement methods*.
- ISO 12364:2001, *Two-wheeled motorcycles—Antilock braking systems (ABS)—tests and measurement methods*.
- ISO 12366:2001, *Two-wheeled mopeds—Antilock braking systems (ABS)—tests and measurement methods*.

The informal group used the feedback from the GRRF presentations to assist with the completion of the proposed GTR, a copy of which is being placed in

developing GTRs. Those that chose not to participate are kept apprised of the GTR progress from progress reports which are presented at the GRRF meetings and then posted on the UN's Web site.

the docket.<sup>8</sup> Where national regulations or standards address the same subject, e.g., dry stop or heat fade performance requirements, the informal group reviewed comparative data on the relative stringency of the requirements from the research and studies and included the most stringent options. Additional testing was conducted to confirm or refine the testing and performance requirements. Qualitative issues, such as which wet brake test to include, were discussed on the basis of the original rationales and the appropriateness of the tests to modern conditions and technologies. In each of these steps, specific technical issues were raised, discussed, and resolved, as discussed below. The informal working group held a total of eight meetings concerning the development of the GTR. In November 2006, WP.29 approved the GTR on Motorcycle Brake Systems, and established it in the Global Registry as Global Technical Regulation No. 3.

The GTR on motorcycle brake systems consists of a compilation of the most stringent and relevant test procedures and performance requirements from current standards and regulations. As a result of the comparison process, the selected performance requirements of the GTR are mainly drawn from the UNECE Regulation No. 78, the FMVSS No. 122 and the Japanese Safety Standard JSS 12-61 (JSS 12-61). The GTR is comprised of several fundamental tests, each with their respective test procedures and performance requirements. These tests and procedures are listed below along with the national regulation on which they are based:

- Burnish procedure (FMVSS No. 122)
- Dry stop test with each service brake control actuated separately (UNECE Regulation No. 78/JSS 12-61)
- Dry stop test with all service brake systems applied simultaneously (FMVSS No. 122)
- High speed test (JSS 12-61)
- Wet brake test (UNECE Regulation No. 78/JSS 12-61)
- Heat fade test (UNECE Regulation No. 78/JSS 12-61)
- Parking brake test (UNECE Regulation No. 78/JSS 12-61)
- ABS tests (UNECE Regulation No. 78/JSS 12-61)
- Partial failure test—split service brake systems (FMVSS No. 122)

<sup>8</sup>The first formal proposal for a GTR concerning motorcycle brake systems was presented during the 58th GRRF session in September 2005. A more detailed report on the technical details, deliberations and conclusions, which led to the proposed GTR, was provided separately as informal document No. GRRF-58-16. Both documents will be available in the docket.

- Power-assisted braking system failure test (new)

The GTR process was transparent to country delegates, industry representatives, public interest groups, and other interested parties. Information regarding the meetings and negotiations was publicly available through notices published periodically by the agency and UN Web site.<sup>9</sup> In the U.S., NHTSA published notice of its intent to add motorcycle brake systems to its list of recommendations of standards for consideration as a GTR in January 2001 (66 FR 4893, Jan. 18, 2001; Docket No. NHTSA-00-7538). The agency later published notice that Canada had submitted a proposal for the establishment of a motorcycle brakes GTR, and sought public comment on the formal proposal (69 FR 60460, Oct. 8, 2004; Docket No. NHTSA-03-14395). In October 2006, NHTSA published a further update on the status of the proposed motorcycle brake systems GTR, and requested comments specific to the motorcycle brakes GTR and NHTSA's intent to vote positively on behalf of the United States for its establishment (71 FR 59582, Oct. 10, 2006; Docket No. NHTSA-2003-14395). The agency did not receive comments in response to any of these notices regarding the motorcycle brake systems GTR.

## V. Proposed Improvements to FMVSS No. 122

### A. General

#### 1. New Terminology

For this proposal, definitions in FMVSS No. 122 (paragraph S4) were revised or added where necessary, such as new proposed terms used to describe antilock brake systems (ABS), vehicle maximum speed (Vmax), and peak braking coefficient (PBC). Additionally, in order to streamline the proposed regulatory text to more closely reflect the GTR text, some of the new proposed terms are common terminology and definitions based on the UN document titled "Special Resolution No. 1 Concerning the Common Definitions of Vehicle Categories, Masses and Dimensions (S.R.1)"<sup>10</sup> (UN Doc. S.R.1) developed for the purposes of the GTRs. Thus, certain new definitions that may

<sup>9</sup> See <http://www.unece.org/trans/main/wp29/wp29wgs/wp29grf/grf-infmotobrake7.html> for a record of all GRRF meetings and documents presented therein.

<sup>10</sup> World Forum for Harmonization of Vehicle Regulations (WP.29), *Special Resolution No. 1 Concerning the Common Definitions of Vehicle Categories, Masses and Dimensions (S.R.1)*, U.N. Doc. TRANS/WP.29/1045 (Sept. 15, 2005), available at <http://www.unece.org/trans/doc/2005/wp29/TRANS-WP29-1045e.pdf>.

be similar to existing 49 CFR Part 571 definitions are proposed to be added to § 571.122 S4, *Definitions*. For example, current FMVSS No. 122 specifies that performance requirements must be met when the “motorcycle weight is unloaded vehicle weight plus 200 pounds.”<sup>11</sup> This is effectively equivalent to the mass term “lightly loaded” in the proposed rule, which is the testing condition specified for the proposed dry stop test—all service brake controls actuated, the high-speed test, the antilock brake systems tests, and the partial failure test.<sup>12</sup> These proposed terms, some of which may be similar or equivalent to existing terms defined elsewhere in 49 CFR Part 571, are used in the motorcycle brakes GTR in an effort to streamline the GTR and maximize harmonization benefits.

Additionally, the proposed rule divides motorcycles into five categories, which are referenced in the GTR. These motorcycle categories are based on number of wheels and maximum speed, and were originally defined in the UN Doc. S.R.1, as amended in May 2007.<sup>13</sup> We included these categories in the definitions portion of proposed FMVSS No. 122 because under the GTR some performance tests do not apply to certain motorcycle categories, and certain motorcycle categories have different performance requirements than others.

Category 3–1 and category 3–3 motorcycles are two-wheeled motorcycles. Category 3–1 motorcycles are two-wheeled motorcycles with an engine cylinder capacity not exceeding 50 cm<sup>3</sup> and a maximum design speed not exceeding 50 kilometers per hour (km/h). Category 3–3 motorcycles are two-wheeled motorcycles with an engine cylinder capacity exceeding 50 cm<sup>3</sup> or a maximum design speed exceeding 50 km/h. Category 3–2 motorcycles are three-wheeled motorcycles of any wheel arrangement with an engine cylinder capacity not

exceeding 50 cm<sup>3</sup> and a maximum design speed not exceeding 50 km/h. Category 3–4 motorcycles are those manufactured with three wheels asymmetrically arranged in relation to the longitudinal median plane with an engine cylinder capacity exceeding 50 cm<sup>3</sup> or a maximum design speed exceeding 50 km/h. Finally, category 3–5 motorcycles are motorcycles manufactured with three wheels symmetrically arranged in relation to the longitudinal median plane with an engine cylinder capacity exceeding 50 cm<sup>3</sup> or a maximum design speed exceeding 50 km/h.

## 2. Vehicle Test Speed and Corrected Stopping Distance

Deceleration or stopping distance performance requirements are set for a specified initial test speed. While professional test riders can approach this initial test speed, it is unlikely that the test will be started at the exact speed specified, affecting the stopping distance measurement. The current FMVSS No. 122 does not specify a speed tolerance for this potential variation, but consistent with the GTR, the proposed rule specifies Japan’s existing general tolerance of  $\pm 5$  km/h in S6.1.4.

A method for correcting the measured stopping distance is specified in JSS 12–61 to compensate for the difference between the specified test speed and the actual speed where the brakes were applied. Although not specified directly in the regulations, the current FMVSS No. 122 and CMVSS No. 122 also apply a correction factor to test data, using the method specified in Society of Automotive Engineers (SAE) standard J299, *Stopping Distance Test Procedure*. The informal group evaluated the above noted stopping distance correction methods and the one specified in ISO 8710:1995, *Motorcycles—Brakes and braking devices—tests and measurement methods*.

SAE J299 offers the most basic method for estimating the corrected distance, and the method is applicable to a speed tolerance of  $\pm 3.2$  km/h ( $\pm 2$  mph). The ISO 8710 and JSS 12–61 methods are based on the same principles, but also take into consideration the brake system reaction time. These methods are applicable to a wider speed tolerance of  $\pm 5$  km/h. However, a small error in handling the system reaction time is apparent in the ISO 8710 equation, which results in higher than expected corrected values. Based on this analysis, the informal group agreed that the stopping distance correction method specified in JSS 12–61 was the most appropriate for the

GTR. Therefore, as with the existing Japanese standard, the specified test speeds in the GTR include a general tolerance of  $\pm 5$  km/h (S6.1.4), using the JSS stopping distance correction method to normalize the measured test results, if necessary, to compensate for the difference between the specified test speed and the actual speed where the brakes were applied (see S5.3.2(b)).

## 3. Test Method To Measure Peak Braking Coefficient

The peak braking coefficient (PBC) is a measure of the coefficient of friction of the test surface and is an important parameter in evaluating the brake performance of a vehicle. PBC is effectively equivalent to the peak friction coefficient (PFC) as defined in FMVSS No. 121, *Air brake systems*, and FMVSS No. 135, *Light vehicle brake systems*. The GTR specifies test surface conditions, one of which is that the high-friction “test surface has a nominal [PBC] of 0.9, unless otherwise specified.” For reasons of objectivity, we are specifying in the proposed rule a PBC equal to 0.9 for the high-friction dry test surface used for the motorcycle brake system tests. NHTSA has discussed the issues surrounding objective measurement of PBC/PFC at length in an early-1990s rulemaking that added ABS requirements for medium and heavy vehicles (see e.g., 60 FR 13216, Mar. 10, 1995; Docket Nos. 92–29, 93–69).

FMVSS No. 122 currently specifies that the road tests be conducted on an 8-foot-wide level roadway having a skid number of 81. The skid number is also a measure of the coefficient of friction of the test surface and is derived by measuring the friction using a locked wheel, whereas the PBC is derived by measuring the peak surface friction before wheel lockup occurs. PBC is a more relevant surface friction measurement for non-locked wheel tests, as those included in FMVSS No. 122 and in the GTR. Other Federal motor vehicle safety standards for braking systems, FMVSS No. 121 and FMVSS No. 135, specify the road test surface using PBC of 0.9 when measured using the American Society for Testing and Materials (ASTM) E1136–93 (Reapproved 2003) standard reference test tire, in accordance with ASTM Method E1337–90 (Reapproved 2002), at a speed of 40 mph without water delivery.

The UNECE Regulation No. 78 and the JSS 12–61 do not specify the coefficient of friction for the test surface but prescribe that the test surface be level, dry, and affording good adhesion. For the ABS tests where road surface

<sup>11</sup> 49 CFR 571.122, S6.1. “Unloaded vehicle weight” is defined under 49 CFR 571.3(b) to mean “the weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use.”

<sup>12</sup> Lightly loaded means the sum of unladen vehicle mass (mass of the vehicle with bodywork and all factory fitted equipment, and fuel tanks filled to at least 90 percent) and driver mass “plus 15 kg for test equipment, or the laden condition, whichever is less.” FMVSS No. 122 S4, *Definitions* (proposed).

<sup>13</sup> See WP.29, *Amendment to Special Resolution No. 1 Concerning the Common Definitions of Vehicle Categories, Masses, and Dimensions*, U.N. Doc. ECE/TRANS/WP.29/1045/Amend.1 (May 9, 2007), available at <http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29doc/1000/ECE-TRANS-WP29-1045a1e.pdf>.

friction requirements are specified, the UNECE Regulation No. 78 and JSS 12–61 specify a method that is based on the same principles as measuring the PBC. This is determined by finding the wheel lock threshold through a series of braking tests with the ABS disabled for the individual motorcycle being evaluated, and uses the tires on the motorcycle compared with the ASTM Method, which uses a reference test (control) tire on a skid trailer.

The GTR defines the test surface using a PBC value instead of a skid number value since peak braking coefficient is a more representative measure of the type of braking tests performed in the requirements with a rolling tire. However, the decision was made to not specify the method used to measure the coefficient of friction but leave it to the national regulations to specify which of the above test methods should be used to measure PBC. In the U.S., the ASTM Method for measuring PBC to define surface friction has been included in Federal motor vehicle safety standards since the early-1990's and was also used by the U.S. automotive industry prior to that date. Accordingly, the agency proposes that the PBC of the test surface will be measured using the ASTM E1136–93 (Reapproved 2003) standard reference test tire, in accordance with ASTM Method E1337–90 (Reapproved 2002).

As mentioned above, the GTR also maintains an option for Contracting Parties to specify in their respective national regulations the value of PBC for the high-friction dry test surface used for the motorcycle brake system tests. Because of objectivity concerns, we are proposing a PBC of 0.9 as opposed to a nominal PBC of 0.9 (the default option in the GTR).

4. Test Sequence

We are proposing a specific testing order to eliminate any potential effect of

the test sequence on braking performance and to harmonize with the GTR. The proposed sequence was selected based on increasing severity of the test on the motorcycle and its brake components, in order to preserve the condition of the brakes.

The current FMVSS No. 122 specifies a particular sequence in which tests should be conducted, ending with the wet brake test. The purpose here is to minimize the variability of test results through consistency in both the condition of the brakes throughout the tests and in the way in which the brakes are evaluated. There is no specified test order in the UNECE Regulation No. 78. Similarly, JSS 12–61 indicates that tests can be done in any order, with the exception that the fade test be conducted last.

The fade test would have the greatest effect on the condition of the motorcycle brakes, which could affect brake performance in subsequent tests. For this reason, current FMVSS No. 122 specifies that a re-burnishing be conducted after the fade test, to refresh the brake components. In order to eliminate the need for re-burnishing, the GTR specifies that the fade test be the last of the motorcycle brake system performance tests, which is consistent with the existing practice in JSS 12–61.

The ABS test would be the next most severe test, which will result in braking at or near the limits of traction. Thus, the GTR specifies that the ABS test would precede the fade test, for motorcycles equipped with ABS. The remaining tests are not as severe on the brake system and tires, therefore the GTR sequenced them according to increasing test speed for the dry stop performance tests, followed by the wet brake performance test.

Consistent with the GTR, we are proposing a specified test sequence as follows:

- (1) Dry stop test—single brake control actuated;
- (2) Dry stop test—all service brake controls actuated;
- (3) High speed test;
- (4) Wet brake test;
- (5) If fitted:
  - (a) Parking brake system test;
  - (b) ABS test;
  - (c) Partial failure, for split service brake systems test;
  - (d) Power-assisted braking system failure test.
- (6) Heat fade test.

The informal group that developed the technical specifications for the GTR assessed alternatives to the testing sequence, including selecting a test sequence based on the loading of the motorcycle in order to save time, and relocating the wet brake test to second-last, before the final fade test. Either option would place the more severe brake tests earlier in the test sequence, which could affect braking performance in subsequent tests. The GTR therefore kept the test sequence as noted above.

5. Brake Application Force Measurement

Controls for the application of the brakes can include hand and foot actuated control levers. The various national standards and regulations have slightly different brake control input force limits, and in the case of a hand actuated control lever, there is also a discrepancy as to the location of application of the input force. One consistent element is the location and direction of application of the input force to the foot actuated lever (*i.e.* pedal). Consistent with the GTR, the proposed rule specifies input forces in accordance with the national regulation on which the individual test is based, to minimize confusion.

The respective input forces are noted in the following table:

Regulation	Foot control, $F_P$ (N)	Hand control, $F_L$ (N)
FMVSS No. 122 .....	$25 < F_P < 400$ .....	$10 < F_L < 245$
UNECE Regulation No. 78/JSS 12–61 .....	$F_P < 350$ .....	$F_L < 200$

A discussion on brake control actuation force specifications for evaluating motorcycles equipped with ABS is provided below in paragraph V.B.7.

With respect to the location of the input force on the hand-controlled lever, UNECE Regulation No. 78 and JSS 12–61 place the input force 50 mm from the end of the lever, while FMVSS No. 122 locates the input force 30 mm from

the end of the handle bar grip. On most models (but not all), the control lever typically extends slightly beyond the handle bar grip, such that the control forces are almost at the same location regardless of the method followed. Depending on the regulation, however, it is not entirely clear whether this measurement should be taken along the length of the control lever or parallel to

the handle bar grip; or, how to measure with a curved or angled control lever. Some interpretation is required.

In developing the GTR, there was agreement that none of the three national regulations is clear enough with respect to measuring the location of the input force on the hand-controlled lever. In an effort to define a common practice, the GTR includes a

revised description for the location of the input force on the control lever and its direction of application, based on ISO 8710:1995, *Motorcycles—Brakes and braking devices—tests and measurement methods*. This proposed rule adopts the GTR's harmonized specification of input force.

Finally, for those motorcycles that use hydraulic fluid for brake force transmission, the GTR stipulates that the master cylinder shall have a sealed, covered, separate reservoir for each brake system. This includes one or more separate reservoirs located within the same container, such as commonly found on passenger cars. Such containers may only have one sealed, covered filling cap. The proposed rule incorporates these hydraulic service brake system requirements in S5.1.9.

#### 6. Brake Temperature Measurement

Brake test requirements typically specify that initial brake temperature (IBT) be measured at the start of each braking performance run to enhance test repeatability. The two measurement methods that are generally used in brake standards and regulations worldwide include (1) the use of plug-type thermocouples, and (2) the use of rubbing-type thermocouples. We propose to retain the plug-type thermocouples brake temperature measurement method in FMVSS No. 122.

Plug-type thermocouples are imbedded in the brake friction material (brake pad for disc brakes or brake shoes for drum brakes) one millimeter below the contact surface between the friction material and the brake disc or brake drum. This placement of the thermocouple allows no contact with the friction surfaces and provides an accurate reading of the temperature at the friction material/disc or drum interface. Rubbing-type thermocouples are placed so that they are in direct contact with both the friction material and the disc or drum. Although this type of thermocouple can provide a quicker response to temperature changes, it has some limitations regarding its durability and its effectiveness when used on brakes with cross-drilled or grooved discs. In addition, for a given brake system, the rubbing-type thermocouple generally provides higher temperature readings compared with the plug-type thermocouple.

The two methods of measuring the IBT were included in the GTR and each Contracting Party may specify which temperature measurement would be accepted in its national regulation. FMVSS No. 122, as well as all the other

brake standards in the Federal motor vehicle safety standards, currently specifies the plug-type thermocouple for measuring the initial brake temperature. UNECE Regulation No. 78 and JSS 12–61 also prescribe brake temperature measurement, but neither regulation makes reference to specific measurement equipment or installation methods. NHTSA does not have experience using the rubbing-type thermocouple either in brake research or compliance testing. Given the limitations of the rubbing-type thermocouple, we believe that the plug-type thermocouple would be the more effective option for measuring IBT in the proposed FMVSS No. 122. Therefore, the proposed rule specifies that initial brake temperature is measured by plug-type thermocouples.

With respect to the actual brake temperature values specified for testing purposes, each of the national regulations on which the GTR performance requirements are based specifies a value for the IBT. For most tests, the UNECE Regulation No. 78 and JSS 12–61 specify that the IBT shall be less than or equal to 100 °C (212 °F), whereas FMVSS No. 122 specifies an IBT between 55 °C and 65 °C (130 °F and 150 °F). In developing the GTR, it was agreed that a narrow IBT range could improve the repeatability of the performance tests. However, test data indicated that the narrow range specified by FMVSS No. 122 might not be achievable for those motorcycles equipped with a combined brake system. Therefore, the GTR specifies an IBT between 55 °C and 100 °C in order to encompass all brake systems, and the proposed rule specifies this same IBT range as a test condition.

#### 7. Burnishing Procedure

The current FMVSS No. 122 includes a burnishing procedure. In order to harmonize with the GTR, we are proposing a slight variation of the current procedure, to include some aspects of procedures currently used by motorcycle manufacturers in preparation for UNECE Regulation No. 78/JSS 12–61 type approval testing.

The burnishing procedure serves as a conditioning of the foundation brake components to permit the brake system to achieve its full capability. Burnishing typically matches the friction components to one-another and results in more stable and repeatable stops during testing. UNECE Regulation No. 78 and JSS 12–61 do not include any burnishing procedure. Under the UNECE and the JSS regulations, the motorcycle is generally presented for type approval compliance testing in a

burnished condition, using a procedure determined by the motorcycle manufacturer. All Federal motor vehicle safety standards for brake systems (FMVSS Nos. 105, 121, 122 and 135) currently include a burnishing procedure. The burnishing procedure of FMVSS No. 122 specifies 200 stops with both brakes applied simultaneously, decelerating from a speed of 30 mph at 12 fps<sup>2</sup> with an IBT between 55 °C and 65 °C (130 °F and 150 °F).

The burnishing procedure in the GTR is based on FMVSS No. 122, but also includes some aspects of procedures currently used by motorcycle manufacturers in preparation for UNECE Regulation No. 78/JSS 12–61 type approval testing. For example, the initial speed proposed for the procedure has been changed to 50 km/h to round-off the metric equivalent, which is a slight increase from 30 mph (48 km/h) as specified by FMVSS No. 122. An initial speed of 0.8 Vmax was adopted for category 3–1 and 3–2 motorcycles, which have a Vmax of 50 km/h or less. Instead of making complete stops, the proposal also includes braking the motorcycle at the specified deceleration down to a speed between 5 km/h and 10 km/h, after which the motorcycle may be accelerated to the initial test speed for the next stop in the burnishing procedure. The primary reason for not braking the motorcycle to a complete stop is to expedite the burnishing procedure. The increased motorcycle kinetic energy resulting from the small initial speed increase of 2 km/h is likely to offset any reduction in kinetic energy resulting from not braking the motorcycle until a complete stop is reached. The GTR specifies burnishing the brakes separately since this would result in a more complete burnish for both front and rear brakes, as compared with the current FMVSS No. 122 method of using both brakes simultaneously. Hence, consistent with the GTR, the proposed rule specifies that each brake be burnished for 100 decelerations.

Finally, the GTR changes the IBT from the range of 55 °C to 65 °C currently specified in FMVSS No. 122 to an IBT less than or equal to 100 °C. The primary reasons for changing the IBT are to accommodate the higher operational temperatures of motorcycles equipped with disc brakes and to reduce the cooling times between stops. In developing the GTR, it was agreed that although a narrow IBT range is important to achieve good repeatability of the performance tests, the IBT range is not as critical for the burnishing procedure.

## 8. Notice of Wear

We are proposing the GTR requirement that “friction material thickness shall be visible without disassembly, or where the friction material is not visible, wear shall be assessed by means of a device designed for that purpose.” FMVSS No. 122 S5.2.2, *Notice of wear* (proposed). Current FMVSS No. 122 requires that the “brake system [ ] be installed so that the lining thickness of drum brake shoes may be visually inspected, either directly or by use of a mirror without removing the drums, and so that disc brake friction lining thickness may be visually inspected without removing the pads.” FMVSS No. 122 S5.1.5, *Other requirements*. Allowing wear of friction material thickness to be assessed either visually or by means of a device increases design freedom while serving the same purpose of indicating friction material wear, without the need for disassembly.

### B. Specific Performance Tests

#### 1. Dry Stop Test—Single Brake Control Actuated

The GTR has a provision for a dry stop test with single brake control that is based on UNECE Regulation No. 78 and JSS 12–61 tests. Current FMVSS No. 122 does not have a requirement that tests each brake system separately in a split brake service system, but only a requirement that tests the front and rear brake simultaneously. In the main FMVSS No. 122 dry stop test with both brake controls actuated simultaneously, the test rider judges how to apportion the force actuated to the front and rear brakes. This may give less repeatable test results or allow the test rider to compensate for a “weak” brake. As such, an additional test specifying that each split brake be tested individually would improve FMVSS No. 122.

The purpose of a dry stop test requirement with the separate actuation of each brake control is to ensure a minimum level of motorcycle braking performance on a dry road surface for each independent brake system. Each of the major national motorcycle brake regulations, UNECE Regulation No. 78, FMVSS No. 122, and JSS 12–61, includes a dry stop test in its test procedures. The UNECE Regulation No. 78 and the JSS 12–61 test procedures and performance requirements are similar. The UNECE Regulation No. 78 and JSS 12–61 regulations require that the braking performance be evaluated separately for each brake control, with the motorcycle in the laden condition and at test speeds of 40 km/h or 60 km/h depending on the motorcycle

category. The only exception is for motorcycle category 3–4, where it is specified that the brakes at all wheels shall be operated via a single foot actuated control.

Current FMVSS No. 122 performance requirements are quite different as they specify motorcycles be tested in what is effectively the lightly-loaded condition,<sup>14</sup> and with all brake controls actuated simultaneously. The exception is the pre-burnish test requirements, which specify that each independently actuated service brake system must be capable of stopping the motorcycle (in effectively the lightly-loaded condition) within specified stopping distances. Current FMVSS No. 122 also specifies test requirements from 30 mph (48.3 km/h), 60 mph (96.6 km/h) and 80 mph (128.8 km/h). Consistent with being tested in the lightly-loaded condition and with both brakes applied together, the FMVSS No. 122 deceleration requirements are higher than in the UNECE Regulation No. 78 and JSS 12–61. The FMVSS No. 122 and the UNECE Regulation No. 78/JSS 12–61 tests are conducted with the engine disconnected, which means that only the foundation brake performance is measured and engine braking is not a factor. Although current FMVSS No. 122 also specifies that independent service brake systems be evaluated separately, that test is conducted with the brakes in the pre-burnished condition, hence requiring a lower level of performance.

In independent studies of the relative severity of the tests as they apply to category 3–3 motorcycles, the industry concluded that the UNECE Regulation No. 78/JSS 12–61 test was marginally more stringent, whereas the NHTSA/Transport Canada findings indicated that the FMVSS No. 122 test was marginally more stringent.<sup>15</sup> Despite the difference in these findings, neither study demonstrated a significant

difference in stringency between these national regulations.

The primary advantage of the UNECE Regulation No. 78/JSS 12–61 requirement is that each brake control is tested separately, which ensures that each independent brake system meets specific performance criteria. As mentioned above, in the main FMVSS No. 122 dry stop test with both brake controls actuated simultaneously, the test rider judges how to apportion the force actuated to the front and rear brakes. This may give less repeatable test results or allow the test rider to compensate for a “weak” brake. Therefore, consistent with the GTR, the proposed rule includes the dry stop test with single brake control based on UNECE Regulation No. 78/JSS 12–61 requirements. Unlike present UNECE/JSS national standards, the performance requirement can be met only through measurement of the stopping distance.

#### 2. Dry Stop Test—All Service Brake Controls Actuated

The GTR contains a provision to test the service brakes with the brake control applied simultaneously, which is very similar to the current FMVSS No. 122 dry stop test with both brake controls actuated simultaneously. The purpose of this test with all service brake controls actuated is to evaluate the full braking performance of motorcycles from a speed of 100 km/h with both front and rear brakes applied simultaneously. The current FMVSS No. 122 includes a stopping distance test from 60 mph (96 km/h) with all brake controls actuated simultaneously, with the motorcycle in the lightly-loaded condition. The stopping distance requirement from this speed is 185 feet (56.4 meters), which is equivalent to an average deceleration of 6.4 m/s<sup>2</sup> over the entire stop. The current requirements of UNECE Regulation No. 78 and JSS 12–61 do not include a performance test from such a speed.

The GTR performance specifications are based on the FMVSS No. 122 test noted above. These test parameters are relevant since they represent the typical operating conditions of a motorcycle with a single rider traveling at highway speeds. In addition, testing in the lightly loaded condition with a full brake application helps to evaluate motorcycle stability during braking. Consistent with the GTR, in the proposed rule this test would apply to motorcycle categories 3–3, 3–4 and 3–5, but not to motorcycle categories 3–1 and 3–2. The latter are motorcycles with a maximum speed of less than 50 km/h. Given this speed restriction, motorcycle categories 3–1 and 3–2 will use a test speed based on

<sup>14</sup> As mentioned above, current FMVSS No. 122 specifies that performance requirements must be met when the “motorcycle weight is unloaded vehicle weight plus 200 pounds.” 49 CFR 571.122, S6.1. “Unloaded vehicle weight” is defined under 49 CFR 571.3(b) to mean “the weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use.” This current FMVSS No. 122 test mass condition is effectively equivalent to the mass condition “lightly loaded” in the proposed rule. Lightly loaded means the sum of unladen vehicle mass (mass of the vehicle with bodywork and all factory fitted equipment, and fuel tanks filled to at least 90 percent) and driver mass “plus 15 kg for test equipment, or the laden condition, whichever is less.” FMVSS No. 122 S4, *Definitions* (proposed).

<sup>15</sup> These studies will be posted in the current docket.



90 percent of the maximum speed, or almost at the same exact speed as the 40 km/h test speed for the dry stop test—single brake control actuated. As the level of stringency was deemed comparable for both dry stop tests, it was agreed that specifying a dry stop test with all the service brake controls actuated for motorcycle categories 3-1 and 3-2 would be redundant.

The brake application force specified in the GTR is less than or equal to 245 N for hand levers and less than or equal to 400 N for foot pedals. Since this GTR performance requirement is adopted from FMVSS No. 122, with a slight increase in speed to 100 km/h from 96 km/h, the GTR retained the corresponding control lever/pedal force parameters to maintain the stringency of the original test. If this dry stop test was adopted with the force parameters from UNECE Regulation No. 78 and JSS 12-61 Standards (200 N/350 N for the hand lever/foot pedal controls, respectively), it would increase the stringency of the test since it would effectively be proposing that the current FMVSS No. 122 performance requirements be met with lower application forces.

The stopping distance performance requirement from a speed of 100 km/h is 198.5 feet (60.5 meters). In keeping with the original requirements on which this test is based (rounded to 100 km/h), the GTR maintains the performance requirement for this dry stop test in terms of stopping distance only.

The approach for setting forth the performance requirements in current FMVSS No. 122 is to specify progressively higher performance requirements at set break points as test speeds decrease, based mainly on the fact that the PBC increases as the motorcycle speed decreases. When viewed in the context of FMVSS No. 122, the placement of break points are provided to accommodate the current FMVSS No. 122 test requirements from speeds of 30 mph, 60 mph, 80 mph and up to 120 mph. However, for the purpose of the GTR, it became evident that maintaining the original FMVSS No. 122 break points would have the unintended effect of introducing two levels of stringency that are dependent on the test speed, making it inconsistent with the other dry stop tests in the GTR—*i.e.*, both the high speed test and the dry stop test single brake control actuated have constant performance requirements irrespective of the test speed. For this reason, the GTR contains a single performance requirement based on the 100 km/h performance requirement in the current FMVSS No. 122, for all motorcycles to which this test applies.

### 3. High-Speed Test

The purpose of the high-speed test is to evaluate the full braking performance of the motorcycle from a high speed and with both front and rear brakes applied simultaneously. Each of the major national motorcycle brake regulations, UNECE Regulation No. 78, FMVSS No. 122, and JSS 12-61, includes a high-speed test in its requirements. The UNECE Regulation No. 78 and the JSS 12-61 tests are similar and are performed from a speed of 160 km/h or 0.8 of the vehicle's maximum speed ( $V_{max}$ ), whichever is less. The UNECE Regulation No. 78 test requires that motorcycle braking performance and behavior be recorded; however, it does not have specific performance requirements. The performance required by JSS 12-61 includes achieving a mean fully developed deceleration (MFDD) of at least 5.8 m/s<sup>2</sup> or coming to a stop prior to the equivalent braking distance. The high-speed effectiveness test of FMVSS No. 122 is conducted from a test speed that is based on the speed capability of the motorcycle, not exceeding 193.2 km/h (120 mph). When tested at the maximum speed of 120 mph, the required stopping distance is 861 feet (262.5 meters), equivalent to an average deceleration of 5.5 m/s<sup>2</sup>. Based on these figures, the FMVSS No. 122 test appears to be more stringent due to the higher test speed, whereas the JSS 12-61 appears to be more stringent based on a deceleration requirement.

The test conditions for current FMVSS No. 122 and the UNECE Regulation No. 78/JSS 12-61 high speed tests are quite similar, including the motorcycle test mass and the simultaneous application of both brakes. The main difference between test parameters, besides the difference in the motorcycle test speeds, is that the FMVSS No. 122 test is conducted with the engine disconnected (clutch disengaged), whereas the UNECE Regulation No. 78/JSS 12-61 test is conducted with the engine connected (clutch engaged). With a connected engine, the subsequent engine braking can assist in the deceleration of the motorcycle. This effect is reduced to a minimum by placing the transmission in the highest gear during the braking maneuver. The benefit of having the engine connected is the effect of stabilizing the motorcycle while braking from such a high speed.

Based on the NHTSA/Transport Canada Review of Motorcycle Brake Standards,<sup>16</sup> it was determined during development of the GTR that 100 mph

(160 km/h) or 0.8  $V_{max}$  is adequate for a high speed effectiveness test since the benefits of testing from higher speeds do not warrant the potential hazard to which the rider is exposed. The GTR limits the test speed to 160 km/h to address test facility limitations and safety concerns. The FMVSS No. 122 and JSS 12-61 performance requirements are very similar from a maximum speed of 160 km/h. The equivalent average deceleration in FMVSS No. 122 is 5.5 m/s<sup>2</sup> from 100 mph, compared to the JSS 12-61 MFDD of 5.8 m/s<sup>2</sup> from 160 km/h. In actual testing, the performance differences for the high-speed tests were too small to clearly identify one testing procedure as being more stringent than the other. The GTR also specifies that the high speed test be conducted with the motorcycle engine connected and the transmission in the highest gear, per JSS 12-61, which has the effect of enhancing motorcycle stability during braking from test speeds of 160 km/h.

### 4. Wet Brake Test

The proposed wet brake test provision differs from the current FMVSS No. 122 wet brake test in that instead of submerging the brake system in water and then testing the brakes, the water is sprayed directly onto the brakes during the test. This procedure is based on UNECE Regulation No. 78 and JSS 12-61, which the reviews of motorcycle brake standards found to be more stringent than current FMVSS No. 122. Accordingly, we believe that motorcycle brake safety will be enhanced as a result of this change in wet brake test procedure.

The purpose of the wet brake test is to ensure a minimum level of braking performance when the motorcycle is ridden in heavy rain conditions. Each of the major national motorcycle brake regulations, UNECE Regulation No. 78, FMVSS No. 122, and JSS 12-61, includes a wet brake test, but different philosophies are found in them. The UNECE Regulation No. 78 and the JSS 12-61 test procedures and performance requirements are similar, but are different from the FMVSS No. 122 test. UNECE Regulation No. 78 was developed 20 years ago in the United Kingdom to deal with problems in the field where the braking performance of motorcycles with exposed disc brakes was significantly reduced when ridden in heavy rain. This coincided with the large scale introduction of disc brakes on motorcycles. Therefore, in order to simulate heavy rain conditions, the UNECE Regulation No. 78 test requires a brake performance test with a wetted brake. This is achieved by spraying

<sup>16</sup> This study will be posted in the current docket.

water directly onto the brakes during the test. The UNECE Regulation No. 78 wet brake performance evaluation begins with a baseline test where each brake is tested separately and is required to decelerate a laden motorcycle at a specified rate, using the conditions of the dry stop test—single brake control actuated. For comparison, the same test is then repeated, but with a constant spray of water to wet the brakes. The difference in performance is evaluated immediately after the application of the respective brake, to ensure a minimum rise in deceleration performance with wet brakes. In addition, a drying brake can sometimes result in an excessively high pad friction leading to motorcycle instability and wheel lock; therefore a check for this “over recovery” is also included.

As with the UNECE Regulation No. 78/JSS 12–61 requirement, the current FMVSS No. 122 specifies an evaluation of wet brake performance by comparison of a baseline dry stop test result with performance after wetting. However, the philosophy behind the test is quite different, as the test is based on brake performance recovery following the motorcycle crossing an area of standing water. As such, the wetting procedure consists of immersing the front and rear brakes in water, separately, for two minutes each. Performance is evaluated with all brakes applied simultaneously and the wet brake recovery performance is based on the fifth stop after having immersed the brakes. The motorcycle is also tested in the lightly-loaded condition. Practical problems can occur when carrying out the brake immersion, due to low exhaust systems and other mechanical system locations, which may affect the motorcycle engine or transmission.

The respective brake regulations address minimum performance requirements for wet brakes, albeit under different conditions. In terms of the overall performance requirements, the stringency comparison studies by NHTSA/Transport Canada and the industry both concluded that the UNECE Regulation No. 78/JSS 12–61 performance requirements are more stringent. During development of the GTR, it was agreed that the UNECE Regulation No. 78/JSS 12–61 procedure akin to braking while riding in the rain is a more common operating condition than crossing an area covered with water. Therefore, consistent with the GTR, the proposed wet brake test is based on the contents of the UNECE Regulation No. 78/JSS 12–61 test, and is applicable to all motorcycle categories. At present, the UNECE Regulation No. 78/JSS 12–61 procedure excludes brakes

that are fully enclosed because water is prevented from reaching the braking surface. For the purposes of the GTR, however, there was general agreement that the scope be expanded to include testing of enclosed disc brakes or drum brakes that have ventilation or inspection holes, as these include potential entry points for water spray.

#### 5. Heat Fade Test

We propose to change the current FMVSS No. 122 heat fade test to the GTR heat fade test provision, which is based on the UNECE Regulation No. 78 and JSS 12–61 fade test, because the results from both stringency studies indicated that the latter fade test is more stringent than the current FMVSS No. 122 fade test. The heat fade test ensures that a minimum level of braking performance is maintained after numerous consecutive brake applications. In terms of real world conditions, this could be akin to frequent braking while driving in a busy suburban area or on a downhill gradient. Each of the current national regulations includes a test to evaluate the brake for heat fade and any change in brake performance.

As with the wet brake test, the UNECE Regulation No. 78 and JSS 12–61 share the same test procedure and performance requirements. Each requires that the brakes be tested separately, with the motorcycle loaded to its maximum mass capacity. The FMVSS No. 122 test parameters are different in that all brakes are applied simultaneously and the motorcycle test mass is set at 200 pounds (90.7 kg) above the unloaded motorcycle mass (the 200 pounds includes the mass of the test rider and test equipment).

Each test begins with a baseline test with an IBT between 55 °C and 100 °C, which provides the benchmark for performance comparison and evaluation of the heated brakes. This is followed by 10 consecutive fade stops with the purpose of building heat within the brakes. The similarities between national regulations end here. In the UNECE Regulation No. 78/JSS 12–61, the final performance test occurs with one stop immediately following the 10 fade stops. FMVSS No. 122 specifies an additional five recovery stops, and the performance in the fifth stop is compared to the baseline performance. The respective regulation test parameters include additional differences such as initial test speeds, brake lever and pedal control forces, deceleration rates, and the transmission gear selection (engine connected/disconnected). Finally, to evaluate brake fade performance, the FMVSS No. 122

procedure compares the brake pedal and lever actuation forces necessary to maintain the same deceleration as in the baseline test, whereas the UNECE Regulation No. 78/JSS 12–61 procedures compare deceleration (or stopping distance) for the same brake pedal and lever actuation forces as used in the baseline test.

Although the national regulations have distinct differences, they share the common goal of evaluating the effect of heat on braking performance. The stringency of the respective tests was evaluated separately by the joint NHTSA and Transport Canada study, and by the industry. The results from both studies indicated that the UNECE Regulation No. 78/JSS 12–61 fade test was more stringent, thus providing the basis for the testing specifications of the GTR.

Minor adjustments were made to the referenced national test procedure. In addition to the IBT adjustment, the text was revised to use the average brake control force from the baseline test, calculated from the measured values between 80 percent and 10 percent of the specified vehicle test speed. The brake heating procedure was also made more objective. UNECE Regulation No. 78 presently requires that the motorcycle decelerate to the lesser of 3 m/s<sup>2</sup> or the maximum achievable deceleration rate with that brake control. For the purposes of the GTR, the latter performance requirement is made more objective by specifying that, at a minimum, the motorcycle meet the deceleration rate for the dry stop test—single brake control actuated, as noted in Table 2.

The proposed fade test is applicable to motorcycle categories 3–3, 3–4 and 3–5, as is presently the case in the UNECE Regulation No. 78/JSS 12–61 and FMVSS No. 122. Only Canada’s national regulation, FMVSS No. 122, includes a fade test requirement for motorcycles with an engine size less than 50 cc and a top speed less than 50 km/h (*i.e.*, motorcycle categories 3–1 and 3–2). However, during development of the GTR, none of the participants in the informal group could substantiate the need to include the fade test for those motorcycle categories. There was no negative experience reported due to the absence of a fade test for these smaller motorcycles, and therefore the GTR does not specify the heat fade test for such motorcycles.

#### 6. Parking Brake System Test

The proposed parking brake test would improve upon the current FMVSS No. 122 parking brake system test by specifying a more stringent

loading condition. The purpose of the parking brake system performance requirement is to ensure that motorcycles required to be equipped with parking brakes can remain stationary without rolling away when parked on an incline.

The current FMVSS No. 122 specifies that the parking brake system be capable of holding the motorcycle stationary for five minutes when tested in the lightly-loaded condition on a 30 percent grade, in both the forward and reverse directions (to the limit of traction of the braked wheels). In addition, FMVSS No. 122 requires that the parking brake be of a friction type with solely mechanical means to retain engagement. The parking brake requirements in UNECE Regulation No. 78/JSS 12–61 are equivalent and require that the brake must be capable of holding the motorcycle stationary on an 18 percent grade in the laden condition (*i.e.*, the maximum weight limit specified by the manufacturer), in both the forward and reverse directions. No time limit is specified in either the UNECE or JSS regulation.

The GTR uses the UNECE Regulation No. 78/JSS 12–61 parking brake test. The level of stringency appears to be similar to that in FMVSS No. 122, given the UNECE Regulation No. 78's laden condition on an 18 percent grade versus the FMVSS No. 122's lightly-loaded condition on a 30 percent grade. During development of the GTR, however, it was agreed that the laden condition is the worse case loading condition and test facilities around the world are more likely to have an 18 percent grade than a 30 percent grade available for testing.

Consistent with the GTR, the proposed parking brake test includes a performance requirement that the motorcycle remain stationary for five minutes, which is present in current FMVSS No. 122. In addition, the GTR retains the common requirement that the parking brake system be designed to retain engagement solely by mechanical means, but not include the current FMVSS No. 122 requirement that the parking brake be of a friction type. This removes a design restriction and allows a manufacturer to use any parking brake system design that retains engagement by mechanical means.

#### 7. Antilock Brake System (ABS) Performance Test

The current FMVSS No. 122 does not have any requirements for ABS performance. The proposed rule does not require ABS but does contain ABS performance requirements when such brake systems are present, to ensure minimum ABS performance in

motorcycles that are so equipped. The purpose of the specified ABS test procedures is to assess the stability and stopping performance of a motorcycle with the ABS functioning.

UNECE Regulation No. 78 and JSS 12–61 include ABS-specific performance requirements but do not require that ABS be fitted on motorcycles. Common to both national regulations are wheel lock tests on high-friction and low-friction surfaces and an ABS failed systems performance test. In addition, the UNECE Regulation No. 78 performance requirements include an ABS adhesion utilization (*i.e.*, efficiency) test on high-friction and low-friction surfaces, a high-friction surface to low-friction surface transition stop and a low-friction surface to high-friction surface transition stop. As mentioned above, current FMVSS No. 122 does not include any ABS-specific performance requirements.

The agency believes that the ABS definition developed for the GTR to upgrade FMVSS No. 122 is not as comprehensive as the ABS definition the agency uses in other Federal motor vehicle safety standards, FMVSS No. 105, *Hydraulic and Electric Brake Systems*; FMVSS No. 121, *Air Brake Systems*; and FMVSS No. 135, *Light Vehicle Brake Systems*. However, we believe both definitions can be interpreted to mean the same thing. The two definitions are presented below:

- GTR Definition: *Antilock brake system or ABS* means a system which senses wheel slip and automatically modulates the pressure producing the braking forces at the wheel(s) to limit the degree of wheel slip.
- The current FMVSS Definition: *Antilock brake system or ABS* means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

- (1) Sensing the rate of angular rotation of the wheels;
- (2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which interpret those signals and generate responsive controlling output signals; and
- (3) Transmitting those controlling signals to one or more modulators which adjust brake actuating forces in response to those signals.

The agency seeks comment on the proposed GTR definition and on the ABS definition used in the other braking standards.

During the development of the GTR, each of the ABS performance tests and their corresponding requirements was reviewed to assess their appropriateness for the proposed motorcycle brake

system GTR.<sup>17</sup> With the exception of the ABS adhesion utilization test and the low-friction surface to high-friction surface transition stop, the Contracting Parties agreed to adopt, with selected revisions and clarifications, the remaining ABS test procedures and performance requirements. Possible alternatives for those tests on which agreement was not achieved are discussed further below.

In the case of the wheel lock test on a low-friction surface, the present UNECE Regulation No. 78 states that for a road surface with a PBC less than or equal to 0.45, the specified initial test speed of 80 km/h may be reduced for safety reasons, but does not specify by how much. In order to ensure consistency in the way the motorcycles are evaluated and to achieve the objective of rider safety, the GTR and proposed rule specify that the test speed is the lesser of 0.8 Vmax or 60 km/h for the low-friction surface test.

With regard to the low-friction to high-friction surface transition test, it was initially suggested that the motorcycle be evaluated while crossing from a wetted low-friction surface to a wetted high-friction surface (with a PBC exceeding 0.8). There was no reported issue in obtaining a wetted surface with a PBC exceeding 0.8 during the ABS validation tests. However, it was noted that there might be a problem in obtaining such a PBC on a wetted surface, and therefore the GTR removed all references to a wetted surface.

Finally, when evaluating the performance of the ABS, the GTR specifies that the ABS be cycling throughout the respective tests. This means that the ABS is repeatedly modulating the brake force to prevent the directly controlled wheels from locking. Depending on the system, some brake feedback may be felt through the brake control, such that it is not possible to maintain the specified control force. Data obtained during the ABS validation tests revealed challenges while trying to maintain a consistent maximum brake control force, within the 20 percent range as initially proposed. Also, of the motorcycles tested, all ABS systems cycled at brake control actuation forces well below the proposed maximum limits.

The GTR specifies that the test rider apply sufficient force to ensure that the ABS is fully cycling throughout the test. Two methodologies were considered to accomplish this result. The first was based on the tests in UNECE Regulation

<sup>17</sup> ABS performance test reviews used in the drafting of GTR provisions will be posted in the docket.

No. 78, in which minimum brake control actuation forces are specified, with the caveat that a higher force may be used if necessary to activate the ABS. In this case, it was agreed that stipulating minimum brake actuation forces was unnecessary; therefore the first method considered was simply to apply the necessary brake actuation force to activate the ABS. The second method considered specified maximum brake control actuation forces that cannot be exceeded. Unlike the first method, the second method was designed to ensure that all riders would have the benefit of the operation of ABS at or below specified maximum brake actuation forces, under the specified test conditions, and to facilitate verification testing. However, some cautioned that the latter method would also restrict design, which is not a desirable condition.

Although the validation testing did provide important information toward setting maximum brake control actuation forces, there was concern that too few motorcycles were tested to allow setting fixed limits. Therefore, the GTR specifies the first method noted above.

#### a. ABS Performance Test—Stopping Performance Requirement

An adhesion utilization test is included in the UNECE regulation only, and compares the separate performance of the front and rear ABS brakes to the separate maximum braking performance of the front and rear brakes with the ABS disabled. It is evaluated on two road surfaces, a high-friction surface and a low-friction surface.

Several discussions were held on the issues of test repeatability and variability of the results. The UNECE Regulation No. 78 test has a potential for producing less repeatable results because it is a test of the maximum motorcycle braking performance as achieved by the rider of the motorcycle. Numerous factors come into play when attempting to achieve maximum performance, including rider skill, the condition of the test equipment and site (tires, brakes and track surface), and the weather conditions. For example, the performance of ABS may be favorable when tested by a poorly performing rider; however, the efficiency of ABS can diminish significantly when tested by an expert rider.

In conducting such tests, some ABS efficiency results were noted to exceed 100 percent (*i.e.*, improved deceleration compared to non-ABS braking performance), which can occur when the test rider is not able to achieve the maximum available deceleration rate. In

addition to rider influence, we believe that the UNECE Regulation No. 78 procedure is flawed in that it prescribes a constant control force for the entire stop. The available surface friction (*i.e.*, peak braking coefficient, or PBC) increases as the motorcycle speed decreases, and thus the ABS system will have the advantage of higher deceleration rates at lower speeds. Therefore, to obtain the maximum deceleration capability without ABS, it is expected that the rider would have to increase the braking control force as the motorcycle is being decelerated.

Safety and logistical issues were also noted with the UNECE Regulation No. 78 adhesion utilization test:

- *Rider safety.* The test requires that the rider achieve an impending locked-wheel braking condition with the ABS disabled, to obtain maximum deceleration data with which to evaluate ABS in later tests. This impending locked-wheel braking condition is at the beginning of loss-of-control of the motorcycle, which could result in a crash. Even with protective outriggers in place, it is a hazardous condition that is asked of the test rider.
- *Logistical.* The test requires modifying the brake system to disable the ABS. This may not be a simple task, or may not be possible depending on the complexity of the motorcycle brake system. Furthermore, the standard requires that maximum deceleration be recorded with an altered brake system (*i.e.*, with disabled ABS), hence possibly outside the manufacturer's design parameters.

In light of these issues, alternate ABS tests were developed at the fourth informal group meeting in June 2005, based on the UNECE Regulation No. 78. The tests developed consisted of braking on both high- and low-friction surfaces with ABS cycling, but with emphasis placed on maintaining motorcycle stability rather than actual stopping performance. Nevertheless, the tests also specified stopping performance for the high-friction surface test only, based on the minimum performance requirements of the general UNECE Regulation No. 78 dry stop test. The developed tests did not specify a stopping distance performance requirement for the low-friction surface test, as there was no baseline test in UNECE Regulation No. 78 with which to compare it. The tests neither required the brake system to be altered, nor the rider to attempt to obtain the maximum attainable deceleration rate, thereby addressing the safety and logistical issues.

This alternate test was presented at the 58th GRRF in September 2005. While there was no issue raised with

regard to the test procedure, the relative stringency of the stopping performance requirements was thought to be too low compared to the existing UNECE Regulation No. 78 ABS requirement, which could result in unnecessarily long stopping distances when ABS is cycling.

The ABS test agreed on for the GTR and proposed here is conducted with all service brake controls actuated simultaneously, whereby brake and stability performance requirements are measured on low- and high-friction surfaces. The benefits of testing all service brake controls simultaneously include being able to compare the motorcycle ABS deceleration performance to the available PBC, without modification of the brake system and without rider influence.

The brake performance requirement is based on the UNECE Regulation No. 78 requirement that braking with the ABS cycling shall meet at least 70 percent of the maximum braking performance without ABS. Regarding stability during the ABS tests, the proposal defines wheel lock as the condition where the wheel attains 100 percent slip, and states in several of the performance requirements of the ABS tests that there must be no wheel lock. We are aware that momentary wheel lock at 100 percent slip may occur during normal cycling of the ABS but note that it is difficult to establish a proposed time frame for such momentary lock-up duration. As a result, for the ABS tests, the regulatory text includes that wheel lock is allowed as long as the stability of the motorcycle is not affected to the extent that it requires the operator to release the control or causes the motorcycle to pass outside the test lane.

Unlike the high-friction surface where measurement of PBC yields consistent results, PBC values can vary on the same low-friction, wetted surface. Given this characteristic, a range of PBC values is necessary for the low-friction ABS tests. Following the ABS validation tests, the proposed specification of a PBC range from 0.3 to 0.45 on a low-friction surface was revised as none of the track surfaces on which the motorcycles were tested fell in this range. The GTR specifies that the track surface have a PBC less than or equal to 0.45, and that the performance requirement is based on 70 percent of the track surface PBC at the time of testing. This is a more stringent requirement than previously considered in the development of the GTR's ABS tests, whereby the performance requirement was based on a PBC of 0.3, even though the motorcycle could be tested on a surface with a PBC of 0.45.

Braking performance in terms of stopping distance and deceleration for individually braked wheels was also considered. Maximum braking performance at each wheel is significantly affected by the motorcycle design. For example, different braking effectiveness is available through the rear wheel of a sport motorcycle compared to that of a cruiser motorcycle. Therefore, it is not possible to set constant maximum stopping distance or deceleration performance requirements for each wheel individually, for all motorcycle types. Given this, and that individual wheel braking performance is already covered in the dry stop test—single brake control actuated test, further testing for individually braked wheels is not considered necessary. In the event of a motorcycle with ABS installed on only one wheel, the test rider can still apply all service brake systems simultaneously as specified to meet the stability and stopping performance requirements.

**b. ABS Performance Test—Low-Friction to High-Friction Surface Transition Stop**

This is an existing test in UNECE Regulation No. 78, with the performance requirement that the motorcycle does not deviate from its initial course and that its deceleration shall rise to an “appropriate” value in a “reasonable” time. To make the test more objective, actual performance values were incorporated in the GTR test to define what is appropriate and reasonable.

At the fifth informal meeting in October 2005, Japan presented some preliminary test data that revealed a wide range of ABS performance responses to the sudden change in surface friction. Thus, at that time, it was not possible to determine a specific value that would be required to improve the objectivity of the UNECE test. The subsequent ABS validation tests provided additional insight in this regard, with a view to establishing specific performance requirements. In all cases, a rise in deceleration could be observed in a graphical depiction of the motorcycle deceleration over time, to various degrees. Regarding the response time to the change in surfaces, the actual test surfaces and the methods used to calculate the time interval varied sufficiently to make it difficult to define a time limit on the basis of the testing so far. Based on this data, the GTR introduced a limit of 1.0 seconds in order to match the current UNECE requirement that the deceleration should rise in a “reasonable time,” although there was very limited, confirmed technical support for such a figure. It was also agreed that when

more data becomes available, these specifications could be reconsidered.

Setting a minimum performance requirement to account for a rise in deceleration proved more difficult. Different criteria were applied to establish a method to objectively quantify changes in the deceleration rates before and after the transition point. Although each criterion yielded a rise in deceleration, the magnitude of the rise in the deceleration varied over time. This variation is related to the operating characteristics of the ABS as it cycles the brakes, which causes the motorcycle to slow at different deceleration rates throughout the stop. For the same motorcycle, ABS cycling can change depending on various factors including the available traction at that time, as interpreted by the hardware and software that comprises the ABS system. These provide sinusoidal-like deceleration signatures, before and after the transition point. As such, there is no clear point where the deceleration can be shown to have increased. Rather, a segment of the deceleration data shall be analyzed, before and after the transition point, from which trends can be established to compare deceleration rates.

In view of these findings, validation testing has demonstrated a need for further data analysis and possibly the testing of a larger sample of motorcycles to propose performance limits in terms of a minimum deceleration rate. In terms of quantifying a minimum rise in deceleration, the GTR keeps the performance requirement general, by stating that the deceleration shall increase after passing over the transition point.

**8. Partial Failure Test—Split Service Brake System**

The current FMVSS No. 122 partial failure test remains largely unchanged, except for a change in the terminology of applicability due to the newly proposed motorcycle categories. This is not a substantive change, as current FMVSS No. 122 indicates that the partial service brake system failure test “do[es] not apply to a motor-driven cycle whose speed attainable in 1 mile is 30 m.p.h. or less,” and the proposed partial failure test specifications are not applicable to motorcycle categories 3–1 and 3–2. Motorcycle categories 3–1 and 3–2 are motorcycles with a maximum design speed not exceeding 50 km/h (31.1 mph). Thus, the proposed service brake system partial failure test is not substantially different from the current FMVSS No. 122 test.

A motorcycle split service brake system is based on the passenger car

brake system. Its use is unique to motorcycles in Canada and the United States. The purpose of this test is to ensure that, in the event of a pressure component leakage failure in one of the hydraulic subsystems, a minimum level of braking performance is still available in the remaining hydraulic subsystem to allow the rider to bring the motorcycle to a stop. FMVSS No. 122 is the only national regulation that addresses a failure test for motorcycles equipped with a split service brake system.

**9. Power-Assisted Braking System Failure Test**

The current FMVSS No. 122 does not have any performance requirements to test the failure of a power-assisted braking system. The proposed rule would not require power-assisted braking systems but does contain performance requirements for when such brake systems fail, to ensure minimum brake system performance in motorcycles that are so equipped. None of the world’s motorcycle brake regulations or standards currently include such a performance requirement, most likely because the application of power-assisted braking systems on motorcycles is relatively new.

The GRRF recognized that some motorcycles are presently equipped with power-assisted braking systems, and that the use of such systems could expand in the future. Existing standards are limited to motor vehicles where this technology has been in use for many years, such as on passenger cars. At present, however, there is no known performance requirement in the event of the failure of a power-assisted braking system on a motorcycle. The GTR therefore specifies a test to ensure that, in the event of a power-assisted braking system failure, a minimum level of braking performance is still available to allow the rider to bring the motorcycle to a stop. Certifying to the performance requirement is not required if the motorcycle is equipped with another separate service brake system that operates without power-assist.

In summary, the proposed test is based on the dry stop test—single brake control actuated (paragraph S6.3 of the proposed FMVSS No. 122), whereby the minimum performance requirement was initially set to that specified for the secondary brake system for motorcycles equipped with CBS. In developing the GTR, some believed this performance requirement was too low. For the revised version of the test, in the case of separate service brake systems, each brake control shall be tested separately and capable of meeting the minimum

brake performance for the single rear brake system. In the case of motorcycles equipped with CBS or a split service brake system, the proposed rule, consistent with the GTR, specifies testing of each brake control separately and the minimum performance requirements are those for the secondary brake system.

### C. Summary of Improvements

This proposal, if made final, would improve the current FMVSS No. 122 requirements and test procedures in several areas. First, it would make the dry brake test requirement more stringent by specifying testing of each service brake control individually with the motorcycle in the fully loaded condition (“laden”). Second, the proposal would establish a more stringent high speed test requirement by specifying a slightly higher rate of deceleration. Third, the proposal would replace the existing wet brake test with one that better simulates actual in-service conditions, by spraying water onto the brake disc instead of submerging the brake system before testing. Fourth, the proposal would specify an improved heat fade test based on European and Japanese national regulations, which share the same test procedure and performance requirements. Fifth, the proposal would mandate performance requirements for antilock brake systems when motorcycles are so equipped. Finally, the proposal would establish a new power-assisted braking system failure test requirement to evaluate the motorcycle’s performance in the event of a failure in the power-assisted braking system, if fitted.

### VI. Benefits, Costs, and the Proposed Compliance Date

Although this proposal would add and update FMVSS No. 122 test procedures, we anticipate that virtually all motorcycles sold in the U.S. can meet the performance requirements as proposed, and thus, there is no measurable safety benefit derived from the proposal. However, NHTSA believes that the proposed performance requirements would help ensure the safety of motorcycle brake systems and thus have a beneficial effect on safety. The proposal includes several tests that would update and enhance performance requirements—tests both at the fully loaded condition (“laden”) and lightly loaded vehicle weight, which ensure adequate braking performance at the two extremes of the loading conditions; a wet brake test that is more representative of the manner in which brakes are wetted during real world

riding in wet conditions; a variety of ABS performance tests, for motorcycles so equipped, to ensure adequate antilock performance during emergency braking or on slippery road conditions; and a new test in the event of a failure in the power-assisted braking system, if a motorcycle is so equipped.

Moreover, as mentioned above, motorcycle manufacturers, and ultimately, consumers, both here and abroad, can expect to achieve cost savings through the formal harmonization of differing sets of standards when the Contracting Parties to the 1998 Global Agreement implement the Motorcycle Brake Systems GTR. Harmonization enables motorcycle manufacturers to test their models to just one regulation/series of tests to sell globally.

We believe that although the proposal would add some new requirements to FMVSS No. 122 and replace some test procedures and performance requirements with ones based on more stringent standards used in another national regulation, none of the proposed tests would result in measurable costs to motorcycles. The proposal includes performance requirements that constitute the best practices from various standards and regulations. Some of the tests, such as the wet brake test, the ABS performance requirements, and the tests in the loaded condition, are an upgrade to the existing FMVSS No. 122. But current FMVSS No. 122 does not reflect the advancement of modern braking technologies, and motorcycles sold in the U.S. can virtually all meet the performance requirements as proposed without any major design changes. The agency believes that motorcycles sold in the U.S. market can comply with the requirements of ECE Regulation No. 78 and JSS 12–61 without any modifications, and vice versa. As a result, any costs for design changes by motorcycle manufacturers to comply with the proposed performance requirements are expected to be negligible. Also, additional testing costs to comply with ABS performance requirements, if the motorcycle is equipped with ABS, are expected to be minimal.

The agency has tentatively determined that virtually all of the current motorcycle fleet would comply with the proposal, if made final. Therefore, we are proposing to make the upgraded requirements mandatory at the beginning of the first September that is two full years after the publishing of a final rule. For example, if a final rule is adopted on December 1, 2009, compliance would be mandatory

beginning September 1, 2012. Optional early compliance would be permitted on and after 30 days after the date of publication of a final rule in the **Federal Register**.

### VII. U.S. Selection of Options Within the GTR

This NPRM fulfills our obligation to initiate domestic rulemaking to adopt the provisions of the GTR. The NPRM is based on the Motorcycle Brake Systems GTR. Certain provisions of the GTR contain options that Contracting Parties may select from when implementing the GTR into their national regulations. NHTSA’s specifications where there are options in the GTR are explained here:

- We propose to specify that peak braking coefficient (PBC) be measured using the ASTM E1136 standard reference test tire, in accordance with ASTM Method E1337–90. In the GTR, the decision was made not to specify the method used to measure the coefficient of friction but leave it to the national regulations to choose which of two test methods enumerated in the GTR should be used to measure PBC.

- We specify in high friction test surface conditions a PBC equal to 0.9 instead of a “nominal” PBC of 0.9 to make the proposed test procedures more objective.

- We propose that the initial brake temperature (IBT) be measured by plug-type thermocouples, as opposed to rubbing-type thermocouples. The two methods of measuring the IBT are included in the GTR and each Contracting Party must specify which temperature measurement it will use in its national regulation.

- The GTR includes a requirement stating that the “brake linings shall not contain asbestos.” The GTR includes this requirement, which was adopted from UNECE Regulation No. 78, even though no test method or performance measure is included in the GTR to determine that the lining contains no asbestos. None of the brake standards in the Federal motor vehicle safety standards, including FMVSS No. 122, contain any requirement concerning the material of the brake lining. Concerns about asbestos relate to long-term environmental exposure. This is not within the scope of our rulemaking authority. Therefore, this NPRM does not include the proposal stating that “brake linings shall not contain asbestos.”

- We propose adding a parenthetical to the GTR parking brake test that is present in current FMVSS No. 122 (*see* current S5.6, S7.9; proposed S6.8.3). In 1978, NHTSA amended the FMVSS No.

122 parking brake test, clarifying that the test does not specify that a motorcycle be held on a 30 percent grade for 5 minutes if the limit of traction of its braked wheels is reached on a lower grade so that the motorcycle begins to slide (43 FR 46547, Oct. 10, 1978). This amendment was based on an interpretation the agency provided in response to a petition for exemption by a company whose motorcycle's limit of traction was reached on a 20 percent grade. The amendment had no effect upon the safety of the rule since it was a statement and clarification of an existing agency interpretation. A similar limit-of-traction provision exists with respect to the parking brake system performance requirements for hydraulically braked motorcycles (§5.2.1 of 49 CFR 571.105).

- While most of the current tests in FMVSS No. 122 evaluate performance through stopping distance, the UNECE Regulation No. 78 and JSS 12-61 test methods allow brake performance to be measured through the use of either mean fully developed deceleration or stopping distance. While the GTR specifies performance requirements in reference to the respective national regulation on which the test was based, the performance tests proposed by NHTSA measure performance exclusively in stopping distance where applicable, to enhance enforceability of the Standard as opposed to providing optional performance measures. This is consistent with how performance requirements are stated in other Federal motor vehicle safety standards. This differs from the GTR in that our proposed performance tests do not allow manufacturers a choice to measure performance using either deceleration or stopping distance, but requires measurement of performance using stopping distance only where it is the applicable performance measure.

The Executive Committee of the 1998 Agreement and WP.29 are aware that the U.S. intended to make these choices as allowed in the GTR. We believe that the proposed provisions, if adopted, would improve motorcycle brake systems in the United States.

## VIII. Regulatory Analyses and Notices

### A. Vehicle Safety Act

Under 49 U.S.C. Chapter 301, *Motor Vehicle Safety* (49 U.S.C. 30101 *et seq.*), the Secretary of Transportation is responsible for prescribing motor vehicle safety standards that are practicable, meet the need for motor vehicle safety, and are stated in objective terms. 49 U.S.C. 30111(a). When prescribing such standards, the

Secretary must consider all relevant, available motor vehicle safety information. 49 U.S.C. 30111(b). The Secretary must also consider whether a proposed standard is reasonable, practicable, and appropriate for the type of motor vehicle or motor vehicle equipment for which it is prescribed and the extent to which the standard will further the statutory purpose of reducing traffic accidents and associated deaths. *Id.* Responsibility for promulgation of Federal motor vehicle safety standards was subsequently delegated to NHTSA. 49 U.S.C. 105 and § 322; delegation of authority at 49 CFR 1.50.

The agency carefully considered these statutory requirements in proposing these amendments to FMVSS No. 122. We believe that the proposed amendments to FMVSS No. 122 are practicable. This document does not propose significant changes to the current performance requirements of FMVSS No. 122. Currently, we believe that all motorcycle brakes will pass the proposed tests. Additionally, if made final, the amendments would harmonize the U.S. requirements with the Motorcycle Brake Systems Global Technical Regulation.

We believe that this proposed rule would be appropriate for the vehicles subject to the performance requirements. If adopted, the proposal would continue to exclude motorcycles for which the requirements and test procedures are impractical or unnecessary (e.g., low-speed motorcycles, categories 3-1 and 3-2, continue to be excluded from the heat fade test).

Finally, the agency has tentatively concluded that the proposed amendments would provide objective procedures for determining compliance. The proposed test procedures have been evaluated by the agency, and we have tentatively concluded that they help achieve repeatable and reproducible results. Further, we are proposing test procedures to provide improved objectivity to existing performance requirements.

### B. Executive Order 12866 and DOT Regulatory Policies and Procedures

NHTSA has considered the impacts of this rulemaking action under Executive Order 12866 and the Department of Transportation's related policies and procedures. This rulemaking document was not reviewed by the Office of Management and Budget under E.O. 12866. It is not considered to be significant under the Department's Regulatory Policies and Procedures (44 FR 11034, Feb. 26, 1979). This

document proposes test procedures and performance requirements that would impose minimal additional costs on manufacturers, and is not expected to require design changes to current motorcycles. Given the minimal impacts of the proposed rule, we have not prepared a full regulatory evaluation.

NHTSA does not anticipate direct safety benefits from this proposed rule. However, NHTSA believes that the proposed performance requirements would help ensure the safety of motorcycle brake systems and thus have a beneficial effect on safety.

### C. Executive Order 13132 (Federalism)

Executive Order 13132 requires NHTSA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government." Under Executive Order 13132, the agency may not issue a regulation with Federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, the agency consults with State and local governments, or the agency consults with State and local officials early in the process of developing the proposed regulation. NHTSA also may not issue a regulation with Federalism implications and that preempts State law unless the agency consults with State and local officials early in the process of developing the proposed regulation.

NHTSA has examined today's proposal pursuant to E.O. 13132 and concluded that no additional consultation with States, local governments or their representatives is mandated beyond the rulemaking process. The agency has concluded that the proposal does not have federalism implications because the rule does not have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

Further, no consultation is needed to discuss the preemptive effect of this NPRM. NHTSA rules can have

preemptive effect in at least two ways. First, the National Traffic and Motor Vehicle Safety Act contains an express preemption provision: "When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter." 49 U.S.C. 30103(b)(1). It is this statutory command that preempts State law, not today's rulemaking, so consultation would be inappropriate.

Second, in addition to the express preemption noted above, the Supreme Court has recognized that State requirements imposed on motor vehicle manufacturers, including sanctions imposed by State tort law, can stand as an obstacle to the accomplishment and execution of a NHTSA safety standard. When such a conflict is discerned, the Supremacy Clause of the Constitution makes the State requirements unenforceable. See *Geier v. American Honda Motor Co.*, 529 U.S. 861 (2000). NHTSA has not discerned any potential State requirements in connection with the proposed rule, however, in part because such conflicts can arise in varied contexts. We cannot completely rule out the possibility that, if the proposal is adopted as a final rule, such a conflict might become apparent in the future through subsequent experience with the standard. NHTSA may opine on such conflicts in the future, if warranted.

#### D. Executive Order 13045

Executive Order 13045 (62 FR 19885, April 23, 1997) applies to any rulemaking that: (1) Is determined to be "economically significant" as defined under E.O. 12866, and (2) concerns an environmental, health or safety risk that NHTSA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, we must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by us.

This rulemaking is not subject to the Executive Order because it is not economically significant as defined in E.O. 12866. It also does not involve decisions based on health risks that disproportionately affect children.

#### E. Executive Order 12988 (Civil Justice Reform)

With respect to the review of the promulgation of a new regulation, section 3(b) of Executive Order 12988, "Civil Justice Reform" (61 FR 4729, February 7, 1996), requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Specifies in clear language the preemptive effect; (2) specifies in clear language the effect on existing Federal law or regulation, including all provisions repealed, circumscribed, displaced, impaired, or modified; (3) provides a clear legal standard for affected conduct rather than a general standard, while promoting simplification and burden reduction; (4) specifies in clear language the retroactive effect; (5) specifies whether administrative proceedings are to be required before parties may file suit in court; (6) explicitly or implicitly defines key terms; and (7) addresses other important issues affecting clarity and general draftsmanship of regulations. This document is consistent with that requirement.

Pursuant to this Order, NHTSA notes as follows. The preemptive effect of this proposed rule is discussed above. NHTSA notes further that there is no requirement that individuals submit a petition for reconsideration or pursue other administrative proceeding before they may file suit in court.

#### F. Regulatory Flexibility Act

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996) whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (*i.e.*, small businesses, small organizations, and small governmental jurisdictions). However, no regulatory flexibility analysis is required if the head of an agency certifies the rule would not have a significant economic impact on a substantial number of small entities. The SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide a statement of the factual basis for certifying that a rule would not have a significant economic impact on a substantial number of small entities.

We have considered the effects of this rulemaking action under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) and certify that this proposal would not have a significant economic impact on

a substantial number of small entities. The agency is not currently aware of any motorcycle manufacturer that is considered a small business. The brake systems installed on motorcycles are typically developed by one of the major brake component suppliers, which are independent companies. There are cases where the motorcycle manufacturer may perform some of the brake system design and development in-house, and have the system components manufactured by an outside supplier. NHTSA does not consider any of these businesses to be small business entities that would be significantly economically impacted by this rulemaking.

#### G. National Environmental Policy Act

We have analyzed this proposed amendment for the purposes of the National Environmental Policy Act and determined that it would not have any significant impact on the quality of the human environment.

#### H. Paperwork Reduction Act

Under the Paperwork Reduction Act of 1995, a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid Office of Management and Budget (OMB) control number. The proposed rule does not contain any new information collection requirements.

#### I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA) (Pub. L. 104-113; 15 U.S.C. 272) directs us to use voluntary consensus standards in regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.*, materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies, such as the Society of Automotive Engineers (SAE) and the American Society for Testing and Materials (ASTM). The NTTAA directs us to provide Congress, through OMB, explanations when we decide not to use available and applicable voluntary consensus standards.

ASTM E1136, *Standard Specification for a Radial Standard Reference Test Tire*, and ASTM Method E1337-90, *Standard Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire*, are incorporated by reference in the regulatory text. This is



consistent with the NTTAA because these are industry voluntary consensus standards. NHTSA notes that the above ASTM standards are approved for incorporation by reference under 571.500, *Low-speed vehicles*.

#### J. Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA) requires Federal agencies to prepare a written assessment of the costs, benefits and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local or tribal governments, in the aggregate, or by the private sector, of more than \$100 million in any one year (adjusted for inflation with base year of 1995). Before promulgating a NHTSA rule for which a written statement is needed, section 205 of the UMRA generally requires us to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows us to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if we publish with the final rule an explanation why that alternative was not adopted.

The proposed rule would not impose any unfunded mandates under the Unfunded Mandates Reform Act of 1995. This rulemaking does not meet the definition of a Federal mandate because it would not result in costs of \$100 million or more to either State, local, or tribal governments, in the aggregate, or to the private sector. Thus, this rulemaking is not subject to the requirements of sections 202 and 205 of the UMRA.

#### K. Plain Language

Executive Order 12866 requires each agency to write all rules in plain language. Application of the principles of plain language includes consideration of the following questions:

- Have we organized the material to suit the public's needs?
- Are the requirements in the rule clearly stated?
- Does the rule contain technical language or jargon that isn't clear?
- Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule easier to understand?
- Would more (but shorter) sections be better?

- Could we improve clarity by adding tables, lists, or diagrams?

- What else could we do to make the rule easier to understand?

If you have any responses to these questions, please include them in your comments on this proposal.

#### L. Regulation Identifier Number (RIN)

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

#### M. Privacy Act

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477 at 19478).

#### IX. Public Participation

##### *How do I prepare and submit comments?*

Your comments must be written and in English. To ensure that your comments are correctly filed in the Docket, please include the docket number of this document in your comments.

Your comments must not be more than 15 pages long. (49 CFR 553.21). We established this limit to encourage you to write your primary comments in a concise fashion. However, you may attach necessary additional documents to your comments. There is no limit on the length of the attachments.

Please submit two copies of your comments, including the attachments, to the Docket Management Facility at the address given above under **ADDRESSES**.

Comments may also be submitted to the docket electronically by logging onto the Federal eRulemaking Portal Web site at <http://www.regulations.gov>. Follow the online instructions for submitting comments.

Please note that pursuant to the Data Quality Act, in order for substantive data to be relied upon and used by the agency, it must meet the information quality standards set forth in the OMB and DOT Data Quality Act guidelines.

Accordingly, we encourage you to consult the guidelines in preparing your comments. OMB's guidelines may be accessed at <http://www.whitehouse.gov/omb/fedreg/reproducible.html>. DOT's guidelines may be accessed at <http://dmses.dot.gov/submit/DataQualityGuidelines.pdf>.

*How can I be sure that my comments were received?*

If you wish Docket Management to notify you upon its receipt of your comments, enclose a self-addressed, stamped postcard in the envelope containing your comments. Upon receiving your comments, Docket Management will return the postcard by mail.

*How do I submit confidential business information?*

If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given above under **FOR FURTHER INFORMATION CONTACT**. In addition, you should submit two copies, from which you have deleted the claimed confidential business information, to the Docket Management Facility at the address given above under **ADDRESSES**. When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation. (49 CFR Part 512.)

*Will the agency consider late comments?*

We will consider all comments that Docket Management receives before the close of business on the comment closing date indicated above under **DATES**. To the extent possible, we will also consider comments that Docket Management receives after that date. If Docket Management receives a comment too late for us to consider it in developing a final rule (assuming that one is issued), we will consider that comment as an informal suggestion for future rulemaking action.

*How can I read the comments submitted by other people?*

You may read the comments received by Docket Management at the address given above under **ADDRESSES**. The hours of the Docket are indicated above in the same location. You may also see the comments on the Internet. To read the comments on the Internet, go to

<http://www.regulations.gov>. Follow the online instructions for accessing the dockets.

Please note that even after the comment closing date, we will continue to file relevant information in the Docket as it becomes available. Further, some people may submit late comments. Accordingly, we recommend that you periodically check the Docket for new material.

#### List of Subjects in 49 CFR Part 571

Motor vehicle safety, Reporting and record keeping requirements, Tires.

In consideration of the foregoing, NHTSA proposes to amend 49 CFR 571 as follows:

#### PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

1. The authority citation for Part 571 continues to read as follows:

**Authority:** 49 U.S.C. 322, 30111, 30115, 30117 and 30166; delegation of authority at 49 CFR 1.50.

2. Section 571.122 is revised to read as follows:

#### § 571.122 Standard No. 122; Motorcycle brake systems.

S1. *Scope.* This standard specifies requirements for motorcycle service brake systems and, where applicable, associated parking brake systems.

S2. *Purpose.* The purpose of the standard is to ensure safe motorcycle braking performance under normal and emergency riding conditions.

S3. *Application.* This standard applies to motorcycles.

#### S4. Definitions.

*Antilock brake system* or *ABS* means a system which senses wheel slip and automatically modulates the pressure producing the braking forces at the wheel(s) to limit the degree of wheel slip.

*Baseline test* means a stop or a series of stops carried out in order to confirm the performance of the brake prior to subjecting it to a further test such as the heating procedure or wet brake stop.

*Brake* means those parts of the brake system where the forces opposing the movement of the motorcycle are developed.

*Brake system* means the combination of parts consisting of the control, transmission, and brake, but excluding the engine, whose function it is to progressively reduce the speed of a moving motorcycle, bring it to a halt, and keep it stationary when halted.

*Category 3-1 motorcycle* means a two-wheeled motorcycle with an engine cylinder capacity in the case of a thermic engine not exceeding 50 cm<sup>3</sup>

and whatever the means of propulsion a maximum design speed not exceeding 50 km/h.

*Category 3-2 motorcycle* means a three-wheeled motorcycle of any wheel arrangement with an engine cylinder capacity in the case of a thermic engine not exceeding 50 cm<sup>3</sup> and whatever the means of propulsion a maximum design speed not exceeding 50 km/h.

*Category 3-3 motorcycle* means a two-wheeled motorcycle with an engine cylinder capacity in the case of a thermic engine exceeding 50 cm<sup>3</sup> or whatever the means of propulsion a maximum design speed exceeding 50 km/h.

*Category 3-4 motorcycle* means a motorcycle manufactured with three wheels asymmetrically arranged in relation to the longitudinal median plane with an engine cylinder capacity in the case of a thermic engine exceeding 50 cm<sup>3</sup> or whatever the means of propulsion a maximum design speed exceeding 50 km/h. (This category definition is intended to include motorcycles with sidecars.)

*Category 3-5 motorcycle* means a motorcycle manufactured with three wheels symmetrically arranged in relation to the longitudinal median plane with an engine cylinder capacity in the case of a thermic engine exceeding 50 cm<sup>3</sup> or whatever the means of propulsion a maximum design speed exceeding 50 km/h.

*Combined brake system* or *CBS* means:

(a) For motorcycle categories 3-1 and 3-3: a service brake system where at least two brakes on different wheels are actuated by the operation of a single control.

(b) For motorcycle categories 3-2 and 3-5: a service brake system where the brakes on all wheels are actuated by the operation of a single control.

(c) For motorcycle category 3-4: a service brake system where the brakes on at least the front and rear wheels are actuated by the operation of a single control. (If the rear wheel and the asymmetrical wheel are braked by the same brake system, this is regarded as the rear brake.)

*Control* means the part actuated directly by the rider in order to supply or control the energy required for braking the motorcycle to the transmission.

*Driver mass* means the nominal mass of a driver that equals 75 kg (68 kg occupant mass plus 7 kg of luggage mass).

*Engine disconnected* means when the engine is no longer connected to the driving wheel(s).

*Gross vehicle mass* means the maximum mass of the fully laden solo vehicle, based on its construction and design performances, as declared by the manufacturer.

*Initial brake temperature* means the temperature of the hottest brake before any brake application.

*Laden* means the gross vehicle mass.

*Lightly loaded* means mass in running order plus 15 kg for test equipment, or the laden condition, whichever is less. In the case of ABS tests on a low friction surface (paragraphs 4.9.4. to 4.9.7.), the mass for test equipment is increased to 30 kg to account for outriggers.

*Mass in running order* means the sum of unladen vehicle mass and driver mass.

*Peak braking coefficient* or *PBC* means the measure of tire-to-road surface friction based on the maximum deceleration of a rolling tire.

*Power-assisted braking system* means a brake system in which the energy necessary to produce the braking force is supplied by the physical effort of the rider assisted by one or more energy supplying devices, for example vacuum assisted (with vacuum booster).

*Secondary brake system* means the second service brake system on a motorcycle equipped with a combined brake system.

*Service brake system* means a brake system which is used for slowing the motorcycle when in motion.

*Sidecar* means a one-wheeled vehicle that is attached to the side of a motorcycle.

*Single brake system* means a brake system which acts on only one axle.

*Split service brake system* or *SSBS* means a brake system that operates the brakes on all wheels, consisting of two or more subsystems actuated by a single control designed so that a single failure in any subsystem (such as a leakage type failure of a hydraulic subsystem) does not impair the operation of any other subsystem.

*Stopping distance* means the distance traveled by the motorcycle from the point the rider begins to actuate the brake control to the point at which the motorcycle reaches full stop. For tests where simultaneous actuation of two controls is specified, the distance traveled is taken from the point the first control is actuated.

*Test speed* means the motorcycle speed measured the moment the rider begins to actuate the brake control. For tests where simultaneous actuation of two controls is specified, the motorcycle speed is taken from the moment the first control is actuated.

*Transmission* means the combination of components that provide the

functional link between the control and the brake.

*Unladen vehicle mass* means the nominal mass of a complete vehicle as determined by the following criteria:

(a) Mass of the vehicle with bodywork and all factory fitted equipment, electrical and auxiliary equipment for normal operation of vehicle, including liquids, tools, fire extinguisher, standard spare parts, chocks and spare wheel, if fitted.

(b) The fuel tanks filled to at least 90 percent of rated capacity and the other liquid containing systems (except those for used water) to 100 percent of the capacity specified by the manufacturer.

*V<sub>max</sub>* means either the speed attainable by accelerating at a maximum rate from a standing start for a distance of 1.6 km on a level surface, with the vehicle lightly loaded, or the speed measured in accordance with International Organization for Standardization (ISO) 7117:1995.

*Wheel lock* means the condition that occurs when there is 100 percent wheel slip.

#### S5. General requirements.

##### S5.1 Brake system requirements.

Each motorcycle shall meet each of the test requirements specified for a motorcycle of its type and for those brake features on the motorcycle.

S5.1.1 *Service brake system control operation.* Each motorcycle shall have a configuration that enables a rider to actuate the service brake system control while seated in the normal driving position and with both hands on the steering control.

S5.1.2 *Secondary brake system control operation.* Each motorcycle shall have a configuration that enables a rider to actuate the secondary brake system control while seated in the normal driving position and with at least one hand on the steering control.

##### S5.1.3 Parking brake system.

(a) If a parking brake system is fitted, it shall hold the motorcycle stationary on the slope prescribed in S6.8.2. The parking brake system shall:

- (1) have a control which is separate from the service brake system controls; and
- (2) be held in the locked position by solely mechanical means.

(b) Each motorcycle equipped with a parking brake shall have a configuration that enables a rider to be able to actuate the parking brake system while seated in the normal driving position.

S5.1.4 *Two-wheeled motorcycles of categories 3-1 and 3-3.* Each category 3-1 and 3-3 two-wheeled motorcycle shall be equipped with either two separate service brake systems, or a split service brake system, with at least one

brake operating on the front wheel and at least one brake operating on the rear wheel.

S5.1.5 *Three-wheeled motorcycles of category 3-4.* Each category 3-4 motorcycle shall comply with the brake system requirements in S5.1.4. A brake on the asymmetric wheel (with respect to the longitudinal axis) is not required.

S5.1.6 *Three-wheeled motorcycles of category 3-2.* Each category 3-2 motorcycle shall be equipped with a parking brake system plus one of the following service brake systems:

- (a) two separate service brake systems, except CBS, which, when applied together, operate the brakes on all wheels; or
- (b) a split service brake system; or
- (c) a CBS that operates the brake on all wheels and a secondary brake system which may be the parking brake system.

S5.1.7 *Three-wheeled motorcycles of categories 3-5.* Each category 3-5 motorcycle shall be equipped with:

- (a) a parking brake system; and
- (b) a foot actuated service brake system which operates the brakes on all wheels by way of either:
  - (1) a split service brake system; or
  - (2) a CBS and a secondary brake system, which may be the parking brake system.

S5.1.8 *Two separate service brake systems.* For motorcycles where two separate service brake systems are installed, the systems may share a common brake, if a failure in one system does not affect the performance of the other.

S5.1.9 *Hydraulic service brake system.* For motorcycles that use hydraulic fluid for brake force transmission, the master cylinder shall:

- (a) have a sealed, covered, separate reservoir for each brake system; and
- (b) have a minimum reservoir capacity equivalent to 1.5 times the total fluid displacement required to satisfy the new to fully worn lining condition with the worst case brake adjustment conditions; and
- (c) have a reservoir where the fluid level is visible for checking without removal of the cover.

S5.1.10 *Warning lamps.* All warning lamps shall be mounted in the rider's view.

##### S5.1.10.1 Split service brake system warning lamps.

(a) Each motorcycle that that is equipped with a split service brake system shall be fitted with a red warning lamp, which shall be activated:

- (1) When there is a hydraulic failure on the application of a force of  $\leq 90$  N on the control; or
- (2) without actuation of the brake control, when the brake fluid level in

the master cylinder reservoir falls below the greater of:

- (i) that which is specified by the manufacturer; and
- (ii) that which is less than or equal to half of the fluid reservoir capacity.

(b) To permit function checking, the warning lamp shall be illuminated by the activation of the ignition switch and shall be extinguished when the check has been completed. The warning lamp shall remain on while a failure condition exists whenever the ignition switch is in the "on" position.

S5.1.10.2 *Antilock brake system warning lamps.* Each motorcycle equipped with an ABS system shall be fitted with a yellow warning lamp. The lamp shall be activated whenever there is a malfunction that affects the generation or transmission of signals in the motorcycle's ABS system. To permit function checking, the warning lamp shall be illuminated by the activation of the ignition switch and extinguished when the check has been completed. The warning lamp shall remain on while a failure condition exists whenever the ignition switch is in the "on" position.

##### S5.2 Durability.

S5.2.1 *Compensation for wear.* Wear of the brakes shall be compensated for by means of a system of automatic or manual adjustment.

S5.2.2 *Notice of wear.* The friction material thickness shall either be visible without disassembly, or where the friction material is not visible, wear shall be assessed by means of a device designed for that purpose.

S5.2.3 *Testing.* During all the tests in this standard and on their completion, there shall be no friction material detachment and no leakage of brake fluid.

S5.3 *Measurement of dynamic performance.* There are two ways in which brake system performance is measured. The particular method to be used is specified in the respective tests in S6.

##### S5.3.1 Stopping distance.

(a) Based on the basic equations of motion:  $S = 0.1 \cdot V + (X) \cdot V^2$ ,

Where:

S = stopping distance in meters

V = initial vehicle speed in km/h

X = a variable based on the requirement for each test

(b) To calculate the corrected stopping distance using the actual vehicle test speed, the following formula is used:  $S_s = 0.1 \cdot V_s + (S_a - 0.1 \cdot V_a) \cdot V_s^2 / V_a^2$ ,

Where:

S<sub>s</sub> = corrected stopping distance in meters

V<sub>s</sub> = specified vehicle test speed in km/h

S<sub>a</sub> = actual stopping distance in meters

V<sub>a</sub> = actual vehicle test speed in km/h

**Note to S5.3.1(b):** This equation is only valid when the actual test speed ( $V_a$ ) is within  $\pm 5$  km/h of the specified test speed ( $V_s$ ).

**S5.3.2 Continuous deceleration recording.** The other method used to measure performance is the continuous recording of the vehicle instantaneous deceleration from the moment a force is applied to the brake control until the end of the stop.

**S6. Test conditions, procedures and performance requirements.**

**S6.1 General.**

**S6.1.1 Test surfaces.**

**S6.1.1.1 High friction surface.** A high friction surface is used for all dynamic brake tests excluding the ABS tests where a low-friction surface is specified. The high-friction surface test area is a clean, dry and level surface, with a gradient of  $\leq 1$  percent. The high-friction surface has a peak braking coefficient (PBC) of 0.9.

**S6.1.1.2 Low-friction surface.** A low-friction surface is used for ABS tests where a low-friction surface is specified. The low-friction surface test area is a clean and level surface, with a gradient of  $\leq 1$  percent. The low-friction surface has a PBC of  $\leq 0.45$ .

**S6.1.1.3 Measurement of PBC.** The PBC is measured using the American Society for Testing and Materials (ASTM) E1136–93 (Reapproved 2003) standard reference test tire, in accordance with ASTM Method E1337–90 (Reapproved 2002), at a speed of 40 mph without water delivery.

**S6.1.1.4 Parking brake system tests.** The specified test slope has a clean and dry surface that does not deform under the weight of the motorcycle.

**S6.1.1.5 Test lane width.** For two-wheeled motorcycles (motorcycle categories 3–1 and 3–3) the test lane width is 2.5 meters. For three-wheeled motorcycles (motorcycle categories 3–2, 3–4 and 3–5) the test lane width is 2.5 meters plus the vehicle width.

**S6.1.2 Ambient temperature.** The ambient temperature is between 4 °C and 45 °C.

**S6.1.3 Wind speed.** The wind speed is not more than 5 m/s.

**S6.1.4 Test speed tolerance.** The test speed tolerance is  $\pm 5$  km/h. In the event of the actual test speed deviating from the specified test speed (but within the  $\pm 5$  km/h tolerance), the actual stopping distance is corrected using the formula in S5.3.2(b).

**S6.1.5 Automatic transmission.** Motorcycles with automatic transmission shall meet all test requirements—whether they are for “engine connected” or “engine disconnected.” If an automatic transmission has a neutral position, the

neutral position is selected for tests where “engine disconnected” is specified.

**S6.1.6 Vehicle position and wheel lock.** The vehicle is positioned in the center of the test lane for the beginning of each stop. Stops are made without the vehicle wheels passing outside the applicable test lane and without wheel lock.

**S6.1.7 Test sequence.** Test sequence is as specified in Table 1.

**S6.2 Preparation.**

**S6.2.1 Engine idle speed.** The engine idle speed is set to the manufacturer’s specification.

**S6.2.2 Tire pressures.** The tires are inflated to the manufacturer’s specification for the vehicle loading condition for the test.

**S6.2.3 Control application points and direction.** For a hand control lever, the input force ( $F$ ) is applied on the control lever’s forward surface perpendicular to the axis of the lever fulcrum and its outermost point on the plane along which the control lever rotates (see Figure 1). The input force is applied to a point located 50 millimeters (mm) from the outermost point of the control lever, measured along the axis between the central axis of the fulcrum of the lever and its outermost point. For a foot control pedal, the input force is applied to the center of, and at right angles to, the control pedal.

**S6.2.4 Brake temperature measurement.** The brake temperature is measured on the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, using a plug-type thermocouple that is embedded in the friction material, as shown in Figure 2.

**S6.2.5 Burnishing procedure.** The vehicle brakes are burnished prior to evaluating performance.

**S6.2.5.1 Vehicle condition.**

(a) Vehicle lightly loaded.

(b) Engine disconnected.

**S6.2.5.2 Conditions and procedure.**

(a) **Initial brake temperature.** Initial brake temperature before each brake application is  $\leq 100$  °C.

(b) **Test speed.**

(1) Initial speed: 50 km/h or 0.8  $V_{max}$ , whichever is lower.

(2) Final speed = 5 to 10 km/h.

(c) **Brake application.** Each service brake system control actuated separately.

(d) **Vehicle deceleration.**

(1) Single front brake system only:

(i) 3.0–3.5 m/s<sup>2</sup> for motorcycle categories 3–3 and 3–5

(ii) 1.5–2.0 m/s<sup>2</sup> for motorcycle categories 3–1 and 3–2

(2) Single rear brake system only: 1.5–2.0 m/s<sup>2</sup>

(3) CBS or split service brake system: 3.5–4.0 m/s<sup>2</sup>

(e) **Number of decelerations.** There shall be 100 decelerations per brake system.

(f) For the first stop, accelerate the vehicle to the initial speed and then actuate the brake control under the conditions specified until the final speed is reached. Then reaccelerate to the initial speed and maintain that speed until the brake temperature falls to the specified initial value. When these conditions are met, reapply the brake as specified. Repeat this procedure for the number of specified decelerations. After burnishing, adjust the brakes in accordance with the manufacturer’s recommendations.

**S6.3 Dry stop test—single brake control actuated.**

**S6.3.1 Vehicle condition.**

(a) The test is applicable to all motorcycle categories.

(b) **Laden.** For vehicles fitted with CBS and split service brake system, the vehicle is tested in the lightly loaded condition in addition to the laden condition.

(c) Engine disconnected.

**S6.3.2 Test conditions and procedure.**

(a) **Initial brake temperature.** Initial brake temperature is  $\geq 55$  °C and  $\leq 100$  °C.

(b) **Test speed.**

(1) Motorcycle categories 3–1 and 3–2: 40 km/h or 0.9  $V_{max}$ , whichever is lower.

(2) Motorcycle categories 3–3, 3–4 and 3–5: 60 km/h or 0.9  $V_{max}$ , whichever is lower.

(c) **Brake application.** Each service brake system control actuated separately.

(d) **Brake actuation force.**

(1) Hand control:  $\leq 200$  N.

(2) Foot control:

(i)  $\leq 350$  N for motorcycle categories 3–1, 3–2, 3–3 and 3–5.

(ii)  $\leq$  for motorcycle category 3–4.

(e) **Number of stops:** until the vehicle meets the performance requirements, with a maximum of 6 stops.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

**S6.3.3 Performance requirements.** When the brakes are tested in accordance with the test procedure set out in paragraph S6.3.2., the stopping distance shall be as specified in column 2 of Table 2.

**S6.4 Dry stop test—all service brake controls actuated.**

**S6.4.1 Vehicle condition.**

(a) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(b) Lightly loaded.

(c) Engine disconnected.

**S6.4.2 Test conditions and procedure.**

(a) *Initial brake temperature.* Initial brake temperature is  $\geq 55$  °C and  $\leq 100$  °C.

(b) *Test speed.* Test speed is 100 km/h or  $0.9 V_{max}$ , whichever is lower.

(c) *Brake application.* Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels.

(d) *Brake actuation force.*

(1) Hand control:  $\leq 250$  N.

(2) Foot control:

(i)  $\leq 400$  N for motorcycle categories 3–3 and 3–5.

(ii)  $\leq 500$  N for motorcycle category 3–4.

(e) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

**S6.4.3 Performance requirements.**

When the brakes are tested in accordance with the test procedure set out in paragraph S6.4.2., the stopping distance (S) shall be  $S \leq 0.0060 V^2$  (where V is the specified test speed in km/h and S is the required stopping distance in meters).

**S6.5 High speed test.**

**S6.5.1 Vehicle condition.**

(a) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(b) Test is not required for vehicles with  $V_{max} \leq 125$  km/h.

(c) Lightly loaded.

(d) Engine connected with the transmission in the highest gear.

**S6.5.2 Test conditions and procedure.**

(a) *Initial brake temperature.* Initial brake temperature is  $\geq 55$  °C and  $\geq 100$  °C.

(b) *Test speed.*

(1) Test speed is  $0.8 V_{max}$  for motorcycles with  $V_{max} > 125$  km/h and  $< 200$  km/h.

(2) Test speed is 160 km/h for motorcycles with  $V_{max} \geq 200$  km/h.

(c) *Brake application.* Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels.

(d) *Brake actuation force.*

(1) Hand control:  $\leq 200$  N.

(2) Foot control:

(i)  $\leq 350$  N for motorcycle categories 3–3 and 3–5.

(ii)  $\leq 500$  N for motorcycle category 3–4.

(e) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control(s) under the conditions specified in this paragraph.

**S6.5.3 Performance requirements.**

When the brakes are tested in accordance with the test procedure set out in paragraph S6.5.2, the stopping distance (S) shall be  $\leq 0.1 V + 0.0067 V^2$  (where V is the specified test speed in km/h and S is the required stopping distance in meters).

**S6.6 Wet brake test.**

**S6.6.1 General information.**

(a) The test is comprised of two parts that are carried out consecutively for each brake system:

(1) A baseline test based on the dry stop test—single brake control actuated (S6.3).

(2) A single wet brake stop using the same test parameters as in (1), but with the brake(s) being continuously sprayed with water while the test is conducted in order to measure the brakes' performance in wet conditions.

(b) The test is not applicable to parking brake systems unless it is the secondary brake.

(c) Drum brakes or fully enclosed disc brakes are excluded from this test unless ventilation or open inspection ports are present.

(d) This test requires the vehicle to be fitted with instrumentation that gives a continuous recording of brake control force and vehicle deceleration.

**S6.6.2 Vehicle condition.**

(a) The test is applicable to all motorcycle categories.

(b) *Laden.* For vehicles fitted with CBS and split service brake systems, the vehicle is tested in the lightly loaded condition in addition to the laden condition.

(c) Engine disconnected.

(d) Each brake is fitted with water spray equipment as shown in Figure 3.

(1) *Disc brakes—sketch of water spray equipment.* The disc brake water spray equipment is installed as follows:

(i) Water is sprayed onto each brake with a flow rate of 15 liters/hr. The water is equally distributed on each side of the rotor.

(ii) If the surface of the rotor has any shielding, the spray is applied 45° prior to the shield.

(iii) If it is not possible to locate the spray in the position shown on the sketch, or if the spray coincides with a brake ventilation hole or similar, the spray nozzle may be advanced by an additional 90° maximum from the edge of the pad, using the same radius.

(2) *Drum brakes with ventilation and open inspection ports.* The water spray equipment is installed as follows:

(i) Water is sprayed equally onto both sides of the drum brake assembly (on the stationary back plate and on the rotating drum) with a flow rate of 15 liters/hr.

(ii) The spray nozzles are positioned two-thirds of the distance from the outer circumference of the rotating drum to the wheel hub center.

(iii) The nozzle position is  $> 15^\circ$  from the edge of any opening in the drum back plate.

**S6.6.3 Baseline test—test conditions and procedure.**

(a) The test in paragraph S6.3 (dry stop test—single brake control actuated) is carried out for each brake system but with the brake control force that results in a vehicle deceleration of 2.5–3.0 m/s<sup>2</sup>, and the following is determined:

(1) The average brake control force measured when the vehicle is traveling between 80 percent and 10 percent of the specified test speed.

(2) The average vehicle deceleration in the period 0.5 to 1.0 seconds after the point of actuation of the brake control.

(3) The maximum vehicle deceleration during the complete stop but excluding the final 0.5 seconds.

(b) Conduct 3 baseline stops and average the values obtained in (1), (2), and (3).

**S6.6.4 Wet brake test—test conditions and procedure.**

(a) The vehicle is ridden at the test speed used in the baseline test set out in S6.6.3 with the water spray equipment operating on the brake(s) to be tested and with no application of the brake system.

(b) After a distance of  $\geq 500$  m, apply the average brake control force determined in the baseline test for the brake system being tested.

(c) Measure the average vehicle deceleration in the period 0.5 to 1.0 seconds after the point of actuation of the brake control.

(d) Measure the maximum vehicle deceleration during the complete stop but excluding the final 0.5 seconds.

**S6.6.5 Performance requirements.**

When the brakes are tested in accordance with the test procedure set out in paragraph S6.6.4, the wet brake deceleration performance shall be:

(a) The value measured in paragraph S6.6.4(c) shall be  $\geq 60$  percent of the average deceleration values recorded in the baseline test in paragraph S6.6.3(a)(2), *i.e.*, in the period 0.5 to 1.0 seconds after the point of actuation of the brake control; and

(b) The value measured in S6.6.4(d) shall be  $\leq 120$  percent of the average

deceleration values recorded in the baseline test S6.6.3(a)(3), *i.e.*, during the complete stop but excluding the final 0.5 seconds.

#### S6.7 Heat fade test.

##### S6.7.1 General information.

(a) The test comprises three parts that are carried out consecutively for each brake system:

(1) A baseline test using the dry stop test—single brake control actuated (S6.3).

(2) A heating procedure which consists of a series of repeated stops in order to heat the brake(s).

(3) A hot brake stop using the dry stop test—single brake control actuated (S6.3), to measure the brake's performance after the heating procedure.

(b) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(c) The test is not applicable to parking brake systems and secondary service brake systems.

(d) All stops are carried out with the motorcycle laden.

(e) The heating procedure requires the motorcycle to be fitted with instrumentation that gives a continuous recording of brake control force and vehicle deceleration.

##### S6.7.2 Baseline test.

S6.7.2.1 *Vehicle condition—baseline test.* Engine disconnected.

S6.7.2.2 *Test conditions and procedure—baseline test.*

(a) *Initial brake temperature.* Initial brake temperature is  $\geq 55^\circ\text{C}$  and  $\leq 100^\circ\text{C}$ .

(b) *Test speed.* Test speed is 60 km/h or 0.9  $V_{\text{max}}$ , whichever is the lower.

(c) *Brake application.* Each service brake system control is actuated separately.

(d) *Brake actuation force.*

(1) Hand control:  $\leq 200\text{ N}$ .

(2) Foot control:

(i)  $\leq 350\text{ N}$  for motorcycle categories 3–3 and 3–5.

(ii)  $\leq 500\text{ N}$  for motorcycle category 3–4.

(e) Accelerate the vehicle to the test speed, actuate the brake control under the conditions specified and record the control force required to achieve the vehicle braking performance specified in the table to S6.3.3 (Table 2).

##### S6.7.3 Heating procedure.

S6.7.3.1 *Vehicle condition—heating procedure.* Engine transmission:

(a) From the specified test speed to 50 percent specified test speed: connected, with the highest appropriate gear selected such that the engine speed remains above the manufacturer's specified idle speed.

(b) From 50 percent specified test speed to standstill: disconnected.

S6.7.3.2 *Test conditions and procedure—heating procedure.*

(a) *Initial brake temperature.* Initial brake temperature is (prior to first stop only)  $\geq 55^\circ\text{C}$  and  $\leq 100^\circ\text{C}$ .

(b) *Test speed.*

(1) Single brake system, front wheel braking only: 100 km/h or 0.7  $V_{\text{max}}$ , whichever is the lower.

(2) Single brake system, rear wheel braking only: 80 km/h or 0.7  $V_{\text{max}}$ , whichever is the lower.

(3) CBS or split service brake system: 100 km/h or 0.7  $V_{\text{max}}$ , whichever is the lower.

(c) *Brake application.* Each service brake system control actuated separately.

(d) *Brake actuation force.*

(1) For the first stop: The constant control force that achieves a vehicle deceleration rate of 3.0–3.5  $\text{m/s}^2$  while the vehicle is decelerating between 80 percent and 10 percent of the specified speed.

(2) For the remaining stops:

(i) The same constant brake control force as used for the first stop.

(ii) Number of stops: 10.

(iii) Interval between stops: 1000 m.

(e) Carry out a stop to the conditions specified in this paragraph and then immediately use maximum acceleration to reach the specified speed and maintain that speed until the next stop is made.

S6.7.4 *Hot brake stop—test conditions and procedure.* Perform a single stop under the conditions used in the baseline test (S6.7.2) for the brake system that has been heated during the procedure in accordance with S6.7.3. This stop is carried out within one minute of the completion of the procedure set out in S6.7.3 with a brake control application force less than or equal to the force used during the test set out in S6.7.2.

S6.7.5 *Performance requirements.*

When the brakes are tested in accordance with the test procedure set out in S6.7.4, the stopping distance  $S_2$  shall be  $\leq 1.67 S_1 - 0.67 \times 0.1V$ ,

Where:

$S_1$  = corrected stopping distance in meters achieved in the baseline test set out in S6.7.2.

$S_2$  = corrected stopping distance in meters achieved in the hot brake stop set out in S6.7.4.

$V$  = specified test speed in km/h.

S6.8 *Parking brake system test—for motorcycles with parking brakes.*

S6.8.1 *Vehicle condition.*

(a) The test is applicable to motorcycle categories 3–2, 3–4 and 3–5.

(b) Laden.

(c) Engine disconnected.

S6.8.2 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is  $\leq 100^\circ\text{C}$ .

(b) *Test surface gradient.* Test surface gradient is equal to 18 percent.

(c) *Brake actuation force.*

(1) Hand control:  $\leq 400\text{ N}$ .

(2) Foot control:  $\leq 500\text{ N}$ .

(d) For the first part of the test, park the vehicle on the test surface gradient facing up the slope by applying the parking brake system under the conditions specified in this paragraph. If the vehicle remains stationary, start the measurement of the test period.

(e) On completion of the test with vehicle facing up the gradient, repeat the same test procedure with the vehicle facing down the gradient.

S6.8.3 *Performance requirements.* When tested in accordance with the test procedure set out in S6.8.2, the parking brake system shall hold the vehicle stationary (to the limits of traction of the braked wheels) for 5 minutes when the vehicle is both facing up and facing down the gradient.

##### S6.9 ABS tests.

###### S6.9.1 General.

(a) The tests are only applicable to the ABS fitted on motorcycle categories 3–1 and 3–3.

(b) The tests are to confirm the performance of brake systems equipped with ABS and their performance in the event of ABS electrical failure.

(c) *Fully cycling* means that the anti-lock system is repeatedly modulating the brake force to prevent the directly controlled wheels from locking.

(d) Wheel-lock is allowed as long as the stability of the vehicle is not affected to the extent that it requires the operator to release the control or causes a vehicle wheel to pass outside the test lane.

(e) The test series comprises the individual tests in Table 3, which may be carried out in any order.

###### S6.9.2 Vehicle condition.

(a) Lightly loaded.

(b) Engine disconnected.

S6.9.3 *Stops on a high-friction surface.*

S6.9.3.1 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is  $\geq 55^\circ\text{C}$  and  $\leq 100^\circ\text{C}$ .

(b) *Test speed.* Test speed is 60 km/h or 0.9  $V_{\text{max}}$ , whichever is lower.

(c) *Brake application.* Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake control in the case of a service brake system that operates on all wheels.

(d) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(e) If one wheel is not equipped with ABS, the control for the service brake on that wheel is actuated with a force that is lower than the force that will cause the wheel to lock.

(f) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(g) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

**S6.9.3.2 Performance requirements.** When the brakes are tested in accordance with the test procedures referred to in S6.9.3.1:

(a) the stopping distance (S) shall be  $\leq 0.0063V^2$  (where V is the specified test speed in km/h and S is the required stopping distance in meters); and

(b) there shall be no wheel lock and the vehicle wheels shall stay within the test lane.

**S6.9.4 Stops on a low friction surface.**

**S6.9.4.1 Test conditions and procedure.** As set out in S6.9.3.1, but using the low friction surface instead of the high friction one.

**S6.9.4.2 Performance requirements.** When the brakes are tested in accordance with the test procedures set out in S6.9.4.1:

(a) the stopping distance (S) shall be  $\leq 0.0056 V^2/P$  (where V is the specified test speed in km/h, P is the peak braking coefficient and S is the required stopping distance in meters); and

(b) there shall be no wheel lock and the vehicle wheels shall stay within the test lane.

**S6.9.5 Wheel lock checks on high and low friction surfaces.**

**S6.9.5.1 Test conditions and procedure.**

(a) *Test surfaces.*

(b) *Initial brake temperature.* Initial brake temperature is  $\geq 55$  °C and  $\leq 100$  °C.

(c) *Test speed.*

(1) On the high friction surface: 80 km/h or 0.8 Vmax, whichever is lower.

(2) On the low friction surface: 60 km/h or 0.8 Vmax, whichever is lower.

(d) *Brake application.*

(1) Each service brake system control actuated separately.

(2) Where ABS is fitted to both brake systems, simultaneous actuation of both brake controls in addition to (1).

(e) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(f) *Brake application rate.* The brake control actuation force is applied in 0.2–0.5 seconds.

(g) Number of stops: until the vehicle meets the performance requirements, with a maximum of 3 stops.

(h) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

**S6.9.5.2 Performance requirements.** When the brakes are tested in accordance with the test procedures set out in S6.9.5.1, there shall be no wheel lock and the vehicle wheels shall stay within the test lane.

**S6.9.6 Wheel lock check—high to low friction surface transition.**

**S6.9.6.1 Test conditions and procedure.**

(a) *Test surfaces.* A high friction surface immediately followed by a low friction surface.

(b) *Initial brake temperature.* Initial brake temperature is  $\geq 55$  °C and  $\leq 100$  °C.

(c) *Test speed.* The speed that will result in 50 km/h or 0.5 Vmax, whichever is the lower, at the point where the vehicle passes from the high friction to the low friction surface.

(d) *Brake application.*

(1) Each service brake system control actuated separately.

(2) Where ABS is fitted to both brake systems, simultaneous actuation of both brake controls in addition to (1).

(e) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(f) Number of stops: until the vehicle meets the performance requirements, with a maximum of 3 stops.

(g) For each stop, accelerate the vehicle to the test speed and then actuate the brake control before the vehicle reaches the transition from one friction surface to the other.

**S6.9.6.2 Performance requirements.** When the brakes are tested in accordance with the test procedures set out in S6.9.6.1, there shall be no wheel lock and the vehicle wheels shall stay within the test lane.

**S6.9.7 Wheel lock check—low to high friction surface transition.**

**S6.9.7.1 Test conditions and procedure.**

(a) *Test surfaces.* A low friction surface immediately followed by a high friction surface with a PBC  $\geq 0.8$ .

(b) *Initial brake temperature.* Initial brake temperature is  $\geq 55$  °C and  $\leq 100$  °C.

(c) *Test speed.* The speed that will result in 50 km/h or 0.5 Vmax, whichever is the lower, at the point where the vehicle passes from the low friction to the high friction surface.

(d) *Brake application.*

(1) Each service brake system control applied separately.

(2) Where ABS is fitted to both brake systems, simultaneous application of both brake controls in addition to (1).

(e) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(f) Number of stops: until the vehicle meets the performance requirements, with a maximum of 3 stops.

(g) For each stop, accelerate the vehicle to the test speed and then actuate the brake control before the vehicle reaches the transition from one friction surface to the other.

(h) Record the vehicle's continuous deceleration.

**S6.9.7.2 Performance requirements.** When the brakes are tested in accordance with the test procedures set out in S6.9.7.1:

(a) there shall be no wheel lock and the vehicle wheels shall stay within the test lane, and

(b) within 1 second of the rear wheel passing the transition point between the low and high friction surfaces, the vehicle deceleration shall increase.

**S6.9.8 Stops with an ABS electrical failure.**

**S6.9.8.1 Test conditions and procedure.** With the ABS electrical system disabled, carry out the test set out in S6.3 (dry stop test—single brake control actuated) applying the conditions relevant to the brake system and vehicle being tested.

**S6.9.8.2 Performance requirements.** When the brakes are tested in accordance with the test procedure set out in S6.9.8.1:

(a) the system shall comply with the failure warning requirements of S5.1.10.2; and

(b) the minimum requirements for stopping distance shall be as specified in column 2 under the heading "Single brake system, rear wheel(s) braking only" in Table 2.

**S6.10 Partial failure test—for split service brake systems.**

**S6.10.1 General information.**

(a) The test is only applicable to vehicles that are equipped with split service brake systems.

(b) The test is to confirm the performance of the remaining subsystem in the event of a hydraulic system leakage failure.

**S6.10.2 Vehicle condition.**

(a) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(b) Lightly loaded.

(c) Engine disconnected.

**S6.10.3 Test conditions and procedure.**

(a) *Initial brake temperature.* Initial brake temperature is  $\geq 55$  °C and  $\leq 100$  °C.

(b) *Test speed.* Test speed is 50 km/h and 100 km/h or  $0.8 V_{\max}$ , whichever is lower.

(c) Brake actuation force.

(1) Hand control:  $\leq 250$  N.

(2) Foot control:  $\leq 400$  N.

(d) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops for each test speed.

(e) Alter the service brake system to induce a complete loss of braking in any one subsystem. Then, for each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

(f) Repeat the test for each subsystem.

S6.10.4 *Performance requirements.*

When the brakes are tested in accordance with the test procedure set out in S6.10.3:

(a) The system shall comply with the failure warning requirements set out in paragraph 3.1.11.; and

(b) The stopping distance (S) shall be  $\leq 0.1 V + 0.0117 V^2$  (where V is the specified test speed in km/h and S is the required stopping distance in meters).

S6.11 *Power-assisted braking system failure test.*

S6.11.1 *General information.*

(a) The test is not conducted when the vehicle is equipped with another separate service brake system.

(b) The test is to confirm the performance of the service brake system

in the event of failure of the power assistance.

S6.11.2 *Test conditions and procedure.* Carry out the test set out in S6.3.3 (dry stop test—single brake control actuated) for each service brake system with the power assistance disabled.

S6.11.3 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in S6.11.2, the stopping distance shall be as specified in column 2 of Table 4. Note that if the power assistance may be activated by more than one control, the above performance shall be achieved when each control is actuated separately.

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## TABLES AND FIGURES TO § 571.122

Table 1. Test Sequence

Test order	Paragraph
1. Dry stop - single brake control actuated	S6.3.
2. Dry stop - all service brake controls actuated	S6.4.
3. High speed	S6.5.
4. Wet brake	S6.6.
5. Heat fade*	S6.7.
6. If fitted:	
6.1. Parking brake system	S6.8.
6.2. ABS	S6.9.
6.3. Partial failure, for split service brake systems	S6.10.
6.4. Power-assisted braking system failure	S6.11.

\* Heat fade is always the last test to be carried out.

Table 2. Performance requirements, Dry stop test – single brake control actuated.

Column 1	Column 2
Motorcycle Category	STOPPING DISTANCE (S) (Where V is the specified test speed in km/h and S is the required stopping distance in meters)
Single brake system, front wheel(s) braking only:	
3-1	$S \leq 0.1 V + 0.0111 V^2$
3-2	$S \leq 0.1 V + 0.0143 V^2$
3-3	$S \leq 0.1 V + 0.0087 V^2$
3-4	Not applicable
3-5	$S \leq 0.1 V + 0.0105 V^2$
Single brake system, rear wheel(s) braking only:	
3-1	$S \leq 0.1 V + 0.0143 V^2$
3-2	$S \leq 0.1 V + 0.0143 V^2$
3-3	$S \leq 0.1 V + 0.0133 V^2$
3-4	Not applicable
3-5	$S \leq 0.1 V + 0.0105 V^2$
Vehicles with CBS or split service brake systems: for laden and lightly loaded conditions.	
3-1 and 3-2	$S \leq 0.1 V + 0.0087 V^2$
3-3	$S \leq 0.1 V + 0.0076 V^2$
3-4	$S \leq 0.1 V + 0.0077 V^2$
3-5	$S \leq 0.1 V + 0.0071 V^2$
Vehicles with CBS – secondary service brake system:	
ALL	$S \leq 0.1 V + 0.0154 V^2$

Table 3. ABS tests.

ABS TESTS	PARAGRAPH
a. Stops on a high friction surface - as specified in S6.1.1.1.	S6.9.3
b. Stops on a low friction surface - as specified in S6.1.1.2.	S6.9.4
c. Wheel lock checks on high and low friction surfaces.	S6.9.5
d. Wheel lock check - high to low friction surface transition.	S6.9.6
e. Wheel lock check - low to high friction surface transition.	S6.9.7
f. Stops with an ABS electrical failure.	S6.9.8

Table 4. Performance requirements, Power-assisted braking system failure test.

Column 1	Column 2
Vehicle Category	STOPPING DISTANCE(S) (Where V is the specified test speed in km/h and S is the required stopping distance in metres)
Single brake system:	
3-1	$S \leq 0.1 V + 0.0143 V^2$
3-2	$S \leq 0.1 V + 0.0143 V^2$
3-3	$S \leq 0.1 V + 0.0133 V^2$
3-5	$S \leq 0.1 V + 0.0105 V^2$
Vehicles with CBS or split service brake systems:	
All	$S \leq 0.1 V + 0.0154 V^2$

Figure 1. Hand control lever force application points and direction.

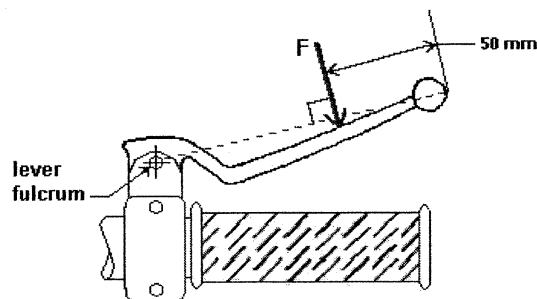


Figure 2. Typical Plug Type Thermocouple Installations

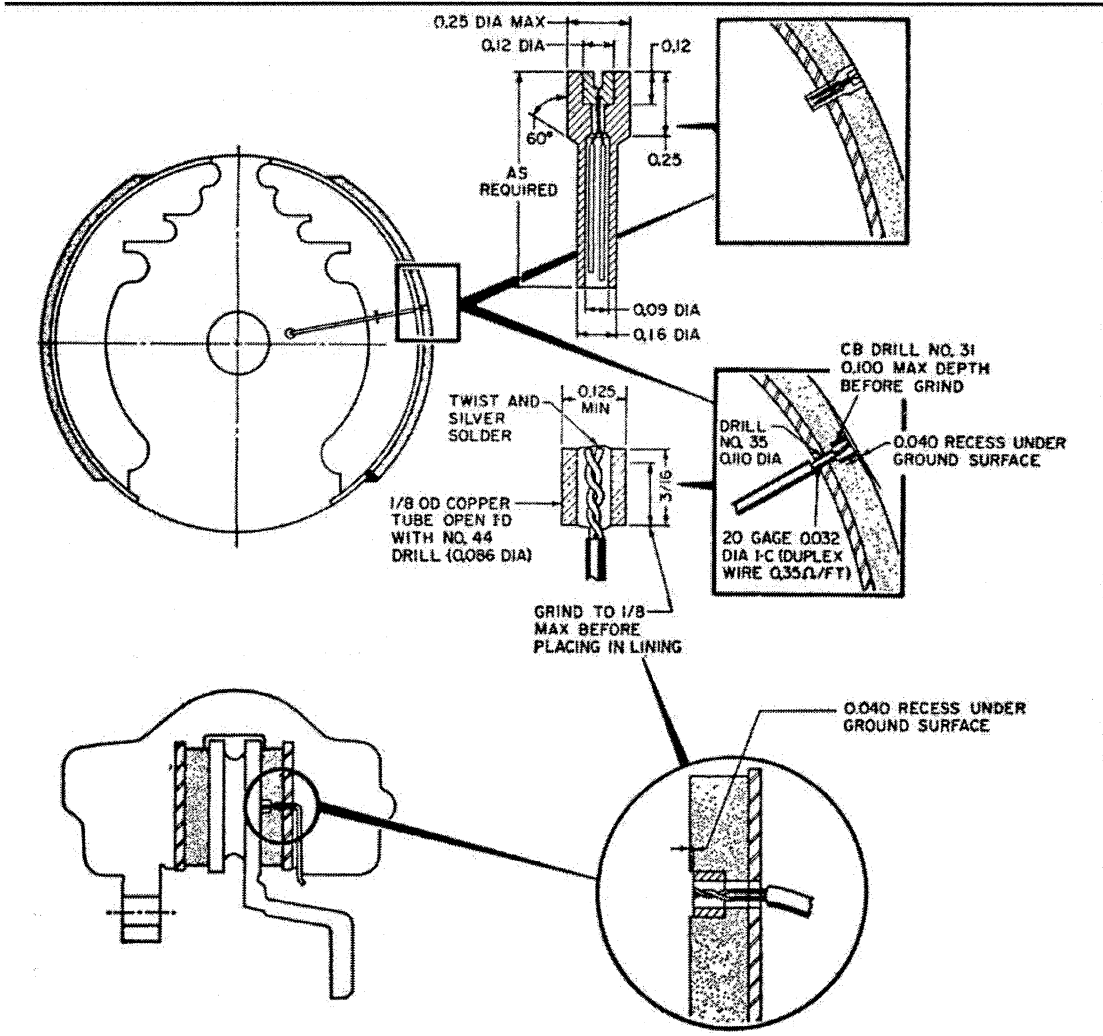
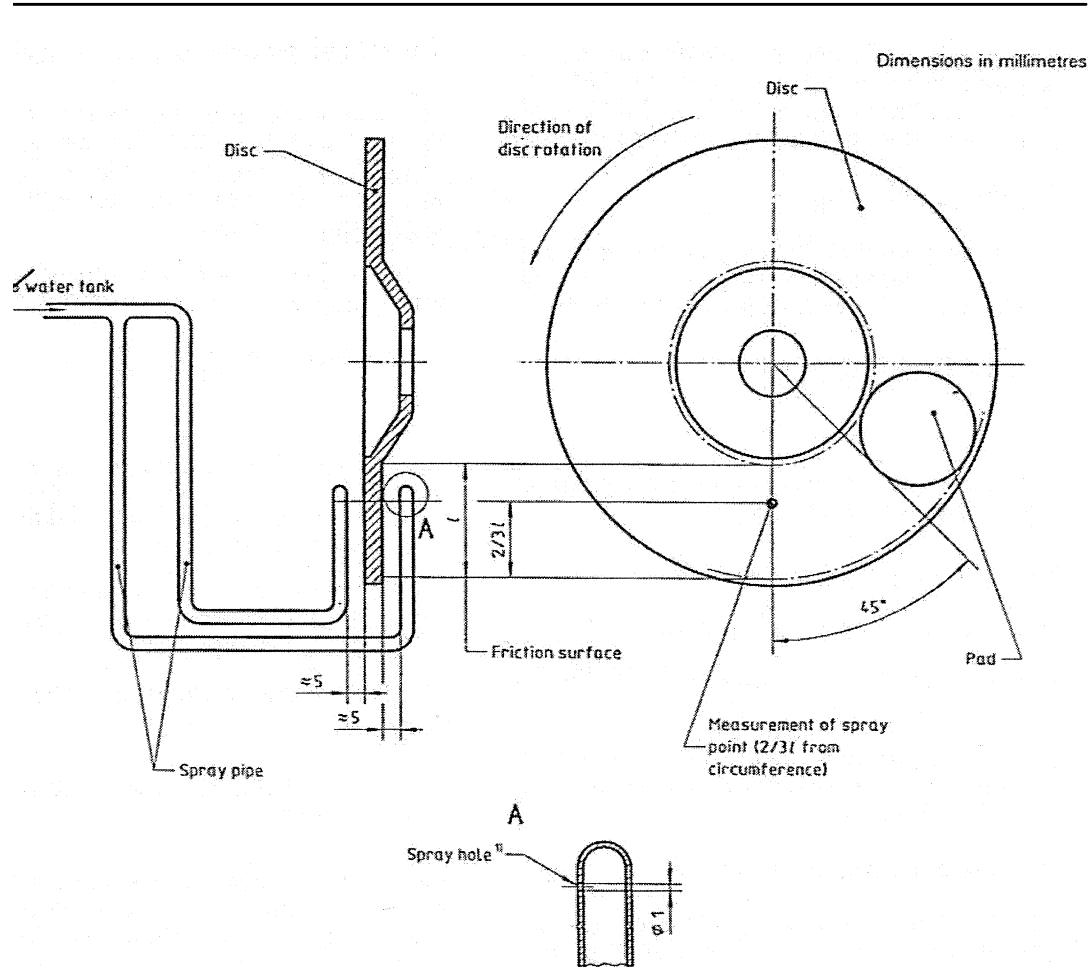


Figure 3. Wet brake test.



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