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DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. NHTSA-2026-0728]

RIN 2127-AN00

Federal Motor Vehicle Safety Standards; Modernization of FMVSS No. 135 to Accommodate ADS-Equipped Vehicles

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

ACTION: Notice of proposed rulemaking.

SUMMARY: NHTSA is proposing to amend Federal Motor Vehicle Safety Standard (FMVSS) No. 135, "Light vehicle brake systems." The proposed modifications would distinguish how regulations apply to vehicles with and without manually operated driving controls. The proposed modifications would clarify definitions, telltale requirements, performance requirements, and test procedures in the standard and remove sections that are no longer relevant. The stopping distance performance requirements, which address the primary safety purpose of the standard, would still apply to all subject vehicles. This rulemaking would remove unnecessary regulatory burdens and costs without detriment to vehicle safety.

DATES: Comments should be submitted no later than [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].**

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

- *Electronic submissions:* Go to the Federal eRulemaking Portal at http://www.regulations.gov. Follow the online instructions for submitting comments.
- *Fax:* (202) 493-2251.

- *Mail or Hand Delivery:* Docket Management, U.S. Department of Transportation, 1200 New Jersey Avenue S.E., West Building, Suite W58-213, Washington, D.C. 20590, between 9 a.m. and 5 p.m., Monday through Friday, except on Federal holidays. To be sure someone is there to help you, please call (202) 366-9826 or (202) 366-9317 before coming.

Instructions: All submissions must include the agency name and docket number for this notice. Note that all comments received will be posted without change to http://www.regulations.gov, including any personal information provided. Please see the Privacy Act heading below.

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 https://www.transportation.gov/privacy.

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 via internet.

Confidential Business Information: If you claim that any of the information in your comment (including any additional documents or attachments) constitutes confidential business information within the meaning of 5 U.S.C. 552(b)(4) or is protected from disclosure pursuant to 18 U.S.C. 1905, please see the detailed instructions given under the Public Participation heading of the SUPPLEMENTARY INFORMATION section of this document.

FOR FURTHER INFORMATION CONTACT: For technical issues, you may contact Ms. Lina Valivullah, Office of Automation Safety; Telephone: 202-366-1810; Email: Lina.Valivullah@dot.gov; Facsimile: 202-493-2739. For legal issues, you may contact Mr. David Jasinski, NHTSA Office of the Chief Counsel, Email: David.Jasinski@dot.gov. The

mailing address of these officials is: National Highway Traffic Safety Administration, 1200 New Jersey Avenue, S.E., Washington, D.C. 20590.

SUPPLEMENTARY INFORMATION:

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I. Executive Summary

This rulemaking is intended primarily to modernize Federal Motor Vehicle Safety Standard No. 135, "Light vehicle brake systems," to apply the standard's performance requirements to vehicles equipped with Automated Driving Systems (ADS) that do not have manually operated driving controls. Though these vehicles currently are not available for consumer purchase, there is considerable testing, development, and validation of these vehicles, as well as localized deployment by manufacturers and rideshare operators. Vehicle automation technology has the potential to reduce roadway crashes and fatalities while increasing mobility. As the technology is still maturing and many of the potential benefits are yet to be realized, NHTSA is engaging in a process to modernize existing FMVSS to remove unnecessary barriers to technological innovation while ensuring motor vehicle safety is not compromised.

In this document, NHTSA proposes to amend FMVSS No. 135 to clarify the requirements and test procedures for vehicles with and without manually operated driving

controls, while retaining the existing requirements for stopping distance. NHTSA proposes to revise the current requirements that all light vehicles contain hand- or foot-operated brake controls, removing those requirements for vehicles designed never to be operated by a human. For vehicles without manually operated driving controls, the agency proposes application of existing performance requirements through alternative test procedures. The proposed changes also include language modifications, corrections of typographical errors, and removal of outdated information to clarify the braking performance requirements for all subject vehicles. NHTSA is not proposing changes to any stopping distance requirements in FMVSS No. 135. Regardless of the manner of brake control application, the brake systems must be capable of safely stopping the vehicle, as already required by the standard. This rulemaking would remove unnecessary regulatory burdens and costs with no negative impact to vehicle safety. For ADS-equipped vehicles that contain manually operated driving controls, the existing requirements of the standard would still apply.

Importantly, this proposal is intended to remove unintended design barriers that exist in FMVSS No. 135 and maintain existing brake performance requirements for designs that are newly enabled. The proposal would ensure that ADS-equipped vehicles without manually operated driving controls *can* stop within an appropriate distance once brake controls are actuated. However, *whether* the vehicle's brakes are actuated appropriately given a specific driving scenario is an independent question relating to ADS performance. To this end, NHTSA is in the process of developing safety performance tests for ADS-equipped vehicles, which would be implemented in a separate standard. As with any ADS-equipped vehicle, NHTSA will not hesitate to use its strong and broad defect enforcement authority to address unsafe ADS performance if the proposal is finalized.

II. Background

This proposed rule is intended primarily to address ADS-equipped vehicles that do not have manually operated driving controls. An ADS commonly is considered to be a combination

of hardware and software that can perform all real-time operational and tactical functions required to operate a vehicle on a sustained basis[1]—functions traditionally performed by a human driver using manually operated driving controls. As defined in part 571.3 and used throughout this document, *manually operated driving controls* means a system of controls: (i) used by an occupant for real-time, sustained, manual manipulation of the motor vehicle's heading (steering) and/or speed (accelerator and brake); and (ii) positioned such that they can be used by an occupant, regardless of whether the occupant is actively using the system to manipulate the vehicle's motion. In an ADS-equipped vehicle designed to be operated only by an ADS, manually operated driving controls are not inherently necessary. Further, in an ADS-operated vehicle, the inclusion of a manually operated driving control that directly overrides ADS operation could pose a safety risk through intentional or unintentional misuse by a vehicle passenger. A vehicle occupant that is a passenger, not a driver, should also not be expected to perform driver functions such as engaging the parking brake.

NHTSA has published prior *Federal Register* notices requesting comment, proposing changes, and updating existing regulations to address vehicle automation. These notices include a request for comment (RFC), "Removing Regulatory Barriers for Vehicles with Automated Driving Systems," published on February 13, 2018,[2] and a subsequent advance notice of proposed rulemaking (ANPRM) with the same title published on May 28, 2019.[3] The RFC posed questions about identifying and addressing regulatory barriers for vehicles that lack traditional manual controls or have unconventional seating. The ANPRM focused on the challenges of testing and verifying compliance for vehicles without traditional manual controls. A separate notice of proposed rulemaking (NPRM), "Occupant Protection for Automated Driving Systems,"[4] was published on March 30, 2020, with the corresponding final rule, "Occupant

[1] *See, e.g.,* SAE J3016_202104; Tex. Transp. Code § 545.451.

[2] 83 FR 6148

[3] 84 FR 24433

[4] 85 FR 17624

Protection for Vehicles with Automated Driving Systems," published on March 30, 2022.[5] The rulemaking focused on crashworthiness standards for ADS-equipped vehicles without manual driving controls, revising definitions and updating occupant protection standards to exclude vehicles specifically designed not to contain any occupants. The 2022 final rule also established the definition in 49 CFR 571.3 for *manually operated driving controls*. On December 3, 2020, NHTSA published an ANPRM titled, "Framework for Automated Driving Systems," to discuss and request comment on the manner in which the agency would define, assess, and manage objectively the safety of ADS performance while ensuring the needed flexibility to enable further innovation.[6] The ANPRM included recognition of a phased approach to addressing ADS safety including NHTSA's modernization of the FMVSS for ADS-equipped vehicles without traditional manual driving controls. Earlier this year, NHTSA published three NPRMs proposing to amend FMVSS No. 102, "Transmission shift position sequence, starter interlock, and transmission braking effect;" FMVSS Nos. 103 and 104, "Windshield defrosting and defogging systems" and "Windshield wiping and washing systems;" and FMVSS No. 110, "Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with a GVWR of 4,536 kilograms (10,000 pounds) or less;" to eliminate unnecessary barriers to vehicles without manually operated driving controls in furtherance of these modernization efforts.[7]

NHTSA proposes amendments to the existing requirements to allow ADS-equipped vehicles that do not contain manually operated driving controls, and therefore cannot be driven by a human occupant, to be certified under FMVSS No. 135. ADS-equipped vehicles without manually operated driving controls currently face regulatory barriers presented by requirements for manual controls such as a foot-operated service brake pedal, which is unnecessary for

[5] 87 FR 18560

[6] 85 FR 78058

[7] 91 FR 12532, 91 FR 12537, and 91 FR 16172, respectively.

operation of the vehicle by the ADS. Some ADS-equipped vehicles do have manually operated driving controls, especially if converted from a conventional vehicle or if equipped with controls only for specialized use. NHTSA maintains that any vehicle equipped with manually operated driving controls must continue to meet all existing safety requirements associated with manual controls, regardless of whether the vehicle is equipped with an ADS.

General updates and corrections to the regulatory text are also discussed in this document. The final rule establishing FMVSS No. 135, "Passenger car brake systems," was published on February 2, 1995,[8] to harmonize passenger vehicle braking requirements with international standards. The new standard replaced the application of FMVSS No. 105, "Hydraulic brake systems," to passenger cars. At that time, brake standards were written to provide flexibility for vehicles with and without antilock brake systems. Over time, sections of the standard have become superfluous. The standard also was written with verbiage for telltales that is not in line with current usage. In addition, on September 30, 1997, a final rule was published expanding the application of FMVSS No. 135 to multi-purpose passenger vehicles, trucks, and buses with a gross vehicle weight rating (GVWR) of 3,500 kilograms (7,716 pounds) or less. The revised Code of Federal Regulations (CFR) as of October 1, 1997, contained typographical errors for some test requirements in FMVSS No. 135, specifically pedal force and initial brake temperatures, which were not corrected in subsequent versions of the CFR. The regulatory text amendments in this document include plain language edits for clarity, corrections to typographical errors, and removal of sections that are no longer relevant.

[8] 60 FR 6411

III. Proposed Changes

a. Brake Controls and Test Specifications

Background

FMVSS No. 135, "Light vehicle brake systems," specifies requirements for service brake and parking brake systems in passenger cars, multi-purpose passenger vehicles, trucks, and buses with a GVWR of 3,500 kilograms (7,716 pounds) or less. The purpose of the standard is to ensure safe braking performance under normal and emergency driving conditions. Brake performance is evaluated using the vehicle's *stopping distance,* which is defined as the distance traveled by a vehicle from the point of application of force to the brake control to the point at which the vehicle reaches a full stop. FMVSS No. 135 currently requires service brakes to be activated by means of a foot control. It requires control of the parking brake to be independent of the service brake control and to be either a hand or foot control. In addition, the standard includes wheel lockup sequence and adhesion utilization requirements for vehicles without an antilock brake system (ABS). The standard applies to passenger cars manufactured on or after September 1, 2000, and to multi-purpose passenger vehicles, trucks and buses with a GVWR of 3,500 kilograms (7,716 pounds) or less, manufactured on or after September 1, 2002.

Proposal

As stated, the intention of the standard is to ensure safe braking performance in a variety of conditions. Paragraph S5.3.1 currently requires independent manual controls for activation of the service brakes and the parking brake. In an ADS-equipped vehicle without manually operated driving controls, the ADS would perform the driving task and any vehicle occupants would be passengers. The ADS would operate the service brakes and the parking brake without the need for a foot-operated service brake pedal, or a hand- or foot-operated parking brake control. Therefore, some manufacturers may want the ability to remove these manual controls. It is NHTSA's expectation that if these controls are removed, passengers will still be provided with a

means to direct an ADS-operated vehicle to come to a stop, though how a passenger would indicate they wanted the ADS-operated vehicle to stop[9] would likely vary by manufacturer.

In some vehicles, the inclusion of a brake pedal that directly overrides ADS operation could pose a safety risk through intentional or unintentional misuse by a vehicle passenger. In addition, operation of the parking brake is the responsibility of the vehicle operator; a passenger that is not responsible for operating the vehicle is not responsible for control of the parking brake. For these reasons, NHTSA proposes to amend S5.3.1 to clarify that the requirements for a foot-operated service brake control and a separate hand or foot-controlled parking brake only apply to vehicles equipped with manually operated driving controls. The requirement for independent operation of the service brakes and the parking brake would be unchanged. NHTSA seeks comment on potential consequences of removing the requirements for hand- and foot-operated brakes in ADS-operated vehicles. For vehicles without manually operated driving controls, NHTSA also proposes to require that the service brake control and the parking brake control are activated by on-board systems. This clause precludes the use of an external command system in which the braking signal can only be sent from outside the vehicle, rather than being directed by an on-board ADS. Further, in an ADS-operated vehicle, a control that is designed for operation by a vehicle occupant to direct the vehicle to a stop and is not the primary braking control would not be considered part of the service or parking brake controls. NHTSA seeks comment on other considerations and concerns related to ADS vehicle operation.

To clarify the terminology in FMVSS No. 135 for vehicles with and without manually operated driving controls, NHTSA is proposing to add a definition for *service brake control.* Though the term is not defined explicitly in FMVSS No. 135, *service brake control* is used

[9] NHTSA is taking no position at this time as to how a passenger should be able to direct an ADS-operated vehicle to stop, or how the ADS should respond to such direction. NHTSA will continue to consider this issue as it addresses ADS performance. In the meantime, the agency will oversee the ability of passengers to request stops, and responses by the ADS to such requests, using its defect authority. Until NHTSA establishes FMVSS on this topic, manufacturers have the responsibility to ensure that the design and performance of such systems do not pose an unreasonable risk to safety.

throughout the standard to refer to the brake pedal. For all vehicles subject to FMVSS No. 135, the service brake control would mean the vehicle component used to activate a service brake system. As NHTSA has always used foot-operated service brake control to mean a pedal, the service brake control for a vehicle with manually operated driving controls would specifically refer to a foot-operated pedal. For vehicles without manually operated driving controls, the service brake control would be the vehicle component that translates the electronic braking command into mechanical input to the service brake system. For example, in lieu of muscular force applied to a service brake pedal, an ADS-operated vehicle might use a linear actuator to initiate braking. As the linear actuator would receive an electronic signal to engage the brakes and translate that signal into physical displacement, it would function as the service brake control. The agency has tentatively concluded that the proposed definition is non-restrictive, as physical actuation of one or more components occurs even in brake systems with electronics, hydraulics, and pneumatics. The proposed definition does not preclude the use of non-mechanical braking by means of a regenerative braking system (RBS) because a vehicle equipped with an RBS must also have mechanical brakes. However, NHTSA has considered that it may be appropriate to define the service brake control as a "vehicle component *or subsystem*" to clarify the meaning for vehicles with certain technologies such as an RBS or a distributed brake-by-wire system. For example, in a vehicle with a distributed brake-by-wire system, it would be appropriate to consider the component sending command signals to the brake unit on each wheel as part of the service brake control. NHTSA requests comment on the proposed definition and potential alternatives.

NHTSA also proposes to modify the definition for *stopping distance* to clarify the measurement for vehicles with and without manually operated driving controls. The proposed definition does not modify how the stopping distance is determined for vehicles that have a service brake pedal. Stopping distance is still the distance traveled by a vehicle from the point of initial application of force to the service brake control to the point at which the vehicle reaches a

full stop. For vehicles without a service brake pedal, as physical force would not be applied to the service brake control, the stopping distance would be the distance traveled by the vehicle from the point of initial transmission of an electronic command signal to the service brake control to the point at which the vehicle reaches a full stop. ADS-operated vehicles will need to translate the necessary level of braking determined by the ADS from a command signal into physical deceleration. In a vehicle without manually operated driving controls, the test input would be provided to the service brake control as if commanded by the ADS. NHTSA proposes that both definitions for stopping distance would be functionally equivalent in evaluating the physical capability of the brakes, even though braking is initiated through different means.

NHTSA is proposing minor edits to two other definitions to account for ADS-operated vehicles that do not have a driver, by changing "driver action" to "any driver action" in the definition of *brake power unit,* and changing "driver" to "any occupant" in the definition of *lightly loaded vehicle weight*. NHTSA is also condensing the term "lightly loaded vehicle weight" to the acronym "LLVW" in the definition of *maximum speed.* NHTSA also proposes to add a clause in S5.1.3 to clarify that the RBS in an electric vehicle without manually operated driving controls would be considered part of the service brake system.

For test procedures and performance requirements, NHTSA proposes changes to S7 to clarify application of the service brake control, as pedal force specifications do not apply to vehicles without hand- or foot-operated controls. The maximum pedal forces specified in S7 are intended to ensure that the brakes are easily operable by drivers of varying physical strength and will be retained for all brake systems with hand- or foot-operated brake controls. When muscular force is not used to apply the brake control, applied force specifications are unnecessary. For these reasons, and to account for design variations between different vehicles and ADSs, the proposed service brake test procedures state that manufacturer specifications are used for the brake control input when testing vehicles without manually operated driving controls. Regardless of the activation mechanism for the service brakes and the parking brake, all vehicles subject to

FMVSS No. 135 would still need to meet the braking performance requirements of the standard; NHTSA is not proposing any ADS-specific changes to the stopping distance requirements.

The proposed modifications to the standard are intended to maintain the current level of safety performance while ensuring that the standard is not design restrictive. To ensure vehicle compliance with FMVSS No. 135, NHTSA would request data and demonstration of vehicle braking performance from vehicle manufacturers if unable to test the vehicles independently. Laboratory and regulatory compliance testing procedures may be developed and implemented over time as vehicles without manually operated driving controls become more common, including a potential standardized method for NHTSA to input braking commands during compliance testing. At this time, NHTSA intends to work with certifying entities as needed to ensure that all vehicles on public roadways meet the applicable safety requirements.

In addition to ADS-specific changes, NHTSA is proposing to streamline and make technical corrections to the standard. NHTSA proposes to remove the subsections of S7 that only apply to vehicles without ABS. This is because all vehicles subject to FMVSS No. 135 currently are required to have ABS in accordance with FMVSS No. 126, "Electronic stability control systems for light vehicles."[10] FMVSS No. 135 contains testing requirements and definitions that were adopted prior to the establishment of FMVSS No. 126, when vehicles may not have been equipped with ABS and needed additional safeguards for safe braking performance. The wheel lockup sequence and adhesion utilization requirements in S7.2 and S7.4 are specific to vehicles without ABS. The standard also contains definitions and instrumentation specifications for those test procedures that are no longer used and may be removed without consequence. Keeping these vestigial sections in the standard is not beneficial. For these reasons, NHTSA proposes to remove definitions for "Adhesion utilization curves," "Brake factor," "Brake hold-off pressure," "Braking ratio," and "Objective brake factor;" paragraphs S6.4.2 and S6.4.3 for torque wheel test

[10] 49 CFR 571.126

instrumentation; and sections S7.2 and S7.4 for wheel lockup sequence and adhesion utilization test procedures and performance requirements. In addition, NHTSA previously reserved section S7.3 for use as ABS performance testing. Given the requirements of FMVSS No. 126 render this reservation unnecessary, the subsection title will be removed. Sections S7.2, S7.3, and S7.4 will be left as [RESERVED]. With the proposed changes, the test order in Table 1 would also be revised to remove S7.2 through S7.4.

As all vehicles subject to FMVSS No. 135 are equipped with ABS, NHTSA proposes to modify S5.3.2, by removing the language stating, "for vehicles equipped with ABS." NHTSA also proposes to remove the word "manual," to clarify that any control to disable the ABS is prohibited. As revised, S5.3.2 would read, "A control to disable the ABS, either fully or partially, is prohibited." Likewise, the 'if equipped' clause for ABS in S6.3.6 would be removed, resulting in, "The ABS is fully operational for all tests, except where specified in the following sections." NHTSA will also simplify the language in the Application section for clarity, removing references to dates that have passed.

Other revisions throughout S7 would correct the erroneous notation for initial brake temperature (IBT) and pedal force specifications. Specifically, the lower bounds for IBT and pedal force are stated as maximum values rather than minimum values. Because the specifications are written correctly in the publicly available laboratory test procedure document[11] and existing vehicle service brake systems meet the requirements as intended when tested for compliance, NHTSA believes these corrections will not result in changes to vehicle brake systems. Another proposed revision for clarity is to move test condition paragraph S7.7.3 (h) to S7.7.2, designating it as new paragraph S7.7.2 (e), because it is more appropriately categorized as a vehicle condition; the contents of the paragraph would remain unchanged. NHTSA further proposes to revise S7.10.3 (g) of the brake warning telltale test procedure because the pressure

[11] *See* https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/tp-135-01_tag.pdf.

level or fluid level determination is only applicable for a hydraulic circuit failure and indirectly refers to the activation conditions in S5.5.1 (a). The revised text explicitly states to verify the brake warning telltale has been activated, and if the activation is due to a hydraulic circuit failure, to record the brake fluid level drop, differential pressure, or supply pressure drop necessary to activate the telltale, in alignment with S5.5.1 (a)(1) through (3). All other test specifications would remain unchanged.

b. Telltales and Indicators

Background

Section S5.5 of FMVSS No. 135 requires a brake system warning indicator that shall be in front of and in clear view of the driver and which shall be activated when the ignition switch is in the "on" position and whenever a variety of conditions occur, including gross loss of fluid or fluid pressure, electrical functional failure, application of the parking brake, brake lining wear-out, and other brake system or subsystem failures. The purpose of the brake system warning indicator is to inform the driver when there is a malfunction in the braking system and to provide feedback when the parking brake is engaged.

Proposal

NHTSA proposes to rename "brake system warning indicator" to "brake system warning telltale" to align with the definitions of telltales and indicators found in FMVSS No. 101, "Controls and displays." A telltale is defined in FMVSS No. 101 as "an optical signal that, when illuminated, shows the actuation of a device, a correct or improper functioning or condition, or a vehicle system's failure to function." Each of the conditions in which the brake system warning indicator must be activated are conveying information related to improper functioning or failure to function (S5.5.1(a), (b), (d), (e), (f), and (g)), or the actuation of a device (S5.5.1(c)). Further, FMVSS No. 101 classifies display items related to brake system warnings as telltales. This change in language to be consistent with other telltale requirements clarifies meaning and reduces confusion.

Section S5.5 of FMVSS No. 135 requires the brake system warning telltale to be mounted in front of and in clear view of the driver. A driver is defined in 49 CFR part 571.3 as the occupant of a motor vehicle seated immediately behind the steering control system. By this definition, an ADS-equipped vehicle without manually operated driving controls does not have a driver because the vehicle is not equipped with manually operated driving controls, including a steering control system. As such, the occupants of a vehicle without manually operated driving controls would be designated as passengers.

Some stakeholders have indicated that telltales are relevant only to the driver, and the information merely needs to be conveyed to the ADS for vehicles designed not to be operated by a human driver. NHTSA tentatively disagrees with this approach. The agency believes that certain telltales provide safety critical information that is necessary to provide human occupants with contextual information about the risk they may incur should they use the vehicle. The brake system warning is one such telltale, as it provides information about the operational safety of the vehicle. This telltale is also among those NHTSA has consistently treated as requiring special prominence given the safety critical nature of the information this telltale conveys.[12] A passenger would utilize the information from this telltale to make safety-related decisions about whether and how to use the vehicle. Information about a system or subsystem malfunction, for example, may elicit passenger responses such as electing not to initiate a trip, stopping an ongoing trip, or reporting the malfunction. NHTSA proposes that for vehicles without manually operated driving controls, the brake system warning telltale must be clearly visible to occupants in all designated seating positions, but seeks comment on this approach. The agency believes this is superior to requiring the telltale to be visible only to the passenger in the front left designated seating position (*i.e.*, the traditional "driver's seat") because, for these vehicles, there will be no need for passengers to occupy any particular seating position for the vehicle to operate. NHTSA has

[12] *See*, *e.g.*, 49 CFR 571.101 S.5.5.5.

previously addressed other telltale requirements for vehicles without manually operated driving controls by stating that the visual warnings must be provided to all front row occupants.[13] However, NHTSA acknowledges that the "front row" may be unclear in vehicles with novel seating configurations. NHTSA requests comment on the proposed requirement and seeks information on other options that would fulfill the safety purpose while being design neutral. For instance, if a vehicle showed a brake system warning telltale on a screen visible to some, but not all occupants, and would not allow a trip to commence unless an occupant acknowledged the existence of the underlying condition and elected to proceed, would this provide a superior means of communication than a passive display in view of all occupants? Would such an approach be appropriate if displayed on a required application on an occupant's mobile phone for a vehicle that does not include any screens? The agency is interested in how best to ensure that important telltales are communicated to vehicle occupants while allowing for design flexibility.

For vehicles with manually operated driving controls, the brake system warning telltale will still be required to be mounted in front of and in clear view of the driver. In addition, for all ADS-operated vehicles, NHTSA further encourages the use of supplemental notifications communicating safety-relevant information to passengers via app notifications, in-vehicle alerts, or other methods, in addition to the required telltales.

FMVSS No. 135 requires the brake warning system telltale to appear when the parking brake is activated to alert the driver and reduce the likelihood of driving with the parking brake activated. For ADS-equipped vehicles that do not have manually operated driving controls, NHTSA tentatively concludes that such an activation does not serve a safety purpose because the ADS would control and monitor the status of the parking brake as part of normal vehicle operation. NHTSA proposes to add a clause to S5.5.1(c) of FMVSS No. 135 excepting vehicles

[13] 49 CFR 571.305a

without manually operated driving controls from the requirement to activate the brake system warning telltale when application of the parking brake occurs.

Regardless of telltales for vehicle occupants, NHTSA expects an ADS to be aware of the operational status of each safety critical vehicle system and subsystem and respond appropriately to identified degradations, failures, and malfunctions that create risks to safe performance. In other words, NHTSA expects ADS-equipped vehicles to adjust their operation if a safety critical vehicle system is in a degraded state. As with any ADS-equipped vehicle, NHTSA will not hesitate to use its strong and broad defect enforcement authority to address unsafe ADS performance. NHTSA requests comment on whether a performance standard would be appropriate for ADS response in the event of a brake system degradation, failure, or malfunction. If so, how should such performance requirements be constructed? Comments containing supporting data are the most informative.

c. Parking Brake Requirements

Background

A *parking brake* is defined in 49 CFR part 571.3 as "a mechanism designed to prevent the movement of a stationary motor vehicle." Section S5.2 of FMVSS No. 135 requires that each vehicle be equipped with a parking brake system of a friction type with solely mechanical means to retain engagement. Section S7.12 contains the test procedure and performance requirements for the parking brake system; it requires that the parking brake system can hold the vehicle stationary for 5 minutes in both a forward and reverse direction on a 20 percent grade. As previously discussed, the final rule establishing FMVSS No. 135, "Passenger car brake systems," was published in 1995 to harmonize passenger vehicle braking requirements with European standards, and replaced the application of FMVSS No. 105, "Hydraulic brake systems," to passenger cars. The requirement for a friction-type parking brake was carried over to FMVSS No. 135 from FMVSS No. 105. The requirement appears to have been based on industry best practice that emerged when brake failure was more common, before the widespread use of split

service brake systems, to address the potential need for the parking brake to serve as an emergency brake if the primary braking system failed. FMVSS No. 135 did not include a dynamic vehicle deceleration requirement for the parking brake, though it was proposed in the original NPRM in 1985.

In the NPRM for FMVSS No. 135, published May 10, 1985,[14] and again in a supplemental NPRM published January 14, 1987,[15] NHTSA proposed a dynamic parking brake test intended to be consistent with international regulations and to ensure that a driver could use the parking brake to stop a moving vehicle in emergency situations. Several vehicle manufacturers submitted comments opposing inclusion of a dynamic parking brake test. After reviewing the comments, NHTSA agreed that a dynamic parking brake test would provide no significant safety benefits. The decision was based on the state of brake system technology and the fact that FMVSS No. 105 did not include a dynamic parking brake test. As noted by commenters, the international requirement pre-dated the widespread use of split service brake systems and the justification for using the parking brake in an emergency was no longer relevant. NHTSA had no evidence that complete brake failure (simultaneous failure of both circuits of a split brake system) occurred with any significant frequency. NHTSA was also concerned that applying the parking brake in emergency situations could cause wheel lockup and instability. The agency further noted that the initial impetus to harmonize with the European requirements for a dynamic parking brake requirement would likely become moot, given that the United Nations (UN) Economic Commission for Europe was discussing deletion of the requirement.

Currently, UN Regulation No. 13, "Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking," and No. 13-H, "Uniform provisions concerning the approval of passenger cars with regard to braking," require that the parking braking system in subject vehicles hold "by a purely mechanical device." The UN regulations

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[14] 50 FR 19744

[15] 52 FR 1474

further require that the "parking braking systems shall act on braking surfaces connected to the wheels through components of adequate strength;" in practice, this language effectively requires a friction type system. There are no dynamic parking brake requirements. There is a proposed amendment to the regulations submitted by industry to allow use of "a park lock device as an alternative to or in combination with the means acting on the braking surfaces." The amendment is under consideration but has not yet been adopted. Likewise, the Alliance for Automotive Innovation submitted comment to the Department of Transportation requesting that NHTSA remove the friction-type parking brake requirement from FMVSS No. 135.[16] Vehicle and equipment manufacturers have developed other parking brake designs (*e.g.*, mechanical drivetrain locks) that may be better suited to different vehicle use cases. Manufacturers are only permitted to supplement, not replace, the friction type system under the existing requirements.[17]

Proposal

The purpose of the parking brake is to prevent inadvertent vehicle movement when parked. NHTSA maintains that the parking brake system must use solely mechanical means to retain engagement to meet the safety need. The parking brake is intended to keep the vehicle from unintended roll-away and must stay engaged regardless of the operational state of the vehicle, including potential loss of electric power. This precludes the adoption of fully electrically actuated parking brakes, which may lose the ability to hold the vehicle if power is lost. However, NHTSA agrees that the requirement for a friction-type system is unnecessarily restrictive, as there is no demonstrated need for the parking brake to be designed as a dynamic emergency brake, and other mechanisms have been designed that can perform the same function. The existing performance requirement for the parking brake system to hold the vehicle stationary for five minutes in both a forward and reverse direction on the grade would remain unchanged, as would the requirement that the system retain engagement through solely mechanical means.

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[17] NHTSA Interpretation ID: 18165.135

For these reasons, NHTSA proposes to remove the friction type specification for the parking brake system.

Effective Date

As provided by 49 U.S.C. 30111(d), an FMVSS may not become effective before the 180th day after the standard is prescribed or later than one year after it is prescribed. However, NHTSA may provide a different effective date after finding, for good cause shown, that a different effective date is in the public interest. NHTSA must publish the reasons supporting such a finding. Similarly, 5 U.S.C. 553(d) provides that a final rule cannot become effective until at least 30 days after the date of publication except, among other reasons, the rule grants or recognizes an exemption, relieves a restriction, or for good cause found and published with the rule. It is in the public interest for this proposed rule, if adopted, to be effective immediately. This proposed rule clarifies existing requirements and removes unnecessary regulatory requirements for ADS-equipped vehicles without manually operated controls. There is no need for lead time for regulated entities to comply with this proposed rule. NHTSA seeks comment on whether the rule could be made effective within a time period shorter than 180 days or upon publication of any final rule.

IV. Request for Comment

NHTSA seeks public comment on the proposed changes, including the proposed exceptions to the requirements for hand- and foot-operated brake controls, the proposed definitions, the proposed revisions to the test procedures, the proposed telltale requirements for vehicles without manually operated driving controls, and the proposed removal of the friction type parking brake requirement. NHTSA will submit a redline-change version of the standard in its entirety to the docket to facilitate review of the proposed changes.

V. Rulemaking Analyses and Notices

Executive Order (E.O.) 12866 and E.O. 14192

NHTSA has considered the impact of this rulemaking action under Executive Orders 12866 and 14192. This action was reviewed by the Office of Management and Budget (OMB) as a significant regulatory action under section 3(f) of E.O. 12866. This proposed rule, if finalized as proposed, is expected to be an E.O. 14192 deregulatory action because it removes an unnecessary regulatory burden for the reasons discussed above. At this stage, the agency has not quantified any potential benefits or costs. For this rule, NHTSA does not anticipate any new regulatory costs, as it would remove unnecessary requirements and provide clarity and flexibility without adding any new requirements. NHTSA does not anticipate any safety disbenefits for the proposed changes. The benefits to this rule would be reduced compliance costs and potential safety benefits from removing the ability of an occupant to interfere with the safe operation of the vehicle by the ADS. However, given the still-developing nature of this market, NHTSA cannot quantify the number of vehicles that may be potentially affected by this proposed rule. Further, NHTSA believes that it is more likely that these vehicles would seek exemptions from this standard rather than include the unnecessary equipment. Though NHTSA could seek to quantify compliance costs on a per-vehicle basis, any estimate that was based on traditional vehicle configurations may not be accurate, given the different design and nature of ADS-equipped vehicles without manually operated driving controls. NHTSA requests comment on these assumptions and any other information that could help quantify their impacts in the final rule.

Regulatory Flexibility Act

Under the Regulatory Flexibility Act (RFA) (5 U.S.C. 601-612) (as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996; 5 U.S.C. 601 et seq.), agencies must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rulemaking on small entities (*i.e.*, small businesses, small

organizations, and small government jurisdictions). No regulatory flexibility analysis is required, however, if the head of an agency or an appropriate designee certifies that the rulemaking will not have a significant economic impact on a substantial number of small entities. NHTSA has concluded and hereby certifies that this proposed rule will not have a significant economic impact on a substantial number of small entities; therefore, an analysis is not included. This proposed rule will only except certain vehicles from standards that are not applicable to them.

National Environmental Policy Act

The Department has analyzed the environmental impacts of this notice of proposed rulemaking pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.). Pursuant to 49 CFR 1.81, the Secretary has delegated the "functions" under NEPA to the Administrators "as they relate to the matters within the primary responsibility of each Operating Administration." NHTSA has determined that this rule is categorically excluded pursuant to 23 CFR 771.118(c)(4). Categorical exclusions are actions identified in an agency's NEPA procedures that do not normally have a significant impact on the environment and therefore do not require either an environmental assessment (EA) or environmental impact statement (EIS). *See* DOT Order 5610.1D § 9. In analyzing the applicability of a categorical exclusion, the agency must also consider whether extraordinary circumstances are present that would warrant the preparation of an EA or EIS. *Id*. § 9(b). The Department's Operating Administrations (OAs) may apply CEs established in another OA's procedures. *Id*. § 9(f). To do so, the Operating Administration "must evaluate the action for extraordinary circumstances identified in the OA procedures in which the CE is established to determine if a normally excluded action may have a significant impact and coordinate with the originating OA to ensure that the CE is being applied correctly." *Id*. This rulemaking, which proposes to amend FMVSS No. 135, "Light vehicle brake systems," to update the regulatory language and exempt ADS-equipped vehicles without manually operated driving controls from certain requirements that presume a person in the vehicle is driving, is categorically excluded pursuant to 23 CFR 771.118(c)(4): Planning and

administrative activities not involving or leading directly to construction, such as: Training, technical assistance and research; promulgation of rules, regulations, directives, or program guidance; approval of project concepts; engineering; and operating assistance to transit authorities to continue existing service or increase service to meet routine demand. NHTSA has coordinated with the Federal Transit Administration to ensure that this CE is being applied correctly. NHTSA does not anticipate any environmental impacts, and there are no extraordinary circumstances present in connection with this rulemaking.

Executive Order 13132 (Federalism)

NHTSA has examined this rule pursuant to Executive Order 13132 (64 FR 43255, August 10, 1999) and has concluded tentatively that no additional consultation with States, local governments, or their representatives is mandated beyond the rulemaking process. The agency has concluded tentatively that this rule, does not have sufficient federalism implications to warrant consultation with State and local officials or the preparation of a federalism summary impact statement. NHTSA expects that this rule, if adopted, would 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."

NHTSA rules can have a preemptive effect in 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 by Congress that preempts any non-identical State legislative and administrative law addressing the same aspect of performance. NHTSA is not aware of any State motor vehicle equipment or inspection laws or regulations that require ADS-equipped vehicles that do not have manual

driving controls to be equipped with a brake pedal. However, NHTSA seeks comment on whether any such State requirements exist that would be preempted by this rule, if adopted.

The express preemption provision described above is subject to a savings clause under which compliance with a motor vehicle safety standard prescribed under this chapter does not exempt a person from liability at common law. 49 U.S.C. 30103(e). Pursuant to this provision, State common law tort causes of action against motor vehicle manufacturers that might otherwise be preempted by the express preemption provision generally are preserved.

NHTSA rules can also preempt State law if complying with the FMVSS would render the motor vehicle manufacturers liable under State tort law. Because most NHTSA standards established by an FMVSS are minimum standards, a State common law tort cause of action that seeks to impose a higher standard on motor vehicle manufacturers generally will not be preempted. If and when such a conflict does exist—for example, when the standard at issue is both a minimum and a maximum standard—the State common law tort cause of action is impliedly preempted. See *Geier v. American Honda Motor Co*., 529 U.S. 861 (2000).

Pursuant to Executive Orders 13132 and 12988, NHTSA has considered whether this proposed rule would preempt State common law causes of action. The agency's ability to announce its conclusion regarding the preemptive effect of one of its rules reduces the likelihood that preemption will be an issue in any subsequent tort litigation. This rule addresses the application to vehicles without manually operated driving controls of requirements that a hand- or foot-operated service brake pedal be installed on the vehicle for operation by a human driver. As the requirement to meet stopping distance is not changed by this rule, NHTSA believes this change will have no effect on safety. Thus, NHTSA tentatively concludes that no conflict with State common law causes of action would occur. Without any conflict, there could not be any implied preemption of a State common law tort cause of action. NHTSA also seeks comment on this tentative conclusion.

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; Feb. 7, 1996), requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect; (2) clearly specifies the effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct, while promoting simplification and burden reduction; (4) clearly specifies the retroactive effect, if any; (5) specifies whether administrative proceedings are to be required before parties file suit in court; (6) adequately defines key terms; and (7) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. This document is consistent with that requirement.

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

Privacy Act

Please note that 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 online at www.transportation.gov/privacy.

National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law 104-113, as amended by Public Law 107-107 (15 U.S.C. 272), directs the agency to evaluate and use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or is 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). The NTTAA directs us to provide Congress (through OMB) with explanations when the agency decides not to use available and potentially applicable voluntary consensus standards.

Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104-4, 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 annually (adjusted for inflation with base year of 1995). This NPRM would not result in a cost of $100 million or more when adjusted for inflation to either State, local, or tribal governments, in the aggregate, or the private sector. Thus, this NPRM is not subject to the requirements of sections 202 of the UMRA.

Executive Order 13609 (Promoting Regulatory Cooperation)

The policy statement in section 1 of Executive Order 13609 provides, in part: The regulatory approaches taken by foreign governments may differ from those taken by U.S. regulatory agencies to address similar issues. In some cases, the differences between the regulatory approaches of U.S. agencies and those of their foreign counterparts might not be necessary and might impair the ability of American businesses to export and compete internationally. In meeting shared challenges involving health, safety, labor, security, environmental, and other issues, international regulatory cooperation can identify approaches that are at least as protective as those that are or would be adopted in the absence of such cooperation. International regulatory cooperation can also reduce, eliminate, or prevent unnecessary differences in regulatory requirements.

Severability

The issue of severability of FMVSSs is addressed in 49 CFR 571.9. It provides that if any FMVSS or its application to any person or circumstance is held invalid, the remainder of the part and the application of that standard to other persons or circumstances is unaffected. Comments are requested on the severability of this proposed FMVSS.

Regulation Identifier Number

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.

Rulemaking Summary, 5 U.S.C. 553(b)(4)

As required by 5 U.S.C. 553(b)(4), a summary of this rule can be found in the Abstract section of the Department's Unified Agenda entry for this rulemaking at www.reginfo.gov. A summary of this proposal can be found at regulations.gov/document/NHTSA-2026-0728 under the Document Details tab.

VI. Public Participation

How long do I have to submit comments?

Please see DATES section at the beginning of this document.

How do I prepare and submit comments?

- Your comments must be written in English.
- To ensure that your comments are correctly filed in the Docket, please include the Docket Number shown at the beginning 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.

- If you are submitting comments electronically as a PDF (Adobe) File, NHTSA asks that the documents be submitted using the Optical Character Recognition (OCR) process, thus allowing NHTSA to search and copy certain portions of your submissions. Comments may be submitted to the docket electronically by logging onto the Docket Management System website at www.regulations.gov. Follow the online instructions for submitting comments.
- You may also submit two copies of your comments, including the attachments, to Docket Management at the address given above under ADDRESSES.

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://www.bts.gov/programs/statistical_policy_and_research/data_quality_guidelines.

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?

You should submit a redacted "public version" of your comment (including redacted versions of any additional documents or attachments) to the docket using any of the methods identified under **ADDRESSES**. This "public version" of your comment should contain only the portions for which no claim of confidential treatment is made and from which those portions for

which confidential treatment is claimed has been redacted. See below for further instructions on how to do this.

You also need to submit a request for confidential treatment directly to the Office of the Chief Counsel. Requests for confidential treatment are governed by 49 CFR part 512. Your request must set forth the information specified in part 512. This includes the materials for which confidentiality is being requested (as explained in more detail below); supporting information, pursuant to part 512.8; and a certificate, pursuant to part 512.4(b) and part 512, Appendix A.

You are required to submit to the Office of the Chief Counsel one unredacted "confidential version" of the information for which you are seeking confidential treatment. Pursuant to part 512.6, the words "ENTIRE PAGE CONFIDENTIAL BUSINESS INFORMATION" or "CONFIDENTIAL BUSINESS INFORMATION CONTAINED WITHIN BRACKETS" (as applicable) must appear at the top of each page containing information claimed to be confidential. In the latter situation, where not all information on the page is claimed to be confidential, identify each item of information for which confidentiality is requested within brackets: "[ ]."

You are also required to submit to the Office of the Chief Counsel one redacted "public version" of the information for which you are seeking confidential treatment. Pursuant to part 512.5(a)(2), the redacted "public version" should include redactions of any information for which you are seeking confidential treatment (*i.e.*, the only information that should be unredacted is information for which you are not seeking confidential treatment).

NHTSA is currently treating electronic submission as an acceptable method for submitting confidential business information to the agency under part 512. Please do not send a hardcopy of a request for confidential treatment to NHTSA's headquarters. The request should be sent to Dan Rabinovitz in NHTSA's Office of the Chief Counsel (NCC) at Daniel.Rabinovitz@dot.gov. You may either submit your request via email or request a secure file transfer link. Manufacturers or any companies that already have a Confidential Business

Information (CBI) Portal account or an Enterprise Account with NHTSA should use the CBI Portal for their submission. If you submit a CBI request, please also email a courtesy copy of the request to Mr. David Jasinski at David.Jasinski@dot.gov.

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 in developing the final rule, 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 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, Motor vehicles.

Proposed Regulatory Text

In consideration of the foregoing, NHTSA proposes to amend 49 CFR part 571 as set forth below.

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 1.95 and 501.8.

2. Section 571.135 is revised to read as follows:

§ 571.135 Standard No. 135; Light vehicle brake systems.

S1. ***Scope.*** This standard specifies requirements for service brake and associated parking brake systems.

S2. ***Purpose.*** The purpose of this standard is to ensure safe braking performance under normal and emergency driving conditions.

S3. ***Application.*** This standard applies to passenger cars. This standard also applies to multi-purpose passenger vehicles, trucks and buses with a gross vehicle weight rating (GVWR) of 3,500 kilograms (7,716 pounds) or less.

S4. ***Definitions.***

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 modulator devices which adjust brake actuating forces in response to those signals.

Backup system means a portion of a service brake system, such as a pump, that automatically supplies energy in the event of a primary brake power source failure.

Brake power assist unit means a device installed in a hydraulic brake system that reduces the amount of muscular force that a driver must apply to actuate the system, and that, if inoperative, does not prevent the driver from braking the vehicle by a continued application of muscular force on the service brake control.

Brake power unit means a device installed in a brake system that provides the energy required to actuate the brakes, either directly or indirectly through an auxiliary device, with any driver action consisting only of modulating the energy application level.

Electric vehicle or *EV* means a motor vehicle that is powered by an electric motor drawing current from rechargeable storage batteries, fuel cells, or other portable sources of electrical current, and which may include a non-electrical source of power designed to charge batteries and components thereof.

Electrically-actuated service brakes means service brakes that utilize electrical energy to actuate the foundation brakes.

Functional failure means a failure of a component (either electrical or mechanical in nature) which renders the system totally or partially inoperative yet the structural integrity of the system is maintained.

Hydraulic brake system means a system that uses hydraulic fluid as a medium for transmitting force from a service brake control to the service brake and that may incorporate a brake power assist unit, or a brake power unit.

Initial brake temperature or *IBT* means the average temperature of the service brakes on the hottest axle of the vehicle 0.32 km (0.2 miles) before any brake application.

Lightly loaded vehicle weight or *LLVW* means unloaded vehicle weight plus the weight of a mass of 180 kg (396 pounds), including any occupant and instrumentation.

Maximum speed of a vehicle or *VMax* means the highest speed attainable by accelerating at a maximum rate from a standing start for a distance of 3.2 km (2 miles) on a level surface, with the vehicle at its LLVW, and, if an EV, with the propulsion batteries at a state of charge of not less than 95 percent at the beginning of the run.

Peak friction coefficient or *PFC* means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Pressure component means a brake system component that contains the brake system fluid and controls or senses the fluid pressure.

Regenerative braking system or *RBS* means an electrical energy system that is installed in an EV for recovering or dissipating kinetic energy, and which uses the propulsion motor(s) as a retarder for partial braking of the EV while returning electrical energy to the propulsion battery(s) or dissipating electrical energy.

Service brake control means the vehicle component used to activate a service brake system. For a vehicle with manually operated driving controls, this is a foot-operated pedal. For a vehicle without manually operated driving controls, this is the vehicle component that translates the electronic braking command into mechanical input to the service brake system.

Snub means the braking deceleration of a vehicle from a higher reference speed to a lower reference speed that is greater than zero.

Split service brake system means a brake system 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 pressure component of a hydraulic subsystem except structural failure of a housing that is common to two or more subsystems, or an electrical failure in an electric subsystem) does not impair the operation of any other subsystem.

Stopping distance means the distance traveled by a vehicle from the point of initial application of force to the service brake control to the point at which the vehicle reaches a full stop, if the vehicle has manually operated driving controls. For a vehicle without manually operated driving controls, *stopping distance* means the distance traveled by the vehicle from the point of initial transmission of an electronic command signal to the service brake control to the point at which the vehicle reaches a full stop.

Variable brake proportioning system means a system that has one or more proportioning devices which automatically change the brake pressure ratio between any two or more wheels to compensate for changes in wheel loading due to static load changes and/or dynamic weight transfer, or due to deceleration.

Wheel lockup means 100 percent wheel slip.

S5. ***Equipment requirements.***

S5.1. *Service brake system.* Each vehicle must be equipped with a service brake system acting on all wheels.

S5.1.1. *Wear adjustment.* Wear of the service brakes must be compensated for by means of a system of automatic adjustment.

S5.1.2. *Wear status.* The wear condition of all service brakes must be indicated by either:

(a) Acoustic or optical devices warning the driver at his or her driving position when lining replacement is necessary, or

(b) A means of visually checking the degree of brake lining wear, from the outside or underside of the vehicle, utilizing only the tools or equipment normally supplied with the vehicle. The removal of wheels is permitted for this purpose.

S5.1.3 *Regenerative braking system.*

(a) For an EV equipped with RBS and a service brake pedal, the RBS is considered to be part of the service brake system if it is automatically activated by an application of the service brake pedal, if there is no means provided for the driver to disconnect or

otherwise deactivate it, and if it is activated in all transmission positions, including neutral.

(b) For an EV equipped with RBS and without manually operated driving controls, the RBS is considered to be part of the service brake system.

(c) For an EV that is equipped with both ABS and RBS that is part of the service brake system, the ABS must control the RBS.

S5.2. *Parking brake system.* Each vehicle must be equipped with a parking brake system with solely mechanical means to retain engagement.

S5.3. *Controls.*

S5.3.1.

(a) The parking brake must be controlled independently of the service brakes.

(b) For vehicles with manually operated driving controls, the service brakes must be activated by means of a foot pedal, and the parking brake must be operable by either a hand or foot control.

(c) For vehicles without manually operated driving controls, the service brake control and parking brake control must be activated by on-board systems.

S5.3.2. A control to disable the ABS, either fully or partially, is prohibited.

S5.4. *Reservoirs*.

S5.4.1. *Master cylinder reservoirs.* A master cylinder must have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment must not result in a complete loss of brake fluid from another compartment.

S5.4.2. *Reservoir capacity.* Reservoirs, whether for master cylinders or other type systems, must have a total minimum capacity equivalent to the fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoirs move from a new lining, fully retracted position (as adjusted initially to the manufacturer's recommended setting) to a fully worn, fully applied position, as determined in accordance with S7.17(c) of this standard. Reservoirs must

have completely separate compartments for each subsystem except that in reservoir systems utilizing a portion of the reservoir for a common supply to two or more subsystems, individual partial compartments must each have a minimum volume of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem, during a full stroke of the piston. Each brake power unit reservoir servicing only the brake system must have a minimum capacity equivalent to the fluid displacement required to charge the system piston(s) or accumulator(s) to normal operating pressure plus the displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir or accumulator(s) move from a new lining, fully retracted position (as adjusted initially to the manufacturer's recommended setting) to a fully worn, fully applied position.

S5.4.3. *Reservoir labeling.* Each vehicle equipped with hydraulic brakes must have a brake fluid warning statement that reads as follows, in letters at least 3.2 mm (1⁄8 inch) high: "WARNING: Clean filler cap before removing. Use only _____ fluid from a sealed container." (Inserting the recommended type of brake fluid as specified in 49 CFR 571.116, *e.g.*, "DOT 3.") The lettering must be:

(a) Permanently affixed, engraved or embossed;

(b) Located so as to be visible by direct view, either on or within 100 mm (3.94 inches) of the brake fluid reservoir filler plug or cap; and

(c) Of a color that contrasts with its background, if it is not engraved or embossed.

S5.4.4. *Fluid level indication.* Brake fluid reservoirs must be so constructed that the level of fluid can be checked without need for the reservoir to be opened. This requirement is deemed to have been met if the vehicle is equipped with a transparent brake fluid reservoir or a brake fluid level indicator meeting the requirements of S5.5.1(a)(1).

S5.5. *Brake system warning telltales.* Each vehicle must have one or more visual brake system warning telltales which meet the requirements of S5.5.1 through S5.5.5. For vehicles with manually operated driving controls, all brake system warning telltales must be mounted in front

of and in clear view of the driver. For vehicles without manually operated driving controls, all brake system warning telltales must be in clear view of all designated seating positions. In addition, a vehicle manufactured without a split service brake system must be equipped with an auditory warning signal that activates under the conditions specified in S5.5.1(a).

S5.5.1. *Activation*. A telltale must be activated when the vehicle power (ignition or start) switch is in the "on" ("run") state and whenever any of conditions (a) through (g) occur:

(a) A gross loss of fluid or fluid pressure (such as caused by rupture of a brake line but not by a structural failure of a housing that is common to two or more subsystems) as indicated by one of the following conditions (chosen at the option of the manufacturer):

(1) A drop in the level of the brake fluid in any master cylinder reservoir compartment to less than the recommended safe level specified by the manufacturer or to one-fourth of the fluid capacity of that reservoir compartment, whichever is greater.

(2) For vehicles equipped with a split service brake system, a differential pressure of 1.5 MPa (218 psi) between the intact and failed brake subsystems measured at a master cylinder outlet or a slave cylinder outlet.

(3) A drop in the supply pressure in a brake power unit to one-half of the normal system pressure.

(b) Any electrical functional failure in an antilock or variable brake proportioning system.

(c) Application of the parking brake, except in vehicles without manually operated driving controls.

(d) Brake lining wear-out, if the manufacturer has elected to use an electrical device to provide an optical warning to meet the requirements of S5.1.2(a).

(e) For a vehicle with electrically-actuated service brakes, failure of the source of electric power to those brakes, or diminution of state of charge of the batteries to less than a level

specified by the manufacturer for the purpose of warning a driver of degraded brake performance.

(f) For a vehicle with electric transmission of the service brake control signal, failure of a brake control circuit.

(g) For an EV with a regenerative braking system that is part of the service brake system, failure of the RBS.

S5.5.2. *Function check.*

(a) All telltales must be activated as a check function by either:

(1) Automatic activation when the vehicle power (ignition or start) switch is transitioned to the "on" ("run") state when the engine is not running, or when the vehicle power (ignition or start) switch is in a state between "on" ("run") and "start" that is designated by the manufacturer as a check state, or

(2) A single manual action by the driver, such as momentary activation of a test button or switch mounted on the instrument panel in front of and in clear view of the driver, or, in the case of a telltale for application of the parking brake, by applying the parking brake when the vehicle power (ignition or start) switch is in the "on" ("run") state.

(b) In the case of a vehicle that has an interlock device that prevents the engine from being started under one or more conditions, check functions meeting the requirements of S5.5.2(a) need not be operational under any condition in which the engine cannot be started.

(c) The manufacturer must explain the brake check function test procedure in the owner's manual.

S5.5.3. *Duration*. Each telltale activated due to a condition specified in S5.5.1 must remain activated as long as the condition exists, whenever the vehicle power (ignition or start) switch is in the "on" ("run") state, whether or not the engine is running.

S5.5.4. *Function*. When a telltale is activated, it may be continuous or flashing, except that the telltale on a vehicle not equipped with a split service brake system must be flashing. The auditory warning required for a vehicle manufactured without a split service brake system may be continuous or intermittent.

S5.5.5. *Labeling*.

(a) Each telltale must display a word or words in accordance with the requirements of Standard No. 101 (49 CFR 571.101) and this section, which must be legible to the driver under all daytime and nighttime conditions when activated. Unless otherwise specified, the words must have letters not less than 3.2 mm (1⁄8 inch) high and the letters and background must be of contrasting colors, one of which is red. Words or symbols in addition to those required by Standard No. 101 and this section may be provided for purposes of clarity.

(b) Vehicles manufactured with a split service brake system may use a common brake warning telltale to indicate two or more of the functions described in S5.5.1(a) through S5.5.1(g). If a common telltale is used, it must display the word "Brake."

(c) A vehicle manufactured without a split service brake system must use a separate telltale to indicate the failure condition in S5.5.1(a). This telltale must display the words "STOP—BRAKE FAILURE" in block capital letters not less than 6.4 mm (1⁄4 inch) in height.

(d) If separate telltales are used for one or more of the conditions described in S5.5.1(a) through S5.5.1(g), the telltales must display the following wording:

(1) If a separate telltale is provided for the low brake fluid condition in S5.5.1(a)(1), the words "Brake Fluid" must be used except for vehicles using hydraulic system mineral oil.

(2) If a separate telltale is provided for the gross loss of pressure condition in S5.5.1(a)(2), the words "Brake Pressure" must be used.

(3) If a separate telltale is provided for the condition specified in S5.5.1(b), the letters and background must be of contrasting colors, one of which is yellow. The telltale must be labeled with the words “Antilock” or “Anti-lock” or “ABS”; or “Brake Proportioning,” in accordance with Table 1 of Standard No. 101.

(4) If a separate telltale is provided for application of the parking brake as specified for S5.5.1(c), the single word “Park” or the words “Parking Brake” may be used.

(5) If a separate telltale is provided to indicate brake lining wear-out as specified in S5.5.1(d), the words “Brake Wear” must be used.

(6) If a separate telltale is provided for the condition specified in S5.5.1(g), the letters and background must be of contrasting colors, one of which is yellow. The telltale must be labeled with the symbol “RBS.” RBS failure in a system that is part of the service brake system may also be indicated by a yellow lamp that also indicates “ABS” failure and displays the symbol “ABS/RBS.”

(7) If a separate telltale is provided for any other function, the display must include the word “Brake” and the appropriate additional labeling.

S5.6. *Brake system integrity.* Each vehicle must meet the complete performance requirements of this standard without:

(a) Detachment or fracture of any component of the braking system, such as brake springs and brake shoes or disc pad facings other than minor cracks that do not impair attachment of the friction facings. All mechanical components of the braking system must be intact and functional. Friction facing tearout (complete detachment of lining) must not exceed 10 percent of the lining on any single frictional element.

(b) Any visible brake fluid or lubricant on the friction surface of the brake, or leakage at the master cylinder or brake power unit reservoir cover, seal, and filler openings.

S6. ***General test conditions.*** Each vehicle must meet the performance requirements specified in S7 under the following test conditions and in accordance with the test procedures and test sequence specified. Where a range of conditions is specified, the vehicle must meet the requirements at all points within the range.

S6.1. *Ambient conditions.*

S6.1.1. *Ambient temperature.* The ambient temperature is any temperature between 0 °C (32 °F) and 40 °C (104 °F).

S6.1.2. *Wind speed.* The wind speed is not greater than 5 m/s (11.2 mph).

S6.2. *Road test surface.*

S6.2.1. *Pavement friction.* Unless otherwise specified, the road test surface produces a peak friction coefficient (PFC) of 1.02 when measured using an ASTM F2493 standard reference test tire, in accordance with ASTM E1337-19 (incorporated by reference, see §571.5), at a speed of 64.4 km/h (40 mph), without water delivery.

S6.2.2. *Gradient.* Except for the parking brake gradient holding test, the test surface has no more than a 1 percent gradient in the direction of testing and no more than a 2 percent gradient perpendicular to the direction of testing.

S6.2.3. *Lane width.* Road tests are conducted on a test lane 3.5 m (11.5 ft) wide.

S6.3. *Vehicle conditions.*

S6.3.1. *Vehicle weight.*

S6.3.1.1. For the tests at GVWR, the vehicle is loaded to its GVWR such that the weight on each axle as measured at the tire-ground interface is in proportion to its gross axle weight rating, with the fuel tank filled to 100 percent of capacity. However, if the weight on any axle of a vehicle at LLVW exceeds the axle's proportional share of the GVWR, the load required to reach GVWR is placed so that the weight on that axle remains the same as at LLVW.

S6.3.1.2. For the test at LLVW, the vehicle is loaded to its LLVW such that the added weight is distributed in the front passenger seat area.

S6.3.2. *Fuel tank loading.* The fuel tank is filled to 100 percent of capacity at the beginning of testing and may not be less than 75 percent of capacity during any part of the testing.

S6.3.3. *Lining preparation.* At the beginning of preparation for the road tests, the brakes of the vehicle are in the same condition as when the vehicle was manufactured. No burnishing or other special preparation is allowed, unless all vehicles sold to the public are similarly prepared as a part of the manufacturing process.

S6.3.4. *Adjustments and repairs.* These requirements must be met without replacing any brake system parts or making any adjustments to the brake system except as specified in this standard. Where brake adjustments are specified (S7.1.3), adjust the brakes, including the parking brakes, in accordance with the manufacturer's recommendation. No brake adjustments are allowed during or between subsequent tests in the test sequence.

S6.3.5. *Automatic brake adjusters.* Automatic adjusters are operational throughout the entire test sequence. They may be adjusted either manually or by other means, as recommended by the manufacturer, only prior to the beginning of the road test sequence.

S6.3.6. *Antilock brake system (ABS)*. The ABS is fully operational for all tests, except where specified in the following sections.

S6.3.7. *Variable brake proportioning valve*. If a vehicle is equipped with a variable brake proportioning system, the proportioning valve is fully operational for all tests except the test for failed variable brake proportioning system.

S6.3.8. *Tire inflation pressure.* Tires are inflated to the pressure recommended by the vehicle manufacturer for the GVWR of the vehicle.

S6.3.9. *Engine.* Engine idle speed and ignition timing are set according to the manufacturer's recommendations. If the vehicle is equipped with an adjustable engine speed governor, it is adjusted according to the manufacturer's recommendations.

S6.3.10. *Vehicle openings.* All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

S6.3.11. *State of charge of batteries for EVs.*

S6.3.11.1. The state of charge of the propulsion batteries is determined in accordance with SAE Recommended Practice J227a (1976) (incorporated by reference, see §571.5). The applicable sections of J227a (1976) are 3.2.1 through 3.2.4, 3.3.1 through 3.3.2.2, 3.4.1 and 3.4.2, 4.2.1, 5.2, 5.2.1 and 5.3.

S6.3.11.2. At the beginning of the burnish procedure (S7.1 of this standard) in the test sequence, each propulsion battery is at the maximum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, of, if the manufacturer has made no recommendation, not less than 95 percent. During the 200-stop burnish procedure, the propulsion batteries are restored to the maximum state of charge determined as above, after each increment of 40 burnish stops until the burnish procedure is complete. The batteries may be charged at a more frequent interval during a particular 40-stop increment only if the EV is incapable of achieving the initial burnish test speed during that increment. During the burnish procedure, the propulsion batteries may be charged by external means or replaced by batteries that are at a state of charge of not less than 95 percent. For an EV having a manual control for setting the level of regenerative braking, the manual control, at the beginning of the burnish procedure, is set to provide maximum regenerative braking throughout the burnish.

S6.3.11.3. At the beginning of each performance test in the test sequence (S7.2 through S7.17 of this standard), unless otherwise specified, an EV's propulsion batteries are at the state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. No further charging of any propulsion battery occurs during any of the performance tests in the test sequence of this standard. If the propulsion batteries are depleted during a test sequence such that the vehicle reaches automatic shut-down, will not accelerate, or the low state of charge brake warning lamp is illuminated, the vehicle is to

be accelerated to brake test speed by auxiliary means. If a battery is replaced rather than recharged, the replacement battery is charged and measured for state of charge in accordance with these procedures.

S6.3.12. *State of charge of batteries for electrically-actuated service brakes.* A vehicle equipped with electrically-actuated service brakes also performs the following test series. Conduct 10 stopping distance tests from a speed of 100 kph or the maximum vehicle speed, whichever is less. At least two of the 10 stopping distances must be less than or equal to 70 meters. The vehicle is loaded to GVWR and the transmission is in the neutral position when the service brake control is actuated and throughout the remainder of the test. Each battery providing power to the electrically-actuated service brakes, is in a depleted state of charge for conditions (a), (b), or (c) of this paragraph as appropriate. An auxiliary means may be used to accelerate an EV to test speed.

(a) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries and with automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at not more than five percent above the EV actual automatic shut-down critical value. The critical value is determined by measuring the state-of-charge of each propulsion battery at the instant that automatic shut-down occurs.

(b) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries and with no automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at an average of not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.5.1(e) of this standard, is illuminated.

(c) For a vehicle which has one or more auxiliary batteries that provides electrical energy to operate the electrically-actuated service brakes, each auxiliary battery is at not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.5.1(e) of this standard, is illuminated.

S6.3.13. *Electric vehicles.*

S6.3.13.1.

(a) For an EV equipped with an RBS that is part of the service brake system, the RBS is operational during the burnish and all tests, except for the test of a failed RBS.

(b) For an EV equipped with an RBS that is not part of the service brake system, the RBS is operational and set to produce the maximum regenerative braking effect during the burnish, and is disabled during the test procedures. If the vehicle is equipped with a neutral gear that automatically disables the RBS, the test procedures which are designated to be conducted in gear may be conducted in neutral.

S6.3.13.2. For tests conducted "in neutral," the test operator of an EV with no "neutral" position (or other means such as a clutch for disconnecting the drive train from the propulsion motor(s)) does not apply any electromotive force to the propulsion motor(s). Any electromotive force that is applied to the propulsion motor(s) automatically remains in effect unless otherwise specified by the test procedure.

S6.4. *Brake temperature measurement.* The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in Figure 1. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the metal rubbing surface of a drum or rotor. For center-grooved shoes or pads, thermocouples are installed within 3 mm (.12 in) to 6 mm (.24 in) of the groove and as close to the center as possible.

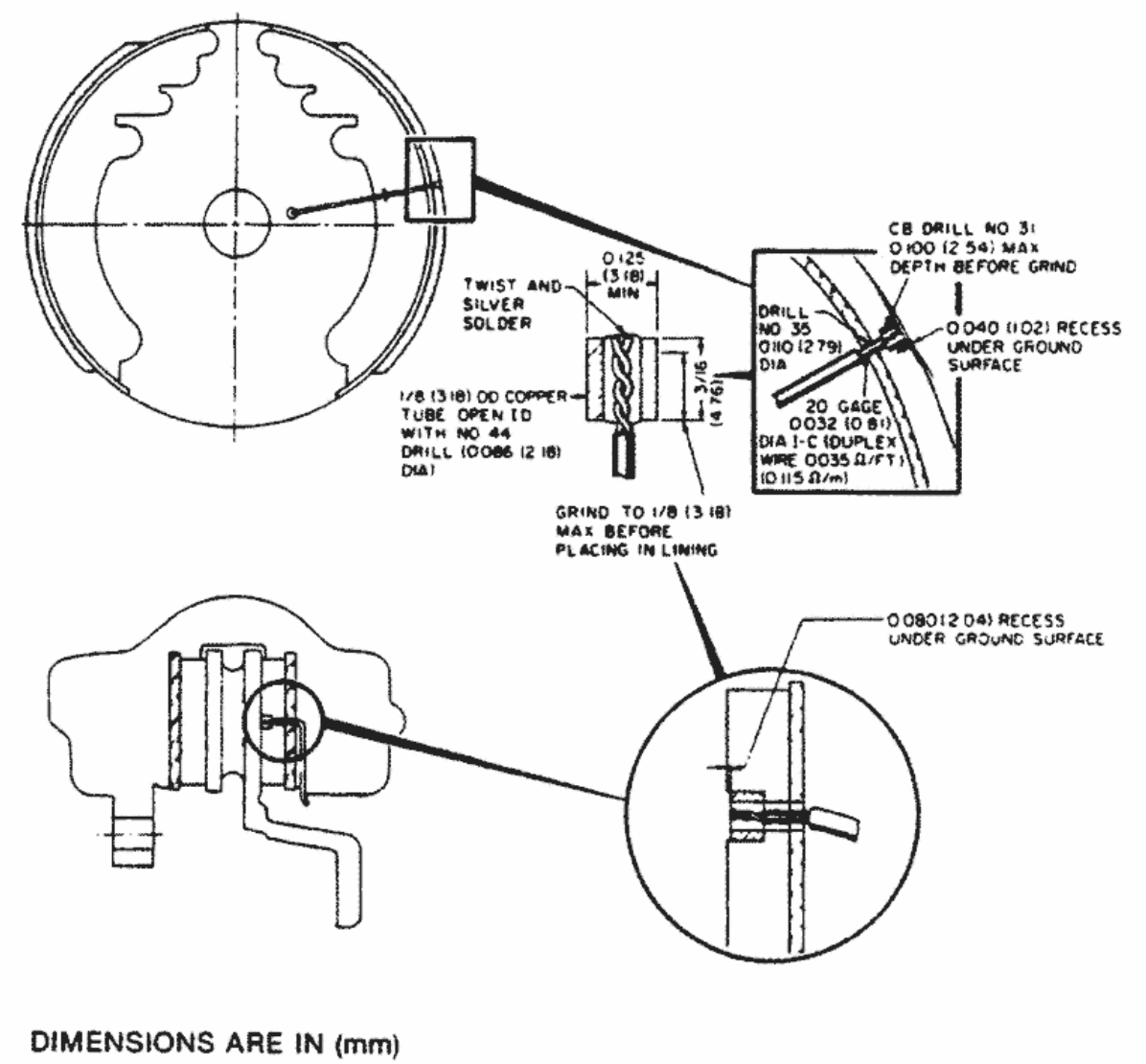

Figure 1–Typical Plug-Type Thermocouple Installations

S6.5. *Procedural conditions.*

S6.5.1. *Brake controls.* For a vehicle with a service brake pedal, all service brake system performance requirements, including the partial system requirements of S7.7, S7.10 and S7.11, must be met solely by use of the service brake pedal.

S6.5.2. *Test speeds.* If a vehicle is incapable of attaining the specified normal test speed, it is tested at a speed that is a multiple of 5 km/h (3.1 mph) that is 4 to 8 km/h (2.5 to 5.0 mph) less than its maximum speed and its performance must be within a stopping distance given by the formula provided for the specific requirement.

S6.5.3. *Stopping distance.*

S6.5.3.1. The braking performance of a vehicle is determined by measuring the stopping distance from a given initial speed.

S6.5.3.2. Unless otherwise specified, the vehicle is stopped in the shortest distance achievable (best effort) on all stops. Where more than one stop is specified for a given set of test conditions, a vehicle is deemed to comply with the corresponding stopping distance requirements if at least one of the stops is made within the prescribed distance.

S6.5.3.3. In the stopping distance formulas given for each applicable test (such as $S \leq 0.10V + 0.0060V^2$), S is the maximum stopping distance in meters, and V is the test speed in km/h.

S6.5.4. *Vehicle position and attitude.*

S6.5.4.1. The vehicle is aligned in the center of the lane at the start of each brake application. Steering corrections are permitted during each stop.

S6.5.4.2. Stops are made without any part of the vehicle leaving the lane and without rotation of the vehicle about its vertical axis of more than ±15° from the center line of the test lane at any time during any stop.

S6.5.5. *Transmission selector control.*

S6.5.5.1. For tests in neutral, a stop or snub is made in accordance with the following procedures:

(a) Exceed the test speed by 6 to 12 km/h (3.7 to 7.5 mph);

(b) Close the throttle and coast in gear to approximately 3 km/h (1.9 mph) above the test speed;

(c) Shift to, or select, neutral; and

(d) When the test speed is reached, apply the brakes.

S6.5.5.2. For tests in gear, a stop or snub is made in accordance with the following procedures:

(a) With the transmission selector in the control position recommended by the manufacturer for driving on a level surface at the applicable test speed, exceed the test speed by 6 to 12 km/h (3.7 to 7.5 mph);

(b) Close the throttle and coast in gear; and

(c) When the test speed is reached apply the brakes.

(d) To avoid engine stall, a manual transmission may be shifted to neutral (or the clutch disengaged) when the vehicle speed is below 30 km/h (18.6 mph).

S6.5.6. *Initial brake temperature (IBT).* If the lower limit of the specified IBT for the first stop in a test sequence (other than a parking brake grade holding test) has not been reached, the brakes are heated to the IBT by making one or more brake applications from a speed of 50 km/h (31.1 mph), at a deceleration rate not greater than 3 m/s^2 (9.8 fps^2).

S7. *Road test procedures and performance requirements.* Each vehicle must meet all the applicable requirements of this section, when tested according to the conditions and procedures set forth below and in S6, in the sequence specified in Table 1:

Table 1—Road Test Sequence

Testing order	Section No.
Vehicle loaded to GVWR:	
1 Burnish	S7.1
2 Cold effectiveness	S7.5
3 High speed effectiveness	S7.6
4 Stops with engine off	S7.7
Vehicle loaded to LLVW:	
5 Cold effectiveness	S7.5
6 High speed effectiveness	S7.6
7 Failed antilock	S7.8
8 Failed proportioning valve	S7.9
9 Hydraulic circuit failure	S7.10
Vehicle loaded to GVWR:	
10 Hydraulic circuit failure	S7.10
11 Failed antilock	S7.8
12 Failed proportioning valve	S7.9
13 Power brake unit failure	S7.11
14 Parking brake	S7.12
15 Heating snubs	S7.13
16 Hot performance	S7.14
17 Brake cooling	S7.15
18 Recovery performance	S7.16

Table 1—Road Test Sequence	
Testing order	**Section No.**
19 Final inspection	S7.17

S7.1. *Burnish*.

S7.1.1. *General information.* Any pretest instrumentation checks are conducted as part of the burnish procedure, including any necessary rechecks after instrumentation repair, replacement or adjustment. Instrumentation check test conditions are in accordance with the burnish test procedure specified in S7.1.2 and S7.1.3.

S7.1.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In gear.

S7.1.3. *Test conditions and procedures.* The road test surface conditions specified in S6.2 do not apply to the burnish procedure.

(a) IBT: ≤100 °C (212 °F).

(b) Test speed: 80 km/h (49.7 mph).

(c) Service brake control: Adjust service brake control as necessary to maintain specified constant deceleration rate.

(d) Deceleration rate: Maintain a constant deceleration rate of 3.0 m/s^2 (9.8 fps^2).

(e) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(f) Number of runs: 200 stops.

(g) Interval between runs: The interval from the start of one service brake application to the start of the next is either the time necessary to reduce the IBT to 100 °C (212 °F) or less, or the distance of 2 km (1.24 miles), whichever occurs first.

(h) Accelerate to 80 km/h (49.7 mph) after each stop and maintain that speed until making the next stop.

(i) After burnishing, adjust the brakes as specified in S6.3.4.

S7.2. [Reserved]

S7.3. [Reserved]

S7.4. [Reserved]

S7.5. *Cold effectiveness.*

S7.5.1. *Vehicle conditions.*

(a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In neutral.

S7.5.2. *Test conditions and procedures.*

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) For each stop, bring the vehicle to test speed and then stop the vehicle under the specified conditions.

S7.5.3. *Performance requirements.*

(a) Stopping distance for 100 km/h test speed: ≤70m (230 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0060V^2$.

S7.6. *High speed effectiveness.* This test is not run if vehicle maximum speed is less than or equal to 125 km/h (77.7 mph).

S7.6.1. *Vehicle conditions.*

(a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In gear.

S7.6.2. *Test conditions and procedures.*

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: The test speed is 160 km/h (99.4 mph) or 80 percent of Vmax, whichever is slower.

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

S7.6.3. *Performance requirements.*

Stopping distance: $S \leq 0.10V + 0.0067V^2$.

S7.7. *Stops with Engine Off.*

S7.7.1. *General information.* This test is for vehicles equipped with one or more brake power units or brake power assist units. This test is also for EVs.

S7.7.2. *Vehicle conditions*.

(a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

(c) Vehicle engine: Off (not running).

(d) Vehicle power switch: May be returned to the "on" state after turning the engine off, or a device may be used to "kill" the engine while leaving the power switch in the "on" state.

(e) For an EV, this test is conducted with no electrical power supplied to the vehicle's propulsion motor(s), but with the RBS and brake power or power assist still operating, unless cutting off the supply of electrical power to the propulsion motor(s) also disables those systems.

S7.7.3. *Test conditions and procedures.*

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) All system reservoirs (brake power and/or assist units) are fully charged and the vehicle's engine is off (not running) at the beginning of each stop.

S7.7.4. *Performance requirements.*

(a) Stopping distance for 100 km/h test speed: ≤70m (230 ft.)

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0060V^2$.

S7.8. *Antilock functional failure.*

S7.8.1. *Vehicle conditions.*

(a) Vehicle loading: LLVW and GVWR.

(b) Transmission position: In neutral.

S7.8.2. *Test conditions and procedures.*

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) Functional failure simulation:

(1) Disconnect the functional power source, or any other electrical connector that creates a functional failure when disconnected.

(2) Determine whether the brake system telltale is activated when any electrical functional failure of the antilock system is created.

(3) Restore the system to normal at the completion of this test.

(h) If more than one antilock brake subsystem is provided, repeat test for each subsystem.

S7.8.3. *Performance requirements.* For service brakes on a vehicle equipped with one or more antilock systems, in the event of any single functional failure in any such system, the service brake system must continue to operate and must stop the vehicle as specified in S7. 8.3(a) or S7. 8.3(b).

(a) Stopping distance for 100 km/h test speed: ≤85 m (279 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0075V^2$.

S7.9. *Variable brake proportioning system functional failure.*

S7.9.1. *Vehicle conditions.*

(a) Vehicle load: LLVW and GVWR.

(b) Transmission position: In neutral.

S7.9.2. *Test conditions and procedures*.

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) Functional failure simulation:

(1) Disconnect the functional power source or mechanical linkage to render the variable brake proportioning system inoperative.

(2) If the system utilizes electrical components, determine whether the brake system telltale is activated when any electrical functional failure of the variable proportioning system is created.

(3) Restore the system to normal at the completion of this test.

(h) If more than one variable brake proportioning subsystem is provided, repeat the test for each subsystem.

S7.9.3. *Performance requirements.* The service brakes on a vehicle equipped with one or more variable brake proportioning systems, in the event of any single functional failure in any such system, must continue to operate and must stop the vehicle as specified in S7.9.3(a) or S7.9.3(b).

(a) Stopping distance for 100 km/h test speed: ≤110 m (361 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0100V^2$.

S7.10. *Hydraulic circuit failure.*

S7.10.1. *General information.* This test is for vehicles manufactured with or without a split service brake system.

S7.10.2. *Vehicle conditions.*

(a) Vehicle load: LLVW and GVWR.

(b) Transmission position: In neutral.

S7.10.3. *Test conditions and procedures.*

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Test surface: PFC of 1.02.

(f) Alter the service brake system to produce any single failure. For a hydraulic circuit, this may be any single rupture or leakage type failure, other than a structural failure of a housing that is common to two or more subsystems. For a vehicle in which the brake signal is transmitted electrically between the brake pedal and some or all of the foundation brakes, regardless of the means of actuation of the foundation brakes, this may be any single failure in any circuit that electrically transmits the brake signal. For an EV with RBS that is part of the service brake system, this may be any single failure in the RBS.

(g) Verify the brake warning telltale has been activated. For a hydraulic circuit failure, record the brake fluid level, differential pressure, or supply pressure drop necessary to activate the brake warning telltale.

(h) Number of runs: After the brake warning telltale has been activated, make the following stops depending on the type of brake system:

(1) 4 stops for a split service brake system.

(2) 10 consecutive stops for a non-split service brake system.

(i) For vehicles with a service brake pedal, each stop is made by a continuous application of the service brake control.

(j) Restore the service brake system to normal at the completion of this test.

(k) Repeat the entire sequence for each of the other subsystems.

S7.10.4. *Performance requirements.* For vehicles manufactured with a split service brake system, in the event of any failure in a single subsystem, as specified in S7.10.3(f) of this standard, and after activation of the brake system telltale as specified in S5.5.1, the remaining portions of the service brake system must continue to operate and must stop the vehicle as specified in S7.10.4(a) or S7.10.4(b). For vehicles not manufactured with a split service brake system, in the event of any failure in any component of the service brake system, as specified in S7.10.3(f), and after activation of the brake system telltale as specified in S5.5.1 of this standard, the vehicle must stop 10 times consecutively as specified in S7.10.4(a) or S7.10.4(b).

(a) Stopping distance from 100 km/h test speed: ≤168 m (551 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0158V^2$.

S7.11. *Brake power unit or brake power assist unit inoperative (System depleted).*

S7.11.1. *General information.* This test is for vehicles equipped with one or more brake power units or brake power assist units.

S7.11.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

S7.11.3. *Test conditions and procedures.*

(a) IBT: Between 65 °C (149 °F) and 100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles with a service brake pedal, the applied pedal force is between 65 N (14.6 lbs) and 500 N (112.4 lbs). For vehicles without manually operated driving controls, the service brake control is activated in accordance with manufacturer specifications.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) Disconnect the primary source of power for one brake power assist unit or brake power unit, or one of the brake power unit or brake power assist unit subsystems if two or more subsystems are provided.

(h) If the brake power unit or power assist unit operates in conjunction with a backup system and the backup system is automatically activated in the event of a primary power service failure, the backup system is operative during this test.

(i) Exhaust any residual brake power reserve capability of the disconnected system.

(j) Make each of the 6 stops. For vehicles equipped with a service brake pedal, stop the vehicle with a continuous application of the service brake control.

(k) Restore the system to normal at completion of this test.

(l) For vehicles equipped with more than one brake power unit or brake power assist unit, conduct tests for each in turn.

(m) For vehicles with electrically-actuated service brakes (brake power unit), this test is conducted with any single electrical failure in the electrically-actuated service brakes

instead of a failure of any other brake power or brake power assist unit, and all other systems intact.

S7.11.4. *Performance requirements.* The service brakes on a vehicle equipped with one or more brake power assist units or brake power units, with one such unit inoperative and depleted of all reserve capability, must stop the vehicle as specified in S7.11.4(a) or S7.11.4(b).

(a) Stopping distance from 100 km/h test speed: ≤168 m (551 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0158V^2$.

S7.12. *Parking brake.*

S7.12.1. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

(c) Parking brake burnish:

(1) For vehicles with parking brake systems not utilizing the service friction elements, the friction elements of such a system are burnished prior to the parking brake test according to the published recommendations furnished to the purchaser by the manufacturer.

(2) If no recommendations are furnished, the vehicle's parking brake system is tested in an unburnished condition.

(d) Parking brake applications: 1 application and up to 2 reapplications, if necessary.

S7.12.2. *Test conditions and procedures.*

(a) IBT:

(1) Parking brake systems utilizing service brake friction materials are tested with the IBT ≤100 °C (212 °F) and have no additional burnishing or artificial heating prior to the start of the parking brake test.

(2) Parking brake systems utilizing non-service brake friction materials are tested with the friction materials at ambient temperature at the start of the test. The

friction materials have no additional burnishing or artificial heating prior to or during the parking brake test.

(b) Parking brake control force for vehicles equipped with a hand- or foot-operated parking brake control: Hand control ≤400 N (89.9 lbs); foot control ≤500 N (112.4 lbs).

(c) Hand force measurement locations: The force required for actuation of a hand-operated brake system is measured at the center of the hand grip area or at a distance of 40 mm (1.57 in) from the end of the actuation lever as illustrated in Figure 3.

(d) Parking brake applications: 1 application and up to 2 reapplications, if necessary.

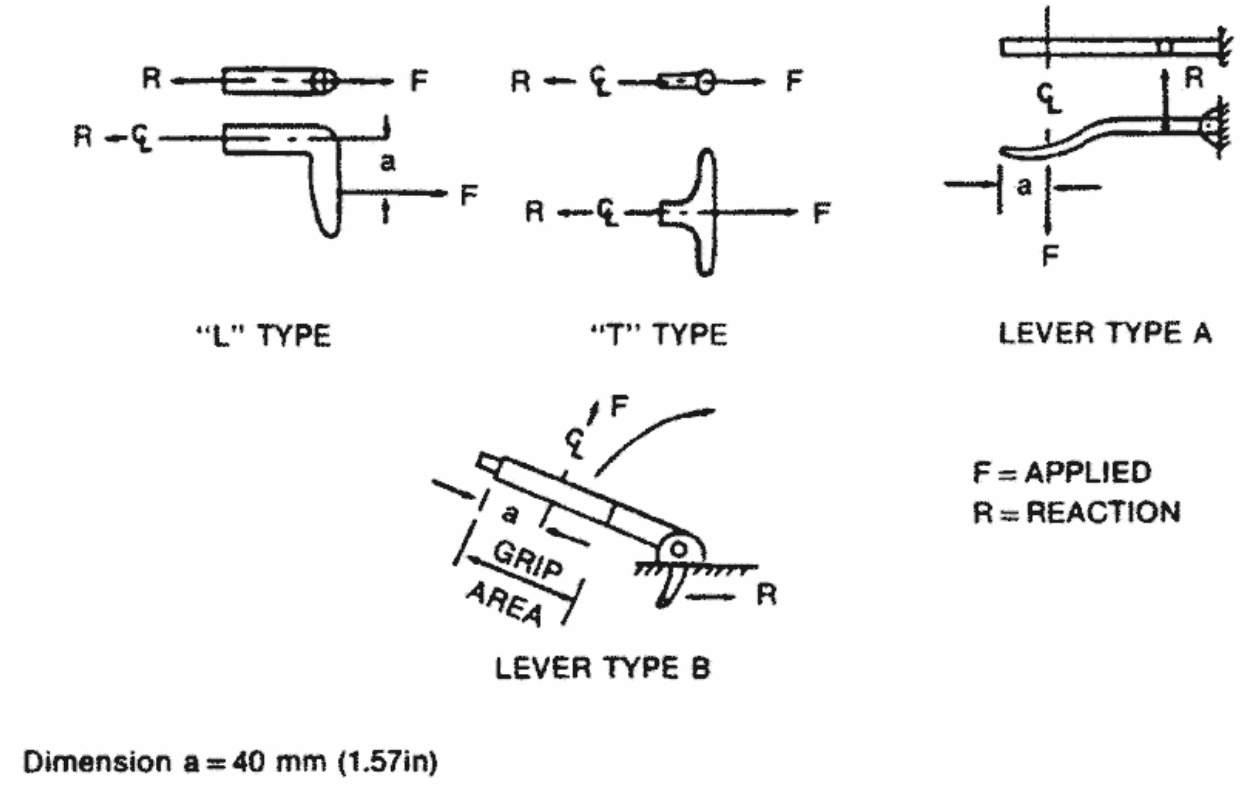

Figure 3–Location for Measuring Brake Application Force (Hand Brake)

(e) Test surface gradient: 20 percent grade.

(f) Drive the vehicle onto the grade with the longitudinal axis of the vehicle in the direction of the slope of the grade.

(g) Stop the vehicle and hold it stationary by applying the service brake and place the transmission in neutral.

(h) With the service brake applied sufficiently to just keep the vehicle from rolling, apply the parking brake as specified in S7.12.2(i) or S7.12.2(j).

(i) For a vehicle equipped with mechanically-applied parking brakes, make a single application of the parking brake control with a force not exceeding the limits specified in S7.12.2(b). For a vehicle using an electrically-activated parking brake, apply the parking brake by activating the parking brake control.

(j) In the case of a parking brake system that does not allow application of the specified force in a single application, a series of applications may be made to achieve the specified force.

(k) Following the application of the parking brakes, release all force on the service brake control and, if the vehicle remains stationary, start the measurement of time.

(l) If the vehicle does not remain stationary, reapplication of a force to the parking brake control at the level specified in S7.12.2(b) as appropriate for the vehicle being tested (without release of the ratcheting or other holding mechanism of the parking brake) is used up to two times to attain a stationary position.

(m) Verify the operation of the parking brake application telltale.

(n) Following observation of the vehicle in a stationary condition for the specified time in one direction, repeat the same test procedure with the vehicle orientation in the opposite direction on the same grade.

S7.12.3. *Performance requirement.* The parking brake system must hold the vehicle stationary for 5 minutes in both a forward and reverse direction on the grade.

S7.13. *Heating snubs.*

S7.13.1. *General information.* The purpose of the snubs is to heat up the brakes in preparation for the hot performance test which follows immediately.

S7.13.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In gear.

S7.13.3. *Test conditions and procedures.*

(a) IBT:

(1) Establish an IBT before the first brake application (snub) between 55 °C (131 °F) and 65 °C (149 °F).

(2) IBT before subsequent snubs are those occurring at the distance intervals.

(b) Number of snubs: 15.

(c) Test speeds: The initial speed for each snub is 120 km/h (74.6 mph) or 80 percent of Vmax, whichever is slower. Each snub is terminated at one-half the initial speed.

(d) Deceleration rate:

(1) Maintain a constant deceleration rate of 3.0 m/s^2 (9.8 fps^2).

(2) Attain the specified deceleration within one second and maintain it for the remainder of the snub.

(e) Service brake control: Adjust as necessary to maintain specified constant deceleration rate.

(f) Time interval: Maintain an interval of 45 seconds between the start of brake applications (snubs).

(g) Accelerate as rapidly as possible to the initial test speed immediately after each snub.

(h) Immediately after the 15th snub, accelerate to 100 km/h (62.1 mph) and commence the hot performance test.

S7.14. *Hot performance.*

S7.14.1. *General information.* The hot performance test is conducted immediately after completion of the 15th heating snub.

S7.14.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

S7.14.3. *Test conditions and procedures.*

(a) IBT: Temperature achieved at completion of heating snubs.

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control:

(1) For vehicles with a service brake pedal, the first stop is done with an average pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop. For vehicles without a service brake pedal, the first stop is done with an average control input not greater than the average control input recorded during the shortest GVWR cold effectiveness stop.

(2) For vehicles with a service brake pedal, the second stop is done with a pedal force not greater than 500 N (112.4 lbs). For vehicles without a service brake pedal, the manufacturer's recommended input is used for the second stop.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 2 stops.

(f) Immediately after the 15th heating snub, accelerate to 100 km/h (62.1 mph) and commence the first stop of the hot performance test.

(g) If the vehicle is incapable of attaining 100 km/h, it is tested at the same speed used for the GVWR cold effectiveness test.

(h) Immediately after completion of the first hot performance stop, accelerate as rapidly as possible to the specified test speed and conduct the second hot performance stop.

(i) Immediately after completion of the second hot performance stop, commence S7.15.

S7.14.4. *Performance requirements.*

(a) For the first hot stop, the stopping distance must be less than or equal to a calculated distance which is based on 60 percent of the deceleration actually achieved on the shortest GVWR cold effectiveness stop. The following equations are used in calculating the performance requirement:

$$d_c = \frac{0.0386V^2}{S_c - 0.10V}$$

$$S = 0.10V + \frac{0.0386V^2}{0.60(d_c)}$$

Where:

d_c = the average deceleration actually achieved during the shortest cold effectiveness stop at GVWR (m/s^2),

S_c = actual stopping distance measured on the shortest cold effectiveness stop at GVWR (m), and

V = cold effectiveness test speed (km/h).

(b) In addition to the requirement in S7.14.4(a), the stopping distance for at least one of the two hot stops must be S ≤89 m (292 ft) from a test speed of 100 km/h (62.1 mph) or, for reduced test speed, $S \leq 0.10V + 0.0079V^2$. The results of the second stop may not be used to meet the requirements of S7.14.4(a).

S7.15. *Brake cooling stops.*

S7.15.1. *General information.* The cooling stops are conducted immediately after completion of the hot performance test.

S7.15.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In gear.

S7.15.3. *Test conditions and procedures.*

(a) IBT: Temperature achieved at completion of hot performance.

(b) Test speed: 50 km/h (31.1 mph).

(c) Service brake control: Adjust as necessary to maintain specified constant deceleration rate.

(d) Deceleration rate: Maintain a constant deceleration rate of 3.0 m/s^2 (9.8 fps^2).

(e) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(f) Number of runs: 4 stops.

(g) Immediately after the hot performance stops drive 1.5 km (0.93 mi) at 50 km/h (31.1 mph) before the first cooling stop.

(h) For the first through the third cooling stops:

(1) After each stop, immediately accelerate at the maximum rate to 50 km/h (31.1 mph).

(2) Maintain that speed until beginning the next stop at a distance of 1.5 km (0.93 mi) from the beginning of the previous stop.

(i) For the fourth cooling stop:

(1) Immediately after the fourth stop, accelerate at the maximum rate to 100 km/h (62.1 mph).

(2) Maintain that speed until beginning the recovery performance stops at a distance of 1.5 km (0.93 mi) after the beginning of the fourth cooling stop.

S7.16. *Recovery performance.*

S7.16.1. *General information.* The recovery performance test is conducted immediately after completion of the brake cooling stops.

S7.16.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

S7.16.3. *Test conditions and procedures*.

(a) IBT: Temperature achieved at completion of cooling stops.

(b) Test speed: 100 km/h (62.1 mph).

(c) Service brake control: For vehicles equipped with a service brake pedal, the average pedal force is no greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop. For vehicles without a service brake pedal, the average control input is no greater than the average control input recorded during the shortest GVWR cold effectiveness stop.

(d) Wheel lockup: No lockup of any wheel is allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 2 stops.

(f) Immediately after the fourth cooling stop, accelerate at the maximum rate to 100 km/h (62.1 mph).

(g) Maintain that speed until beginning the first recovery performance stop at a distance of 1.5 km (0.93 mi) after the beginning of the fourth cooling stop.

(h) If the vehicle is incapable of attaining 100 km/h, it is tested at the same speed used for the GVWR cold effectiveness test.

(i) Immediately after completion of the first recovery performance stop accelerate as rapidly as possible to the specified test speed and conduct the second recovery performance stop.

S7.16.4. *Performance requirements.*

The stopping distance, S, for at least one of the two stops must be within the following limits:

$$\frac{0.0386V^2}{1.50d_c} \leq S - 0.10V \leq \frac{0.0386V^2}{0.70d_c}$$

where d_c and V are defined in S7.14.4(a).

S7.17. *Final inspection.* Inspect:

(a) The service brake system for detachment or fracture of any components, such as brake springs and brake shoes or disc pad facings.

(b) The friction surface of the brake, the master cylinder or brake power unit reservoir cover, and seal and filler openings, for leakage of brake fluid or lubricant.

(c) The master cylinder or brake power unit reservoir for compliance with the volume and labeling requirements of S5.4.2 and S5.4.3. In determining the fully applied worn condition, assume that the lining is worn to

(1) rivet or bolt heads on riveted or bolted linings or

(2) within 0.8 mm (1/32 inch) of shoe or pad mounting surface on bonded linings or

(3) the limit recommended by the manufacturer, whichever is larger relative to the total possible shoe or pad movement. Drums or rotors are assumed to be at nominal design drum diameter or rotor thickness. Linings are assumed adjusted for normal operating clearance in the released position.

(d) The brake system telltales, for compliance with operation in various key positions, lens color, labeling, and location, in accordance with S5.5.

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Administrator.

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