Source of flooding and location	#Depth in feet above ground. *Elevation in feet (NGVD)
Maps are available for inspection at City Hall, City of Pawnee, 510 Illinois Street, Pawnee, Oklahoma.	
Purcell (City), McClain County (FEMA Docket No. 7108)	
Canadian River:	
Approximately 1,500 feet downstream of U.S. Highway 77	*1,033
Approximately 12,600 feet upstream of U.S. Highway 77	*1,044
Just downstream of Atchison, Topeka, and Santa Fe Railroad	*1,061
Canadian River (Shallow Flooding):	
Approximately 200 feet north of the intersection of Atchison, Topeka, and Santa Fe Railroad and Ninth Avenue extended	#2
Canadian River Overflow:	
Just upstream of Atchison, Topeka, and Santa Fe Railroad Relief Bridge	*1,057
Walnut Creek:	
Approximately 3,400 feet downstream of U.S. Highway 77	*1,034
Just downstream of U.S. Highway 77	*1,038
Approximately 400 feet upstream of Interstate Highway 35	*1,048
Approximately 300 feet downstream of Sunset Drive extended	*1,049
Approximately 4,850 feet upstream of Interstate Highway 35	*1,050
Maps are available for inspection at City Hall, City of Purcell, 230 West Main Street, Purcell, Oklahoma.	
TEXAS	
Cherokee County (Unincorporated Areas) (FEMA Docket No. 7114)	
Keys Creek:	
At Pine Crest Lake	*342
At County Road 1401	*346
Approximately 2,750 feet downstream of U.S. Highway 79	*357
Approximately 800 feet upstream of U.S. Highway 79	*371
At Myrtle Drive	*378
Approximately 1,400 feet upstream of Myrtle Drive	*382
Maps are available for inspection at County Extension Office, 201 Sixth Street, Room 104, Rusk, Texas.	
Cibolo (City), Bexar and Guadalupe Counties (FEMA Docket No. 7114)	
Cibolo Creek:	
Approximately 8,000 feet downstream of Schaefer Road	*664
Just downstream of Schaefer Road	*672
At confluence with Dietz Creek	*686
Maps are available for inspection at City Hall, City of Cibolo, 109 South Main, Cibolo, Texas.	
Mineral Wells (City), Palo Pinto County (FEMA Docket No. 7114)	
Pollard Creek:	
Approximately 3,000 feet downstream of Southwest 22nd Street	*835
Southwest 1st Street	*869
Just upstream of Pollard Creek Dam No. 1–A	*916
Pollard Creek Tributary No.1:	
Confluence with Pollard Creek	*842
At corporate limits	*863
Pollard Creek Tributary No. 2:	
At Park Road	*872
At Northwest 2nd Street	*879
Just upstream of Pollard Creek Dam No. 2	*910
Maps are available for inspection at City Hall, City of Mineral Wells, 211 SW First Avenue, Mineral Wells, Texas.	
UTAH	
Joseph (Town), Sevier County (FEMA Docket No. 7114)	
Indian Creek:	
At the intersection of 3rd Street and A Street	#1
At the intersection of 3rd Street and C Street	#2
At the intersection of 5th Street and D Street	#3
Maps are available for inspection at Town Hall, Town of Joseph, 95 North State Street, Joseph, Utah.	
WASHINGTON	
Cowlitz County (Unincorporated Areas) (FEMA Docket No. 7108)	
Toutle River:	
Approximately 16,600 feet upstream of the confluence with the Cowlitz River	*88
Approximately 25,000 feet upstream of the confluence with the Cowlitz River	*116
Just upstream of Tower Road	*137
Approximately 34,800 feet upstream of the confluence with the Cowlitz River	*146
Maps are available for inspection at Cowlitz County, Department of Building and Planning, 207 Fourth Avenue North, Kelso, Washington.	

(Catalog of Federal Domestic Assistance No. 83.100, ''Flood Insurance.'')

Dated: January 26, 1995.

Richard T. Moore,

Associate Director for Mitigation.

[FR Doc. 95–2590 Filed 2–1–95; 8:45 am]

BILLING CODE 6718–03–P

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. 85–06; Notice 8]

RIN 2127–AA13

Federal Motor Vehicle Safety Standards; Hydraulic Brake Systems; Passenger Car Brake Systems

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

ACTION: Final rule.

SUMMARY: This rule establishes a new Federal motor vehicle safety standard, FMVSS No. 135, Passenger Car Brake Systems, and replaces Standard FMVSS No. 105, Hydraulic Brake Systems, as it applies to passenger cars. NHTSA's decision to establish the new standard results from the agency's efforts to harmonize its standards with international standards. The agency has determined that this new standard will achieve the goal of international harmonization while remaining consistent with the statutory mandate to ensure motor vehicle safety.

DATES: *Effective Date:* The amendments made by this rule are effective March 6, 1995. As of this date, manufacturers have the option of complying with either FMVSS No. 105 or with FMVSS No. 135. Compliance with FMVSS No. 135 becomes mandatory on September 1, 2000.

Petitions for Reconsideration: Any petition for reconsideration of this rule must be received by NHTSA no later than March 6, 1995.

ADDRESSES: Petitions for reconsideration should be submitted to: Administrator, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590.

FOR FURTHER INFORMATION CONTACT: Ms. Terri Droneburg, Office of Vehicle Safety Standards, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590 (202) 366–6617.

SUPPLEMENTARY INFORMATION:

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I. Background

A. Federal Motor Vehicle Safety Standards

The National Traffic and Motor Vehicle Safety Act (''the Safety Act''), recently revised and codified ''without substantive change'' at 49 U.S.C. Chapter 301, authorizes the National Highway Traffic Safety Administration (NHTSA) to issue Federal motor vehicle safety standards (FMVSS) to ensure motor vehicle safety. The Safety Act requires that each FMVSS be objective and practicable so that a manufacturer can certify that each of its vehicles meets all applicable standards. Each FMVSS specifies the performance requirements and any necessary test conditions and procedures that NHTSA uses in its periodic tests of motor vehicles and motor vehicle equipment. Each tested vehicle must meet the objective requirements contained within the applicable FMVSS. Under this self-certification system, the government does not subjectively approve or disapprove a type of vehicle or a type of braking system.

B. European Braking Requirements

Unlike the self-certification system used in the United States, the European community has established a ''type approval'' system in which the government approves each type of motor vehicle or item of motor vehicle equipment, based on whether it can meet the safety requirements. For example, the current United Nations Economic Commission for Europe (ECE) braking regulation, Regulation 13 (R13) and its proposed harmonized regulation, R13H, use a calculation method to determine the adhesion utilization of a vehicle as designed. Manufacturers submit their calculations (or the input parameters necessary to make the calculations) to governmental authorities along with a prototype vehicle, and the governments then approve or disapprove the vehicle type based on a review of those calculations and testing of actual vehicles.

C. Harmonizing US and European Braking Regulations

In order to eliminate any unnecessary non-tariff barriers to trade in accordance with the General Agreement on Tariffs and Trade (GATT), the United States has participated in discussions held within the Meeting of Experts on Brakes and Running Gear (GRRF) of the ECE. As a result of these discussions, NHTSA has issued a series of rulemaking notices proposing to establish a new FMVSS, FMVSS No. 135, Passenger Car Brake Systems. Likewise, the GRRF has also developed a proposed new Regulation 13–H, which would be compatible with FMVSS No. 135. Throughout the rulemaking, NHTSA has emphasized that any requirements it adopts must be consistent with the need for safety and the Safety Act. The agency emphasizes that safety cannot be sacrificed in its efforts to harmonize the FMVSS with the ECE regulations.

On May 10, 1985, NHTSA published in the **Federal Register** (50 FR 19744) a notice of proposed rulemaking (NPRM; Docket 85–06, Notice 1) to establish FMVSS No. 135, which would replace FMVSS No. 105 as it applies to passenger cars. On January 14, 1987, NHTSA published in the **Federal Register** (52 FR 1474) a supplemental notice of proposed rulemaking (SNPRM; Docket 85–06, Notice 4), to improve and refine the proposed Standard. On July 3, 1991, NHTSA published in the **Federal Register** (56 FR 30528) a second SNPRM (Docket 85–06, Notice 5) as a result of comments on the SNPRM and vehicle testing by NHTSA.

In these previous notices, NHTSA set out its overall approach to developing the proposed harmonized standard. The agency stated that the new standard would differ from the existing one primarily in containing a revised test procedure based on harmonized international procedures developed during discussions held between NHTSA and GRRF. NHTSA stated its belief that the new FMVSS would ensure the same level of safety for the aspects of performance covered by FMVSS No. 105, while improving safety by addressing some additional safety issues. The agency proposed establishing new adhesion utilization requirements that it believes would ensure stability during braking under all friction conditions.

In this final rule, after considering the public comments on all of the notices, NHTSA has made several minor revisions to the requirements proposed in the July 1991 SNPRM. This document explains the changes incorporated in the final rule and the reasons for the agency's decision.

D. Antilock Brake Systems

One issue that NHTSA considered during the process of developing a harmonized standard was what requirements are appropriate for vehicles equipped with antilock brake systems. While NHTSA was evaluating comments to the July 1991 SNPRM, Congress enacted the Highway Safety Act of 1991, which directs NHTSA to publish an advance notice of proposed rulemaking (ANPRM) to consider the need for additional brake performance

standards for passenger cars, including ABS standards. (59 FR 281, January 4, 1994.) Vehicles included in this evaluation effort are passenger cars, light trucks, and multi-purpose vehicles (MPV's).

Given that NHTSA is reviewing the need for antilock systems separately, the agency has decided not to include requirements addressing ABS performance in this final rule to establish FMVSS No. 135. The previously proposed section on ABS will be reserved until all the issues in the research program have been evaluated. At that time, the agency will consider how best to proceed with requirements applicable to ABS on light vehicles and may initiate a separate rulemaking for that purpose.

II. Summary of Comments on the July 1991 SNPRM (Notice 5)

Over 30 commenters responded to the July 1991 SNPRM. Commenters included vehicle manufacturers, brake manufacturers, international organizations, safety advocacy groups, and individuals. The commenters addressed a wide range of topics, including adhesion utilization, the various effectiveness requirements, equipment requirements such as the failure warning indicators, and test conditions such as the road test surface, lockup conditions, burnish procedures, and the instrumentation.

Advocates for Highway and Auto Safety (Advocates) and the Center for Auto Safety (CAS) generally opposed the supplemental proposal, believing that the proposed FMVSS No. 135 was less stringent than FMVSS No. 105 and the previous harmonization proposals. Advocates and CAS opposed several specific proposals in the 1991 SNPRM, including the increase in certain stopping distances, eliminating automatic brake warning indicators, specifying certain aspects of the new adhesion utilization test, eliminating the pre-burnish test, changing the burnish testing procedure and the fade and recovery sequence, allowing momentary wheel lockup, and introducing peak friction coefficient (PFC) values as a substitute for skid numbers in defining the adequacy of testing surfaces.

In contrast, the former Motor Vehicle Manufacturers Association (MVMA),[1] General Motors (GM), Ford, Chrysler, and manufacturers from Europe and Japan have strongly supported harmonized safety standards in general and a harmonized passenger car brake standard in particular. For instance, GM stated that the payoff for successfully harmonizing brake regulations is significant. When the U.S. and European regulations are commonized, it is most probable that this uniform set of requirements will be recognized and accepted throughout all vehicle importing and exporting countries. This will enable manufacturers to build vehicles with standardized brake systems acceptable throughout the world, thereby providing significant cost savings to vehicle buyers. It continued that harmonization of brake regulations will also represent an important milestone in the ongoing efforts to commonize motor vehicle safety regulations, and thereby dismantle one of the most significant non-tariff barriers to international motor vehicle trade.

Notwithstanding their general support for harmonization, vehicle manufacturers expressed concern about what they perceive as the increased stringency of portions of FMVSS No. 135 in relation to FMVSS No. 105.

III. NHTSA Decision

A. Overview

After reviewing the comments, NHTSA has decided to establish FMVSS No. 135, with respect to hydraulic brake systems on passenger cars. The new standard includes equipment requirements, dynamic road test requirements, system failure requirements, and parking brake requirements, as well as test conditions and procedures related to these requirements. With respect to the equipment requirements, FMVSS No. 135 includes provisions addressing the brake lining wear indicator, an ABS disabling switch, reservoir labeling, and a brake system warning indicator. With respect to the test conditions, FMVSS No. 135 includes provisions addressing the ambient temperature, the road test surface, instrumentation, and the initial brake temperature. With respect to the dynamic road tests, FMVSS No. 135 includes provisions addressing permissible wheel lockup, the test sequence, burnish, the wheel lock sequence test, the torque wheel test, the cold effectiveness test, the high speed effectiveness test, the hot performance test, and the fade and recovery test. FMVSS No. 135 also includes requirements for a static parking brake test and several types of system failure tests, including stops with the engine off, ABS functional failure, proportional valve functional failure, hydraulic circuit failure, and power assist failure.

The following discussion follows the order set forth in the regulatory text for FMVSS No. 135 to facilitate the reader's understanding of the issues.

B. Application

In each previous proposal, NHTSA proposed that FMVSS No. 135 would apply to passenger cars. Kelsey-Hayes asked whether this definition included all purpose vehicles, mini-vans, and light trucks.

NHTSA notes that 49 CFR 571.3 defines passenger car, multipurpose passenger vehicle, and truck. All purpose vehicles and mini-vans ordinarily come within the definition of multipurpose passenger vehicle. At this time, FMVSS No. 135 will apply only to passenger cars and not to multipurpose passenger vehicles or trucks, although application to other types of vehicles may be considered at a later date.

C. Definitions

In the 1991 SNPRM (Notice 5), NHTSA proposed definitions for certain terms, including directly controlled wheel and antilock brake system.

Bendix and Mercedes Benz requested a clarification of the definition of an ABS ''directly controlled wheel.'' Bendix recommended that the definition include a select average or drive shaft sensor control of an axle, which it believed would provide sufficient accuracy to control individual wheel slip, thereby avoiding adhesion utilization testing. GM commented that the definition in the 1991 SNPRM would prohibit a type of ABS control known as ''select low'' that uses a single, centrally located sensor on the rear axle to partially control the systems operation.

Given that NHTSA is considering whether to equip vehicles with ABS in a separate rulemaking, the agency has decided that it is not necessary at this time to define ''directly controlled wheel.'' Accordingly, this term is not included in the definition section of the regulatory text. The agency may revisit this issue if the agency decides to propose requirements for antilock brakes on passenger cars. The agency has included a new definition for ''antilock brake system.''

The GRRF and Fiat requested that the definition of initial brake temperature be based on the temperature of the hottest service brake rather than the average of both brakes on an axle, claiming that there should be little difference in the ''cold'' temperature across each axle.

[1] The MVMA became the American Automobile Manufacturers Association in early 1993. This notice will refer to the group by its former name, MVMA. The membership of the new group is slightly different than that of the MVMA, and to refer to the group by its new name would lead to imprecision in indicating which manufacturers were represented by its comments.

After reviewing the comments, NHTSA has determined that there is no reason to modify the proposed initial brake temperatures. Commenters provided no convincing data or arguments to support their requested changes to initial brake temperatures that have been proposed in the NPRM and the two SNPRMs.

D. Equipment Requirements

1. Lining Wear Indicator

In the 1991 SNPRM (Notice 5), NHTSA proposed that the harmonized standard include requirements to warn the driver about excessive brake wear. Specifically, this warning could be done either by a device that warns a driver that lining replacement is necessary or by a device that provides a visual means of checking brake lining wear from outside the vehicle. The agency believed that this proposal would reduce the likelihood that cars would be driven with excessively worn brake linings.

Advocates recommended that all cars have an in-cab visual or audible alarm, stating that an outside visual check would be ineffective, therefore resulting in many owners being unaware of brake lining deterioration. Advocates further stated that the increasing intervals between maintenance checks required of newer cars means that repair personnel would not have an opportunity to discover brake lining wear before it reaches dangerous levels. Honda commented that, for drum brakes, inspection holes on drums may be insufficient to spot the areas of worst brake wear, and recommended allowing removal of the brake drum.

After reviewing the comments, NHTSA continues to believe that the proposed requirements for warning drivers about excessive brake wear are appropriate. Section S5.1.2 of FMVSS No. 135 requires a manufacturer to warn of worn brake linings in one of two ways: (1) An acoustic or optical device warning the driver at his or her driving position, or (2) a visual means of checking brake lining wear from the outside or underside of the vehicle, using tools or equipment normally supplied with the vehicle. The agency notes that FMVSS No. 105 does not require an in-cab warning indicator. Based on this fact, the agency disagrees with Advocates about the need to mandate an in-cab visual or audible alarm.

NHTSA has decided not to adopt Honda's request to allow the removal of the drum brake to identify the wear status. The agency believes that it has provided appropriate ways to determine excessive brake wear. The agency is concerned that adopting Honda's request might be detrimental to safety.

VW, Fiat, Mercedes Benz, GRRF, and Toyota requested that the agency permit the use of the International Organization for Standardization (ISO) brake symbol, a circle with two arcs outside the circle on opposite sides, for the brake wear indicator in lieu of the proposed words. The commenters stated that symbols are more appropriate for a harmonized standard.

NHTSA has decided to permit use of the ISO symbol as a supplement to the words ''brake wear.'' Nevertheless, the agency believes that it would be inappropriate to allow only the ISO symbol as an alternative to the required words. The agency believes that the symbol's meaning would be unclear or ambiguous to a driver, since in this country they are not generally understood to represent the concept of brake wear.

2. ABS Disabling Control Switch

In the 1991 SNPRM (Notice 5), NHTSA proposed (S5.3.2) to prohibit, for vehicles equipped with ABS, a manual control that would fully or partially disable the ABS. Previous notices did not address an automatic disabling switch. The subject was discussed within GRRF, however, and it was decided that R13H would not allow a disabling switch.

JAMA, and Toyota requested a change in the regulatory text to permit ABS disabling switches for off-road vehicles. The commenters stated this is necessary because ABS tends to lengthen stopping distances in rough, gravelly, or muddy terrain. MVMA, Chrysler and Ford opposed permitting a manual ABS disabling switch, but wanted the agency to allow an intelligent or automatic switch (*i.e.*, one not controlled by the vehicle occupants) to accommodate off-road conditions.

NHTSA has decided not to permit either a manual or an automatic ABS disabling switch. The agency notes that no commenter requested any kind of ABS-disabling switch for passenger cars, which are the subject of this rulemaking. Moreover, Mercedes, MVMA, Ford, and Chrysler stated that passenger cars should not have an ABS disabling switch. While those commenters favoring an ABS disabling switch focused on its use for off-road vehicles, FMVSS No. 135 applies only to passenger cars as defined in § 571.3(b). These definitions preclude including MPV's as passenger cars. The agency therefore believes that there is no reason to permit an ABS-disabling switch under the new standard.

3. Vehicle and Reservoir Labeling

In the 1991 SNPRM (Notice 5), NHTSA proposed requirements for the reservoir label in S5.4.3 and the warning indicators in S5.5.5. The agency tentatively concluded that it would be inappropriate to allow use of ISO symbols with respect to these devices, except that such symbols could be used in addition to the required labeling to enhance clarity. The agency noted that this was consistent with FMVSS No. 101, Controls and Displays and past agency decisions made in response to petitions for inconsequential noncompliance based on the use of ISO symbols in place of words or symbols required by FMVSS No. 101.[2] The agency has denied these petitions in cases where it believed that the symbol's meaning would not be readily apparent to drivers.

VW, Fiat, Mercedes Benz, and Toyota commented that the agency should permit use of the ISO brake symbol in FMVSS No. 135 in lieu of the words ''brake,'' ''park,'' or ''parking brake,'' and in lieu of the words ''ABS'' or ''anti-lock'' for ABS failure. GRRF stated that symbols are more appropriate for international use than words in any single language.

Notice 5 and this final rule (Section S5.5.5(a)) allow the use of ISO symbols in addition to the required labeling for the purpose of clarity. However, the agency has decided not to allow the ISO symbol alone to be used as a substitute for the required words. NHTSA believes that the ISO symbol can be ambiguous to some drivers since the ISO symbol, is not universally understood to represent brakes. The agency notes that the commenters did not provide any data showing that the ISO brake failure warning indicator is clearly understood by drivers in countries in which it is currently in use. Moreover, the meaning of the symbol is not readily apparent from its appearance, in contrast to some symbols, such as the one for horns, whose meaning is understandable on its face.

Fiat and the GRRF requested that S5.4.3 be amended to allow the ISO brake fluid symbol to be used on the brake reservoir instead of DOT fluid designations.

NHTSA has decided not to allow the ISO symbol instead of the DOT brake fluid designations (*e.g.*, DOT 3, DOT 4, and DOT 5). The purpose of this requirement is to inform drivers about what kind of brake fluid to add to their vehicles and to avoid use of an improper fluid. The agency notes that

[2] NHTSA notes that FMVSS No. 101 allows the use of some ISO symbols, but not the ones at issue.

the ISO has no rating equivalent to DOT 5 fluid and does not differentiate between DOT 3 and DOT 4 fluids. Even though the agency has decided not to allow use of the ISO symbol, a manufacturer may use the ISO symbol as a supplement to the required textual words.

4. Brake System Warning Indicators

In the SNPRMs (Notices 4 and 5), NHTSA proposed to require (S5.5.2) brake system malfunction indicators to be activated by either an automatic brake indicator check function or a manual check function. While FMVSS No. 105 currently requires brake indicator lamps to be activated automatically when the vehicle is started, in Europe the check function often requires manual action, such as pressing a button or applying the parking brake.

Advocates and CAS opposed the use of a manual check function to check brake system integrity in lieu of an automatic check function. Advocates argued that the existing requirement for all operating systems to be automatically monitored for the driver when turning the ignition key has been ''one of the great advances in American automobile regulation'' and disagrees that the need for safety will be met by this approach.

After reviewing the available information, NHTSA has decided to permit the manual check function in the final rule, as an alternative to the automatic check function. The agency believes that requiring an automatic check function is not necessary to ensure safety. Moreover, the agency has granted several petitions for inconsequential noncompliance from manufacturers that did not provide an automatic check function. These decisions to grant the petitions are consistent with the agency's current belief that allowing use of a manual brake warning indicator, which is consistent with international harmonization, will not have any corresponding detriment to safety.

BMW recommended that NHTSA modify S5.5.3 which specifies the duration during which an indicator is activated. BMW claimed that some ABS warning indicators can only be detected after a certain minimum wheel speed is achieved. Accordingly, it requested that the antilock failure indicator only be required to activate when a road speed of 10 km/h is achieved.

While NHTSA agrees with BMW that the wheel must be rotating to properly check a wheel sensor, the agency believes that it is important for the check function to be able to be performed while the vehicle is stationary. Given the current state of technology, NHTSA believes that the ABS malfunction warning system can be designed to remember if there had been an ABS sensor failure the last time the vehicle's speed was over the threshold, even after the ignition has been turned off. Accordingly, BMW's request is denied.

VW recommended decreasing the minimum lettering height for the brake warning indicator letters to 2 mm (5/64-inch), claiming that the proposed 3.2 mm (1/8-inch) height is larger than necessary.

NHTSA has decided to retain the minimum letter height, based on its concern that some drivers, especially elderly drivers, would not be able to distinguish letters under 3.2 mm. The agency further notes that the 1/8'' dimension is the same as the dimension currently specified in FMVSS No 105.

Kelsey-Hayes commented that, if a separate indicator is used for ABS failure, rear-only ABS equipped vehicles should use a failure indicator specifying ''Rear Anti-lock.''

NHTSA believes that it would be inappropriate to require the words ''Rear Anti-Lock'' to distinguish a rear wheel ABS from a four wheel ABS. The indicator's purpose is to inform the operator that there is a malfunction with the vehicle's ABS. The driver should be aware, through the owner's manual and/or information provided at the time of the vehicle's purchase, whether it is equipped with a four-wheel or rear-only ABS. However, even though the agency will not require this information, adding the word ''rear'' to the ABS failure warning is not prohibited under the standard.

Kelsey-Hayes stated that both red service brake failure warning indicators ''Brake'' and yellow ''ABS'' malfunction indicators should be activated simultaneously in the case of a service brake failure in cars equipped with separate lights.

NHTSA disagrees with Kelsey-Hayes' recommendation for simultaneous activation of both lights in case of a service brake failure, unless the service brake failure is one that also disables or impairs the operation of the ABS. The two lights signal different types of failures, with different consequences. There can be failures that affect both systems, in which case both indicators would activate. However, automatically activating the ABS indicator in case of any service brake failure would be misleading, and therefore inappropriate.

E. General Test Conditions

1. Ambient Temperature

In S6.1.1 of the 1991 SNPRM, NHTSA proposed that for all tests specified in S7, the ambient temperature be between 0°C (32°F) and 40°C (104°F).

Bendix commented that NHTSA should permit the low adhesion tests to be conducted at temperatures less than 32°F because the ambient temperature provision requires testers either to wet the test surface or artificially make ice.

NHTSA notes that the issue of low temperature testing is moot since Bendix's comment was made with respect to the ABS performance test in proposed S7.3, which the agency has decided not to adopt in today's final rule. Even if this test had been adopted, NHTSA notes that it would be unnecessary to use ice to represent a low PFC. The agency further notes that no other commenter suggested the need to use ice for any test.

2. Road Test Surface

In the 1991 SNPRM, NHTSA proposed that the primary stopping distance tests be performed on a test surface with a PFC of 0.9. This road test surface specification differed from FMVSS No. 105, the NPRM, and the 1987 SNPRM, all of which specified a skid number of 81 to define the road test surface. In response to comments to Notice 4, NHTSA decided to propose a PFC for the test surface. The agency noted that PFC is a more relevant surface adhesion measurement for the non-locked wheel tests required by FMVSS No. 135, since the maximum deceleration attained in a non-locked wheel stop is directly related to PFC, but not skid number.

Fiat, Toyota, and GRRF stated that ECE R13 specifies that the test surface should be ''a road surface affording good adhesion.'' VW requested that the standard provide the option of specifying either a skid number or a PFC.

NHTSA, after reviewing its test data and other available information, continues to believe that a PFC of 0.9 is an appropriate, objective value for the test surface. ECE R13's specification that the road surface should afford ''good adhesion'' is unreasonably subjective and therefore inappropriate for an FMVSS. Such an imprecise test condition would lead to unreasonable variability, thereby causing test results that varied based on the road surface and not the vehicle's actual braking ability. Similarly, it would be inappropriate to allow the optional use of skid numbers, which would result in unnecessary variability, since the same

vehicle might have different test results based on which method was used to define the test surface. As explained in the 1991 SNPRM (Notice 5), PFC is more relevant than skid number for the non-locked wheel tests, since the maximum deceleration that can be attained in a non-locked wheel stop is directly related to PFC, which represents the maximum friction available.

GM and MVMA requested that the agency adopt a dry road PFC of 1.0, since compared with a PFC of 0.9, they believe 1.0 more closely parallels a skid number of 81 specified in FMVSS No. 105. Ford requested that the test surface be specified at 0.95 PFC. GM stated that not raising the PFC to 1.0 would require manufacturers to compensate for the loss of adhesion by equipping vehicles with higher rolling resistance tires, which would adversely affect the fuel economy of GM's car fleet by 1.2 mpg. GM further commented that compared with FMVSS No. 105, a cold effectiveness stopping distance of 70 m on a PFC of 0.9 would significantly increase the requirement's stringency.

Based on industry-government cooperative testing to evaluate the effect of fluctuations of PFC on vehicle stopping performance, NHTSA has determined that a PFC of 0.9 reasonably represents stopping on a dry surface and will not be a significant source of variability in the stopping[3] distance tests. While this testing focused on heavy vehicle stopping performance, the agency believes that the test findings are applicable to passenger cars subject to FMVSS No. 135, since the tests addressed the road surface coefficients of friction. Testing indicates that the expected minor variability of a high coefficient of friction surface appears to have a negligible impact on vehicle stopping distance performance. Variation of the average stopping distances for the six different surfaces was small, with the deviation from the average being only 5 feet. Accordingly, the agency believes that any variability in the stopping performance on a high coefficient of friction surface is more likely due to variation in the vehicle's performance rather than test surface variability.

NHTSA has decided that a test road surface specification of PFC 1.0 would result in practicability problems for the agency. It would have to conduct compliance testing on a surface with a PFC higher than 1.0. Such a surface is difficult to find. The agency also notes that GM conducted an extensive survey of actual road surfaces, which indicated that a PFC of 0.9 is fairly typical.

As explained in detail in NHTSA's decision to require heavy vehicles to be equipped with antilock brake systems, using PFC values to express test surfaces is appropriate even though these values may indicate some fluctuation. Given this fluctuation, the agency has considered whether the fluctuation significantly affects the requirement's objectivity. In an earlier rulemaking about FMVSS No. 208, Occupant Crash Protection, the agency explained that since some variability in any test procedure is inherent, the agency need only be concerned about preventing ''unreasonable'' or ''excessive'' variability to avoid causing manufacturers to ''overdesign'' vehicles to exceed the minimum levels of protection specified by the Federal safety standards. (49 FR 20465, May 14, 1984; 49 FR 28962, July 17, 1984.) With respect to the tests in FMVSS No. 135, variability of the PFC value of the test surface will have a negligible impact on a vehicle's ability to comply with the requirements.

Ford stated that it would be impossible to build a track to exactly a PFC of 0.9, given PFC variability, test tire variability, and changing track surfaces due to aging and weathering.

In evaluating the requirement's practicability, NHTSA has considered possible difficulties with respect to building and maintaining test surfaces with a PFC of 0.9 for the high coefficient stopping tests. (Those interested in building and maintaining a test surface should refer to NHTSA's ''Manual for the Construction and Maintenance of Skid Surfaces,'' (DOT HS 800 814.) Variations in PFC for high coefficient of friction surfaces do not affect stopping distance test results appreciably. After reviewing the comments and available information, NHTSA has concluded that specified test surfaces can be achieved and maintained. As explained above, recent ''Round Robin'' testing related to research about heavy vehicle braking by the agency and others on several test tracks indicates that the test surface specification does not raise practicability or objectivity concerns.

MVMA, GM, and Ford recommended use of a correction factor for stopping distance to account for testing on surfaces with PFCs that differed from those prescribed in the standard. They stated that a manufacturer is fortunate if the tests they conduct are actually carried out on surfaces with the precise PFC as specified in the harmonized standard.

NHTSA believes that it would be inappropriate to specify a stopping distance correction factor, as requested by the comments. The agency notes that the same variables that will apply to manufacturer testing in accordance with FMVSS No. 135 also applied to their testing under FMVSS No. 105, and no correction factor was established or needed at the time. NHTSA further notes that a manufacturer may test its vehicles on whatever surface it likes, and may make any corrections it chooses. The FMVSS specifies requirements with which manufacturers must certify that their vehicles comply on a given surface under specified test conditions. Moreover, the agency will follow the procedures specified in the FMVSS for purposes of compliance testing. If a manufacturer is confident that its testing on a different surface will yield results comparable to agency test results under FMVSS No. 135 (by applying a correction factor), it need not exactly follow every agency specification.

Advocates opposed the proposal to replace skid numbers with PFC. It claimed that PFC numbers cannot be correlated to skid numbers because they do not describe the same event. Advocates further commented that most state highway authorities use skid numbers to evaluate a roadway's skid resistance, and that NHTSA would make it impossible for data comparison by encouraging different authorities to use different measurement standards. In contrast, Fiat, Ford, ITT-Teves, GRRF, OICA, Mercedes, and MVMA stated that using PFC rather than skid numbers will lead to more repeatable road surface adhesion measurements and that PFC directly correlates to vehicle stopping distance.

PFC and skid number can both be measured simultaneously during traction tests. However, the two road surface specifications are used for different purposes. Highway officials use skid numbers to determine when to resurface a road, not to determine test vehicle performance in stopping tests. The agency notes that because FMVSS No. 135 evaluates a vehicle's capability during braking to use the available friction capability at the interface between the tire and road, PFC is the more appropriate measure for that purpose. It is not necessary to establish a correlation between the two numbers, for any given surface.

While ITT-Teves, MVMA, and Ford agreed with the proposed use of the ASTM test tire and test procedure, the GRRF, VW, Mercedes Benz, Fiat, and OICA, stated that the ASTM test methods for determining PFC are not

[3] ''MVMA/NHTSA/SAE Round Robin Brake Test,'' Transportation Research Center of Ohio, Report No. 091194, August 26, 1991.

familiar in Europe. They requested NHTSA to consider other methods of determining adhesion or PFC, but suggested no specific test method or procedure.

NHTSA is aware that the ASTM trailer and test method are not widely used outside of the United States. However, any method of determining PFC specified in the standard must be objective and repeatable. Those commenters that requested consideration of other methods did not provide any evidence that there are other standardized methods in existence that are as objective, repeatable, and universally accepted as the ASTM method that has been specified.

NHTSA also notes that the concerns expressed by several European entities about compliance need not adversely affect them, since the agency does not insist that any manufacturer use a specific test method or procedure. Rather, the individual manufacturer must determine whether to test exactly to the specifications of FMVSS No. 135 or to use its own methods of determining that its braking systems will meet the requirements of the standard. NHTSA, as stated earlier, will use the procedures established in FMVSS No. 135 in its own testing. The agency has decided to specify the ASTM test procedure for all of its compliance tests. The agency emphasizes that GRRF's suggested wording (i.e., ''a surface affording good adhesion'') would be inappropriate for a Federal safety standard since it is not objective. The two specifications are not in conflict with each other, however. Because NHTSA's goal is to define ''good adhesion'' objectively, the agency has decided to specify a surface measured with a standard test method to a specific adhesion level.

Honda recommended that the test condition state ''PFC shall be situated between the slip ratio of 10 to 30 percent and the friction coefficient of the road surface.'' It stated that this slip ratio was appropriate because most roads are within this range. It stated that slip ratios can vary even if PFC value remains constant.

NHTSA believes that slip ratios are not appropriate for defining a pavement surface to be used for stopping distance tests, because the minimum stopping distance is obtained at the maximum traction value, which is defined directly by the PFC. The agency believes that it is most important to provide a surface with the available traction defined so that all vehicles have an equal chance for achieving the shortest stop, regardless of the optimum vehicle slip ratio for each vehicle. For a given PFC, the vehicle slip ratio at which maximum traction is achieved varies depending on the vehicle characteristics. Accordingly, slip ratio cannot be used to define a test surface, because it is vehicle-dependent.

3. Instrumentation

In the 1991 SNPRM (Notice 5), NHTSA specified in S6.4, the instrumentation to measure brake temperature, brake line pressure, and brake torque.

The GRRF, Ford, Fiat, and VW recommended that NHTSA allow alternative methods to measure brake temperature. Ford stated that plug type thermocouples develop problems as brake pad wear occurs and that use of rubbing-type thermocouples would reduce cost and time.

NHTSA notes that a standard must include a specific method to ensure objectivity, so that the requirements are the same for all vehicles. In addition, a specific method ensures uniformity and thus facilitates compliance testing. The specification of plug-type thermocouples is the same as specified in Society of Automotive Engineers' (SAE) Recommended Practices and is identical to that specified in FMVSS No. 105, FMVSS No. 121, and FMVSS No. 122. The agency is not aware of any problems resulting from use of this procedure. NHTSA further notes that while the agency will use plug type thermocouples specified in S6.4.1 for its own testing, a manufacturer may use whatever type of brake temperature measuring device it prefers for its own testing. Nevertheless, NHTSA does not recommend using rubbing-type thermocouples in FMVSS No. 135, based on agency testing that indicates that the two types of thermocouples give different readings for brake temperature.

Bendix recommended that NHTSA specify whether brake linings can be heated up to an initial brake temperature (IBT) before the static parking brake test and that a procedure be specified. The procedure would be important for vehicles with parking systems not utilizing the service friction elements.

NHTSA notes that IBT as defined in S4, and S6.5.6, describes the procedure for establishing IBT, and S7.12.2(a) sets the maximum IBT (no minimum) for the parking brake test regardless of the type of friction elements. The non-service brake friction materials should not be heated because under normal driving circumstances they are never used (heated up) until the parking brake is applied after the vehicle stops. This is not necessarily the case with service brake friction materials. Therefore, it would be unrealistic to describe a heating procedure.

However, the agency has decided to revise section S7.12.2(a) as follows to clarify the requirements on IBT for both service and non-service parking brake friction materials. Specifically, the revised language makes clear that IBT applies to both service and parking brake friction materials.

''7.12.2(a) IBT.

(1) Parking brake systems utilizing service brake friction materials shall be tested with the IBT ≤ 100°C (212°F) and shall 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 shall be tested with the friction materials at ambient temperature at the start of the test. The friction materials shall have no additional burnishing or artificial heating prior to or during the parking brake test.''

F. Road Test Procedures and Performance Requirements

1. Permissible Wheel Lockup

In the 1991 SNPRM (Notice 5), NHTSA proposed to allow wheel lockup of 0.1 seconds or less of any wheel during several road tests. This differed from earlier proposals that prohibited any type of lockup. The agency concluded that, due to pavement irregularities, it would be extremely difficult for a test driver to achieve maximum deceleration without causing momentary lockup of one or more wheels. The agency believed that the brief lockup time permitted would not result in vehicle instability, especially considering that, even ABS controlled brakes occasionally undergo nominal, self-correcting lockup conditions for very short periods of time.

Advocates and CAS opposed permitting any lockup, stating that it may result in vehicle instability. Advocates believed that allowing momentary lockup would result in the sale of more rear-biased vehicles that are susceptible to skidding. Bendix recommended a revised wheel lock criteria to increase the permitted lockup time, stating that it would take longer than 0.1 seconds for a driver to detect and react to wheel lock up. It believed that this would lead to less aggressive driver performance in testing to FMVSS No. 135 specifications, as drivers tried to avoid any type of lockup.

NHTSA has decided to permit a minimal amount of wheel lock up to facilitate vehicle testing. The agency believes that it will not be detrimental to safety as alleged by Advocates.

Allowing momentary wheel lockup during compliance testing will not affect a vehicle's real world ability to lock or not lock its wheels. Rather, this provision merely acknowledges that momentary lockup may inadvertently occur during compliance testing due to road surface irregularities, as test drivers attempt to achieve the shortest stops possible. Therefore, this provision ensures that entire test runs are not invalidated due to such an occasional occurrence.

NHTSA also notes that while Advocates claimed that the proposal to permit momentary lockup during stops represents ''a significant modification of the current FMVSS No. 105 test procedure'' whose real-world safety implications are unknown, FMVSS No. 105 in fact generally permits lockup of one wheel during stopping distance tests. The provision being adopted today thus represents a more stringent test condition, not a less stringent one.

In response to Bendix's comment, the momentary lockup is not a situation that a driver is supposed to detect and respond to; it is simply an allowance for a minor, inadvertent occurrence during testing. Therefore, Bendix's request to permit a longer lockup period is not necessary or appropriate.

Honda and Ford recommended that S7.2.1(f) be changed to define wheel lock as an angular velocity of zero, rather than the current definition of 10 percent of vehicle speed. They reasoned that it would be difficult to read the definite value with a 10 percent margin, because speed recorded on the data sheet changes gradually and the data also includes vehicles vibration.

The wording proposed for S7.2.1(f) was not intended to redefine wheel lockup as 10 percent of vehicle speed (90 percent wheel slip). Rather, it was intended to provide a practical criterion for making a determination that wheel lockup (100 percent wheel slip) exists, given the limitations of current instrumentation and recording devices. The proposal was based on the agency's experience at the Vehicle Research & Test Center (VRTC). Much of the vehicle testing that NHTSA has relied on to formulate FMVSS No. 135 was conducted at VRTC. This testing indicated that, with the instrumentation used by VRTC, it would be difficult to accurately measure zero angular velocity, due to spurious ''signal noise''. Thus, it would be extremely difficult to ascertain when a wheel reached an angular velocity of zero.

The comments expressed by Ford and Honda indicate that they have experienced similar problems with ''signal noise'' due to vibration and ''drift'' of the signal when reading the vehicle speed trace, which make it more difficult to relate the wheel rotational speed measurement to that variable than to read its absolute value. The difference between the agency's experience and that of Ford and Honda is probably due to differences in the instrumentation packages used.

After further reviewing this issue, NHTSA has decided to remove the proposed S7.2.1(f) entirely, because it was probably biased toward a particular type of instrumentation, and the agency does not want to impose unnecessary restrictions on what instrumentation is used to test for compliance with the standard. In order to clarify the meaning of wheel lockup, a definition stating that wheel lockup means 100 percent wheel slip has been added to S4. This definition is the same as has recently been added to both FMVSS No. 105, Hydraulic Brake Systems, and FMVSS No. 121, Air Brake Systems.

As a practical matter, NHTSA notes that there is essentially no difference between the method proposed in Notice 5 and that recommended by Ford and Honda. Once a wheel reaches 90 percent slip, complete lockup will be essentially instantaneous. As clarified in this final rule, there is no question of what is meant by wheel lockup. How that is measured is left to individual testing organizations, as is true for other aspects of standard.

2. Road Test Sequence

In the 1991 SNPRM (Notice 5), NHTSA proposed the following road test sequence: Burnish and wheel lock sequence at gross vehicle weight rating (GVWR); wheel lock sequence, ABS performance, and the torque wheel test at lightly loaded vehicle weight (LLVW); the torque wheel, cold effectiveness, high speed effectiveness, stops with engine off at GVWR; cold effectiveness, high speed effectiveness, failed ABS, failed proportional valve, and hydraulic circuit failure at LLVW; and hydraulic circuit failure, failed ABS, failed proportional valve, power brake unit failure, the static and dynamic parking brake tests, heating snubs, hot performance, brake cooling, recovery performance, and final inspection at GVWR.

JAMA and GRRF supported the proposed road test sequence, even though R13H does not specify a test sequence. GM recommended modifying the test sequence by eliminating two of the four ballast changes (*i.e.,* reduce the times needed to switch between lightly loaded and fully loaded). It also recommended not including the full ABS test and the dynamic parking brake test.

As explained below, NHTSA has decided not to include the full ABS test and the dynamic parking brake test. Nevertheless, the agency believes that it would be inappropriate to change the test sequence for the sake of reducing the test preparation effort. The agency emphasizes that the test sequence being adopted specifies that the GVW and LLVW wheel lock sequence tests be conducted first, since their results determine whether the torque wheel test needs to be conducted. The agency further notes that the test sequence being adopted permits removal of the torque wheels as soon as that test is completed. This is important since the torque wheels might get wet or otherwise adversely affected if they were not removed. Based on these considerations, the agency has determined that it would be inappropriate to switch the test sequence, which would result in fewer ballast changes.

3. Pre-Burnish

FMVSS No. 105 specifies a pre-burnish requirement to evaluate brakes in the brand new condition. In the initial NPRM (Notice 1), NHTSA proposed a similar requirement for the harmonized standard. However, in the 1987 SNPRM (Notice 4), the agency explained that it no longer believed a pre-burnish test was necessary for safety, given the relatively short period of time that the vehicle's brakes remain in the pre-burnished condition.

In comments to both SNPRMs, Advocates and CAS strongly opposed deleting this test. They stated that it takes hundreds of miles of use before brakes are properly burnished, especially for vehicles used in rural areas, in which long distances may be traveled with few brake applications. Advocates stated that certain brakes, most particularly disc-type brakes, are highly resistant to burnishing. That organization argued that the agency acknowledged this high mileage need for proper burnishing in the 1985 NPRM, but attempted to rationalize this concession in the first SNPRM. It also argued that stopping distance performance may be considerably greater before burnish than afterwards.

Advocates stated that deleting a pre-burnish test would allow manufacturers to produce and sell cars whose pre-burnish, on-the-road braking capability is unknown. It stated that it does not believe this is in the best interests of traffic safety, and that it does not believe the agency can allow cars to be sold and used that have no regulatory control

over their stopping distances before burnishing takes place.

NHTSA is not persuaded by the comments from CAS and Advocates regarding the need for a pre-burnish test, and has decided to not include this test in the final rule. The arguments by CAS and Advocates are essentially the same as those made in response to the 1987 SNPRM (Notice 4). These comments were already addressed in the preamble to the 1991 SNPRM (Notice 5, 56 FR 30533).

Advocates has made an unsupported statement that disc brakes are highly resistant to burnishing. No test data or other evidence was supplied to support this allegation. Regardless, the pertinent question is not how long or how many miles it takes to burnish brakes in use, but whether there is a big enough difference in performance before and after the 200-stop burnish specified in the standard to present a safety problem. If some types of brakes do take a long time to become fully burnished, then they would not be fully burnished after the 200-stop burnish sequence specified in the standard, so they would have to meet the cold effectiveness stopping requirements in a partially-burnished state. If that were the case, their eventual, fully-burnished performance would be even better than that required by the standard.

Advocates also argued that stopping distances before burnish may be considerably longer than after burnish. This statement was also unsupported by any test data. Agency testing conducted during the development of this standard (Harmonization of Braking Regulations—Report No. 1, Evaluation of First Proposed Test Procedure for Passenger Cars, Volume 1, May, 1983, DOT HS 806–452) showed that in some cases stopping distances were somewhat shorter after burnish, and in other cases stopping distances were shorter in the unburnished state. However, the overall conclusion was that the burnish had a small effect on stopping distances. Also, this research was done using the burnish procedure specified in FMVSS No. 105, which is more severe than that specified in FMVSS No. 135, and would therefore have a greater effect on braking performance.

4. Burnish

Burnish procedures serve as a conditioning to permit the braking system to achieve its full capability. In the 1987 SNPRM (Notice 4), NHTSA proposed specifying 200 burnish stops. The agency stated that the burnish procedures would stabilize brake performance and reduce vehicle and test variability. In the 1991 SNPRM (Notice 5), the agency proposed almost the same requirements as the earlier SNPRM. The only substantive change from the earlier notice entailed specifying that the pedal force would be adjusted as necessary to maintain the specified constant deceleration rate.

Kelsey-Hayes and Honda recommended that the burnish procedures be made consistent with the ones in FMVSS No. 105, with respect to the number of burnishes, the test speed, and the deceleration rate. Specifically, both commenters recommended that the test speed be 65 km/h (40.4 mph) and the deceleration rate to be 3.5 m/s (11.5 fps). While these conditions enabled Kelsey-Hayes to conduct the FMVSS No. 105 burnish on a secluded public road, the proposed burnish requirements for FMVSS No. 135 would have to be conducted at a commercial test facility, which may not be readily available. Honda stated that the cost of the proposed FMVSS No. 135 burnish test was more than the cost of the FMVSS No. 105 burnish, even though the brake temperatures at the end of the respective burnish procedures are the same. JAMA and Toyota recommended that the test speed be reduced from 80 km/h to 70 km/h because the brake temperature would increase too much under the proposed burnish speed.

NHTSA has decided to adopt the burnish procedure as proposed in the 1987 and 1991 SNPRMs. As explained in those notices, the agency purposely changed the burnish procedure from the one in FMVSS No. 105 to provide a more realistic burnish. NHTSA believes that the new burnish procedure will more closely match real world situations, including the actual type of burnish most drivers will achieve in the course of normal driving. The burnish procedure in the harmonized standard will better reflect the real world capabilities of the brakes in a passenger car. The new burnish procedure itself will not affect the time or mileage needed to burnish brakes for the average driver. NHTSA believes that the burnish procedures adopted by today's final rule represent an efficient burnish procedure that is consistent with R13 and the ECE harmonized version of R13H.

NHTSA is not able to determine the meaning of JAMA's comment that the temperature ''would increase too much'' under the specified burnish procedure. As previously stated, the agency believes that the specified burnish is more representative of actual driving experience. Therefore, any temperature increase during burnish would also be experienced on the road.

Advocates and CAS stated that the burnish procedure proposed for FMVSS No. 135 would not ensure that cars are tested with properly burnished brakes. They stated that decreasing the deceleration rate, lowering the initial brake temperature, and introducing a variable pedal force would extend the time and mileage needed to complete a full burnish. Advocates further believed the proposed burnish procedure would not evaluate how well the brake system reacts to higher temperatures, along with the resulting potential for fade during the initial burnishing.

NHTSA believes that Advocates and CAS misunderstand a fundamental principle of brake burnish procedures: a less severe burnish results in a more severe test. The burnish procedure has no bearing whatsoever on how long it will take a vehicle to achieve full performance in actual use. More specifically, the agency notes that the changes proposed in the 1987 SNPRM (Notice 4) about the burnish procedure (*e.g.*, lower initial brake temperature, lower deceleration rate) would be more similar to typical driving than those in FMVSS No. 105. Moreover, NHTSA believes that most vehicles will not be driven for long periods of time in a significantly less burnished condition than that obtained from the burnish procedures being adopted.

Advocates also said that it does not agree with NHTSA'S claim that drivers rarely exceed a deceleration rate of 3.0 m/s(2) except in emergencies. Advocates claimed that typical stop-and-go braking deceleration rates, especially in congested urban expressway traffic with high speed differentials, can exceed this rate. NHTSA acknowledges that deceleration rates can exceed 3.0 m/s(2), but burnish is meant to simulate typical use, not these unusual circumstances.

MVMA, Ford, Chrysler, and GM requested a modification of initial brake temperature from < 100 °C (212 °F) to ''ambient temperature plus 100 °C.'' They believed that this would normalize the actual amount of brake burnish achieved and thus could reduce the amount of time required to run the burnish.

NHTSA notes that the burnish IBT is set at an upper limit to avoid overheating. Since the friction coefficient of the brake linings varies with the IBT, allowing a ''range of IBT upper limits'' is not an objective test condition.

NHTSA continues to believe that the burnish procedures being adopted in this final rule represents an efficient, representative burnish procedure that is consistent with the GRRF proposal.

Honda requested the agency clarify that the road surface condition specified

in S6.2 not apply to S7.1.3(j) (*i.e.*, that the road surface with a PFC of 0.9 not apply to burnish procedures).

NHTSA agrees with Honda that this provision needs to be clarified since burnish is merely a conditioning procedure for brakes and does not actually test for a specified stopping distance on a road of a particular adhesion quality. The PFC of the road surface has no effect on the burnish. Accordingly, S7.1.3 is modified to include a sentence stating that ''The road test surface conditions specified in S6.2 do not apply to the burnish procedure.''

5. Adhesion Utilization

a. General. In the NPRM (Notice 1) and both SNPRMs (Notices 4 and 5), NHTSA proposed adhesion utilization requirements to ensure that a vehicle's brake system is able to utilize the available adhesion at the tire-road interface to ensure stable stops within a specified distance. Adhesion utilization is addressed to some extent by FMVSS No. 105's (and the proposed standard's) service brake effectiveness requirements, since stops must be made within specified distances without leaving a lane of specified width. Under both standards, however, all of those stops are made on a high friction surface. The existing standard does not include any requirements concerning stops made on lower friction surfaces, such as wet roads. Therefore, unlike most of the proposed requirements for FMVSS No. 135, the adhesion utilization requirements do not have any corresponding requirement in FMVSS No. 105.

NHTSA notes that the proposed adhesion utilization requirements evolved considerably over the course of the NPRM and two SNPRM's. Persons interested in the reasons for that evolution, leading up to the proposal set forth in the 1991 SNPRM, are referred to those three notices.

In the 1991 SNPRM, NHTSA proposed a two-step procedure for assessing adhesion utilization based on a determination of the vehicle's brake balance: a wheel lock sequence test and then, for those vehicles that did not pass the wheel lock sequence test, a torque wheel test. The purpose of the wheel lock sequence test is to identify those vehicles that are heavily front biased, since such vehicles would be considered to have inherently good stability characteristics. The purpose of the torque wheel test is to evaluate more precisely those vehicles that fail the wheel lock sequence test, since torque wheels directly measure braking forces. The agency believed that this approach, which is based on a suggestion from the Organization Internationale des Constructeurs d'Automobiles (OICA), would accommodate vehicles that are heavily front biased in their brake balance and those that are closer to neutral balance. The agency believed that this proposal would ensure an appropriate level of safety as well as facilitate harmonization since GRRF agreed to adopt this approach as part of its harmonized adhesion utilization procedures.

CAS opposed the adhesion utilization tests proposed in the 1991 SNPRM. It requested that the agency specify other methods of adhesion utilization to produce objective results for all passenger cars. CAS was concerned that vehicles that marginally pass the wheel lock sequence test would undergo no further testing of front-to-rear brake balance. Instead of the proposed adhesion utilization tests, CAS suggested the use of Hunter Manufacturing's low-speed plate brake tester.

NHTSA believes that the adhesion utilization tests being adopted in today's final rule provide the most practicable and appropriate methods to evaluate a vehicle's adhesion utilization. The wheel lock sequence test screens out vehicles with front bias, which have inherently superior stability.[4] CAS appears to misunderstand the agency's regulatory framework, since a vehicle either passes or fails a requirement in a FMVSS; there is no provision for a marginal pass. For instance, a vehicle that ''marginally passes'' FMVSS No. 105 still complies with the standard. Therefore, the agency believes CAS's argument is not relevant to the regulatory framework set forth by statute and incorporated in the Federal motor vehicle safety standards. The agency further notes that the Hunter test apparatus is a simplified version of the road transducer pad that the NHTSA in light of comments by the industry considered prior to selecting torque wheels as the most acceptable method of measuring adhesion utilization. Therefore, the agency believes that it would be inappropriate to require this method of evaluating compliance.

Advocates stated that the real-world effects of the adhesion utilization test are uncertain and that NHTSA has not demonstrated a connection between real-world situations and the wheel lock sequence results. Advocates further commented that there is more to braking stability than front-axle bias and that plow-out skids will result in lane departures and stopping distances that are too long for safety purposes, even for vehicles with front axle bias and ABS.

Advocates further stated that

> Real-world crash results for cars tested under the two-part Adhesion Utilization protocol may not be favorable for significant numbers of production cars. The truncation of the testing protocol that has accompanied the proposed two-stage system of the current SNPRM comprising the Wheel-lock Sequence and Torque Wheel (especially due to adoption of the 90% efficiency rationale) creates a ''window'' of allowable production variability that can permit a significant, but unquantifiable, percentage of assembly-line vehicles to be rear-brake biased. Under certain operating conditions, especially those uncontrolled by the reduced performance specifications of the current proposed rule, such as the elimination of a low-coefficient surface test, many cars may experience serious instability under severe braking. The plain fact is that even if both parts of the two-stage test as proposed are used for a given car model, this still will not ensure that all cars will have appropriate front-brake bias and does not foreswear the potential for an unknown number of production units to be susceptible of serious spin-out crashes in panic braking situations. Despite advocating the two-stage test in this SNPRM, the agency itself obviously still harbors doubts over its adequacy to detect cars with rear-brake bias.

Advocates has expressed two concerns. Their first concern is that, by having a simple wheel lock sequence test, manufacturers would produce cars that have too much front axle bias in their brake systems, because such a vehicle would always pass the wheel lock sequence test. The extreme example of this would be a car with no brakes at all on the rear wheels. Such a vehicle would always be dynamically stable, but if braked to the point of wheel lockup would provide no ability to steer. This concern by Advocates ignores the adhesion utilization requirement is only one of many requirements in the standard, and therefore is not the sole factor in determining brake system design. If a manufacturer were to produce a car with too much front bias, it would compromise the vehicle's ability to satisfy other requirements of the standard, such as service brake stopping distances, partial failure, failed power assist, and parking brake requirements.

Advocates' second concern is that, because of the 10% allowance for test variability, a vehicle could pass the torque wheel test and still be rear-biased, and therefore ''susceptible of serious spin-out crashes.'' While it is theoretically possible for a vehicle to be slightly rear-biased and still pass the torque wheel test, NHTSA believes this

[4] A heavily front biased vehicle will skid but remain stable heading forward, since the front wheels will lock first. In contrast, a rear biased vehicle will spin out, since the rear wheels will lock first and those wheels would tend to lead.

possibility is extremely remote. If a manufacturer were to design a vehicle to exhibit slight rear bias, production and test variability would create too great a risk that the vehicle would not comply with either the wheel lock sequence test or the torque wheel test. Rather, the 10% allowance is meant to allow cars to be designed with brake balance that is still front-biased, but closer to ideal than could be achieved if the manufacturer had to worry about a failure of the torque wheel test due to test variability. Also, for a vehicle to exhibit a tendency to spin out, it must experience a condition where the rear wheels are locked and the front wheels are not. Any vehicle falling in the 10% ''window'' would be so close to ideally balanced that the point of wheel lockup would be essentially simultaneous for both axles, and a condition of rear axle lockup without front axle lockup would be almost impossible to maintain.

b. Wheel Lock Sequence Test. NHTSA explained its tentative determination in the SNPRM (Notice 5) that the wheel lock sequence test would identify those vehicles that are heavily front biased. Such vehicles have good stability characteristics because their front brakes always lock first during braking, regardless of test surface. Accordingly, a heavily front biased vehicle would not need to be subject to the torque wheel test, since it would be considered to have inherently good stability characteristics. Under the proposal, a vehicle would need to meet the wheel lock sequence test requirements on all test surfaces that would result in a braking ratio of between 0.15 and 0.80, inclusive, at each of two vehicle loading conditions: GVWR and LLVW.[5] The wheel lock sequence test would require a brake application at a linear, increasing rate such that lockup of the first axle is achieved between 0.5 and 1.0 second.

GRRF agreed to the proposed wheel lock sequence test and planned to add it to R13 and R13H. Ford and Chrysler stated that there were insufficient data to establish whether the wheel lock sequence test could be consistently repeated. Ford believed that there is potential for discrepancies between manufacturer testing and NHTSA testing.

NHTSA believes that Ford and Chrysler are incorrect in their assessment of the wheel lock sequence test. The agency notes that the available test data indicate that the wheel lock sequence test is objective and can be consistently repeated.[6] As explained above, the wheel lock sequence test is the first part of the adhesion utilization test procedure, and evaluates whether there is sufficient front axle bias to ensure stability in a lock up situation. If a car has insufficient front axle bias to consistently meet the wheel lock sequence test, it does not automatically fail to comply with FMVSS No. 135. Rather, it would be tested under the torque wheel method. If the vehicle passes the torque wheel test, the wheel lock sequence test results are irrelevant.

NHTSA expects that 90 to 95 percent of cars will pass the wheel lock sequence test, meaning only 5 to 10 percent of the cars will have to be tested with the torque wheel method. This will reduce potential testing expenses by a greater amount than the agency could have foreseen at the time it published the 1991 SNPRM.[7]

Ford requested that the agency specify a braking ratio of 0.15 to 0.70 instead of the proposed ratio of 0.15 to 0.80. It believed that this change would help avoid degradation and flat spotting of tires, since under its recommended ratios only wet surfaces would be required.

NHTSA has determined that it would be inappropriate to lower the upper limit in the braking ratios. If Ford's recommendation were adopted, there would be no assurance of stability on typical dry road surfaces. Therefore, the agency has decided to require the wheel lock sequence test be performed at any ratio between 0.15 to 0.80.

More generally, NHTSA has considered whether the range of possible test surfaces for the wheel lock sequence test raises practicability concerns. The agency notes that a manufacturer will not need to test a vehicle on every possible surface but could instead make predictions based on testing at several points and brake design characteristics. Moreover, instead of using the wheel lock sequence test to screen out vehicles, a manufacturer could conduct only the torque wheel tests, which do not involve a wide range of test surfaces, if a manufacturer doubted that its vehicle could pass the wheel lock sequence test on all applicable test surfaces. Given the availability of the torque wheel test, NHTSA believes that there are no practicability concerns presented by the wide range of test surfaces in the wheel lock sequence test.

Bendix requested that NHTSA clarify whether the definition of wheel lock in S7.2.1(f) is applicable to all testing situations or just those in S7.2. After reviewing this comment, NHTSA has modified the description of wheel lock in S7.2.1(f) to clarify that it only applies for purposes of the adhesion utilization test.

MVMA and Ford noted that the proposed wheel lock sequence test permits wheel lockups of ''less than 0.1 second;'' however, the balance of the SNPRM permits lockup ''for not longer than 0.1 second.'' The agency has decided to standardize this factor so all references to wheel lockup will read -'' ≤ 0.1 second.''

MVMA, Chrysler, Ford, Toyota, and the Japanese Automobile Manufacturers Association (JAMA) commented that it would be difficult to comply with the proposed test condition for lockup to be achieved between 0.5 and 1.0 seconds after initial brake application. Several commenters suggested an upper limit of 1.5 seconds, which they believed would still preclude spike stops. Ford suggested that the requirement specify no maximum time, provided the vehicle's speed was greater than 15 kilometers per second (km/s) at the time lock up occurred.

After reviewing the available information including agency testing, NHTSA has determined that it is appropriate to raise the ceiling to 1.5 seconds. The agency has decided not to remove the ceiling altogether, given the need to have a specification that is independent of the actual pedal force rate since the pedal force rate required to achieve lock up within a specified time will vary among vehicles.

Suzuki, Toyota, and JAMA recommended that S7.2.3(c)(3) be amended to allow braking force to be terminated 0.1 seconds after the first axle locks or when the front axle locks. Suzuki stated that there is no need to require continued braking beyond the first axle lock, since the test is designed to determine which axle locks first. Toyota and JAMA stated that if the rear axle locks first, then the pedal must be immediately released to prevent accidents.

After reviewing the comments, NHTSA has decided to modify S7.2.3(c)(3) to state the following: ''The pedal is released when the second axle

[5] This is defined in Section S4 as the unloaded vehicle weight plus the weight of a mass of 180 kg, including driver and instrumentation.

[6] ''Harmonization of Braking Regulations, Report Number 7, Testing to Evaluate Wheel Lock Sequence and Torque Transducer Procedures,'' DOT HS 807611, February 1990.

[7] When the 1991 SNPRM was published, the percentage of cars that may have been required to be torque wheel tested was already small, given that the agency expected that 95 percent of all cars would pass the wheel lock sequence test. Thus, only five percent of all cars were expected to be torque wheel tested. As a result of the increased use of antilock brake systems that do not need to be torque wheel tested, the agency anticipates that in model year 1999, the number of cars that might need torque wheel testing will be less than one percent.

locks, or when the pedal force reaches 1000 N (225 lbs), or 0.1 seconds after first axle lockup, whichever occurs first.'' This modification of the language should avoid the problems cited by the commenters.

BMW requested that the wheel lock sequence test be run at speeds of 50 km/h, claiming that the conditions proposed in the 1991 SNPRM demand a higher initial speed and brake pedal application rate than the OICA proposal. NHTSA believes that the proposed test speed of 65 km is appropriate for safety and consistent with ECE R13H. BMW neither raised a safety concern nor provided any documentation to support its request to lower the test speed. Accordingly, the test speed for the wheel lock sequence test is adopted as proposed.

Ford, Chrysler, and MVMA requested deleting the speed channel filtering test condition or clarifying it so that it applies only to analog instrumentation methods. They stated that a low pass filter, having a low cut-off frequency is applicable to analog data recording but not digital data recording.

NHTSA has decided to clarify S7.2.3(g) and (h) so that it refers only to analog instrumentation. These sections address the automatic recording of data and speed channel filtration and are unnecessary for digital data recording.

In the 1991 SNPRM (Notice 5), NHTSA proposed a modified wheel lock sequence test for a vehicle equipped with an antilock brake system on one or both axles. Under this proposal, an ABS equipped vehicle would have to be capable of stopping on a surface with a transition from a high PFC to a low PFC without wheel lockup exceeding 0.1 seconds, after decelerating in a hard braking from 100 km/g to a stop. The agency believed that this would test the ABS's ability to compensate for changes in surface quality and conditions encountered in everyday driving. The agency requested comment about the need to adopt other aspects of Annex 13 addressing braking efficiency and split coefficient of friction surfaces, as more advanced ABS are sold in the United States.

MVMA and Ford requested that vehicles with axles not directly controlled by ABS be allowed to be certified as complying with the wheel lock sequence test. They incorrectly stated that while the 1991 SNPRM only applied the wheel lock sequence test to non-ABS vehicles, a vehicle with rear wheel only ABS should also be permitted to demonstrate brake balance by the wheel lock sequence test. They stated that the use of the wheel lock sequence test is unrelated to whether the vehicle is equipped with ABS and should be allowed for either design as an alternative to the torque wheel test.

After reviewing the comments, NHTSA has decided that only vehicles without any ABS should be required to run the wheel lock sequence test. The agency notes that differentiating between all-wheel and rear-wheel ABS as it relates to brake balance is not appropriate since in either case rear wheel lockup will not occur if the ABS is operational.

c. Torque Wheel Test. Under the 1991 SNPRM (Notice 5), a vehicle that failed any single test run of the wheel lock sequence test would be subjected to the torque wheel[8] test to directly measure braking forces under a wide range of deceleration conditions and provide data needed to generate detailed adhesion utilization calculations. Under the proposal, to pass the torque wheel test, a vehicle would need to demonstrate that the plots of its adhesion utilization performance fell within a specified range. Section S7.4.3 sets forth the test conditions for the torque wheel procedure, including initial brake temperature, test speed, pedal force, cooling, number of test runs, test surface, and the data to be recorded.

NHTSA tentatively concluded that the torque wheel test represented an objective and repeatable method for gathering data for the construction of adhesion utilization curves. The agency noted that the torque wheel procedure requires more expensive test equipment and more time to administer than the wheel lock sequence test.

After reviewing the available information, NHTSA has decided to modify the section on torque wheel testing in S7.4 to exclude from testing any car equipped with ABS. The agency has determined that adhesion utilization testing is only relevant for brake balance in the event of lock up, which will either not occur, or occur for negligible amounts of time, on wheels controlled by ABS. Assuming the ABS is operating, this is true for vehicles in which all wheels are directly controlled by ABS, or on rear wheel-only ABS vehicles. In rear wheel-only ABS vehicles, the front wheels would always lock before the rear wheels, which would not lock at all, or lock for negligible amounts of time. Accordingly, the number of cars that will have to undergo adhesion utilization testing will drop to a small percentage of the overall fleet as ABS becomes more prevalent over the next few years.[9]

GM, Ford, MVMA, and Chrysler requested that S7.4.3 be changed to require stops from 50 km/h at both GVWR and LLVW, in addition to the proposal for stops from 100 km/h. They stated that the additional test runs would increase the database's statistical accuracy and provide stopping data at the speed at which the wheel lock sequence test is conducted. They state that specifying an additional test speed will reduce the standard error in the estimate by 30 percent. In addition, GM stated that by specifying two test speeds, a manufacturer would no longer be able to design speed sensitive brake systems specifically designed to handle stops from 100 km/h. Similarly, Ford commented that alternating between the test speeds would avoid speed conditioning of the brakes.

After reviewing the comments and other available information, NHTSA has decided to modify S7.4.3 to require five stops from 100 km/h, and five stops from 50 km/h, at each of the test weights, LLVW and GVW, for a total of 20 stops. The agency agrees with the commenters that stops from both speeds will prevent speed conditioning and ensure that manufacturers design brakes that will be effective over a wide range of initial speeds. NHTSA has decided to increase the maximum pedal force rate to 200 N/second (45.0 lbs./sec.) for the stops from 50 km/h in order to achieve sufficient deceleration levels.

Ford stated that the paired torque and force values generated for S7.4.4 may not be uniformly distributed when plotted against each other, a situation that may affect the overall outcome. Ford stated that data point distribution will not be uniform if the pedal force and the vehicle deceleration are not changing linearly. It recommended using a linear regression analysis after dividing the input force into several increments and averaging all data points within the respective increments to yield a single average value for that increment.

NHTSA has determined that the modification recommended by Ford is not necessary. The agency believes that there will be no ''constant pedal force'' increments at all, if the rates of pedal force application are held within the limits prescribed in S7.4.3(c). The agency notes that in evaluating this phenomenon in the context of worst case scenarios, VRTC determined that

[8] Torque wheels are strain gauge instrumented devices that fit between the brake rotor or drum and the wheel assembly, and which directly measure the reaction torque that is developed by the friction between the tire and road surface during braking.

[9] The agency estimates that by model year 1999, when FMVSS No. 135 will come into full force, approximately 85–90 percent of passenger cars will be ABS-equipped.

there was no significant change in the results.[10]

Ford and MVMA commented that the test condition in S7.4.3(i), which specifies 20 to 25 snubs from 50 km/h at each of the two loading conditions, is excessive. They state that one or two stops from each loading condition would be sufficient for determining variable proportioning valve (VPV) performance. Alternatively, Ford and MVMA stated that the digital data obtained for each of the torque wheel test stops would provide another source of data for determining variable proportioning valve performance. They requested that if the agency decides to require 20 to 25 snubs, then the snubs be performed at the end of the test sequence to avoid any non-repeatable conditioning of the brake lining.

NHTSA has determined that 20 to 25 snubs to determine the variable proportioning valve performance may be unnecessary, but that the suggested 1 to 2 stops would be inadequate to cover the entire range of brake pressures. The agency has decided to modify S7.4.3(i) to specify 15 snubs. The agency believes that this test procedure will be sufficient to appropriately evaluate variable proportioning valve performance without introducing unnecessary conditioning of brake linings. The agency notes that these extra snubs are only needed when the vehicle is equipped with a variable proportioning valve. With fixed proportioning, the test is a static test, which will have no effect on conditioning of the brake linings.

Ford stated that the linear regression data should only include torque data collected when the vehicle deceleration is within the range of 0.15g to 0.80g rather than when torque output values are > 34 N/minute.

NHTSA agrees with Ford's comment and has modified S7.4.4(b) to reflect this change. The agency believes that it would be inappropriate to use data compiled outside the required performance range of the torque wheel test, since such data may not be relevant to the actual performance requirements.

GRRF, GM, Ford, the MVMA, Suzuki, JAMA, Toyota, Honda, and OICA commented that the upper limit line in Figure 2 in S7.4.4(h) (represented in S7.4.5.1 by the equation $z = 0.1 + 0.7 (k - 0.2)$) is unnecessary and should be eliminated. Ford and GM stated that the line is unnecessary because, even though the wheel lock sequence test has no check for excessive front bias, the cold effectiveness test does. Suzuki, JAMA, Toyota, and OICA stated that the adhesion utilization requirement in S7.4.5.2 for a rear axle is more stringent than the requirement than S7.4.5.1, making S7.4.5.1 redundant.

NHTSA agrees with the commenters that a vehicle that is so front-biased that it would not satisfy the efficiency requirement proposed in Notice 5 would in all probability not be able to meet the cold effectiveness and/or other stopping performance requirements in the standard. Therefore, the efficiency requirement proposed in S7.4.5.1 of Notice 5 is essentially redundant. Accordingly, the agency has decided not to include the upper line in Figure 2. In addition to deleting the area of Figure 2 defined by the equation $z = 0.1 + 0.7 (k - 0.2)$, NHTSA is modifying S7.4.5 by deleting the text of S7.4.5 and S7.4.5.1, and renumbering S7.4.5.2 as S7.4.5.

Chrysler recommended using deep dish wheels and changing tires on the torque wheels, claiming that use of torque wheels will deform normal road wheels by pushing them further out than their normal position. Ford and MVMA requested that the agency modify the requirement to permit use of a separate set of tires in the torque wheel test, based on its concern that lockup situations in other tests under FMVSS No. 135 could flatten or wear spots on tires.

NHTSA has decided to permit manufacturers to use a separate set of tires for the torque wheel test, even though the agency believes that it is unlikely that the tires will be worn down prior to the adhesion utilization test which comes at the beginning of FMVSS No. 135's test sequence. The agency notes that new tires will not alter the adhesion utilization curve for the vehicle. The agency agrees with Chrysler that manufacturers using deep dish rims can avoid tire demounting and thus simplify testing, if they can use such rims with tires already mounted. Based on these considerations, the agency has modified S7.4.2(d) to permit optional use of a separate set of tires for the torque wheel test.

Suzuki commented that for purposes of the torque wheel test, the definition of LLVW should be changed to unloaded weight plus 200 kg, rather than the present 180 kg. It stated that 180 kg may be insufficient to cover the total weight of the driver and required instrumentation.

NHTSA believes that most instrumentation packages fall within the 180 kg specified in the Standard. Moreover, the agency is not aware of any instrumentation packages that exceed the weight allowed for LLVW testing. Based on these considerations, the agency has decided not to change S7.4.2.

Hunter, a manufacturer of a brake balance tester, stated that its device can provide results similar to a road transducer pad. It further stated that its device can be used without the need to modify the vehicle.

NHTSA is aware of Hunter's brake balance tester, which is a simplified version of the road transducer pad. While the Hunter device can provide a rough measure of adhesion utilization, NHTSA believes that the methods of measuring adhesion utilization adopted by the agency are superior to the Hunter device, since the torque wheels evaluate adhesion utilization more precisely. The agency notes that the automotive industry and foreign governments interested in harmonization have stated that the proposed methods of measuring AU are appropriate.

In the 1991 SNPRM, the agency stated that assuming one torque wheel equipment package will service the needs for five years of typical yearly production runs of 30,000 to 100,000 vehicles, the torque wheel would result in a unit cost increase of $0.15 to $0.50 per vehicle.

Kelsey-Hayes stated that NHTSA underestimated the expense of torque wheel equipment. It stated that the agency's discussion of the economic burden associated with the cost of one set of torque wheels over a test run is misleading and incomplete, since numerous sets of torque wheel instrumentation will be required.

NHTSA believes that its estimates in the 1991 SNPRM were reasonably accurate, with the following minor modifications. The agency expects that the cost for a set of four torque wheels (including adapters to accommodate varying wheel mounting bolt patterns) to be approximately $40,000 and $15,000 for the on-board digital data acquisition system that will record the testing results. The equipment should last five production years, which correlates to an annual expense of $11,000 per year. This figure is further reduced when amortized on a per vehicle basis. The agency estimates that direct labor costs for each test to be approximately $50 (including costs for instrumentation technicians, and drivers). The agency estimates that the marginal cost increase per car attributed to the torque wheel test will be between $0.10 and $0.16, depending on the size of the vehicle's production run and the number of vehicles in the run that the manufacturer wants to test, since the manufacturer need not test every vehicle in a vehicle run. The agency

[10] "Harmonization of Braking Regulations, Report Number 7, Testing to Evaluate Wheel Lock Sequence and Torque Transducer Procedures," DOT HS 807611, February 1990.

further notes that less than 1.0 percent of vehicles will actually have to undergo the test by model year 1999, given that most vehicles will be equipped with antilock systems and even most of those non-ABS equipped vehicles will pass the wheel lock sequence test. Based on the above considerations, NHTSA has concluded that the expense and time required to administer the torque wheel test will not pose an unreasonable burden on manufacturers.

The agency notes that torque wheels have been in use at least for the last 50 years for evaluating vehicle characteristics other than adhesion utilization. Most of the major vehicle manufacturers already have torque wheels and use them extensively. Therefore, the cost of torque wheels for FMVSS No. 135 needs to be amortized over more than just its use in evaluating adhesion utilization.

No costs associated with the test surface are expected for torque wheel testing because a high coefficient of friction test surface is already required for testing under the existing standard. No costs are expected for the wheel lock sequence test because, if enough surfaces are not already available to potential users, they could use the torque wheel test, given that it would be cheaper to use than constructing and maintaining new test surfaces. In other words, costs associated with the wheel lock sequence test might be so high that manufacturers would go directly to the torque wheel test to incur lesser costs.

6. Cold Effectiveness

The cold effectiveness test evaluates the ability of a vehicle's brake system to bring a vehicle to a quick and controlled stop in an emergency situation. In the 1991 SNPRM, NHTSA proposed the same cold effectiveness test as proposed in the 1987 SNPRM, with some minor modifications. Specifically, the agency proposed that vehicles would have to stop within 70 m in both the fully loaded and lightly loaded conditions. Based on testing and information supplied by the commenters, the agency believed that this stopping distance requirement for a cold effectiveness test is equivalent in stringency to the current requirement in FMVSS No. 105. The agency continues to believe that the requirements for the cold effectiveness test are of equivalent stringency, as explained below.

Like the other effectiveness tests, the proposed stopping distance requirements for the cold effectiveness test was expressed in the form of an equation. Specifically, this equation provides that stopping distance must be less than or equal to 0.10V + 0.0060V, where V refers to velocity in km/h. The first part of the equation, the 0.10V term, accounts for brake system reaction time of 0.36 second. The second part of the equation, 0.0060V, represents an assumed mean fully developed deceleration rate. The specified performance criterion is not the deceleration rate or the system reaction time, but the stopping distance.

Commenters disagreed about the stringency of the proposed stopping distance tests. While GRRF agreed to the proposed 70 m requirement in the interest of harmonization, GM, Ford, MVMA, Advocates, and the CAS disagreed with the proposed stopping distances. GM stated that the reduction in maximum allowable pedal force increased stringency by 27 percent. It further stated that of nine cars it tested, three failed to meet the proposed 70 m and an additional four failed to meet the 70 m within 10 percent compliance margin. Based on this information, GM argued that a significant number of its vehicles would fail the proposed cold effectiveness test, even though they would comply with FMVSS No. 105. Ford and MVMA stated that the stopping distance was appropriate if the PFC were raised to 1.0.

In contrast, Advocates and CAS commented that the proposed stopping distances were not sufficiently stringent. Advocates stated that the stopping distance should be reduced from 70 m in order to force more original equipment manufacturers to include ABS and brake power assist units as standard equipment. CAS objected to increasing the reaction time component in the stopping distance formula.

After reviewing the available information, NHTSA has determined that requiring a passenger car to come to a complete stop within 70 m (230 feet) from 100 km/h (62.1 mph) provides an appropriate level of braking performance. The agency has decided to require the cold effectiveness test to be conducted at both LLVW and GVWR, with the pedal force being between 65 and 500 N (14.6 to 112.4 lbs).

As it has emphasized in earlier notices, NHTSA notes that it is inappropriate to look only at the raw numbers in FMVSS No. 105 and FMVSS No. 135 and state that one standard is more or less stringent than the other. Agency tests conducted on identical vehicles to the performance requirements in FMVSS No. 105 and FMVSS No. 135 indicate that the average margin of compliance for the cold effectiveness tests at GVWR in the two standards were almost identical (11.5 percent for FMVSS No. 135, and 11.9 percent for FMVSS No. 105). Therefore, NHTSA does not agree with GM's assertions that FMVSS No. 135 is more stringent than FMVSS No. 105.

NHTSA notes that the stopping distances specified in FMVSS No. 135 are slightly longer than the distances specified in FMVSS No. 105. Nevertheless, the agency is confident that the two FMVSSs provide a comparable level of safety, for the following reasons. First, the new burnish procedure in FMVSS No. 135, which is closer to real world practice, is not as severe as that in FMVSS No. 105. As a result, the longer stopping distances in the new standard are mostly attributable to the less severe, but more realistic, burnish procedures, not to an inherent weakening of brake efficiency requirements. Second, the maximum allowable pedal force has been reduced from 150 lbs in FMVSS No. 105 to 112.4 lbs in FMVSS No. 135. Along with lengthening the stopping distances slightly, the lower pedal force will more closely reflect the pedal forces likely to be applied by real world drivers, as opposed to those on a test track.

NHTSA notes that CAS incorrectly assumes that increasing the brake reaction time component in the stopping distance equation, by itself, decreases the test's stringency. Brake reaction time is merely part of a formula by which stopping distances are gauged, but it is the stopping distance, and not the formula, which determines the stringency of the rule. To illustrate, in the 1991 SNPRM, the agency increased the reaction time component of the cold effectiveness test equation from 0.07V to 0.10V. However, the stopping distance remained at 70 m. To compensate for this change in the system reaction time, the deceleration term was modified slightly. Accordingly, a vehicle must still stop in 70 m, so there is no actual increase or decrease in stringency from the first SNPRM.

NHTSA believes that Advocates' concern about the installation of power assist units is moot. According to Ward's Automotive Reports (December 30, 1993 and April 18, 1994 Reports), all current U.S. cars and import cars are equipped with power brakes. Moreover, antilock brake systems are quickly becoming a feature available on many cars. As stated above, by MY 1999 the agency expects 85 to 90 percent of all new cars to be ABS-equipped. The market is responding directly to consumer preference, and therefore Advocates' goal of having more vehicles equipped with ABS is being achieved without a more stringent stopping distance requirement.

NHTSA disagrees with GM's comment that the cold effectiveness stopping distance requirements are 27 percent more stringent due to lower allowable pedal force, because cold effectiveness stops are usually not pedal force limited. In other words, despite the maximum allowable pedal force of 150 lbs in FMVSS No. 105, vehicles rarely needed to be braked with such a pedal force to pass the stopping distance requirement. In fact, pedal forces rarely exceeded the 112.4 lbs (500 N) permitted in FMVSS No. 135. Therefore, the agency does not believe that the lower maximum pedal force allowed in the new standard will result in increasing the stringency of the cold effectiveness requirements in comparison with FMVSS No. 105.

Toyota commented that the minimum initial brake temperature should be raised from 50 °C to 65 °C, but did not give any reasons for the request.

Based on testing conducted at VRTC, NHTSA believes that the present minimum initial brake temperature, which was proposed in the NPRM and the two SNPRMs, represents an appropriate temperature at which to begin the cold effectiveness test runs, and has no information indicating it should be changed. Therefore, the agency is retaining the initial brake temperature requirement as proposed.

7. High Speed Effectiveness

In the 1991 SNPRM (Notice 5), NHTSA proposed a high speed effectiveness test because cars are sometimes driven at higher speeds than provided for in the cold effectiveness test that is conducted at 100 km/h (62.1 mph). The agency proposed that under the high speed effectiveness test for vehicles capable of a maximum speed over 125 km/h, a vehicle would be tested at a speed representing 80 percent of its maximum speed, with a maximum limit of 160 km/h (99.4 mph). The upper speed limit was specified due to facility limitations and safety concerns during testing. The agency proposed that the high speed test would only be conducted for vehicles with a maximum speed greater than 125 km/h. The agency proposed a new equation to reflect the change in system reaction time from 0.07V to 0.10V. The agency stated that while the SNPRM proposal is more stringent than the latest GRRF proposal, the agency's test data indicated that all test cars would be able to meet the proposed requirement.

The GRRF generally accepted the high speed effectiveness formula, and the maximum test speed limit. Nevertheless, it requested that NHTSA delete the lower speed limit proposed in the 1991 SNPRM, since R13 does not specify a lower limit. GRRF further stated that the cold effectiveness test and high speed effectiveness tests are qualitatively different because the former is run with the engine in neutral, while the latter is run with the engine in gear.

NHTSA is pleased that the GRRF has agreed to incorporate the proposed high speed test in R13H. Nevertheless, the agency believes that it is necessary to include the lower limit test speed. Accordingly, NHTSA has decided not to conduct the high speed test for vehicles with a maximum speed under 125 km/h, since it would be illogical and would provide no safety benefits to conduct a high speed test at a lower speed than the speed required by the cold effectiveness test. The agency notes that 80 percent of the lowest maximum speed for the high speed effectiveness test is 100 km/h. The agency does not believe that running a high speed test at a speed lower than 100 km/h, the cold effectiveness test speed, is worthwhile, regardless of engine drive position.

Ford commented that the test should be run only at GVWR, but gave no reason for deleting the LLVW run.

NHTSA has decided that it is consistent with the interests of motor vehicle safety to test at both GVWR and LLVW since vehicles are used at both weights. Similarly, it is in the interest of international harmonization to test at both load conditions, since R13 does so. Accordingly, in FMVSS No. 135's high speed effectiveness test, a vehicle will be tested at both LLVW and GVWR. The test will be conducted at a pedal force between 65 and 500 N (14.6 to 112.4 lbs).

JAMA and Toyota recommended specifying only four runs at high speeds instead of the six proposed in the 1991 SNPRM.

NHTSA previously addressed this issue in the 1987 SNPRM in which the agency proposed increasing the number of test runs from four to six. In that notice, NHTSA explained that such a change would minimize driver effects and decrease test variability, because the prescribed performance would have to be achieved on only one stop in the six runs. Even though reducing the number of runs to four might nominally decrease the expense of the test, such a change could increase the test's stringency.

8. System Failure

In previous notices, NHTSA proposed stopping distance requirements for situations involving the engine being off, antilock functional failure, variable proportioning valve failure, hydraulic circuit failure, and the power assist unit being inoperative. Aside from the engine off requirement, FMVSS No. 105 includes similar requirements which are crucial if part of the service brake system or engine should fail or become inoperative. These requirements ensure that the vehicle's brake system will still be able to bring the vehicle to a controlled stop within a reasonable distance.

a. Stops with engine off.—In the NPRM and two SNPRMs, NHTSA proposed requirements to address stops with the engine off. The agency explained that the proposed requirement was reasonable since engine stalling is a relatively common occurrence, even though FMVSS No. 105 does not include a comparable requirement. The proposal to require vehicles to stop within 73 m after engine failure was slightly less stringent than the 1987 SNPRM's proposed requirement for stops within 70 m. The agency stated that the proposal was consistent with the latest proposal by GRRF and thus will promote harmonization.

Advocates and CAS were concerned that the longer permissible stopping distance of 73 m in the engine failure condition would increase crashes. The GRRF recommended that the vehicle be able to stop after engine failure within 70 m rather than the proposed 73 m. The GRRF stated that the requirements of R13 and R13H should be easily met, provided that there is an adequate reservoir in the braking system and a non-return valve is fitted to the brakes. This equipment should ensure that the brakes can operate even without the engine running.

NHTSA has decided to adopt the engine failure test with a stopping distance of 70 m. Throughout the rulemaking, the agency has attempted to make the engine failure stopping distance consistent with GRRF and consistent with the stopping distance requirement in the cold effectiveness test. In the 1991 SNPRM, the agency stated that its proposal was consistent with the GRRF. This was true when the stopping distance was 73 m for both the cold effectiveness and engine off tests. Since the cold effectiveness stopping distance is now 70 m, the agency is adopting a stopping distance of 70 m for the engine off test. The engine off test will be performed at GVWR, with six stops from 100 km/h, using a pedal force between 65 N and 500 N.

b. Antilock functional failure.—In the two SNPRMs, NHTSA proposed separating the antilock and variable proportioning valve failure requirements into different sections to

reflect the differing failure modes. In the 1991 SNPRM, the agency proposed slightly different stopping distances to reflect the increase in system reaction time and higher decelerations on the cold effectiveness test, while maintaining the same percentages as in the 1987 SNPRM.

For Antilock functional failure, NHTSA proposed a stopping distance of 85 m from a test speed of 100 km/h. The proposed requirement would apply only to functional failures of the ABS system and not to structural failures that are covered by the hydraulic circuit failure requirements. The proposed stopping distance maintains the philosophy that antilock functional failure performance should be 80 percent of the cold effectiveness performance requirement, and is consistent with the requirements adopted for Regulation R13H.

Without explaining what it perceived to be inconsistent, Fiat requested that the agency make the antilock failure requirements in FMVSS No. 135 consistent with R13H. Advocates and CAS requested that NHTSA adopt a stopping distance of 80 meters as proposed in the NPRM. They commented that the SNPRM's proposed stopping distance of 85 meters, while lower than the distance proposed in the 1987 SNPRM, still exceeded the NPRM by 5 meters.

NHTSA has decided to adopt the 85 meter stopping distance requirement for antilock functional failure, as proposed. The agency believes Fiat's comment must have been based on a mistaken impression that the requirement in Regulation 13H was some other value. In fact, the two requirements are harmonized.

The observations of CAS and Advocates that the performance requirement has changed by 5 meters since the NPRM (Notice 1) is correct. Due to various changes in the equations, which have been explained in the two SNPRMs, the proposed requirement went from 80 meters to 86 meters, and then back to 85 meters. Nevertheless, the 80 percent of cold effectiveness performance concept has been maintained throughout this rulemaking. The value being adopted is in agreement with that philosophy, is harmonized with the proposed Regulation 13H, and is considerably more stringent than the corresponding requirement in FMVSS No. 105. CAS and Advocates have provided no justification for returning to an 80 meter value.

Ford, ITT–TEVES, GM, BMW, Chrysler, the GRRF, and MVMA requested that the agency clarify the definition of an ABS ''functional failure simulation'' to indicate that only the ABS system is covered by this requirement. GM and Chrysler stated that the ABS failure test should not be misunderstood to include failures affecting other aspects of the service brake system. They explained that although ABS have previously been added on to the service brake system, increasingly ABS is completely integrated into the service brake system.

Based on the comments, NHTSA believes that it is necessary to clarify the meaning of the phrase ''any single functional failure in any such system.'' Since this requirement applies to antilock systems, only a failure in an antilock system is covered by this requirement. Nevertheless, if a functional failure of the ABS also affects or degrades the service brake system, no artificial means are entailed to keep the service brake system intact when that failure is introduced. In such a situation, the vehicle with the failed ABS and failed service brake system resulting from the single failure, will then be subject to both the ABS failure and partial system failure tests. As the commenters state, manufacturers are increasingly building integrated brake systems rather than installing add-on antilock systems. The agency believes that this requirement is appropriate since it will prohibit any single ABS failure from degrading the service brake systems beyond the performance requirements of the ABS failure test. To ensure clarity, NHTSA has decided to add the following provision to S7.8.2(g)(1): ''Disconnect the functional power source, or any other electrical connector that would create a functional failure.''

Ford recommended deleting the ABS functional failure test at LLVW, stating it was the same as the LLVW cold effectiveness test, if the ABS functional failure is limited to a non-actuation failure mode. In the cold effectiveness test, ABS is active and therefore may actuate during the test. For the ABS functional failure test, the ABS is not working. If the ABS is of an add-on type design rather than an integrated system, and if the cold effectiveness test is conducted at a brake force level that does not result in activation of the ABS, then it is true that the tests would be redundant. However, in many cases one or both of those conditions are not met, so the tests would be different. Therefore, it would be inappropriate to delete the test as requested by Ford.

Bendix stated that with respect to S7.8.2(g)(2)[11], the electrical function failure induced should be one that makes the system inoperative in order to activate the warning indicator. Kelsey-Hayes requested that the agency clarify the meaning in S7.8.2(g)(2) about the continuing operation of the system.

An electrical functional failure that makes the ABS inoperative is required by S5.5.1(b) to activate the warning indicator. S7.8.2(g)(2) is the test to determine compliance with S5.5.1(b). In response to Kelsey-Hayes, the agency notes that an unplugged ABS module should activate the antilock system warning indicator. The agency has decided to clarify paragraph S7.8.3 by adding the words ''service brake'' before the word ''system.''

c. Variable brake proportioning functional failure.—In the 1991 SNPRM (Notice 5) NHTSA proposed a stopping distance of 110 meters from a test speed of 100 km/h to evaluate variable proportioning valve failure. This was slightly shorter than the distance of 112 meters proposed in the 1987 SNPRM. In both notices, the proposal was based on the mean fully developed deceleration rate of 60 percent of that required for the cold effectiveness test. In the 1991 SNPRM, the agency revised the proposal to better define how a variable proportioning valve failure is simulated and to clarify that a warning to the driver of valve failure is only required where there is an electrical functional failure in the variable proportioning valve.

Fiat commented that the variable proportioning valve functional failure test is not necessary given that neither EEC directive 75–524 nor R13 and R13H test for this type of failure, despite years of experience.

NHTSA believes that the lack of documented variable proportioning valve passenger car failures in the U.S. is not a sufficient reason against specifying this requirement. The agency notes that there have been considerable problems with variable proportioning valves on trucks, the vehicle type most typically equipped with variable proportioning valves, both in the U.S. and in Europe. Fiat produced no data to support its assertion that the test is unnecessary for passenger cars. NHTSA notes that a corresponding requirement is included in the proposed Regulation 13H.

ITT–TEVES recommended a stopping distance of 168 m for the variable proportioning valve failure test. It reasoned that vehicles would not be able to meet the 110 m stopping distance because of wheel lock caused by a dynamic load transfer from the rear to the front of the vehicle during braking.

[11] This section requires a determination of whether an ABS electrical functional failure activates the brake system warning indicator.

NHTSA disagrees with ITT–TEVES recommendation to dramatically increase the stopping distance requirement for the variable proportioning valve test. The agency believes that it would be inconsistent with motor vehicle safety to allow a vehicle that is so greatly influenced by an operational variable proportioning valve that when the valve fails the brakes lock up and the vehicle needs 168 meters to stop. The agency further notes that the problem discussed by the commenter, which might affect trucks in rare cases, is even less likely to affect passenger cars.

The GRRF stated that the 60% cold effectiveness requirement is more stringent than the European specification in Regulation 13. Nevertheless, the GRRF stated that it could accept the proposed performance requirement for variable proportioning valve functional failure for purposes of Regulation 13H, provided that its concerns set forth below with respect to S7.9.2(g)(1) are met.

Chrysler, Ford, MVMA, and the GRRF commented that when a variable proportioning valve is disconnected or fails for any reason, it reverts to a default position, functioning at the lowest pressure possible in its proportioning range. Therefore, they state that S7.9.2(g)(1) should be changed to reflect this default condition. They believe that to require the proportioning valve to be operated in any specified position in its operating range would require equipment that is not found on current vehicles.

NHTSA agrees with the commenters that S7.9.2(g)(1) should be revised to allow the variable proportioning valve to return to its normal, default, position, when disconnected, since this will more accurately test the vehicle's real world braking ability. Accordingly, the agency has decided not to require the variable proportioning valve to be held in any position in its operating range, thus allowing it to revert to its uncontrolled condition.

NHTSA notes that the stopping distances for variable proportioning valve functional failure are shorter than those of FMVSS No. 105 (while the stopping distances for structural failure are longer). The agency has determined that the stopping distances which are more stringent for functional failures are appropriate, since functional failures are more likely to occur.

d. Hydraulic circuit failure. In the 1991 SNPRM (Notice 5), NHTSA proposed a stopping distance of 168 m (551 feet) from a test speed of 100 km/h. This proposal is identical to that included in the proposed Regulation 13H. It maintains the same deceleration term as in the 1987 SNPRM (Notice 4), but reflects the proposed reaction time changes in the equation for the cold effectiveness performance requirement.

Advocates stated that increasing the stopping distance in the hydraulic circuit failure test by 42 feet from the NPRM (Notice 1) decreased the Standard's stringency compared to the initial proposal. It further stated that the 1991 SNPRM (Notice 5) also was less stringent than the 1987 SNPRM (Notice 4). There were no other comments regarding the stringency of this requirement.

Based on testing and other available information, NHTSA has decided to adopt the proposed stopping distance of 168 meters (551 feet) from a test speed of 100 km/h for both the hydraulic circuit failure tests. The agency has decided to adopt the stopping distance formula ($0.10V+0.0158V^2$), as proposed in the 1991 SNPRM. As explained in previous notices, it is not possible to compare the stringency of FMVSS No. 105 and FMVSS No. 135 directly when discussing hydraulic circuit failure requirements. This is primarily because there is a significant difference in allowable pedal force during the test. FMVSS No. 105 limits pedal force to 150 lbs, whereas the maximum pedal force in FMVSS No. 135 is 500 N (112.4 lbs). Although as a general matter, the stopping distance of a vehicle improves as greater pedal force is applied, it is not possible to quantify a precise relationship between stopping distance and pedal force. The relationship between these factors is non-linear; it varies among vehicle models, and depends upon various parts of the vehicle, including tires and brake system components. It is broadly true, however, that as pedal force increases, stopping distance decreases.

In response to Advocates' comment regarding the changes between the 1985 NPRM (Notice 1) and the 1991 SNPRM (Notice 5), the rationale for those changes was set forth in the two SNPRMs.

Bendix requested that S7.10.3(f) be clarified so that the induced failure for testing would be limited to the normal braking circuits, but not as part of the ABS that is not part of the normal braking circuit.

NHTSA notes that it is not clear exactly what Bendix means by ''normal braking circuits.'' Section S7.10.3(f) states that the failure is to be induced in the service brake system. The failure could be anywhere in that system, including any part of an ABS that is common to the service brake system. Any part of the ABS that is not common to the service brake system would be subject to testing to the failed ABS requirements, not the hydraulic circuit failure requirements. The agency believes the test condition is clear as stated, and further clarification is unnecessary. Therefore, S7.10.3(f) is adopted as proposed.

e. Power assist unit inoperative. In the 1991 SNPRM, NHTSA proposed a stopping distance of 168 m (551 feet) from a test speed of 100 km/h. This proposal is identical to that included in the proposed Regulation 13H. It maintains the same deceleration term as in the 1987 SNPRM, but reflects the proposed reaction time changes in the equation for the cold effectiveness performance requirement.

Advocates opposed the proposed stopping distance of 168 m for stops with an inoperative power assist, stating that it compared unfavorably with the 165 m proposed in the 1987 SNPRM and the 155 m proposed in the NPRM. In contrast, Ford and GM stated that the agency had proposed a significant increase in stringency from FMVSS No. 105. These commenters recommended a stopping distance of 177 meters (580 ft), stating that such a distance would be equivalent to R13, and would still be more stringent than the 456 foot stopping distance in FMVSS No. 105 because of the decreased maximum pedal force.

After reviewing the comments, NHTSA has decided to adopt the proposed stopping distance of 168 meters (551 feet) from a test speed of 100 km/h for stops when the power assist is inoperative. The agency has decided to adopt the stopping distance formula, ($0.10V+0.0158V^2$), as proposed in the 1991 SNPRM.

As explained in the section on hydraulic circuit failure, it is not possible to compare the stringency of FMVSS No. 105 and FMVSS No. 135 directly when discussing power assist failure requirements, primarily because there is a significant difference in allowable pedal force during the test. None of the commenters who asked for a more or less stringent stopping distance value provided justification for their requests.

9. Parking Brake Requirements

a. Dynamic test. In the NPRM and 1987 SNPRM, NHTSA proposed a dynamic parking brake test that it believed was consistent with the GRRF decisions. The dynamic test was intended to ensure that the driver could use the parking brake to stop a moving vehicle during emergency situations. In the 1991 SNPRM, NHTSA proposed requiring that vehicles utilizing the

service brake's friction linings for the parking brake be tested at a speed of 80 km/h and that vehicles utilizing separate friction linings for the parking brake be tested at 60 km/h. The agency decided that it was not necessary to include a stopping distance requirement, as was proposed in the 1987 SNPRM.

Volkswagen, Mercedes Benz, GM, Suzuki, MVMA, Chrysler, Ford, and OICA objected to the proposed dynamic parking brake test. These commenters stated that the agency had not identified any safety need for a dynamic parking brake test and that FMVSS No. 105 has no such test. These commenters stated that such a test is neither needed nor appropriate since the primary purpose of the parking brake is to statically hold a vehicle on a gradient and not to provide deceleration capabilities for a moving vehicle. They state that it is potentially dangerous for drivers to apply parking brakes in a dynamic situation because it is difficult to modulate the application force. Moreover, such applications could lead to uncontrollable rear wheel lock up and loss of vehicle control.

Volkswagen, Mercedes Benz, GM, Suzuki, MVMA, Chrysler, Ford, and OICA stated that the dynamic parking test was adopted in ECE R13 prior to the almost universal use of dual split service brake systems. Such brake systems provide extra braking reserves in the event of a partial failure because an independent part of the split system remains intact and unaffected by the failure in the other part of the system. According to the commenters, ECE is no longer working on revising its dynamic test, and is even discussing eliminating it.

Mercedes commented that a dynamic test penalizes parking brake designs that are highly self energizing (*i.e.*, that require a relatively low control force but are highly effective in static situations) because their static-efficient design makes them more susceptible to fading. It stated that deleting the dynamic test would improve the design of parking brakes by permitting the optimization of their static holding performance.

In contrast, Advocates and CAS supported including a dynamic parking brake test, although they opposed the agency's decision not to propose stopping distance requirements in the 1991 SNPRM. Advocates stated that the important function of a dynamic standard for parking brake performance is the ability to control manufacture of parking brake systems either with or without separate friction that will reasonably stop a car from controlling test speeds when there is a complete failure of service brakes. That organization stated that without a specific stopping distance requirement, the agency was essentially conceding its attempt to strengthen .105 in order to ensure adequate dynamic performance of the parking brakes when all service brakes fail.

CAS commented that NHTSA's defect files contradict GM's comment that current brake system designs ''obviate the safety need'' for emergency brakes and performance standards. It believed that in many instances drivers have had to use the emergency brake as a last resort to stop the car.

After reviewing the available information, NHTSA has determined that a dynamic parking brake test would provide no significant safety benefits. This decision is based on the fact that FMVSS No. 105 does not include a dynamic parking brake test and on the current state of braking technology. As the manufacturers correctly stated, the ECE requirement pre-dated the widespread use of split service brake systems, which are now standard on all passenger cars. Therefore, the justification for using the parking brake in an emergency situation is no longer relevant. The agency further notes that the partial failure requirements are sufficient in dynamic emergency situations.

Advocates and CAS argued that these requirements are needed to address the situation of ''complete failure'' of a service brake system. The agency has no evidence that complete brake failure (simultaneous failure of both circuits of a split brake system) occurs with any significant frequency. Moreover, because the parking brake is for static situations such as parking and not dynamic ones, the parking brake is not designed to act in dynamic emergencies. Therefore, the agency is concerned that applying the parking brake in emergency situations may cause wheel lockup and instability. The agency further notes that the initial impetus to harmonize with the ECE with respect to a dynamic parking brake requirements will likely become moot, given that the ECE is currently discussing deletion of this requirement from R13 and R13H.

b. Static test. FMVSS No. 105 requires that a passenger car's parking brake be able to hold the vehicle when it is parked on a 30 percent grade and a force is applied to the parking brake control not exceeding 125 pounds for foot operated parking brake systems and 90 pounds for hand operated parking brake systems. In the NPRM, the agency proposed requiring the brake to hold the vehicle when parked on a 20 percent grade and a force not exceeding 500N (112 pounds) for foot-operated parking brakes and 320N (72 pounds) for hand operated parking brakes.

In the 1991 SNPRM (Notice 5), NHTSA proposed that the parking brake be able to hold the vehicle when it is parked on a 20 percent gradient and a force is applied to the parking brake control not exceeding 500N (112 pounds) for foot operated brakes and 400N (90 pounds) for hand operated brakes. The static parking brake test is a pass/fail type of test, *i.e.*, the parking brake either holds the vehicle or it does not. Accordingly, the test's stringency is determined by the gradient and the allowable control force. The two test conditions are interrelated since the higher the force that is applied to the control, the steeper the gradient on which the vehicle can be held in place. In proposing in the SNPRMs to have the hand control force limit at 400 N, the agency stated that the static parking brake test would be somewhat less stringent for manual transmission vehicles, but would be equivalent for automatic transmission vehicles, which make up the majority of cars sold in the U.S. today.

Advocates objected to the reinstatement in the 1987 SNPRM (Notice 4) of the 400 N (90 lbs.) allowable control force for hand brakes, stating that the 320 N (72 lbs.) level proposed in the NPRM clearly recognized the increasing prevalence of hand-operated parking brakes in the American car fleet and the simultaneous surge in numbers and percentage representation of elderly car operators who often cannot apply high levels of force to hand-operated parking brakes.

Advocates also argued that other aspects of the existing parking brake requirements of FMVSS No. 105 have been weakened. That organization noted that the gradient for the parking brake test is 30 percent in FMVSS No. 105, as opposed to 20 percent in the proposed FMVSS No. 135. Advocates stated that in order to offset this less stringent test parameter, the agency proposed lower allowable control forces in the NPRM, 500 N for foot-operated systems and 320 N for hand-operated systems, but later conceded the proposed improvement for hand-operated systems.

Advocates stated that in the 1987 SNPRM, NHTSA reasoned that it was appropriate to specify a less severe gradient and a stronger engagement force for hand-operated parking brakes, because the ''requirements are somewhat less stringent than those of FMVSS No. 105, but [the agency] also believes that the FMVSS No. 105 level of stringency for those particular requirements is unsupported as

resulting in any measurable safety benefits over the proposal.''

Advocates argued that the agency's argument represents an unsupported rationalization of an European standard with much less of a discernible safety benefit. That commenter stated that on any reasonable intuitive basis, it is clear that FMVSS No. 105 was aimed at a higher level of safety and that the agency's original NPRM would have strengthened FMVSS No. 105 and established improved safety for the American motorist. That organization argued that NHTSA has made no effort at any time over the life of FMVSS No. 105 to collect real-world data on the safety benefits of its parking brake performance requirements.

In contrast, Kelsey-Hayes commented that manufacturers will have to make design changes since the 500 N (112 lbs) maximum foot operated pedal force is a significant difference from the 556N (125 lbs) permitted in FMVSS No. 105. Fiat stated that the agency should consider a grade of 18 percent, which would be consistent with R13H.

The comments of Advocates and Kelsey-Hayes relate to proposals made in the original NPRM (Notice 1) and the 1987 SNPRM (Notice 4). Those arguments were already addressed by the agency in the second SNPRM (Notice 5), and no new arguments have been presented by the commenters. The requirements adopted in this final rule are unchanged from the two SNPRMs.

Fiat is mistaken in its assertion that the grade should be 18%, to be consistent with R13H. Although the gradient specified in R13 has been changed to 18%, a corresponding change has not been made in the latest proposal for R13H, the ECE's most recent statement about brake harmonization. Therefore, the gradient and parking brake application force levels adopted in this final rule are consistent with R13H.

Ford commented that the agency should substitute the phrase ''with the average pedal force determined from the shortest GVWR cold effectiveness stop'' for the phrase ''the service brake applied sufficiently to just keep the vehicle from rolling.'' Ford believes the actual force applied will vary greatly from driver to driver, and the language as it presently stands is not an objective measure of the amount of force.

NHTSA believes such a modification is not necessary. The agency notes that the requirement is derived from the language in FMVSS No. 105, which has not presented any problem. The minimum force necessary to keep the vehicle from rolling is a function of the vehicle, tires, and roadway. The driver just keeps increasing the force until that point is reached, and it will not vary from driver to driver.

Bendix requested that NHTSA specify whether the brake linings can be heated up to an initial brake temperature before the static parking brake test; and if so, to specify a procedure. Bendix stated that the procedure would be especially important for vehicles with parking systems that do not utilize the service friction elements.

NHTSA has decided to clarify the initial brake temperature requirements in S7.12.2(a), because the proposal did not distinguish the maximum initial brake temperature for the parking brake test by the type of friction element and did not state how the initial brake temperature should be achieved for the parking brakes. In the final rule, the agency has decided to specify that the parking brakes with service brake friction materials are to be tested with the initial brake temperature less than or equal to 100°C (212°F), while parking brakes with non-service brake friction materials are to be tested at ambient temperature at the start of the test.

10. Fade and Recovery

In the 1985 NPRM (Notice 1), NHTSA proposed a fade and recovery test to ensure adequate braking capability during and after exposure to the high brake temperatures caused by prolonged or severe use. Such temperatures are typically experienced in long, downhill driving. Specifically, the agency developed a heating sequence for this proposal based on SAE Recommended Practice J1247 (Apr 80), ''Simulated Mountain Brake Performance Test Procedure.'' Among its provisions was reducing the interval between snubs from 45 seconds to 30 seconds.[12] The agency stated that the proposed sequence was similar to those in FMVSS No. 105, but produced a temperature cycle that more closely approximates an actual mountain descent than either FMVSS No. 105 or the ECE draft test procedure. Accordingly, the agency decided not to propose the ECE's draft proposed heating sequence.

In the 1991 SNPRM, NHTSA specified a heating sequence in S7.14, a hot performance test in S7.15, a cooling sequence in S7.16, and a recovery requirement in S7.17. The agency proposed that the required stopping distance during the hot performance test be the shorter of 89 meters from a test speed of 100 km/h or 60 percent of the deceleration achieved on the shortest fully loaded cold effectiveness stopping distance. In addition, the agency revised certain test conditions and procedures in the NPRM and 1987 SNPRM to reflect changes in performance agreed to by the ECE and EEG. For instance, the agency proposed that the pedal force be adjusted as necessary during each snub to maintain the specified constant deceleration rate, rather than applying a specific pedal force. The 1991 SNPRM also proposed that the interval between the start of the snubs would be 45 seconds. The proposed modifications to the fade and recovery test were consistent with modifications made to other road tests being introduced in FMVSS No. 135. These include permitting momentary wheel lockup and a longer reaction time in calculating the maximum stopping distance.

a. Heating snubs. In response to the proposal in S7.14 about heating snubs, JAMA, MVMA, Chrysler, Ford, GM, and the GRRF stated that the 45 second interval between snubs is appropriate. Chrysler submitted test data showing that brake temperatures and brake lining temperatures at 30 second intervals were significantly higher than under test conditions in FMVSS No. 105, addressing fade.

In contrast, CAS and Advocates favored a 30 second interval, as proposed in the NPRM. The advocacy groups claimed that by allowing cooler brakes the stopping distance requirements will be less stringent. Advocates stated that increasing the time interval between heating snubs from 30 seconds in the NPRM to 40 seconds in the 1987 SNPRM, to 45 seconds in the 1991 SNPRM contradicted NHTSA's earlier proposals and would not result in brake temperatures comparable to those obtained in FMVSS No. 105.

Based on its testing and other available information, NHTSA has determined that the 45 second interval is appropriate. As a result of this time interval and other changes, the requirement will be closer in stringency to ECE R13 and FMVSS No. 105. NHTSA believes that FMVSS No. 135's heating snub procedure is roughly equivalent to the requirements in FMVSS No. 105. The agency notes that in the 1987 SNPRM, the agency lengthened the time interval between snubs to 40 seconds, but shortened the stopping distance on the hot stop test to compensate.

b. Hot performance. In response to the proposal in S7.15 about hot performance, commenters addressed such issues as the stopping distance requirement, the pedal force, and the number of stops. In Notice 5, the agency increased the stopping distance in the

[12] In the 1987 SNPRM, NHTSA proposed an interval of 40 seconds.

hot stop test slightly to maintain the same relationship to the cold effectiveness stop.

JAMA and Toyota recommended that the stopping distance for the hot performance test be lengthened to 90 meters. Similarly, Ford requested that the stopping distance be lengthened to 93 meters. In contrast, Advocates objected to the proposed increase in stopping distance from 80 meters in the NPRM, to 86 meters in the 1987 SNPRM, to 89 meters in the 1991 SNPRM. It stated that the increased stopping distances will result in the hot performance test being less likely to evaluate fade since brakes will remain cooler.

After reviewing the available information, NHTSA has decided to specify a stopping distance for the hot performance test of 89 meters, as proposed in the 1991 SNPRM. The agency believes that this stopping distance requirement will ensure adequate braking capability during and after exposure to high brake temperatures caused by prolonged or severe use. The first hot stop is done with a pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness test. The stopping distance for the first hot stop must be less than or equal to the distance corresponding to 60 percent of the deceleration actually achieved on the shortest GVWR cold effectiveness stop. The second hot stop is done with a pedal force not greater than 500N, and the stopping distance on at least one of the two stops must also be less than or equal to 89 m or $0.10V+0.0079V^2$. The agency notes that the results of the second stop may only be used to satisfy the 89 m stopping distance requirement, and not the 60 percent requirement.

In response to Advocates, JAMA, Toyota, and Ford, NHTSA notes that throughout this rulemaking, the hot performance stopping distance has always been determined by a formula based on a constant percentage of the deceleration rate for the cold effectiveness stop, and as the latter was changed, so was the former. Accordingly, the stopping distance proposed in the 1991 SNPRM served to retain the same relationship to the cold effectiveness test. None of the commenters presented compelling reasons why that philosophy should be abandoned.

Ford, GM and MVMA expressed concern about the proposed pedal force test conditions for the hot performance stops. GM stated that the proposed pedal force levels may make it difficult to comply with the stopping distance requirement. GM requested that the agency adopt a pedal force limitation of 500 N (112 lbs.) for both hot stops. Ford recommended using a constant pedal force corresponding to approximately 90 percent in the cold effectiveness deceleration.

NHTSA has decided not to modify the test conditions with respect to pedal force for these tests. The purpose of the hot performance test is to determine how much the stopping performance of the vehicle will be degraded as the result of the brakes being heated, as might happen during a mountain descent or severe stop-and-go driving. The hot performance is measured against two separate criteria. First, the vehicle must attain a specific minimum level of absolute performance. Second, it must attain a specified percentage of the performance actually achieved in the ''cold'' condition, as measured by the cold effectiveness test, even if that performance was significantly higher than required. In order to determine compliance with the latter requirement, the performance in the hot performance test is compared to the performance of the brakes in the cold effectiveness test. In order for that comparison to be meaningful, the test conditions for the two tests should be as close to identical as possible.

For the cold effectiveness test, the test conditions are that the pedal force must not exceed 500N (112 pounds), and the wheels must not lock for more than 0.1 second. There are two different methods of conducting this test. European testers usually use a constant pedal force throughout any given test run. This constant pedal force is increased in subsequent runs, until the point of wheel lockup is reached, or the constant force reaches the 500N limit, whichever occurs first. In the U.S., testers generally apply an initial ''spike'' of pedal force, up to the point where the 500N limit is reached or a ''chirp'' is heard, indicating the start of wheel lockup, and then the driver ''backs off'' on pedal force to the point where the wheels do not stay locked. The ''U.S.'' method generally produces a slightly shorter stopping distance, but either method is allowed as long as neither limitation (500N or wheel lockup) is violated.

For the hot performance test, the ideal situation would be to exactly duplicate the input (pedal force vs. time curve) from the cold effectiveness test, so the outputs (stopping distances) from the two tests can be compared. If the constant pedal force method has been used for the cold effectiveness test, that is relatively easy to do. If the ''U.S.'' method has been used, however, the input is impossible to duplicate exactly. In order to accommodate both methods of testing, FMVSS No. 135 specifies that the pedal force for the first hot stop is to be not greater than the average pedal force recorded on the best cold effectiveness test run. The agency is aware that this test condition does not ensure that the input from the cold effectiveness test will be duplicated exactly. However, it is an objective test condition, and government and industry experts who have discussed this subject in numerous GRRF ad hoc meetings have not been able to come up with a better approach. Accordingly, unless and until the European and United States industry can agree on a replacement procedure, NHTSA believes it would be inappropriate to modify the requirements.

Ford commented that the mean pedal force requirement left a loophole that would allow ABS equipped vehicles to apply the full 500 N pedal force in the cold effectiveness test and again in the first hot stop. It believed that this would mask the hot versus cold performance.

NHTSA notes that although the situation described by Ford is theoretically possible, it is highly unlikely that a manufacturer would use this ''loophole'' to build a vehicle with poor hot performance characteristics. The agency notes that such a brake system design would create too great a likelihood that the ABS would allow lockup of greater than 0.1 seconds or that the vehicle would have problems passing the high speed effectiveness or failed-ABS tests.

Ford and Chrysler recommended that only one of the two stops be required to meet the performance requirements. Chrysler stated that the second stop is only run because of test driver uncertainty during the first stop. It cited problems caused by the need for the test driver to obtain the maximum performance from the brake system that, at the end of the heating snubs, has unknown performance requirements. Chrysler believed that if the first stop is invalidated because of wheel lock or driver hesitation, the driver should be permitted to use this knowledge in the second stop.

Chrysler's assertion that the second stop is only run because of test driver uncertainty during the first stop is untrue. The reason a second stop is needed is that there are two separate requirements to be satisfied: a comparison with cold effectiveness performance and a minimum level of absolute performance. The first stop provides the comparison with cold performance, because the pedal force is limited to the average pedal force applied on the best cold effectiveness stop. In most cases, stopping

performance is degraded as a result of heating rather than improved, so Chrysler's concern over inadvertent wheel lockup shouldn't be a problem on this stop.

The required level of absolute performance may or may not be met on this first stop. If it is not, the second stop allows a pedal force up to 500N. The reasoning for allowing a greater pedal force is that, in an actual driving situation, a driver will apply increased force to the brake pedal to compensate somewhat for degraded brake performance.

Multiple attempts are not allowed on the hot stop because it is important to measure hot performance while the brakes are still hot. If multiple runs were allowed, the performance measured on subsequent runs would not necessarily be a true measure of hot brake performance. While this fact makes the test somewhat more difficult to run, the agency found in its testing that it did not present problems for experienced test drivers.

c. Recovery performance. The GRRF and Fiat believed that to harmonize with R13H, the provision about pedal force needed to be modified to state that ''a pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness stops.'' The GRRF further stated that the fade and recovery and hot performance tests should be compared with the cold effectiveness test and that the comparison would only be valid if the input (*i.e.*, pedal force) is the same in each test and the output (deceleration or stopping distance) is measured as in R13 and R13H.

The wording in S7.14.3(c) regarding the hot stop is already as requested by GRRF and Fiat, and NHTSA has decided to make a corresponding change in S7.16.3(c) to accommodate GRRF's request. The agency believes that this modification will help harmonize the standards without any corresponding detriment to safety.

Advocates recommended returning to an over-recovery deceleration based on 120 percent of the shortest GVWR cold effectiveness stop.

As explained in the 1987 SNPRM when the deceleration rate was increased to 150 percent, the test is still more stringent than FMVSS No. 105, even at the higher level. The performance requirement has remained unchanged since 1987, and Advocates has presented no reason why it should be changed now. Accordingly, the agency has adopted the requirement as proposed in the two SNPRMs.

Bendix and Ford requested the agency to define ''average pedal force'' more fully. Bendix also asked the agency to define the phrase ''not greater than'' for purposes of the hot performance test.

NHTSA believes the terms ''average'' and ''not greater than'' are used the same way they would be defined in any dictionary, and therefore no definition is needed in the standard. Nevertheless, to avoid any misunderstanding, the terms are explained as follows: The term ''average pedal force'' is defined as the average value taken from the initiation of the pedal force until completion of the cold effectiveness stop. It is calculated from the pedal force/time curve of the shortest GVWR cold effectiveness stop, and includes any overshoot or spike that may be present at the beginning of the test. The phrase ''not greater than'' means that the maximum pedal force which can be applied during the first hot stop cannot exceed the average pedal force.

GM, MVMA, JAMA, Toyota and Ford believe that the response term (0.10V) of the recovery stop equation (S7.17.4) has been omitted (i.e., '' * * *≤ S–0.10V ≤ * * * '' instead of '' * * * ≤ S ≤ * * * '', thereby resulting in an ''apples-to-oranges'' comparison of the recovery stopping distance without adjusting for response time to the cold effectiveness stopping distance which is adjusted for response time. They believe the intent is to regulate recovery as a function of cold effectiveness performance after both are corrected to eliminate the response time distance. They believe that the equation should read as follows: $0.0386V^2/1.50d_c \leq S–0.10V \leq 0.0386V^2/0.70d_c$

NHTSA agrees that the 0.10V term should be in the stopping distance for recovery performance and has therefore made the following correction to the equation in S7.17.4:

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

G. Miscellaneous Comments

Advocates argued for inclusion of water recovery, spike stop and final effectiveness requirements that appear in FMVSS No. 105, but are not included in FMVSS No. 135. Advocates believes that the absence of these requirements will result in a degradation of safety.

NHTSA has already addressed the need, or lack of it, for these requirements in previous notices, and need not be repeated here. Advocates presented nothing to justify their arguments but unsupported conjecture. The agency has considered Advocates' comments, and has decided that there is insufficient justification for inclusion of these requirements.

Advocates also made general comments opposing this rulemaking as a whole. They stated that the resulting standard is decidedly inferior in multiple aspects to the existing FMVSS No. 105. Advocates expressed the fear that the new standard would allow the importation of cars without power assist, antilock brakes, automatic brake monitoring, and other desirable features of superior brake performance, that meet only the minimum requirements of FMVSS No. 135. It stated that these would likely be the smallest, cheapest cars on the market, which would also have the poorest overall crashworthiness.

The agency notes that none of the advanced safety features mentioned by Advocates are presently required by FMVSS No. 105. Advocates' assertion that FMVSS No. 135 is inferior to FMVSS No. 105 is contradicted by previously cited agency and industry test data which show the new standard to be at least, if not more difficult to meet, overall, than the existing FMVSS No. 105. Accordingly, the agency is not convinced by Advocates' arguments in opposition of the new standard, and has decided to issue this final rule.

IV. Regulatory Analysis

A. Executive Order 12866 (Regulatory Planning and Review) and DOT Regulatory Policies and Procedures

This rulemaking document was not reviewed under Executive Order 12866. NHTSA has considered the economic implications of this regulation and determined that it is not significant within the meaning of the DOT Regulatory Policies and Procedure. A Final Regulatory Evaluation (FRE) has been prepared setting forth the agency's detailed analysis of the economic effects of this rule, and has been placed in the public docket.

Based on its analysis, NHTSA has determined that FMVSS No. 135 ensure an equivalent level of safety for those aspects of performance covered by FMVSS No. 105 and will also address additional areas of brake performance which offer safety benefits. It will offer decreased costs for the production of passenger cars, by reducing non-tariff barriers to trade. Further, the agency believes that the full test procedure in the new standard will require approximately the same amount of time and money to complete as the existing procedure under FMVSS No. 105.

B. Regulatory Flexibility Act

In accordance with the Regulatory Flexibility Act, NHTSA has evaluated the effects of this action on small entities. Based upon this evaluation, I certify that the final rule will not have a significant economic impact on a substantial number of small entities. Only relatively simple changes will generally be needed for all passenger cars to meet this standard. These changes will not significantly affect the purchase price of a vehicle. No changes will be needed for many cars. While some change in compliance costs may occur, the change will not be of a magnitude which will significantly affect the purchase price of a vehicle. For these reasons, neither manufacturers of passenger cars, nor small businesses, small organizations, and small governmental units which purchase motor vehicles, will be significantly affected by the proposed standard. Accordingly, no regulatory flexibility analysis has been prepared.

C. Executive Order 12612 (Federalism)

This action has been analyzed in accordance with the principles and criteria contained in Executive Order 12612, and it has been determined that the final rule did not have sufficient Federalism implications to warrant preparation of a Federalism Assessment. No State laws are affected.

D. Executive Order 12778 (Civil Justice Reform)

This final rule does not have any retroactive effect. Under 49 U.S.C. 30103, whenever a Federal motor vehicle safety standard is in effect, a State may not adopt or maintain a safety standard applicable to the same aspect of performance which is not identical to the Federal standard, except to the extent that the State requirement imposes a higher level of performance and applies only to vehicles procured for the State's use. 49 U.S.C. 30161 sets forth a procedure for judicial review of final rules establishing, amending or revoking Federal motor vehicle safety standards. That section does not require submission of a petition for reconsideration or other administrative proceedings before parties may file suit in court.

E. National Environmental Policy Act

The agency has considered the environmental implications of this rule in accordance with the National Environmental Policy Act of 1969 and determined that this rule will not significantly affect the human environment. No changes in existing production or disposal processes result.

List of Subjects in 49 CFR Part 571

Imports, Motor vehicle safety, Motor vehicles, Rubber and rubber products, Tires.

PART 571—[AMENDED]

In consideration of the foregoing, 49 CFR part 571 is being amended as follows:

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

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

2. Section 571.101 is amended by revising table 2 as follows:

§ 571.101 Standard No. 101: Controls and displays.

* * * * *

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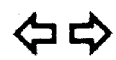
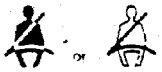
TABLE 2
Identification and Illumination of Displays

Column 1	Column 2	Column 3	Column 4	Column 5
Display	Telltale Color	Identifying Words or Abbreviation	Identifying Symbol	Illumination
Turn Signal Telltale	Green	Also see FMVSS108	 [1] [6]	—
Hazard Warning Telltale		Also see FMVSS 108	 [2] [6]	—
Seat Belt Telltale		Fasten Belts or Fasten Seat Belts Also see FMVSS 208		—
Fuel Level Telltale		Fuel		—
Gauge	—			Yes
Oil Pressure Telltale		Oil		—
Gauge	—			Yes
Coolant Temperature Telltale		Temp		—
Gauge	—			Yes
Electrical Charge Telltale		Volts, Charge or Amp		—
Gauge	—			Yes
Highbeam Telltale	Blue or Green[4]	Also see FMVSS 108	 [6]	—
Brake System [8]	Red[4]	Brake. Also see FMVSS 105 & 135	—	—
Malfunction in Anti-Lock or	Yellow	Antilock, Anti-lock, or ABS. Also See FMVSS 105 & 135	—	—
Variable Brake Proportioning System[6]	Yellow	Brake Proportioning Also see FMVSS 135	—	—
Parking Brake Applied [8]	Red[4]	Park or Parking Brake Also see FMVSS 105 & 135	—	—
Brake Air Pressure Position Telltale		Brake Air Also see FMVSS 121	—	—
Speedometer	—	MPH[5]		Yes
Odometer	—	—[3]	—	—
Automatic Gear Position	—	Also see FMVSS 102	—	Yes

[1] The pair of arrows is a single symbol. When the indicator for left and right turn operate independently, however, the two arrows will be considered separate symbols and may be spaced accordingly.

[2] Not required when arrows of turn signal tell-tales that otherwise operate independently flash simultaneously as hazard warning tell-tale.

[3] If the odometer indicates kilometers, then "KILOMETERS" or "km" shall appear, otherwise, no identification is required.

[4] Red can be red-orange. Blue can be blue-green.

[5] If the speedometer is graduated in miles per hour and in kilometers per hour, the identifying words or abbreviations shall be "MPH and km h" in any combination of upper or lower case letters.

[6] Framed areas may be filled.

[7] The color of the telltale required by S4.5.3.3 of Standard No. 208 is red; the color of the telltale required by S7.3 of Standard No. 208 is not specified.

[8] In the case where a single telltale indicates more than one brake system condition, the word for Brake System shall be used.

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3. Section 571.105 is amended by revising S3 to read as follows:

§ 571.105 Standard No. 105: Hydraulic brake systems.

* * * * *

S3. *Application.* This standard applies to multipurpose passenger vehicles, trucks, and buses with hydraulic brake systems, and to passenger cars manufactured before September 1, 2000, with hydraulic brake systems. At the option of the manufacturer, passenger cars manufactured before September 1, 2000 may comply with the requirements of Federal Motor Vehicle Safety Standard No. 135, *Passenger Car Brake Systems*, instead of the requirements of this standard.

4. A new § 571.135 is added to read as follows:

§ 571.135 Standard No. 135: Passenger car 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 manufactured on or after September 1, 2000. In addition, passenger cars manufactured before September 1, 2000, may, at the option of the manufacturer, meet the requirements of this standard instead of Federal Motor Vehicle Safety Standard No. 105, *Hydraulic Brake Systems.*

S4. *Definitions.*

Adhesion utilization curves means curves showing, for specified load conditions, the adhesion utilized by each axle of a vehicle plotted against the braking ratio of the vehicle.

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 factor means the slope of the linear least squares regression equation best representing the measured torque output of a brake as a function of the measured applied line pressure during a given brake application for which no wheel lockup occurs.

Brake hold-off pressure means the maximum applied line pressure for which no brake torque is developed, as predicted by the pressure axis intercept of the linear least squares regression equation best representing the measured torque output of a brake as a function of the measured applied line pressure during a given brake application.

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 driver action consisting only of modulating the energy application level.

Braking ratio means the deceleration of the vehicle divided by the gravitational acceleration constant.

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 driver 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 lightly loaded weight.

Objective brake factor means the arithmetic average of all the brake factors measured over the twenty brake applications defined in S7.4, for all wheel positions having a given brake configuration.

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.

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 leakage-type failure of a pressure component in a single subsystem (except structural failure of a housing that is common to two or more subsystems) does not impair the operation of any other subsystem.

Stopping distance means 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.

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 shall be equipped with a service brake system acting on all wheels.

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

S5.1.2. *Wear status.* The wear condition of all service brakes shall 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.

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

S5.3. *Controls.*

S5.3.1. The service brakes shall be activated by means of a foot control. The control of the parking brake shall be independent of the service brake

control, and may be either a hand or foot control.

S5.3.2. For vehicles equipped with ABS, a control to manually disable the ABS, either fully or partially, is prohibited.

S5.4. *Reservoirs.*

S5.4.1. *Master cylinder reservoirs.* A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall 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, shall 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 shall 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 shall 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 shall 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 shall have a brake fluid warning statement that reads as follows, in letters at least 3.2 mm (⅛ 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 shall 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 shall 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 indicator.* Each vehicle shall have one or more visual brake system warning indicators, mounted in front of and in clear view of the driver, which meet the requirements of S5.5.1 through S5.5.5. In addition, a vehicle manufactured without a split service brake system shall be equipped with an audible warning signal that activates under the conditions specified in S5.5.1(a).

S5.5.1. *Activation.* An indicator shall be activated when the ignition (start) switch is in the ''on'' (''run'') position and whenever any of conditions (a), (b), (c) or (d) 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.

(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).

S5.5.2. *Function check.*

(a) All indicators shall be activated as a check function by either:

(1) Automatic activation when the ignition (start) switch is turned to the ''on'' (''run'') position when the engine is not running, or when the ignition (''start'') switch is in a position between ''on'' (''run'') and ''start'' that is designated by the manufacturer as a check position, 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 an indicator for application of the parking brake, by applying the parking brake when the ignition is in the ''on'' (''run'') position.

(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 shall explain the brake check function test procedure in the owner's manual.

S5.5.3. *Duration.* Each indicator activated due to a condition specified in S5.5.1 shall remain activated as long as the condition exists, whenever the ignition (''start'') switch is in the ''on'' (''run'') position, whether or not the engine is running.

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

S5.5.5. *Labeling.*

(a) Each visual indicator shall display a word or words in accordance with the requirements of Standard No. 101 (49 CFR 571.101) and this section, which shall be legible to the driver under all daytime and nighttime conditions when activated. Unless otherwise specified, the words shall have letters not less than 3.2 mm (⅛ inch) high and the letters and background shall 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 indicator to indicate two or more of the functions described in S5.5.1(a) through S5.5.1(d). If a common indicator is used, it shall display the word ''Brake.''

(c) A vehicle manufactured without a split service brake system shall use a separate indicator to indicate the failure condition in S5.5.1(a). This indicator shall display the words ''STOP—BRAKE FAILURE'' in block capital letters not less than 6.4 mm (¼ inch) in height.

(d) If separate indicators are used for one or more than one of the functions described in S5.5.1(a) to S5.5.1(d), the indicators shall display the following wording:

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

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

(3) If a separate indicator is provided for the condition specified in S5.5.1(b), the letters and background shall be of contrasting colors, one of which is yellow. The indicator shall be labeled with the words ''Antilock'' or ''Anti-lock'' or ''ABS''; or ''Brake Proportioning,'' in accordance with Table 2 of Standard No. 101.

(4) If a separate indicator 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 indicator is provided to indicate brake lining wear-out as specified in S5.5.1(d), the words ''Brake Wear'' shall be used.

(6) If a separate indicator is provided for any other function, the display shall include the word ''Brake'' and appropriate additional labeling.

S5.6. *Brake system integrity.* Each vehicle shall 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 shall be intact and functional. Friction facing tearout (complete detachment of lining) shall 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 O °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 0.9 when measured using an American Society for Testing and Materials (ASTM) E1136 standard reference test tire, in accordance with ASTM Method E 1337–90, 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% gradient in the direction of testing and no more than a 2% 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 GAWR, with the fuel tank filled to 100% 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% of capacity at the beginning of testing and may not be less than 75% 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).* If a car is equipped with an 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 car 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.

S6.4. *Instrumentation.*

S6.4.1. *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.

S6.4.2. *Brake line pressure measurement for the torque wheel test.* The vehicle shall be fitted with pressure transducers in each hydraulic circuit. On hydraulically proportioned circuits, the pressure transducer shall be downstream of the operative proportioning valve.

S6.4.3. *Brake torque measurement for the torque wheel test.* The vehicle shall be fitted with torque wheels at each wheel position, including slip ring assemblies and wheel speed indicators to permit wheel lock to be detected.

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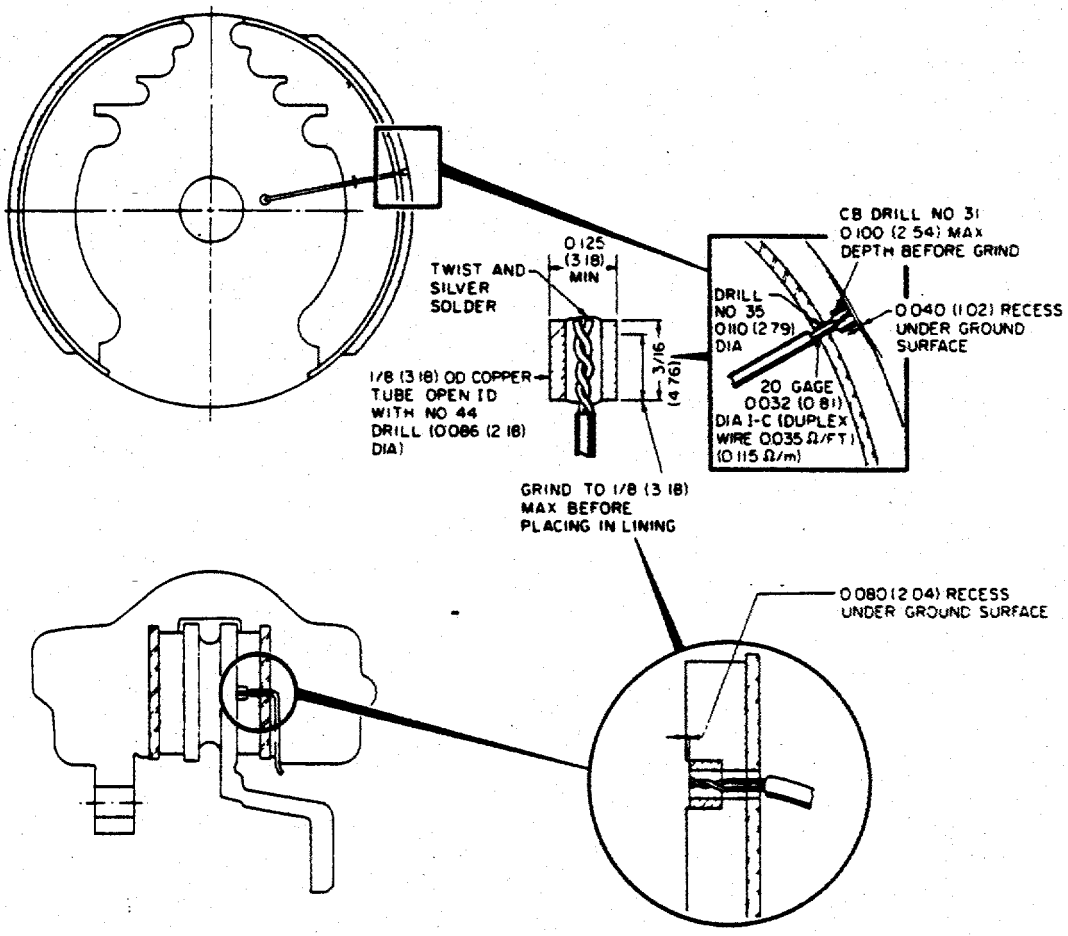

DIMENSIONS ARE IN (mm)

Figure 1–Typical Plug-Type Thermocouple Installations

S6.5. *Procedural conditions.*

S6.5.1. *Brake control.* 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 control.

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 required 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 $S=0.10V+0.0060V^2$), S is the maximum stopping distance in meters, and V is the test speed in km/h.

S6.5.4. *Vehicle position and attitude.*

S6.5.4.3. 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 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 shall 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 SCHEDULE

Testing order	Section No.
Vehicle loaded to GVWR:	
1 Burnish	S7.1
2 Wheel lock sequence	S7.2
Vehicle loaded to LLVW:	
3 Wheel lock sequence	S7.2
4 ABS performance	S7.3
5 Torque wheel	S7.4
Vehicle laded to GVWR:	
6 Torque wheel	S7.4
7 Cold effectiveness	S7.5
8 High speed effectiveness	S7.6
9 Stops with engine off	S7.7
Vehicle loaded to LLVW:	
10 Cold effectiveness	S7.5
11 High speed effectiveness	S7.6
12 Failed antilock	S7.8
13 Failed proportioning valve	S7.9
14 Hydraulic circuit failure	S7.10
Vehicle loaded to GVWR:	
15 Hydraulic circuit failure	S7.10
16 Failed antilock	S7.8
17 Failed proportioning valve	S7.9
18 Power brake unit failure	S7.11
19 Parking brake—static	S7.12
20 Parking brake—dynamic	S7.13
21 Heating snubs	S7.14
22 Hot performance	S7.15
23 Brake cooling	S7.16
24 Recovery performance	S7.17
25 Final inspection	S7.18

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 must be 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) Pedal force: 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 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 *Wheel lockup sequence.*

S7.2.1 *General information.*

(a) The purpose of this test is to ensure that lockup of both front wheels occurs either simultaneously with, or at a lower deceleration rate than, the lockup of both rear wheels, when tested on road surfaces affording adhesion such that wheel lockup of the first axle occurs at a braking ratio of between 0.15 and 0.80, inclusive.

(b) This test is for vehicles without antilock brake systems.

(c) This wheel lock sequence test is to be used as a screening test to evaluate a vehicle's axle lockup sequence and to determine whether the torque wheel test in S7.4 must be conducted.

(d) For this test, a simultaneous lockup of the front and rear wheels refers to the conditions when the time interval between the first occurrence of lockup of the last (second) wheel on the rear axle and the first occurrence of lockup of the last (second) wheel on the front axle is ≤ 0.1 second for vehicle speeds > 15 km/h (9.3 mph).

(e) A front or rear axle lockup is defined as the point in time when the last (second) wheel on an axle locks up.

(f) Vehicles that lock their front axle simultaneously or at lower deceleration rates than their rear axle need not be tested to the torque wheel procedure.

(g) Vehicles which lock their rear axle at deceleration rates lower than the front

axle shall also be tested in accordance with the torque wheel procedure in S7.4.

(h) Any determination of noncompliance for failing adhesion utilization requirements shall be based on torque wheel test results.

S7.2.2 *Vehicle conditions.*

(a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In neutral.

S7.2.3 Test conditions and procedures.

(a) IBT: ≥ 50 °C. (122 °F), ≤ 100 °C, (212 °F).

(b) Test speed: 65 km/h (40.4 mph) for a braking ratio ≤ 0.50; 100 km/h (62.1 mph) for a braking ratio > 0.50.

(c) Pedal force:

(1) Pedal force is applied and controlled by the vehicle driver or by a mechanical brake pedal actuator.

(2) Pedal force is increased at a linear rate such that the first axle lockup occurs no less than one-half (0.5) second and no more than one and one-half (1.5) seconds after the initial application of the pedal.

(3) The pedal is released when the second axle locks, or when the pedal force reaches 1000 N (225 lbs), or 0.1 seconds after first axle lockup, whichever occurs first.

(d) Wheel lockup: Only wheel lockups above a vehicle speed of 15 km/h (9.3 mph) are considered in determining the results of this test.

(e) Test surfaces: This test is conducted, for each loading condition, on two different test surfaces that will result in a braking ratio of between 0.15 and 0.80, inclusive. NHTSA reserves the right to choose the test surfaces to be used based on adhesion utilization curves or any other method of determining ''worst case'' conditions.

(f) The data recording equipment shall have a minimum sampling rate of 40 Hz.

(g) Data to be recorded. The following information must be automatically recorded in phase continuously throughout each test run such that values of the variables can be cross referenced in real time.

(1) Vehicle speed.

(2) Brake pedal force.

(3) Angular velocity at each wheel.

(4) Actual instantaneous vehicle deceleration or the deceleration calculated by differentiation of the vehicle speed.

(h) Speed channel filtration. For analog instrumentation, the speed channel shall be filtered by using a low-pass filter having a cut-off frequency of less than one fourth the sampling rate.

(i) Test procedure. For each test surface, three runs meeting the pedal force application and time for wheel lockup requirements shall be made. Up to a total of six runs will be allowed to obtain three valid runs. Only the first three valid runs obtained shall be used for data analysis purposes.

S7.2.4. *Performance requirements.*

(a) In order to pass this test a vehicle shall be capable of meeting the test requirements on all test surfaces that will result in a braking ratio of between 0.15 and 0.80, inclusive.

(b) If all three valid runs on each surface result in the front axle locking before or simultaneously with the rear axle, or the front axle locks up with only one or no wheels locking on the rear axle, the torque wheel procedure need not be run, and the vehicle is considered to meet the adhesion utilization requirements of this Standard. This performance requirement shall be met for all vehicle braking ratios between 0.15 and 0.80.

(c) If any one of the three valid runs on any surface results in the rear axle locking before the front axle or the rear axle locks up with only one or no wheels locking on the front axle the torque wheel procedure shall be performed. This performance requirement shall be met for all vehicle braking ratios between 0.15 and 0.80.

(d) If any one of the three valid runs on any surface results in neither axle locking (*i.e.*, only one or no wheels locked on each axle) before a pedal force of 1000 N (225 lbs) is reached, the vehicle shall be tested to the torque wheel procedure.

(e) If the conditions listed in paragraph (c) or (d) of this section occur, vehicle compliance shall be determined from the results of a torque wheel test performed in accordance with S7.4.

S7.3. *ABS performance. [Reserved.]*

S7.4. *Adhesion utilization (Torque Wheel Method).*

S7.4.1. *General information.* This test is for vehicles without any ABS. The purpose of the test is to determine the adhesion utilization of a vehicle.

S7.4.2. *Vehicle conditions.*

(a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In neutral.

(c) Tires: For this test, a separate set of tires, identical to those used for all other tests under Section 7.0, may be used.

S7.4.3. *Test conditions and procedures.*

(a) IBT: ≥ 50°C (122°F), ≤ 100 °C (212°F).

(b) Test speeds: 100 km/h (62.1 mph), and 50 km/h (31.1 mph).

(c) Pedal force: Pedal force is increased at a linear rate between 100 and 150 N/sec (22.5 and 33.7 lbs/sec) for the 100 km/h test speed, or between 100 and 200 N/sec (22.5 and 45.0 lbs/sec) for the 50 km/h test speed, until the first axle locks or until a pedal force of 1 kN (225 lbs) is reached, whichever occurs first.

(d) Cooling: Between brake applications, the vehicle is driven at speeds up to 100 km/h (62.1 mph) until the IBT specified in S7.4.3(a) is reached.

(e) Number of runs: With the vehicle at GVWR, run five stops from a speed of 100 km/h (62.1 mph) and five stops from a speed of 50 km/h (31.1 mph), while alternating between the two test speeds after each stop. With the vehicle at LLVW, repeat the five stops at each test speed while alternating between the two test speeds.

(f) Test surface: PFC of at least 0.9.

(g) Data to be recorded. The following information must be automatically recorded in phase continuously throughout each test run such that values of the variables can be cross referenced in real time:

(1) Vehicle speed.

(2) Brake pedal force.

(3) Angular velocity at each wheel.

(4) Brake torque at each wheel.

(5) Hydraulic brake line pressure in each brake circuit. Hydraulically proportioned circuits shall be fitted with transducers on at least one front wheel and one rear wheel downstream of the operative proportioning or pressure limiting valve(s).

(6) Vehicle deceleration.

(h) Sample rate: All data acquisition and recording equipment shall support a minimum sample rate of 40 Hz on all channels.

(i) Determination of front versus rear brake pressure. Determine the front versus rear brake pressure relationship over the entire range of line pressures. Unless the vehicle has a variable brake proportioning system, this determination is made by static test. If the vehicle has a variable brake proportioning system, dynamic tests are run with the vehicle both empty and loaded. 15 snubs from 50 km/h (31.1 mph) are made for each of the two load conditions, using the same initial conditions specified in this section.

S7.4.4. *Data reduction.*

(a) The data from each brake application under S7.4.3 is filtered using a five-point, on-center moving average for each data channel.

(b) For each brake application under S7.4.3 determine the slope (brake factor) and pressure axis intercept (brake hold-off pressure) of the linear least squares equation best describing the measured torque output at each braked wheel as a function of measured line pressure applied at the same wheel. Only torque output values obtained from data collected when the vehicle deceleration

is within the range of 0.15g at 0.80g are used in the regression analysis.

(c) Average the results of paragraph (b) of this section to calculate the average brake factor and brake hold-off pressure for all brake applications for the front axle.

(d) Average the results of paragraph (b) of this section to calculate the average brake factor and brake hold-off pressure for all brake applications for the rear axle.

(e) Using the relationship between front and rear brake line pressure determined in S7.4.3(i) and the tire rolling radius, calculate the braking force at each axle as a function of front brake line pressure.

(f) Calculate the braking ratio of the vehicle as a function of the front brake line pressure using the following equation:

$$z = \frac{T_1 + T_2}{P}$$

where z = braking ratio at a given front line pressure;

T_1, T_2 = Braking forces at the front and rear axles, respectively, corresponding to the same front brake line pressure, and

P = total vehicle weight.

(g) Calculate the adhesion utilized at each axle as a function of braking ratio using the following equations:

$$f_1 = \frac{T_1}{P_1 + zhP / E}$$

$$f_2 = \frac{T_2}{P_2 - zhP / E}$$

where f_i = adhesion utilized by axle i

T_i = braking force at axle i (from (e))

P_i = static weight on axle i

i = 1 for the front axle, or 2 for the rear axle

z = braking ratio (from (f))

h = height of center of gravity of the vehicle

P = total vehicle weight

E = wheelbase

(h) plot f_1 and f_2 obtained in (g) as a function of z, for both GVWR and LLVW load conditions. These are the adhesion utilization curves for the vehicles, which are compared to the performance requirements in S7.4.5, shown graphically in Figure 2.

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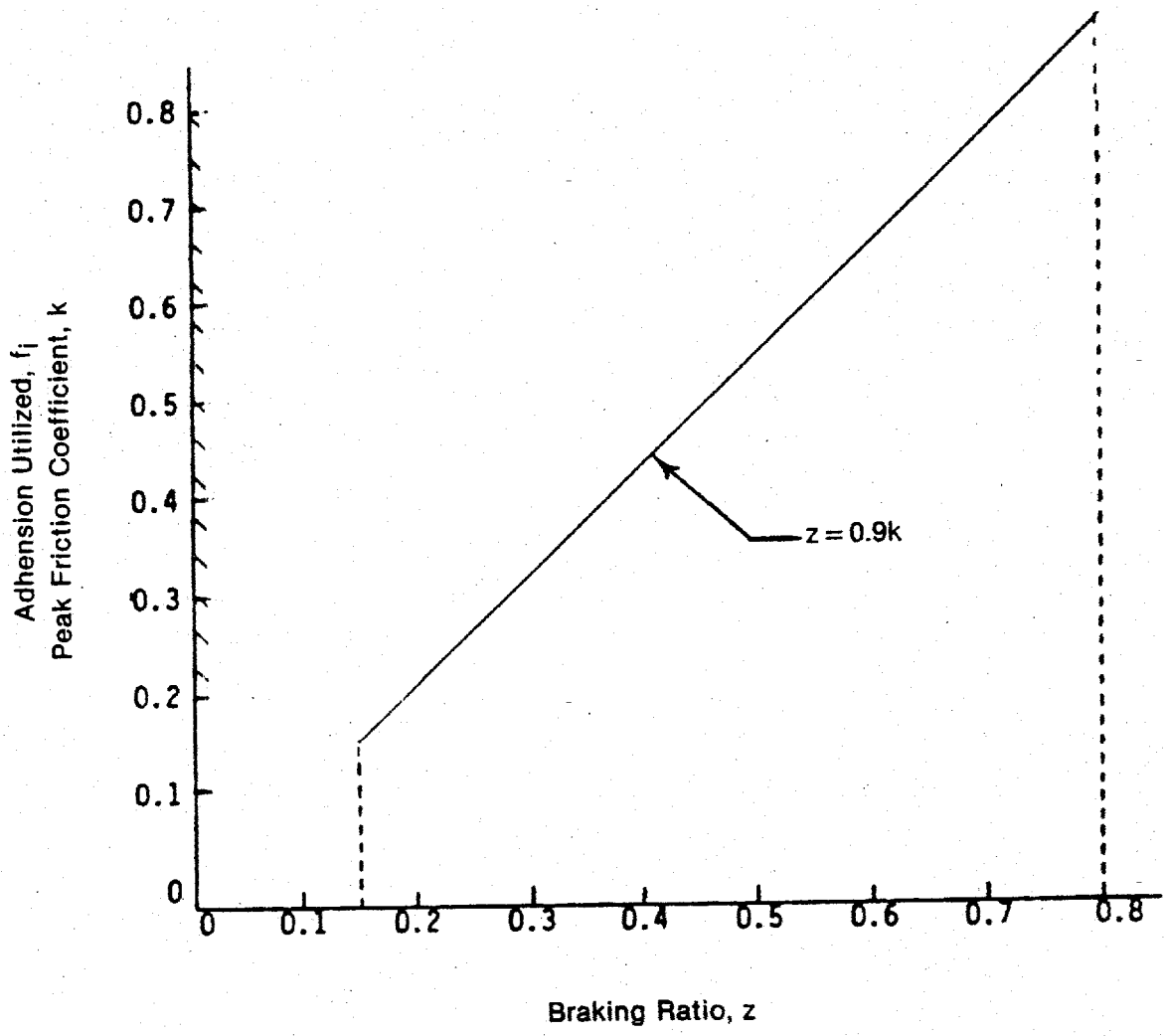

Figure 2–Adhesion Utilization Requirements

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S7.4.5. *Performance requirements.* For all braking ratios between 0.15 and 0.60, each adhesion utilization curve for a rear axle shall be situated below a line defined by z = 0.9k where z is the braking ratio and k is the PFC.

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: > 50°C (122°F), < 100°C (212°F).

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

(c) Pedal force: > 65N (14.6 lbs), < 500 N (112.4 lbs).

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

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 0.9.

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

S7.5.3. *Performance requirements.*

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

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

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: > 50°C (122°F), < 100°C (212°F).

(b) Test speed: 80% of vehicle maximum speed if 125 km/h (77.7 mph) < vehicle maximum speed < 200 km/h (124.3 mph), or 160 km/h (99.4 mph) if vehicle maximum speed ≥ 200 km/h (124.3 mph).

(c) Pedal force: > 65 N (14.6 lbs), < 500 N (112.4 lbs).

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

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 0.9.

S7.6.3. *Performance requirements.*

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

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.

S7.7.2. *Vehicle conditions.*

(a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

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

(d) Ignition key position: May be returned to ''on'' position after turning engine off, or a device may be used to ''kill'' the engine while leaving the ignition key in the ''on'' position.

S7.7.3. *Test conditions and procedures.*

(a) IBT: ≥ 50°C (122°F), ≤ 100°C (212°F).

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

(c) Pedal force: ≥ 65 N (14.6 lbs), ≤ 500 N (122.4 lbs).

(d) Wheel lockup: No lockup of any wheel 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 0.9.

(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: ≥ 50°C (122°F), ≤ 100°C (212°F).

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

(c) Pedal force: ≥ 65 N (14.6 lbs), ≤ 500 N (112.4 lbs).

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

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 0.9.

(g) Functional failure simulation:

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

(2) Determine whether the brake system indicator 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 shall continue to operate and shall 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: ≥ 50°C (122°F), ≤ 100°C (212°F).

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

(c) Pedal force: ≥ 65 N (14.6 lbs), ≤ 500 N (112.4 lbs).

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

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 0.9.

(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 indicator 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 function failure in any such system, shall continue to operate and shall stop the vehicle as specified in S7.9.3(a) and 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 our 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: ≥ 50 °C (122 °F), ≤ 100 °C (212°F).

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

(c) Pedal force: ≥ 65 N (14.6 lbs), ≤ 500 N (122.4 lbs).

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

(e) Test surface: PFC of 0.9.

(f) Alter the service brake system to produce any one rupture or leakage type of failure other than structural failure of a housing that is common to two or more subsystems.

(g) Determine the control force pressure level or fluid level (as appropriate for the indicator being tested) necessary to activate the brake warning indicator.

(h) Number of runs: After the brake warning indicator 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) 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 rupture or leakage type of failure in a single subsystem, other than a structural failure of a housing that is common to two or more subsystems, and after activation of the brake system indicator as specified in S5.5.1, the remaining portions of the service brake system shall continue to operate and shall 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 one rupture or leakage type of failure in any component of the service brake system and after activation of the brake system indicator as specified in S5.5.1, the vehicle shall by operation of the service brake control 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. *Power brake 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: ≥ 50°C (122°F), ≤ 100°C (212°F).

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

(c) Pedal force: ≥ 65 N (14.6 lbs), ≤ 500 N (112.4 lbs).

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

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 0.9.

(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 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 by 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.

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, shall 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—Static test.*

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.

S7.12.2. *Test conditions and procedures.*

(a) IBT:

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

(b) Parking brake control force: 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.

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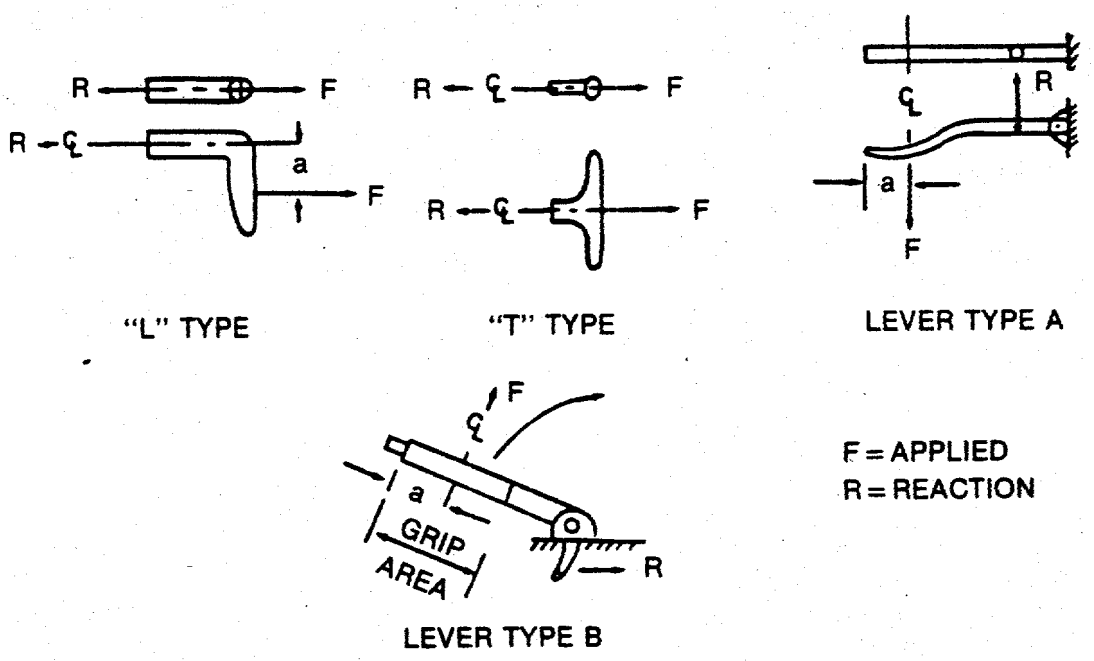

Dimension a = 40 mm (1.57in)

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

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(d) Parking brake applications: 1 apply and 2 reapply if necessary.
(e) Test surface gradient: 20% 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 control 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) The parking brake system is actuated by a single application not exceeding the limits specified in S7.12.2(b).
(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 indicator.
(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 shall 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:
(l) Establish an IBT before the first brake application (snub) of ≥ 55°C (131°F), ≥ 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% 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/s² (9.6 fps²).
(2) Attain the specified deceleration within one second and maintain it for the remainder of the snub.
(e) Pedal force: Adjust as necessary to maintain the 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) Pedal force: (1) The first stop is done with a pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop.
(2) The second stop is done with a pedal force not greater than 500 N (112.4 lbs).
(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed 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 second hot performance stop, drive 1.5 km (0.98 mi) at 50 km/h (31.1 mph) before the first cooling stop.
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 shall be 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/s²),
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) Pedal force: Adjust as necessary to maintain specified constant deceleration rate.
(d) Deceleration rate: Maintain a constant deceleration rate of 3.0 m/s² (9.9 fps²).
(e) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed 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) Pedal force: The pedal force shall not be greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop.

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed 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 indicators, for compliance with operation in various key positions, lens color, labeling, and location, in accordance with S5.5.

Issued: January 23, 1995.

Ricardo Martinez,

Administrator.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 651

[Docket No. 950124025–5025–01; I.D. 122094A]

RIN 0648–AD33

Northeast Multispecies Fishery

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Final rule; technical amendment.

SUMMARY: NMFS issues this final rule to make corrections and clarifications to the regulations implementing Amendment 5 to the Northeast Multispecies Fishery Management Plan (FMP) and subsequent framework actions.

EFFECTIVE DATE: February 1, 1995, except for § 651.9(e)(36), amendments to § 651.20(b)(2)(ii), and § 651.20(c)(2)(ii), and § 651.20(c)(4) introductory text, which will be effective on June 11, 1995.

FOR FURTHER INFORMATION CONTACT: Bridgette S. Davidson, NMFS, Fishery Management Specialist, 508–281–9347.

SUPPLEMENTARY INFORMATION: The New England Fishery Management Council (Council) submitted Amendment 5 to the FMP to NMFS on September 27, 1993. Amendment 5, with some exceptions, was approved on January 3, 1994. The final rule for Amendment 5 was published on March 1, 1994 (59 FR 9872). This final rule makes several corrections and clarifications to the regulations and to subsequent amendments to the regulations—59 FR 9872, March 1, 1994; 59 FR 26972, May 25, 1994; 59 FR 36725, July 19, 1994; 59 FR 42176, August 17, 1994.

The definition of ''sink gillnet'' (§ 651.2) was modified in Framework Adjustment 4 to the FMP and is further clarified here. The definition is revised to clarify that a sink gillnet is a bottom-tending gillnet.

Section 651.4(f)(2)(iv) is modified to reflect the Council's intent. Although the preamble to the final regulations for Amendment 5 stated that vessel owners would be allowed to change their 1994 permit category within 30 days of receiving their permit, there was no specific language in the regulations prohibiting a change in category after that time during the initial fishing year. The Council did not intend for vessels to switch between days-at-sea (DAS) programs, except during the renewal process to receive a 1995 limited access multispecies permit. The regulations are modified accordingly.

Section 651.5 requires any operator of a vessel in possession of multispecies harvested from the exclusive economic zone to have an operator's permit. Recreational vessels that are exempt from a multispecies permit are also exempt from the operator's permit requirements. This exemption was inadvertently omitted from the final rule implementing Amendment 5. This final rule clarifies that only vessels that are required to have a multispecies permit are required to have an operator with an operator's permit.

The regulations implementing mesh obstruction and tie-up inadvertently had no correlated prohibitions. Section 651.9(b)(11) and (e)(36) are added by this final rule to address this omission; however, the prohibition at § 651.9(e)(36) will be effective beginning June 11, 1995, due to the emergency action published in the **Federal Register** on (59 FR 63926, December 12, 1994), which temporarily added prohibitions to that section. The emergency action is effective through March 12, but the Council is expected to vote to extend the emergency for an additional 90 days, i.e., through June 11, 1995. If the emergency action is not extended, NMFS will publish a notice to modify the effective date of this rule.

In order to reflect more accurately the prohibition at § 651.9(b)(1), the word ''accruing'' is replaced with ''using'' when discussing a vessel using all of its annual DAS allocation.