Flexibility Act (RFA) (5 U.S.C. 601 *et seq.*), do not apply.

This action directly regulates growers, food processors, food handlers, and food retailers, not States or tribes, nor does this action alter the relationships or distribution of power and responsibilities established by Congress in the preemption provisions of FFDCA section 408(n)(4). As such, the Agency has determined that this action will not have a substantial direct effect on States or tribal governments, on the relationship between the national government and the States or tribal governments, or on the distribution of power and responsibilities among the various levels of government or between the Federal Government and Indian tribes. Thus, the Agency has determined that Executive Order 13132, entitled ''Federalism'' (64 FR 43255, August 10, 1999) and Executive Order 13175, entitled ''Consultation and Coordination with Indian Tribal Governments'' (65 FR 67249, November 9, 2000) do not apply to this action. In addition, this action does not impose any enforceable duty or contain any unfunded mandate as described under Title II of the Unfunded Mandates Reform Act (UMRA) (2 U.S.C. 1501 *et seq.*).

This action does not involve any technical standards that would require Agency consideration of voluntary consensus standards pursuant to section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) (15 U.S.C. 272 note).

VII. Congressional Review Act

Pursuant to the Congressional Review Act (5 U.S.C. 801 *et seq.*), EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. This action is not a ''major rule'' as defined by 5 U.S.C. 804(2).

List of Subjects in 40 CFR Part 180

Environmental protection, Administrative practice and procedure, Agricultural commodities, Pesticides and pests, Reporting and recordkeeping requirements.

Dated: August 29, 2017.

Michael L. Goodis,

Director, Registration Division, Office of Pesticide Programs.

Therefore, 40 CFR chapter I is amended as follows:

PART 180—[AMENDED]

■ 1. The authority citation for part 180 continues to read as follows:

Authority: 21 U.S.C. 321(q), 346a and 371.

■ 2. In § 180.685, redesignate paragraph (a)(1) as paragraph (a) and add alphabetically the following commodity ''Cacao bean, dried bean'' to the table in paragraph (a) in alphabetical order to read as follows:

§ 180.685 Oxathiapiprolin; tolerances for residues.

(a) * * *

Commodity	Parts per million
* * * *	*
Cacao bean, dried bean	0.15
* * * *	*

* * * * *

[FR Doc. 2017–20747 Filed 9–26–17; 8:45 am]

BILLING CODE 6560–50–P

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. NHTSA–2017–0085]

RIN 2127–AL68

Federal Motor Vehicle Safety Standards; Electric-Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection

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

ACTION: Final rule.

SUMMARY: NHTSA is issuing this final rule to amend Federal Motor Vehicle Safety Standard (FMVSS) No. 305, ''Electric-powered vehicles: Electrolyte spillage and electrical shock protection,'' to adopt various electrical safety requirements found in Global Technical Regulation (GTR) No. 13, ''Hydrogen and fuel cell vehicles,'' and other sources. This final rule updates FMVSS No. 305 using modern and harmonized safety requirements and facilitates the introduction of new technologies, including hydrogen fuel cell vehicles (HFCVs) and 48-volt mild hybrid technologies. This final rule is a deregulatory action. It imposes no costs and adjusts FMVSS No. 305 to give more flexibility to manufacturers not only to use modern electrical safety designs to produce electric vehicles, but also to introduce new technologies to the U.S. market. To expand FMVSS No. 305's performance requirements beyond post-crash conditions, NHTSA adopts electrical safety requirements to protect against direct and indirect contact of high voltage sources during everyday operation of electric-powered vehicles. Also, NHTSA adopts an optional method of meeting post-crash electrical safety requirements, consistent with that in GTR No. 13, involving use of physical barriers to prevent direct or indirect contact (by occupants, emergency services personnel and others) with high voltage sources.

DATES:

Effective date: This final rule is effective September 27, 2017.

Compliance date: The compliance date for the amendments in this final rule is September 27, 2018. Optional early compliance is permitted.

Petitions for reconsideration: Petitions for reconsideration of this final rule must be received not later than November 13, 2017.

ADDRESSES: Petitions for reconsideration of this final rule must refer to the docket and notice number set forth above and be submitted to the Administrator, National Highway Traffic Safety Administration, 1200 New Jersey Avenue SE., Washington, DC 20590. Note that all petitions received will be posted without change to *http://www.regulations.gov,* including any personal information provided.

Privacy Act: Please see the Privacy Act heading under Rulemaking Analyses and Notices.

FOR FURTHER INFORMATION CONTACT: For technical issues, you may call William J. Sánchez, Office of Crashworthiness Standards (telephone: 202–493–0248) (fax: 202–493–2990). For legal issues, you may call Deirdre Fujita, Office of Chief Counsel (telephone: 202–366–2992) (fax: 202–366–3820). Address: National Highway Traffic Safety Administration, U.S. Department of Transportation, 1200 New Jersey Avenue SE., West Building, Washington, DC 20590.

SUPPLEMENTARY INFORMATION:

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I. Executive Summary

a. Overview

NHTSA is issuing this final rule to update FMVSS No. 305, ''Electric-powered vehicles: Electrolyte spillage and electrical shock protection.'' As indicated in its title, one purpose of FMVSS No. 305 is to reduce deaths and injuries from electrical shock. Currently, the standard focuses on post-crash safety, requiring vehicles with high voltage sources to protect vehicle occupants, rescue workers and others who may contact the vehicle after a crash. To protect against electric shock, FMVSS No. 305 currently requires that, during and after the crash tests specified in the standard, high voltage sources in the vehicle must be either (a) electrically isolated from the vehicle's chassis [1] or (b) their voltage must be at levels considered safe from harmful electric shock.[2] This final rule amends the standard to adopt a physical barrier compliance option that prevents direct and indirect contact [3] of high voltage sources post-crash by way of ''electrical protection barriers.'' An electrical protection barrier is a physical barrier that encloses a high voltage source to prevent direct contact (by occupants, emergency services personnel and others) of the high voltage source from any direction of access.

This final rule is a deregulatory action as it imposes no costs and adjusts FMVSS No. 305 to give more flexibility to manufacturers not only for current electric vehicle designs, but also for introducing new technologies to the U.S. market, including hydrogen fuel cell vehicles (HFCVs) and 48-volt mild hybrid technologies. In adopting the physical barrier option, this final rule adjusts the standard to remove an obstruction that prevented HFCVs from being offered for sale in the U.S. Adopting the physical barrier option also enables manufacturers to produce 48-volt mild hybrid systems without having to use electrical isolation safety measures that involve more complexity, higher consumer costs, and higher mass, without an incremental safety benefit. This rule responds to petitions for rulemaking from Toyota Motor North America Inc. (Toyota) [4] and the Auto Alliance (Alliance).[5]

NHTSA is also issuing this final rule as part of the agency's ongoing effort to avoid unnecessary differences in the vehicle safety standards of different countries through a harmonization process under the United Nation Economic Commission for Europe (UNECE) 1998 Global Agreement (''1998 Agreement''). The efforts of the U.S.[6] and other contracting parties to the 1998 Agreement culminated in the establishment of GTR No. 13, ''Hydrogen and fuel cell vehicles.'' NHTSA voted in June 2013 in favor of establishing GTR No. 13.[7] This final rule adopts requirements based on the electrical safety requirements of GTR No. 13.[8]

Similar to FMVSS No. 305, GTR No. 13 has requirements intended to reduce deaths and injuries from electrical shock, but addresses both normal vehicle operation and post-crash safety. Also, while the various post-crash compliance options in GTR No. 13 are like those in FMVSS No. 305, GTR No. 13 includes the physical barrier option to prevent direct and indirect contact [9] of high voltage sources.

On March 10, 2016, NHTSA issued the notice of proposed rulemaking (NPRM) on which this final rule is based (81 FR 12647). The NPRM proposed adopting GTR No. 13's normal vehicle operation requirements, and proposed adopting a post-crash physical barrier compliance option like that in GTR No. 13.

Comments on the NPRM were generally supportive of the proposed changes. Some commenters requested modifying the proposed regulatory text to clarify the wording of requirements and test procedures or to align the text with GTR No. 13 and ECE R.100, ''Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train,'' and some suggested NHTSA should not adopt some requirements for lack of safety need.

This final rule adopts most aspects of the proposal, with some parts changed in response to commenters. The final rule improves motor vehicle safety by expanding FMVSS No. 305's protections to normal vehicle operations. The updated post-crash performance requirements ensure that new power train configurations provide a comparable level of post-crash safety as that of existing electric vehicles.

This final rule reflects the state-of-the art in vehicle electrical safety. It draws from the findings from the agency's research on the physical barrier compliance option in GTR No. 13 (Battelle study),[10] ECE R.100, and the

[1] Since the physiological impacts of direct current (DC) are less than those of alternating current (AC), the standard specifies lower minimum electrical isolation requirements for DC high voltage sources with electrical isolation monitoring systems (100 ohms/volt) than for AC components (500 ohms/volt).

[2] Under this low voltage option, electrical components are low voltage if their voltage is less than or equal to 60 VDC or 30 VAC. VDC is the voltage for direct current sources and VAC is voltage for alternating current sources. These low voltage levels will not cause electric shock.

[3] Contact of a conductive part that is energized due to loss of electrical isolation of a high voltage source is an indirect contact of a high voltage source.

[4] Petitioner Toyota requested the physical barrier option to allow HFCVs to be offered for sale in the U.S. After its submission of the petition for rulemaking, Toyota pursued and was granted a temporary exemption from FMVSS No. 305 for an HFCV (see grant of petition, January 2, 2015 (80 FR 101)). Toyota incorporates electrical protection barriers (conductively connected to the electric chassis with low resistance) and maintains at least a 100 ohms/volt electrical isolation into its design. NHTSA granted the petition for exemption on the basis that the exemption would make the development or field evaluation of a low emission (zero emission) vehicle easier and would not unreasonably reduce the safety of the vehicle.

[5] Petitioner Alliance requested the physical barrier option to facilitate the production of 48volt mild hybrid technologies as well as HFCVs.

[6] The U.S. was one of several contracting parties to the 1998 Agreement that proposed the development and establishment of GTR No. 13.

[7] Each Contracting Party that voted for a new GTR that has been established under the 1998 Agreement is obligated by that Agreement to initiate its process for adopting the GTR into national law. However, the Agreement does not obligate such a Contracting Party to adopt the GTR. The Contracting Party retains full discretion under the Agreement to decide for itself whether to adopt the GTR.

[8] NHTSA is considering initiating rulemaking in the future on other aspects of GTR No. 13 directly pertaining to the fuel system integrity of HFCVs.

[9] Contact of a conductive part that is energized due to loss of electrical isolation of a high voltage source is an indirect contact of a high voltage source.

[10] NHTSA contracted with the Battelle Memorial Research Institute to research failure modes associated with physical barriers that could result in electric shock. Battelle identified different scenarios involving failure of electrical isolation, direct contact protection, or indirect contact protection and a combination of failure of two or more these protection measures. Battelle then evaluated the possibility of electric shock in each

electrical safety requirements in a January 2014 version of SAE J1766.[11]

The rule not only gives more flexibility to manufacturers to use modern electrical safety designs to produce electric vehicles and introduce new vehicle technologies, but also paves the way globally for future innovations on vehicle electrical safety. A new GTR is under development [12] for electric vehicle safety (EVS–GTR) which includes specifications for high voltage electrical components and rechargeable electric energy storage systems. In November 2016, NHTSA and other parties developing the new draft GTR completed the document's high voltage electrical safety provisions. The parties designed the draft GTR to reflect the provisions of GTR No. 13, ECE R.100, and the requirements proposed in the March 2016 NPRM and adopted by this final rule.

We estimate that the final rule will result in essentially no cost to consumers in the U.S. This rule adopts requirements that closely mirror the electrical safety provisions of GTR No. 13, which have already been implemented by manufacturers in this country.

b. Summary of the Final Rule and Highlighted Differences With the NPRM

This section summarizes the requirements adopted by this final rule. For the convenience of the reader, we also note the few notable differences between this rule and the NPRM. The reasons underlying our decisions are explained in the body of this preamble and in the NPRM.

1. Every Day (Normal) Vehicle Operations

This final rule adds electrical safety requirements for vehicle performance during every day (normal) vehicle operations to mitigate the risk of electric shock due to direct or indirect contact of high voltage sources or loss in electrical isolation. We also adopt requirements to assure electrical safety during refueling and to mitigate driver error in vehicle operation.

i. Direct Contact Protection From High Voltage Sources

The rule specifies:

A. IPXXD protection degree for high voltage sources inside passenger and luggage compartments, and IPXXB protection degree for high voltage sources outside passenger and luggage compartments.[13]

B. IPXXB protection degree for service disconnects that can be opened or removed without tools.[14]

C. Markings on certain electrical protection barriers of high voltage sources (*i.e.,* barriers that can be physically accessed, opened, or removed without the use of tools) and on or near electric energy storage devices. As to the latter, the NPRM also proposed to require markings on or near electric energy conversion devices (fuel cells), but the agency concludes conversion devices are benign in and of themselves in that they are not high density energy sources. Thus, conversion devices do not need to be marked. (Note that the electric protection barrier around a fuel cell is required to be marked.) In another change from the NPRM, markings are not required on electrical connectors and on the vehicle charge inlet [15] because of a lack of a need for the markings.

D. In a change from the NPRM, this rule has distinct direct contact protection requirements for connectors and the vehicle charge inlet. First, it requires that the IPXXB/IPXXD protection levels be met by each connector when connected to its mating component. IPXXD protection degree is required for connectors located inside the passenger and luggage compartments. IPXXB protection degree is required for connectors and vehicle charge inlets located outside these compartments. Second, connectors must meet at least one of the following three requirements: (1) If a connector or vehicle charge inlet can be separated from its mating component without the use of tools, the IPXXB/IPXXD protection level must be provided when the connector is uncoupled from its mating component; (2) if a connector or vehicle charge inlet can be separated from its mating component without the use of tools, the voltage of live parts of the connector or vehicle charge inlet becomes less than or equal to 60 VDC or 30 VAC within one second of separating from its mating component; or, (3) the connector has a locking mechanism (at least two distinct actions are needed to separate the connector from its mating component), and there are other components that must be removed to separate the connector from its mating component and these cannot be removed without the use of tools.

E. This rule requires orange color outer coverings for cables of high voltage sources that are located outside electrical protection barriers.

ii. Indirect Contact Protection From High Voltage Sources

This rule requires exposed conductive parts of electrical protection barriers to be conductively connected to the chassis with a resistance less than 0.1 ohms, and the resistance between two simultaneously reachable exposed conductive parts of electrical protection barriers that are within 2.5 meters of each other must be less than 0.2 ohms.[16]

iii. Electrical Isolation of High Voltage Sources

A. This rule requires 500 ohms/volt or higher electrical isolation for AC high voltage sources and 100 ohms/volt or higher for DC high voltage sources.

B. Where AC and DC buses are connected, this rule permits AC high voltage sources to have electrical isolation of 100 ohms/volt or higher, provided they also have the direct and indirect contact protection described in i and ii, above.

iv. Monitoring Systems

This rule requires an electrical isolation monitoring system for DC high voltage sources on fuel cell vehicles.

of these scenarios. Battelle's evaluation noted that multiple failures in protection measures were needed for a person to experience electric shock. The final report is available at *https://www.regulations.gov/document?D=NHTSA-2016-0029-0003.*

[11] SAE J1766, ''Recommended practice for electric, fuel cell, and hybrid electric vehicle crash integrity testing,'' January 2014, SAE International, *http://www.sae.org.*

[12] In November 2011, the Executive Committee of the 1998 Agreement established a working group to develop a GTR for electric vehicle safety. The United States is a co-chair of this working group, along with the European Union, Japan, and China. *See,* draft Global Technical Regulation on Electric Vehicle Safety, September 2016. *https://www2.unece.org/wiki/display/trans/EVS+12th+session.*

[13] IPXXB and IPXXD ''protection degrees'' refer to the ability of the physical barriers to prevent entrance of a probe into the barrier, to ensure no direct contact with high voltage sources. ''IPXXB'' is a probe representing a small human finger. ''IPXXD'' is a slender wire probe. Protection degrees IPXXB and IPXXD are International Electrotechnical Commission specifications for protection from direct contact of high voltage sources.

[14] A service disconnect is a device for deactivation of an electrical circuit when conducting checks and services of the electric battery, fuel cell stack, or other high voltage source.

[15] The vehicle charge inlet is the device on the electric vehicle into which the charge connector is inserted for the purpose of transferring energy and exchanging information from an external electric power supply.

[16] This ensures that in the event of loss in electrical isolation, no dangerous voltage potentials are produced between exposed conductive parts of electrical protection barriers and the electrical chassis, and therefore very low levels of current would flow through a human body contacting different parts of the vehicle. Since current flows through the path of least resistance, most of the current flow will be through the chassis than through the human body which has a significantly higher resistance.

v. Electrical Safety During Charging

This final rule requires:

A. Electrical isolation greater than or equal to 500 ohms/volt between the electrical chassis and other high voltage sources connected to the vehicle charge inlet (for connecting to the AC external power supply). Note that this is a change from the 1 million ohms isolation resistance requirement proposed in the NPRM.

B. IPXXB/IPXXD protection level for the vehicle charge inlet when connected to the charge connector and IPXXB/IPXXD protection level or low voltage when separated from the charge connector.

C. Conductive connection of the electric chassis to earth ground before and during the application of exterior voltage to the vehicle.[17]

vi. Mitigating Driver Error

This final rule includes requirements for—

A. Providing at least a momentary indication to the driver when the vehicle is first placed in ''possible active driving mode'' after manual activation of the propulsion system.[18] This is a change from the NPRM to clarify when the momentary indication must be provided.

B. Informing the driver if the vehicle is still in a possible active driving mode,[19] by an audible or visual signal when he or she leaves the vehicle; and,

C. Preventing vehicle movement of more than 150 millimeters (mm) by its own propulsion system when the vehicle charging system is connected to the external electric power supply in such a way that charging is possible. (The 150 mm limit is a change from the NPRM, which did not specify a distance.)

2. Post-Crash Safety

This final rule also amends FMVSS No. 305's post-crash electrical safety requirements.

i. Direct and Indirect Contact Protection From High Voltage Sources

The rule adds an optional method of meeting post-crash electrical safety requirements through physical barrier protection of high voltage sources. The specifications of this optional method of electric safety include requirements ensuring that:

A. High voltage sources are enclosed in barriers that prevent direct human contact with high voltage sources (IPXXB protection level),

B. Exposed conductive parts of electrical protection barriers are conductively connected to the chassis with a resistance less than 0.1 ohms. The resistance between any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other must be less than 0.2 ohms.

C. Voltage between exposed conductive parts of an electrical protection barrier and the electrical chassis, and between two simultaneously reachable exposed conductive parts of the electrical protection barrier that are less than 2.5 meters from each other, must be less than or equal to 60 VDC or 30 VAC (low voltage). (The NPRM was worded to apply this requirement to voltage between any exposed conductive parts of the vehicle.)

ii. Electrical Isolation

An AC high voltage source that is conductively connected to a DC high voltage source may meet an electrical isolation requirement of 100 ohms/volt or greater, provided the AC high voltage source also has physical barrier protection specified in i(A) and i(B), above.[20] (The NPRM had proposed requiring all three elements i(A), i(B), and i(C) of physical barrier protection for such AC high voltage sources.)

3. Definitions, Figures, and Test Procedures

We make minor changes to a number of proposed definitions to clarify the standard and to achieve consistency with other definitions. We adopt terms such as ''high voltage live parts,'' ''exposed conductive parts of electrical protection barriers,'' and ''possible active driving mode'' in place of proposed terms that were less clear.

We make a minor correction to Figure 7b and clarify Figure 8.

We clarify several test procedures, including how we will use the IPXXB and IPXXD protection degree probes and how we determine the voltage between various conductive parts. We provide manufacturers the option of choosing between two methods for measuring resistance, and, in a change from the NPRM, provide that resistance between two exposed conductive parts of the electrical protection barrier may be computed from measured resistances.

4. Compliance Date

The compliance date for this final rule is one year from the date of publication of the final rule in the **Federal Register**. Optional early compliance is permitted. (The NPRM proposed a compliance date of 180 days after the publication of the final rule in the **Federal Register**.)

II. Background

a. Overview of the GTR Process

The United States is a contracting party to the 1998 Agreement, which was entered into force in 2000 and is administered by the UN ECE's Working Party (WP).29. The purpose of this agreement is to establish GTRs.

GTR No. 13 addresses hydrogen fuel cell vehicle technology. NHTSA closely collaborated with experts from contracting parties to the 1998 Agreement, particularly Germany and Japan, to develop a GTR for hydrogen fueled vehicles that establishes levels of safety that are equivalent to or exceeds those for conventional gasoline fueled vehicles. The collaborative effort in this process led to the establishment of GTR No. 13 in June 2013.

The U.S. voted on June 27, 2013 in favor of establishing GTR No. 13. In voting yes to establishing the GTR, NHTSA is obligated to submit the technical regulation to the process used in the U.S. to adopt the requirement into our law or regulation.[21] By issuance of the March 10, 2016 NPRM preceding this final rule, NHTSA initiated the process for considering adoption of GTR No. 13.

This final rule addresses the electrical safety requirements in GTR No. 13 (*i.e.,* the electrical isolation requirements, physical barrier requirements, etc.) and not GTR No. 13's hydrogen fuel system and fuel container integrity requirements. NHTSA will commence a

[17] Current will flow through the path of least resistance and therefore most of the current resulting from a loss of electrical isolation would flow through the ground connection rather than through the human body.

[18] Vehicles with an internal combustion engine that directly or indirectly provides the vehicle's propulsion power on start up are excluded from this requirement.

[19] I.e., the vehicle mode when application of pressure to the accelerator pedal or release of the brake system causes the electric power train to move the vehicle.

[20] I.e., they provide IPXXB protection degree and indirect contact protection of resistance between exposed conductive parts of the electrical protection barrier and electric chassis of 0.1 ohms and between two simultaneously reachable exposed conductive parts within 2.5 meters of each other of 0.2 ohms.

[21] As noted above, under the terms of the 1998 Agreement, NHTSA is not obligated to adopt the GTR after initiating this process. In deciding whether to adopt a GTR as an FMVSS, we follow the requirements for NHTSA rulemaking, including the Administrative Procedure Act, the National Highway and Motor Vehicle Safety Act (Vehicle Safety Act) (49 U.S.C. 30101 *et seq.*) Presidential Executive Orders, and DOT and NHTSA policies, procedures and regulations. Among other things, FMVSSs issued under the Vehicle Safety Act ''shall be practicable, meet the need for motor vehicle safety, and be stated in objective terms.'' 49 U.S.C. 30111.

separate proceeding on incorporating the latter portions of GTR No. 13 into the relevant FMVSSs.

b. Overview of GTR No. 13

HFCVs have an electric drive-train powered by a fuel cell that generates electric power electrochemically using hydrogen. The hydrogen is electrochemically combined with oxygen (from air) within the fuel cell system to produce high-voltage electric power. The electric power is supplied to the electric drive motors and/or used to charge batteries and capacitors. HFCVs may also be equipped with batteries to supplement the output of fuel cells and may also recapture energy during stopping through regenerative braking, which recharges batteries and thereby improves efficiency.

The fuel cell provides DC power while the drive motors typically operate on AC. Therefore, the power train has: (a) Inverters to convert DC power to AC to run the motors and (b) converters to convert AC power generated in the drive motor during regenerative braking to DC to store energy in the batteries. In many respects, the electric power train of an HFCV is like that of electric and hybrid electric vehicles.

GTR No. 13 specifies electrical safety requirements during normal vehicle operation and after a crash test, to protect against electric shock in the event of a failure in the high voltage propulsion system. GTR No. 13 includes a compliance option for electrical vehicle safety that prevents direct and indirect contact of high voltage sources by way of ''physical barriers.'' [22]

c. Physical Barrier Option

The industry has long requested NHTSA to adopt a physical barrier option into FMVSS No. 305. In 2010, NHTSA decided against adoption of a physical barrier option because the agency believed not enough was known about the option.[23] Commenters to an NPRM to upgrade FMVSS No. 305's electrical shock protection requirements had asked NHTSA to adopt the option in the final rule. NHTSA declined the request,[24] explaining that (a) sufficient notice might not have been provided for the provision, (b) the agency was uncertain whether the option would sufficiently account for indirect contact failure modes, and (c) the agency wished to pursue research on this safety approach. NHTSA undertook a research program (later known as the Battelle study, discussed in detail in the NPRM, 81 FR at 12656–12659) to better understand the issues related to a physical barrier option for electrical safety.

Since that decision in 2010, several milestones ensued. GTR No. 13 was established, a product of shared data and knowledge from governing bodies and international experts around the world. The Battelle study was completed and the physical barrier countermeasure design was made more robust in response to its findings, with SAE International revising SAE J1766 in January 2014 to set forth more protective safety practices than it had before. Importantly, there have now been years of worldwide recognition of the physical barrier option as an acceptable means of providing electrical safety in electric powered vehicles, with years of experience in design labs and in the field showing no evidence of associated safety problems.

d. Petitions for Rulemaking

This final rule responds not only to GTR No. 13 but also to petitions for rulemaking from Toyota and the Alliance. The petitions are discussed in detail in the March 10, 2016 NPRM. See 81 FR at 12659–12663.

Petitioner Toyota believes that an additional compliance option that includes elements of the physical barrier option in GTR No. 13 is needed to allow HFCVs to be offered for sale in the U.S.

HFCVs and other electric powered vehicles operate with their DC high voltage sources (*e.g.* high voltage battery) connected to the AC high voltage sources (*e.g.* electric motor). In a moderate to severe crash (*e.g.,* crash speeds at which an air bag would deploy), electric powered vehicles are generally designed with an automatic disconnect mechanism that activates and breaks the conductive link between the electrical energy storage system and the rest of the power train. Under these crash conditions in which an automatic disconnect mechanism activates, Toyota states that its HFCVs would be able to meet the current electrical safety requirements of FMVSS No. 305. However, in low speed crashes where the automatic disconnect mechanism is not designed to activate—so that the vehicle can be driven away after a minor crash (fender-bender)—Toyota states that its HFCVs would not be able to meet the electrical safety requirements in FMVSS No. 305. The electrical isolation for fuel cell stacks would need to be 500 ohms/volt or greater to comply with FMVSS No. 305, which may not be technically feasible. The petitioner believes that the additional compliance option requested in its petition would solve this problem and would not cause any reduction in the level of electrical safety now required by FMVSS No. 305.

Petitioner Alliance requests a physical barrier compliance option to facilitate the production of 48-volt mild hybrid technologies as well as hydrogen fuel cell vehicles. The petitioner asks NHTSA to amend FMVSS No. 305 to adopt a physical barrier option incorporated in the SAE J1766 January 2014,[25] section 5.3.4, for 48-volt mild hybrid systems. The Alliance believes that the provisions for physical barriers in section 5.3.4 incorporate the requirements of GTR No. 13 and provide for physical barriers that ensure equal levels of safety as that afforded by the current FMVSS No. 305 electrical safety requirements.

The Alliance states that while vehicles with 48-volt mild hybrid systems use mostly low-voltage components that do not present any danger of harmful electric shock, AC voltage sources contained within the system can exceed the 30 volt threshold in FMVSS No. 305 for consideration as a high voltage source. Since these systems are grounded to the vehicle chassis, they cannot meet FMVSS No. 305's existing electrical isolation option. The petitioner states that, while it is feasible to design a 48-volt mild hybrid system that is isolated from the chassis and meets FMVSS No. 305's electrical isolation requirements, such designs involve more complexity, higher consumer costs, and higher mass resulting in reduced fuel economy and increased emissions. The petitioner believes that these consequences are inappropriate when there would be no incremental safety benefit gained beyond that associated with SAE J1766's physical barrier option.

III. Overview of the Comments

NHTSA received six comments on the NPRM. Comments were received from two motor vehicle manufacturer associations (the Alliance and the Association of Global Automakers (Global)), three vehicle manufacturers (Mercedes-Benz USA LLC (Mercedes-Benz), Tesla Motors Inc. (Tesla), and Fuji Heavy Industries on behalf of Subaru of America Inc. (Subaru)), and one individual.

The commenters strongly support that FMVSS No. 305 should include

[22] A detailed description of GTR No. 13 can be found in the NPRM. See 81 FR at 12651–12654.

[23] See final rule, 75 FR 33515, June 14, 2010; response to petitions for reconsideration, 76 FR 45436, July 29, 2011.

[24] *Id.*

[25] SAE J1766, ''Recommended practice for electric, fuel cell, and hybrid electric vehicle crash integrity testing,'' January 2014, SAE International, *http://www.sae.org.*

requirements for normal vehicle operation and incorporate a physical barrier option for electrical safety. They request changes to the proposed regulatory text to improve clarity of or correct wording and to align the regulatory language, including definitions, to that in GTR No. 13 and ECE R.100. Some commenters suggest NHTSA not adopt or reduce the stringency of particular requirements for lack of safety need, such as the marking of connectors and the vehicle charge inlet, and a ''one million ohms'' isolation requirement for charging electrical energy storage devices. Several commenters suggest NHTSA adopt separate performance requirements for connectors and for the vehicle inlet, that include direct contact protection when connected and separated from its mating component. Some commenters request NHTSA change how the agency will conduct compliance tests, such as by limiting the number of resistance and voltage measurements between exposed conductive parts. Several commenters request the compliance date for the amendments be longer than 180 days.

IV. Response to the Comments

a. Definitions and Terminology (General)

Commenters request modifications to certain definitions and terms generally used in the regulatory text. The Alliance believes that the definition of ''exposed conductive part'' should be revised to clarify that the part is not normally energized (that energization can occur under a fault condition). The Alliance also requests replacing the term, ''exposed conductive parts'' in the regulatory text with ''exposed conductive parts of electrical protection barriers,'' so as to exclude conductive parts that are not part of the electrical protection barriers and the electric power train, such as hose clamps. Similarly, Global suggests the term be replaced with ''exposed conductive part of the electrical protection barrier enclosing the high voltage source,'' throughout the regulatory text. Commenters suggest ''electrical barriers,'' should be replaced with ''electrical protection barriers,'' in the regulatory text for consistency and to reduce ambiguity. The Alliance requests a broadened definition for ''external electric power supply,'' to refer to ''electric energy storage device,'' in part because the proposed definition uses the term ''propulsion battery,'' which is not defined. The Alliance requests replacing the term, ''live parts'' with ''high voltage live parts'' in the regulatory text since electrical safety requirements apply to high voltage sources.

NHTSA reviewed these comments and generally agrees with revising the definitions and terms at issue, to clarify the text of FMVSS No. 305. We summarized our decisions in Table 1 and have incorporated appropriate changes into the regulatory text.

The Alliance asks that we amend the definition of ''high voltage source'' to make clear that a component is a high voltage source based on its working voltage. The current definition states: ''*High voltage source* means any electric component contained in the electric power train or conductively connected to the electric power train that has a working voltage greater than 30 VAC or 60 VDC.'' The commenter states that the definition can be read in two different ways because ''it is not clear if the *component* or the electric *power train* is being modified by the given voltage limits.'' (Emphasis in text.) NHTSA's intent was to modify the ''component.'' [26] We have clarified the definition in the regulatory text.

The Alliance and Global point out that the definition of luggage compartment mistakenly refers to ''protecting the power train'' instead of ''protecting the occupant.'' We note that the definition's reference to ''hood'' should also refer to ''trunk lid,'' as in the U.S. luggage compartments are usually thought of as trunks, which are thought to have ''trunk lids.'' We have made the corrections in the text.

The Alliance requests adding a definition for the term ''connector,'' assuming NHTSA will adopt separate electrical safety requirements for connectors (this issue is discussed in a section below). The Alliance states that a connector is a device that provides mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing. Since this final rule adopts such separate requirements for connectors, the agency agrees to add a definition for ''connector'' to the regulatory text.

The Alliance states that ''electric energy storage device'' in proposed S5.4.3.2 is too specific and thereby restrictive, and that ''electric circuit'' should be used instead. We concur the proposed term is overly specific, but since ''electric circuit'' is not used or defined in FMVSS No. 305, we will use ''electric component'' in place of the term at issue.[27]

Subaru requests clarification of the meaning of the term ''normal vehicle operation.'' Subaru asks whether the term refers to anytime the vehicle is being driven under its own power or to any vehicle operation when no system faults or abnormalities are present. Subaru asks whether the reference to normal vehicle operation in the definition of the term, ''live parts,'' [28] includes the vehicle's driving under its own electric power and static charging modes.

NHTSA believes that ''normal vehicle operation'' includes operating modes and conditions that can reasonably be encountered during typical operation of the vehicle, such as driving, parking and standing in traffic, as well as, charging using chargers that are compatible with the specific charging ports installed on the vehicle. It does not include conditions where the vehicle is damaged, either by a crash or road debris, subjected to fire or water submersion, or in a state where service and or maintenance is needed or being performed.

The Alliance, Global and Subaru ask about adding a definition for an ''enclosure,'' since in the NPRM the agency used the term ''enclosure'' as though an enclosure was distinct from an electrical protection barrier. We meant the terms to be synonymous. However, rather than add the definition, for simplicity we have removed the term ''enclosure'' from the standard and only use the term ''electrical protection barrier.''

For the convenience of the reader, Table 1 below shows the notable added and revised terms.

[26] In FMVSS No. 305, an electric component that is contained in the electric power train or is conductively connected to it is considered to be a high voltage source if its working voltage is greater than 30 VAC or 60 VDC. Working voltage is defined in FMVSS No. 305 as the highest root mean square voltage of the voltage source, which may occur across its terminals or between its terminals and any conductive parts in open circuit conditions or under normal operating conditions. Therefore, the reference to working voltage in the definition of ''high voltage source'' in FMVSS No. 305 is that for the electrical component and not the power train.

[27] The term, ''electric component,'' is currently used in the definition of a ''high voltage source'' in FMVSS No. 305.

[28] The NPRM proposed to define live part to mean a conductive part of the vehicle that is electrically energized under normal vehicle operation (S4).

TABLE 1—NOTABLE TERMS AND DEFINITIONS THE COMMENTERS ASK TO BE ADDED OR AMENDED; NHTSA RESPONSE

Term at issue	Requested change	Reason for request	Does NHTSA agree	NHTSA response
Connector	NHTSA should define the term [29]	Clarity; enables distinct requirements for "connectors".	Yes	Defining the term will clarify the standard.
Electrical barriers	Use "electrical protection barriers"	Consistency and reduces ambiguity	Yes	NHTSA agrees the same term should be used throughout the standard.
Electrical protection barrier.	Change the NPRM's definition to make clear the term includes "enclosures".	Clarity	No	See "enclosure" (below). The change is unnecessary.
Enclosure	NHTSA should define the term	This term should be defined since it is used several times.	No, the change is unnecessary.	Revised the text to remove references to "enclosure" and use electrical protection barrier instead.
Exposed conductive part.	Add to the NPRM's definition to clarify that the part is not normally energized; Use "exposed conductive part of the electrical protection barrier" [30].	Clarify that the part is not normally energized; energization can occur under fault condition. This also excludes conductive parts that are not part of the electric power train, such as hose clamps.	Yes	NHTSA concurs, to clarify the standard. Also, we clarify the term "cover" in the definition. NHTSA agrees to replace "exposed conductive part," with "exposed conductive part of the electrical protection barrier," in the standard.
External electric power supply.	Revise definition to refer to "electric energy storage device" rather than to "propulsion battery".	To improve accuracy of the definition	Yes	The change clarifies the standard.
High voltage source	Revise definition as "means any electric component which is contained in the electric power train or conductively connected to the electric power train and has a working voltage greater than 30 VAC or 60 VDC".	Should make clearer what is being modified.	Yes	We agree the change clarifies the standard.
Live parts	Use "High voltage live parts"	To clarify the applicability of the term	Yes	Clarifies the standard.
Luggage compartment.	Correct the reference to "power train"	Correction	Yes	We correct the error, and add "trunk lid."
Normal vehicle operation.	NHTSA should clarify the term	To clarify if it includes driving and charging modes.	Yes	We clarify the term in the preamble.
Electric energy storage device (specific to. S5.4.3.2)	Use "electric circuit"	Term is too specific and restrictive	Yes, but use "electric component".	"Electric circuit" is not defined.

b. Clarification of Application of Requirements

The Alliance requests we add paragraphs to the regulatory text explicitly stating that the electrical safety requirements (S5.3) and the monitoring system requirement (S5.4) of FMVSS No. 305 do not apply to the DC part of a 48-volt mild hybrid system. (This pertains to the DC part that is conductively connected to the electrical chassis and that has a working voltage less than or equal to 60 VDC, and the maximum voltage between the DC live part and any other live part is less than or equal to 30 VAC or 60 VDC.) The commenter states that the draft EVS–GTR includes such a statement.

We do not believe there is a need for such a provision in FMVSS No. 305, for several reasons.

First, as discussed in a previous section, we are amending the definition of "high voltage source," as the Alliance requests, to make clear that a component is a high voltage source based on its working voltage. That change provides the clarification the commenter seeks.

Second, the Alliance asks that NHTSA provide in the preamble the following statement for further clarification. The commenter's statement is: "Where electrical circuits, that are galvanically connected to each other, and fulfilling the condition, that the maximum voltage between a DC live part and any other live part (DC or AC) is less [than] or equal [to] 30 VAC and 60 VDC, only the components or parts of the electric circuit that operate on high voltage are classified as high voltage sources." We concur that the statement is consistent with NHTSA's intent.

Third, the agency does not believe the above-quoted text is needed in FMVSS No. 305 because of a fundamental difference between the standard and the draft EVS–GTR. (This difference also exists between FMVSS No. 305 and GTR No. 13 and ECE R.100.) The electrical safety requirements in FMVSS No. 305 apply to each high voltage source in the power train, while the electrical safety requirements in the draft EVS–GTR would apply to high voltage buses and electric circuits. This means that NHTSA determines whether the electrical safety requirements of FMVSS No. 305 apply to electric components that are connected to or part of the electric power train by individually assessing each component separately, analyzing its working voltage.[31] To illustrate, in a 48-volt mild hybrid system, NHTSA will assess the working voltage of each DC component. If the working voltage of the component is not greater than 60 VDC, NHTSA does not subject it to the electrical safety requirements in FMVSS No. 305, regardless of whether it is galvanically connected to other electrical components that would be considered high voltage sources.[32] Accordingly, the

[29] The Alliance suggests "a connector is a device that provides mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing." This definition was suggested by the Alliance and added in the draft EVS–GTR available at *https://www2.unece.org/wiki/display/trans/EVS+13th+session.*

[30] Similar to the Alliance's request, Global requests replacing "exposed conductive part" with "exposed conductive part of the electrical protection barrier enclosing the high voltage source" in the regulatory text. Due to the similarity with the Alliance's request and because there is no need to specify that electrical protection barriers enclose high voltage sources, Global's request was not adopted in the final rule.

[31] Working voltage is defined in FMVSS No. 305 as the highest root mean square voltage of the voltage source which may occur across its terminals or between its terminals and any conductive part in open circuit conditions or under normal operating systems.

[32] In contrast, the draft EVS–GTR applies to high voltage buses and electric circuits. In a 48-volt mild hybrid system, the DC electrical sources are low voltage (working voltage is less than or equal to 60

Continued

additional text for excluding the DC part of 48-volt mild hybrid systems from electrical safety requirements requested by the Alliance is not necessary in FMVSS No. 305.

c. Electrical Safety for Connectors and the Vehicle Charge Inlet

GTR No. 13 specifies direct contact protection requirements for high voltage connectors separately. Per GTR No. 13, connectors do not need to meet IPXXB protection if they are located underneath the vehicle floor and are provided with a locking mechanism, or require the use of tools to separate the connector, or the voltage reduces to below 30 VAC or 60 VDC within one second after the connector is separated.

In the NPRM, NHTSA expressed disagreement with the GTR's exclusion of connectors under the floor. (*See* 81 FR at 12654–12655; *id.* at 12664.) NHTSA believed that if connectors are high voltage sources and if they can be accessed, opened, or removed without the use of tools, regardless of whether they are located under the floor, they should be required to meet the same requirements for direct contact protection as other high voltage sources, including barriers providing protection degree IPXXD or IPXXB, based on whether they are located inside or outside the passenger or luggage compartment areas, respectively. Additionally, the agency noted that ''vehicle floor'' and ''connector'' are not defined in GTR No. 13.

Comments Received

The agency received several comments on this issue. The Alliance and Global request the regulatory text include a separate section setting forth direct contact protection requirements that connectors and the vehicle charge inlet must meet. The Alliance suggests the following definition for ''connector'': ''A connector is a device that provides mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing.'' [33]

The Alliance and Global suggest that the separate section specify that connectors and the vehicle charge inlet must provide protection degree IPXXD or IPXXB, as appropriate, when connected to its mating component. Further, each connector or vehicle charge inlet must also meet one of the following: (1) It must provide, in an uncoupled state, protection degree IPXXD or IPXXB, as appropriate, if the connector or vehicle charge inlet can be uncoupled from its mating component without a tool; (2) the voltage of the live parts become equal to or less than 60 VDC or 30 VAC within 1 second after separating from its mating component; or (3) it has a locking mechanism that prevents the connector or vehicle charge inlet from being uncoupled from its mating component without a tool.

In its comment, Tesla asks NHTSA to confirm whether various scenarios involving its connectors underneath the floor of its vehicles would meet the proposed requirements.[34] Tesla requests that NHTSA clarify what we consider ''acceptable'' for connectors underneath the floor.[35]

Agency Response

NHTSA has reviewed the comments and agrees with the recommendations to include separate requirements for direct contact protection of connectors and vehicle charge inlets. In drafting the NPRM, we determined that connectors were high voltage sources and that they should meet all the requirements for high voltage sources. However, the commenters provide more information about connectors, pointing out that they connect high voltage cables to high voltage sources through a mating component. Like high voltage conductors (cables), connectors need to have direct contact protection. But, commenters point out, connectors are unique in that they are designed to be disconnected from their mating component. Therefore, additional safety provisions are required to ensure the safety of this coupling and re-coupling design mechanism. For this reason, we have decided there is a need to specify unique safety provisions for connectors and vehicle charge inlets.

We have based our final rule on the requirements suggested by the Alliance and Global. The requirements are harmonized with GTR No. 13, ECE R.100, and the draft EVS–GTR for electric vehicles. When a connector is connected to its mating component, it should have direct contact protection IPXXD or IPXXB based on whether the connector is inside or outside the passenger or luggage compartment, respectively. Additionally, connectors are required to meet at least one of the three following requirements: (1) It must provide protection degree IPXXD or IPXXB, as appropriate, in the uncoupled state, if the connector or vehicle charge inlet can be uncoupled from its mating component without a tool; (2) the voltage of the high voltage live parts become equal to or less than 60 VDC or 30 VAC within 1 second after separating from its mating component; or (3) it has a locking mechanism (at least two distinct actions are needed to separate the connector from its mating component) [36] and there are other components that must be removed in order to separate the connector from its mating component and these cannot be removed without the use of tools.

Regarding Tesla's recommendation that we incorporate Table 4 of ISO 6469–3 for connectors, we believe there is no need for such an amendment. ISO 6469–3 was revised in 2011 and its requirements for connectors are similar to those in this final rule.[37]

Regarding Tesla's inquiry about connectors underneath the floor, connectors and electrical protection barriers located under the vehicle's floor are treated the same as other connectors and electrical protection barriers located outside of the passenger and luggage compartments.[38] A connector located

VDC). The DC high voltage sources are conductively connected to AC electrical components such as the motor than can be a high voltage source (working voltage is greater than 30 VAC). Since the EVS draft GTR applies to high voltage buses and circuits, the electrical safety requirements for the high voltage source in a 48-volt system would also apply to the DC source though it is considered low voltage. For this reason, specific statements are needed in the EVS GTR to exclude these low voltage sources from electrical safety requirements that are intended for high voltage sources.

[33] This definition was added in the draft EVS–GTR available at *https://www2.unece.org/wiki/display/trans/EVS+13th+session.*

[34] Tesla indicates that the high voltage source in its vehicles is located underneath the vehicle's floor, in the form of a battery. The commenter states this is unlike hybrid-electric vehicles, in which the high voltage source is located in or near the vehicle trunk.

[35] While the commenter suggested incorporating Table 4 of ISO 6439–3, it later corrected that it meant to refer to the 2001 version of ISO 6469–3.

[36] Locking mechanisms on connectors are intended to prevent inadvertent disconnection of the connector from its mating component. Locking mechanism designs include locking levers and screw locking. In these types of locking mechanisms, two distinct actions are needed to uncouple the connector. For a locking lever, the lever would need to be pressed down and then the connector pulled out. For screw locking, the connector would need to be unscrewed and then pulled out.

[37] The requirements for connectors in GTR No. 13, ECE R.100, and the draft EVS–GTR are also consistent with the 2011 revision of ISO 6469–3.

[38] In the NPRM, NHTSA noted that electrical protection barriers and connectors located under the vehicle floor should not be excluded from IPXXB direct contact protection and marking requirements because it is possible that the high voltage sources enclosed by these barriers and connectors may be accessed following a rollover crash or during vehicle maintenance. 81 FR at 12654–12655. The agency stated in the NPRM that if connectors and electrical protection barriers located under the vehicle floor can be accessed, opened, or removed without the use of tools they should be required to meet the same requirements for high voltage markings and direct contact protection as electric protection barriers and connectors not located under the vehicle floor. *Id.*

under the floor that has IPXXB protection level and that cannot be separated from its mating component without tools would comply with the above direct contact protection requirements for connectors. (If it can be separated from its mating component without tools, it must provide protection degree IPXXB in the uncoupled state or the live parts must be equal to or less than 60 VDC or 30 VAC within 1 second from separating from its mating component). Regarding a connector located under the vehicle's floor where the access point to the connector is smaller than a finger could fit through, the connector would need to meet IPXXB protection degree if parts surrounding the connector (that limit access to the connector) can be opened, disassembled or removed without the use of tools.[39]

d. Markings

NHTSA proposed marking requirements (yellow high voltage symbol) on or near electric energy storage/conversion devices, and on electrical protection barriers in general. We proposed that the markings would not be required for electrical protection barriers that cannot be physically accessed, opened, or removed without the use of tools. The proposed provisions were based on GTR No. 13 requirements, but unlike GTR No. 13, the NPRM did not exclude from the marking requirement (1) electrical protection barriers or high voltage sources located under the vehicle floor; (2) connectors generally; or (3) the vehicle charge inlet. NHTSA also proposed that cables for high voltage sources that are not located within electrical protection barriers must be identified by an orange colored outer covering.

Comments Received

The agency received multiple comments on this issue.

The Alliance, Global and Subaru request that connectors be excluded from the marking requirement. The Alliance and Global state that some connectors can be so small that the markings on these connectors would be not easily read and that high voltage cables going into the connectors are required to have orange outer covers, which should signal that the cables and their connectors are high voltage. The Alliance also notes that high voltage connectors do not necessarily carry high current. The Alliance states that the inclusion of a marking requirement for connecters would necessitate product development efforts, increased economic cost and compliance burden, without a commensurate increase in safety.

Subaru believes that markings should not be necessary on or near electric storage/conversion devices which are not in plain view of vehicle occupants during normal vehicle operation. Subaru states that a device that is mounted under a seat, and that is not visible without first removing the seat, should not have to be marked.

Tesla believes that high voltage sources underneath the vehicle are subject to a harsh physical environment, and that the markings on them are not likely to survive the vehicle's life. Tesla asks NHTSA to allow for alternative placement of high voltage markings when a vehicle's high voltage source is located under the vehicle's floor.

Agency Response

The agency agrees with the Alliance and Global request to exclude connectors from requiring markings. The agency is persuaded by the commenters that connectors do not necessarily carry high current and that the increased economic cost and compliance burden resulting from a marking requirement are not warranted. The connectors are small, so markings on them would not be easily read. Further, we agree that since high voltage cables going into the connectors are required to have orange outer covers, those covers will sufficiently indicate that the cables and their connectors are high voltage. Importantly, the markings are also not needed because, in a change from the NPRM, we have decided to require connectors to have direct contact protection when connected and disconnected from their mating component. (As discussed above, the direct contact protection consists of IPXXD or IPXXB protection when connected to the mating component, and at least one of the following: (1) IPXXD or IPXXB protection when separated from its mating component if the connector can be uncoupled without a tool; (2) a low voltage requirement within 1 second after separation from its mating component; or (3) it cannot be uncoupled from its mating component without the use of tools. Thus, we conclude that connectors will sufficiently protect against the risk of electrical shock without the markings.

Similarly, the agency also agrees with the Alliance and Global request to exclude the vehicle charge inlet from requiring markings. The markings are not necessary because this final rule requires vehicle charge inlets to have direct contact protection when connected and disconnected from their mating component, like connectors.

The agency does not agree with Subaru's request to omit the high voltage marking on electric energy storage/conversion[40] devices that are not in plain view of vehicle occupants during normal vehicle operation. GTR No. 13, ECE R.100, and the draft EVS–GTR require the high voltage symbol on or near electric energy storage devices. Since an electric energy storage device is a high density energy source, we believe there is a safety need for the marking, as persons (such as maintenance, repair and rescue personnel and consumers working on their vehicles) encountering the electric energy storage device should be warned of the electrical shock risks. However, we are revising the proposed regulatory text to indicate that the marking on electric energy storage devices ''shall be present'' rather than ''shall be visible.'' This terminology is consistent with the draft EVS–GTR. The final rule's wording (''shall be present'') acknowledges that the marking is not, and does not have to be, ''visible'' on an electric energy storage device when the device is located under the floor away from view.

Thus, under this final rule, the electric energy storage device must be marked, and the electrical protection barrier for the device must also be marked with a visible high voltage symbol if it can be accessed, opened, and removed without the use of tools. To illustrate, if an electric energy storage device is accessible when the floor mat is pulled out and a floor panel is opened (without the use of tools), the floor panel has to have a high voltage symbol that is visible to the person when he/she pulls out the floor mat.

NHTSA has decided not to require electric energy conversion devices to be marked with the high voltage symbol. Electric energy conversion devices include fuel cells which convert chemical energy to electric energy. A fuel cell only becomes a high voltage source when hydrogen is supplied to it. Since conversion devices (*e.g.,* fuel cells) are not high density energy sources, we are not requiring them to be

[39] The test method to evaluate protection from direct contact with high voltage sources (S9.1) specifies that before assessing IPXXB or IPXXD protection degree for high voltage components, parts surrounding the high voltage source are opened, disassembled, or removed without the use of tools.

[40] We do not agree with the idea of excluding a device from the marking requirements simply because the device is not in plain view of the occupants. However, as discussed further below, we are omitting the marking requirement generally for electric energy conversion devices. The rest of this response to Subaru pertains to marking electric energy storage devices.

marked. However, the electric protection barrier around a conversion device (*e.g.,* fuel cell) will have to be marked, and the mark is required to be visible.

NHTSA does not agree with Tesla's request to allow alternative positions for the high voltage symbol mark on high voltage sources that are located underneath the vehicle's floor. We do not believe there is a need for the change as the regulatory text requires that the mark be ''on or near'' electric energy storage devices without providing specifics for the location of the high voltage marking. We note also that this final rule provides that electrical protection barriers that cannot be physically accessed, opened, or removed without the use of tools are excluded from the marking requirement,[41] which may bear on Tesla's labeling of its devices.

e. Indirect Contact Protection

Exposed conductive parts of electrical protection barriers must be protected against indirect contact[42] during normal vehicle operation and post-crash. The NPRM proposed that the resistance between exposed conductive parts of electrical protection barriers and the electrical chassis must be less than 0.1 ohms and that the resistance between any two simultaneously reachable exposed conductive parts of electrical protection barriers that are within 2.5 meters of each other be less than 0.2 ohms (proposed S5.3(c)(2)). The NPRM also proposed (S5.3(c)(3)) that the voltages between an electrical protection barrier and other exposed conductive parts must be less than or equal to 30 VAC or 60 VDC (''low voltage requirement''). These proposed requirements would protect against electric shock if any electrically charged components lose isolation within the protective barrier and two exposed conductive parts of the electrical protection barrier are contacted simultaneously, by shunting[43] any harmful electrical current to the vehicle chassis.

Comments Received

Global comments that the reference to ''any two simultaneously reachable exposed conductive parts'' in proposed S5.3(c)(2) ''would result in excessive testing requirements, due to the number of potential combinations of two simultaneously reachable exposed parts.'' The commenter recommends that manufacturers be authorized to identify a ''worst case'' pair of conductive parts for testing under the provision to reduce the potential number of combinations. Global also recommends that greater specification for the phrase ''any two simultaneously reachable,'' be provided, such as a measured distance.

Agency Response

NHTSA believes that the regulatory text already provides the specification that the simultaneously reachable exposed conductive parts of electrical protection barriers must be located within 2.5 meters of each other. Thus, we do not believe the requirement results in an excessive number of resistance measurements. However, NHTSA is correcting the reference to ''exposed conductive parts of the electrical protection barriers'' in S5.3(c)(2) to qualify that they are exposed conductive parts of the electrical protection barrier of the high voltage source under consideration in S5.3.

Comments Received

Global comments that the low voltage requirement (S5.3(c)(3)) is too broad in scope and recommends limiting this testing requirement to exposed conductive parts of the electrical protection barriers. Global states that in the event of a barrier failure, a voltage differential could exist with regard to all exposed conductive parts of the chassis and all metal parts connected to the chassis. The Alliance comments that the requirements in S5.3(c)(3) should be consistent with the requirement in S5.3(c)(2). I.e., the Alliance believes that the voltage measurements for S5.3(c)(3) between exposed conductive parts should be made on the same exposed conductive parts of electrical protection barriers for which resistance measurements are made for S5.3(c)(2).

Agency Response

The agency agrees with the comments of Global and the Alliance and has worded S5.3(c)(3) to reflect the recommended changes. As adopted, S5.3(c)(3) specifies that the voltage between exposed conductive parts of the electrical protection barrier and the electrical chassis must be less than or equal to 30 VAC or 60 VDC.[44] In addition, the voltage between an exposed conductive part of the electrical protection barrier and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than or equal to 30 VAC or 60 VDC.

f. Electrical Isolation Requirements

Under FMVSS No. 305's current post-crash safety requirements, vehicles must meet either electrical isolation requirements or low voltage requirements. The current requirements for electrical isolation are that the electrical isolation of the high voltage source must be greater than or equal to: 500 ohms/volt for an AC high voltage source; 500 ohms/volt for a DC high voltage source without electrical isolation monitoring during vehicle operation; or 100 ohms/volt for a DC high voltage source with an electrical isolation monitoring system during vehicle operation.

The NPRM proposed to change these requirements (S5.3(a)) and add specifications that high voltage sources must have electrical isolation during normal vehicle operation (S5.4.3.1). Briefly, the proposed electrical isolation requirements are: AC high voltage sources have 500 ohms/volt or higher electrical isolation from the electric chassis; DC high voltage sources have 100 ohms/volt or higher electric isolation from the electric chassis; or, AC high voltage sources that are conductively connected to the DC high voltage sources may have 100 ohms/volt or higher electrical isolation from the electric chassis provided they also provide physical barrier protection.

[41] Markings are not required on electrical protection barriers that cannot be physically accessed, opened, or removed without the use of tools. The persons who will access the powertrain with tools will be maintenance personnel technically aware of the vehicle's electrical system, and not first responders. We believe that maintenance personnel will have basic knowledge of the workings of the electrical system, so the electrical shock warning symbol is not necessary.

[42] Indirect contact refers to the contact of persons with exposed conductive parts.

[43] Shunting is when a low-resistance connection between two points in an electric circuit forms an alternative path for a portion of the current. If a human body contacts an electrical protection barrier that is energized due to loss in electrical isolation of a high voltage source enclosed in the barrier, most of the current would flow through the chassis rather than through the human body because the current path through the chassis has significantly lower resistance (less than 0.1 ohm) than the resistance of the human body (greater or equal to 500 ohm).

[44] In the NPRM, S5.3(c)(3) was worded such that the voltage measurements were between the electrical protection barrier and ''other exposed conductive parts,'' which includes the electrical chassis. Since in this final rule we have modified the proposed wording of S5.3(c)(3) to make the voltage measurements between exposed conductive parts of electrical protection barriers (in response to Global's comment), the agency has separately added a requirement to S5.3(c)(3) to account for the voltage measurement between exposed conductive parts of the electrical protection barrier and the electrical chassis. This change in the language of S5.3(c)(3) makes it more consistent with the language of S5.3(c)(2) and is not a substantive change from the NPRM.

Comments Received and Agency Response

The Alliance first requests that the regulatory text of the electrical isolation option under post-crash conditions (S5.3(a)) and during normal vehicle operating conditions (S5.4.3.1) be replaced by the language in GTR No. 13.

The agency declines this request. The requirements of the electrical isolation option in FMVSS No. 305 and GTR No. 13 are identical, while the text in FMVSS No. 305 is more concise.

Second, the Alliance requests changes to the proposed physical barrier protection requirements for AC high voltage sources that are conductively connected to DC high voltage sources and that comply with the lower electrical isolation limit of 100 ohms/volt under post-crash conditions (S5.3(a)(2)). The proposed text in the NPRM permits an AC high voltage source to have an isolation resistance of only 100 ohms/volt if three physical protection requirements are met.[45] The Alliance suggests that the low voltage requirement is ''not logically needed.'' It states that the electric shock scenario identified in NHTSA's Battelle study[46] of physical barriers will never happen if it maintains a minimum electrical isolation of more than 100 ohms/volt, protection against direct contact (IPXXB), and protection against indirect contact (resistance between exposed conductive parts and the electrical chassis and between two exposed conductive parts of less than 0.1 ohms and 0.2 ohms, respectively).

NHTSA has carefully analyzed electrical safety implications under the conditions of a minimum electrical isolation of 100 ohms/volt, resistance between exposed conductive parts of electrical protection barriers and the chassis of 0.1 ohms, and electrical isolation between two exposed conductive parts of 0.2 ohms. The results of the analysis[47] showed that under these conditions, the electric current through the body would be significantly lower than 10 milliamps (mA) DC and 2 mA AC, which are considered safe levels of current for protection from electric shock. Therefore, the agency agrees to this change in the regulatory text requested by the Alliance. Accordingly, S5.3(a)(2) is modified so that AC high voltage sources that are conductively connected to DC high voltage sources may comply with the lower electrical isolation limit of 100 ohms/volt provided they meet the physical protection requirements of S5.3(c)(1) and S5.3(c)(2).

g. Electrical Safety During Charging

Like GTR No. 13, the NPRM proposed (S5.4.5) to require electric vehicles whose rechargeable energy storage system are charged by conductively connecting to a grounded external power supply to have a device to enable conductive connection of the electrical chassis to the earth ground during charging. This proposal was to ensure that in the event of electrical isolation loss during charging, a person contacting the vehicle does not form a ground loop with the chassis and sustain significant electric shock. Additionally, like GTR No. 13, the NPRM proposed (S5.4.3.3) to require the isolation resistance between the high voltage source and the electrical chassis to be at least 1 million ohms when the charge coupler is disconnected. This proposal was to ensure that the magnitude of current through a human body when a person contacts a vehicle undergoing charging is low and in the safe zone.

Comments Received

The agency received many comments regarding the requirement for isolation resistance of 1 million ohms during charging.

The Alliance states that the requirement should only be applicable to conductive charging with an AC external electric power supply, noting that the isolation resistance of one million ohms should be required for the high voltage source (high voltage buses) that are conductively connected to the contacts of the vehicle charge inlet, and not to the vehicle charge inlet itself.

Mercedes-Benz states that the 1 million ohms isolation resistance specification—

> is intended as a system reliability requirement, not a safety requirement. The safety relevant requirements on an isolation resistance are already specified in S5.4.3.1. . . . [T]he regulatory text [should] explicitly remove the 'one million ohm' specification and instead state that the isolation resistance, measured at the vehicle charge inlet, must comply with the requirements stated in S5.4.3.1.

Tesla states that it does not believe the insulation resistance requirement for the vehicle's inlet is aligned with the associated high voltage hazards that the NPRM proposes to mitigate. Tesla believes that the intent of the insulation resistance requirement is to prevent high voltage current from flowing through the human body. Tesla believes that Section 11.7 of the IEC 61851–1:2010[48] more accurately captures this prevention for AC equipment because it specifically applies to cord and plug-connected equipment. Tesla also recommends that NHTSA ''provide clear requirements for off-board (including charging) equipment(s)'' since any fault current that is generated while charging would be a function of both the vehicle as well as the electric vehicle supply equipment.

Agency Response

To evaluate these comments, NHTSA requested information from technical experts in the working group for the draft EVS–GTR on electric vehicle safety, in which NHTSA participates. Technical information was provided by Mr. Takahiko Miki[49] from the Organisation Internationale des Constructeurs d'Automobiles (OICA).[50] Mr. Miki noted that the one million ohms electrical isolation requirement is from IEC 61851–1. Mr. Miki also noted that the requirements in IEC 61851–1 apply to conductive charging of electric vehicles with an AC external electric power supply.

Mr. Miki provided the following detailed explanation of protective measures in vehicles during charging to prevent electric shock. Mr. Miki noted that protection against electric shock during charging by connecting to an AC external electric power supply is provided by the vehicle and the off-board electric vehicle supply equipment (*i.e.* charge connector) and provided a description of these protection systems. Protection systems in the vehicle include: (1) Protection against direct contact with high voltage live parts and (2) indirect contact protection from high voltage sources (equipotential bonding—earthing/grounding). Protection systems in the electric vehicle supply equipment (charge connector) include: (1) Earthing/grounding conductor between the electrical chassis of a vehicle and the

[45] These are proposed as: (1) IPXXB protection level (S5.3(c)(1)), (2) resistance between exposed conductive parts of the electrical protection barrier and chassis of less than 0.1 ohms and between any two simultaneously reachable exposed conductive parts of barriers less than 2.5 m apart of less than 0.2 ohms (S5.3(c)(2)), and (3) the voltage between electrical protection barrier enclosing the high voltage source and other exposed conductive parts of less than or equal to 30 VAC or 60 VDC (''low voltage requirement'') (S5.3(c)(3)).

[46] *Supra.* The NPRM discusses the Battelle study in detail, see 81 FR at 12656.

[47] We have docketed a memorandum showing our analysis. See the docket for this final rule.

[48] IEC 61851–1:2010, ''Electric vehicle conductive charging system—Part I: General Requirements,'' *https://webstore.iec.ch/publication/6029.*

[49] Miki, T., ''Personal Protection during Charging.'' Submitted at the 12th EVS GTR meeting in Paris on September 15, 2016, EVSTF09–32–TF2–04.docx. *https://www2.unece.org/wiki/display/trans/9th+Task+Force+meetings+in+Paris.*

[50] OICA is an international organization of motor vehicle manufacturers whose members include 39 national trade associations around the world.

earth/ground, (2) earthing/grounding continuity monitor, and (3) automatic disconnection of supply (residual current device (RCD),[51] charging circuit interrupting device (CCID) [52] located in the charge electric vehicle supply equipment or in the fixed electrical installation, or both) operated by the fault current that disconnects one or more of the line conductors.

The AC external electric power supply is grounded to earth ground. When an electric vehicle is connected to the AC external electric power supply by the charge connector, the vehicle electrical chassis is connected to the earth/ground through the earthing/grounding conductor. If electrical isolation/insulation is lost during charging, the leakage current (residual current) [53] would flow to the earth/ground through the earthing/grounding conductor. Under such conditions, a human body contacting high voltage-exposed conductive parts of the vehicle would not experience electric shock if the leakage current is less than or equal to maximum current levels considered to be safe. If the leakage current reaches or exceeds specified safety threshold levels, the RCD/CCID would open the circuit to interrupt the supply of electric energy. A similar form of this type of electric shock protection measure is provided in homes for use of common household electric equipment.

The electrical isolation of high voltage sources that are connected to the vehicle charge inlet during charging by connecting the AC external electric power supply is determined based on the characteristics of the RCD/CCID to ensure that leakage current would be significantly lower than the leakage current level that would trip the RCD/CCID to open the circuit. This electrical isolation requirement is not for electric shock protection but to ensure that charging is not interrupted under normal charging conditions. Mr. Miki recommends that the electrical isolation between the electrical chassis and high voltage sources that are conductively connected to the vehicle charge inlet during AC charging be greater than or equal to 500 ohms/volt because with this level of electrical isolation, the leakage current would be sufficiently lower than the leakage (residual) current level that would trip the RCD/CCID to open the circuit and interrupt the electric energy supply.[54]

In light of the new information provided by Mr. Miki and the commenters, the agency is modifying the proposed isolation resistance requirement for high voltage sources for charging the electric energy storage device (S5.4.3.3). High voltage sources conductively connected to the vehicle charge inlet during charging (through conductive connection to the AC external electric supply) are required to have electrical isolation from the electric chassis of 500 ohms/volt when the charge connector is disconnected.

We believe the modified language responds to the comments from the Alliance, Mercedes-Benz, and Tesla. Additionally, the modified requirement is consistent with that developed in the draft EVS–GTR for electric vehicles.

Regarding Tesla's recommendation for NHTSA to provide clear requirements for off-board (including charging) equipment, the agency is looking into this matter. The safety measures in the electric vehicle supply equipment, such as the RCD/CCID in the charge connector, are specified in the National Electric Code (NEC)—Article 625: Electric Vehicle Charging System and in the Underwriters Laboratory (UL) 2954, ''Electric vehicle supply equipment.'' Adding requirements for off-board equipment is not in scope of this final rule since the agency did not include any such requirements in the NPRM. The agency may consider the need for and the feasibility of requirements for off-board electric vehicle equipment in the future.

h. Mitigating Driver Error

NHTSA proposed three provisions for mitigating the likelihood of driver error in operating electric vehicles (S5.4.6). First, the heading and text of proposed S5.4.6.1 proposed that at least a momentary indication shall be given at ''start up'' when the vehicle is in a possible active driving mode.[55] (''Start up'' is also used in GTR No. 13.) Second, the NPRM proposed that drivers be provided an audible or visual signal if the vehicle is still in the possible active driving mode when the driver leaves the vehicle. Third, for vehicles that have on-board electric energy storage devices that can be charged externally, the NPRM proposed to prohibit vehicle movement by the vehicle's own propulsion system when the external electric power supply is physically connected to the vehicle charge inlet.

Comments Received and Agency Response

The agency received comments from Global, the Alliance and Tesla on the proposal. Global requests a clarification of the meaning of ''start up'' used in the first provision. Global asks if ''start up'' refers to the time of engine start or some other meaning.

NHTSA meant ''start up'' to refer to the time when the vehicle is first placed in a possible active driving mode (*e.g.,* reverse, drive, or other driving gears) after manual activation of the propulsion system. The provision at issue is intended to reduce operational errors that could have safety implications. For example, a driver might not realize the vehicle is in an active driving mode when he or she pressed on the accelerator pedal, which could result in a potential crash condition. However, to reduce ambiguity, we have modified the final rule regulatory text by replacing the phrase, ''upon start up,'' with the phrase, ''when the vehicle is first placed in possible active driving mode after manual activation of the propulsion system.'' Once driving is initiated, notification is not needed when the vehicle is put in neutral to change gears (for manual-drive vehicles).

The Alliance believes the heading of the third provision for mitigating driver error should be revised from ''Prevent drive-away during charging'' to ''Prevent drive-away'' to reflect that the concern is that the driver may drive the vehicle away after charging is

[51] RCD is a mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions. A residual current device can be a combination of various separate elements designed to detect and evaluate the residual current and to make and break current. [Source: IEC 61851–1, IEV 442–05–02]

[52] CCID is a device that continuously monitors the differential current among all of the current-carrying line conductors in a grounded system and rapidly interrupts the circuit under conditions where the differential current exceeds the rated Measurement Indication Unit (MIU) value of a charging circuit interrupting device. The device is identified by the letters CCID followed by the differential trip current rating of either 5 or 20 indicating the tripping rating in MIU. [Source: UL 2231–1]

[53] Leakage current is the current flowing through ground due to a fault condition. The magnitude of leakage current is determined as the difference in the current flowing through the positive terminal and that returning on the negative terminal. Therefore, it is also referred to as residual current.

[54] For DC charging, the power input to the vehicle is isolated from the ground by the isolation transformer. Therefore, electric shock protection is maintained even if isolation resistance is reduced (fault condition), because the current loop to the ground is not established. Additionally, DC charging stations monitor the combined isolation resistance of the vehicle and the electric vehicle supply equipment. If the DC charging station detects that the combined isolation resistance is lower than the specified value (for electric shock protection), the DC output cable is not energized (power supply is terminated).

[55] ''Possible active driving mode'' is the vehicle mode when the application of pressure to the accelerator pedal or release of the brake system causes the electric power train to move the vehicle.

completed without disconnecting the charge connector. The Alliance also notes that a simple physical connection without any conductive connection may not be detected by vehicle systems. The commenter recommends changing the phrase, ''physically connected to the vehicle charge inlet,'' to ''physically connected to the vehicle charge inlet in such a way that charging is possible.''

The agency agrees generally with the Alliance's recommended changes and has changed the proposed regulatory text. We believe the changes improve clarity and removes ambiguity about when and under what conditions the requirement to prevent vehicle movement applies.[56]

Tesla states that the phrase, ''preventing physical vehicle movement by its own power,'' is vague and needs clarification. Tesla requests that the agency draw a clear distinction between when a vehicle is considered stationary and when it is in ''movement under its own power.'' The commenter suggests using a provision in FMVSS No. 114, ''Theft protection and rollaway prevention.'' S5.2.5 of FMVSS No. 114 specifies that a vehicle must not move more than 150 mm on a 10 percent grade when the gear selection control is locked in ''park.''

The agency sees merit in Tesla's suggestion to improve objectivity of the requirement for preventing vehicle movement when the charge connector is connected to the vehicle charge inlet. S5.2 in FMVSS No. 114 specifies provisions to prevent rollaway in vehicles equipped with a transmission with a ''park'' position. One provision is that when the vehicle is resting on a 10 percent grade and the vehicle's gear selection control is locked in ''park,'' the vehicle must not move more than 150 mm when the brakes are released. To distinguish minor vibrations of the vehicle when it is idling from vehicle movement ''under its own power,'' the agency is modifying the proposed regulatory text to state that the vehicle must not move more than 150 mm[57] by its own propulsion system when the charge connector is physically connected to the vehicle charge inlet in such a way that charging is possible.

[56] If the charge connector is not connected correctly to the vehicle charge inlet, then charging may not even initiate and driving away with the charge connector physically connected would not result in an electric safety hazard.

[57] Vehicle movement of 150 mm is deemed sufficiently low such that the charge connector would not disengage from the vehicle inlet or damage the charging equipment.

i. Test Procedures and Figures in FMVSS No. 305

The NPRM proposed test procedures for evaluating IPXXB and IPXXD direct contact protection (S9.1), measuring resistance between exposed conductive parts and between an exposed conductive part and the electrical chassis to evaluate indirect contact protection (S9.2), and measuring voltage between exposed conductive part of an electrical protection barrier and the electrical chassis or any other exposed conductive part of the vehicle for indirect contact protection (S9.3).

For evaluating direct contact protection, the proposed test procedure in S9.1 detailed how the IPXXB and IPXXD probes are used and manipulated to determine if high voltage live parts are contacted. Subaru comments that the description of manipulating the IPXXB finger probe does not specifically note that it is only applicable to the IPXXB probe and not the IPXXD probe. NHTSA agrees and has corrected this omission to indicate that the described manipulation of the finger probe only applies to the IPXXB probe.

In proposed S9.1 the NPRM did not explicitly provide criteria for assessing whether high voltage live parts were contacted, though such information is provided in GTR No. 13. To make S9.1 clearer, and to better harmonize the test procedure in FMVSS No. 305 with that in GTR No. 13, the criteria for verification of IPXXD and IPXXB protection degree in GTR No. 13 are included in the regulatory text.

For measuring resistance between two exposed conductive parts, the NPRM at S9.2 provided two methods that could be used. Global states that the two methods were provided in GTR No. 13 as compliance options for manufacturers to select for evaluating indirect contact protection. The commenter recommends we include regulatory text to make clear that it is at the manufacturer's option to choose either test method to certify compliance. The agency agrees that the two methods were provided as compliance test options for manufacturers and has included the recommended regulatory text in S9.2 of FMVSS No.305.

Global expresses concern that provisions for indirect contact protection in S9.2 create an inordinate certification burden on manufacturers due to the phrase, ''any two exposed conductive parts.'' The commenter requests that instead of measuring the resistance between two exposed conductive parts, resistance may be calculated using the separately measured resistances of the parts of the electrical chassis.

NHTSA agrees with this requested change from Global. The agency notes that GTR No. 13, ECE R.100, and the draft EVS–GTR permit resistances to be calculated using the separately measured resistances of the relevant parts in the electric path. NHTSA believes that a calculation option is acceptable for the requirement at issue because resistances can be computed from other measured resistances on an actual vehicle in a straightforward manner, and do not involve potentially subjective judgment calls on the part of evaluators as to whether assumptions underlying a calculation are merited.

For measuring voltage between exposed conductive parts of electrical protection barriers, the NPRM specified a method in which the DC power supply, voltmeter, and ammeter are connected between measuring points. The Alliance and Global point out that the DC power supply should not be connected in this test (S9.3a). The agency agrees and has corrected the regulatory text. Additionally, NHTSA believes that calculating the voltage between two exposed conductive parts from the measured voltages between the exposed conductive parts and the electrical chassis is straightforward and unambiguous and so is permitting a calculation option for determining voltage between exposed conductive parts.

The proposal provided specifications of the IPXXB probe in Figure 7b of the regulatory text. The Alliance and Global note errors in the specification for R2 and R4. The agency has corrected the errors in Figure 7b.

The Alliance and Global provide an improved Figure 8 in which the text is clearer than the NPRM's Figure 8. The agency has included the new figure in FMVSS No. 305.

j. Compliance Date

The NPRM proposed a compliance date of 180 days after the date of publication of the final rule in the **Federal Register**, with optional early compliance permitted.

The Alliance states that, although the proposed amendments to FMVSS No. 305 are vital to enable the production of advanced fuel cell and 48-volt mild hybrid vehicles, the ''in use'' requirements may require some modification of currently-certified electric vehicles. The commenter asks that the compliance date be modified to align it with the first September 1st that is at least 180 days after the publication of the final rule in the **Federal Register**, with optional early compliance permitted. An individual, Mr. Albert Torres, also believes that a longer compliance date should be provided.

Agency Response

The agency believes that most, if not all, electric-powered vehicles currently sold in the United States would be able to comply with the updated requirements in FMVSS No. 305 by the proposed compliance date. However, as noted by the Alliance, some vehicles may need some minor modifications to comply with some of the modifications in FMVSS No. 305, such as the marking requirements. Therefore, the agency finds good cause to provide more time to comply with this final rule. The agency believes one year from the date of publication of the final rule is sufficient time for vehicle manufacturers to comply with the updated FMVSS No. 305 requirements. Therefore, the compliance date for the amendments in FMVSS No 305 is one year after publication of the final rule. We permit optional early compliance with this final rule.

We note that in the ''DATES'' section at this beginning of this document NHTSA indicates that the ''effective date'' of this final rule is the date of publication of the rule. The ''effective date'' in the **DATES** section is the date the amendments should be incorporated into the CFR. That date is different from the ''compliance date'' discussed above. As stated above, NHTSA is permitting optional early compliance with this final rule. Because of this, we are amending 49 CFR 571.305 (FMVSS No. 305) on the date of publication of this final rule so that interested manufacturers can begin certifying the compliance of their vehicles with the amended standard from that date.

V. Rulemaking Analyses and Notices

Executive Order 12866 and DOT Regulatory Policies and Procedures

This rulemaking document was not reviewed by the Office of Management and Budget (OMB) under Executive Order (E.O.) 12866. It is not considered to be significant under E.O. 12866 or the Department's Regulatory Policies and Procedures. The amendments made by this final rule will have no significant effect on the national economy, as most of the requirements are already in voluntary industry standards and international standards that current electric powered vehicles presently meet.

This final rule updates FMVSS No. 305 to incorporate the electrical safety requirements in GTR No. 13. This final rule also responds to petitions for rulemaking from Toyota and the Alliance to facilitate the introduction of fuel cell vehicles and 48-volt mild hybrid technologies into the vehicle fleet. The final rule adds electrical safety requirements in GTR No. 13 that involve electrical isolation and direct and indirect contact protection of high voltage sources to prevent electric shock during normal operation of electric powered vehicles. Today's final rule also provides an additional optional method of meeting post-crash electrical safety requirements that involve physical barriers of high voltage sources to prevent electric shock due to direct and indirect contact with live parts. Since there is widespread conformance with the requirements that would apply to existing vehicles, we anticipate no costs or benefits associated with this rulemaking.

Executive Order 13771

Executive Order 13771 titled ''Reducing Regulation and Controlling Regulatory Costs,'' directs that, unless prohibited by law, whenever an executive department or agency publicly proposes for notice and comment or otherwise promulgates a new regulation, it shall identify at least two existing regulations to be repealed. In addition, any new incremental costs associated with new regulations shall, to the extent permitted by law, be offset by the elimination of existing costs. Only those rules deemed significant under section 3(f) of Executive Order 12866, ''Regulatory Planning and Review,'' are subject to these requirements. As discussed above, this rule is not a significant rule under Executive Order 12866 and, accordingly, is not subject to the offset requirements of 13771.

NHTSA has determined that this rulemaking is a deregulatory action under E.O. 13771, as it imposes no costs and, instead, amends FMVSS No. 305 to give more flexibility to manufacturers not only to use modern electrical safety designs to produce electric vehicles, but also to introduce new technologies to the U.S. market, including hydrogen fuel cell vehicles and 48-volt mild hybrid technologies. Although NHTSA was not able to quantify any cost savings for this rule, in adopting an optional method of meeting post-crash electrical safety requirements involving use of physical barriers to prevent direct or indirect contact (by occupants, emergency services personnel and others) with high voltage sources, this final rule adjusts the standard to remove an obstruction that prevented HFCVs to be offered for sale in the U.S. Use of the physical barrier option will also enable manufacturers to produce 48-volt mild hybrid systems without having to use electrical isolation safety measures that involve more complexity, higher consumer costs, and higher mass, without an incremental safety benefit.

Regulatory Flexibility Act

NHTSA has considered the effects of this final rule under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.,* as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996). I certify that this final rule will not have a significant economic impact on a substantial number of small entities. Any small manufacturers that might be affected by this final rule are already subject to the requirements of FMVSS No. 305. Further, the agency believes the testing associated with the requirements added by this final rule are not substantial and to some extent are already being voluntarily borne by the manufacturers pursuant to SAE J1766. Therefore, to the extent there is an economic impact on the manufacturers, it will only be minor.

National Environmental Policy Act

NHTSA has analyzed this rulemaking action for the purposes of the National Environmental Policy Act. The agency has determined that implementation of this action will not have any significant impact on the quality of the human environment.

Executive Order 13132 (Federalism)

NHTSA has examined today's final rule pursuant to Executive Order 13132 (64 FR 43255; Aug. 10, 1999) and concluded that no additional consultation with States, local governments, or their representatives is mandated beyond the rulemaking process. The agency has concluded that the final rule does not have sufficient federalism implications to warrant consultation with State and local officials or the preparation of a federalism summary impact statement. The final rule does not have ''substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.''

NHTSA rules can have preemptive effect in two ways. First, the National Traffic and Motor Vehicle Safety Act contains an express preemption provision:

When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter. 49 U.S.C. 30103(b)(1).

It is this statutory command that preempts any non-identical State legislative and administrative law [58] addressing the same aspect of performance, not today's rulemaking, so consultation would be inappropriate.

Second, the Supreme Court has recognized the possibility, in some instances, of implied preemption of State requirements imposed on motor vehicle manufacturers, including sanctions imposed by State tort law. That possibility is dependent upon there being an actual conflict between a FMVSS and the State requirement. If and when such a conflict exists, the Supremacy Clause of the Constitution makes the State requirements unenforceable. See *Geier* v. *American Honda Motor Co.,* 529 U.S. 861 (2000), finding implied preemption of state tort law on the basis of a conflict discerned by the court,[59] not on the basis of an intent to preempt asserted by the agency itself.

NHTSA has considered the nature (*e.g.,* the language and structure of the regulatory text) and objectives of today's final rule and does not discern any existing State requirements that conflict with the rule or the potential for any future State requirements that might conflict with it. Without any conflict, there could not be any implied preemption of state law, including state tort law.

Executive Order 12988 (Civil Justice Reform)

With respect to the review of the promulgation of a new regulation, section 3(b) of Executive Order 12988, ''Civil Justice Reform'' (61 FR 4729; Feb. 7, 1996), requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect; (2) clearly specifies the effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct, while promoting simplification and burden reduction; (4) clearly specifies the retroactive effect, if any; (5) specifies whether administrative proceedings are to be required before parties file suit in court; (6) adequately defines key terms; and (7) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. This document is consistent with that requirement.

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

Privacy Act

Please note that anyone can search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477–78), or online at *http://www.dot.gov/privacy.html.*

Paperwork Reduction Act

Under the Paperwork Reduction Act of 1995 (PRA), a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid OMB control number. There are no information collection requirements associated with this NPRM.

National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law 104–113, as amended by Public Law 107–107 (15 U.S.C. 272), directs the agency to evaluate and use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or is otherwise impractical. Voluntary consensus standards are technical standards (*e.g.,* materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies, such as the Society of Automotive Engineers (SAE). The NTTAA directs us to provide Congress (through OMB) with explanations when the agency decides not to use available and applicable voluntary consensus standards. The NTTAA does not apply to symbols.

FMVSS No. 305 has historically drawn largely from SAE J1766, and does so again for this current rulemaking, which updates FMVSS No. 305 to facilitate the development of fuel cell and 48-volt mild hybrid technologies. It is based on GTR No. 13 and the latest version of SAE J1766 January 2014.

Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA), Pub. L. 104–4, requires Federal agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of more than $100 million annually (adjusted for inflation with base year of 1995). Adjusting this amount by the implicit gross domestic product price deflator for the year 2013 results in $142 million (106.733/75.324 = 1.42). This final rule will not result in a cost of $142 million or more to either State, local, or tribal governments, in the aggregate, or the private sector. Thus, this final rule is not subject to the requirements of sections 202 of the UMRA.

Executive Order 13609 (Promoting Regulatory Cooperation)

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

The agency participated in the development of GTR No. 13 to harmonize the standards of fuel cell vehicles. As a signatory member, NHTSA is obligated to initiate rulemaking to incorporate electrical safety requirements and options specified in GTR No. 13 into FMVSS No. 305. The agency has initiated rulemaking by way of the March 10, 2016 NPRM and completes it with this final rule.

Regulation Identifier Number

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in

[58] The issue of potential preemption of state tort law is addressed in the immediately following paragraph discussing implied preemption.

[59] The conflict was discerned based upon the nature (*e.g.,* the language and structure of the regulatory text) and the safety-related objectives of FMVSS requirements in question and the impact of the State requirements on those objectives.

the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

Plain Language

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

• Have we organized the material to suit the public's needs?

• Are the requirements in the rule clearly stated?

• Does the rule contain technical language or jargon that isn't clear?

• Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule easier to understand?

• Would more (but shorter) sections be better?

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

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

If you have any responses to these questions, please write to us with your views.

List of Subjects in 49 CFR Part 571

Imports, Motor vehicles, Motor vehicle safety.

In consideration of the foregoing, NHTSA amends 49 CFR part 571 as follows:

PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

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

Authority: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.95.

■ 2. In § 571.305:
■ a. Revise S1 and S2;
■ b. Under S4:
■ i. Add in alphabetical order definitions for ''Charge connector,'' ''Connector,'' ''Direct contact,'' ''Electrical protection barrier,'' ''Exposed conductive part,'' ''External electric power supply,'' and ''Fuel cell system'';
■ ii. Revise the definitions of ''High voltage source'';
■ iii. Add in alphabetical order definitions for ''Indirect contact,'' ''Live part,'' ''Luggage compartment,'' ''Passenger compartment,'' and ''Possible active driving mode'';
■ iv. Revise the definition of ''Propulsion system''; and
■ v. Add in alphabetical order definitions for ''Protection degree IPXXB,'' ''Protection degree IPXXD,'' ''Service disconnect,'' and ''Vehicle charge inlet'';
■ c. Revise S5.3 and S5.4; and
■ d. Add S5.4.1, S5.4.1.1, S5.4.1.1.1, S5.4.1.2, S5.4.1.3, S5.4.1.4, S5.4.1.5, S5.4.1.6, S5.4.2, S5.4.2.1, S5.4.2.2, S5.4.3, S5.4.3.1, S5.4.3.2, S5.4.3.3, S5.4.4, S5.4.5, S5.4.6, S5.4.6.1, S5.4.6.2, S5.4.6.3, S9, S9.1, S9.2, S9.3, and figures 6, 7a, 7b, and 8.

The revisions and additions read as follows:

§ 571.305 Standard No. 305; Electric-powered vehicles: electrolyte spillage and electrical shock protection.

S1. *Scope.* This standard specifies requirements for limitation of electrolyte spillage and retention of electric energy storage/conversion devices during and after a crash, and protection from harmful electric shock during and after a crash and during normal vehicle operation.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries during and after a crash that occur because of electrolyte spillage from electric energy storage devices, intrusion of electric energy storage/conversion devices into the occupant compartment, and electrical shock, and to reduce deaths and injuries during normal vehicle operation that occur because of electric shock or driver error.

* * * * *

S4. * * *

Charge connector is a conductive device that, by insertion into a vehicle charge inlet, establishes an electrical connection of the vehicle to the external electric power supply for the purpose of transferring energy and exchanging information.

Connector means a device providing mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing.

Direct contact is the contact of persons with high voltage live parts.

* * * * *

Electrical protection barrier is the part providing protection against direct contact with high voltage live parts from any direction of access.

Exposed conductive part is the conductive part that can be touched under the provisions of the IPXXB protection degree and that is not normally energized, but that can become electrically energized under isolation fault conditions. This includes parts under a cover, if the cover can be removed without using tools.

External electric power supply is a power supply external to the vehicle that provides electric power to charge the electric energy storage device in the vehicle through the charge connector.

Fuel cell system is a system containing the fuel cell stack(s), air processing system, fuel flow control system, exhaust system, thermal management system, and water management system.

High voltage source means any electric component which is contained in the electric power train or conductively connected to the electric power train and has a working voltage greater than 30 VAC or 60 VDC.

Indirect contact is the contact of persons with exposed conductive parts.

Live part is a conductive part of the vehicle that is electrically energized under normal vehicle operation.

Luggage compartment is the space in the vehicle for luggage accommodation, separated from the passenger compartment by the front or rear bulkhead and bounded by a roof, hood or trunk lid, floor, and side walls, as well as by electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

Passenger compartment is the space for occupant accommodation that is bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead or rear gate, as well as electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

Possible active driving mode is the vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system causes the electric power train to move the vehicle.

Propulsion system means an assembly of electric or electro-mechanical components or circuits that propel the vehicle using the energy that is supplied by a high voltage source. This includes, but is not limited to, electric motors, inverters/converters, and electronic controllers.

Protection degree IPXXB is protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the jointed test finger probe, IPXXB, in Figure 7b.

Protection degree IPXXD is protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the test wire probe, IPXXD, in Figure 7a.

Service disconnect is the device for deactivation of an electrical circuit when conducting checks and services of the vehicle electrical propulsion system.

* * * * *

Vehicle charge inlet is the device on the electric vehicle into which the charge connector is inserted for the purpose of transferring energy and exchanging information from an external electric power supply.

* * * * *

S5.3 *Electrical safety.* After each test specified in S6 of this standard, each high voltage source in a vehicle must meet one of the following requirements: electrical isolation requirements of subparagraph (a), the voltage level requirements of subparagraph (b), or the physical barrier protection requirements of subparagraph (c).

(a) The electrical isolation of the high voltage source, determined in accordance with the procedure specified in S7.6, must be greater than or equal to one of the following:

(1) 500 ohms/volt for an AC high voltage source; or

(2) 100 ohms/volt for an AC high voltage source if it is conductively connected to a DC high voltage source, but only if the AC high voltage source meets the physical barrier protection requirements specified in S5.3(c)(1) and S5.3(c)(2); or

(3) 100 ohms/volt for a DC high voltage source.

(b) The voltages V1, V2, and Vb of the high voltage source, measured according to the procedure specified in S7.7, must be less than or equal to 30 VAC for AC components or 60 VDC for DC components.

(c) Protection against electric shock by direct and indirect contact (physical barrier protection) shall be demonstrated by meeting the following three conditions:

(1) The high voltage source (AC or DC) meets the protection degree IPXXB when tested according to the procedure specified in S9.1 using the IPXXB test probe shown in Figures 7a and 7b;

(2) The resistance between exposed conductive parts of the electrical protection barrier of the high voltage source and the electrical chassis is less than 0.1 ohms when tested according to the procedures specified in S9.2. In addition, the resistance between an exposed conductive part of the electrical protection barrier of the high voltage source and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than 0.2 ohms when tested using the test procedures specified in S9.2; and

(3) The voltage between exposed conductive parts of the electrical protection barrier of the high voltage source and the electrical chassis is less than or equal to 30 VAC or 60 VDC as measured in accordance with S9.3. In addition, the voltage between an exposed conductive part of the electrical protection barrier of the high voltage source and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than or equal to 30 VAC or 60 VDC as measured in accordance with S9.3.

S5.4 *Electrical safety during normal vehicle operation.*

S5.4.1 *Protection against direct contact.*

S5.4.1.1 *Marking.* The symbol shown in Figure 6 shall be present on or near electric energy storage devices. The symbol in Figure 6 shall also be visible on electrical protection barriers which, when removed, expose live parts of high voltage sources. The symbol shall be yellow and the bordering and the arrow shall be black.

S5.4.1.1.1 The marking is not required for electrical protection barriers that cannot be physically accessed, opened, or removed without the use of tools. Markings are not required for electrical connectors or the vehicle charge inlet.

S5.4.1.2 *High voltage cables.* Cables for high voltage sources which are not located within electrical protection barriers shall be identified by having an outer covering with the color orange.

S5.4.1.3 *Service disconnect.* For a service disconnect which can be opened, disassembled, or removed without tools, protection degree IPXXB shall be provided when tested under procedures specified in S9.1 using the IPXXB test probe shown in Figures 7a and 7b.

S5.4.1.4 *Protection degree of high voltage live parts.*

(a) Protection degree IPXXD shall be provided for high voltage live parts inside the passenger or luggage compartment when tested according to the procedures specified in S9.1 using the IPXXD test probe shown in Figure 7a.

(b) Protection degree IPXXB shall be provided for high voltage live parts in areas other than the passenger or luggage compartment when tested according to the procedures specified in S9.1 using the IPXXB test probe shown in Figures 7a and 7b.

S5.4.1.5 *Connectors.* Direct contact protection for a connector shall be provided by meeting the requirements specified in S5.4.1.4 when the connector is connected to its corresponding mating component, and by meeting at least one of the requirements of subparagraphs (a), (b), or (c).

(a) The connector meets the requirements of S5.4.1.4 when separated from its mating component, if the connector can be separated without the use of tools;

(b) The voltage of the live parts becomes less than or equal to 60 VDC or 30 VAC within one second after the connector is separated from its mating component; or,

(c) The connector is provided with a locking mechanism (at least two distinct actions are needed to separate the connector from its mating component) and there are other components that must be removed in order to separate the connector from its mating component and these cannot be removed without the use of tools.

S5.4.1.6 *Vehicle charge inlet.* Direct contact protection for a vehicle charge inlet shall be provided by meeting the requirements specified in S5.4.1.4 when the charge connector is connected to the vehicle inlet and by meeting at least one of the requirements of subparagraphs (a) or (b).

(a) The vehicle charge inlet meets the requirements of S5.4.1.4 when the charge connector is not connected to it; or

(b) The voltage of the high voltage live parts becomes equal to or less than 60 VDC or equal to or less than 30 VAC within 1 second after the charge connector is separated from the vehicle charge inlet.

S5.4.2 *Protection against indirect contact.*

S5.4.2.1 The resistance between all exposed conductive parts of electrical protection barriers and the electrical chassis shall be less than 0.1 ohms when tested according to the procedures specified in S9.2.

S5.4.2.2 The resistance between any two simultaneously reachable exposed conductive parts of the electrical protection barriers that are less than 2.5 meters from each other shall be less than 0.2 ohms when tested according to the procedures specified in S9.2.

S5.4.3 *Electrical isolation.*

S5.4.3.1 *Electrical isolation of AC and DC high voltage sources.* The electrical isolation of a high voltage source, determined in accordance with the procedure specified in S7.6 must be greater than or equal to one of the following:

(a) 500 ohms/volt for an AC high voltage source;

(b) 100 ohms/volt for an AC high voltage source if it is conductively connected to a DC high voltage source, but only if the AC high voltage source meets the requirements for protection against direct contact in S5.4.1.4 and the protection from indirect contact in S5.4.2; or

(c) 100 ohms/volt for a DC high voltage source.

S5.4.3.2 *Exclusion of high voltage sources from electrical isolation requirements.* A high voltage source that is conductively connected to an electric component which is conductively connected to the electrical chassis and has a working voltage less than or equal to 60 VDC, is not required to meet the electrical isolation requirements in S5.4.3.1 if the voltage between the high voltage source and the electrical chassis is less than or equal to 30 VAC or 60 VDC.

S5.4.3.3 *Electrical isolation of high voltage sources for charging the electric energy storage device.* For the vehicle charge inlet intended to be conductively connected to the AC external electric power supply, the electric isolation between the electrical chassis and the high voltage sources that are conductively connected to the vehicle charge inlet during charging of the electric energy storage device shall be greater than or equal to 500 ohms/volt when the charge connector is disconnected. The electrical isolation is measured at the high voltage live parts of the vehicle charge inlet and determined in accordance with the procedure specified in S7.6. During the measurement, the rechargeable electric energy storage system may be disconnected.

S5.4.4 *Electrical isolation monitoring.* DC high voltage sources of vehicles with a fuel cell system shall be monitored by an electrical isolation monitoring system that displays a warning for loss of isolation when tested according to S8. The system must monitor its own readiness and the warning display must be visible to the driver seated in the driver's designated seating position.

S5.4.5 *Electric shock protection during charging.* For motor vehicles with an electric energy storage device that can be charged through a conductive connection with a grounded external electric power supply, a device to enable conductive connection of the electrical chassis to the earth ground shall be provided. This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

S5.4.6 *Mitigating driver error.*

S5.4.6.1 *Indicator of possible active driving mode.* At least a momentary indication shall be given to the driver each time the vehicle is first placed in possible active driving mode after manual activation of the propulsion system. This requirement does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle's propulsion power when the vehicle is first placed in a possible active driving mode after manual activation of the propulsion system.

S5.4.6.2 *Indicator of possible active driving mode when leaving the vehicle.* When leaving the vehicle, the driver shall be informed by an audible or visual signal if the vehicle is still in the possible active driving mode.

S5.4.6.3 *Prevent drive-away.* If the on-board electric energy storage device can be externally charged, vehicle movement of more than 150 mm by its own propulsion system shall not be possible as long as the charge connector of the external electric power supply is physically connected to the vehicle charge inlet in a manner that would permit charging of the electric energy storage device.

* * * * *

S9 *Test methods for physical barrier protection from electric shock due to direct and indirect contact with high voltage sources.*

S9.1 *Test method to evaluate protection from direct contact with high voltage sources.*

(a) Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools.

(b) The selected access probe is inserted into any gaps or openings of the electrical protection barrier with a test force of 10 N ± 1 N with the IPXXB probe or 1 to 2 N with the IPXXD probe. If the probe partly or fully penetrates into the electrical protection barrier, it is placed in every possible position to evaluate contact with high voltage live parts. If partial or full penetration into the electrical protection barrier occurs with the IPXXB probe, the IPXXB probe shall be placed as follows: starting from the straight position, both joints of the test finger are rotated progressively through an angle of up to 90 degrees with respect to the axis of the adjoining section of the test finger and are placed in every possible position.

(c) A low voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp may be connected between the access probe and any high voltage live parts inside the electrical protection barrier to indicate whether high voltage live parts were contacted.

(d) A mirror or fiberscope may be used to inspect whether the access probe touches high voltage live parts inside the electrical protection barrier.

(e) Protection degree IPXXD or IPXXB is verified when the following conditions are met:

(i) The access probe does not touch high voltage live parts. The IPXXB access probe may be manipulated as specified in S9.1(b) for evaluating contact with high voltage live parts. The methods specified in S9.1(c) or S9.1(d) may be used to aid the evaluation. If method S9.1(c) is used for verifying protection degree IPXXB or IPXXD, the lamp shall not light up.

(ii) The stop face of the access probe does not fully penetrate into the electrical protection barrier.

S9.2 *Test method to evaluate protection against indirect contact with high voltage sources.* At the option of the manufacturer, protection against indirect contact with high voltage sources shall be determined using the test method in subparagraph (a) or subparagraph (b).

(a) *Test method using a resistance tester.* The resistance tester is connected to the measuring points (the electrical chassis and any exposed conductive part of electrical protection barriers or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other), and the resistance is measured using a resistance tester that can measure current levels of at least 0.2 Amperes with a resolution of 0.01 ohms or less. The resistance between two exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

(b) *Test method using a DC power supply, voltmeter and ammeter.*

(1) Connect the DC power supply, voltmeter and ammeter to the measuring points (the electrical chassis and any exposed conductive part or any two simultaneously reachable exposed conductive parts that are less than 2.5 meters from each other) as shown in Figure 8.

(2) Adjust the voltage of the DC power supply so that the current flow becomes more than 0.2 Amperes.

(3) Measure the current I and the voltage V shown in Figure 8.

(4) Calculate the resistance R according to the formula, $R=V/I$.

(5) The resistance between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

S9.3 *Test method to determine voltage between exposed conductive parts of electrical protection barriers and the electrical chassis and between* *exposed conductive parts of electrical protection barriers.*

(a) Connect the voltmeter to the measuring points (exposed conductive part of an electrical protection barrier and the electrical chassis or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other).

(b) Measure the voltage.

(c) The voltage between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured voltages between the relevant electrical protection barriers and the electrical chassis.

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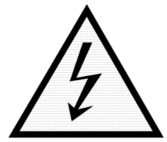


Figure 6. S5.4.1.1 Marking of high voltage equipment.

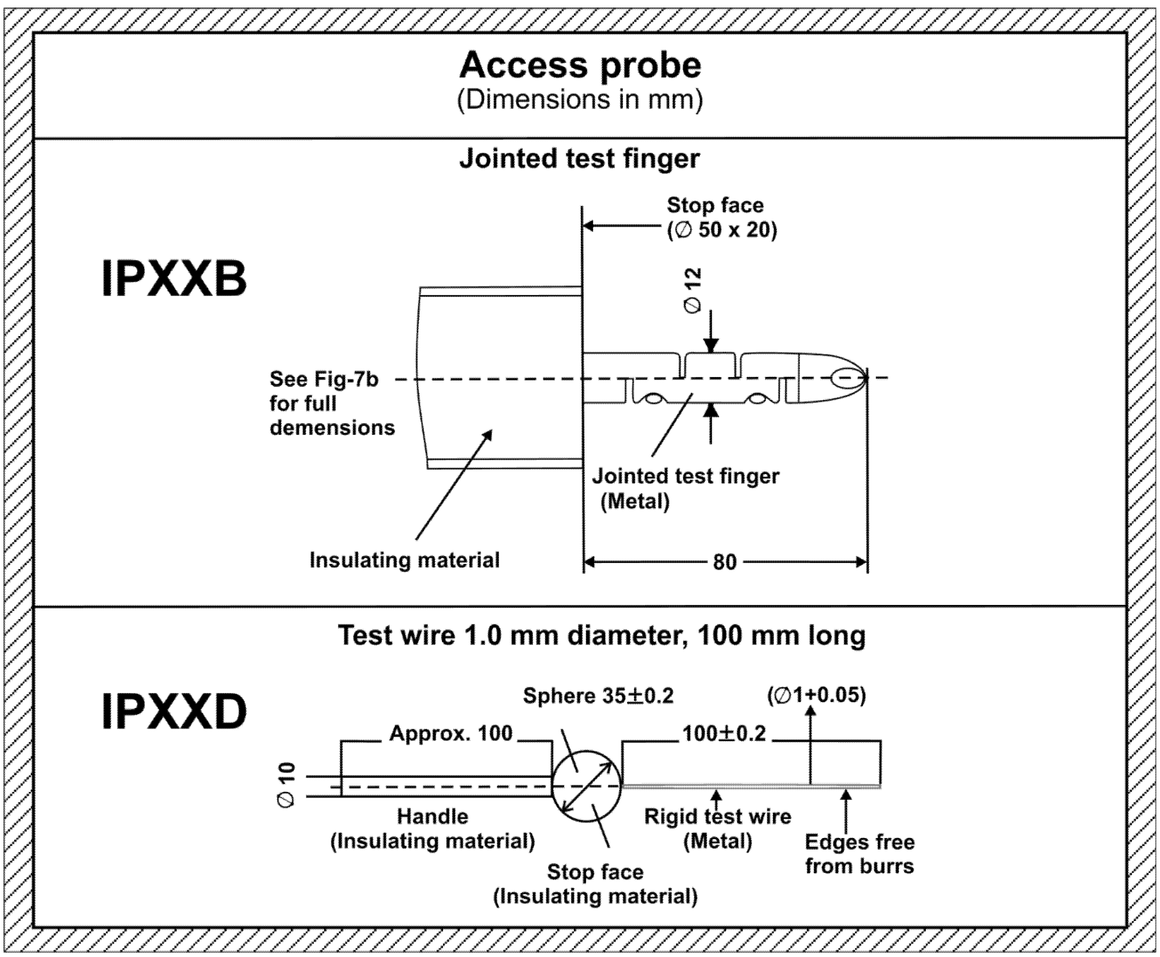
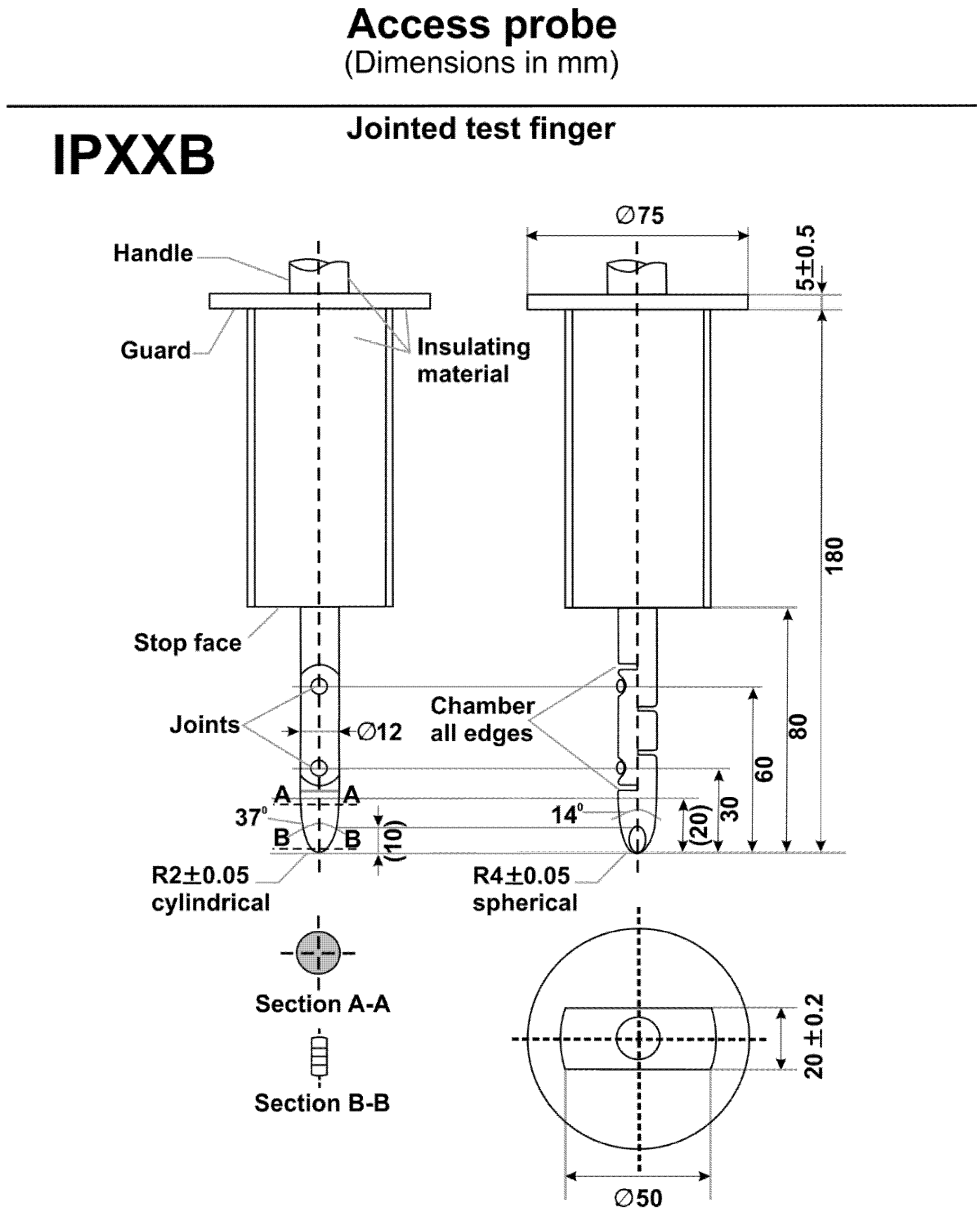


Figure 7a. S4, S5.3, S5.4.1.3, and S5.4.1.4 Access probes for the tests of direct contact protection. Access probe IPXXB (top) and Access probe IPXXD (bottom).



Material: metal, except where otherwise specified
Linear dimensions in millimeters
Tolerances on dimensions without specific tolerance:
on angles, 0/10 degrees
on linear dimensions:
up to 25 mm: 0/-0.05 mm
over 25 mm: ±0.2 mm
Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0° to +10° tolerance.

Figure 7b. S4, S5.3, S5.4.1.3, and S5.4.1.4 Jointed test finger IPXXB

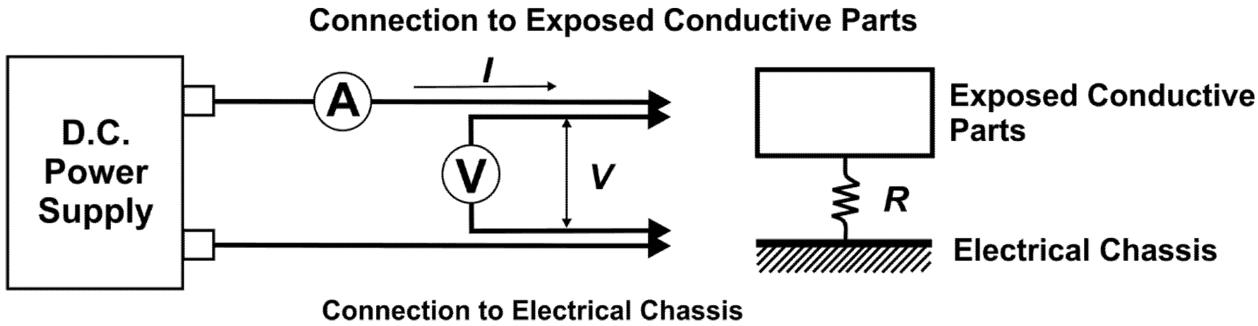


Figure 8. S9.2 Connection to determine resistance between exposed conductive parts of electrical protection barrier and electrical chassis

Jack Danielson,

Acting Deputy Administrator.

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