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PROPOSAL FOR A GLOBAL TECHNICAL REGULATION ON
DOOR LOCKS AND DOOR RETENTION COMPONENTS

Transmitted by the expert from the United States of America

Note: This document is distributed to the Experts on Passive Safety only.

A. STATEMENT OF TECHNICAL RATIONALE AND JUSTIFICATION

1.1. Introduction

Current regulations were designed to test for door openings in vehicles that were built in the 1960s. Aside from changes made to United States of America and Canadian requirements in the early to mid-1990s to address rear door openings, no significant changes have been made to any of the current regulations. While existing regulations governing door openings have proven largely effective, door openings continue to present the risk of serious injury or death to vehicle occupants, particularly when an occupant is unbelted.

The precise size of the safety problem posed by inadvertent door openings is difficult to quantify because very few jurisdictions gather the type of crash data needed to evaluate the problem. This task is further compounded by the effect of occupant belt use on injury risk. Notwithstanding the difficulty in quantifying the overall benefit associated with the establishment of a global technical regulation internationally, the types of changes to door retention components needed to upgrade existing regulations and standards appear to be quite small. Additionally, vehicle manufacturers, and the ultimate consumers of motor vehicles, can expect to achieve further cost savings through the formal harmonization of differing sets of standards that already largely replicate each other.

Research conducted by the United States indicates that there are approximately 42,000 door openings during a crash in the United States per year.1/ While this number corresponds to less than one per cent of the roughly six million crashes that occur in that country each year, the majority of those crashes do not occur at speeds where a door opening is likely. Rather, door failures appear to be most common in moderate- to high-speed crashes.2/

Structural failures of the latch and striker are the leading cause of door openings. The United States' evaluation of its data indicates that about two-thirds (64.5 per cent) of door openings involve damage to the latch or striker, either alone or in combination with damage to one or more hinges. The next most likely causes of a door opening are the failure of the vehicle structure holding the door in place or the door itself. In 8.37 per cent of the evaluated cases, the door support, e.g., B-pillar or C-pillar, was damaged; while in 9.68 per cent of the evaluated cases, the door structure caused the door to open without damaging the actual door retention components. Only rarely did a door open with no damage to the door whatsoever (2.15 per cent).

The type of crash also has an impact on the likely type of door failure. The primary source of failure in side impact crashes was damage to the latch/striker assembly, while damage to the door supports

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1/ At the request of the ad hoc working group established by the Working Party on Passive Safety, the U.S. provided data on the magnitude of the door ejections and door openings based on 1994-99 National Automotive Sampling System (NASS) and Fatal Analysis Reporting System (FARS) annual estimates. No data from other jurisdictions were presented.

2/ In the United States the average delta V for crashes where a door opens is approximately 30.5 km/h; the average delta V for crashes where there is no failure of the door retention system is approximately 21 km/h.

was a distant secondary source. In rollover crashes, non-structural failures, i.e., those where there is no damage to the door, are more common. Side door openings constitute approximately 90 per cent of all door ejection fatalities and 93 per cent of the serious injuries.

In 1991, the United States conducted an engineering analysis of door latch systems in cases involving vehicle side door openings to determine the loading conditions and failure modes of door latch systems in crashes.3/ This analysis revealed the following four distinct failure modes:

Structural Failures. Structural failures are characterized as physical damage to the latch, striker, or hinges. Other types of structural failures include broken attachment hardware or separation of a latch, striker, or hinge from its support structure.

Detent Lever-Fork Bolt Misalignment (Bypass) Failures. Detent lever-fork bolt misalignment (bypass) failures may occur when the striker is subjected to longitudinal forces in conjunction with lateral forces. These forces cause the fork bolt to move and become misaligned with the detent lever, causing the latch to open. These forces most typically occur in frontal and oblique frontal impacts.

Linkage Actuation Failures. Linkage actuation failures are caused by forces being transmitted to the door’s linkage system (i.e., the connection between the door handle and the door latch) due to vehicle deformation during a crash. It may be possible to observe some bowing of the door after a linkage actuation failure.

Inertial Force Failures. Inertial force failures are latch openings due to acceleration of latch system components relative to each other, which produce sufficient inertial force to activate the latch. Often, there is no visible damage to the latch or striker system. Inertial loading typically occurs in rollover crashes or when a portion of the vehicle other than the door is impacted at a high speed.

These four failure modes can be categorized as either structural failures or actuation failures. Structural failures usually leave clear evidence of the component failure and result in an inoperable door retention system. Actuation failures consist of latch by-pass, linkage actuation, and inertial force failures. Often a door opening caused by an actuation failure will not leave any readily visible evidence that the crash caused the door to open and will not affect the retention system’s subsequent ability to open and close correctly. Thus, many of the failures associated with a latch by-pass, linkage actuation, or inertial force failure will be represented by the 2.15 per cent of crashes where no damage to the door was observed.

According to the United States of America statistics, less than one per cent of occupants who sustain serious and fatal injuries in tow-away crashes are ejected through doors. Yet, despite the relatively rare occurrence of door ejections in crashes, the risk of serious or fatal injury is high when ejection does occur. Door ejections are the second leading source of ejections in all crashes in the United

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3/ Door Latch Integrity Study: Engineering Analysis and NASS Case Review, December, 1991, Docket No. NHTSA-1998-3705.

States of America. They are particularly likely in rollover crashes. Door ejections constitute 19 per cent (1,668) of ejection fatalities and 22 per cent (1,976) of ejection serious injuries in the United States each year.

The rate of ejections through doors is heavily dependent on belt use. 94 per cent of serious injuries and fatalities attributable to ejections through doors in the United States involve unbelted occupants. While the risk of ejection will likely vary from jurisdiction to jurisdiction, based on differing rates of belt use, the incidence of door openings should be relatively constant among various jurisdictions given the similarity in door designs and the lack of occupant behaviour patterns as a factor in door failures.

1.2. Procedural Background

During the one-hundred-and-twenty-sixth session of WP.29 of March 2002, the Executive Committee of the 1998 Global Agreement (1998 Agreement) adopted a Programme of Work, which includes the development of a global technical regulation (gtr) to address inadvertent door opening in crashes. The Executive Committee also charged the Working Party on Passive Safety (GRSP) to form an informal working group (working group) to discuss and evaluate relevant issues concerning requirements for door locks and door retention components to make recommendations regarding a potential gtr.

The United States volunteered to lead the group's efforts and develop a document detailing the recommended requirements for the gtr. The United States of America presented an informal document WP29/2003/6 in March 2003, formally proposing the work and highlighting the relevant issues to be addressed in the gtr.

The working group met to generally evaluate the likelihood of developing a door retention gtr on 2-3 September and on 9 December 2002, in Paris (France) and Geneva (Switzerland), respectively. A more thorough evaluation of the United States of America proposal was conducted on 3-4 April 2003 in London (England). On 23-24 July 2003 in Paris (France), a draft deliberative document of a global technical regulation, based on the discussions and agreements made during the previous meetings was presented for review. On 18-19 November 2003, there was further discussion on the revised version of the draft gtr. During the December 2003 GRSP session the draft gtr was presented and discussed. The working group had a meeting on 4-6 February 2004 to finalize the gtr before submission as a formal document to the GRSP.

The Contracting Parties represented on the working group were the Netherlands, France, Canada, Japan, United States of America, and the European Union. Representatives from the European Association of Automotive Suppliers (CLEPA) and the International Organization of Motor Vehicle Manufacturers (OICA) were also participants.

1.3. Existing Regulations, Directives, and International Voluntary Standards

There are several existing regulations, directives, and standards that pertain to door locks and door retention components. All share similarities. The Canadian and United States of America regulations are very similar to each other and the Japanese and UNECE Regulations are very similar to each other. The Australian regulation has commonalities to both of the above-mentioned pairs. A preliminary analysis has been made to identify the differences in the application, requirements, and test procedures of the North American and UNECE Regulation No. 11 (informal document No. 15 of the thirty-first GRSP session). There are no apparent conflicts between the gtr and other existing international standards. However, the gtr does incorporate aspects of the existing regulations, directives and standards that are not common to all existing requirements. Given the minor variability in the door retention designs among these jurisdictions that currently regulate door design, it is not expected that the additional requirements imposed by the gtr are likely to drive major, costly changes to existing door retention designs.

The following regulations, directives and international voluntary standards were considered in drafting the gtr:

(FMVSS No. 206)
European Union Directive 70/387/EEC, concerning the doors of motor vehicles and their trailers.
Canada Motor Vehicle Safety Regulation No. 206 – Door locks and door retention components. (CMVSS No. 206). [Note: The North American regulations FMVSS and CMVSS No. 206 are substantially similar].
Japan Safety regulation for Road Vehicle Article 25 –
Australian Design Rule 2/00 – Side Door Latches and Hinges
SAE J839, September 1998 – Passenger Car Side Door Latch Systems
SAE J934, September 1998 – Vehicle Passenger Door hinge Systems
ISO – No standards found

1.4. Discussion of Issues Addressed by the gtr

The proposed gtr provides that certain door retention components on any door leading directly into an occupant compartment, i.e., a compartment containing one or more seating accommodations, must comply with the requirements of the gtr. Tractor trailers are excluded because they do not meet this criterion. The gtr excludes folding doors, roll-up doors, detachable doors, and doors that provide emergency egress, as these types of doors would require entirely new test procedures and are not in such common use as to justify the development of new requirements and test procedures.

During the development of the gtr, the working group had thorough discussions on all sections. The following discussions reflect the working groups' evaluation of the issues that lead to the final recommendations.

1.4.1. Applicability

The application of a door retention component gtr uses, to the extent possible, the revised vehicle classification and definitions that the Working Party on General Safety (GRSG) Common Task Group has prepared. Difficulties were encountered in determining which vehicles would be covered. Currently, UNECE Regulations only apply to M1 and N1 vehicles that have 9 seats or less and weight 3,500 kg or less. Some members illustrated that it would be difficult to apply full door tests, such as the proposed inertial load, to large trucks and specialized vehicles. With the decision not to propose adoption of two full door tests, discussed in greater detail below, these concerns should be largely resolved. Likewise, the retention of a calculation for meeting the inertial load requirements would allow a jurisdiction to avoid applying a full-door inertial load test for doors on heavier vehicles. The members concerned about the applicability of door retention requirements on heavier vehicles proposed that the gtr only apply to passenger cars, light commercial vehicles, and vans and that other vehicles be excluded initially, then added in the future after further evaluation of various door designs. Some of those arguing in favour of a more inclusive gtr noted that current Australian, Canadian and United States of America requirements already apply to all vehicles other than buses (M2 and M3 vehicles) and that the applicability of existing requirements to commercial trucks has not proven problematic for vehicle manufacturers. These members preferred the exclusion of specific door types rather than entire classes of vehicles.

[To accommodate both positions, the gtr will apply to all vehicles except buses, with exceptions for specific door designs. However, if a jurisdiction determines that its domestic regulatory scheme is such that full applicability is inappropriate, it may limit domestic regulation to vehicles with a gross vehicle weight of 3,500 kg or less.]

[To accommodate both positions, the gtr will apply to all vehicles with a gross vehicle weight of 3,500 kg or less, with exceptions for specific door designs. Jurisdictions may require heavier vehicles to meet some or all of the requirements set forth in the gtr to retain their current levels of vehicle safety.]

1.4.2. General Requirements

The ad hoc committee agreed that the gtr should specify requirements for side and back doors, door retention components and door locks. Australian, Canadian and United States of America regulations have provisions for back doors and door locks, the UNECE regulations do not.

Currently, UNECE regulations require that the sliding door systems be tested in a fully latched position and an intermediate latched position, if there is no intermediate position, when unlatched, the door must move into an apparent open position. The Canadian and United States of America regulations have no latching system requirements for the sliding doors. The committee agreed it was appropriate to regulate the sliding side door latching system, but recognized that the existing UNECE requirement to determine whether a sliding side door was unlatched was too subjective. Accordingly, the gtr specifies a door closure warning system that activates when the sliding side door is not latched and there is no intermediate/secondary latching position.

The adoption of a requirement in the gtr that side doors remain shut during vehicle dynamic crash tests, as well as a requirement that at least one door per row be operable following a crash test, was considered. Existing UNECE regulations with dynamic crash test components already require the door stay closed during the test and be able to be open afterwards. It is believed that it is unnecessary to repeat this requirement in the gtr and its inclusion would make the certification process under this standard very difficult. However, recognizing the value of such a requirement, non-UNECE countries have agreed to consider adopting a similar requirement in their domestic regulations. This will result in a harmonized requirement outside of the context of the gtr.

Force levels identified in the current component static tests for latches and hinges have been harmonized to eliminate variations due to rounding of unit conversions.

1.4.3. Performance Requirements

1.4.3.1. Hinged Doors Issues

Currently, UNECE Regulation No. 11 has similar hinged door requirements to FMVSS No. 206, although UNECE Regulation No. 11 does not distinguish between cargo and non-cargo door latches. The group agreed that cargo doors (i.e., double doors) meet the same requirements as hinged doors if they provide access to the occupant-seating compartment. Additionally, the term "cargo door" has been eliminated to clarify that doors that do not lead into an occupant compartment with one or more seat positions are not regulated by the gtr.

1.4.3.2. Load Tests

Both standards require load tests of the hinge systems in the longitudinal and transverse directions. These tests remain, but have been reworded such that the loads are applied based on the alignment of the hinge system and not the alignment of the vehicle. A load test in the vertical direction was evaluated and ultimately rejected except for back doors. Since a large number of door openings occur during vehicle rollovers, it was suggested that perhaps a load test in the vertical direction would help reduce these types of openings. However, the committee ultimately determined that the addition of a load test conducted in a direction orthogonal to the existing tests could not be justified at the present time. Those countries concerned about protecting against rollover crash door openings may determine that such a test would be useful outside the context of the gtr.

1.4.3.3. Inertial Test

The working group has agreed to recommend adopting a dynamic inertial test requirement to the gtr, as an option to the inertial calculation. There are provisions for this type of testing in both the UNECE and FMVSS regulation, but there is no specified test procedure. A test procedure was developed based on the testing currently conducted for the UNECE requirement and validated by Canada and the United States of America. In addition to the longitudinal and transverse tests, tests in the vertical direction were considered. Conducting the inertial test in the vertical direction is feasible, but it much more difficult to conduct than the tests in the longitudinal and transverse directions. Since the most common failure mode demonstrated in the inertial tests conducted by Canada was in the direction of door opening, the committee determined that a test in the vertical direction appeared to be beneficial only for back door designs, which commonly open in the vertical direction. However, those countries concerned about protecting against rollover crash door openings may determine that such a test would be useful outside the context of the gtr.

[1.4.3.4. New Combination Component Test

The gtr adds a new combination test procedure for hinged side doors that is representative of the combination of longitudinal compressive and lateral tensile forces that occur in real-world latch failures. Currently, no regulation, directive, or international voluntary standard has such a requirement. Examples of the types of crashes in which such forces could occur are crashes in which either the front or the rear of the vehicle is impacted (including in an offset mode). The proposed combination test procedure is a static bench test capable of evaluating the strength of the latching systems and designed to detect fork bolt detent bypass failures. No other test procedure within the gtr simulates these types of latch failure conditions.

In the combination test, the latch is mounted on a flat steel plate that moves horizontally and the striker is mounted on a vertically moving ram device. During the test, the latch and striker, while in their primary coupled position, are simultaneously moved such that lateral tension (i.e., force applied perpendicularly to the coupled latch and striker) and longitudinal compressive forces (i.e., force applied against the latch toward the striker) are applied at their interface.

The required forces for the primary position of the hinged side door latching systems would be simultaneous forces of 16,000 N longitudinal compressive force and 6,650 N lateral tensile force. The longitudinal force application device is moved at a rate of one centimeter per minute until the longitudinal force is achieved.]

1.4.3.5. Door Hinges

Both the UNECE and FMVSS regulations have the same load testing requirements for door hinges. The current side door requirements for hinges, which are based on SAE Recommended Practice J934, *Vehicle Passenger Door Hinge Systems*, appear to test adequately the strength and design of door hinges. The United States' comprehensive analysis of its data and possible failure modes has not revealed problems with door hinges. Accordingly, these requirements have been included in the gtr. The current UNECE requirements only allow for the hinges to be mounted on the forward edge in the direction of travel. This requirement was based on the safety concern of a possible inadvertent opening while the vehicle is in motion. This requirement, as stated, was found to be design restrictive and the safety concerns were resolved by developing text to regulated the design and not prohibit it.

1.4.3.6. Hinged Side Door System Tests (Full Door Tests)

Canada and the United States of America have developed a series of new test procedures designed to simulate real world door opening in crashes. These tests consist of door-in-frame quasi-static (full door) tests in both longitudinal and lateral directions, independent from the door system.

The lateral full door test is designed to simulate latch failures in crashes that produce outwards forces on the door (i.e., through occupant loading or inertial loading) such as side crashes that result in vehicle spin and rollover. The longitudinal full door test is designed to simulate a collision in which the side of the vehicle is stretched, leading to the possibility that the striker could be torn from its mated latch (i.e., far side door in side impacts, and front and rear offset crashes on the opposite side door).

The committee has decided against supporting the adoption of full door tests into the gtr because the tests raise concerns about unduly restricting door designs, developing a repeatable and enforceable test procedure, and addressing door openings under real world conditions. Because of the current European Union requirement for both the component tests and a door closure requirement in dynamic tests, there is some question as to whether a full door test provides any additional value. In an analysis of the proposed tests using its FARS and NASS databases, the United States was unable to correlate the proposed tests with a reduction on door openings in real world crashes at a level that was statistically significant.

Some members of the working group have evaluated the contemplated test procedures. They expressed concern that the new procedure will end up being unduly design restrictive, given the limitations of the test frame. For example, it may be that multiple test frames would be required to ensure an appropriate "fit" between the door and the test frame. This is because placement of the test load relative to the latch mechanism may be sufficiently different to produce significantly different results, and because door specific holes must be drilled into the test frame. Additionally, the test frame may not adequately address new latch designs that may be mounted in non-traditional locations. Likewise, the procedure does not allow manufacturers the benefit of non-latch attachments that are primarily used for side impact purposes but also may have a positive effect on door closure.

Those members voicing concerns over the new procedures have argued that conducting the proposed tests on a test frame rather than on the full vehicle is impractical because not all loads can be applied to a closed door. However, it may be possible to cut the door frame and attach it to the test frame, although such an approach may not fully replicate the actual door-in-frame as installed in the vehicle since cutting the door frame may change its characteristics. Such an approach may address the fit between the latch and striker, as well as the physical characteristics of the door and the doorframe.

1.4.3.7. Side Sliding Doors Issues

The requirements and test procedures in both UNECE Regulation No. 11 and the North American standards were discussed and the current requirements for the track and slide combinations of side sliding doors were included in the gtr. The latch/striker system requirements of UNECE Regulation No. 11 were also included. However, neither regulation had a detailed full vehicle sliding door test procedure that simulates real world door openings in crashes.

The procedure in the gtr is based on a procedure that Canada and the United States of America have been developing. It is a full vehicle test in which a sliding door is tested by applying force against the entire door. The test setup is initiated by placing two loading plates against the interior of the door at its forward and aft edges. The loading plates are placed adjacent to the latch/striker system located at the door edge. If the door edge has two latch/striker systems, the loading plate is placed between the two systems. If a door edge does not have a latch/striker system, the loading plate is placed at a point midway along the length of the door edge. An outward lateral force of 17,800 N is then applied to the loading plates, placing force against the two door edges. A test failure would be indicated by a 10 cm separation of the door from the vehicle frame, [a total displacement over 460 mm,] or the breakage of any latch or striker prior to the end of the test. The gtr requires that there be no more than 10 cm of separation, even if the retention system does not fail, because, unlike hinged doors, the configuration of sliding doors allows for separation of the door from the frame without the latch system failing. The 10 cm limit is based on the size of an infant's head and is a commonly used measurement for maximum allowable open space in building code restrictions designed to address the risk of injury due to excessive gaps.

1.4.3.8. Door Locks

Unlike the door lock and door retention component requirements in North America, UNECE Regulation No. 11 does not have provisions for door locks. It was agreed to adopt the North American requirements for front door locks of having the outside handle be inoperative when the locking mechanism is engaged, since this is already standard practice in Europe and Japan. There was more debate over the requirements for rear door locks.

The North American standards require that when the door lock is engaged the both the inside and outside release controls shall be inoperative. Some of the working group members expressed concerns over including such requirements in the gtr, because it might hamper egress from the vehicle in a post crash environment. Others insisted that such requirements are necessary for the protection of children in the rear seat. In discussing this issue, several recommendations were made for inclusion in the gtr:

- i) a door that can be opened with a single movement of the door handle when the door is in a locked position must be fitted with a child safety lock,
- ii) automatic door locks that allow the driver to engage or disengage the child safety locks from the front seat would be acceptable,
- iii) doors that require some action other than the release of the door with a single movement of the door handle when the door is in a locked position may have child locks, but would not be required to have such locks; these doors could be required to have a manual door-lock release that would allow rear-seat passengers to open the door in the event of a crash.

The United States of America indicated that child locks are not regulated in the current North American standards, and that it is important that doors not be allowed to open from the interior with a single movement of the door handle when the door is locked.

The philosophical difference in opinion among the members of the committee in how best to address the need for egress from a rear seat against the need to prevent children from opening a locked door precluded a single solution to rear door lock requirements. Instead, the committee has crafted a requirement that the interior door locking mechanism on a rear door, when engaged, must be releasable by an action other than the simple, single pull on the interior door handle. A jurisdiction may require that the separate action be directly available to either the driver of the vehicle or an occupant immediately adjacent to the locked door, or that the vehicle be equipped with either an automatic or manual child lock system. Neither type of system would be prohibited as a supplemental safety device, and a jurisdiction could determine that either system was acceptable as the primary safety device.

1.5. Reference Documents used by the Working Group

A list of informal documents used by this Informal group is listed and available on the UNECE website. In addition, test reports and other pertinent documents detailing Canada and the United States of America proposed test procedures are accessible from the United States of America Department of Transportation Docket Management System (Docket No. NHTSA-1996-3705) Web access at http://dms.dot.gov/

Number of Informal Document */	Title of Informal Document
TRANS/WP.29/GRSP/2001/1	Proposal for Draft Candidate gtr on Door Latches and Door Retention Components (OICA)
Informal document No. 15 of the thirty-first GRSP session	Comparison Between FMVSS No. 206 and UNECE Regulation No. 11 (U.S.)
INF GR/DL/1/1	Agenda September 2002 Meeting
INF GR/DL/1/2	Summary of Lateral Full Door Test (U.S.)
INF GR/DL/1/3	Summary of Longitudinal Full Door Test (U.S.)
INF GR/DL/1/4	Summary of Combination Test (U.S.)
INF GR/DL/1/5	Summary of Transport Canada Sliding Door Test (Canada)
INF GR/DL/1/6	Transport Canada Test Reports (Canada)
INF GR/DL/2/1	Agenda December 2002 Meeting
INF GR/DL/2/2	Proposal for a Test Procedure Concerning the Resistance against Inertial Loads of Side Door Locks on Motor Vehicles (OICA)
INF GR/DL/2/3	Comparison of Locking Requirements in FMVSS 206 with UNECE Regulation No. 11 (OICA)
INF GR/DL/3/1	Agenda April 2003 Meeting
INF GR/DL/3/2	Crash Data on US Door Ejection/Openings (U.S.)
INF GR/DL/3/3	Full Door and Combination Detailed Test Procedures (U.S.)
INF GR/DL/3/4	Dynamic Inertial Sled Test Pulse (UTAC France)
INF GR/DL/4/1	Agenda July 2003 Meeting
INF GR/DL/5/1	Agenda November 2003 Meeting
INF GR/DL/5/2	BMW Presentation, “Proposed Door Test Procedures - Hinged Side Doors”
INF GR/DL/5/3	Photos and acceleration plots of inertial loading in z-direction

*/ Informal Report (INF), GRSP Informal group (GR), Door Locks and Door Retention Components (DL), Meeting No., and Report Number

B. GLOBAL TECHNICAL REGULATION "X"

1. Scope and Purpose. This regulation specifies requirements for vehicle door locks and door retention components, including latches, hinges, and other supporting means, to minimize the likelihood of occupants being thrown from a vehicle as a result of impact.

2. Application. This regulation applies to the components on side or back doors and door retention components that lead directly into a compartment that contains one or more seating accommodations in [Category 1-1 vehicles, or Category 2 vehicles [<3,500 kg], as defined by gtr 0.]

3. Definitions:

3.1. "Auxiliary Door Latch" is a latch, other than the primary door latch, fitted to a door or door system that is equipped with more than one latch.

3.2. "Back Door" is a door or door system on the back end of a motor vehicle through which passengers can enter or depart the vehicle. [or cargo can be loaded or unloaded.] It does not include:
(a) A trunk lid; or
(b) A door or window that is composed entirely of glazing material and whose latches and/or hinge systems are attached directly to the glazing material.

3.3. "Child Safety Lock System" is a locking mechanism which can be engaged and released independently of other locking mechanisms and which, when engaged, prevents operation of the interior door handle or other release mechanism. The lock release/engagement mechanism may be manual or electric and may be located anywhere on or in the vehicle.

3.4. "Door Closure Warning System" is a system that will activate a visual signal located where it can be clearly seen by the driver when a door latch system is not in its fully latched position and while the vehicle ignition is activated.

3.5. "Door Hinge System" is the complete set of hinges on a door and its surrounding doorframe.

3.6. "Door Latch System" consists, at a minimum, of a latch and a striker.

3.7. "Door System" is the door, latch, striker, hinges, sliding track combinations and other door retention components on a door and its surrounding doorframe. The door system of a double door includes both doors.

3.8. "Double Door" is a system of two doors where the front door or wing door opens first and connects to the rear door or bolted door, which opens second.

3.9. ["Folding Door" is a movable barrier, which will close off an entranceway to a bus, multipurpose passenger vehicle or truck, consisting of two or more hinge panels that swing, slide, or rotate; does not have a striker and latch assembly; and is normally controlled from a location adjacent to the vehicle's driver seat.]

3.10. "Fork-bolt" is the part of the latch that engages and retains the striker when in a latched position.

3.11. "Fork-bolt Opening" is the direction opposite to that in which the striker enters to engage the fork-bolt.

3.12. "Fully Latched Position" is the coupling condition of the latch that retains the door in a completely closed position.

3.13. "Latch" is a mechanical device employed to maintain the door in a closed position relative to the vehicle body with provisions for deliberate release (or operation).

3.14. "Primary Door Latch" is a latch equipped with both a fully latched position and a secondary latched position.

3.15. "Primary Door Latch System" consists, at a minimum, of a primary door latch and a striker.

3.16. "Secondary Latched Position" refers to the coupling condition of the latch that retains the door in a partially closed position.

3.17. "Side Front Door" is a door that, in a side view, has 50 per cent or more of its opening area forward of the rearmost point on the driver's seat back, when the seat back is adjusted to its most vertical and rearward position.

3.18. "Side Rear Door" is a door that, in a side view, has 50 per cent or more of its opening area to the rear of the rearmost point on the driver's seat back, when the driver's seat is adjusted to its most vertical and rearward position.

3.19. "Striker" is a mechanical device with which the latch engages on the opposing member of the latch system.

3.20. "Trunk Lid" is a movable body panel that provides access from outside the vehicle to a space wholly partitioned from the occupant compartment by a permanently attached partition or fixed or fold-down seat back.

4. General Requirements

4.1. The requirements apply to all side and back doors and door components except for those on folding doors, roll-up doors, detachable doors, and doors that are designated to provide emergency egress.

4.2. Door Latches

4.2.1. Each hinged door system shall be equipped with at least one primary door latch.

4.2.2. Each sliding door system shall be equipped with either a:

a) a primary door latch, or
b) a latch system with a fully latched position and a door closure warning system.

5. Performance Requirements

5.1. Hinged doors

5.1.1. Load Test One. Each primary door latch system, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch such that the latch and the striker anchorage are not compressed against each other. When in the secondary latched position, the primary latch system shall not separate when a load of 4,500 N is applied in the same direction when tested in accordance with paragraph 7.1.1.1.

5.1.2. Load Test Two. Each primary door latch system, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the direction of the fork-bolt opening and parallel to the face of the latch. When in the secondary latched position, the primary latch system shall not separate when a load of 4,500 N is applied in the same direction when tested in accordance with paragraph 7.1.1.1.

5.1.3. Load Test Three. The primary door latch system on back doors shall not disengage from the fully latched position when a load of 9,000 N is applied in a direction orthogonal to the directions specified in paragraphs 5.1.1 and 5.1.2 when tested in accordance with paragraph 7.1.1.1.

5.1.4. Inertia Load.

5.1.4.1. The primary door latch on each hinged door shall not disengage from the fully latched position when an inertia load of 30 g - 36 g is applied to the door latch system, including the latch and its activation mechanism, in the directions parallel to the vehicle's longitudinal and transverse axes with the locking mechanism disengaged and when tested in accordance with paragraph 7.1.1.2.

5.1.4.2. The primary door latch on each hinged back door shall also not disengage from the fully latched position when an inertia load of 30 g - 36 g is applied to the door latch system, including the latch and its activation mechanism, in the direction parallel to the vehicle's vertical axis, with the locking mechanism disengaged and when tested in accordance with paragraph 7.1.1.2.

5.1.5. [Combination Force Application for Hinged Side Doors, except double doors. Each primary door latch system, shall not separate from the fully latched position under simultaneous forces of 16,000 N applied in the direction perpendicular to the face of the latch such that the latch and striker anchorage are in compression and 6,650 N applied in the direction of the fork bolt opening and parallel to the face of the latch when tested in accordance with paragraph 7.1.1.3.]

5.1.6. Auxiliary Door Latches. Each auxiliary latch system shall be provided with a fully latched position and shall comply with the requirements specified in paragraphs 5.1.1., 5.1.2., and 5.1.4.

5.1.7. Door Hinges.

5.1.7.1. Each door hinge system shall:

(a) Support the door,
(b) Not separate when a longitudinal load of 11,000 N is applied,
(c) Not separate when a transverse load of 9,000 N is applied, and
(d) On back doors only, not separate when a vertical load of 9,000 N is applied.

5.1.7.2. All tests required by paragraph 5.1.7.1 are conducted in accordance with paragraph 7.1.2.

5.1.7.3. In the event that a single hinge within the hinge system is tested, the hinge must bear a load proportional to the total number of hinges in the hinge system.

5.1.7.4. On side doors with rear mounted hinges that can be operated independently of other doors,

(a) The interior door handle shall be inoperative when the speed of the vehicle is greater than or equal to 4 km/h, and
(b) A door closure warning system shall be provided for those doors.

5.2. Sliding Side Doors

5.2.1. Load Test One. The door latch system, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch when tested in accordance with paragraph 7.2.1.1.

5.2.2. Load Test Two. The door latch system, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the direction of the fork-bolt opening and parallel to the face of the latch when tested in accordance with paragraph 7.2.1.1.

5.2.3. Inertia Load

Each door latch system shall not disengage from the fully latched position when an inertia load of 30 g – 36 g is applied to the door latch system, including the latch and its activation mechanism, in the directions parallel to the vehicle's longitudinal and transversal axes with the locking mechanism disengaged and when tested in accordance with paragraph 7.2.1.2.

5.2.4. Door System

5.2.4.1. The track and slide combination or other supporting means for each sliding door, while in the closed primary latched position, shall not separate from the door frame when a total force of 18,000 N along the vehicle transverse axis is applied to the door in accordance with paragraph 7.2.2.

5.2.4.2. The sliding door fails this requirement if any one of the following occurs:

5.2.4.2.1. The separation between any point on the door edge and the doorframe exceeds 100 mm, as measured by passing a 100 mm diameter sphere completely through the gap between the door and the body of the vehicle after completion of the test.

5.2.4.2.2. Either ram reaches a total displacement of 460 mm.

5.3. Door Locks

5.3.1. Each door shall be equipped with at least one locking mechanism which, when engaged, shall prevent operation of the exterior door handle or other exterior latch release control and which has an operating means and a lock release/engagement mechanism located within the interior of the vehicle.

5.3.2. Rear side doors

Each rear side door shall be equipped with at least one locking mechanism which, when engaged, prevents operation of the interior door handle or other interior latch release control and requires separate actions to unlock the door and operate the interior door handle or other interior latch release control.

5.3.2.1. This may be achieved, in agreement with the relevant approval authorities, by:

(a) a child safety lock system, or

(b) a lock release/engagement mechanism located within the interior of the vehicle and readily accessible to the driver of the vehicle or an occupant seated adjacent to the door.

5.3.2.2. Either system described in paragraph 5.3.2.1 (a) and (b) shall be permitted as an additional locking feature.

5.3.3. Back doors

Each back door equipped with an interior door handle or other interior latch release control, shall be equipped with at least one locking mechanism which, when engaged, prevents operation of the interior door handle or other interior latch release control and requires separate actions to unlock the door and operate the interior door handle or other interior latch release control.

6. Test Conditions

(no general test conditions specified)

7. Test Procedure

7.1. Hinged Doors

7.1.1. Door Latches

7.1.1.1. Load Test One, Two, and Three Force Application. Compliance with paragraphs 5.1.1., 5.1.2. and 5.1.3. is demonstrated in accordance with annex 1.

7.1.1.2. Inertia Force Application. Compliance with paragraph 5.1.4. is demonstrated in accordance with annex 2.

7.1.1.3. Combination Force Application. Compliance with 5.1.5. is demonstrated in accordance with annex 3.

7.1.2. Door Hinges. Compliance with paragraph 5.1.7. is demonstrated in accordance with annex 4.

7.2. Sliding Side Doors.

7.2.1. Door Latches

7.2.1.1. Longitudinal and Transverse Force Application. Compliance with paragraphs 5.2.1. and 5.2.2., is demonstrated in accordance with annex 1.

7.2.1.2. Inertia Force Application. Compliance with 5.2.3. is demonstrated in accordance with annex 2.

7.2.2. Door System. Compliance with paragraph 5.2.4. is demonstrated in accordance with annex 5.

Annex 1

Latch Test for Load Test One, Two, and Three Force Applications

1. Purpose. These tests are intended to establish minimum performance requirements and test procedures for evaluating and testing passenger car side door latch systems for their ability to resist force load perpendicular to the latch face, in the direction of door opening and for back doors, orthogonal to the first two directions, while in the fully and secondary latched positions. It is limited to tests that can be conducted on uniform test fixtures and equipment in commercially available laboratory test facilities.

2. Definitions.

2.1. Latch—A mechanical device employed to maintain the door in a closed position relative to the vehicle body with provisions for deliberate release (or operation).

2.2. Basic latch components (nomenclature) are:

2.2.1. Plate—The main body or frame for supporting working components, appendages, and transmitting or distributing loads to the door structure.

2.2.2. Ratchet—A member of the latch connected to the fork bolt to provide an abutment or abutments which, when properly indexed, become engaged with a related pawl to inhibit motion of the fork bolt in one direction.

2.2.3. Pawl—A member of the latch that can be caused to engage the abutments of the ratchet to inhibit relative motion between the two parts except in one direction.

3. Basic Requirements

3.1. Load Test One. The primary door latch and striker assembly, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch such that the latch and the striker anchorage are not compressed against each other. When in the secondary latched position, the primary latch and striker assembly shall not separate when a load of 4,500 N is applied in the same direction.

3.2. Load Test Two. The primary door latch and striker assembly, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the direction of the fork-bolt opening and parallel to the face of the latch. When in the secondary latched position, the primary latch and striker assembly shall not separate when a load of 4,500 N is applied in the same direction.

3.3. Load Test Three. The primary door latch and striker assembly shall not disengage from the fully latched position when a load of 9,000 N is applied in a direction orthogonal to the directions specified in paragraphs 3.1 and 3.2.

4. Test Operation

4.1. Load Test One

4.1.1. Equipment. Tensile testing machine (see Figure 1).

4.1.2. Procedures

4.1.2.1. Fully Latched Position

4.1.2.1.1. Attach the test fixture to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount fixture with latch and striker in fully latched position in the test machine so as to apply a load in the direction specified in paragraph 3.1.

4.1.2.1.2. Locate weights to apply a 900 N load tending to separate the latch and striker in the direction of the door opening.

4.1.2.1.3. Apply the test load at a rate not to exceed 5 mm/min until failure. Record maximum load.

4.1.2.2. Secondary Latched Position

4.1.2.2.1. Attach the test fixture to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount fixture with latch and striker in secondary latched position in the test machine so as to apply a load in the direction specified in paragraph 3.1.

4.1.2.2.2. Locate weights to apply an 900 N load tending to separate the latch and striker in the direction of the door opening.

4.1.2.2.3. Apply the test load at a rate not to exceed 5 mm/min until failure. Record maximum load.

4.1.2.2.4. The test plate to which the door latch is mounted will have a striker cut-out configuration similar to the environment in which the door latch will be mounted on normal vehicle doors.

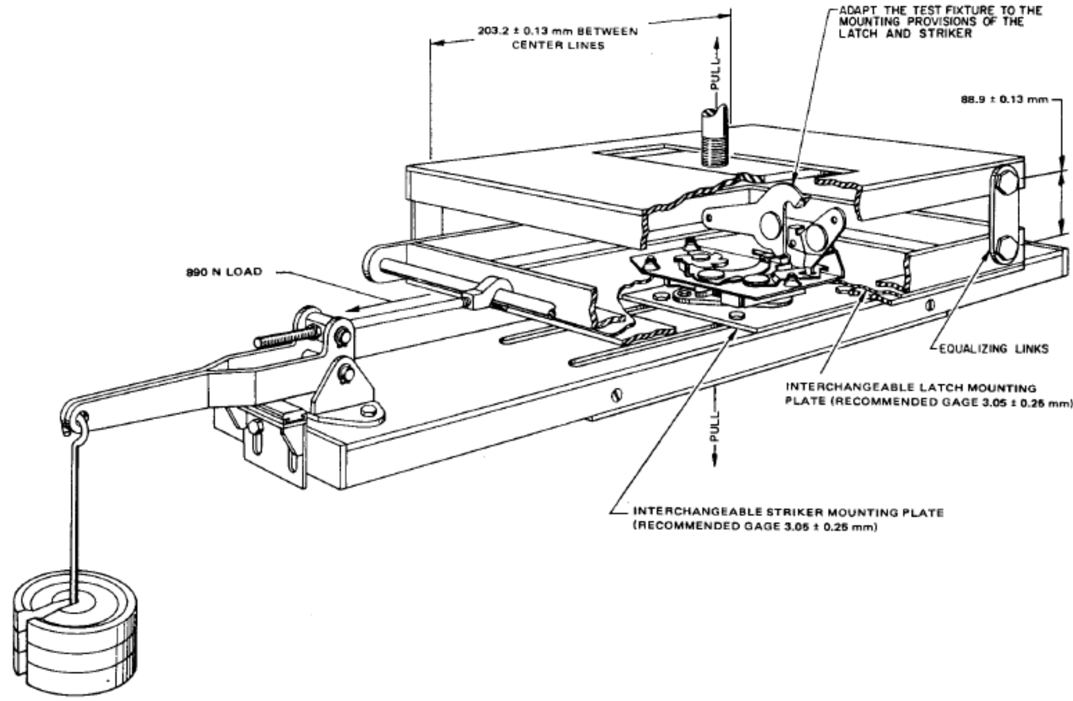


FIGURE 1—DOOR LATCH—STATIC LOAD TEST FIXTURE (LONGITUDINAL LOAD)

4.2. Load Test Two and Three

4.2.1. Equipment. Tensile testing machine (see Figure 2).

4.2.2. Procedures

4.2.2.1. Fully Latched Position

4.2.2.1.1. Adapt the test fixture to the mounting provisions of the latch and striker. Mount fixture with the latch and striker in fully latched position in the test machine so as to apply a load in the directions specified in paragraph 3.2 and, for back doors also paragraph 3.3.

4.2.2.1.2. Apply the test load at a rate not to exceed 5 mm/min until failure. Record the maximum load.

4.2.2.2. Secondary Latched Position

4.2.2.2.1. Adapt the test fixture to the mounting provisions of the latch and striker. Mount fixture with the latch and striker in secondary latched position in the test machine so as to apply a load in the directions specified in paragraph 3.2.

4.2.2.2.2. Apply the test load at a rate not to exceed 5 mm/min until failure. Record the maximum load.

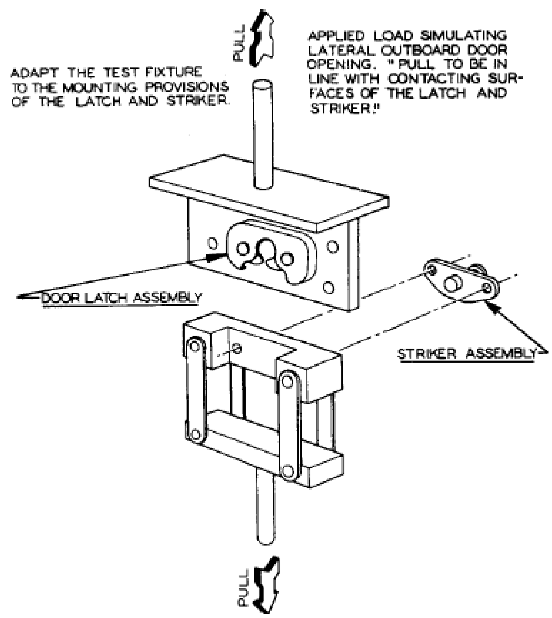


FIGURE 2—DOOR LATCH—STATIC LOAD FIXTURE (LATERAL LOAD)

Annex 2

Inertial Test Procedures

1. Purpose. To determine the ability of the vehicle latch system to resist inertia loading by means of a mathematical analysis of the component parts in their true car relationship or by evaluation using a dynamic test.

2. Test Requirements

2.1. The primary door latch on each hinged door shall not disengage from the fully latched position when an inertia load of 30 g - 36 g is applied to the door latch system, including the latch and its activation mechanism, in the directions parallel to the vehicle's longitudinal and transverse axes with the locking mechanism disengaged.

2.2. The primary door latch on each hinged back door shall also not disengage from the fully latched position when an inertia load of 30 g – 36 g is applied to the door latch system, including the latch and its activation mechanism, in the direction parallel to the vehicle's vertical axis, with the locking mechanism disengaged.

2.3. Validate the requirements using either by mathematical calculation or by a dynamic test (see items 3.1. and 3.2., and Figure 1).

3. Test Procedures

3.1. Option 1, Calculation Consideration—Each component or subassembly can be calculated for its minimum inertia load resistance in a particular direction. Their combined resistance to the unlatching operation must assure that the door latch system (when properly assembled in the vehicle door) will remain latched when subjected to an inertia load of 30 g in any direction. Figure 2 is an example of the components and combinations of components to be considered.

3.2. Option 2, Dynamic Test (allows for evaluation using full vehicle or door-on-sled)

3.2.1. <u>Full Vehicle Test</u>

3.2.1.1. Test Equipment

3.2.1.1.1. An acceleration device

3.2.1.1.2. A vehicle or a vehicle body in white (i.e., vehicle frame, doors and other door retention components) including door(s), door latch(es), exterior door handles with mechanical latch operation, interior door opening lever and the locking device (to be attached to the sled device).

3.2.1.1.3. A device or means for recording door opening 1/ 2/

3.2.1.1.4. Equipment for measuring and recording accelerations.

3.2.1.2. Test Setup

3.2.1.2.1. Close the door and ensure that the latch is in the primary position

3.2.1.2.2. Mount the high speed camera to the exterior of each side and the back of the vehicle facing the doors

3.2.1.2.3. Ensure doors are shut in the primary latched position, tethered and unlocked

3.2.1.2.4. Attach the device for record door openings

3.2.1.2.5. Rigidly secure the full vehicle or vehicle body in white to a device that when accelerated together assure that all points on the crash pulse curve are within the corridor defined in Figure 2.

3.2.1.2.6. Longitudinal Setup. Orient the acceleration device in the direction of a frontal impact.

3.2.1.2.7. Transverse Setup. Orient the acceleration device in the direction of a side impact.

3.2.1.2.8. For vehicles that have asymmetrical doors on each side, two tests will be conducted from each side of the vehicle

3.2.2. Door Deceleration Test

3.2.2.1. Test Equipment

3.2.2.1.1. The door assembly including all its door-retention and load-bearing components (i.e., latch, striker and hinges)

3.2.2.1.2. A buck to mount the door(s)

3.2.2.1.3. An acceleration device

1/ It is important to note that a failure of the inertial dynamic test only constitutes the latch system releasing from both the primary and secondary positions. Thus, a door system that fails in the primary latched position but retains the secondary position can still pass compliance.

2/ The purpose of this device is to record a door opening during that rebounds off the tether and closes again. Possible devices can include a high speed camera speed with a rate of 500 frames per second or higher or a marker stick which is placed 100 mm from the door end and used to visibly mark the door if an opening occurs.

3.2.2.1.4. A tether

3.2.2.1.5. A means for recording door opening 3/

3.2.2.1.6. Equipment for measuring and recording accelerations

3.2.2.2. Test Setup

3.2.2.2.1. Ensure that the latch and striker are engaged in the primary position and that the door is tethered and unlocked

3.2.2.2.2. Mount the door assemblies either separately or combined to the buck. The doors should be mounted to correspond to their orientation in the vehicle and to the direction required for inertial load tests (see below)

3.2.2.2.3. Attach the device for recording door openings

3.2.2.2.4. Mount the buck to the acceleration device

3.2.2.2.5. Longitudinal Setup. Orient the door subsystem(s) on the acceleration device in the direction of a frontal impact (the door(s) should be configured similar to their in-vehicle-position)

3.2.2.2.6. Transverse Setup. Orient the door subsystem(s) on the acceleration device in the direction of a side impact (the door(s) should be configured similar to their in-vehicle-position)

3.2.2.2.7. Vertical/Orthogonal (for back doors only). Orient the door subsystem(s) on the acceleration device in the direction of a side impact (the door(s) should be configured similar to their in-vehicle-position)

3.2.3. Test Operation

3.2.3.1. The test acceleration pulse corridor is defined in Table 1 and graphically shown in Figure 3.

3.2.3.2. Accelerate the test fixture to 30 g's over a period of 16 to 20 ms and hold the acceleration within the pulse corridor (defined in Figure 1) for at least 20 ms in the following directions:

3/ The purpose of this device is to record a door opening during that rebounds off the tether and closes again. Possible devices can include a high speed camera speed with a rate of 500 frames per second or higher or a marker stick which is placed 100 mm from the door end and used to visibly mark the door if an opening occurs.

3.2.3.2.1. In both horizontal directions parallel to the vehicle longitudinal axis (positive and negative X-direction)

3.2.3.2.2. In both horizontal transverse directions (positive and negative Y-direction)

3.2.3.2.3. Table 1 and Figure 2 presents the pulse corridors for the acceleration of the test

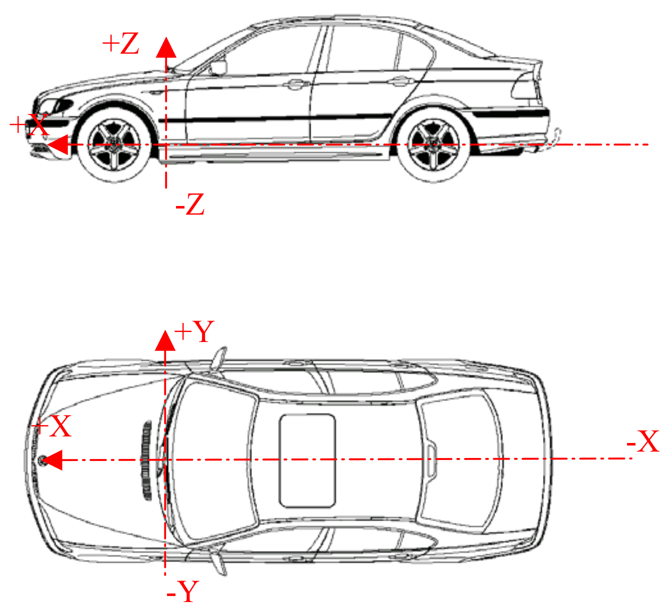
3.2.3.3. Then decelerate the device over a period of 20 to 40 ms.

3.2.3.4. When the test is complete, verify whether that the door latch(es) are still in either the primary or secondary latched position. Perform the following validation test:

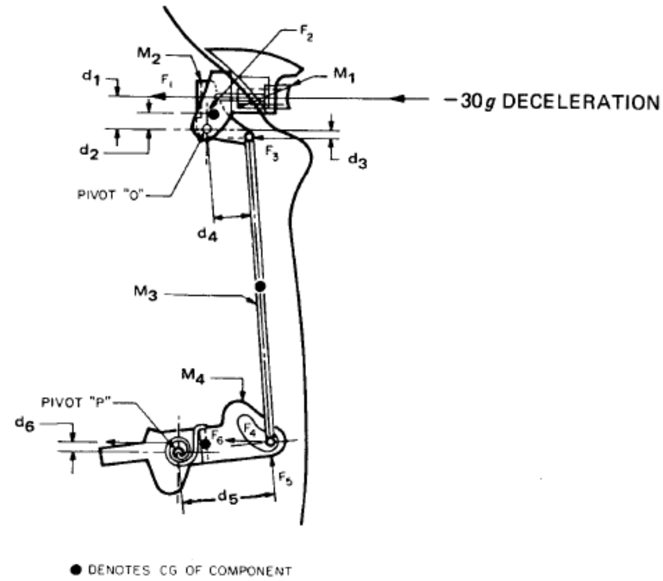
3.2.3.4.1. Apply a horizontal (±5 degrees) force of 250 N perpendicular to the longitudinal centreline of the vehicle in the door opening direction. The force shall be applied at a point on the door that is 5 cm (±1 cm) from the centre of the exterior door. The door shall not open from the secondary latched position

3.2.3.4.2. Ensure that the door did not open and close during the test.

Figure 1 - Vehicle Coordinate Reference System for Inertia Testing



X	=	**longitudinal direction**
Y	=	**transversal direction**
Z	=	**vertical direction**



Given: Door Latch System Subjected to 30 g Deceleration
Average Push-Button Spring Output Force = 4.5 N
Pawl Spring Output Torque = 0.45 N·m
$a = 30g$ (m/s^2)
$F = ma = 30mg = 294.2 \cdot m$

$M_1 = 0.0163$ kg	$d_1 = 31.50$ mm
$M_2 = 0.0227$ kg	$d_2 = 10.67$ mm
$M_3 = 0.0122$ kg	$d_3 = 4.83$ mm
$M_4 = 0.0422$ kg	$d_4 = 31.50$ mm
	$d_5 = 37.60$ mm
	$d_6 = 1.91$ mm

$$F_1 = M_1a - \text{(avg. spring output)} = (0.0163 \times 294.2) - 4.5 = 0.30\ \text{N}$$

$$F_2 = M_2a = 0.0227 \times 294.2 = 6.68\ \text{N}$$

$$F_3 = \frac{M_3a}{2} = (0.0122/2) \times 294.2 = 1.80\ \text{N}$$

$$\Sigma M_o = F_1 \times d_1 + F_2d_2 - F_3d_3 = 0.30 \times 31.5 + 6.68 \times 10.67 - 1.80 \times 4.83 = 72.0\ \text{N·mm}$$

$$F_5 = \frac{M_o}{d_4} = \frac{72.0}{31.50} = 2.30\ \text{N}$$

$$F_6 = M_4a = 0.0422 \times 294.2 = 12.42\ \text{N}$$

$$\Sigma Mp = \text{(pawl spring output)} - \left(\frac{F_5 \times d_5 + F_6 \times d_6}{1000}\right) = 0.45 - \left(\frac{2.30 \times 37.60 + 12.42 \times 1.91}{1000}\right) = 0.34\ \text{N·m}$$

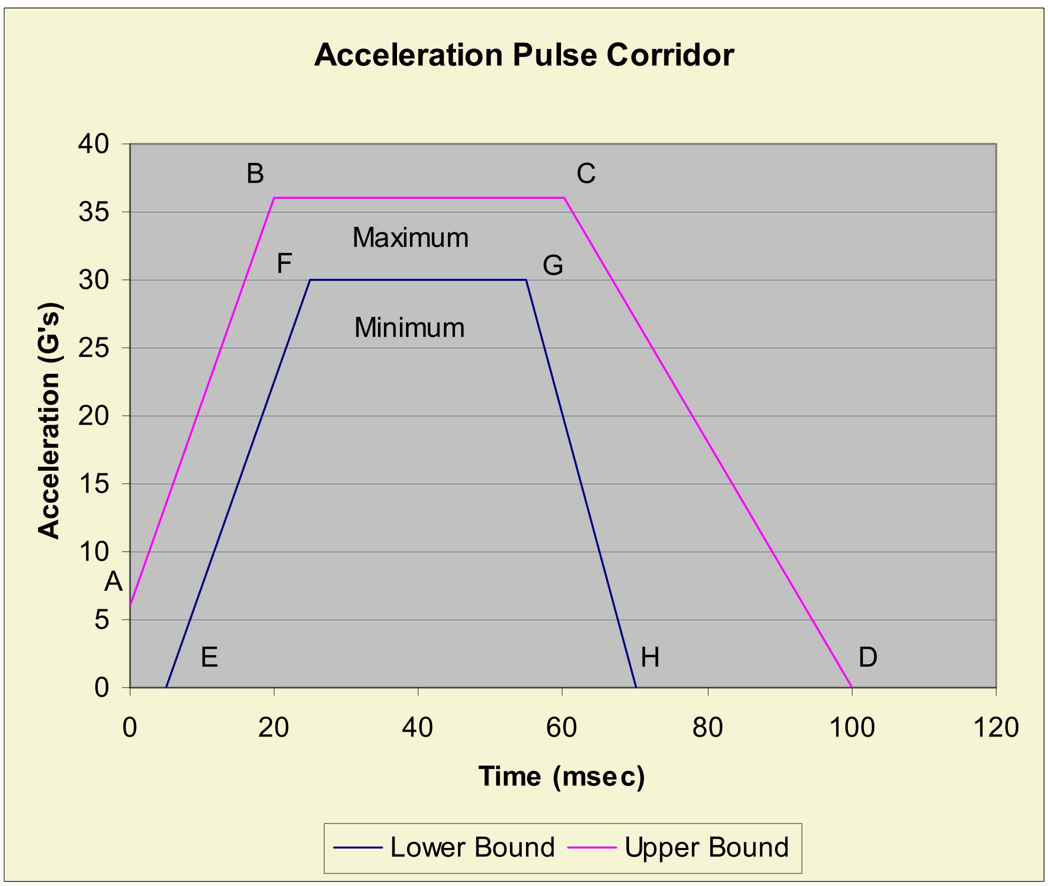
EQUATIONS		METRIC UNITS	
SYMBOL	**DEFINITION**	**SYMBOL**	**DEFINITION**
m	Mass	kg	Kilogram
a	Acceleration	m/s^2	Meter per second squared
g	Gravitational Acceleration	m/s^2	9.806 650 Meter per second squared
d	Distance to Pivot	mm	Millimeter
F	Force	N	Newton
M	Moment About a Point	N·m	Newton Meter (preferred)
		N·mm	(Newton-Millimeter)

Figure 2 – Inertial Loading – Sample Calculation

Table 1 - Sled Pulse Corridor

Upper Bound			Lower Bound		
Point	Time	Acceleration	Point	Time	Acceleration
A	0	6	E	5	0
B	20	36	F	25	30
C	60	36	G	55	30
D	100	0	H	70	0

Figure 3 – Sled Pulse



[Annex 3

Combination Loading Test

The test is conducted with the latch and striker in their fully latched position, and loaded such that:

(1) a constant tension force as specified in paragraph 5.1.5. is applied by a transverse loading device in the direction of the fork bolt opening, and parallel to the face of the latch, and

(2) while maintaining the constant transverse load, a compression load through the striker and perpendicular to the face of the latch is then applied at a rate of 10 mm per minute as specified in paragraph 5.1.5.

Test Equipment

The test equipment consists of:

A test device is prepared for mounting the latch mechanism. [This involves cutting a notch in the rigid plate so that the striker and longitudinal shaft can apply load to the latch mechanism without interfering with the rigid plate. Holes must be drilled and tapped into the plate to allow mounting of the latch mechanism, and the striker attached to the loading device.] An illustration of the device is shown in [Figure 1].

Pre-test Conditions

1. The trolley with the latch is positioned and the longitudinal ram is run down to engage the striker with the latch in the primary latched position.

2. Movement of the latch is constrained in a direction parallel to the face of the latch.

Test Procedure

1. The transverse ram loads the latch to 6,650 N and maintains this load throughout the course of the test.

2. When the transverse load of 6,650 N is reached, the longitudinal ram applies a compressive load on the latch at a displacement rate of 10 mm/min.

3. After reaching the longitudinal load of 16,000 N, compliance is achieved by maintaining the load and not separating for at least 10 seconds]

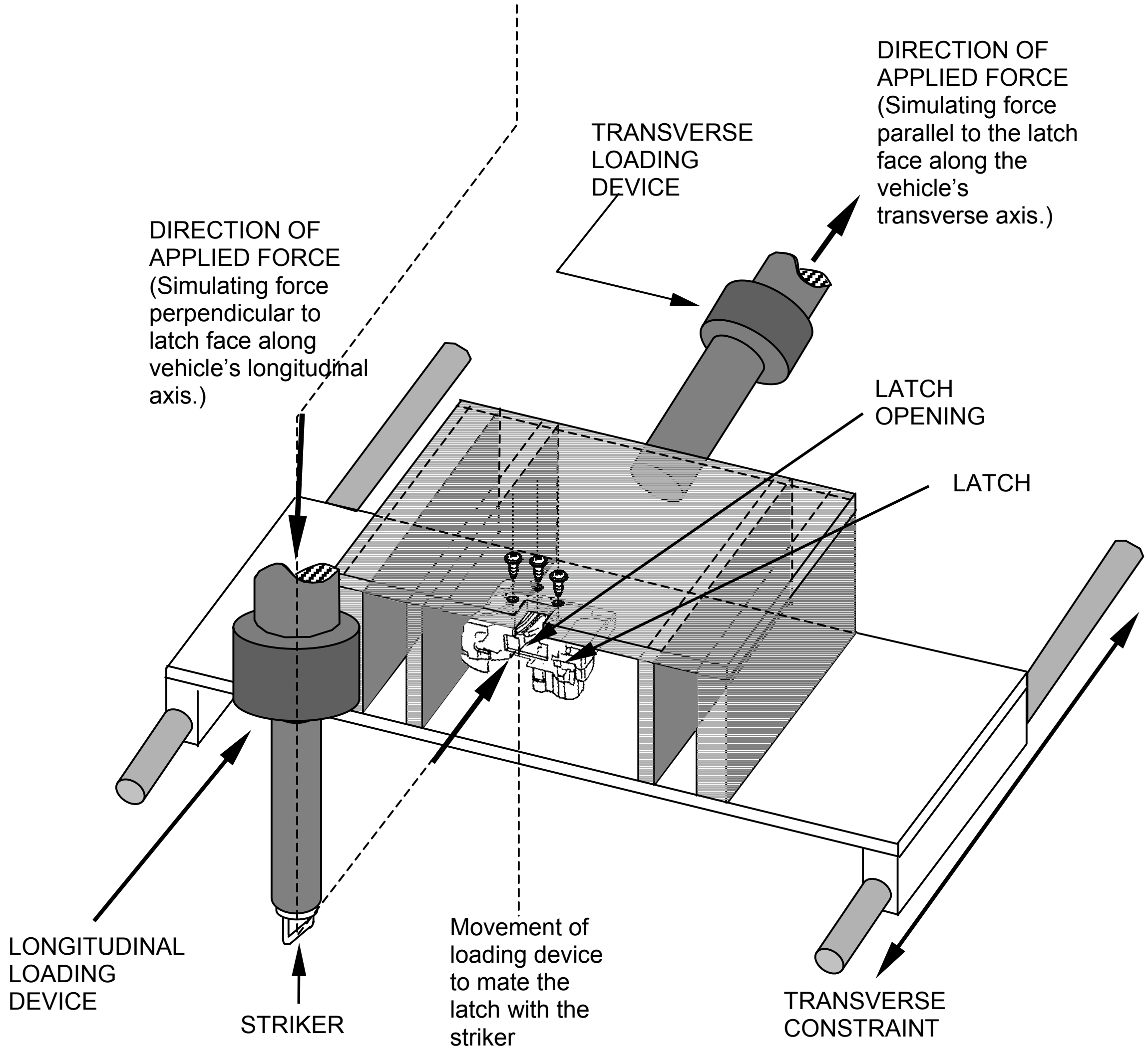


Figure 1 – Combination Loading Test
(Note, Figure being updated)

(Procedure)

Annex 4

Hinge Test Procedure

1. Purpose. These test are conducted to determine the ability of the vehicle hinge system to withstand a test load in the longitudinal and transversal vehicle directions.

2. Definitions

2.1. Hinge—That system used to position the door relative to the body structure and control the path of the door swing for passenger ingress and egress.

2.2. Hinge Components

2.2.1. Door Member—That portion of the hinge normally affixed to the door structure and constituting the swinging member.

2.2.2. Body Member—That portion of the hinge normally affixed to the body structure and constituting the fixed member.

2.2.3. Hinge Pin—That portion of the hinge normally interconnecting the body and door members and establishing the swing axis.

3. Basic Requirements

3.1. Longitudinal Load—A vehicle passenger door hinge system, when tested as described in paragraph 4, must be capable of withstanding an ultimate longitudinal load of 11,000 N.

3.2. Transverse Load—A vehicle passenger door hinge system, when tested as described in paragraph 4, must be capable of withstanding an ultimate transverse load of 9,000 N.

4. Test Procedure

4.1. Multiple Hinge Evaluation

4.1.1. Longitudinal Load Test

4.1.1.1. Equipment

4.1.1.1.1. Tensile testing machine

4.1.1.1.2. A typical static test fixture is illustrated in Figure 1.

4.1.1.2. Procedure

4.1.1.2.1. Attach a test fixture to the mounting provision of the hinge system. Hinge attitude must simulate vehicle position (door fully closed) relative to the hinge centreline. For test purposes, the distance between the extreme ends of one hinge in the system to the extreme end of another hinge in the system is to be set at 406 mm. The load is to be applied equidistant between the linear centre of the engaged portions of the hinge pin and through the centreline of the hinge pin in the longitudinal vehicle direction.

4.1.1.2.2. Apply the test load at a rate not to exceed 50 mm/min until failure. Failure to consist of separation of either hinge. Record maximum load.

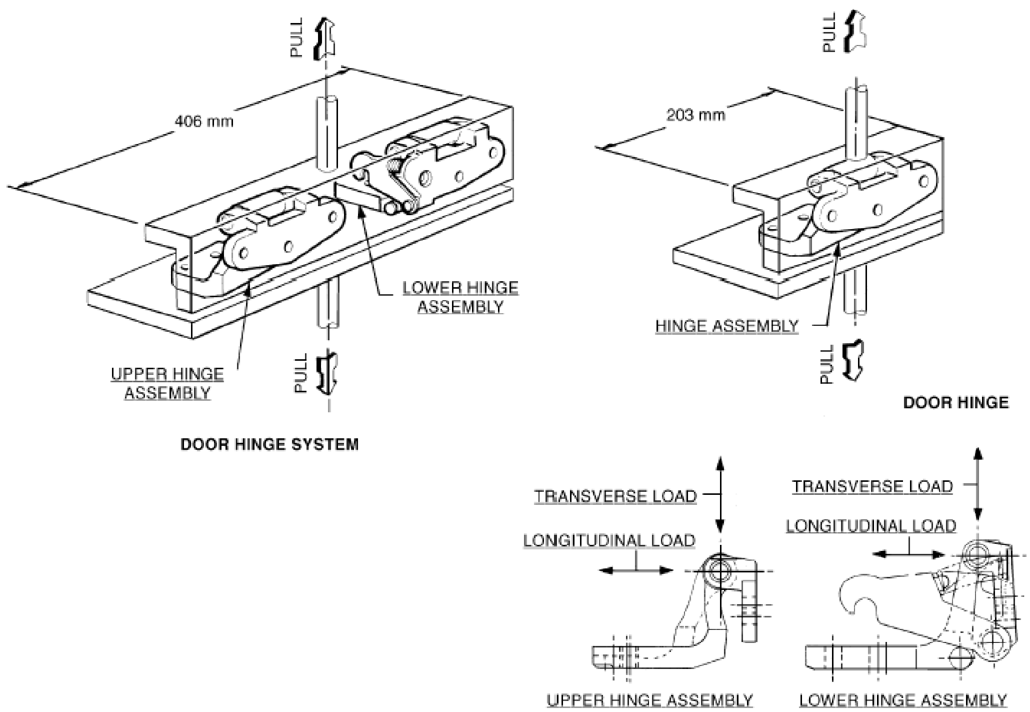


FIGURE 1—STATIC LOAD FIXTURES (TRANSVERSE LOAD)

4.1.2. Transverse Load Test

4.1.2.1. Equipment

4.1.2.1.1. Tensile testing machine

4.1.2.1.2. A typical static test fixture is illustrated in Figure 1.

4.1.2.2 Procedure

4.1.2.3 Attach the test fixture to the mounting provisions of the vehicle hinge system. Hinge attitude must simulate vehicle position (door fully closed) relative to the hinge centreline. For test purposes, the distance between the extreme ends of one hinge in the system to the extreme opposite end of another hinge in the system is to be set at 406 mm. The load is to be applied equidistant between the linear centre of the engaged portions of the hinge pins and through the centreline of the hinge pin in the transverse vehicle direction.

4.1.2.4 Apply the test load at a rate not to exceed 50 mm/min until failure. Failure to consist of separation of either hinge. Record maximum load.

4.2. Single Hinge Evaluation. In some circumstances, it may be necessary to conduct evaluations of individual hinges in a hinge system. In such cases, the results for an individual hinge, when tested in accordance with the procedures below, shall be such as to indicate that system requirements in paragraphs 3.1 and 3.2 are met. (For example, an individual hinge in a two-hinge system must be capable of withstanding 50 per cent of the load requirements of the total system.)

4.2.1. Test Procedures

4.2.1.1. Longitudinal Load—Attach a test fixture to the mounting provision of the hinge. Hinge attitude must simulate the vehicle position (door fully closed) relative to the hinge centreline. For test purposes, the load is to be applied equidistant between the linear centre of the engaged portions of the hinge pin and through the centreline of the hinge pin in the longitudinal vehicle direction. Apply the test load at a rate not to exceed 50 mm/min until failure (failure to consist of separation of either hinge). Record maximum load.

4.2.1.2. Transverse Load—Attach the test fixture to the mounting provision of the vehicle hinge. Hinge attitude must simulate the vehicle position (door fully closed) relative to the hinge centreline. For test purposes, the load is to be applied equidistant between the linear centre of the engaged positions of the hinge pin and through the centreline of the hinge pin in the transverse vehicle direction. Apply the test load at a rate not to exceed 50 mm/min until failure (failure to consist of separation of either hinge). Record maximum load.

4.3. For piano-type hinges, the hinge spacing requirements are not applicable and arrangement of the test fixture is altered so that the test force is applied to the complete hinge.

Annex 5
Sliding Side Door
Full Door Test

1. General Provisions

1.1. Tests are conducted using a full vehicle or a body in white with the sliding door and its retention components.

1.2. The test is conducted using two force application devices capable of applying the outward transverse forces specified in paragraph 5.2.4. The force application system shall consist of two plates, two load cells capable of measuring the applied force specified in paragraph 5.2.4., two linear displacement measurement devices, and equipment for recording the applied force and displacement rate. The test setup is shown in Figure 4.

2. Test Setup

2.1. Remove all interior trim and decorative components from the sliding door assembly.

2.2. Remove seats and any interior components that may interfere with the mounting and operation of the test equipment.

2.3. Mount the force application devices and associated support structure to the floor of the test vehicle.

2.4. Determine the forward and aft edge of the sliding door, or its adjoining vehicle structure, that contains a latch/striker.

2.5. For any tested door edge that contains one latch/striker, the following set-up procedures are used:

2.5.1. The force application plate is 150 mm in length and 50 mm in width.

2.5.2. Place the force application device and force application plate against the door so that the applied force is horizontal and normal to the vehicle's longitudinal centreline, and vertically centred on the door-mounted portion of the latch/striker.

2.5.3. The force application plate is positioned as close to the edge of the door as possible. It is not necessary for the force application plate to be vertical.

2.6. For any tested door edge that contains more than one latch/striker, the following set-up procedures are used:

2.6.1. The force application plate is 300 mm in length and 50 mm in width.

2.6.2. Place the force application device and force application plate against the door so that the applied force is horizontal and normal to the vehicle's longitudinal centreline, and vertically centred on a point mid-way between the outermost edges of the latch/striker.

2.6.3. The force application plate is positioned as close to the edge of the door as possible. It is not necessary for the force application plate to be vertical.

2.7. For any tested door edge that does not contain at least one latch/striker, the following set-up procedures are used:

2.7.1. The force application plate is 300 mm in length and 50 mm in width.

2.7.2. Place the force application device and force application plate against the door so that the applied force is horizontal and normal to the vehicle's longitudinal centreline, and vertically centred on a point mid-way along the length of the door edge ensuring that the loading device avoids contact with the window glazing.

2.7.3. The force application plate is positioned as close to the edge of the door as possible. It is not necessary for the force application plate to be vertical.

2.8. The door is unlocked. No extra fixtures or components may be welded or affixed to the sliding side door or any of its components.

3. Test Procedure

3.1. Close the sliding door, ensuring that all door retention components are fully and properly engaged.

3.2. Place the load application structure so that the force application plates are in contact with the interior of the sliding door.

3.3. Move both force application devices at a rate of [5 mm per minute] until a force of 9,000 N is achieved on each ram [or until the ram displaces 460 mm from their initial position].

3.4. If one of the force application devices reaches the target force of 9,000 N prior to the other, maintain the 9,000 N force with that force application device until the second force application device reaches the 9,000 N force [or 460 mm of displacement].

3.5. Once the combined target force of 18,000 N is achieved, hold the force minimum of 10 seconds.

<u>Test Equipment</u>

The test equipment consists of:

1. A vehicle structure, complete with sliding door(s) assembly and all door-retention and load-bearing components.

2. Two loading devices, or rams, capable of applying the outward transverse load requirements [for a minimum displacement of 460 mm]

3. Two load cells of sufficient capacity to measure the applied load

4. Two linear displacement measurement devices required for measuring ram displacement during the test. [Note: Deflection measurements are necessary if the load is to be applied at a constant displacement rate, or if maximum displacement is a criterion.]

5. Equipment for measuring and recording the applied load and the ram displacement rate.

<u>Pre-test Setup</u>

1. Remove all interior trim and decorative components from the sliding door assembly.

2. Remove seats and any interior components, which may interfere with the mounting and operation of test equipment.

3. The rams and associated support structure are mounted rigidly to the floor of the test vehicle.

4. The load application structure shall consist of two loading plates.

5. Determine the forward and aft edge of the sliding door (or its adjoining vehicle structure), which contains a compliant latch/striker. The door edge containing such a latch/striker, and the opposite door edge, are to be tested. If adjacent door edges contain a compliant latch/striker, both sides are to be tested.

6. For forward and aft door edge to be tested that contains exactly one compliant latch/striker, the following set-up procedures are to be used:
   a. The loading plate shall be 150 mm in length and 50 mm in width.
   b. Locate the loading device and loading plate such that the applied load will be horizontal, normal to the vehicle’s longitudinal centreline, and centred on the door-mounted portion of the compliant latch/striker. Any non-compliant door retention components on this door edge are to be ignored in this set-up.
   c. The loading plate should be positioned as close to the edge of the door as possible. It is not necessary for the loading plate to be vertical.

7. For any door edge to be tested that contains more than one compliant latch/striker, the following set-up procedures are to be used:
   a. The loading plate shall be 300 mm in length and 50 mm in width.
   b. Locate the loading device and loading plate such that the applied load will be horizontal, normal to the vehicle’s longitudinal centreline, and centred on a point mid-way between the outermost compliant latch/strikers. Any non-compliant door retention components on this door edge are to be ignored in this set-up.

c. The loading plate should be positioned as close to the edge of the door as possible. It is not necessary for the loading plate to be vertical.

8. For any door edge to be tested that does not contain at least one compliant latch/striker, or that contains only non-compliant door retention components, the following set-up procedures are to be used:
   a. The loading plate shall be 300 mm in length and 50 mm in width.

Test Procedure

1. After the sliding door is closed, and the load application structure is placed so that the force application plates are in contact with the interior of the sliding door, both force application devices are moved at a rate of [5 mm per minute] until a force of 9,000 N is achieved on each ram [or until the rams displace 460 mm from their initial position.]

2. If one of the force application devices reaches the target force of 9,000 N prior to the other, 9,000 N force is maintained with that force application device until the second force application device reaches the 9,000 N force [or 460 mm of displacement]. After reaching the combined target force of 18,000 N, compliance is achieved by maintaining the load and not separating for at least 10 seconds.

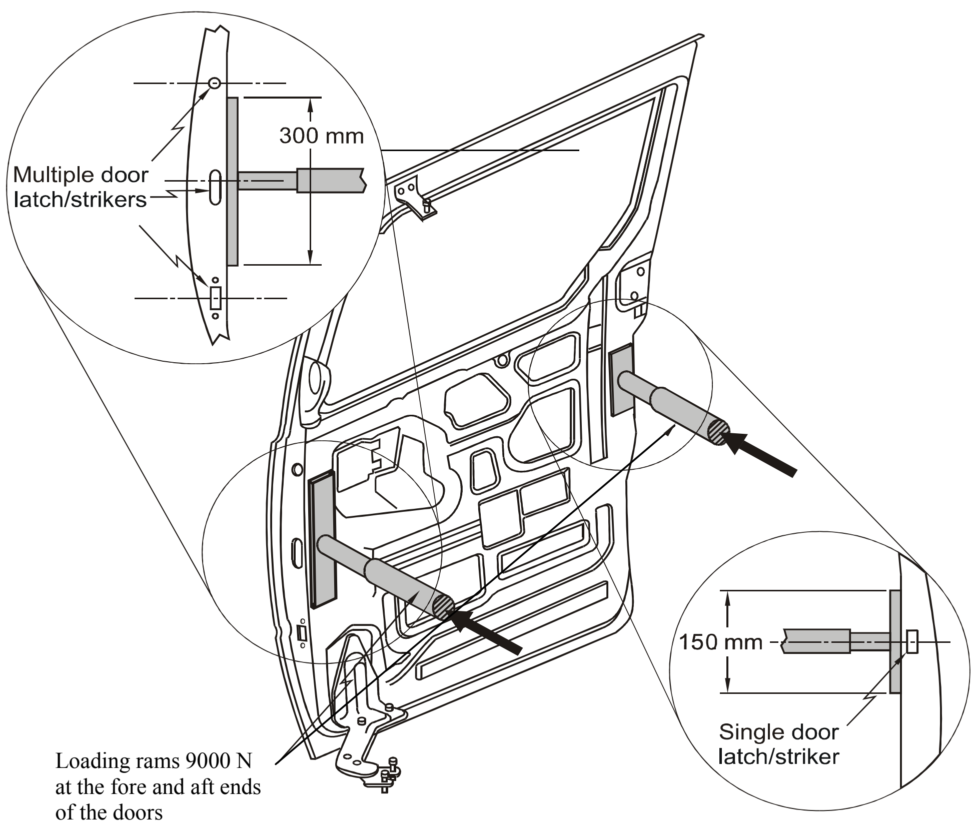


Figure 4 – Sliding Door Full Vehicle Test Procedure
(Note: Sliding door is shown separated from the vehicle)