



Low Speed Bumper Impact: Canada, China, Europe, Gulf States, Korea, and United States Regulations

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To determine if the front and rear bumper systems protect the vehicle when subject to the impact testing defined in:

- United States Federal Motor Vehicle Safety Regulation (FMVSR) 49 Code of Federal Register (CFR) Part 581
- Canada Motor Vehicle Safety Standard (CMVSS) 215
- Korea Motor Vehicle Safety Standard (KMVSS) Article 93
- Economic Commission for Europe (ECE) R 42.00
- People's Republic of China National Standard GB 17354
- Middle East Gulf Standardization Organization (GSO) 41

1.2 Applicability. The applicability of this test procedure is based on which countries the vehicle will be sold in order to meet the government regulations.

1.2.1 Canada. All vehicles with safety classification as a passenger motor vehicle. It excludes multipurpose passenger and light truck vehicles. Vehicles that can meet the Canadian regulation by compliance to 49 CFR Part 581 or ECE R 42.00 regulations.

1.2.2 United States. All vehicles with safety classification as a passenger motor vehicle. It excludes multipurpose passenger and light truck vehicles.

1.2.3 China and Europe. Vehicles classified as M1.

1.2.4 Korea. All vehicles classified as passenger cars and multipurpose vehicles. Vehicles can meet the Korean regulation by demonstrating compliance to the ECE R 42.00 regulation.

1.2.5 Gulf States. Vehicles classified as passenger cars.

1.3 Remarks. This standard establishes requirements for impact resistance of a vehicle in low speed front and rear collisions. The vehicle is impacted with a series of pendulum and barrier impacts prescribed in the Canadian, Chinese, European, Gulf States, Korean, and United States bumper regulations. The vehicle is then evaluated to the criteria defined in the regulations to determine if the vehicle is in compliance.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

49 CFR Part 581	GB 17354	MVSS 108
CMVSS 215	GSO 41	SAE J449
ECE R 42.00	KMVSS Article 93	SAE J599

2.2 GM Standards/Specifications.

None

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2.3 Additional References.

- Hunter Wheel Aligner, available from Hunter Engineering Company, Bridgeton, Missouri
- John Bean Visualiner, available from John Bean Company, a division of Snap-On Incorporated, Conway, Arizona
- neoVI FIRE, available from Intrepid Control Systems, Incorporated, Madison Heights, Michigan

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Impact Pendulum. The impact pendulum is described and shown in Appendix A, Figures A1 and A2.

3.2.1.1 Testing device shall be either a pendulum (parallelogram type construction) or moving barrier (carriage).

3.2.1.2 The pendulum shall have a minimum of two arms.

3.2.1.3 The pendulum's vertical impact height shall be adjustable so the center of the pendulum ridge can be set from 381 mm to 533 mm (15 in to 21 in) to ground.

3.2.1.4 Plane A of the pendulum shall be vertical from release until the onset of rebound and the arc described by any point on the impact line shall be constant with a radius of 3.4 m (minimum) (11 ft (minimum)) and shall lie in a plane parallel to the vertical plane through the vehicle's longitudinal centerline. Parallel means that rotational movement about the vertical axis shall be restricted to ± 2 degrees.

3.2.1.5 The impact ridge of the pendulum shall be constructed of hardened steel with Rockwell hardness of 34 HRC. It should be shaped to the dimensions specified in Appendix A (Figures A1 and A2). The impact ridge and the surfaces in Planes A and B should be finished with a surface roughness of 32, as specified by SAE J449.

3.2.1.6 With Plane A vertical, the impact line shown in Appendix A (Figures A1 and A2) shall be horizontal at the same height as the test device center of percussion.

3.2.1.7 The pendulum shall have the capability to swing at a velocity up to and including 8.2 km/h (5.1 mph) at the point of impact.

3.2.1.8 The pendulum mass shall have the capability to adjust to be equal to the vehicle Maximum Curb Mass (see 7.1 Glossary).

3.2.2 Impact Barrier Characteristics.

3.2.2.1 The barrier impact surface shall be sufficiently large so that when struck by a tested vehicle no portion of the vehicle projects or passes beyond the surface.

3.2.2.2 The barrier shall be faced with 19 mm ($\frac{3}{4}$ in) plywood.

3.2.2.3 The drive propulsion system for the barrier must have the capability to propel a vehicle up to and including a velocity of 8.2 km/h (5.1 mph) at the point of impact.

3.2.2.4 The approach to the barrier shall be a horizontal surface that is large enough for the vehicle to attain a stable attitude and speed before impact and will not restrict vehicle motion during impact.

3.2.2.5 The barrier wall surface shall be sufficiently rigid so an insignificant amount of energy is absorbed by the barrier wall when struck by a vehicle.

3.2.3 Other Equipment.

3.2.3.1 Speed Transducer. A fifth wheel tachometer generator, light trap, or equivalent.

3.2.3.2 A protractor or similar equipment should be available for measuring vehicle angular position relative to the pendulum. The angles may be marked on the floor.

3.2.3.3 Wheel Alignment. John Bean Visualiner, available from John Bean Company, a division of Snap-On Incorporated, Hunter Wheel Aligner, available from Hunter Engineering Company, or equivalent.

3.2.3.4 Headlight Aim Wall per SAE J599.

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3.2.3.5 Tire pressure gauge.

3.2.3.6 Vehicle scale capable of measuring mass at each tire.

3.2.3.7 Two high speed color video cameras capable of a minimum of 500 frames. One camera shall be mounted for the side view and one camera shall be mounted for the overhead view of the test.

3.2.3.8 Digital color photo camera.

3.2.3.9 Data acquisition equipment (load cells, displacement transducer, software, etc.) capable of generating a force deflection curve for each impact.

3.2.3.10 Engine stop switch (optional).

3.2.3.11 Trouble Code Reader for Service Engine Soon (SES) light.

3.2.4 Equipment Calibration. All instrumentation is to be calibrated as required. Record instrumentation calibration details in Appendix B, Data Sheet B1, unless the information is otherwise preserved in the testing laboratory records.

3.3 Test Vehicle/Test Piece. Components and vehicles used for this test shall be representative of production.

3.4 Test Time.

Calendar time: 2 d

Test hours: 16 h

Coordination hours: 2 h

3.5 Test Required Information.

3.5.1 Pendulum Mass. Obtain pendulum mass from the test facility and record in Appendix B, Data Sheet B1.

3.5.2 Vehicle Ground Line. Obtain vehicle ground lines to determine bumper impact bar target dimension and variation to ground.

3.5.3 Wheel Alignment Design Specifications. Obtain design specifications for caster, camber, and toe for each wheel position.

3.6 Personnel/Skills. Prior experience in setting up and running test and experience in the use of the referenced test equipment are critical to achieving the estimated times shown in 3.4.

4 Procedure

4.1 Preparation.

4.1.1 Vehicle Selection.

4.1.1.1 Select a vehicle, model, body style, etc., that is representative of the class of vehicles to be tested. Record vehicle information in Appendix C, Data Sheet C1.

4.1.1.2 The same test vehicle shall be used for the complete test sequence (pendulum impacts and barrier) on a given front or rear bumper system.

4.1.2 Vehicle Preparation. Perform 4.1.2.1.1 thru 4.1.2.1.5 on the vehicle before testing.

4.1.2.1 Vehicle Build.

4.1.2.1.1 Remove the front and rear bumper systems from the test vehicle.

4.1.2.1.2 For vehicles to be tested to 49 CFR Part 581 only. Remove headlamp washers from the vehicle. Also, remove optional equipment that is bumper face bar mounted.

Note: Optional equipment is defined as equipment that the customer can check a box on the order form. Equipment that is specified as standard for a specific model is not optional equipment and cannot be removed for the test.

4.1.2.1.3 Trailer hitches (unless integral to the bumper impact bar) and license plate brackets are removed from the vehicle.

4.1.2.1.4 Replace bumper system components that do not meet production intent.

4.1.2.1.5 Reinstall bumper systems on the vehicle.

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4.1.2.2 Tires.

4.1.2.2.1 Record tire size in Appendix C, Data Sheet C2.

4.1.2.2.2 Record vehicle manufacturer's recommended tire pressure in Appendix C, Data Sheet C2. Inflate tires to within ± 14 kPa (2 psi) of recommended tire pressure and record in Appendix C, Data Sheet C2.

4.1.2.3 Wheel Alignment. Record design specifications for wheel alignment in Appendix C, Data Sheet C2.

4.1.2.3.1 Perform a front and rear wheel alignment check if alignment is specified for the test vehicle. If the alignment values exceed the design specifications, align the wheels to be within specification.

4.1.2.3.2 Record the alignment values in the pretest table in Appendix C, Data Sheet C2.

4.1.2.4 Drivability Evaluation. The GM Validation Engineer (or agreed upon designate) shall drive the vehicle to determine that steering, powertrain, and brakes operate normally.

4.1.2.4.1 Drive the vehicle slowly on level, straight ahead roadway to assure proper wheel alignment. Stop the vehicle to determine that service and parking brake systems operate normally.

4.1.2.4.2 Record observations, including any corrections, in Appendix C, Data Sheet C2.

4.1.2.5 Headlamps. Check headlamps for aim per SAE J599 and adjust as necessary to meet design specification and record data in Appendix C, Data Sheet C2.

4.2 Conditions.

4.2.1 Environmental Conditions. Temperature of +16 °C (minimum) (60.8 °F (minimum)).

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 United States Bumper Test. Perform 4.3.1.1 thru 4.3.1.6.12.4 in order specified in this procedure.

4.3.1.1 Vehicle Mass. Weigh the vehicle, and if necessary, add or subtract mass to equal the Maximum Curb Mass for the class of vehicles being certified. Record weight on each tire in Appendix D, Data Sheet D1.

4.3.1.2 Bumper Heights. Perform 4.3.1.2.1 thru 4.3.1.2.6 to determine height of pendulum relative to the bumper.

4.3.1.2.1 Obtain the front and rear bumper to ground target height specification using nominal curb mass ground line from ground line math file and record in Appendix D, Data Sheet D1.

4.3.1.2.2 Press front of vehicle down at center of the front bumper slowly until deflection of 25 mm (1 in) is attained. Then permit the vehicle to rise at approximately the same rate.

4.3.1.2.3 Press rear of vehicle down at center of the rear bumper slowly until deflection of 25 mm (1 in) is attained. Then permit vehicle to rise at approximately the same rate.

Note: Front bumper shall always be done first and measurements shall be made without disturbing the vehicle.

4.3.1.2.4 Measure and record the vehicle bumper heights in Appendix D, Data Sheet D1.

4.3.1.2.5 Obtain from Chassis Engineering the vehicle build height variation at the bumper impact bar and record in Appendix D, Data Sheet D1.

4.3.1.2.6 Calculate the minimum and maximum standing height (Low Car/High Car) per Appendix D, Data Sheet D1.

4.3.1.3 Vehicle Inspection.

4.3.1.3.1 The vehicle shall be inspected before testing and the results shall be recorded in Appendix D, Data Sheet D1. The questions on the data sheets are detailed to follow for procedural steps for this general inspection. If any of the defined vehicle systems are damaged, repair to production intent or obtain a new test vehicle.

4.3.1.3.2 Inspect each of the lamps/lenses for operation and damage (breakage or cracks). Repair or replace as necessary. Record results in Appendix D, Data Sheet D1.

4.3.1.3.3 Active Shutters or Active Grille for Vehicles Sold in U.S. and Canada.

4.3.1.3.3.1 The function of the active shutter/grille must be checked after each impact. This is done by using a neoVI FIRE (available from Intrepid Control Systems, Incorporated), or equivalent device, that bridges a laptop with appropriate software to the vehicle Assembly Line Diagnostic Link (ALDL). Using this device the active

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shutter/grille must be observed cycling from open to close a minimum of five (5) times without issue after each impact. After each impact, record in Appendix D, Data Sheet D1 whether the active shutter/grille functioned properly.

4.3.1.4 Pendulum Impact Preparation.

4.3.1.4.1 Location. The pendulum impacts shall include the most severe locations and sequence indicated by engineering judgment allowable under the regulation. Severe pendulum locations are typically close to lamps and the outboard longitudinal impacts (meant to weaken the impact bar). Record the reasons and fill in the chart for the locations in Appendix D, Data Sheet D1.

4.3.1.4.2 Mass. Add or subtract weight from the Pendulum Box in order for the Pendulum Effective Impact Mass to equal the mass of the test vehicle (Maximum Curb Mass). Calculate and record amount of weights to be added to the pendulum and record in Appendix D, Data Sheet D1.

4.3.1.5 Pretest Photographs. Photograph the vehicle in the pretest condition. The number of photos and locations are to be at the discretion of the GM Validation Engineer.

4.3.1.6 Test Sequence. Test the vehicle according to 49 CFR Part 581.

4.3.1.6.1 Parts on the vehicle cannot be repaired or replaced between impacts.

4.3.1.6.2 Perform the impacts at intervals of ≥ 30 minutes to allow adequate time for bumper system restoration.

4.3.1.6.3 Place the front wheels in the straight ahead position parallel to the vehicle's longitudinal centerline.

4.3.1.6.4 Disengage the brakes.

4.3.1.6.5 Place the transmission in neutral.

4.3.1.6.6 For each pendulum impact, align the vehicle so that it touches, but does not move the test device.

4.3.1.6.7 Instrument each vehicle to obtain force and deflection data from each impact.

4.3.1.6.8 Video photo each impact.

4.3.1.6.9 Longitudinal Impacts.

4.3.1.6.9.1 Impact the vehicle's front and rear bumper two (2) times with the pendulum parallel to the centerline axis of the vehicle at a speed of 4.2 km/h (2.6 mph).

4.3.1.6.9.2 Impact heights shall be at or between 406 mm to 508 mm (16 in to 20 in) to ground.

4.3.1.6.9.3 Pendulum hits at 406 mm (16 in) or 508 mm (20 in) to ground must include the vehicle build height variation per Appendix D, Data Sheet D1 (for instance 406 mm High Car and 508 mm Low Car).

4.3.1.6.9.4 Maximum outboard location of the pendulum (plan view) shall be inboard of the vehicle corner test position as illustrated in Appendix E, Figure E2.

4.3.1.6.9.5 The second impact shall be ≥ 50 mm (≥ 2 in) up/down or 305 mm (12 in) laterally to the first impact.

4.3.1.6.9.6 For impacts at 508 mm (20 in) to ground install test device illustrated in Appendix A, Figure A1, Plane B; all other impacts use test device illustrated in Figure A2 (Plane A only).

4.3.1.6.9.7 If the vehicle is equipped with Active Shutter/Grille, check for operation according to 4.3.1.3.3 after each longitudinal impact. Record results in Appendix D, Data Sheet D1.

4.3.1.6.9.8 Record impact locations, speed, and plane loads in Appendix D, Data Sheet D1.

4.3.1.6.10 Corner Impacts.

4.3.1.6.10.1 Align the vehicle so Plane A of the pendulum is at a 60 degree angle in plan view to the centerline of vehicle illustrated in Appendix E, Figure E1.

4.3.1.6.10.2 Impact the front and rear corner once each with the impact line at a height of 508 mm (20 in) Low Car, as described on Appendix D, Data Sheet D1 using the test device illustrated in Appendix A, Figure A1, Plane B, at a speed of 2.6 km/h (1.6 mph).

4.3.1.6.10.3 Impact the opposite front and rear corner once each with the impact line at any height between 508 mm (20 in) and 406 mm (16 in) to ground at a speed of 2.6 km/h (1.6 mph) using test device illustrated in Appendix A, Figure A2 (Plane A).

4.3.1.6.10.4 Pendulum hits at 406 mm (16 in) to ground should include the vehicle build height variation as described in Appendix D, Data Sheet D1 (406 mm High Car).

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4.3.1.6.10.5 If the vehicle is equipped with Active Shutter/Grille, check for operation according to 4.3.1.3.3 after each corner impact. Record results in Appendix D, Data Sheet D1.

4.3.1.6.10.6 Record impact locations, speed, and plane loads in Appendix D, Data Sheet D1.

4.3.1.6.11 Barrier Impact.

4.3.1.6.11.1 Impact the front and rear bumper system into a fixed barrier longitudinally forward and rearward at a speed of 4.2 km/h (2.6 mph) that is perpendicular to the line of travel of the vehicle.

4.3.1.6.11.2 The engine shall be running at idle speed during this impact, and the transmission in neutral.

Note: During the barrier impact, there have been instances where the automatic transmission shift lever moves from Neutral to Drive (especially on rear impacts). An engine stop switch can be installed to the vehicle to turn off the engine post barrier impact.

4.3.1.6.11.3 Record speed in Appendix D, Data Sheet D1.

4.3.1.6.12 Inspection.

4.3.1.6.12.1 Inspect the vehicle and record posttest results to Appendix D, Data Sheet D1.

Note: License plate lamps are allowed to be damaged under 49 CFR Part 581.

4.3.1.6.12.2 If the vehicle is equipped with Active Shutter/Grille, check for operation according to 4.3.1.3.3 barrier impact. Record results in Appendix D, Data Sheet D1.

4.3.1.6.12.3 Photograph vehicle posttest.

4.3.1.6.12.4 Check front end alignment and record results on Appendix C, Data Sheet C2.

4.3.1.6.12.5 Perform posttest Drivability Evaluation and record results to Appendix C, Data Sheet C2.

4.3.2 Canada, China, European, Gulf States, and Korea Bumper Test. Perform 4.3.2.1 thru 4.3.2.7.11.4 in order specified in this procedure.

4.3.2.1 If the vehicle was used for United States Bumper Test, replace the bumper system with new components. Headlamp washer and all optional bumper face bar mounted equipment shall be reinstalled for the GB 17354; ECE R 42.00; GSO 41; KMVSS Article 93 Bumper Test series.

4.3.2.2 Vehicle Mass. Weigh the vehicle and ballast to the Unladen Weight (see 7.1 Glossary) plus the weight of passengers. Amount and the distribution of weight are to be as shown in Table 1. The mass of one passenger is 75 kg (165.4 lb). Record the weight on each tire in Appendix F, Data Sheet F1.

Table 1: Distribution of Weight

Number of Seating Positions	Number of Passengers for Test	Distribution
2 and 3	2	2 in the front seats
4 and 5	3	2 in the front seats 1 in the back seat
6 and 7	4	2 in the front seats 2 in the rearmost seats
8 and 9	5	2 in the front seats 3 in the rearmost seats (When the rear row of seats has only two (2) seating positions, one person shall be on the second row from the rear.)

4.3.2.3 Bumper Heights. Perform 4.3.2.3.1 thru 4.3.2.3.6 to determine height of pendulum relative to the bumper.

4.3.2.3.1 Obtain the front and rear bumper to ground Target Height Specification for a vehicle from the nominal curb mass ground line located in the Ground Line math file and record in Appendix F, Data Sheet F1.

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4.3.2.3.2 Press front of vehicle down at center of the front bumper slowly until deflection of 25 mm (1 in) is attained. Then permit the vehicle to rise at approximately the same rate.

4.3.2.3.3 Press rear of vehicle down at center of the rear bumper slowly until deflection of 25 mm (1 in) is attained. Then permit vehicle to rise at approximately the same rate.

Note: Front bumper shall always be done first and measurements shall be made without disturbing the vehicle.

4.3.2.3.4 Measure and record the vehicle bumper heights in Appendix F, Data Sheet F1.

4.3.2.3.5 Obtain from Chassis Engineering the vehicle build height variation at the bumper impact bar and record in Appendix F, Data Sheet F1.

4.3.2.3.6 Calculate the minimum and maximum standing height (Low Car/High Car) per Appendix F, Data Sheet F1.

4.3.2.4 Vehicle Inspection.

4.3.2.4.1 The vehicle shall be inspected before testing and the results shall be recorded in Appendix F, Data Sheet F1. The questions on the data sheets are detailed to follow for procedural steps for this general inspection. If any of the defined vehicle systems are damaged, repair to production intent or obtain a new test vehicle.

4.3.2.4.2 Inspect each of the lamps/lens for operation and damage (breakage or cracks). Repair or replace as necessary. Record results in Appendix F, Data Sheet F1.

4.3.2.4.3 Active Shutters or Active Grille for Vehicles Sold in Canada.

4.3.2.4.3.1 The function of the active shutter/grille must be checked after each impact. This is done by using a neoVI FIRE (available from Intrepid Control Systems, Incorporated), or equivalent device, that bridges a laptop with appropriate software to the vehicle ALDL. Using this device, the active shutter/grille must be observed cycling from open to close a minimum of five (5) times without issue after each impact. After each impact, record in Appendix D, Data Sheet D1 whether the active shutter/grille functioned properly.

4.3.2.5 Pendulum Impact Preparation.

4.3.2.5.1 Location. The pendulum impacts shall include the most severe locations and sequence indicated by engineering judgment allowable under the regulation. Severe pendulum locations are typically close to lamps and the outboard longitudinal impacts (meant to weaken the impact bar). Record the reasons and fill in the chart for the locations in Appendix F, Data Sheet F1.

4.3.2.5.2 Mass. Add or subtract weight from the pendulum box in order for the pendulum effective impact mass to equal the mass of the test vehicle (unladen weight plus passengers). Calculate and record amount of weights to be added to the pendulum and record in Appendix F, Data Sheet F1.

4.3.2.6 Pretest Photographs. Photograph the vehicle in the pretest condition. The number of photographs and locations shall be at the discretion of the GM Validation Engineer.

4.3.2.7 Test Sequence. Test the vehicle according to the GB 17354, ECE R 42.00, GSO 41, and KMVSS Article 93 regulations.

4.3.2.7.1 Parts on the vehicle can be repaired or replaced between pendulum impacts.

4.3.2.7.2 Perform the impacts at intervals of ≥ 30 minutes to allow adequate time for bumper system restoration.

4.3.2.7.3 Align the front wheels in the straight ahead position parallel to the vehicle's longitudinal centerline.

4.3.2.7.4 Disengage the brakes.

4.3.2.7.5 Place the transmission in neutral.

4.3.2.7.6 Each pendulum impact shall be aligned to the vehicle so that it touches, but does not move the test device.

4.3.2.7.7 Instrument each vehicle to obtain force and deflection data from each impact.

4.3.2.7.8 Video photograph each impact.

4.3.2.7.9 Longitudinal Impacts.

4.3.2.7.9.1 Impact the vehicle's front and rear bumper two (2) times with the pendulum parallel to the centerline axis of the vehicle at a speed of 4.2 km/h (2.6 mph).

4.3.2.7.9.2 Use pendulum heights as calculated in Appendix F, Data Sheet F1 (445 mm to ground $\pm$ build height tolerance).

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4.3.2.7.9.3 Maximum outboard location of the pendulum (plan view) shall be inboard of the vehicle corner test position (Appendix E, Figure E2).

4.3.2.7.9.4 The second impact shall be ≥ 300 mm (≥ 12 in) laterally to the first impact.

4.3.2.7.9.5 Use test device illustrated in Appendix A, Figure A2 (Plane A **only**).

4.3.2.7.9.6 If the vehicle is equipped with Active Shutter/Grille, check for operation according to 4.3.2.4.3 after each longitudinal impact. Record results in Appendix F, Data Sheet F1.

4.3.2.7.10 Corner Impact.

4.3.2.7.10.1 Align the vehicle so Plane A of the pendulum is at a 60 degree angle in plan view to the centerline of vehicle in Appendix E, Figure E1.

4.3.2.7.10.2 Impact the front and rear corner once each with the impact line at a height of 445 mm (17.5 in) Low Car (Appendix F, Data Sheet F1) using the test device illustrated in Appendix A, Figure A2 (Plane A **only**) at a speed of 2.6 km/h (1.6 mph).

4.3.2.7.11 Inspection.

4.3.2.7.11.1 Inspect the vehicle and record posttest results on Appendix F, Data Sheet F1.

4.3.2.7.11.2 Photograph vehicle posttest.

4.3.2.7.11.3 Check front end alignment at record results on Appendix C, Data Sheet C2.

4.3.2.7.11.4 Perform posttest Drivability Evaluation and record results on Appendix C, Data Sheet C2.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results.

5.2.1 Protective Criteria for ECE R 42.00, 49 CFR Part 581, GB 17354, GSO 41, and KMVSS Article 93.

Requirements to be met during and after completion of testing (5.2.1.1 thru 5.2.2.4).

5.2.1.1 Lighting Requirements. Each lamp or reflective device, except license plate lamps, shall be operative, free of cracks and shall comply with applicable visibility requirement of Motor Vehicle Safety Standard (MVSS) 108.

5.2.1.2 The aim of each headlamp shall be adjustable to within the beam aim inspection limits specified in SAE J599, measured with the aiming method appropriate for that headlamp.

5.2.1.3 The vehicle's hood, trunk, and doors (including the tailgate) shall operate in the normal manner.

5.2.1.4 The vehicle's fuel and cooling systems shall have no leaks or constrictions and all sealing devices and caps shall operate in the normal manner. The term cooling system does not include the air conditioning system.

5.2.1.5 The vehicle's exhaust system shall have no leaks or constrictions. Designed exhaust system drain points and flow restriction do not constitute leaks or constrictions.

5.2.1.6 The vehicle's powertrain, suspension, steering, and braking systems shall remain in adjustment and shall operate in the normal manner. Movement of the automatic transmission shift lever from the neutral position to the drive position during a test impact does not constitute a noncompliance as long as the movement does not impair the subsequent operation of the transmission or other parts of the powertrain system.

5.2.2 Additional Protective Criteria for 49 CFR Part 581.

5.2.2.1 The vector force exerted on the combined surfaces of Planes A and B of the pendulum test device shall not exceed 8896 N (2000 lb) during any one pendulum impact.

5.2.2.2 The exterior vehicle surfaces shall have no separation of surface materials, paint, polymer coating or other covering materials from the surface to which they are bonded and no permanent deviations from their original contours 30 minutes after completion of each pendulum and barrier impact, except where such damage occurs to the bumper face bar and the components and associated fasteners that directly attach the bumper face bar to the chassis frame.

5.2.2.3 There shall be no breakage or release of fasteners or joints except for the associated fasteners that directly attach the bumper face bar to the chassis frame.

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5.2.2.4 A pressure vessel used to absorb impact energy in an exterior protection system by the accumulation of gas pressure or hydraulic pressure shall not suffer loss of gas or fluid accompanied by separation of fragments from the vessel.

5.3 Test Documentation.

5.3.1 Instrument calibration is to be recorded on Appendix B, Data Sheet B1 and included with the Test Report.

5.3.2 Record test results on Appendices C, D, and F Data Sheets. Digital files of pretest and posttest photographs, force deflection curves and videos to be included with all data sheets.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary.

Bumper Face Bar: Any bumper system component that contacts the impact ridge and any bumper system component that is connected as a part of the load bearing structure. It's important to note that contact with the impact ridge is not the sole criteria to qualify a component as part of the bumper system. Components should be considered on a case-by-case basis.

Items contacted by the impact ridge:

- Items that function as part of the bumper system qualify as Bumper Face Bar components. This includes load bearing components, as well as cosmetic components whose primary function is to conceal unsightly aspects of the bumper's construction (such as moldings, cutout patches, and tape strips).
- Items with a specific function separate from the bumper system do not qualify as Bumper Face Bar components. Examples of these include illumination devices (e.g., fog lamps and directional signals) and exterior components of park aid sensors.
- Items not generally associated with the bumper system, but designed to perform a protective function, may qualify as Bumper Face Bar components in specific applications. Examples of these include grilles and emblems.

Items not contacted by the impact ridge:

- Shielding panels that do not contact the impact ridge do not qualify as Bumper Face Bar and must be categorized as "exterior surfaces."
- Any component of the bumper system which can be contacted by the impact ridge of the pendulum test device, in any permissible pendulum stroke is considered Bumper Face Bar, whether or not it was actually contacted in a particular test sequence.

Constrictions: Damage to coolant, fuel, or exhaust passage as a result of a test impact to the extent that vehicle operation would be adversely affected.

Exterior Vehicle Surface: Any surface of a component which is visible to the customer, which usually have a decorative coating or finish applied and which are intended to enhance the vehicle appearance.

A component in the bumper system carries load and that is covered by the Bumper Fascia (not visible) when mounted on the vehicle is not an exterior vehicle surface.

Leaks: Any visible posttest surface wetting or fluid flow from the coolant or fuel systems or visible or audible posttest flow of gases from the exhaust system (other than at design terminal and drain points) to an extent greater than that which existed prior to test.

Maximum Curb Mass: The mass of a vehicle that has 100% of the option content and all fluid containers are full. It does not include any passengers or luggage.

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Multipurpose Passenger Vehicle: A motor vehicle that carries ten persons or less constructed either on a truck chassis or with special features for occasional off road operation.

Optional Equipment: Equipment that requires an option code to be built in the vehicle.

Pendulum Mass: The total mass of the components of pendulum box, ballast, impact ridge, Planes A and B (when required), all the instrumentation and hardware mounted on the pendulum box, and effective mass of the pendulum arms (as designed by each test facility).

Permanent Deviation: The damage when visible surfaces of a component are stressed so that it does not return to its original condition. This deformation can occur to both visible and non-visible components of the vehicle. The customer likely would be unaware of the non-visible deformation, therefore, would not be regarded as damage. The damage criterion is focused on visible surfaces that would detract from the appearance and market value of the vehicle. The damage criterion does not apply to microscopic surface deviations. Magnifying or measuring equipment should not be used when determining posttest damage. The visible surfaces shall be viewed for normally observable changes based on this test procedure.

Unladen Weight: The mass of a vehicle that has 100% of the option content and all fluid containers are full. It does not include any passengers or luggage.

7.2 Acronyms, Abbreviations, and Symbols.

&	And
#	Number
ALDL	Assembly Line Diagnostic Link
CFR	Code of Federal Register
CHMSL	Center High Mounted Stop Lamp
CMVSS	Canada Motor Vehicle Safety Standard
ECE	Economic Commission for Europe
EPA	Environmental Protection Agency
FMVSR	Federal Motor Vehicle Safety Regulation
GSO	Gulf Standardization Organization
IVER	Integration Vehicle Engineering Release
KMVSS	Korea Motor Vehicle Safety Standard
LF	Left Front
LH	Left Hand
LR	Left Rear
MOB	Maximum Outboard
MVSS	Motor Vehicle Safety Standard
RF	Right Front
RH	Right Hand
RR	Right Rear
SES	Service Engine Soon
VIN	Vehicle Identification Number

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

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