PMG | TECHNOLOGIES

TEST REPORT

CMVSS 216 / FMVSS 216a – ROOF CRUSH RESISTANCE

Vehicle: **MERCEDES-BENZ METRIS 2015**
UN: **22-258**
Contract: **22-7144**
Report: **RP22-0536**

Presented to:
TRAVOIS RV – VR INDUSTRIES INC.
2005 Country Road 4
L'Orignal, Ontario
K0B 1K0

Date: **2022-03-10**

SUMMARY

Pursuant to a request from **TRAVOIS RV – VR INDUSTRIES INC.**, we performed compliance tests on a **MERCEDES-BENZ METRIS 2015**, identified at PMG Technologies as **UN22-258**, to Canada Motor Vehicle Safety Standard (CMVSS) 216 "Roof Crush Resistance", and Federal Motor Vehicle Safety Standard (FMVSS) 216a "Roof Crush Resistance".

Testing was performed between **February 24, 2022** and **February 25, 2022** at the PMG Technologies Test and Research Center in Blainville (Quebec).

Test results show that the vehicle **meets** the minimum requirements of CMVSS 216 and FMVSS 216a for the verified subsections.

Verified by	Paul Monnier TREP # 6036273		Date: **2022-03-09**
Approved by	Hugo Brunet P.Eng. #5080749		Date: **2022-03-09**

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INTRODUCTION

CMVSS 216 and FMVSS 216a establish strength requirements for the passenger compartment roof. The purpose of these standards is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

These standards apply to passenger cars, multi-purpose passenger vehicles, trucks or buses with a GVWR of 4 536 kg (10 000 pounds) or less, except trucks with a GVWR greater than 2 722 kg (6 000 pounds) built from a cutaway chassis, school buses and convertibles.

Passenger cars, multi-purpose passenger vehicles, trucks or buses with a GVWR of 4 536 kg (10 000 pounds) or less that are built in two or more stages not using a chassis-cab and passenger cars, multi-purpose passenger vehicles, trucks or buses with a GVWR greater than 2 722 kg (6 000 pounds) but not greater than 4 536 kg (10 000 pounds) that have an altered roof shall conform to the requirements of TSD 216 or TSD 220.

The versions of the standards that tests were based upon are:

- CMVSS 216: SOR/2014-307, s. 21., dated December 12, 2014
- TSD 216, Revision 1R, dated July 24, 2010
- FMVSS 216a: 49 CFR 571.216a, dated on January 6, 2012 [49 CFR Ch. V (10-1-20 Edition)].

The test procedure used complies with NHTSA's TP-216-00 (May 6, 2009).

SUMMARY OF RESULTS

Requirements	Pass	Fail	Pages
S5.1(a) The lower surface of the test device must not move more than 127 mm.	X		4, 5
S5.1(b) No load greater than 222 N may be applied to the head form located at the head position of a 50th percentile adult male.	X		
S5.2(a) The maximum applied force (N) to the vehicle's roof is for vehicles with a GVWR of 2,722 kg or less, is any value up to and including 3 x UVM (kg) x 9.8.	N/A	N/A	
S5.2(b) The maximum applied force (N) to vehicles with a GVWR greater than 2,722 kg, is any value up to and including 1.5 x UVM (kg) x 9.8.	X		

DATA SHEET NO. 1

TEST VEHICLE DATA

Manufacturer	Body style	Make, model, year
TRAVOIS RV – VR INDUSTRIES INC.	Cargo Van	MERCEDES-BENZ, METRIS, 2015
Class of vehicle	Odometer	Designated seating positions
TRUCK	4 923 km	2
Date of manufacture	GVWR	VIN
12/2015	3 050 kg	WD3BG2EAXG3125446

GENERAL INFORMATION

Engine	Transmission	Displacement
3 cyl. trans front	4 speed Auto.	2.0 ℓ

Odometer reading at the start of testing	Odometer reading at the end of testing
4923 km Date: 2022-02-24	4923 km Date: 2022-02-25

Tire make and type	Tire size		Tire pressure	
	Front	Rear	Front	Rear
Not verified	225/55R17	225/55R17	300 kPa	310 kPa

GROSS WEIGHT RATING

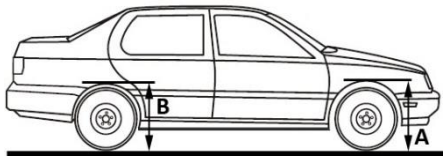
Front axle (GAWR)	Rear axle (GAWR)	Vehicle (GVWR)
1 550 kg	1 550 kg	3 050 kg

UNLOAD VEHICLE WEIGHT (UVW)

Total
2 268 kg*

TEST VEHICLE ATTITUDE

Measured at wheel cutoff



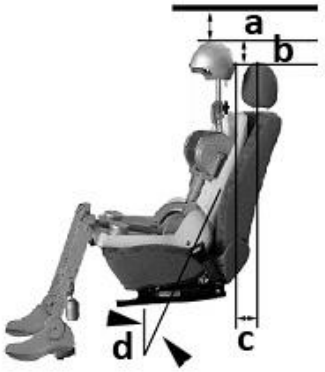
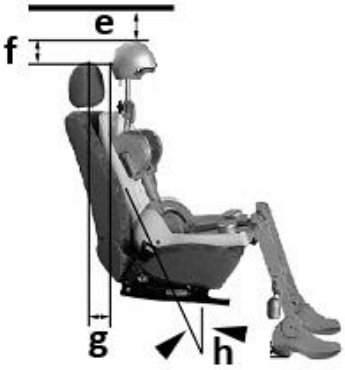
Measuring point	Measured
A: Average value of the heights of the front	0 mm
B: Average value of the heights of the rear	0 mm

COMMENTS:

- The UVW was provided by the manufacturer.

DATA SHEET NO. 2

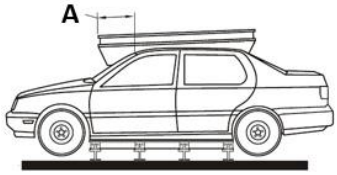
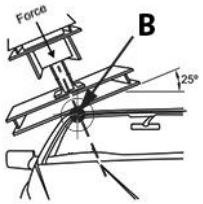
HEAD RESTRAINT MEASUREMENT DEVICE DATA

Driver			Passenger		
					
a	Vertical distance between the top of the head and the inner surface of the roof	150 mm	e	Vertical distance between the top of the head and the inner surface of the roof	135 mm
b	Distance between the top of the head and the top of the headrest	40 mm	f	Distance between the top of the head and the top of the headrest	30 mm
c	Distance between the back of the head and the top of the headrest	78 mm	g	Distance between the back of the head and the top of the headrest	80 mm
d	Seatback angle	23 deg	h	Seatback angle	23 deg

COMMENTS:
None

DATA SHEET NO. 3

PRE-TEST DATA (PASSENGER SIDE)

Description	Observations
Once the vehicle installed on the test bench, the attitude of the vehicle was respected (0 ± 0.5°).	Yes
Force application plate angles.	Pitch angle: 5 deg. Roll angle: 25 deg.
The application plate force was aligned with the longitudinal center line of the vehicle.	Yes
Distance "A" between the test plate and the forward foremost point of the roof is 254 mm (0–10 mm).	 259 mm
Distance "B" between the centerline of test plate and the actual lateral application point of the roof is 0 mm (± 10 mm). A positive value denotes an application point closer to the centerline of the vehicle.	 -5 mm
Max. applied force for vehicle with a GVWR: ≤ 2722 kg = UVW x 9.8 m/s^2 x 3.0 = or > 2722 = UVW x 9.8 m/s^2 x 1.5 =	2 268 kg x 9.8 m/s^2 x 1.5 = 33 340 N
All windows were closed and doors were locked before the test.	Yes
The head form 201 was properly aligned with the coordinates of HRMD.	Yes

COMMENTS:
None

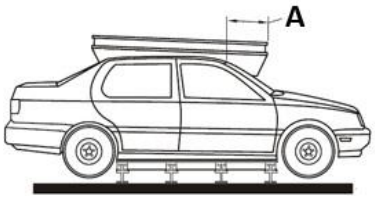
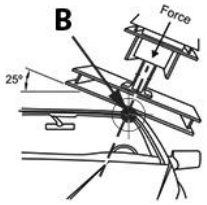
POST-TEST DATA (PASSENGER SIDE)

Description	Observations
Maximum load required	33 340 N
Maximum load applied (compression loading)	|-35 091| N
Maximum displacement	107 mm
S5.1(a) Max. displacement ≤ 127 mm	Yes (Pass)
S5.2(a) or (b) Max. load applied ≥ Max. load required	|-35 091 | N ≥ 33 340 N* Yes (Pass)
Head contact occurred	No
S5.1(b) Head resultant force > 222 N	No (Pass)
The second head positioning fixture (HPF) shifted from its original position.	No

COMMENTS:
* At the client's request, we exceeded the maximum required applied force.

DATA SHEET NO. 4

PRE-TEST DATA (DRIVER SIDE)

Description	Observations
Once the vehicle installed on the test bench, the attitude of the vehicle was respected (0 ± 0.5°).	Yes
Force application plate angles.	Pitch angle: 5 deg. Roll angle: 25 deg.
The application plate force was aligned with the longitudinal center line of the vehicle.	Yes
Distance "A" between the test plate and the forward foremost point of the roof is 254 mm (0–10 mm).	 255 mm
Distance "B" between the centerline of test plate and the actual lateral application point of the roof is 0 mm (± 10 mm). A positive value denotes an application point closer to the centerline of the vehicle.	 5 mm
Max. applied force for vehicle with a GVWR: ≤ 2722 kg = UVW x 9.8 m/s^2 x 3.0 = or > 2722 = UVW x 9.8 m/s^2 x 1.5 =	2 268 kg x 9.8 m/s^2 x 1.5 = 33 340 N
All windows were closed and doors were locked before the test.	Yes
The head form 201 was properly aligned with the coordinates of HRMD.	Yes

COMMENTS:
None

POST-TEST DATA (DRIVER SIDE)

Description	Observations
Maximum load required	33 340 N
Maximum load applied (compression loading)	|-35 074| N
Maximum displacement	104 mm
S5.1(a) Max. displacement ≤ 127 mm	Yes (Pass)
S5.2(a) or (b) Max. load applied ≥ Max. load required	|-35 074 | N ≥ 33 340 N* Yes (Pass)
Head contact occurred	No
S5.1(b) Head resultant force > 222 N	No (Pass)
The second head positioning fixture (HPF) shifted from its original position.	No

COMMENTS:
* At the client's request, we exceeded the maximum required applied force.

CONCLUSION

Test results show that the vehicle **meets** the minimum requirements of CMVSS 216 and FMVSS 216a for the verified subsections.

APPENDIX A

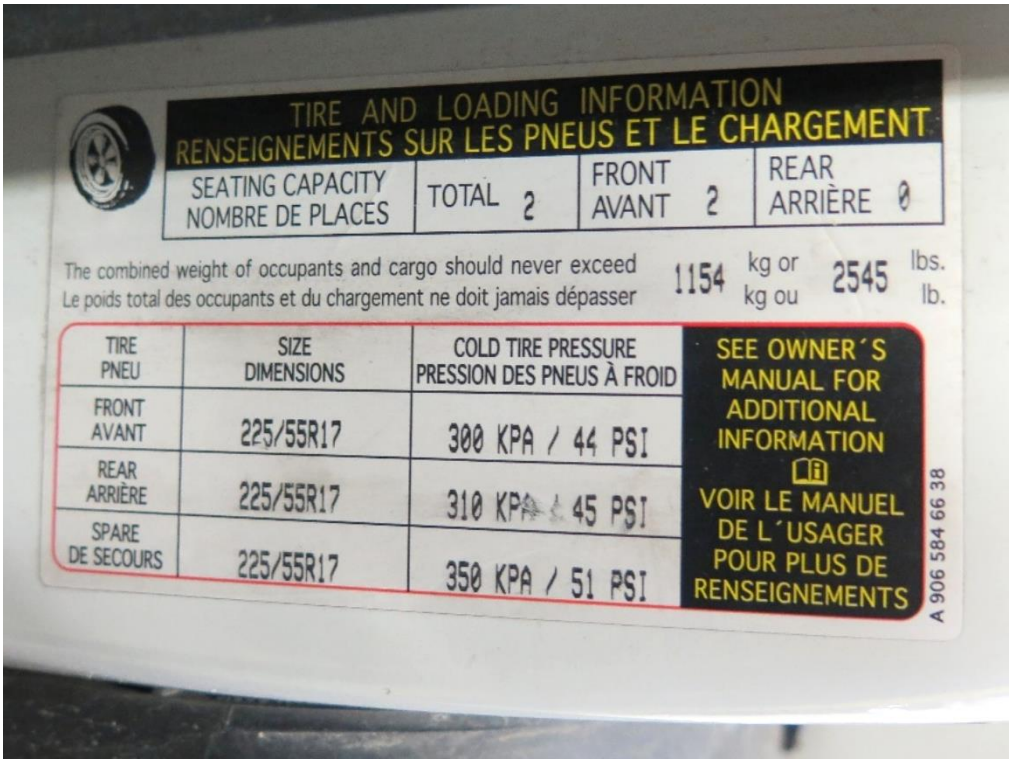
TEST PHOTOGRAPHS

TEST VEHICLE

1. ¾ Front view

2. ¾ Rear view

3. Statement of compliance label



4. Tire information label

INSTRUMENTATION

5. Head Restraint Measurement Device (HMRD)

6. Head positioning fixture

DRIVER SIDE

7. Roof – pre-test

8. Area above seat

9. Front view with test device aligned at initial contact point – pre-test

10. Front view with test device on a stop condition

11. Rear view with test device aligned at initial contact point – pre-test

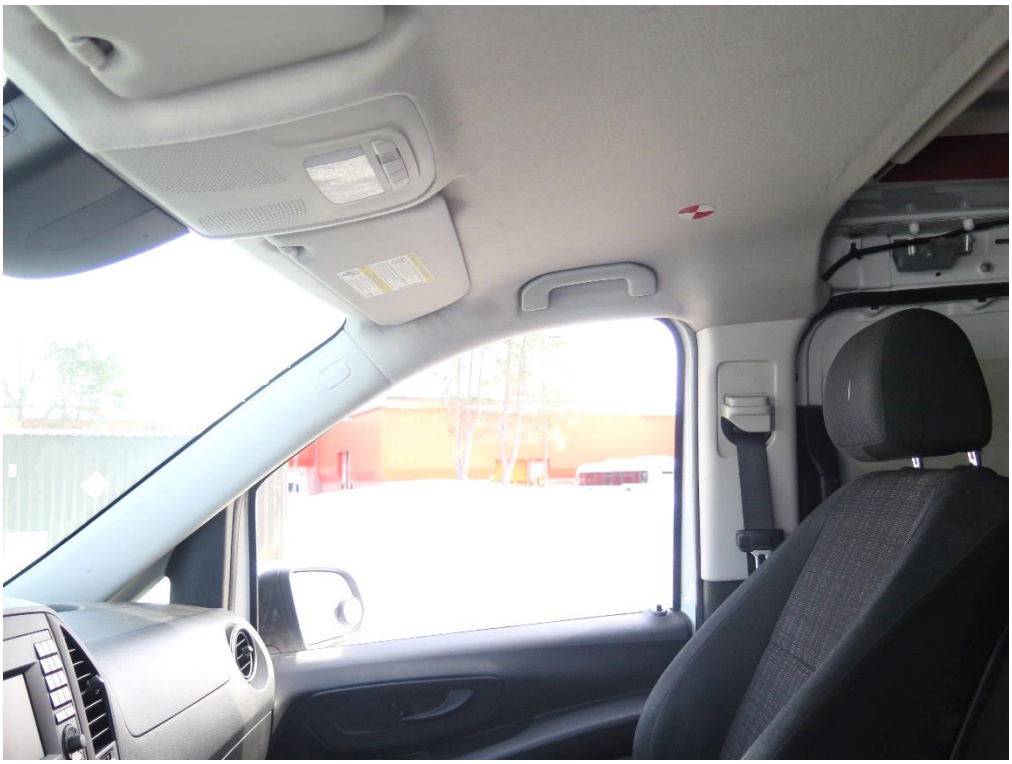
12. Rear view with test device on a stop condition

13. Vehicle on test bench

14. Roof – post-test

PASSENGER SIDE

15. Roof – pre-test



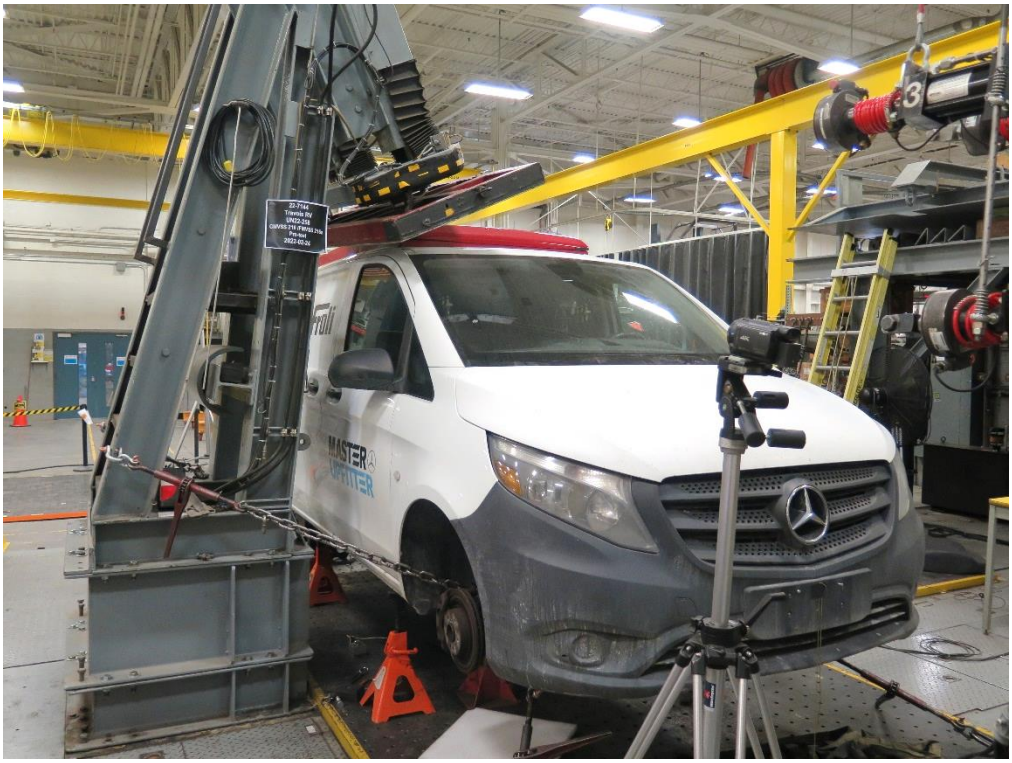
16. Area above seat

17. Front view with test device aligned at initial contact point – pre-test

18. Front view with test device on a stop condition

19. Rear view with test device aligned at initial contact point – pre-test

20. Rear view with test device on a stop condition



21. Vehicle on test bench

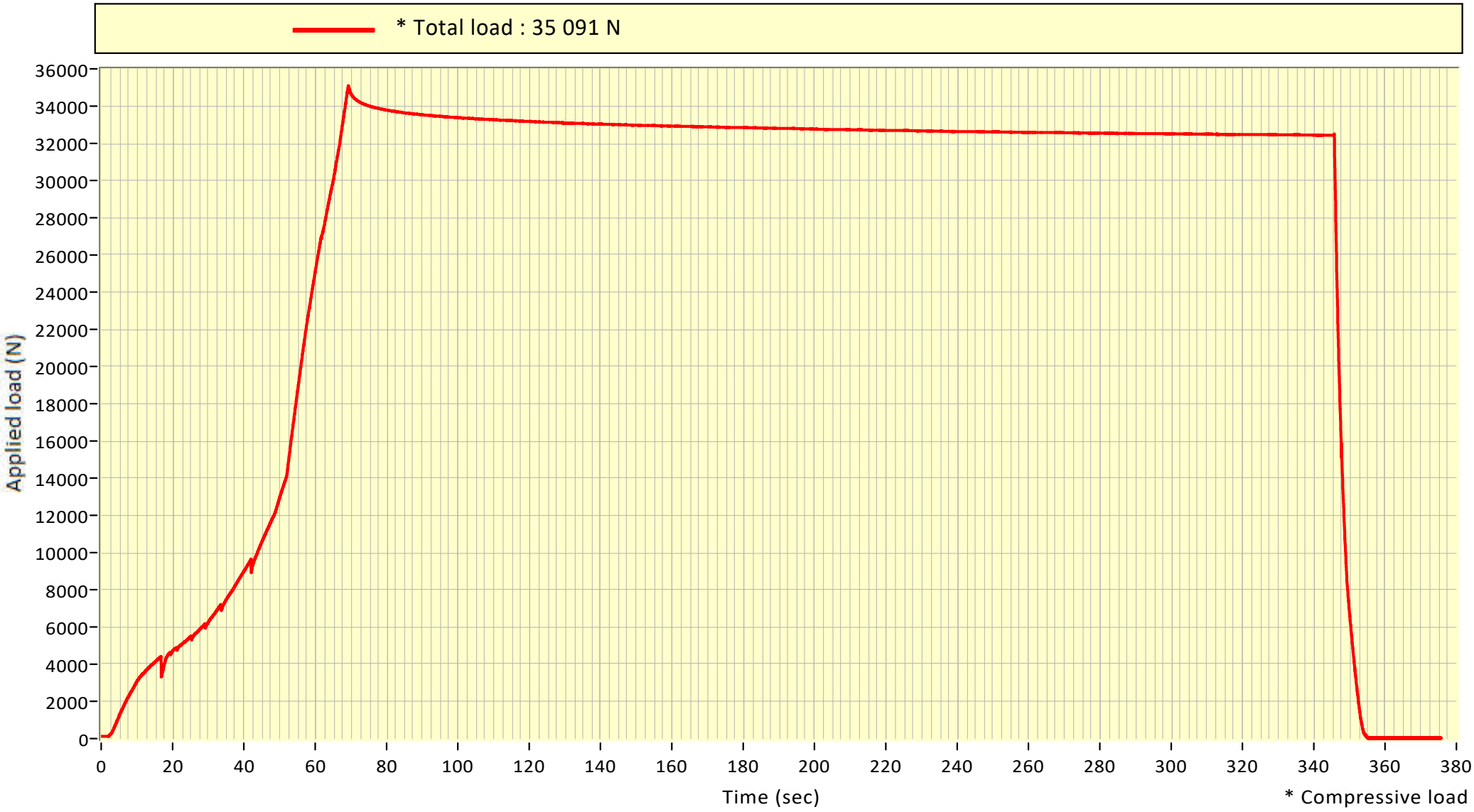
22. Roof – post-test

APPENDIX B

GRAPHICAL DATA

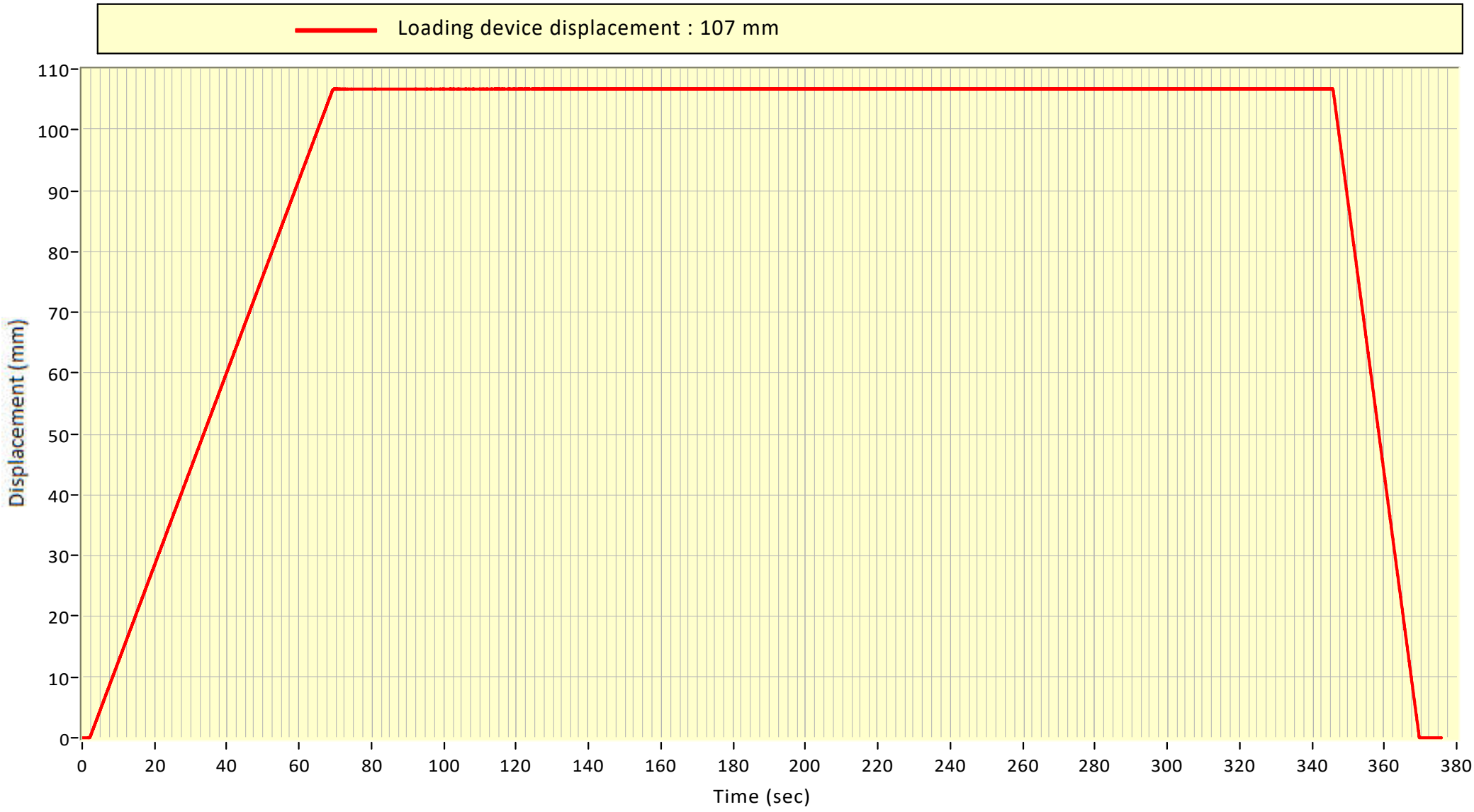
CMVSS 216 and FMVSS 216a - Roof crush resistance — passenger side

Vehicle : MERCEDES METRIS 2015
Test period : 2022-02
UN No.: 22-258



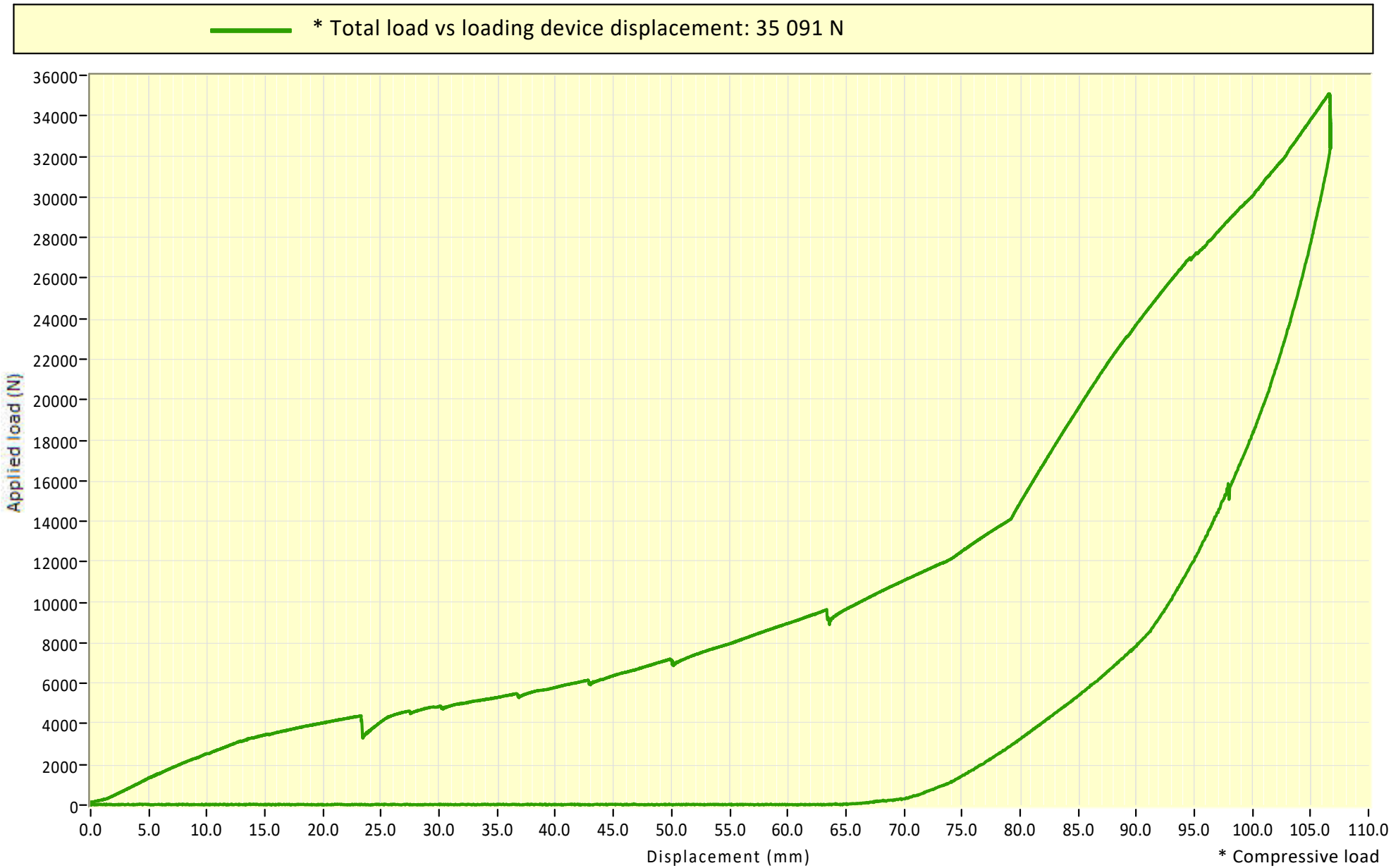
CMVSS 216 and FMVSS 216a - Roof crush resistance — passenger side

Vehicle : MERCEDES METRIS 2015
Test period : 2022-02
UN No.: 22-258



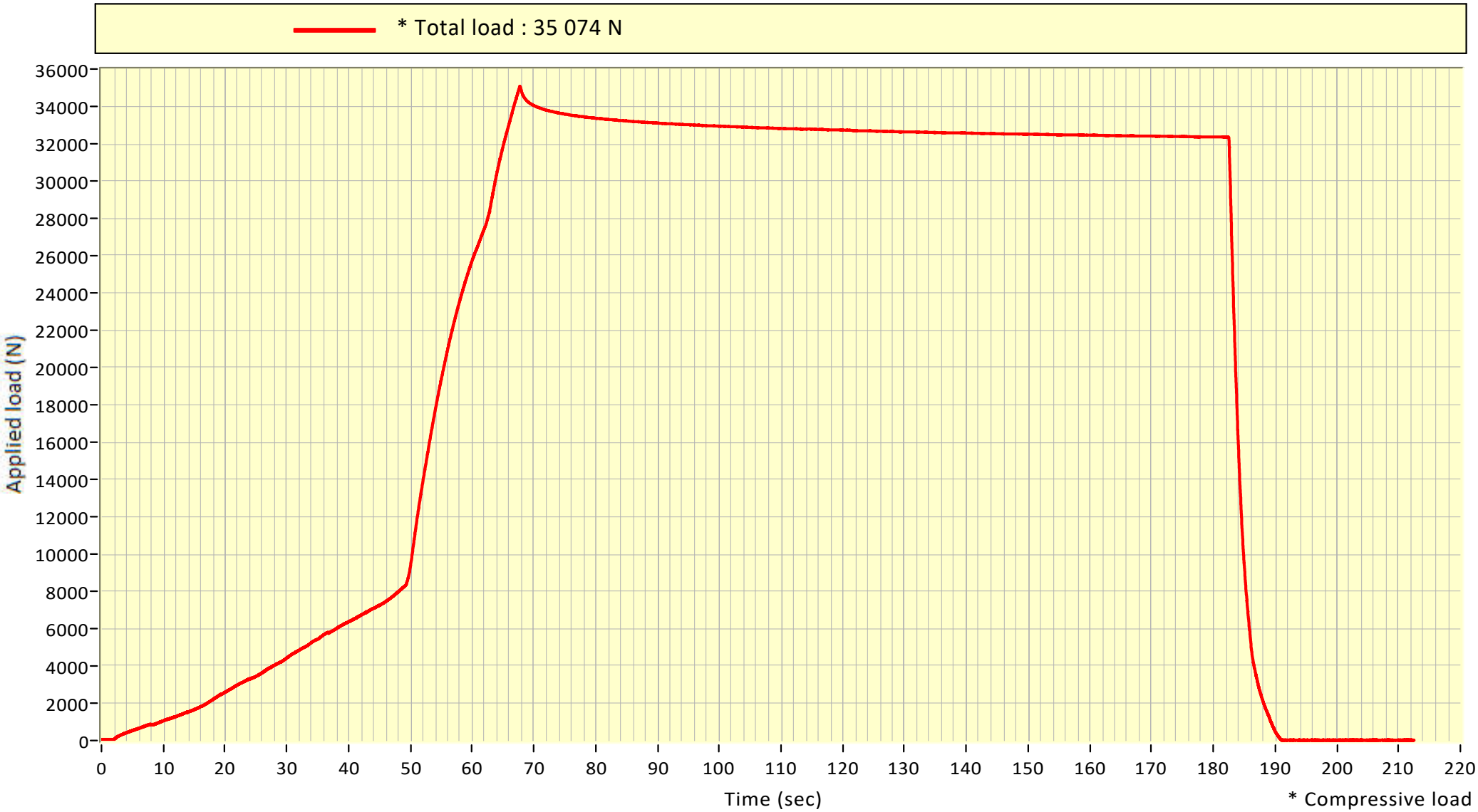
CMVSS 216 / FMVSS 216a - Roof crush resistance — passenger side

Vehicle : MERCEDES METRIS 2015
Test period : 2022-02
UN 22-258



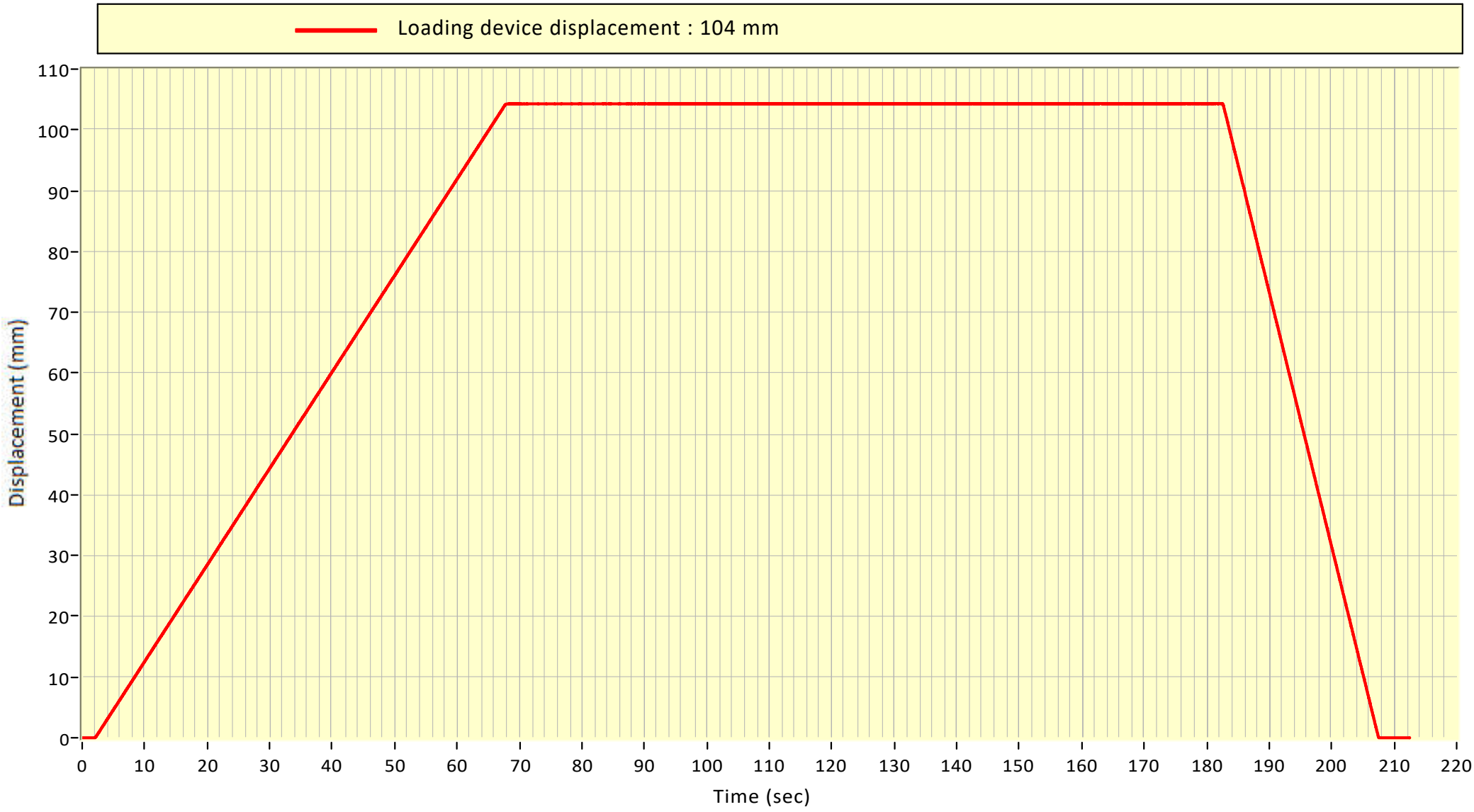
CMVSS 216 and FMVSS 216a - Roof crush resistance — driver side

Vehicle : MERCEDES METRIS 2015
Test period : 2022-02
UN No.: 22-258



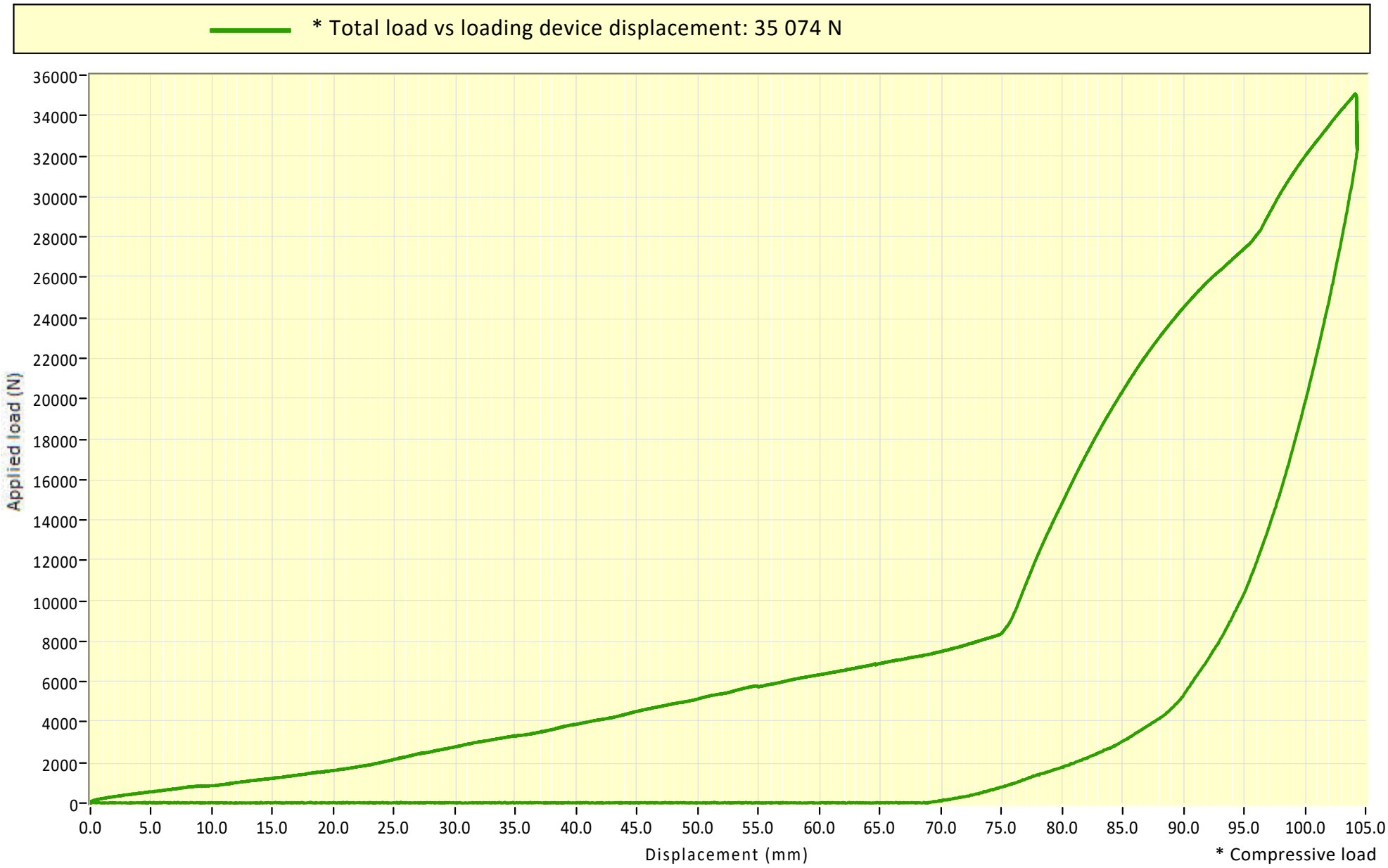
CMVSS 216 and FMVSS 216a - Roof crush resistance — driver side

Vehicle : MERCEDES METRIS 2015
Test period : 2022-02
UN No.: 22-258



CMVSS 216 / FMVSS 216a - Roof crush resistance — driver side

Vehicle : MERCEDES METRIS 2015
Test period : 2022-02
UN 22-258



APPENDIX C

INSTRUMENTATION

INSTRUMENTATION

Following is the instrumentation used for compliance testing to CMVSS 216 and FMVSS 216a. Calibration certificates may be provided upon request.

Description	Manufacturer	Model	Serial no.	Calibration due date
Load cell: Front load	Tovey	SW10-10K-8000	108628A	2022-06-05
Load cell: Middle load	Tovey	SW10-10K-8000	108629A	2022-06-05
Load cell: Rear load	Tovey	SW10-10K-8000	108630A	2022-06-05
Loading device displacement	Temposonic	GH50124R051VM	90315749	2022-10-12
Specimen displacement (Y)	Temposonic (1)	GR05UVM	248(1)	2022-12-17
Load cell: Passenger head	Humanetics	9555TF	078	2022-06-22
Load cell: Driver head	Humanetics	9555TF	079	2022-06-22

APPENDIX D

CMVSS 216, TSD 216

216 ▼ Roof Crush Resistance

Roof Crush Resistance (Standard 216)

216 (1) Every passenger car, multi-purpose passenger vehicle, truck or bus with a GVWR of 4 536 kg or less, except trucks with a GVWR greater than 2 722 kg built from a cutaway chassis, school buses and convertibles, shall conform to the requirements of *Technical Standards Document No. 216, Roof Crush Resistance* (TSD 216), as amended from time to time.

(2) Every passenger car, multi-purpose passenger vehicle, truck or bus with a GVWR of 4 536 kg or less that is built in two or more stages not using a chassis-cab and every passenger car, multi-purpose passenger vehicle, truck or bus with a GVWR greater than 2 722 kg but not greater than 4 536 kg that has an altered roof shall conform to the requirements of TSD 216 or TSD 220, which is referred to in section 220 of this schedule.

(3) Until August 31, 2016, the vehicles referred to in subsections (1) and (2) may conform to the requirements of this section as it read on the day before the day on which this version of the section came into force.

(4) [Repealed, SOR/2014-307, s. 21]

SOR/94-291, s. 5; SOR/2000-402, s. 1; SOR/2006-94, s. 4(E); SOR/2009-291, s. 4; SOR/2014-82, s. 6; SOR/2014-307, s. 21.

amended 2014.04.23, amended 2014.12.31

Transport Canada
Motor Vehicle Safety

Transports Canada
Sécurité des véhicules automobiles

TECHNICAL STANDARDS DOCUMENT
No. 216, Revision 1R

Roof Crush Resistance

The text of this document is based on Federal Motor Vehicle Safety Standard No. 216a, *Roof Crush Resistance,* as published in the United States *Code of Federal Regulations*, Title 49, Part 571, revised as of May 12, 2009, as well as the Final Rule (correcting amendment) published in the *Federal Register* on Wednesday, April 7, 2010 (Vol. 75, No. 66, p. 17604).

Publication Date:	**July 24, 2010**
Effective Date:	**July 24, 2010**
Mandatory Compliance Date:	**September 1, 2016**

(Ce document est aussi disponible en français.)

Introduction

As defined by section 12 of the *Motor Vehicle Safety Act*, a Technical Standards Document (TSD) is a document that reproduces an enactment of a foreign government (e.g. a Federal Motor Vehicle Safety Standard issued by the United States National Highway Traffic Safety Administration). According to the Act, the *Motor Vehicle Safety Regulations* may alter or override some provisions contained in a TSD or specify additional requirements; consequently, it is advisable to read a TSD in conjunction with the Act and its counterpart Regulation. As a guide, where the corresponding Regulation contains additional requirements, footnotes indicate the amending subsection number.

TSDs are revised from time to time in order to incorporate amendments made to the reference document, at which time a Notice of Revision is published in the *Canada Gazette*, Part I. All TSDs are assigned a revision number, with "Revision 0" designating the original version.

Identification of Changes

In order to facilitate the incorporation of a TSD, certain non-technical changes may be made to the foreign enactment. These may include the deletion of words, phrases, figures, or sections that do not apply under the Act or Regulations, the conversion of imperial to metric units, the deletion of superseded dates, and minor changes of an editorial nature. Additions are underlined, and provisions that do not apply are ~~stroked through~~. Where an entire section has been deleted, it is replaced by: "[CONTENT DELETED]". Changes are also made where there is a reporting requirement or reference in the foreign enactment that does not apply in Canada. For example, the name and address of the United States Department of Transportation are replaced by those of the Department of Transport.

Effective Date and Mandatory Compliance Date

The effective date of a TSD is the date of publication of its incorporating regulation or of the notice of revision in the *Canada Gazette*, and the date as of which voluntary compliance is permitted. The mandatory compliance date is the date upon which compliance with the requirements of the TSD is obligatory. If the effective date and mandatory compliance date are different, manufacturers may follow the requirements that were in force before the effective date, or those of this TSD, until the mandatory compliance date.

In the case of an initial TSD, or when a TSD is revised and incorporated by reference by an amendment to the Regulations, the mandatory compliance date is as specified in the Regulations, and it may be the same as the effective date. When a TSD is revised with no corresponding changes to the incorporating Regulations, the mandatory compliance date is six months after the effective date.

Official Version of Technical Standards Documents

The PDF version is a replica of the TSD as published by the Department and is to be used for the purposes of legal interpretation and application.

Table of Contents

Table of Figures

S1. Scope

This Technical Standards Document (TSD) ~~standard~~ establishes strength requirements for the passenger compartment roof.

S2. Purpose

The purpose of this Technical Standards Document (TSD) ~~standard~~ is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

S3. Application, incorporation by reference, and selection of compliance options

[CONTENT DELETED] For applicability, see Schedule III and subsections 216(1) and 216(2) of Schedule IV to the *Motor Vehicle Safety Regulations*.

S4. Definitions

Altered roof means the replacement roof on a motor vehicle whose original roof has been removed, in part or in total, and replaced by a roof that is higher than the original roof. The replacement roof on a motor vehicle whose original roof has been replaced, in whole or in part, by a roof that consists of glazing materials, such as those in T-tops and sunroofs, and is located at the level of the original roof, is not considered to be an altered roof. (*Toit modifié*)

[1]**Convertible** ~~means a vehicle whose A-pillars are not joined with the B-pillars (or rearmost pillars) by a fixed, rigid structural member.~~ (*Décapotable*)

S5. Requirements

S5.1 When the test device described in S6 is used to apply a force to a vehicle's roof in accordance with S7, first to one side of the roof and then to the other side of the roof:

(a) the lower surface of the test device must not move more than 127 millimetres, and

(b) no load greater than 222 Newtons (50 pounds) may be applied to the head form specified in S5.2 of Title 49 of the U.S. *Code of Federal Regulations* (CFR) 571.201 located at the head position of a 50th percentile adult male in accordance with S7.2 of this TSD ~~section~~.

[1] Please see subsection 2(1) of the *Motor Vehicle Safety Regulations* (MVSR) for the applicable definition.

S5.2 The maximum applied force to the vehicle's roof in Newtons is:

(a) for vehicles with a GVWR of 2 722 kilograms (6 000 pounds) or less, any value up to and including 3.0 times the unloaded vehicle mass ~~weight~~ of the vehicle, measured in kilograms and multiplied by 9.8, and

(b) for vehicles with a GVWR greater than 2 722 kilograms (6 000 pounds), any value up to and including 1.5 times the unloaded vehicle mass ~~weight~~ of the vehicle, measured in kilograms and multiplied by 9.8.

S6. Test device

The test device is a rigid unyielding block whose lower surface is a flat rectangle measuring 762 millimetres by 1 829 millimetres.

S7. Test procedure

Each vehicle must be capable of meeting the requirements of S5 when tested in accordance with the procedure in S7.1 through S7.6.

S7.1 Support the vehicle off its suspension and rigidly secure the sills and the chassis frame (when applicable) of the vehicle on a rigid horizontal surface(s) at a longitudinal attitude of 0 degrees ± 0.5 degrees. Measure the longitudinal vehicle attitude along both the driver and passenger sill. Determine the lateral vehicle attitude by measuring the vertical distance between a level surface and a standard reference point on the bottom of the driver and passenger side sills. The difference between the vertical distance measured on the driver side and the passenger side sills is not more than ± 10 mm. Close all windows, close and lock all doors, and close and secure any moveable roof panel, moveable shade, or removable roof structure in place over the occupant compartment. Remove roof racks or other non-structural components. For a vehicle built on a chassis-cab incomplete vehicle that has some portion of the added body structure above the height of the incomplete vehicle, remove the entire added body structure prior to testing (the vehicle's unloaded vehicle mass ~~weight~~ as specified in S5 includes the mass ~~weight~~ of the added body structure).

S7.2 Adjust the seats in accordance with S8.3.1 of Title 49 of the U.S. CFR 571.214. Position the top center of the head form specified in S5.2 of Title 49 of the U.S. CFR 571.201 at the location of the top center of the Head Restraint Measurement Device (HRMD) specified in Title 49 of the U.S. CFR 571.202a, in the front outboard designated seating position on the side of the vehicle being tested as follows:

(a) Position the three dimensional manikin specified in Society of Automotive Engineers (SAE) Surface Vehicle Standard J826, revised July 1995, "Devices for Use in Defining and Measuring Vehicle Seating Accommodation," (incorporated by reference, see paragraph S3.2), in accordance to the seating procedure specified in that document, except that the length of the lower leg and thigh segments of the H-point machine are adjusted to 414 and 401 millimetres, respectively, instead of the 50th percentile values specified in Table 1 of SAE J826 (July 1995).

(b) Remove four torso weights from the three-dimensional manikin specified in SAE J826 (July 1995) (two from the left side and two from the right side), replace with two HRMD torso weights (one on each side), and attach and level the HRMD head form.
(c) Mark the location of the top center of the HRMD in three dimensional space to locate the top center of the head form specified in Title S5.2 of 49 of the U.S. CFR 571.201.

S7.3 Orient the test device as shown in Figure 1 of this TSD ~~section~~, so that –

(a) Its longitudinal axis is at a forward angle (in side view) of 5 degrees (± 0.5 degrees) below the horizontal, and is parallel to the vertical plane through the vehicle's longitudinal centerline;

(b) Its transverse axis is at an outboard angle, in the front view projection, of 25 degrees below the horizontal (± 0.5 degrees).

S7.4 Maintaining the orientation specified in S7.3 of this TSD ~~section~~ –

(a) Lower the test device until it initially makes contact with the roof of the vehicle.

(b) Position the test device so that –

(1) The longitudinal centerline on its lower surface is within 10 mm of the initial point of contact, or on the center of the initial contact area, with the roof; and

(2) The midpoint of the forward edge of the lower surface of the test device is within 10 mm of the transverse vertical plane 254 mm forward of the forwardmost point on the exterior surface of the roof, including windshield trim, that lies in the longitudinal vertical plane passing through the vehicle's longitudinal centerline.

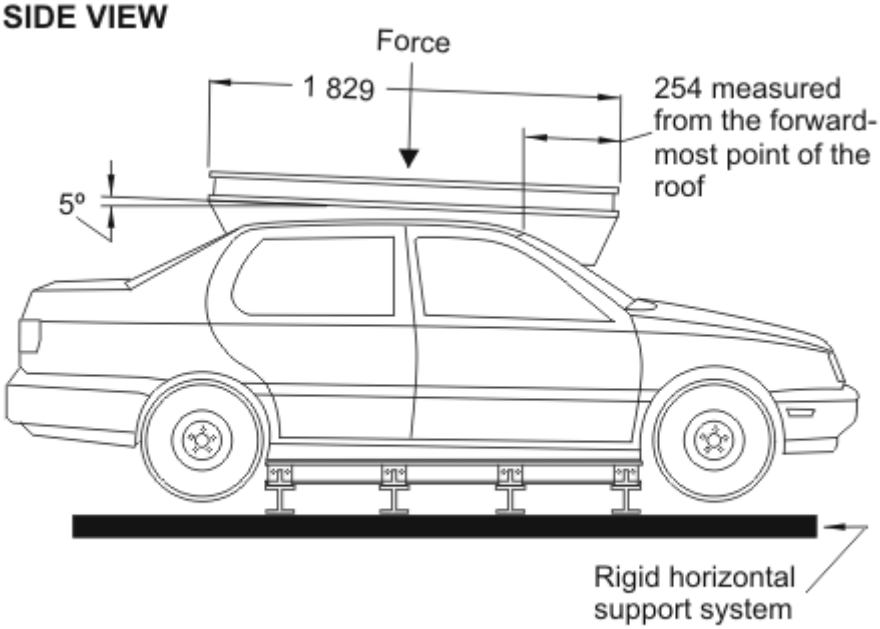
S7.5 Apply force so that the test device moves in a downward direction perpendicular to the lower surface of the test device at a rate of not more than 13 millimetres per second until reaching the force level specified in S5. Guide the test device so that throughout the test it moves, without rotation, in a straight line with its lower surface oriented as specified in S7.3(a) and S7.3(b). Complete the test within 120 seconds.

S7.6 Repeat the test on the other side of the vehicle.

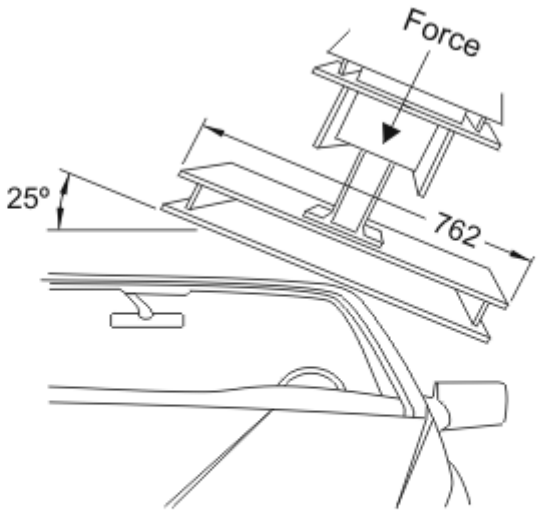
S8 –S9

[CONTENT DELETED]

SIDE VIEW



FRONT VIEW



Notes:
1. Dimensions in mm
2. Not to scale

Figure 1 — Test Device Orientation

APPENDIX E

FMVSS 216A

FIGURE 2 TO §571.216

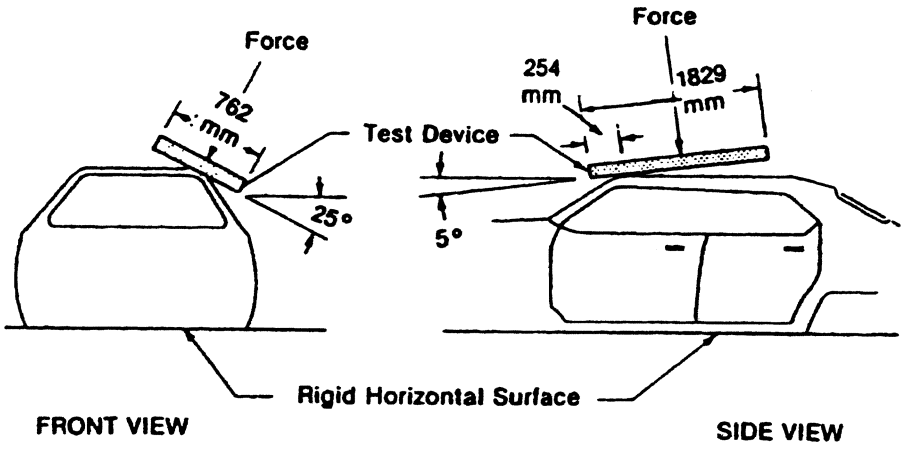


Figure 2.- Test Device Location And Application To The Roof

[36 FR 23300, Dec. 8, 1971, as amended at 38 FR 21930, Aug. 14, 1973; 56 FR 15517, Apr. 17, 1991; 58 FR 5633, Jan. 22, 1993; 60 FR 13647, Mar. 14, 1995; 64 FR 22578, Apr. 27, 1999; 65 FR 4581, Jan. 31, 2000; 74 FR 22384, May 12, 2009]

EDITORIAL NOTE: At 74 FR 22384, May 12, 2009, §571.216 was amended by revising S3; however, the amendment included two paragraphs (a).

§571.216a Standard No. 216a; Roof crush resistance; Upgraded standard.

S1. *Scope.* This standard establishes strength requirements for the passenger compartment roof.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

S3 *Application and selection of compliance options.*

S3.1 *Application.*

(a) This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kilograms (10,000 pounds) or less, according to the implementation schedule specified in S8 and S9 of this section. However, it does not apply to—

(1) School buses;

(2) Vehicles that conform to the rollover test requirements (S5.3) of Standard No. 208 (§571.208) by means that require no action by vehicle occupants;

(3) Convertibles, except for optional compliance with the standard as an alternative to the rollover test requirement (S5.3) of Standard No. 208; or

(4) Trucks built in two or more stages with a GVWR greater than 2,722 kilograms (6,000 pounds) not built using a chassis cab or using an incomplete vehicle with a full exterior van body.

(b) At the option of the manufacturer, vehicles within either of the following categories may comply with the roof crush requirements (S4) of Standard No. 220 (§571.220) instead of the requirements of this standard:

(1) Vehicles built in two or more stages, other than vehicles built using a chassis cab;

(2) Vehicles with a GVWR greater than 2,722 kilograms (6,000 pounds) that have an altered roof as defined by S4 of this section.

(c) Manufacturers may comply with the standard in this §571.216a as an alternative to §571.216.

S3.2 *Selection of compliance option.* Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon the request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it selected for a particular vehicle or make/model.

S4. *Definitions.*

Altered roof means the replacement roof on a motor vehicle whose original roof has been removed, in part or in total, and replaced by a roof that is higher than the original roof. The replacement roof on a motor vehicle whose original roof has been replaced, in whole or in part, by a roof that consists of glazing materials, such as those in T-tops and sunroofs, and is located at the level of the original roof, is not considered to be an altered roof.

Convertible means a vehicle whose A-pillars are not joined with the B-pillars (or rearmost pillars) by a fixed, rigid structural member.

S5. *Requirements.*

S5.1 When the test device described in S6 is used to apply a force to a vehicle's roof in accordance with S7, first to one side of the roof and then to the other side of the roof:

(a) The lower surface of the test device must not move more than 127 millimeters, and

(b) No load greater than 222 Newtons (50 pounds) may be applied to the head form specified in S5.2 of 49 CFR 571.201 located at the head position of a 50th percentile adult male in accordance with S7.2 of this section.

S5.2 The maximum applied force to the vehicle's roof in Newtons is:

(a) For vehicles with a GVWR of 2,722 kilograms (6,000 pounds) or less, any value up to and including 3.0 times the unloaded vehicle weight of the vehicle, measured in kilograms and multiplied by 9.8, and

(b) For vehicles with a GVWR greater than 2,722 kilograms (6,000 pounds), any value up to and including 1.5 times the unloaded vehicle weight of the vehicle, measured in kilograms and multiplied by 9.8.

S6. *Test device.* The test device is a rigid unyielding block whose lower surface is a flat rectangle measuring 762 millimeters by 1,829 millimeters.

S7. *Test procedure.* Each vehicle must be capable of meeting the requirements of S5 when tested in accordance with the procedure in S7.1 through S7.6.

S7.1 Support the vehicle off its suspension and rigidly secure the sills and the chassis frame (when applicable) of the vehicle on a rigid horizontal surface(s) at a longitudinal attitude of 0 degrees ±0.5 degrees. Measure the longitudinal vehicle attitude along both the driver and passenger sill. Determine the lateral vehicle attitude by measuring the vertical distance between a level surface and a standard reference point on the bottom of the driver and passenger side sills. The difference between the vertical distance measured on the driver side and the passenger side sills is not more than ±10 mm. Close all windows, close and lock all doors, and close and secure any moveable roof panel, moveable shade, or removable roof structure in place over the occupant compartment. Remove roof racks or other non-structural components. For a vehicle built on a chassis-cab incomplete vehicle that has some portion of the added body structure above the height of the incomplete vehicle, remove the entire added body structure prior to testing (the vehicle's unloaded vehicle weight as specified in S5 includes the weight of the added body structure).

S7.2 Adjust the seats in accordance with S8.3.1 of 49 CFR 571.214. Position the top center of the head form specified in S5.2 of 49 CFR 571.201 at the location of the top center of the Head Restraint Measurement Device (HRMD) specified in 49 CFR 571.202a, in the front outboard designated seating position on the side of the vehicle being tested as follows:

(a) Position the three dimensional manikin specified in SAE Standard J826 JUL95 (incorporated by reference, see § 571.5), in accordance to the seating procedure specified in that document, except that the length of the lower leg and thigh segments of the H-point machine are adjusted to 414 and 401 millimeters, respectively, instead of the

50th percentile values specified in Table 1 of SAE J826 JUL95.

(b) Remove four torso weights from the three-dimensional manikin specified in SAE J826 (July 1995) (two from the left side and two from the right side), replace with two HRMD torso weights (one on each side), and attach and level the HRMD head form.

(c) Mark the location of the top center of the HRMD in three dimensional space to locate the top center of the head form specified in S5.2 of 49 CFR 571.201.

S7.3 Orient the test device as shown in Figure 1 of this section, so that—

(a) Its longitudinal axis is at a forward angle (in side view) of 5 degrees (±0.5 degrees) below the horizontal, and is parallel to the vertical plane through the vehicle's longitudinal centerline;

(b) Its transverse axis is at an outboard angle, in the front view projection, of 25 degrees below the horizontal (±0.5 degrees).

S7.4 Maintaining the orientation specified in S7.3 of this section—

(a) Lower the test device until it initially makes contact with the roof of the vehicle.

(b) Position the test device so that—

(1) The longitudinal centerline on its lower surface is within 10 mm of the initial point of contact, or on the center of the initial contact area, with the roof; and

(2) The midpoint of the forward edge of the lower surface of the test device is within 10 mm of the transverse vertical plane 254 mm forward of the forwardmost point on the exterior surface of the roof, including windshield trim, that lies in the longitudinal vertical plane passing through the vehicle's longitudinal centerline.

S7.5 Apply force so that the test device moves in a downward direction perpendicular to the lower surface of the test device at a rate of not more than 13 millimeters per second until reaching the force level specified in S5. Guide the test device so that throughout the test it moves, without rotation, in a straight line with its lower surface oriented as specified in S7.3(a) and S7.3(b). Complete the test within 120 seconds.

S7.6 Repeat the test on the other side of the vehicle.

S8. *Phase-in schedule for vehicles with a GVWR of 2,722 kilograms (6,000 pounds) or less.*

S8.1 *Vehicles manufactured on or after September 1, 2012, and before September 1, 2013.* For vehicles manufactured on or after September 1, 2012, and before September 1, 2013, the number of vehicles complying with this standard must not be less than 25 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2009, and before September 1, 2012; or

(b) The manufacturer's production on or after September 1, 2012, and before September 1, 2013.

S8.2 *Vehicles manufactured on or after September 1, 2013, and before September 1, 2014.* For vehicles manufactured on or after September 1, 2013, and before September 1, 2014, the number of vehicles complying with this standard must not be less than 50 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2010, and before September 1, 2013; or

(b) The manufacturer's production on or after September 1, 2013, and before September 1, 2014.

S8.3 *Vehicles manufactured on or after September 1, 2014, and before September 1, 2015.* For vehicles manufactured on or after September 1, 2014, and before September 1, 2015, the number of vehicles complying with this standard must not be less than 75 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2011, and before September 1, 2014; or

(b) The manufacturer's production on or after September 1, 2014, and before September 1, 2015.

S8.4 *Vehicles manufactured on or after September 1, 2015.* Except as provided in S8.8, each vehicle manufactured on or after September 1, 2015 must comply with this standard.

S8.5 *Calculation of complying vehicles.*

(a) For purpose of complying with S8.1, a manufacturer may count a vehicle if it is certified as complying with this standard and is manufactured on or after September 1, 2012, but before September 1, 2013.

(b) For purposes of complying with S8.2, a manufacturer may count a vehicle if it:

(1) Is certified as complying with this standard and is manufactured on or after September 1, 2012, but before September 1, 2014; and

(2) Is not counted toward compliance with S8.1.

(c) For purposes of complying with S8.3, a manufacturer may count a vehicle if it:

(1) Is certified as complying with this standard and is manufactured on or after September 1, 2012, but before September 1, 2015; and

(2) Is not counted toward compliance with S8.1 or S8.2.

S8.6 *Vehicles produced by more than one manufacturer.*

S8.6.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8.1 through S8.3, a vehicle produced by more than one manufacturer must be attributed to a single manufacturer as follows, subject to S8.6.2:

(a) A vehicle that is imported must be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, must be attributed to the manufacturer that markets the vehicle.

S8.6.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S8.6.1.

S8.7 *Small volume manufacturers.* Vehicles manufactured during any of the three years of the September 1, 2012 through August 31, 2015 phase-in by a manufacturer that produces fewer than 5,000 vehicles for sale in the United States during that year are not subject to the requirements of S8.1, S8.2, and S8.3.

S8.8 *Final-stage manufacturers and alterers.*

Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter are not subject to the requirements of S8.1 through S8.3. Instead, all vehicles produced by these manufacturers on or after September 1, 2016 must comply with this standard.

S9 *Vehicles with a GVWR above 2,722 kilograms (6,000 pounds).*

(a) Except as provided in S9(b), each vehicle manufactured on or after September 1, 2016 must comply with this standard.

(b) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S8.1 through S8.3. Instead, all vehicles produced by these manufacturers on or after September 1, 2017 must comply with this standard.

Figure 1 to §571.216

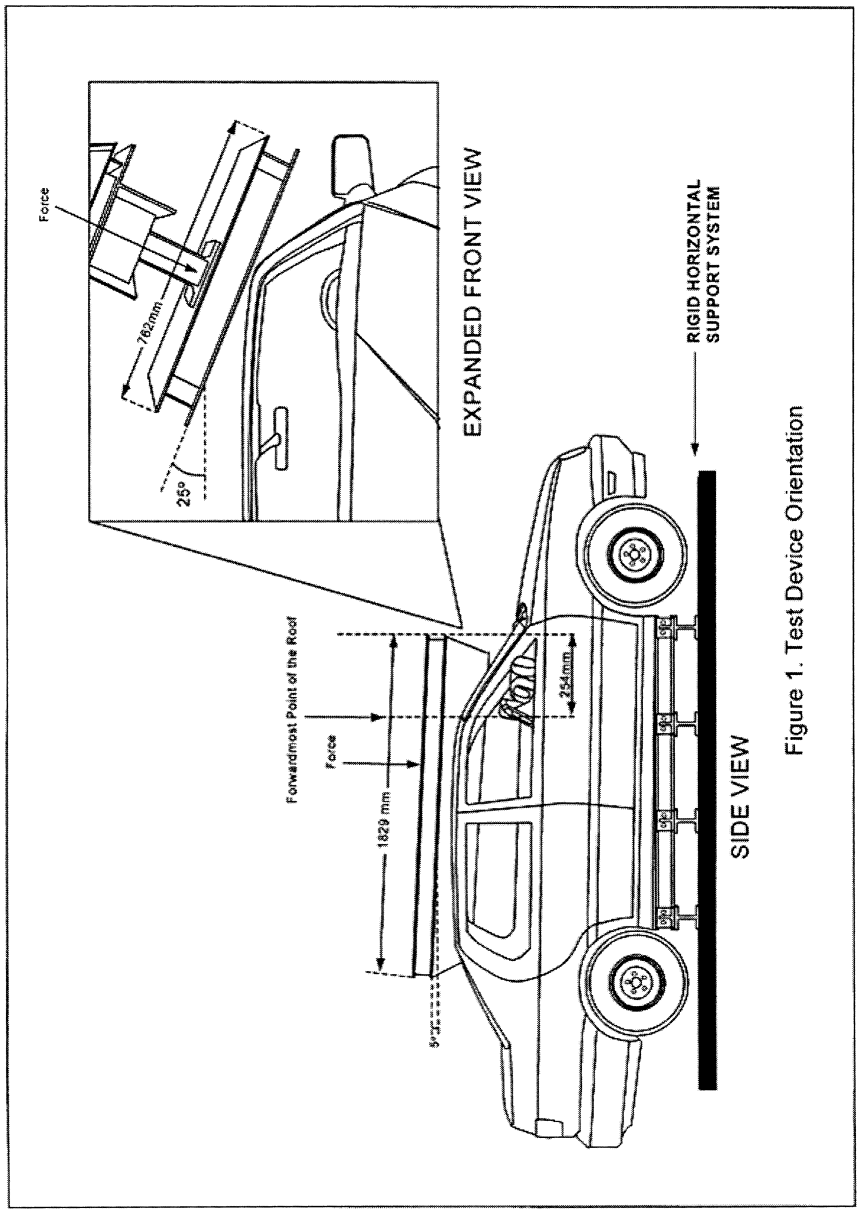


Figure 1. Test Device Orientation

[74 FR 22384, May 12, 2009, as amended at 75 FR 17605, Apr. 7, 2010; 77 FR 768, Jan. 6, 2012]

§ 571.217 Standard No. 217; Bus emergency exits and window retention and release.

S1. *Scope*. This standard establishes requirements for the retention of windows other than windshields in buses, and establishes operating forces, opening dimensions, and markings for bus emergency exits.

S2. *Purpose*. The purpose of this standard is to minimize the likelihood of occupants being thrown from the bus and to provide a means of readily accessible emergency egress.

S3. *Application*. This standard applies to buses, except buses manufactured for the purpose of transporting persons under physical restraint.

S4. *Definitions*. *Adjacent seat* means a designated seating position located so that some portion of its occupant space is not more than 10 inches from an emergency exit, for a distance of at least 15 inches measured horizontally and parallel to the exit.

Daylight opening means the maximum unobstructed opening of an emergency exit when viewed from a direction perpendicular to the plane of the opening.

Mid-point of the passenger compartment means any point on a vertical transverse plane bisecting the vehicle longitudinal centerline that extends between the two vertical transverse planes which define the foremost and rearmost limits of the passenger compartment.

Occupant space means the space directly above the seat and footwell, bounded vertically by the ceiling and horizontally by the normally positioned seat back and the nearest obstruction of occupant motion in the direction the seat faces.

Passenger compartment means space within the school bus interior that is between a vertical transverse plane located 76 centimeters in front of the forwardmost passenger seating reference point and a vertical transverse plane tangent to the rear interior wall of the bus at the vehicle centerline.

Post and roof bow panel space means the area between two adjacent post and roof bows.

Push-out window means a vehicle window designed to open outward to provide for emergency egress.

Sliding window means a bus window designed to open by moving vertically or horizontally to provide emergency egress.

Wheelchair means a wheeled seat frame for the support and conveyance of a physically disabled person, comprising at least a frame, seat, and wheels.

Wheelchair securement anchorage means the provision for transferring wheelchair securement device loads to the vehicle structure.

Wheelchair securement device means a strap, webbing or other device used for securing a wheelchair to the school bus, including all necessary buckles and other fasteners.

S5. *Requirements*.

S5.1 *Window retention*. Except as provided in S5.1.2, each piece of window glazing and each surrounding window frame when tested in accordance with the procedure in S5.1.1 under the conditions of S6.1 through S6.3, shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 4-inch diameter sphere under a force, including the weight of the sphere, of 5 pounds until any one of the following events occurs:

(a) A force of 1,200 pounds is reached.

(b) At least 80 percent of the glazing thickness has developed cracks running from the load contact region to the periphery at two or more points, or shattering of the glazing occurs.

(c) The inner surface of the glazing at the center of force application has moved relative to the window frame, along a line perpendicular to the undisturbed inner surface, a distance equal to one-half of the square root of the minimum surface dimension measured through the center of the area of the entire sheet of window glazing.

S5.1.1 An increasing force shall be applied to the window glazing through the head form specified in Figure 4, outward and perpendicular to the undisturbed inside surface at the center of the area of each sheet of window glazing, with a head form travel of 2 inches per minute.