



Inspection/Test Report: Dynamic Strength Test for WTORS Anchorages of Forward-Facing Wheelchairs ≤ 200kg

Legislation

PAS 2012-1:2019 Annex C (referenced to 2018/858)

Inspection/Test Details

Location of Inspection/Test: Braunability UK, The Horseshoe, Coat Road, Martock, TA12 6EY (test witnessed remotely)
Date of Inspection/Test: 12 & 17 March 2021
VCA Representative(s): Fraser Coulter
Inspectors Home Office Location: VCA HQ
Manufacturer's Representative(s): Paul Nieuwenhuis
Reason for Test Report: Test report only

Manufacturer Details

Name and Address: Tripod Mobility B.V.
Collseweg 10
5674 TR Nuenen / The Netherlands
Type: SKT
Commercial Description: Caddy Tripod / Caddy Maxi Tripod
Category: M₁ SPV (Wheelchair Accessible Vehicle)

Conclusion

The above-mentioned vehicle/components were tested in accordance with the above-mentioned legislation and were found to comply in all respects. This report relates only to the items tested.

Witness Engineer/Test Engineer
Signature:

Name: Fraser Coulter
Position: Type Approval Engineer
Date: 18 March 2021

List of Annexes

| Annex | No of Pages | Subject |
|-------|-------------|---|
| I | 2 | Comparison of vehicle and WTORS test geometry |
| II | 14 | Braunability Test Reports (combined) |





Issue Record

Issue 0 is original report

Worst Case Rationale

Test report to cover **160kg** dynamic wheelchair tests in both SWB and LWB versions of the VW Caddy. Testing was conducted in a BiW which had been converted to be representative of Tripod Mobility production intent.

Note: Include information on variants and versions this report covers, as applicable. Supporting documents may be annexed to this report

Inspection/Tests Required

| | |
|---------------------------------|--|
| | Yes, NA, See Report ... / Approval ... / Annex ... |
| WTORS Anchorages: | Yes |
| WTORS Components – Dynamic Test | Yes |

Vehicle/Component Specification

| | |
|------------------------------------|--------------------------|
| Vehicle Type/Variant/Version: | Caddy SWB and Caddy Maxi |
| Wheelchair Front Tie-down Details: | EF3J |
| Wheelchair Rear Tie-down Details: | BQE16MK |
| Occupant Restraint Details: | SBT-11040-A |

Manufacturer's Documentation

Manufacturer's documentation is complete and reflects the agreed specification for the components tested and covers all variants and versions agreed in the worst case rationale. Information document uploaded to job folder and identified by job number.

Yes

Facility and Equipment Checks

Facility Appraisal reference and date (*Reference and date if formal; state if ad-hoc appraisal*).

Ad-Hoc

Calibration certificates checked and valid, recorded in the following table:

Yes

| Equipment | Serial / Certificate No. | Calibration due* |
|------------------|--------------------------|-------------------|
| Data Acquisition | UIG133 | 09 April 2021 |
| Accelerometers | UIG 108 | 21 September 2021 |
| | UIG 275 | 21 September 2021 |
| | UIG125 | 21 September 2021 |
| | UIG 276 | 21 September 2021 |

*Specify calibrated date + (interval) or calibration due date.



Inspection/Test Requirements

WTORS Anchorages

(Anchorage strength may be tested using either the dynamic or static options below.)

General Requirements

| | | |
|-------------|---|-----|
| Footnote W3 | Longitudinal plane of the intended wheelchair-travelling position is parallel to the longitudinal plane of the vehicle. | Yes |
| Footnote W3 | Appropriate information is made available to the vehicle owner that, in order to be capable of withstanding the forces transmitted by the tie-down mechanism during the various driving conditions, a wheelchair with a structure meeting the relevant part of ISO 7176-19:2008 is recommended. | Yes |

Dynamic Testing

| | | |
|----------------------------------|---|-----|
| 2018/858, Ann II, Part III, 0.1. | Anchorage strength requirements are considered to be met if the dynamic WTORS component test is carried out in a representative body structure. | Yes |
|----------------------------------|---|-----|

Geometric Requirements

| | | |
|---|--|-----|
| 2018/858, Ann II, Part III, 1.2. R14.07, 5.4.2.2. | Side-view projected angles of the lines between the SWC P-point and the lower occupant anchorages are between 30 and 80 degrees from the horizontal. | Yes |
| 2018/858, Ann II, Part III, 1.2. | Upper actual anchorage(s) are located at least 1,100 mm above the horizontal plane, passing through the points of contact between the rear tyres of the SWC and the vehicle floor. This condition is still satisfied after the static/dynamic strength test. | Yes |

WTORS Components – Dynamic Test

Dynamic Test Set-up

| | | |
|------------------------------------|---|-----|
| ISO10542, Ann A, 4.2.(a) | Wheelchair design meets characteristics specified in Annex E. | Yes |
| ISO10542, Ann A, 4.2.(b) | Hybrid III dummy used with mass of 77.7 kg. Close-fitting cotton clothes worn and static resistance of all joints set to 1 g. | Yes |
| 2018/858, Ann II, Part III, 2.3.1. | Test carried out in representative vehicle body structure* OR | Yes |



~~All anchorages on sled set up are within an absolute linear distance
of 50 mm from those on the vehicle*~~

**Strikethrough, as appropriate.*

*Note: There is no tolerance on the SWC P-point with respect to the declared
travelling position of the wheelchair and so measurements of anchorage positions
should be normalised to give the P-point as the origin in both sets of measurements.*

| | | |
|------------------------------|---|-----|
| VCA | In the case of out-of-vehicle tests, comparison of anchorage positions is attached to the report as an Annex. | NA |
| ISO10542, Ann A, 5.7. VCA | Wheelchair reference plane parallel to vehicle longitudinal plane (+/- 3°). Where the wheelchair does not rest on a horizontal surface, this attitude is replicated on the sled, wherever possible. | Yes |
| ISO10542, Ann A, 5.8. | Tie-downs installed and tensioned, as per manufacturer's instructions. | Yes |
| ISO10542, Ann A, 5.12. | ATD is positioned upright in the SWC and symmetrical about its centreline with the pelvis as far back on the seat as possible and hands resting on thighs. | Yes |
| ISO10542, Ann A, 5.14.-5.18. | Occupant restraint installed, as per manufacturer's instructions. | Yes |
| ISO10542, Ann E, E.2.I | Tyre pressures set to 320 ⁺³⁰ / ₋₀ kPa. (where applicable) | Yes |

Dynamic Test Results

| | | | | |
|--------------------------|---|----------------------------|------|-----|
| ISO10542, Ann A, 4.1.(c) | Sled velocity change: Requirement: 48 ⁻⁰ / ₊₂ km/h | Test 1:49.2 Test 2:48.9 | km/h | Yes |
| ISO10542, Ann A, 4.1.(d) | Acceleration pulse conforms to ISO 10542 requirements. Requirement: > 0g for 75 ms; > 15 g for 40 ms; > 20 g for 15 ms | | | Yes |
| ISO10542, 5.2.3.(a) | ATD retained in seat of SWC. | | | Yes |
| ISO10542, 5.2.3.(b) | SWC is in an upright position on the impact sled. | | | Yes |
| ISO10542, 5.2.3.(c) | No WTORS component became detached or separated. | | | Yes |
| ISO10542, 5.2.3.(d) | Tools not required for release of SWC from tie-down system. | | | Yes |
| ISO10542, 5.2.3.(e) | Tools not required for release of ATD from restraint system. | | | Yes |
| ISO10542, 5.2.3.(f) | No part of the WTORS exhibits signs of tearing, fragmentation, fracture, or complete failure (unless designed to do so, e.g. load | | | Yes |



limiting webbing).

ISO10542,
5.2.3.(g)

WTORS exhibits no dangerous roughness, sharp edges or
protrusions likely to increase the risk of injury.

SO10542,
5.2.2.(a)

Movement of the SWC and ATD is within limits:

| | | | |
|--|----------------|----|------------|
| - Horizontal excursion of SWC: | Test 1: 175.86 | mm | Limit: 200 |
| | Test 2: 178.32 | | |
| - Horizontal excursion of ATD knee: | Test 1: 229.63 | mm | Limit: 375 |
| | Test 2: 217.49 | | |
| - Horizontal excursion of ATD head: | Test 1: 521.42 | mm | Limit: 650 |
| | Test 2: 461.61 | | |

ISO10542,
5.2.2.(b)

Horizontal excursion of ATD knee is at least 1.1 times excursion of
SWC.

Remarks (condition of anchorages after test):

Minor burn marks on upper belt around upper anchorage point

Remarks

Note: VCA apply measurement uncertainty to calibrated items but not test results.



Annex I – Comparison of Vehicle and WTORS Test Geometry

Caddy SWB separate stalks

| Measured with arbitrary datum | | | | | | | | | | |
|--|---------|------|------|------------|------|------|------------|---|---|-----|
| | Vehicle | | | WTORS Test | | | | | | |
| | X | Y | Z | X | Y | Z | | | | |
| Front left | 1460 | -225 | -189 | 1460 | -225 | -189 | | | | |
| Front right | 1460 | 225 | -189 | 1460 | 225 | -189 | | | | |
| | | | | | | | | | | |
| Rear left | 0 | -150 | -265 | 0 | -150 | -265 | | | | |
| Rear right | 0 | 150 | -265 | 0 | 150 | -265 | | | | |
| | | | | | | | | | | |
| LB | 118 | 441 | 22 | 118 | 441 | 22 | | | | |
| LNB | 118 | 441 | 22 | 118 | 441 | 22 | | | | |
| Upper | 96 | 486 | 1116 | 96 | 486 | 1116 | | | | |
| Reel | 46 | 618 | 77 | 46 | 618 | 77 | | | | |
| | | | | | | | | | | |
| P point | 561 | 0 | 300 | 561 | 0 | 300 | | | | |
| | | | | | | | | | | |
| Corrected to make P-point the origin (0,0,0) in both cases | | | | | | | | | | |
| | Vehicle | | | WTORS Test | | | Difference | | | |
| | X | Y | Z | X | Y | Z | X | Y | Z | Abs |
| Front left* | 899 | -225 | -489 | 899 | -225 | -489 | 0 | 0 | 0 | 0 |
| Front right* | 899 | 225 | -489 | 899 | 225 | -489 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Rear left | -561 | -150 | -565 | -561 | -150 | -565 | 0 | 0 | 0 | 0 |
| Rear right | -561 | 150 | -565 | -561 | 150 | -565 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| LB | -443 | 441 | -278 | -443 | 441 | -278 | 0 | 0 | 0 | 0 |
| LNB^ | -443 | 441 | -278 | -443 | 441 | -278 | 0 | 0 | 0 | 0 |
| Upper | -465 | 486 | 816 | -465 | 486 | 816 | 0 | 0 | 0 | 0 |
| Reel^ | -515 | 618 | -223 | -515 | 618 | -223 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| P point | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



Caddy Maxi

| Measured with arbitrary datum | | | | | | | | | | | | | | |
|--|--|---------|------|------|--|------------|------|------|--|------------|-----|------|-----|--|
| | | Vehicle | | | | WTORS Test | | | | | | | | |
| | | X | Y | Z | | X | Y | Z | | | | | | |
| Front left | | 1240 | -250 | -261 | | 1240 | -250 | -261 | | | | | | |
| Front right | | 1240 | 250 | -261 | | 1240 | 250 | -261 | | | | | | |
| | | | | | | | | | | | | | | |
| Rear left | | 0 | -150 | -283 | | 0 | -150 | -297 | | | | | | |
| Rear right | | 0 | 150 | -283 | | 0 | 150 | -297 | | | | | | |
| | | | | | | | | | | | | | | |
| LB | | 118 | -444 | 22 | | 118 | -444 | 22 | | 115 | 463 | 22 | | |
| LNB | | 118 | 444 | 22 | | 118 | 444 | 22 | | 115 | 463 | 22 | | |
| Upper | | 72 | 486 | 1094 | | 72 | 486 | 1094 | | 76 | 475 | 1105 | | |
| Reel | | 63 | 618 | 77 | | 50 | 618 | 77 | | 50 | 605 | 83 | | |
| | | | | | | | | | | | | | | |
| P point | | 506 | 0 | 300 | | 506 | 0 | 300 | | | | | | |
| | | | | | | | | | | | | | | |
| Corrected to make P-point the origin (0,0,0) in both cases | | | | | | | | | | | | | | |
| | | Vehicle | | | | WTORS Test | | | | Difference | | | | |
| | | X | Y | Z | | X | Y | Z | | X | Y | Z | Abs | |
| Front left* | | 734 | -250 | -561 | | 734 | -250 | -561 | | 0 | 0 | 0 | 0 | |
| Front right* | | 734 | 250 | -561 | | 734 | 250 | -561 | | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | | | | | |
| Rear left | | -506 | -150 | -583 | | -506 | -150 | -597 | | 0 | 0 | 14 | 14 | |
| Rear right | | -506 | 150 | -583 | | -506 | 150 | -597 | | 0 | 0 | 14 | 14 | |
| | | | | | | | | | | | | | | |
| LB | | -388 | -444 | -278 | | -388 | -444 | -278 | | 0 | 0 | 0 | 0 | |
| LNB^ | | -388 | 444 | -278 | | -388 | 444 | -278 | | 0 | 0 | 0 | 0 | |
| Upper | | -434 | 486 | 794 | | -434 | 486 | 794 | | 0 | 0 | 0 | 0 | |
| Reel^ | | -443 | 618 | -223 | | -456 | 618 | -223 | | 13 | 0 | 0 | 13 | |
| | | | | | | | | | | | | | | |
| P point | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | |

| | |
|----------------|------------------|
| Test Number: | T-12834 |
| Test Date: | 3/17/2021 |
| Test Engineer: | Ben Cox |
| Test House: | UDL |
| Witness 1: | Fraser Coulter |
| Witness 2: | Paul Nieuwenhuis |

| | |
|-----------|-----------------|
| Customer: | Tripod Mobility |
| Address: | Collseweg 10 |
| | 5674 TR Nuenen |
| | Netherlands |
| | 0 |
| | 0 |
| | 0 |

Test Objectives & Setup Details:

Caddy Maxi

Equipment Used In Test:

| Component | Description | Post Test |
|---------------------|--------------------|-----------|
| Occupant Restraint | SBT-11040-A | Pass |
| Anchorage Type | Bolted | Pass |
| 3rd Point Restraint | SBT-11040-A | Pass |
| Anchorage Type | Bolted | Pass |
| Front Tie-Down | EF3J | Pass |
| Anchorage Type | Bolted | Pass |
| Rear Tie-Down | BQE16MK | Pass |
| Anchorage Type | Bolted | Pass |
| Combined System | N/A | Pass |
| Anchorage Type | N/A | Pass |
| | | |
| Wheelchair | 160Kg (+- 1Kg) | Pass |
| ATD | 50th %ile Hybrid 3 | Pass |

Instrumentation:

| Type | Variant | Unwin ID | Last Calibration |
|------------------|------------------------------|----------|---------------------|
| Data Acquisition | BR00476 | UIG 133 | 09/04/2020 |
| Accelerometer | Sled Accelerometer (UIG108) | UIG108 | 09/21/2020 10:28:46 |
| Accelerometer | Sled Accelerometer (UIG 275) | UIG 275 | 09/21/2020 10:31:31 |
| Accelerometer | Sled Accelerometer (UIG 125) | UIG 125 | 09/21/2020 10:27:17 |
| Accelerometer | Sled Accelerometer (UIG 276) | UIG 276 | 09/21/2020 10:23:05 |

Instrumentation Calibrated Annually



Post Test Observations According to ISO 10542 PAS 2012

| | | |
|---|---|------|
| a | ATD Shall be retained in seat of the SWC | Pass |
| b | The SWC shall remain in an upright position on the impact sled | Pass |
| c | No WTORS anchorage components or securement end fittings shall be detached or separated | Pass |
| d | Release of the SWC from the wheelchair tie-down shall not require the use of tools | Pass |
| e | Release of the ATD from the occupant restraint shall not require the use of tools | Pass |
| f | No part of the WTORS shall exhibit visible signs of tearing, fragmentation, fracture or complete failure of any load-bearing part unless such parts are intended to fail in a manner that limits the forces on the occupant | Pass |
| g | The WTORS shall exhibit no dangerous roughness, sharp edges or protrusions likely to increase the risk of injury to the occupant | Pass |
| h | The force required to open the buckle of any tie down or occupant restraint components shall not exceed 60N when tested as specified by 6.2.2.5 of ECE R16:1996, in accordance with the procedures of 7.8 | Pass |

During Test Observations According to ISO 10542 PAS 2012

| | | Result | Complies? |
|---|---|-------------|-----------|
| a | The horizontal excursion of the test wheelchair P-Point (Xwc) shall not exceed 200mm | 176 mm | Passed |
| b | The horizontal excursion of the ATD Knee (Xknee) shall not exceed 375mm | 230 mm | Passed |
| c | The horizontal excursion of the ATD Head (Xhead) shall not exceed 650mm | 521 mm | Passed |
| d | The WTORS shall prevent the wheelchair from imposing forward loads on the occupant Ratio of Xknee / XWC to be greater than or equal to 1.1 | 1.31 | Passed |
| e | Inbound velocity (delta V 48kph +2 -0) | 49.2 km.h-1 | Passed |
| f | Cumulative Time to hold 20g (>15ms) | 21.6 ms | Passed |
| h | Cumulative Time to hold 15g (>40ms) | 56.6 ms | Passed |

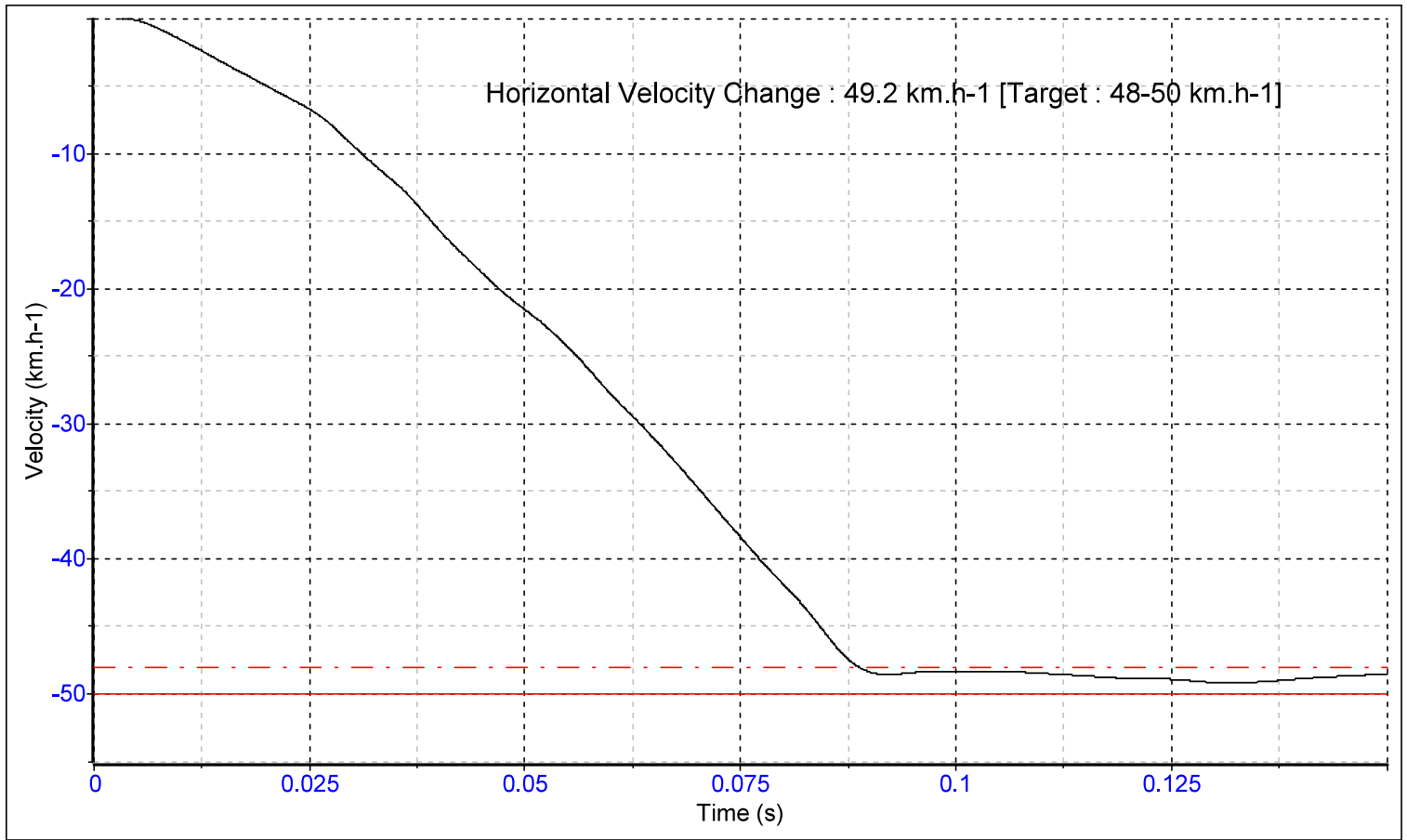
Test Pass or Fail Overall

Pass

Notes



Pulse Graph for Velocity T-12834

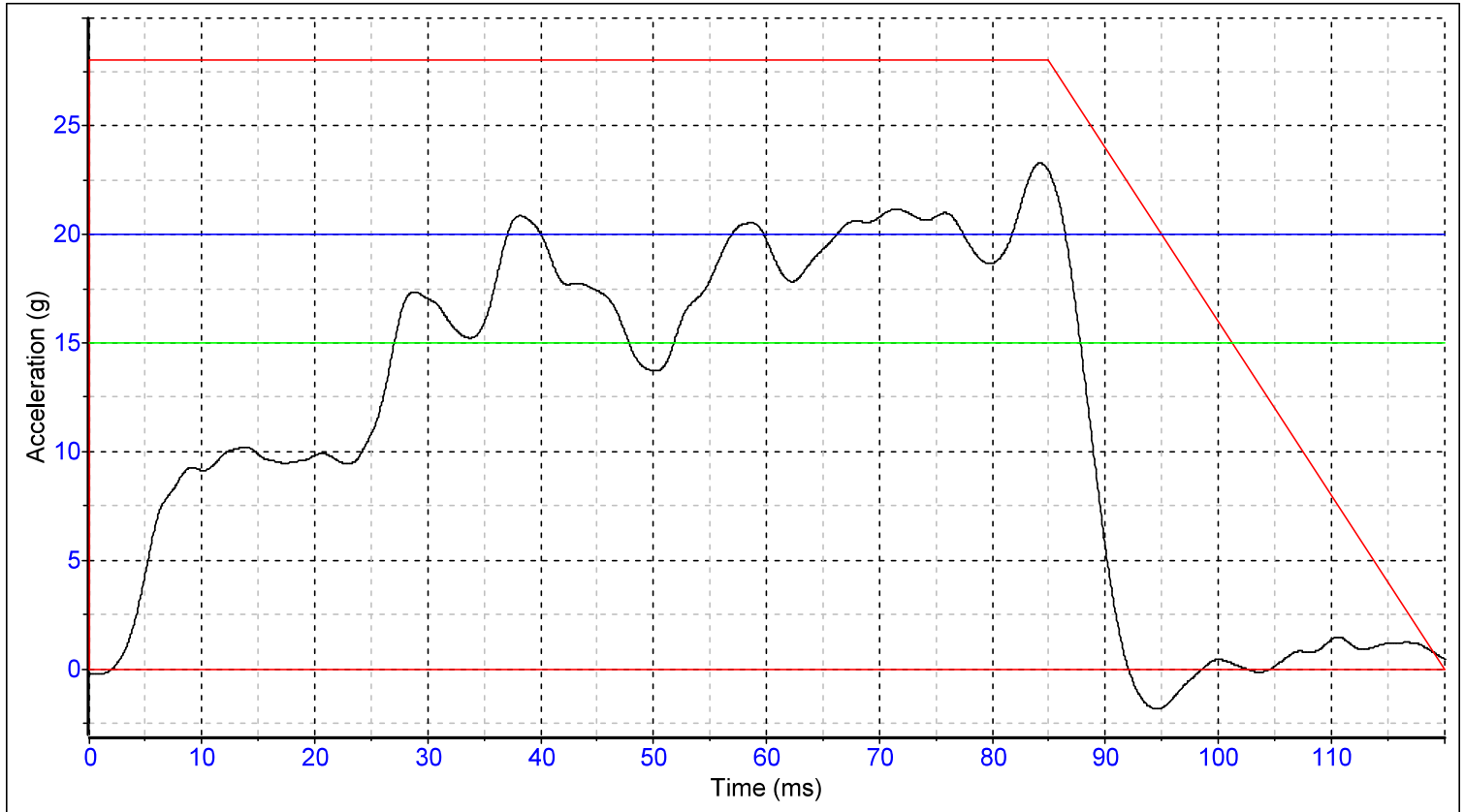


Camera Frame Rate = 1000 Fps



18-Mar-21

Pulse Graph for Deceleration T-12834



Time at 20g (Single Peak) : 11.2 ms [t1 : 81.8 ms, t2 : 86.5 ms] (Cumulative) : 21.6 ms

Time at 15g (Single Peak) : 36.0 ms [t1 : 51.9 ms, t2 : 87.8 ms] (Cumulative) : 56.6 ms



Camera Frame Rate = 1000 Fps

Test Photos T-12834

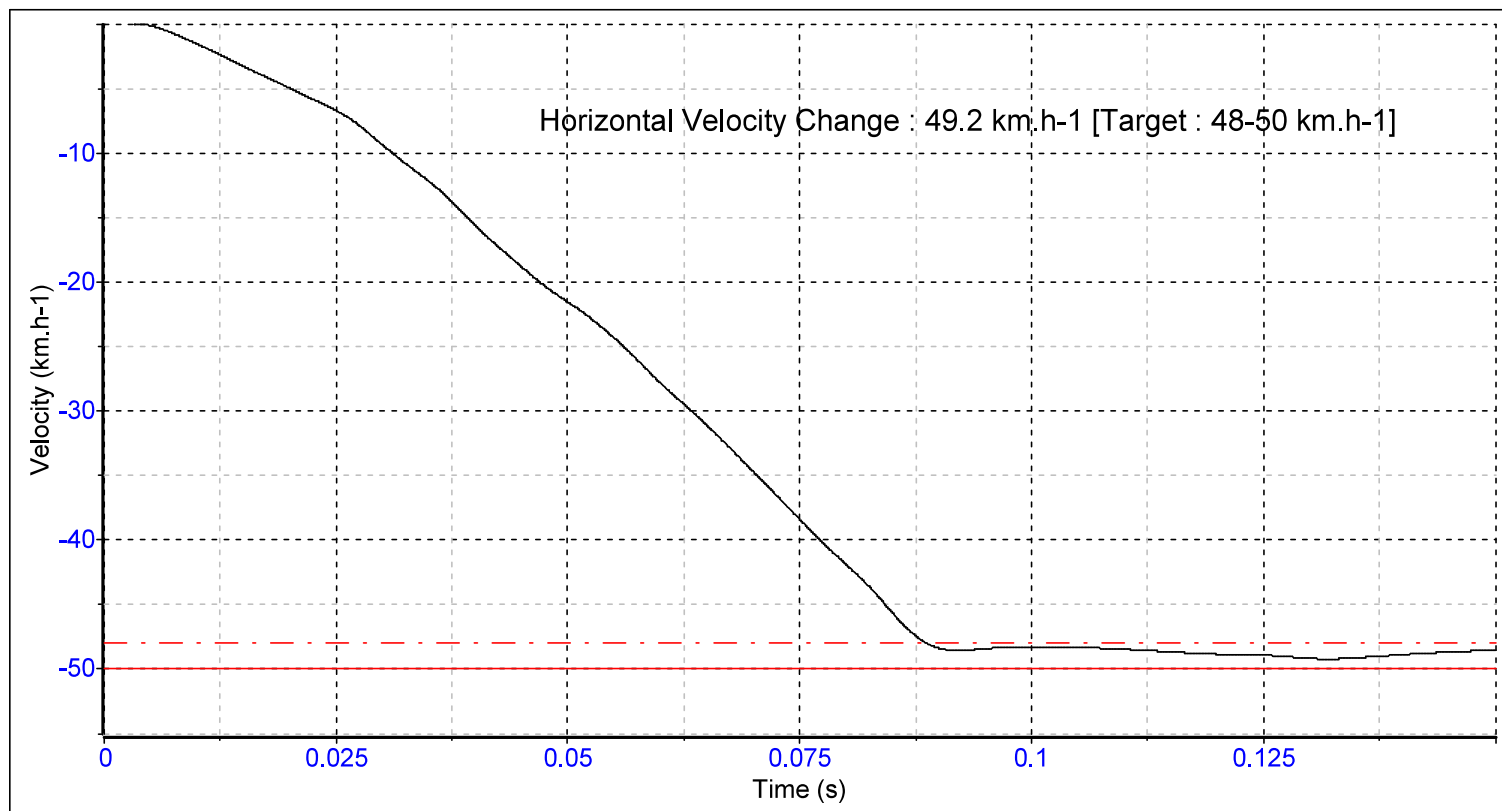


Pre Test

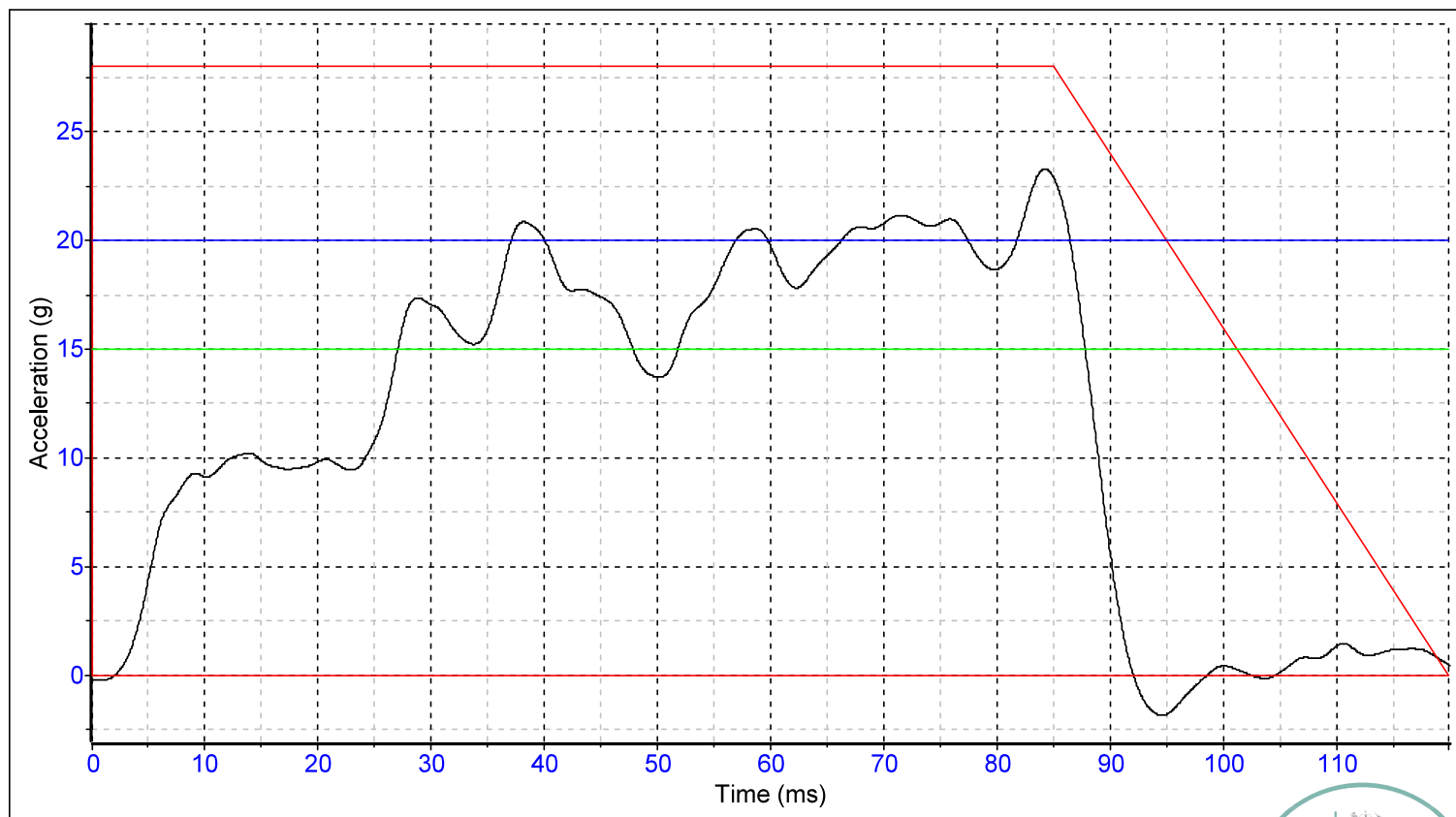


Post Test

Pulse Graph for Velocity T-12834

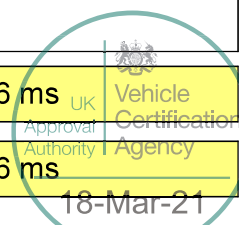


Pulse Graph for Deceleration T-12834



Time at 20g (Single Peak) : 11.2 ms [t1 : 81.8 ms, t2 : 86.5 ms] (Cumulative) : 21.6 ms

Time at 15g (Single Peak) : 36.0 ms [t1 : 51.9 ms, t2 : 87.8 ms] (Cumulative) : 56.6 ms



Excursions T-12834



Excursion Measurements

SWC Excursion = 175.86 mm

Max Excursion = 200 mm

Knee Excursion = 229.63 mm

Max Excursion = 375 mm

Head Excursion = 521.42 mm

Max Excursion = 650 mm

Ratio Knee / SWC = 1.31

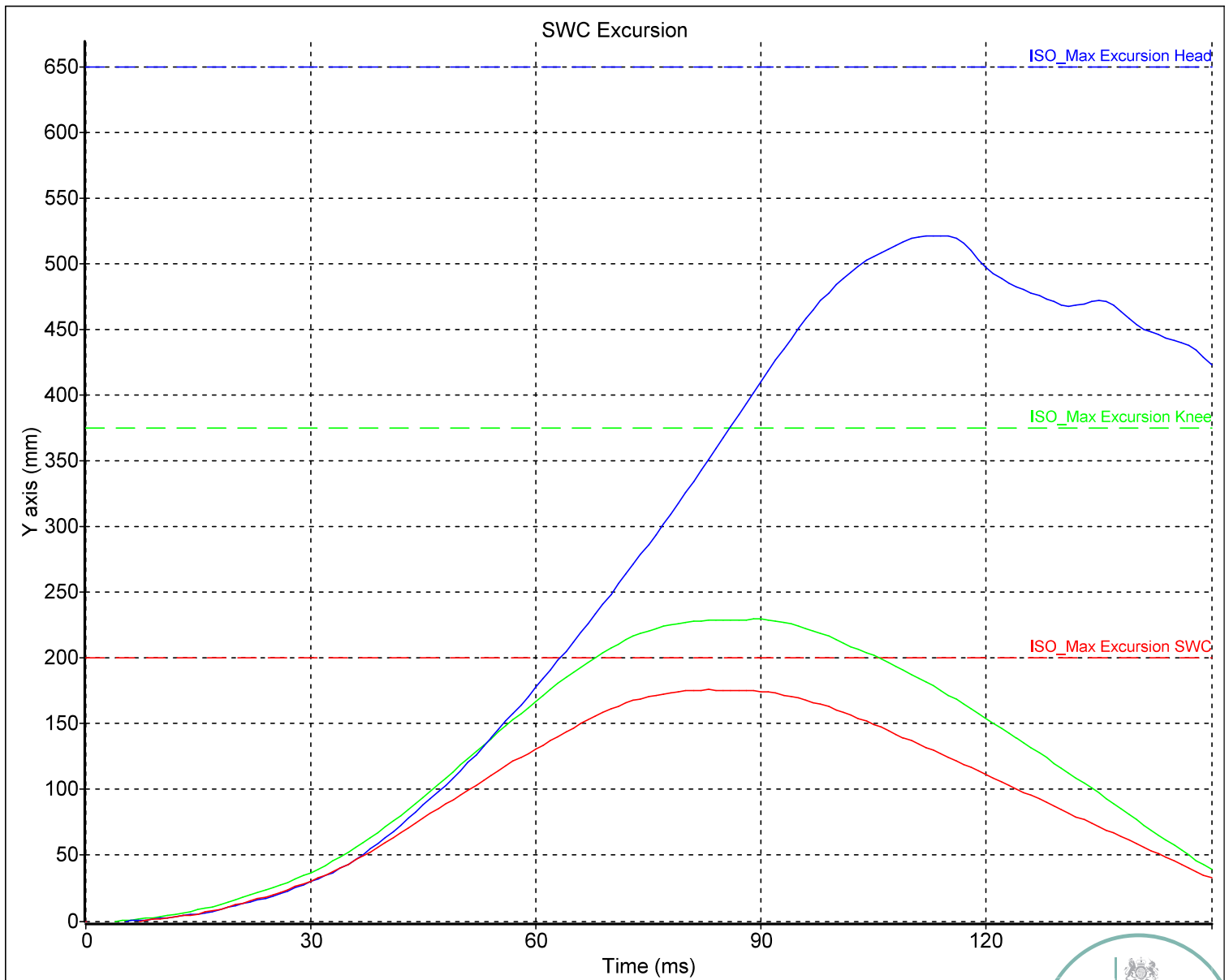
Video Depth Perception

Camera to Sled = 3019 mm

Sled to SWC = 548 mm

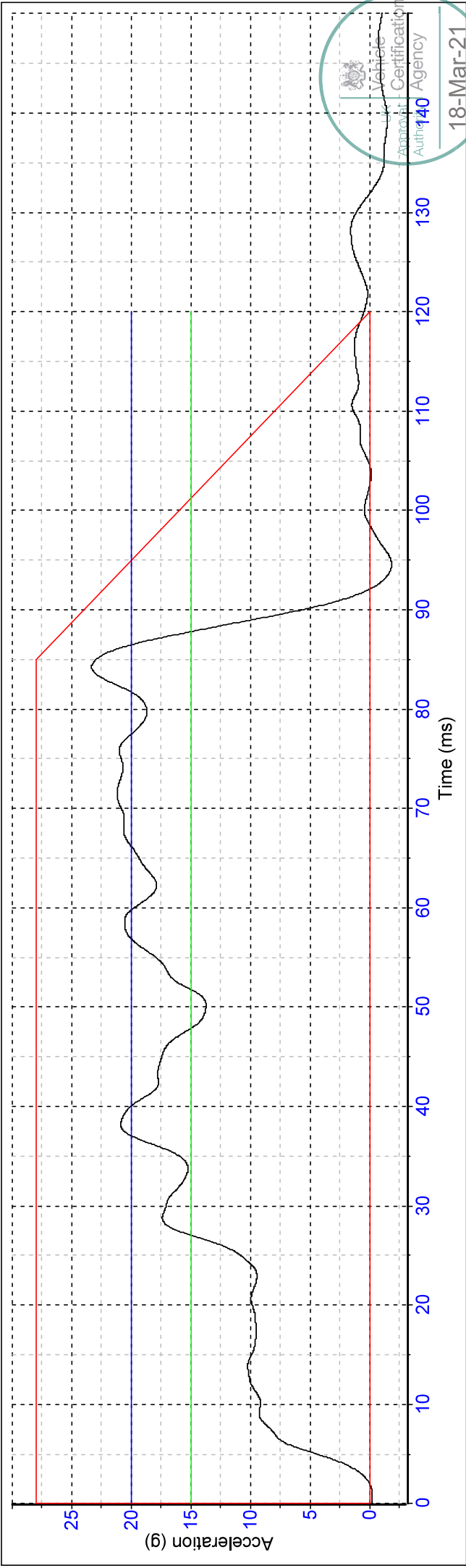
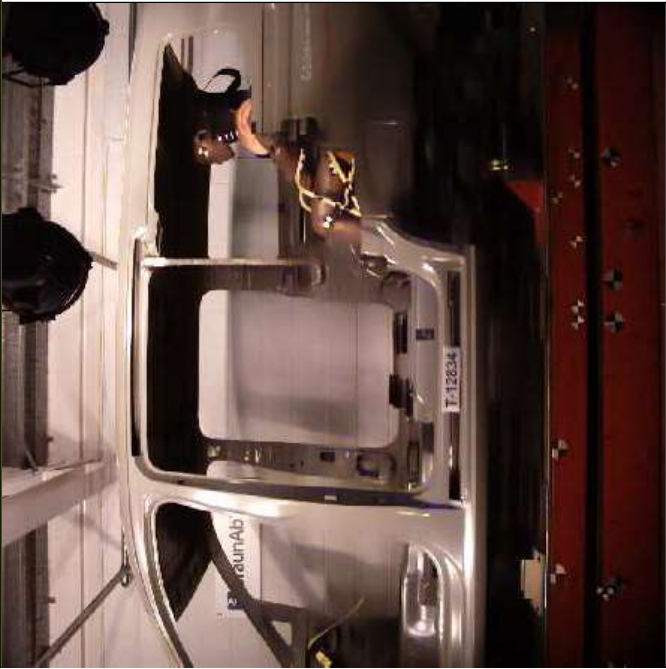
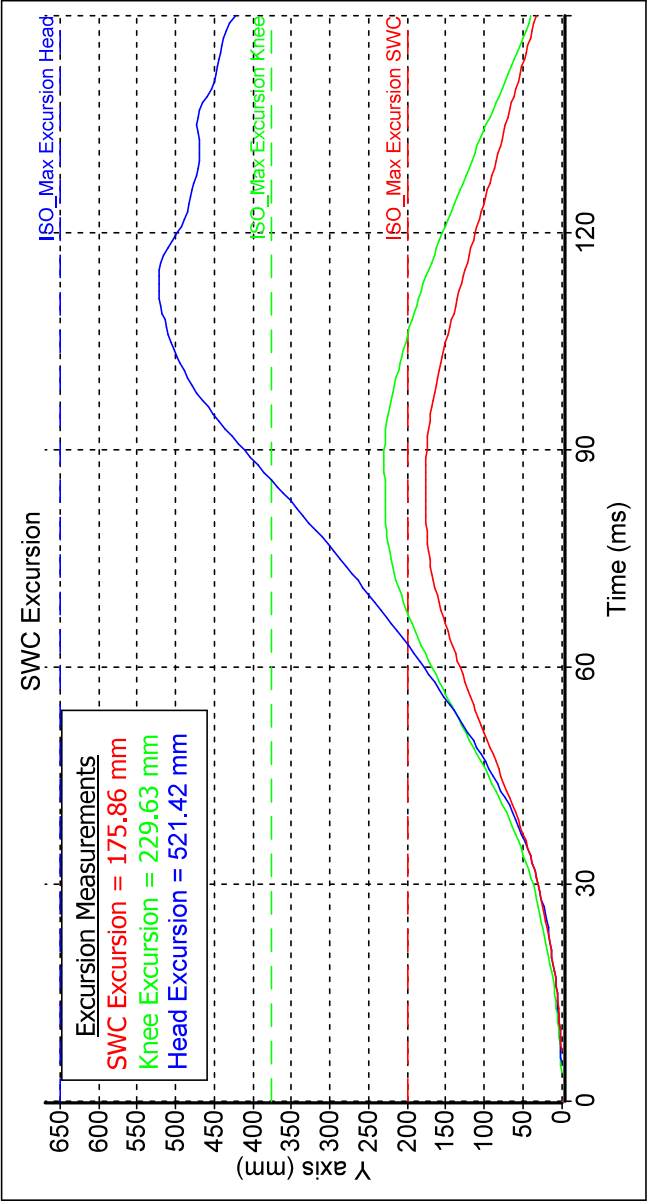
Sled to Knee = 635 mm

Sled to Head = 687.00 mm



Time at 20g : 21.6 ms
Time at 15g : 56.6 ms

Deceleration and Excursions for T-12834



| | |
|----------------|------------------|
| Test Number: | T-12840 |
| Test Date: | 3/16/2021 |
| Test Engineer: | Ben Cox |
| Test House: | UDL |
| Witness 1: | Fraser Coulter |
| Witness 2: | Paul Nieuwenhuis |

| | |
|-----------|-----------------|
| Customer: | Tripod Mobility |
| Address: | Collseweg 10 |
| | 5674 TR Nuenen |
| | Netherlands |
| | 0 |
| | 0 |
| | 0 |

| Test Objectives & Setup Details: |
|----------------------------------|
| Caddy SWB. 160kg |

| Equipment Used In Test: | | |
|-------------------------|----------------|-----------|
| Component | Description | Post Test |
| Occupant Restraint | N/A | Pass |
| Anchorage Type | N/A | Pass |
| 3rd Point Restraint | N/A | Pass |
| Anchorage Type | N/A | Pass |
| Front Tie-Down | N/A | Pass |
| Anchorage Type | N/A | Pass |
| Rear Tie-Down | N/A | Pass |
| Anchorage Type | N/A | Pass |
| Combined System | N/A | Pass |
| Anchorage Type | N/A | Pass |
| | | |
| Wheelchair | 160Kg (+- 1Kg) | Pass |
| ATD | 50th %ile N/A | Pass |

| Instrumentation: | | | |
|------------------|------------------------------|----------|---------------------|
| Type | Variant | Unwin ID | Last Calibration |
| Data Acquisition | BR00476 | UIG 133 | 09/04/2020 |
| Accelerometer | Sled Accelerometer (UIG108) | UIG108 | 09/21/2020 10:28:46 |
| Accelerometer | Sled Accelerometer (UIG 275) | UIG 275 | 09/21/2020 10:31:31 |
| Accelerometer | Sled Accelerometer (UIG 125) | UIG 125 | 09/21/2020 10:27:17 |
| Accelerometer | Sled Accelerometer (UIG 276) | UIG 276 | 09/21/2020 10:23:05 |

Instrumentation Calibrated Annually



Post Test Observations According to ISO 10542 PAS 2012

| | | |
|---|---|------|
| a | ATD Shall be retained in seat of the SWC | Pass |
| b | The SWC shall remain in an upright position on the impact sled | Pass |
| c | No WTORS anchorage components or securement end fittings shall be detached or separated | Pass |
| d | Release of the SWC from the wheelchair tie-down shall not require the use of tools | Pass |
| e | Release of the ATD from the occupant restraint shall not require the use of tools | Pass |
| f | No part of the WTORS shall exhibit visible signs of tearing, fragmentation, fracture or complete failure of any load-bearing part unless such parts are intended to fail in a manner that limits the forces on the occupant | Pass |
| g | The WTORS shall exhibit no dangerous roughness, sharp edges or protrusions likely to increase the risk of injury to the occupant | Pass |
| h | The force required to open the buckle of any tie down or occupant restraint components shall not exceed 60N when tested as specified by 6.2.2.5 of ECE R16:1996, in accordance with the procedures of 7.8 | Pass |

During Test Observations According to ISO 10542 PAS 2012

| | | Result | Complies? |
|---|---|-------------|-----------|
| a | The horizontal excursion of the test wheelchair P-Point (Xwc) shall not exceed 200mm | 178 mm | Passed |
| b | The horizontal excursion of the ATD Knee (Xknee) shall not exceed 375mm | 217 mm | Passed |
| c | The horizontal excursion of the ATD Head (Xhead) shall not exceed 650mm | 462 mm | Passed |
| d | The WTORS shall prevent the wheelchair from imposing forward loads on the occupant Ratio of Xknee / XWC to be greater than or equal to 1.1 | 1.22 | Passed |
| e | Inbound velocity (delta V 48kph +2 -0) | 48.9 km.h-1 | Passed |
| f | Cumulative Time to hold 20g (>15ms) | 25.8 ms | Passed |
| h | Cumulative Time to hold 15g (>40ms) | 56.9 ms | Passed |

Test Pass or Fail Overall

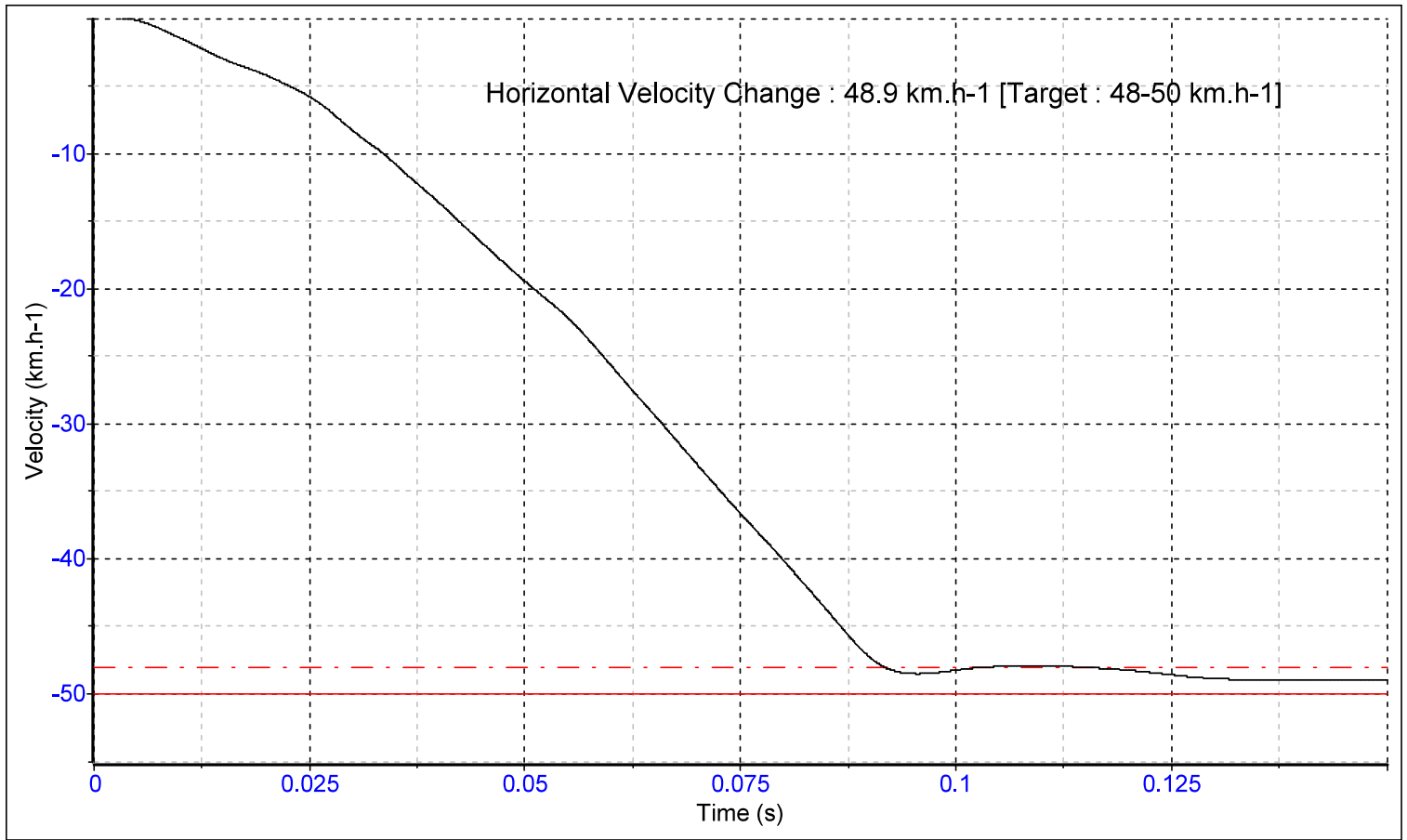
Pass

Notes

pulse and excursions were all good



Pulse Graph for Velocity T-12840

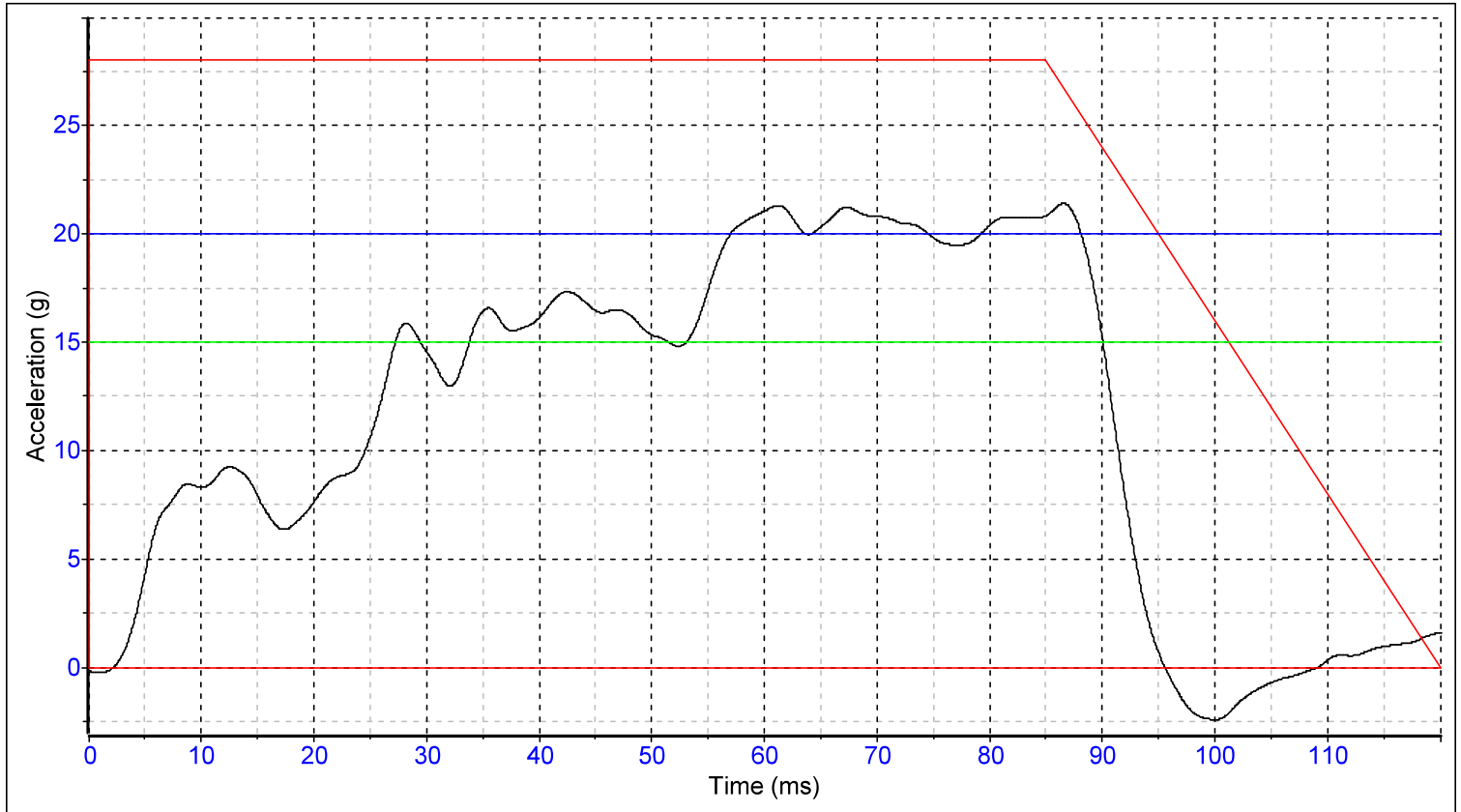


Camera Frame Rate = 1000 Fps



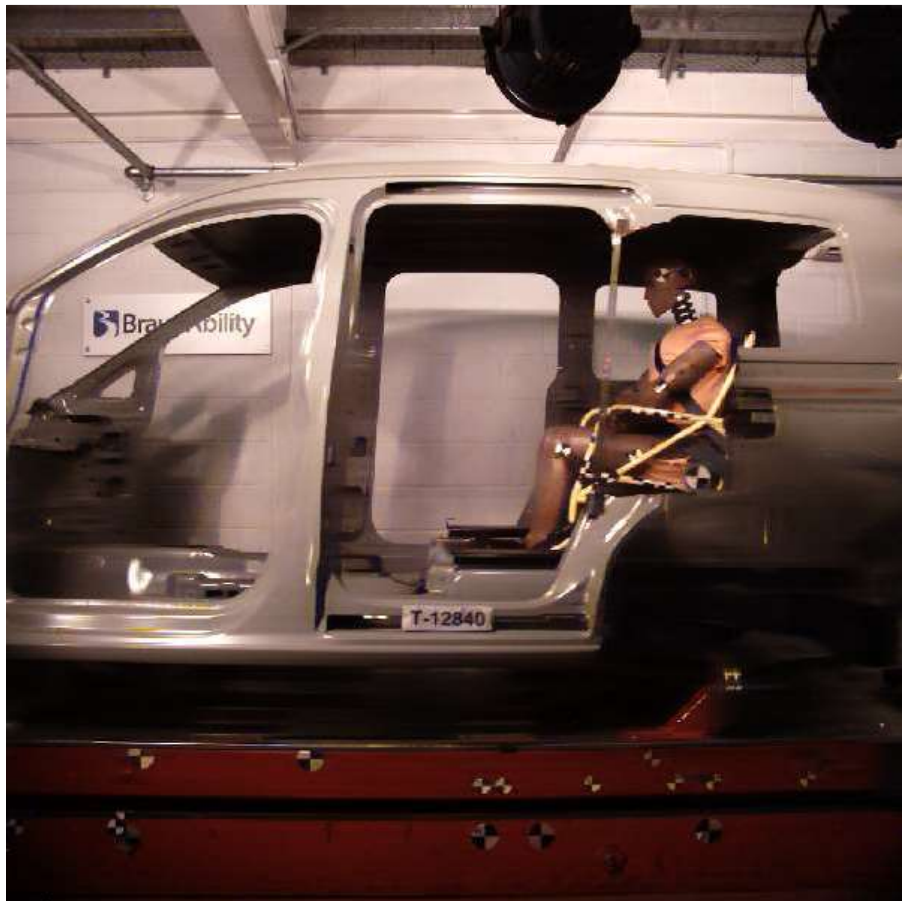
18-Mar-21

Pulse Graph for Deceleration T-12840



Time at 20g (Single Peak) : 10.3 ms [t1 : 79.3 ms, t2 : 88.1 ms] (Cumulative) : 25.8 ms

Time at 15g (Single Peak) : 37.0 ms [t1 : 53.1 ms, t2 : 90.1 ms] (Cumulative) : 56.9 ms



Camera Frame Rate = 1000 Fps

Test Photos T-12840



Pre Test



Post Test

Excursions T-12840



Excursion Measurements

SWC Excursion = 178.32 mm

Max Excursion = 200 mm

Knee Excursion = 217.49 mm

Max Excursion = 375 mm

Head Excursion = 461.61 mm

Max Excursion = 650 mm

Ratio Knee / SWC = 1.22

Video Depth Perception

Camera to Sled = 3019 mm

Sled to SWC = 548 mm

Sled to Knee = 635 mm

Sled to Head = 687.00 mm

