

Sled Impact Test

**MP 1802  
Sunrise Medical**

**Frontal Impact of a Q400M/Q500M Power Wheelchair  
Secured by a Surrogate Four-Point, Strap-Type Tiedown  
and Loaded with a Hybrid III Large Male ATD  
Restrained by a Surrogate Vehicle-Anchored Three-Point Belt**

Tested in accordance with Annex A of  
ISO 7176-19 (2008): *Wheeled Mobility Devices for Use in Motor Vehicles*  
as amended by EN 12184:2014

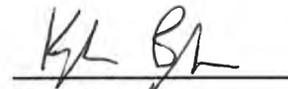
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## **ACKNOWLEDGMENT AND DATA USE RESTRICTION**

This test was sponsored by Sunrise Medical of Fresno, California and was conducted in accordance with procedures set forth in Annex A of ISO 7176-19 (2008): *Wheeled Mobility Devices for Use in Motor Vehicles*. The wheelchair's performance has been measured and evaluated according to the requirements of 5.2 of ISO 7176-19 including evaluation with the amendments described in EN 12184:2014. Advertisements and marketing literature should refer to the requirements and provisions of ISO 7176-19, but should not refer to the University of Michigan or the University of Michigan Transportation Research Institute (UMTRI). Requests for copies of this report, test film, and video should be directed to the test sponsor.

## TEST METHODS

This frontal impact test was conducted on the UMTRI impact sled in accordance with Annex A of ISO 7176-19. The sled operates on the rebound principle, achieving the desired change in velocity by reversing direction during the impact event. The sled crash pulse is trapezoidal in shape and is reported as an average deceleration level in *g*. The sled velocity is monitored immediately before and after impact.

Data generated during the test were digitized live using a TDAS onboard data acquisition system. All signals were filtered to the requirements of SAE J-211. The photo documentation consisted of high-speed (1000-frames/sec) digital video from right, left, and right-rear side views of the impact event. A strobe flash and simultaneous voltage pulse record and synchronize the onset of impact deceleration on video and transducer signals.

## TEST SETUP

The Q400M/Q500M power wheelchair was placed on the sled platform facing forward and secured using a surrogate four-point, strap-type tiedown meeting specifications of Annex E of ISO 7176-19. The front and rear tiedown straps were hooked to the securement points provided on the base frame of the wheelchair<sup>1</sup>.

The wheelchair was loaded with a Hybrid III large male anthropomorphic test device (ATD) that was restrained by a surrogate vehicle-anchored three-point belt. The left side of the lap belt was anchored to the sled platform forward and slightly outboard of the left-rear wheelchair tiedown anchor, while the right side of the lap belt and the lower portion of the shoulder belt formed a continuous loop through a D-ring anchored to the sled platform forward and slightly outboard of the right-rear tiedown anchor of the wheelchair. The left side of the lap and the lower portion of the shoulder belt were joined by a heavy-duty three-bar clip near the right hip of the ATD. The upper anchorage of the shoulder belt was bolted to a rigid fixture that simulates the geometry of a typical vehicle sidewall anchor point. The pelvic belt was tightened to fit snugly over the ATD's pelvic region. The shoulder belt was tightened snugly across the ATD's chest with a 75-mm block between the belt and ATD, and the block was removed prior to the test.

The test was conducted using 48-kph (30-mph) and 20-g average impact conditions to determine the frontal-impact response of the wheelchair and compliance with the criteria in 5.2 of ISO 7176-19. The following table provides further details about the test equipment and setup.

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<sup>1</sup> The securement points provided on the wheelchair do not meet the location requirements specified by clause B.3a and illustrated by Figure B.2 of ISO 7176-19. The last two pre-test photographs of this report compare the locations of the rear and front securement points to the required zones represented by the plexiglass template. For the securement-point locations to comply with ISO 7176-19, the contact points between the tiedown hooks and the securement points must both fall within the designated zones.

## SUMMARY OF TEST SETUP AND PRE-TEST MEASUREMENTS

<p><b>GENERAL TEST INFORMATION</b></p> <p>Test number          Test date          Wheelchair type          Wheelchair tiedown          Occupant restraint          Anthropomorphic Test Dummy (ATD)          Wheelchair orientation          Sled platform          Desired impact velocity (<math>\Delta V</math>)          Desired average sled deceleration</p>	<p>MP 1802          June 20, 2018          Q400M/Q500M power wheelchair          Surrogate four-point, strap-type tiedown          Surrogate vehicle-anchored three-point belt          Hybrid III large male @ 101.2 kg (225 lb)          Forward facing          Rigid steel plate          48 kph (30 mph)          20 g</p>
<p><b>WHEELCHAIR TIEDOWN</b></p> <p>Front-to-rear anchor-point distance          Rear tiedowns              Lateral distance between anchor points              Angle wrt horizontal              Angle wrt to wheelchair center plane              Anchor point to rear-wheel hub              Length (anchor point to securement point)          Front tiedowns              Lateral distance between anchor points              Angle wrt horizontal              Angle wrt to wheelchair center plane              Length (anchor point to securement point)</p>	<p>1295 mm (51.0 in)          279 mm (11.0 in)          14 degrees          0 degrees          635 mm (25.0 in)          495 mm (19.5 in)          724 mm (28.5 in)          39 degrees          13 degrees          381 mm (15.0 in)</p>
<p><b>OCCUPANT RESTRAINT</b></p> <p>Shoulder belt upper anchor point location              Behind ATD shoulder              Above ATD shoulder              Above sled platform              Left of wheelchair centerline          Angle of pelvic belt wrt to horizontal          Angle of shoulder-belt              Projected frontal view wrt horizontal              Projected lateral view wrt horizontal</p>	<p>305 mm (12.0 in)          178 mm (7.0 in)          1207 mm (47.5 in)          305 mm (12.0 in)          44 degrees          54 degrees, measured on ATD torso          30 degrees, measured above ATD shoulder</p>
<p><b>FOOTSTRAPS POSITIONING</b></p> <p>In front of ATD knee center          Above ATD knee center</p>	<p>521 mm (20.5 in)          51 mm (2.0 in)</p>
<p><b>ATD POSITIONING</b></p> <p>Shoulder height above sled platform          H-point height above sled platform</p>	<p>1029 mm (40.5 in)          521 mm (20.5 in)</p>
<p><b>WHEELCHAIR</b></p> <p>Weight          Wheelbase          Seatback angle wrt vertical          Seatback height (with headrest)          Seatpan angle wrt horizontal          Seat surface height from floor @ SB junction          Seatpan length</p>	<p>145.5 kg (320 lb)          686 mm (27.0 in)          4 degrees          838 mm (33.0 in)          2 degrees          483 mm (19.0 in)          457 mm (18.0 in)</p>
<p><b>POSTURAL SUPPORT DEVICES</b></p>	<p>Head, arm, foot, calf and lateral torso supports          Pelvic positioning belt</p>

## TEST RESULTS

The Q500M power wheelchair was effectively secured during frontal-impact loading and the ATD was effectively restrained from forward and rearward excursions by the surrogate vehicle-anchored three-point belt and wheelchair back support, respectively. The maximum forward excursion of point P on the wheelchair was 164 mm, which is below the ISO 7176-19 excursion limit of 200 mm.

The wheelchair was upright on the sled platform at the completion of the test, and the ATD was seated in the wheelchair with the torso upright. All tiedown hooks remained engaged with the wheelchair securement points. The rear securement-point brackets deformed, but showed no signs of failure and the wheelchair could be released from the four-point tiedown without the use of tools. The batteries remained attached to the battery compartment, within the wheelchair footprint, and out of the wheelchair user's space throughout the test.

Peak forward excursion of the ATD's head was limited to approximately 428 mm and peak forward knee excursion was about 205 mm, which are below the ISO 7176-19 limits of 650 mm and 375 mm. The ATD's head to travel 405 mm rearward from its initial position, which is below the ISO 7176-19 limit of 450 mm. The ratio of the ATD's forward knee excursion to the wheelchair point P forward excursion was 1.2, which is just above the minimum of 1.1. The post-test height of the ATD's H-point did not change from the pre-test height.

The results of this test show that the Q400M/Q500M power wheelchair *meets* all of the performance criteria for wheelchair dynamic strength specified in 5.2 of ISO 7176-19 as amended by EN 12184:2014. The following tables summarize the test results and compliance with ISO 7176-19.