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## Crash testing of the Balder Finesse wheelchair according to ISO 7176-19:2008

(2 appendices)

### Summary

A crash test of the Balder Finesse wheelchair has been performed according to ISO 7176-19:2008, chapter 5.2. The wheelchair was crash tested loaded with a Hybrid III-dummy, 79.2 kg, in 49.0 km/h.

| Standard chapter |                           | Comment | Fulfilment of requirement |
|------------------|---------------------------|---------|---------------------------|
| 5.2.1a           | Horizontal excursion      |         | Yes                       |
| 5.2.1b           | Knee vs. WC excursion     |         | Yes                       |
| 5.2.1c           | Battery movement          |         | Yes                       |
| 5.2.2a           | ATD torso angle <45°      |         | Yes                       |
| 5.2.2b           | Securement points         |         | Yes                       |
| 5.2.2c           | Separation of <100 grams  |         | Yes                       |
| 5.2.2d           | Sharp edges radius > 2 mm |         | Yes                       |
| 5.2.2e           | Load carrying components  |         | Yes                       |
| 5.2.2f           | Tilt-in space locking     |         | -                         |
| 5.2.2g           | Removal of ATD, no tools  |         | Yes                       |
| 5.2.2h           | WC removal, no tools      |         | Yes                       |
| 5.2.2i           | Post height diff < 20%    | 9%      | Yes                       |
| 5.2.2j           | No webbing failure        |         | Yes                       |

The test object fulfilled the requirements according to ISO 7176-19:2008, chapter 5.2.

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## 1 Introduction

On assignment of Etac AS a crash test of the Balder Finesse wheelchair was performed according to ISO 7176-19:2008, chapter 5.2. The purpose of the test was to evaluate if the wheelchair fulfilled the crash test requirements with a 79.2 kg dummy.

## 2 Test object

|                                |                                                                                                                                                                                |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wheelchair model:              | Balder Finesse with tilt function and Balder Finesse with stand up function <sup>(1)</sup> .                                                                                   |
| WC weight:                     | 142.8 kg empty, 145 kg for testing (2.2 kg were added to the wheelchair to achieve a weight of 145 kg of the wheelchair to simulate the heaviest available Balder wheelchair). |
| Occupant weight range:         | Balder Finesse with tilt function: 18 – 120 kg <sup>(2)</sup><br>Balder Finesse with stand up function: 18 – 100 kg <sup>(2)</sup> .                                           |
| Corresponding SP test reports: | 4P03471F, tested with a 22.5 kg dummy.                                                                                                                                         |
| Test object arrival at SP:     | 2014-06-02                                                                                                                                                                     |
| Selection of test object:      | The test object has been selected by the client without SP's assistance                                                                                                        |

<sup>(1)</sup> The Balder Finesse wheelchair comes in two different versions, one version with tilt function and one version with a stand up function. The mechanical differences between these models are small and it is SP's assessment that these differences does not influence the crash test performance. Therefore the test results for the stand up version is considered to be valid also for the tilt version.

<sup>(2)</sup> It is SP's assessment that the wheelchair fulfills the complete occupant weight range by approved tests with the smallest and largest permitted test dummy within the occupant weight range without testing all the dummy sizes in between.

## 3 Test method and performance

|                    |                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------|
| Test method:       | ISO 7176-19:2008, section 5.2                                                                                   |
| Test date:         | 2014-06-02                                                                                                      |
| Test facility:     | SP Structural and Solid Mechanics crash laboratory in Borås.                                                    |
| Crash pulse:       | 15g for >40 ms, 20g for >15 ms, 48-50 km/h.                                                                     |
| Pulse measurement: | Two accelerometers mounted on the sled, the graph can be found in appendix 1.<br>SP inv. nos. 403201 and 403350 |

|                            |                                                                                                                                       |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Velocity measurement:      | Optical time sensors measuring the time for the sled to travel a distance of 1 meter just before impact.<br>SP inv. no. 900081.       |
| Excursion measurement:     | The excursion values were measured from the high-speed film by the film analysis program, TEMA, with an accuracy of $\pm 5$ mm.       |
| Film camera:               | HG 2000 High-speed camera, 1000 frames per second, with a Schneider Variogon 1.8/10-100 lens.                                         |
| Crash test dummy:          | Hybrid III, 50 <sup>th</sup> percentile, 79.2 kg.<br>SP inv. no. 401460.                                                              |
| Occupant restraint system: | Shoulder belt: Q-Straint, Q5-6410-BLK<br>Lap belt: Q-Straint, Q8-6325<br>An extra additional restraint was used as safety precaution. |
| 4-point tie down system:   | SP Surrogate tie down system.                                                                                                         |
| Photographs:               | Photos were taken before and after the test and can be found in appendix 2.                                                           |

The test object was mounted in a forward direction on the impact sled and attached with the surrogate tie down system. A Hybrid III-dummy, 79.2 kg, was positioned in the test object and fixated with the 3pt occupant restraint.

The sled was accelerated to a speed of 49.0 km/h before impact.



Figure 1 Test setup



## 4 Test results

The test results showed in this report refer only to the tested object.

**Table 1 Test results**

| Standard chapter |                                                                                                                                                                                                                              | Requirement | Result/ Comment | Requirement fulfilment |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|------------------------|
| 5.2.1a           | Horizontal excursion: Head forward                                                                                                                                                                                           | < 650 mm    | 214 mm          | Yes                    |
| 5.2.1a           | Horizontal excursion: Head rearward                                                                                                                                                                                          | < 450 mm    | 363 mm          | Yes                    |
| 5.2.1a           | Horizontal excursion: Knee forward                                                                                                                                                                                           | < 375 mm    | 207 mm          | Yes                    |
| 5.2.1a           | Horizontal excursion: Wheelchair point forward                                                                                                                                                                               | < 200 mm    | 103 mm          | Yes                    |
| 5.2.1b           | Knee vs. WC excursion: $X_{knee} / X_{wc}$                                                                                                                                                                                   | > 1.1       | 2.0             | Yes                    |
| 5.2.1c           | Batteries of powered wheelchairs shall:<br>- not move completely outside the wheelchair footprint<br>- not move into the wheelchair user's legs space                                                                        |             |                 | Yes                    |
| 5.2.2a           | The wheelchair shall remain in an upright position on the test platform. The ATD shall be retained in the wheelchair in a seated posture, as determined by the ATD torso being oriented at no more than 45° to the vertical. |             |                 | Yes                    |
| 5.2.2b           | The wheelchair securement points shall not show visible signs of material failure.                                                                                                                                           |             |                 | Yes                    |
| 5.2.2c           | Components, fragments or accessories of the wheelchair with a mass in excess of 100g shall not have completely separated from the wheelchair.                                                                                |             |                 | Yes                    |
| 5.2.2d           | Wheelchair components that may contact the occupant shall not fragment or separate in a manner that produces sharp edges, as defined by having a radius less than 2 mm.                                                      |             |                 | Yes                    |
| 5.2.2e           | Primary load carrying components of the wheelchair shall not show visible signs of failure.                                                                                                                                  |             |                 | Yes                    |

|        |                                                                                                                                                                                |    |     |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|
| 5.2.2f | Locking mechanisms of tilt-in-space seat adjusters shall not show signs of failure.                                                                                            |    | N/A |
| 5.2.2g | Removal of ATD from the wheelchair shall not require the use of tools.                                                                                                         |    | Yes |
| 5.2.2h | Release of wheelchair from the tiedown system shall not require the use of tools.                                                                                              |    | Yes |
| 5.2.2i | The post-test height of the average of left and right ATD H-points relative to the wheelchair ground plane shall not have decreased by more than 20% from the pre-test height. | 9% | Yes |
| 5.2.2j | The wheelchair and its components shall not cause partial or complete failure of the webbing of any of the WTORS assemblies during the test.                                   |    | Yes |

The test object fulfilled the requirements according to ISO 7176-19:2008, chapter 5.2.

## 5 Measurement uncertainty

The measurement uncertainty for the deceleration pulse is less than 1.5%. Reported uncertainty corresponds to an approximate 95 % confidence interval around the measured value. The interval has been calculated in accordance with GUM (The ISO guide to the expression of uncertainty in measurements), which is normally accomplished by quadratic addition of the actual standard uncertainties and multiplication of the resulting combined standard uncertainty by the coverage factor  $k=2$ .

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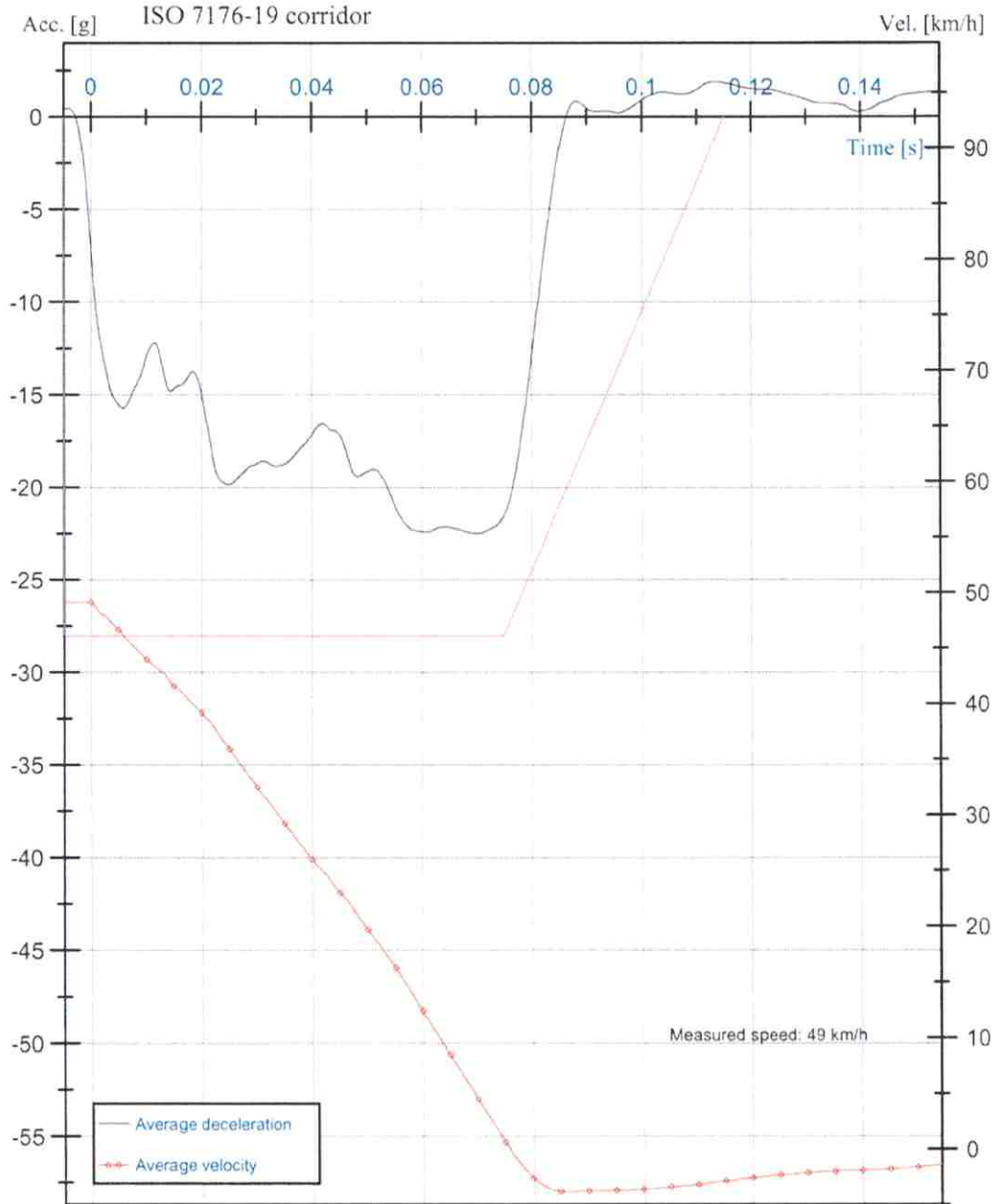
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### Appendices

- Appendix 1 Deceleration graph (1 page)
- Appendix 2 Photos (5 pages)

Appendix 1

### Sled deceleration, Average pulse, CFC 60



|                     |                                         |
|---------------------|-----------------------------------------|
| <b>Customer:</b>    | Etac                                    |
| <b>Test object:</b> | Balder wheelchair, Midsized adult dummy |
| <b>Standard:</b>    | ISO 7176-19                             |
| <b>Test date:</b>   | 2014-06-02 <b>Test:</b> 11              |

Appendix 2



Photo 1. Before test



Photo 2. Before test



Appendix 2



Photo 3. Before test



Photo 4. Before test



Appendix 2



Photo 5. After test



Photo 6. After test

Appendix 2



Photo 7. After test



Photo 8. After test



Appendix 2



Photo 9. After test



Photo 10. After test