The Australian/New Zealand Truck Underrun Dynamic Crash Test Standard (AS/NZ 3845.2)

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Truck underrun
Truck Underrun Crashes

- Ongoing safety issue in both industrialised and developing countries
- Worldwide, thousands killed and seriously injured
Truck Underrun Crashes

- Highly aggressive:
  - extreme geometric, stiffness and mass incompatibility
- Car occupant protection features ineffective
- Severe/fatal injury risk to vehicle occupants
Truck underrun

Rigid barrier design

Full barrier

50% offset

Energy dissipating barrier design
Rigid Underrun Crash (10 tonne truck & handbrake on – 50 km/h)
Modified energy absorbing system
75 km/h
### Performance criteria - Comparison with Regulations – barrier test forces much too weak

<table>
<thead>
<tr>
<th>Load position</th>
<th>E.C.E R 58 maximum</th>
<th>USA (FMVSS 223/224)</th>
<th>Brazil</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer P₁</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Off centre P₂</td>
<td>100</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Centre P₃</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Actual loads from crash tests 160 kN
In 1977 Heavy Vehicle Safety report the House of Representatives Standing Committee on Road Safety concluded after hearing arguments for and against underrun barriers that:

The committee recommends that the Advisory Committee on Vehicle performance extend the Draft regulation on under run barrier to cover all trucks where load carrying tray overhangs the rear suspension ...
Based on MASH terminology & test protocols
– Vehicles, impact speed and criteria

**TABLE 7.1**
TEST MATRIX FOR REAR UNDERRUN PROTECTION DEVICES

<table>
<thead>
<tr>
<th>Test Level</th>
<th>Feature</th>
<th>Test designation</th>
<th>Impact conditions (Note 1)</th>
<th>Impact point</th>
<th>Evaluation Criteria (refer to Table 5.1 of MASH) (Note 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Rear underrun protection device</td>
<td>2-51 2270P</td>
<td>Vehicle: 70</td>
<td>Nominal Speed (km/h): 70</td>
<td>Nominal Angle θ deg.: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-52 2270P</td>
<td>Vehicle: 70</td>
<td>Nominal Speed (km/h): 70</td>
<td>Nominal Angle θ deg.: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-54 1500A</td>
<td>Vehicle: 70</td>
<td>Nominal Speed (km/h): 70</td>
<td>Nominal Angle θ deg.: 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-55 1500A</td>
<td>Vehicle: 70</td>
<td>Nominal Speed (km/h): 70</td>
<td>Nominal Angle θ deg.: 0</td>
</tr>
</tbody>
</table>
Australian Standard – revised 2017

Centre impact

30% overlap

\[ Y = \frac{A}{2} + 0.2W \]
Tests 51, 52, 54 and 55

- Truck weight (10,000 kg) as per MASH protocol and truck placed in second gear and the parking brake set
- RUPD fixed to rear of the truck in the same way as would be installed in service.
- Maximum rearward displacement of the RUPD beyond the face of the rear of the truck not to exceed 500 mm.
- RUPD may deform under the impact loading but no joint failures or buckling of RUPD’s key support structures or of the support truck structure allowed.
Evaluation Criteria:

C: Acceptable test article performance may be by redirection, controlled penetration, or controlled stopping of the vehicle.

D: Detached elements, fragments or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone.

F. The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.
Insurance Institute for Highway Safety (IIHS) rate rear under-run barriers

56 km/h

Great Dane
Applies to units equipped with the RIG30 rear impact guard system.

Manac
Applies to all 90,000 series dry van, refrigerated and open top units built after June 2011.

Hyundai Translead
Applies to all standard dry van and refrigerated units built after April 2011.
Summary

• UN ECE, US FMVSS & Brazilian regulations exist but not adopted internationally need to increase load demand and clearance to 400 mm

• AS/NZS 3845.2 barrier standard contains underrun crash test based on US MASH crash testing for Australia and New Zealand

<table>
<thead>
<tr>
<th></th>
<th>P1 (Outer Edge)</th>
<th>P2 (Off Centre)</th>
<th>P3 (Centre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>200 kN</td>
<td>200 kN</td>
<td>100 kN</td>
</tr>
</tbody>
</table>
Further References

• Papers can be downloaded from:

• A/Prof. George Rechnitzer’s PhD
  https://www.filesanywhere.com/fs/v.aspx?v=8b6a69875e67767ca2a4

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Questions?