ROLLER BRAKE TESTING

Chair
Chris Loose – ATA

Panel members
Brett Patterson - RMS
Dan Cleary - VIS Nepean Transport Equipment
Joe Bourke - Levanta
Les Bruzsa - NHVR
Joint Industry – Brake test day
Marulan Safety Station – 14/15 August 2017

Focus
• Collaboration and data collection on Roller Brake Testing (RBT) performance standards and procedures

Sponsors
• National Heavy Vehicle Regulator
• Australian Trucking Association
• Heavy Vehicle Industry Association
• RBT equipment suppliers
• State Road Agencies (RMS, ACT and VicRoads)
• Heavy Vehicle Operators (and drivers)
ADR 35 Brakes

- Service brakes (Laden / Unladen)
  - Truck – 3.78 m/s\(^2\)
  - Car/bus – 4.19 m/s\(^2\)
  From 100 km/h with max. control force 685 N
- Park brake
  - 18% gradient
  In each direction, for not less than 5 minutes

NB
All at optimised test conditions
Trailers are design to be compatible (“tram lines”).
HVNL PERFORMANCE STANDARDS

The Law (HVNL) - HV (VS) National Regulation

<table>
<thead>
<tr>
<th>HVNL in–service brake performance requirements for a heavy motor vehicle or heavy combination</th>
<th>Service brakes</th>
<th>Emergency brakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak deceleration from any speed (assumed to be from less than 10 km/h)</td>
<td>4.4 m/s²</td>
<td>1.5 m/s²</td>
</tr>
<tr>
<td>Average deceleration from any speed (assumed to be stop from at least 35 km/h)</td>
<td>2.8 m/s²</td>
<td>1.1 m/s²</td>
</tr>
<tr>
<td>Stopping distance, defined as from 35 km/h to a stop within</td>
<td>16.5 m</td>
<td>40.5 m</td>
</tr>
<tr>
<td>Parking brake must be able to keep the heavy vehicle or any combination stationary on a</td>
<td></td>
<td>12% gradient</td>
</tr>
</tbody>
</table>

Table 1: HVNL requirements for minimum for brake efficiency

Vehicles must comply to all requirements.

Equipment limitation.

Applies to vehicle or vehicle combination *
INDUSTRY ACTION

National Heavy Vehicle Inspection Manual (NHVIM)
Brakes / RBT only

Nov 14  Ver 1   First adopted QLD/ACT
Nov 15  Ver 2.0  Average/peak PS for non RBT tests
Feb 16  Ver 2.1  Issued. Nothing on braking
Jun 16  Ver 2.1  Becomes effective
          NHVIM fact sheet – brake testing *
Jul 17  Ver 2.2  - Std from 3.0 / 4.5 kN/tonne to
          2.8 / 4.4 m/s^2 - average/peak,
          “Brake" drag remove
          VSG 14 – RBT *
TIMELINE

14 May 15  NHVR attend ITC and supported the RBT tap
July 16    NHVIM comes into force most areas
1 June 16  Meeting with NHVR – no progress
- Dec 16 TAP – draft 1\textsuperscript{st} edition
- Mar 17  TAP – draft 2\textsuperscript{nd} edition
25 May 17 ITC meeting – vigorous debate with NHVR
22 June 17 ITC met with NHVR - consider dynamic
14 Aug 17 Marulan JIET RBT program
29 Sept 17 4\textsuperscript{th} transition period extension to 31 Jan 18
Brake testing in NSW

Roads and Maritime undertakes the majority of heavy vehicle inspections (that includes RBT) undertaken nationally.

There are approximately
- 170 HVAIS in NSW that have Roller Brake test machines.
- Roads and Maritime operates 38 Roller Brake Test machines from fixed heavy vehicle inspection sites and 24 mobile units.

- Due to the volume of heavy vehicles tested, RBT performance standards changes on industry has predominantly been identified in NSW.
The top three defects identified were:

- Brakes (37,591 faults)
- Ancillary Equipment (32,062 faults)
- Body/Chassis (19,436)
Brake fault analysis (Q1 - 2017)

- Brake fault codes

**Brake Fault Code items:**

On road Inspections - 6,448 brake fault code items:
- 967 x Service brake/s have excessive travel,
- 894 x More the 30% brake imbalance between wheels,
- 505 x Service brake/s not properly adjusted,
- 402 x Service brake indicator indicates adjustment required,
- 348 x Service brakes inoperative.

HVIS (Registration inspections - 9,235 brake fault code items):
- 1,308 x More the 30% brake imbalance between wheels,
- 734 x Service brake/s have excessive travel,
- 441 x Service brake/s not properly adjusted,
- 414 x Brake system air leaks,
- 303 x ADR 35 System to operator correctly.
Brake faults detected
In 1998, the previous Roads and Traffic Authority undertook physical heavy vehicle testing to establish the kN/tonne roller brake testing performance required for a heavy vehicle to comply with the applicable Road Transport law.

- This resulted in the performance standard of 3kN/tonne requirement in NSW.
- With the introduction of the NHVIM in NSW (June 2016) a RBT performance standard of 4.4kN/tonne was required.

A NSW transition period was implemented with warnings issued for vehicles detected between 3kN/t and 4.4kN/t.
Transition period monitoring

On-Road enforcement Official warnings
Percentage of warnings to inspections per month

[Graph showing the percentage of warnings to inspections per month from June 2016 to May 2017. The graph indicates a trend of increasing warnings over time, with peaks in September 2016 and February 2017, and a general upward trend.]
Vehicle analysis

• More than 50% of the official warnings were issued to 2 truck manufactures and 3 trailer manufactures.

• 78% of the warnings were issued to TRAILERS (Trailers, Other Trailer and Domestic Trailer) and 13% to PRIME MOVERS.

• No particular trend in year of manufacture.
  • 90% of the notices were issued to vehicles manufactured between 1998 and 2017.
Roller brake testing

• Static mass vs dynamic mass

The following example shows the difference between static vs dynamic testing – with the static mass (18.53t) and dynamic mass (13.65t) shown on the lower part of the document.

**Example below;** 2005 Krueger 3 Axle (airbag) trailer

Note: if the Static mass is used it provides a brake force of 5.2kN /tonne.

However if the Dynamic mass is used a brake force of 7.12kN /tonne is achieved
Joint Industry – Brake test day

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DAN CLEARY – VIS NEPEAN
STATIC VS DYNAMIC

Static Braking

- Suspension Input
- Reaction Forces into Chassis
STATIC VS DYNAMIC

• Static has been used traditionally by the early adopters of roller brake testers throughout Europe.
• The more recent adopters of roller brake testers for enforcement & vehicle inspection use dynamic – such as NZ and Nth America.
• The Static Method ignores that weight changes through the test and hence overstates accuracy.
• 2011 Hendrickson in the US did extensive testing to confirm that trailing arm suspensions were the main contributing suspension type causing this issue.
• The two variable inputs cannot be ignored scientifically. New methods need to be implemented to deal with the issue.
Figure 3: Apparent weight change during PBBT Test

- Static weight
- Dynamic weight

Suspension Style vs. Brake Force (Axle Weight Off-loading)
Apply and Weight Acquisition vs. PBBT Score

Figure 4
DAN CLEARY – VIS NEPEAN
STATIC VS DYNAMIC

Static

- Suspension Input
- Reaction Forces into Chassis

Braking
STATIC VS DYNAMIC – WHAT WE KNOW SO FAR

- Static clearly produces false negatives
- Dynamic can sometimes produce false positives if excessive weight unloads through the test
- Option to reduce the occurrence of false positives
  - Limit range of inputs
  - Identify unrealistic/theoretically incorrect results
  - Terminate test earlier
  - Improve accuracy of data collected.
JOE BOURKE – LEVANTA
THE TEST PROCEDURE
Why Test Brakes?
Why Test Brakes?

Queensland Government
Department of Transport and Main Roads

Tasmanian Government
Transport

Northern Territory Government

Government of South Australia
Department of Planning, Transport and Infrastructure

TMC
Technical & Maintenance Conference

Roads & Maritime

NHVR
National Heavy Vehicle Regulator

Victorian Roads

TCT
Australian Capital Territory Government

Victorian Roads

Why test brakes on an RBT?

- Reduced maintenance cost
- Faster diagnosis of problems
- Detect problems that may not otherwise be obvious
- Reduced running costs
- Reduced driver fatigue
- Improved corporate image
<table>
<thead>
<tr>
<th>Test Type</th>
<th>Site Specific Requirements</th>
<th>Performance %</th>
<th>Pass</th>
<th>Fail</th>
<th>Inspection of Machine Components &amp; Skid Marks</th>
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</thead>
<tbody>
<tr>
<td>Service Brake Test</td>
<td>66%</td>
<td>Pass</td>
<td>☑</td>
<td>☐</td>
<td>Fail</td>
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<tr>
<td>Secondary Brake Test</td>
<td>33%</td>
<td>Pass</td>
<td>☑</td>
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<tr>
<td>Park Brake Test</td>
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<td>Pass</td>
<td>☑</td>
<td>☐</td>
<td>Fail</td>
</tr>
</tbody>
</table>

**Testing Area Set Up As Per Site Requirements & AS2058.1-1995**
Yes ☑

**Relevant Documentation Completed As Per Site Requirements**
Yes ☑

**Comments:**

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**Service Brake Test**

Brake Test

- Test Description: Foot Brake Test
- Test Duration: 2.4 sec
- Speed of Test: 0.05
- Decel Rate: 0.9 m/s²
- Acceleration: 0.7 m/s²

- 66%

**Handbrake Test**

Brake Test

- Test Description: Hand Brake Test
- Test Duration: 0.6 sec
- Speed of Test: 0.02
- Decel Rate: 0.5 m/s²
- Acceleration: 0.2 m/s²

- 33%
<table>
<thead>
<tr>
<th>Service</th>
<th>Left</th>
<th>Dif</th>
<th>Right</th>
<th>Total</th>
<th>Notes</th>
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<tr>
<td></td>
<td>Test Weight</td>
<td>3400 kg</td>
<td>3400 kg</td>
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<td></td>
<td>Rolling Resistance</td>
<td>0.68 kN</td>
<td>0.96 kN</td>
<td>1.64 kN</td>
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<td>1 Service</td>
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<td>1.46 kN</td>
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<td>Brakeforce</td>
<td>23.50 kN</td>
<td>23.80 kN</td>
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<td></td>
<td>71%</td>
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<td></td>
<td></td>
<td>2 Service</td>
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<td>Rolling Resistance</td>
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<td>24.58 kN</td>
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<td></td>
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<td>Brakeforce</td>
<td>16.14 kN</td>
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<td>Wheel Lock</td>
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<td>Rolling Resistance</td>
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<td>0.92 kN</td>
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<td>Brakeforce</td>
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<td>Deceleration</td>
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<tr>
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<td>3320 kg</td>
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<td>Deceleration</td>
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<td>34%</td>
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<td></td>
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<td>Wheel Lock</td>
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<td></td>
<td>4 Service</td>
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<td>5960 kg</td>
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<td>Rolling Resistance</td>
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<td>0.92 kN</td>
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<td>Ovally</td>
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<tr>
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<td>Wheel Lock</td>
<td>Brakeforce</td>
<td>1.05 kN</td>
<td>0.92 kN</td>
<td>1.94 kN</td>
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<tr>
<td></td>
<td>Deceleration</td>
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<td>3%</td>
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<td>Deceleration</td>
<td>39%</td>
<td>39%</td>
<td>39%</td>
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<td>Parking: Brakeforce</td>
<td>17.36 kN</td>
<td>41.60 kN</td>
<td>58.96 kN</td>
<td></td>
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<tr>
<td></td>
<td>Parking: Brake Efficiency</td>
<td>14%</td>
<td>32%</td>
<td>23%</td>
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</tr>
</tbody>
</table>
Testing Procedure

Tyre Pressures correct

All tyres are inflated to the OEM recommended pressures as under inflation will give erroneous results.
The air system can be held at 650 kPa (90 psi) or above. Lower air pressure may cause otherwise sound brakes to fail the test. In addition, maintenance is required to the air system when the system cannot achieve the required pressure.

During testing the driver is responsible for maintaining the test air pressure or vacuum reserve and communicating this to the inspector so that the test can be performed correctly. Vacuum systems can be monitored by the brake fail light or vacuum light. However, air systems are the primary systems of concern to the trucking industry.
On level surface, in an appropriate safe location with the air system pressure above 650kpa (90psi), release the park brakes and driver should then apply the brake pedal to the floor slowly several times for vehicles fitted with automatic slack adjusters on foundation drum brakes to ensure correct adjustment is obtained prior to testing beginning.
The area for testing must be flat, level and take into account the length of the vehicle to be tested.
The vehicle must be located squarely to the RBT and be centred on the RBT unit. The inspector should be able to observe this visually. If the vehicle is not square to the RBT unit then it should be removed and repositioned correctly.
A mobile or above-ground RBT unit will typically raise an axle group by 150 mm. This could create an issue with the axle group’s load sharing capability. All axles in an axle group must be at the same level as an axle under test within that group. There must be a sufficiently wide platform on the RBT unit to allow for this. Ideally, no part of the axle group under test may be off the level test bed (e.g. on the ramp). Where the vehicle under test is not parallel to the test surface the inspector should ensure the suspension travel of the test axle has not bottomed out. Air suspension should be dropped and raised back to ride height while in the test position if possible.

The use of platforms to level the vehicle element under testing minimises these problems.
During the Test:

The driver should listen to the instructions from the tester
When the roller start, let the wheels find the path of least resistance (within reason)
Apply the brake slowly and smoothly, just like stopping at a red light.
Apply the brake to full pedal and hold until the rollers stop (either by slip or manual stop)
When testing the park brake apply it as smoothly as possible in one action.
LES BRUZSA - NHVR
THE NHVR TEST
PROCEDURE/TIMELINE

- Early December 2017, lock test procedure
- 1 February 2018, transition period ends
- NHVR enforcement test produced
- NHVIM update
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PANEL Q & A

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