How trailer brakes are certified

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I want to explain how heavy trailer brakes are certified in Australia. It is a specialist domain and it is in need of reform. The trailer brake system is usually constructed using approved sub-assemblies, which are the axle brakes, the air control system and the suspension. The approval numbers for these subassemblies are shown on the trailer compliance (or identification) plate. The ratings of the sub-assemblies can be found on the Australian approval's website (which is now called ROVER and was previously the RVCS).
The brake systems on a truck model must be proven by tests. The performance levels are in Australian Design Rule (ADR) 35/06. Basically, a truck brake system must be designed to stop the fully laden truck from 100km/h at a minimum deceleration of 3.78m/s*s. This means stopping within 102m. Trailer brakes in contrast are proven by 'approved calculations' that are overseen by the Federal regulator rather than a complete system performance test.
Trailer axles which include the trailer 'Foundation Brake System.' can get an approval in the ADR system called a Component Type Approval (CTA). The ratings can be found on the Federal vehicle approvals system called ROVER. An example of approvals details are shown in the text box. A CTA approval is also required for the Trailer Air Control System and the Trailer Suspension.

Foundation Brake Approval - To get a sub-assembly approval the trailer axle brakes must be measured by tests conducted on a single axle (assuming the axles cannot be separated). The tests are conducted on a test trailer with a single axle from a starting speed of 60km/h and with the axle loaded to its rated level. The test is done on a sealed level road with tyres in good condition. The tyre size using the tests is not publicly reportable. The average deceleration of the trailer is measured from multiple tests at five air pressure control levels between 0.2E (130 kPa) and 1.0E (650kPa). The averaged retardation torque produced by the brakes on one axle can then be calculated at each air pressure control level. A valid test has no wheel lock-up.
The results of the five stopping tests are reported to the regulator and, assuming approval is granted, are reported publicly as a single value, which is the brake torque produced when 1.0E air pressure is applied to the brake actuator. The other four test values are not published so the trailer designer does not know how 'linear' the results are. This is a problem. It could be that wheels lock up at a control level less than 1.0E, in which case the valid results are linearly extrapolated to produce the reportable value (**torque at 1.0E**).

Make = SAF-HOLLAND, Model = RZ-20-4218. 'Trailer Braking Component'.
Gross Axle Load Rating = 12t. Brake output torque = 31,070 Nm at 1.0E control.
Park brake static torque = 31,070 Nm.
Actuator strokes: 18mm (0.2E), 23mm (0.4E), 28.8mm (0.6E), 35.5 (0.8E), 40mm (1.0E).

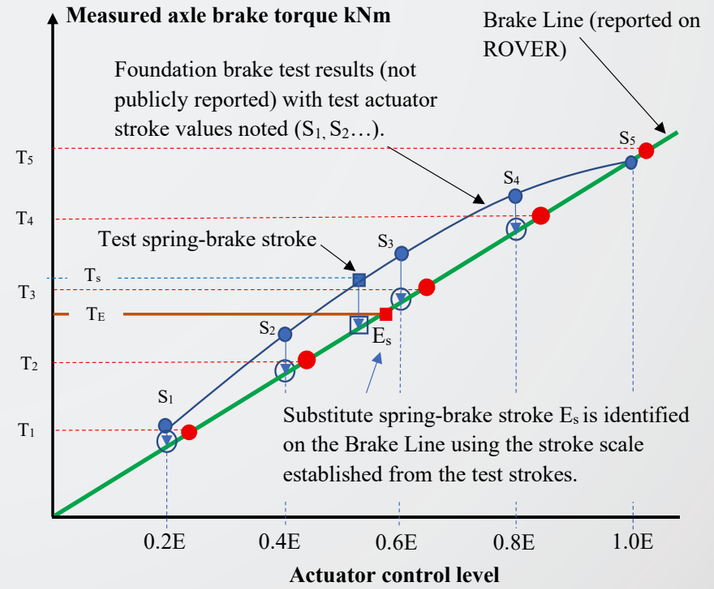
Air Control System Approval – The brake tests mentioned above are done with the brake actuator selected by the brake supplier. The brake air control system takes the air pressure applied at the front of a trailer and applies a different, conditioned pressure to the brake actuators. The pressure applied to each axle in a multi-axle brake system could be different. The air control system is tested on a bench. The air pressure transfer ratios at five incoming pressure levels (0.2E, 0.4E, 0.6E, 0.8E and 1.0E) are tested. The time taken for air pressure to reach 65 per cent is also measured.

Suspension Approval – The suspensions used on a trailer with more than one axle can be either 'brake reactive' or 'non brake reactive'. Airbag suspensions are declared to be non-reactive, so most suspensions on modern trailers are non-reactive. For a brake-reactive suspension, the brake systems of the axles must be set-up taking account of the load shifts that occur between axles during hard braking events. The multi-axle suspension is described by three numbers which are called the 'skid limits' that describe the extent of load transfers that occurs at high deceleration rates. The brake actuators and slack adjuster settings on each axle are selected taking account of the skid limit numbers, so that all the axles have wheel lock-up at about the same control air pressure applied at the front of the trailer.

Actuator substitution - The air brake actuators supplied on axles are often different to those fitted during the stopping tests, because the brake actuator is an integral element of the air control system and changing it would invalidate the air control kit. The brake performance can be 'corrected' for the different actuator using the procedure as illustrated on the graph. This correction is based upon the stroke that each actuator produces when installed on the foundation brake at five control levels: (0.2E, 0.4E, 0.6E, 0.8E and 1.0E); and when the spring brake is active with no control air pressure. The procedure for the correction can be found in Administrator's Circular 38-2-5 which can be found on the Road Vehicle Certification System (RVCS) website (as can other relevant circulars). The procedure assumes that the force from an actuator is proportional to the diaphragm area, which is only approximately true. A better test procedure for the substitute actuator is needed.

Trailer calculations - The trailer designer calculates the expected brake performance for the trailer design using all the information I have described. The calculation method must be approved by the Federal regulator, which is the Vehicle Standards Section inside the Department of Infrastructure, Transport, Regional Development, Communications and the Arts. The calculation is based upon the test levels declared by the three kit suppliers for: foundation brake, air control system and brake reactive suspension (if fitted). The foundation brake characterisation uses a single torque value at 1.0E, which is insufficient. The single torque at 1.0E value defines a straight line that I show in the graph as the 'Brake Line'.

Emergency and parking brakes - Trailers must have emergency brakes that come on immediately when the trailer air supply pressure goes low. For heavy trailers the emergency and parking brakes are the spring brakes. The performance of these brakes is calculated based upon the measured actuator stroke with the spring brake only active. There is no mandatory road test for emergency brake characterisation. This is a deficiency.



Blues strokes (test actuator) and red strokes (substitute actuator) are both measured at the same control level. The position of the red stroke dots on the Brake Line is proportioned from the inferred blue dot positions. The torque values for the substitute actuator can then be estimated.

Vale Gary Liddle AO,
ARTSA-I Life Member
Gary Liddle was a true leader in the Australian transport sector. Gary's career achievements included being CEO of VicRoads, Chair at AustRoads, Deputy Sectary of Dept Transport, Victoria, Chair of the International Road (Safety) Assessment Program, and Enterprise Professor at Melbourne University. Gary was instrumental in facilitating ARTSA Data, which analyses the NEVDIS truck and trailer data. Aside from his achievements, Gary was a great person who always wanted to help others and give back to his community.

Overview - The Australia approach of certifying trailers by calculations provides flexibility for local trailer manufacturers. The reliability of the approved foundation brake data is questionable. It is notable that the New Zealand authorities do not accept the Australian CTA data for trailer calculations in NZ.

The July article will describe the ARTSA-i brake calculator project and how it can be used to check brake certification performance based upon the approved data.

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