The ARTSA-I Brake Calculator

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In my June *Prime Mover* magazine article, I described how Australian trailer braking systems on new trailers can be certified by calculations. ARTSA-i has developed a brake calculator that can be used for trailer certification. It can also be used to predict general heavy vehicle brake system performance which is useful to certify brake modifications, and Performance-Based System (PBS) vehicle performance. The brake calculator project is funded by the National Heavy Vehicle Regulator's (NHVR) Heavy Vehicle Safety Initiative (HVSI), supported by the Australian Government.

The calculator will predict the deceleration performance of any of the vehicle types shown in Figure 1 when they are loaded and unloaded. The calculator is applicable to heavy vehicles with full air brakes.

The ARTSA-i calculator has a 'wheel-lock' model that predicts the brake level at which wheel lock-up will occur. All brake calculators should have such a feature; however, to my knowledge the only one that has is the ARTSA-i brake calculator. When locked up, a wheel is unable to provide road-handling (lateral) forces during heavy braking. The result can be side-sliding and loss of directional control. The new trailer design rule ADR 38/0* requires (at Clause 11) that the wheel on a trailer not exhibit wheel lock-up until a deceleration performance level of 0.45g is achieved.

Well balanced brake systems will not exhibit wheel-lock until emergency brake levels occur. Whilst some might argue that an 'Antilock' feature, which is standard in an 'EBS', will protect against wheel lock-up, the operation of Antilock on a heavy vehicle is undesirable because it lessens stopping distance performance. A brake system should always be designed for maximum unaided performance. The brake designer or modifier can use the ARTSA-i brake calculator to optimise or verify the brake performance.

The wheel lock-up model in the ARTSA-i brake calculator is illustrated in Box 2. If the utilisation of any axle on the vehicle exceeds the available road friction (which is usually set at 0.75 but can be adjusted lower for slippery surfaces), then the retardation force is set to a fixed level (that does not increase as control level is increased). The other aspect of the wheel lock-up model is the transfer of weight during deceleration from the rear axle group to the front axle group, and transfer of weight within the axle group. This allows the calculator to predict the lock-up of wheels on each axle, which is needed to determine compliance with brake rules by calculation rather than test. The ARTSA-i brake calculator calculates weight transfers during deceleration braking.

Some main outputs of the brake calculator are illustrated in Box 1. They are the stopping distance and the deceleration of the vehicle as a function of the foot pedal brake control level (0 – 650kPa).

Figure 1: The Calculator vehicle selection page.

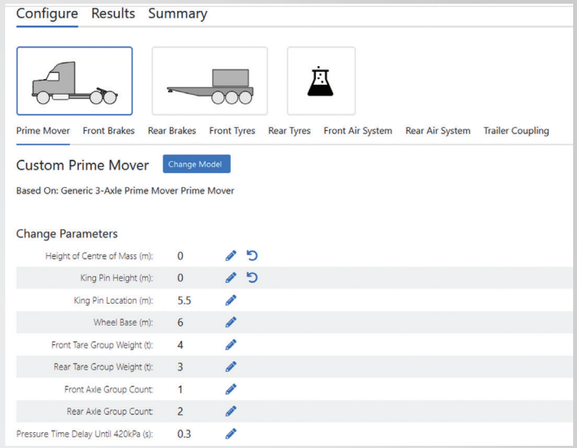
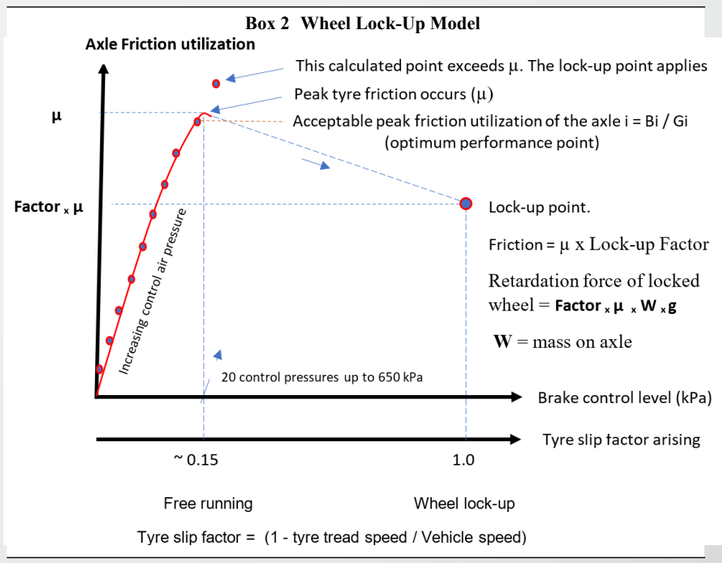


Figure 2: The dimension specification page for a Prime Mover

Figure 3: The specification page for the brakes on a Semi-trailer.

The brake calculator has been developed so that brake engineers and vehicle modifiers can predict the performance of a brake system without testing. This is especially necessary for trailer certification and for checking that a modified heavy vehicle complies with rules.



The calculator is user friendly and allows a very complex vehicle to be specified in a few tens of seconds. Some of the set-up pages are shown in Figures 2 & 3. The calculator contains a library of the brake Component Type Approvals (CTAs) for foundation brakes. The user can select a particular brake make and model and the calculator will populate the parameters. Readers with an interest in using the brake calculator should email ARTSA-i at exec@artsa.com.au. The ARTSA-i brake calculator is intended to be a freely available tool for industry and it is another demonstration of the benefits that are flowing the Australian Government's Heavy Vehicle Safety Initiative program.

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