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THE NEW BRAKE RULE

From the Brake Code to the Heavy-vehicle Brake Rule

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General overview

The Land Transport Safety Authority (LTSA) has the task and obligation to identify road safety risks, analyse the possible means and ways to reduce those risks and implement the most appropriate solution.

As part of this activity a rule-development programme is in place, the aim of which is to consolidate, clarify, simplify and improve the safety requirements for vehicles.

It is widely agreed that brakes are the most important safety system in a vehicle, and this can be simply demonstrated:

- To achieve and sustain a speed of 100 km/h with a vehicle combination having a gross combined mass of 44000 kg, an engine with 250kW output is sufficient, although today the industry expects more powerful engines.
- On the other hand, to stop the very same vehicle combination according to the legal requirements, i.e. 0.5g deceleration, the required peak performance of the brakes must be at least 6000 kW, and again, the industry expects even better brakes.

Identifiable safety risks

In New Zealand, during the last four years two significant events have highlighted the importance of heavy-vehicle brakes. The first was the "Inquiry into Truck Crashes" of the Transport Committee, the findings of which were reported to the House of Representatives. In respect of brakes of heavy vehicles, this report concluded that in 6-11% of crashes where heavy vehicles were involved, inadequate brake performance was a predominant factor. Vehicle Testing New Zealand also expressed serious concerns regarding the condition and performance of heavy-vehicle brakes checked during CoF inspection, although this inspection is carried out with unladen vehicles, which prevents full evaluation of the brake performance. It was also recorded in the report that an LTSA roadside audit (carried out with very basic equipment only) had found that 16% of heavy vehicles have obvious brake problems.

The second significant event was the Heavy Vehicle National Brake Survey, carried out by the LTSA in 1998. During the survey 1064 heavy vehicles (approximately 1% of the New Zealand heavy vehicle fleet) were checked with a highly sophisticated portable brake-testing equipment, which allowed a full and in-depth brake analysis of fully laden vehicles and vehicle combinations. The summary of the survey was made public in the form of a report in September 1998. It was found that a significant

portion of the tested vehicles had to be ordered off the road due to serious or expressly dangerous brake defects. The details are given in the table below:

Results of Heavy Vehicle National Brake Survey			
	Hydraulic brakes	Non-coded air brakes	Coded air brakes
Vehicles ordered off the road (%):	6.8	23	25
Due to serious defects (%):	3.8	16.8	21.5
Due to dangerous defects (%):	3	6.2	3.5

A follow-up survey was carried out on a much smaller sample later in 1998. During this survey vehicle operators could not avoid the brake tests (due to the deliberate selection of the time and location of the tests). The results of this survey showed a failure rate much higher than the one found during the national survey, therefore the results in the table above should be considered as conservative ones.

Review of heavy-vehicle brake requirements

Although the LTSA has implemented numerous measures to increase compliance of brakes with applicable requirements, it has become obvious that a more comprehensive overview of these requirements and their enforcement is necessary. This is also in line with the recommendations for brakes in the report of the Transport Committee for the House of Representatives.

A comprehensive review of the regulations for brakes is also warranted by the fact that the legal requirements for heavy vehicle brakes are fragmented and there are several points that would require clarification and updating. For example, the legislation which contains most of the system requirements for air brakes dates back to 1936 (it is the *Goods Service Vehicles Construction Regulations 1936*), but there are four further regulations and three industry codes which contain requirements for heavy-vehicle brakes.

The legislation contains different requirements for the brakes of heavy vehicles if they are operated individually or in combination with a GVM or GCM

- not exceeding 39000kg;
- of 39000kg – 44000kg; and
- exceeding 44000kg.

Thus the brake performance of vehicles in combination could be unmatched and this is potentially dangerous.

A further problem is that these requirements are not consistent with each other. For example, one regulation requires that a vehicle must be able to stop within 7m from 30km/h speed, but another regulation contains 20 feet and 20mph for the same stopping-distance requirement. Another example: goods service vehicles are required to comply with the stopping distance requirements with full load, but passenger service vehicles must comply when unladen.

It may also be noted that this speed range is unrealistically low. Most international standards prescribe significantly higher initial speed for the stopping distance tests to replicate the realistic operational speed of heavy vehicles.

A significant updating of the legislation is also necessary to ensure that our law does encourage the application of the newest technologies (ABS, ASR, electronic brake control, brake-by-wire, integrated brake and engine/transmission management systems, etc.), and that vehicles which are manufactured to comply with leading international standards are accepted in New Zealand without any bureaucratic obstacles. Here it may be noted that the number of these standards are dropping dramatically, as globalisation of vehicle standards occurs, and the UN/ECE regulations and the FMVSS standards are emerging as the two main sets of vehicle standards.

The Heavy-vehicle Brake Rule

The basic philosophy which underlies the proposed Heavy-vehicle Brake Rule is that the brake system must meet applicable standards and requirements when a vehicle enters service; it must be properly maintained; and this maintenance should be verified, at least during the CoF inspections.

The rule will apply to every heavy vehicle and their combinations.

Brake requirements, applicable standards and specifications

A brake is considered as appropriate or safe, if it can stop a vehicle or vehicle combination in an efficient and controlled manner at any load condition. Compliance with Regulation UN/ECE 13 ensures this, as this regulation contains detailed and quantitative requirements for the required stopping distances (from a realistic initial speed) and detailed quantitative requirements for the brake-force distribution between the axles or axle groups of a vehicle at both light and full load. In addition, UN/ECE 13 also contains detailed specifications to ensure balanced brake performance of vehicles used in combination, even if one of them is lightly and the other one is heavily laden.

A detailed analysis showed that FMVSS 121 provides a brake performance and brake force balance similar to UN/ECE 13, although not through detailed technical specifications, but by means of a very prescriptive and detailed performance and test procedures. As the overall deceleration required in FMVSS 121 is marginally lower than in UN/ECE 13, it is proposed that compliance with FMVSS 121 could only be acceptable if a slight GVM reduction is applied for the vehicle.

Accordingly, it is proposed that compliance with UN/ECE 13 or any equivalent standards be acceptable.

As a significant portion of the heavy-vehicle fleet is manufactured domestically (mainly trailers and semi-trailers, but also buses and bus chassis), the rule will propose "domestic" specifications, based on UN/ECE 13, however it is proposed that the compliance and certification procedure be simpler and less expensive. It will also be proposed that if a vehicle is modified in a manner that it may affect the brake system or its performance, the brake system must comply with the domestic brake specification and be certified accordingly.

From this perspective, the aim of the rule will be to ensure that the brake systems of heavy vehicles in the New Zealand fleet are designed and manufactured to the same or equivalent standards, therefore the vehicles are safe and have a balanced, matching brake performance when entering service. At the same time, the compliance regime will be cost effective both for imported and domestically manufactured vehicles.

In parallel with the development of the rule, appropriate computer software is also being developed to carry out brake calculations according to the domestic specifications. The input data for this software is the wheel brake characteristics, i.e. output vs. input, for example *brake drum/disc torque vs. S-cam torque/chamber pressure*, etc. It is significantly different from the present Brake Code software, which allows the brake output calculation from the brake-lining friction coefficient, brake-drum diameter S-cam radius and other data.

Maintenance requirements

Proper maintenance is necessary to ensure that the brakes are kept within safe tolerance, to ensure that they have a good and steady performance. *Land Transport Rule: Vehicle Standards Compliance 1998* (the Compliance Rule) also requires that a vehicle must be kept within safe tolerance of its original specification. One of the most important issue here is the quality or specification of spare parts, such as brake linings or pads, valves, S-cams, brake chambers, etc., used during maintenance. The rule will require that the components and spare parts must comply with the specification set by the manufacturer of the vehicle or brake system. Although the rule will not specifically require that the replacement components must be supplied by the vehicle manufacturer, compliance with UN/ECE 13 implicitly requires this, for example for brake linings and pads, except if the replacement item complies with UN/ECE 90.

In-service or CoF inspection

The ratio between the GVM and the unladen mass of heavy vehicles, especially trailers, has significantly increased over the past fifteen years. This has led to a point when neither a brake test on a roller-brake tester nor a stopping-distance test with an unladen or lightly-laden vehicle can verify the condition and performance of the brakes, due to the premature lock-up of the wheels during the tests. This has been

verified both by means of engineering analysis and by numerous practical tests during the Heavy Vehicle National Brake Survey.

The rule will propose that the brake tests must be carried out with either laden vehicles or with brake-testing machines or arrangements where the load can be applied or imitated so that the premature lock-up of the wheels can be avoided and the actual brake performance checked. It is understood that this requirement may raise numerous practical questions, for example how to test petrol tankers or stock vehicles with full load etc. but there are several possible solutions to address these questions, and which would be suitable to carry out laden brake tests without any significant cost increase.

It is known that there are different attempts in several countries to evaluate the brake performance of heavy vehicles by carrying out so-called low-intensity brake tests and extrapolate the test results, however international experts still argue about the reliability of this method. In addition, a method like this always requires a thorough knowledge of the brake characteristics of the vehicle being tested. Such test methods and evaluation procedures would only be considered if their reliability and accuracy has been properly verified.

The next phase of the rule

The Ministry of Transport has approved the LTSA's proposal to develop this rule. A *Blue Paper - Discussion Document* has been prepared and circulated for industry consultation. Numerous submissions have been received, which will be considered during the next phase of rule development. The Red Draft of the rule is in progress and its release for industry consultation is planned for the second half of this year.