Low Volume Vehicle Technical Association Incorporated

Low Volume Vehicle Standard 35-00(00) (Braking Systems)

This Low Volume Vehicle Standard corresponds with:
Transport (Vehicle Standards) Regulation 1990: (13) Brakes

Original version effective from 1 December 2000

Background

The Low Volume Vehicle Technical Association Incorporated (LVVTA) represents ten hobbyist and specialist groups who are dedicated to ensuring that their members' vehicles, when scratch-built or modified, meet the highest practicable safety standards.

The information in these standards has stemmed from work undertaken by founding member groups that commenced prior to 1990 and has been progressively developed as an integral part of NZ Government safety rules and regulations by agreement and in consultation with the Land Transport Safety Authority.

As a result, the considerable experience in applied safety engineering built up by LVVTA members over the past ten years can be of benefit to members of the NZ public who also wish to build or modify light motor vehicles.

Availability of low volume vehicle standards

Low volume vehicle standards are prepared by the Low Volume Vehicle Technical Association (Inc.) in consultation with the Land Transport Safety Authority of New Zealand.

Low volume vehicle standards are printed and distributed by the Low Volume Vehicle Technical Association (Inc.). Information on the availability of the low volume vehicle standards and their amendments may be obtained by writing to the Low Volume Vehicle Technical Association (Inc.) at the address shown below.

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Braking Systems 35-00(00)

Purpose of this standard

The purpose of this low volume vehicle standard is to specify requirements for braking performance, in order to ensure efficient and consistent brake operation under normal and emergency driving situations.

Section 1 Application

1.1 Scope of the standard

This standard applies to all low volume vehicles of the classes specified in *1.2*, except for those vehicles specified in *section 4* that are modified in such a way that certification to the *Low Volume Vehicle Code* is not required.

1.2 Category, class, and date of application

1.2(1) Low volume vehicles of Classes MA, MB, MC, MD1, MD2, NA, and L-group must comply with *2.1* and *2.2*.

1.2(2) Modified production low volume vehicles of Class MA modified on or after 1 January 1992 in such a way as to directly or indirectly affect any braking systems must, in addition to *1.2(1),* comply with either:

(a) one or more of the approved standards specified in *item 1* of the *second schedule* of the *Transport (Vehicle Standards) Regulations 1990*; or

(b) the low volume vehicle technical requirements specified in *2.3* and *2.4*.

1.2(3) Modified production low volume vehicles of Classes MB, MC, and NA modified on or after 1 January 1993 in such a way as to directly or indirectly affect any braking systems must, in addition to *1.2(1),* comply with either:

(a) one or more of the approved standards specified in *item 1* of the *second schedule* of the *Transport (Vehicle Standards) Regulations 1990*; or

(b) the low volume vehicle technical requirements specified in *2.3* and *2.4*.

1.2(4) Modified production low volume vehicles of Classes MD1, MD2, and L-group modified on or after 1 March 1999 in such a way so as to directly or indirectly affect any braking systems must, in addition to *1.2(1),* comply with either:

(a) one or more of the approved standards specified in *item 1* of the *second schedule* of the *Transport (Vehicle Standards) Regulations 1990*; or

(a) the low volume vehicle technical requirements specified in *2.3* and *2.4*.

1.2(5) Scratch-built low volume vehicles of Classes MA, MB, MC, MD1, MD2, NA, and L-group manufactured on or after 1 January 1992 must, in addition to *1.2(1*), comply with either:

(a) one or more of the approved standards specified in *item 1* of the *second schedule* of the *Transport (Vehicle Standards) Regulations 1990*; or

(b) the low volume vehicle technical requirements specified in *2.3* and *2.4*.

Section 2 Low volume vehicle general safety and technical requirements

2.1 Requirements for all low volume vehicles

Low volume vehicles must be certified in accordance with the procedures specified in *Chapter 2* of the *Low Volume Vehicle Code* and other applicable requirements in this section.

2.2 General safety requirements

2.2(1) Low volume vehicles must be properly designed and constructed using materials and components that are fit for their purpose, and that comply with all legal requirements applicable to low volume vehicles that relate to the construction and equipment on a motor vehicle, and which make the vehicle safe to operate on roads.

NOTE: The requirement specified in *2.2(1)* is the roadworthiness requirement from *2.1* of *Chapter 2* of the *Low Volume Vehicle Code*, which is required as part of this low volume vehicle standard, and is reproduced here in the interest of convenience.

2.2(2) All low volume vehicles, except those specified in *section 3,* must comply with the following general safety requirements:

(a) a brake must be easily adjustable to compensate for wear and must be maintained in good condition and efficient working order; and

(b) the friction surfaces of a brake must be within safe tolerance of their state when manufactured and must not be scored, damaged or weakened to the extent that the performance of the brake is impaired; and

(c) the runout and thickness of a brake or brake disc must be within the vehicle manufacturer's recommendations. If the manufacturer's recommended minimum thickness is not known, the thickness must not be reduced to less than 90% of the original thickness; and

(d) the braking effort on each braked wheel of a vehicle must be in proportion to the load carried by that wheel, except when an anti-skid or stabilising device varies any braking effort to any wheel independently of the driver; and

(e) engine brakes or drive-line retarders on a vehicle must be designed and constructed so that their use does not cause the drive axle wheels to skid; and

(f) if a vehicle is fitted with a warning system that is part of, or associated with, the use of a brake component or system, that warning system must function correctly.

NOTE: The requirements specified in *2.2(2)* are the applicable general safety requirements from *regulation 13* of the *Transport (Vehicle Standards) Regulations 1990* which are required as part of this low volume vehicle standard, and are reproduced here in the interest of convenience.

2.3 Technical requirements for braking systems

2.3(1) All low volume vehicles, except those specified in *section 3,* must comply with the applicable requirements in *2.3* and *2.4*.

2.3(2) All low volume vehicles which are either scratch-built, or have braking systems modified to such an extent that they are outside the scope of this low volume vehicle standard, must, in addition to this standard, comply with the relevant braking design and construction requirements specified in the applicable section of the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual.*

Discs and drums

2.3(3) Brake disc and drum assemblies must be compatible with the weight and performance potential of the vehicle to which they are fitted, by incorporating:

(a) braking surface swept area in accordance with specifications contained in the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*; and

(b) donor disc or drum material thickness must not be machined beyond the specifications of the brake component manufacturer.

2.3(4) Where brake disc adaptations have taken place, the adaptation must not incorporate:

(a) any welding to any cast or forged suspension upright or stub axle, or steering arm; or

(b) any reduction of the spindle diameter by machining or any other means; or

(c) any alteration to the original radii contained on the spindle.

Master cylinders

2.3(5) A dual-circuit master cylinder system must be fitted to:

(a) all scratch-built low volume vehicles; and

(b) all modified production low volume vehicles which are fitted with any master cylinder other than that fitted by the original vehicle manufacturer.

2.3(6) Master cylinder reservoirs fitted to low volume vehicles must have a greater hydraulic fluid capacity than the combined total volume of all cylinders operating within the system.

2.3(7) Relocated or remounted master cylinders must be located on a part of the vehicle structure with sufficient strength and rigidity to securely attach the cylinder and support the cylinder during application of all normal and emergency braking loads.

2.3(8) Adjustable balance-bar assemblies which actuate twin master cylinders must:

(a) be capable of being securely locked into position to prevent unintended changes in front to rear brake balance; and

(b) in the case of balance bar rods within a custom-built balance-bar assembly, be manufactured from a material of:

(i) appropriate strength; and

(ii) suitable diameter.

Vacuum servo systems

2.3(9) Vacuum servo systems fitted to low volume vehicles must provide and maintain sufficient vacuum to enable the braking system to operate safely at all engine speeds including idle.

2.3(10) Remote vacuum servos fitted to low volume vehicles, if exposed to or fitted near the road surface, must be protected by a chassis or sub-frame member, or purpose designed shield, from damage by irregular road surfaces or debris.

2.3(11) Vacuum brake hoses used on low volume vehicles must:

(a) be of a type purposely designed for automotive applications; and

(b) incorporate a one-way check valve to prevent unintended loss of vacuum whilst the engine is not running.

Pedal assemblies

2.3(12) Brake pedal assemblies used within low volume vehicles must incorporate:

(a) an effective return spring; and

(b) a positive return stop; and

(c) an acceptable amount of free pedal movement before the braking system is actuated.

2.3(13) Relocated or remounted brake pedal assemblies must be located on a part of the vehicle structure with sufficient strength and rigidity to securely attach the assembly and support the assembly during application of all normal and emergency braking loads.

2.3(14) Brake pedals and brake pedal push-rods used within low volume vehicles:

(a) may be modified by taking into account the specifications provided within the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*; and

(b) must not be lengthened or shortened by the process of solely butt-welding the two or more sections together.

Manufacture and modification of components

2.3(15) Welding may only be carried out within a brake modification or adaptation if:

(a) the welding is carried out by a person who:

(i) holds a relevant current qualification or trade certification for the type of welding being undertaken; or

(ii) has demonstrated to the low volume vehicle certifier, a satisfactory level of competence in the method of welding being undertaken; and

(b) documentation of a form specified by the *Low Volume Vehicle Technical Association Incorporated*, which verifies *2.3(15)(a)* is supplied by the person who undertakes the welding; and

(c) welded components which, upon failure could result in a total loss of braking control, are non-destructively tested, using either the ultra-sonic, x-ray, or magnetic particle method, by either a CBIP-approved person holding the relevant current certification for the type of NDT being undertaken, or a person holding ASNT NDT Level 3 qualification; and

(d) documentation of a form specified by the *Low Volume Vehicle Technical Association Incorporated*, which verifies *2.3(15)(c)* is supplied by the person who undertakes the NDT testing.

Hydraulic brake pipes

2.3(16) All hydraulic brake pipes fitted to low volume vehicles must be of a type purposely designed for automotive applications.

2.3(17) Hydraulic brake pipes fitted to low volume vehicles must:

(a) follow the shortest practical route; and

(b) be connected using double or ball flares; and

(c) be securely fastened to the vehicle structure at intervals:

(i) originally utilised by the vehicle manufacturer; or

(ii) no further apart than 300 mm.

2.3(18) Hydraulic brake pipes fitted to low volume vehicles must be mounted in such a position so as to be:

(a) protected from being damaged by curbs, irregular road surfaces, or jacking equipment; and

(b) no closer than 100 mm to any part of the vehicle's exhaust system, unless protected by a suitable heat-shield; and

(c) away from any moving components within the engine compartment; and

(d) able to be visually inspected without being removed; and

(e) protected from any chafing or abrasion where the hydraulic brake pipe passes through rigid sections.

2.3(19) Hydraulic brake pipes which are mounted adjacent to any drive-shafts in low volume vehicles which have been modified in such a way which results in substantially increased power output, the lines must;

(a) be re-directed away from the vicinity of the drive-shaft; or

(b) be protected in the event of a drive-shaft failure by a 360-degree safety loop at each end of the drive-shaft, positioned within 150 mm of each drive-shaft universal.

Hydraulic brake hoses

2.3(20) All hydraulic brake hoses fitted to low volume vehicles must be of a type purposely designed for automotive applications.

2.3(21) Hydraulic brake hoses must not be used to replace rigid brake pipes, except for where movement between vehicle parts make this necessary.

2.3(22) Hydraulic brake hoses fitted to low volume vehicles must be attached and located in such a way so as not to be able to:

(a) come into contact with any moving parts such as wheels, tyres, brake or suspension components; and

(b) become caught or pinched between suspension spring coils.

2.3(23) Hydraulic brake hoses must be located and attached to low volume vehicles in such a way that they are not fully extended, or under tension or excessive torsion at, or at any combination of, upward or downward suspension travel, or full steering lock.

Braking bias systems

2.3(24) Low volume vehicles may be fitted with one or more proportioning valves which are purposely designed for automotive applications.

2.3(25) Proportioning valves which are adjustable from inside a vehicle must have the facility to be temporarily disabled or locked into a position of normal operation to prevent unintended changes in front to rear brake balance occurring whilst the vehicle is being operated on public roads.

Anti-lock braking systems

2.3(26) Modified production low volume vehicles originally fitted by the vehicle manufacturer with an anti-lock braking system may be converted to a non anti-lock braking system, provided that:

(a) the vehicle is provided with a warning label permanently positioned so as to alert the driver that the vehicle is longer equipped with an ABS system; and

(b) the vehicle has any warning lights originally installed by the vehicle manufacturer to indicate the presence of an ABS system removed or de-activated; and

(c) all parts of the braking system which are unique to ABS are removed and either:

(i) replaced with the relevant parts from a non-ABS fitted variant of the same make and model; or

(ii) the system is modified to a non-ABS configuration using purpose-built braking components; and

(d) documentation in a form specified by the *Low Volume Vehicle Technical Association Incorporated*, verifies that *2.3(26)(c)* has been complied with.

2.3(27) Scratch-built low volume vehicles incorporating anti-lock braking must utilise a complete system from one make and model of donor vehicle, installed in the same way as originally installed to the donor vehicle by the original vehicle manufacturer.

Parking brake systems

2.3(28) All low volume vehicles must be fitted with a park brake system that operates on at least one axle.

2.3(29) Parking brake cables fitted to low volume vehicles must be:

(a) positioned or protected from being contacted by any moving parts of the vehicle; and

(b) securely fastened.

2.3(30) Modifications to parking brake cables fitted to low volume vehicles must be carried out by suitably experienced professionals using components and attachment methods purposely designed for parking brake applications.

2.3(31) Low volume vehicles must not be fitted with a cardan-shaft parking brake system unless the vehicle is equipped with a dual circuit service brake system.

2.3(32) Low volume vehicles must not be fitted with a hydraulically operated parking brake system.

2.3(33) Parking brake lever assemblies must be located and attached onto a part of the vehicle structure sufficiently strong to securely attach the parking brake lever assembly.

Other requirements

2.3(34) Service brake and park brake systems on low volume vehicles must provide a ready means of adjustment in order to compensate for wear of the braking components.

2.3(35) All components used within a braking system on a low volume vehicle must be purposely designed for automotive applications.

2.3(36) Speedometers fitted to low volume vehicles must provide an accurate indication of the vehicle's speed, and be visible to the driver in a normal seated position, in order to enable accurate service brake performance testing.

2.3(37) All fasteners incorporated in high load or critical locations on vehicles which undergo braking system modifications or adaptations, either:

(a) must be the original fasteners supplied by the original vehicle manufacturer; or

(b) must be of an appropriate size for the application; and

(i) must have a tensile strength of grade-8.8 metric or higher; and

(ii) if of a higher tensile strength than grade-8.8, must not be electroplated.

2.4 Brake performance requirements

Service brake test requirements

2.4(1) Low volume vehicles must be fitted with a service brake system that operates on all road wheels, which enables:

(a) braking effect to occur with a pedal force of 6.6 kilograms; and

(b) maximum braking effect to be achieved with a pedal force of no more than 68 kilograms.

2.4(2) Low volume vehicles must meet the applicable following brake test requirements, conducted on a hard level road surface that is free of loose material, without the deliberate aid of engine compression, during which smooth progressive braking must be achieved without exhibiting any significant premature lock-up at either end of the vehicle, or any imbalance between the two sides of the vehicle:

(a) modified production low volume vehicles which have attained an increase in engine power output from the original vehicle manufacturer's specifications of between 20% and 50%, or have any modifications to the service brake system, or have any modifications which result in a change in or relocation of weight or centre of gravity, must achieve:

(i) 3 consecutive cycles from 100 kph to standstill each at an average deceleration of not less than 0.65G; and

(ii) within a total time of 2 minutes from the start of the first cycle to the completion of the third cycle; or

(b) all scratch-built low volume vehicles, and modified production low volume vehicles which have attained an increase in engine power output from the original vehicle manufacturer's specifications of more than 50%, must achieve:

(i) 5 consecutive cycles from 100 kph to standstill each at an average deceleration of not less than 0.65G; and

(ii) within a total time of 3 minutes from the start of the first cycle to the completion of the fifth cycle.

2.4(3) Low volume vehicles tested in accordance with *2.4(2)(a)* must be retested against the requirements specified in *2.4(2)(b)*, if the vehicle either:

(a) exhibits during the test any significant decrease in brake-fade resistance between cycles; or

(b) has, in the opinion of the certifier, braking componentry which may not be of sufficient durability relative to the performance potential or mass of the vehicle.

2.4(4) Low volume vehicles that are fitted with a hand-operated service brake for persons with disabilities must be able to be braked no less effectively with the hand-control than with the original foot control.

Parking brake test requirements

2.4(5) Low volume vehicles which are fitted with a parking brake system must be capable of either:

(a) holding the vehicle in a stationary position without any assistance from the service braking system or transmission on a gradient of one in five; or

(b) alternatively, on vehicle types for which such a test is appropriate, bringing the vehicle from a speed of 30 kph to a stationary position within a distance of 18 metres.

Section 3 Exclusions

3.1 Service brake test exclusions

3.1(1) Low volume vehicles which, during the process of conducting the service brake performance test are not able to readily attain a speed of 100 kph, are not required to meet the 100 kph requirement specified in *2.4(2)* and instead must meet 0.6G from whatever speed the vehicle is able to practicably achieve for the purpose of the tests.

3.1(2) Low volume vehicles which are required to be tested to 0.65G, but which due to a wet or slippery road surface at the time of testing the testing process may be unsafe, can at the discretion of the certifier be tested to 0.55G.

3.2 Parking brake exclusions

3.2(1) Low volume vehicles of Classes-LA, LB, LC, LD, and LE-1 are not required to comply with *2.3(28)*.

3.2(2) Low volume vehicles originally manufactured prior to 1 January 1990 that retain the original vehicle manufacturer's cardan-shaft parking brake system are not required to comply with *2.3(31)*.

3.3 Motor-sporting exclusions

3.3(1) Low volume vehicles designed and used primarily for motor-sporting events recognised by the Low Volume Vehicle Technical Association (Inc.) are not required to comply with *2.3(21)*.

3.3(2) Modified production low volume vehicles, for which a valid MotorSport New Zealand Authority Card that specifies hydraulic handbrakes is issued, are not required to comply with *2.3(32)*.

3.4 Disability exclusions

Braking systems fitted with additional servo assistance to enable a person with disabilities to operate the brakes with decreased pressure are not required to comply with *2.4(1),* provided that a label warning of the braking system's increased sensitivity is permanently attached in a prominent location where it is clearly visible to the driver when seated in a normal position.

Section 4 Modification criteria

4.1 Modifications not requiring certification

4.1(1) A vehicle is not required to be certified to the *Low Volume Vehicle Code* where the only modification to the vehicle is the fitting of any one or more of the following items, provided that the safe performance of the vehicle is not compromised:

(a) after-market brake disc pads or linings which are catalogued for the specific make and model of vehicle to which they are fitted; or

(b) after-market disc rotors provided that the rotors;

(i) are catalogued for the specific make and model of vehicle to which they are fitted; and

(ii) attach without any modifications to any inter-related components; and

(iii) have no effect on the positioning or operation of the hub assembly or any related systems or parts.

4.1(2) A vehicle is not required to be certified to the *Low Volume Vehicle Code* where the only modifications to the vehicle are those to the vehicle's original engine, that result in an increase of no more than 20% in engine power output from the original vehicle manufacturer's specifications, provided that the safe performance of the vehicle is not compromised.

4.1(3) A vehicle is not required to be certified to the *Low Volume Vehicle Code* where the only modification to the vehicle is the fitting of an engine other than that fitted by the original vehicle manufacturer, provided that the safe performance of the vehicle is not compromised, and that the engine:

(a) is of the same or less capacity or power output; and

(b) is of the same configuration; and

(c) is of the same motive power; and

(d) has the same weight, location, and centre of gravity; and

(e) has the same ancillary equipment; and

(f) is of the same design and casting family of cylinder block and cylinder head(s).