

Helping New Zealanders Build & Modify Safe Vehicles



WHEEL ADAPTOR MINIMUM SPECIFICATIONS

► Introduction

Chapter 12 of the NZ Car Construction Manual (NZCCM) specifies that an adaptor can provide a maximum spacing of each wheel away from the hub surface of 30 mm, unless the hub assembly donor vehicle is substantially heavier than the vehicle to which the adaptors are fitted. The Chapter does not, however, specify a minimum thickness that an adaptor can be.

For the sake of clarity, this information sheet is referring to wheel **adaptors** rather than wheel **spacers**.

- Wheel **adaptors** use the vehicle's original equipment (OE) studs or bolts to affix the adaptors to the hub, and have a separate group of pressed-in studs to mount the wheel – in this way, a different wheel pitch circle diameter can be achieved.
- **Spacers** are sandwiched between the wheel and hub, and the wheel is held on with the vehicle's OE studs or bolts.



Image 1: Wheel adaptors.

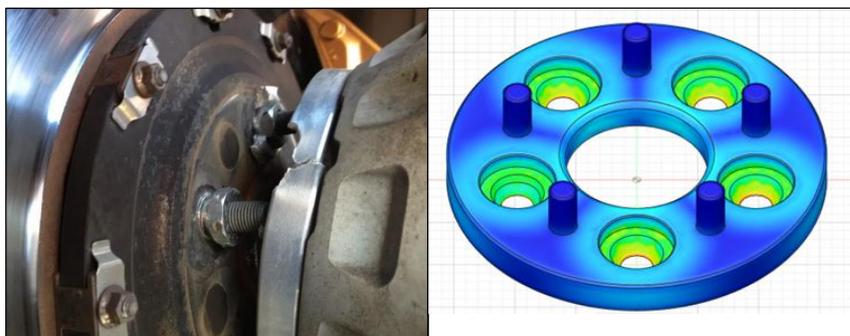


Image 2: Wheel spacers.

► How Thin Is Too Thin?

There are hundreds of different kinds of wheel adaptors on the market worldwide. For some years it has been generally accepted that the minimum allowable thickness for a wheel adaptor was 20 mm, which provided sufficient strength around the studs and enough material for a tapered nut to seat into. Recently however, LVV Certifiers and LVVTA technical staff have increasingly been presented with adaptors down to 10 mm thickness. This has raised concerns at the strength available in the adaptor, particularly around the wheel mounting studs. This is because the material at this point is very thin, and when mounted to the vehicle it is expected in many cases to support nearly half a ton of weight in shear, and must also cope with the tension/compression loadings present throughout normal driving and cornering. Given that adaptors are often fitted to vehicles with wheels that have a greater than average amount of offset, the loadings on the adaptor can be significant, especially as these wheels are usually very wide.

If a wheel adaptor were to fail, it would likely result in the affected wheel parting company with the vehicle – risking the loss of braking and directional control. LVVTA has several examples of poorly made, too-thin adaptors on its 'wall of shame', which have been examined and Finite Element Analysis (FEA) modelled as part of the research behind the development of this Information Sheet (shown in Image 4). There are many recorded instances overseas of wheel



Left, Image 3: This adaptor failed on a track day, and has broken around the seating area for the nuts. Image reproduced from www.gtr.co.uk

Right, Image 4: Finite Element Analysis (FEA) model.

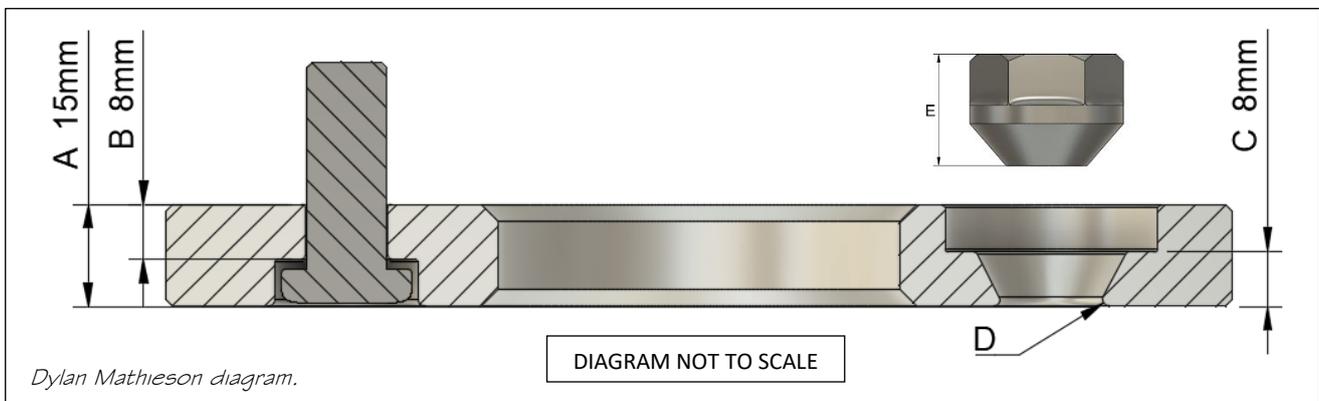
adaptors failing while driving, and if the failure point is not at the stud mountings, it frequently occurs at the point around where the adaptor is held against the hub. The latter is the area where the material is thinnest, and loadings are highest, and this situation is often exacerbated by the use of poor-quality materials to manufacture adaptors, and incorrect or missing radii at the base of the tapered holes. Most wheel adaptors that LVVTA technical staff have seen are cast, or machined from billet alloy, of varying grades and heat treatment processes.

► Wheel Adaptor Minimum Specifications

Note when reading these wheel adaptor specifications that:

- the term ‘adaptor retaining nut’ means a nut used to hold the wheel adaptor to the vehicle hub, usually supplied as part of the wheel adaptor kit; and
- the term ‘wheel mounting stud’ refers to the studs pressed into the wheel adaptor, used to attach the wheel.

After analysing failures and using FEA modelling (*shown in Image 4*), LVVTA technical staff have established a minimum specification for wheel adaptors, which is based on a material specification equivalent to 6061 T6 grade aluminium (the material that most adaptors are made from). Particular attention must be paid to the heat treatment grade – this must be at least equivalent to T6. The specifications are as follows:



- **Dimension A: The minimum thickness an adaptor can be is 15 mm.** The thickness of a wheel adaptor is defined as the distance by which the adaptor spaces the wheel away from the hub.
- **Dimension B: The amount of material remaining above the shoulder of the pressed-in wheel mounting stud must be at least 8 mm.** This is to ensure there is enough material remaining to prevent the wheel mounting stud from pulling through, either from over-tightening or dynamic loading.
- **Dimension C: The minimum dimension for the taper height is 8 mm.** This is the measurement from the inner face of the adaptor to the top of the taper for the adaptor retaining nut.
- **Dimension D: Attachment holes can be up to 1.3 x larger at the base of the taper in the adaptor than the vehicle’s OE stud or bolt diameter.** This would, for instance, allow a 16 mm hole at the base of the taper for a vehicle with 12 mm OE wheel studs. Having a larger hole with a step, radius, or chamfer at the base of the taper is one of two methods used to avoid any stress fractures at the base of the taper – the other option being to utilise an adaptor retaining nut that has a flatter taper angle than that present in the mounting hole in the adaptor, in order to clamp the adaptor to the hub using the top third of both taper surfaces. Both of these methods are intended to prevent the highest point of loading being applied where the material is thinnest (i.e., the base of the taper).
- **Dimension E: The minimum height that the tapered seat adaptor retaining nut must be is 10 mm.** Note that the adaptor retaining nut must meet all other applicable requirements specified in the NZCCM, including the number of turns of engagement required. Slim-line or half-nuts often do not provide sufficient thread engagement, so cannot be used in this situation. Note also that any adaptor retaining nut used must have an external hex profile.

- **The adaptor must be made of a material of at least equivalent specification to 6061 T6 grade aluminium.** This includes the material's yield strength, ultimate strength, and hardness.
- **The adaptor must meet the location requirements specified in the NZCCM,** as follows:

12.23.1

A wheel adaptor fitted to a low volume vehicle between the hub and wheel assembly to affect a change in the wheel stud pattern, must locate, with a close tolerance fit, using the centre spigot or tapered wheel nuts or bolts:

- (a) the adaptor against the hub assembly; and*
- (b) the wheel assembly against the adaptor.*

Note 1: Some vehicle manufacturers use a tapered-head bolt to attach the wheel to the hub, rather than studs and nuts. Some wheel adaptors available for these vehicles use the OE wheel bolts rather than pressed-in studs to mount the wheel to the adaptor, and due to significant potential issues with this type of wheel adaptor, vehicle modifiers should contact the LVVTA office for more information, as these are outside the scope of this Information Sheet.

Note 2: Wheel adaptors must meet all other applicable requirements from *Chapter 12 of the NZCCM* (which can be downloaded free of charge from the [LVVTA website](#)).

► **Finally**

If you have any questions or you would like clarification on any of the requirements specified in this Information Sheet, please contact your LVV Certifier, or a member of the LVVTA technical staff by emailing tech@lvvta.org.nz.



FOR FURTHER INFORMATION PLEASE CONTACT YOUR LVV CERTIFIER, OR LVVTA.