

## Caravan: Ratings – Ball-Loading – Tyre Pressures... Optimization

- ATM Rating** – (Aggregate Trailer Mass Rating)
- GTM Rating** – (Gross Trailer Mass Rating)
- Tare Mass** – *Actual Mass ... that must be measured*
- Ball-Loading** – *Actual Mass ... that must be measured*

The ATM & GTM are *Ratings*... determined by the manufacturer.

You do not “weigh the ATM or the GTM”... on a weigh-bridge, you weigh the “**all-up mass**” (with *all* of the (disconnected) ‘van on the weigh-bridge), and the “**axle loading**” (with just the tyres of the ‘van on the weigh-bridge).

The “*all-up mass*” must *not* exceed the *ATM Rating*.  
The “*axle loading*” must *not* exceed the *GTM Rating*.

**The Tare Mass is the actual measured mass of the vehicle as it leaves the manufacturer.**

- The vehicle is fitted with everything that was stated on the *Purchase Contract*.
- The vehicle is empty. The gas cylinder(s) and the water tank(s) are empty.

Selecting the **ATM Rating** is the first and most important decision made by the manufacturer. It is a market-driven *commercial* decision... in line with the *needs* (size) of caravan required by a customer, and the towing capabilities of the intended tow-vehicle. “Needs” primarily consist of the required number and size of sleeping berths, the number and type of appliances and accessories, the extent of “self-containment” facilities - primarily the capacity of water tanks and gas cylinders - and the mass (and volume) of personal luggage desired to be carried.

Selecting the **GTM Rating** is a critical *engineering* decision... it should be in proportion to the ATM Rating, and relative to where the different masses of all “storage compartments” (water, gas, luggage, etc.) are located, in a *side view*. When a ‘van is loaded in “a typical and reasonable manner” to its maximum legal pay-load, the ATM Rating and the GTM Rating *both* should be reached... without exceeding the prescribed Ball-Loading.

The GTM Rating must *not* exceed the *lowest* of the “Axle-Group” Ratings. The “Axle-Group” comprises the: Wheels; Tyres; Suspension Structure; Springs; Axles and Wheel-Bearings.

Selecting the **Axle-Group** components is an important *engineering* decision... in particular that they are a “matched set”, strong enough to with-stand the highest shock loadings that they are likely to be subjected to, but without being an “over-kill”.

Selecting the **Tyre Size** - Load Rating - is a very important *engineering* decision... tyres must never be *over-loaded*, or ran for extended periods near their maximum load-rating. Depending on the on-road / off-road usage, a reasonable safety-factor must be included, so as to best-prevent a tyre being damaged by any hard impact that may reasonably well be expected. However, ‘van tyres should never be ran at a small fraction of their load capability.

Between empty and fully-loaded conditions, the load on each ‘van tyre - usually LT (light truck) or C (commercial) - will only vary by a couple of hundred *kilograms*... unlike heavy trucks and trailers where the difference may be several *tonnes*. Tyre manufacturers have spent much time testing their tyres, hence it is vital to seek their recommendations for optimum tyre selection.

Selecting the **Spring Rate** - and travel - is an important *engineering* decision... It has to be high enough to withstand the hardest shock-loading likely to be experienced, without “bottoming out” (and having no suspension movement left). However, it must be low enough to comfortably “accommodate” the normal undulations of road surfaces, without vibrating and shaking the ‘van (and cutlery!) to pieces. Ideally, springs should be “variable rate”... initially “soft” to handle “cobblestones”, then progressing to “hard” as they compress more when subjected to larger impacts.

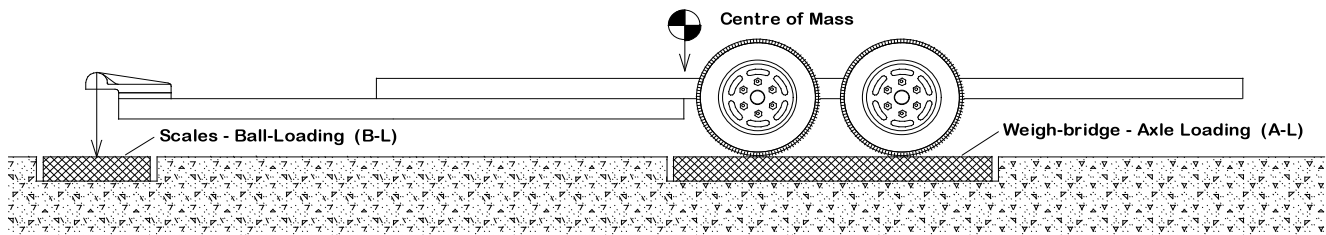
If the springs are *too* soft - and especially if the tyre inflation pressures are *too low* - the 'van will "wallow and sway" over the road... certainly an uncomfortable / scary situation for the tow-vehicle occupants, and other road-users.

Should **dampers** - shock-absorbers - be fitted??? Would they improve the handling, stability and ride qualities of the 'van? Coil springs provide *no* damping at all, hence bouncing will continue until it dies down... or starts up again at the next bump. Leaf springs *do* provide some damping due to the friction created by the leaves rubbing together. However, this only happens during "*bumps*" when the axle is forced upwards, rather than - as would be much preferred - during "rebounds" when the axle is moving down-wards, and the spring leaves are effectively (slightly) separated from each other.

Selecting the **Ball-Loadings** - for both the empty and fully-loaded conditions - is an important *engineering* decision... and is one of the most influential factors regarding a 'van's handling and stability characteristics. The *optimum* Ball-Loadings will be different for different 'van designs - depending on such factors as mass-distribution, length and inertias - hence they need to be properly determined by adequate testing on various road surfaces and curves. Recommended Ball-Loadings may be stated either as specific masses, or as a percentage of the actual mass of the 'van.

It is essential that large "variables" in the load-distribution along the length of the 'van, have the least possible effect on the Ball-Loading. In particular, the water tanks *must* be positioned *each* side (front and rear) of the axle(s), and as *close* as possible to it / them, so that their contents - empty or full - will *not* appreciably increase or decrease the Ball-Loading.

Designing the **Centre-of-Mass** location (in a side view) - for both the empty and fully-loaded conditions - is an important *engineering* decision... the base (empty) 'van must be designed so that the Centre-of-Mass is slightly ahead of the axle-group centre-line, so as to provide the pre-determined Ball-Loading. The location of all storage compartments - and their maximum mass limits - must be designed so that when fully-loaded, the new Centre-of-Mass location (which will probably be slightly *ahead* of the "empty Centre-of-Mass"), will still provide the optimum Ball-Loading.



Selecting the **Tyre Inflation Pressures** - for both the empty and fully-loaded conditions - is the final highly-important *engineering* decision... for designing a "matched set" of items affecting the handling / stability / ride characteristics of a 'van.

Rather than simply relying on long-held "old husbands' tales" of "how to pump 'em up", it is imperative to use the recommended inflation pressures from the "Standards Manual" of the **Tyre & Rim Association**.

This Manual lists - for every available tyre size - the recommended inflation pressure for whatever load the tyre is statically subjected to. The same pressure will definitely *not* be used for both the *empty* and the *fully-loaded* conditions.

A typical tyre may have respective figures (for a 200 kg load increase) of 275 kPa and 400 kPa.

In light of requirements under the consumer-protection legislation, and to best-prevent possible claims of negligence, it would seem to be most prudent for 'van manufacturers to ensure their products are *professionally* designed and engineered, sufficiently tested, manufactured, and inspected, before being offered for sale.

Two crucial items for 'vans and trailers - in relation to "safe" and "fit for purpose" - would no doubt include professionally determining the optimum Ball-Loadings, and *total* "spring rate"... which takes in the suspension springs *and* the tyres... the latter of which depends on the construction of the tyres and the inflation pressure.

It is reasonable for owners to expect that a new 'van or trailer has been properly evaluated in "real world" conditions, such that these crucial items have been realistically determined, rather than just being guessed, or taken-for-granted rough ball-park figures that have been used in the past, on units that may have been *completely* different in design and mass.

A lot of caravans are indeed designed in a *most* professional manner, and provide the best possible handling and safety characteristics... giving peace-of-mind to the tow-vehicle driver and passengers.

Unfortunately there are also many 'vans that have *not* been properly designed and tested... with resultant problems and complaints / litigation by their owners. How many of these have been involved in nasty incidents - or tragic accidents - on the road???

This 'van had an *empty* Ball-Loading of 360 kg!!! There were two large water tanks... *both* ahead of the axles; what would be Ball-Loading if these two tanks were *full*???. The buyer could not even legally tow the 'van - when it was *completely empty* - behind his new pride-and-joy tow vehicle...



## Captions:

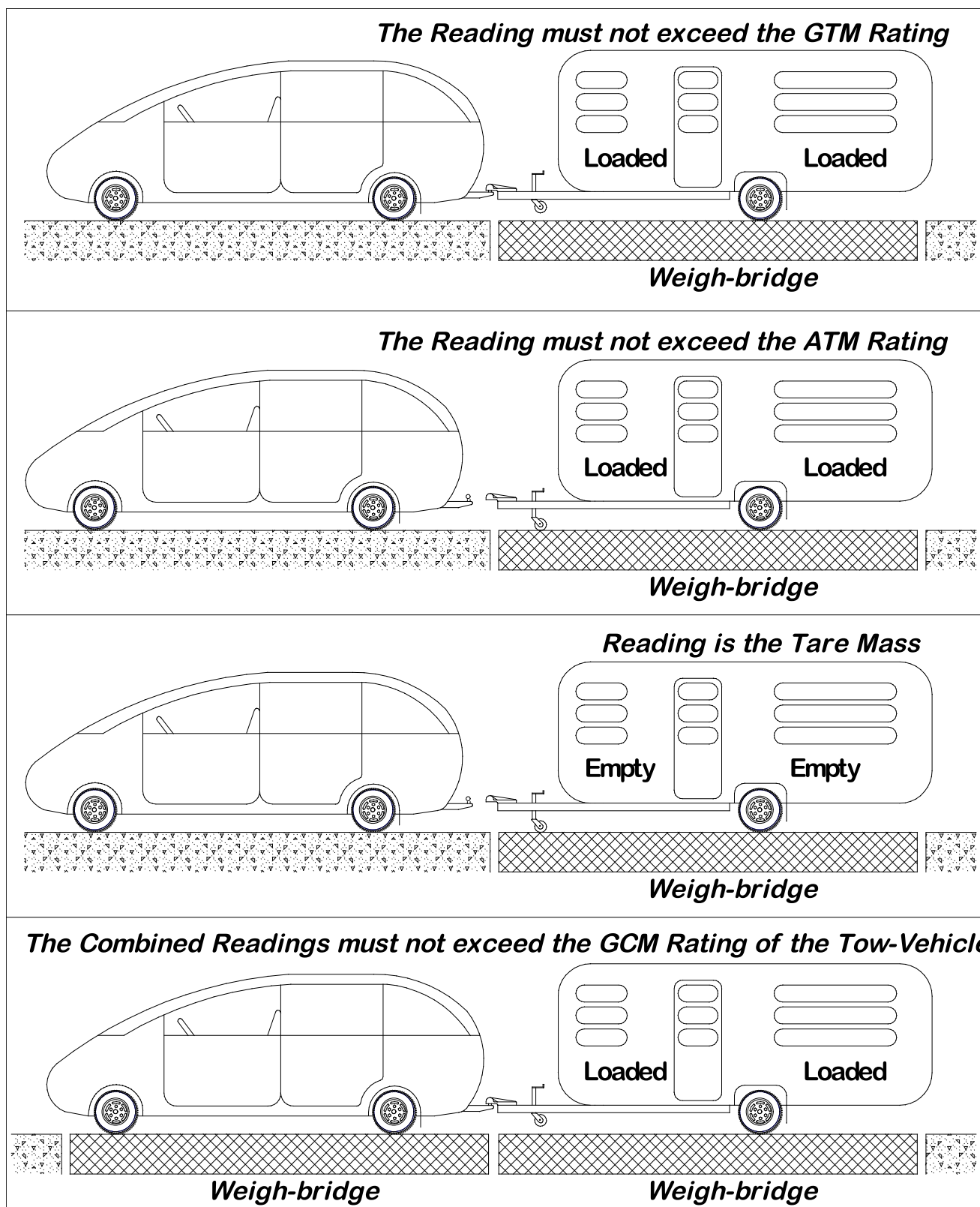
**Manufacturers:** "Ensure that your 'vans are *professionally* designed... so as to provide the best possible stability, handling and ride characteristics"

**Buyers:** "Ask the Dealer *exactly* what design and testing has been conducted on your intended new 'van model, and is all necessary information available for you"

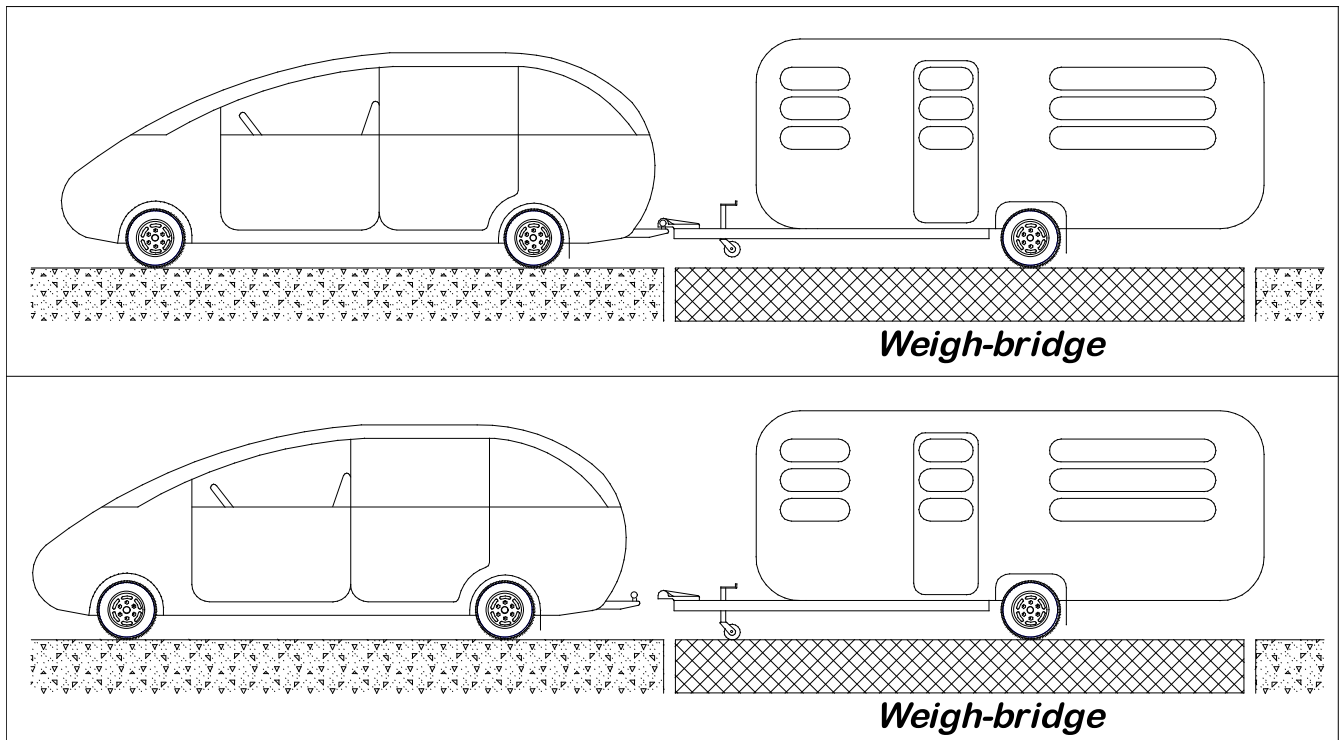


**Disclaimer:** The above information is provided in good faith, and is believed to be correct. However, it is *not* to be deemed to be legal or professional engineering advice.

## Caravan Ratings & Masses



$$\text{Legal Load-Carrying Capacity} = \text{ATM Rating} - \text{Tare Mass}$$



**The *difference* between the two weigh-bridge readings is the Ball-Loading**

**Tow-Vehicle Ratings... that must *not* be exceeded:**

- **GVM: Gross Vehicle Mass (Rating)**
- **GCM: Gross Combination Mass (Rating)**
- **RAC: Rear Axle Capacity (Rating)**
- **Maximum Permitted Towing Capacity: (Rating)**
- **Maximum Permitted Coupling Down-load Capacity: (Rating)**

**Tow-Bar: Maximum Permitted Towing & Down-load Limits: (Ratings)**