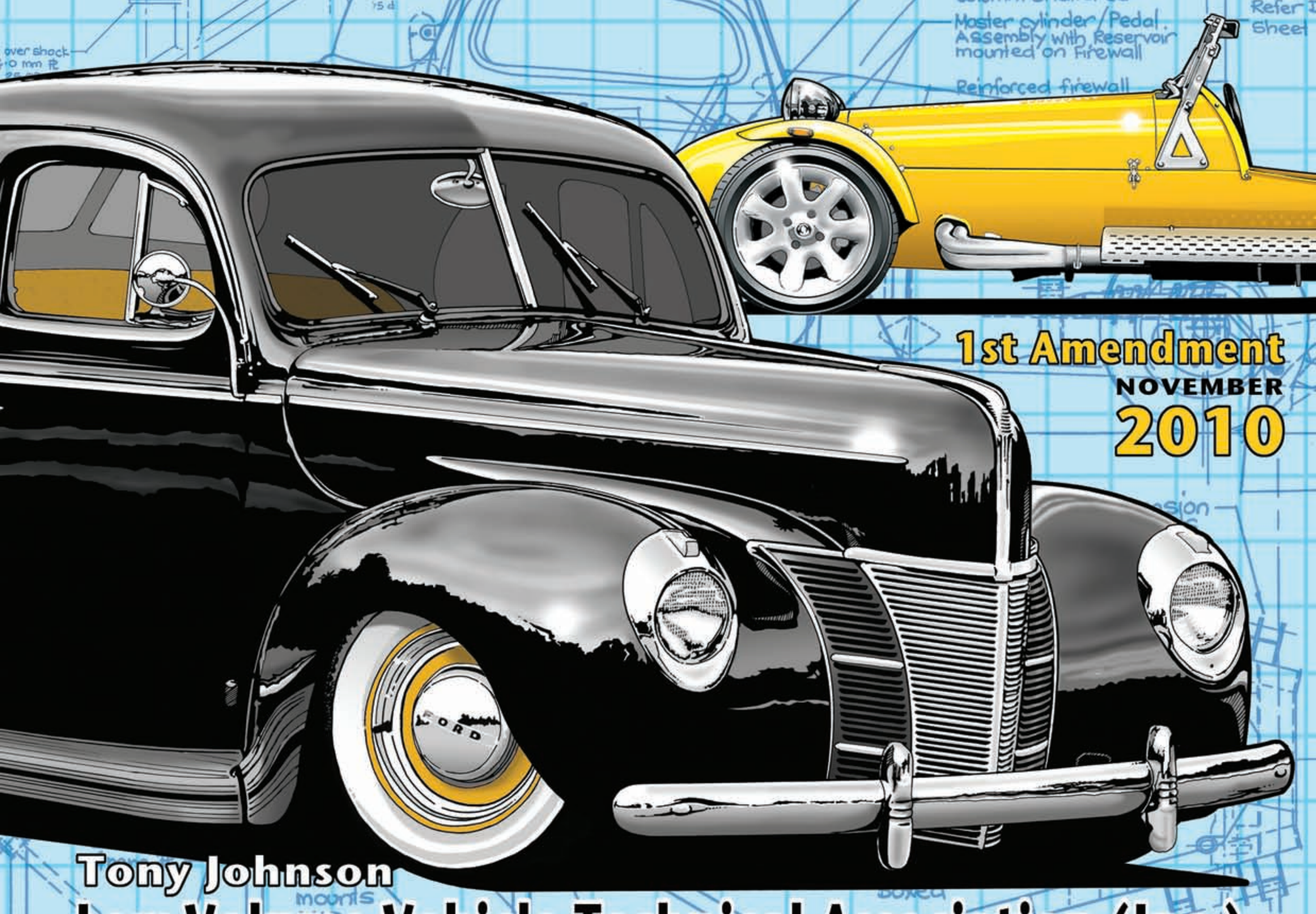
THE NEW ZEALAND

CAR CONSTRUCTION MANUAL

CHAPTER 18

ATTACHMENT SYSTEMS



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CAR
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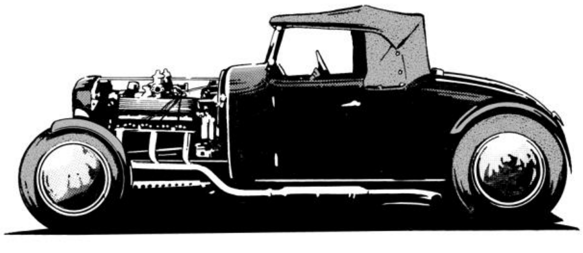

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NZHRA, and its key personnel, have, and continue to since the inception of LVV certification, form the back-bone of the LVV certification system in New Zealand. LVVTA is very appreciative of NZHRA's on-going commitment and integrity.

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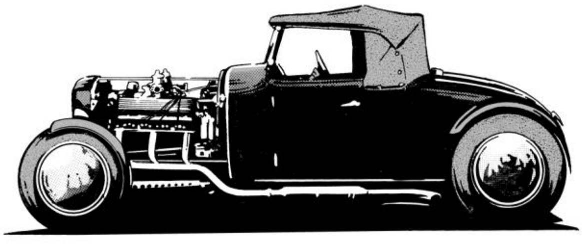

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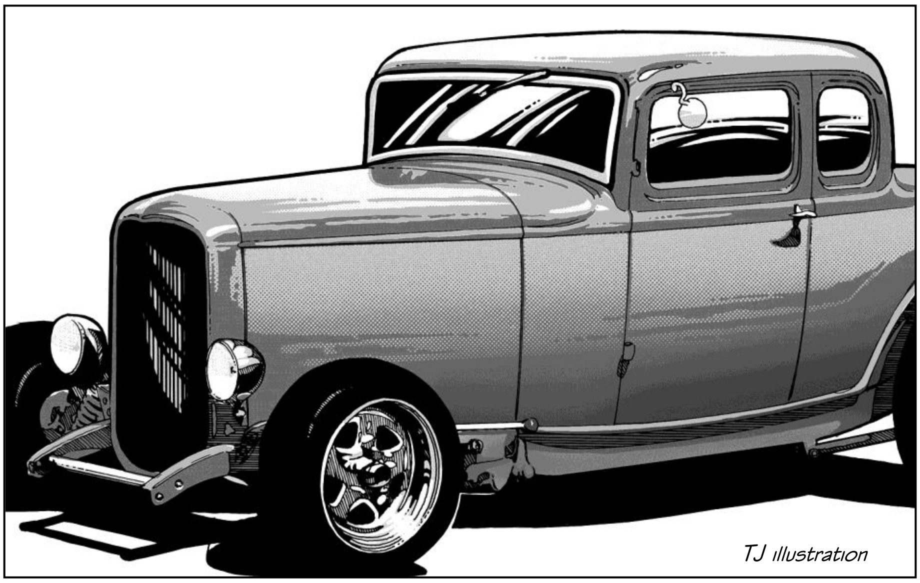
Chapter 18:

ATTACHMENT SYSTEMS



TJ illustration

Chapter 18 Contents:

Key: (for full key details, refer to 'Chapter 2 – About this Manual')

Normal type: Provisions of the NZ Car Construction Manual for all vehicles
Normal type in shaded box: Special provisions of the NZ Car Construction Manual for vehicles built or modified before specified dates
Italic type: *Extracts from any relevant LVVTA Low Volume Vehicle Standards*
Script type: Helpful hints, tips, explanations, clarifications, and interpretations
Shaded text & dotted vertical stroke in margin: Latest amendments since previous version

TJ illustration

CHAPTER 18: ATTACHMENT SYSTEMS

Introduction:

The success of a vehicle's design and construction process depends largely on the many attachment processes used throughout the various components and systems within the vehicle. The correct types of attachment, in particular welding procedures and fastener details, are critical elements of a finished vehicle, and key contributors to its on-going safety and reliability. Usually, getting this part right is easy, as long as a builder or modifier has the right information before he or she goes out to buy the fasteners or arrange the welding. Note that where a production vehicle has its original fasteners in their original locations, the requirements in this chapter do not apply.

Technical requirements:

18.1 Adhesives and bonding agents

18.1.1

An adhesive or bonding agent, if used within a low volume vehicle, must be:

(a) supported by documented evidence to verify that the adhesive or bonding agent is of sufficient strength to be able to withstand the loading requirements to which it will be subjected throughout the life of the vehicle; and

(b) applied in accordance with the specifications and instructions of the adhesive or bonding agent manufacturer.

18.1.1

The onus of proof is on the vehicle owner to provide whatever documented evidence is necessary to satisfy the LVV Certifier that the adhesive or bonding agent is sufficiently strong for its application.

18.1.2

An adhesive or bonding agent, if used within a low volume vehicle, must not be used on any component that performs a critical function, attaches critical components, or attaches components that are under, or transmit high loadings.

18.1.2

'Critical' in this context, is a component, which, upon its failure, could lead to a loss of either braking control or steering control of the vehicle.

18.2 General fastener requirements

18.2.1

A fastener used in a safety-related application within a low volume vehicle must:

(a) be of an appropriate size and grade for the application; and

(b) be secured with a 'nyloc' nut, spring washer, split-pin, or other vibration-proof locking device; and

(c) be in good condition.

18.2.2

A fastener used in a safety-related application within a low volume vehicle must not:

(a) have any head markings incorporated by the fastener manufacture removed; or

(b) in the case of a stainless steel fastener, be electroplated.

18.2.3

The threaded section of a fastener used in a safety-related application within a low volume vehicle must protrude through the outer end of the nut to which it attaches by not less than two full threads.

18.3 Locking device requirements

18.3.1

A 'nyloc' nut must not:

(a) be used to secure a fastener in a low volume vehicle, where there are extremely high temperatures within the immediate vicinity; or

(b) in the case of attachment of safety-related components or systems, be attached to a fastener in a low volume vehicle repeatedly.

18.3.2

A split-pin must not, in the case of attachment of safety-related components or systems, be used to secure a fastener in a low volume vehicle more than once.

8.2.1

'Loctite' or other thread adhesives are not an approved vibration-proof locking device for the purpose of LVV certification, as such a system puts the LVV Certifier in a position where he would be 'approving' something he can't see.

Normal single-grip spring washers should not be used against aluminium surfaces as they will gouge the aluminium – 'nylocs' or multi-grip washers should be used instead.

18.3.1

'Nylocs' should not be used in such applications as brake caliper mounts, or brake rotor to hub mounts.

Like split pins, 'nylocs' are not designed to be used repeatedly; - if removed, they should be replaced by a new 'nyloc'.

18.4 Critical function fasteners (non-stainless steel)

18.4.1

A fastener used in a safety-related application within a low volume vehicle that is used to perform a critical function, attach critical components, or attach components that are under, or transmit, high loadings must, in addition to 18.2 and 18.3:

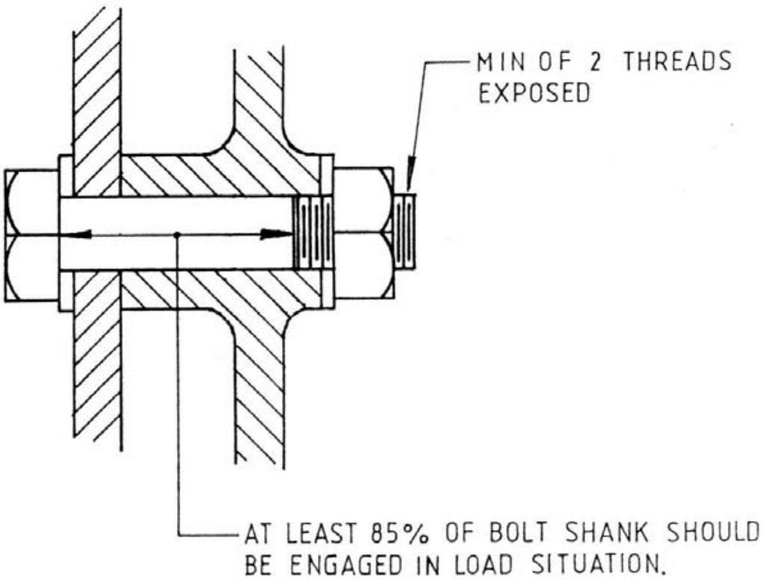
(a) have the correct shank area for the application (see Diagram 18.1); and

(b) have an equivalent tensile strength of between grade-8.8 metric (grade-5 imperial) and grade-10.9 metric (grade-8 imperial); and (see Table 18.1)

(c) if of a higher tensile strength than grade-8.8 metric (grade-5 imperial), not be electroplated unless: (see Table 18.1)

  (i) documented evidence is provided to substantiate that a post-plating heat-treatment process has occurred in order to prevent hydrogen entrapment; or

  (ii) the electroplating process is carried out as part of the manufacturing process by the fastener manufacturer, and documented evidence is provided to substantiate the origin of the fastener.



GW diagram

Diagram 18.1 Correct bolt-shank area

18.4.1

'Critical' in this context, is a component, which, upon its failure, could lead to a loss of either braking control or steering control of the vehicle, such as a suspension arm, steering shaft, brake pedal, or brake pedal pushrod.

Electroplating is any process that involves 'electrolysis', which includes zinc, cadmium, gold, and silver.

Ceramic coatings such as 'HPC' and 'Pro-coat' present no problems in this regard, are durable, and provide an excellent looking finish.

18.4.1(b)

Grades above 10.9 metric (grade-8 imperial) are not designed for cyclic loading and should not be used for critical applications where cyclic loading (such as steering, suspension, and brakes) is involved.

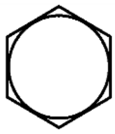
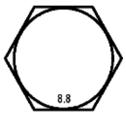
BOLT MARKING	IDENTIFICATION	BOLT MARKING	IDENTIFICATION
	Plain hex-head bolt, mild steel – not high-tensile		Hex-head bolt with six lines: grade-10.9 metric (grade-8 imperial) – 67 tons per sq in
	Okay to electroplate		**No electroplating** without post-plating heat treatment (unless bolt is supplied already plated by bolt manufacturer)
	Hex-head bolt with three lines: grade-8.8 metric (grade-5 Imperial) – 54 tons per sq in		Unmarked button-head internal-hex cap-screw: Very high-tensile – approx 84 tons per sq in
	Okay to electroplate		**No electroplating** without post-plating heat treatment (unless bolt is supplied already plated by bolt manufacturer)
	Hex-head bolt with 8.8 marking: grade-8.8 metric (grade-5 Imperial) – 54 tons per sq in		Marked button-head internal-hex cap-screw: Very high-tensile – approx 84 tons per sq in
	Okay to electroplate		**No electroplating** without post-plating heat treatment (unless bolt is supplied already plated by bolt manufacturer)

Table 18.1 Fastener (non-stainless steel) tensile strength identification guide table

18.5 Critical function fasteners (stainless steel)

18.5.1

A stainless steel fastener used in a safety-related application within a low volume vehicle that is used to perform a critical function, attach critical components, or attach components that are under, or transmit, high loadings must, in addition to 18.2 and 18.3:

(a) have the correct shank area for the application (see Diagram 18.1); and

(b) have an equivalent tensile strength of between grade-8.8 metric (grade-5 imperial) and grade-10.9 metric (grade-8 imperial). (see Table 18.2)

18.5.1

See Table 18.2 for stainless steel fastener tensile-strength identification.

'Critical' in this context, is a component, which, upon its failure, could lead to a loss of either braking control or steering control of the vehicle, such as a suspension arm, steering shaft, brake pedal, or brake pedal pushrod.

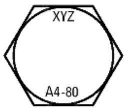
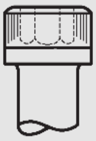
BOLT MARKING	IDENTIFICATION	BOLT MARKING	IDENTIFICATION
	Hex-head bolt with ‘304’ or ‘316’ marking: Equivalent or less than mild steel – 25-35 tons per sq in **<u>Not</u> equivalent to grade-5**		Hex-head bolt with ‘A2-70 marking: Almost equivalent to grade-5 – ‘70’ denotes 700 MPa which equates to 46 tons per sq in **<u>Equivalent</u> to grade-5**
	Plain hex-head bolt with no marking: Equivalent or less than mild steel – 25-35 tons per sq in **<u>Not</u> equivalent to grade-5**		Button-head internal-hex cap-screw with ‘A2-70’ marking: Almost equivalent to grade-5 – ‘70’ denotes 700 MPa which equates to 46 tons per sq in **<u>Equivalent</u> to grade-5**
	Internal hex-head cap-screw with ‘304’ or ‘316’ marking: Equivalent or less than mild steel – 25-35 tons per sq in **<u>Not</u> equivalent to grade-5**		Hex-head bolt with ‘A4-80’ marking: Equivalent to grade-5 – ‘80’ denotes 800 MPa which equates to 52 tons per sq in **<u>Equivalent</u> to grade-5**
	Plain internal hex-head cap-screw with no marking: Equivalent or less than mild steel – 25-35 tons per sq in **<u>Not</u> equivalent to grade-5**		Button-head internal-hex cap-screw with ‘A4-80’ marking: Equivalent to grade-5 – ‘80’ denotes 800 MPa which equates to 52 tons per sq in **<u>Equivalent</u> to grade-5**

Table 18.2 Stainless steel fastener tensile strength identification guide table

18.6 Critical function fastener torque settings

18.6.1

A fastener used in a safety-related application within a low volume vehicle, that is used to perform a critical function, attach critical components, or attach components that are under, or transmit high loadings, must be tightened to the torque setting appropriate to the size, grade, and surface condition of the fastener. (see Table 18.3)

18.6.1

A light coating of oil should be applied prior to tightening (unless component or fastener manufacturer specifies otherwise), to enable the correct torque to be achieved.

SIZE	GRADE	SURFACE	TORQUE
6 mm (or 1/4 imperial)	8.8 metric (grade-5 imperial)	un-plated	10.5 Nm (7.7 ft lbs)
		plated	9.9 Nm (7.3 ft lbs)
	10.9 metric (grade-8 imperial)	un-plated	15 Nm (11 ft lbs)
		plated	14 Nm (10.3 ft lbs)
8 mm (or 5/16 imperial)	8.8 metric (grade-5 imperial)	un-plated	26 Nm (19 ft lbs)
		plated	24 Nm (17.7 ft lbs)
	10.9 metric (grade-8 imperial)	un-plated	36 Nm (26 ft lbs)
		plated	34 Nm (25 ft lbs)
10 mm (3/8 or 7/16 imperial)	8.8 metric (grade-5 imperial)	un-plated	51 Nm (37 ft lbs)
		plated	48 Nm (35 ft lbs)
	10.9 metric (grade-8 imperial)	un-plated	72 Nm (53 ft lbs)
		plated	67 Nm (49 ft lbs)
12 mm (or 1/2 imperial)	8.8 metric (grade-5 imperial)	un-plated	89 Nm (65 ft lbs)
		plated	83 Nm (61 ft lbs)
	10.9 metric (grade-8 imperial)	un-plated	125 Nm (92 ft lbs)
		plated	117 Nm (86.2 ft lbs)
14 mm (or 9/16 imperial)	8.8 metric (grade-5 imperial)	un-plated	141 Nm (103 ft lbs)
		plated	132 Nm (97 ft lbs)
	10.9 metric (grade-8 imperial)	un-plated	198 Nm (146 ft lbs)
		plated	185 Nm (136 ft lbs)
16 mm (or 5/8 imperial)	8.8 metric (grade-5 imperial)	un-plated	215 Nm (158 ft lbs)
		plated	200 Nm (147 ft lbs)
	10.9 metric (grade-8 imperial)	un-plated	305 Nm (224 ft lbs)
		plated	285 Nm (210 ft lbs)

Table 18.3 Fastener torque-setting guide table

18.7 General welding requirements

18.7.1

Welding used in any structural or safety-related application may only be carried out within a low volume vehicle provided that:

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

18.7

General welding requirements are basic requirements that apply to all structural or safety-related welding throughout a low volume vehicle.

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

(ii) has demonstrated to the Low Volume Vehicle Certifier, by application of an LVVTA-approved welding test procedure, a satisfactory level of competence in the method of welding undertaken;

and

(b) for the purpose of confirming compliance with 18.7.1(a), either:

(i) a report is supplied by the person who carries out the welding to verify that the requirements of 18.7.1(a)(i) have been met; or

(ii) the Low Volume Vehicle Certifier verifies that the requirements of 18.7.1(a)(ii) have been met.

Where a non-critical component within a low volume vehicle was modified or constructed before 1992, or where there is no way of confirming who carried out the welding, 18.7.1 does not apply, provided that after thorough visual inspection, no fatigue cracking or fracturing is evident.

18.7.2

Welding of any structural or safety-related areas incorporated within any chassis modification or construction or other component within a low volume vehicle must not:

(a) be ground other than for:

(i) light 'dressing' at the start and stop points of weld beads; or

(ii) achieving a radius at joins or external corners, provided that a weld depth of not less than the thickness of the parent material is maintained;

or

(b) be covered by any plastic filler or any other material that may have the effect of changing the visual appearance of the weld shape prior to being inspected.

Where a chassis or other component within a low volume vehicle was modified or constructed before 1992, 18.7.2 does not apply, provided that after thorough visual inspection, no fatigue cracking or fracturing is evident. Specific investigation for fatigue cracking or excessive grinding may be carried out, with removal of filler and paint if necessary to assist the inspection process.

18.7.1(a)(ii)

Builders can carry out their own chassis and other non-critical component welding even if they are not formally qualified, providing that the builder meets the requirements of a practical test applied by an LVV Certifier.

This test has been developed specifically to enable competent people to carry out their own structural welding if they so desire.

18.7.2

While strongly discouraged, 'smoothing' (via the use of paint prep or filler) of welds for show purposes can take place. The LVV Certifier in this case however, needs to carry out an inspection before the smoothing takes place, and furthermore, be satisfied that no grinding will occur after the inspection and prior to the smoothing process.

18.7.2(a)(ii)

This is to allow a radius to be provided where chassis C-section rails have been boxed.

18.9

See the 'Useful Information' section at the end of this chapter for information on welding castings and forgings.

18.8 Chassis welding requirements

18.8.1

In addition to 18.7, any welding carried out within a chassis modification or construction on a low volume vehicle, must be:

(a) in the case of a production or custom ladder chassis, by either:

(i) arc electrode; or

(ii) metal inert gas (MIG); or

(iii) tungsten inert gas (TIG);

or

(b) in the case of a production or custom space-frame chassis which incorporates chassis tubes which have a wall thickness of 2 mm (3/32") or less, by either:

(i) metal inert gas (MIG); or

(ii) tungsten inert gas (TIG); or

(iii) gas brazing; or

(iv) oxy-acetylene.

18.9 Critical function welding requirements

18.9.1

In addition to 18.7, any safety-related component within a low volume vehicle that is used to perform a critical function, or that is under, or transmits, high loadings, must not:

(a) be welded by any process other than tungsten inert gas (TIG); or

(b) have any weld:

(i) ground, linished, or smoothed in any way; or

(ii) covered by plastic filler or any other material that may have the effect of changing the visual appearance of the weld shape.

18.9.2

In addition to 18.7 and 18.9.1, the welding of any component within a low volume vehicle that is used to perform a critical function, must:

18.9.1

'Critical' in this context, is a component, which, upon its failure, could lead to a loss of either braking control or steering control of the vehicle, such as a suspension arm, steering intermediate shaft, brake pedal, or brake pedal pushrod.

18.9.1(b)

'Linish' means to finish or prepare by means of a high-speed belt-sanding process. Note that this clause does not preclude the minor 'dressing' by linishing if required as part of the NDT (non-destructive testing) process.

18.9.2(a)

The best NDT methods are x-ray, ultra-sonic, and magnetic-particle, because they are the types that not only look for surface cracking or fracturing, but can also identify poor weld fusion.

(a) be non-destructively tested, and comply with, as a minimum, Tables 6.1 or 6.2 of the AS/NZS 1554.1:2004 Standard, or an equivalent standard, as applicable to the method of weld examination undertaken, by a person holding not less than a current NDT Level 2 qualification in CBIP, ASNT, AINDT, or other equivalent certification; and

(b) be accompanied by a report supplied by the person who undertakes the non-destructive testing to verify that the requirements of 18.9.2(a) have been met, and that the component is considered to be free of defects.

18.9.2(a)

Magnetic-particle is considered the best all-round NDT method. Note however that because magnetic-particle will not work on aluminium or stainless steel, dye-penetrant should be used on aluminium and stainless steel components.

18.9.2(b)

Welds for critical items must be defect-free.

Exclusions:

No exclusions apply to this chapter.

Useful Information:

'G-force' in relation to fastener strength

A 'G' is something that most of us petrol-heads write off as being too complicated to properly understand, and not really all that important anyway. However, it is actually worth understanding. To be sure, it's a complicated thing from a correct scientific point of view, but what it's really all about is how things become heavier when certain forces are applied. Here's a hitch-hikers' guide to it:

If you sit in the passenger seat of a car while it's parked in the drive and cradle a 5 kg (11 lb) fire extinguisher in your arms, its weight is 5 kg, downwards. If your buddy hops in the driver's seat and drives your car (which happens to be a road-going circuit car with a big flash braking system) while you're holding the extinguisher, and does a full-on panic stop that generates 1 'g' of deceleration (Mum's grocery-getter might produce .6 to .7 of a 'g'), that extinguisher will still weigh 5kg downwards, but will now <u>also</u> weigh 5kg in the <u>forward</u> direction – you'd have to really hang on to it. If you were involved in a light crash (an easy get-out-and-walk-away job) which generated, say, 5 'g' deceleration, the extinguisher still weighs 5 kg (11 lbs) downwards, but now <u>also</u> weighs 25 kg (55 lbs) (5 kg weight x 5 'g') in the <u>forward</u> direction – you'd never be able to hold onto it.

20 'g' is generally considered to be about the limits of survivability for a sustained impact (you'll hear about much greater 'g' loads during an IndyCar crash, but that's only a peak load for a millisecond, and it depends on where the sensors are located. If the crash was a biggie, say 20 'g' (average for the duration of the crash as happens in a head-on), then that 5 kg (11 lb) extinguisher (in addition to still weighing 5 kg downwards), now becomes a 100 kg (220 lb) (5 kg x 20) forward-direction missile.

This is why seatbelt anchorages are such a big deal; if you weigh 100 kg (220 lbs), then in that bad crash, the seatbelt anchorages have to effectively hold over 2000 kg (4400 lb). Think of your gas tank – you figure the fastening system has got to be strong enough to support the weight of the small tank and the fuel that's in it, maybe 50 kg (110 lb), but in reality, you've got to think of your fastening system, not as holding something that weighs 50 kg, but something that could (in the event of a collision) weigh a ton.

F1 and IndyCars can generate more than 4 'g' in cornering (that's 4 times the braking force you'll experience in a NZ V8 Touring Car – in the sideways direction!) Top Fuel dragsters are generating more than 8 'g' of acceleration off the start-line, plus close to the same amount of deceleration under parachute deployment - which is why some of the old-timers are retiring from drag racing because of eye problems – the massive 'g' loads that their eyes have been subjected to over and over during years of popping the 'chute at Top Fuel speeds are literally trying to pull their eyeballs away from their stringy bits.

This is also a good reason to bring home that 396 and Turbo 400 for the next project on a trailer, and not in the back of your station wagon or van. But still do a good job of tying it down!

That's a very crude and unscientific explanation of the 'g' subject, and those with an engineering degree will pick at the terminology - but at least this way, us practical folk can all understand it.

Electroplating fasteners

During the acid cleaning and plating procedures that are carried out during the electroplating process, various chemical reactions take place within the item, which sets free hydrogen atoms, which dissolve into the steel. These atoms concentrate themselves into high stress areas like the head-to-shank corners, and thread corners at the shank end. This concentration of hydrogen atoms weakens the area that they settle in, and this weakening is what is known as 'hydrogen embrittlement'.

Tiny cracks can begin at these points, particularly after continued movement and loading, eventually leading to the failure of the component, which is known as a 'hydrogen embrittlement fracture'. There is a lot of evidence of this happening within the car hobby movement over the years as people have had high-tensile fasteners and other components electroplated. Actual examples seen include bolt heads popping off, shearing of bolt shanks under a load far less than that which the bolts are made to withstand, and even tubular suspension radius rods.

Hydrogen absorption and entrapment, and subsequent embrittlement, becomes more likely in higher tensile strength materials. The higher the strength of the steel, the higher the likelihood of electroplating causing a failure. Springs (such as trunk-lid springs) are a classic example – chrome them and they probably won't last a week!

Also, bear in mind that a fastener that does an important job should never be electroplated more than once, as the hydrogen embrittlement that is likely to occur during the process is cumulative.

The tensile strength cut-off point (where there is sufficient likelihood of absorption of hydrogen and subsequent component failure to justify the caution of plating items beyond that point) is 60 tons per square inch. This means that any fastener with a tensile strength of greater than grade-8.8 metric (grade-5 imperial) falls into the high-risk category, and must not be electroplated without evidence of the appropriate post-plating heat-treatment process to draw out the hydrogen from the component.

High-tensile fasteners which already feature silver or gold coloured zinc or cadmium plating or passivating off the shelf are generally considered acceptable if purchased from a reputable supplier. Be aware that there is some rubbishy stuff about – always purchase fasteners from a reputable engineering supplier or specialised fastener supplier.

Because of the poor quality passivated fasteners that are on the market, it's not really worth the risk of using them in a high-stress or critical application, unless there's a very good reason for wanting to do so.

Tensile strengths of imperial and metric fasteners

Below is a table (Table 18.4) that shows how an imperial fastener compares with a metric fastener in terms of tensile strength. One other thing this table highlights, is what a huge difference there is in strength between a low grade fastener like plain mild steel compared to, say, a grade-8 imperial. Most hobby car people know that a grade-8 imperial bolt is stronger than a mild steel bolt, but many wouldn't realise that the grade-8 is in fact 3 times stronger. The fasteners shown in shading are the common stainless steel types.

Imperial	Lbf/in² (psi)	Mpa (N/mm²)	Metric
		1200	Grade-12.9 (AS 1110) High Tensile
		1100	
		1034	Grade-10.9 (AS 1110) High Tensile
SAE Grade-8 (AS 2465) High Tensile	**150,000**	**1000**	
		900	
SAE Grade-5 (AS 2465) High Tensile	**120,000**	**827**	Grade-8.8 (AS 1110) High Tensile
Stainless steel; 316-80, A4-80, 2343	**116,000**	**800**	Stainless steel; A4-80, 2343
Stainless steel; 304-70, 316-70	**101,000**	**700**	Stainless steel; A2-70 (304), A4-70 (316)
		600	
Stainless steel; no markings, or 316, 304 only	**72,000**	**500**	Stainless steel; no markings
BSW Mild Steel (AS 2451)	**62,000**	**427**	
		400	Grade-4.6 (AS 1111), Mild Steel (AS 1390)

Table 18.4 Fastener tensile strength comparison guide table

Rivnuts

'Rivnuts' are an excellent new device, ideal for providing what is effectively a captured nut anywhere you want one. Their use however, should be restricted to non-critical components, as they are not designed to withstand high torque loadings. Use them for mounting the coil to the firewall, but not for anything big, or critical to the safety of the vehicle.

Stainless steel fasteners

Stainless steel fasteners look great, continue to look great for a long time, and are now easier than ever to source, so they're certainly the hot ticket for our hobby cars. However, care must be taken to get the right ones. There is a common perception that 'stainless steel bolts are strong'. This is far from the truth, and an easy trap for even older players to fall into. The majority of stainless steel fasteners in fact have less tensile strength than a grade-8.8 metric (grade-5 imperial) bolt, and many have even less tensile strength than a normal mild steel bolt.

What these bolts do have is excellent anti-corrosive qualities, so stainless steel bolts are ideal for the food, beverage, and marine industries, and those are in fact the applications that most stainless steel bolts are manufactured for – applications where strength is not required.

So the moral of this story is that most commonly available stainless steel bolts have tensile strengths well below a level acceptable for critical (high stress or load) automotive applications, and therefore can't be used in the important places in our hobby vehicles. Use Table 18.2 to ensure that the stainless steel fasteners you buy for the important jobs are in fact as strong as they need to be.

Another trick with stainless fasteners is that, generally speaking, most of them that do have the required load capabilities, are only available in metric threads. There are, of course, specialist companies that do provide imperial high load rating stainless steel bolts, but you might need to look beyond your local engineering supply store.

Used fasteners

In critical safety-related situations, such as attachment of steering or braking components, previously used bolts should be avoided due to the risk that they could have been over-tightened beyond their material strength limits, sometime in their past lives. This is especially the case with smaller fasteners, where over-tightening is much easier to do than most people realise.

Be careful – if you're using previously used bolts, you could in fact be installing into your pride and joy what may well be a hi-tensile fastener, but is in fact actually weaker than a plain mild steel one.

Welding of castings and forgings

A basic, but very important engineering principle threaded throughout the whole LVV certification process in New Zealand is that a forging or casting in a critical situation like suspension, steering, or brakes, must not be heated and bent, or welded, except in such highly controlled circumstances, that it is beyond the realm of the hobby car industry.

A forging or casting that is heated during a welding process must be re-heat treated afterwards, and this cannot be done correctly unless the exact molecular structure of the material of the forging or casting has been properly established beforehand by a metallurgist – which in turn enables the appropriate heat-treatment method to be established. This process is costly, and not practicable in one-off situations.

There is a very real risk of changes occurring within the molecular structure of a steel forging or casting when a welding process is applied, particularly if too much heat is applied during the heating or welding process, and the problems that this can create are often irreversible.

If anyone has a legitimate need to do this, it may be considered, but only after receiving written approval from the Technical Advisory Committee on a case-by-case basis.

The old practice of heating and bending, or welding, forgings or castings is for the history books; better components and machining processes are available now, to the extent that these practices can be left behind in the 'good old days' forever!

Torque settings

When tightening fasteners in a critical situation, like attaching braking or steering or suspension components, the correct torque setting should be applied to prevent either:

- insufficient clamping force against the fastener and nut, resulting in the fastener becoming loose over time; or
- a more common mistake; weakening of the fastener by over-tightening, resulting in a failure of the fastener, either immediately or at some later date.

It's amazing how many people, even experts, are guilty of over-tightening bolts. It's not until you start applying the correct torque settings to fasteners that you realise how tight they shouldn't be.

Using Table 18.3, which provides the approximate correct torque setting for common sizes and grades of bolts, is a good practice to get into. Note that this table is a guide only, as there is some variance between the correct torque loading for a fine thread and a coarse thread. The amount of lubrication applied affects the torque loading also.