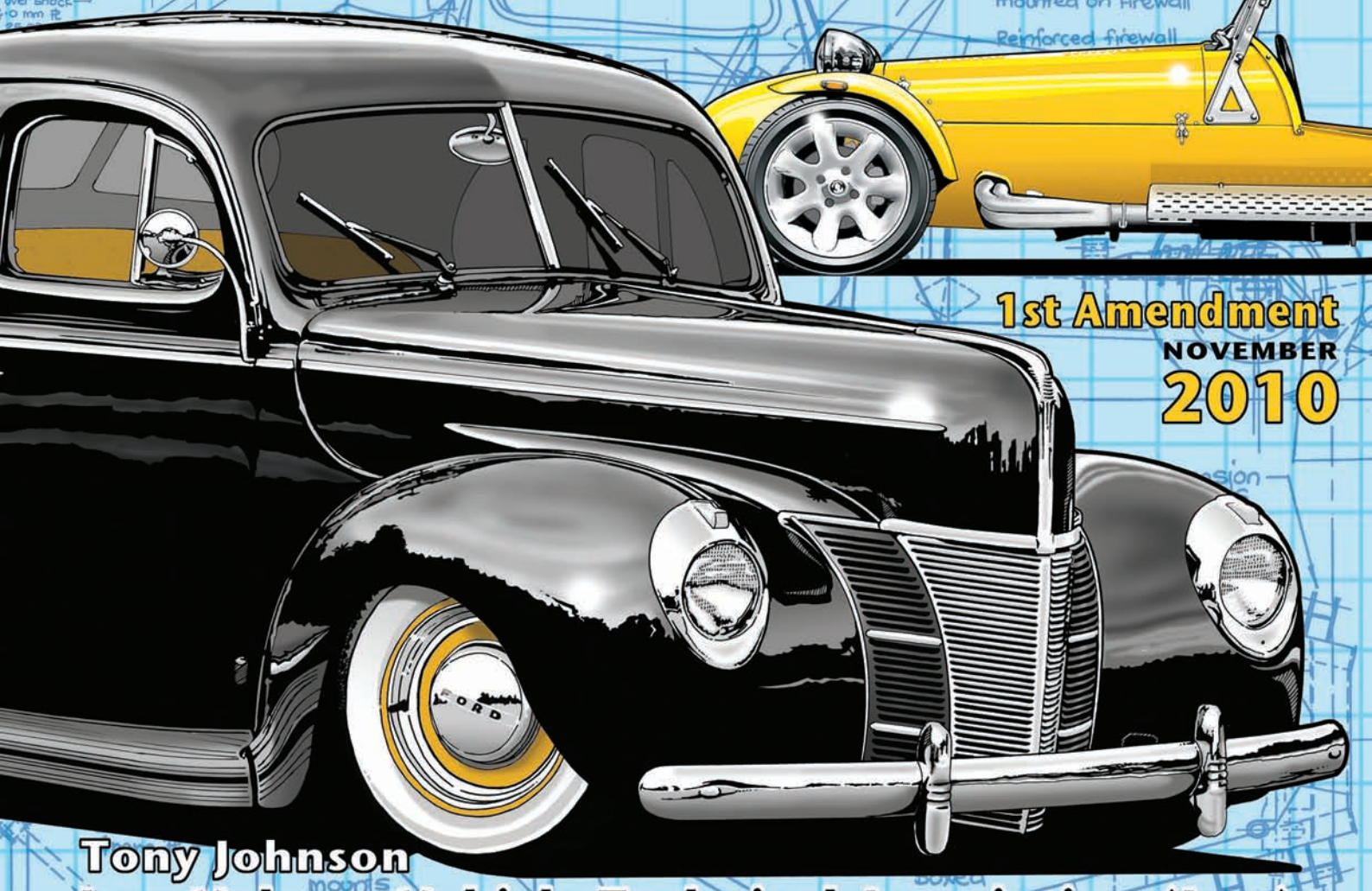
THE NEW ZEALAND

CAR CONSTRUCTION MANUAL

CHAPTER 15

GLAZING & VISION



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Tony Johnson

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CAR
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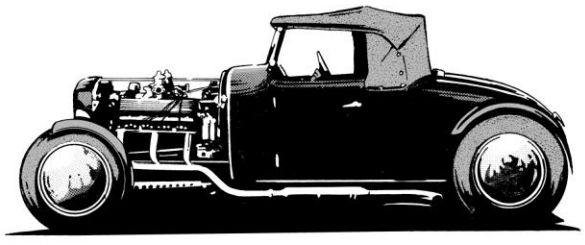

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The New Zealand Car Construction Manual is published and owned by the Low Volume Vehicle Technical Association Incorporated (LVVTA). LVVTA is an incorporated society and was established in 1992, and represents approximately 50,000 motor vehicle enthusiasts throughout New Zealand.

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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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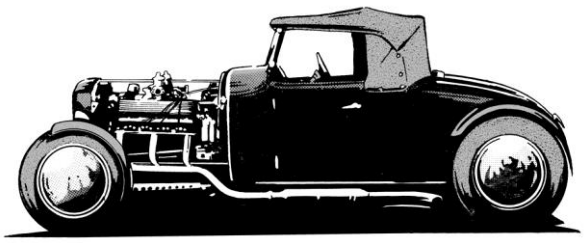

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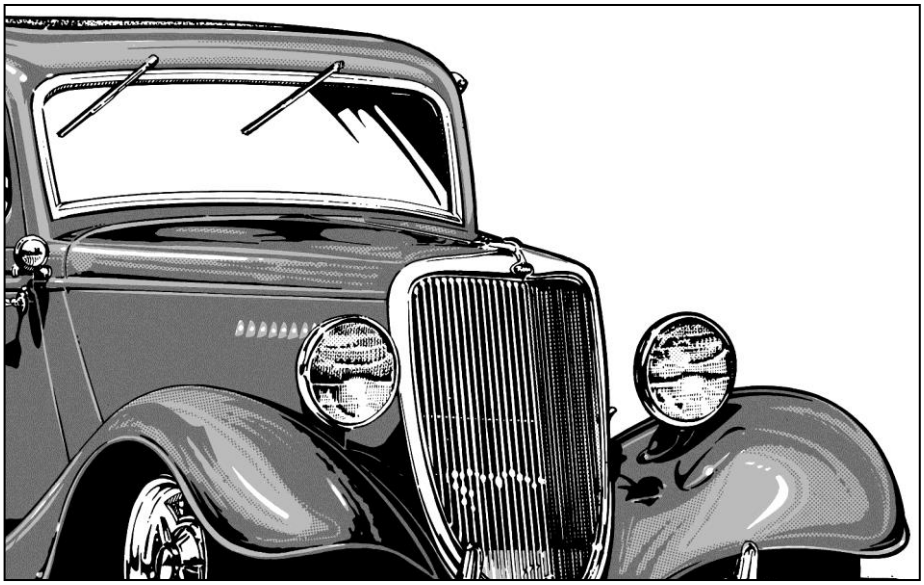
Chapter 15:

GLAZING & VISION



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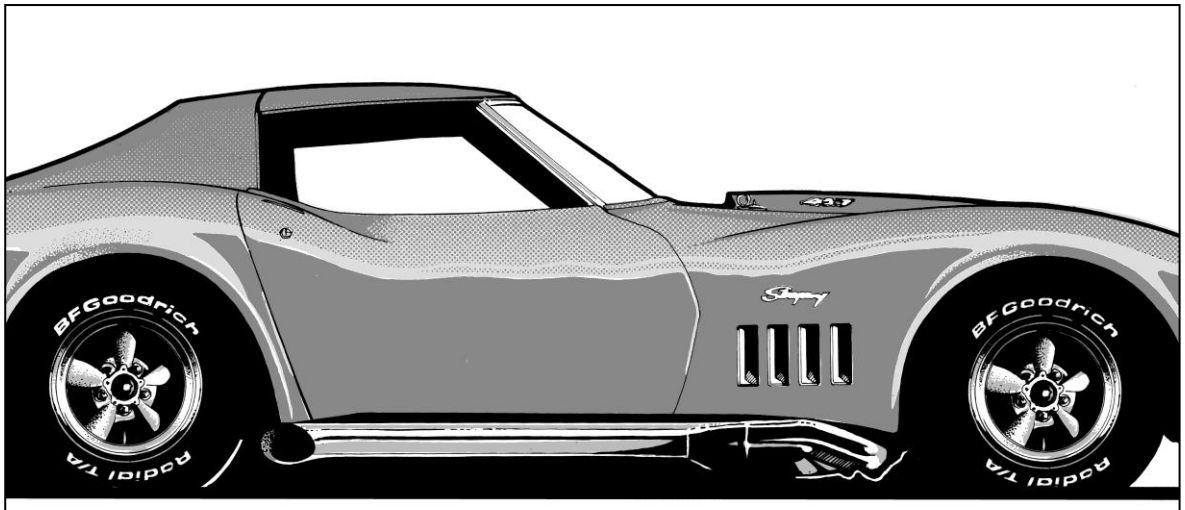
Chapter 15 Contents:

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



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CHAPTER 15: GLAZING & VISION

Introduction:

Having good vision whilst driving a low volume vehicle is achieved by the right attention to a combination of systems; primarily, the kind of glazing used, and the positioning of rear view mirrors. Additionally, the driver's vision can be further influenced by the presence of engine hood protrusions, and during wet weather conditions, the quality of the windscreen washing and wiping system. With the right attention paid to these areas, your chances of saving your pride and joy from errant gates, posts, and other objects capable of damaging that $5000-plus paint-job are maximised. The correct glazing will also minimise the likelihood of serious injury if someone was to come into contact with it during an impact.

Note that where original or authentic reproduction parts are fitted to a production vehicle, the requirements in this chapter do not apply.

Glazing requirements

15.1 General glazing requirements

15.1.1

Glazing fitted to a low volume vehicle must:

(a) be structurally strong and in good condition; and

(b) securely attached to the vehicle; and

(c) have no damage, cracks or chips in any glazing beyond that specified in Section 5-1 of the New Zealand Transport Agency Vehicle Inspection Requirements Manual (VIRM); and

15.1.1(c)

Any LVV Certifier or WoF issuer can provide the details specified for glazing damage in the NZTA VIRM.

(d) have no bubbling in an overlay that could impair the driver's vision in any direction; and

(e) not have, either as the type of glass or as an overlay, any mirroring effect.

15.1.2

A laminated windscreen fitted to a low volume vehicle must not show any signs of discoloration.

15.1.3

15.1.3

Glazing fitted to a low volume vehicle must not have any modification made to, or incorporated within the glazing, including overlays, decals, stone-guards, demisters, antennas, or heaters, other than that specified in Section 5-1 of the New Zealand Transport Agency Vehicle Inspection Requirements Manual (VIRM).

Any LVV Certifier or WoF issuer can provide the details specified for glazing modifications in the NZTA VIRM.

15.1.4

15.1.4

The overall visible light transmittance of any glazing fitted to a low volume vehicle must not be less than:

See the 'Useful Information' section for more visible light transmittance details.

(a) in the case of a windscreen, 70%; and

(b) in the case of side and rear glazing, 35%.

15.2 Windscreens

15.2.1

15.2.1

A windscreen, other than one specified in 15.7, fitted to a low volume vehicle manufactured before 1 July 1986 must be made from either:

If a windscreen is made after 1991, the glazing used must be only that specified in 15.2.2, irrespective of the age of the vehicle.

(a) toughened automotive safety glass that meets either:

(i) an approved trade name listed in Table 15.1; or

(ii) an approved standard specified in 15.5;

or

(b) laminated automotive safety glass that meets either:

(i) an approved trade name listed in Table 15.1; or

(ii) an approved standard specified in 15.5.

15.2.2

A windscreen, other than one specified in 15.7, fitted to a low volume vehicle manufactured on or after 1 July 1986 must be made from laminated automotive safety glass that meets an approved standard specified in 15.5.

15.3 Side and rear windows

15.3.1

Side and rear glazing, other than that specified in 15.7, fitted to a low volume vehicle manufactured before 1 January 1991 must be made from either:

(a) toughened automotive safety glass that meets either:

(i) an approved trade name listed in Table 15.1; or

(ii) an approved standard specified in 15.5;

or

(b) laminated automotive safety glass that meets either:

(i) an approved trade name listed in Table 15.1; or

(ii) an approved standard specified in 15.5.

15.3.2

Side glazing, other than that specified in 15.7, fitted to a low volume vehicle manufactured after 1 January 1991 must be made from either:

(a) toughened automotive safety glass that meets an approved standard specified in 15.5; or

(b) laminated automotive safety glass that meets an approved standard specified in 15.5.

15.3.1

If a windscreen is made after 1991, the glazing used must be only that specified in 15.3.1(b), irrespective of the age of the vehicle.

15.4 Approved trade names for glazing

15.4.1

Approved trade names for a windscreen, side window, or rear window fitted to a low volume vehicle are as specified in Table 15.1.

▪ Armourfloat	▪ HMC Glass Safety Hankuk TV5	▪ Sunmat
▪ Armourplate	▪ Indestructo	▪ Suntex Safety Glass
▪ Blindex	▪ Nippon Safety	▪ Temperlite
▪ Duolite Safety	▪ NM Laminated Safety Glass FHP	▪ Temperlite Santa Marina
▪ Duplate Safety	▪ Peerless	▪ Thorex Connex
▪ Flolite	▪ Plexite	▪ Triplex
▪ Ford Indestructo	▪ Safetyflex	▪ Triplex Plate
▪ Ford Safety Glass	▪ Safety MGB (Meloplate)	▪ Tuflite
▪ Ford Silver Arrow	▪ Safety MGB (Melite Safety Plate)	▪ Tyneside
▪ Glacetex	▪ Sekurit	▪ Veracetex
▪ Hankuk Glass Safety Heat Line	▪ Sigla	
▪ HMC Glass Safety Hankuk TF5	▪ Spectrofloat Splintex	

Table 15.1 Approved trade names for glazing

15.5 Approved standards for glazing

15.5.1

Approved standards with which a windscreen, side window, or rear window, other than one specified in 15.7, fitted to a low volume vehicle must meet are:

(a) UN/ECE Regulation No. 43, Uniform provisions concerning the approval of safety glazing and glazing materials; and

(b) Council Directive of 31 March 1992 on safety glazing and glazing materials on motor vehicles and their trailers; and

(c) British Standard 857:1967, Specification for safety glass for land transport; and

(d) British Standard 5282:1975, Specification for road vehicle safety glass; and

(e) British Standard AU 178a: 1992, Specification for road vehicle safety glass; and

(f) Federal Motor Vehicle Safety Standard No. 205, Glazing Materials; and

15.5.1

When looking to determine if a piece of glazing meets an approved standard, look for the markings shown in Diagrams 15.2 or 15.3. These markings verify that the glazing complies with one or more of the approved standards specified in 15.5.1.

Table 15.2 enables the codes incorporated within approved standards markings to be identified.

(g) American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways – Safety Code; and

(h) Technical Standard for Window glass, Jisha Circular No. 899 of October 1 1983; and

(i) Japanese Industrial Standard R 3211-1992, Safety glass for road vehicles; and

(j) New Zealand Standard 5443:1987, Safety glass for land vehicles; and

(k) Australian Standard 2080-1987, Safety glass for land vehicles; and

(l) Australian/New Zealand Standard 2080:1995, Safety glass for land vehicles; and

(m) Australian Design Rule 8/00, Safety Glazing Material; and

(n) South African Standard SABS 1191/1193-1978, Standard specifications for safety glass for vehicles; and

(o) Allgemeine Bauartgenehmigung (ABG), issued by the German Kraftfahrt-Bundesamt for glazing directly behind, or to the left or right of the rear of, the driver's seatback in its rearmost and upright position that is marked in accordance with the ABG.

15.5.1

The approved standards specified in 15.5.1 for glazing are copied from the Land Transport Rule – Glazing, Windscreen Wipe and Wash, and Mirrors 1999, reproduced here in the interest of convenience.

Diagrams 15.1, 15.2, and 15.3, and Tables 15.1 and 15.2 are copied from the Land Transport New Zealand Vehicle Inspection Requirements Manual (In-service Certification), and reproduced here in the interest of convenience.

15.6 Identification of approved standards for glazing

15.6.1

A windscreen, side window, or rear window fitted to a low volume vehicle, that is required to meet an approved trade name specified in 15.4.1, or approved standard specified in 15.5.1, must be marked to show compliance with an approved standard, by either:

(a) in the case of glazing fitted before 1 January 1997, either:

(i) an adhesive sticker affixed to the glazing that features information as shown in part (a) of Diagram 15.1; or

(ii) permanently etched markings to the glazing that features information as shown in part (b) of Diagram 15.1;

or

15.6.1(a)

Diagram 15.1 shows the format and the type of information that should be permanently etched into a piece of glazing.

(b) in the case of glazing fitted after 1 January 1997, permanently etched markings that contains wording, characters, or symbols, as shown in part (b) of Diagram 15.1, that specify:

(i) the approved standard with which the glazing complies; and

(ii) the type of glazing used; and

(iii) the thickness of the glazing in millimetres, or in the case of laminated glass only, the thickness of the interlayer in millimetres; and

(iv) the identity of the vendor or installer of the glazing.

15.6.1(b)

Diagram 15.1 shows the format and the type of information that should be permanently etched into a piece of glazing.

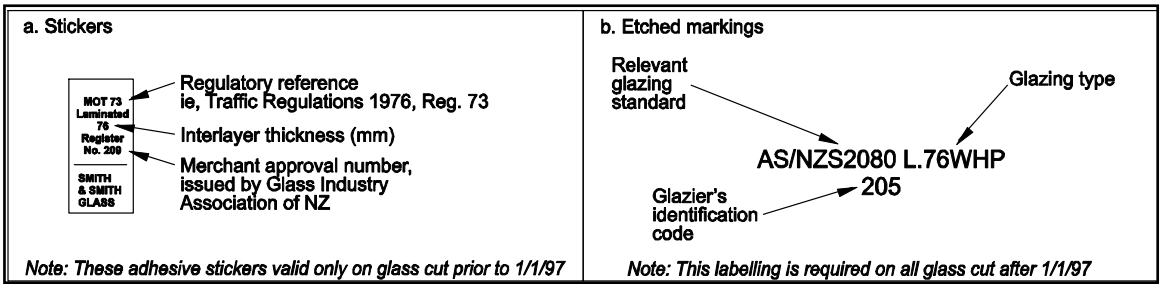

Diagram 15.1 Identification of approved glazing

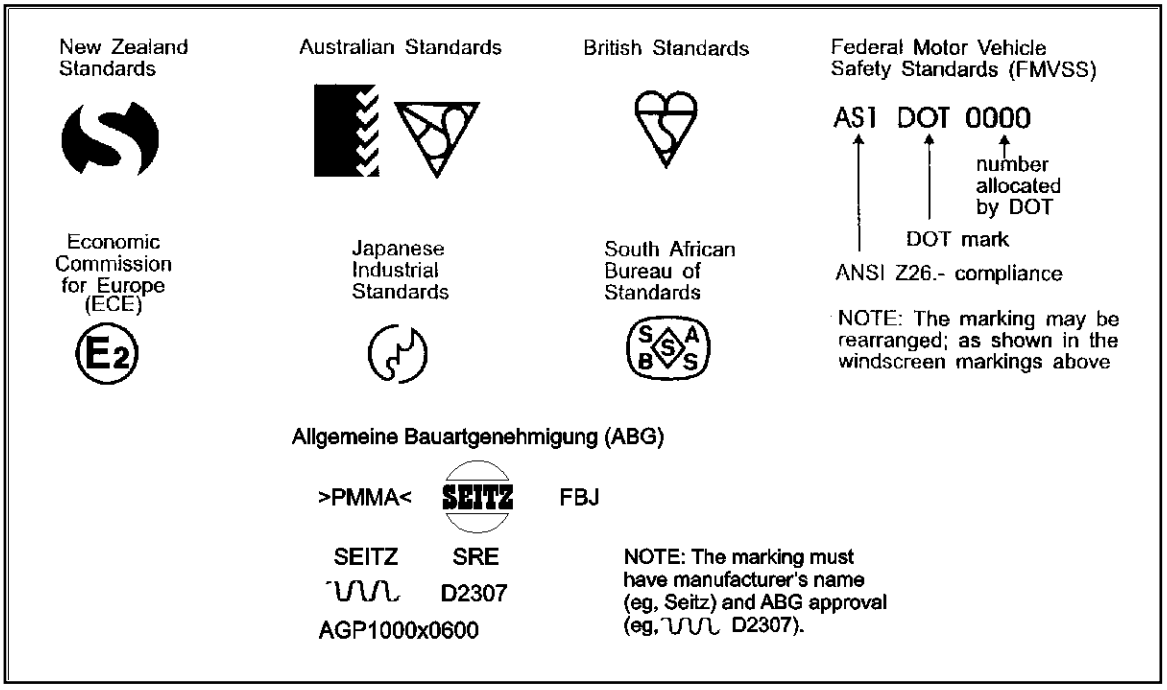

Diagram 15.2 Common approved standards markings

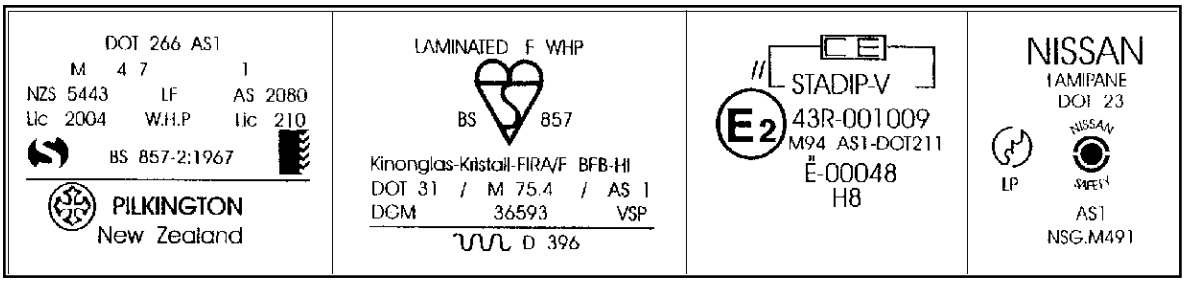

Diagram 15.3 Common laminated windscreen approved standards markings

L =	laminated glass
F =	float glass
P =	plate glass
LF =	laminated float
LP =	laminated plate
/ =	toughened, when near the E2 mark
// or /// =	laminated, when near the E2 mark
TS =	toughened glass
TP =	toughened plate
T =	toughened or tempered
Z =	zone tempered
WHP =	complies with impact test
DOT =	Department of Transport (USA)
A↧S or A↥S =	the glass, in the direction of the arrow, complies with the 70% light transmission requirement
ANSI =	American National Standards Institute
FMVSS codes	
AS1 =	for use anywhere in the vehicle
AS2 =	for use anywhere in the vehicle other than windscreen
AS3 =	for rear and rear side windows only
AS4 and AS5 =	plastic glazing not suitable for driver's vision
Glazing cut from mother sheet	
L.76WHP =	laminated, 0.76 mm interlayer, suitable for all locations
L.38 =	laminated, 0.38 mm interlayer, must not be used for windscreens
PCZ26.1 =	polycarbonate, meets requirements of ANSI Z26, must not be used for windscreens

Table 15.2 Identification of codes for approved laminated glazing

15.7 Alternative rigid plastic glazing materials

15.7.1

Side and rear glazing fitted to a low volume vehicle may be made from a rigid plastic material, provided that each piece of glazing:

(a) meets the technical requirements of item 4, test numbers 2, 10, 13,16,17,19,20,21,and 24 of the ANSI-Z26.1-1983 Standard, and any subsequent amendments; and

(b) is attached to the vehicle in such a way so as to:

(i) be protected against any sliding abrasion that will affect the driver's vision through the glazing; and

(ii) where the glazing is fixed, is able to be forcibly removed in the event of an emergency;

and

(c) is permanently and indelibly marked with the approved LVVTA alternative standard marking.

15.7.2

A scratch-built low volume vehicle that incorporates as part of its design a compound curvature windscreen, may have a windscreen that is manufactured from an alternative rigid plastic material provided that:

(a) no approved automotive toughened or laminated automotive safety glass windscreens are available for the application; and

(b) the glazing material used complies with all test requirements of the ANSI-Z26.1-1983 Standard specified in 15.7.1 except for test 17; and

(c) the glazing material is permanently and indelibly marked with the approved LVVTA alternative standard marking.

15.8 Alternative non-rigid plastic glazing materials

15.8.1

A convertible low volume vehicle that incorporates a folding soft-top roof may have the rear window made from a non-rigid plastic material, provided that the material is transparent.

15.7.1

'Rigid' plastic means a hard or solid plastic, as opposed to a soft fold-up type of plastic, such as that typically used for the rear window of a convertible soft-top.

There are a number of brands of polycarbonate and acrylic material that meet these technical requirements and can be used in side and rear windows. See the 'Useful Information' section at the end of this chapter for more guidance.

Information on the specified markings for rigid glazing can be obtained from LVVTA.

15.7.2

Test 17 is the scratch-resistance test, which cannot be complied with as the scratch-resistant coating applied to the outer side of the material will be damaged during the heating and forming process while making the windscreen.

Information on the specified markings for rigid glazing can be obtained from LVVTA.

15.8

'Non-rigid' plastic means a soft foldable plastic, such as that typically used for the rear window of a convertible soft-top.

15.8.2

A convertible low volume vehicle that incorporates a folding soft-top roof may have the side windows made from a non-rigid plastic material, provided that:

(a) the material is transparent and provides clear vision to the driver in all directions; and

(b) windows can be easily opened or detached in the event of an emergency.

15.8.2

The material must be made of a clear plastic material such as that normally used for a rear window in a folding convertible soft-top.

15.9 Wind deflectors

15.9.1

A wind deflector that is fitted to a low volume vehicle instead of a windscreen must be made from either:

(a) toughened automotive safety glass that meets an approved standard specified in 15.5, and that meets the identification requirements specified in 15.6; or

(b) laminated automotive safety glass that meets an approved standard specified in 15.5, and that meets the identification requirements specified in 15.6; or

(c) a non-shattering transparent rigid plastic polycarbonate material.

15.9.1

A 'wind deflector' (rather than a 'windscreen') is not required to be made of toughened or laminated automotive safety glass, providing it meets the requirement specified in 15.9.1(c).

A 'wind deflector' is defined like this; - if the driver looks <u>through</u> the screen, it's a windscreen; if he looks <u>over</u> it, it's a wind deflector.

Polycarbonate is more suited than acrylic, as polycarbonate will not break and leave a hard edge.

15.10 Wind wings

15.10.1

A soft-top convertible low volume vehicle may be fitted with wind wings provided that the wind wings:

(a) are made from a non-shattering transparent rigid plastic material; and

(b) have all corners and edges rounded and radiused; and

(c) are mounted outward of the outer edges of the windscreen; and

(d) are not part of the side windows; and

(e) are not required to be detached in the event of an emergency exit.

15.10.1

Wind wings are typically used on early convertible sports cars, and are attached to the outside of the windscreen frames to reduce buffeting in the passenger compartment.

Windscreen wiping & washing requirements

15.11 General windscreen wiping & washing requirements

15.11.2

A windscreen wiping and washing system fitted to a low volume vehicle must:

(a) incorporate components that are of a suitable size, type, and output, so as to ensure reliable operation; and

(b) be securely mounted and in good condition.

15.12 Windscreen wipers

15.12.1

A low volume vehicle that is fitted with a windscreen must be fitted with a windscreen wiping system that:

(a) is electrically operated; and

(b) provides a swept area such that no significant area of the windscreen remains unswept by the wipers, other than for:

(i) the areas at the top of the intersection points of the wipers' swept areas; and

(ii) the areas at the outer-most upper corners of the windscreen;

and

(c) together with the windscreen washers, is capable of maintaining clear visibility through the windscreen during all weather conditions; and

(d) has not less than two speeds, or a variable speed control, that will achieve:

(i) a low speed of not less than 20 cycles per minute; and

(ii) a high speed of not less than 45 cycles per minute; and

(iii) no greater variation between the lowest speed and the highest speed of 15 cycles per minute.

A low volume vehicle that was built or modified before January 1992 is not required to comply with 15.12.1.

15.12.1(b)

Defining the correct swept area is difficult without a lot of complex and time-consuming mathematical calculations. Builders should follow diagram 15.4 as a start, and work on wiper numbers, pivot positioning, and arm length, to achieve the greatest possible swept area.

The problem of achieving a good swept area is extra tricky with a chopped windscreen. Not only is getting a good swept area more difficult on a roof-chopped vehicle, it's also more important, because of the vision area already lost through the chop.

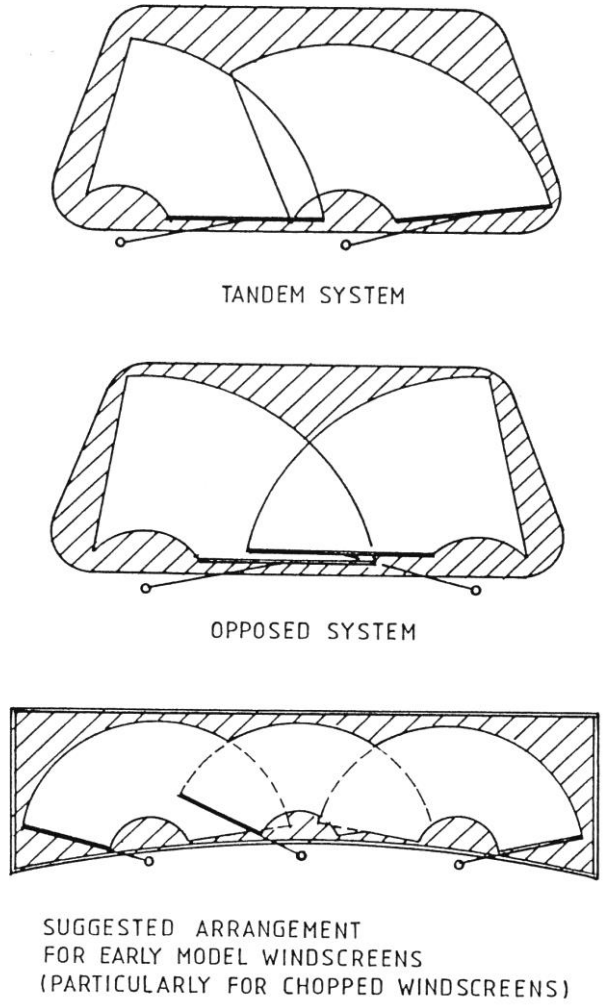

Diagram 15.4 Windscreen wiper swept area

Diagram 15.4

One of the most important areas in which to achieve a good 'sweep', is at the driver's-side A-pillar. Note that the 'Tandem System' diagram shows a full sweep up to, and parallel to, the A-pillar on the left-hand side. This diagram is viewed from outside the vehicle, so that in a right-hand drive vehicle, the driver gets the best possible swept area in the A-pillar region.

15.13 Windscreen washers

15.13.1

A low volume vehicle that is fitted with a windscreen must be fitted with a windscreen washer system that:

(a) is electrically operated; and

(b) incorporates a water reservoir that has a capacity of not less than one litre; and

(c) is capable of directing water onto the exterior of the windscreen within each area swept by a wiper, so that when the windscreen wiping system is operated, water will be dispersed to the whole area swept by the wipers; and

15.13.1

This requirement only applies to scratch-built low volume vehicles, and modified production low volume vehicles where the windscreen wiping system has been modified.

(d) together with the windscreen wipers, is capable of maintaining clear visibility through the windscreen during all weather conditions.

A low volume vehicle that was built or modified before January 1992 is not required to comply with 15.13.1.

Forward vision requirements:

15.14 General forward vision requirements

15.14

Note that a windscreen demisting system is not mandatory. The TAC highly recommends incorporating a demisting system during a scratch-build, however this is not a requirement.

15.14.1

A windscreen fitted to a low volume vehicle that has a fixed roof must have a minimum height of clear visibility area, measured on a vertical plane, of not less than 165 mm (6 ½").

15.14.1

The measurement must be made vertically, irrespective of windscreen angle. The measurement is made this way to ensure that the actual visibility area does not reduce below the minimum allowable figure because of a lot of rake on the windscreen.

15.14.2

Low volume vehicles must be designed and constructed so as to provide to the driver a clear view to the front and both sides of the vehicle from the normal driving position, and the following requirements must be complied with:

(a) the front seats must be mounted in such a way so as to provide the driver as far as practicable with the best available view to the front and both sides of the vehicle; and

(b) any roll-bar or roll-cage fitted to the vehicle must not have any bars positioned in such a way so as to restrict the driver's forward and side vision.

15.15 Fixed-roof vehicle forward vision requirements

On vehicles where the bottom edge of the windscreen is curved (as is the case with most early cars), the vertical measurement of 165 mm should be taken at a point half-way between the mid-point of the windscreen and the A-pillar. Measuring at this point is more representative of where the driver gains his or her forward vision from, rather than at the dead centre of the windscreen.

15.15.1

A low volume vehicle which has a fixed roof must not have any components or fittings forward of the firewall which protrude above a straight line from the centre-point of the windscreen measured both vertically and horizontally to: (see Diagram 15.5)

(a) in the case of protrusions 250 mm (10") or less in width, a point at ground level 15 m (49') forward of the front of the vehicle; or

(b) in the case of protrusions between 250 mm (10") and 400 mm (16") in width, a point at ground level 12 m (39') forward of the front of the vehicle; or

(c) in the case of protrusions 400 mm (16") or more in width, a point at ground level 8 m (26') forward of the front of the vehicle.

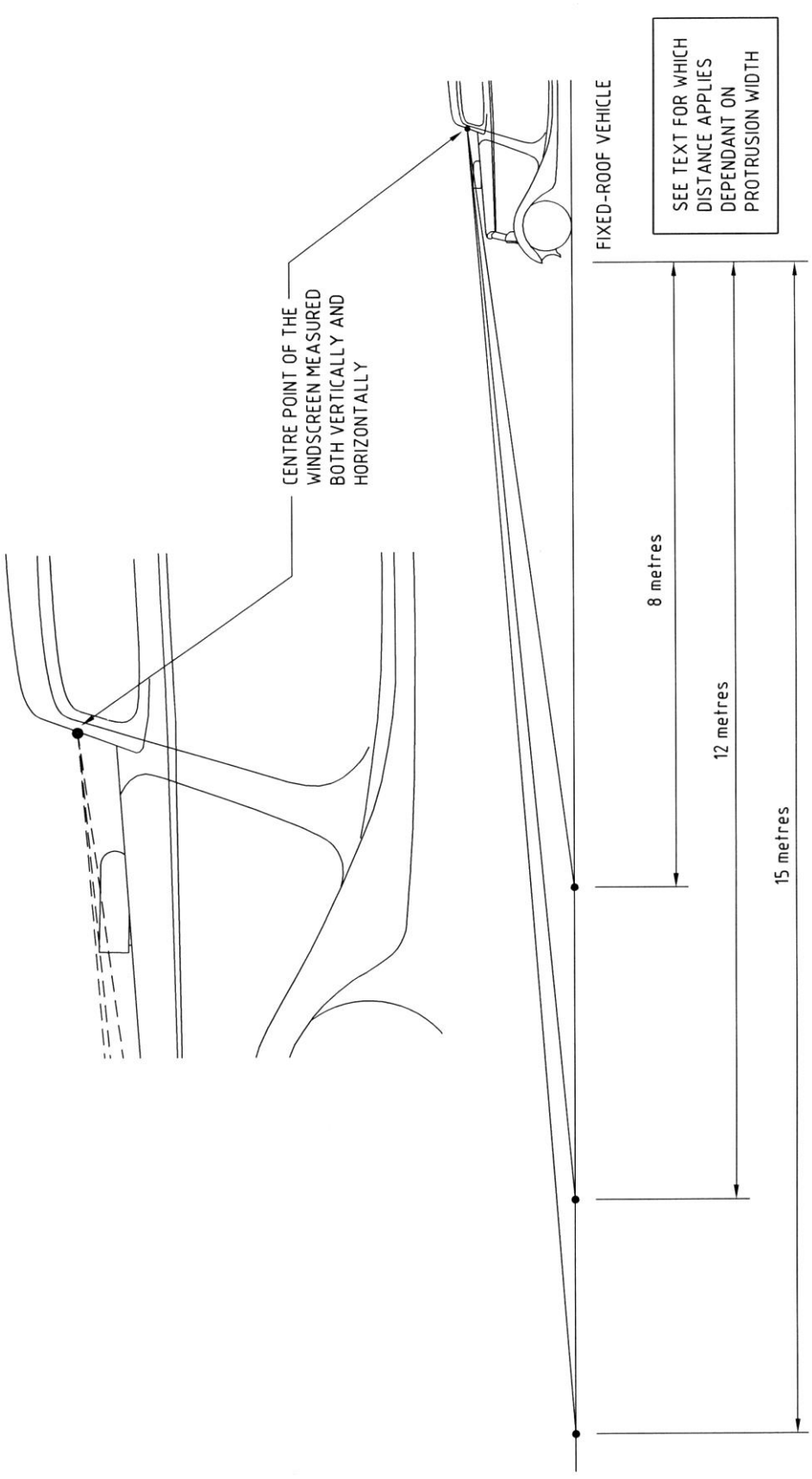

Diagram 15.5 Engine protrusion sight-line (fixed roof vehicles)

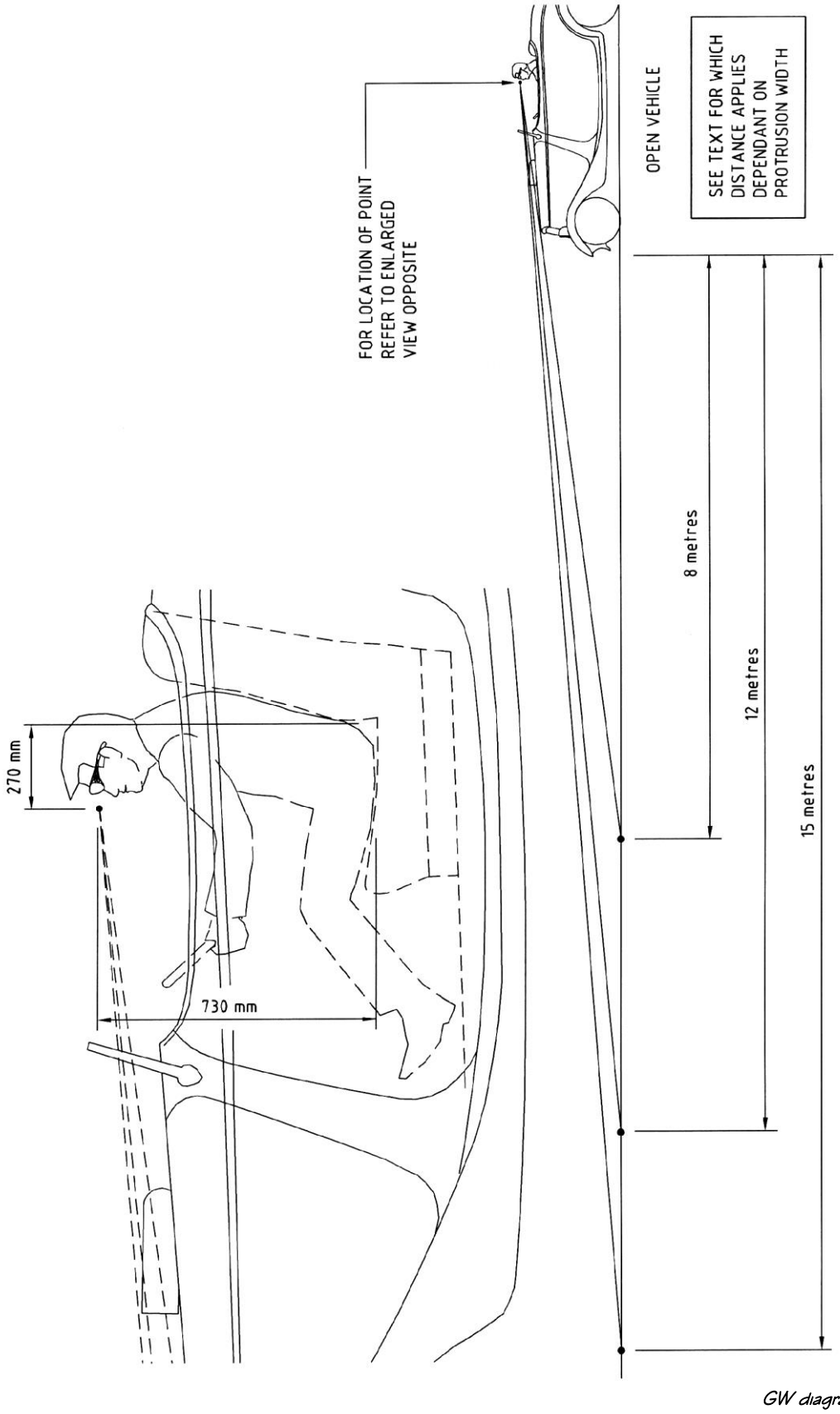

Diagram 15.6 Engine protrusion sight-line (open vehicles)

15.16 Open vehicle forward vision requirements

15.16.1

A low volume vehicle which does not have a fixed roof must not have any components or fittings forward of the firewall which protrude above a straight line measured from a point on the vehicle's longitudinal centre-line 730 mm (28 ¾") above and 270 mm (10 ½") forward of the junction of the uncompressed seat base and back, with the seat in its rear-most and lowest position, to: (see Diagram 15.6)

(a) in the case of protrusions 250 mm (10") or less in width, a point at ground level 15 m (49') forward of the front of the vehicle; or

(b) in the case of protrusions between 250 mm (10") and 400 mm (16") in width, a point at ground level 12 m (39') forward of the front of the vehicle; or

(c) in the case of protrusions 400 mm (16") or more in width, a point at ground level 8 m (26') forward of the front of the vehicle.

Rear vision requirements:

15.17 Rear view mirror requirements

15.17.1

A low volume vehicle must be fitted with:

(a) one interior rear view mirror; and

(b) one exterior rear view mirror on the side of the vehicle nearest the driver; and

(c) in the case of a left-hand drive low volume vehicle, an exterior rear view mirror on the side of the vehicle opposite the driver.

15.17.2

A rear view mirror fitted to a low volume vehicle must be designed and positioned, and be of such dimensions, so as to:

(a) be capable of reflecting to the driver as far as practicable, a clear view of the road to the rear of the vehicle, and of any approaching or overtaking vehicles; and

(b) not unreasonably obstruct the driver's forward vision.

15.17.3

A rear view mirror fitted to a low volume vehicle must:

(a) be able to be adjusted, and maintain its adjusted position; and

(b) be mounted in such a way so as to ensure against the driver's vision through the rear view mirror being obscured by vibration; and

(c) incorporate secure bonding of the glass to the mounting surface.

15.18 Rear view mirrors from production vehicles

15.18.1

A rear view mirror sourced from a production motor vehicle may be fitted to a low volume vehicle, provided that:

(a) *the rear view mirror is unmodified; and*

(b) *the rear view mirror is mounted so as to replicate the location and installation method used by the donor vehicle manufacturer; and*

(c) *the vehicle to which the mirror was originally fitted was manufactured in either:*

(i) *the United States of America on or after 1 January 1976; or*

(ii) *Europe or the United Kingdom on or after 1 January 1971; or*

(iii) *Japan on or after 1 January 1983; or*

(iv) *Australia on or after 1 January 1988.*

A low volume vehicle that was built or modified before January 1992 is not required to comply with 15.18.1.

15.19 Rear view mirrors from other sources

15.19.1

An interior rear view mirror from a source other than that specified in 15.18.1 must:

(a) *have a radius of not less than 3 mm (1/8") on all edges and corners of the mirror and its attachment structure which face toward the passenger compartment of the vehicle; and*

(b) *be designed and attached in such a way as to collapse, break off, bend away, or swing away upon impact, leaving no sharp edges, rigid mounting points or dangerous protrusions facing the occupants in doing so.*

A low volume vehicle that was built or modified before January 1992 is not required to comply with 15.19.1.

15.19.2

An exterior rear view mirror from a source other than that specified in 15.18.1 must have a radius of not less than 3 mm (1/8") on all edges and corners of the mirror and its attachment structure which face toward the front of the vehicle.

A low volume vehicle that was built or modified before January 1992 is not required to comply with 15.19.2.

Exclusions:

15.20 Interior rear view mirror exclusions

15.20.1

A low volume vehicle that is designed in such a way that an interior rear view mirror would not provide to the driver sufficient vision to the rear of the vehicle for safe operation, is not required to comply with 15.17.1(a), provided that the vehicle is fitted with an exterior rear view mirror on each side of the vehicle.

15.20.1

This exclusion would typically apply to a mid-engined vehicle where there is little or no rearward vision behind the driver, due to the presence of the rear bulkhead in front of the engine.

15.21 C-zone mirror positioning exclusions

15.21.1

An interior rear view mirror fitted to a low volume vehicle is not required to comply with 15.19.1, provided that it is positioned within the C-zone, as specified in 16.3 of 'Chapter 16 - Interior Equipment.

15.21.1

This exclusion would typically apply to a sports car that uses a centrally positioned dash-mounted interior rear view mirror.

15.22 Original equipment mirror exclusions

15.22.1

A rear view mirror fitted to a modified production low volume vehicle is not required to meet 15.19 provided that the mirror is either:

(a) *a standard or optional item supplied by the vehicle manufacturer, or an item which is an authentic reproduction of such equipment; or*

(b) *an item which was available as after-market equipment at the time the vehicle was manufactured.*

15.23 Split windscreen wiping swept area exclusions

15.23.1

A low volume vehicle which features a split, or two-piece windscreen, is not required to meet 15.12.1(b), provided that:

(a) the vehicle was manufactured before 1950; and

(b) the swept area provided by the wipers is maximised, and the driver has good forward vision.

Useful information

Visible light transmittance

Visible light transmittance (VLT), in the context of percentages, means the amount of light that can be transmitted through a piece of glass. This is determined by the level of tinting in the glass, or in an overlay. The amount of VLT that a given piece of glass has is pretty much impossible for someone to accurately identify without the correct measuring equipment.

A car builder needs to make sure that the person or company cutting his glass, or supplying tint film, fully understands the requirements specified in 15.2 to 15.6, and then rely on that person's industry knowledge. Obviously, it's important to use a company that knows what they're doing.

Laminated safety glass

Laminated glass consists of two (or more) layers of glass, which have been adhered together with an interlayer of plastic sheet material. In the event of an impact and subsequent damage to the glass, the interlayer keeps the broken glass together rather than individual fragments becoming separated and scattering. Laminated safety glass must be used in all windscreens.

Laminated automotive safety glass has a thickness of 6.76 mm (17/64"); this comprises two 3 mm (1/8") layers of toughened glass, with a 0.76 mm (1/32") interlayer sandwiched and bonded between the two layers of glass.

Note that there is a difference between approved automotive laminated safety glass, and approved architectural laminated safety glass. Despite looking identical, and nowadays even having the same interlayer thickness, architectural glass must never be used in an automotive application.

Toughened safety glass

Toughened glass is a single sheet of glass which has been subjected to special processes which creates a tough compression-stressed layer on the glass surface, to increase its strength in the event of an impact, and to ensure that the glass breaks into tiny fragments, rather than large jagged pieces. Toughened glass is only allowed to be used in side and rear windows.

Alternative rigid plastic glazing

There are a number of plastic materials on the market that meet the requirements of 15.7.1 and 15.7.2. These materials include 'Lucite SAR' ('SAR' meaning scratch and abrasion resistant); 'Lexan MR' series ('MR' meaning mar ['mar' meaning scratch] resistant); 'Cyrolon AR' series ('AR' meaning abrasion resistant); and Tuffak CM-2.

'Lexan', 'Cyrolon', and 'Tuffak' products are all polycarbonates, whereas 'Lucite' is an acrylic.

The best products for automotive use are polycarbonate materials which will bend almost indefinitely, whereas acrylic will only bend a small amount and then break, leaving a sharp edge (less than ideal in a roll-over situation), so check out what the products that you are looking at are made from.