

**THE COMPREHENSIVE PSV GLASS GUIDE TO
THE REMOVAL AND INSTALLATION OF
DIRECT GLAZED BUS AND COACH GLASS**

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The procedures used in this guide have been taken with permission from Dow Automotive, using the PU adhesive system.

This guide details the procedure for the safe removal and installation of bonded windows in buses and coaches inside a garage environment, and to provide an informative guide to good practice in structural adhesive bonding.

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For further safety information, please download the file:
'H&S in MV repair and associated industries' and refer to sections:
180-186 Automotive Glazing, 246-265 Noise and Vibration,
368-378 Work at Height, 397-407 Skin Care



SYMBOLS used in the guide



Information



Caution



Stop, Danger



Eye Protection required



Gloves required



Face Mask required



Safety Boots



Recycle





Bus and Coach Glass

Section 2

BUS AND COACH GLASS



GENERIC

Standards

All laminated and toughened glass used in the UK Transport Industry has to comply with E43r or BS857 and will be permanently kite marked to show the standard.

Bus and coach glass handling

- Do not place glass directly onto hard surfaces such as concrete. Put down a protective layer (cardboard, foam, wood) first.
- Never attempt to manually lift glass up and down access platform stairs on your own.

Always handle glass with extreme care. Use manual vacuum lifting devices and seek assistance with weights over 25kg.

Ceramic band

The black band around the glass inner face is a ceramic enamel ink fired on during manufacturing.

The primary function of the black band is to protect the PU (polyurethane) bond line by blocking UV light radiation (which can cause a chemical breakdown of the PU and lead to potential bond separation).

Aesthetic standards are achieved by using dot fade-out patterns.

SPECIFIC

Body Sideglass

Toughened glass is used in bus and coach side windows, whether single or double glazed, due to its durability and safety features; it has been purposely manufactured to break into small blunt dice shaped pieces when broken to reduce potential injury to passengers.

Toughened Glass Manufacturing

Toughened glass is produced by heating a sheet of ordinary annealed glass to softening point then rapidly cooling it. It is the speed of cooling that determines the toughened quality.

Toughened Glass Handling

Working with glass can be as safe as working with any other material providing sensible precautions are taken. Glass, when broken, will cut any soft material it comes in contact with. Glass supplied by PSV Glass will already have the edges arised, smooth or polished. However always treat glass edges with care.

Although toughened glass cannot be repaired, it can be protected from scratches by applying a polyester film to the inner face.

Windscreens

Laminated glass is used in the manufacturing of bus and coach windscreens due to its ability to contain occupants in the event of a front end collision, and if impacted will crack, not shatter, therefore maintaining forward vision.

Windscreen Manufacturing

Windscreens are produced by placing two perfectly matched flat annealed glasses on moulds in a furnace, where they are heated to produce just the right of sag required for glass to take the shape of the mould.

Then a thin layer (0.76micron) of plasticised PVB (polyvinyl butyral) film known as an interlayer, is sandwiched between them. The windscreen is placed in an autoclave where pressure causes a superheating of the PVB; this bonds the two glasses together and turns the PVB transparent.

Windscreen Handling

The exposed edge of a windscreen must be protected during transportation as a small edge shell could become the start of a crack during fitting.

The windscreen edge must never be exposed to moisture whether in storage or when fitted, moisture can get between the layers causing delamination; this separation could affect the safety performance of the windscreen by glass fragments (spalling) striking an occupant should the windscreen break.

Small chips and cracks can be repaired by injecting a liquid resin into the damaged area. The permissible repair zones and size of repair are described in a code of conduct BS AU242.





Bonding

glass or windscreen to body

Section 3

BONDING glass or windscreen to body



Correctly named direct glazing, the advantages over an indirect glazing system (rubber) are:

- Glass can absorb some of the torsional body loadings therefore increasing rigidity and strength.
- Allows an expansion of engineering and design freedom.
- Aerodynamic and aesthetically styled flush glazing and 'ribbon' effect possible.
- Improved water resistance.

The PU described in this guide, is a single component adhesive that cures from the outside to the inside by reaction to the moisture in the atmosphere. The greater the humidity, the faster the curing.

Priming

Priming is a means of chemically transforming a surface to improve its performance. Wiping the prepared surface with a conditioner causes a reaction that will make the bond more adhesive. Primers must be allowed to thoroughly dry out before applying the adhesive, they must be re-applied if left on too long – minimum and maximum drying times are given in the relevant sections of this guide.

Adhesives

The adhesives used in this guide are known as polyurethane (PU) as opposed to MS polymers. Unfortunately they are not compatible and as it would be difficult to know at the time of the repair which system you are dismantling, the recommendation would be to remove all traces of adhesive from the rebate at the strip down stage.

Properties

The PUs used in this guide are 'high modulus' which means they have a higher resistance to distortion or flexing than standard adhesives.

They are also 'non-conductive' which means that because they contain no carbon, so the moisture in the atmosphere doesn't contribute to aluminium frame corrosion or to adhesion failure.

They have good 'UV stability' which means they can be used as a back fill with good weathering properties.

Working time

Working time is the period of time between the start to finish of the PU bead extrusion and the installation of the glass in the rebate, or the amount of time available to work with the PU before it starts to skin over.

Safe to manoeuvre time

Following glass installation and back fill. This is the time the PU has built up sufficient structural strength in the early curing process to enable the vehicle to be manoeuvred in the garage. This is dependent on the ambient temperature at the time of glazing and the weight of the glass, amount of glass curvature and volume of PU. Lower temperatures result in longer safe to manoeuvre times. Check for any movement following any manoeuvring.

Cold weather conditions

Cold weather will slow down the curing process but there is another important factor to consider – condensation. In cold weather, at temperatures of below +5°C, condensation is likely to build up on a glass or metal surface. This can occur when the bus or coach or the glass component is brought from a cold environment into a warm garage, or when glazing is attempted in a cold garage.

Any condensation, water or ice present on the vehicle aperture or glass unit will have a detrimental effect on the adhesion qualities of the PU, and must be completely eliminated before bead application. It will not be possible to achieve a good bonding adhesion at ambient temperatures below +5°C.

Hot weather conditions

Hot weather has the effect of speeding up the curing process to a level where the chemical cross-linking of the PU begins to 'gas-off'. This can occur at ambient temperatures of above +25°C, which is equivalent to an aperture surface temperature of up to +40°C.

At these temperatures, the working time is considerably reduced to below that which is feasibly possible.

In these conditions, time must be allowed for the aperture surface temperature to cool down to below +25°C before bead application can be made.



BONDING glass or windscreen to body



Repainted surfaces

Where a body aperture has been repainted with an air drying paint, it is necessary that the freshly painted surfaces are allowed to dry for a minimum of 24 hours prior to bonding application. This is to allow the solvents in the paint to completely evaporate.

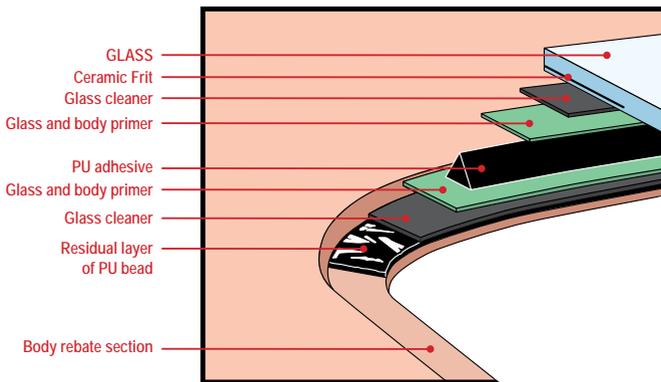
Low bake paints will need to dry for 4 hours minimum prior to glass installation.

Adhesive bead

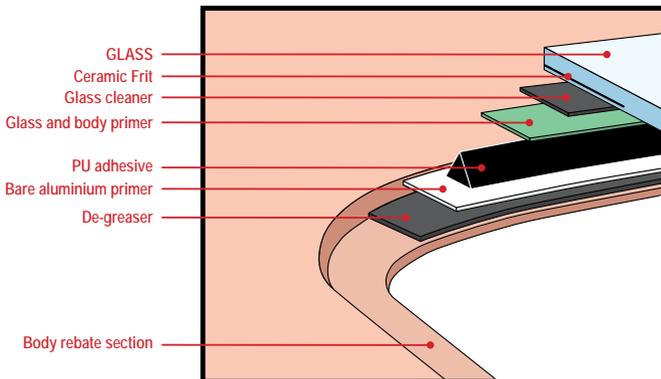
The normal procedure in direct glazing is to apply a triangular bead of adhesive to the body rebate, position the glass over it and push firmly together. The triangular shape of the bead helps squeeze out air pockets when compressed.

Refer to www.psvglass.com for further reading

STANDARD GLAZING



BARE FRAME GLAZING (or doubts whether old adhesive is PU)



Cleanliness is a key requirement, and in order to achieve satisfactory results, it is essential to provide a dust-free working area, and well away from where products containing solvents or silicones are being used.





Tools

and equipment required

Section 4

TOOLS and equipment required



I. Tools and equipment required

Access Platform (2 man + window)

- Heavy duty glass stand
- Industrial vacuum cleaner
- Thermo-hygrometer
- Electric cut-out knife (Fein)
- Milwaukee Cordless Application Gun
- 70mm offset straight blade
- 25.4mm 'L' shaped blade
- 75kg Vacuum handles x 2
- Dust covers
- Paring knife



II. PPE required

- Safety goggles
- Safety footwear
- Standard rigger gloves
- Anti-vibration gloves
- Nitrile gloves - powder free

III. Consumables

- 1000ml PU adhesive
- 2 x Glass cleaner sachets
- 2 x 15ml Glass and body primer
- 3 x Wired primer applicators
- 1 nozzle
- 1 nozzle - pre-cut
- Glass cleaner in spray bottle
- Black box wipes
- Single Edge Blades
- Paper Towels
- Clean Edge Tape
- Spacer blocks
- New Bodyside Window or Windscreen
- Bare aluminium primer
- De-greaser

These parts are normally in a kit



Needed if removing old PU

Make yourself aware of the COSHH information contained in the Safety Data Sheets for all cleaners, activators, primers and adhesives.
See www.psvglass.com/downloads





Glass

removal and installation

Section 5



If you plan to remove more than 2 windows from the bus, refer to the manufacturer's instructions as the chassis/body may need to be supported.

Before beginning bodyside window removal, verify the new glass is the correct one and the PUs and primers are current. Never use outdated products as this could jeopardise the structural integrity of the bus.

Before beginning windscreen removal, remove wiper arms and heater braid following the manufacturers instructions.



PPE: FULL FACE VISOR, RIGGER GLOVES, ANTI-VIBRATION GLOVES AND SAFETY BOOTS

1. Take precautions that the bus or coach will not start or move, position bollards around working area.
2. Fit protective covers to inside and mask up surrounding paintwork on outside and attach sheeting to collect broken glass or debris particles.
3. Remove any trims following manufacturer's instructions and check orientation of glass.
4. Remove all contaminants from the surrounding area to prevent them from making contact with the PU when cutting. Spray with water so it flows into the PU when you make your cuts. Using a combination of the Fein oscillating cutter and pare back knife, lubricate with water and cut out the in-fill and remove.

5. Ensure the glass is being supported by a colleague. From outside the vehicle, using a combination of the Fein oscillating cutter and suitable knife, cut the adhesive bead across the top then work downwards, finally across the bottom. The glass can now be carefully pulled / pushed away with the help of a colleague and lifted and lowered to the ground. Dispose of old glass in accordance with local procedures.
6. Using a clean pare back knife, cut the old adhesive layer, (both inner and outer beads), back to a residual thickness of approximately 1mm. If there is evidence of corrosion or you believe the adhesive to not be a polyurethane then pare back the old adhesive as close to the painted substrate as possible.
7. At this point clean up all broken glass particles and old adhesive strips from the aperture and the surrounding working area. Remove sheeting and dispose of the collected broken glass particles. Ensure there are no broken parts on seats or in vents. Sweep up all debris in preparation for the next 'clean' stages. Dispose of broken glass as soon as possible ensuring no particles are left behind in and around vehicle inspection pits.
8. Apply Clean-Edge tape to the aperture to act as masking for the in-fill.





- Check that the aperture is in good condition.
- Ensure that the aperture is clean and dry.
- Assess the safe-lifting implications.
- Always dry-fit the glass before applying primers or adhesives.

The bus body and the new bodyside window part **MUST** be at least 5°C; the upper limit for application is 30°C.

Ensure adequate ventilation when using primers and when using oscillating cutting equipment, particularly as fumes from cut PU in an enclosed area could exceed acceptable toxic levels.



PPE: NITRILE GLOVES AND MASK

9. Clean the residual layer of PU bead and aperture with the **Glass cleaner** wet tissue in the sachet. Wipe over the surface moving in one direction only, rotating the cloth every metre making sure the surface has been completely covered. Using a dry tissue, immediately and thoroughly wipe off the **Glass cleaner** from the surface, rotating the tissue every metre, allow any excess solvent to evaporate.
10. Shake the **Glass and body primer** bottle vigorously for at least 1-minute, making sure the steel balls can be heard; if not tap lid sharply until steel balls are released.
11. Apply a continuous coating of **Glass and body primer** with a new felt applicator directly onto cleaned surface, starting in one corner of the aperture. Maintain an even and continuous coating. As **Glass and body primer** is very hygroscopic, the lid must be replaced immediately. (Once opened, its contents must be used within 2-days).
12. Allow the primer to dry for a minimum of 5-minutes, 'touch-dry', through to a maximum of 24-hours.



Do not use superglue to glue in the spacer blocks as the vapours released will infiltrate the PU at the bond face.

13. Glue in the spacer blocks (see Spare Parts list (iii) for spacer block heights) adjacent to bond line.



Oxidisation / Corrosion / Poor adhesion

Preparation

- A. Remove all the original adhesive layer and surface pre-treatment in the affected areas.
- B. It is advisable if possible to go past the affected areas into the sound areas of the aperture. This will ensure that you have eliminated all of the affected area.
- C. Thoroughly abrade the affected area using 'Scotch-brite' or similar to remove the oxidation/corrosion and original surface pre-treatments.
- D. Remove/brush completely the aperture to remove all dirt and debris.
- E. Clean the complete aperture with De-greaser using a lint free tissue to apply. Use a separate lint free tissue to dry the cleaned area.

Primer application

- F. Thoroughly shake Bare aluminium primer for a minimum of 60 seconds.
- G. Pour Bare aluminium primer into Part A container and thoroughly shake for a minimum of 60 seconds.
- H. Leave to stand for 5 minutes.
- I. Using a felt wire applicator load and apply the mixed primer to the previously abraded and cleaned section of the aperture.
- J. The primer film application should be left to dry for a minimum of 30 minutes.





- Check that the corners of the glass are in good condition.
- Look carefully for any edge damage.
- Ensure that there are no scratches on the face of the glass.
- Check that the BS857 or E43r kite mark is visible.
- Ensure correct orientation of glass.



PPE: NITRILE GLOVES AND MASK

14. Thoroughly clean the external side of the glass using **Glass cleaner** with tissue paper. Wipe over the surface moving in one direction only, rotating the tissue every metre making sure the area has been completely covered. Also clean the edge using a tissue paper, immediately and thoroughly wipe off the **Glass cleaner** from the surface, rotating the tissue every metre, allow any excess solvent to evaporate.
15. Apply Clean-Edge tape to outer face edge and cut into taper to form masking for the in-fill.
16. Attach two vacuum handles to the outer face of the new glass and place the glass on a trestle, handles downwards.
17. Obtain a **Glass cleaner** pouch, inside you will have a wet and dry tissue, clean the whole ceramic band including the glass edge using the wet tissue, then using the dry tissue wipe the cleaner off the glass until completely dry.
18. Shake the **Glass and body primer** bottle vigorously for at least 1-minute, making sure the steel balls can be heard; if not tap lid sharply until steel balls are released.
19. Apply a continuous coating of **Glass and body primer** with a new felt applicator directly onto the activated areas of the glass, **INCLUDING ALL AROUND THE EDGE OF THE GLASS**. Maintain an even and continuous coating. As **Glass and body primer** is very hygroscopic, the lid must be replaced immediately. (Once opened, its contents must be used within 2-days).
20. Allow the primer to dry for a minimum of 5-minutes, 'touch-dry', through to a maximum of 24-hours.

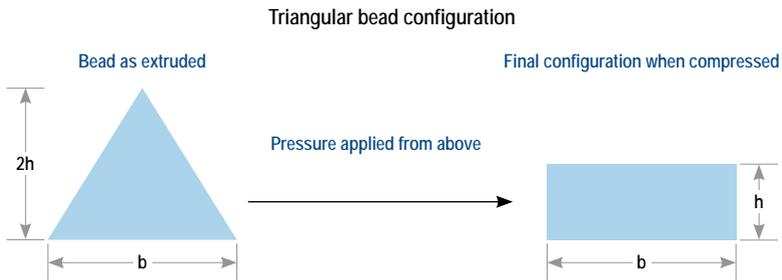




PPE: NITRILE GLOVES AND SAFETY BOOTS

To apply PU adhesive, select a pre-cut nozzle.

21. Carefully cut the end of the crimped material sausage and fit the nozzle to the cut end. It may be necessary to manually squeeze a small amount of material from the end to hold the nozzle in place. Load in to the application gun.
22. Start the adhesive bead application in either the upper l.h. or r.h corners of the aperture. Do not start in the middle section of the aperture.
23. Ensure that all joints of adhesive are correctly made should a new material sausage be used, i.e. joints overlapped or tooled and NOT butt jointed, height and volume maintained and no small air void at the base of the two joined beads.



Installation



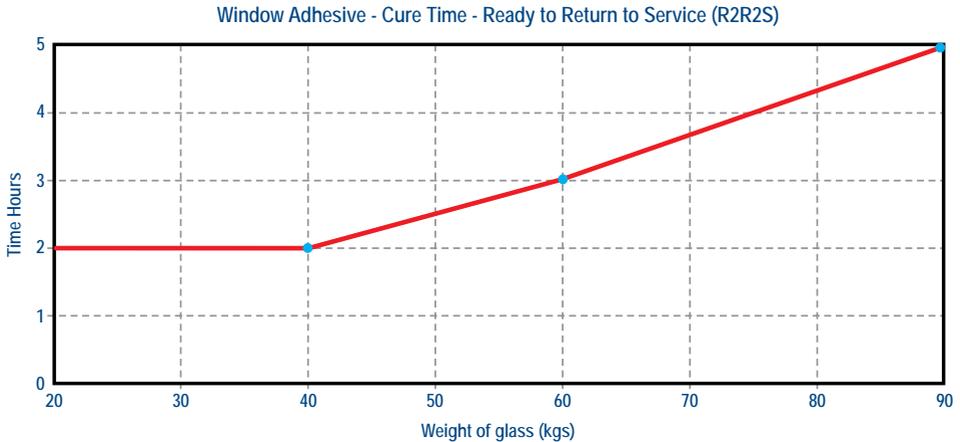
PPE: NITRILE GLOVES



The window must be installed immediately of operation 25.

24. As soon as the adhesive has been applied to the aperture, lift the window into position using the vacuum handles, locating the bottom edge first onto the spacer blocks, then pushing in at the top. When the window contacts the adhesive, apply even pressure around the window and push it into position.

25. Make any minor adjustments to the positioning of the window to ensure that it is flush and centralised. Use tape if necessary to hold the glass in position.
26. Apply directly into the in-fill edge adhesive joint in a continuous bead, ensuring an over-spill.
27. Tool off the excess over-spill with a wooden or plastic spatula. Aim to achieve a flush or concave finish.
28. Remove the Clean-Edge tape.





PPE: NITRILE GLOVES

29. Remove protective covers from both outside and inside vehicle.
30. Remove any stickers from window and clean both sides of window and surrounding bodywork.
31. Thoroughly clean entire working area ensuring no broken glass particles remain on inspection pit walls or on driver's seat.
32. All spent blades and chemicals must be disposed of in accordance with local regulations.
33. Book vehicle in for re-filming if applicable.
34. Re-fit any trims, wiper arms, heating braids in reverse order, following the manufacturers instructions.
35. Job complete.

contact TECHNICAL SUPPORT
support@psvglass.co.uk for further advice



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