

GGF Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Types of Systems and Precautions in Use

5.18.4 April 2008

Contents

Foreword

1. Scope
2. Definitions and Descriptions
3. Breakage Characteristics of Glass
4. Design Considerations
5. Containment Systems
6. References

Foreword

This document clarifies the recommendations concerning the use of adhesive backed polymeric film applied to glass in the overhead position for the containment of glass in the event of failure. It is the first of two documents, the second of which describes a test method.

1. Scope

This document describes and recommends the general types of containment systems used with adhesive backed polymeric film applied to glass in the overhead position for containment of glass in the event of glass failure. It is concerned with self weight, snow loading and snow loading plus intermittent wind loading. This document does not cover the risk of injury from objects falling through the glass, nor can it cover every possible containment system.

Note: Each installation of adhesive backed polymeric film for containment purposes has to be individually assessed.

2. Definitions and Description

2.1 See GGF Datasheet 5.18.3 "GGF

Recommendations for Adhesive Backed Polymeric Film Applied to Glass: Definitions, Descriptions and Components".

2.2 Containment System

A system designed to attach an installed adhesive backed polymeric film to the glazing bar, glazing system or frame, and thereby provide containment of glass in the overhead position in the event of glass failure. This should not be confused with the containment characteristics for personal safety given in BS EN 12600.

3. Breakage Characteristics of Glass

The breakage characteristics and associated properties of commonly used glass types are described below.

3.1 Laminated glass to BS EN ISO 12543-2 or BS EN ISO 12543-3

When laminated glass is broken the pieces of glass are held together by the interlayer(s) and are likely to remain in position and continue to provide short term weather resistance.

Note: laminated glass includes laminated annealed, laminated thermally toughened, laminated heat soaked thermally toughened and laminated heat strengthened glasses.

3.2 Thermally toughened glass in accordance with BS EN 12150-1, BS EN 14179-1, BS EN 13024-1, or BS EN 14321-1.

Thermally toughened glass is stronger than ordinary annealed glass of equal thickness and is therefore comparatively difficult to break. In addition, thermally toughened glass will withstand the

maximum thermal stress associated with solar radiation.

Note: Thermally toughened glass will not break due to thermal stress in all architectural situations except when a fire occurs in the building. When broken, thermally toughened glass shatters into small relatively harmless pieces, which are likely to fall.

Thicker toughened glass, when broken, will exhibit a greater tendency for the small pieces to stay together and fall in clusters.

Thermally toughened glass may contain Nickel Sulphide (NIS) inclusions which could cause spontaneous breakage although the risk of this happening is very low.

3.3 Heat soaked thermally toughened glass to BS EN 14179-1

Heat soaked thermally toughened glass has the same properties and breakage characteristics as thermally toughened glass. However, the incidence of breakage due to Nickel Sulphide inclusions is negligible.

3.4 Heat strengthened glass to BS EN 1863-1

Heat strengthened glass will withstand the thermal stress associated with solar radiation but it breaks in a manner similar to annealed glass (section 4.6).

The built-in stresses in heat strengthened glass, which are lower than those in thermally toughened glass, make it much less susceptible to spontaneous fracture due to Nickel Sulphide inclusions.



3.5 Wired glass to BS EN 572-3 or BS EN 572-5

When wired glass is broken, the wire will hold most pieces of the glass together thereby preventing them from falling.

3.6 Annealed glass excluding wired glass (e.g. to BS EN 572 parts 1-8 and BS EN 1748-1-1)

When annealed glass is broken, it tends to break into dangerous pieces which are likely to fall.

4. Design Considerations

4.1 Glass breakages may occur for many reasons including the following:

- Excessive loads (e.g. self-load, snow, wind loads)
- Inadequate framing or other glazing defects
- Incorrect glazing procedures
- Impact from falling, wind-borne or thrown objects
- The higher thermal stresses encountered in non-vertical overhead glazing
- Malicious attack
- Damaged or defective glass
- Breakage due to Nickel Sulphide inclusions in thermally toughened glass
- Explosive pressures

4.2 The breakage of glass in non-vertical overhead glazing is a very rare occurrence. The risk of injury from falling broken glass may be reduced by the use of adhesive backed polymeric film and a suitable containment system.

4.3 Thermally toughened glass in the overhead position may, when broken, create risks by falling down in fragments and / or as clusters of fragments. If adhesive backed polymeric film is installed to such glazing an appropriate risk assessment must be completed in order to determine whether a containment system is necessary.

4.4 In no circumstances should adhesive backed polymeric film be installed by itself to overhead thermally toughened or heat soaked thermally toughened glass without an appropriate risk assessment and, where necessary, the use of an appropriate containment system. Installation of adhesive backed polymeric film to such glazing can significantly increase the risk if the glass fails and the sheet of film and

glass falls as one piece.

5. Containment Systems

5.1 General

Suitable containment systems include:

- Silicone structural adhesive
- Mechanically fixed batten bar
- Adhesively fixed batten bar
- Polyester and acrylic foam tapes
- Structural washers

Note: The minimum recommended bite depth for new blast resistant glazing with any one dimension >1 m is 30 mm, although this value may be adjusted in future with further testing and technological development. Containment systems such as the structural silicone and batten bar methods can effectively increase the bite depth of the glazing within the frame.

Figures 1 to 7 give examples of possible glazing systems with installations of containment systems.

In all situations, both the safety film and the containment system must be installed according to the manufacturers' recommendations.

It is strongly recommended that the installer only use containment systems that have been tested in accordance with the GGF Datasheet 5.18.5 "GGF Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Test Method". The testing must be carried out by an independent test laboratory such as the GGF test facility.

5.2 Silicone Structural Adhesive

A silicone structural adhesive is used to bridge between the safety film and the frame. This has the following minimum characteristics:

- The gap between the edge of the safety film and the frame margin shall be 1.0 + 0.0 / - 0.5 mm
- The silicone shall be a neutral cure structural silicone with good adhesion to plastic and glass surfaces (silicone adhesives often contain adhesion promoters for this purpose), with good weatherability and UV resistance
- The structural silicone shall be added such that the final cross section is triangular

-There shall be at least 10 mm width of contact between the structural silicone and the safety film

-There shall be at least 10 mm width of contact between the structural silicone and the frame

-It is often necessary to clean the frame prior to application of the structural silicone. Wipe away any dust or debris using a soft dry cloth and cleaning with IPA (isopropyl alcohol) is usually suitable for this purpose, but cleaning with soapy water may also be necessary

-Installation of the structural silicone shall otherwise be according to the manufacturer's recommendations, including the time and conditions required for the silicone to attain full performance; the adhesive backed polymeric film manufacturer may have additional requirements

-It may be necessary to cut away the gasket flush with the frame in order to ensure that a width of structural silicone of 10 mm contacts the frame and/or safety film.

Figures 1 and 2 give an example of a possible silicone structural adhesive containment system.

Note: Dow Corning 995 and Tremco ProGlaze SSG structural silicone sealants may be suitable for this type of containment system. Other similar silicones are also suitable but it is expected that the manufacturer or installer of the safety film / containment system will ensure that adequate testing has been completed to demonstrate that the particular silicone selected performs as required.

5.3 Mechanically Fixed Batten Bar

5.3.1 General

There are various possible types of a batten bar with mechanical securing of film which typically have the following minimum characteristics:

-The safety film is installed to the glass surface but with additional film so that the film is extended past the vision area of the glazing and between the batten bar and the frame; some systems further extend the film so that it wraps inside the batten bar

-A batten bar is installed such that the safety film is between the batten bar and the frame, and is secured to the frame with self-tapping screws set a suitable intervals.

-The distance between the batten bar and the safety film / glass surface may be critically important and must be in accordance with the manufacturer's recommendations

-The batten bar should not extend past the frame

5.3.2 To improve the performance of a mechanically fixed batten bar, dependent upon the design, the following additional criteria may apply:

-A structural silicone or similar high bond high performance adhesive may be included between the batten bar and the surface of the safety film to enhance the retention of the film between the batten bar and the frame. Alternatively, double sided high bond strength foam tape may be used between the batten bar and the safety film rather than structural silicone

-An additional gasket may be present on the batten bar so that the safety film is firmly pressed firmly towards the glass. This is aimed at avoiding shearing of the film at the point where it curves away from the glass and under the batten bar, as well as increasing bite depth

-Both the options above may be present in a mechanically fixed batten bar

-It may be necessary to cut away the gasket flush with the frame in order to ensure that the batten bar contacts the frame sufficiently and / or the distance between the batten bar and the safety film on the glazing is correct

-Doors are similar treated

Figures 3, 4 and 5c give examples of possible installations of mechanically fixed batten bar containment systems.

5.4 Adhesively Fixed Batten Bar

This system is similar to the mechanically fixed batten bar; but self tapping screws are not used; they have the following minimum characteristics:

-The gap between the edge of the safety film and the frame margin shall be 1.0 + 0.0 / - 0.5 mm

-A batten bar of suitable cross section profile is fitted so that one flat surface contacts the safety film and one flat surface contacts the frame; often the batten bar has a simple L shaped profile

-Double sided high bond strength foam adhesive tape is used to adhere the

batten bar to the safety film and the batten bar to the frame

-The batten bar should not extend past the frame and should have a minimum width of 12 mm contact with both the frame and safety film

-The system is designed so that the batten bar minimises shearing of the safety film along an edge of the batten bar
-It may be necessary to cut away the gasket flush with the frame in order to ensure that the batten bar contacts the frame and / or safety film sufficiently for good adhesion

-Both the safety film and the batten bar are otherwise installed according to manufacturer's recommendations

-Doors may be similar treated

Figures 3, 5a and 5b give examples of possible installations of adhesively fixed batten bar containment systems

Note: At the current state of technology, carefully designed mechanically fixed batten bar systems have higher performance than adhesively fixed batten bar systems. However, some adhesively fixed batten bars design ensures greater absorption of sudden stresses so that less stress is transferred to the frame; this characteristic may enhance performance of adhesively fixed batten bars in, for example, an explosion.

5.5 Polyester and Acrylic Foam Tapes

These systems are similar to adhesively fixed batten bar systems except that a polyester or acrylic tape is used in place of a batten bar. Self tapping screws cannot be used.

-The gap between the edge of the safety film and the frame margin shall be 1.0 + 0.0 / - 0.5 mm

-The tape is fitted so that part contacts the safety film and part contacts the frame

-Double sided high bond strength foam adhesive tape is used to adhere the tape to the safety film and the tape to the frame

-The tape should not extend past the frame and should have a minimum width of 12 mm contact with both the frame and safety film

-The system is designed so that the tape minimises shearing of the safety film

-It may be necessary to cut away the gasket flush with the frame in order to ensure that the tape can contact the frame and / or safety film sufficiently for good adhesion

-Both the safety film and the tape are otherwise installed according to manufacturer's recommendations

-Doors may be similar treated

Figure 6 gives an example of a polyester or acrylic tape containment system.

Note: At the current state of technology, both mechanically and adhesively fixed batten bar systems have higher performance than polyester and acrylic tape systems.

5.6 Structural Washers

Structural washers are used with bolted structural glazing systems. Guidance on these systems should be obtained from the system manufacturer because certain types of systems do not have re-usable fittings or components.

It is also important to ensure that the sequence of unfastening and re-tightening the fittings are done correctly. Structural washers vary in form but typically have the following characteristics:

-316 Stainless steel is used for the structural washers

-Double sided high bond strength foam tape is used between the washer and film; this adheres the washer both to the fittings supplied by the structural glazing manufacturer and to the safety / security film

-A plastic spacer may be used between the washer and the metal retaining plate; this avoids binding of the metal washer to the metal plate and allows easier tightening of the complete assembly

-The fittings are removed and safety / security film is installed close to the holes already cut through the glazing; it is usually best to treat one fitting at a time rather than remove all the fittings at the same time

Figure 7 gives an example of a structural washer containment system

6. References

6.1 UK Home Office publication “Bombs – Protecting People and Property”, 4th edition, Appendix 2.

Current GGF Datasheets for adhesive backed polymeric film are:

5.18.1 “Visual Quality for Adhesive Backed Polymeric Filmed Glass”

5.18.2 “Installation Quality Standard for Applying Adhesive Backed Polymeric Film to Glass”

5.18.3 “GGF Recommendations for Adhesive Backed Polymeric Film Applied to Glass: Definitions, Descriptions and Components”

5.18.4 “GGF Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of

Glass in the Event of Failure: Types of Systems and Precautions in Use”

5.18.5 “GGF Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Test Method”

5.18.6 “GGF Recommendations for Blast Mitigation: Adhesive Backed Polymeric Film Applied to Glass”

5.18.7 “GGF Standard for On-Site Peel Adhesion Testing of Aged Adhesive Backed Polymeric Film Applied to Vertical Flat Glass”

Figure 1: Example of installing film on framed glazing

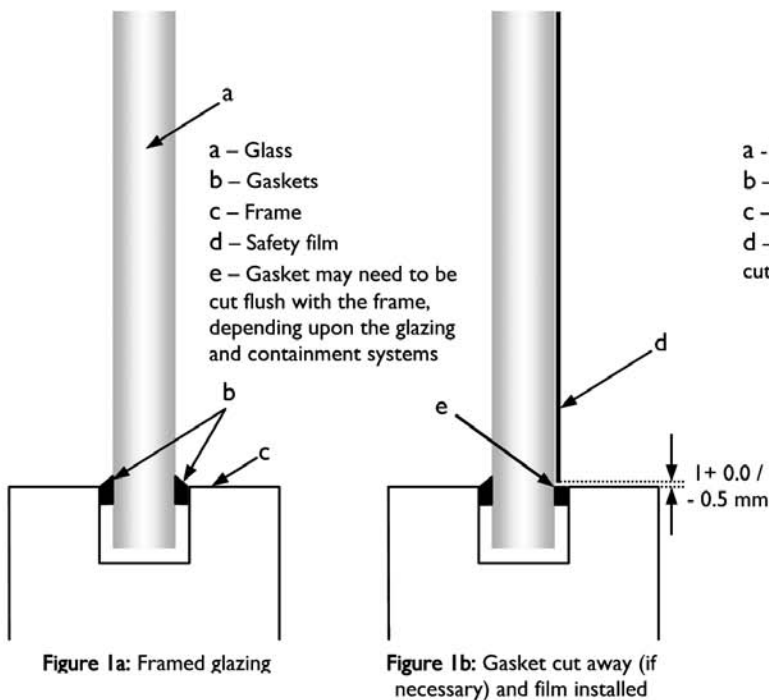


Figure 2: Example of a structural silicone containment system on framed glazing

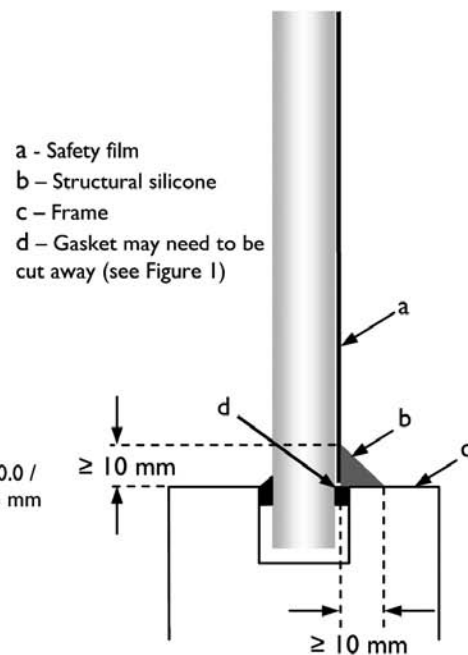


Figure 3: Example of a mechanically or adhesively fixed batten bar containment system

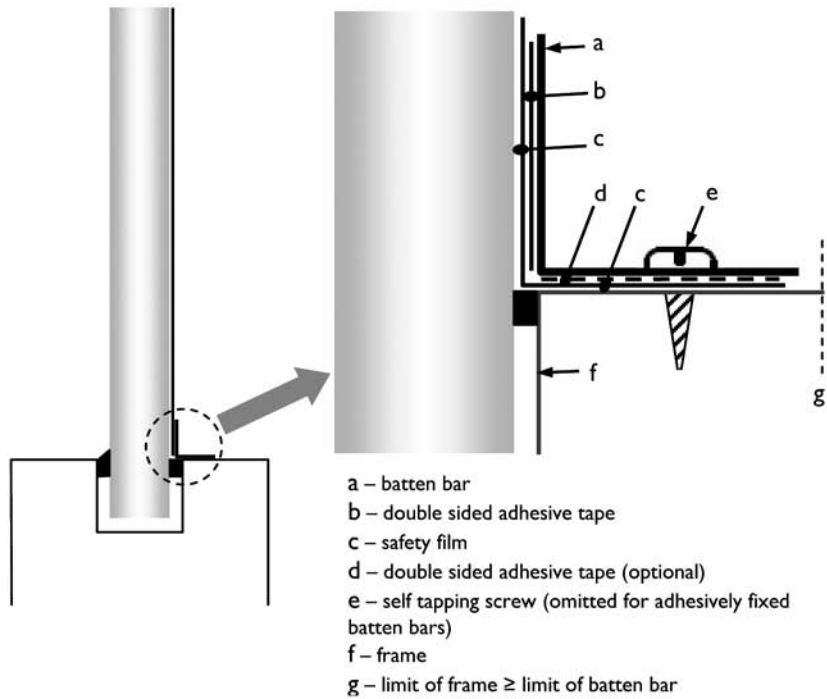


Figure 4: Example of a mechanically fixed batten bar containment system on framed glazing (see Figure 5c for close-up schematic)

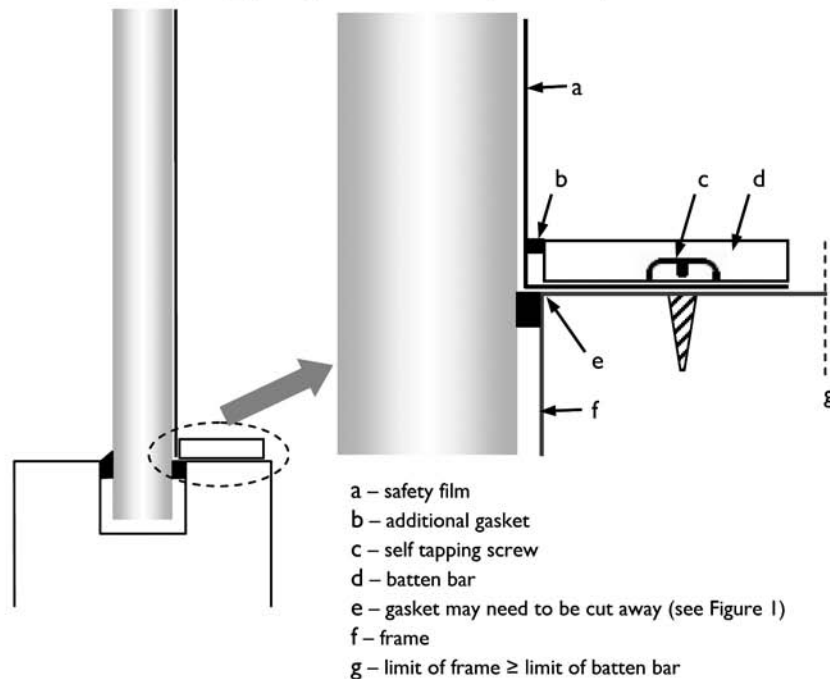


Figure 5: Schematic diagrams of mechanically and adhesively fixed batten bar containment systems

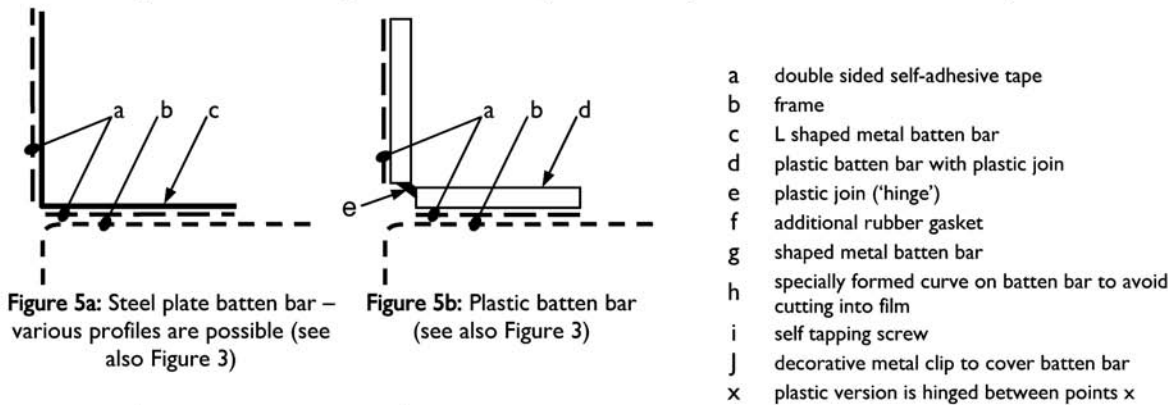


Figure 5a: Steel plate batten bar – various profiles are possible (see also Figure 3)

Figure 5b: Plastic batten bar (see also Figure 3)

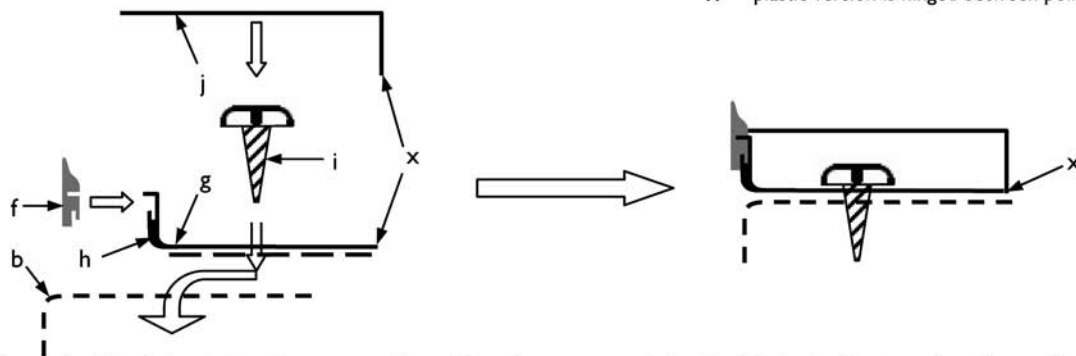
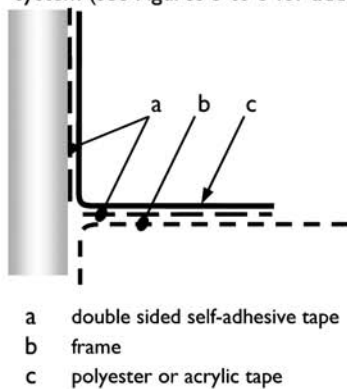


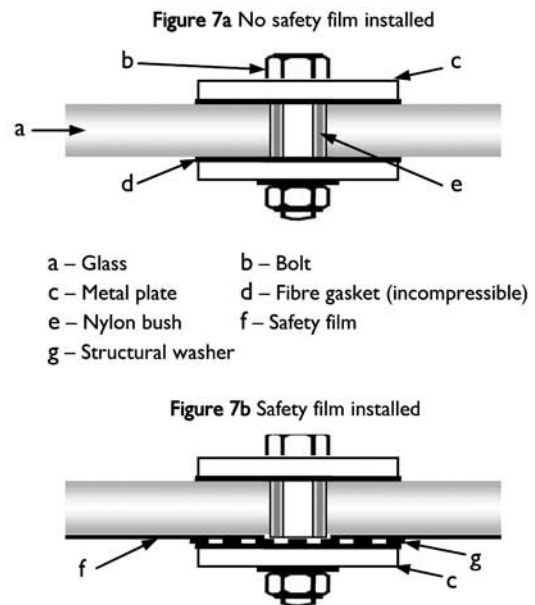
Figure 5c: Aluminium batten bar, secured by self tapping screws and double sided adhesive tape (see Figures 3 and 4); a plastic version is identical except there is a hinge joining the two sections at points x

Figure 6: Example of polyester or acrylic tape containment system (see Figures 3 to 5 for additional details)



- a double sided self-adhesive tape
- b frame
- c polyester or acrylic tape

Figure 7: Example of installing film on bolted glazing



- a – Glass
- b – Bolt
- c – Metal plate
- d – Fibre gasket (incompressible)
- e – Nylon bush
- f – Safety film
- g – Structural washer

Note: Some structural washer systems use a thin plastic spacer between the structural washer and the metal retaining plate