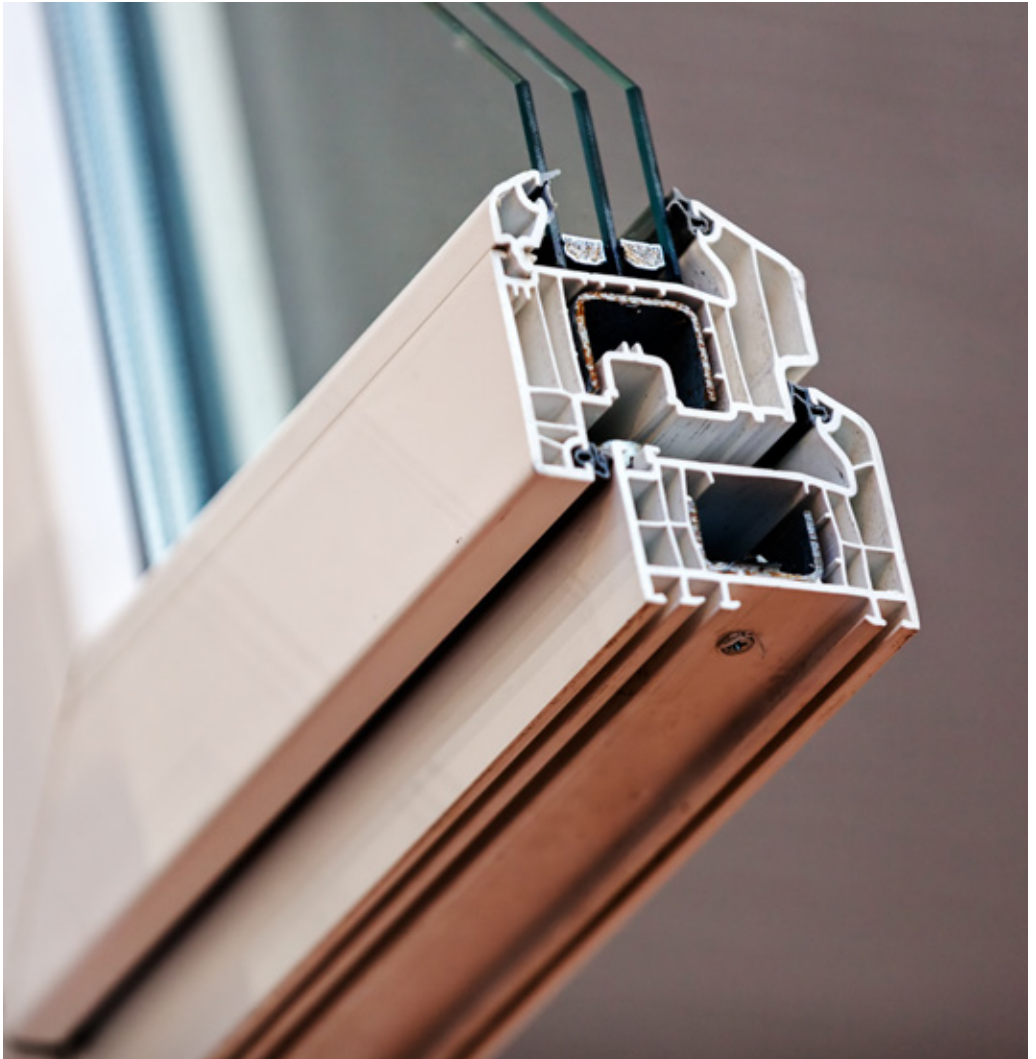


Triple Glazing Guidance

Guidance for IGU Manufacturers, Frame Fabricators and Installers



Foreword

In recent years the use of Triple Glazing (Insulating Glass Units consisting of 3 panes of glass with 2 cavities) has been on the increase. This increase may be seen as a response to some of the lifestyle shows on TV, where dwelling designs have used larger areas of glazing than referenced in Building Regulation Guidance. Consumer demand for triple glazing accelerated during 2014 following high profile promotion of triple glazing within the industry. Demand is also being created due to the increased awareness of the thermal benefits of triple glazing and is becoming the standard specification within low and zero energy homes.

This guidance document is for the use of manufacturers and installers in relation to triple glazing in the UK.

Scope

This guidance document will consider the benefits associated with triple glazing, the factors that should be considered by manufacturers and installers of triple glazed windows. The factors to be considered are thermal performance, acoustic performance, IGU and frame design and specification, manufacturing requirements, the effects on distribution and installation and the possible effects on optical and visual quality.

Definitions

Insulating Glass Unit (IGU) – An assembly consisting of at least 2 panes of glass separated by one or more continuous perimeter spacers, hermetically sealed along the periphery, mechanically stable and durable.

Double Glazing – An IGU manufactured using 2 panes of glass separated by a cavity of controlled width.

Triple Glazing – An IGU manufactured using 3 panes of glass incorporating 2 cavities of controlled width.

U_w – Whole window U-value for a window of standard size and configuration, calculated in accordance with BS EN ISO 10077 Parts 1 & 2.

U_f – U-value of the window/door framing material calculated in accordance with BS EN ISO 10077 Parts 1 & 2.

U_g – Centre pane U-value of the IGU calculated in accordance with BS EN 673.

g-value – The normal solar energy transmittance of the glazing unit as determined by BS EN 410.

WER – Window Energy Rating scheme operated by British Fenestration Rating Council (BFRC) or similar bodies.

DSER – Doorset Energy Rating scheme operated by British Fenestration Rating Council (BFRC) or similar bodies.

IGU and Window Thermal Performance

Thermal Performance

The thermal performance of installed windows is expressed either as a whole window U-value (U_w) or, where Window Energy Ratings (WER) are being used, as a rating from G to A+, A+ being the highest rating. When calculating WERs, the g-value of the IGU is also considered to determine the benefit from solar gain through the window glazing. The third element included within the calculation is air leakage. In some buildings, in particular those subject to planning constraints due to heritage issues, compliance with building regulations may be demonstrated by using centre pane U-values (U_a).

Doorset Energy Ratings (DSER) are also used as a method of complying with Building Regulations. Whole door U-value and air leakage is used in the calculation and the g-value of the glass is only considered where the proportion of glazing is greater than 60%.

The thermal performance of an IGU is measured as centre pane U-value and is usually calculated using the methods described in BS EN 673. The heat loss of a window or door (U-value) is calculated in accordance with BS ISO 10077 parts 1 & 2. If WERs or DSERs are being used they are calculated in accordance with the rules determined by organisations such as BFRC to comply with the requirements contained within the Building Regulations.

When using triple glazing, the effect on U-value will depend on the configuration and specification of the IGU. With certain double glass unit specifications, the whole window U-value may be better than that achieved using a basic specification triple glass IGU.

WERs and DSERs will also be affected by the use of triple glazing when compared with double glazing, not only due to changes in

U-value but also a reduction in g-value will reduce the contribution of solar gain. Although a reduction in solar gain may have an effect on WERs, it may also be beneficial in some locations in summer months by reducing the overheating of rooms.

Table 1 below gives some typical values for a range of IGU configurations with warm edge spacer bar (average value):

Typical values for double glass IGU							
IGU Thickness	IGU Configuration	Number of Low-E coatings	Cavity Gas	Centre Pane U-value to BS EN 673	g-value BS EN 410	Typical PVC-u Double Glazed Window	
						Whole window U-value U _w	Window Energy Rating (WER)
28mm	4-20-4	1	Air	1.5	0.7	1.6	-13 (C)
28mm	4-20-4	1	Argon	1.2	0.71	1.3	+7 (A)
Typical values for triple glass IGU							
IGU Thickness	IGU Configuration	Number of Low-E coatings ⁽¹⁾	Cavity Gas	Centre Pane U-value to BS EN 673	g-value BS EN 410	PVC-u Window as above with Triple Glazed	
						Whole window U-value U _w	Window Energy Rating (WER)
28mm ⁽²⁾	4-8-4-8-4	1	Argon	1.3	0.63	1.4	-9 (B)
28mm	4-8-4-8-4	2	Argon	1.0	0.61	1.1	+2 (A)
36mm ⁽²⁾	4-12-4-12-4	1	Argon	1.1	0.64	1.3	-8 (B)
36mm	4-12-4-12-4	2	Argon	0.8	0.61	1.1	22 (A++)
40mm	4-14-4-14-4	1	Argon	1.0	0.64	1.1	+13 (A+)
40mm	4-14-4-14-4	2	Argon	0.7	0.61	1.0	+29 (A++)
44mm	4-16-4-16-4	1	Argon	0.9	0.64	1.1	+19 (A+)
44mm	4-16-4-16-4	2	Argon	0.6	0.61	0.9	+36 (A++)

Note ⁽¹⁾: The values used in this table are on the basis that if 1 low-e coating is used, it is on surface 3 for double glass and surface 5 for triple glass. If 2 low-e coating are used on triple glass, it is on surfaces 3 and 5. If this configuration is not used, it will adversely affect the g-value and possibly reduce the WER or DSR.

Note ⁽²⁾: There is no benefit of using triple glazing, subject to cavity width, unless 2 panes of low-e glass are used.

IGU and Window Thermal Performance

Benefits to the homeowner

Provided the triple glazed windows and doorsets are correctly specified, taking table 1 into account, there are significant benefits for homeowners.

A reduction in whole window/doorset u-value will result in an improvement in comfort levels for the occupant and lower heating costs. The improvement in comfort is the result of the inner glass surface temperature remaining closer to the ambient room temperature due to reduced heat loss by conduction and convection through the glazing. This reduces the downdraughts caused by the air close to the glazing being cooled by heat loss and forming convection currents within the room. This also reduces the cold areas within the room.

It is this improvement in thermal performance and subsequent increased comfort levels for the homeowner that may influence their behaviour, resulting in reduced heating system thermostat settings with the associated reduction in heating costs.

When triple glazing is correctly specified, the reduction in g-value and the resultant solar gain loss is more than compensated for by the improvement in U-value.

Acoustic performance

As with double glass IGUs, the acoustic performance of installed windows depends on more than just the glass unit specification. If the same framing system is used and installation quality is the same, the use of triple glass IGUs will not necessarily improve the sound reduction associated with the whole window. Other factors relating to the building itself, not associated with the window, have significant effect on the acoustic performance although many people wrongly attribute poor sound attenuation to the performance of the window only.

When considering the IGU, improving sound reduction through the window relates to the specification of the glass used rather than just adding an additional pane of glass. The important part of the specification to consider is the glass panes themselves; if all panes are the same thickness (e.g. 4mm), resonance occurs that limits the level of sound reduction through the glazing. The acoustic performance through the glazing may be reduced in a number of ways, the simplest would be the replacement of one pane with one of a different thickness, for example replacing one 4mm pane with a 6mm pane. Further improvement will be achieved by incorporating one pane of specialist acoustic laminated glass.

Table 2 showing relationship between IGU (manufacturer's data) and Window sound reduction index (BS EN 14351-1 Annex B)

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IGU Manufacture

Specification considerations

The specification of the triple glass IGU must be determined based on the following issues:

- Number and performance of low emissivity coatings to be used, refer to table 1 in relation to thermal performance of IGU and potential thermal performance of whole window.
- Cavity fill e.g. 90% Argon.
- Use of warm edge spacer bar, as shown in Table 1. Guidance from spacer bar manufacturer should be sought regarding the level of desiccant fill required in hollow warm edge spacer bars.
- As the exposure orientation (North, South etc.) of the installed IGU cannot be known at the point of IGU manufacture, it is recommended, but not essential, that triple glass IGUs should be manufactured with a thermally toughened or heat strengthened centre pane to resist the issue of thermal fracture caused by differential solar heating, particularly with south facing elevations. For Commercial premises a thermal safety check should always be carried out.
- Secondary sealant depths in triple glass IGUs may need to be increased above that used in double glass IGUs. Guidance should be obtained from sealant manufacturers.
- Bars and leading will need to be considered regarding alignment when using duplex bars and face fix astragals.

Components

Manufacturers of IGUs will need to consider the following issues relating to the supply, storage, picking and processing of components used in the manufacture of triple glass units. The main issue being one of volume:

- Stock control and material ordering
 - Manufacture of Triple Glass IGUs requires additional volumes of components, 50% more glass, 100% more spacer bar, additional desiccant and, if thicker units are being manufactured, additional volumes of primary/secondary sealant.

IGU Manufacture

The introduction of triple glass IGU will affect all areas of the manufacturing process resulting in:

- Additional glass cutting, processing and toughening capacity for centre pane.
- Additional processing time for spacer bar preparation and application.
- Consideration should be given to handling, storage and delivery of triple glass units due to the increased weight and volume.

Window and doorset design

The frame design and the effect on the aesthetics of the finished frame should be considered.

If an existing framing system is to be used and is modified to accept a deeper IGU, the symmetry of the frame will be changed by modifying the glazing bead either by making it narrower, changing the design to give a bolelection effect or a combination of both. Changes to the frames aesthetics should be explained to consumers and installers. Installation of a triple glass IGU into an existing frame system designed for double glass IGUs will require the system to be re-tested for a number of aspects of performance such as thermal, security, weathering and durability.

If a new frame system is designed specifically to suit triple glass IGUs, the performance of the new system in terms of weathering, durability, thermal performance and security must be assessed.

Frame fabrication

Dependant of the method being used to enable the frame to accommodate triple glazing and the overall IGU depth, it may be necessary to manufacture a specific frame for triple glazing or use a different bead size or type.

Consideration must also be given to the additional weight of the IGU and the effect on the service life expectancy of the hardware, in particular the hinges. Hardware manufacturers should be consulted to ensure the correct hardware is used to accommodate the additional weight of the IGU.

Manufacturing of the frame is similar to that for double glass IGUs and therefore will have little or no effect on manufacturing time provided it can be integrated into a normal production batch/run.

Where frames are being factory glazed, the use of triple glass IGUs will increase the weight of the glazed frame and therefore manual handling issues as well as vehicle capacity, as detailed for IGU manufacturers, will need to be considered. Where frames are being supplied with loose IGUs, the handling and distribution of the unglazed frames does not change but again, as with IGU manufacturers, the distribution and handling of heavier IGUs should be considered.

Installation

The process of installing triple glass IGU frames will not change from that of installing double glass frames, however there will be issues concerned with the manual handling and installation of triple glass IGUs due to the additional weight

- Handling of IGU will need to be considered, in particular given the additional weight of the IGU, it may require additional handling of the IGU to the frame often through the client's home.
- Correct setting blocks will need to be used to ensure the entire weight of the IGU is evenly and correctly distributed onto the frame/sash. It is vital to ensure the setting/location blocks are of sufficient width to support the triple glass unit across its entire depth.

Care will be needed when beading standard window systems that have a modified bead size or design.

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