

insulating glass units – visual quality overview

The majority of glass used in buildings today is manufactured from high quality float glass. In many installations, the glass may require some additional processing in order to provide the optimum performance in terms of safety, security and energy management. Float glass may be coated, to provide a specific level of solar control or thermal insulation, or both. It may be screen printed or flood coated with ceramic frit, or the surface altered, in order to provide decoration or privacy. In addition the glass may be heat treated to impart certain characteristics, thermally toughened for increased strength and safe breakage, heat strengthened for additional strength and glazing frame retention, heat soak tested to reduce the risk of spontaneous breakage, bent for aesthetic appeal, laminated for safety, sound attenuation and security and included in double or triple glazing units to provide improved thermal insulation and noise reduction. All these processes involve changes to the raw float glass in one way or another, usually resulting in varying amounts of alteration in the visual quality and appearance of the original float glass. There are quality standards for float glass and most of the processed products derived from the float glass, as mentioned above. There are also other standards that relate to some of these products in combination within multiple glazing units. This technical note is designed to inform of these standards, highlighting specific features of the product and summarising any comments or requirements for the visual quality.

Float Glass

Float glass is manufactured on a continuous basis; typical float plants produce around 700 tonnes of glass per day. This requires a similar volume of raw materials to be introduced during the same period, which are melted down, mixed and refined at high temperatures while contained within a refractory lined furnace. The molten material is then formed in a continuous ribbon of glass. The standard for float glass in Europe is EN 572 Glass in Building – Basic soda lime silicate glass products – Part 2: Float glass, and defines optical, visual and spots faults and the acceptance levels. The viewing distance for float glass is 4.5 metres.

Coated Glass

A large proportion of solar control and low emissivity coated glass is manufactured by applying layers of metals and metal oxides or nitrides, in various combinations of very thin layers, to the surface of float glass. The standard for the above described coated glass in Europe is EN 1096 Glass in Building – Coated Glass – Part 3 : Requirements and test methods for class C and D coatings and Part 1 of this standard defines uniformity, stains, spots, pinholes and scratch faults and the acceptance levels. The glass is viewed from a minimum distance of 3 metres for no more than 20 seconds.

Thermally Toughened Glass

In many cases, float or coated float glass may be thermally toughened. This is most commonly performed within a horizontal oscillating toughening plant. The plant consists of four sections, the on-load section, where glass is positioned ready for processing. Next is the furnace, where panes of glass are heated above their softening point. The cooling section, where the glass is rapidly quenched in order to create the necessary stress within the glass, which provide increased strength and 'break safe' characteristics, followed by more gentle cooling to a temperature where the glass may be safely handled, and finally on to the offload section where the glass may be identified, packaged and removed to a holding frame. The standard for toughened glass in Europe is EN 12150 Glass in building – Thermally toughened soda lime silicate safety glass – Parts 1 and 2. The standard does not contain any visual quality limits, but does stipulate that visual inspection should be included during the manufacturing process. The processor is responsible for determining the visual quality standards to be used for their products. However, the standard does mention the existence of roller wave and pitting (roller pick-up but only refers to glass of 8 mm thickness or greater), and anisotropy, but does not define any limits regarding these characteristics. The Glass and Glazing Federation have issued a standard, GGF Standard for the Quality of Thermally Toughened Soda Lime Silicate Safety Glass for Building 4.4. This standard does offer advice in terms of faults within the glass, stating that they should be as the requirements of the basic glass in the relevant section of EN 572. Surface damage is also addressed, such as scratches and scuffs, when the glass is viewed from no less than 3 metres in natural daylight.

Heat Strengthened Glass

Heat strengthened glass is produced in a similar way to thermally toughened glass with the exception that the cooling of the glass, after heating, is less intense, resulting in lower stress levels within the glass. This means that the glass breaks similar to annealed glass, so it cannot be used as a safety glass, but it is roughly twice as strong as annealed float glass. The standard for heat strengthened glass in Europe is EN 1863 Glass in building – Heat Strengthened soda lime silicate safety glass – Parts 1 and 2. The standard does not contain any visual quality limits, but does stipulate that visual inspection should be included during the manufacturing process. The processor is responsible for determining the visual quality standards to be used for their products. However, the standard does mention the existence of roller wave and anisotropy, but does not define any limits regarding these characteristics.

Heat Soak Tested Glass

Heat soak tested glass is produced by carefully heating and cooling thermally toughened glass in an oven. The heat soak test is performed on thermally toughened glass only. It is an additional process designed to minimise the likelihood of glass suddenly breaking (spontaneous fragmentation) due to the presence of nickel sulphide particles within the body of the glass when installed, where the breakage may result in harm to people. The standard for heat soak tested glass in Europe is EN 14179 Glass in building – Heat soaked thermally toughened soda lime silicate safety glass – Parts 1 and 2. The standard does not contain any visual quality limits, but does stipulate that visual inspection should be included during the manufacturing process. The processor is responsible for determining the visual quality standards to be used for their products. However, the standard does mention the existence of roller wave and pitting (roller pick-up, but only refers to glass of 8 mm thickness or greater), and anisotropy, but does not define any limits regarding these characteristics.

PVB Laminated Float Glass

PVB Laminated float glass is produced by placing a thin layer of plastic material, in this case polyvinylbutyral, or PVB, between two layers of float glass and subjecting the laminate to a heating regime, under pressure, in order to bond the interlayer and glass together, resulting in a three ply laminate. Laminates may also be produced with a greater number of glass and PVB layers, to provide more robust glass structures. Three ply laminates are generally used where people may fall onto the glass (human impact) as a safety glazing material, since the glass may break but the pieces are held together safely by the PVB layer. 5 ply or more laminates are primarily used for security glazing, where increased resistance to access through the glass is necessary to protect people or valuable items. The standard for laminated glass in Europe is EN ISO 12543 Glass in building – Laminated glass and laminated safety glass – Parts 1 to 6. Part 6 deals with appearance and defines, vents, creases and streaks, spots and linear defects and the acceptance levels. The glass is visually inspected at a distance of 2 metres under diffuse daylight conditions.

Decorative Glass

Decorative glass types are wide ranging and varied. There are many methods of decoration including materials stuck onto the surface of glass, paint or enamel applied to the glass surface, colourant within the glass, laser patterns within the glass, patterns cut in the glass surface, printing on the interlayers within laminated glass, coloured interlayers, surface alteration such as sand blasting or acid etching, to name some of the most common types. There are no visual quality standards for these products other than where they might be related to any of the previous mentioned glass types and relevant standards. It is left to the glass processor to specify any necessary standards for these products, based on the capability of the people and equipment involved during manufacture within that company.

Discussion

At this point it can be understood that the glass product used by the insulating glass manufacturer or glass processor are, in general, already provided to a standard quality, which involves visual inspection from a minimum distance of 2, 3 or 4.5 metres, depending on the product. It then follows that any insulating glass units or processed glass that are produced by further processing of these products is unlikely to result in a betterment of these standards. It is possible to improve the quality of finished products by individual selection of panes of the desired quality once additional processing is complete, but it is also likely to result in increased rejection rates and costs for the units. Recognised insulating glass unit standards take account of the visual quality of the basic glass products when used in combination within a unit, providing the only practical evaluation of the appearance of the unit. Where a visual quality standard is to be applied to a contract where it is more onerous than current recognised standards, the manufacturer of the finished products should ensure that a standard is produced in writing and agreed by both parties prior to commencing supply. Training should be provided to incorporate the agreed standard within the operations of all parties involved.

Insulating Glass Units

Insulating glass units are manufactured by bonding together two or more panes of glass with spacers between each pane, at the perimeter edges, to result in a unit of pre-determined width. The specification of most units now includes at least one coated pane within the unit and very often heat treated or laminated glass. In the UK the only widely recognised industry standard is produced by the Glass and Glazing Federation. Visual quality standard for installed insulating glass units constructed from flat transparent glass 4.10. Original copies of the standard may be obtained from the GGF offices in London or the GGF website. In recent years, there has been a tendency in the architectural market to prefer a more detailed standard regarding visual quality and for specific projects the Hadamar standard, a body in Germany, similar to the Glass and Glazing Federation in the UK and Ireland, is adopted and included in project specifications. Original copies may be obtained from the Bundesverband Flachglass e. V. website. Another alternative standard which is occasionally adopted is the CEKAL standard, a French organisation, Critères d'appréciation de l'aspect des vitrages. Original copies are available from CEKAL Association website.

Note: An important point to consider in using the above insulating glass unit standards, is that they both conflict with the requirements of some EN standards.

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