double glazing Interesting stuff

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Thermal performance

The maximum insulating efficiency of a standard IGU is determined by the thickness of the space. Typically, most sealed units achieve maximum insulating values using a space of 16–19 mm (0.63–0.75 in) when measured at the centre of the IGU.

IGU thickness is a compromise between maximising insulating value and the ability of the framing system used to carry the unit. Some residential and most commercial glazing systems can accommodate the ideal thickness of a double paned unit. Issues arise with the use of triple glazing to further reduce heat loss in an IGU. The combination of thickness and weight results in units that are too unwieldy for most residential or commercial glazing systems, particularly if these panes are contained in moving frames or sashes.

This trade-off does not apply to vacuum insulated glass (VIG), or evacuated glazing,[5] as heat loss due to convection is eliminated, leaving radiation losses and conduction through the edge seal.[6] These VIG units have most of the air removed from the space between the panes, leaving a nearly-complete vacuum. VIG units which are currently on the market are hermetically sealed along their perimeter with solder glass, that is, a glass frit having a reduced melting point. Such a glass seal is rigid, and will experience increasing stress with increasing temperature differential across the unit. This stress may prevent vacuum glazing from being used when the temperature differential is too great. One manufacturer provides a recommendation of 35 °C.

Vacuum technology is also used in some non-transparent insulation products called vacuum insulated panels.

An older-established way to improve insulation performance is to replace air in the space with a lower thermal conductivity gas. Gas convective heat transfer is a function of viscosity and specific heat. Monatomic gases such as argon, krypton and xenonare often used since (at normal temperatures) they do not carry heat in rotational modes, resulting in a lower heat capacity than poly-atomic gases. Argon has a thermal conductivity 67% that of air, krypton has about half the conductivity of argon.[7] Krypton and xenon are very expensive. These gases are used because they are non-toxic, clear, odourless, chemically inert, and commercially available because of their widespread application in industry. Some manufacturers also offer sulfur hexafluoride as an insulating gas, especially to insulate sound. It has only 2/3 the conductivity of argon, but it is stable, inexpensive and dense. However, sulphur hexafluoride is an extremely potent greenhouse gas that contributes to global warming. In Europe, SF
6 falls under the F-Gas directive which ban or control its usage for several applications. Since 1 January 2006, SF
6 is banned as a tracer gas and in all applications except high-voltage switchgear.[8]

In general, the more effective a fill gas is at its optimum thickness, the thinner the optimum thickness is. For example, the optimum thickness for krypton is lower than for argon, and lower for argon than for air.[9] However, since it is difficult to determine whether the gas in an IGU has become mixed with air at time of manufacture (or becomes mixed with air once installed), many designers prefer to use thicker gaps than would be optimum for the fill gas if it were pure. Argon is commonly used in insulated glazing as it is the most affordable. Krypton, which is considerably more expensive, is not generally used except to produce very thin double glazing units or relatively thin, or extremely high performance triple glazed units. Xenon has found very little application in IGUs because of cost.[10]