

## GLASS TYPES USED IN BUILDINGS

### INTRODUCTION

Selecting the right glass for a project requires detailed information on the performance properties of the glass type and the manufacturing processes involved. Each process has limitations, and each individual glass processor may have further limitations. Therefore, the specification of glass for a particular project may often be a collaborative effort between the designer and the glazing contractor or processor. This TECHnote outlines the glass types commonly used in buildings and where they are likely to be used.

### COMMONLY USED GLASS TYPES

Most glass used in the construction industry is manufactured using the float glass process to produce **annealed** glass in various thicknesses. The annealed glass may undergo further processing to produce other types of glass. The Australian Glass and Window Association (AGWA) classifies glass into various types including the following:

**Annealed or float glass:** Basic flat glass processed by slow controlled cooling to prevent residual stress in the glass. Annealed glass can be cut, machined, drilled, edged and polished but tends to break into large, jagged shards. As it provides optical clarity, it is often used in double-glazed windows.

**Toughened (tempered) glass:** Annealed glass treated with a thermal tempering process, where the glass is heated to 600°C and then cooled rapidly whilst the core remains hot. The differential cooling rates, of the glass surface and core, results in the surface being in a state of compression and the core in a state of tension. This makes toughened glass more resistant to breakage and causes it to break into small, regular, square fragments, rather than long shards. Fully tempered glass is approximately four times stronger than annealed glass of the same thickness and configuration.

Toughened glass cannot be cut or drilled after tempering, and processes such as edge-grinding, sandblasting or acid-etching can cause premature failure. Nickel sulphide impurities in the glass can also cause it to break. Heat soaking can reduce this risk and is required by the NCC for some glazed assemblies. It is used in building facades, glass sliding doors, building entrances, bath and shower screens, and interior partitions.



Annealed glass   Laminated glass   Lamination

Laminated glass fragmentation   Toughened (tempered) glass fragmentation   Coated glass

**Laminated glass:** Comprising two or more layers of glass permanently bonded together with an interlayer of resin, the glass and interlayer can be in a variety of colours and thicknesses. Lamination may be a result of the cast in place method (CIP), where the resin is poured between two sheets of glass, or the more commonly used heat and pressure method. The method used is dependent on such factors as glass texture or type of interlayer required, e.g. resin poured for textured glass and polyvinyl butyral (PVB) applied using heat and pressure method. The most common interlayer used is PVB, other polymers used include ethylene vinyl acetate (EVA) or polyurethane (PU). Interlayer selection is determined by properties required, e.g. PVB has a higher safety performance.

Laminated glass is considered as **safety glass** because of its ability to stay intact (held by the interlayer) when broken, rather than shattering. The interlayer can also provide sound dampening, fire resistance, ultraviolet filtering or decorative effects. It is used in building facades and where cyclone resistance, ballistic resistance and high security are required.

**Coated glass:** Glass with a permanent coating applied to the surface by controlled exposure to vapours to modify its appearance and provide other properties such as low maintenance (self-cleaning glass), special reflection/transmission/absorption properties, scratch resistance or corrosion-resistance. The coating process may take place when the glass is still in the float line and still warm (*hard coated*) or in a vacuum vessel when the glass is cold (*off-line* or *vacuum*). The process used is dependent on factors such as application and emissivity required, e.g. insulating glass units (IGUs) or non-IGUs. Coated glass may be toughened or laminated. It is used in building facades, shower screens, pool fencing, balustrades, splashbacks, and architectural and frameless glass.

**Security glass:** A type of laminated glass consisting of multiple layers of glass and rigid interlayers, varied to provide the resistance level required. It is used to resist physical, ballistic and bomb blasts.

### Some common AS 1288 applications of glass, other than windows

#### Doors:

- Wardrobes: Grade A Safety glass, organic-backed or solid-backed.
- Doors in bathrooms: Grade A safety glass or Grade B safety glass conforming to Table 5.1.
- Decorated glass panels: 3 to 4 mm thick annealed glass panel with maximum area of 0.1 m<sup>2</sup> or 5 to 6 mm with maximum area of 0.26 m<sup>2</sup>.

#### Bathrooms:

Frameless glazing: Grade A toughened or toughened laminated safety glass with minimum thickness of 6 mm.

#### Glazing in schools and early childhood centres:

Glazing within 1000 mm of floor level: Grade A safety glass conforming to Table 5.1 for fully framed and Table 5.3 for unframed glazing.

#### Shop fronts:

Glass conforming to clauses 5.6 and 5.7.

#### Balustrading:

Dependent on glass support conditions – cantilevering, two-edge, three-edge, or four-edge.

#### Mirrors:

Glass may either be Grade A safety glass or annealed glass if fully backed with a solid material.

### Relevant standards

AS 1288 *Glass in buildings – Selection and installation.*

AS 2208 *Safety glazing materials in buildings.*

AS 4666 *Insulating glass units.*

AS/NZS 4667 *Quality requirements for cut-to-size and processed glass.*

AS/NZS 4668 *Glossary of terms used in the glass and glazing industry.*

### Relevant worksections

0432 *Curtain walls.*

0451 *Windows and glazed doors.*

0456 *Louvre windows.*

0461 *Glazing.*

0462 *Structural silicone glazing.*

0466 *Structural glass assemblies.*

0467 *Glass components.*

0524 *Partitions – glazed.*

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### OTHER GLASS TYPES

Other commonly used glass types not identified by the AGWA include:

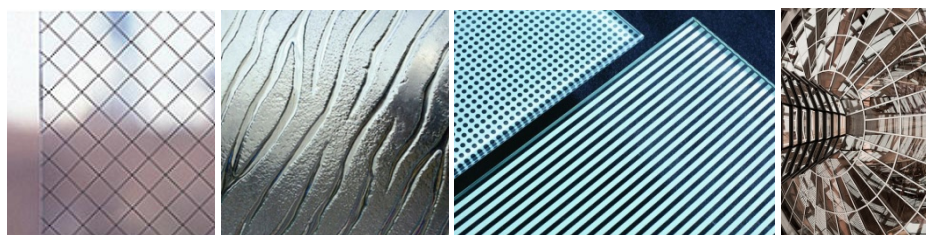
**Heat strengthened glass:** Heat strengthened glass is subjected to the same process as toughened glass (and shares similar properties) but allowed to cool more slowly. It is generally twice as strong as annealed glass of the same thickness and configuration. It is used where safety glass is not required but a greater resistance to wind loading and thermal stress is required, e.g. curtain walls and skylights.

**Fire-resistant glass:** May be toughened, (clear plate) wired or laminated glass, depending on the integrity and/or insulation level required. Fire-resistant glass is installed as part of a tested and approved glazing system to achieve the required fire-rated performance. Clear plate wired glass is often used in fire doors.

**Low iron (ultraclear) glass:** Glass with a large portion of the iron content removed, to eliminate the green tinge associated with standard float glass. Low iron glass has a higher level of solar energy transmission and so is suitable for solar heat collectors, commercial greenhouses and photovoltaics. It is available toughened or laminated.

**Wired (reinforced) glass:** Glass where wire mesh is embedded during the manufacturing process and may be either clear plate or figured rolled glass. Both types are classified as Grade B safety glass to AS 2208. Figured rolled wire glass is used in domestic shower screens and other locations where privacy is required.

Polished wire glass is an optically clear glass achieved by polishing the surface.



Polished wire glass

Kiln formed glass

Ceramic coated, fritted glass

Mirrored glass

### SPECIAL (DECORATIVE) GLASS

**Acid etched glass:** An acid wash applied to one surface of the glass to produce a frosted finish. It is similar in appearance to sandblasted glass but marks less and is easier to handle, process and maintain. It can be toughened to achieve Grade A safety requirements. Original sheets of acid etched glass have a clear border of 10 to 15 mm around the entire perimeter of the sheet. It is used decoratively or to achieve privacy.

**Ceramic-coated glass:** Also known as ceramic fritted, opacified, colour clad, ceramic base painted, or ceramic baked glass. Paint is applied onto clear, tinted, patterned or reflective glass (pyrolytic only), which is then heat strengthened. The paint may be applied by silk screen, digital printer, or roller/curtain coater. This glass may be used internally or externally, e.g. as spandrel glass or splashbacks.

**Mirrored glass:** Glass with a metallic coating applied to one side of the glass, e.g. silver, aluminium, gold, chrome; and sealed with a protective layer. Mirrored glass may be used for specific functions or for aesthetics. A one-way mirror has a thinner coating and no protective or opaque layer.

**Patterned glass:** Flat glass with a textured patterned surface, achieved by the figured rolled or casting method. The figured rolled method involves passing heated glass (usually after exiting the furnace where it is made) between rollers with a negative relief of the pattern. The cast glass method, also known as *kiln, formed*, involves heating and softening the glass sufficiently so it will melt over into moulds. Patterned glass is commonly used in interior decoration and architecture to achieve privacy or to create a decorative finish (or both if desired).

**Sandblasted glass:** Glass pressure-blasted with a fine abrasive. Patterns can be achieved by masking off the clear areas with a protective film. It is recommended that the areas of working be restricted to 0.5 mm (deep) for both acid etching/sandblasting on toughened glass, and that areas within 25 mm of pane edges and holes/cut-outs be protected to minimise glass fracture. There may also be slight variances in etched depth, which may affect transparency level. It is used decoratively or to achieve privacy.

### AS/NZS 4668 Definitions

**Blemish:** A noticeable imperfection.

**Body tinted glass:** Glass produced by small additions to the melt of metal oxides, which do not materially affect the basic properties except for colour and solar energy transmission.

**Casting:** Process of shaping glass by pouring it into a mould or onto a table.

**Cladding glass:** Glass with coloured ceramic enamel fused on the surface. Normally used for curtain wall cladding.

**Curved glass:** Glass that has been deliberately shaped by forming or bending.

**Figured rolled:** Glass produced by the rolling process. Used where transparency is not important.

**Safety glass:** Glass so constructed, treated or combined with other materials as to reduce, in comparison with ordinary sheet glass, rolled glass or plate glass, the likelihood of cutting and piercing injury to persons by the glass should it be broken by human contact, which meets the test requirements of the relevant safety glazing Standards.

**Spandrel glass:** Glass used in exterior wall panels between floors.

### Characteristics to consider

**Glass thickness:** Refer to AS 1288 and AS/NZS 4667 for limitations and requirements.

**Edge processing:** The edge of the finished glass can have impact on the long-term structural performance of the glass system. The typical edge types are:

Edge Outline	Description
	Flat ground
	Flat polish
	Ground pencil edge
	Polished pencil edge
	Ground mitre
	Bevel
	Seamed edges

**Surface coating:** This is usually described by function, e.g. self-cleaning, low emission; or by coating type, e.g. pyrolytic hard coating.

**Reflective coating:** This is usually to reduce heat and light transmission.