

04

toughened and heat treated glass



Producing **toughened and heat strengthened glass** begins with the feeding by conveyor of cut-to-size annealed sheets of glass (with minimum arrised edges) into a furnace. The glass oscillates back and forth on ceramic rollers to an approximate temperature of 620°C. Under computer control, the glass moves into the quench where it is rapidly cooled by high pressure cool air. This 'snap' cooling or quenching induces compressive stresses to the glass surface, while the centre remains in tension. Although the physical characteristics remain unchanged, the additional stresses created within the glass increases its strength by 4–5 times (for toughened glass) compared to that of annealed glass of equal thickness. Toughened safety glass produced by National Glass is manufactured to the requirements of AS/NZS2208 *Safety glazing materials in buildings* and AS/NZS2080 *Safety glass for land vehicles*.

what is heat treated glass?

In this section **heat treated** will refer to heat strengthened and heat soaked glass.

toughened glass

features and applications

- Safety** – Toughened safety glass is manufactured to AS/NZS2208 and 2080 and is a Grade A safety glass as per AS1288;
- Stronger** – Up to 500% stronger than annealed glass and therefore is more resistant to thermal breakage and can withstand greater windloads. Can be used within a temperature range of minus 70°C to plus 250°C (surface temperature should not exceed 250° C if other surface is lower than 0°C ambient);
- Frameless** – Allows reduction of framing members to produce a cleaner frameless look;
- Ease of handling** – Standard arrised edge makes handling easier;
- Matching** – Ease of matching tinted toughened Safety Grade A glass and tinted annealed glass;
- Delivery** – Plastic wrapped or papered to avoid scratches during delivery;
- Thicknesses** – Available 3–12mm Grade A Safety Glass and 15–25mm toughened glass. Flat automotive and marine toughened is available in 4–12mm;
- Applications** – Recommended for door, side and low lites, frameless entries, balustrades with handrails, shower enclosures and furniture.

design and glazing notes

- **Surface treatments** – Toughened glass cannot be drilled or edgeworked in any manner. Sand blasting and other surface treatments should be carried out prior to toughening. Deep sand blasted patterns greater than 1mm are not permissible;
- **Templates** – For toughened glass ordered to templates refer to our template processing guidelines;
- **Minimum edgework** – Finish on toughened glass up to 12mm is a standard arrised edge. Minimum edge work on greater thicknesses will be a flat ground edge;
- **Bowing** – Slight distortion or bowing may occur after toughening but is largely controllable. It will vary with substance, tint, surface treatment, size and shape of the glass. Ceramic painted, sand blasted or reflective coated glass has a greater tendency to bow and special tolerances would be advised. Flatness will be measured when the glass is standing on edge with a straight edge placed along the full length of the panel and a wedge measurement taken at the centre position;
- **Visual distortion** – The furnacing of glass panels can produce slight corrugated distortion or roller waves. This visual effect is in the form of distortion bands 250–300mm apart. It is more noticeable in tinted and reflective toughened glass. It is recommended that the roller wave run horizontal on the glass subject to the sizing constraints of the toughening furnace. Less visual distortion is evident with a heat strengthened glass. Talk to our staff about specific optical requirements;
- **Quench pattern** – During the quenching phase of the toughening process, the glass is rapidly cooled by high velocity blasts of air. Inevitably this results in slightly higher levels of compression at those areas adjacent to the air nozzles. The consequence of this is the occasional appearance of a strain pattern or iridescent spots or darkish shadows. This effect is referred to as the quench pattern as it occurs in the furnace quench. Typically, the pattern is only visible at times of polarised light (polarised sunglasses) or by viewing the glass from the inside at acute angles. Similarly, the thicker and more reflective the glass, the more obvious the pattern will be;
- **Plastic wrap** on toughened glass is used to protect the glass during transport. The plastic wrap should be removed no later than one month after exposure to sunlight.

spontaneous breakage

On rare occasions, toughened glass can break for what seems to be no apparent reason. A variety of contaminants in the raw stock can lead to problems either during or subsequent to the toughening process. Investigation into some instances of spontaneous breakage has identified an impurity in the glass called nickel sulphide as the cause. Most often however, breakage is usually due to surface damage or excessive loading on toughened glass.

nickel sulphide NiS

Microscopic **nickel sulphide** stones are a rare, undetectable contaminant in raw glass stock. The heating and rapid surface cooling processes of glass toughening is believed to change NiS stones from a stable to unstable state. Heat soaking is a method used to lower the chances of spontaneous breakage.

heat soaking

Heat soaking involves heating toughened glass in a special oven at temperatures close to 280°C to 290°C for several hours to induce breakages that may be caused by inclusions or contaminants in the glass. However heat soaking does not guarantee detection of all inclusions or contaminants that may lead to spontaneous breakages.

heat strengthening

Though not suitable for Grade A safety glass applications, the probability of nickel sulphide inclusions inducing spontaneous breakage is practically nonexistent with heat strengthened glass.

See also page 29.

ordering guidelines

For edgework and processing guidelines for toughened glass refer to Section 12. Before ordering, please refer to the following for your order's compliance:

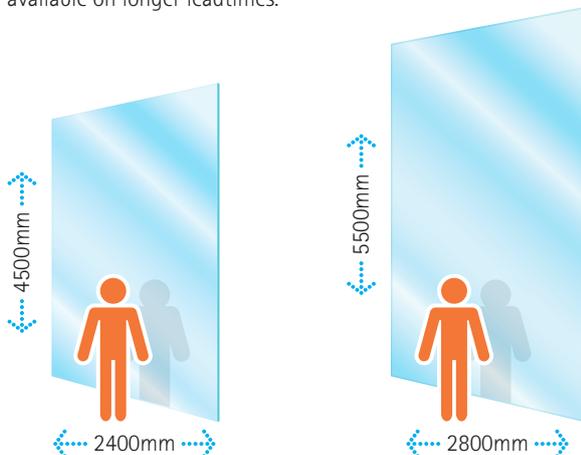
- Product type and thicknesses;
- Maximum size;
- Minimum size;
- Minimum edgework;
- Toughened identification stamp.

product type and thicknesses

- 3–12mm clear/tinted;
- 4–12mm clear/tinted (AS/NZS2080 Auto.);
- 15–25mm clear;
- EVantage™;
- Stopsol®/Solarcool®;
- Sunergy®;
- Sungate® 500 / Other hard coat low-E;
- Acid Etched;
- Cathedral;
- Gluechip;
- Kosciusko;
- Satinlite;
- Screenview;
- Spotswood;

maximum size

The National Glass toughening furnace can produce sizes up to 4500mm x 2400mm. Sizes up to 5500mm x 2800mm are available on longer leadtimes.



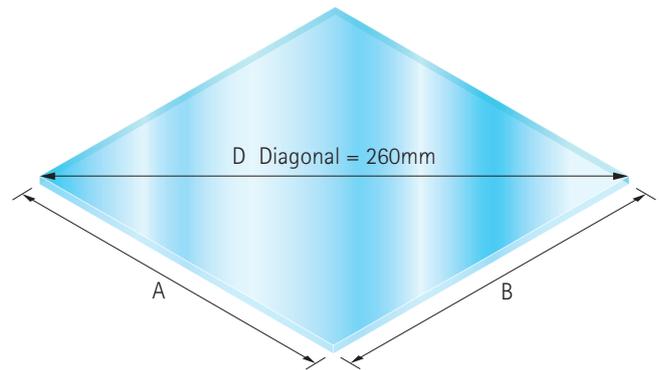
minimum size

The smallest panel of glass that can be toughened must equal 260mm in the diagonal measurement. Smaller sizes are available on extended leadtimes. The minimum size for panels with Flat Ground/Polish (straight edges) will be 250mm x 100mm.

calculating minimum toughened glass size

$$A^2 + B^2 = C$$

$$\sqrt{C} = D \text{ (Diagonal measurement)}$$



minimum edgework

Clean cut edges for toughened glass is not permitted. Minimum finish is standard arris 3–12mm. Flat ground edge is required for 15mm thicknesses and over. The minimum size for panels with Flat Ground/Polish (straight edges) will be 250mm x 100mm.

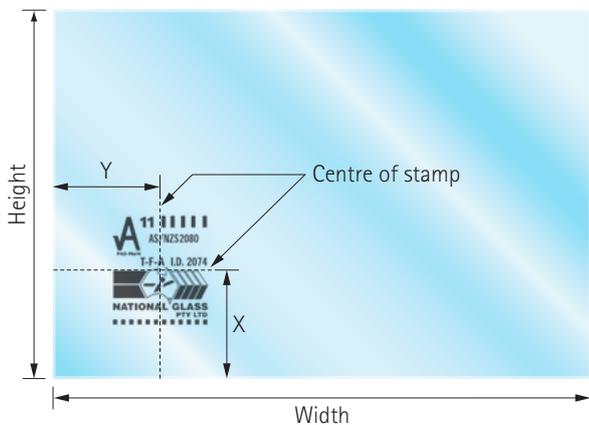
For more information on edgework profiles and edge working in general, refer "Edgework and Processing", Section 12.

toughened identification stamp

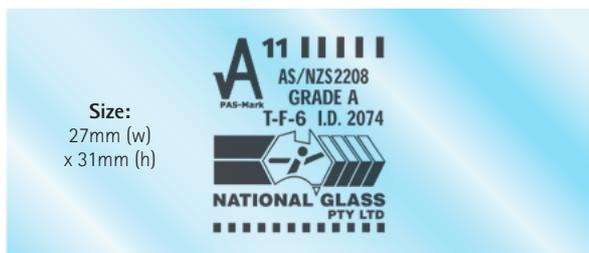
Permanent stamps are located in the 'normal position' at the bottom left/right hand corner or 'special position' to customer specification. Please state either **Glazing** (or architectural), **Automotive** or special sized stamps for louvres.

No stamp request: Our glass labels conform to the requirement under AS/NZS2208:1996 as a non-permanent marking. To assist with identification we also attach a small self-destroying label to all squares of toughened glass that are ordered without a permanent stamp. You may choose to remove the label in your factory or leave to confirm to your client that toughened safety glass has been used.

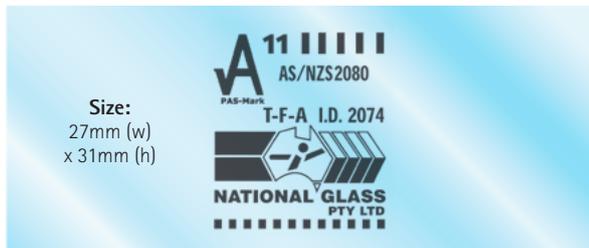
Stamps in special positions: Please nominate on drawing position of stamp.



architectural stamp



automotive stamp



louvre face stamp

Small discrete ID stamp placed on face of glass (41mm x 3mm).

AS/NZS2208 GRADE A T-F-6 I.D. 2074

heat strengthened glass

Heat strengthened glass is produced in the same manner as toughened safety glass except that the cooling process is slower. Heat strengthened glass is generally twice as strong as annealed glass, has more resistance to heat fracture and is subject to greater windloading than annealed glass. Heat strengthened float glass on its own is NOT a safety glass, but can be laminated to meet requirements. When heat strengthened glass breaks, it fragments into larger pieces and tends to stay intact in the opening until replaced. This is particularly useful in high rise spandrel and above ground floor panels because the fragments do not fall to the ground below. Like toughened glass, it cannot be cut, drilled or edgeworked.

Less visual distortion is also evident when compared to toughened safety glass. Because heat strengthened glass has a flatter surface and less distortion than toughened glass it is commonly used in laminated form as an alternative to toughened glass. This allows the interlayer to adhere more evenly to both laminate lites for a flatter finish. In addition to these benefits, the probability of nickel sulphide inclusions inducing spontaneous breakage in heat strengthened glass is practically non-existent.

See also "Heat Strengthened Laminated Glass" page 34.

features and applications

- Less visual distortion** than toughened glass;
- Stronger** – up to 200% stronger than annealed glass. Can resist temperature differential of 180°C;
- Fall out protection** – less likely to fall out of opening in the event of breakage as compared to annealed or toughened glass;
- Safety** – when laminated complies to AS/NZS2208 and as a Grade A Safety glass per AS1288;
- Applications** – spandrels, overhead glazing as a H/S laminated, higher wind load areas and where visual appearances are critical.

chemically toughened glass

Produced in a molten salt bath process, **chemically toughened glass** retains the optical quality and flatness of annealed glass. It is also claimed that chemically toughened glass is not affected by nickel sulphide inclusions and spontaneous breakages and has greater impact resistance than toughened glass. Chemically toughened float glass on its own is **not** a safety glass, but can be laminated to meet requirements.