Ordinary float glass is one of the most durable building materials. The durability of float glass under normal conditions of exposure is excellent, but it’s thermal resistance and mechanical strength properties are limited. Where added resistance to wind load and thermal stress is required, Float Glass might need to be heat-treated in order to increase its strength.
Guardian, one of the leading glass making Companies worldwide, offers two heat-treated glass products for architectural as well as residential and automotive applications. One heat-treated glass product which is suitable where safety glazing requirements need to be respected is tempered glass. In areas where added resistance to wind load and thermal stress is required, the heat-strengthened glass shall be the product of choice.

**Process**

The heat-treatment process of ordinary Float Glass consists in heating the glass beyond its softening point (over 600°C) and then cooling it down rapidly. This cooling freezes the outer surfaces in their dilated mode while allowing the inner material to retract as temperature drops, thus creating compression strength on the outer layers and tension in the inner layer. Compression strengths in tempered glass are higher than in heat-strengthened glass.

At Guardian, heat treatment is performed in horizontal furnaces, ensuring good surface properties with tight tolerances. However, the treatment process causes some optical distortion of the glass surface which is often referred to as roller-wave and warp. Such distortion is inherent to the process and can not be considered as a defect, provided it is in between the tolerance levels as laid down in the applicable standards.
Tempered glass has been available to the architectural marketplace for more than 30 years and is surpassed in volume only by annealed glass. Guardian alone has produced millions of square metres of tempered glass for a wide variety of applications. Tempered glass has been used traditionally in commercial applications where wind, snow or thermal loads exceed the strengths capabilities of heat-strengthened glass and in situations where tempered glass is mandated as a safety glass meeting legal regulations.

**Characteristics**

Tempered glass offers higher mechanical and thermal strength than annealed or heat-strengthened glass, while retaining other normal properties.
- Tempered glass has approximately four times the mechanical and thermal strength of annealed glass of equal thickness.
- With the exception of strength and breakage characteristics, tempered glass retains the normal properties of annealed glass, including chemical resistance, hardness, expansion and deflection.
- Tempered glass has a breakage pattern of small particles, that are much safer than the large and sharp pieces resulting from a broken lite of annealed glass. It is therefore called “safety glass”.

**Applications**

- Suitable where safety glazing is required.
- Emergency exits.
- Entry areas and store fronts, where required by building regulations.
- Extremely high wind loads.

**Important note**

With tempered glass, spontaneous breakage can occur occasionally resulting from inclusion of materials such as nickel sulfide. These inclusions are inherent to the production process. When the window breaks, the tempered glass splinters into numerous pieces, which can fall out of the opening either wedged together or as individual pieces. Although the risk of spontaneous breakage is usually minimal, planners should take alternatives into consideration, where applicable. Guardian recommends heat-strengthened glass, for which such cases of spontaneous breakage are unknown. In areas, for which tempered glass is mandatory, Guardian performs additional heat soak tests on the tempered glass. When nickel sulfide inclusions are heated, their volume can increase. If this happens, small transverse forces can then lead to spontaneous breakage. Heat soaking accelerates this heat up and expansion process. The heat-soak test consists in heating the tempered glass at 290°C for 8 hours. If inclusions are present, breakage is far more apt to occur during heat soaking than later at the installation site. Nevertheless, heat soaking is not an absolute guarantee that tempered glass cannot break after it is installed. However, this process does significantly decrease the probability of spontaneous breakage resulting from nickel sulfide inclusions.

**Conformances**

- BS 6206A:
- 1981 Kitemark Licence KM 10170
- DIN 1249 Part 12
- EN 12150
- ASTM 1048-92

**Availability**

- Minimum dimensions: 152 x 382 mm
- Maximum dimensions: 2000 x 3650 mm
- Thickness: 3 to 12 mm
- Optional for clear - and Low-e tempered: Heat soak test
- Mandatory for solar control and reflective tempered: Heat soak test
Generally Guardian’s heat-strengthened glass is recommended for designing building facades. Its typical radial breaking properties also ensure a maximum safety standard, because the glass remains in the frame. Heat-strengthened glass has even higher quality surface characteristics as compared to tempered glass. Moreover, heat-strengthened glass eliminates the danger of occasional spontaneous breakage, as can occur with tempered glass as a result of nickel sulfide inclusions.

**Characteristics**
- Heat-strengthened glass offers higher mechanical and thermal strength than annealed glass, while retaining other normal properties.
- Heat-strengthened glass has approximately twice the mechanical and thermal strength of annealed glass of equal thickness.
- With the exception of strength and breakage characteristics, heat-strengthened glass retains the normal properties of annealed glass, including chemical resistance, hardness, expansion and deflection.
- Heat-strengthened glass normally has a breakage pattern of large pieces, similar to the breakage pattern of annealed glass. The exact nature of the break pattern depends on the intensity of the applied load, position of the break origin, the glass temperature and the related factors.
- Heat-strengthened glass is hardly prone to spontaneous breakage than tempered glass.

**Applications**
- Suitable for use in spandrel and/or vision areas where added resistance to wind load and thermal stress is required.
- Laminated solariums.
- Laminated skylights.
- High wind load areas.

**Important note:**
Heat-strengthened glass does not meet the provisions of the BS6206A as a safety glass product. The use of heat-strengthened glass in entryways is prohibited.

**Availability**
- Minimum dimensions: 300 x 400 mm
- Maximum dimensions: 2000 x 3650 mm
- Thickness: 4 to 10 mm

**Physical effects - not to be classified as product faults:**
- **Iridescence:** physical effect with heat treated glass resulting from the distribution of the internal stress. Perception of dark-coloured rings or stripes with polarized light and/or when observed through polarizing lenses is possible depending on the viewing angle.
- **Interference:** prism effect of insulating glass when light is reflected or transmitted, visible in the form of coloured stripes or rings (Newton’s rings) on the surface of the glass.

**Conformances**
- EN1863
- ASTM C 1048-92