The following slides describe the glass making process, and review the tempering process.

These slides are courtesy of Andersen Windows, Stillwater, Minnesota.
Glass

What is the difference between (regular) annealed glass and tempered glass?
Raw materials are mixed together in a furnace that heats them to 2800 degrees F. As the materials melt and mix together, they float on a bath of molten tin. This is where the term ‘float glass’ comes from.

- As the glass comes out of the furnace is slowly cooled and travels down the line on rollers.

- As it moves down the line the glass is checked for defects by a laser. Any defects are marked and cut out further down the line in the cutting process.

- As the new glass comes to the end of the line is cut to size, and stacked on racks to be shipped.

These steps are summarized in the next diagram.
**Float Glass: The Process**

Cullet is glass that is recycled and ground into small pieces.

- **Furnace**
  - Molten Glass: 2800° F

- **Tin Bath**
  - Molten Tin: 1100° F

- **Annealing Lehr**
  - Slow cooling

- **On-line Cutting**

*Slide courtesy of Andersen Windows*
Annealed Glass

• Advantages:
  – Cost

• Limitations:
  – Breaks in sharp pieces
  – Not as strong as Tempered Glass
  – Size limitations

Slide courtesy of Andersen Windows
The tempering process consists of the following steps:

1) First the glass is washed and then heated.

2) In order to temper glass, it must reach 1100°F (the softening point for glass.)

3) The glass is then cooled with cold air. Quenching with forced cold air sets up the tension and compression zones.

4) The tempered glass continues down the rollers to cool more and be packed for shipping. Glass to be tempered must be cut to size before the tempering step.

A flow chart in the next slide provides a summary of the tempering process.
Tempered Glass: The Process

1. Washing
2. Furnace - 1100° F
3. Quench
4. Cold Forced Air
5. Cooling & Packing

Slide courtesy of Andersen Windows
Tempered Glass

• Glass expands when heated
• Quenching “freezes” this expansion on the outside
• Center cools more slowly, and contracts. Sets up tension and compression zones.

Slide courtesy of Andersen Windows
- Tempered Glass is required for door products and some windows installed near doors. If tempering is done improperly then distortion can result.

- Tempered glass is stronger than annealed glass. If annealed glass (raw float) has a strength factor of “1”, tempered glass would be “4”.

Slide courtesy of Andersen Windows
Tempered Glass

• Advantages:
  – 4 times the stronger than annealed
  – Breaks into small, harmless pieces.
  – Qualifies as Safety Glazing

• Limitations:
  – Must be cut to size before tempering
  – Optical distortion (roller wave, strain pattern)

Slide courtesy of Andersen Windows