

Annealing

Internal stress, in PLAZCRYL-PLAZCAST can result in crazing (very fine cracks) which will later evolve into larger cracks, during forming or in the presence of solvents (for example during bonding or painting).

Internal stress can be a result of:

1. **Machining** – All methods of machining cause local overheating, thus resulting in internal stress.
2. **Forming** – Forming PLAZCRYL-PLAZCAST too cold, overheating PLAZCRYL-PLAZCAST or cooling PLAZCRYL-PLAZCAST too fast or unevenly, after thermoforming, will cause internal stress.

It is strongly recommend annealing all extruded sheet components before cementing, painting or screen printing.

Annealing time and temperatures

PLAZCRYL-PLAZCAST should be annealed at 65⁰C - 80⁰C.

The time needed for annealing PLAZCRYL-PLAZCAST will depend on the thickness of the sheet and the temperature chosen.

The general guidelines for annealing PLAZCRYL-PLAZCAST sheets are given in the table below:

Annealing temperature	Annealing time (Hours)	Cooling time	Cooling rate	Remarks
PLAZCRYL 65 ⁰ C PLAZCAST 75 ⁰ C	$= 1 + [0.3 \times \text{thickness (mm)}]$	2 hours	12 ⁰ C/hour	Recommended for annealing of sheets following thermoforming or bonding.
80 ⁰ C		2 hours	15 ⁰ C/hour	Recommended for annealing of flat sheets following machining.

A rapid annealing cycle which is reliable, especially for thin sheets, is to pre-heat the oven to 80 °C, anneal for one hour, then remove the parts from the oven and allow cooling to room temperature.

** Sheets thicker than 8 mm should be cooled for 3 hours (at rate of 10⁰C/hour).

It is recommended to anneal without PE protection film.

PLAZCRYL-PLAZCAST sheets must be cooled down slowly to avoid repeated induction of the internal stress due to cooling down too fast after annealing. The maximum cooling speed after annealing has to be less than 45 °C per hour.

It is important to allow the parts to cool naturally in the oven, to avoid fresh stresses due to thermal shock.

Sheets thinner than 2 mm should be heated for 2 hours.

Remove the sheet only after it has cooled below 60°C.

PLAZCRYL-PLAZCAST extruded sheets are able to take up rather high tensile stresses, but only if corrosive substances do not simultaneously act upon the materials.

Tensile stresses are induced by machining, laser-cutting, thermoforming, varying heating and external stresses, for instance.

Sheets cold formed are under high tensile stress. Special attention must be given to the installation area, where some chemical may cause cracks to them.

As accidental contact with corrosives cannot be ruled out, tensile stresses must be avoided. Stress relief tempering of the parts can achieve reduction of internal stresses. External stresses must be excluded by using adequate fastening systems.

Normalizing PLAZCAST

PLAZCAST contains internal stresses introduced during the polymerization stage at casting process which under normal circumstances have no effect on the behaviour of the finished article. However, if components are being machined to very close tolerances it is advisable to remove these casting stresses by a process called normalizing (stress-relieving). By heating PLAZCAST above its glass transition temperature (PMMA Tg is about 115°C), the stresses are relaxed giving rise to uniform shrinkage of approximately 2%.

The normalizing process consists:

Heating the pieces under controlled temperature and time cycle which depends on the thickness. Process is done in an air circulating oven and held there until it has been heated uniformly. Pieces are allowed to cool down slowly to avoid the reintroduction of thermal stresses.

Stages for normalizing

Heating: up to 140 °C

Heating rate is about: sheets thickness x 10 (minutes).

First Holding time

Thickness	Time (minutes)
3	55
6	100
12	225
20	390
40	700

First Cooling stage to 105 °C to 110 °C

Cooling rate is about: sheets thickness x 10 (minutes).

Second holding time:

About half the time that was at first holding stage

Cooling rate: **No great than 4 °C per hour**

Minimum cooling time: **21 hours**

The maximum allowable **differential** between the material and ambient temperature at the time of removal from the oven is 7 °C.

The treatment conditions for thick sheet and block are especially critical.