

TECHNICAL BULLETIN

Quench Patterns in Heat-Treated Glass

Heat-treating glass (both fully tempering and heat-strengthening) is a process in which glass is uniformly heated in a furnace until the entire thickness of the glass has reached a temperature of approximately 1200° F. Following the heating process, the glass exits the furnace and is rapidly cooled, or quenched, by a blast of air uniformly delivered to both surfaces of the glass through a series of air nozzles or slots. The quenching process places the surface of the glass in a state of high compression and the central core in compensating tension.

The glass surfaces directly opposite the air nozzles or slots will achieve a relatively higher level of surface compression than adjacent areas. This variation in compression creates a slight difference in the density of the glass causing the glass to become optically anisotropic. This results in light passing through the glass to differ in appearance as one's eyes move across the surface. Thus, a pattern of faint light and/or dark spots or lines can be observed under certain lighting and viewing conditions. This quench pattern is commonly referred to as strain pattern.

ASTM International document C 1048 — *Standard Specifications for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass* makes reference to this phenomenon as follows:

Section 7.5 Strain Pattern—In heat-strengthened and fully tempered glass, a strain pattern, which is not normally visible, may become visible under certain light conditions. It is characteristic of these kinds of glasses and should not be mistaken as discoloration or nonuniform tint or color.

The Glass Association of North America (GANA) refers to strain pattern in its *Glazing Manual* as:

A specific geometric pattern of iridescence or darkish shadows that may appear under certain lighting conditions, particularly in the presence of polarized light (also called quench marks). The phenomenon is caused by the localized stresses imparted by the rapid air cooling of the tempering operation. Strain pattern is characteristic of heat-treated glass.

Visibility of the strain or quench pattern may be enhanced by thicker glasses, tinted glasses, and coated glasses. This pattern can also become more visible when wearing polarized sunglasses (and is frequently observed in the back lite of automobiles). A lite of glass that has visible strain pattern when glazed in a specific light condition may exhibit greater, lesser, or no strain pattern when glazed in a different location or under different lighting conditions.

Quench pattern, its presence and/or intensity, is not a glass defect or a processing defect and is not cause for rejection. It is inherent in the heat-treating process and, in no way affects the structural integrity or safety of the glass.