

Failure Analysis of Cracked Auto Mirrors

Failure Analysis: Manufacturing Engineer Examines the Root Cause of Automobile Rear View Mirror Failures

The root cause of the failure of customer returns of heated automobile rear view mirrors was investigated.

Theory: Glass fracture theory suggests that the condition of the glass surface is the dominant factor. Theoretically, glass should fail at 1 million pounds per square inch (PSI). In reality the failure stresses is measure in the range from 2500 to 30,000 PSI. These values are much lower than the theoretical strength, and their variation is quite broad. The explanation for this behavior is that the strength is controlled by surface defects.

Description: The heated mirrors in this study showed a peak in customer returns in the winter months. This is the time the mirror heater is heavily used. Since the mirror is heated from its backside; the front surface is put in tension and causes the failures. The mirrors in question have a convex curvature that is put into the coated glass before it is "scribed and broken" to size. The scribing operation occurs from the front.

Analysis: A failure analysis was performed on samples of these mirrors to determine the cause of failure. Figure #1 is a sample of a failed mirror. It has a horizontal crack in the middle that goes across the entire mirror.



Figure #1: Photograph of a representative cracked mirror. The horizontal crack traverses it just below the "4".

The failure analysis reveals that this failure resulted from a "crush" that occurred at the scribe "start" point (Figure #2). Because the height of the curved mirror surface is variable, the scribe wheel hits the surface too hard in some instances.

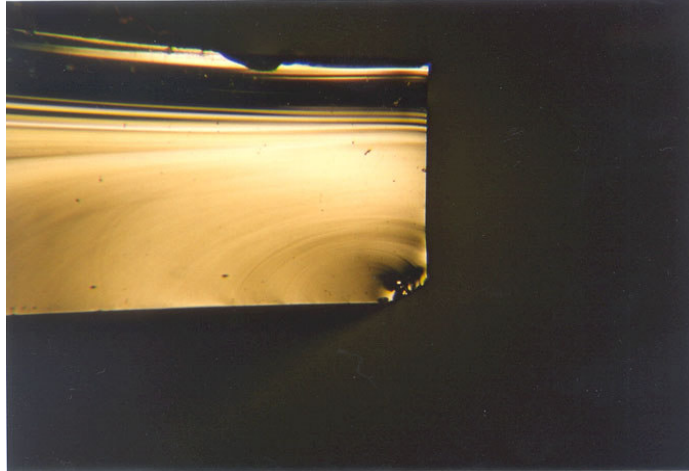


Figure #2: Photo micrograph of a typical crack initiation point. The crack originated at a crush point seen on the lower right corner. The coated side of the mirror is on the bottom right of the mirror in the photograph (Mag. 30X).

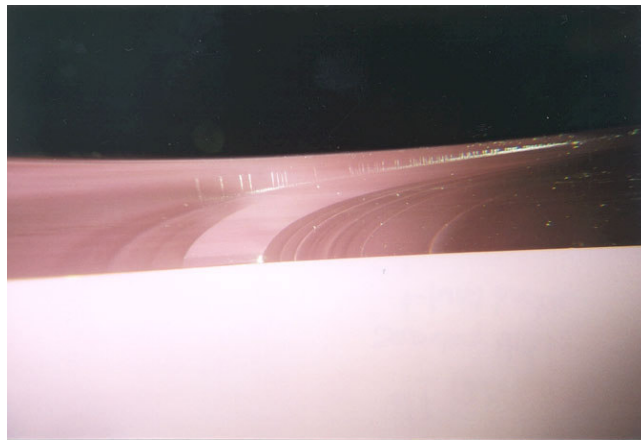


Figure #3: Photo micrograph some of the Wallner lines on the same crack shown in Figure #1.. The crack travels from right to left The coated side of the mirror is on the bottom of the photograph (Mag. 20X).



Figure #4: Higher magnification photo micrograph of a representative crush found at the failure origin (Mag 200X)

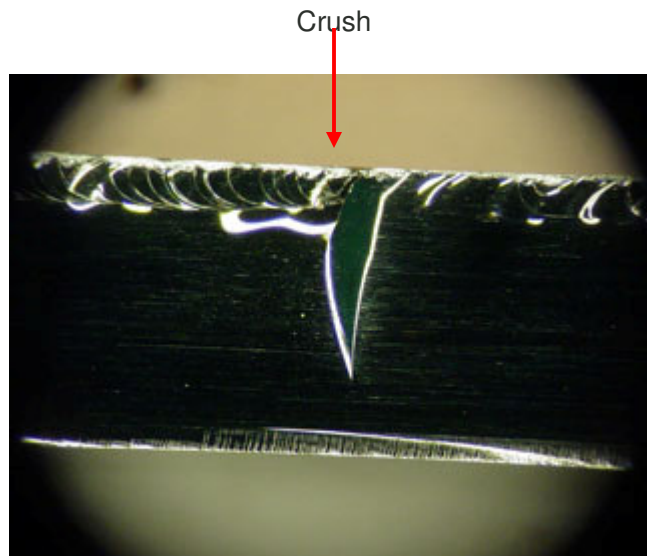


Figure #5: Start point on a mirror that shows a crush at the top of the starting point. The starting point is on the top of the "winged" shaped crack in the middle of the picture (Mag 30X).

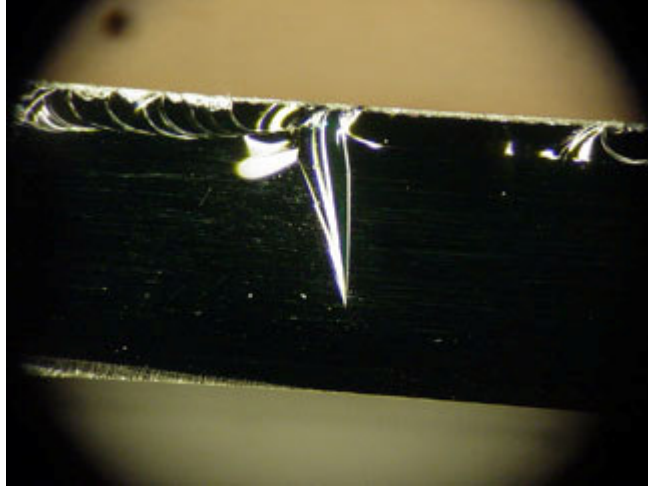


Figure #6: Start point on an a mirror that has no crush at the top of the starting point. The starting point is on the top of the "winged" shaped crack in the middle of the picture (Mag. 30X).

Conclusion: The cracking of these rear view mirrors was caused by a "crush" caused by the scribe wheel when it started the scribing process.