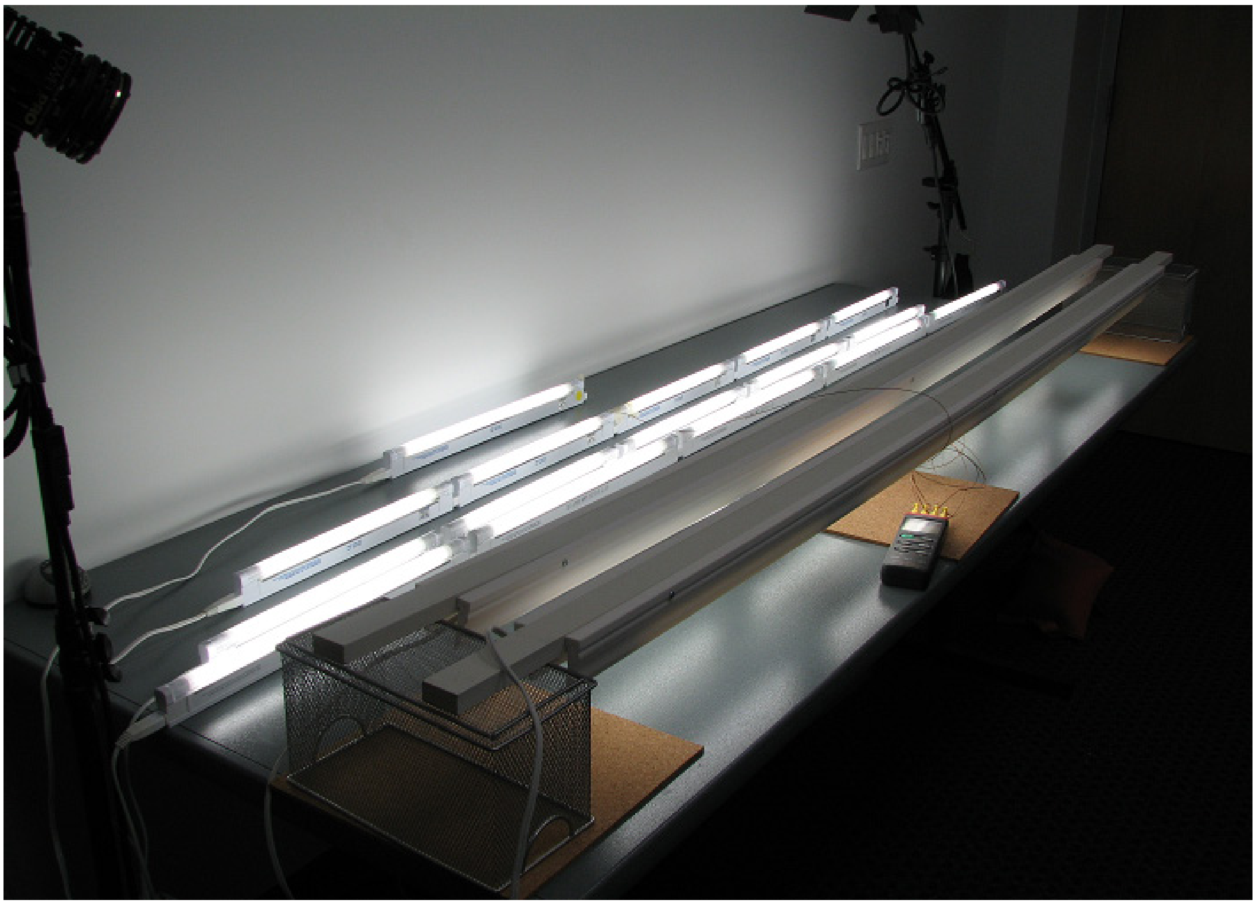
The fixtures were first operated tube-up; thus, the heat of the fluorescent bulbs essentially radiated to the sides or straight up. When installed into appliances such as a salad bar, the fixtures are typically mounted with the tube down inside a metal channel. This allows the bulb heat to rise and surround the fixture itself, heating the whole fixture. After gathering initial temperature data, the test setup was modified with the addition of two custom fabricated “channels” within which fixtures were mounted. These channels were then suspended with the tubes down; see the photo below. It was found that while fixture shroud temperatures did rise when mounted within the channel, the increase was at most several degrees Fahrenheit.



Temperatures were found to vary considerably both between the various fixtures as well as at either end of the shroud on a given fixture. In addition, the fixtures located at the ends of a “string” of fixtures exhibited lower temperatures at the outer end of the fixture. In general, during continuous operation, the cooler fixtures operated around 140° F at one end or the other; some showed nearly the same temperature at both ends. While cycling, the cooler fixtures operated around 115° to 125° F.

Several tests were run whereby a shorted filament was simulated by installing a short across the filament pins. [1] In those cases, that end of the tube always operated 15° to 20° F cooler than the end with a “good” filament. A tube with an open filament, of course, would neither ignite initially nor continue operating after the filament had burned open.

[1] Such tests were conducted on both re-tubed failed fixtures, and new fixtures. Meaningful differences were not noted between the fixtures under the short condition.

Summary

The non-failed fixtures received all carry date codes from 08/07 through 10/07, and all contain the filament PTC. The same part found added to the old, failed fixture 6F as a modification.

The electrical design of the newer ballast within these fixtures will:

- in the event of an open filament, cause the ballast to not start up at all
- allow the ballast to start up a shorted filament, but the new PTC will protect the ballast from damage until the tube actually ignites.

The PTC does not cause a fixture to shutoff in the event of any type of bulb failure—the PTC's function is only to protect the ballast. The ballast design will cause a fixture to shutoff except in the event of a shorted filament. In that case, the new PTC should prevent catastrophic damage to the ballast.

If a filament shorts during operation, the ballast will continue producing high voltage and the tube will remain lit, since the filament is not heated by the ballast (except when the tube is not fired). Because the PTC takes the place of the shorted filament, both the tube and ballast should continue to operate normally without any noticeable temperature rise.

During exhaustive functional tests, 360° Test Labs was unable to find a failure mechanism that would produce the melted plastic shrouds found on the new and failed fixture samples, including recreating the method used by Client engineers to recreate the failure in the past. Brownout conditions only resulted in low light emission and slow starting, while higher-than-normal voltage "surge" conditions did not result in noticeable damage until the AC input voltage was raised, and maintained at for several hours, approximately 41% higher than nominal. Even then, only the two remaining 240VAC fixtures failed catastrophically.

While the revised ballast design of the new fixtures may prevent such damage as melting shrouds from occurring, we cannot confirm this possibility. Further, since concurrently operated, re-tubed failed fixtures have performed similarly, the older aluminum capped tubes are in-question. Issues with similar aluminum capped tubes were addressed in past testing by 360° Test Labs.