

Understanding the Mold Stress Test *The “Understanding the Product Safety Tests” Series*

Mold Stress Testing, also known as Mold Stress-Relief Distortion Testing, is conducted on products that have a plastic enclosure. The test involves putting the product in an oven at a raised temperature and evaluating what happens to the enclosure plastic as a result. The time in the oven is only the pre-cursor to an engineering review of the enclosure after removal from the oven.

Molded in Stress: Molding plastic parts is a process that requires considerable skill. Selection of the material, design of the part, mold design, and control of temperatures and pressures during both the molding and cooling processes all affect the molded part quality. Subtle variations to any of the elements of this process can cause a plastic to retain invisible stresses locked inside the molded part. These invisible internal stresses can lead to failure of the part over time = cracking, warping, shrinkage = serious concerns if they occur with a plastic enclosure.

The Purpose of the Test:

- To verify that the product’s enclosure does not have excessive residual stresses in the plastic that could lead to hazardous failure of the enclosure material.

Test Method: In general, a product that has a plastic enclosure is placed in an oven for a period of time and then allowed to cool to room temperature in an attempt to release any residual stresses in the enclosure plastic. After the product cools to room temperature, it is examined to determine if there has been any failure of the enclosure material that would expose the user to a hazard (i.e. access to a shock hazard through an opening that developed in the enclosure).

- 1) **Maximum Enclosure Temperature:** The mold stress test requires data from the operating temperature test = the maximum temperature on the plastic enclosure material. The maximum temperature on the enclosure plastic is used to determine the temperature setting of the oven for the Mold Stress Test.
- 2) **Oven Setting:** The product safety standards typically require setting the oven to a temperature that is 10°C above the maximum temperature measured on the plastic enclosure material, but not less than 70°C.
 - BE CAREFUL – this is not the maximum temperature measured within the product, it is the maximum temperature measured on the plastic enclosure material. This is a big difference! You don’t want to melt the entire product due to an incorrect oven temperature setting.
 - UL746C, the UL standard for Polymeric Materials used in Electrical Equipment, offers an alternate test method that involves operating the product at full load while it is inside an oven set at 60°C.
- 3) **Test Time:** Most standards specify leaving the product in the oven, at the test temperature setting, for a period of 7 hours.
- 4) **Cooling to Room Temperature:** At the completion of the test time, the product is removed from the oven and allowed to cool to room temperature before being examined for hazards.

Pass/Fail Criteria: Pass/Fail criteria can vary by standard. Be sure to check the safety standards that apply to your product. Criteria in the standards includes:

- 1) The enclosure material should not become distorted to the point that it allows access to a “hazard” = if an opening develops in the enclosure, the opening is checked for “access” to hazards using the accessibility probes.



Pass/Fail Criteria: (Continued)

- 2) No reduction of creepage & clearance distances below the distances specified in the standard – the product must continue to comply with the creepage & clearance distance requirements after the mold stress test.
- 3) No damage to the strain relief system for cord connected products – when in doubt, the product must continue to comply with the strain relief test after the mold stress test.
- 4) Any distortion of the plastic enclosure should not interfere with operation of the machine.
- 5) UL746C states that the enclosure cannot be soft as determined by technician handling as the product is removed from the oven. This standard also prohibits any shrinkage, warpage, or other distortion after cooling. Note that these are far more stringent requirements than for most other product safety standards that contain this test.

Test Objectives: The objectives are to find weakness in a plastic enclosure caused by variations in the molding process. This includes:

- a) Identifying materials that are too thin.
- b) Identifying corners, bends, and protrusions in plastic enclosures that are too sharp of bend and are therefore susceptible to distortion from molded in stresses.
- c) Identifying enclosures that were cooled too fast during the molding process = uniform controlled cooling is critical to minimizing residual stresses in molded parts.
- d) Identifying enclosures that were molded with an inconsistent material flow rate or pressure across the mold, both of which can lead to increased residual stresses in molded parts.

Conclusion: As you can see, we don't simply perform the tests because they are in the standard. Each test in the standard has a set of objectives that relate to the 6 Hazards of Product Safety. The Mold Stress Test is performed as part of the accessibility review for Shock, Energy, & Injury hazards. Verifying the physical integrity of the product's enclosure is crucial to insuring the product continues to provide protection from a Risk of Shock, a potentially serious hazard that could lead to death by electrocution. It is also critical to insuring that no opening develops in the enclosure that could allow access to hazardous moving parts. It is therefore an extremely important test – another test that directly saves lives.

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