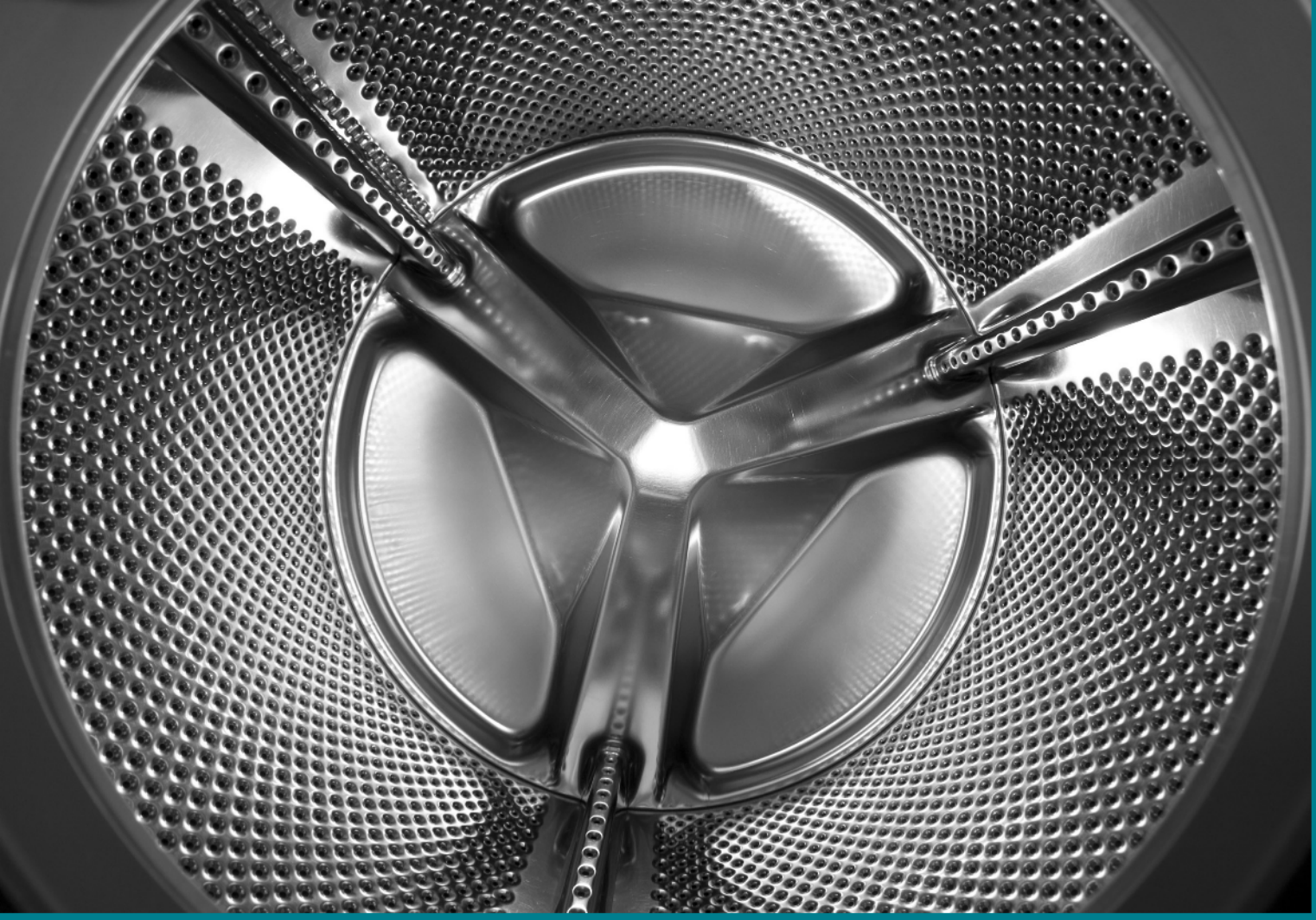

Reducing Injury and Damage Related to Electric Dryer Fires

Fire Containment Tests for the Second Edition of UL 2158

Reducing Injury and Damage Related to Electric Dryer Fires: Fire Containment Tests for the Second Edition of UL 2158

Despite their widespread use in U.S. homes, clothes dryers are involved in a significant number of residential fires. According to some estimates, dryer fires produce annual U.S. property losses approaching $100 million, and lead to multiple consumer deaths and hundreds of injuries. Proper installation and effective maintenance of clothes dryers can significantly reduce the risk of appliance-related fires. But recent research has shown that product construction and design considerations are also important elements in building safer dryers.

This UL white paper reviews research by UL and others that has resulted in the development of testing requirements included in the revised second edition of UL 2158, the Standard for Safety for Electric Clothes Dryers. The white paper then discusses the fire containment requirements, identifying potential design considerations for manufacturers, and the importance of testing a variety of alternate materials and components to meet the requirements for compliance. The white paper concludes with a discussion of the potential benefits for manufacturers, retailers and consumers when the fire containment requirements become effective in March 2013.

The Causes and Consequences of Dryer Fires

Statistics compiled by the U.S. Consumer Product Safety Commission (CPSC) confirm that fires involving clothes dryers are numerous and costly, and occasionally result in deadly consequences. According to data collected by the Commission, there were an average of 8000 dryer-related residential fires annually between 2002 and 2004. These fires resulted in estimated annual property damage of $81.7 million, and caused an average of 210 injuries and 10 deaths each year.[1]

In more recent years, there has been a reduction in the number of dryer-related residential fires, but an increase in the value of lost and damaged property. According to comparable CPSC data for the period between 2006 and 2008, there was an annual average of 7000 dryer-related fires in the United States, 1000 fewer than the 2002-2004 period. However, these fires resulted in estimated annual property damage of $91.8 million,

a 12% increase from the 2002-2004 period, causing an average of 230 injuries each year, a 10% increase.[2]

The causes of electric dryer fires have been extensively researched over the past decade by the CPSC, industry associations including the Association of Home Appliance Manufacturers (AHAM), individual appliance manufacturers, and standards organizations including UL. Yet, while some research has pointed to the accumulation of lint and the subsequent reduction of air flow as a primary cause of dryer fires, other testing has supported claims that the cause of dryer fires can be attributed to a number of factors.

In its "Final Report on Electric Clothes Dryers and Lint Ignition Characteristics" published in May 2003, the CPSC focused on the buildup of lint in or near a dryer's heating elements. According to the CPSC report, "lint that accumulates inside the dryer can ignite if the lint contacts certain areas of the heater housing, if the lint is in proximity to the heater, or if lint is ingested by the heater box."[3] CPSC research also found that the accumulation of lint around a heater housing can ignite when a dryer exhaust vent is blocked and a dryer's high-limit thermostat fails.

But a study on clothes fire dryer incidents published by AHAM in 2002 refuted the notion of lint as the primary contributor to dryer fires, arguing instead that dryer fires can be linked to a number of potential factors. Based on a careful evaluation of 191 clothes dryer fire incidents during a six month period in 2001, AHAM determined that factors such as a dryer load, a dryer's electrical system, and a dryer's mechanical system also played a role in reported dryer fires. Importantly, AHAM reported that, "in 91% of the incidents investigated, the accumulation of lint on the screen was less than 25%."[4]

Consumer behavior has also been identified as a factor in dryer fires. In addition to allowing lint and fibers to accumulate in a dryer filter and venting system, an equally significant fire risk can result from the drying of certain types of materials. According to data from the U.S. Fire Administration's National Fire Information Resource System (NFIRS), the buildup of lint, dust and fiber and the drying of wearing apparel, including synthetic or contaminated materials, were the primary ignition sources in over half of U.S. residential dryer fires during the period from 2002 to 2004.[5]

While increased consumer education regarding these risks can help reduce the number of dryer fires, recent research has focused attention on the design of dryers themselves, and the ability of a dryer unit to actually contain a fire, should one occur. This research has led to important changes in UL's safety Standard for electric clothes dryers that will help minimize property damage caused by dryer fires and mitigate risks to consumers.

Research on Dryer Fire Containment Issues

The most significant work on dryer fire containment was produced by a joint task group, consisting of representatives from UL, CSA, and several major appliance manufacturers. Formed in late 2002 following ongoing extensive discussions between the CPSC, AHAM, UL and other interested parties, the task group focused on the development of a protocol for testing the fire containment capabilities of clothes dryers, and on the identification of acceptable testing parameters.

The task group's efforts resulted in the development of two separate fire containment tests. In the first of these tests, the drum load fire containment test, the exterior of each sample dryer is draped with a single layer of cheesecloth, covering the top, bottom, front, back and sides of a dryer. (Cheesecloth is highly flammable, so any damage to the cheesecloth wrapping is deemed to be evidence of a dryer's inability to contain a fire.) The dryer drum is then loaded with cloths with a dry weight equivalent to one pound of cloth for each cubic foot of dryer drum volume. The cloths are then ignited with a propane torch, the dryer door closed, and the exterior cheesecloth repositioned to ensure complete coverage of the dryer.

In the second test, the base lint fire containment test, the exterior of each sample dryer is again draped on all sides with a single layer of cheesecloth, and loaded with cloths with a dry weight equivalent to one pound of cloth for each cubic foot of drum volume. In addition, all electrical components and connectors located in base of a dryer unit are covered with eight layers of cheesecloth to simulate the accumulation of lint. The internal cheesecloth in the base is then ignited, and the exterior cheesecloth repositioned to ensure complete coverage of the dryer.

Both drum load fire containment testing and base lint fire containment testing are conducted with the drum in a rotating condition (simulating a dryer in actual operation) as well as in a static condition (simulating a dryer that has completed a drying cycle). A separate dryer sample is used to test for each condition. If any portion of the exterior cheesecloth ignites prior to the seven-hour test time limit, the test sample is deemed to have failed the test.

Following the development of the fire containment tests, members of the joint task group then conducted independent testing of products according to the test protocols to validate the approach and testing parameters. UL contributed to this effort by conducting its own testing in 2004 and 2005 to determine whether the newly developed tests would better assess a dryer's ability to contain a fire. In UL's testing, only 28% of the units tested did not ignite the exterior cheesecloth, thereby helping to substantiate the importance of the fire containment tests in evaluating the safety of electric dryers.

The testing by UL and other members of the joint task group ultimately led to the recommendation to incorporate the drum load fire containment test and the base lint fire containment test into UL 2158. These tests were incorporated into a revised version of the second edition of UL 2158, issued in March 2009. Manufacturers seeking or wishing to maintain certification to UL 2158 will need to demonstrate compliance with these additional tests before March 20, 2013.

Dryer Design Issues Potentially Affecting Compliance

Manufacturers can increase the likelihood of compliance with the fire containment objectives of UL 2158 by considering certain design aspects of their dryer models in advance of testing. Specifically, the use of plastics and other polymeric materials in dryer components, the position of ventilation openings, and the presence of openings in the bottom of the dryer can directly affect the potential for dryer fires to develop, and can speed or impede their spread. Careful evaluation of design options during the product development stage can mean the difference between complying with the fire containment tests and achieving certification, or failing the tests and reevaluating alternative approaches and configurations.

Plastics and polymeric materials are commonly used in a variety of dryer components, including drum baffles, fans and fan housings, and lint screens and frames. Depending on their use in the final dryer assembly, UL 2158 requires that these materials meet one of three flammability classifications found in UL 94, including HB (for horizontal burn), as well as the more stringent 5VA or 5VB classifications. However, HB-rated materials may ignite more quickly under the base lint fire containment test or the drum load fire containment test, allowing hot, molten plastic to flow throughout the unit and escape from the dryer cabinet. Alternatively, the melting or deformation of parts formed of thermoplastic materials may create unexpected openings in the fire enclosure, allowing flames or other burning materials to escape, or for fresh air to reach materials smoldering within the dryer cabinet.

In evaluating the use of polymeric materials in dryer components, manufacturers should consider the intended location of components to determine whether their use increases the risk of fire or has the potential to contribute to a fire's spread. Polymeric materials may need to be replaced with metal parts or otherwise shielded to protect them from flames originating from within a dryer. In addition, manufacturers should evaluate the use of HB-rated materials in general, and may need to utilize materials that have a more stringent fire resistance classification to comply with the dryer fire containment requirements.

The position of ventilation openings in a dryer cabinet and their proximity to combustible materials and potential flame spread should also be evaluated. Although UL 2158 requires that ventilation openings be equipped with louvers or other types of barriers to limit the likelihood of expulsion of burning insulation, flames and burning material may still escape a dryer cabinet under actual fire conditions.

Special attention must be given to openings in the bottom of a dryer unit. UL 2158 restricts the individual and cumulative size of unused openings in a bottom enclosure. However, under the rigors of the base lint fire containment test in UL 2158, previously inconsequential openings may provide oxygen to flaming parts or permit passage of flaming or molten materials, thus leading to ignition of the cheesecloth during the testing. More strict fabrication quality standards for the bottom of a dryer cabinet can lead to a reduction in the number of openings, and the remaining openings can then be shielded or otherwise blocked.

Other design modifications or changes that may improve the likelihood of complying with UL 2158's fire containment tests include closing or shielding other openings in a dryer cabinet or base with noncombustible materials, and the use of stronger and more fire-resistant seals and gaskets. Additional modifications that can mitigate the risk of fire may be possible, depending on the unique characteristics of each dryer model submitted for testing.

Ultimately, design options to decrease the likelihood of dryer fires and to increase consumer safety must also account for dryer performance, manufacturing and costs. Each manufacturer will need to thoroughly evaluate all options, including their impact on safety, and their eventual cost to determine the best approach. UL has the requisite resources and expertise that can provide a framework for this process and expedite the analysis required.

Determining Representative Dryer Samples for Testing

The complexity of fire containment tests will typically require testing of a minimum of four dryer samples for each dryer model being certified to UL 2158. Once an initial dryer model has been tested, additional models from the same manufacturer may require fewer samples. The actual number of dryer samples required for testing will depend on the product configuration and whether the materials and components used in the additional models are identical to those in the initial model tested.

A group of clothes dryer models may be covered by testing representative samples to address the worst case conditions. In order to choose representative samples from the various models and constructions produced by a manufacturer, it is important to understand the differences between models and consider all alternative constructions.

Some common areas of construction variation within a line of clothes dryers include:

Alternative Polymeric Materials — When various materials are utilized for polymeric parts, the fire containment tests should be conducted with each material specified. Initial testing may be conducted with the material with the lowest temperature and flammability ratings to determine if the part experiences charring, igniting, melting or deforming. If the part is unaffected, there is no need to test additional materials.

In determining the worst case material for testing, it is important to note that the flammability rating of a material is a threshold rating. This means that different materials with the same flammability rating may react differently when exposed to the dryer fire containment tests. For example, one material may not ignite at all while another material with the same flammability rating may ignite briefly or burn steadily. Therefore, it is important to determine if the part was impinged upon by flames during testing.

It is also important to consider a material's response to the heat produced by a fire. If a part deforms or melts when exposed to heat, unexpected openings may be created in the enclosure. Such openings can allow additional oxygen to be introduced into an enclosure, causing a fire to intensify or allowing it to propagate outside of a dryer enclosure.

Bottom Openings — Openings in the bottom of a dryer allow oxygen to be introduced into a clothes dryer enclosure, and may also allow flames to propagate outside of a dryer enclosure. Although the requirements of UL 2158 limit the number of bottom openings, models with extra manufacturing holes in the bottom plate should be selected for the base fire containment test. Most often, these models are the basic models in a series with the fewest options.

Exhaust Venting Configuration — For clothes dryers configured to allow either rear, side, or bottom venting, the base fire containment test may need to be repeated in each venting configuration. This is because the placement of cheesecloth in the base will vary depending on the location of exhaust venting.

Stacked Configurations — Although the testing of an individual dryer is considered representative of two identical stacked dryers, the base fire containment test must be repeated on a stacked washer/dryer combination.

Optional Drum Lamp — When a clothes dryer is provided with an optional drum lamp, the load fire containment test must be conducted both with and without the drum lamp.

Drum Size, Opening Configuration and Airflow — When the clothes drum size and/or drum opening configuration varies, the load fire containment test must be conducted with each drum size and configuration. In addition, if an alternate blower results in changes to the airflow, the load fire containment test must be conducted with each blower.

Front/Rear Controls — For clothes dryers with the option for controls to be located on the front or rear, the load fire containment test must be conducted with both control configurations.

In addition to anticipating the number of test samples required, manufacturers seeking UL 2158 certification should also be prepared to provide additional documentation on a dryer's design, including a description of all wiring routing paths and locations of all routing devices. Flammability ratings on all nonmetallic parts used in a dryer's construction, such as baffles, lint screens and frames, lint screen holders, drum seals, lamp lens, and access panels, should also be documented and made available for review. Further, the materials used in these parts must be controlled for the specific material manufacturer and designation, since a change in the material could affect the outcome of the fire containment tests. Finally, a description of any gaps in panels that make up the outer enclosure is also advised.

Benefits for Manufacturers, Appliance Retailers and Consumers

The fire containment tests in UL 2158 have the potential to significantly reduce the risk of electric dryer fires, damage to residential property, and the injury or death of consumers. As such, manufacturers and retailers have a unique opportunity to offer consumers access to safer electric clothes dryers. In addition, the availability of safer dryer models may accelerate the replacement of older dryers, thereby increasing unit sales levels. The advent of safer dryers also presents an ideal environment in which to remind consumers about the importance of regular dryer cleaning and maintenance, reinforcing their role in the overall effort to increase safety.

Conclusion

The fire containment testing included in the revised version of UL 2158, Electric Clothes Dryers, will impose new requirements for appliance manufacturers seeking UL certification now through the effective date of March 20, 2013, when all UL Certified electric clothes dryers will need to have demonstrated compliance with the fire containment tests. In addition to the lengthy review process required to assess compliance with the revised Standard, research by UL and others has shown that a significant number of current clothes dryer designs are unlikely to pass the recently added fire containment tests without some product modifications.

Manufacturers are strongly encouraged to promptly evaluate their products against the fire containment requirements and consider design changes necessary for compliance with the new requirements well ahead of the March 2013 deadline. Doing so will support uninterrupted product certification and continued market access.

For more information about the "Reducing Injury and Damage Related to Electric Dryer Fires: Fire Containment Tests for the Second Edition of UL 2158" white paper, please contact Michelle Anderson, Principle Engineer – Kitchen & Laundry Machines - at Michelle.Andersen@ul.com

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