the standard in safety

Underwriters Laboratories

The Fire & Security Authority®

2010 ISSUE 4

Saving Lives by Understanding Fire Behavior in Residential Structures

UL fire research team completes residential fire behavior and ventilation tactics study for the fire service

by Steve Kerber

There is a continued tragic loss of firefighters' and civilian lives, as shown by fire statistics. It is believed that one significant contributing factor is the lack of understanding of fire behavior in residential structures resulting from natural ventilation and use of ventilation as a firefighter practice on the fire ground. Under the United States Department of Homeland Security (DHS) Assistance to Firefighter Grant Program, Underwriters Laboratories examined fire service ventilation practices as well as the impact of changes in modern furnishings and house geometries. There has been a steady change in the residential fire environment over the past several decades. These changes include larger homes, more open floor plans and volumes and increased synthetic fuel loads. UL conducted several room fire experiments and a series of 15 full-scale residential structure fires to examine this change in fire behavior and the impact of firefighter ventilation tactics.

(continued on page 4)

In this issue:

The Fire & Security Authority UL

www.ul.com/fsa

2010 Issue 4

02

What's Hot...

UL is one step closer to providing global market access

The new Global UL Mark & the pan-European UL-EU Mark provide global market access for products covered by the Construction Products Directive (CPD)

The Global UL Mark is the first mark available in UL's portfolio of market-leading certification marks to demonstrate product compliance with requirements in the U.S., Canada, Europe and other markets where the UL Mark is accepted. The Global UL Mark provides manufacturers with the unique opportunity for direct access to multiple strategic markets with a single, highly recognized mark and one product submittal.

For European market access, UL is proud to introduce the new pan-European UL-EU Mark, designed to accompany the CE marking to demonstrate compliance to European standards for products covered within the Construction Products Directive (CPD), demonstrating a manufacturer's commitment to safety across Europe.

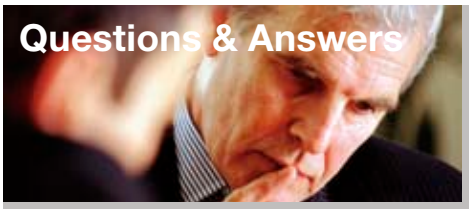
UL's new marks provide another solution to aid customers in reducing critical time to market and compliance costs by combining global testing and certification with UL.

For more information, please contact Betsy Titus at +1.847.664.2530 or Elizabeth.Titus@us.ul.com.

UL EU c UL US LISTED EU

The new Global UL Mark & the pan-European UL-EU Mark provide global market access for products covered by the Construction Products Directive (CPD)

Questions & Answers



Are there any UL fire-resistance rated designs that allow me to add additional layers of gypsum board to one side of the wall (the accessible side) to achieve a 2 hour rating?

Yes, there are several 2 hour fire-resistance-rated wall designs published in the UL Fire Resistance Directory and Online Certifications Directory that are nonsymmetrical in construction which can be utilized to enhance the rating. These designs typically include one layer of gypsum board on one side and multiple layers on the opposite side. In some case, the multiple layers are separated by resilient or furring channels. As such, it is often possible to add additional layers of gypsum board to an existing 1 hour wall which utilizes one layer of board on each side, thereby creating a 2 hour wall.

The key to using this approach is determining the specific type of gypsum board in place on the existing wall, and verifying it complies with the requirements of the proposed 2 hour multi-layer design. Ideally this information can be found on the "as-built" construction documents. If not, it may be necessary to remove a sheet of the existing gypsum board on the accessible side to view the marking information printed on the back side of the board. Assuming the existing wall aligns with one of the 2 hour multi-layer designs in terms of board type, board orientation, stud properties, fastening details, etc., the additional layers of gypsum board are simply installed on the accessible side of the wall in accordance with the requirements of the published design. This approach represents a cost effective, code compliant solution to enhancing the performance of an existing wall.

If this approach is unsuccessful for whatever reason, a second approach to achieving a 2 hour fire-resistance rating is to construct a 2 hour shaft wall adjacent to the existing 1 hour wall. While more costly than simply adding additional layers of gypsum board to the existing wall, this approach also accomplishes the goal of providing a 2 hour rating.

Fire-resistance rated designs are published in the UL Fire Resistance Directory and Online Certifications Directory.

For more information, please contact Rich Walke at +1.847.664.3084 or Richard.N.Walke@us.ul.com.

UL and ICC-ES Collaboration

Dual evaluation & certification program for building materials and systems

The purpose of the program is to provide code officials and construction professionals with a reliable means to verify that these products comply with applicable codes and standards.

One stop for complete code compliance

This program offers the building products industry a streamlined approach to demonstrating compliance with the family of International Codes produced by the International Code Council and access to information about certified products on the websites of both ICC-ES and UL.

Product categories available for the program

Any building products, such as gypsum sheathing products and roofing materials and systems, for which the manufacturer currently has or desires to have UL certification and an ICC-ES Evaluation Report are eligible. Manufacturers must be under UL's regular Follow-up Program and under UL's quality audit program based on ICC-ES requirements.

Key benefits to manufacturers

Manufacturers who take advantage of the UL/ICC-ES alliance will benefit from the combined strengths of the two organizations. The program provides a comprehensive and collaborative framework for the testing, inspection, certification and evaluation of building products, resulting in a UL certification and an ICC-ES evaluation report.

There is an expedited turn-around time for both the ICC-ES evaluation report and UL certification, especially when compared to obtaining these individually. The compliance information is placed in product directories on both ICC-ES and UL websites.

Through the use of both the trusted ICC-ES Mark and the highly regarded UL Mark, manufacturers can obtain acceptance of products both nationally and internationally, wherever the family of International Codes have been adopted, and obtain wider exposure for building products through the network of ICC-ES and UL relationships.

Key benefits to code officials

Code officials will benefit from this new program through added assurance that building products and systems meet the rigorous testing requirements of both ICC-ES and UL.

Evaluation reports and certifications are simultaneously posted for free and easy access on both ICC-ES and UL websites to assist in finding code-complying products. In addition, UL's code correlation database, the only database of its kind in the industry, directly connects the listings with specific code sections, to assist AHJs in their code compliance decisions and acceptance of certified products. The listing information is also embedded in electronic versions of the I Codes.

How the program works

Manufacturers may contact either ICC-ES or UL. Prior to any testing, ICC-ES and UL discuss the project scope and testing requirements together with the client. UL is responsible for all testing and inspections required for UL certification. Either UL or a properly accredited laboratory with an established relationship with UL performs any additional testing required by ICC-ES. UL prepares and submits the application packages to ICC-ES on behalf of the client. Based on this information, ICC-ES makes its decision on whether to issue an evaluation report. UL conducts all product and quality inspections associated with the program. UL and ICC-ES are each responsible for issuing their respective certification or evaluation report.

Information on the dual Listing program is available at **www.ul.com/iccesbms**.

For more information, please contact Jacob Borgerson at +1.847.664.2473 or Jacob.Borgerson@us.ul.com.

Saving Lives by Understanding Fire Behavior (continued from cover)

This fire research project developed the empirical data that is needed to quantify the fire behavior associated with these scenarios and result in immediately developing the necessary firefighting ventilation practices to reduce firefighter death and injury.

Impact of modern furnishings

The increased use of synthetic materials in the home has created faster flashover times when sufficient air is available. Two side by side comparison experiments demonstrated flashover times of less than 4 minutes with modern furnishings as compared to more than 29 minutes with legacy furnishings. Modern furnishings were purchased new from local retailers and are commonly found in today's homes and the legacy furnishings were purchased used and were typical of furnishings found in homes of the 1950's and into the 1970's. This difference in flashover times has a substantial impact on occupant and firefighter safety.

Full-scale house experiments

Two houses were constructed in the large fire facility of Underwriters Laboratories in Northbrook, IL. The first of two houses constructed was a one-story, 1200 ft2, 3 bedrooms, 1 bathroom house with 8 total rooms. The second house was a two-story 3200 ft2, 4 bedroom, 2.5 bathroom house with 12 total rooms. The second house featured a modern open floor plan, two-story great room and open foyer. Fifteen experiments were conducted varying the ventilation locations and the number of ventilation openings. Ventilation scenarios included ventilating the front door only, opening a window only, opening the front door and a window near the seat of the fire, opening the front door and a window remote from the seat of the fire, opening a door and a higher window in the two-story house, and sequentially opening multiple windows. One scenario in each house was conducted in triplicate to examine repeatability.

The furnishings in both houses were similar for all of the experiments and every room in the houses was furnished. Instrumentation was placed throughout the houses to measure temperature, gas concentrations, and gas velocities. Video was recorded in six locations inside the houses and two locations outside the houses.

Experimental timeline

All of the experiments began with all of the exterior doors and windows closed and all of the interior doors in the same locations, either open or closed, for every experiment. The fire was ignited in a sofa in the living room of the one story house and in a sofa in the family room for the two story house using a remote ignition device comprised of three stick matches. The flaming fire was allowed to grow until ventilation operations were simulated by making openings. The one story house was ventilated at 8 minutes after ignition. This was determined based on three factors, time to achieve ventilation limited conditions in the house, potential response and intervention times of the fire service and window failure times from the window experiments. The ventilation time for the two story house was 10 minutes for the same reasons as the one story house with added time due to the main purpose of achieving ventilation limited conditions. The larger volume created a longer time to consume the oxygen.

After ventilation the fire was allowed to grow until flashover or perceived maximum burning rate based on the temperatures, observation of exterior conditions and monitoring of the internal video. Once the fire maintained a peak for a period of time, with respect given to wall lining integrity, a hose stream was flowed in through an external opening and the experiment was terminated.

Experimental results

Tenability in these two homes was limited for occupants but the possibility of savable lives, especially behind closed doors should be considered by the fire service in their risk

How Fire Can Affect Your Home

Left: Modern Room

Right: Modern Room at 3:30 after ignition

Left: Legacy room

Right: Legacy Room 5:00 after ignition

Left: One-Story House

Right: 3D Rendering

analysis. Also, emphasis should be placed on closing doors when the fire service is educating the public. Tenability for firefighters can also be quantified for these experiments. Firefighters had 100 seconds in the one-story house and 200 seconds in the two-story house after ventilation before water would have to be applied to remove the hazard or the firefighter would have to exit the house. These numbers should be considered conservative as the fire were allowed to become ventilation limited and decrease to a low temperature without becoming extinguished.

A significant portion of the 100 second and 200 second time to firefighter untenability is fresh air being entrained into the ventilation limited fire. In many of the experiments the time from the beginning of temperature escalation until untenability was less than 10 seconds. This provides little warning that the fire is going to flashover and highlights the need to understand that ventilation openings are not only allowing hot gases to escape but fresh air to enter.

Several ventilation comparisons could be made from the experimental series. First, the more ventilation openings that were made the faster the fire room transitioned to flashover. This shows that even in these modestly furnished homes fuel is not the limiting factor and that more air will create more burning and less tenability. Ventilating near the seat of the fire localized the combustion and temperatures within the house. Ventilating remote from the seat of the fire created a flow path with expanded the area available to burn and further decrease tenability within the homes. Allowing air into a ventilation limited fire low and letting the hot gases out high can create prime conditions for a flashover, even in a large volume like the two-story family room. More efficient ventilation can mean more efficient air entrainment which can lead to faster flashover times if water is not applied in the shorter tenability window.

Left: Two-Story House
Right: 3D Rendering

Left: One-Story Living Room Furnishings
Right: Two-Story Family Room Furnishings

Left: One-Story Experiment
Right: Two-Story Experiment

Fire service tactical considerations

It was paramount for the results of these experiments to be translated to the fire service. Therefore, several tactical considerations were developed for the fire service with the assistance of a technical panel of fire service leaders assembled for this project. First, the stages of fire development change when a fire becomes ventilation limited. It is common with today's fire environment to have a decay period prior to flashover which emphasizes the importance of ventilation. Forcing entry has to be thought of as ventilation as well. While forcing entry is necessary to fight the fire it must also trigger the thought that air is being fed to the fire and the clock is ticking before either the fire gets extinguished or it grows until an untenable condition exists jeopardizing the safety of everyone in the structure. A common event during the experiments was that once the fire became ventilation limited the smoke being forced out of the gaps of the houses greatly diminished or stopped all together. No some showing during size-up should increase awareness of the potential conditions inside. Once the front door is opened attention should be given to the flow through the front door. A rapid in rush of air or a tunneling effect could indicate a ventilation limited fire.

During a Vent Enter Search (VES) operation primary importance should be given to closing the door to the room. This eliminates the impact of the open vent and increases tenability for potential occupants and firefighters while the smoke ventilates from the now isolated room. Every new ventilation opening provides a new flow path to the fire and vice versa. This could create very dangerous conditions when there is a ventilation limited fire. Conditions in every experiment for the closed bedroom remained tenable for temperature and oxygen concentration thresholds. This means that the act of closing a door between the occupant and the fire or a firefighter and the fire can increase the chance of survivability. During firefighter operations if a firefighter is searching ahead of a hoseline or becomes separated from his crew and conditions deteriorate then a good choice of actions would be to get in a room with a closed door until the

(continued on page 7)

Minister Raitt Promotes Fire Safety in the Workplace

The Honourable Lisa Raitt, Canada's Minister of Labour, raised awareness of health and safety issues in the workplace, including fire prevention, during her recent visit to Underwriters Laboratories of Canada (ULC).

On October 4, 2010, Minister Raitt, accompanied by staff from the Labour Program and Human Resources and Skills Development Canada (HRSDC) visited and toured ULC's head office in Toronto, Ontario. The HRSDC Labour Program is responsible for the administration of both the Canadian Labour Code and the Government of Canada Treasury Board Policy on Fire Protection. Through the Fire Protection Services program, the Labour Program ensures that federal properties and their occupants are protected from fire hazards.

Since the visit coincided with Fire Prevention Week, a tour was given of the ULC Electrical Laboratory, including the testing of smoke alarms.

"By improving the well-being of workers, we can help ensure that Canadian workplaces continue to be efficient, innovative and productive," said Minister Raitt. "Through partnerships with experts like Underwriters Laboratories of Canada, our government is working to improve occupational health and safety measures, including fire safety."

ULC is one of Canada's accredited standards development organizations and for the last 90 years has been conducting leading fire research, working with first responder organizations to improve fire safety and helping raise consumer awareness. ULC maintains and operates laboratories and certification services for; the examination, testing, and classification of devices; constructions, materials and systems to determine their relation to life, fire and property hazards.

"Underwriters Laboratories of Canada was delighted to welcome Minister Raitt to our Canadian headquarters, and to emphasize the benefits of occupational health and fire safety," said Mr. Martin Oughton, President and General Manager of ULC. "Because safety matters so much to everyone at ULC, hearing her perspective on the state of fire safety and being able to discuss and demonstrate how our certification, standards development and training programs benefit Canadians helps us further our safety mission."

ULC also thanked the Minister and HRSDC for funding the development of their standard CAN/ULC-S575, Integrated Systems Testing and Commissioning of Fire Protection and Life Safety Systems. ULC Standards works with industry stakeholders representing both public and private sectors to advance the safety and security of people and property. ULC Standards also represents Canada as an active and vital participant in international standard development initiatives. Specifically, they share a Canadian perspective and offer expertise in various international committees.

Staff from the Labour Program are active participants on a number of the ULC Standards Committees.

For more information, please contact Kevin Wu at +1.416.757.5250 or Kevin.Wu@ca.ul.com

In the photo, from left to right: Kevin Wu, Paul Muia, Peter Nanda, Emmanuel Sopeju, Martin Oughton, Minister Lisa Raitt, Anna Ananiadis, Randy de Launay, Mike Prasad, John Arrabito.

Underwriters Laboratories Launches the ULtimate Fire Wizard

Underwriters Laboratories has launched the ULtimate Fire Wizard, an Internet-based tool that allows architects, designers and code authorities to quickly and easily locate fire-resistance-rated assemblies meeting their project specifications.

For decades, architects, designers and code authorities have relied on UL fire-resistance-rated designs for safe, code-compliant installations. With hundreds of UL designs to choose from, selecting the optimum design meant hours of searching through UL product directories.

The free online Wizard uses a simple three-step process to significantly reduce the time needed to identify a suitable design. After completing the search, a search summary can be viewed or printed for use in the construction document package.

To access the ULtimate Fire Wizard go to **www.ul.com/firewizard**.

For more information, please contact Rich Walke at +1.847.664.3084 or Richard.N.Walke@us.ul.com.

Saving Lives by Understanding Fire Behavior (continued from page 5)

fire is knocked down or escape out of the room's window with more time provided by the closed door.

All of these experiments were designed to examine the first ventilation actions by an arriving crew when there are no ventilation openings. It is possible that the fire will fail a window prior to fire department arrival or that a door or window was left open by the occupant while exiting. It is important to understand that an already open ventilation location is providing air to the fire, allowing it to sustain or grow. In the experiments where multiple ventilation locations were made it was not possible to create fuel limited fires. The fire responded to all the additional air provided.

That means that even with a ventilation location open the fire is still ventilation limited and will respond just as fast or faster to any additional air. It is more likely that the fire will respond faster because the already open ventilation location is allowing the fire to maintain a higher temperature than if everything was closed. In these cases rapid fire progression if highly probable and coordination of fire attack with ventilation is paramount.

If air is added to the fire and water is not applied in the appropriate time frame, the fire gets larger and safety decreases. Examining the times to untenability gives the best case scenario of how coordinated the attack needs to be. Taking the average time for every experiment from the time of ventilation to the time of the onset of firefighter untenability conditions yields 99 seconds for the one-story house and 199 seconds for the two-story house. In many of the experiments from the onset of firefighter untenability until flashover was less than 10 seconds. These times should be treated as being very conservative. If a vent location already exists due to the homeowner leaving a window or door open, then the fire will respond faster to additional ventilation opening because the temperatures in the house are going to be higher. Coordination of fire attack crew is essential for a positive outcome in today's fire environment.

This research study developed empirical fire test data to demonstrate fire behavior resulting from varied ventilation opening locations in legacy residential structures compared to modern residential structures. The data will be used to provide education and guidance to the fire service in proper use of ventilation as a firefighting tactic that will result in mitigation of the firefighter injury and death risk associated with improper use of ventilation.

For information about this project contact Steve Kerber at Stephen.Kerber@us.ul.com. Also visit **www.ul.com/fireservice** to view the complete report and the online fire service training module.

Underwriters Laboratories

333 Pfingsten Road
Northbrook, IL 60062-2096
United States of America

Non-Profit Org.
U.S. Postage
PAID
Permit No. 1009
Northbrook, IL

Calendar of Events

January 12–15, 2011
International Builders Expo
Orlando, FL
www.buildersshow.com

January 16–18, 2011
Intersec, Dubai
Dubai, UAE
www.intersecexpo.com

January 17–22, 2011
BAU 2011
Munich, Germany
www.bau-muenchen.com

January 31–February 2
Fire & Materials Conference
San Francisco, CA
www.intersciencecomms.co.uk

February 16–18, 2011
International Roofing Expo
Las Vegas, NV
www.theroofingexpo.com

February 17–19, 2011
PragoAlarm/PragoSec
Prague, Czech Republic
www.pragoalarm.cz

March 7–8, 2011
Campus Fire Safety
Columbus, OH
www.campusfiresafety.org

March 15, 2011
IFPA/SFPE — Product Show
Chicago, IL
www.ifpanet.org

March 22–25, 2011
SUPDET — Suppression and Detection Symposium
Orlando, FL
www.nfpa.org

March 24–26, 2011
FDIC — Fire Department Instructors' Conference
Indianapolis, IN
www.fdic.com

If you would like *The Fire & Security Authority* to consider publishing your upcoming events, contact Darlene Knauss, editor, in Northbrook, IL, by e-mail at Darlene.Knauss@us.ul.com. Please type "Calendar" in the subject line.

The Fire & Security Authority®
Published by the Regulatory Services Department and the Building Materials/Life Safety and Security Industries of Underwriters Laboratories Inc.

A Nationally Recognized Testing Laboratory (NRTL)

Managing Editor
Darlene Knauss
T:: +1.847.664.3985
E:: Darlene.Knauss@us.ul.com

Address changes and additions
T:: +1.847.664.2461
F:: +1.847.509.6257
E:: Diane.E.Fonzino@us.ul.com