CPSA 6(b)(1) Cleared 6/24/98

LOG OF MEETING

SUBJECT: Underwriters Laboratories (UL) Fire Council

DATE: April 22-24, 1996

PLACE: Oak Brook Hills Hotel, Oak Brook, Illinois

COMMISSION ATTENDEES: James F. Hoebel, Engineering Sciences
Rikki Khanna, Engineering Sciences

NON-COMMISSION ATTENDEES: See attached report

LOG ENTRY SOURCE: James F. Hoebel

SUMMARY: This was the 34th meeting of the UL Fire Council. The Fire Council is one of UL's Engineering Councils. Council members assist and advise UL engineers in the establishment of safety requirements. Members of the Fire Council include representatives from Federal agencies, cities and states, academia, fire services, model building codes, insurance companies, and research laboratories. Manufacturers are not members or participants.

The first day consisted of a tour of UL's new large-scale fire testing facility, containing a 120' by 120' by 55' high primary test cell. The other UL fire test facilities were also toured.

The regular council meeting comprised the next two days. The attached summary report contains the complete agenda, UL presentations, discussions, and action items. CPSC staff had submitted the subjects of halogen lamp fires, Christmas lights, reinspection and rewiring of electrical systems, thermoplastic materials, electric blankets, wire connectors, smoke detectors, CO detectors, rangetop cooking fires, and flammable refrigerants.

333 Pfingsten Road
Northbrook, Illinois 60062-2096
(847) 272-8800
FAX No. (847) 272-8129
MCI Mail No. 254-3343
Telex No. 6502543343

Underwriters Laboratories Inc.

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Subject 670

May 31, 1996

TO: The Members Of The UL Fire Council

Thanks to each of you for participating in the thirty-fourth meeting of the Fire Council on April 23 and 24, 1996. Once again staff has benefited immensely from the contribution of your expertise and the insight of your individual and collective experience.

Attached is a summary report of the discussions. To the greatest possible extent we have attempted to incorporate your observations, comments, and suggestions in this report, especially where they concern actions that may be undertaken by our staff. The results of our actions will be reported to you prior to the next meeting. I encourage you to review items of special interest to you and write to me with any questions, concerns or unresolved issues.

On behalf of UL, I thank each of you who attended for all your contributions at the meeting; and thanks to all for your assistance throughout the years. The thirty-fourth Fire Council meeting played a key role in our mission to foster public safety. Your continuing help is greatly appreciated.

Sincerely,

J R Beyreis

J. R. BEYREIS
Vice President - Engineering
Chairman, Fire Council

JRB:jcr

Fire Council

REPORT OF THE THIRTY-FOURTH MEETING OF THE FIRE COUNCIL OF UNDERWRITERS LABORATORIES INC.

APRIL 23-24, 1996

The Fire Council convened at 9:00 AM on April 23, 1996 at the Oak Brook Hills Hotel , Oak Brook, Illinois.

The following were present for all or part of the meeting:

MEMBERS

John Berndt .... Ottawa, Ontario, Canada
Pat D. Brock .... Stillwater, OK
John Canestro .... Castro Valley, CA
Tony Chow .... Etobicoke, Ontario, Canada
Richard A. Comstock .... Irving, TX
S. J. Couvillon .... Hartford, CT
Rick Dumala .... Victoria,B.C., Canada
Robert Gazdik .... St. Paul, MN
Peter Higginson .... Scarborough, Ontario, Canada
James F. Hoebel .... Bethesda, MD
Alfred J. Hogan .... Lake Buena Vista, FL
Richard E. Hughey .... Parsippany, NJ
Mark Jachniewicz .... New York, NY
Gerald H. Jones .... Kansas City, MO
Larry Litchfield .... Phoenix, AZ
David A. Lucht .... Worcester, MA
D. Peter Lund .... Boston, MA
James W. Martin .... Hartford, CT
Rick McCullough .... Regina, Saskatchewan, Canada
James A. Milke .... College Park, MD
Gordon Murdoch .... Vancouver, B.C., Canada
Martin H. Reiss .... Wellesley, MA
J. Kenneth Richardson .... Ottawa, Ontario, Canada
James C. Roberts .... Raleigh, NC
Jim W. Sealy .... Dallas, TX
David W. Stroup .... Washington, DC
Jim L. Tidwell .... Fort Worth, TX
Perry C. Tyree .... Colorado Springs, CO
Richard A Vognild .... Birmingham, AL

Robert J. Vondrasek . . . . Quincy, MA
Klaus Wahle . . . . Washington, D.C.

ASSOCIATE MEMBERS

John G. Degenkolb . . . . Carson City, NV
Harold E. Nelson . . . . Baltimore, MD
Patrick E. Phillips . . . . Las Vegas, NV
Myron J. Sasser . . . . Birmingham, AL
Chester W. Schirmer . . . . Pinehurst, NC

GUESTS

John Davenport . . . . Hartford, CT
Tom Frost . . . . Country Club Hills, IL
Richard Holguin . . . . Los Angles, CA
Rikki Knanna . . . . Washington, DC
Chuck Ramani . . . . Whittier, CA

STAFF

James R. Beyreis . . . . Northbrook, IL
Lee Dosedlo . . . . Northbrook, IL
James Barthman . . . . Santa Clara, CA
Kerry Bell . . . . Northbrook, IL
Bob Berhinig . . . . Northbrook, IL
Ed Briesch . . . . Northbrook, IL
Jane Coen . . . . Northbrook, IL
Bob Della Valle . . . . Melville, NY
Dave Dini . . . . Northbrook, IL
Shari Duzac . . . . Santa Clara, CA
Dr. P. Gandhi . . . . Northbrook, IL
Don Grob . . . . Northbrook, IL
Lee Hewitt . . . . Northbrook, IL
Dan Kaiser . . . . Northbrook, IL
Paul Kelly . . . . Northbrook, IL
Marty Magera . . . . Northbrook, IL
John Mahal . . . . Northbrook, IL
Bill Metes . . . . Northbrook, IL
Paul Patty . . . . Northbrook, IL
Bob Pollock . . . . Northbrook, IL

Ken Rhodes	Northbrook, IL
Bill Schallhammer	Northbrook, IL
Steve Schmit	Northbrook, IL
Dwayne Sloan	Research Triangle Park, NC
Jim Urban	Northbrook, IL
Bob Williams	Northbrook, IL

List of Acronyms

American Association of Retired Persons (AARP)
American Gas Association (AGA)
American Gas Association Laboratory (AGAL)
American National Standard Institute (ANSI)
American Petroleum Institute (API)
American Society for Testing and Materials (ASTM)
Association of Home Appliance Manufacturers (AHAM)
Asphalt Roofing Manufacturers Association (ARMA)
Authorities Having Jurisdiction (AHJ)
Board for Coordinating Model Codes (BCMC)
Builders Hardware Manufacturers Association (BHMS)
Building Officials & Code Administrators (BOCA) International, Inc.
Consumer Product Safety Commission (CPSC)
Canadian Standard Association (CSA)
Environmental Protection Agency (EPA)
Failure Modes and Effects Analysis (FMEA)
Fault Tree Analysis (FTA)
Gas Research Institute (GRI)
Gas Appliance Manufacturers Association (GAMA)
Hazard-Based Safety Engineering (HBSE)
Heating, Ventilating, and Air-Conditioning (HVAC)
Industry Advisory Committee (IAC)
Industry Advisory Group (IAG)
Insurance Institute for Property Loss Reduction (IIPLR)
Intermediate Calorimeter (ICAL)
International Conference of Building Officials (ICBO)
International Electrotechnical Commission (IEC)
International Standardization Organization (ISO)
Memorandum of Understanding (MOU)
Mutual Recognition Agreement (MRA)
National Electric Code (NEC)
National Electrical Manufacturers Association (NEMA)
National Fire Incident Data (NFIRS)
National Fire Protection Association (NFPA)
National Fire Protection Research Foundation (NFPRF)
National Institute of Building Sciences (NIBS)
National Institute of Standards and Technology (NIST)
National Research Council (NRC) of Canada
Occupational Safety & Health Administration (OSHA)
Solvent Distillation Units (SDU)

Standard Generalized Mark-Up Language (SGML)
Uniform Building Code (UBC)
Uniform Fire Code (UFC)
Underwriters Laboratories Certificate Verification Service (ULCVS)

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1.0 ELECTRICAL HAZARDS

1.1 HALOGEN LAMP FIRES

A recent article in the Arizona Republic newspaper alludes to problems with Halogen bulbs. Has UL received any similar notices of problems and is additional study being conducted or anticipated?

JOHN MAHAL (EXT. 42984):

Halogen bulbs have been in use for a number of years, initially as a light source for overhead and slide projectors which require an intense white light. Many sizes, shapes and wattages of halogen bulbs are now used in a variety of lighting products, including fixtures, track lighting and portable lamps.

Halogen bulbs, with higher operating temperature and higher pressure within the glass enclosure than incandescent bulbs, can present potential burn, casualty, fire and ultraviolet exposure hazards when not used in accordance with the manufacturer's instructions. As an example, a 100 Watt Type A (incandescent) bulb can reach a surface temperature of 260°C (500°F), while the temperatures on the glass of a halogen bulb can reach 600°C (1112°F). Burns may occur if the bulb is accidentally touched and, if the bulb is located in close proximity to combustible material, ignition of the material may result. A potential casualty hazard exists due to the halogen bulb's high operating pressure. Direct exposure and close proximity to a single envelope tungsten halogen bulb without a glass filter may result in ultraviolet exposure.

To address these potential hazards, the Standard for Portable Electric Lamps, UL 153, and the Standard for Incandescent Lighting Fixtures, UL 1571, have requirements which address the use of halogen bulbs. Both Standards include markings to warn users of the possible burn hazard associated with halogen bulbs and instruct the user to deenergize the lamp or fixture before replacing the bulb. Listed fixtures and portable lamps that use single envelope halogen bulbs must be provided with a guard or shield to act as a containment barrier to limit the emission of particles in the event the bulb ruptures.

Guarding and temperature limits in UL 1571 address potential fire hazards for fixtures that employ halogen bulbs. For Listed portable lamps, the fire hazard is addressed by conducting a number of abnormal tests for which lamp performance to be considered acceptable shall not result in 1) emission of flame or molten metal, 2) combustion of material on which the unit is resting or located near the unit, 3) exposure of parts involving a risk of electric shock, and 4) dielectric breakdown.

While UL is unable to determine how many lamps employ halogen bulbs as their light source, manufacturers were issued just over 63,240,000 UL Listing Marks for portable lamps in 1995, and almost 62,790,000 UL portable lamp Listing Marks were issued in 1994. With such a high number of portable lamps in the United States, UL has, on occasion, received incident reports of fires alleging portable lamps as the potential cause of the fire. When consumers fail to follow instructions for keeping lighting products away from combustible materials such as draperies, the combustible materials may be ignited when they contact the bulb.

As a result of reports on torchiere style floor lamps that employ halogen bulbs above 300 watts, in which careless use by consumers resulted in ignition of combustibles, UL issued an April 2, 1996 UL 153 bulletin announcing required action for continuance of UL Listing of halogen torchiere floor lamps. The bulletin indicated that three fires were recently reported to have occurred in Tempe, Arizona, allegedly caused when curtains or other combustible material came in contact with the bulbs of halogen torchiere floor lamps.

UL revised the existing safety requirements for these products by taking the following actions:

1. Effective May 2, 1996, UL withdrew Listings of halogen torchiere lamps provided with bulbs rated higher than 300 watts. UL also withdrew Listings of these type lamps with 300 watt bulbs that employ metal mesh lamp guards.

2. To continue using UL's Listing Mark on these lamps after May 2, 1996, manufacturers had to revise their product to:

    - Use bulbs rated not more than 300 watts.
    - Use a guard or lamp containment barrier made of glass in accordance with UL 153.
    - Bear a marking indicating that replacement bulbs are to be 300 watts maximum.

UL also issued an April 2, 1996 public notice urging consumers with 500 watt halogen torchiere floor lamps to replace the 500 watt halogen bulb with a maximum 300 watt halogen bulb. The release indicated that if misused by placement of the lamp to close to combustible materials, such as draperies and other fabrics, 500 watt halogen bulbs could ignite these materials. The public notice provided cautionary measures for consumers to follow for any type of indoor halogen lamp or fixture or other lighting product used within the home. Safety tips included:

- Carefully read all safety instructions and markings that come with the product before use.

- Place torchiere lamps in locations where they cannot be tipped over by children, pets, or a strong draft from an open window.

- Never use a light bulb of a different type or higher wattage than indicated by the manufacturer's instructions.

- If you have a portable halogen torchiere lamp, make sure not to use a bulb rated higher than 300 watts, even though the lamp may specify a maximum of 500 watts.

ACTION: UL will continue to study this matter and consider the need for additional revisions to UL 153.

1.2 CHRISTMAS LIGHTS

Each year, reports of fires associated with electric Christmas lights are in the news. Although some of these instances may involve products not Listed to the UL standard, and the UL standard may be reasonably adequate, much of this product comes from sources that may not have adequate quality control. What additional steps can UL take to improve quality assessment requirements for this class of product to reduce the annual fire toll?

JOHN MAHAL (EXT. 42984):

UL has undertaken measures to upgrade construction requirements in the Standard for Christmas Tree and Decorative Lighting Outfits, UL 588. These requirements become effective January 1, 1997.

For product requirements, UL has:

- Upgraded requirements for insulation piercing terminals. All components employing insulation piercing terminals are now subjected to testing as currently established in UL 588.

- Moved coverage of extension cords for decorative lighting to UL 817, which has more stringent requirements for extension cords.

- Developed new marking requirements to assist the consumer in the safe use of these products.

- Decreased the rating of line fuses for parallel type lighting strings from 7 amperes to 5 amperes.

- Increased the minimum wire size for series strings to No. 22 AWG from No. 24 AWG.

UL has also taken other steps to enhance the safety of these products. As this industry utilizes independent vendors and does not generally own their manufacturing facilities, UL has revised the procedures followed in establishing new factory locations and product constructions. Also, UL has opened special categories for components for better control.

- The category for intermediate and candelabra base lamps (C7 and C9 lamps) has changed from Component Recognition to Classification, thus allowing the consumer to purchase over-the-counter replacement lamps identified with the UL Classification Mark. New markings will alert the consumer to purchase UL Classified Lamps which, when used, will improve safe long term use of the lighted products.

- Lighting strings, in addition to decorative outfits, now utilize hologram Listing Marks, limiting the ability of manufacturers to counterfeit UL Marks and successfully market substandard products.

- Even though new products are similar to previously Listed products, the new products are subjected to a complete test program, which helps increase control over product variations.

- New manufacturing locations are subject to an Initial Production Inspection (IPI) after products produced at the factory are submitted for evaluation, helping to assure consistent production by additional vendors.

- The frequency of Follow-Up inspections have been realigned to coincide with the industry's seasonal production so that more inspections are conducted during peak production times.

- UL is providing increased training of Field Representatives that conduct Follow-Up Service for products covered under UL 588.

1.3 LISTING OF PROCESS EQUIPMENT

Listing of Process Equipment such as the following:

- *Gas Cabinets*
- *Chemical dispensing units*
- *Safety cabinets for the storage and handling of Flammable/combustible liquids*
- *Workstations as defined in the Uniform Fire Code (UFC): A defined space or an independent principle piece of equipment using Hazardous Production Material (HPM) within a fabrication area where a specific function, a laboratory procedure or a research activity occurs.*

Approved cabinets serving a workstation are included as a part of the workstation. A workstation may contain ventilation equipment, fire-protection devices, sensors for gas and other hazards, electrical devices and other processing and scientific equipment.

- *Liquid transporters, such as HPM carts*
- *Similar chemical container housings*

Questions:

1. *Is UL currently evaluating any of the product types listed above?*
2. *If UL were to List such a product type, what criteria would be applied to create a standard or set of standards for such an evaluation?*
3. *Would existing standards such as the following be applied, and if so, in what way?*
    - *NFPA 496 for Type Z purged equipment*
    - *NEC Articles 501 and 504 to determine suitability in classified locations.*
    - *NFPA 30*
    - *OSHA 29 CFR 1 910.106*
    - *Uniform Fire Code Articles 79, 80, and 51*
    - *Environmental Protection Agency criteria*
4. *Would there be some justification for Listing only certain components on certain products, such as the electrical devices or control panel only?*

ED BRIESCH (EXT. 43174):

UL is prepared to accept submittal of any of the equipment mentioned. Of all the product types in the above list, UL currently receives submittals of only flammable liquid storage cabinets. The requirements for these products are found in the Standard for Flammable Liquid Storage Cabinets, UL 1275. Manufacturers who have Listed flammable liquid storage cabinets can be found in the Gas and Oil Equipment Directory under the category "Flammable Liquid Storage Cabinets" (EHCU).

Although UL does not currently receive submittals of the other types of equipment, if a submittal were received, requirements would be developed to evaluate the product using requirements taken from existing UL Standards for similar types of equipment. Component parts would be evaluated to the UL Standards for the particular components. In addition, requirements found in NFPA Codes and Standards, including the National Electrical Code, OSHA regulations, the Uniform Fire Code or other applicable installation use and maintenance code would be applied where applicable. EPA requirements may be considered if operation of the equipment results in use of or potential release of a hazardous material into the environment.

For example, if the product being investigated handles a flammable liquid and falls under the guidelines of the Flammable and Combustible Liquids Code, NFPA 30, the requirements in NFPA 30 would be applied, including the area classification scheme and the extent of those classified areas. NFPA 30 Articles 79 and 80 and OSHA 29 CFR 1910.106 of the UFC would also be considered. The National Electrical Code Articles 500, 501, and 504, which address hazardous (classified) locations, would also be applied. Electrical equipment mounted within the classified areas would need to meet requirements for use in those classified areas. If component equipment or entire rooms in the classified areas were to be protected by pressurization to reduce the potential for ignition, NFPA 496, the Standard for Purged and Pressurized Enclosures for Electrical Equipment would be applied. If the equipment were to be involved with the manufacture of semiconductor devices, Article 51 of the UFC would also be considered.

The guide information for the product category, which is found in the UL product directories, and the product label information may be used to determine the Standards that were used to evaluate a particular product. Staff at UL's main offices and Local Engineering Services (LES) offices around the country can assist users and inspection authorities find information on tested products. UL can also perform Field Evaluations of products that are already installed. However, it is usually more advantageous to have the products investigated and Listed or Classified before installation.

Should a manufacturer submit only a component part of an overall piece of equipment, such as a control panel, UL would evaluate just the component, and the markings on the component would identify the specific part and not reference the overall piece of equipment. For example, a control panel for use in hazardous locations would bear the product identity of "Industrial Control Panel For Use In Hazardous Locations."

1.4 REINSPECTION AND REWIRING OF ELECTRICAL SYSTEMS IN OLDER HOMES

CPSC is involved in demonstrating the feasibility of correcting wiring hazards in older homes. UL recently completed a study of technology for detecting conditions that could cause electrical wiring systems fires. A discussion on the findings of the study would be appreciated.

CPSC encourages reinspection of older homes according to NFPA 73 and correction of identified hazards. A 26 minute video is available from CPSC.

DAVE DINI (EXT. 42982):

In 1994, the CPSC began a two-year effort designated the "Home Electrical System Fires Project." The overall objective of this project was to reduce loss from residential fires associated with electrical wiring systems. The major elements of the Home Electrical Systems Fires Project were to:

1. Promote electrical inspections of older dwellings to identify hazards that need correction,

2. Stimulate the repair and correction of known hazards, and

3. Demonstrate effective, economical electrical products that can upgrade the safety of electrical wiring systems in residences.

As part of the Home Fires Project, CPSC conducted some electrical inspections of older homes to identify hazards that needed attention. These inspections were conducted in accordance with NFPA 73, Residential Electrical Maintenance Code for One-and Two-Family Dwellings.

Residential fire data for the year 1993[1], the most current year for which this type of data is available, shows that there were almost one-half million residential fires in 1993 that caused almost 4,000 deaths, 25,000 injuries, and about five billion dollars in property loss. Electrical distribution equipment was identified in 43,000 of these fires. A study conducted by CPSC in 1987 indicated that the frequency of fires in the electrical system was disproportionately higher in homes more than 40 years old. Approximately one-third of the existing housing in the U.S. falls into this category. The residential electrical distribution systems in many older homes that had experienced fire had neither been inspected nor renovated since they were first built.

The disproportionately high incidence of fire in the electrical systems of older homes can usually be attributed to one or more of the following factors:

- Inadequate and overburdened electrical systems
- Defeated or compromised overcurrent protection
- Misuse of extension cords and makeshift circuit extensions
- Worn-out wiring devices not being replaced
- Poorly performed electrical repairs
- Socioeconomic considerations resulting in unsafe installations

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[1] Source - 1993 Residential Fire Loss Estimates from CPSC. Estimates were derived by applying proportions observed in National Fire Incident Data (NFIRS), obtained from the U.S. Fire Administration, to aggregate national estimates from a survey conducted by the National Fire Protection Association (NFPA).

While some of these factors do not lead to fires by themselves, combinations of these factors increase the likelihood of a potentially unsafe situations. Eventually, these factors can lead to electrical overheating and/or arcing faults that cause fires.

In mid-1994, UL was awarded a project by CPSC, as part of the Home Electrical System Fires Project, to conduct an in-depth study of technologies to detect and monitor precursory conditions that could lead to or directly cause fires in residential wiring systems. In particular, this study focused on how these technologies could be applied to older residential wiring systems. The project included:

1) Conducting a comprehensive review of published and unpublished literature on devices and systems that could decrease the likelihood of residential fires,

2) A survey of industry organizations and manufacturers for new products and systems that could decrease the likelihood of residential fires, and

3) The acquisition and analysis of promising devices and systems for ease of installation, reliability, cost and effectiveness in decreasing the likelihood of fires in residential wiring systems, particularly older residential wiring systems.

As a result, eleven products were procured in order to evaluate the technologies that they were intended to exemplify. These products fell into the following five general categories:

1. Arc-Fault Detection Technology - This technology is intended to respond to arcing faults in the electrical wiring system by looking for specific signature characteristics of the current, voltage, or electromagnetic fields associated with arcing faults.

2. Modified-Trip Circuit-Breaker Technology - This technology is intended to modify the trip characteristics of conventional residential circuit breakers. Essentially, the technology causes a circuit breaker to trip magnetically or instantly at levels of overcurrent that would normally result in the circuit breaker tripping thermally. The result is faster response time at levels of overcurrent that would typically correspond to the thermal trip region of a conventional circuit breaker.

3. Ground-Fault Interrupting Technology - This technology as it presently exists is intended to respond to a ground-fault condition to reduce the risk of electric shock in the residential distribution system. Ground-fault protection has been used very successfully for about the last 25 years to significantly reduce rates

of accidental death from electrocution in the U.S. However, the fire prevention capabilities of the GFCI are not well known. The new application of this technology is to reduce the risk of fire in the residential distribution system.

4. Supplementary Protection Technology - This technology consists of the innovative application of conventional supplemental overcurrent and/or thermal protection technology incorporated at the outlet receptacle or attachment plug in order to respond to specific conditions of temperature or current.

5. Surge-Protection Technology - This existing technology is intended to limit the magnitude of transient overvoltages in the electrical distribution system. Consideration is given to the fact that repeated exposure to transient overvoltages can cause damage to electrical insulation.

It was determined that no single product or technology in the examined state of development would provide protection against all electrical ignition scenarios likely to be encountered in residential wiring systems. However, the evaluation of the technologies that the involved products exemplified indicated that the potential exists to further combine certain technologies, once fully developed, into products that should significantly reduce the risk of fire beyond the scope of present conventional overcurrent protection technology.

From the technologies analyzed, arc-fault detection appears to be very promising, especially when added to residential branch-circuit breakers and combined with other proven technologies such as ground-fault protection. However, additional research must still be considered to better define the nature of residential electrical ignition sources, the levels of arc-fault protection needed, and standardized test methods to verify the effectiveness of practical products that would utilize this technology.

Single copies of this complete Report can be requested free of charge from the CPSC at:

U. S. Consumer Product Safety Commission
Office of the Secretary
Washington, DC 20207

Requests should reference the Report titled, "Technology for Detecting and Monitoring Conditions that Could Cause Electrical Wiring System Fires," dated September, 1995.

1.5 THERMOPLASTIC MATERIALS IN ELECTRICAL PRODUCTS

The trend is to increase the fire load from electrical products and equipment by substituting thermoplastic materials for other materials that generally have characteristics of being more resistant to distortion, ignition and flammability. At a recent public meeting with the CPSC staff, UL noted that new ways of looking at critical safety questions were being explored, such as a hazard-based safety engineering analysis.

What specific steps is UL planning to take to address this issue? Can UL give a specific example of their application of hazard-based safety engineering? What additional research is underway at UL to look at properties of thermoplastics that could adversely affect product performance when electrical failure occur?

DAVE DINI (EXT. 42982):

Over the last 18 months there have been a number of discussions and meetings between UL, industry representatives, and CPSC relative to the role of thermoplastics in the performance of electrical products. In order to contribute to the development of a better understanding of the role of thermoplastics in electrical products, CPSC provided a number of field reports of product failures as case studies.

From UL and industry analysis of these field reports, two general observations were made and agreed upon with CPSC. These were:

1. The product safety performance concerns expressed by CPSC are not a matter of the performance of any single material or generic grouping of materials such as "thermoplastics." Rather, the safety performance concerns relate to a much broader process of material selection, evaluation, and application of materials for use in the fabrication of electrical products.

2. There are multiple approaches to address material selection and product performance and that the imposition of a single solution approach may be both unnecessary and undesirable. One approach to addressing material selection and product performance is to draw on field experience as the basis for developing revised or new product safety requirements. The difficulty is that such a process seems to necessitate that adverse field performance must occur before requirements can be addressed. A second approach to enhancement of product safety is to provide for assessment of hazard scenarios as an element of product design. Such a process would be intended to

identify and avoid product features which may contribute to adverse performance prior to introduction of the products into commerce. A number of approaches have been used for this purpose.

Considering the above two general observations, it was agreed that four actions would be pursued. These are:

- CPSC will continue, to the greatest extent permitted by law, to provide detailed information relating to field performance of products which may be used as a basis for identifying opportunities and actions to achieve enhanced product safety requirements.

- UL will draw on information provided by CPSC and others, to work with industry and others having an interest to identify and pursue opportunities to enhance existing product safety requirements for relevant products.

- UL will pursue development and application of a hazard-based safety engineering process to supplement the use of established product safety requirements and standards.

- Members of industry agreed to provide CPSC with available materials relative to hazard-based safety engineering processes and the application of hazard-based safety engineering processes by individual manufacturers.

The use of hazard-based safety engineering analysis and tools recognizes that product performance cannot be addressed solely in terms of generic material characterization, such as "thermoplastics." The use of hazard-based safety engineering analysis and tools, such as Hazard-Based Safety Engineering (HBSE), Fault Tree Analysis (FTA), and Failure Modes and Effects Analysis (FMEA), can often be used to supplement the use of standards. There are three general areas that may benefit from such approaches. These are:

1. To analyze product failures identified through field reports in order to:

    a. Identify root causes and contributing factors involved in failures, and

    b. Determine whether or not existing requirements for the product are in need of review and revision.

2. To evaluate new and/or unusual products or product features that may not be addressed by existing product requirements.

3. To establish an enhanced process to assist in the identification of product features, during routine product evaluations, that may not be contemplated by existing product requirements.

Underwriters Laboratories anticipates pursuing an approach to apply hazard-based safety engineering analysis as an element in the review of field reports, including those provided to UL by CPSC. UL also expects to pursue development of procedures for evaluating new or unusual products to formally implement the use of hazard-based safety engineering analysis and tools. UL will consider development of a process for routine application of hazard-based safety engineering analysis and tools that can be used during routine product investigations to help identify product features bearing on safety that may or may not otherwise be discovered through other means.

1.6 ELECTRIC BLANKETS

We understand that only one company still manufactures electric blankets, and this product is UL Listed. Given the history of fire reports associated with electric blankets over the years , why does UL permit a construction that does not include any back-up system of thermal protection in the blanket, but relies on the chemical composition of the heating element wires to limit temperatures? Where is the second line of defense in case the heating element material is mis-manufactured and overheats? Are requirements for this type of construction going to be included in the UL standard?

BOB DELLA VALLE (EXT. 22918):

Electric blankets of the self limiting type employ a positive temperature coefficient semiconductor (PTC) wire which serves as the heater. Its inherent operating characteristics enable this wire to limit its own surface temperature in response to changing external conditions. This type of construction has existed since the early 1980's. There has only been one blanket manufacturer with UL Listings employing a self limiting construction and the predominant amount of electric blankets produced today by this manufacturer are of the self limiting type. Older styles of electric blankets, produced by several manufacturers, had non-self limiting wire and required a minimum number of thermostats dependent upon the blanket size to protect against overheating.

In view of the operating characteristics of the semiconductor PTC wire, overheating conditions are unlikely to occur. The wire is inherently self limiting and will not exceed its maximum temperature. As ambient temperature increases, the wire produces less heat. As the ambient temperature decreases, the PTC wiring produces more heat, up to the design limit.

UL permits the self limiting characteristics of the PTC heater wire to serve as the temperature limiting means in an electric blanket based upon the following:

1. Compliance with UL's Subject 1434 bulletin for thermistor type devices. This type of evaluation includes physical construction and "Resistance versus Temperature" measurements at different oven temperatures before and after all testing. Some of the testing is as follows:

   - 100,000 cycle endurance;
   - Heat, cold and humidity;
   - Freezer cycling for 1000 cycles;
   - Crush;
   - Roller Flexing;
   - Thermal runaway;
   - 1000 hour limited aging at 105°C;
   - 3000 hour extended aging at 80°C.

2. The construction and the performance of the wire is evaluated to the Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581 in order to determine its suitability as an appliance wiring material for use in an electric blanket. This is primarily a physical evaluation of the insulating materials of the PTC conductor and its protective sheathing. Some of the testing is as follows:

   - Tensile strength and elongation of insulation;
   - Heat shock;
   - Dielectric Strength;
   - Cold bend;
   - Spark;
   - Flexing.

3. Compliance with the Standard for Electrically Heated Bedding, UL 964, which includes some of the following tests to evaluate the wiring's performance in the end-use application:

   - Normal Temperature;
   - Flexing of the bedding;
   - Bunching;
   - Laundering;
   - Various foldings while monitoring temperatures.

   A self limiting electric blanket is also subjected to abnormal operation tests, wherein one conductor of the semiconductor PTC wire is opened to simulate a break in the wire. The performance of the external protective circuit (blanket control) is evaluated to the requirements of the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

4. UL requires 100 percent production line testing of blankets and quarterly re-examination testing, wherein the electric blanket is subjected to the complete end product test program. The performance of the PTC wire employed in the end product is therefore being evaluated for continued compliance with the requirements in production. UL's required PTC wire production line testing (Resistance versus Temperature measurements) and Follow-Up Service Inspections and Re-examination Testing serve as a control point check of continued compliance with the requirements.

   For example, Resistance versus Temperature measurements conducted as part of the production line testing for semiconductor PTC wire is done on a sampling of each batch of wire to determine that the chemical composition and manufacturing process of the wire produce an acceptable composition and tolerance of wire thickness. If the results of this check are not acceptable, the entire batch of wire is discarded.

5. Finally, the PTC wire manufacturer has its own quality control system for the critical control points of the manufacturing process. For example, one process determines that the wall thickness of the PTC material is within an acceptable range.

ACTION: UL will develop requirements for Electric Blankets employing semiconductor PTC heating elements which will be proposed to UL's Industry Advisory Group as revisions to the Tenth Edition of the Standard for Electrically Heated Bedding, UL 964.

1.7 WIRE CONNECTORS FOR USE WITH ALUMINUM WIRING

Last year UL listed a connector that had practical application only in older homes that were built with controversial aluminum wiring. The wiring has been linked to reports of burned outlets and fires, and Government for years has recommended against the use of this type of connector in these homes. The listing was the subject of a recent New York Times article (December 24, 1995).

Given the history of aluminum wiring in homes, why didn't UL seek the guidance of it's Engineering Councils (Fire and Electrical) prior to promulgating the listing? Is UL prepared to take a second look at this product, conduct further investigation using its own test facilities to address the safety concerns, and seek council guidance before making further decisions about listings?

LEE HEWITT (EXT. 42906):

In general, the reports of burned outlets and fires are from a time period before the development of UL 486C. The reports related to improperly installed connections of aluminum wire to wire binding screws on outlets and wall switches and did not include cable connectors or twist-on connectors. Subsequently, "CO/ALR" wiring devices and a new alloy of aluminum wire were developed, and UL upgraded requirements for both the wiring and the wiring devices.

In the early 1980's interest in cable connectors led UL to develop new requirements for the Standard for Splicing Wire Connectors, UL 486C, which became effective January 2, 1987. Although UL 486C contained requirements for a variety of splicing connectors, including twist-on connectors for use with aluminum wire, manufacturers at that time did not submit any twist-on devices for use with aluminum wire combinations to UL for evaluation. As a result, after January 2, 1987, there were no UL Listed twist-on devices for use with aluminum wire combinations.

The CPSC recommendation concerning the use of this type of connector was based on pre-1987 connectors. This new connector is the first UL Listed twist-on connector for use with aluminum wiring to meet the stringent requirements contained in UL 486C. Other types of products have also been Listed to these same requirements.

UL is undertaking further review of requirements for this type of product. UL has also scheduled an Industry Advisory Group (IAG) meeting for May 1996 and invited CPSC to participate. Proposals discussed at the IAG meeting will be processed through UL's Standards development process, and any UL bulletins proposing revisions to this Standard will be distributed to the UL Electrical Council in the usual manner.

As these products are covered in the UL Electrical Construction Materials Directory, Council Bulletins and Reports for this product category are directed to the Electrical Council of Underwriters Laboratories. In March of 1995, a Bulletin announcing the Listing of the Ideal twist-on device for use with aluminum combinations was sent to the Electrical Council. UL issued a Council Bulletin rather than a Council Report for this product, since the requirements used to evaluate the device were already published in the Standard for Splicing Wire Connectors, UL486C and had been in effect since 1987. This topic was also discussed at the April 1995 Electrical Council meeting.

ACTION: UL will consider the need for additional requirements for wire connectors for use with aluminum wiring.

2.0 UL DIRECTORIES AND STANDARDS

2.1 MAKING UL DIRECTORIES MORE USER FRIENDLY

Last year a status report was given on a program to make the UL Directories more "user friendly." An update of that program would be appreciated.

I believe that the listing booklets could be made user friendly rather simply by providing a cross listing of terms in the index. Architects, engineers, craftsmen, manufacturers, etc. use different terms. Let's discuss.

JANE COEN (EXT. 43337):

Currently, UL is undertaking the redesign of its Listing Information System database and publishing processes, and the conversion of its Listing Information data to the Standard Generalized Mark-Up Language (SGML) format. These initiatives represent a major undertaking and are being pursued, to a large degree, in response to feedback from UL's clients and others. The end objective is to provide users of UL's Listing Information with a much broader range of products and services that meet their needs.

As part of the SGML conversion, the structure of the Listing Information will be analyzed, and enhanced to facilitate the creation of a variety of information products in both paper and electronic form. Electronic products will provide efficient browsing and powerful search capability. Listing Information will be available on-line, most likely through the Internet on either a subscription or usage fee basis. The publication of CD-ROM Listing Information products will be considered if there is sufficient market demand to justify the investment.

The content of the existing Listing Information will, as part of the SGML conversion process, be analyzed to identify any existing data anomalies or inconsistencies of use. These will be modified during the conversion process to enhance the quality of the Listing Information content. Solutions to reduce the confusion resulting from terminology differences which exist between the varying users of UL Listing Information, i.e., architects, engineers, craftsmen, manufacturers, Authorities Having Jurisdiction, etc., will be pursued as part of this effort.

UL welcomes the Fire Council members' input into this process, identifying enhancement opportunities that would improve the value of UL's Listing Information in satisfying the needs of its users. Jane Coen at UL's corporate headquarters in Northbrook, Illinois will serve as the central repository for Fire Council input.

Ms. Coen can be reached at 333 Pfingsten Road, Northbrook, IL 60062; telephone, (847) 272-8800 ext. 43337 or fax, (847) 509-6218.

In response to Council members' questions, UL confirmed that it intends to:

1) continue to reference UL Standards in the Guide Information published in UL's Directories, and

2) build a search engine into the redesigned Listing Information System to facilitate word searches in future electronic products.

One Council member recommended that UL use the CSI Guide to assign product names to help eliminate the confusion that results from differences in terminology between UL's current nomenclature and that being used by others outside of UL. UL agreed to investigate the feasibility of adopting the terminology contained in the CSI Guide.

A Council member questioned whether UL could add common product names to its Directories' product indices, e.g., trade names that have become generic. The Council member agreed to send Ms. Coen a list of examples for UL's further consideration.

UL will consult with Council member and others to determine appropriate terminology that should be incorporated into UL's directories to reduce confusion.

2.2 UL DIRECTORIES IN ELECTRONIC FORMAT

What progress has been made in getting the UL Directories available in electronic format? Will they be available "on-line" or on CD-ROM or both?

Making UL Directories on-line.

JANE COEN (EXT. 43337):

UL is currently involved in selecting the outside vendor(s)/consultant(s) that will assist UL in the conversion of its Listing Information data to the Standard Generalized Mark-Up Language (SGML) format. The conversion process will involve a thorough analysis of the data, with electronic access and extensive search capabilities representing fundamental requirements of the new database design. The conversion will begin during the latter half of 1996 and continue into 1997. Listing Information will be available on-line, most likely through the Internet on either a subscription or usage fee basis. The publication of CD-ROM Listing Information products will be considered if there is sufficient market demand to justify the investment.

Selected on-line and/or raster-scanned image CD-ROM products may be made available later this year. Product offerings will be announced through UL's publications, "On the Mark" and "The Code Authority," as well as through special bulletins and UL's Home Page on the Internet.

One Council member indicated that UL's future electronic products need to be compatible with those offered through other organizations such as NFPA, ANSI, and NIBS, particularly in cases where the other organizations' systems reference UL documents.

ACTION: UL will conduct additional research to fully assess the compatibility issues involved.

2.3 UL DIRECTORY SIZE

The soft cover editions of the 1994 Uniform codes measure 6-1/2" x 9". NFPA's handbook for Standards 30, 54, and 58 measure approximately the same size. UL Directories measure 5" x 9". Given the increased size of the Directories, the escalating costs for printing and the diminishing space on my book shelves, has UL considered changing the size of the Directories to 6-1/2" x 9"?

JANE COEN (EXT. 43337):

Currently, the systems involved in publishing UL's Product Directories impose considerable restrictions on the trim size of the books. The restrictions largely reflect the original system design that required a single set of data logic to be used to generate the Product Directories and the 3" x 5" Listing Cards available to UL clients.

In 1994, UL considered changing the trim size of all of its Directories (with the exception of the General Information Directory) to 8" x 9-1/4" to reduce printing costs and improve the usability of the Directories by decreasing their bulk. After extensive analysis, it was decided that only the Recognized Components Directory and the new Plastics Recognized Components Directory would be changed to the larger trim size.

Printing the Directories in the 8" x 9-1/4" size involves printing two columns of data per page, requiring a slight compression of the data to reduce its width. Since UL did not want to reduce the size of the artwork for the Systems, Designs and Constructions included in the Fire Resistance, Building Materials and Roofing

Systems Directories, it did not change the trim size of the four Directories that comprise the Fire Protection set of books. The page counts for the balance of the Directory titles did not warrant a change in trim size.

UL is currently consulting with a number of publishing/printing vendors as part of the massive project to redesign UL's Listing Information System database and publishing processes, and convert the Listing Information data to the Standard Generalized Mark-Up Language (SGML) format. UL's specifications being provided to the vendors include flexibility in the types of output required. It is UL's intent to design a system that will provide maximum flexibility to allow information products and services to be customized to end users' needs, inasmuch as possible and practical, from a business standpoint.

In response to a Council member's's question, UL responded that there was no initiative underway to standardize the trim size of UL's Directories with those of other organizations like NFPA or ANSI.

2.4 UL'S POSITION ON ADOPTION OF STANDARDS BY REFERENCE

At the recent ICBO code changes meeting in Sparks, NV, it was said that the Board of Directors has approved the adoption of standards by reference. While the specific proposal concerned ASTM E-119, it seems to be the intent to adopt other Standards by reference as well. The Committee originally disapproved the proposal. After lengthy discussion, it was "approved" by a 6-4 vote. Statements were made concerning agencies other than ASTM who also write Standards such as NFPA, UL and ICBO itself.

What is the position of UL on the adoption of Standards by reference and what will UL do?

BOB WILLIAMS (EXT. 42570):

UL supports referencing other standards within standards or codes. As a result of processing of referencing standards, the standards become adopted by the organization. A standard should be adopted by reference only if the standard is thoroughly reviewed and acceptable to the organization developing the standard or code.

Other options are available to the standards developer, such as specifically referencing a paragraph or section of the standard as applicable, obtaining authorization from the original standards developer to reproduce portions of the standard, or rewording the requirement to be referenced.

Caution must be exercised when adopting a standard by reference during the ANSI approval process. It is UL's belief that all documents referenced in an ANSI document also be ANSI approved.

A Council member noted that it is important from a legal aspect that the edition and date of the code or standard be included in the reference. UL agreed, and noted that the following statement is included in all Standards that contain references, "Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard."

Another Council member noted that U.S. Congress passed a law on garage door operators that references the UL Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems, UL 325. Consequently, UL must notify CPSC when changes are proposed to this Standard.

2.5 HARMONIZATION OF TESTING AND PRODUCT STANDARDS - U.S., CANADA AND INTERNATIONAL

Different standards are referenced in the building codes used in the States and Canada; these standards are often similar but not identical. Harmonization would benefit product manufacturers, developers and the enforcement community.

BOB WILLIAMS (EXT. 42570):

UL agrees that harmonization would benefit all sectors. UL is actively involved in the harmonization of standards between the United States and Canada, working closely with CSA and ULC to harmonize or develop identical standards. UL is also actively participating with NFPA, CSA, and inspection authorities in Mexico to harmonize codes. UL will continue to expend resources to harmonize standards as supported by industry and others.

3.0 DETECTOR ISSUES

3.1 CPSC SUGGESTIONS FOR RESIDENTIAL SMOKE DETECTORS

CPSC staff suggested ten improvements to UL 217 to increase the effectiveness and reliability of smoke detectors. UL has responded, agreeing to add a survivability test and the need to modify the dust test. What is UL's schedule for these changes? What are UL's plans for the other eight CPSC suggestions?

PAUL PATTY (EXT. 42752):

Underwriters Laboratories has been developing revisions to the UL Standard for Safety for Single and Multiple Station Smoke Detectors, UL 217 that are based on recommendations from BOCA (to remove permissive language from the Standard), CPSC, and a task group working on the harmonization of UL 217 and the Canadian Standard for Smoke Alarms, ULC S531. A bulletin proposing these revisions was issued April 5, 1996. This bulletin covers the CPSC suggestions for:

- Required means for alarm silence, with override,
- Survivability Test,
- Revised date code marking, and
- Revised Audibility Test

These proposals address the CPSC suggestions as submitted, or with slight modifications based on comments UL received during a January 1995 IAC, with a CPSC representative in attendance, and an October 1995 meeting between UL and CPSC staff.

UL will continue to study the following CPSC suggestions:

- Standardized mounting bases,
- Smoldering Smoke Test,
- Dust Test,
- Revised owner's manual information,
- Corrosion Test, and
- Reliability Predictions.

A Council member asked if UL could develop a separate smoldering smoke test for ionization type smoke detectors. Staff responded that it is possible to develop additional smoldering smoke and fire tests for inclusion in UL 217 if the need arises and will result in a more effective smoke detector. The current UL 217 Smoldering and Fire tests are comparable to tests contained in other Safety Standards such as the EN series and ISO Standard used by other Test Houses around the world. In a mixed fuel environment, categorization of smoke detectors by fire type may not be workable, because it is difficult to predict which type of fire may occur. Accordingly, the current UL 217 addresses the mixed fuel issue by requiring all smoke detectors, regardless of principle of operation, to respond to four flaming fires and one smoldering fire within the limits of the Standard.

The Council member also commented that he had observed a very low energy mattress fire test, initiated by a cigarette, that resulted in stratification of smoke only 2 to 3 ft. above floor level. He noted that detectors may be located in the wrong location to respond to this type of situation. UL and several Council members requested a copy of this data for evaluation and suggested that this type of information should be sent to NFPA 72 Chapter 5 for review. Other Council members questioned whether individuals would remain in the area as these conditions slowly develop for the period of time required to create levels of smoke that would be life threatening.

A Council member commented that information available from NFPA indicates that 25 percent of in-house fires are smoldering, 50 percent are flaming, and 25 percent are rapid flashover type. Another noted that many fatalities are a result of fires originating in another room.

ACTION: UL will contact the Council member that reported the low-energy smoldering mattress fire to obtain a copy of the report for analysis and distribution to the Fire Council members.

3.2 NEMA SMOKE DETECTOR PROJECT AND DEVELOPMENT OF FALSE ALARM RESISTANCE SPECIFICATIONS FOR SMOKE DETECTORS

Two years ago, UL reported that a NEMA project, set up to look at various combustion gases and heat release rates, was nearly completed. What was the purpose of this project? Can we have a report on the findings of this project?

As shown by recent CPSC studies, many smoke detectors are disconnected by occupants to address unwanted alarms [1,2]. This translates into a greater number of preventable deaths. The studies have shown that the death rate in fires in which smoke detectors were inoperable was nearly double the rate in fires where detectors were operable [1]. "Investigators found that 59 percent of the detectors that failed to alarm were found disconnected from their power sources." More than one-third of occupants surveyed reported that detector power supplies were disconnected intentionally due to nuisance alarms of which cooking was the most frequent nuisance alarm cited [2]. A second frequently cited nuisance alarm is from shower steam.

The current UL test standard does not fully address the most common nuisance alarm problems that are resulting in the intentional disabling of smoke detectors, and thus loss of life. UL 217 does include the Humidity Test, however, this test does not accurately represent the steam conditions that a detector will be exposed to when mounted in the vicinity of a steam-filled bathroom which is then opened to the rest of the house. Cooking sources are not addressed at all. It is proposed that tests be developed which will address these common nuisance alarm sources. Such tests might consist of exposing a detector to standardized cooking scenarios, such as the heating of oil, burning of toast, or the frying of bacon or sausage. These tests could *than be used to establish minimum detection limits. The establishment of false alarm limits is consistent with UL 2034 for CO detectors.*

References:

1. *Smith, L.E., "Fire Incident Study National Smoke Detector Project," U.S. Consumer Product Safety Commission, January 1995.*

2. *Smith, C.L., "Smoke Detector Operability Survey Report on Findings (revised)," U.S. Consumer Product Safety Commission, October 1994*

PAUL PATTY (EXT. 42752):

Underwriters Laboratories Inc. recently completed a special research project sponsored by the National Electrical Manufacturers Association (NEMA). The purpose of the NEMA project was to develop data for fire signature profiles of combustible products and materials, recognition patterns that may aid in differentiating between hazardous and nonhazardous events, and recognition patterns to distinguish between different types of combustibles. Nonhazardous or contained fire signatures were recorded for typical home layouts, using four different sizes of rooms. Test instruments that simulated ion and infrared detectors were placed at locations representative of installation instructions provided with detectors, and alarm conditions were created using previously identified false alarm sources, such as burning toast, meat cooking in a broiler, and steam generated by a shower. Cone Calorimeter Tests were also conducted to measure burning characteristics of over fifteen different materials, and large scale tests were conducted to verify some of the observations recorded during the Cone Calorimeter Tests.

The results of this limited test program indicate that smoke/fire detection systems based upon the recognition of multiple fire phenomena; smoke, heat, fire gases (CO and/or CO_2), can reduce false alarms and therefore improve the effectiveness of smoke/fire detectors in saving lives. The data developed during this project is preliminary in nature. Smoke signatures and gas concentrations vary, depending on room size, material burned, and the burn rate. Further study is needed to provide specific information related to smoke, gas, temperature build-up rates, and end-point activation concentrations. Consideration must also be given to normal background levels of smoke, gas, and temperature.

The Report of this project, "Special Service Investigation Without Listing Fire/ Smoke Signatures," is dated February 15, 1996. A copy may be obtained by writing to the National Electrical Manufactures Association, 1300 N. 17th Street, Suite 1847, Rosslyn, VA.

A Council member asked if it would be possible to add spacing requirements for smoke detectors similar to the spacing requirements for heat detectors. UL responded that spacing requirements and related installation considerations are addressed by NFPA 72 and the installation instructions provided with each product. These recommend a 25 to 30 ft. spacing for detectors, in accordance with Chapter 5 of NFPA 72. Additional guidelines are provided in NFPA 72 Chapter 2 for household applications. Classification of detectors by fire type has been discussed at the International level, but no consensus has been reached with respect to how this information can be used when mixed fuel sources are encountered.

A Council member asked if it would be possible to add a Humidity Plunge with Condensation Test to UL 217 to determine the ability of a detector to ignore water condensation resulting from exposure to hot moist air from a shower. The member also questioned whether it may be more appropriate to develop an entire new standard for this test. UL responded that ISO/TC21/SC3 Catalogue of Environmental Tests includes a Damp Heat, Cyclic (Operational) Test for non-residential type smoke detectors which simulates the situation described by the Council member. This subject will be discussed at the next UL IAC meeting.

Another Council member indicated that he has been working on smoke/fire signatures for some time and may have information that would assist UL's studies of this subject.

ACTION: UL will contact the Council member that offered to provide data on smoke/fire signatures to obtain and analyze that information. UL welcomes any additional information that our Council members or others may provide on these issues. All such information will be presented and discussed at the next IAC meeting.

3.3 UPDATE ON STATUS OF RESIDENTIAL CARBON MONOXIDE DETECTOR STANDARD

Please provide an update on the status of residential carbon monoxide detector standards.

PAUL PATTY (EXT. 42752):

Underwriters Laboratories has received several reports of incidents in which the fire department or other agencies have responded to a carbon monoxide detector alarm and were unable to measure any appreciable carbon monoxide. These and similar experiences associated with the use of carbon monoxide detectors have raised several questions as to appropriate action to be taken when there is indication of carbon monoxide by Listed detectors.

Responding agencies reported to UL that:

1) Carbon monoxide detectors were found to be located to close to gas ranges, gas furnaces and the like;

2) Detectors in buildings located near expressways may be affected by outdoor ambient conditions present during heavy traffic conditions; and

3) People were calling the Fire Department or Gas Company even though no symptoms of carbon monoxide poisoning were experienced. The alarm threshold limit requirements in UL 2034, the Standard for Single and Multiple Carbon Monoxide Detectors are such that very few healthy people should experience the physiological effects of carbon monoxide exposure when a carbon monoxide detector first indicates an alarm. Consequently, the typical response to a carbon monoxide detector alarm does not require that the fire department or local gas company be involved.

As a result of these reports and comments received during a mid-1994 ANSI canvass of UL 2034, several changes to UL 2034 were proposed and discussed at a December 13, 1994 IAG meeting. These proposals were modified in response to subseuent comments and issued as UL 2034 requirements that became effective in 1995. The following provides a summary of the new requirements:

1. Instructions and Markings:

   A. A new marking is required to be located on the product and instructions provided in the owner's manual that direct that the fire department is to be called only if anyone feels or exhibits symptoms of carbon monoxide exposure. If no carbon monoxide exposure symptoms are evident, the known sources of carbon monoxide are to be shut down, the area ventilated, all those that may have been exposed to carbon monoxide are to breath fresh air, and a qualified technician is to be summoned to correct the problem. (Effective 6-01-95.)

   B. A marking shall be provided on the face of the carbon monoxide detector, in contrasting color from background, that identifies the unit as a carbon monoxide detector. (Effective 6-01-95.)

2. Construction and test changes.

   A. A reset button with 100 ppm override is required. (Effective 10-01-95.)

B. The stability portion of the sensitivity test has been modified to require that detectors tolerate carbon monoxide levels at or below the 2.5 COHb (carboxyhemoglobin) level with no alarm, but may provide warning signals at or below this level. (Effective 10-01-95.)

C. A test has been added that replicates rush hour carbon monoxide buildups, which can cycle between 0 - 2.5 percent COHb on a 24 hour basis. (Effective 10-01-95.)

Underwriters Laboratories has been actively participating in carbon monoxide workshops sponsored by AGA, GRI, CPSC, and EPA. UL also spoke at the recent CPSC Hearing on carbon monoxide detectors.

ACTION: Once the reports from the workshop committees and the CPSC Hearing are available, UL will hold an IAG meeting to discuss the reports and consider the need to propose additional revisions to UL 2034.

4.0 CHARACTERISTICS OF MATERIALS

4.1 ANALYTICAL DESIGN OF FIRE RESISTANT ASSEMBLIES

A standard should be developed on methods of analysis for fire resistant assemblies. In the minutes of the IAC meeting on Fire Resistance Methods and Materials, reference was made of applying models to enhance product evaluations. Just as experimental methods should be documented in a "standard," analytical methods should be subject to the same level of documentation and review. Of particular concern for reviewers would be the basis of the approach, assumptions, coefficients relating to the fire exposure and evaluation method of the output. Essentially, similar issues are reviewed when describing an experimental method. Not subjecting analytical methods to a similar level of review sets up two tiers of evaluation methods (either analytical or experimental) by UL - those subject to review by the Councils and those not subject to review.

BOB BERHINIG (EXT. 42292):

UL has used analytical methods in evaluations to determine fire endurance ratings for building assemblies for many years. The complexity of the analyses have ranged from use of extrapolation to establish fire endurance ratings for a range of material thicknesses, to using a finite element computer model to determine the required thicknesses of protective materials as a function of steel mass and similar variables.

Council members reported the output data from most fire models are sensitive to the material properties. UL responded that most material properties used in fire models are developed at UL and results from fire models that are used for product certifications are bracketed by fire test data. A senior UL engineer reviews each analysis. The purpose of the review is to ensure that consistency is maintained by the various UL staff members performing the analyses.

Input from Council members is requested when innovative products or innovative methods of evaluation are used to investigate products. The request for input from the Council is not differentiated by the evaluation method, whether it be analytical or experimental. The Council requested and UL agreed that greater attention be given to ensure Council input is requested when innovative methods or products are part of an investigation.

UL agrees that an effort is needed to develop a standard method for the analytical design of fire resistive assemblies. This need is also recognized by the International Organization for Standardization (ISO). A working group in the Fire Endurance Sub-Committee (ISO TC92/SC2/WG2) is assigned the topic "Calculation Methods." The current work statement of the working group includes a directive to draft a Standard Guide for evaluating the predictive capability of calculation models dealing with the thermal and mechanical behavior of fire exposed structures. Although UL is not drafting a standard method for the analytical design of fire resistive assemblies at this time, UL staff does actively participate in ISO TC92/SC2 functions.

UL reported that work on developing standardized methods for the analytical determination of the fire performance of building assemblies is well underway in Australia. The March 1996 edition of Australian Building Codes Board News reports, "Fire Code Reform Centre Limited's Fire Engineering Guidelines will shortly be available to identify appropriate procedures and verification methodology for fire engineered, building fire-safety designs intended to achieve equivalence with the Building Code of Australia performance requirements." UL has requested a copy of the Guidelines.

4.2 DEVELOPMENT OF TEST PROTOCOL AND ACCEPTANCE CRITERIA TO QUANTIFY AND CATEGORIZE THE COMBUSTIBILITY OF STRUCTURAL ELEMENTS

The absence of a method to reliably determine meaningfully, the relative combustibility of building components has led to the current regulatory practice of classifying materials or assemblies as either combustible or non-combustible. The result is the possible exclusion of some materials from applications for which, in certain circumstances, they may be well suited.

DR. PRAVINRAY GANDHI (EXT. 43354):

Several forums have investigated defining the degrees of combustibility of construction materials and application of this concept to the regulations in their Codes.

The National Research Council (NRC) of Canada has used the Cone Calorimeter as a test apparatus to assess combustibility of construction materials. Their research was conducted with the samples in a horizontal orientation at an applied flux level of 50 kW/m², deviating from the ASTM E1354 test protocol with the use of an insulated sample holder to minimize the heat losses from the sample edges.

The National Institute of Standards and Technology (NIST) also developed data for a number of materials and products using the cone calorimeter. These tests were conducted at 75 kW/m², with samples positioned horizontally in a standard sample holder.

The Board for Coordinating Model Codes (BCMC) decided to further investigate the use of the Cone Calorimeter as a substitute for the ASTM E136 test method currently required in the NFPA 220 standard. The BCMC Task Group considered the NIST approach and test parameters as being appropriate for their use. However, to improve the repeatability of peak heat release rate data, the Task Group considered data scan time of 2s. The group also recognized the limitations of the Cone Calorimeter for testing specific types of products such as layered materials, materials with metal skins, and thin materials.

There are several important issues to consider in the application of degrees of combustibility to construction materials. These issues are as follows:

1. Definitions used for non-combustible and limited combustible construction materials are defined in the standard NFPA 220. In this standard, a non-combustible material is defined as one that meets the requirements of ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C. A limited combustible material is defined as one having a potential heat value not exceeding 3500 BTU/lb when tested in accordance with NFPA 259, Standard Test Method for Potential Heat of Building Materials, and meeting the specified flame spread index in accordance with NFPA 255, Standard Test Method of Surface Burning Characteristics of Building Materials. A scale to define the degrees of combustibility of construction materials using the Cone Calorimeter has been discussed, but is not yet defined in the codes.

2. There is not, as yet, a clearly defined scope for applicability of a system using the Cone Calorimeter. For example, the fire safety objectives for construction materials need to be explicitly defined. Additionally, it may be beneficial to define the use and limitations of the system using the Cone Calorimeter, and identify the exceptions.

3. Once the fire safety objectives have been identified and stated explicitly, methods to measure appropriate factors may be explored. It is possible that the fire safety objectives may include several factors such as ignitability, heat release, and flame spread.

4. A method to use the data generated to regulate products based on occupancy will need to be defined. The method, for example, may categorize the measured performance in classes.

5. Finally, comparing the method to existing requirements and full scale fire test data would be beneficial, and demonstrate that the method improves fire safety.

UL has been participating in various forums, such as the deliberations of BCMC, to explore the concept of degrees of combustibility. Additionally, UL is working with NFPRF to investigate the use of the Intermediate Calorimeter (ICAL) to determine the degrees of combustibility. UL has already developed several Standards where product combustibility is the fire safety objective, e.g., Fire Test of Upholstered Furniture, UL 1056; Fire Test of Mattresses, UL 1895; and Fire Tests for Foamed Plastics Used for Decorative Purposes, UL 1975.

UL will continue to work with code groups such as the ICC and the BCMC to identify areas where limited combustibility is a fire safety objective and develop test protocols that address these objectives.

Several Fire Council members urged UL to provide leadership in this issue; especially with respect to the development of objective-based codes. One Council member described the research project being undertaken by NRC to study the correlation of the Cone Calorimeter data with respect to large-scale tests. Further, it was suggested that the higher flux level considered by the BCMC was not necessarily better, since it may mask critical flammability behavior.

ACTION: UL will keep the Fire Council informed on this subject.

4.3 STANDARD METHODOLOGY FOR THE MEASUREMENT OF THE RATE AT WHICH THE REGULATED PERFORMANCE ATTRIBUTES OF BUILDING COMPONENTS DEGRADE UNDER SIMULATED SERVICE CONDITIONS.

Concern over the determination of long-term performance of innovative materials remain a substantial barrier to the introduction of innovative technologies to the marketplace.

BOB BERHINIG (EXT. 42292):

The creation of a standard methodology to measure the rate at which regulated performance attributes of building components degrade under all simulated service conditions is a desirable goal. The possible combinations of regulated performance attributes and simulated service conditions that could be considered are essentially limitless, making it difficult to define one standard methodology.

UL has several Standards and Classification programs related to the fire performance of building materials that include requirements pertaining to evaluating the retention of the fire performance characteristics under service conditions. Conditions applied in such evaluations include cycling, accelerated laundering and dry cleaning, exposure to corrosive atmospheres, accelerated weathering, and accelerated aging.

UL's Classification program for intumescent coatings intended for fire resistive assemblies, covered in the UL category for Mastic Coatings (CDWZ) includes requirements for subjecting the coatings to aging, high humidity, washing, and chlorine exposures. The coating materials, after being exposed to the simulated service conditions, are subjected to the fire test conditions described in Standard UL 263, Fire Tests of Building Construction and Materials.

Field experience often serves as a bases for development of simulated service conditions to be part of UL's Classification requirements. Presently, UL is investigating the reliability and reproducibility of equipment intended to measure the rate of expansion and the expansion pressure developed by intumescent materials. It is envisioned that the retention of these performance characteristics under simulated service conditions will become part of UL's Classification program for materials intended to seal openings upon exposure to fire. Typical products include firestops and perimeter seals for fire doors.

Authorities Having Jurisdiction and insurance organizations have also provided UL with informaiton which provides a basis for development of simulated service conditions. The inclusion of requirements in codes and regulations will stimulate the development of data that measures the rate performance attributes degrade under simulated service conditions. UL commented that it is important that the building codes provide recognition of simulated service conditions. At the January 1996 Industry Advisory Conference for Fire Resistance Methods and Materials, UL urged manufacturers to submit proposals related to the measurement of performance characteristics under simulated service conditions to the model code organizations.

A Council member noted that the rate of change of a material's properties is important. Another noted that requirements in the Standard should reflect real world conditions, e.g. doors being slammed. UL responded that UL requirements are intended to reflect real world conditions. For example, fire doors are subjected to 100,000 cycles of opening and closing; and coatings for columns and beams for exterior applications are tested unaged and aged, with a 75 percent limitation on changes in critical properties. UL noted that additional support of such requirements is needed in the Codes.

Another Council member asked if UL collects information on degradation of products. UL responded that there is no mechanism for following up on the durability on products, other than monitoring incident reports and obtaining input from UL's Councils, IACs and IAGs.

4.4 PROPRIETARY FIRE TEST DATA

It is understandable why industry is reluctant to divulge proprietary information concerning their products. However, in a climate of performance-based design, the design community will need access to property values and performance measures relating to the response of the materials/assemblies to fire conditions. The opportunity exists for UL to serve as a "clearinghouse" for such information. Given UL's status as an independent test laboratory, UL is arguably the best source of such data.

BOB BERHINIG (EXT. 42292):

UL is aware of the expanding role of performance-based fire codes. UL also understands the need for test data as input for various fire models that may be used to implement performance based codes, and is interested in providing a means to make such data available.

By definition, proprietary data cannot be published in public documents such as UL's Directories. UL conducts tests that result in proprietary data and UL provides test reports containing such data to the owners of the proprietary information. These UL reports can include material property values such as thermal conductivity, heat release rates, material density and smoke generation as a function of exposure to various environmental conditions, including fire. The UL reports are available to the design community at the discretion of the owners of the proprietary information.

UL, as a reference source for proprietary data, could publish the source and type of proprietary information potentially available to the design community. Council members indicated that it would also be desirable for UL to publish sources of research test data reports, together with key words to identify the scope of the project.

ACTION: UL will solicit input from the Council requesting identification of the specific data desired by the Council members. Upon receiving the Council input, UL will prepare a proposal for publication of the data in a Directory. The proposal will be circulated to the Council and to UL clients for further input.

4.5 UL 2097 TESTS FOR FIRE RESISTANCE OF BUILDING JOINT SYSTEMS - HOSE STREAM AND VERTICAL SPECIMEN HEIGHT

Please review and discuss the outstanding disagreement concerning UL 2079 "Tests for Fire Resistance of Building Joint Systems." Especially, the hose stream and vertical specimen height as argued by Arcon International.

BOB BERHINIG (EXT. 42292):

The following is a synopsis of the hose stream test and vertical specimen height comments received and UL responses provided during the ANSI canvass of Standard UL 2079, Tests for Fire Resistance of Building Joint Systems.

HOSE STREAM TEST

In comments dated September 18, 1995, the following was expressed:

(Objection) - The rationale of hose stream testing a floor joint system "not designed to be load bearing" is questioned. Is not the application of a stream of water an induced load? Therefore, a load is being applied to a joint system "not designed to be load bearing."

The application of hose stream is in the opposite direction that a joint system is loaded for in use. Therefore, it could be argued that joint systems designed to be load bearing should also be subjected to a hose stream (having impact, erosion and cooling effects) from it's fire side.

(Solution) - To be consistent, the hose stream on floor joint systems should be applied to all or none.

The following comments were dated January 30, 1996:

"Your answer does not address the contradictions that may arise from not being consistent; which are: failing to apply the hose stream to all floor specimens; or, that the hose stream may not be applicable to floors at all. These were pointed out by our previous comments."

The comments dated January 30, 1996 also indicated both BOCA and BCMC do not require a hose stream to be applied to joints in floor specimens.

UL is currently proposing that the hose stream be applied only to wall-to-wall and head-of-head wall joint systems.

UL has also been advised that some Authorities Having Jurisdiction desire that the hose stream be applied to joint systems in horizontal assemblies, especially to those joint systems that are designed to be non-load bearing. In response to this need, UL proposes to include information in its Fire Resistance Directory identifying those joint systems that have withstood the hose stream exposure. This action is also in accordance with comments made on this subject at the 1994 Fire Council Meeting (Agenda Item 2.10).

VERTICAL SPECIMEN HEIGHT

The concerns of the commentor regarding vertical specimen height are related to the magnitude of furnace pressure being applied to the test specimen. For vertical specimens, the applied furnace pressure is a function of the test specimen length and the specification used to control furnace pressure.

In comments dated September 18, 1995, the following was stated:

(Objection) The location of the vertical positive pressure plane is less severe than as currently required under the acceptance criteria of a major building code established in 1991. Under that provision the neutral plane divides the height as follows; 2/3 positive pressure and the lower 1/3 negative pressure. UL has made the argument that the difference is negligible. This is only true for the minimum furnace heights required by this standard, reference Table 1.

Table 1 - PRESSURE DIFFERENCES

Furnace Height	UL Pressure	Current Pressure
108	0.055	0.06
120	0.06	0.0667
132	0.065	0.0733
144	0.07	0.08

Joint systems previously rated have been subjected to more severe acceptance criterion. Laboratories complying with the current requirements must make adjustments. There is no reason to lessen this established requirement, especially if the industry is complying with the 1991 requirement.

Many factors affect the recorded unexposed temperatures. There is data that proves pressure is one of these factors. For example, an unexposed temperature difference of 33°F[1] was noted between two unexposed thermocouples (414°F and 381°F) with a pressure difference noted in the above table. The specimen failed under the current criteria but would have passed under the proposed UL 2079 test.

Joint systems meeting the current criteria may be slightly more expensive giving a monetary advantage to those who do not meet current requirements. Lessening established criteria creates needless re-evaluation and re-design of approved joint systems to be cost competitive.

(Solution) Rephrase this section to state that the upper 2/3 of the furnace shall be under positive pressure.

1 Omega Point Laboratory Test #92177 on 18 in. Max. Jt. Width TC #7 and #8

Our response to the commentor stated:

"Based upon Sec. 13.7 of UL 2079, the minimum furnace pressure at the top of the 3 ft. vertical furnace will be approximately 0.025 in. of water, and the minimum furnace pressure will be approximately 0.555 in. of water at the top of a 9 ft. vertical furnace.

It is acknowledged the positive pressure difference of 0.03 in. of water may influence the fire resistive performance of joint samples. However, when joint systems are installed in the field, the pressure magnitude experienced by the joint system will not be function of its width.

Pressure requirements in UL 2079 are based upon several items, one of which is the premise that a pressure of 0.01 in. of water will occur 12 in. below a horizontal surface or a pressure of approximately 0.02 in. of water will exist at horizontal surfaces. UL 2079 provides for at least 0.025 in. of positive furnace pressure when samples are tested in a 3 ft. high vertical furnace. This results in all samples tested in accordance with UL 2079 being exposed to approximately the same minimal level of positive furnace pressure without regard to the joint system's width, location, or orientation."

Our response also stated:

"With respect the furnace pressure in vertical furnaces, UL 2079 requires the magnitude of positive pressure to be a minimum of 0.01 in. at the mid-height of the specimen, whereas your recommendation specifies the neutral pressure plane be placed at 1/3 the specimen height.

An advantage of the UL 2079 specification is that it provides for a tolerance because only a minimum pressure is specified as compared to your recommendation that identifies the singular value of zero. It should also be noted that any variation from the minimum pressure value specified in UL 2079 will result in a larger positive pressure zone in the vertical furnace.

For comparison purposes, it will be assumed the pressure within a vertical furnace will follow a linear pressure gradient of 8 Pa per meter or approximately 0.01 in. of water per foot which agrees with the values in your table. For discussion purposes, we will assume the furnace heights range from 3 ft. (the minimum sample length) to 9 ft. (the minimum sample length permitted for representation of full-scale samples). The pressure at the top of the furnace for these four conditions are:

	Pressure at Top of Furnace	
Furnace Height	UL 2079	Commentor
3 ft.	0.025 in. H_20	0.020 in. H_20
9 ft.	0.055 in. H_20	0.060 in. H_20

For the range of furnace heights from 3 ft. to 9 ft., the maximum pressure difference is 0.005 in. water. It is difficult to imagine that a significant difference in fire endurance performance of any fire resistive assembly can be solely attributed to a positive furnace pressure difference of 0.005 in. of water considering the accuracy of the instrumentation used to measure furnace pressure and considering furnace pressure is usually only reported in increments of 0.01 in. of water. It is believed variations in samples and variations in internal furnace conditions would be more dominant in resulting unexposed surface temperature differences than a positive pressure difference of 0.005 in. of water.

Further, should a pressure difference of 0.005 in. of water be significant, then the appropriateness of using furnaces with heights greater than 9 ft. would appear to be of greater concern than the specifications of Standard UL 2079, Sec. 13.7 or those proposed by you."

A difference of opinion remains on this issue. UL believes the requirements in Standard UL 2079 provide for an accurate and reproducible method for testing joints in both vertical and horizontal specimens. The furnace pressure requirements of Standard UL 2079 for vertical samples require: 1) a minimum position pressure of 0.01 in. of water at the mid-height of the sample and 2) all components of the joint system be tested under a positive furnace pressure condition.

Standard UL 2079 requires that joints in horizontal assemblies be exposed to a minimum positive furnace pressure of 0.01 in. of water as measured 12 in. below the exposed surface of the specimen. Requirements in UL 2079 provide for approximately equal minimum positive pressure for joints in either horizontal or vertical assemblies. The commentor did not object to the pressure requirement for joints in horizontal assemblies.

A Fire Council member suggested that UL consider requiring a specific positive pressure magnitude at the top of all vertical samples. Another Council Member suggested that this positive pressure magnitude be 0.05 inches of water.

ACTION: UL will continue to study this matter.

4.6 ROOF COVERING MATERIALS HAIL AND WIND RESISTANCE

Please discuss UL plans for Testing "hail resistance" and "wind resistance" of prepared Roof Covering Materials.

The Texas Insurance Commissioner has plans to give insurance reduction to homes with "hail resistant" roofs.

KEN RHODES (EXT. 42211):

UL uses the Standard for Wind Resistance of Prepared Roof Covering Materials, UL 997, to evaluate the wind resistance characteristics of roof covering materials. This test method uses an air velocity of 60 mph and is based upon research and test recommendations presented in a 1960 publication by William C. Cullen who was at that time with the Organic Building Materials Section of the

National Bureau of Standards. UL has also conducted UL 997 tests at increased wind velocities when requested to do so to meet local jurisdictional requirements.

UL is working with the Asphalt Roofing Manufacturers Association (ARMA) to develop a tab bond strength test to supplement UL 997. The purpose of this test is to evaluate the tenacity of the bonding adhesive, which is an important consideration in high wind regions.

UL is also completing a Standard for Impact Resistance of Prepared Roof Covering Materials, UL 2218, which is based on research and testing sponsored by the Insurance Institute for Property Loss Reduction (IIPLR). This test method utilizes free-falling steel balls dropped from heights to generate kinetic energies consistent with like diameter hailstones falling at terminal velocities. This test does not take into account the effects of weathering or aging which are known to have a significant effect on performance of certain types of prepared roof coverings.

UL chose steel balls instead of ice balls based on past experience in evaluating the impact resistance of solar panels. UL tested solar panels using ice balls shot with an air cannon, and found that it was very difficult to maintain the consistency of the ice balls and accurate velocity of the shot. Subsequent research led to revision of the applicable UL Standard to specify use of steel balls.

A Council member asked how the impact resistance test results will be reported. UL responded that roofing materials will be ranked in classes of ascending order, e.g., Class 1 through 4 where Class 1 would have the least resistance to impact.

4.7 INTERMEDIATE SCALE MULTI-STORY TEST APPARATUS

Discussion of the intermediate scale multi-story apparatus being constructed AT UL.

BOB BERHINIG (EXT. 42292):

UL has constructed a multi-story test apparatus that is intended to:

1. measure the flammability characteristics of curtain wall assemblies and

2. measure the effectiveness of a building joint system as a fire barrier between the curtain wall and the floor slab.

The test apparatus consists of a two-story high structure with each story containing a nominal 10 ft. by 10 ft. by 7 ft. high room. The curtain wall extends from the base of the test apparatus to above the ceiling of the second story room.

UL is represented on an ASTM task group (E5.11.14) which is developing a standard for measuring the performance of building joint systems between curtain walls and floors. The ASTM task group is presently discussing general requirements for the test method and the acceptance criteria.

UL is developing requirements for Classification of the building joint system between the curtain wall and the floor slab when tested using the multi-story apparatus. For tests of these joint systems, it is anticipated the instrumentation typically specified in UL and ISO fire endurance test methods will be used. It is also anticipated that the fire environment in the lower level will be monitored with plate thermometers. A Council Member reported an ISO working group is developing a fire test method based upon input from Canada.

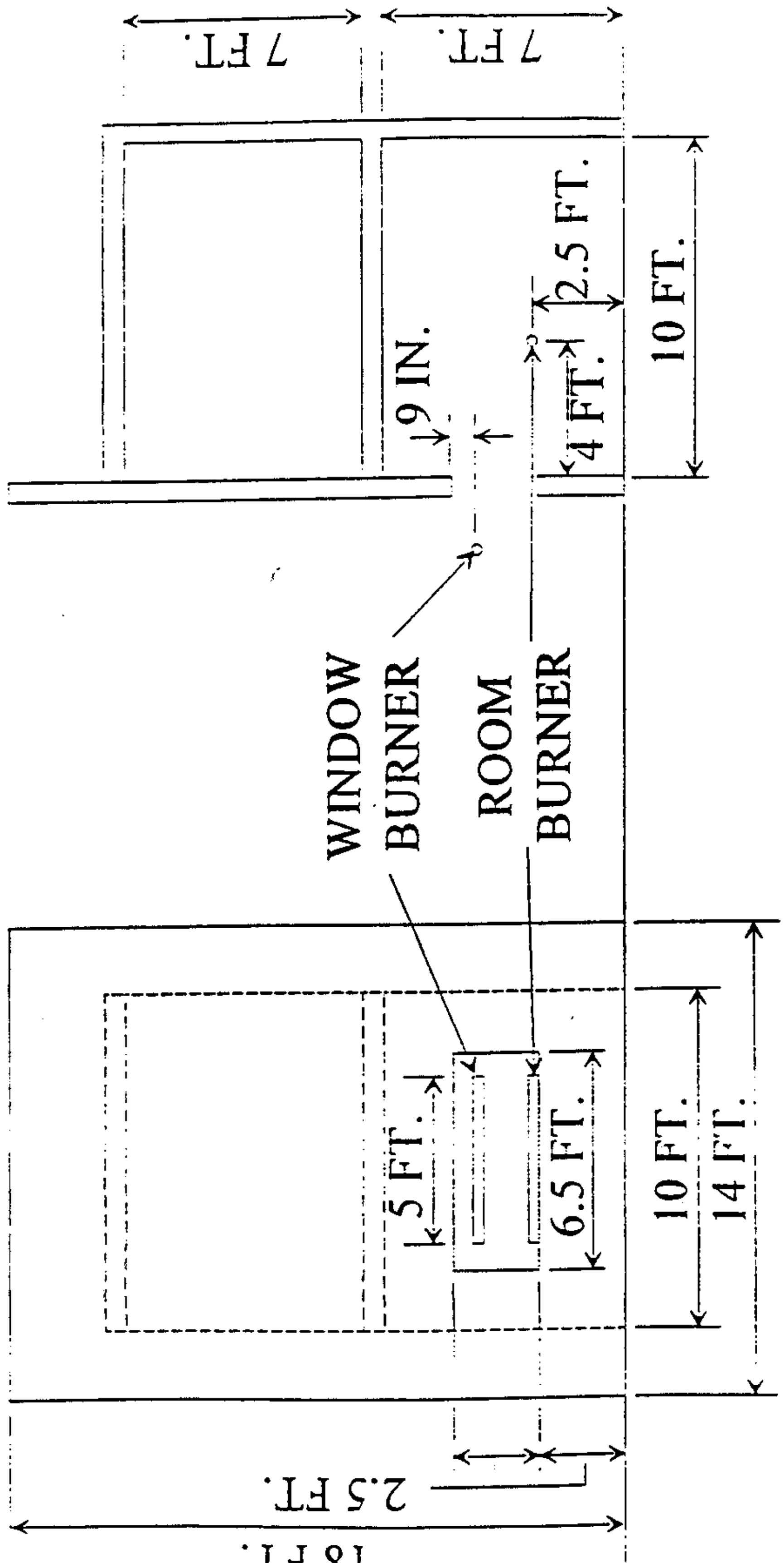
Data from a round-robin test program among thirteen European fire test laboratories have indicated the plate thermometers to be suitable devices for controlling fire endurance furnaces. Data from the round-robin test program indicated harmonized exposure conditions were obtained from full-scale vertical panel furnaces of various sizes, with different lining materials and different fuel sources when the furnaces were controlled using data from plate thermometers.

UL also anticipates using the multi-story test apparatus to Classify curtain wall assemblies with respect to flammability characteristics. The Classification of the curtain wall assemblies will be based upon requirements currently being proposed for inclusion in the Uniform Building Code.

A Council member asked what type of flame source is used. UL responded that two burners are used--as shown in the drawing on the following page.

ACTION: UL will review the proposals prepared by the ISO working group for possible inclusion in its Classification program. It is anticipated that the 1997 Fire Resistance Directory will include Classified Joint Systems intended for use between floor slabs and curtain walls.

MULTI-STORY TEST APPARATUS



5.0 FIRE SUPPRESSION AND EXTINGUISHING SYSTEMS

5.1 CLEAN AGENT SYSTEMS LISTINGS

UL Lists systems based on tests performed on systems designed in accordance with manufacturers' computer programs. The computer programs become part of the Listing. Does UL understand the workings of the programs? How is UL able to determine that the programs are not changed subsequent to the Listing?

KERRY BELL (EXT. 42629):

Currently, the Standard on Clean Agent Extinguishing Systems, NFPA 2001, requires software programs used to calculate the distribution of clean agent to be listed. UL's investigation of a computer software program used to calculate the distribution of clean agent in piping distribution systems consists of applying the requirements and testing concepts described in Section 33 of the Standard for Halogenated Agent Extinguishing System Units, UL 1058. Typically, the manufacturer conducts a substantial amount of experimental and developmental testing prior to submitting their software program to UL for investigation. In general, UL uses a performance-orientated approach to investigate software program accuracy rather than a prescriptive approach. As a part of UL's countercheck of the program's accuracy, a minimum of five different piping arrangements are installed so that all the limitations for the software program can be properly verified by test. As a minimum the following parameters of the program are evaluated:

- Maximum percent of agent in the pipe
- Minimum and maximum discharge time
- Minimum and maximum pipeline flow rates
- Variation in piping volume to each nozzle
- Maximum variation in nozzle pressure
- Maximum nozzle orifice area relative to inlet pipe area
- Nozzle vapor time-imbalance
- Tee installation orientations
- Minimum and maximum flow splits for each type tee

Although each individual step or element of the computer program is not reviewed by UL, the general methodology and limitations established by the manufacturer are discussed in detail so that UL's engineering staff has a good understanding of the principles by which the software program functions. In addition, a detailed review of the results of each test is made immediately after it is conducted, so that any unusual trends in the test results can be considered in the development of the subsequent test arrangements. With this approach, a comprehensive evaluation of the program's accuracy and capabilities can be made.

Currently, all software programs used to calculate the distribution of clean agent in a piping network are made available to users in the floppy disc format. To confirm the accuracy of these programs on an ongoing basis, UL covers the software under our Follow-Up Service. Under UL's Follow-Up Service Agreement, the manufacturer is obligated to make the product in accordance with the UL procedure, and should advise UL of any changes. Annually, UL picks up a set of the floppy discs from manufacturer's stock and uses these discs to calculate pre-established piping systems to determine that no changes have been made which may impact the program's accuracy.

5.2 EXTINGUISHING SYSTEMS FOR COMMERCIAL COOKING EQUIPMENT

It has been brought to my attention that recent changes in the type of oil being used in deep-fat fryers has negated the ability of automatic ANSUL Systems to extinguish these fires. They reportedly re-ignite after the system has been discharged. Any information relative to this problem?

Please provide an update on testing of commercial cooking equipment protection using the new UL 300 test standard.

- *Have any non-liquid agents qualified for Listing?*
- *Has any testing of automatic sprinklers or water spray nozzles been accomplished for this purpose?*

KERRY BELL (EXT. 42629):

UL's Listing of pre-engineered fire extinguishing systems for the protection of commercial cooking equipment has spanned more than 30 years. In the early 1990's, it became apparent that some of the test protocols and requirements used to investigate this equipment needed to be updated to take into account changes in cooking equipment technology and cooking techniques that have occurred in recent years. On July 13, 1992, UL published the first edition of Standard for Fire Testing of Fire Extinguishing Systems for Protection Restaurant Cooking Areas, UL 300. This standard incorporated several changes in the procedure used to investigate the ability of pre-engineered systems to extinguish fires occurring in these areas. In particular, the test protocols used to conduct the appliance fire extinguishment tests were enhanced.

Typically, the most difficult appliance fire to extinguish is the deep fat fryer. The most significant changes in UL's test procedures and requirements related to conducting the deep fat fryer test are described as follows:

PARAMETER	PREVIOUS REQUIREMENTS	UL 300 REQUIREMENTS
Test Procedure for Fryers	Fryer allowed to burn freely for a period of 1 min without heating source on.	Fryer required to burn freely for at least 2 min with heating source on until system actuation.
Construction of Fryers	Fabricated, noninsulated fryer representing the largest coverage area used for testing	Commercially available fryer used for testing with specified requirements for heating and cooling rates. If requested nozzle coverage included multiple fryers using a single nozzle, testing of this configuration is required.

In addition to these changes, the oil used for the deep fat fryer test was more clearly defined with respect to the minimum auto-ignition temperature. While the introduction of a minimum auto-ignition temperature may have, to some degree, contributed to the increase in severity of these fire tests, the primary contributors, in our opinion, were those changes described in the previously mentioned table. UL has been utilizing vegetable oil for deep fat fryer testing since the early 1980's.

The new requirements in UL 300 became effective on November 21, 1994. Only those products that demonstrated compliance with the new requirements were authorized to be manufactured with the UL Listing Mark after this date.

It was reported that Underwriters Laboratories of Canada is currently reevaluating the 2 minute pre-burn period for deep fat fryers. A council member suggested that this criteria may be overly severe.

Currently, only wet chemical fire extinguishing systems have demonstrated compliance with the new UL 300 requirements. However, it is important to recognize that subscribers to UL's Listing Service for these systems have made substantial changes to the nozzle limitations and installation criteria. The fire extinguishing system's agent container nameplate references the version of the installation manual (by part number) intended to be used for installing and maintaining the system. System units complying with the new UL 300 will reference the most recent version of the installation instructions.

In regard to automatic sprinklers and water spray nozzles, only one spray nozzle is currently Listed for this application. This product is currently included as a part of an industry review program with an effective date of March 31, 1997. The purpose of this review is to apply revised fire test criteria for these types of products. Also, manufacturers of water mist systems have expressed an interest in developing nozzles intended for the protection of restaurant cooking areas.

ACTION: UL will reevaluate the appropriateness of the 2 minute pre-burn criteria for deep fat fryers and similar appliances.

6.0 FIRE RESISTANCE OF PRODUCTS OR ASSEMBLIES

6.1 ABOVEGROUND STORAGE TANKS; SECONDARY CONTAINMENT EMERGENCY VENTING BY CONSTRUCTION

Evaluation of the outer concrete vault as a means to provide emergency venting by form-of-construction for the secondary containment of an Insulated Tank.

SHARI DUZAC (EXT. 32550):

UL recently Listed an Aboveground Insulated Secondary Containment Flammable Liquid Tank with emergency venting by form-of-construction for a nonmetallic secondary containment system. Details of the investigation can be found in the Council Report dated March 15, 1996 submitted to the Fire Council.

Emergency venting for UL Listed tanks is typically provided by a vent device of a predetermined size that opens at a preset pressure. Emergency venting for UL Listed tanks can also be provided by constructional features such as a purposely weakened shell-to-roof seam which will rupture locally, in a controlled manner, upon sudden pressurization, quickly relieving pressure and protecting the entire tank shell against complete collapse. This type of vent construction is used on the primary tank of large vertical-cylindrical tanks.

The emergency vent construction recently Listed by UL is for the secondary containment system on a rectangular tank and is most similar to a weakened shell-to-roof seam. It should be emphasized that, unlike conventional weak shell-to-roof seams, this construction relieves pressure surges in the secondary containment without rupturing any part of the primary tank or the secondary containment liner. The rectangular primary tank, like other insulated aboveground storage tanks, relieves pressure surges with an emergency vent device.

The established test protocol for Insulated Aboveground Secondary Containment Tanks includes a production line leakage test at 3 psig and a hydrostatic strength test at 15 psig on the secondary containment. There is also an interstitial communications test to make sure a leak could be detected within 24 hours and a hydrocarbon pool fire test to monitor performance of the emergency venting on the secondary containment. In addition to the established test protocol for secondary containment tanks, UL added a new "Pressure Surge Test" to simulate sudden pressurization of the secondary containment system. Under the pressure surge conditions, the tank has been shown to relieve excessive pressure in the secondary in a consistent and controlled manner.

UL recently published a new directory titled "Listed Storage Tanks" specifically for use by authorities, specifiers, and tank buyers. The directory includes diagrams of tanks, a glossary of tank terminology and details about UL's services for the tank industry. Copies may be obtained by contacting Publications Stock at any UL office.

6.2 HOSE STREAM TESTING

ASTM and NFPA activities regarding Hose Stream Testing.

BOB BERHINIG (EXT. 42292):

During the latest ANSI canvas of Standard UL 263, Fire Tests of Building Construction and Materials, a comment was received regarding: 1) the conduct of the hose stream test on a duplicate sample after the sample was subjected to a fire exposure having a duration less than the fire endurance rating period,and 2) the magnitude of the water pressure and time duration of the hose stream test being dependent upon the fire endurance rating period.

UL's reply to the commentor indicated the topic of hose stream testing would be included on the Fire Council agenda to ensure the commentor's opinion received exposure to the Council.

UL's reply to the commentor also cited the conclusions reached by a joint ASTM/NFPA task group which reported in 1994 that the use of a duplicate specimen for hose stream testing should be retained. UL also responded that an ASTM task group (E5.11.08) is developing a Standard for hose stream testing that would be independent of any fire test Standard. The first draft of the hose stream test method was distributed by the task group at the its December 4, 1995 meeting.

UL plans to continue its participation in both the ASTM and NFPA activities. A need to propose specific revisions to hose stream requirements in Standard UL 263 may become apparent as the ASTM/NFPA discussions proceed.

6.3 VISIBILITY V.S. SMOKE DENSITY

Regarding Steiner Tunnel Test (ASTM E84) - Flame Spread and Smoke Density. Please describe what is the relationship of smoke density and actual distance or ability to see under various smoke density conditions.

KEN RHODES (EXT. 42211):

The original smoke density concept established many years ago for the Steiner Tunnel Test was to provide an index based on the comparison of the smoke generation of red oak (arbitrarily defined as 100) with that of the test specimen. The relative index was determined by comparing respective areas under curves that plot decrease in photocell output (obscuration) vs. time. This Smoke Developed Classification lacked the factors needed to establish a relationship between total smoke released and visibility, which is considered necessary for hazard assessment.

Visibility has typically been measured experimentally as a function of the ability to see an exit sign. Visibility is influenced by smoke release rate, total smoke, and by the volume of the space involved. UL conducted an experiment where effluent from the Steiner Tunnel was captured in a room. The visibility of exit signs within the room was documented in relationship to the smoke-developed index for the respective test sample. The results were published as Bulletin of Research No. 56, April 1965, which is no longer in print.

Conversion of the obscuration data to optical density provides an advantage since it can be related to the concentration of particles in a smoke-filled environment. A relationship to visibility (ability to see exit sign) has been established with optical density divided by path length. Optical density may be derived from the Steiner Tunnel obscuration data using the following formula:

$$Optical\ Density = \log_{10} \frac{I_o}{I}$$

I_o = Original intensity
I = Transmitted intensity

The equipment required to measure smoke release rate and total smoke released was installed in the Steiner Tunnel in 1991. Since that time, every UL 723 material test and UL 910 communication cable test conducted in the Steiner Tunnel has included calculations of smoke release rate and total smoke developed. This data has been archived for future reference.

A statistical analysis of over a thousand data points from these tests was conducted to correlate the smoke-developed index with total smoke released for use in hazard-based assessment. This statistical analysis was reported in a paper prepared by David Sheppard and Pravin Gandhi of UL entitled "Estimating Smoke Hazard for Steiner Tunnel Smoke Data." This paper was published in Fire Technology First Quarter 1996. A copy of this paper may be obtained by contacting Pravin Gandhi, (Ext. 43354) or David Sheppard (Ext. 43610) at UL's Northbrook Office, (847) 272-8800.

A Council member asked if the ASTM E 662 smoke chamber test data correlates with the Steiner Tunnel smoke-developed index. UL responded that it does not. This test uses a small sample (3 in. X 3 in. up to 1 in. thick) that is totally exposed to a radiant heater in a collection chamber.

Another Council member commented that there are other test methods that permit smoke to accumulate like it does in actual fire situations, as opposed to a changing velocity in the Steiner Tunnel. UL responded that while other methods may simulate fire scenarios on a small scale, the Steiner Tunnel provides for progressive involvement information that cannot be obtained by the other methods.

ACTION: UL will review the information previously published as Bulletin of Research No 56 to determine if it may be appropriate for publication in another form.

6.4 PERFORMANCE OF SMOKE CONTROL SYSTEMS AND DAMPERS

Discussion of the performance of smoke control systems and dampers. UL is interested in learning about any experience or information that Council members may have related to the operation of smoke control systems, and in particular, the operation of dampers in smoke control systems.

DAN KAISER (EXT. 42074):

ASHRAE has sponsored a research project for fire dampers in which it was concluded that dampers should be tested under heated airflow conditions. The reliability of fire and leakage rated dampers is dependent upon sufficiently stringent test criteria, the ability of the manufacturers to produce the products consistently, proper user specification, proper installation and proper maintenance. UL has identified actions to address these different issues and UL is seeking input from the Fire Council Members as to the appropriateness of these actions.

UL plans to revise the test requirements in the Standard for Fire Dampers, UL 555 and the Standard for Leakage Rated Dampers for Use in Smoke Control Systems, UL 555S to test dampers under heated airflow conditions rather than the current static temperature test and ambient airflow tests. The proposed airflow ratings will be established with a minimum velocity 2000 fpm. Additional airflow ratings will be proposed in increments of 1000 fpm. A safety factor will be incorporated in the test method. UL is also considering eliminating Class I, III, and IV ratings for leakage rated dampers to harmonize with the Uniform Building Code.

UL plans to address consistent product manufacturing by adding factory tests of manufactured dampers to the UL Follow-Up Program.

To assist with user specifications, UL will expand upon the Guide Information for Dampers in the Building Materials Directory. UL also plans to establish a new product category for dampers that are evaluated to both UL 555 and UL 555S. These dampers are commonly referred to as "combination" dampers.

UL would appreciate Council comments with regard to damper testing.

6.5 DEVELOP AN ACCEPTANCE TEST WITH ACCEPTANCE CRITERIA FOR BUILDING SMOKE CONTROL SYSTEMS

Provide needed "threshold" criteria for determination of system effectiveness.

DAN KAISER (EXT. 42074):

There are three different methods used to control the movement of smoke developed from fires:

a) smoke control,
b) smoke management, and
c) passive smoke barrier systems.

The tests and acceptance criteria for evaluating these systems varies with the method used.

Smoke control systems, such as pressurized stair towers in a high rise building, utilize pressure differentials at smoke boundaries to control smoke movement. Testing of smoke control systems should focus on the performance of all components (fans, dampers ducts, smoke and heat detectors etc.), detection and control sequencing, measurement of door opening forces in stairwells and measurement of design pressure differentials across smoke barriers.

Smoke management systems are used to control smoke movement in large spaces, such as atriums and malls by maintaining a minimum smoke layer height from the floor within the large space. Evaluations of smoke management systems should focus on a thorough review of the design assumptions to ensure that the smoke layer height is adequately determined. The system should be tested by evaluating all of the components (exhaust fans, dampers, smoke and heat detectors etc.), detection and control sequencing, exhaust capabilities, and airflow velocities. Cold smoke bomb testing of smoke management systems is not recommended since the heat normally associated with fire conditions is not present to cause the smoke to rise and layer against the ceiling of the area.

Smoke barrier systems should be evaluated for tightness and also to ensure proper detection and HVAC system shutdown.

6.6 POSITIVE PRESSURE FIRE DOOR TESTING

An update will be presented to the Fire Council on the results of the National Fire Protection Research Foundation fire door research project. Also, the new proposed UL 10C Standard for Positive Pressure Fire Testing of Doors Assemblies will be discussed.

The rationale provided on page 2 of UL 10C states this standard was developed to be responsive to ICBO. The proposed standard has merit, however, there are several pending code changes which have been recommended for approval by the ICBO Code Development Committee. As such, if the desire by UL is to be responsive to ICBO, it would be prudent to wait until the ICBO membership votes on the proposed changes so that the standard reflects the needs of ICBO and other code bodies.

Several technical changes need further discussion, such as: location of the neutral plane, calibration of furnace and cotton pad testing. Some of the technical points in this proposed standard seem to conflict with the finding of the National Fire Protection Research Foundation (NFPRF) Fire Door Project, yet it is stated that UL 10C is based on this work.

JIM URBAN (EXT. 42772):

National Fire Protection Research Foundation Research Project

The research project established by the National Fire Protection Research Foundation (NFPRF) to address the development of a positive pressure fire door test method was completed. The National Fire Door Fire Test Project resulted in the issuance of the three Technical Reports listed below.

- Positive Pressure Furnace Tests - July 1994
- Positive Pressure Room Burn Tests - March 1995

- Induced Failure Mode Test - October 1995

The objective of the Positive Pressure Furnace Test Project was to observe and compare the effects of fire testing four different types of single swing fire doors (3 ft. wide x 7 ft. high) under positive pressure with the neutral pressure plane located 40 in. above the sill. Tests were conducted with the furnace operating with [1] normally aspirated (pre-mix) burners and [2] diffusion (post-mix) burners. An extension of the project consisted of two tests conducted with the neutral pressure plane located 20 in. above the sill with the furnace operating with diffusion (post-mix) burners.

The following general observations and measurements were recorded during the Positive Pressure Furnace Tests:

1. Unexposed surface flaming was not observed on any of the door assemblies.

2. None of the door assemblies ignited the cotton pad.

3. Radiant heat flux and unexposed surface temperature measurements were similar for tests conducted with aspirated and diffusion burners.

4. Tests conducted with the neutral plane located at 20 in. above the sill produced results similar to tests conducted with the neutral plane located at 40 in. above the sill.

In the Positive Pressure Room Burn Tests Project, the tests were conducted in a 16 ft. x 14 ft. x 8 ft. high room burn test facility. Fire doors installed in the room were exposed to a ventilation controlled, post flashover fire following the NFPA 252 standard time-temperature curve. The performance of three types of single swing fire doors (3 ft. wide x 7 ft. high) and two types of pairs of doors (6 ft. wide x 7 ft. high) was monitored with the neutral pressure plane in the room maintained at 40 in. above the sill. During one test, the upper latch corner of the door was mechanically deflected into the room to create deliberate "induced failure mode" to determine conditions necessary for flame passage to occur.

The following general observations and measurements were recorded during the Positive Pressure room Burn Tests:

1. None of the door samples ignited the cotton pad during the first 10 minutes of the test.

2. None of the door samples moved away from the frame stop more than the thickness of the door.

3. None of the pairs of doors separated more than 3/8 in. at their meeting edges.

4. None of the door samples had visible flames on the unexposed surface during the fire exposure period.

5. Intermittent flaming was observed through the mechanically induced gap.

The purpose of the Induced Failure Mode Test Project was to investigate the effect of various induced gaps and holes on the passage of flames and heat through and around simulated fire doors. The furnace test was conducted following the standard NFPA 252 time-temperature curve with the neutral pressure plane located 40 in. above the sill. The test was conducted with the furnace using a diffusion (post-mix) burner.

The following general observations and measurements were recorded during the Induced Failure Mode Test.

1. Flaming was produced through holes as small as 3/4 in. diameter, when located above the neutral plane.

2. The same gap opened later in the test produced more flaming than when originally opened.

3. Gaps/holes far above the neutral plane showed more flaming than those closer to the neutral plane versus no flaming for the same sized hole below the neutral plane.

4. A hole as small as ½ in. diameter, located above the neutral plane, was sufficient to ignite a cotton pad.

The three Technical Reports issued by NFPRF contain no conclusions or recommendations. Building code writers, manufacturers and public interests had sought independent test documentation of positive pressure parameters aimed at developing new provisions in the codes. These interests were represented on the NFPRF Technical Advisory committee in order to communicate developed information to code enforcers and industry.

Proposed Standard UL 10C
Positive Pressure Fire Tests of Door Assemblies

The International Conference of Building Officials (ICBO) has indicated a desire to develop a positive pressure test method for swinging fire doors. Over the last several years ICBO has reviewed numerous amendments to the test for fire doors. In an attempt to consolidate the proposed changes in a unified document, as well as to create a document that will be useful to other code bodies that are desirous of adopting a positive pressure test method, UL is proposing the development of a new test standard, Positive Pressure Fire Tests of Door Assemblies, UL 10C.

The proposed Standard for Positive Pressure Fire Tests of Door Assemblies, UL 10C, has been developed based on the work completed by the National Fire Protection Research Foundation (NFPRF) in its National Fire Door Fire Test Project. Additional information for the development of the standard was obtained from various international standards such as "Fire tests on building materials and structures", BS 476: Part 20, and additional test information and methodology available to Underwriters Laboratories and the test community.

The following is a list of the major changes and the substantiations for the changes between the existing UL 10B standard (Fire Tests of Door Assemblies) and the draft of UL 10C.

1. UL 10C is proposed to address only swinging doors. It is understood that since ICBO indicated only a desire for a positive pressure test for swinging fire doors, and the NFPRF project only generated data for swinging doors, the scope of the draft of UL 10C is limited to swinging doors.

2. Based on the NFPRF work, it was shown that the international type of thermocouple (i.e., BS 476) used to measure unexposed surface temperature demonstrates certain advantages. Therefore, this type of thermocouple is specified for use in the UL 10C draft. As there was no evidence to support the use of the international type of thermocouple used to measure furnace temperature over those currently used in UL 10B, the current thermocouples are included in the UL 10C draft.

3. The limitation on "excess smoke" specified in the current Uniform Building Code Standard 7-2 test method was not included since there is no current test protocol available to make a valid measurement of "excess smoke". The UL 10C draft refers to the Recommended Practice for the Installation of Smoke-Control Door Assemblies, NFPA 105, for evaluation of smoke passage around the sample and anticipates that smoke from the sample will be limited by the positive pressure test method.

4. Proposed UL 10C contains a description of the test furnace. The description is consistent with furnaces currently in use in this country with the exception that the burner type is limited to a post mix rather than a premix type. The post mix burner type was chosen as a worst-case condition considering the passage of flames to the unexposed side of the assembly when the opening is compromised and is consistent with the same fire scenario that occurs in a

burning room. The change to a post mix burner will not affect current testing laboratory's abilities to test assemblies on their current equipment. The NFPRF project showed that current systems can be converted to post mix with relative ease and still meet the rigorous evaluation of ICBO Evaluation Services.

5. There are no "gap gauges" included in proposed UL 10C since the current methods of measuring gaps, along with observations of flaming, will control the measurement of the excess distortion of the sample.

6. Relative movement of the door away from the frame stop has been retained as the door thickness for the first half of the fire test, and 1-1/2 times the door thickness for the second half of the test, and as a result of the hose stream. There was some interest in decreasing the limit for movement to an overall maximum of door thickness, but there was insufficient data available to justify the need for this reduction.

7. The "cotton pad" test is not included in proposed UL 10C because of both its limited reliability and usefulness, and the ability of the furnace to provide visible flaming due to the use of post mix burners to simulate the escape of hot gases.

8. The location of the neutral pressure plane during the test was established at "a minimum of 1/3 down from the top of the door." This location was selected as being relatively consistent with the location which would naturally occur in many "typical" burning rooms while still exposing the door assembly to positive pressure to evaluate its performance. By establishing the pressure plane at a "minimum" distance, a test sponsor can choose to lower the neutral plane so that a determination of performance to various international standards can be made at the same time as to UL 10C.

9. In order to clarify the application of the hose stream exposure, the pattern for the hose stream test has been further defined.

10. To maintain further consistency with international standards, minimal amounts of flaming (less than 10 seconds, sustained) have been made an exception to the "No Flaming" requirement in proposed UL 10C.

Comments on the proposed UL 10C were solicited from UL's Fire Council, Industry Advisory Conference for Fire Doors and Subscribers to various fire door Classification and Listing services in our Bulletin dated February 26, 1996.

UL also introduced the proposed UL 10C at the January 29-February 9, 1996 ICBO Code Development Committee hearings in Sparks, Nevada. Comments at the hearing appeared to focus on two areas;

1. the use of the cotton-pad test and

2. the use of post-mix furnace burners in lieu pre-mixed burners.

Fire Council members indicated that UL should consider establishing the neutral pressure plane at one specific location. If the neutral pressure plane location was left as a variable in the test protocol, it would make labeling of fire doors cumbersome for manufacturers and code enforcement confusing since the fire door label would need to specify the exact neutral pressure plane location tested.

Council members also indicated that consideration should be given to the actions taken at the ICBO Code Development hearings with regard to the UBC 7-2 fire door test protocol. Actions taken at these hearings:

1. established the neutral pressure plane location at 40 in. or less,

2. included the use of the cotton pad test for doors having an unexposed surface temperature rise of 650° F or less,

3. limited door movement during the fire exposure period to no greater than the door thickness,

4. permitted intermittent light flaming not exceeding a 10 second duration and 6 inches in length in doors rated greater than 20 minutes, and

5. allowed post-mixed (diffusion) or pre-mixed (aspirated) furnace burners to be used.

ACTION: UL plans to review all comments received as well as the annual report of the ICBO Code Development Committee hearings. It is anticipated that a revised draft of the proposed UL 10C will be distributed by June 1, 1996.

6.7 EVALUATION OF SMOKE LEAKAGE FOR FIRE DOORS

The smoke leakage from a smoke-and-draft control door, as measured by UL 1784, is applicable only to 20-minute doors. What should be done to evaluate smoke leakage for fire doors of greater duration?

JIM URBAN (EXT. 42774):

A proposed revision to the UBC Standard 7-2 (Fire Tests of Door Assemblies) addressing air leakage through door assemblies was approved by ICBO's Fire Risk Assessment Code Development Committee at the January 29-February 9, 1996 hearings. If adopted at ICBO's September 8-13, 1996 annual meeting, the proposed code revision would establish air leakage requirements for 20 min rated door assemblies tested in accordance with UL 1784. The proposed requirement limits air leakage to a maximum of 3.0 cfm/sq. ft. of door opening at a test pressure of 0.10 inches of water.

In order to cover fire door assemblies rated greater than 20 min, code authorities would need to adopt or develop air leakage ratings for door assemblies based on the type of opening to be protected, occupancy, and/or area of use. Table 3-2.1 in NFPA 105 has some guidelines. This would be the same type of scenario used to specify fire door assemblies rated 20 min 3/4 h, 1 h, 1-1/2 h and 3 h. Architects, building owners, code authorities and specifiers could then require an opening in a building to be provided with a door assembly bearing the appropriate "Air Leakage Rating" and/or "Fire Rating".

The Standard for Air Leakage Tests of Door Assemblies, UL 1784, is a test method that is independent of the door assembly fire rating. The test protocol determines a numerical air leakage rating in cubic feet per minute per square foot of door opening . In the UL 1784 test, door assemblies and other types of fire barriers can be investigated at various pressures up to 0.30 inches of water and at ambient or elevated temperatures up to 400°F.

UL's air leakage Classifications are listed in the Building Materials Directory. The assemblies are intended to be installed in accordance with the National Fire Protection Association's Recommended Practice for the Installation of Smoke-Control Assemblies, NFPA 105. The current UL air leakage Classifications cover fire door assemblies rated 20 min through 3 h.

6.8 UL 1784 AIR LEAKAGE TESTING OF SMOKE AND DRAFT CONTROL DOORS

At the ICBO code changes committee meetings in Sparks, NV earlier this month, the Fire Risk Assessment Committee finally approved a code revision which introduces air leakage limitations on smoke-and-draft control doors (20 minute) based on UL 1784. Door and gasketing manufacturers expressed grave concerns over the way UL indicated to them that testing would be done in order to List and label. They indicated that UL would require individual testing for each size of door, type of door (wood or hollow metal), various *amounts of glazing, etc. and opposed approval of the change for those reasons. Would it not be possible to test the door exhibiting the greatest amount of leakage, the maximum window size, etc. which would meet the 3 cfm/sq. ft. of door surface and then accept all others up to that maximum size and configuration?*

JIM URBAN (EXT. 42774):

With regard to air leakage investigations, UL does not require every size of door, type of door, type of gasketing, method of installation, etc. to be tested for Classification purposes. UL's test sample selection practices for evaluating air leakage rated door assemblies are based on the same sound engineering practices used to evaluate fire doors and many other types of building products.

For investigations conducted in accordance with the Standard for Air Leakage Tests of Door Assemblies, UL 1784, UL reviews the product construction and installation method information provided by the client and develops a matrix of all products intended to be covered by UL's Classification program. The purpose of the matrix is to facilitate UL's selection of samples for testing.

UL then selects for testing the door assembly samples that represent the "worst case conditions" of the characteristic being evaluated, e.g., maximum air leakage. The number and types of door assemblies selected for testing are chosen to ensure sufficient data is developed to determine the performance rating characteristics for the entire group of doors submitted for the investigation.

6.9 FIRE DOOR CLOSER TESTING

Because of the impact upon manufacturers with the adoption of positive pressure fire testing of fire doors, I understand that the Builders Hardware Manufacturers Assn. (BHMA) conducted fire tests on their hardware including door closers. In the course of that fire testing the hydraulic door closers produced significant flaming on the unexposed side of the door at somewhere between 60 and 90 minutes. That would result in being classified as a failure. Flaming did not occur during the first 60 minutes. Apparently it took that length of time for the heat to be transmitted through the door and the body of the closer to heat the hydraulic liquid to a point of ignition. It is my understanding that UL has not been fire testing door closers, but after this research, it seems that some sort of fire testing should be done. Should the closer be included in the fire testing of the door, be an independent test on a typical door by simply determining whether the fluid is combustible, or some other evaluation made?

JIM URBAN (EXT. 42774):

Door closers are part of the hardware package that needs to be provided on a fire door assembly. The protection of an opening depends not only upon the use of a Labeled fire door, but also upon the use of a Labeled fire door frame, Labeled lock, hinges and Labeled door closer.

Historically, UL has not required that door closers be installed on fire doors that are evaluated for fire rating, as the function of the door closer is completed when the fire door is returned to the closed position. The exception to this practice has been concealed or semi-concealed door closers that may affect the integrity of the door under fire test conditions. Based on this practice, UL has a limited data base covering the performance of door closers mounted on fire doors during fire tests conducted under current neutral pressure testing protocols.

In the developmental research testing conducted for the Builders Hardware Manufacturers Association (BHMA) to the proposed new positive pressure fire door test protocol, door closers were mounted on the fire door test assemblies, along with a cross-section of other builders hardware devices. During the conduct of these positive pressure fire tests, the closers were found to develop unexposed surface flaming. This unexposed surface flaming would not meet the conditions of acceptance in the current neutral pressure fire test protocols.

ACTION: UL will investigate the unexposed surface flaming phenomenon of door closers tested under the proposed positive pressure fire door test to determine if the same situation would occur under the current fire test protocols and consider the need to develop a test program to reevaluate door closers under fire conditions.

6.10 FIRE TESTING OF WINDOW ASSEMBLIES

The ICBO Fire Risk Assessment Committee approved a code revision for the Standard on Fire Testing of Window Assemblies. It would establish the neutral pressure plane so that it will be at 1/3 the height of the test specimen. This does not apply to glazing in fire doors but only to windows. How does UL propose to regulate the application of "an approved label or Listing Mark?" Typically wired glass windows have not been labeled as is required by the Codes? With this change, it becomes more apparent that fire testing and labeling needs to be done.

JIM URBAN (EXT. 42774):

Regulation of Listing Mark

With the adoption of a positive pressure fire test protocol for fire windows and glazing materials, UL would propose to regulate the application of our Classification Mark (label) similarly to our current programs. Fire windows and glazing materials currently eligible to bear a UL Classification Mark (label), based on current neutral pressure fire testing protocols, would be permitted to bear a supplemental adjunct marking if the product was determined to also comply with the new positive pressure fire test protocol. A typical adjunct marking might read "Also meets UBC 7-4, 1997."

If a fire window or glazing material was investigated only to the positive pressure fire test protocol, UL would establish a new product category and Classification Mark label. The new label might read "Classified in Accordance With UBC 7-4, 1997." The new listings would appear in the Building Materials Directory.

Labeling of Wired Glass Windows

Wired glass manufacturers and their distributors have always had the option of providing a Classification Mark (label) on their fire rated products. In the past, they had no incentive or reason to apply a label since code authorities, specifiers and other end users were not enforcing the requirement for the products to be provided and installed with a label. With the introduction of non-wired, fire rated glazing materials and a clarification of the labeling requirements in NFPA 80 several years ago, code authorities and others began to require labels on fire rated glazing, including wired glass.

UL's experience in the glazing materials category indicates that the demand for labeled fire rated glazing materials is increasing. Currently, approximately 36 wired glass distributors are cutting wired glass to size and applying a UL Classification Mark (label) to each cut piece. Glazing Material listings appear in the Building Materials Directory.

7.0 ALARM SYSTEMS

7.1 FIRE ALARM CERTIFICATE PROGRAM UPDATE

Update on UL's Certificate program for installed fire alarm systems, discussion of current issues, and UL's plans for expanding the program.

STEVE SCHMIT (EXT. 42128):

The 1993 edition of the National Fire Alarm Code, NFPA 72 contained a requirement that called for installed central station fire alarm systems to be certified by an independent third party. UL's Fire Alarm Certification Service program fulfills the prescribed requirements for certifying these systems.

In UL's experience, it is common for a municipality's adopted code to be one or two editions behind the latest available NFPA fire alarm code. It is not surprising then to find that the number of Certificated alarm installations in the US is small compared to the entire installed base. As of March 16, 1996, there were 2,471 Certificated Central Station systems and 688 Certificated Local, Auxiliary or Remote Station systems. Certificate counts have grown by 13 and 78 percent respectively since January 1, 1995. The charts at the end of this item provide a partial listing of the jurisdictions.

UL maintains active relationships with 24 municipalities that have specific ordinances or orders requiring UL Certificates for installed fire alarm systems. We are working with 18 more who are in varying stages of adopting local codes. In working with these jurisdictions, UL has noted some common characteristics and problems:

1. Compliance Environment - These municipalities had to take specific action in order to create a compliance environment. Simply adopting NFPA 72-1993 does not result in third party certification. The communities had to mandate Certification by special order or by specifying UL Certification in their ordinances/codes.

2. Compliance Cost - Businesses within the community are most concerned about the cost of compliance. Direct UL costs, once explained to the community, are not as important as the cost of bringing installations up to code. There is no direct UL cost to the AHJ. UL's charge to an alarm company for a Certificate is $30/year. Phase in periods for different types of occupancies and allowing compliance to older code editions mitigates cost concerns to a significant degree.

3. Sole Sourcing Compliance Work - Mandating a specific private company like UL in a local ordinance is generally not acceptable. These communities have adopted codes calling for third party certification by an "approved" Certification body. The Fire Department then handles the administrative task of determining criteria for acceptable third parties.

UL has developed an array of support services for AHJs implementing code compliance programs. Included are: consultations to review local issues, sharing solutions from other municipalities, networking with other AHJs who are using the UL system, access to on-line Certificate Verification Services directly from UL via modem or through the Insurance Services Office's ISOTEL network, paper-based Certificate status change notification programs, and local training seminars.

UL is currently developing a package of AHJ focused materials to detail our support mechanisms. In addition, UL is forming a systematic marketing program aimed at identifying and reaching out to communities most likely to benefit from participation in the program.

Fire Alarm Certificate Counts in
Jurisdictions Requiring Certificates

Jurisdiction	Central Station Count	Other Type Count	Total Certificate Count for These Jurisdictions
Baltimore County, MD	8	49	57
Boca Raton, FL	0	0	0
Boston, MA	10	38	48
Brooklyn Park, MN	104	2	106
Carmel, CA	120	0	120
Chanhassen, MN	30	0	30
Delray Beach, FL	141	0	141
Eden Praire, MN	124	1	125
Elk Grove, CA	15	20	35
Fairoaks, CA	22	10	32
Framington, MA	0	3	3
Glendale, CA	34	119	153
Hooksett, NH	0	0	0
Lancaster, PA	32	2	34
Maitland, FL	1	0	1
Maple Grove, MN	52	0	52
New Hanover County, NC	86	2	88
Olathe, KS	30	0	30
Orland Park, IL	1	181	182
Plymouth, MN	233	1	234
San Francisco, CA	3	0	3
San Rafael, CA	49	0	49
Stockton, CA	209	70	279
Vernon, CA	3	0	3
Totals	1307	498	1805

Fire Alarm Certificate Counts in Jurisdictions With More Than 10 Certificates

No Known Local Ordinance or Order

Jurisdiction	Central Station Count	Other Types Count	Total Certificate Count for These Jurisdictions
Cincinnati, OH	13	0	13
Highland Beach, FL	18	0	18
Jackson, MI	15	0	15
Los Angeles, CA	17	1	18
Mesa, AR	0	20	20
Milwaukee, WI	29	0	29
Minnetonka, MN	23	0	23
Queen Creek, AR	0	26	26
Sacramento, CA	11	2	13
St. Joseph, MI	12	0	12
Sterling, VA	10	0	10
Wakarusa, IN	24	0	24
Totals	172	49	221

7.2 CENTRAL STATION CERTIFICATION

I have repeatedly asked this question and got a bad answer. I'll try a different tactic.

As an example, Las Vegas has a number of alarm companies that trade on the fact that they are Central Station. (I don't know if this is for Fire or Burglary). The Fire Departments do not know and they allow that the buildings comply under the Fire Code. Since UL shows that there are no Central Station Systems in Las Vegas proper, and very few in the State (5 near Reno) why is this allowed? I think there is only one true answer. UL must show there are two types of alarm companies. Those that are approved as installers of alarm systems but have no systems installed that meet UL's requirements, and those that are approved installers and have approved *systems installed. Say what they are approved for (Fire or Burglary and what grade, Central Station, Remote, Proprietary, Municipal or Local). I think that this will get the attention of the Fire departments that the systems installed are not approved. This will benefit UL and the Fire Department.*

STEVE SCHMIT (EXT. 42128):

Under UL's Certificate Service program, an Alarm Service Company demonstrates that it can provide code complying alarm service by submitting to rigorous examination of actual work. Upon acceptable demonstration of it's abilities, a company's name is included in UL's records, under the category supported by the examination, as being eligible to request Certificates on code complying alarm installations.

An alarm company is *not* obligated by its relationship with UL to provide code complying service for every alarm system installation. The company *is* obligated to provide complying service for systems covered by a UL Certificate. As noted in the UL Guide information for all alarm system categories, "A(n)... alarm system is considered to be Listed only if a current active UL Certificate has been issued for the alarm system." Alarm Companies which have not had any alarm systems covered by a Certificate for 4 years are required to requalify in order to maintain their name in UL's List of qualified alarm service companies.

Because of the dynamic nature of the business, printed identification of companies by whether or not they have issued Certificates in a given municipality would likely be obsolete information shortly after publication. For this reason, UL provides AHJs with two powerful communication resources:

1. Underwriters Laboratories Certificate Verification Service (ULCVS) is an on-line database available free of charge to AHJs that provides immediate access to current information on alarm service company certificate status.

2. UL will mail notification of Certificate status changes to any AHJ that wishes to use the Certificate Service Program to help administer code compliance. Interested AHJs can contact Steve Schmit at UL's Northbrook office for more information or to establish participation in the UL Certification status notification program.

7.3 RANGETOP COOKING FIRES

Cooking fires involving ranges and ovens are associated with nearly 100,000 residential structural fires annually, a major fire problem. CPSC is investigating the feasibility of detecting an incipient "fire" in time to shut off the range. We have recently learned of a Gas Research Institute funded project *that is looking into technological approaches that could sense imminent boiling, control temperature, and detect and control boil dry, boil over, burn out, and flame out. Is UL aware of any similar studies involving electric ranges?*

DON GROB (EXT. 43117):

The CPSC Range Fire Project is a two-year-funded project running from October 1994 to September 1996, the goal of which is reduce the incidents of cooktop fires. The following is a summary of meetings and other activities that have taken place since the inception of the project.

<u>November 3, 1994</u>

On this date, a kickoff meeting was held and attended by representatives from gas and electric range manufacturers, UL, the Association of Home Appliance Manufacturers (AHAM), Gas Appliance Manufacturers Association (GAMA), American Gas Association (AGA) Laboratories, US Fire Administration, American Association of Retired Persons (AARP), and several Consummer Product Safety Commission (CPSC) staff members. A key point made during the meeting was that, whereas over the last six years fire incidents due to all causes has decreased somewhat, incidents due to range and cooktop fires have remained relatively steady. In opening remarks, Ms. Ann Brown, Chairperson of CPSC, stated that this effort was to focus on technological solutions. The project consists of two phases:

- Phase I (now completed) consisted of gathering information on available technology to detect fires as well as information on food items and procedures involved in fire incidents.

- Phase II (currently ongoing) is to test and analyze feasible devices to prevent fires. The plan at that time was to be a call for bids for an engineering contract to look at the parameters of cooktop fires, what fire detection and suppression technologies exist today that can be adapted for use with or on a cooktop, cost analysis of detection and suppression devices, negative effects (such as nuisance tripping and adverse cooking performance) of potential devices, and perhaps other factors related to this problem. CPSC indicated it had no intention of writing a mandatory standard but planned to use the voluntary standards process currently in place (UL for electric products and Z21 for gas products).

<u>January 10, 1995</u>

A second meeting was held and attended by representatives from manufacturers of range controls for gas and electric ranges, UL, AHAM, GAMA, AGA

Laboratories, NIST, and several CPSC staff members. CPSC indicated they were considering having NIST perform this work rather than an outside contractor. During the discussions industry felt that the biggest problem would be in defining the "signature" characteristic to sense or monitor to prevent a fire (e.g., particle detection, heat rise, etc.) without causing nuisance tripping when considering cooking methods as diverse as flambe or wok cooking to more traditional methods. Also a number of factors would have to be considered (i.e., different types of products, power outages, gas shutdowns, ability to restart safely, etc.). It was also pointed out that ranges and cooktops generally do not have one main shut-off switch that could be controlled to operate should an impending fire condition develop. It was again reiterated that after the completion of their work, CPSC would like to turn the project over to the voluntary standards' system to develop the requirements for inclusion in those standards, conduct industry meetings, establish effective dates, etc.

February 1, 1995

The National Institute of Standards and Technology (NIST) was given the charge to perform this work.

May 1, 1995

NIST's first draft of their "Experimental Plan" was sent to UL and others for comment. The plan outlined the measurements that would be recorded and the instruments and methods that would be used in the experimental series of the project. Experiments would be performed to ascertain the pre-ignition environments of various combinations of ranges and foods. It was expected that analysis of the results would determine the existence of a condition or combination of conditions with potential to provide input to a pre-ignition sensor. Also, a literature search would be conducted to determine the sensing devices and technologies capable of detecting one or more cooking related conditions.

May 4, 1995

In commenting on the plan, UL suggested other variables such as amount of food, size of the cooking pan, watt density of the heating elements, burner control setting, and range hood air flow be considered in the analysis.

June 29, 1995

Representatives from range manufacturers, UL, AHAM, AGAL, NIST and CPSC attended a demonstration of NIST's proposed setup for conducting the proposed tests.

November 1, 1995

NIST published their report (officially titled "Study of Technology for Detecting Pre-Ignition Conditions of Cooking Related Fires Associated With Electric and Gas Ranges and Cooktops, Phase 1"). The conclusions were based on measurements and observations of experiments using various combinations of specific gas and electric ranges, pans, foods, and ventilation. The following conclusions were reached:

1. Strong indicators of impending ignition were temperatures, smoke particulates, and hydrocarbon gases.

2. Weak indicators and non-indicators of impending ignition were velocity above the burner and infrared imaging of the cooking area.

3. Promising detection technologies include: tin oxide sensors and narrow band infrared adsorption for hydrocarbon detection, scattering or attenuation types of photoelectric devices for smoke particle detection, thermocouples for thermometry of the burner, pan, range hood, or range surface (top and below).

4. Logical processing of signals from two or more of the detection technologies could be an important means by which false alarms of pre-ignition conditions are eliminated.

5. Control technologies exist that are applicable to the safe shutdown and restart of gas and electric ranges upon detection of approaching ignition.

6. Other observations comparing stainless steel verses aluminum pans, open-coil electric versus high-output gas ranges, and the behavior of oil, bacon, and sugar were also noted.

November 28, 1995

A meeting was held to discuss the ongoing range fire project and was attended by representatives from range manufacturers, UL, AHAM, NIST, and CPSC. There was a discussion of what was and what was not accomplished in Phase 1, what could be accomplished in Phase 2, and a review of NIST's proposed Phase 2 plan. The following concerns were expressed:

1. How would "downdraft" ranges and cooktops affect the strong indicators of impending ignition identified in Phase 1 (i.e., temperatures, smoke particulates, and hydrocarbon gases) when considering differences in air flow patterns and air velocities from those of updraft hoods?

2. Would cooking with a large amount of oil (much greater than the 250-500 ml tested) generate the same level of hydrocarbons as that which was measured just prior to ignition of the smaller amount even though ignition of the larger amount may not be imminent?

3. Are pans other than the types tested (stainless steel and aluminum) readily available and in use and should these be included in the test plan? The use, especially in rural areas, of cast iron was mentioned.

4. The condition of the pan (i.e., its flatness at the bottom) obviously affects heat transfer to the pan. How will its condition affect the indicators of an impending fire?

5. The test plan should include conducting tests at locations on the range and/or hood where sensors might be feasibly located.

6. Should the scope of the project be broadened to look at the possibility of locating sensors at points in the kitchen other than at the range cooking surface or hood? The plus side of this is that the sensor could be in best possible position to react before a fire starts; the negative side is that some sort of audio, light, etc., link would have to be made in order to shut the range down.

7. Are there normal cooking conditions that would produce similar results to those encountered prior to ignition which could lead to nuisance tripping? Open door oven broiling and cooktop surface grilling were mentioned. Industry would provide further input on this.

8. How would contamination and possible physical abuse of sensors affect their "reliability?" UL 991 and other test programs that UL has or could develop could address this concern.

NIST had agreed to modify their proposed plan for Phase 2 to take into account the comments made at this meeting.

At this time, UL is not aware of a specific research project underway for gas cooktops at GRI that specifically addresses rangetop cooking fires. There was some work done to test an advanced cooktop controller designed to monitor the cooking process, and perhaps this technology could be applied to also help control cooking fires. An article "Making Gains in the Mainstream" in the February 1996 issue of Appliance described this technology. UL will continue to monitor developments related to this matter and apply them to UL's requirements as appropriate.

8.0 GENERAL

8.1 REDUCTION OR ELIMINATION OF MUNICIPAL INSPECTIONS

Continuation of the Plenary Breakfast discussion on the reduction and elimination of municipal buildings inspections. The impact on the community and safety of buildings and product installation. How should we respond?

JIM BEYREIS (EXT. 42301):

It has been reported that New York City is approximately two years behind in the completion of building inspections. In order to reduce the backlog, New York City now offers the option of having the architect or contractor sign a declaration of conformance in lieu of an inspection. The city audits about 20 percent of these installations to confirm conformance. Some architects and contractors are reluctant to sign the declaration, as such action exposes them to additional liability and insurance costs.

Other communities are experiencing budget restrictions that make it increasingly difficult to maintain the past level of inspections. While it may be appropriate in the short term to maintain the current practice of inspecting every installation, increasing budget restrictions may require adjustments be made.

UL recognizes that a variety of changes are taking place in inspection procedures around the country and wants to be prepared to address the future needs of the inspection community. UL would welcome any information the Council members may have regarding these changes and suggestions on how they should be addressed.

8.2 U.S./EUROPEAN UNION MUTUAL RECOGNITION AGREEMENT ON PRODUCT ACCEPTANCE

Continuation of the Plenary Breakfast discussion on the impact of the U.S./European Union Mutual Recognition Agreement on product acceptance. What are the implications for acceptance authorities? Certifiers? Others? How should we respond?

JIM BEYREIS (EXT. 42301):

The U.S. government is planning to sign a Mutual Recognition Agreement (MRA) with the European Union by June 1996. Even if this MRA is established, UL will continue to confirm that Listed products for use in the U.S. comply with the requirements that conform to the installation practices followed in U.S. jurisdictions.

A Council member asked if products sent from Europe for use in the U.S. may bear some other national certification mark. UL responded that this was unlikely. Products from Europe have been sold in the U.S. for decades, provided with the UL Mark of conformity. European product manufacturers would not expect that the establishment of an MOU would make IEC Standards appropriate for products sold in the U.S.

Another Council member noted that many products with non-Canadian marks of conformity are marketed in Canada. Canada is working to develop a common identifier to be used as evidence of compliance with Canadian requirements. UL responded that UL's CUL and other Marks for Canadian products indicate that the product has been evaluated to Canadian requirements. UL has provided unique Marks for Canada so that Canadian authorities can have confidence that products which bear such marks have been investigated to the appropriate Canadian requirements.

UL commented that U.S. manufacturers often find it to their advantage to have the U.S. national standards changed to become harmonized with international standards. The information technology equipment manufacturers have been particularly supportive of such harmonization with international standards, to enable worldwide acceptance of their products. UL anticipates that this concept will expand into other product areas as manufacturer's develop foreign markets.

A Council member asked if the scope of the MRA will address Standard changes. UL responded that there is no current agreement. There are continuing efforts to establish MRAs at the government level, where it is not clear who has responsibility. In addition, negotiations at the government level do not include the people directly impacted by the MRA.

At least for the short term, UL will continue to establish bilateral agreements with other certification organizations, work with them to validate their data, and use the data to permit the application of the UL Mark on the product. This approach has proven successful and has no impact on the inspection community.

9.0 FLAMMABLE FLUIDS AND GASES

9.1 FLAMMABLE REFRIGERANTS

Due to environmental concerns, and based on research work, ad hoc meetings, and harmonization efforts with IEC Standards, UL has developed proposed requirements for household refrigerators and freezers that may employ a flammable refrigerant.

DON GROB (EXT. 43117):

Concern over depletion of the stratospheric ozone layer by certain types of chemicals, the implementation of the Montreal Protocol, and the U.S. Clean Air Act of 1990 have resulted in an intensive search for suitable replacements for the particular chlorofluorocarbon refrigerants identified in the Protocol. Refrigerants R-11 & R12 are no longer being produced in the United States. R-22 is scheduled for phaseout starting in the year 2010.

UL is aware of over 40 new refrigerants that have been proposed (and marketed in some way) to serve as replacements for the current refrigerants commonly used, R-11, R-12, R-22 and R-502. The following factors are being evaluated in considering alternative refrigerants: thermodynamic properties, availability, cost, material and system compatibility, chemical stability, toxicity, flammability, detectability, ozone depletion and greenhouse warming potentials, and energy efficiency goals set down by the U.S. Department of Energy. The ideal refrigerant replacement would be a substance that has no effect on the ozone layer, has a very low greenhouse warming potential, has the same or better refrigerant characteristics, and can be used with no modification of the current refrigeration system.

New refrigerants are being considered from two aspects, new equipment uses and as a replacement refrigerant in existing equipment. UL believes that for a replacement refrigerant, the requirement should be to use a nonflammable refrigerant replacement. This is because the safety evaluation of the equipment was based on the use of a nonflammable refrigerant.

UL has Listed household refrigerators and freezers using R134a, which is Classified by UL as practically nonflammable. This refrigerant is also being used in the automotive industry as a replacement in automotive air-conditioning systems. It has gained wide acceptance in the marketplace in the USA. However, other countries have an increasing concern about greenhouse warming and have not included R-134a among the top choices for replacement refrigerants.

Hydrocarbons such as propane and isobutane have highly desirable refrigerant properties, zero ozone depletion potential and very low greenhouse warming potential. Consequently, a number of countries have identified propane and isobutane, along with ammonia, as the refrigerants of choice. The only question raised relates to the potential flammable risk in the event that a leak occurs and an ignition source is present.

New equipment could be designed to address the risks associated with the use of a flammable refrigerant by the use of explosion proof components, leak analysis and a limited charge amount. UL has discussed such requirements for heat pumps and air conditioners in various forums with industry and other interested parties. There is ongoing work under the International Electrotechnical Commission (IEC) standards making process to also develop such safety standards.

Under the ASHRAE 34 nomenclature procedure, there is a category identified as "A1/A2" for refrigerants that are nonflammable in their original composition, but because they are a blend of chemicals without a single boiling point (non-azeotropic or zeotropic), they can fractionate under certain conditions, and the worst case fractionated composition is flammable. By understanding the fractionation analysis and the conditions where the flammable composition occurs, UL can develop safety requirements for such products for both new equipment and as a replacement refrigerant. Proposals addressing these considerations have been issued under UL Subject 2205. A copy of these proposals may be obtained from Steve Leva at 847-272-8800, extension 42419.

9.2 PROBABILITY OF STRUCTURAL FIRE DUE TO FLAMMABLE REFRIGERANTS

UL has done one demonstration of an artificially induced ignition of a cabinet full of a gaseous mixture. Has UL done, or does it plan to do, a quantification of risk under actual use conditions; i.e., what is the probability of a structural fire or explosion?

DON GROB (EXT. 43117):

A number of outside organizations have conducted a "risk" analysis of refrigerant systems, which generally evaluates the probable leak occurrence rate, the probability of an ignition source being present, and the probability of an ignition (i.e., fuel/air ratios below the lower flammable limit or above the upper flammable limit will not ignite). The calculated risk is generally in the order of 1 to 100 parts per million per year. This would translate to the following type of statement. "*If all refrigerators in the U.S.A. were instantly converted to (a specific) flammable refrigerant, this would result in an additional (1 to 100) fires per year on the average and (50 to 200) fires per year in the worst case.*" Since there are a specified known number of fires per year associated with the product the additional impact could be evaluated.

UL believes that calculating the probability of an event is not the type of criteria that should be used to develop safety requirements, but that specific safety requirements should be in place to address the risks and reduce the risks. Since the flammable gases are heavier than air and can pool in an enclosed space or a basement, only small charge sizes are permitted. UL's proposals have followed the concepts that either the leaked amount will not result in a flammable mixture, or that any ignition source in the area where a flammable mixture could occur shall be of an explosion proof design. IEC requirements permit much larger charge sizes, and they do not address pooling of a leaked refrigerant or the possibility of ignition sources outside of the product.

UL has conducted research on actual occurances of leaked refrigerant in room sized spaces. Charge sizes of 120 grams (approximately four ounces) have been ignited by Ignition sources located up to 10 feet away when the refrigerator door was opened following a refrigerant leak into the food compartment. UL tests have also demonstrated that the leakage of a smaller quantity of flammable refrigerant into a freezer compartment can be ignited by an adjacent gas stove when the freezer compartment door is opened. In several tests, the refrigerant ignition or explosion ignited combustible materials of the refrigerator and other combustibles in the path of the explosion.

UL will continue to monitor IEC work in this area, and propose additional revisions for the existing Standard for Household Refrigerators and Freezers (UL 250), Standard for Heating and Cooling Equipment (UL 1995), and Field Conversion/Retrofit of Alternative Refrigerants in Household Refrigerators and Freezers (Subject 2205) as needed.

9.3 VERTICAL LP GAS TANK PRESSURE RELIEF VALVE IDENTIFICATION

Vertical LP-Gas pressure vessels have relief valves installed at the top of the container. Because a means of accessing the top of the container is not normally provided (a.k.a., ladder), how does UL and field inspectors verify that a properly rated relief valve is installed in the container.

MARTY MAGERA (EXT. 42552):

Currently four manufacturers of LP-Gas Container Assemblies maintain UL Listings on a wide range of tanks, sized between 59 and 2000 gallons water capacity. Since all of these Listed products are constructed horizontally, UL has not yet dealt with any other configuration. Beyond a size of 1000 gallons, there are some advantages in constructing storage tanks for vertical installation. When this happens, it is difficult to verify the ratings of safety devices located at the top of the tank. While this question assumes that the vertical tank has already been installed, and the rating of the pressure relief valve is not known, there are at least two methods available to address this concern prior to installation:

1. From an enforcement perspective, there is an advantage to require that all LP-Gas storage containers be covered under the UL 644 Container Assembly Program. UL is well prepared and would welcome the opportunity to investigate any configuration of LP-Gas pressure vessels. Upon completion of such a program, the Manufacturer would be able to confirm by the application

of the UL Listing Mark on the product that all necessary and properly rated safety devices were correctly installed. Unannounced factory visits by UL would verify or otherwise address the integrity and the quality control methods of the manufacturer.

2. In lieu of requiring the use of a Listed container, some National Codes, or enhancements of local codes, have specified that plans for certain installations of LP-Gas containers be submitted to the Local Authorities prior to installation. Presumably, the acceptability of ratings of the safety devices could be determined during the review process.

However, when neither of these methods has been employed, and the concern for safety is such that an on-site inspection is warranted, every possible effort should be made to obtain the necessary equipment to conduct a safe inspection. While UL has not yet investigated a vertical tank, either in a factory or a field environment, we have conducted numerous field inspections on equally challenging products. Some investigations that come to mind include work on vertical cracking towers for the distillation of petroleum products, the evaluation of track level wiring methods for elevated transportation systems, and two story vertical baling machines for recycling applications. In each case, innovative assistance from the local municipality, a utility provider, or even a rental agency was prearranged through the owner of the product to complete the required on-site inspection. From our experience, delays in the application of the Listing Mark and the possibility of additional fees for a return visit have been more than enough to encourage prompt action on the part of the equipment owner who is seeking our services. Similar or greater pressure could be exerted by the Local Authority Having Jurisdicition to encourage the owner of the tank to provide the necessary equipment for the inspection and obtain acceptance of the installation.

9.4 LP GAS TEMPERATURE GAUGE REQUIREMENTS

NFPA 58, Section 2-3.3.2(b)(3)e requires LP-Gas pressure vessels with a capacity greater than 2,000 gallons w.c. be provided with a temperature gauge. The thermometer is provided to allow the person filling the container to check the internal temperature before filling the pressure vessel. Section 2-3.6 requires container connections to be provided with a method of protection for this opening in case of mechanical damage to the thermometer or a leak around the opening. To date, our contacts with the LP-Gas industry have not considered the thermometer to require such protection because of the size of the opening. Given the clear intent of Section 2-3.6, has UL listed any thermometers for LP-Gas service with the controls specified in the referenced Section? If, not how would UL evaluate a thermometer used for LP-Gas service?

MARTY MAGERA, (EXT. 42552):

UL has not investigated thermometers or temperature gauges intended for LP-Gas service. Codes do not specify the use of Listed devices, and consequently there has been little incentive for manufacturers to seek Listing. If the need arises, UL could quickly develop a Listing Program for Temperature Gauges and Related Devices.

There are two principal methods used to measure fluid temperature within a large tank. NFPA 58 Section 2-3.3.2 makes specific reference to a temperature gauge. Most likely this is a dial type device that threads into a tank fitting, similar to a typical pressure gauge. Elsewhere in NFPA 58, Appendix F makes reference to another construction which consists of a thermometer and a thermometer well.

A typical thermometer well is a closed-end tube that is either threaded onto an appropriate fitting, or welded into the wall of the tank. It is designed to temporarily hold a common glass-bulb or bi-metal thermometer, usually in a temperature conductive liquid like ethylene glycol, which is poured into the well. Thermometer wells are used in a number of UL Listed LP-gas products such as strainers and meters. In these applications, a representative sample must meet certain qualifying material specifications, a 525 psi aerostatic leakage test, and a 1750 psi hydrostatic strength test. Since a thermometer well is primarily an internal device which is not subject to mechanical abuse, additional protection against excess leakage to atmosphere has not been an issue.

A temperature gauge, constructed like a typical pressure gauge and not properly protected, could be subject to accidental damage where the dial portion could be snapped off the mounting stem. Depending on the internal construction, a significant leak might occur. Fortunately, most temperature gauges are inherently leak-tight, but a meaningful test program should address this concern either through construction or performance requirements.

A test program for temperature gauges would include requirements from NFPA 58. Areas that would be addressed include the compatibility of the body material with the fluid in the tank, the melt temperature of the body material, the leak rate that could result from a damaged gauge, and the construction of the tank connection into which the gauge is threaded.

Specifications for materials and their characteristics are found in NFPA 58 Section 2-3.1.2, which addresses general resistance to any chemical reaction with LP-Gas, establishes a minimum melting point requirement, provides examples of acceptable materials, and excludes certain other materials.

NFPA 58 Section 2-3.1.3 establishes a minimum working pressure rating of 250 psi. Based on this value, UL would apply safety factors and conduct aerostatic leakage tests at 1-1/2 times rated pressure and hydrostatic strength tests at 5 times rated pressure.

Requirements for gaskets appear in NFPA 58 Section 2-3.1.4, which addresses chemical resistance. This Section also addresses the need for metal gaskets, or for nonmetallic materials to be confined in metal with a high melt temperature, or otherwise protected against fire exposure.

Finally, NFPA 58 Section 2-3.5.2 addresses the need to protect against the uncontrolled release of a product in the event of a catastrophic failure of the gauge. While it is clear that this Section specifically addresses Pressure Gauges, this principle could appropriately be extended to a temperature gauge. Any temperature gauge Listing Program would include tests to verify that leakage through the gauge, under normal and abnormal conditions, could not exceed the limits specified in UL and NFPA requirements.

9.5 ZONE 0 CLASSIFICATION SCHEME

The 1996 National Electrical Code now provides a parallel classification scheme to the Historical "Division" Classification. The Zone 0 concept is based on the IEC Zone Classification Scheme used in Europe and around the world. Since the Code revision, UL has issued revision to our existing Division Hazardous Location Standards to allow an option of Zoning Markings based on existing Division Hazardous Locations Standards to allow an option of Zoning Marking Bases on existing division requirements.

PAUL KELLY (EXT 42326):

The 1996 National Electrical Code now allows for two parallel classification schemes for Class I hazardous locations within the United States - the traditional U.S. Division scheme and the new U.S. Zone scheme. This new U.S. Zone scheme is based on the international IEC Zone approach to hazardous locations involving explosive gas atmospheres. While these two classification schemes are independent, their apparent differences actually reflect an overall similarity in the way hazardous locations are addressed throughout the world.

Formerly, in the NEC, a U.S. Class I hazardous location could be divided into Divisions, Gas Groups and Temperature Classes - with specific protection methods being allowed based on the Division involved. Now, in a new Article 505 in the 1996 NEC, a U.S. Class I hazardous location could alternatively be divided into Zones, Gas Groups and Temperature Classes - with specific protection methods being allowed based on the Zone involved. With the exception of the allowable protection methods, the other differences between Divisions and Zones are mainly organizational in nature (for example, grouping the same gases into 4 Gas Groups for Divisions versus 3 for Zones). The following table provides a general comparison between U.S. NEC/UL Class I Division and Zone classification schemes.

COMPARISON BETWEEN U.S. NEC/UL CLASS I DIVISION & ZONE CLASSIFICATION SCHEMES

NEC/UL Division Classification Scheme	NEC/UL (IEC) Zone Classification Scheme
Class I, Division 1: Where ignitable concentrations can exist under normal operating conditions; may exist frequently because of repair, maintenance or leakage; or may exist due to breakdown of equipment in conjunction with an electrical failure.	*Class I, Zone 0*: Where ignitable concentrations are present continuously or for long periods of time. *Class I, Zone 1*: Where ignitable concentrations are likely to exist under normal operations; may exist frequently because of repair, maintenance or leakage; may exist due to breakdown of equipment in conjunction with an electrical failure; or adjacent to Class I, Zone 0 locations
Class I, Division 2: Where volatile flammable liquids are stored, etc. in closed containers; where ignitable concentrations are normally prevented by positive pressure ventilation; or adjacent to Class I, Division 1 locations.	*Class I, Zone 2*: Where ignitable concentrations are not likely to exist in normal operation or may exist for a short time only; where volatile flammable liquids are stored, etc. in closed containers; where ignitable concentrations are normally prevented by positive pressure ventilation; or adjacent to Class I, Zone 1 locations.

With regard to the protection methods that are allowed in U.S. Class I hazardous locations, while the NEC identifies methods for Divisions, it does not yet contain equivalent text for Zones. Instead of detailing requirements for suitable methods of protection for use in Zones, Article 505 of the 1996 NEC requires all equipment for use in Zones to be Listed - thus relying on agencies such as UL to determine suitability. In response to requests and inquiries from industry, UL has made such a determination.

UL's determination of the suitable requirements for Zone protection methods occurred in two stages. The first stage involved UL issuing proposal bulletins based on Exceptions included in the new Article 505. These bulletins proposed that products complying with UL's hazardous location Division protection method requirements could additionally or alternatively be marked for the corresponding Zone location. The second stage involved UL issuing a proposal bulletin based on guidance provided by the NFPA Standards Council regarding the technical merit of the Zone concept and regarding the benefits of international harmonization. This charge from the Standards Council, in conjunction with requests from industry and UL's knowledge of international hazardous location protection method requirements, resulted in UL issuing a proposal bulletin dated October 31, 1995. This bulletin announced the adoption of the IEC 79 series of standards as modified by a few National Deviations. These National Deviations consist of the NEC and the applicable UL ordinary location requirements for fire and shock concerns. Industry's support of both the first and second stage proposals resulted in their adoption - with U.S. Zone Listings already being issued under both approaches. The following table provides for a comparison between U.S. NEC/UL Class I Division and Zone protection methods.

COMPARISON BETWEEN U.S. NEC/UL CLASS I DIVISION & ZONE PROTECTION METHODS

NEC/UL Division Protection Methods	UL (IEC) Zone Protection Methods
Class I, Division 1: • Explosion proof; • Intrinsically safe (2 fault); or • Purged/pressurized (Type X or Y).	*Class I, Zone 0*: • Intrinsically safe, 'ia' (2 fault); or • Any Class I, Division 1 method *Class I, Zone 1*: • Encapsulation, 'm'; • Flameproof, 'd'; • Increased safety, 'e'; • Intrinsically safe, 'ib' (1 fault); • Purged/pressurized, 'p'; • Any Class I, Zone 0 method; or • Any Class I, Division 1 method.
Class I, Division 2: • Nonincendive circuit; • Nonincendive component; • Non-sparking device; • Oil immersion; • Purged/pressurized (Type Z); • Hermetically sealed; or • Any Class I, Division 1 method.	*Class I, Zone 2*: • Nonincendive circuit, 'nC'; • Nonincendive component, 'nC'; • Non-sparking device, 'nA'; • Restricted breathing, 'nR'; • Hermetically sealed, 'nC'; • Any Class I, Zone 0 or 1 method; or • Any Class I, Division 1 or 2 method

Work remains in clarifying the requirements for certification and installation of equipment and wiring for use in U.S. Zones. In an effort to facilitate this, UL is actively participating with industry in Code and Standards proposals. Specifically, UL is involved in several American Petroleum Institute (API) working groups that are drafting proposals for the 1999 NEC that will clarify installation requirements for U.S. Zones.

Also, UL has recognized the need for education regarding Zones. In response to this need, UL is consulting with industry magazines in the preparation of several Zone articles and is publishing several articles in UL publications. Specifically, the November 1995 and December 1995 editions of the industry magazine "EC&M" included articles that contained helpful information regarding Zones. Also, recent editions of UL's "The Code Authority" (Vol. 4, No. 2 1996) and UL's "On The Mark - World Safety Report" (Spring 1996) provided basic explanations of Zones and then detailed UL's services regarding Zone certification. Further articles are planned and other avenues of education are under consideration.

9.6 SOLVENT DISTILLATION UNITS (SDU)

The Uniform Fire Code (UFC) is the only code that specifically addressees Solvent Distillation Units. There is now consideration being given to allowing ordinary location construction in an area that had formerly been restricted to Division 1 or Division 2 constructions. A coalition of Fire Chiefs, AHJs, manufacturers, users, and the EPA have asked UL to assist in developing proposed requirements for ordinary location Solvent Distillation Units. A draft document was presented at the December 1995 UFC meeting, with further reviews scheduled for the July 1996 meeting.

PAUL KELLY (EXT. 42326):

The Uniform Fire Code (UFC) is the primary code that specifies requirements for Solvent Distillation Units (SDU's) designed to process flammable and combustible liquids. In accordance with these requirements, SDU's designed to process flammable and combustible liquids shall be suitable for use in Class I, Division 1 or 2 locations. This level of requirements was deemed necessary due to the potential for SDU's to generate an explosive gas atmosphere, regardless of whether flammable or combustible liquids were involved.

During 1994, UL participated in an inter-regulatory agency committee involving Fire Chiefs, AHJ's, representatives from governmental environmental agencies and SDU manufacturers and users. The objective was for UL to assist in the development of requirements that could allow for ordinary location SDU's designs as an acceptable alternative to Class 1, Division 1 or 2 designs. A UL advisory group was assembled in early 1995 to discuss the possibility of such requirements. This group included members from the inter-regulatory agency group, as well as additional manufacturers and consultants. As a result of this group's discussions, agreement was reached on a core set of requirements for ordinary location SDU constructions. These requirements were then used as the basis for a draft Outline of Investigation, with the key to allowing ordinary location SDU constructions being a Vapor Concentration test.

This Vapor Concentration test would be conducted under normal and abnormal conditions to determine if a risk of explosion exists at any source of ignition on or around the SDU. If no risk exists under either normal or abnormal conditions, then the SDU need only comply with ordinary location construction requirements. However, should a risk of explosion exist under abnormal conditions, but not normal conditions, or exist under both normal and abnormal conditions, then the SDU would need to comply with Class I, Division 2 or with Class I, Division 1 requirements respectively. A risk of explosion is deemed not to exist if the concentration of any vapor at any source of ignition is at a level less than or equal to 25 percent of the lower flammability level (LFL) for the vapor being tested. This pass/fail criteria provides a four-times safety factor to the evaluation.

UL's Outline of Investigation was reviewed during the December 1995 UFC meeting and was received favorably. A few issues were raised that required further review, and action on the Outline was tabled until revisions could be made to address these issues. UL has revised the requirements and published them as Standard UL 2208, which will be discussed during the July 1996 UFC meeting. UL is holding the distribution and use of UL 2208 pending a revision of the UFC to permit ordinary location SDU constructions by reference to this UL Standard.

10.0 FIRE CHARACTERISTICS OF PRODUCTS AND MATERIALS

10.1 MASTIC CLOSURE SYSTEMS FOR AIR DUCTS

UL will report on new requirements which have been developed to cover mastic closure systems for use with listed rigid and flexible air ducts under the UL category ALKW.

DWAYNE SLOAN (11676):

UL has developed performance requirements for mastic products that are used with UL Listed rigid fiberglass air ducts and air connectors and flexible non-metallic air ducts and air connectors. UL has also developed requirements for pressure sensitive tapes for use with UL Listed flexible non-metallic air ducts and air connectors. These mastic and tape products are listed in the UL category, "Air Duct and Air Connector Closure Systems" (ALKW), which appears in the UL Gas and Oil Equipment Directory.

The UL Standards and markings associated with various air duct closure systems are as follows:

Standard	Part No.	Product Covered	Status of Requirements	Marking
UL 181A	I	Pressure Sensitive Tapes for Use With Rigid Fiberglass Ducts	Published - 1991	181A-P
UL 181A	II	Heat-Activated Tapes For Use With Rigid Fiberglass Ducts	Published - 1991	181A-H
UL 181A	III	Mastic Closure Systems For Use With Rigid Fiberglass Ducts	Published - 1994	181A-M
UL 181B	I	Pressure Sensitive Tapes For Use With Flexible Ducts	Published - 1995	181B-FX
UL 181B	II	Mastic Closure Systems For Use With Flexible Ducts	Proposed - 1995	181B-M

The new requirements provide evaluation criteria that equals or exceeds the air duct joint requirements in the UL Standard for Factory-Made Air Ducts and Connectors, UL 181, and permit the use of any UL Listed 181A or 181B closure system with any duct type specified in accordance with labeling for the closure system. The requirements include fire performance tests that evaluate flame propagation, duration of sustained flaming, dripping of flaming particles, and smoke developed properties of the systems. The adhesion and tensile strength of the joint closure systems are evaluated by conducting tensile joint strength, peel adhesion, shear adhesion, freeze/thaw, mold growth, and temperature/pressure cycling tests.

A Council member asked if there was a separate Standard for mastics for use on metallic duct. UL responded that requirements are being developed for UL 181B to evaluated mastics intended for use with Listed flexible metallic duct. It is anticipated that the title of the Standard will be changed, a corrosion resistance test will be added, and the marking information revised.

A Council member noted that metallic duct is non-flammable, and asked if UL will require mastics to be non-combustible when intended for metallic duct. Another Council member commented that certain jurisdictions permit only metallic duct and may be concerned about use of a material that has 25 flame spread and 50 smoke developed indices in the duct system. UL noted that juridical requirements to use only metallic duct exceed the requirements of NFPA 90A and 90B. UL's requirements are consistent with those in NFPA 90A and 90B and UL 181. However, mastic materials applied to a non-flammable surface may demonstrate flame spread and smoke developed indices considerably less than 25 and 50 respectively. If needed, UL could propose that the measured indices be included in the labeling for the product.

ACTION: UL to consider additional requirements for mastics used with metallic duct.