UL 217, 268 and NFPA 72

California Office of the State Fire Marshal
Smoke Alarm Task Force
February 16 & 17, 2011

Underwriters Laboratories Inc.
## Smoke Alarms and Detectors: Test Standards, Codes, & Certification

### Alarm and Detector Placement
- Specified in NFPA 72 “National Fire Alarm Code”

### Alarm and Detector Performance
- Specified in UL 217 and 268
- ANSI Consensus maintained test standards (UL is the administrator)
- Originally developed by a joint collaboration between NIST (NBS), UL, and the Life Safety industry

### Alarm and Detector Certification Testing
- Initial compliance testing is conducted by UL
- UL follow-up service verifies compliance of subsequently produced units

### Alarm and Detector Usage
- CA BML: UL 217/268 compliant & follow-up service
Smoke Alarm/Detector Placement

NFPA 72 “National Fire Alarm Code” specifies detector placement

- basement
- garage
- bedroom
- hall
- bedroom
- kitchen
- living room
NFPA 72 – 2010 Placement

• Every bedroom
• Within 21 ft of each sleeping area
• Every floor, including basements but not crawl spaces
• No alarms within 10 ft of fixed cooking appliance
  • Alarms 10-20 ft are required to have a hush feature or be photoelectric
  • Photoelectric can be installed within 6 ft if certain additional requirements are met
• Cannot install within 36 inch of:
  • Bathroom door for tub/shower
  • Air handling register
  • Ceiling fan blade
• Additionally for areas greater than 1,000 ft², no further apart than 30 ft/
one per 500 ft²
UL 217 & 268 Standards

UL 217 Single and Multiple Station Smoke Alarms

UL 268 Smoke Detectors for Fire Alarm Systems

STP includes 40 voting members and 3 non-voting members
• 7 AHJs
• 13 Producers
• 6 Testing & Standards (inc. UL)
• 11 General
• 3 Consumer and Government
UL 217/268 Sensitivity Test

(UL 217 Sec. 37, UL 268 Sec. 30)
Performance limits are 0.5 – 4.0 %/ft obscuration
UL 217/268 Fire Test Room

(UL 217 Sec. 44 & 45, UL 268 Sec. 38-40)
UL 217/268 Fire Test Room Schematic
UL 217/268 Fire Test Room Tests

Flaming Test A: Paper fire

Flaming Test B: Wood fire

Flaming Test C: Flammable liquid fire

Smoldering Test: Ponderosa pine
UL 217/268 Flaming Fire Tests

- **Flammable liquid fire**
- **Wood fire**
- **Paper fire**

Must activate within 240 seconds
UL 217/268 Smoldering Test

Must activate between 0.5 and 10 %/ft obscuration
Fire Formula of Modern Homes

- Faster fire propagation
- Rapid changes in fire dynamics
- Shorter escape times
- Shorter time to flashover
- Shorter time to collapse

Larger Homes + Open Spaces + Inc. Fuel Loads =
Void Spaces + Changing Bldg Materials
Room Furnishing Effect on Fire Growth
(www.ul.com/fireservice)
# Dunes I and II: Escape Time Differences

## Flaming Fire Scenarios

<table>
<thead>
<tr>
<th></th>
<th>Alarm Times</th>
<th>Tenability Times</th>
<th>“Escape” Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunes I</td>
<td>140 ± 94 s</td>
<td>1043 ± 365 s</td>
<td>903 s</td>
</tr>
<tr>
<td>Dunes II</td>
<td>43 ± 20 s</td>
<td>169 ± 37 s</td>
<td>126 s</td>
</tr>
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</table>

⇒ Shorter escape times in Dunes II study attributed to significantly faster fire growth rates.

## Smoldering Fire Scenarios

<table>
<thead>
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<th>Tenability Times</th>
<th>“Escape” Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunes I</td>
<td>1790 ± 1163 s</td>
<td>4146 ± 1961 s</td>
<td>2356 s</td>
</tr>
<tr>
<td>Dunes II</td>
<td>1983 ± 894 s</td>
<td>3303 ± 1512 s</td>
<td>1320 s</td>
</tr>
</tbody>
</table>

⇒ Smoldering times are statistically the same.
Follow-Up Activities

Safety focused goal:

**Increase available egress time to non-specific fires.**

Potential solutions must be:
- Performance-based and **not** technology-based
- Open to existing, refined, and innovative methods
Increasing Available Egress Time

How can the available egress time for a non-specific fire be increased?

Reduce fire risk and growth rate
1. Reduce room content.
   • Fewer ignitable items
   • Less fuel

Food for thought
Can “spring cleaning” save lives?
Increasing Available Egress Time

How can the available egress time for a non-specific fire be increased?

Reduce fire risk and growth rate
1. Reduce room content.
2. Reduce flammability of room contents.

⇒ UL-FPRF Smoke Characterization Project demonstrated synthetic materials burn more intensely and produce greater amounts of smoke than cellulosic materials. The report can be used as guide for materials developers to reduce product flammability:
   • Material data generated
   • Test methods developed
Increasing Available Egress Time

How can the available egress time for a non-specific fire be increased?

Reduce fire risk and growth rate
1. Reduce room content.
2. Reduce room content flammability.

Alert occupants earlier
1. Improve effectiveness of alarm alerting signal.
   • Hearing impaired, Children, College students

⇒ R& D efforts worldwide in light, sound, voice, vibration alarm modes
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2. Earlier alarm activation.
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1. Improve effectiveness of alarm alerting signal.
2. Earlier alarm activation.
3. Expand alarm responsiveness to other smoke signatures.
Earlier Alarm Activation

UL-FPRF Smoke Characterization Study
- Alarm technology sensitivity varies for different types of smoke.
  - Ionization alarms triggered earlier for flaming fires
  - Photo alarms triggered earlier for non-flaming fires

Goal
Performance-based solutions may include:
- Single combination technology unit
- Multiple single technology units
- Different technologies that exhibit comparable performance

Formation of STP Task Group for Multi-Criteria
Expand Alarm Responsiveness

UL 217 STP Task Group formed

Goal
Expand UL 217 flaming and smoldering tests to include materials that generate smoke with characteristics outside of the current range of tests.

Rationale
• Expand range of smoke particle sizes currently tested.
• Synthetic materials generate greater heat and smoke release rates than natural materials.
• Prevalence of material in residential settings.
Why Polyurethane Foam?

From the Smoke Characterization Project –

• Fast ignition
• Generate greater heat and smoke release rates than natural materials
• Generate smaller sized particles than most UL 217 test materials
• Produce accumulated smoke comprised of smaller particles than for the UL 217 test materials
• Produce darker color smoke than UL 217 newspaper or wood

Prevalence in residential settings (mattresses, upholstered furniture, etc.)
UL 217/268 Fire Test Room Tests: Flaming test smoke color

Heptane-Toluene
Newspaper
PU Foam
Doug Fire crib
PU foam w/cotton-poly

UL-FPRF Smoke Characterization Project (2007)
UL 217/268 Fire Test Room Tests: Smoldering test smoke color

UL-FPRF Smoke Characterization Project (2007)

Ponderosa Pine

PU Foam
Foam Fire Test Scenario Development

Task Objectives:
- Develop flaming and smoldering foam test scenarios.
- Investigate influence of scenario variables on combustion products.

Sample

Chemistry

Density

Size

Shape

Smoke build-up rate and level

Heating

Mode

Exposure
Expand Alarm Responsiveness – Flaming Fire

Material: UL 1626 “Residential Sprinkler” foam

- Density: 1.70 to 1.90 lb/ft\(^3\) (27.2 to 30.4 kg/m\(^3\))
- PHRR: 230 ±50 kW/m\(^2\)
- HOC: 22 ±3 kJ/g
- Others: being determined

Test Sample: 14.6×14.6×3 inch square
Ignition: 5 mL of isopropanol at corner
Height: Floor level (insulated)
Expand Alarm Responsiveness – Self-Sustained Smoldering Fire Test

**Materials**
Foam: Material: UL 1626 “Residential Sprinkler” foam  
Fabric: Polyester microsuede

**Cushion Sizes**
- Seat: 18 × 6 × 4 inches (l,d,th)  
- Back: 18 × 9 × 4 inches (l,h,th)

**Heat Source**
- 200W cartridge heater  
- ¼ inch diameter  
- 4 inch long  
- 18 minutes
Reduction of Disabled Alarms

UL 217 STP Task Group formed

Goal
Evaluate cooking scenarios to determine if a repeatable test(s) can be created to reduce unwanted alarm activation.

Rationale
Fewer unwanted alarms will reduce the number of alarms that permanently disabled.
CA OSFM Smoke Alarm Task Force
UL 217 & 268, NFPA 72

THANK YOU