Fault Isolators

CFAA Technical Seminar

Stephen Ames  October 30, 2013
Field Device Fault Isolation

- Field Device Fault Isolators when required are detailed in CAN/ULC-S524-06
  - When a data loop serves more than one floor area, a fault within one floor area shall not affect normal operation of devices in another floor area
Field Device Fault Isolation

• Active or supporting field devices serving duct smoke detectors and sprinkler alarm and supervisory switches located within a floor that serves other floors do not need to be separately isolated

• Where fire separations exist, fault isolators shall mount on each side of the separation

• When mounted on opposite sides of the same fire separation isolators shall be offset horizontally to a minimum of 400mm and not be mounted in the same stud space
Field Device Fault Isolation

• In a large open floor plan like Warehouse or Shopping Mall where no fire separation exists between an NBC fire zone a only a single isolator is required

• Where an isolator connects to a single device in an exit or vertical service space it is only required on the floor side area
Isolation location between fire alarm zones

- **Fault Isolation Module**
- **Addressable Smoke Detector**
- **Addressable Heat Detector**
- **Supervised Valve / Monitor Device**
Field devices with internal isolator devices between fire alarm zones

- Addressable Smoke Detector with Isolator
- Addressable Heat Detector
- Supervised Valve / Monitor Device
Isolator locations for a large open area

Zone 1
Zone 2
Zone 3
Zone 4

Fault Isolation Module
Addressable Smoke Detector
Addressable Heat Detector
Isolators for sprinkler risers and duct-type smoke detectors

Zone 1

Zone 2
Sprinkler Room

Zone 3

Zone 4

Zone 5

Zone 6
Zone 7
Zone 8
(Not Separately Fault Isolated)

Zone 9

Zone 10

Fault Isolation Module
Addressable Smoke Detector
Addressable Heat Detector
Supervised Valve / Monitor Device
Duct Smoke Detector

SYSTEM SENSOR
8
Active and supporting field devices connected to data communication (Link Style A)

Addressable Smoke Detector
Addressable Heat Detector
Supervised Valve / Monitor Device
Addressable Manual Station
Exhaust Damper
End of Line Relay
CTL Addressable Control Device

Addressable Loop 2
Addressable Loop 1
Active and supporting field devices connected to data communication (Link Style B)

- **Addressable Smoke Detector**
- **Addressable Heat Detector**
- **Supervised Valve / Monitor Device**
- **Exhaust Damper**
- **Manual Station**
- **End of Line Relay**
- **Addressable Control Device**
Active and supporting field devices connected to data communication (DCLA)

- **Electrical Room**
  - Junction Box
  - ISO
  - Addressable Smoke Detector
  - Addressable Heat Detector

- **Typical Floor**
  - DCLB
  - Addressable Manual Station
  - Addressable Smoke Detector

- **Mechanical Room**
  - CTL
  - Addressable Control Device
  - End of Line Relay

- **Raceways**
  - Primary Raceway
  - DCLA Alternate Raceway

- **Modules**
  - Fault Isolation Module

- **Exhaust Devices**
  - Exhaust Damper
Installation of Fault Isolators for DCLA or DCLC

DCLA or DCLB
Alternate Wiring Raceway
or Cable Assembly

Control Unit or Transponder

Addressable Smoke Detector
Addressable Heat Detector
Addressable Manual Station

INCORRECT
Installation of Fault Isolators for DCLA or DCLC

DCLA or DCLC Alternate Wiring Raceway or Cable Assembly

Correct

Zone 1

Zone 2

Control Unit or Transponder

Addressable Smoke Detector

Addressable Heat Detector

Addressable Manual Station

Junction Box

System Sensor

Independent Fire Alarm Association
Fault Isolator Serving a Single Device in an Exit Stair
Suite Fault Isolators

• An option to comply with the NBC for the short circuit isolation of notification appliances
  – Shall be installed outside the suite protected by the device

• Two other ways to comply
  – Separate Class A notification circuit through the suite and Class B notification circuit in the corridor
  – Individual Class B notification circuit per suite
Application Requirements
Visual Signals (Strobes)

CFAA Technical Seminar

Stephen Ames  October 30, 2013
Presentation Outline

• Why we need strobes
• Legislative Codes and Standards
• Technical and application issues
• Design to meet application needs
• Issues affecting fire alarm system design
• Strobe light units
• Combination strobe and audible signal
• Selectable strobe outputs for versatility
Fire Alarm Strobe Lights

• Why we need strobes

• Strobes are used to supplement audible alarm signals in:
  – Areas where ambient sound levels are too high to hear alarm signal reliably
  – Areas where the occupants may have a hearing impairment
  – Areas where ear protection is worn
  – Special areas such as acoustical enclosures
Legislative Codes and Standards

• National Building Code 2010 – NBC
• Provincial Building Codes
  – Ontario Building Codes 2012 – OBC
  – Other Provincial Codes and Municipal Codes – with various additions
• ADA – Americans with Disabilities Act
2010 National Building Code

• Remains virtually unchanged from 2005 NBC
  – Where ambient sound levels exceed 87 dB
  – Where ear protection is worn
  – Sound insulated or audiometric booths
  – Performance areas where sound may exceed 100 dB
  – Building or portions of a building for persons with hearing impairment
  – Minimum of 10% of rooms in hotel
2015 Proposed NBC Change

• Visual alarm devices need to operate continuously on voice systems during voice paging
• Hearing persons can hear the voice communication message and are not negatively impacted
• Hearing impaired do not know what is happening and turning off the strobes for any reason may delay their evacuation
Provincial Building Codes

• Provincial Codes are Based upon the NBC
  – Include changes and additions for visual signaling appliances - strobes
    • In Ontario the 2012 OBC includes significant requirements for strobes which are based on Occupancy Classification
    • In other provincial and municipal jurisdictions they have imposed additional requirements for inclusion of strobes in occupancies
      – Winnipeg – New requirements as of Jan 1/ 2013
      – Montreal – high-rise residential in-suite requirements
2012 Ontario Building Code

• Includes all of the requirements of the NBC
• Plus additional requirements for
  – Installation of Strobes in Public Corridors for
    • B occupancy – Health Care
    • D occupancy – Office
    • E occupancy – Mercantile
  – Strobes in corridors used by public and floor areas where public may congregate for
    • A occupancy - Assembly
2012 Ontario Building Code

• Exceptions for use of Strobes
  – Strobes permitted in lieu of audible signals in compartments including operating rooms and recovery areas such as ICU and CCU
  – Not required:
    • in classrooms (A Occupancy)
    • Group B Div 3 care occupancy for up to 10 persons
    • In C Occupancies – residential

  *This is the one occupancy where occupants are most likely to be on their own*
ADA Requirements

• No legislative requirements in Canada
• Some US based companies require their leased premises to meet ADA
• Standards for Barrier Free Design of Ontario Government facilities includes regulations requiring a minimum of 75 candela visual signals
• ADA Requirements are the most onerous
  – Strobes are required in “common use” areas including corridors, lobbies, washrooms, meeting rooms, etc.
  – Minimum intensity of 75 candela (OBC is 15)
Codes and Standards

• ULC S 524 -06 provides installation requirements for strobes in Canada

• Additional guidance for strobe application for large volume open spaces can be found in NFPA 72

• Strobes for meeting ADA must be based upon the ADA guidelines
CAN/ULC-S526-07
Visible Signal Standard

• The standard covers requirements for visible signal devices for use in accordance with CAN/ULC-S524

• Performance tests to determine;
  – Horizontal and vertical light dispersion
  – Verify flash rate between 1 and 2 flashes per second
  – Synchronization feature to flash within 0.01 s for 2 hours
CAN/ULC-S526-07
Horizontal Dispersion

<table>
<thead>
<tr>
<th>Degrees</th>
<th>% Rating</th>
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<tbody>
<tr>
<td>0</td>
<td>100%</td>
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<tr>
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<td>30 - 45</td>
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</tr>
<tr>
<td>90</td>
<td>25</td>
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<tr>
<td>Compound 45</td>
<td>24</td>
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</table>

Top view

Wall
CAN/ULC-S526-07
Vertical Dispersion

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Rating</th>
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<tbody>
<tr>
<td>0</td>
<td>100%</td>
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<tr>
<td>5 - 30</td>
<td>90</td>
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<td>80</td>
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</tr>
<tr>
<td>85</td>
<td>12</td>
</tr>
<tr>
<td>90</td>
<td>12</td>
</tr>
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</table>
### CAN/ULC-S526-07 Vertical Dispersion Ceiling-Mount

<table>
<thead>
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<th>Degrees (%)</th>
<th>Rating</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>5 - 25</td>
<td>90</td>
</tr>
<tr>
<td>30 - 45</td>
<td>75</td>
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<td>50</td>
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<tr>
<td>85</td>
<td>25</td>
</tr>
<tr>
<td>90</td>
<td>25</td>
</tr>
</tbody>
</table>

![Side view diagram](image)

- **Ceiling**
- **Side view**
- **0°**
- **45°**
- **90°**
Polar Light Distribution

- Light distribution on both the vertical and horizontal plane
Design and Application
Strobe Application

• When designing strobe layouts, the following elements are critical
  – Line of sight from strobe to occupants
  – Minimum rating of 15 candela
  – Where occupants can see two or more strobes, their operation must be synchronized
  – Mounting arrangement
    • Ceiling – 360° coverage, less than 9 m high, overlap
    • Wall – where more than 1 strobe required, divide room into squares and locate strobes in a offset manner
Strobe Application

• Coverage for corridors **not** wider than 6 m
  
  – Strobe must be located no more than 4.6 m from end of corridor
  
  – Additional strobes placed not more than 30 m apart
  
  – If viewing path interrupted by a door, treat as a separate corridor with additional strobes
  
  – Requirements based upon 15 Candela strobes
# Corridor Spacing For Ceiling or Wall Mounted Visible Signal Devices

<table>
<thead>
<tr>
<th>Corridor Length (m)</th>
<th>Minimum Number of 15cd Strobes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>1</td>
</tr>
<tr>
<td>10 - 40</td>
<td>2</td>
</tr>
<tr>
<td>41 - 70</td>
<td>3</td>
</tr>
<tr>
<td>71 - 100</td>
<td>4</td>
</tr>
<tr>
<td>101 - 130</td>
<td>5</td>
</tr>
<tr>
<td>131 - 160</td>
<td>6</td>
</tr>
</tbody>
</table>
Corridor Examples

39 meter corridor

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4.5m

30m

4.5m

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20 m

---
Corridor Examples

25 Story High Rise

• Typical Commercial Floor
  – Six 15cd strobes or speaker/strobes
• 350 to 400mA total current
• 10 amps of additional power supply
• 20 A/H of additional battery power
Strobe Application

• Strobe Coverage for Area Application (including corridors wider than 6 m)

• Strobes can be wall or ceiling mounted
  – For ceiling mounting refer to table in ULC S524 which provides the area of coverage for each strobe.
  – Number of strobes needed is based upon candela rating, ceiling height and the area to be covered
  – For instance a 15 candela strobe will cover an area of 6.1 m × 6.1 m on a 3 m ceiling, while a 60 candela strobe will cover an area of 12.2 × 12.2 on a 3m ceiling
    • We use less strobes, but with 4 times the rating we use about 3 times the current. For room 12.2 × 12.2, need 4 - 15 candela strobes
Strobe Application

• For wall mounting strobe
  - Locate on wall from 2 m to 2.4 m above floor
  - In square rooms center at the mid point on the wall if coverage possible with one strobe
  - When multiple strobes used, divide area into multiple squares representing area covered and offset strobes for best coverage
  - A design utilizing strobes with different candela may provide lower power consumption, but will require greater diligence by contractor and verifier
Strobe Power Requirements

• Strobes have significant power requirements which affect panel space, power supplies and battery back up

• Manufacturers of fire alarm systems can pick from a number of different equipment solutions when designing systems
  – Include all of the equipment in the panel or transponder or
  – Provide booster power/control units which are field mounted and wired to panel or transponder for supervision and activation
Strobe Power Requirements

• Typical strobe candela and the power requirements (will vary depending on manufacturer)

<table>
<thead>
<tr>
<th>Candela</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>66</td>
</tr>
<tr>
<td>30</td>
<td>94</td>
</tr>
<tr>
<td>75</td>
<td>158</td>
</tr>
<tr>
<td>95</td>
<td>181</td>
</tr>
<tr>
<td>115</td>
<td>210</td>
</tr>
<tr>
<td>135</td>
<td>228</td>
</tr>
<tr>
<td>185</td>
<td>286</td>
</tr>
</tbody>
</table>

• Using all 75 candela strobes you could get a maximum of 12 on a 2 amp circuit (watch for rating v/s voltage)

• For coverage by area you typically will need more strobes than you would need speakers
Room Spacing
Examples from CAN/ULC-S524-06 Table 5

<table>
<thead>
<tr>
<th>Max. Room Size (m)</th>
<th>1 Light per Area</th>
<th>2 Lights per Area</th>
<th>4 Lights per Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.10 x 6.10</td>
<td>15</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>8.53 x 8.53</td>
<td>30</td>
<td>15</td>
<td>N/A</td>
</tr>
<tr>
<td>12.2 x 12.2</td>
<td>60</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>13.7 x 13.7</td>
<td>75</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>18.3 x 18.3</td>
<td>135</td>
<td>95</td>
<td>30</td>
</tr>
<tr>
<td>21.3 x 21.3</td>
<td>185</td>
<td>95</td>
<td>60</td>
</tr>
<tr>
<td>24.4 x 24.4</td>
<td>240</td>
<td>135</td>
<td>60</td>
</tr>
<tr>
<td>27.4 x 27.4</td>
<td>304</td>
<td>185</td>
<td>95</td>
</tr>
<tr>
<td>30.5 x 30.5</td>
<td>375</td>
<td>240</td>
<td>95</td>
</tr>
<tr>
<td>33.5 x 33.5</td>
<td>455</td>
<td>240</td>
<td>135</td>
</tr>
<tr>
<td>36.6 x 36.6</td>
<td>540</td>
<td>305</td>
<td>135</td>
</tr>
<tr>
<td>39.6 x 39.6</td>
<td>635</td>
<td>375</td>
<td>185</td>
</tr>
</tbody>
</table>
Wall Mount Visible Example

Application: 3m x 6m room

Solution:

15 candela strobe
Room Spacing Allocation - Incorrect

• Four 15 cd strobes in 12.2m x 12.2m room
Room Spacing Allocation - Correct

- CAN/ULC-S524-06 clause 5.4.5.8
  - Subdivide the room into multiple squares
  - Install four 15 candela appliances
Wall-Mount Strobe Example

**Application:** 13m x 26m room

**Solution:**
Divide the room into two 13m x 13m rooms

2 - 75 candela strobes
Wall-Mount Strobe Example

Application:
3m x 6m room

*Wall appliance not centered*

Solution: 8m x 8m room size
1 - 30 candela
## Room Spacing For Ceiling Mounted Visible Devices CAN/ULC-S524-06

### Minimum Required Light Output, Candela (cd)

(Effective Intensity)

<table>
<thead>
<tr>
<th>Max. Area Size (m)</th>
<th>Max. Mounting Height (m)</th>
<th>One Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.10 x 6.10</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>9.14 x 9.14</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>12.2 x 12.2</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>15.2 x 15.2</td>
<td>3</td>
<td>95</td>
</tr>
<tr>
<td>6.10 x 6.10</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>9.14 x 9.14</td>
<td>6</td>
<td>45</td>
</tr>
<tr>
<td>12.2 x 12.2</td>
<td>6</td>
<td>80</td>
</tr>
<tr>
<td>15.2 x 15.2</td>
<td>6</td>
<td>115</td>
</tr>
<tr>
<td>6.10 x 6.10</td>
<td>9</td>
<td>55</td>
</tr>
<tr>
<td>9.14 x 9.14</td>
<td>9</td>
<td>75</td>
</tr>
<tr>
<td>12.2 x 12.2</td>
<td>9</td>
<td>115</td>
</tr>
<tr>
<td>15.2 x 15.2</td>
<td>9</td>
<td>150</td>
</tr>
</tbody>
</table>
Ceiling-Mount Visible Example

Application: 6m x 6m room @ 3m ceiling height

*Ceiling appliance centered*

1 - 15 candela strobe
Ceiling-Mount Strobe Example

Application: 3m x 6m room
@ 3m ceiling height

*Ceiling appliance not centered*

- double distance to farthest wall to obtain maximum room size

Solution: 8m x 8m room
1 - 30 candela
Alternate Calculation Method

• New for proposed October 2013 CAN/ULC-S524
• Any design wall or ceiling that provides a minimum of 0.0375 lumens/ft² (0.4036 lumens/m²) of illumination at any point within the covered area shall be permitted in lieu of the prescriptive requirements in the standard.
Large Space Research Project

- Testing requirements that lead to NFPA 72 visual signaling requirements were limited to classroom and office type spaces.
- Tests were conducted in 2 Home Depots and 1 Walmart store.
- Tests were carried out with ceiling mounted strobes (~23’ in Home Depot and 9’ in Walmart)
Large Space Research Project

• Research indicated strobes should be placed over isles, especially those that are likely to remain unchanged such as main isles and checkout stands.
• Designers should take steps to minimize blind spots and to anticipate rack and isle changes.
• Installing technicians need to understand the spacing rules and field modify the installation to prevent appliances from being blocked.
• Design guidelines are now published in NFPA 72 Annex A
Products

• Significant advancements in product design
  – Specific wall and ceiling models (indoor & outdoor)
  – Strobes, horn/strobes, chime strobes and speaker/strobes
  – Multicandela models in standard (15, 15/75, 30, 75, 95 and 110 cd) and high candela models (135, 150, 177, 185)
  – Visible intensity without removing device
  – 2 and 4 wire models
Products Cont’d

• Lower current draw
  – Power supply and battery savings
  – Smaller wire size, more devices per circuit, longer runs

• Synchronization Modules

• Panels with built-in synch protocols

• Booster power supplies (some with built-in synch protocols)
Specification and Application Tools

– Written engineering specifications
– CAD drawings of products
– Data sheets
– Web or CD based voltage drop calculator
– Web or CD based equivalent facilitation tool
Voltage Drops

• All wire has internal resistance. Over a distance this resistance will reduce the amount of voltage available to power notification appliances.

• All appliances have a minimum operating voltage rating—the point at which the device stops functioning.
Voltage Drops

• The challenge to system designers is to size wiring to ensure full functioning of appliances under all worst case voltage conditions for the fire alarm panel and A/V devices.
  – In other words, appliances have to function at 20.4 VDC (ULC defined, panel low battery condition)
  – and even as low as 16 VDC (ULC defined minimum current for A/V devices)
Voltage Drops

• In order for an appliance installed at the end of a typical notification circuit to function when the control panel approaches low battery (20.4 VDC), the appliance would have to operate at lower than 20.4, say as low as 16 volts.

• The calculations required to derive the proper wiring size are made easy by voltage drop calculators designed by equipment manufacturers.
In Conclusion

• A growing percentage of the population relies on visual clues to alert them to emergencies.

• To be effective a visual signal, or its reflection from adjacent walls, must be intense enough to raise the overall light level sharply.

• Designers need to clearly detail placement (including exact mounting height) and candela setting for plans reviewers, installers and verifiers.
Thank You