Strobe Application Guide

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1 FOREWARD

Up to 10 percent of our population suffers from a significant hearing loss. Awareness of these hearing and other disabilities is improving. Employers and owners of commercial and public enterprises are now recognizing our large population of disabled persons.

Edwards Systems Technology was the first fire alarm systems manufacturer to introduce a full line of system-compatible strobe signals that meet or exceed the needs of most hearing impaired persons. In the truest sense of Life Safety, our fire alarm systems are striving to serve the needs of all, not just the needs of most. Effective application of strobe signals goes a long way toward reaching this goal.

While strobe signals have long been a part of most fire alarm systems as mainly optional devices, local, national and international authorities are increasingly identifying them as essential equipment. Legislation such as the U.S. Americans with Disabilities Act, which became effective in January 1992, has established explicit legal requirements for high quality strobes. Supplementary strobe research has identified and qualified some very specific performance standards, as seen in the recent UL 1971 Standard for Signaling Devices for the Hearing Impaired.

Effectiveness is now clearly a major concern. Authorities, including the National Fire Protection Association, have recognized that the minimal standards of the past are no longer effective or acceptable. This is reflected in the 1993 edition of ANSI/NFPA 72 where Chapter 6 makes reference to UL 1971 listed visible notification appliances. Edwards Systems Technology encourages all owners, consultants and specifiers to carefully consider their long-term needs by incorporating our UL 1971 listed strobes into their fire alarm systems. Required already in many jurisdictions, they meet or exceed current regulations in effect across the United States and Canada.

Our strobe Application Guide will help you to successfully apply EST strobes to your new construction and renovation projects. This handbook provides a concise summary of basic guidelines normally followed when recommending strobe signals for fire alarm applications.

The following standards, codes and guides are referenced in this document and should be used to supplement information contained herein.

• ANSI/NFPA 72 National Fire Alarm Code
• UL 1971 Standard for Signaling Devices for the Hearing Impaired
• UL 1638 Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
• ANSI A117.1 1992 Standard for Accessible and Useable Buildings and Facilities
• ADA (AG) Americans with Disabilities Act Accessibility Guidelines
• CAN/ULC-S526 Visual Signal Appliances for Fire Alarm Systems
• UL 464 Audible Signal Appliances
• CAN/ULC-S525 Audible Signal Appliances for Fire Alarm Systems
A U.S. Government Bulletin from December 1992 has been reproduced in Appendix A of this guide to provide supplemental ADA information that may be of interest. See Section 2.5 in this guide for a summary of NFPA 72 strobe requirements.

It is EST's intention to keep product information current and accurate. We cannot cover specific applications or anticipate all requirements. All specifications are subject to change without notice.
2 APPLICATION NOTES

2.1 STROBE CODES and STANDARDS COMPARISON TABLE

<table>
<thead>
<tr>
<th>Description Requirement</th>
<th>NFPA 72</th>
<th>ANSI 117.1</th>
<th>UL 1971</th>
<th>ADA</th>
<th>UL 1638</th>
<th>ULC S526</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Intensity - Corridors</td>
<td></td>
<td>15 cd</td>
<td></td>
<td>75 cd</td>
<td>Private Mode Only</td>
<td>2 cd</td>
</tr>
<tr>
<td>Minimum Intensity - Non-Sleeping Rooms</td>
<td>110 cd (wall mount)</td>
<td>177 cd (ceiling mount)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Distance: Strobe Observer</td>
<td>corridor = 100 ft.</td>
<td>sleeping room = 16 ft. @ 110 cd</td>
<td></td>
<td>100 ft.</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Flash Frequency - Hz</td>
<td>1/3 to 3</td>
<td>1 to 3</td>
<td></td>
<td>1/3 to 3</td>
<td>1 to 3 +/−20%</td>
<td></td>
</tr>
<tr>
<td>Wall mounting (Sleeping)</td>
<td>24” below ceiling</td>
<td></td>
<td>Lower of either: (a) 80” above floor-or (b) 6” below ceiling</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Wall mounting (non-sleeping)</td>
<td>80” to 96” above floor</td>
<td></td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

2.2 STROBE CURRENT CHARACTERISTICS

EST strobes are specifically designed and approved for use with EST manufactured fire alarm systems with both regulated and non-regulated power supplies. They are compatibility tested and listed for use with our panels by both UL and ULC.

Strobes inherently put more demand on fire alarm system signal circuits than typical signaling appliances. Wrong assumptions relative to average current, peak current and inrush current are often made.

One should be aware of the different current draw characteristics of strobe products. We offer the following information:

**INRUSH CURRENT:** Inrush current is caused by the initial charging of the 'empty' energy storage capacitor in the strobe. Inrush current is short in duration and is a factor to consider when using power supplies with high speed electronic fold back circuits or fast acting fuses.

**PEAK CURRENT:** Peak current is the maximum current the strobe will draw while operating. The peak current value MUST be used to determine wire size and system power supply capacity. Failure to use peak current when calculating circuit requirements may result in abnormal operation such as decreased flash rate and/or output.

**AVERAGE CURRENT:** Average current is the mathematical average of the peak current pulses. This is the current you would read with a typical ammeter. Average current is used when determining system battery backup power supply requirements.
2.3 PHOTOSENSITIVE EPILEPSY

The photosensitivity (affect from flashing light) concerns are legitimate. EST fire alarm strobes produce white light flashes at a frequency of 1 Hz to minimize risk to the general public. EST closely monitors ongoing research into the effects of multiple unsynchronized strobes and we commit to any application design changes that these studies warrant.

In August of 1993, representatives from the following groups convened to review the existing performance/installation requirements for visual signaling appliances as they impact people with photosensitive epilepsy.

Epilepsy Foundation of Greater Chicago  
National Association of the Deaf  
National Electrical Manufacturers Association  
ANSI A117.1 Committee  
NFPA, Chapter 6 Committee  
Underwriters Laboratories Inc.

A summary of the issues pertinent to photosensitive epilepsy follows.

Statistics show 6 percent of people with epilepsy react to flashing light (photosensitive response). Expert opinions suggest the actual percentage is probably significantly higher.

Two factors identified as contributing to the onset of a seizure are light intensity and flash rate. The color of the light is a minor contributor. Avoid flash rates in the range of 16 -18 Hz. Keep flash rates to an absolute minimum. There is no frequency which would completely protect everyone with epilepsy. The current US and Canadian public mode strobe standards require flash rates between 1/3 and 3 flashes per second.

It is recommended that 15 candela be the top effective flash intensity in an awake situation and 1/3 Hz to 1 Hz be the range for a single strobe bulb. There should be with no more than 5 Hz exposure to a person in rooms with multiple strobe bulbs. However, there presently is no quantitative data available on how intensity actually contributes in triggering a seizure.

The length of time of exposure is also an important factor and should be the least time possible.
2.4 SINGLE STROBE vs. MULTIPLE STROBES

The ADA bulletin in Appendix A "strongly discourages" the practice of employing many poor quality low intensity strobes for the purpose of fire alarm signaling. The reasons for this are the photosensitivity concerns as noted above and the marked decrease in effectiveness. EST strongly agrees with this position. We recommend only high quality NFPA 72 compliant UL 1971 listed strobes.

The issue of whether or not to have one single, and in some cases very large, strobe merits further discussion. In the most extreme case presented in this Guide, four 110 cd strobes are recommended for a 100’ x 100’ (30.5 m x 30.5 m) area. Four strobes is not a great quantity at all for an area that large. In other cases we have specifically recommended using lower quantities of 110 cd strobes in the place of many 15 cd strobes.

The question of whether or not to apply strobes of an even greater intensity than 110 cd illustrates several practical limitations of fire alarm systems. Single, larger strobes require significantly greater power and should that one strobe malfunction, the public could be left without any visible signaling. For economical reasons we believe the 110 cd strobe to be more than adequate to its task.

2.5 NFPA 72 - STROBE REQUIREMENTS SUMMARY

The following information is extracted from NFPA 72 Chapter 6, 1993 Edition. There are many reference figures and tables in Chapter 6 which should be used along with this guide. Section 3 - APPLICATION GUIDES of this document is based on information in NFPA 72 Chapter 6, 1993 Edition.

NFPA 72 Chapter 6 classifies visible notification signals for fire alarm systems for various uses and purposes. EST strobe products meet the criteria for these three:

**General/Notification** - Visible signals used for alerting the general public or specific individuals responsible for implementation and direction of emergency action.

**Operating Mode, Private** - Visible signaling only to those persons directly concerned with the implementation and direction of emergency action initiation and procedure in the area protected by the fire alarm system.

**Operating Mode, Public** - Visible signaling to occupants or inhabitants of the area protected by the fire alarm system.
2.5.1 VISIBLE SIGNAL CHARACTERISTICS, PUBLIC MODE

NFPA 72 specifies - One method of determining compliance with the section (Section 6.4) of NFPA 72 is that the product be listed in accordance with UL 1971, Signaling Devices for the Hearing Impaired.

Note RE: High Noise Areas - An average sound level greater than 115 dBA shall require the use of a visible signal appliance(s).

There are two methods of visible signaling: the message of notification of an emergency condition is conveyed by direct viewing of the illuminating appliance (as with EST Strobes) or; by means of illumination of the surrounding area.

Light Pulse Characteristics

The flash rate shall not exceed three flashes per second (180 Hz) nor be less than one flash every three seconds (1/3 Hz). A maximum pulse duration shall be two-tenths (0.2 sec) of one second with a maximum duty cycle of 40 per cent. The pulse duration is defined as the time interval between initial and final pints of 10 per cent of maximum signal. The light source shall be clear or nominal white and shall not exceed 1,000 candela (cd) (effective intensity).

Effective Intensity

The conventional method of equating the brightness of a flashing light to that of a steady burning light, as seen by a human observer. The units of effective intensity are expressed in candela (cd). For example, a flashing light which has an effective intensity of 15 candela (cd) has the same apparent brightness to an observer as a 15 candela (cd) steady burning light source.

Appliance Location

Visible notification appliances used in the public mode shall be located so that the operating effect of the appliance can be seen by the intended viewers and shall be of a type, size, intensity and number so that the viewer can discern when they have been illuminated, regardless of the viewer’s orientation. A minimum of one appliance shall be installed in the concentrated viewing path such as might be experienced in such areas as classrooms, theater stages etc.

Wall-mounted appliances shall have their bottoms at heights above the finished floor of not less than 80 in. (2 m) and no greater than 96 in. (2.4 m). A maximum separation between appliances shall not exceed 100 ft. (30 m). Spacing shall be in accordance with NFPA 72 Figure 6-4.4.1 and Tables 6-4.4.1 (a) and (b).
The location of ceiling-mounted appliances is dependent on the rated effective intensity, ceiling height and room size. See NFPA 72 Table 6-4.4.1 (b). See also Sleeping Areas, below.

**Corridors**

The visible appliances shall be rated not less than 15 cd.

The visible appliances shall be located no more than 15 ft (4.57 m) from the end of the corridor with a separation no greater than 100 ft (30.4 m) between appliances. When there is an interruption of the concentrated viewing path, such as a fire door, an elevation change, or any other obstruction, the area shall be considered as a separate corridor.

For corridors not exceeding 20 ft. (6.1 m) wide, see NFPA 72 Table 6-4.4.2. For corridors greater than 20 ft. (6.1 m) wide, refer to Figure 6-4.4.1 and Tables 6-4.4.1 (a) and (b).

**Sleeping Areas**

The visible notification appliance shall be located within 16 ft. (4.87 m) of the pillow. Wall mounted appliances shall be no closer than 24 inches (610 mm) to the ceiling and shall be rated not less than 110 cd. Appliances mounted on the wall closer than 24 inches (610 mm) to the ceiling or on the ceiling shall be rated not less than 177 cd.

**Non-sleeping Rooms**

The visible appliances shall be rated not less than 15 cd and a maximum appliance separation of 100 feet (30 m) is allowed.

If a room configuration is not square, the square room size that will entirely encompass the room or subdivide the room into multiple squares shall be used. In square rooms with appliances not centered or non-square rooms, the effective intensity (cd) from one visible signaling appliance shall be determined by Maximum Room Size dimensions obtained as follows (a) the distance to the furthest wall or (b) double the distance to the furthest adjacent wall, whichever is greater. Refer to NFPA 72 Figure A-6-4.4.1 (a).

Areas so large that they exceed the rectangular dimensions given in the NFPA Figures require additional appliances. Often, proper placement of appliances can be facilitated by breaking down the area into multiple squares and dimensions that fit most appropriately. For example, an area 50 ft (15.2 m) wide and 95 ft (28.9 m) long can be covered with two 110 cd appliances. Irregular areas will take more careful planning to make sure that at least one 15 cd appliance is installed per 20 ft by 20 ft (6.09 m by 6.09 m) room.
2.5.2 VISIBLE SIGNAL CHARACTERISTICS, PRIVATE MODE

Visible signals used in the private mode shall be adequate for their intended purpose. See UL standard 1638 - Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling.

2.5.3 COMBINATION AUDIBLE/VISIBLE SIGNALS

Where audible/visible appliances are installed, the height of the installed appliance shall be as that of strobe only product locations. Combination audible/visible appliances installed in sleeping areas shall comply with Sleeping Areas above. EXCEPTION: Where the combination audible/visible appliance serves as an integral part of the smoke detector, the mounting location shall be in accordance with NFPA 72 Chapter 2.
3 APPLICATION GUIDES

EST recommends that visible signal appliances always be installed in accordance with the latest recognized edition of national and local fire alarm codes.

This chapter details the information that is of concern to building owners, engineers and contractors - How should strobes be installed in a fire alarm system? How many? What type? and Where?

Sample room and building diagrams are included, along with technical specifications.

The Appendices at the end of this guide provide supplemental information to some strobe application regulations including ADA and UL 1971. EST strobe engineering and performance specifications can be found in Appendix C. A helpful product selection chart based on only a few of the strobe products available from EST is included in Appendix D.

Edwards Systems Technology recognizes that the following guidelines may differ from the current standards and practices in some jurisdictions. We recommend, however, that wherever possible you follow the application information herein to help ensure maximum safety. EST products listed to UL 1971 meet or exceed the needs of most hearing impaired persons if properly applied and are designed to comply with or exceed the following standards and regulations:

• ANSI/NFPA 72 National Fire Alarm Code
• UL 1971 Standard for Signaling Devices for the Hearing Impaired
• UL 1638 Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
• ADA (AG) - Americans with Disabilities Act Accessibility Guidelines
• ULC S526 - Visual Signal Appliances for Fire Alarm Systems
• UL 464 - Audible Signal Appliances
• ULC S525 - Audible Signal Appliances for Fire Alarm Systems
• ULC S524 - Standard for the Installation of Fire Alarm Systems

NOTE: Audible signal applications vary widely and at all times must be considered along with visible signal requirements to determine exact signal appliance needs. Combination audible/visible signaling appliances are available from EST and should be used wherever possible.
3.1 STROBE LOCATION -- CORRIDORS

**Use EST Model 7A (15 cd) Strobes - Wall or Ceiling Mount**

**Note:** Audible signal appliances vary widely and require a separate engineering analysis to determine exact audible signal appliance needs. Combination audible/visible signaling appliances are available from EST.

**Reference NFPA 72-1993 Chapter 6**

1) The following guidelines apply to corridors up to 20 feet (6.1 m) wide. For any corridor area which exceeds 20 feet (6.1 m) in width (e.g. lobby areas), separate the area away from the rest of the corridor and use the guidelines for single room applications (see Section 3.3).

2) Strobes may be installed up to 15 ft (4.57 m) from the end wall of a corridor. If the corridor exceeds 30 ft (9.15 m) in length at least two strobes are required. See table 3.1 (a).

3) The maximum spacing between strobes is 100 ft (30.5 m).

4) For long corridors, alternate the strobes from one side to the other along the entire length. Minimum quantities are listed below.

<table>
<thead>
<tr>
<th>Corridor Length ft (m)</th>
<th>Minimum Number of 15 cd Visible Appliances Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 30 (0 - 9.1)</td>
<td>1</td>
</tr>
<tr>
<td>31-131 (9.2 - 39.5)</td>
<td>2</td>
</tr>
<tr>
<td>131 - 230 (39.6 - 69.9)</td>
<td>3</td>
</tr>
<tr>
<td>231 - 330 (70.0 - 100.3)</td>
<td>4</td>
</tr>
<tr>
<td>331 - 430 (100.4 - 130.7)</td>
<td>5</td>
</tr>
<tr>
<td>431 - 530 (130.8 - 161.1)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 3.1 (a)

5) Where a corner exists, install a single strobe facing in either direction.

6) If an interruption of the viewing path exists because of a fire door, elevation change, or other obstruction, consider the two areas as separate corridors.
7) For wall-mount applications, mount the strobes at a height such that the bottom of the strobe is not less than 80 in. (2 m) and no greater than 96 in. (2.4 m) above the finished floor. The top of the lens should be at least 6 in. (150 mm) from the ceiling. For low ceilings where the mounting heights above can't be met, mount the strobe so the top of the lens is 6 in. (150 mm) from the ceiling.

![Figure 3.1 (a) Wall Mount - Location from Ceiling](image)

8) Examples of corridor applications are shown below:

![Figure 3.1 (b) Wall Mount Strobes](image)
Mount strobe anywhere in shaded areas

100' max. strobe spacing

15' max.

15' max.

15' max.

15' max.

15' max.

15' max.

15' max.

20' max.

20' max.

20' max.

Figure 3.1 (c) Ceiling Mount Strobes

Figure 3.1 (d) Wall Mount Strobes

Figure 3.1 (e) Ceiling Mount Strobes
Single strobe for up to 20' x 20' area at entrance. This area is treated separately. See Section 3.3.

Figure 3.1 (f) Wall Mount Strobes

Single strobe for up to 20' x 20' area. This area is treated separately. See Section 3.3.

Figure 3.1 (g) Ceiling Mount Strobes
3.2 STROBE LOCATION - SLEEPING AREA

**Use Model 8A (110 cd) Strobes - Wall Mount Only**

*Note:* Audible signal applications vary widely and require a separate engineering analysis to determine exact audible signal appliance needs. Combination audible/visible signaling appliances are available from EST.

Reference: NFPA 72-1993 Chapter 6

1) The appliances must be rated no less than 110 cd per UL 1971.

2) **Wall-Mount**
   Mount the 110 cd strobe on the wall with a direct and unobstructed viewing path of no less than 16 ft (4.87 m) to the pillow, at least 24 in. (610 mm) from the ceiling to the top of the strobe. (See Fig. 3.2 (a)).

3) **Ceiling Mount**
   (or less than 24 in. (610 mm) below ceiling on wall)
   Use a 177 cd (minimum) strobe, mounted with a direct and unobstructed viewing path of less than 16 ft. (4.87 m) to the pillow. (See Fig. 3.2 (b)).
3.3 STROBE LOCATION - NON-SLEEPING AREAS

NOTE: Audible signal applications vary widely and require a separate engineering analysis to determine exact audible signal appliance needs. Combination audible/visible signaling appliances are available from EST.

Reference: NFPA 72-1993 Chapter 6

1) Install a strobe to supplement the audible signals in any room that has an average ambient sound level of 105 dBA or higher. ADA requires alarm signals not to exceed 120 dBA. Since NFPA and building codes require alarm signals to be 15 dBA above ambient therefore the highest ambient allowed is 105 dBA.

2) Mount the strobes on the wall at a height such that the bottom of the lens is not less than 80 in. (2 m) and no greater than 96 in. (2.4 m) above the finished floor. The top of the lens should be at least 6 in. (150 mm) from the ceiling. For low ceilings where the mounting heights above can't be met, mount the strobe so the top of the lens is 6 in. (150 mm) from the ceiling.

![Diagram of strobe location](image-url)
3) Mount the strobe on the center line of the longest wall.  
Wall mount EST 7A strobes are rated at 15 cd. Use them in rooms up to 40' x 40' size.  
Wall mount EST 8A strobes are rated at 110 cd. Use them in rooms up to 100' x 100' size.

<table>
<thead>
<tr>
<th>Maximum Room Size</th>
<th>EST 15 cd</th>
<th>EST 110 cd</th>
</tr>
</thead>
<tbody>
<tr>
<td>20' x 20'</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>30' x 30'</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>40' x 40'</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>50' x 50'</td>
<td>note 1</td>
<td>1</td>
</tr>
<tr>
<td>60' x 60'</td>
<td>note 1</td>
<td>2</td>
</tr>
<tr>
<td>70' x 70'</td>
<td>note 1</td>
<td>2</td>
</tr>
<tr>
<td>80' x 80'</td>
<td>note 1</td>
<td>4</td>
</tr>
<tr>
<td>90' x 90'</td>
<td>note 1</td>
<td>4</td>
</tr>
<tr>
<td>100' x 100'</td>
<td>note 1</td>
<td>note 2</td>
</tr>
</tbody>
</table>

Note 1 - Rooms larger than 40' x 40' require 15 cd ceiling mounted strobes to supplement 15 cd strobes on the wall.

Note 2 - Rooms larger than 100' x 100' require 60 cd ceiling mounted strobes to supplement 110 cd strobes on the wall.

4) Ceiling Mount EST 7A strobes are rated at 15 cd. Use them in rooms up to 20' x 20' size with ceiling heights less than 10'.

Ceiling Mount EST 8A strobes are rated at 60 cd. Use them in rooms up to 40' x 40' size with ceiling heights less than 10'.

<table>
<thead>
<tr>
<th>Maximum Room Size</th>
<th>Ceiling Height</th>
<th>EST 15 cd</th>
<th>EST 60 cd</th>
</tr>
</thead>
<tbody>
<tr>
<td>20' x 20'</td>
<td>up to 10'</td>
<td>1</td>
<td>not allowed</td>
</tr>
<tr>
<td>20' to 30'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10' to 20'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>30' x 30'</td>
<td>up to 10'</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>20' to 30'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10' to 20'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>40' x 40'</td>
<td>up to 10'</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>20' to 30'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10' to 20'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>larger than 40' x 40'</td>
<td>up to 10'</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>20' centers</td>
<td>40' centers</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20' to 30'</td>
<td>not allowed</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

5) Ensure that there is an unobstructed viewing path to strobes within the area of their intended use. If the viewing path is obstructed by a part wall or partition, reposition the strobes or add additional ones as required. At least one strobe should be positioned in the concentrated viewing path of the room’s occupants.
6) Not all rooms are square, of course, or meet the arbitrary dimensions as shown in the following examples. In some cases they might require a combination of Model 7A (15 cd) and Model 8A (110 cd) strobes to achieve the best cost, power and operational configuration. You must consider how the area is divided by temporary walls and partitions, the likely viewing paths, area traffic and usage, etc.

7) Irregular rooms can be treated as square rooms with the application of just a couple of simple rules. Evaluate an irregular room according to one of the following two methods:

(a) Assume a square room using the longest walls as your base dimension. Then install the most appropriate Model 7A/8A strobe on the wall that offers the best viewing path. (See Fig. 3.3 m).

(b) Subdivide the room into smaller areas so that the entire room is encompassed by multiple square areas. Install the most appropriate Model 7A/8A strobes on the walls of these new areas.

8) Examples of non-sleeping area strobe applications follow. These refer to rooms with specific dimensions. (Ref: NFPA 72-1993 Chapter 6 Section 6.4.4) Please note that the dimensions can't just be converted into square footage (m2) areas and applied to any irregularly shaped rooms that exceed the given maximum dimension. For example, a 20 ft x 20 ft room (400 sq. ft) is not equivalent to a 10 ft x 40 ft (400 sq. ft) room.

All examples shown assume a ceiling height of 10 ft or less.

Figure 3.3 (b) - Rooms up to 20' X 20'

15 cd - Wall Mount

15 cd - Ceiling Mount

110 cd - Wall Mount

110 cd (60 cd) - Ceiling Mount
Figure 3.3 (c) - Rooms up to 30' X 30'

15 cd - Wall Mount

15 cd - Ceiling Mount

110 cd - Wall Mount

110 cd (60 cd) - Ceiling Mount

Figure 3.3 (d) - Rooms up to 40' X 40'

15 cd - Wall Mount

15 cd - Ceiling Mount

110 cd - Wall Mount

110 cd (60 cd) - Ceiling Mount
Figure 3.3 (e) - Rooms up to 50' X 50'

- 15 cd - Wall Mount
  (requires 15 cd on ceiling for supplement)
- 110 cd - Wall Mount

Figure 3.3 (f) - Rooms up to 60' X 60'

- 15 cd - Wall Mount (1)
  (requires 15 cd on ceiling for supplement)
- 110 cd - Wall Mount

- 15 cd - Ceiling Mount
- 110 cd (60 cd) - Ceiling Mount
15 cd - Wall Mount
(requires 15 cd on ceiling for supplement)

110 cd - Wall Mount

15 cd - Ceiling Mount

110 cd (60 cd) - Ceiling Mount

15 cd - Wall Mount
(requires 15 cd on ceiling for supplement)

110 cd - Wall Mount

15 cd - Ceiling Mount

110 cd (60 cd) - ceiling Mount
Figure 3.3 (i) - Rooms up to 90' X 90'
15 cd - Wall Mount
(requires 15 cd on ceiling for supplement)

110 cd - Wall Mount

15 cd - Ceiling Mount

Figure 3.3 (j) - Rooms up to 100' X 100'
15 cd - Wall Mount
(requires 15 cd on ceiling for supplement)

110 cd - Wall Mount

15 cd - Ceiling Mount

110 cd (60 cd) - Ceiling Mount
9) For rooms that require four strobes, do not install them on the center lines of the walls. As Figure 3.3 (k) below illustrates, this will result in inadequate coverage. Remember that a single 110 cd wall mounted strobe is effective for a 50 ft x 50 ft (15.2 m x 15.2 m) area. The entire room can be effectively covered by shifting the strobes off the center lines as shown in Figure 3.3 (j) above, where they have each been shifted 25 feet (7.6 m).

![Figure 3.3 (k)](image)

10) For auditoriums and other large open rooms greater than 100 ft x 100 ft (30.5 m x 30.5 m), install a sufficient quantity of Model 8A (110 cd) strobes around the perimeter of the room such that the maximum spacing is 100 ft (30.5 m) between strobes. If the room is supported by posts in the center area, then install additional strobes on them to increase coverage.

![Figure 3.3 (l)](image)
11) Figure 3.3 (m) above illustrates how an irregularly shaped room can be assessed. In this example, a 40' x 40' square room was assumed, using the longest wall as the base dimension. A single Model 8A (110 cd) strobe is sufficient for this space and may be installed on any of the four walls. It should be installed in a location offering an unobstructed viewing path to all areas of the room.
12) Figure 3.3 (n) and 3.3 (o) above illustrate the results when the same area is assessed in two different ways. In Figure 3.3 (n) four separate areas are identified (20' x 20', 60' x 60', and two 25' x 25') requiring the strobes as shown. In Figure 3.3 (o) the two 25' x 25' areas have been combined and assumed to be the equivalent of a single 50' x 50' area, resulting in fewer strobes being required. Once again, the need for unobstructed viewing paths will determine exact placement. Additional system concerns are overall cost and current requirements. Use of many unsynchronized strobes in a single area also incurs a slight epileptic risk increase, as previously discussed.
13) Figure 3.3 (p) provides an example of a small commercial building. The recommended EST Model 7A and 8A strobes are installed in all retail, corridor and washroom areas. Other normal working areas, such as Storage areas A and B, also have strobes installed. Small storage rooms or closets, where people are normally absent, do not require strobes.
4.0 COMPLIANCE STRATEGIES

4.1 RECOMMENDED STROBE INSTALLATION

Edwards Systems Technology recommends that UL 1971 listed strobes be installed in all buildings that meet the following criteria:

- Federal State/Provincial, Local Government buildings where services are available to the public
- Hotels, motels, hostels
- Restaurants
- Sports, exercise and recreation facilities
- Public meeting halls, theaters and auditoriums
- Commercial sales and rental establishments
- Service establishments
- Airports, train stations, bus stations, commuter stations, passenger and shipping terminals
- Schools, colleges, universities and training institutions
- Social service agencies:
  - day care centers
  - senior citizen centers
  - homeless shelters
  - food banks
  - adoption agencies
  - crisis/treatment centers
  - halfway houses
- Private enterprises employing persons with hearing impairments:
  - washrooms
  - meeting rooms
  - cafeterias and rest areas
  - other general usage areas
  - lobbies
  - hallways
  - usual work areas
**Edwards Systems Technology**

- Medical care facilities, in conjunction with established alarm and evacuation procedures
- Settings with high ambient sound levels (over 105 dB)
- Residences which are home to hearing impaired persons

Where local codes or other regulations require a building fire alarm system or where one is installed voluntarily, EST recommends that a thorough compliance evaluation procedure be followed. The evaluation should include fire alarm system design and installation experts to determine the scope of the system requirements, as well as the local Authority Having Jurisdiction to determine the full applicability of any statutes in effect.

**NEW SYSTEMS**

1. Verify the applicability of the ADA Accessibility Guidelines (ADAAG) and any other statutes or regulations which address accessibility standards for the disabled.

2. Identify and incorporate National, State/Provincial and local code requirements.

3. Identify all work areas normally used by hearing impaired employees. Identify all common and general use areas used by hearing impaired employees.

4. Identify all public common and general use areas used by visitors, patrons and customers. Where applicable, identify all sleeping rooms intended for use by hearing impaired persons.

5. Specify strobes that are listed to UL 1971 and comply with Chapter 6 of NFPA 72.

6. Specify listed visible signals in the areas identified above. It is required that a minimum of 110 candela strobes be installed in sleeping areas.

7. Installations should make allowances for future accessibility as may be required by the hiring of new employees or remodeling to suit tenant needs.
APPENDIX  A

U.S. Architectural and Transportation Barriers Compliance Board  
Bulletin #2: Visual Alarms  
December 1992

The landmark Americans with Disabilities Act (ADA), enacted on July 26, 1990, provides comprehensive civil rights protection to individuals in the area of employment (title I), State and local government services (title II), public accommodation and commercial facilities (title III), and telecommunications (title IV). Both the Department of Justice and the Department of Transportation, in adopting standards for new construction and alterations of places of public accommodation and commercial facilities covered by title II of the ADA, have issued implementing rules that incorporate the Americans with Disability Act Accessibility Guidelines (ADAAG), developed by the Access Board.

Why are visual alarms required?

One American in a hundred has a severe hearing loss; nearly one in ten has a significant loss. Those who are deaf or hard of hearing--a growing percentage of our population, due largely to the growth in the numbers of older persons--depend upon visual cues to alert them to emergencies. A visual alarm provides them with the warning delivered to hearing persons by an audible alarm.

Audible fire alarms have been a standard feature of building construction since the life safety codes of the early 1900's. However, visible did not appear even in accessibility codes until 1980. Early standards required relatively dim flashing lights at exit signs--an alarm system that was effective only along an exit route.

As accessibility, life safety and building codes were revised, however, they began to incorporate alarm technology that was developed for use in schools for persons who are deaf and in factories where ambient noise levels made audible alarms ineffective.
In passing the Americans with Disabilities Act in 1990, Congress specifically directed the Access Board to provide greater guidance regarding communications accessibility. Thus the ADA Accessibility Guidelines (ADAAG) require that where emergency warning systems are provided in new or altered construction, they must include both audible and visible alarms that meet certain technical specifications.

**What are visual alarms?**

Visual alarms are flashing lights used as fire alarm signals. The terms visual alarm signal, visible signal device and visible signaling appliance are used relatively interchangeably within the fire protection community; the National Fire Protection Association (NFPA) calls them visual notification appliances. There is no practical distinction between a visual signal and a visible signal. Although visual signals may be used for other purposes, the type described in this Bulletin is appropriate only for use as an emergency alarm signal.

There are two major categories of fire alarms:

1) **self-contained units**, as exemplified by the single station residential smoke detector unit -- battery-operated or hardwired to building electrical power -- which produces an alarm signal at the fixture itself when activated by an integral sensing device, and

2) **building-wide systems**, integrated -- often zoned -- alarms whose local signals are remotely initiated, either automatically from detectors or manually from pull-stations spread throughout a facility.

**ADAAG** requires that when either type is installed, it must have a visual alarm component.

**Where are visual alarms required?**

Facility design is subject to state and local ordinances that may both require and specify standards for emergency alarm systems. These regulations -- building codes, life safety codes, accessibility codes, technical standards -- are typically derived from national model codes and standards. The requirement for an emergency alarm system in new construction will be established by the applicable State or local building, life safety or fire protection regulation. ADAAG does not mandate an emergency alarm system; its scoping provision at 4.1.3 (14) simply requires that when emergency warning systems are provided, they shall include both audible and visual alarms that comply with 4.28.
Thus the requirement for an alarm system in a facility will trigger the ADAAG technical specifications for alarms. ADAAG 4.1.3 (14) Accessible Building: New Construction requires that visual alarms be installed if emergency warning systems are provided in a new facility. In existing buildings, the upgrading or replacement of a fire alarm system would also require compliance with ADAAG technical provisions for alarms.

Where the need for a visual alarm is not predictable, as in spaces used in common by building occupants or those generally available for use by the public, equivalent warning must be provided to every potential user. This is particularly important in those common use spaces where a person may be alone.

Because it is not always possible to fix the occupancy of a room or space or anticipate its use by a person with a hearing impairment, every common use room or space required to have an emergency alarm system must be served by both audible and visible signals.

ADAAG 4.28.1 General stipulates that alarm systems required to be accessible shall provide visible signals in restrooms, other general and common use areas and hallways and lobbies. Common use areas include meeting and conference rooms and similar spaces that are not the assigned work areas of specific employees.

Where audible alarm signal appliances are installed in corridors and lobbies to serve adjacent public or common use rooms, individual visual alarm signal appliances must be installed in those rooms, since the warning provided by a visual signal, unlike that of a bell or other announcement system, can only be observed within the space that it is installed. System designers and specifiers must therefore be especially sensitive to coverage issues. Dressing, fitting and examination rooms for example, can be easily protected by an audible alarm outside the room or space. However, the customer or patient who has a hearing impairment will not be alerted unless the dressing room he/she is using is protected with a visual alarm in (or above, where partitions are not full height) the space. In general, it will not be sufficient to install visual signals only at audible alarm locations.

3.5 Definitions

Common Use

Refers to those interior and exterior rooms, spaces or elements made available for the use of a restricted group of people (for example, occupants of a homeless shelter, the occupants of an office building or the guests of such occupants).

For information on employee accommodation under title I of the ADA, contact the Equal Employment Opportunity Commission (EEOC) ADA information line at (800) 669-3362 (Voice) or (800) 800-3302 (TDD)
Where are visual alarms not required?

ADAAG does not require that areas used only by employees as work areas be constructed or equipped to be accessible. Thus, visual alarms are not required in individual employee offices and work stations. However, the provision of a visual alarm in the work area of an employee who is deaf or hard-of-hearing may be—like other elements of the workplace accessibility—a reasonable accommodation under title I of the ADA, which addresses employment issues. The potential for such future employee accommodations should be considered when facility wiring is planned to facilitate a later connection to the building alarm system.

Mechanical, electrical and telephone closets, janitor’s closets, and similar non-occupiable spaces that are used by employees but are not common use facilities nor assigned work areas are not required to have visual alarms.

What technical provisions apply to visual alarms?

The technical provisions of ADAAG 4.28 Alarms include minimum standards for the design and installation of single-station and building-wide visual alarm systems. They are based upon research sponsored by the Access Board and other groups, principally Underwriters Laboratories (UL).

To be effective, a visual signal—or its reflection from adjacent walls and ceiling—must be of an intensity that will raise the overall light level sharply, but not so intense as to be unsafe for direct viewing at a specified mounting height. Technical criteria for visual alarm signal appliances are established in ADAAG 4.28.3 Visual Alarms (see sidebars).

In research sponsored by the Access Board, a high-intensity xenon
strobe lamp was found to be the most effective in alerting persons with hearing impairments. White light was judged to be the most discernible; colored lamps (particularly red) were not effective even at extreme intensities. Lamp intensity is given in effective Candela (Cd) measured in use at the source. Note that the 75 Cd minimum must be satisfied across all viewing angles, horizontally and vertically (see Figure 1), when operating at rated voltages, system design must take into account line losses as well.

Like a camera flash, the strobe produces a short burst of high-intensity light. The repetition of this pulse at regular intervals is a flash rate. Pulse duration is the interval between initial signal build-up and decay, measured across the lamp bell curve at a fixed intensity. Pulse duration is limited so that the signal flash is not temporarily blinding.

In the Access Board’s research, ninety per cent of the subjects in standard daylit rooms were alerted by a 75 candela signal mounted 50 feet away. Thus a single visual signal meeting these ADAAG specifications could be expected to serve a large rectangular room or a foot length of corridor if optimally in the center of the space. Its lamp must be installed and oriented so that the signal or its reflection can spread throughout the space. To be effective, the signal must not be obstructed by furnishings, equipment or room geometry.

Testing further indicated that flash rate cycles between one and three Hertz (flashes per second) successfully alerted subjects with hearing impairments; a 3 Hz signal appeared to be somewhat more effective. ADAAG thus requires flash rates within the 1 to 3 Hz range. Rates that exceed 5 Hz may be disturbing to persons with photosensitivity, particularly those with certain forms of epilepsy. Information received during the development of the standards suggested that multiple unsynchronized visual signals within a single space may produce a composite flash rate that could trigger a photoconvulsive response in such persons. A rate in excess of 5 Hz should be avoided, either by raising the intensity and decreasing the number of fixtures or by synchronizing the flash rates of the fixtures. This is particularly important in schools, since children are more frequently affected by photosensitivity than are adults.

Mounting provisions for non-sleeping areas were developed from NFPA signal criteria and UL smoke test findings. Strobes—whether
projected from a wall or suspended from the ceiling--must be a minimum of 6 inches below the ceiling plane and at least 80 inches above the finished floor. To minimize the effect of smoke obscuration in the event of a fire, the lamp itself may not be mounted directly to the ceiling.

Provisions governing the spacing of visual alarms in hallways and corridors will generally require one fixture every 100 feet in linear corridors and hallways; somewhat closer spacing may result in enclosed rooms. In large-volume spaces, visual alarms may be suspended overhead or installed on perimeter walls if sightlines are obstructed. In lengthy corridors, such as in shopping malls and large buildings, it is recommended that appliance spacing be maximized within the limits of the technical provision to minimize the effect of a composite flash rate on persons with photosensitivity. It is further recommended that the placement of visual signals along a corridor alternate between opposing walls to minimize the number of signals in a field of view.

In multipurpose facilities where bleacher seating, athletic equipment, backdrops and other movable elements may at times be deployed or in warehouse and similar building types where devices would not be visible when installed at specified heights, optimal signal placement may require considerable study.

**What criteria affect the design of visual alarm signals?**

Figures 1, 2 and 3 illustrate general fixture placement and lamp coverage in schematic form. In general, it is recommended that visual alarm lamp intensity be maximized so as to require the minimum number of fixtures. Large, high-ceilinged spaces may best be served by suspended flash tubes of very high intensity (lamps up to 1000 candela are available). Smaller rooms--less than 75 feet in their maximum dimension--can be covered by a single centrally located visual alarm meeting ADAAG intensity specifications. For very small rooms, such as dressing rooms, a strobe of lesser intensity may well be sufficient as an equivalent facilitation.

Signal intensity and placement in very small and very large rooms and in
2.2 Equivalent Facilitation

Departures from particular technical and scoping requirements of this guideline by the use of other designs and technologies are permitted where the alternative designs and technologies used will provide substantially equivalent or greater access to and usability of the facility.

Lamp intensity (like sound) decreases in inverse relation to the square of its distance from the viewer. Thus, by varying lamp intensity and spacing, system designers can tailor an installation to the physical conditions of the space being served. It is impossible to provide specific guidance for the design of non-standard installations based upon the photometric calculations necessary to demonstrate equivalent facilitation. Such applications should generally be designed by experienced electrical engineers or fire alarm consultants under performance specifications for coverage and illumination levels derived from the technical provisions of ADAAG 4.28. As there is no process for certifying alternative methods (except in transportation facilities under DOT enforcement), the responsibility for demonstrating equivalent facilitation in the event of a challenge rests with the covered entity.

The American National Standard for Accessible and Useable Buildings and Facilities (CABO/ANSI A117.1-1992), reflecting current NFPA performance recommendations for visual alarms, stipulates lamp, installation and spacing criteria at some variance with ADAAG technical specifications for visual alarms and with this advisory. ANSI Table 4.26.3.2 (a), Room Spacing Allocation, suggests that an alarm installation of several low-intensity lamps within a room is the practical equivalent of a single high-intensity lamp serving that space. Given concerns for economy (lower-candela lamps are less expensive to purchase and connect) and lamp standardization within a building (lower candela lamps are more available and simplify inventorying), specifiers may be motivated to standardize on a minimum-candela fixture, achieving coverage in large rooms by close spacing of low-intensity lamps. The Access Board strongly discourages this practice. Where a single lamp can provide the necessary intensity and coverage, multiple lamps should not be installed because of their potential effect on persons with photosensitivity.

What types of visual alarms are available?

All major suppliers to the fire protection industry manufacture visual
signals, which are readily available to electrical contractors and others responsible for the installation of building alarm systems. Visual alarms incorporating smoke detectors and lamp only signal appliances are supplied through standard sources, although some lamp intensities and visual alarm fixtures may not be commonly stocked. Strobe lamps are commercially available in varying intensities up to 1000 candela. Higher intensities can be provided by specialized manufacture.

Although an integrated audible and visual signal is available at about the same cost as an audible or visual signal alone, more visual signals than audible signals will be necessary for most applications. Careful attention to reflection from surfaces can increase light dispersion and coverage in both new and renovated structures.

What visual alarm requirements apply to sleeping rooms in transient lodging facilities?

ADAAG 9.3.1 requires the installation of a visual alarm--or power outlet for a portable device--connected to the building alarm system in the sleeping rooms of units required to be accessible under Section 9 Accessible Transient Lodging. Because guest room sizes are not large in such occupancies, the technical specification of 4.28.4 Auxiliary Alarms requires only that the signal--intended to alert persons who are awake--be visible in all areas of the room or unit. Portable units with a standard 110 volt electrical cord can be acquired from retailers of products for persons who are deaf and hard-of-hearing.

Visual alarms are not the technology of choice for awakening sleeping persons, however, a UL study concluded that a flashing light more than seven times brighter than that needed to alert office workers (110 candela vs. 15 candela at 20 feet) would be required to arouse a person who was asleep. Alarm system designers are advised to consider the UL findings if visual alarms are to be employed to warn sleeping persons of emergencies.
9.3.2 Equivalent Facilitation.

For purposes of this section, equivalent facilitation shall include the installation of electrical outlets (including outlets connected to a facility's central alarm system) and telephone wiring in sleeping rooms and suites to enable persons with hearing impairments to utilize portable visual alarms and communication devices provided by the operator of the facility.

ADAAG does not establish standards for portable items or auxiliary aids. However, devices that employ technologies other than visual signaling may offer equivalent or superior warning for sleeping guests who have hearing impairments. For example, a signal-activated vibrator was found to be much more effective in alerting sleepers than were the visual signals tested in the UL research. Such devices are commonly available and may be connected to or activated by a building alarm system. Care must be taken that notification devices intended to signal a door knock or bell are separately wired.

Why is there an exception in the scoping requirements of 4.1.3 (14) for "standard health care alarm design practice"?

In medical care settings where a supervised emergency evacuation plan is in pace, it is usually not desirable to install alarms in patient rooms or wards. In such occupancies, personnel responsible for ensuring the safe egress of patients will respond to an intercom message or other signal that is not intended to alert or alarm patients incapable of independent evacuation. The requirements for visual and audible alarms may be modified to suit industry-accepted practices for such facilities.
The standard addresses specific performance targets for strobe manufacturers that go beyond the requirements of the Americans with Disabilities Act (ADA), UL 1638, -- Visual Signaling Appliances, ULC S526 -- Visual Signal Appliances and other international standards.

The UL1971 strobe performance specifications have been adopted in their entirety by NFPA 72 and ANSI A117.1. UL 1971 is accepted as the standard by which effective strobe installations are judged. It specifies requirements for minimum light output for both sleeping and non-sleeping areas, minimum horizontal and vertical light output dispersion and minimum sustained light output.

The following UL 1971 excerpts clarify the new strobe light requirements:

27 Signal Strength and Format Test

27.1 Alarm signaling for the hearing impaired may take the form of flashing light, vibration or air movement. The signal shall be pulsating and shall operate at or above the signal strength rating for the device. The signal format or general plan for organization and arrangement of the signal shall conform to the manufacturer's description of the signal shown in the installation and operations manual for the device.

27.3 The following minimum signal strengths shall be met.

(a) Signaling lights shall produce a candela output in effective intensity in accordance with Table 27.1 and Figures 27.1 - 27.3. The flash rate shall be between 1/3 and 3 hertz. The light output shall be white light. The measurement of the light output shall be in accordance with the procedure described in the Standard for Visual Signaling Appliances, UL 1638.

<table>
<thead>
<tr>
<th>Area to be Signaled</th>
<th>Mounting Height</th>
<th>Required Minimum Intensity</th>
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<tbody>
<tr>
<td>Sleeping</td>
<td>24 inches (0.61 m) or less to ceiling</td>
<td>177 cd</td>
</tr>
<tr>
<td></td>
<td>More than 24 inches (0.61 m) to ceiling</td>
<td>110 cd</td>
</tr>
<tr>
<td>Non-Sleeping</td>
<td></td>
<td>15 cd</td>
</tr>
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</table>

Notes: 1) Distance to ceiling is measured from the top of the signal light lens to the ceiling. 2) Installation shall be illustrated as required in paragraph 46.2 3) The values noted for required intensity are expressed in minimum candela 4) (-) = no requirement

Table 27.1 - Signal Light Intensities
Figure 27.1 - Light Output -- Horizontal Dispersion  
(view from above, looking down)

Figure 27.2 - Light Output -- Vertical Dispersion  
(view from beside strobe)

Figure 27.3 - Light Output -- Vertical Dispersion  
(both side and end view)

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Percent of Rating</th>
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<tr>
<td>0</td>
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<td>5 - 25</td>
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<td>30 - 45</td>
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<td>85</td>
<td>25</td>
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<td>85</td>
<td>12</td>
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<tr>
<td>90</td>
<td>12</td>
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</table>
APPENDIX C

EST STROBE PERFORMANCE SPECIFICATIONS

Horizontal Light Dispersion
- EST Strobe Model 7A

The UL test results below illustrate how the EST Model 7A strobes exceed the requirements for both the ADA 75 cd and UL 1971 15 cd specifications for both wall and ceiling applications.

The UL 1971 15 cd test measures how the strobe performs along its entire horizontal axis. The minimum required strobe intensities and the measured average of the Model 7A strobes are shown at the right.

<table>
<thead>
<tr>
<th>Degrees</th>
<th>UL 1971 Wall and Ceiling Mount Minimum (cd)</th>
<th>EST Average (cd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>5 - 25</td>
<td>13.5</td>
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<tr>
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Figure 7A-1: Average Horizontal Light Distribution of EST 15 cd Strobe
Vertical Light Dispersion  
- EST Strobe Model 7A

The UL test results below illustrate how the EST Model 7A strobes exceed the requirements for both the ADA 75 cd and UL 1971 15 cd specifications for both wall and ceiling applications.

The UL 1971 15 cd test measures how the strobe performs along its entire vertical axis. The minimum required strobe intensities and the measured average of the Model 7A strobes are shown at the right.

<table>
<thead>
<tr>
<th>Degrees</th>
<th>UL 1971 Minimum Pattern (wall)</th>
<th>EST (UL Confirmed) Average (cd)</th>
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</thead>
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<tr>
<td>Wall</td>
<td>Ceiling</td>
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<tr>
<td>0</td>
<td>0</td>
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<tr>
<td>90</td>
<td>1.8</td>
<td>3.75</td>
</tr>
</tbody>
</table>

Figure 7A-2: Average Vertical Light Distribution of EST 15 cd Strobe
Horizontal Light Dispersion
- EST Strobe Model 8A

The UL test results below illustrate how the EST model 8A strobes exceed their requirements for both the ADA and UL 1971 110 cd (wall mount) specifications.

The UL 1971 110 cd test measures how the strobe performs along its entire horizontal axis. The minimum required strobe intensities and the measured average of the Model 8A strobes are shown at the right.

The model 8A strobes are rated at 60 cd for ceiling mount applications.

<table>
<thead>
<tr>
<th>Degrees</th>
<th>UL 1971 Wall and Ceiling Mount Minimum (cd)</th>
<th>EST Average (cd)</th>
</tr>
</thead>
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<td>90</td>
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Figure 8A-1: Average Horizontal Light Distribution of EST 110 cd (60 cd) Strobe
Vertical Light Dispersion
- EST Strobe Model 8A

The UL test results below illustrate how the EST Model 8A strobes exceed the requirements for both the ADA and UL 1971 110 cd (wall mount) specifications.

The UL 1971 110 cd test measures how the strobe performs along its entire vertical axis. The minimum required strobe intensities and the measured average of the Model 8A strobes are shown at the right.

The model 8A strobes are rated at 60 cd for ceiling mount applications.

<table>
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<tr>
<th>Degrees</th>
<th>UL 1971 Wall</th>
<th>Wall Ceiling</th>
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<th>Ceiling</th>
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<tr>
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<td>-</td>
<td>50.6</td>
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<td>107</td>
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<td>45</td>
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<td>-</td>
<td>83</td>
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<tr>
<td>90</td>
<td>90</td>
<td>13.2</td>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

Figure 8A-2: Average Vertical Light Distribution of EST 110 cd (60 cd) Strobe
SAMPLE ENGINEERING SPECIFICATIONS

Model 202 Series Strobe


The 202 Series strobes shall operate at 20-24 Vdc and produce a white light output with a minimum of (75) (120) candela when measured on axis and rated for wall mount applications per UL 1971 at a minimum of (15) (110) candela effective intensity. The strobe shall have a polycarbonate lens and a white sleeve with the word FIRE in red lettering inscribed on the sides. The sleeve shall be removable on site to allow for changing text from wall to ceiling orientation using an EST lens kit.

The 202 Series shall mount to 1-gang electrical boxes. All strobes shall be electrically polarized for alarm circuit supervision with color-coded wire leads. The housing shall be finished in textured (beige) (red) plastic.
Model 692 Series Mini-Signal Horn/Strobe


The 692 Series mini-signal horn/strobes shall operate at 20-24 Vcd and produce a white light output with a minimum of (75) (120) candela when measured on axis and rated for wall mount applications per UL 1971 at a minimum of (15) (110) candela effective intensity. The strobe shall have a polycarbonate lens and a white sleeve with the word FIRE in red lettering inscribed on the sides. The sleeve shall be removable on site to allow for changing the text from wall to ceiling orientation using an EST lens kit.

The 692 Series mini-signal horn/strobe shall produce a sound pressure level of 91 dBA (Peak) at 10 feet (3.05 m) when measured in an anechoic test chamber.

The 692 Series mini-signal horn/strobes shall mount to recessed 1-gang electrical boxes, or to recessed 1-1/2 inch (38 mm) deep 4 inch square electrical boxes with a 1-gang cover, or surface mount to EST 2-gang 27193 series boxes. All horn/strobes shall be electrically polarized for alarm circuit supervision. Terminals shall be provided for the horn connection and separate color-coded wire leads shall be provided for the strobe connection. The housing shall be finished in textured (beige) (red) plastic.
Model 792 Series Horn/Strobe


The 792 series horn/strobes shall operate at 20-24 Vdc and produce a white light output with a minimum of (75) (120) candela when measured on axis and rated for wall mount applications per UL 1971 at a minimum of (15) (110) candela effective intensity. The strobe shall have a polycarbonate lens and a white sleeve with the word FIRE in red lettering inscribed on the sides. The sleeve shall be removable on site to allow for changing the text from wall to ceiling orientation using an EST lens kit.

The 796 Series horn/strobes shall produce a sound pressure level of 103 dBA (Peak) at 10 feet (3.05 m) when measured in an anechoic test chamber.

The 792 Series horn/strobe shall mount to recessed 2-1/8 inch (54 mm) deep 4 inch square electrical boxes or surface mount to EST 897 series boxes. All horn/strobes shall be electrically polarized for alarm circuit supervision. Separate terminals shall be provided for the strobe and horn connections. The housing shall be finished in textured (beige) (red) noryl plastic.
Model 732 series Chime/Strobe


The 732 Series chime/strobes shall operate at 20-24 Vdc and produce a white light output with a minimum of (75) (120) candela when measured on axis and rated for wall mount applications per UL 1971 at a minimum of (15) (110) candela effective intensity. The strobe shall have a polycarbonate lens and a white sleeve with the word FIRE in red lettering on the sides. The sleeve shall be removable on site to allow for changing the text from wall to ceiling orientation using an EST lens kit.

The 732 series chime/strobes shall have an integral volume control and produce a sound pressure level of 91 dBA (Peak) at 10 feet (3.05 m) when measured in an anechoic test chamber. The chime shall operate at 60 strokes per minute from a continuously applied voltage and be capable of being stroked from 1-6 times per second from a pulsing voltage.

The 732 Series chime/strobes mount to recessed 1-1/2 inch (38 mm) deep 4 inch square electrical boxes or surface mount to EST 897 series boxes. All chime/strobes shall be polarized for alarm circuit supervision. Separate terminals shall be provided for the strobe and chime connections. The housing shall be finished in textured (beige) (red) noryl plastic.
# APPENDIX D - EST STROBE PRODUCT SELECTION TABLE

<table>
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<tr>
<th>FEATURE DESCRIPTION</th>
<th>EST MODEL NUMBER</th>
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<td>202</td>
</tr>
<tr>
<td></td>
<td>-7A</td>
</tr>
<tr>
<td>Strobe Only (20-24 V dc)</td>
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<tr>
<td>Mini-Horn/Strobe (20-24 V dc)</td>
<td></td>
</tr>
<tr>
<td>Chime/Strobe (20-24 V dc)</td>
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</tr>
<tr>
<td>Horn/Strobe (20-24 V dc)</td>
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<tr>
<td>ADA Compliant (75 cd)</td>
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<tr>
<td>UL 1971 Listed (15 cd wall and ceiling)</td>
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<tr>
<td>UL 1971 Listed (110 cd wall/60 cd ceiling)</td>
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<tr>
<td>UL 464 Listed (Public Mode)</td>
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<tr>
<td>1-Gang Box Mounting</td>
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<tr>
<td>4 in. Square Box Mounting</td>
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<tr>
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<td>Strobe Wire Connection - Wire Leads</td>
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</table>
Acknowledgements


Appendix B - Based in part on UL 1971 Standard for Signaling Devices for the Hearing Impaired published by Underwriters Laboratories Inc.

Section 2.5 - Based in part on ANSI/NFPA 72 National Fire Alarm Code published by the National Fire Protection Association.