



BSR E1.28 – 202x
Guidance on planning followspot positions in places of public assembly

Approved by the ANSI Board of Standards Review on _____.

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The Entertainment Services and Technology Association
P.O. Box 23200
Brooklyn, NY 11202-3200
USA
Phone: 1-212-244-1505
Email: standards@esta.org

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The Followspot Position Working Group, which authored this standard, consists of a cross section of entertainment industry professionals representing a diversity of interests. ESTA is committed to developing consensus-based standards and recommended practices in an open setting.

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*Extraordinary legacy gift: Ken Vannice

Contact Information

Technical Standards Manager

Karl G. Ruling
ESTA
P.O. Box 23200
Brooklyn, NY 11202-3200
USA
1-212-244-1505 ext. 703
karl.ruling@esta.org

Assistant Technical Standards Manager

Richard Nix
ESTA
P.O. Box 23200
Brooklyn, NY 11202-3200
USA
1-212-244-1505 ext. 649
richard.nix@esta.org

Technical Standards Council Chairpersons

Mike Garl
Mike Garl Consulting LLC
1-865-389-4371
mike@mikegarlconsulting.com

Mike Wood
Mike Wood Consulting LLC
1-512-288-4916
mike@mikewoodconsulting.com

Followspot Position Working Group Chairpersons

Richard Logothetis
Lycian Stage Lighting
Phone: 1-845-469-2285
richard@lycian.com

Stephen Vanciel
IATSE Local 631
Phone: 1-321-278-0379
svanciel@bellsouth.net

Acknowledgments

The Followspot Position Working Group members when this document was approved by the working group on _____ are shown below. The company or organization listed is the company or organization represented.

Voting members:

Observer (non-voting) members:

Interest category codes:

P = producer

DE = designer

G = general interest

U = user

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1 Introduction

1.1 Purpose

The purpose of this document is to offer guidance and to make recommendations for the placement and arrangement of permanent followspot positions in places of public assembly. Information in this document is not intended to conflict with any federal, state or local codes, statutes, ordinances or regulations, or to replace competent professional advice.

1.2 Scope

This document makes recommendations for the operational and functional aspects of permanent followspot positions within places of public assembly, including the determination of their location within the venue, their physical space requirements, and the safety considerations associated with their use.

The scope of this document includes accessibility and environmental concerns, but only to the extent that these concerns relate to (a) the location and configuration of followspot positions, (b) the working environment created by these areas during their intended use, and (c) the working environment created during other activities incidental to their intended use.

Temporary followspot positions are not included in the scope of this document.

2 Definitions

2.1 followspot: A manually operated spotlight intended specifically for illuminating moving objects or performers.

2.2 followspot position: A purpose-designed, permanently located space or platform, specifically intended for one or more followspots.

2.2.1 followspot booth: A followspot position that is an enclosed room or space specifically intended for the placement, use, and operation of followspots.

2.2.2 followspot platform: A followspot position that is an open-sided platform specifically intended for the placement, use, and operation of followspots.

2.3 obstruction: Any interference to the movement of the followspot, its operator, or any interference in the path of the followspot light beam, between the intended followspot position and the performance area, whether predictable or not. Examples of physical obstructions include building structural framing elements and any equipment attached to the building structural framing elements.

2.4 pan angle: The included angle formed by the followspot's horizontal limits of movement, measured at the followspot's beam centerline.

2.5 qualified lighting specialist: A person who by possession of a recognized degree or certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to live event lighting using followspots.

2.6 railing: Any barrier that is intended to function as an OSHA or building code compliant guardrail

2.7 Special-Purpose Industrial Occupancy: An industrial occupancy in which ordinary and low hazard industrial operations are conducted in buildings designed for, and suitable only for, particular types of operations, characterized by a relatively low density of employee population, with much of the area occupied by machinery or equipment.

2.8 throw distance: The line-of-sight distance from the front of the followspot to its intended target when the target is at its farthest point from the followspot.

2.9 tilt angle: The included angle formed by the followspot's vertical limits of movement, measured at the followspot's beam centerline.

3 Type Classifications

The recommended criteria for followspot positions are determined by the venue size and its intended function (i.e., the programming). In general, followspots that must light a stage that is a long distance away will be physically larger and require more power than followspots lighting a stage that is closer. Also, if the general level of illumination on the stage is high, the followspots will need to be larger and use more power than they would if the general light level were lower. The following type listing should be modified to suit the particular situation and is only a rough guide. For example, if the throw distance used in the type listing suggests a type 2, but the stage is expected to be brilliantly illuminated, perhaps type 3 should be used for the design criteria.

3.1 Type 1 position

A followspot position where the throw distance from the followspot position to the stage is up to 80 feet (24.4 m).

3.2 Type 2 position

A followspot position where the throw distance from the followspot position to the stage is 80 to 150 feet (24.4 to 45.7 m)

3.3 Type 3 position

A followspot position where the throw distance from the followspot position to the stage is over 150 feet (45.7 m).

4 Space and Location

The intent of this section is to provide technical guidelines for permanent followspot positions.

4.1 Location

Followspot positions require clear lines of sight from the fixture light source and from the operator's eye to all locations within the venue that the followspot is intended to illuminate. The horizontal and vertical angle of incidence between the beam of light to the performer or object to be illuminated is a critical design decision in determining the location and layout of the followspot position. The specific criteria vary from venue to venue and may change for individual followspot positions within a single venue.

Lighting in a performance venue is an artistic endeavor. There are many suitable geometric relationships between the location of the followspot position and the target. However, there are some general recommendations that apply to a great many venues.

4.1.1 Tilt angles

Followspot positions should be located to provide tilt angles as follows:

In theatres and similar venues, the downward tilt angle should be within the range of 25 degrees to 55 degrees (0.44 to 0.96 radians).

In arenas and similar venues, the downward tilt angle should be within the range of 30 degrees to 55 degrees (0.52 to 0.96 radians).

In addition, allow for steeper or shallower tilt angles when needed. Seek the advice of a qualified lighting specialist in planning followspot tilt angles when any special event may take place.

4.1.2 Pan angles

For theatres and similar venues, the followspot position should be located to allow the followspot's light beam to reach from one side of the stage or performance area to the other without obstruction.

For arenas and similar venues, the pan angle should be a minimum of 135 degrees (2.36 radians), or as necessary to include the entire performance space, whichever is greater.

4.2 Dimensional Requirements

The followspot position must be large enough to house the followspot(s) and operator(s) and must allow sufficient space for followspot movement as intended. Sufficient clearance for access, circulation and equipment maintenance must also be included. Refer to the manufacturer's specifications for the dimensions of the equipment and access requirements. In the absence of specific dimensions, perhaps because the equipment has not been specified, the following recommendations may be used as a guide.

4.2.1 Type 1 position – Approximately 48 square feet (4.6 m²) should be allowed for each followspot and operator.

4.2.2 Type 2 position – Approximately 66 square feet (6.1 m²) should be allowed for each followspot and operator.

4.2.3 Type 3 position – Approximately 100 square feet (9.3 m²) should be allowed for each followspot and operator.

4.3 Access

4.3.1 Equipment Access

The working floor surface of Followspot Positions should be at a building floor level without intervening level changes, unless compliant with OSHA access requirements.

Followspots are often about the size of a person or even larger. Minimum unobstructed horizontal clearance on all access paths should be 36 inches (0.91 m). Minimum unobstructed vertical clearance should be 72 inches (1.82 m).

If clear equipment access via passageways is not provided, a lifting point for hoisting equipment into the followspot position should be provided. The lift point should be designed to support a minimum of 500 pounds (227 kg), and should be located a minimum of eight feet (2.4 m) above the platform surface, adjacent to the platform.

4.3.2 Personnel Access and Egress

Followspot positions should be considered a Special-Purpose Industrial Occupancy. Provisions for access and egress should meet the requirements for Special-Purpose Industrial Occupancy spaces in applicable local, state, and federal codes.

4.4 Followspot Position Windows

Followspot positions could be open to the performance space, or they could be closed off from that space by walls with windows in them. This section offers guidance for followspot positions with windows.

4.4.1 Size

In positions that require windows, the windows should be large enough to permit transmission of the followspot light beam throughout its intended range of movement without obstruction during normal operation. Venue designers should keep in mind that the beam of light emitted from the followspot is a cone that widens as the distance from the followspot increases. The edges of the beam should not be blocked by the edges of the windows. If possible, consult the followspot manufacturer's specifications for the dimensions of the spotlight beam at a given distance. Consideration should be given to the placement of the booth window and its impact on the acoustics of the venue.

4.4.2 Transparency

In positions that require windows, the window glass should not reflect light back into the eyes of the followspot operator, and should not refract in a manner that creates a secondary image, or that distorts the light beam. The glass should not be tinted and should not color or diffuse the beam. Provision should be made to clean the glass on both sides. Refer to Annex B for additional information about window considerations.

4.5 Communication

See [6 Electrical Recommendations](#).

4.6 Floor surfaces

The floor surface should be smooth, and without unprotected openings through which an operator is likely to drop tools or the contents of his or her pockets.

4.7 Space planning

Followspot positions should be designed to permit movement of the followspot and operator throughout the followspot's complete range of motion without obstructions, including possible obstructions from collisions with adjacent followspots, equipment, or operators. Location and space planning should consider the relationship of

the followspot to the audience, both seated and standing, and all the architectural and structural features of the venue that may interfere with the followspot's intended range of motion.

See the informative Annex for drawings depicting some possible followspot placements.

4.8 Wall and ceiling finish

In followspot positions that have walls and ceilings, the wall and ceiling finishes should be a dark color or black to contain light spill.

4.9 Acoustical isolation

Consideration should be given for noise transmission to the audience area from the followspot position, and, where deemed necessary, appropriate noise control measures should be implemented. Refer to Annex B for additional information about acoustical isolation.

5 Structural

5.1 Loading

5.1.1 Live Load Capacity

Minimum live load capacity for followspot positions should be at least 50 pounds per square foot (244 kg/m²), distributed over the entire floor area of the position. The recommended point load capacity for structural design purposes should be taken as 2000 pounds (909 kg) within a 1.0 square foot (0.093 m²) area. Point loads need not be considered concurrently with distributed live loads.

5.1.2 Dead Load Capacity

The dead load should accurately reflect the self-weight of the structure.

5.2 Deflection

The live load deflection of beam elements supporting the working surface of a Followspot Position should not be greater than span/600. The total load deflection of those beam elements should not be greater than span/480.

5.3 Fall Restraint Systems

5.3.1 All followspot positions that contain removable railings, unprotected openings, or that are not otherwise fully enclosed require the mandatory use of Fall Restraint Systems as defined by OSHA 29 CFR 1926.751 and any other applicable codes and legislation.

5.3.2 Fall restraint systems are required to meet the requirements of OSHA 29 CFR 1926.760 and any other applicable codes and legislation.

5.4 Railings

Except as otherwise permitted, railings are required to conform to the requirements of OSHA 1910.23(c).

5.4.1 Removable railings should be used only where supplemental fall protection is provided.

5.4.2 Removable railings should be in place during followspot operation, except where they create an obstruction to the followspot light beam.

5.4.3 When not in place, removable railings should be secured to prevent the removed parts from falling.

5.4.4 Permanently fixed wire rope or other similar material may be used as restraint in followspot positions where conventional railings would obstruct the followspot light beam during normal operation, but are required to meet the strength requirements of standard railings.

5.5 Followspot anchorage

5.5.1 Where Fall Restraint Systems are required, the followspot should be anchored to prevent the followspot from toppling or falling from the followspot position.

5.5.2 The Fall Restraint System anchorage may be used as the followspot anchorage only where specifically designed for such use.

6 Electrical Recommendations

6.1 Followspot power requirements

Recommended power requirements for followspot positions depend on whether the particular position is intended to accommodate the venue's permanently installed equipment, or to accommodate a variety of temporary equipment installed to meet the requirements of a touring company, repertory performance, or other temporary user.

6.1.1 Type 1 installations

A single, dedicated and labeled 20 ampere, 120 volt, single-phase circuit should be provided at the location of each followspot. The receptacle should be a NEMA 5-20 or NEMA L5-20 receptacle.

6.1.2 Type 2 installations

A single, dedicated and labeled 20 ampere, 208 or 240 volt, single-phase circuit should be provided at the location of each followspot. The receptacle should be a NEMA L6-20 receptacle. A single, dedicated and labeled 20 ampere, 120 volt, single-phase circuit may also be provided as required. Labeling should include the location of the overcurrent protection.

6.1.3 Type 3 installations

A single, dedicated and labeled 30 ampere, 208 or 240 volt, single-phase circuit should be provided at the location of each followspot. The receptacle should be a NEMA L6-30 receptacle. A single, dedicated and labeled 20 ampere, 120 volt, single-phase circuit may also be provided as required. Labeling should include the location of the overcurrent protection.

6.2 Overcurrent Protection

Type 1 - Overcurrent protection may be provided in spaces remote from the followspot booth or platform. However, the outlets (receptacles) should be labeled as to location of the circuit breaker panel and breaker number.

Types 2 and 3 - Overcurrent protection should be located within the Followspot position. Such panels should be surface mounted and be large enough to accommodate spare breaker spaces and reserved additional capacity for expansion.

6.3 Communications

Followspot positions should be provided with production communications wiring to outlets located conveniently to the followspot operator, but out of the way of normal followspot operation.

6.4 Data

Data lines compatible with an extension of the lighting data network may be brought to areas where followspots are used. Data lines should be appropriately labeled and should be isolated from the main data lines so that electrical malfunctions at the followspot will not adversely affect the data network.

Type 1 - Data lines optional.

Types 2 and 3 - Data lines recommended.

6.5 Followspot Position Lighting

6.5.1 General lighting

Provision for general illumination for the followspot position is recommended per IESNA standards sufficient for non-performance work and maintenance. Cutoff units with low side emissions should be used to provide minimal light leakage into the auditorium.

A local switch controlling such followspot position lighting should be provided. This switch should have a guard to prevent unintended activation.

6.5.2 Task lighting

Each followspot location should be equipped with dedicated task lighting for illumination of cue sheets, followspot controls, or other areas in a controlled manner during an event. The task lighting should be adjustable to suit the operator. Each task light should have a dedicated dimmer convenient to the followspot operator working at that position. These task lights should be independent of the general illumination lighting control.

7 HVAC**7.1 General**

The followspot operating environment temperature should be maintained within the generally accepted human comfort zone of 50 to 90 degrees F (10 to 32 degrees C). When ambient temperatures exceed 100 degrees F (38 degrees C), the conditioned operating environment temperature at each fixture should not exceed 90 degrees F (32 degrees C). In outdoor venues, additional cooling may be necessary for proper equipment function.

7.2 Special ventilation

If special ventilation is provided, there should be local control.

7.3 Operational noise levels

When designing positions located in close proximity to an audience, HVAC operational noise levels should be considered.

7.4 Heat Load

The heat load of followspot booths should be calculated by assuming that all the power provided to the followspot position will be converted into heat. The heat produced by one operator per followspot should be added to the previous calculation.

Annex

The intent of this Annex is to illuminate and to clarify the concepts presented in the body of the document and to serve as a reference for additional considerations. The body of the document may be used as a guide to provide for the basic functionality, access and safety of follow spot positions. The intent of this Annex is to support the information contained in the body of the document and to present additional information to aid in planning an enhanced environment and anticipate future needs.

The diagrams in this annex are illustrative in nature and are not intended to depict a definitive design solution for any specific application. The diagrams are included only as a reference to illustrate the concepts and relationships between the equipment and the surrounding structure as set forth in the text.

A.1 Guidelines for heat load calculations (informational):

Wattage	BTU/hour
400	1,400
700	2,400
1000	3,400
1600	5,500
2000	6,800
2500	8,500
3000	10,200
4000	13,600
4500	15,400

Ventilation, as referred to in section 7.2, pertains to heat removal rather than removal of toxic gases. Current technology no longer requires the use of ventilation for removal of toxic gases, because carbon arc technology is obsolete.

A.2 Convenience power (additional recommendations)

Type 1 - A minimum of one duplex 20 amp, 120 volt convenience outlet should be provided for every three followspots, located where the outlet is most accessible to all fixtures.

Type 2 - A minimum of two (2) duplex 20 amp, 120 volt convenience outlets should be provided for first two followspots to be installed in a given position. An additional duplex 20 amp, 120 volt outlet should be provided for each two additional followspots within the same given position.

Type 3 - A minimum of two (2) duplex 20 amp, 120 volt convenience outlets should be provided for first two followspots to be installed in a given position. An additional duplex 20 amp, 120 volt outlet should be provided for each two additional followspots within the same given position.

One additional outlet, rated 208-230 VAC, 30 ampere, 3 ϕ , 5 wire should be provided for high power projectors or other equipment.

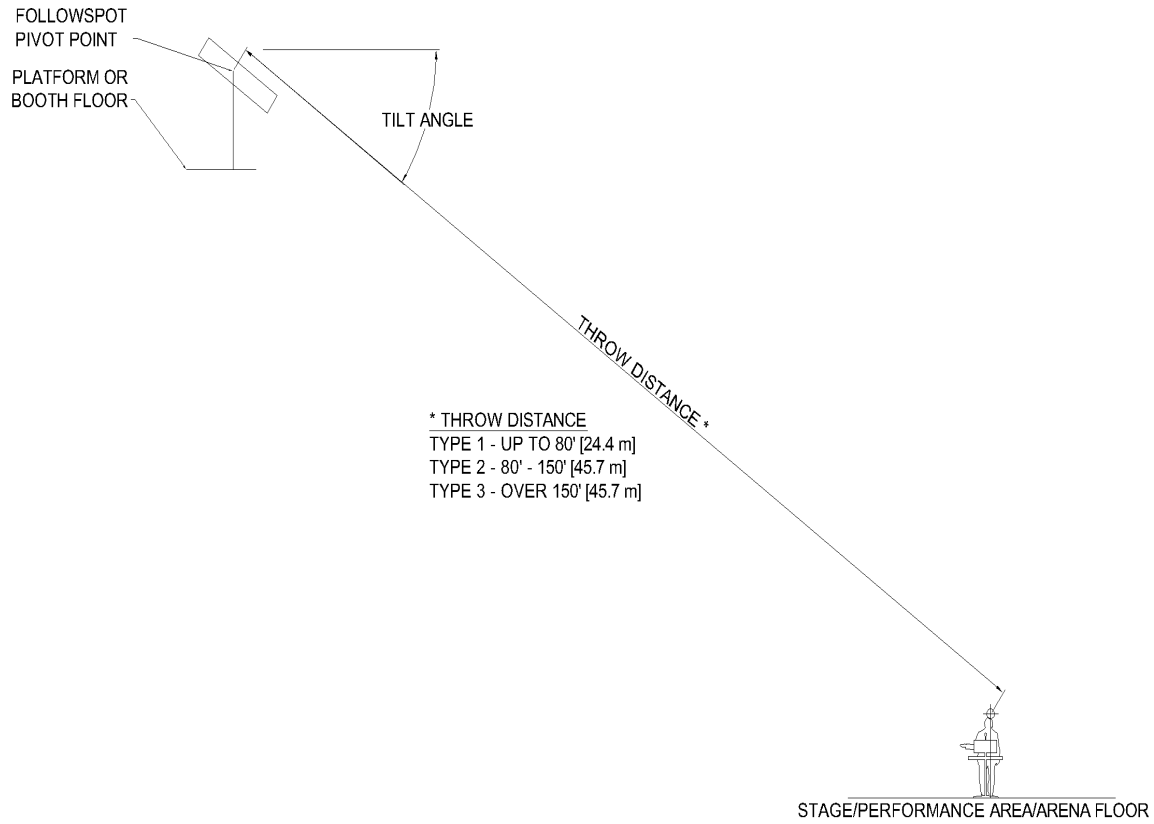
A.3 Miscellaneous additional recommendations

Connectors and Outlets: Under normal operating conditions, followspot positions are dark. Consideration must be given to the location of power and communication outlets to avoid hazards and operational restrictions from such things as headset cables and under foot power cables.

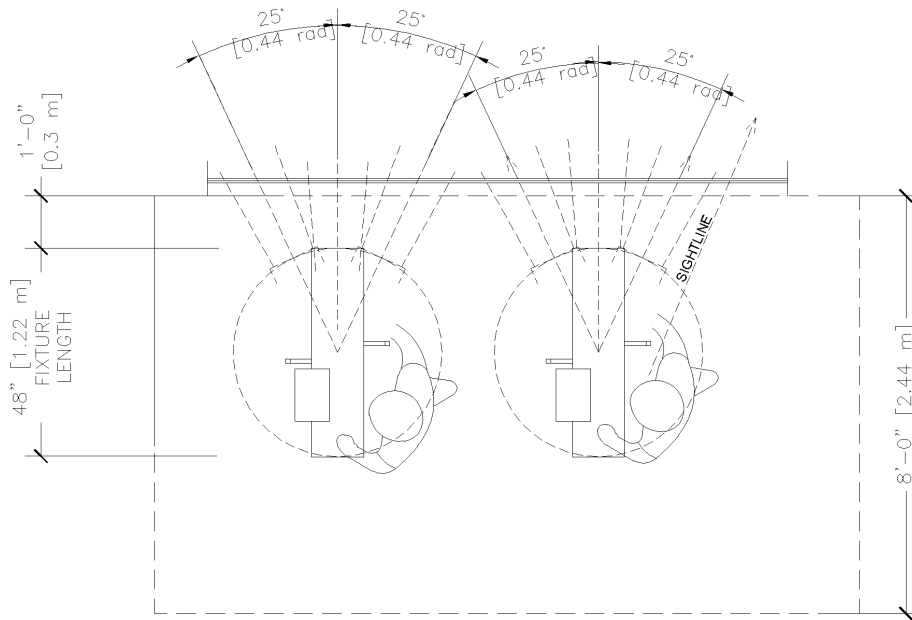
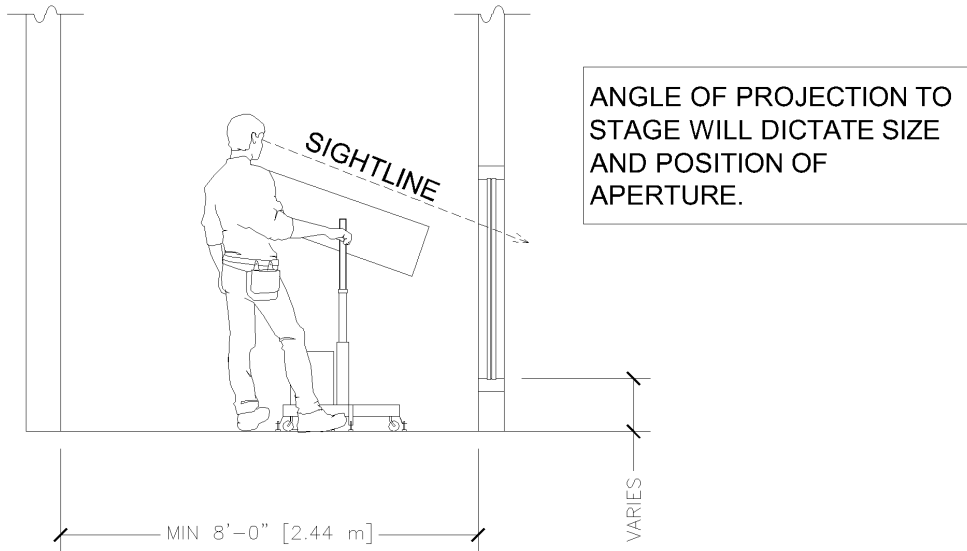
Electrical planning note: When new conduit is being run to followspot positions, it is recommended that the size be increased by one or more trade sizes to accommodate future needs. It is suggested that a robust locking connector (such as pin and sleeve or twist-lock) be used for followspot connections in all types of installations. A bus duct may be provided for potential portable equipment loads in larger booths.

A.4 Drawings

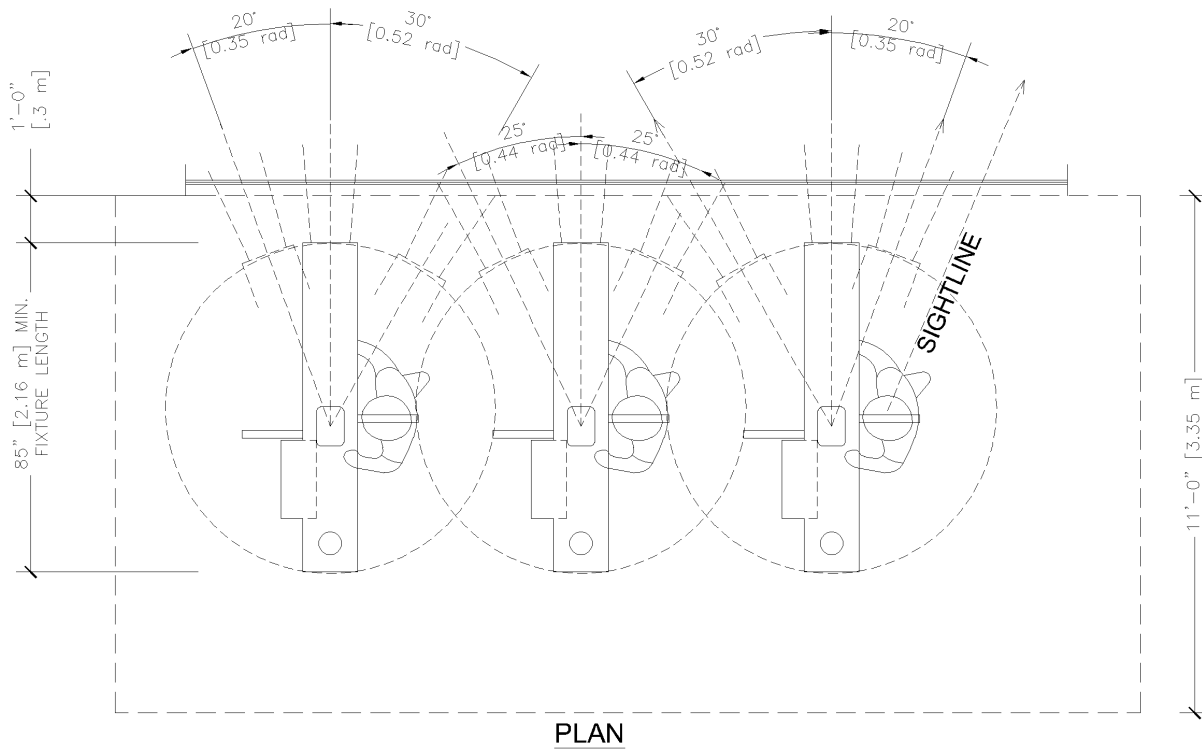
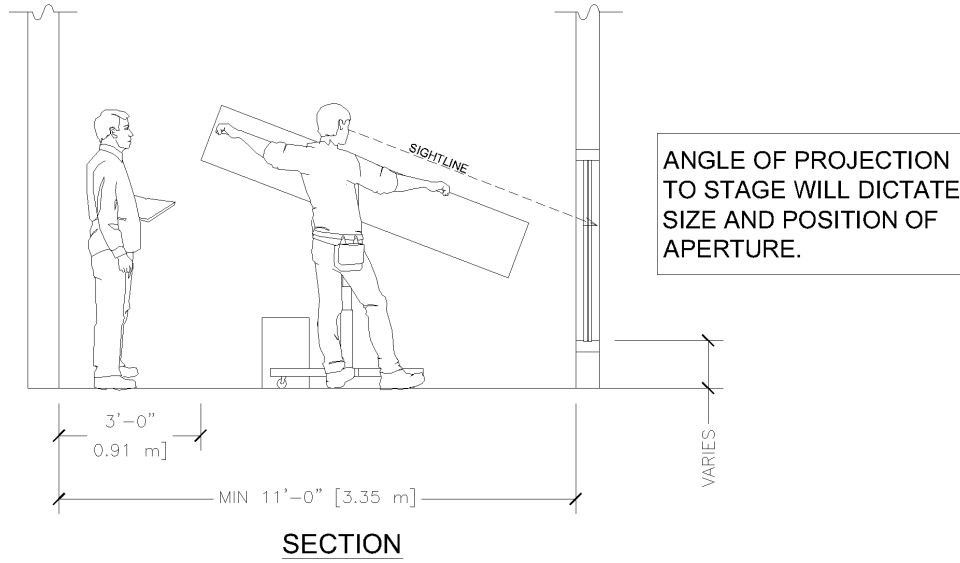
The following drawings illustrate some of the ideas expressed in the main body of this recommended practice and suggest some possible implementations of followspot positions based on the recommendations. Many other implementations are possible; the following drawings should not be interpreted as the only acceptable implementations or as the best possible implementations for all situations.



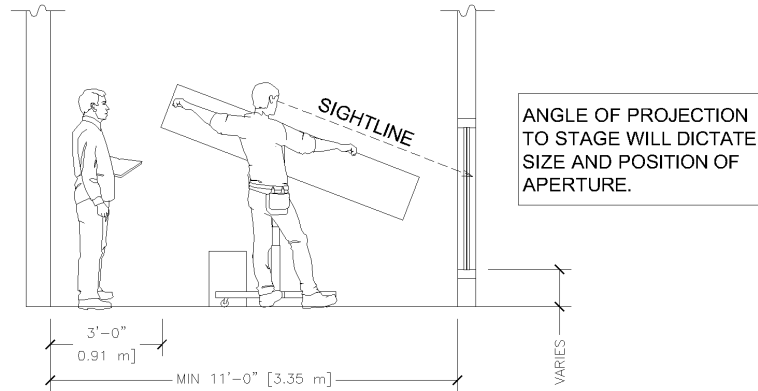
THROW DISTANCE AND PLATFORM LOCATION DIAGRAM



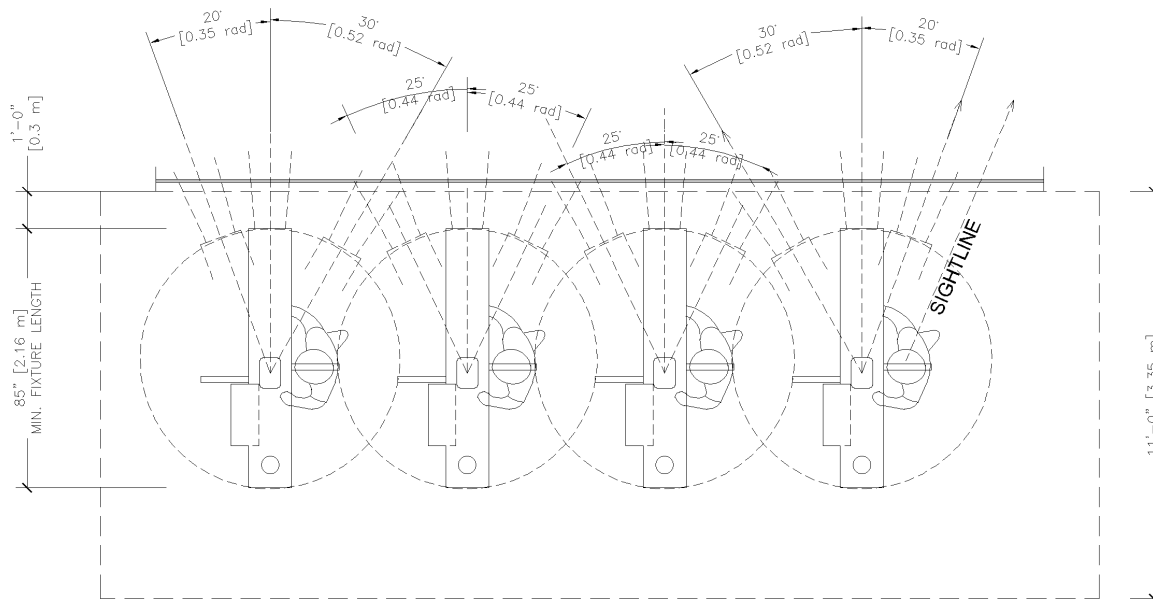
INTIMATE (TYPE 1) VENUE



LARGE (TYPE 2) VENUE
PROSCENIUM THEATRE EXAMPLE

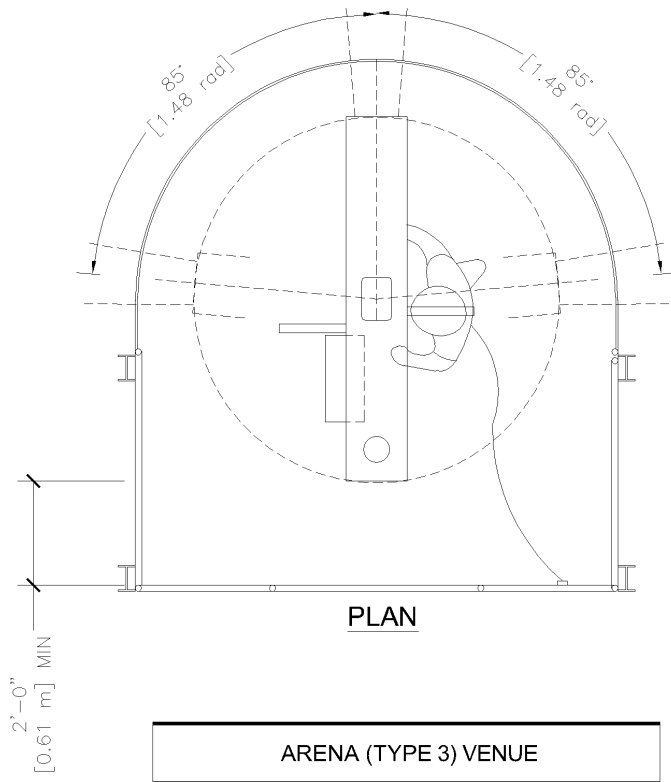
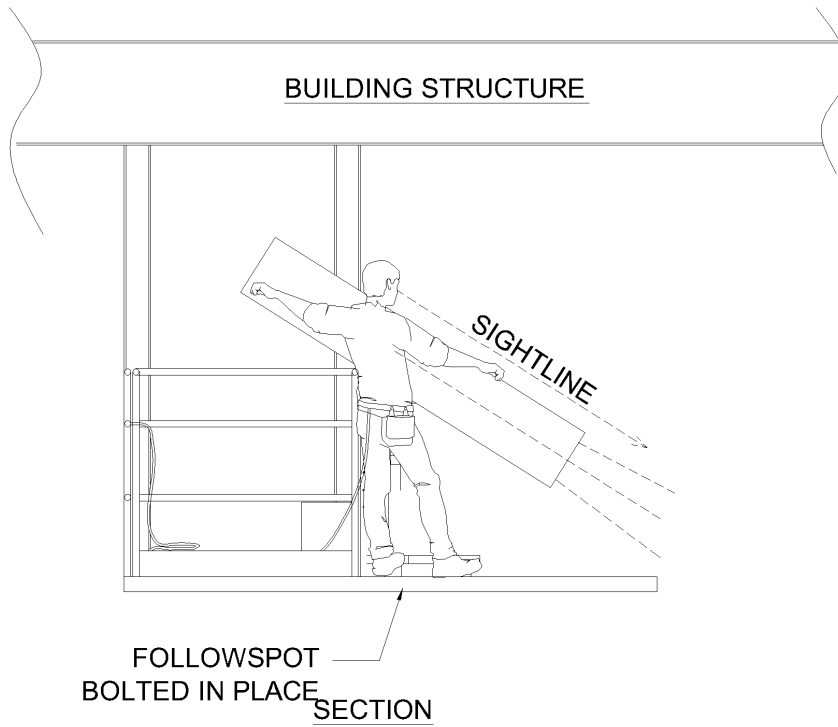


SECTION



PLAN

**LARGE (TYPE 2) VENUE
PROSCENIUM THEATRE/ROAD HOUSE EXAMPLE**



Annex B – Followspot position aperture design caveats

This annex describes the inherent yet not obvious relationships between booth window glass, window construction and location, and acoustical considerations. One cannot place higher emphasis on any single factor without affecting all other factors, so there are caveats to consider in the followspot booth design process.

Ostensibly, the followspot position's most important functions are to accommodate the safety of the operator, and the unobstructed, unaltered passage of the followspot's light beam from the position to the stage. However, the first consideration should be to determine if the local Authority Having Jurisdiction (AHJ) governs any aspect of the aperture design.

From the building code perspective, all interior window and glazing applications are generally covered by the International Building Code (IBC), in Chapter 24. Most of those requirements are benign to followspot position aperture applications, but there are a few parameters that will mandate compliance with the IBC requirements. In simplified terms, the primary considerations can be condensed down to the following points:

- (IBC 2403.3) *Deflection of the pane shall not exceed 1/240 of the glass edge length + ¼ inch, when subjected to IBC 1605 load combinations.*

These loads typically do not apply, because they are intended to address exterior windows.

- (IBC 2403.4) *Where interior glazing is installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges shall be not greater than the thickness of the panels when a force of 50 pounds per linear foot (plf) (730 N/m) is applied horizontally to one panel at any point up to 42 inches (1067 mm) above the walking surface.*

This will generally not apply if the aperture opening is framed on all four sides.

Certain other conditions will trigger additional, special requirements.

2405.2 Allowable glazing materials and limitations

1. *For monolithic glazing systems, the glazing material of the single light or layer shall be laminated glass with a minimum 30-mil (0.76 mm) polyvinyl butyral (or equivalent) interlayer, wired glass, light-transmitting plastic materials meeting the requirements of Section 2607, heat-strengthened glass or fully tempered glass.*

2. *For multiple-layer glazing systems, each light or layer shall consist of any of the glazing materials specified in Item 1.*

Annealed glass is permitted to be used as specified in Exceptions 2 and 3 of Section 2405.3.

All window materials, except laminated glass and plastic materials, must also incorporate screening, or other methods of broken glass containment, but there are exceptions based on the size of the window pane:

2405.3 Screening.

Where used in monolithic glazing systems, annealed, heat-strengthened, fully tempered and wired glass shall have broken glass retention screens installed below the glazing material. The screens and their fastenings shall be: capable of supporting twice the weight of the glazing; firmly and substantially fastened to the framing members; and installed within 4 inches (102 mm) of the glass. The screens shall be constructed of a noncombustible material not thinner than No. 12 B&S gage (0.0808 inch) with mesh not larger than 1 inch by 1 inch (25 mm by 25 mm). In a corrosive atmosphere, structurally equivalent noncorrosive screen materials shall be used. Annealed, heat-strengthened, fully tempered and wired glass, where used in multiple-layer glazing systems as the bottom glass layer over the walking surface, shall be equipped with screening that conforms to the requirements for monolithic glazing systems.

Exception: In monolithic and multiple-layer sloped glazing systems, the following applies:

1. *Fully tempered glass installed without protective screens where glazed between intervening floors at a slope of 30 degrees (0.52 rad) or less from the vertical plane shall have the highest point of the glass 10 feet (3048 mm) or less above the walking surface.*

2. Screens are not required below any glazing material, including annealed glass, where the walking surface below the glazing material is permanently protected from the risk of falling glass or the area below the glazing material is not a walking surface.
3. Any glazing material, including annealed glass, is permitted to be installed without screens in the sloped glazing systems of commercial or detached noncombustible greenhouses used exclusively for growing plants and not open to the public, provided that the height of the greenhouse at the ridge does not exceed 30 feet (9144 mm) above grade.
4. Screens shall not be required in individual dwelling units in Groups R-2, R-3 and R-4 where fully tempered glass is used as single glazing or as both panes in an insulating glass unit, and the following conditions are met:
 - 4.1. Each pane of the glass is 16 square feet (1.5 m²) or less in area.
 - 4.2. The highest point of the glass is 12 feet (3658 mm) or less above any walking surface or other accessible area.
 - 4.3. The glass thickness is 3/16 inch (4.8 mm) or less.
5. Screens shall not be required for laminated glass with a 15-mil (0.38 mm) polyvinyl butyral (or equivalent) interlayer used in individual dwelling units in Groups R-2, R-3 and R-4 within the following limits:
 - 5.1. Each pane of glass is 16 square feet (1.5 m²) or less in area.
 - 5.2. The highest point of the glass is 12 feet (3658 mm) or less above a walking surface or other accessible area.

The requirements for screens are intended to address potential hazards where glass or glass fragments might be knocked loose or broken from the pane.

Section 2406 addresses safety glazing, applicable to hazardous locations, the applicability of which is determined by the criteria in 2406.4:

2406.4 Hazardous locations.

The locations specified in Sections 2406.4.1 through 2406.4.7 shall be considered to be specific hazardous locations requiring safety glazing materials.

2406.4.3 Glazing in windows.

Glazing in an individual fixed or operable panel that meets all of the following conditions shall be considered to be a hazardous location:

1. The exposed area of an individual pane is greater than 9 square feet (0.84 m²).
2. The bottom edge of the glazing is less than 18 inches (457 mm) above the floor.
3. The top edge of the glazing is greater than 36 inches (914 mm) above the floor.
4. One or more walking surface(s) are within 36 inches (914 mm), measured horizontally and in a straight line, of the plane of the glazing.

Exceptions:

1. Decorative glazing.
2. Where a horizontal rail is installed on the accessible side(s) of the glazing 34 to 38 inches (864 to 965 mm) above the walking surface. The rail shall be capable of withstanding a horizontal load of 50

pounds per linear foot (730 N/m) without contacting the glass and be not less than 11/2 inches (38 mm) in cross-sectional height.

3. Outboard panes in insulating glass units or multiple glazing where the bottom exposed edge of the glass is 25 feet (7620 mm) or more above any grade, roof, walking surface or other horizontal or sloped (within 45 degrees of horizontal) (0.79 rad) surface adjacent to the glass exterior.

Given that the majority of followspot positions will be in booths (window opening height dictated by desktop height), or in locations where the operator is working while standing (window opening height determined by downward tilt angle of the followspot), it might be reasonable to suggest that most installations will require bottom window edges greater than 18 inches above the floor, and so would not be considered a hazardous location.

Keep in mind that - if the bottom edge is 18 inches or less - it is likely that the installation will meet all other criteria to be considered as a hazardous location, and testing in accordance with ANSI Z97.1, *Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test*, will apply, unless the exposed surface area of one side of one lite (pane of glass) is 9 sq ft or less. Such an opening size seems too small to be deemed suitable for our applications, but not impossible for a small followspot position.

Requiring that any glazing required for followspot positions must conform to the requirements of IBC Chapter 24, as applicable, addresses all reasonable safety concerns, but then dictates the permissible types of glass or laminate material that could then be used to meet those requirements.

If the IBC requirements do not apply to the specific application, then the designer has more freedom in choices of glass or laminate material. This plays a particularly important role in selection of material for the sake of color, flatness, transmission and reflective properties, and sound transmission. For example, if IBC requirements do not apply, then single panes of glass can be used instead of laminated substrates. This is an important consideration because laminates, by definition, are comprised of multiple layers of material(s), each of which represents layers of diffraction or refraction that affects the quality and quantity of light passing through the pane. Single panes refract less than multiple layered panes.

Optical clarity might also be perceived as an important aspect – and, indeed, it is. However, demanding an optically clear glass will result in increased cost, because such panes are considered highly specialized panes as compared to common window glass properties.

Sound attenuation might be a primary consideration, but expecting an STC rating above 35 – the level at which *loud speech can be heard and understood* - will require a single pane of glass not less than ½ inch thick, or would require multiple panes separated by air space (another distinct refraction layer).

The most important recommendation here is to be mindful of primary design requirements – acoustics, light transmission, and code required safety considerations – and understand how they all interact.