

Fundamentals *of* Lighting *for* Videoconferencing



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Fundamentals of Lighting for Videoconferencing

**Prepared by:
IESNA Committee on
Lighting for Videoconferencing
and Presentation**

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1.0 INTRODUCTION

Whether to witness a presentation, come to an agreement, execute a plan or collect and otherwise exchange information, the business meeting is fundamentally a process of communication. The rise of convenient, low-cost video technology has vastly increased the effectiveness of long-distance business interchange via the videoconference. Videoconferencing reduces the need to locate people in the same room, saving time and money. Essentially, it is an advancement over the telephone conference call, lending the ability to read facial cues and view all manner of visual materials.

A videoconferencing space is any facility where audio- and video-based two-way communication occurs between a local and remote site(s). This incorporates verbal communication supported by live visual images, as well as the transfer and display of supporting information and data such as documents, spreadsheets, images and other multimedia program materials.

The fundamental goal for these environments is to facilitate good communication, both verbal and non-verbal. The video image is part of this dialog, requiring that lighting designers recognize the video camera as a member of the meeting group. A successful videoconferencing space balances the needs of the participants with those of the camera. By understanding the role of room surfaces and adapting photographic and broadcast techniques, traditional lighting design can be modified to simultaneously deliver visual comfort, facilitate group interaction and produce high quality video images for remote participants.

This Design Guide addresses the technical and practical requirements for lighting small- to medium-sized, single-camera videoconference spaces used by ten to twenty participants. Fundamental concepts are accompanied by recommendations that will assist practitioners to configure and specify appropriate lighting systems in the presence of architectural and technical requirements specific to videoconferencing projects. It is not the intent of this Guide to provide cookie-cutter solutions.

This Design Guide is written with lighting and design professionals in mind. However, due to the unique and somewhat unforgiving nature of these spaces,

the full input of a lighting professional as part of a multidisciplinary design team is strongly recommended. Other individuals should find the following information useful and informative.

2.0 APPLICATIONS TO MEETING SPACES

This Design Guide addresses single-camera videoconference systems for small audiences. Business communications of this nature typically occur in spaces characterized as small conference rooms. Concepts and criteria presented here are applicable to any video-based communication environment. This Guide does not attend to the more complex distance learning facilities, corporate studios or educational broadcast facilities. However, situations that are more complex will be handled in the forthcoming *Recommended Practice* edition of this document.

2.1 Environments

The terms *local* (near end) and *remote* (far end) reinforce the fact that a videoconference is communication between two or more locations. From the participant's perspective, *local* refers to their on-camera location. *Remote* refers to the location viewing or receiving their video image. This document, presents guidelines for lighting the *local* site only. These environments are often categorized as:

- dedicated videoconferencing sites
- conference rooms
- educational facilities
- corporate training centers
- corporate board rooms

2.2 Requirements

The camera lacks the capacity to handle a wide range of *luminance*, such as can the eye. The term "luminance" correlates to the perceived brightness of a surface. Specifically, luminance is the amount of light in a specific direction emanating from a measured area of any surface (see **Glossary**). Any surface we see has a luminance associated with it; this is affected by 1) the amount of light falling upon that surface, and 2) its reflective characteristics. As an example, under the same ceiling luminaire, a typical office wall painted white will appear brighter than the same wall painted gray. Under the same amount of light by virtue of its higher reflectivity, the white wall will produce a *greater luminance* than the gray wall, and will appear brighter. This has profound effects in the videoconferencing environment, for the eye takes these differences in stride. The video camera, however, does not.



As such, the video camera changes the way we design lighting in a videoconferencing location. Typical *design requirements* and *visual tasks* must be split into *human* and *camera* subgroups. Human requirements will influence what people see and how they feel during the meeting. Camera requirements affect the quality of the video image seen by the remote participants.

Participant requirements

- visually comfortable room
- glare-free view of video displays and tasks
- sufficient contrast within displays
- clear view of other displays (such as annotation pads, electronic white boards, gray marker boards, and equipment racks)

Participant tasks

- seeing and interacting with local participants
- reading verbal and non-verbal cues
- seeing full room environment
- reading and writing text
- interacting with remote participants (via video display)
- retrieving information (via video desktop or laptop display)

Camera requirements

- proper vertical illumination on faces
- appropriate contrasts between subjects and surrounding room surfaces
- correct subject-to-camera distance
- specific seating arrangement
- no direct views of luminaires
- no direct views of video display monitors

Camera tasks

- providing views of participants and local room
- acquisition of paper-based documents (viewed via a document camera)
- acquisition of visual aides (such as marker boards, display boards, and drawings)

Other considerations

- geometry of the space
- positioning of the participants
- classroom setting (straight, tiered seating)
- conference room style (semi-circular seating)
- other uses of the space

3.0 HUMAN VISUAL REQUIREMENTS

Human visual systems and video cameras all require light to operate. Similarities end there. Where the visual system is an image *interpreter*, the camera is merely an image *detector*. Video cameras

have little tolerance for luminance variation across a single scene. The visual system can handle a range of 1000:1, while the camera can only simulate this over a range of 30:1.^{1,2} A visual system consists of the eye and brain working together.^{3,4,5} This gives people abilities that cameras do not have:

accommodation – (the eye changes focus from one distance to another)

adaptation – (the visual system increases its sensitivity as light levels fall)

constancy – (people tend to consistently interpret the lightness, color, size and shape of objects regardless of their lighting, distance or orientation)

contrast sensitivity – (visibility of objects depends on a combination of their size and contrast)^{3,4,5}

Be aware that videoconferencing cameras do not see the world as humans do. Cameras are highly susceptible to luminance extremes (high and low), quick movements, and other irregularities that the eye/brain takes in stride. A scene that appears fine to the eye can be useless from the standpoint of videoconferencing. For an in-depth description of the visual system, see IESNA ED-100, *Lighting Education Fundamentals Course*⁶; or IESNA HB-9-00, *IESNA Lighting Handbook*, 9th Edition.⁴

3.1 Source-Task-Eye Geometry

Videoconferencing environments present complex spatial and luminance relationships between subjects, tasks and luminaires (see **Figure 1**). These associations must be explored early on during the design phase (see **Section 7.0** — Design Approach). Critical relationships include:

- participant / camera / luminaire
- participant / touch screen (or input computer) / luminaire
- participant / display (or projection screen) / luminaire
- participant / presentation board / luminaire

3.1.1 Distractions. An important aspect of the videoconference room is the comfort of the participants. Careful analysis of the above geometries can help reduce distractions, and will maximize visual comfort for room occupants. Ignoring this analysis can sabotage the experience of participants (and the video conference) by introducing *glare* and *veiling reflections*. From a lighting standpoint, comfort can be insured and maintained by controlling direct



Figure 1. Luminance relationships for the videoconference environment



Figure 2. Normal VDT displays



Figure 3. Veiling reflections on VDT displays

source light (glare) from high-angle fixtures and any reflected light off displays and computer screens (veiling reflections).

3.1.2 Glare and Veiling Reflections. The sensation of glare results when a bright luminous source in the visual field scatters unwanted light across the retina. Veiling reflections are reflections of light off non-matte surfaces, making it difficult or impossible to see desired detail, such as written text.^{4,5,6} (See **Figure 2** and **Figure 3**.)

Veiling reflections result when the light incident upon a surface reflects directly into the eye of the observer. Over time, both glare and veiling reflections will have the following progression of effects upon videoconferencing participants:

- 1) annoyance
- 2) difficulty
- 3) distraction
- 4) discomfort
- 5) disability^{3,4}

The human visual system is designed to cope with distractions, but they can be significantly reduced by properly positioning subjects and luminaires. Typical parabolic luminaires cut off distributions at approximately 45° from nadir, lessening, though not eliminating glare problems. Typical videoconferencing luminaires provide an asymmetrical distribution at 55° to 60° towards the participants. Light at these angles can increase the perception of distraction or discomfort glare as well as provide the desired illuminance on participants faces.