Sound with Images

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LIGHT TERMINOLOGY

● In both the audio-visual and closed circuit television fields, the terminology for illumination is the same. For an acceptable image on the c.c.t.v. monitor, the subject must be illuminated sufficiently; at or above the prescribed minimum indicated in the specifications of the c.c.t.v. camera used. In projection, front or rear, the image on the screen must also be of a sufficient brightness for the entire audience to see the necessary details of the picture.

It might prove helpful, therefore, to indicate a few of the terms referring to illumination which are used either in projection, closed circuit t.v. or both. They are not intended to include *all* the terms used by engineers or consultants.

The *footcandle* was chosen as an arbitrary standard of light intensity. This, according to the literal interpretation, would indicate the intensity of light at one foot from a candle as measured at the center of the light pattern or on the axis of the light. The *footcandle* is a linear term. Thus, 10 candles placed one foot from a surface would produce *10 footcandles*.

As many of the c.c.t.v. cameras in use today are made in foreign countries, the metric equivalent of the *footcandle* has become part of the normal terminology. *One footcandle* is equal to *10.8 lux*; or, approximately *9.3 footcandles* is equal to *100 lux*.

The light output of a source is measured in *lumens*. One *lumen* would result in one *footcandle* of light on an area of one square foot. Total *lumen* output, therefore, could be taken as the average *footcandles* within an area multiplied by that area. Thus, if an area of 10 x 10 feet required an illumination of *100 footcandles*, the required *lumen* output would be determined by the area (100 square feet) times the 100 *footcandles* for a total of *10,000* lumens.

One note should be kept in mind. When a slide or movie projector is rated at a certain *lumen* output, the power rating of the lamp used and the efficiency of the lens system have been taken into account. Changing the lamp of the projector, and/or the lens, will change the *lumen* output unless the same power lamp and same type of lens are substituted.

As the term *lumen* is actually a measure of the light emitted by a theoretically uniform point source at the apex of a unit solid angle, the term *beam lumens* describes the amount of light available within the area bounded by 50 per cent lines, or, those lines beyond which the light falls below one-half maximum intensity.

A similar term, *field lumens*, is used to define the amount of light available within the area up to 10 per cent of maximum intensity.

Another familiar term used in illumination is *candle-power*, a rating applied to light sources. This term follows the "square law" well known to sound men. If the number of *footcandles* required are known, it is a simple matter to divide the *footcandles* by the square of the distance at which the source will be placed to find the *candlepower* rating of the required source. *Candle-power*, therefore, is equal to *footcandles over* $(feet)^2$. It can also be said that *footcandles* are equal to *candlepower* times the distance (in feet) squared.

Just as there are in sound distribution, there are graphs for light distribution. These are plotted for *footcandles versus coverage* at different distances from the axis of projection. Since the *footcandle* was shown as a linear term, the graph is made on linear graph paper. Sources such as spot lights will have a graph which peaks sharply at the axis line and falls off very quickly on either side of the axis. A broad beam, does not rise as high on axis and falls off much more gradually on either side of the axis.

It must be remembered that the term *footcandle* describes the amount of light at a definite distance from the source. Therefore, the graph would have to indicate the distance used to determine the values for the *footcandles* on the vertical axis of the graph.

The term *coverage*, used as the horizontal axis on these graphs, is described in two ways. The area illuminated, taken on a surface perpendicular to the light projection at a specified distance from the source, can be used with the per centage of maximum intensity usually indicated. The *angle of light emission* is the other means of describing the coverage of a source. The latter method provides a simple means to determine the coverage area at any distance from the source with the percentage of maximum intensity indicated.

Beam coverage describes the area within which the intensity of the light is equal to or greater than 50 per cent of the maximum intensity. This one-half point is equivalent to one stop on a camera lens and is useful in determining beam overlaps needed to provide equal or uniform coverage with more than one source.

Field coverage is used to describe the area illuminated up to 10 per cent of the maximum intensity and is useful in determining limits of set or display lighting.

Some of the above terms are applicable in c.c.t.v. work, others in front- or rear-screen projection. In image projection, it is also necessary to be aware of the term *gain*, used to describe the reflection (or transmission) characteristic of a front (or rear) screen. The *gain* of a screen material is usually indicated in the specifications available from the manufacturer.

When the *gain* of the screen material is known, the resulting *luminance* can be determined by multiplying the *illumination* from the projector by the *gain*. *Luminance* defines the amount of light reflected from (or passed through) by a front- or rear- projection screen.

Another factor that should be taken into account when a projection system is designed for a particular project is the *contrast ratio*. This term indicates the proportion of image brightness to non-image brightness or extraneous reflections caused by ambient light, such as the stray light of the projector or light from the window or general room lighting.

Another term commonly used in projection is the *foot-Lambert*. If a random-reflecting surface with a reflection factor R and an area of A square feet were illuminated with E footcandles (E being used as the symbol for illumination), the brightness of the surface would be RE/π *candles/square foot* or RE *foot-Lamberts*. Pi (π) enters into the calculation as the reflection is actually a re-radiation of REA *lumens* into a hemisphere. It is seen, then, that 1 *foot-lambert* is equal to $1/\pi$ *candle/ft*^{2}.

These are by no means all the terms necessary to assist in the design of a projection system. Nor are they intended to be the only ones that an audio man working in audio visual projects is expected to know. Designing large audio-visual presentation rooms and the complicated systems that go into them is a very complex one indeed and can only be handled by a specialist in this field—someone well versed in the technology, techniques, and philosophy of image projection. Simpler situations can be handled by audio men moving into the audio-visual field and the terms mentioned are only a very minute portion of the specialist's lexicography.