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VIDEO LIGHTING: A PHOTOGRAPHIC APPROACH

By

David Lee Haggadone

A THESIS

Submitted to
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1988

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ABSTRACT

VIDEO LIGHTING: A PHOTOGRAPHIC APPROACH

BY

David Lee Haggadone

This thesis examines the application of photographic lighting techniques to video production. Development of specialized illumination skills is approached from a technical perspective. Illumination concepts specifically addressed include: 1) the natural laws which affect light transmission, 2) production factors that interact with the theories to alter the quality of illumination, 3) determination of illumination intensity through either reflected, incident, or spot measurement techniques, and 4) application of the waveform monitor as an illumination measurement device.

The technical discussion is placed within the context of a single camera video production setting. The techniques outlined in the thesis address two specific commercial production areas: product lighting and video portraiture. In the discussion of product lighting, illumination techniques for reflective and matte surface objects are detailed. In portraiture, several illumination patterns are presented, along with a thorough discussion on their proper application. Approached from a technical perspective, photographic lighting techniques have high applicability to video production.

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David Lee Haggadone

1988

To Linda, with all my love

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First and foremost, special thanks are extended to Gary Reid, Thesis Committee Chairman, for his time, energy and input into this project. Through Gary, I have learned a lot about the production process, and also about myself. I am fortunate to have had the opportunity to learn from such a talented individual.

Special thanks are also extended to Robert Albers for his creative input and suggestions for the preparation of this manuscript. Bob's experience and insight into the production process were extremely valuable in the development, implementation, and execution of the production design.

I am very grateful to Don Kemp for his help and engineering support. Don was always willing to explain some of the finer points of television engineering to someone not quite as adept to the engineering process.

Finally, I would like to thank Cecil Daniel, Production Manager at WSAV-TV in Savannah, Georgia for his support. Nobody could ask for a finer, or more creative mentor.

PREFACE

Before progressing into the fine details of the production design, it is first necessary to describe the motivation behind the development of the project. The seeds for this production research project began to germinate during a three year period during which I served as a Television Director in the commercial production industry. During this period, thousands of studio hours were spent supervising product and portraiture sessions for local advertising programming. Very early in my tenure however, I became increasingly dissatisfied with the image quality obtained using standard video production practices. Certainly some technical limitations exist when working in video medium. To blame inferior image quality on the technical limitations of the imaging system, however, seemed to be an excuse rather than an explanation. By comparing the image quality of national advertising programming (typically produced on film) against locally produced commercials (which were videotaped) it became apparent that the local commercials did not have the same "feel". Local advertising production tended to look either 1) flat - lacking the illusion of three-dimensionality, or 2) contrasty - with dark shadows and brilliant highlights.

Both observations seemed to indicate a lack of understanding of the basic principles of television lighting. In an effort to improve lighting skills, I returned to the available literature which examined television lighting techniques. Production texts used at the university level however, provided little insight on how the problem could be alleviated. Instructional material is typically sub-divided into the techniques of television lighting as it relates to the multi-camera production process. Technical instruction primarily focuses on the following production issues:

1) Scientific attributes of light transmission.
2) Fixture attributes and controlling mechanisms.
3) Light grid setup and dimmer control.
4) Fixture mounting and studio safety.
5) Base illumination requirements.

Artistic lighting instruction is typically limited to fixture (key, back, and fill) placement for creating the elusive "Basic Lighting Triangle". Proper application of triangle lighting techniques will theoretically create an electronic image possessing the illusion of depth. Typically, triangle lighting techniques are illustratively applied to the multi-camera production process. The basis of this discussion is not to propose that the instructional material is wrong, but rather that the lighting techniques were sometimes applied to an inappropriate production setting.

Existing lighting instruction is based on illumination control in the television production setting. The lighting techniques were erroneously being applied to the process of video production. The differences between production processes are more than semantical. Television production is the process where multiple cameras are used. Therefore, lighting design and instructional materials were developed in which the primary goal was to facilitate subject and camera movement. The primary goal in commercial production (which exemplifies the video production process) is to create highly controlled, aesthetic product images. Application of television lighting techniques to the video production process (which has an entirely different set of production requirements) simply did not work. The primary lighting problem, therefore, seemed to develop from differences in the production process.

One day, more out of frustration than creativity, I decided to light a model setup using an illumination technique developed for portrait photography. Lighting instruments were removed from the overhead grid, mounted on floor stands, and placed in positions which emulated a portrait photography session. The difference in terms of image quality was startling. This photographic approach to video lighting created an image that was attractive, and had some of the reproduction qualities attributable to

commercial film production. Though illumination contrast was limited, shadow gradation in the portrait lighting approach enhanced the illusion of three-dimensionality.

This thesis represents a continuation of that basic finding, stumbled upon many studio hours ago. To the reader it will hopefully answer some of the questions surrounding the illumination process. If this work supplies the motivation to others to build upon our collective knowledge of lighting, then this effort will have been well worthwhile.

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INTRODUCTION

This thesis examines the advantages and limitations of applying illumination techniques across differing media forms. Specifically, lighting production techniques commonly found in the cinematographic and photographic arts were applied to the video production setting. Motivations for the research are based, in part, on the following technological changes:

1) increased technological sophistication of the video reproduction system, and
2) a dramatic change in the methods used in the process of production.

An important distinction is made between television and video based on differences in the production process. These differences are more than semantic. Though television and video are both created through an electronic imaging process, it is here that the similarities end. Television is the production process historically rooted in the days of live program recording and/or transmission. Lighting techniques developed for television, are based on the requirements and limitations of the multiple camera production process. To facilitate subject and camera movement, lighting fixtures are typically placed high above

the floor on a lighting grid. Technological advancements in camera and electronic editing system designs have led to evolutionary developments in the production process. An increasingly greater amount of programming is being created "film style", utilizing a single video camera. This distinction between production methods is the basis for reevaluation of lighting techniques used in the production setting.

Before discussing the specific research design, it is first necessary to review the available production literature. The literature reviewed for this thesis focused primarily on lighting techniques utilized in the film arts. The information derived from this review will be compared to lighting and technical information contained within standard instructional literature. It is hypothesized that lighting techniques developed for the photographic arts can be successfully implemented in the video production setting.

Literature Review

Certainly, limitations exist when applying production techniques across differing media forms. Technically, 35mm (millimeter) film stock has nearly ten times greater image resolution when compared against a broadcast television signal (Mathias & Patterson, 1985). Present regulatory allocations of the radio frequency spectrum inhibit the transmission of a high resolution video signal. Unless world

standards are developed for the adoption of high definition television (HDTV) transmission, the videographer will be forced to accept this technological limitation.

Video also has limited tonal contrast latitiude in comparison against the photographic production process. Contrast latitude is defined as the area between the lightest and darkest portions of an image through which the imaging system can accurately reproduce tonal gradations. Film stock used in photographic and motion picture production has an approximate contrast latitude of seven f-stops. The photographic process represents a system capable of reproducing a contrast ratio of 128:1. In a properly exposed negative, the brightest element of the scene can be 128 times brighter than the darkest portion, with accurate detail being retained throughout the entire tonal range. Present video camera technology limits electronic reproduction to a total latitude of approximately five f-stops, representing a contrast ratio of 32:1 (Mathias & Patterson, 1985). Transmission limitations require further bandwidth compression of a video signal to prevent interference between broadcast frequencies. A transmitted video image is compressed into a maximum contrast ratio of approximately 20:1 (Fuller, 1982). Maximum system latitude for a broadcast video image is therefore limited to approximately four and one-half f-stops. In video, the brightest and the darkest portions of an image cannot be too

far apart in brightness value. Video images which exceed contrast limits will sacrifice scenic detail at either, and potentially both ends, of the tonal range.

Initially, limited system latitude seems to present a bleak outlook to videographers interested in implementing film lighting techniques. Regardless of the videographers' efforts, maximum system latitude is presently two to three f-stops less than that attainable in film. To place this argument into perspective, it is necessary to compare both media against the reproduction latitude of the human eye. In outdoor situations, the human eye may encounter and adapt to lighting contrast ratios as high as 1000:1 (Mathias & Patterson, 1985). Therefore, the contrast range the human eye can adapt to is far greater than either media forms is capable of recording. "At present, there is no picture reproduction system that can, without adjustment, handle the variations of light intensity encountered in the real world" (Millerson, 1982a). Because the eye is highly adaptable, individuals attempting to record an image, regardless of media, must develop the ability to distinguish between what the eye sees and what the medium is capable of reproducing.

Through maturation of the production process, the film arts have actively developed both subjective and objective methods for replicating natural lighting conditions. Successful cine/photographers have trained themselves to interpret what they see in nature, and the manner in which it will be recorded on film (Ritsko, 1979). To evaluate

tonal contrast and determine exposure, film technicians rely upon the use of a light meter. This technical instrument provides data that allows the photographer to evaluate lighting contrast between highlight and shadow illumination zones. Replication of natural illumination conditions on film is accomplished by manipulating light and shadow density within reproduction limits of the recording system. Videographers could also benefit from the use of a light meter. A light meter provides highly useful illumination data. Through proper usage, the videographer can manipulate illumination patterns, containing them within contrast reproduction limits of the video medium.

Inherent to most video production settings is a technically sophisticated illumination measurement device. The waveform monitor is an engineering instrument for technical evaluation of the video image. Most production texts have not examined the value of the waveform monitor as a method for evaluating subject contrast and exposure. In their book, Electronic Cinematography, Mathias and Patterson (1985) describe how the waveform monitor can function as a measuring device for making lighting and exposure judgements. Essentially the waveform monitor operates as a sophisticated spot meter, analyzing the entire video signal. When used properly, the waveform monitor can provide the video professional with excellent and usable lighting/scenic information.

Though film stock has greater contrast latitude, suggested lighting ratios in color photography are generally quite low. A three f-stop range (8:1 contrast ratio) is suggested for normal color filming, with a four f-stop range (16:1 contrast ratio) suggested for dramatic photographic effects (Ritsko, 1979). Therefore, photographic lighting techniques are potentially applicable to the video production process. The suggested contrast range is easily contained within the limited latitude of the video reproduction system. The primary difference between media formats is measured in terms of total contrast latitude. In film, a three f-stop differential represents a smaller ratio with respect to maximum reproduction limits. Therefore, to create the same aesthetic illumination quality, the videographer will likely find it necessary to reduce the lighting ratio by adding an appropriate amount of fill light to the shadow area (Mathias & Patterson, 1985).

Technological advancements in video camera design have also greatly influenced the potential quality of the resultant images. Technological improvements generally address two specific issues:

1) increased camera sensitivity requiring lower base illumination levels, and
2) improved tonal gradation within reproduction latitude of the imaging system.

Through advancements in pick-up tube design, current camera technology is capable of reproducing 72 discernible shades of gray (Mathias & Patterson, 1985), at considerably reduced illumination levels. Increasing camera sensitivity is viewed as a major step forward, providing the videographer with greater control in balancing illumination and providing accent/highlight illumination opportunities (Wurtzel, 1983). Essentially, technological advancements in camera sensitivity enable the videographer to re-access standard lighting practices. According to Fuller, "Newer video cameras which can handle a greater range of contrast and lower light levels are making it increasingly easier to capture nuances of lighting thought to be the exclusive domain of film." (Fuller, 1982, p. 73).

Creative lighting techniques once exclusively in the domain of film production may now be applicable to the video arts. According to Mathias, "Many of the common practices in video lighting stem from technical or engineering considerations that are no longer relevant. Today's production cameras are much more sensitive and stable than older cameras for which studio lighting techniques were developed" (Mathias & Patterson, 1985, p. 176).

Slow adaption of photographic lighting techniques may be rooted in the production industry's definition of <u>what</u> video is and <u>how</u> production is accomplished. Historically, television programming developed out of live broadcast production techniques. Consequently, lighting techniques

were developed for television production situations that facilitated several cameras with multiple shot positions. Multiple camera techniques necessarily involve compromises in lighting design. Since illumination patterns needed to accommodate several camera locations, the solution was to create "flat" lighting patterns. Therefore, the technological inferiority associated with video has simply been the development of compromised lighting techniques (Mathias & Patterson, 1985). Because media professionals have traditionally approached video as a rapid delivery medium, lighting has generally taken a back seat to expediency. According to Fuller, "the apparent harshness of video is therefore caused by poor lighting, rather than some inherent flaw in the medium" (1982, p. 73).

Technological advancements now enable the videographer to approach production assignments from an entirely different perspective. An increasingly larger percentage of programming is created using a single video camera. As in the film arts, single camera production provides the opportunity to custom design the lighting pattern for specific visual effects. Traditional lighting instruction primarily emphasizes techniques useful in the multi-camera production process. This lighting approach does not meet the creative requirements of the single camera production process. "The solution to multi-camera production has

typically been flat overhead lighting. The problem is that very few people working in video are able to do good lighting" (Millerson, 1982a, p. 10).

Videographers in general, lack an understanding of traditional film lighting techniques. This argument, however, should not be construed as a condemnation of traditional video production literature. Application of film lighting techniques have only become possible through the technical and evolutionary development of the video medium. Several authors reference the difference between production styles. According to Wurtzel (1983): "The later two media (cine/photography) provide the lighting director with the luxury of lighting a subject for one particular angle at a time. Television does not allow this when a program is shot with multiple cameras which are continuously moving to new shot positions throughout a production. One lighting setup must be adequate for all shots and all angles" (p. 154).

Through a review of the available literature, it was concluded that the application of film lighting techniques to the video production setting had not been fully explored. This lack of information represents a significant gap of knowledge in the video production industry.

Production Design

To test the applicability of film lighting techniques, it became necessary to develop a video program which incorporated film lighting fundamentals. Based on the

literature review, the following instructional issues seem pertinent to this study. In his book Lighting for Location Motion Pictures, Ritsko states: "Learning lighting control and lighting effects is probably best accomplished by working with subjects or sets within a limited space, and by using close-ups to determine the lighting pattern" (1979, p. 56). By limiting shot parameters, students of video lighting will better understand lighting control/effects due to the relatively small space they have to concentrate on. Millerson concurs and adds: "Portraiture forms a high proportion of all photography and deserves particular attention to any study of lighting" (1982a, p. 133).

Approached from this point of reference, additional research was conducted on specific film lighting techniques used in portrait and commercial product photography. From this information, an instructional videotape was created which applied some of the lighting techniques used in the film production industry. Development of an instructional program provides an excellent vehicle to test the application of lighting techniques across different production formats.

Following is a brief description of the program developed for this research project. This program was designed to explore the application of film lighting techniques to the video production setting. The primary goal of the program was to develop an instructional method which

demonstrated both basic and advanced photographic lighting fundamentals. The primary audience for this program is:

1) college students with advanced production experience, and
2) professionals working in the video production industry.

Following is a brief outline of the instructional content found in Video Lighting: A Photographic Approach.

Program One: The Scoop on Scopes

This segment begins with a brief explanation on the difference between how the human eye and video camera react to light. Once completed, the program continues with an in-depth analysis of the methods used to measure illumination. Light intensity is typically measured by using either one, or a combination of the following devices:

1) Reflected Light Meter
2) Incident Light Meter
3) Reflected Spot Meter (or waveform monitor)

The advantages and disadvantages of each measurement device are demonstrated. The program emphasizes the use of an incident meter and the waveform monitor for determining accurate illumination and exposure data. Due to the highly technical nature of the waveform monitor, a greater proportion of time is spent explaining monitor display and setup/calibration procedures.

Additional information includes the production methods used to determine lighting ratios. Lighting ratios are commonly expressed for:

1) Overlapping, or

2) Non-overlapping illumination patterns.

Light ratio computation is fully explained through the use of on-screen examples.

A commonly used film lighting technique is applied to the video production setting. Called "pegging the key tone", this technique is developed by film directors to ensure lighting and exposure continuity.

The program continues with a thorough explanation of the method used to calibrate an incident light meter. Calibration procedures are demonstrated for aligning the sensitivity of the meter with the reproduction sensitivity of the video camera.

This segment concludes with a thorough review of the instructional material covered within the program.

Program Two: The Beauty of Glamour Lighting

Program two begins with a thorough description and demonstration of standard lighting and modifying instruments. Fixtures and modifiers applicable to the standard video production setting include:

1) Spot Lights

2) Scoop Lights

3) Umbrella Lighting

4) Soft Box Lighting

This demonstration includes a description of the advantages/disadvantages of each illumination/modifying source. Particular attention is placed on shadow quality and density produced by each illumination instrument.

The remainder of the program concentrates on the four basic illumination patterns used in glamour photography. Presented within the program are the following illumination patterns:

1. Broad lighting
2. Narrow (Short) lighting
3. Frontal (Notan) lighting
4. Side (Rembrandt) lighting

Included within the demonstration is commentary on the attributes and disadvantages of each glamour lighting technique. Applicable lighting demonstrations are created with a variety of instruments to illustrate the effects created by different illumination instruments.

Manipulation techniques are also demonstrated for controlling shadow placement and the key/fill lighting ratio.

Program Three: Hot Shots for Hot Products

Program three begins with a comparison between the procedures used in portrait and product videography. The primary difference between illumination patterns is based on subject reflectance and contrast. In product lighting, contrast and reflectance is typically far greater than that encountered in portraiture.

The demonstration continues with an exploration into product setup and lighting design. Object characteristics are discussed, and the three primary zones of illumination are illustrated. The illumination zones apparent are:

1) Highlight Zones

2) Lit Zones, and

3) Shadow Zones

The combination of these illumination zones provides important visual clues to the viewer on object shape, texture, color, depth and dimension.

The remainder of the program focuses on the application of photographic lighting techniques to the video production setting. Several professional photographic techniques are demonstrated through the usage of on-screen examples. Special features include illuminating problem setups (glassware, reflective metal) commonly found in commercial product videography.

Again, the demonstration program concludes with a review of the instructional material.

Evaluatory Methodology

This program is essentially a self-paced, instructional tool designed to aid the student and working professional in developing their own lighting style. The study of lighting techniques is a highly personalized art form, lacking definitive right/wrong answers. The illumination material should not to be construed as a conclusive method for all production situations. If photographic lighting were approached as such, it would be placed into the realm of science, rather than art.

Testing methodology is, therefore, based on ascertaining the effectiveness of the program to motivate and inform the target audience. An appropriate testing instrument should yield audience opinion on:

1) the merits/value of the content, and

2) acceptability/clarity of presentational style.

Program effectiveness is therefore best evaluated based on data collected via questionnaire and focus-group discussion. Through this two-pronged testing approach, audience attitudes and opinions have been collected on the lighting and instructional techniques utilized within the program.

This thesis production has been tested against two primary audience groups. They are:

1) Advanced production students within the Department of Telecommunication, Michigan State University.

2) A panel of working professionals from within the video production industry.

Both groups were selected for program testing based on the following reasons. First, the concepts demonstrated within the program require more than a basic comprehension of the video production process. The design of the program assumes a certain technical level of expertise, and progresses from that point. Second, an instructional need exists for the development of illumination techniques within both production audiences. As demonstrated by the literature review, instructional material used at the university level emphasizes illumination techniques applicable to the television, not video production process. With respect to the student audience, advanced illumination instruction can be highly beneficial to future professional development. Finally, the program is designed to demonstrate illumination challenges commonly found in local commercial production. This production niche is an area where many students begin their professional career. The professional panel solicited for program review reflects that production niche, since most of the professional evaluators work primarily in the commercial production sector. Though both groups represent different levels of production expertise, the program is designed to provide an instructional platform for the

development of advanced illumination techniques. Therefore, the primary goal of the production is to create an instructional package for the study of advanced illumination concepts.

A thorough analysis of the comments and criticisms obtained via questionnaire and focus-group discussion can be found in the concluding chapter of this thesis.

A LITTLE LIGHT THEORY

A thorough understanding of the natural laws which govern light transmission is essential to any study of creative lighting techniques. In video production all lighting decisions should be based on satisfying both:

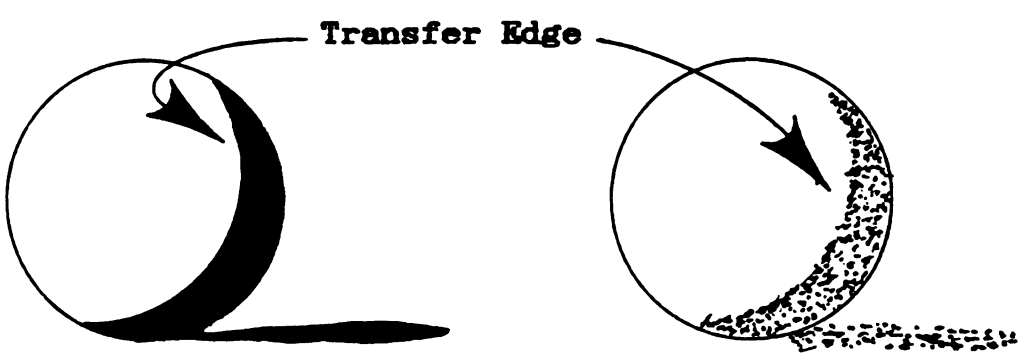
1) the technical requirements of the video reproduction system, and

2) the artistic/creative image design criteria.

Successful and creative lighting control, however, is predicated on fulfilling the technical requirements of the video reproduction system. The focus of this chapter is an examination of the key scientific attributes of light transmission. This chapter also examines how certain production factors interact with the key illumination axioms to alter the transmission and dispersal of light energy. Subsequent chapters will focus on 1) the methods used to measure illumination intensity, and 2) the technical limitations of the video reproduction system. Comprehension of the scientific attributes of illumination provides a foundation on which all creative lighting decisions should be based.

Illumination Quality

Several terms are commonly used in the photographic arts to classify illumination. Specular light is the quality of illumination typically associated with "hard" light sources. Direct sunlight or theatrical spotlights are hard (specular) illumination sources. Highlight, lit and shadow zones created by specular illumination sources are dense, sharp, and well directed. Diffused light sources have the opposite quality attributes. Diffused light sources are classified as having "soft" illumination characteristics. Soft, even illumination is the quality of light associated with an overcast sky. The directionality of diffused illumination is less clearly defined, because shadow density is typically very light. Finally, the Transfer Edge is the transitional region on an object, where illumination changes from the lit zone to the shadow zone. The transfer edge will be either hard (specular) or soft (diffused) dependent upon the quality of light used for primary illumination.



Specular Illumination Diffused Illumination

Figure 1. Illumination Quality

To classify illumination quality, the videographer needs to examine the shadows created by the illumination source. Light sources are classified as being specular (small) or diffused (large) according to:

1) the density of the shadow created by the source, and
2) the clarity of the transfer edge between lit and shadow zones.

In a rather backward manner, illumination quality is determined by the shadows which are attached to, and cast from, the subject.

The first lighting axiom to consider, can be simply stated as follows:

> "The quality of illumination is dependent upon the size of the light source relative to its distance from the subject (object)."

To fully understand the implications of this accepted principle, consider the illumination quality associated with the sun on a bright, cloudless day. Though our sun is several thousand times larger than the earth, it is classified as being a small (specular) illumination source. The distance light energy from the sun must travel to reach the earth's surface, decreases its effective size relative to the surface it illuminates. If the sun were to be moved closer to the earth's surface, illumination quality would change. The sun would become a larger light source directly proportional to its distance from the earth. It is important

to note that illumination quality and intensity are not related terms. Intensity is a measure of light energy which falls upon, or is incident to, a surface plane. Illumination quality is a set of descriptive characteristics about incident illumination.

This analogy can also be applied to the video production setting. For example, a twelve inch fixture can be either a specular (small) or diffused (large) light source when used to illuminate a six inch sphere. When used at a relatively close working position, the fixture is a large light source taking on the qualities associated with diffused illumination. Increasing the working distance between the source and the sphere decreases the relative size of the illumination source. As the distance between the fixture and object is increased, illumination quality will become increasingly more specular.

Returning to our sun analogy, shadows which are attached to and cast from an object, classify the sun as a specular illumination source. On a bright cloudless day, shadows will be dense, and the transfer edge between lit and shadow zones will be hard, sharp and well directed.

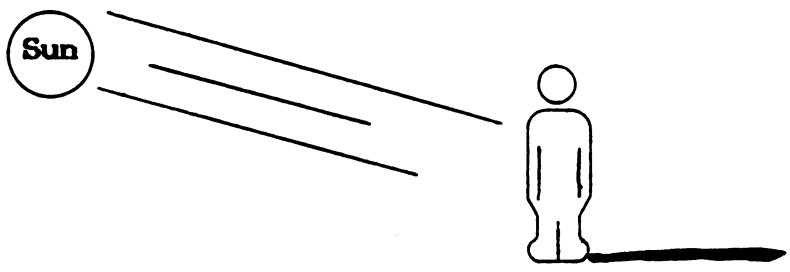


Figure 2. The Sun as a Specular Illumination Source

When clouds envelop our sky, however, illumination quality from our specular light source changes. Shadows which were previously dense, sharp and well defined, become soft and diffused.

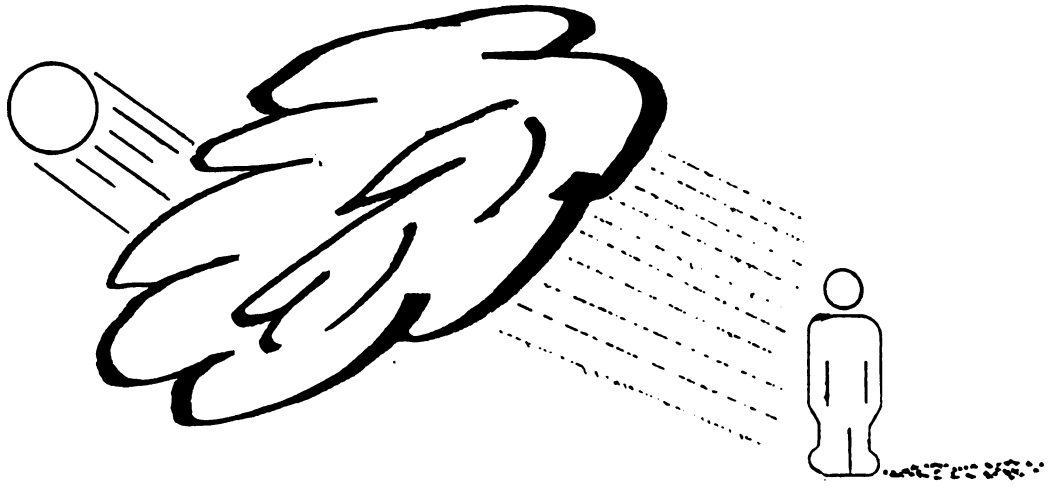


Figure 3. Modified Specular Illumination

Because the distance between the sun and earth is essentially fixed, the sun will always be a specular illumination source. Clouds however, act as a natural modifier of illumination quality. When specular illumination passes through cloud cover, the intense parallel rays of light energy are broken and scattered. The clouds act as a natural diffuser by modifying specular illumination. Being considerably closer to, and larger than the subject, light energy projected through a cloud cover will have diffused illumination characteristics. Though the origination point of illumination does not change, the cloud cover essentially becomes the new illumination source.

This natural modification technique can also be adapted to the video production setting. For example, a specular

light source can be modified to produce diffuse illumination by simply scattering the parallel rays of illumination. This can be accomplished through one of two methods:

1) project illumination through a plane of diffusion material, or
2) reflect illumination from an adjacent surface plane.

Both methods, of course, assume that the plane used to modify the original light source is considerably larger, relative to its position from the subject. When direct illumination strikes the subject only from the projection/reflection plane, that plane becomes the illumination origination point.

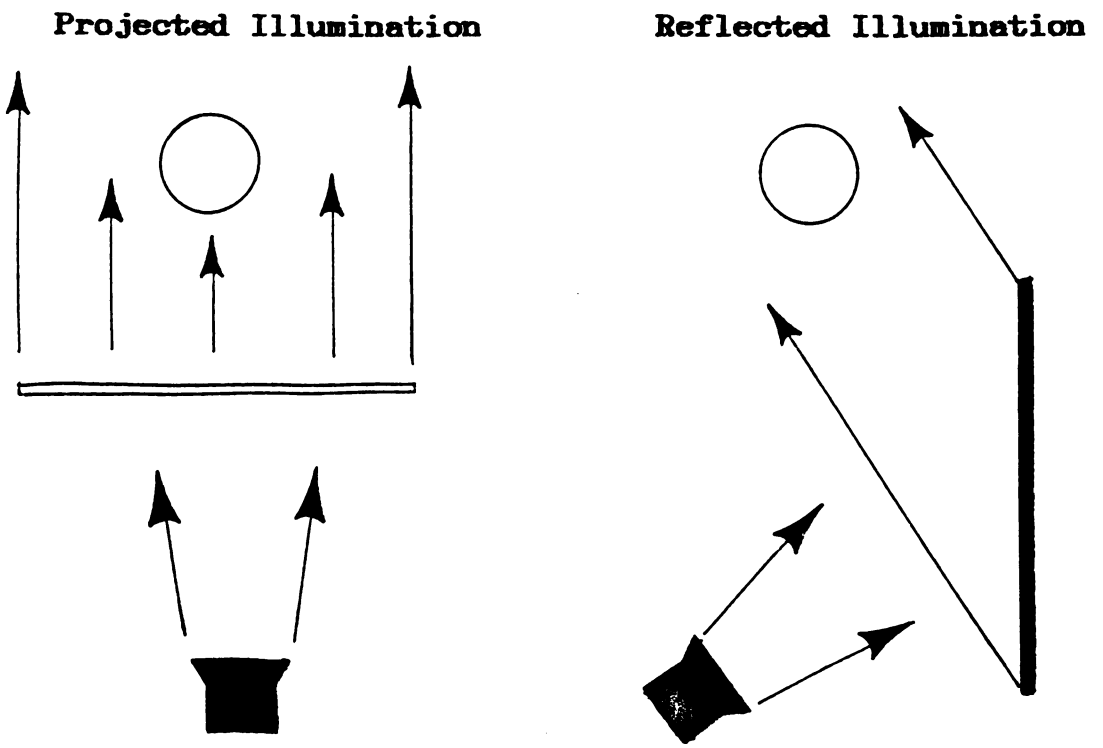


Figure 4. Light Modification Methods

Based on our knowledge of this lighting axiom, the following two methods can be utilized to modify illumination quality in the video production setting:

1) position the illumination source closer, to increase its size relative to the subject, or
2) project/reflect illumination from a larger surface plane to increase the effective size of the fixture.

As the surface plane used to modify specular illumination is moved away from the subject, it becomes smaller (more specular) relative to the size of the subject. The closer the projection/reflection plane, the larger it is relative to the subject. Therefore, illumination quality also changes relative to modifier-to-subject distance. The lighting axiom holds constant, regardless of the lighting method used.

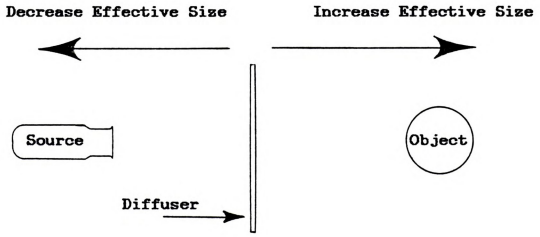


Figure 5. Light Modification Characteristics

Standard production practice for diffusing fixture output, is to place scrimming material at fixture position.

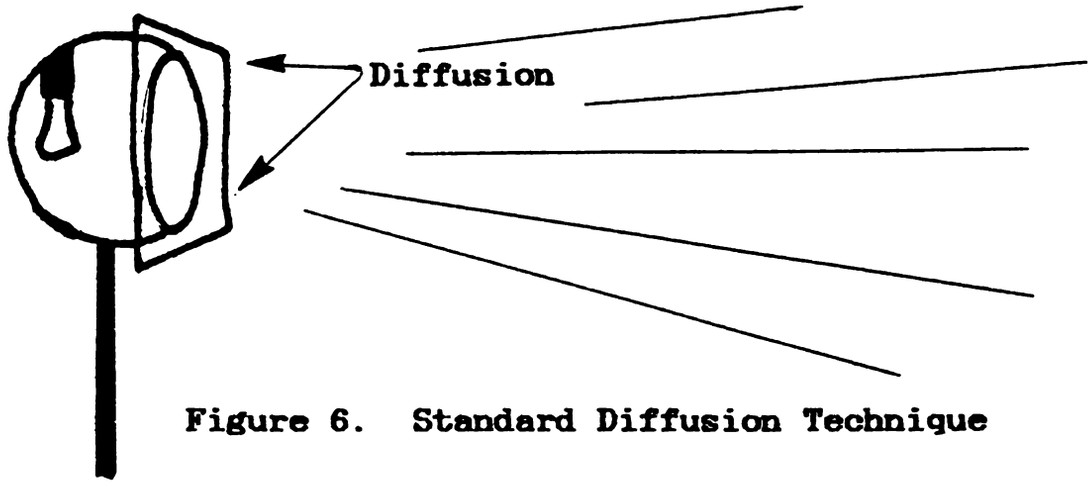


Figure 6. Standard Diffusion Technique

This diffusion technique reduces fixture intensity, but does not significantly alter the specularity of the instrument. The effective size of the light source remains constant, because the relative distance between illumination point and subject has not changed. Illumination intensity changes proportional to the transmission efficiency of the diffusion material used. To increase the effective size of the illumination source, it is necessary to increase the size of the diffusion plane relative to the fixture-subject distance.

Light Reflection

Since we have already touched on reflected lighting techniques, let's continue the discussion with a thorough examination of another lighting axiom:

"The angle of incidence equals the angle of reflectance."

Light reflects from any surface plane proportional to the angle at which light strikes that plane. For example, if light strikes a surface at a 45 degree angle, light will reflect from that plane at an opposite 45 degree angle.

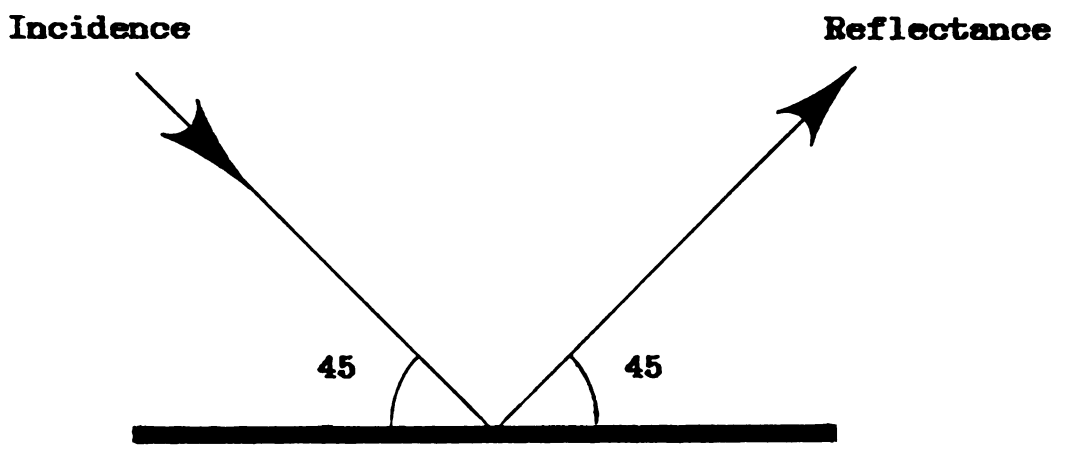


Figure 7. Reflectance Angle

The above analogy oversimplifies the reflective properties of light energy. Pure application of the axiom assumes a flat, highly reflective surface plane. In the production setting, the videographer will be typically faced with surfaces that have radically different reflectance characteristics. Consider for example, the reflective properties of a roughly textured surface.

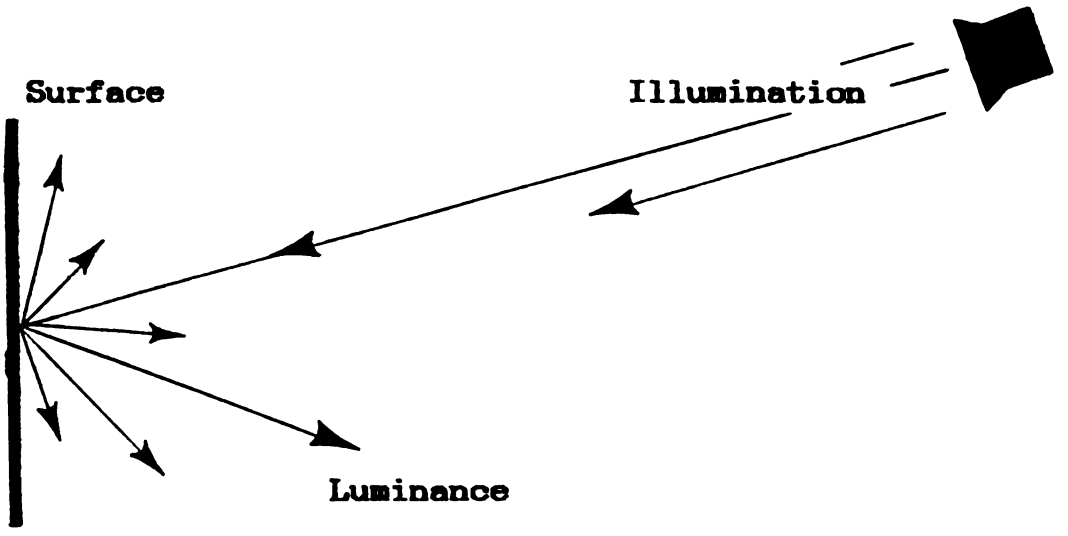


Figure 8. Textured Surface Reflectance

As the example illustrates, surface reflectance is primarily dependent upon surface characteristics of the surface plane. The undulations of a textured surface modifys illumination by redirecting light energy into more than one reflected angle. Light striking a textured surface will not reflect as uniformly as illumination striking a smooth and/or glossy surface plane. Therefore, object surfaces can also be classified according to surface reflectance characteristics.

The previous illustration also indicates that terminology changes after light energy reflects from a surface plane. Light generated from a fixture is referred to as incident illumination. Light reflected from a surface plane back toward camera viewpoint is referred to as luminance. It is important for the videographer to understand the distinction. Luminance is a measure of the

light reflecting properties of an object or surface. Luminance values of scenic content are likely to be different even when scenic elements are lit with equal illumination intensity. This is a common phenomenon, particularily when objects with different surface characteristics are used.

To achieve creative lighting control, the videographer needs to consider the reflective characteristics of the object(s) within a scene. Surface characteristics (texture color, form) modify illumination and affects the luminance values of scenic content. In order to apply an appropriate lighting pattern, the videographer first needs to ascertain the reflective attributes of scenic elements. These attributes include surface texture, and the absorptive quality of the reflecting surface. Any attempt to completely classify surface reflectance values would be fruitless, due to the variety of surfaces encountered in the production setting. Some general guidelines, however, are offered. Mirrors have a highly reflective surface, and redirect nearly 100% of the light incident to the surface. Aluminum foil is also an efficient reflector, but the reflectance value can be decreased by texturing the smooth surface. Cloth has a wide range of reflectance values, ranging from satin (high) to felt (low). Finally, rough wood and stone has minimal reflectance due to surface texture and absorption which inhibits parallel light rays from being redirected in an opposite (but equal) angle.

The angle at which illumination strikes a surface plane also affects the luminance reflected from that plane. For all practical purposes, illumination striking a surface from 0-45 degrees off axis will reflect light proportional to:

1) the intensity of illumination, and

2) the reflective properties of the surface plane.

As illumination is moved farther off-axis, luminance decreases disproportionally. By increasing the illumination angle (relative to the object-lens axis), the fixture will illuminate an increasingly larger surface area. The mathmatical calculation for determining luminance fall-off, is called the Cosine Law. This law is stated as follows:

$$\text{Illumination} = (\text{lumens}/\text{distance}^2) \times \cos^{\text{angle}}$$

In practice, calculation of luminance fall-off is unnecessary. Luminance intensity can be easily determined in the video production setting through various measurement techniques. The videographer however, should be aware of the effect the incident angle has upon surface luminance values.

Therefore, the axiom; "The angle of incidence equals the angle of reflectance" provides the videographer with accurate, but inadequate information. In practice, object reflectance is dependent upon: 1) the efficiency of the reflector, 2) the incident angle of illumination, and 3) the absorptive quality of the reflecting surface.

Light Intensity Falloff

The final lighting axiom to be considered can be simply stated as follows:

> "Light intensity decreases inversely proportional to the square of the distance."

There are certain misconceptions surrounding this basic law of illumination. Light intensity does not "die off" as it is projected from an illumination source, rather it "spreads out" illuminating increasingly larger hypothetical planes.

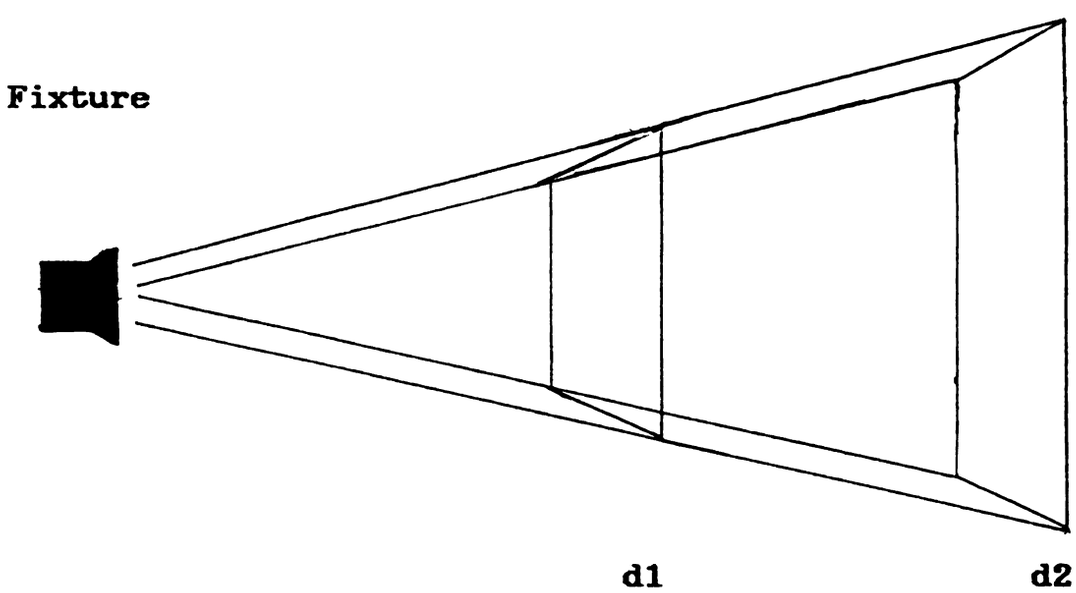


Figure 9. Light Energy Dispersion

In practice, the inverse square law is applicable only with lighting fixtures that produce diverging rays of illumination. Fixtures such as Scoops, Broads and Soft lights fall within this instrument classification. These instruments have a fixed illumination point, and are designed to create for broad illumination coverage.

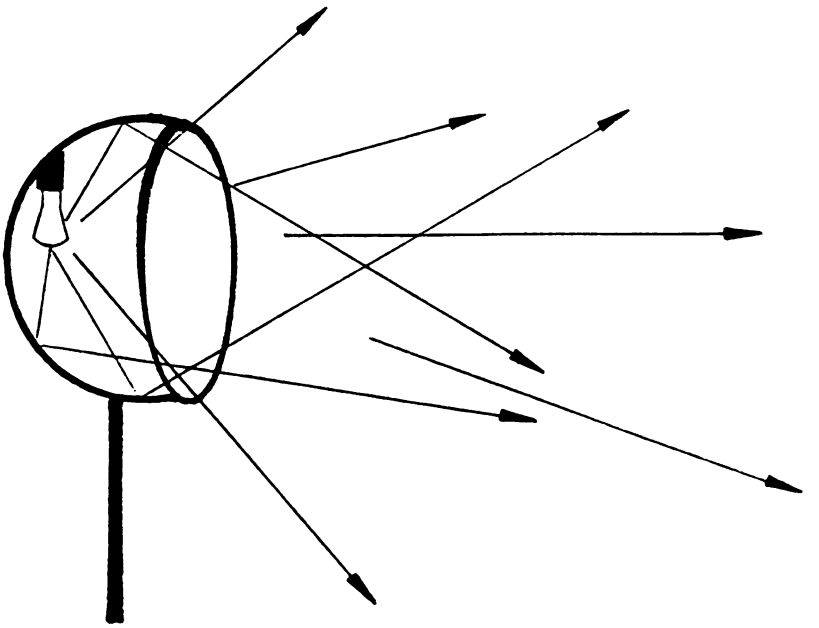


Figure 10. Broad Illumination Instrument Design

Illumination produced by fixtures with variable focal points and/or which utilize a focusing lens, does not "falloff" in the same manner. Spot lights with a fresnel or condensing lens array belong in this fixture classification category. Basically, spot fixtures are designed with illumination modifiers built into the instrument.

Variable focus instruments modify illumination by varying the distance between the lamp and the internal reflector. Decreasing the lamp-to-reflector distance increases the coverage area of the instrument. By increasing the coverage area, the videographer will be decreasing fixture intensity. Focusing (increasing) fixture output to a smaller coverage area is achieved by increasing the lamp-to-reflector distance.

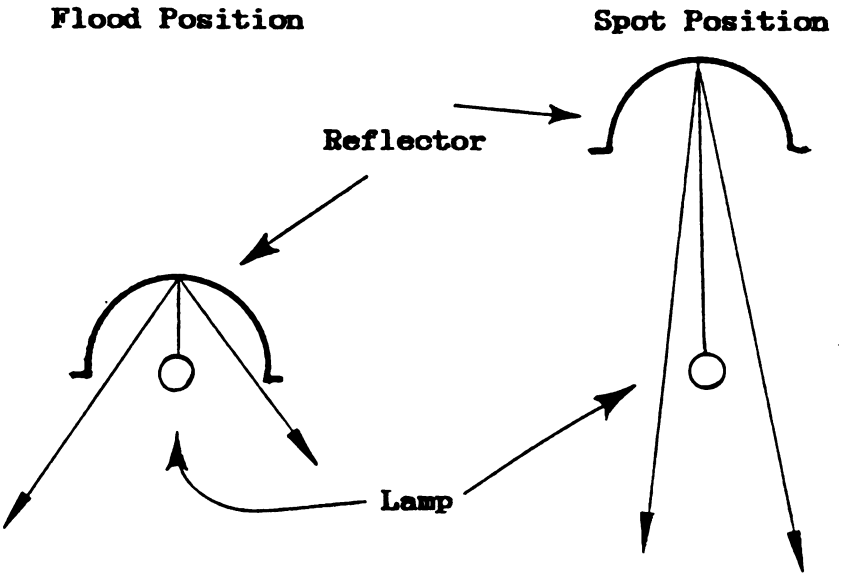


Figure 11. Effects of Reflector Position

The addition of a lens to the front of fixture, further modifies illumination transmission. A Fresnel lens acts essentially as a magnifying glass, redirecting light into parallel rays of illumination.

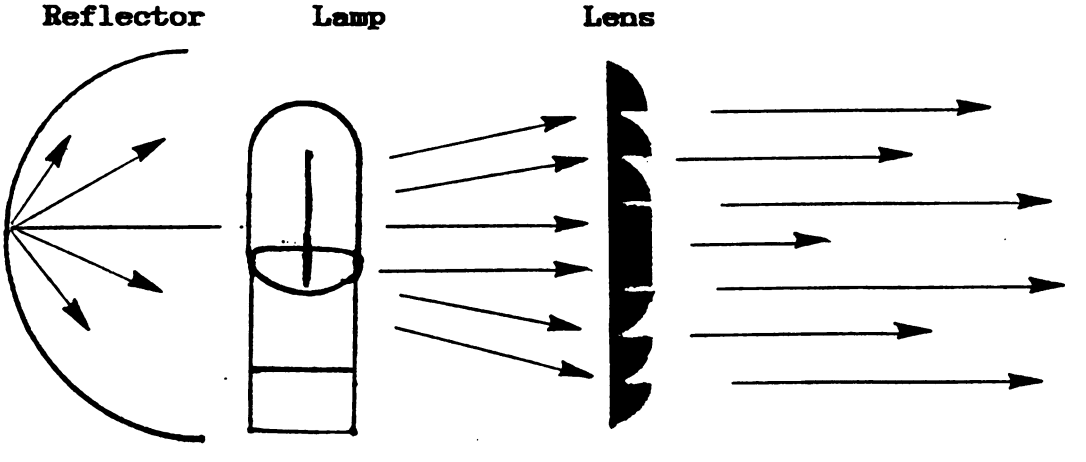


Figure 12. Effect of Fresnel Lens on Beam Dispersion

Light Intensity Falloff (LIF) is therefore difficult to determine due to the variety of fixture and modifier devices used in the production setting. Beam dispersal and fixture efficiency is dependent on the design of the instrument and the modifying technique used to project fixture output. With spot light fixtures, transmission efficiency is also dependent on 1) surface reflectance of the focal plane and 2) the design of the focusing lens. Condensing lenses typically found on Ellipsoidal instruments have radically different transmission characteristics when compared against Fresnel lens design.

A workable adaption of this lighting axiom is crucial to further development of light manipulation techniques. Intelligent fixture placement will allow the videographer to control both light intensity and the falloff ratio. Experience will provide additional knowledge with regards to the transmission characteristics of specific illuminating instruments. For the purpose of continuing this discussion, illumination measurement assumes usage of an instrument whose output falls off inversely proportional to the square of the distance.

Therefore, light intensity falloff (LIF) can be mathematically determined by dividing the square value of the comparitive distances (d). Simply stated, light intensity falloff is expressed as the the following ratio:

$$LIF = d1^{2}/d2^{-2}$$

This ratio provides the videographer with a methodology for determining intensity falloff between two hypothetical planes. By inputing distances into the ratio, the videographer can determine the amount of light falloff (denoted as a percentage) between the two planes.

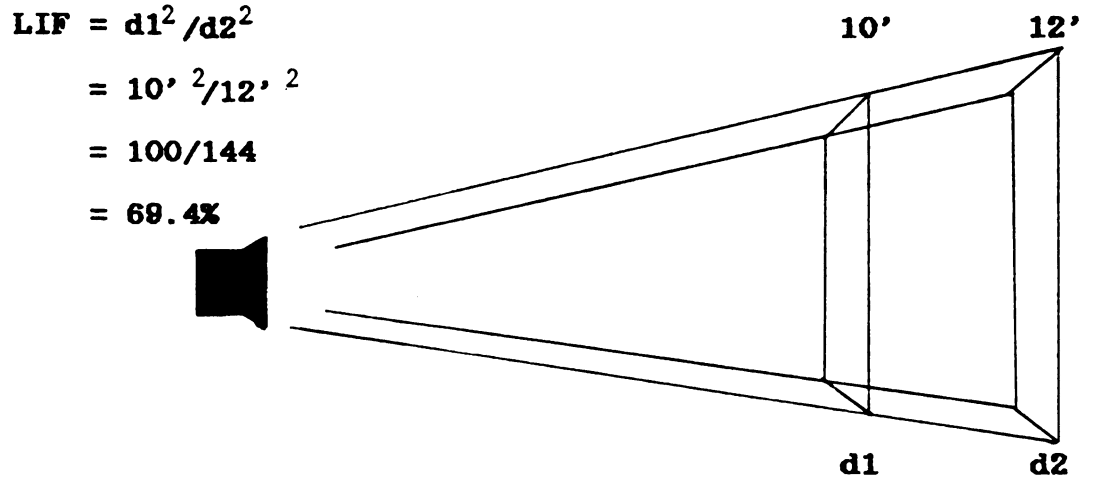


Figure 13. Light Intensity Falloff

Only 70% of a fixture's intensity will be incident to a surface plane 12 feet from the illumination source, in relation to illumination intensity 10 feet from the source. In the photographic arts, illumination intensity is commonly expressed in foot-candles. A foot-candle is a measure of light energy from a single candle (quantified in lumens) which falls upon a hypothetical plane, one foot away from the candle. For simplicity of measurement, a standard energy level has been assigned the value of one foot-candle and all measuring devices adhere to this standard.

Through mathematical computation, the videographer can determine foot-candle (fc) intensity between any two illumination planes. For example, if illumination intensity measured 100 foot-candles at 10 feet from the illumination source, approximately 70 foot-candles will fall on a surface plane measured 12 feet from that source. The following table provides precise data on light intensity falloff at distances of 10 to 20 feet from the illumination point.

Table 1. Light Intensity Falloff

Distance	$d1^2$	$d2^2$	d1/d2	d2 (fc)	LIF (%)
10	100				
11	100	121	100/121	82.6	-17.4
12	100	144	100/144	69.4	-30.6
13	100	169	100/169	59.2	-40.8
14	100	196	100/196	51.0	-49.0
15	100	225	100/225	44.4	-55.6
16	100	256	100/256	39.0	-61.0
17	100	289	100/289	34.6	-65.4
18	100	324	100/324	30.9	-69.1
19	100	361	100/361	27.7	-72.3
20	100	400	100/400	25.0	-75.0

Manipulation of light intensity falloff can be approached from two perspectives. First, by doubling the working distance, intensity will decrease to one-fourth of the original level. One hundred foot-candles measured at 10 feet from the fixture will falloff to a level of 25 foot candles, twenty feet from the illumination source. Second, as the distance from the illumination point is increased, the falloff differential between planes will decrease. When lighting a scene in which the distance between surface planes is predetermined, the videographer can use the

Inverse Square Law to control intensity falloff. For example, holding the distance between scenic planes constant at 4 feet, the following phenonemnon will be observed.

$LIF = d1^2/d2^2$
$LIF = 10^2/14^2$
$LIF = 100/196$
$LIF = 51\%$

$LIF = d1^2/d2^2$
$LIF = 40^2/44^2$
$LIF = 1600/1936$
$LIF = 82.6\%$

Increasing the effective working distance provides a method for reducing light intensity falloff between scenic planes. Reduction of light intensity falloff, however, is at the expense of lowered base illumination levels. Light energy differences can also be determined through calculation of the Inverse Square Law.

$LIF = d1^2/d2^2$
$LIF = 10^2/40^2$
$LIF = 100/1600$
$LIF = 1/16$
$LIF = 6.25\%$

Only 1/16th of a fixture's intensity will be measured at a point 40 feet from the source, compared to the intensity measured at 10 feet. If illumination measured 100 foot-candles at ten feet from the light source, intensity will fall off to 6.25 foot-candles forty feet from the illumination point. To restore illumination intensity, it will be necessary to multiply fixture output by the factor at which intensity has decreased. For example, if a 500 watt fixture measured 100 foot-candles at 10 feet, an 8,000 watt fixture would be needed to supply 100 foot-candle intensity at 40 feet from the illumination point (500w X 16 = 8,000w).

Conclusion

Before progressing into a discussion on the fuction and measurement of illumination intensity, it is necessary to conclude this chapter with some additional general lighting information. The videographer should realize that several production conditions exist which prohibit pure application of the above axioms.

Of primary concern are the illumination characteristics produced by various light fixture designs. Beam dispersal and transmision efficiency vary greatly, and are dependent upon the design criteria of the manufacturer. Even instruments within the same classification have different illumination characteristics. Literature published by the manufacturer, may provide the videographer with detailed information on the performance of a fixture.

Lamp design also plays an important role in beam dispersal characteristics. The size and shape of the glass envelope influence light transmission. Beam dispersal is non-linear when measured at the illumination point due to the different surface planes through which light energy must pass. As the effective working distance increases, the importance of non-linear transmission decreases. Literature published by lamp manufacturers recommends a minimum working distance of ten times the size of the illumination source. For example, a twelve inch fixture should be used no closer than ten feet from the subject (12" X 10 = 120"/12" = 10'). This guideline is primarily applicable to open-face lighting

instruments. Fixtures which shield from direct lamp illumination (ie. soft lights) are designed specifically for close-up working conditions.

Though the usage of Tungsten Halogen lamps is assumed, the videographer should be aware that non-Halogen lamps have different illumination characteristics. Halogen lamps burn at their rated color temperature and maximum output throughout the life of the lamp. Non-Halogen lamps (typically found in older fixtures) decrease in color temperature and rated output as the age of the lamp increases. In order to achieve consistent results, Halogen lamps are recommended.

This chapter has focused on some of the scientific attributes regarding light classification, reflectance, and transmission. These axioms represent the basic knowledge needed for any endeavor in creative lighting to be fruitful. From this perspective, the videographer will be able to make accurate lighting decisions based on a technical knowledge of illumination.

FIXTURES AND THEIR FUNCTIONS

Before exploring the application of illumination in the video production process, it is necessary to review the illumination characteristics produced by commonly used lighting instruments. The illumination theories outlined in the previous chapter provide a theoretical understanding of light transmission characteristics. Lighting fixtures, however, modify and control illumination in distinct ways.

This chapter will, therefore, examine the illumination attributes of lighting instruments commonly used in the video production setting. The fixtures frequently used are:

1. Spot Lights (lens and lensless),
2. Scoop Lights,
3. Broad Lights, and
4. Projection (Ellipsoidal) Lights.

A brief examination of several light modification techniques used in the professional film industry and their application to video production is also included. Illumination modifiers most commonly used include:

1. Soft Boxes,
2. Umbrellas,
3. Gobos, and
4. Patterns (cookies).

By understanding the operational characteristics of a light fixture and lighting modifier, the videographer can design illumination patterns consistent with the creative motivations of the scene.

Spot Lights

Spot lights are typically used to provide the primary source of illumination. The primary illumination source is generally referred to as the "key" light. The key light, however, refers to primary light intensity and directionality and is not a function of fixture design. Any fixture can be used as a key light as long as the intensity of the fixture is stronger than any other illuminating source. The key light also supplies the viewer with information on the quality (specular or diffused) of the illumination source. Because our solar system naturally has one illumination source (the sun), viewers subconsciously interpret production settings with a multitude of shadows as having "unnatural" illumination characteristics.

Spot lights are typically chosen for key illumination based on their projection characteristics. Spot fixture illumination can be focused through optical or mechanical means, concentrating and projecting light energy over great distances. When used at a distance, spot fixtures are classified as being small illumination sources. Small source illumination (relative to subject/object size) will be specular and the shadows created by the instrument will be

hard, sharp and well directed. Therefore, illumination quality produced by a spot fixture is typically associated with illumination produced by the sun (on a clear day) or a theatrical spotlight.

Due to its highly directional and intense beam, illumination from a spot light is easily controlled. When projected through an optical lens, light energy is focused into intense parallel rays of illumination. The most common lens used in spot fixture design is called a Fresnel lens. Figure twelve in the previous chapter details how a Fresnel spot light optically modifies projected illumination.

A lensless spot light uses a mechanical method for focusing and projecting light energy. Lensless spot instruments are commonly used in remote production lighting because they are small, lightweight and easily portable. Spot fixtures of this design focus illumination by changing the distance between the lamp and the reflector housing. Figure eleven in the previous chapter details the mechanical method used to modify projected illumination.

Lensless spotlights represent a design compromise in terms of illumination quality and control. Light energy projected from this instrument has non-linear dispersion characteristics, particularly when used in the "spot" position. Lacking a focusing lens, illumination control is also limited because light energy disperses rapidly as the distance from the source to the subject is increased.

Scoop Lights

Scoops are used in the production setting to provide diffused illumination, the quality of light associated with an overcast sky. Though primarily used as a secondary light source, scoops can also be used for "key" illumination. When used as a key illumination source, the shadow density which defines illumination quality will be light, with subtle gradation at the transfer edge. Through examination of the transfer edge, the videographer can classify the quality of the illumination source.

The primary usage of the scoop light is to provide secondary illumination to the image. When used as a "fill" illumination source, the videographer must determine both appropriate positioning and intensity with respect to the primary illumination source. Positioning is most often based on providing illumination to the shadow zone created by the primary illumination source. Appropriate fill lighting should reduce, but not eliminate the shadow density created by the key light. Shadows provide the viewer with information on surface texture and object dimensionality. Fill intensity should never conflict with the key light effect, or eliminate shadows created by the key.

Scoop lights are designed to spread illumination over a large surface area. The lamp is suspended within a parabolic reflector which disperses light energy into non-parallel rays of illumination. Lacking a focusing mechanism, scoop

illumination is difficult to control. Figure ten in the previous chapter details the manner in which scoop illumination is dispersed.

Since scoop lights have softer illumination characteristics, they are often used to add overall base illumination to the image. Base illumination is the light energy necessary to create an electronic image in the video medium.

Broad Lights

Broad Lights are similar in design and function to scoop fixtures. The primary design difference between fixtures is that broad lights have a shallower parabolic reflector, with rectangular dimensions. The following diagram details the design of the broad illumination instrument.

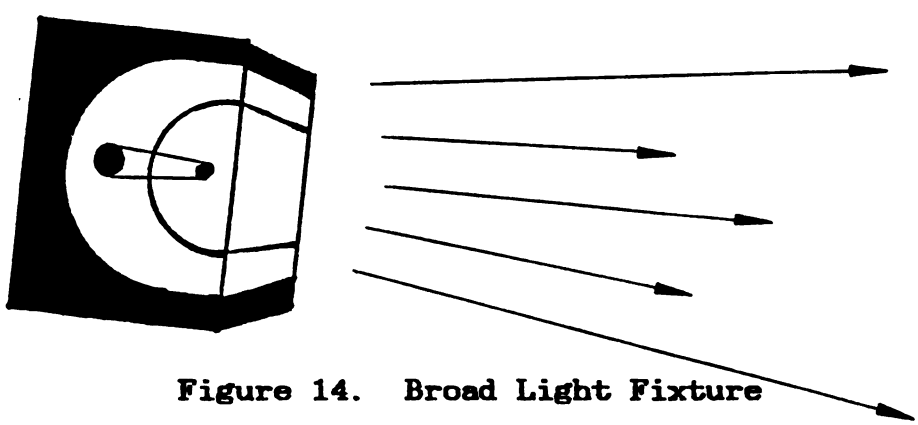


Figure 14. Broad Light Fixture

The reflector within a broad light is designed to inhibit the hemispherical spread of illumination. This instrument is primarily designed to illuminate background surface planes. Broad lights can also be used to provide

overall base illumination in the production setting. Classified as a small light source, illumination produced by a broad fixture has greater specularity than scoop lights used for the same purpose. Having specular and relatively uncontrollable illumination characteristics, broad instruments should never be used for either key or fill illumination coverage.

Projection Lights

Projection instruments are commonly used in video production for projecting illumination effects. The most common effects projector found in video production is an ellipsoidal spotlight. Having a very small diaphragm, illumination quality produced by an ellipsoidal light has the greatest specularity. This instrument is rarely used as the key source, and never for fill or base illumination coverage. Since an ellipsoidal instrument emulates the illumination quality projected from a theatrical spotlight, it can be applied as such in the video production setting.

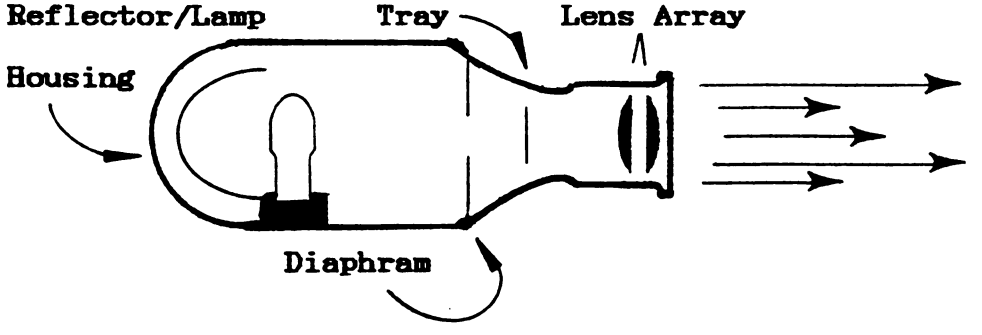


Figure 15. Ellipsoidal Projector

An ellipsoidal fixture utilizes a condensing lens array to focus and narrow beam spread. Incorporated into fixture design is a tray that allows insertion of a metallic disk between the light path and the condensing lens array. By changing the distance between the lamp/reflector housing and the condensing lens, the videographer can manipulate the focus of the pattern projected onto a background surface plane.

The illumination characteristics of an ellipsoidal instrument limit the usefulness of this instrument in the standard production setting. Though a highly efficient projection instrument, its usage is best reserved for projecting patterns onto background surface planes.

Modification Techniques

Several devices have been developed to manipulate illumination quality, intensity, and light/shadow placement. Modification devices generally fall into two specific categories:

1. Diffusion/Reflection
2. Reducing/Blocking

Devices within these classifications are designed to manipulate the illumination quality and intensity projected from an illumination source.

Diffusion/Reflection Devices

Soft boxes and Butterflies are commonly used in the film production setting to change the quality of illumination produced by a small light fixture. Fixture output is projected through a translucent diffusion panel, spreading illumination over a larger surface plane.

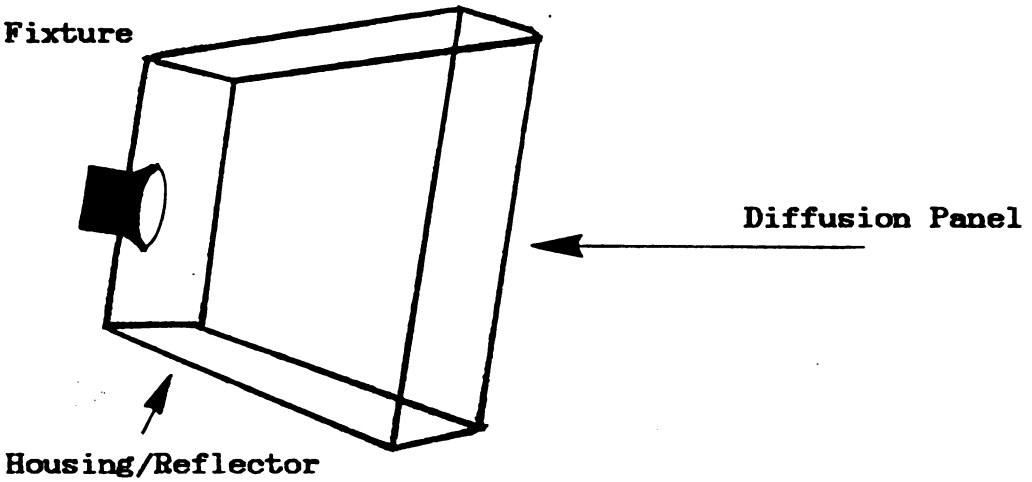


Figure 16. Soft Box Illumination

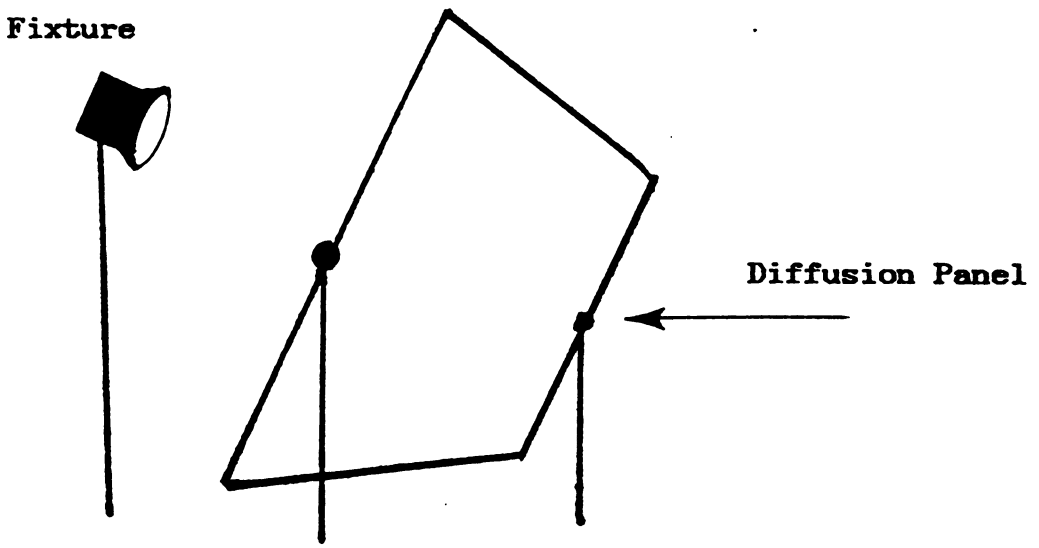


Figure 17. Butterfly Illumination



Soft Boxes and/or Butterflies are particularly useful in both studio and remote production applications. By projecting illumination through translucent diffusion material, this manipulation technique alters the quality of illumination produced by a small light source. Since large source lighting tends to wrap around surface contours, the transfer edge between illumination zones will display soft, subtle gradation.

Several disadvantages of this modification technique need to be considered in the planning stages of production. First, illumination intensity will be considerably reduced as illumination passes through the diffusion material. Although intensity reduction is dependent upon the density of the diffusion material used, a reduction of 50% (one f-stop) provides an approximate starting intensity loss. Second, when illumination is projected through a translucent diffusion panel, light intensity falloff will be greatly increased. To maximize the soft light quality produced by this modification method, the videographer will most likely find it necessary to use the modifier close to subject position. Recommendations on working distance vary according to the illumination effect desired. Generally, the subject-to-modifier distance should equal the longest dimension of the modification device. For example, a six-foot modifier should be placed approximately six feet away from the subject.

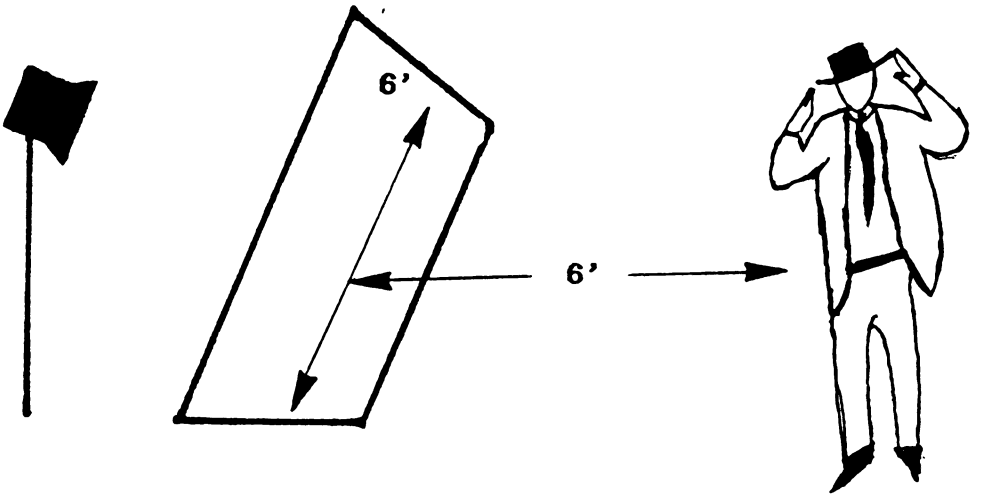


Figure 18. Soft Box/Butterfly Positioning

Soft boxes are large, bulky, and require additional light stands for support. Because they require a large amount of floor space, the videographer may find they are best applied to the single camera production setting. Finally, proper ventilation is necessary to prevent creating a fire hazard. The videographer must allow for ventilating air space between the fixture and the diffusion plane to prevent overheating the diffusion surface.

Umbrellas use a reflection method for changing the size of a small light source. Umbrellas are commonly used in the photographic industry, particularly for glamour portraiture. Instead of projecting light through translucent diffusion material, illumination is bounced off a reflective parabolic surface. Though umbrella lighting is a soft illumination technique, the parabolic reflector produces greater specularity and control than soft box illumination.

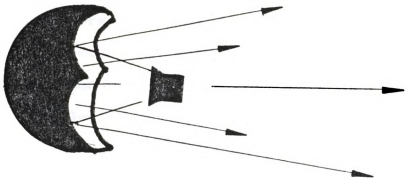


Figure 19. Umbrella Lighting

As with other large source illumination techniques, light energy reflected from an umbrella falls off rapidly as the distance from the source to the subject is increased. When used as either a key or fill illumination source, the difference between illumination zones (highlight, lit and shadow) will be minimal, with subtle gradation at the transfer edge. Commonly used for portraiture, umbrella lighting de-emphasizes facial modeling, creating a light and youthful appearance.

The disadvantages of umbrella lighting are similar to other soft illumination modification techniques. Fixture efficiency is considerably reduced, and dependent on the surface reflectivity of the modifier. The specularity of the illumination source can be changed through selection of the surface material. For example, a white umbrella will produce softer illumination than an umbrella with a reflective silver surface. The videographer should also remember that illumination reflected from an umbrella surface is dispersed and somewhat difficult to control.

Reflectors (or bounce cards) provide an additional method for modifying projected illumination. Reflectors can be constructed or purchased in several configurations and surface reflectance values. Reflective surfaces commonly used in the production setting include: Mirrors, Gloss/Matte Aluminum, Gloss/Matte Foam Core, and Gloss/Matte Black modifiers.

Reflectors are used to redirect light into unlit zones of the subject/object. To properly place a reflector, the videographer should consider the light reflectance axiom. Since "the angle of incidence equals the angle of reflectance", the following diagram details the proper reflectance method:

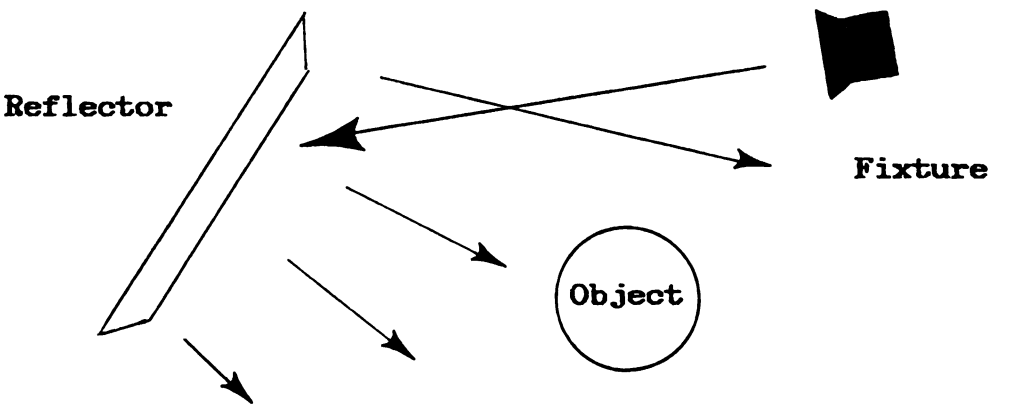


Figure 20. Bounce Illumination

Illumination quality redirected back to the set area will have the same characteristics as the reflecting surface. Mirrors (also called "rifles" or "shotguns") reflect nearly all of the illumination incident to the surface plane. Illumination reflected from a mirror surface will be very specular and highly focused. Matte surface

reflectors will create softer and more diffused bounce illumination. Illumination specularity is therefore dependent upon the characteristics of the reflecting surface. The quality of illumination is also dependent upon the size of the reflector. Reflectors which are larger than the object produce light energy which has softer, subtle illumination characteristics. Second, reflected illumination transmits the same color tonality as the reflecting surface. If a gold reflector is used, illumination projected onto a surface plane will have an overall golden tonality. Though black cards are commonly used to block illumination, they can also be used to reflect black illumination onto surface areas. Black reflectors are commonly used to rim the subject/object with a black highlight, creating visual separation from a high key (light) background plane. The videographer will likely find it necessary to place a black reflector very close to subject/object position. The light energy reflected from a black card is very low, and disperses rapidly as the distance between the reflector and subject/object is increased.

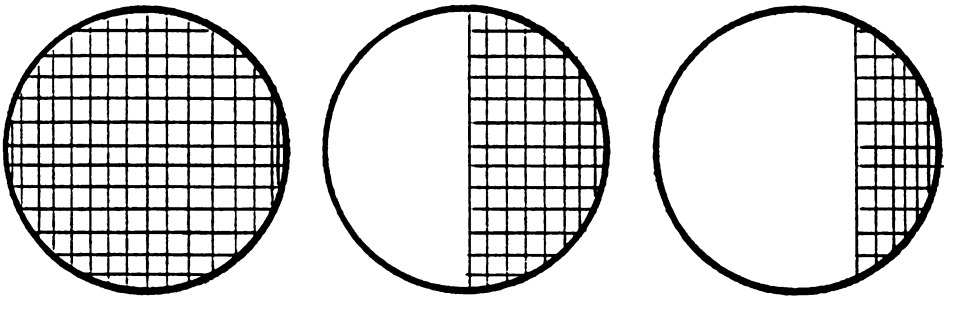
Additional Modification Techniques

Several types of modifiers are commonly used to either reduce or block illumination from striking a surface plane. Proper usage of these illumination modifiers will allow the videographer to manipulate incident illumination with precision.

Reducers

The function of a reducer is to limit illumination intensity projected from a light fixture. The most common reducer is diffusion material placed over the lighting instrument. Diffusion material designed for usage at fixture position is designated with the prefix "Tough" (ie. Tough Spun, Tough Frost, Tough Silk). This designation indicates that the material is capable of withstanding the intense heat generated by the illumination instrument. Diffusers can be purchased with varying densities for reducing illumination by approximately by 12% to 200%. Diffusion material can also be layered to achieve a full range of intensity reduction options. Diffusion material used at fixture position will reduce illumination intensity without altering beam shape. Figure six in the previous chapter details this light modification method.

Scrims (full, half and quarter) are also illumination reducers attached to the illuminating instrument. A scrim is a wire mesh surface within a metal frame.



Full Scrim Half Scrim Quarter Scrim

Figure 21. Illumination Intensity Modifiers

Scrims can also be purchased with varying densities, for control of fixture output. The function of a scrim is similar to diffusion material, with the added advantage of durability. Scrims will not deteriorate with usage.

Finally, a "Net" provides an additional means for reducing fixture intensity. Though most commonly used in the film industry, they can also be applied to the video production setting. Although similar in design to a scrim, the material used in a net is cloth, which requires the modifier be used at a distance from the lighting fixture.

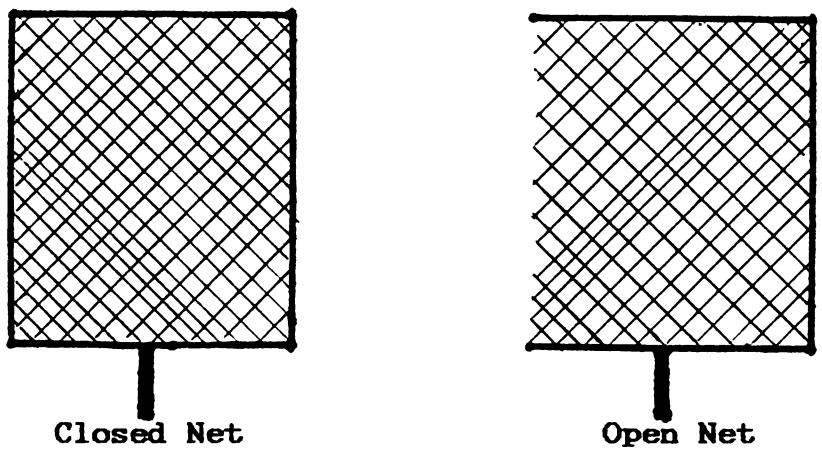


Figure 22. Illumination Quality Modifiers

The amount of intensity modification is dependent upon both the density of the material and the distance between the modifier and the subject. Intensity reduction is increased by placing the modifier closer to subject position. A Net is commonly used in portraiture to artificially create natural light falloff on a subject's

head and shoulders. By manipulating light falloff on the facial structure of the subject, the videographer will subjectively create a slimmer facial appearance.

Blockers

Illumination blockers are commonly called "Gobos", and their function is to eliminate light from falling onto specific portions of the image. Generally constructed from a matte black metallic surface, gobos can be found in many sizes and shapes to fit the specific lighting need.

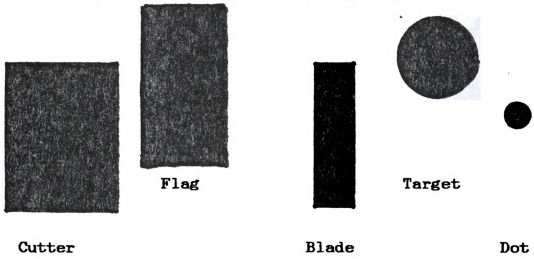


Figure 23. Illumination Blockers

In the video production setting, makeshift gobos can be constructed to fit the requirements of the lighting situation. Matte board or cloth can be hung or placed to block illumination from striking specific portions of the image. Proper ventilation is necessary when using makeshift gobos to prevent creating a potential fire hazard.

Finally, a Cuculoris (cookie) is a patterned illumination blocker used to modify background illumination. Cookies are commonly used within a illumination projector (ellipsoidal) but can also be free standing devices through which illumination is projected.

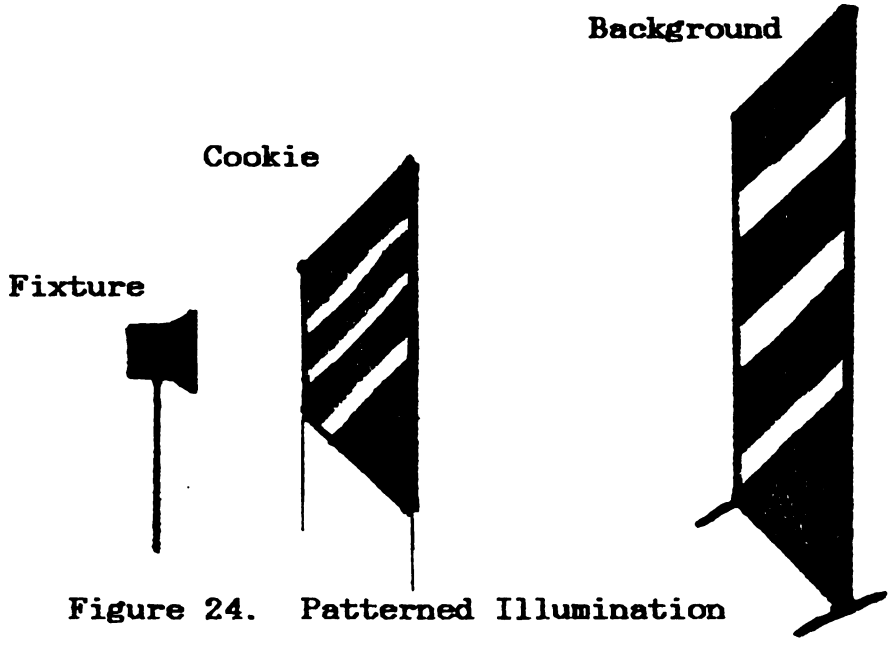


Figure 24. Patterned Illumination

In the video production setting, any device can be used to break up uniform illumination that strikes a background surface plane. Objects commonly available to the videographer (tree branches, lattice, window blinds) will create interesting light/shadow patterns on a background surface plane. The density of the projected shadow is dependent upon the distance between the blocking device and the background surface. By moving the cookie closer to the background, the videographer will create an image with stronger shadow density. Though most commonly used to break

up uniform background illumination, cookies can also be placed between the key light and the subject. This illumination technique will cause a pattern to be projected onto the surface plane of the subject/object, creating an unusual illumination effect.

Conclusion

This chapter has briefly examined the quality and characteristics of fixture and light modifiers in the video production setting. Through experimentation with light fixtures and lighting modifiers, the videographer will develop a repertoire of production skills applicable to a broad range of lighting challenges.

LIGHT MEASUREMENT TECHNIQUES

A commonly neglected area in the study of video production is the development of light measurement techniques. The ability to accurately measure light intensity, however, is imperative to any study of illumination control and manipulation. Measurement accuracy is a crucial step toward the development of creative lighting skills. To develop light measurement and evaluation skills, it is necessary to study the techniques used in the film production industry. In the photographic arts three methods are commonly used to measure and interpret light intensity.

1. Reflected Light Metering.
2. Incident Light Metering.
3. Reflected Spot Metering.

Each of these methods have inherent advantages and disadvantages in the measurement of illumination intensity. The focus of this chapter will, therefore, be an exploration of the measurement methods and their application to the video production setting.

Reflected Light Metering Technique

A reflected light meter is a hand-held device which provides the videographer with an intensity measurement of light reflected from the scene toward camera viewpoint. The reflected light meter is calibrated to provide exposure data based on a middle gray reflectance value. In the photographic arts, this gray value is a scientifically measured shade which reflects 18% of the illumination energy incident to the surface. In video, several competing calibration standards exist, primarily due to differences in camera reproduction sensitivity. All video standards, however, closely resemble the photographic gray scale calibration system. Though it is important to recognize system differences, reproduction criteria has little bearing upon the function of reflected light metering techniques.

Having approximately a thirty degree angle of acceptance, the reflected light meter simply averages scenic luminance that strikes the target of the photo-electric cell.

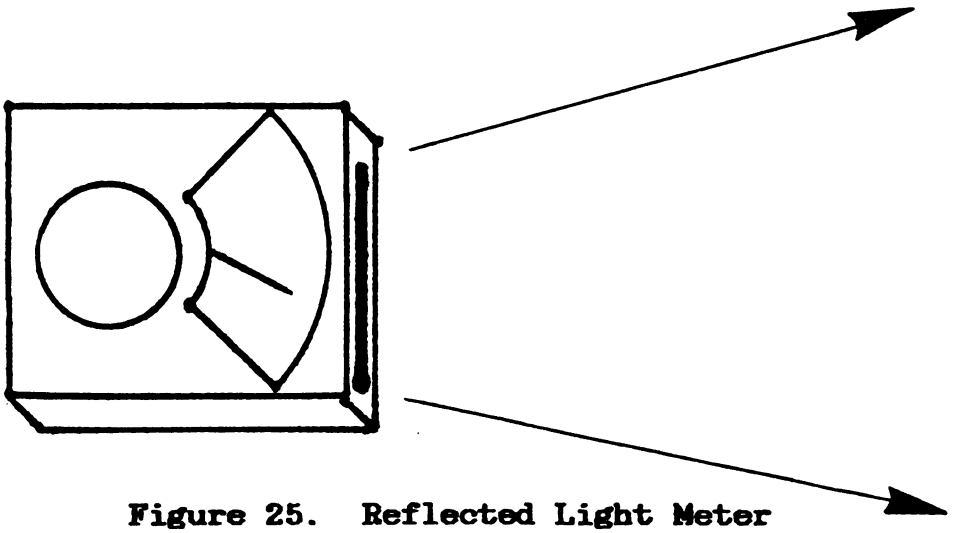


Figure 25. Reflected Light Meter

The automatic iris built into most video production cameras operates essentially in the same manner. The primary difference between an auto iris and a reflected light meter is that the angle of acceptance on a video camera is determined by the focal setting of the lens. A lens set in the wide angle position will have a much greater angle of acceptance then a lens set in the telephoto position.

The reflected light meter is the least sophisticated of measurement devices. Measurement is accomplished by pointing the target of the photo-electric cell toward scenic content. The meter simply averages scenic luminance and provides the videographer with a recommended f-stop setting. In scenes with a limited luminance range, the reflected light meter will provide accurate exposure data. In the video production setting, however, this is rarely the case. Consider, for example, a scene in which the subject of interest occupies only a small portion of the video frame.

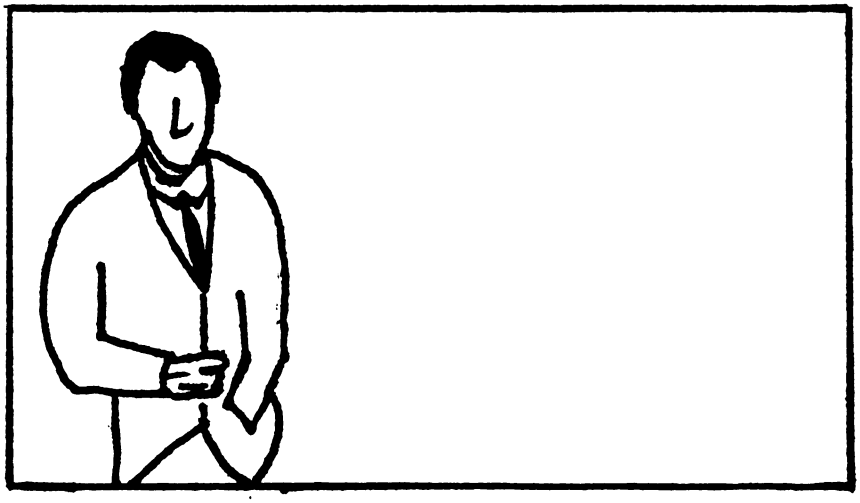


Figure 26. Scenic Reflectance

In this example, the primary subject occupies very little space in the video frame. Subject reflectance will, therefore, minimally influence the overall exposure reading. Since the reflected light meter averages scenic reflectance based on middle gray calibration, the recommended exposure may be innappropriate to scenic conditions. For example, if the background in the above illustration is black, the reflected light meter will average scenic luminance to the middle gray calibration value. Exposure based on reflected meter recommendations will lighten the overall scene, and overexpose the primary subject. The opposite phenonomenon will occur when the subject is placed in front of a white background surface. Again, the reflected light meter will average scenic luminance to a middle gray value, thereby underexposing both the background and the subject of interest.

The primary problem with the reflected light meter is that it averages together all luminance values based on the calibration point. This is generally not a problem under normal production conditions because most scenes have a range of reflective densities. Dramatic high or low key images, however, will not be properly reproduced when exposure is based upon reflected meter recommendations.

Another implementation problem with an averaging light meter is that it is insensitive to the reflective differences between scenic elements. By averaging reflectance values, the videographer is unable to determine

the intensity of scenic highlights, or density of shadow areas. Because video is a medium with a limited contrast range (the difference between highlight and shadow density), specific measurement of luminance values is crucial for lighting control. In video production, a highly sensitive instrument is needed to measure the difference between the lighting extremes. Scenes which exceed the contrast limitations of the video reproduction system will suffer a loss of detail at either, and potentially both, ends of the contrast range. The reflected light meter is useless to the videographer for measuring the contrast differences between lighting extremes.

In order to have full lighting control, the usage of other measurement devices is recommended. The reflected light meter does not provide specific information on the luminance values of scenic content.

Incident Light Metering Technique

The incident light meter is also a hand-held device for measuring light intensity. The incident meter is commonly used in film production to measure the illumination intensity which falls upon (or is incident to) the scene. Illumination is measured at subject/object position by pointing the dome of the incident meter toward the illumination source.

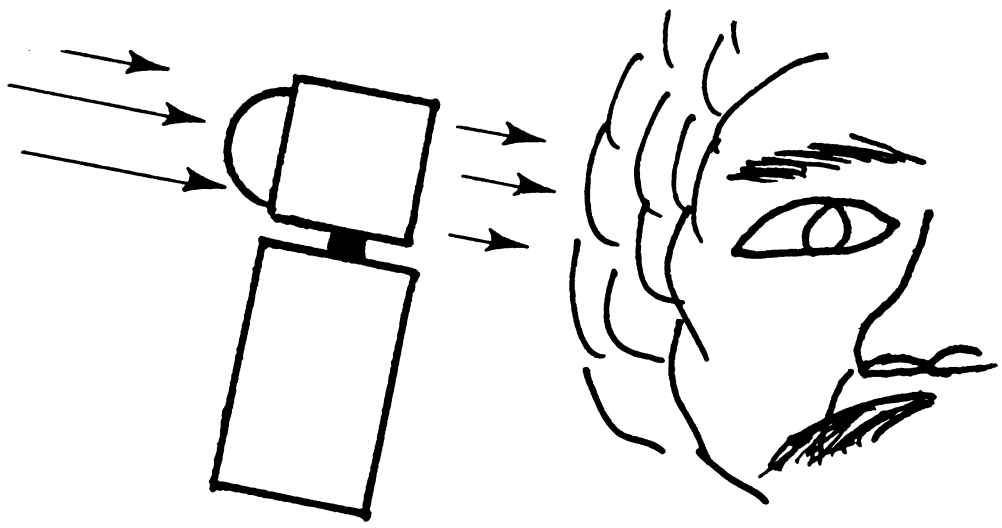


Figure 27. Incident Metering

The dome of the incident meter is hemi-spherical, and the meter is sensitive to illumination that strikes the dome. The incident meter display is calibrated in foot-candles, providing the videographer with valuable data on the intensity of incident illumination.

The advantage to using the incident light meter is that it can be used to determine the:

1) intensity of specific lighting instruments,
2) combined intensity of several illumination sources, and
3) lighting contrast differences between two or more illumination points.

When "roughing in" a lighting setup, the videographer can use an incident meter to measure illumination intensity. By using the foot-candle scale, the videographer can predetermine the lighting ratio between lighting

instruments. Illumination measurement and intrepretation is the subject of further exploration in subsequent chapters of this thesis. The incident light meter is one of the primary measurement tools used to determine an appropriate balance between light fixtures.

Once fixture positions have been established, the incident light meter can be used to determine the combined illumination intensity. Generally referred to as base illumination, the incident meter provides the videographer with precise data on the intensity and balance of illumination throughout the scene.

By placing the incident meter in the shadow zones of an image, the videographer can also determine the lighting ratio between illumination extremes. Because video is a medium with limited contrast latitude, measurement of illuminated and shadow zones is crucial for adequate scenic reproduction. When used correctly, the incident meter provides the videographer with a measurement tool for precise lighting control.

The videographer should also realize there are inherent disadvantages with the incident metering technique. The incident meter is designed to measure illumination that is projected upon the scene. The incident meter, however, cannot measure subject/object luminance, or the reflective qualities of illuminated surfaces. In scenes with a narrow range of reflectance values, the incident meter will suffice

in providing accurate exposure information. Consider, however, a scene with extreme reflectivity differences between object and background surface planes.

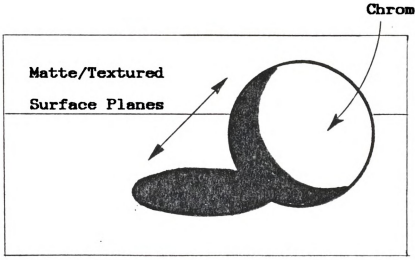


Figure 28. Extreme Reflectance Differential

With this example, if exposure is based on incident illumination, scenic elements with average reflectance values will be accurately reproduced in the video image. The chrome sphere, however, reflects a greater percentage of illumination than the surface on which is sits. Exposure based on an incident light reading will overexpose the chrome sphere. If surface reflectivity differences between surface planes exceeds the reproduction limits, highlights on the sphere will be obliterated. Since the incident meter cannot be used to measure object reflectance, the videographer is unable to determine the ratio between luminance values reflected scenic surfaces.

The incident light meter is an extremely valuable instrument for establishing lighting ratios and base illumination levels. Creative lighting, however, is based on both; 1) measurement of incident illumination , and 2) the measurement of luminance (reflected) values from scenic content. The videographer should realize that other intrepretative methods need to be used in conjunction with incident metering to maintain control over the limited reproduction latitude of the video imaging system.

Reflected Spot Metering Technique

As its name suggests, the reflected spot meter measures luminance values reflected from surface planes, toward camera viewpoint. The difference between reflective metering techniques is that a spot meter has a much narrower range of acceptance. Hand-held spot meters measure scenic reflectance at a horizontal angle of one or two degrees. A telescopic sight is included in the design of the instrument, allowing precise luminance readings.

Reflected spot meters are primarily used by landscape photographers for exposure control and manipulative printing techniques. Reflected spot meters are rarely found in the video production setting, though the usage of a reflective spot meter would greatly benefit lighting control and exposure calibration.

Probably the most sophisticated of all reflected spot metering devices can generally be found in the video

production setting. Though primarily used for camera setup and registration procedures, the waveform monitor can also be used as an extremely sophisticated spot metering device. The waveform monitor provides the most accurate means available for analyzing luminance values. Once the videographer understands the waveform display, this monitor can be creatively used in the design and manipulation of illumination patterns. The remainder of this chapter will examine the function of the waveform monitor, and how it can be used to determine lighting and exposure information.

The Waveform Monitor

The monitor's cathode-ray tube (CRT) display is designed to provide precise reflectance values of scenic content. The vertical axis on the waveform monitor represents a precise measure of signal amplitude or brightness, reflected from the subject or object. The horizontal axis on the CRT display represents scanning position (or time) as the electron beam scans the entire image. Since the waveform monitor measures reflectance values for both fields of the video frame, two identical outputs will be observed on the display.

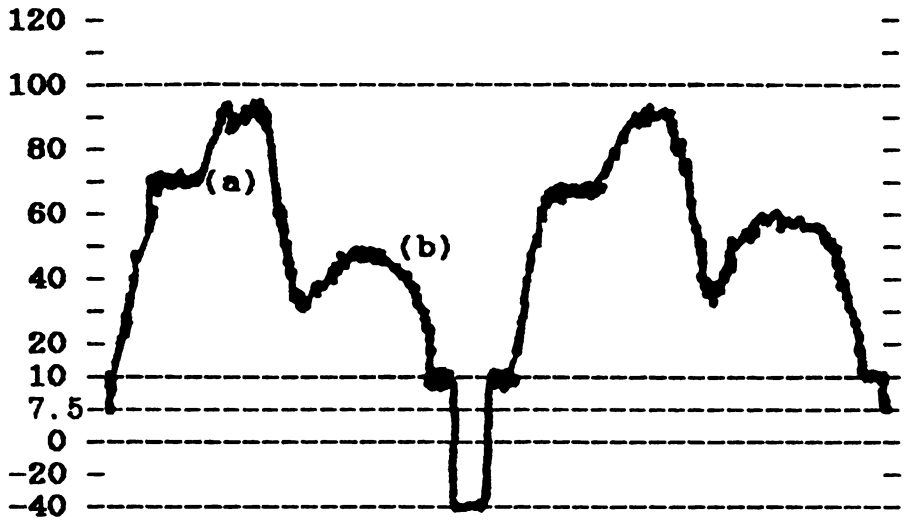


Figure 29. Waveform Monitor Display

Scenic highlights (or brightest portions of the video image) will be represented as peaks on the CRT display, while shadow areas will be represented as valleys on the video landscape. The difference between the highest peak and the lowest valley represents the contrast ratio of the video image.

The vertical axis on the waveform display has several small hash marks (graticules) which are calibrated in IRE (Institute of Radio Engineers) units. Each graticule represents a one percent difference in reflectance intensity. It is important to note that the wavefrom monitor is calibrated to reproduce a logarithmic (1.45:1) rather than a linear (1:1) luminance progression. A logarithmic progression is used because it closely approximates the way the eye/brain combination interprets brightness differences. A luminance reading of 70 (point a) and 50 (point b) IRE

units on the waveform display (figure 29) represents a reflectance difference of 20 IRE units. Because the waveform monitor is calibrated to reproduce a logarithmic progression, a 20% reflectance differential represents an exposure difference of one f-stop. This difference indicates that approximately double the amount of light is reflected from scanning position (a) in comparison to reflected luminance measured at the second scanning position (b).

The waveform display also provides detailed information to the videographer with regards to the reproduction characterisctics of the video camera. To fully understand how the waveform monitor works, it is first necessary to closely examine the information displayed by the device.

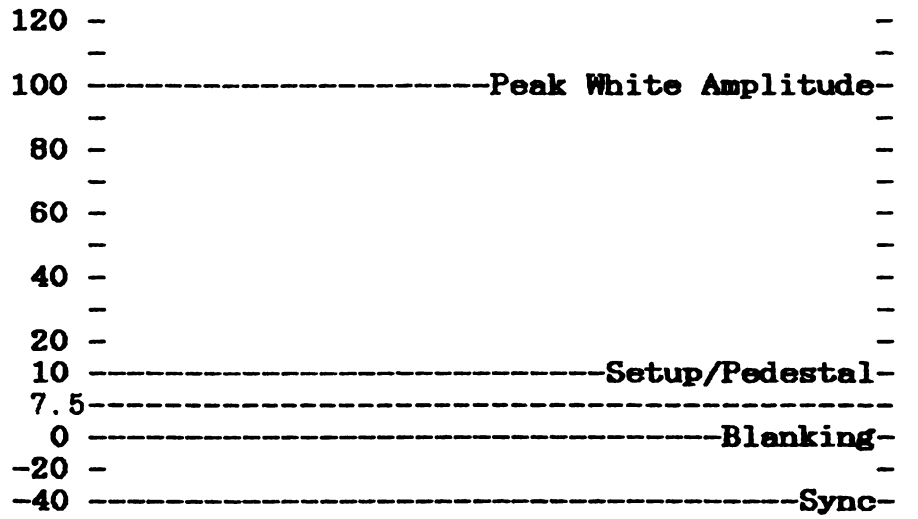


Figure 30. Waveform Display Information

The videographer will observe that solid horizontal lines run across the length of the display at 100, 10, 7.5, 0, and -40 IRE units. Each of these positions communicates vital information to the videographer on the reproduction characteristics of the video camera.

Measured at -40 on the waveform monitor, sync (an abbreviation for syncronization) is a timing pulse necessary for video image reproduction. The sync pulse generated by the camera is not manipulatable, and should always be verified before setup and registration procedures are attempted.

The blanking signal is located at 0 IRE units on the CRT display. The blanking signal represents the time during which the electron beam is turned off and returns to the beginning of the next scanning field. Though blanking is considered to be absolute black, the video black level is actually calibrated at a higher level. Luminance separation between the blanking level and video black level is necessary to prevent beam retrace patterns from appearing in the video image.

The solid lines at 7.5% and 10% represent the range within which the video setup (or pedestal) level is calibrated. The setup level represents video black, or the minimum reflectance value of the video imaging system. Any scenic element with a luminance value that falls within this range will reproduce as black, thereby lacking surface detail or texturing. To establish accurate tonal

reproduction, the setup level is usually calibrated independent of iris adjustments during camera registration procedures. The existance of this black level, however, does not mean to imply that every image should have an element with this reflectance value.

Finally, the solid horizontal line at 100% represents peak signal amplitude of the video imaging system. Any signal that exceeds this level will be clipped, resulting in a loss of highlight detail. One-hundred IRE units represents the maximum reflectance (white) level that any scenic element can have for accurate tonal reproduction.

Since 100 and 7.5 IRE units represent the extreme reproduction limits, the range between these reflectance extremes represents the reproduction latitude of the video imaging system. Reflectance values which exceed the reproduction limits will be either 1) compressed or 2) clipped, and therefore will suffer from a loss of surface detail reproduction.

Reproduction of object luminance values can be altered through lighting and through exposure manipulation. As indicated earlier in this text, a differential of 20 IRE units represents a reflectance difference equal to one f-stop in exposure.

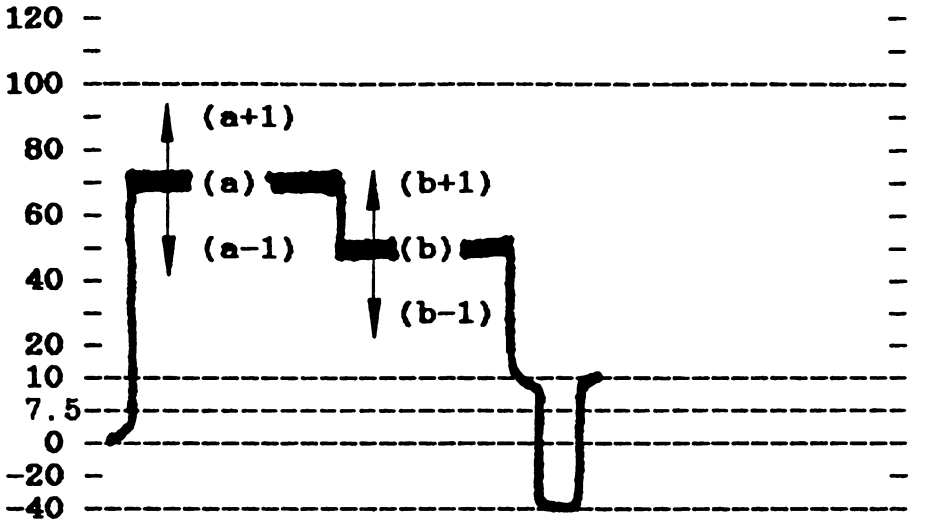
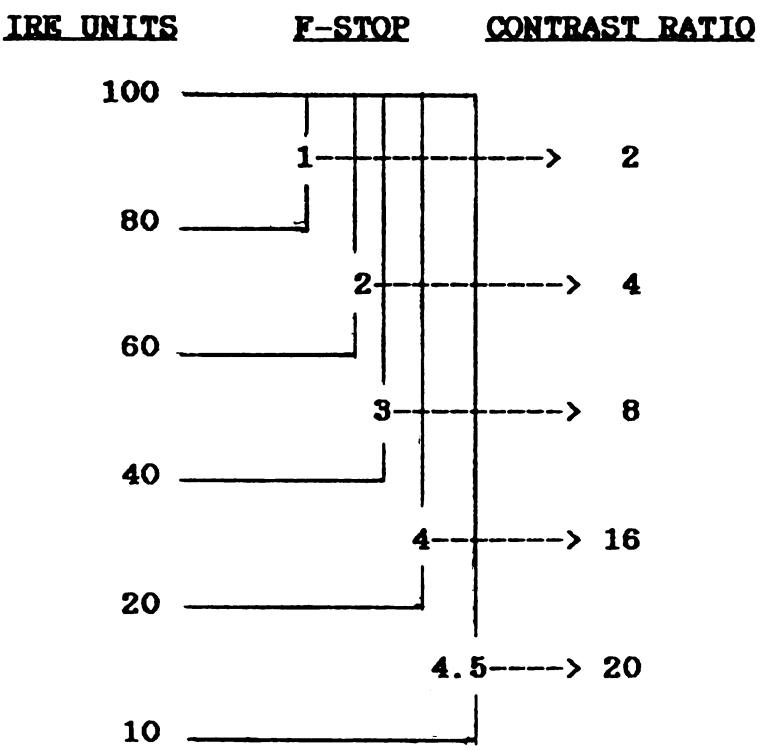


Figure 31. Effect of Exposure Manipulation

For example, if an exposure stop of f-4 is used to create luminance values of 70 and 50 IRE units, opening the iris by one f-stop (f-2.8) will double the amount of light striking the pickup tube. Luminance reproduction values will increase and a corresponding gain (+20 IRE) will be displayed on the waveform monitor. Closing the camera iris by one exposure stop (f-5.6) will have the opposite effect on luminance reproduction values. With this knowledge, it is a simple matter to determine reproduction limits and the contrast latitude (or ratio) of the video reproduction system.

Table 2. Exposure and Contrast Data



Determination of luminance differences is simply a matter of locating and comparing luminance points on the CRT display. For example, if scenic highlights are measured at 80 IRE units on the waveform monitor, and shadow zones reflect at 20 IRE units, the difference between scenic extremes represents a three f-stop differential. A difference of three f-stops can also be expressed as a contrast ratio of 8:1.

Before concluding this discussion on the waveform monitor, it is important to note there are several competing standards used for camera setup and registration procedures.

Chip charts designed to measure camera linearity differ, due primarily to the increased gray scale sensitivity in the latest camera generation. The following table presents two of the most commonly used charts for gray scale calibration. The EIA (USA) gray scale is a nine step chart that has been used for years in setup and registration procedures. The ITE (Japan) gray scale is an eleven step chart that was designed in recognition of the increased tonal reproduction capabilities of the video imaging system.

Table 3. Standard Reflectance Chart Values

STEP	ITE Reflectance	EIA Reflectance
1 (white)	83.0%	----
2	71.0%	60.0%
3	57.0%	41.3%
4	46.0%	28.4%
5	37.0%	19.5%
6	27.4%	13.4%
7	19.5%	9.2%
8	13.4%	6.3%
9	8.3%	4.4%
10	4.75%	3.0%
11	2.0%	----
Center White	89.9%	----
Background	18.0%	13.0%

To determine the contrast ratio represented by the chip chart being used, simply divide the extreme reflectance values represented on the chart display. For example, the ITE and EIA scale represent reflective calibration standards capable of reproducing either a 45:1 (89.9/2.0) or a 20:1 (60.0/3.0) contrast ratio.

The waveform monitor is an extremely valuable luminance measurement instrument for precise lighting design and control. Since the waveform monitor analyzes reflected illumination at each scanning position, the videographer can determine the luminance values at precise points in the video image. The value of understanding the function and operation of the waveform monitor cannot be overestimated. The waveform monitor is the primary measurement instrument on which the development of all creative lighting techniques should be based.

LIGHTING RATIOS, EXPOSURE CONTROL AND TONAL REPRODUCTION

Measurement accuracy and illumination control provide a solid foundation on which to build professional production techniques. Approaching video lighting from a technical perspective provides a basis on which to develop aesthetic lighting creativity. The focus of this chapter will, therefore, be an examination of:

1) the methods used to measure, interpret and control illumination,
2) the relationship between illumination intensity and exposure in video production, and
3) how illumination/exposure manipulation can be creatively used in image design.

Before continuing, it is important to define the terminology used to express illumination intensity. A lighting ratio is a mathematical expression of intensity differences between two or more measurement points. Though generally used to describe intensity differences between a key and fill illumination source, lighting ratios can also express the incident differential between any two illumination planes. Mathematical computation is, therefore, not strictly limited to comparing key/fill illumination intensity. For example, combined (base) subject illumination

can be compared against background illumination intensity. As a mathematical expression of illumination intensity differences, computation between any two illumination points has validity. Since lighting ratios describe incident intensity differences, they are determined by using an incident light meter.

Contrast Ratio

A contrast ratio is a measure of luminance differences reflected from surface planes. Contrast ratios generally fall into one of three classification categories.

1) Subject contrast, or the luminance difference between illumination zones (highlight, lit, shadow) on an individual subject/object.
2) Subject to subject contrast, or the base luminance difference between two or more subjects/objects within the same video frame.
3) Subject to non-subject contrast, or the luminance difference between a subject and a separate (i.e. background) image plane.

Subject/Object luminance values are primarily dependent upon:

1) the amount of light striking a subject/object, and
2) the reflectivity of the surface plane.

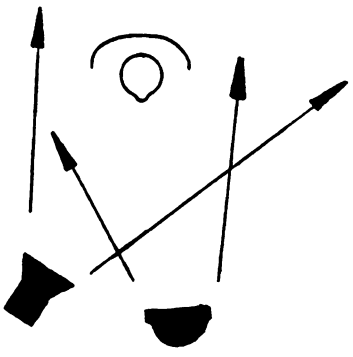
Control and manipulation of surface contrast should, therefore, be of primary technical concern to the videographer. Scenic contrast can be accurately determined in the video production setting by using a waveform monitor.

Both lighting and contrast ratios provide valuable information to the videographer with regard to illumination and exposure control. As indicated, good production technique requires the use of both an incident light meter and a waveform monitor in order to have complete illumination and artistic control.

Lighting Ratios

To determine a lighting ratio (Lr), the videographer first needs to classify the illumination pattern. If the key and fill fixture have overlapping coverage areas, the Overlapping Formula would be used for computation of the lighting ratio. When the key and fill fixture illuminate separate image planes, the Non-Overlapping Formula would be applied.

Overlapping Pattern



Non-Overlapping Pattern

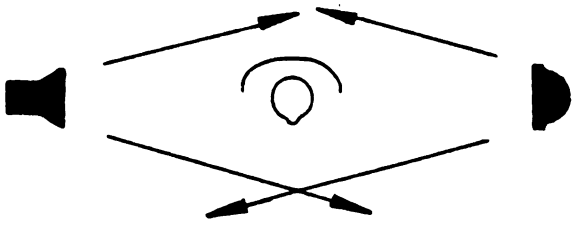


Figure 32. Overlapping/Non-Overlapping Illumination

Mathematical computation of the lighting ratio is easily determined by applying the appropriate formula.

Overlapping Formula	Non-Overlapping Formula
Lr=Key+Fill/Fill	Lr=Key/Fill

Dividing the numerator by the denominator will yield the ratio between the highlight (key) and shadow (fill) zones on the subject. For example, if the key (or key + fill) intensity measured 250 foot-candles (fc), and the fill intensity measured 125 fc, the lighting ratio would be 2:1. If the fill intensity was reduced to 32 fc the lighting ratio would be 250/32, yielding an approximate lighting ratio of 8:1.

A brief explanation will illustrate the proper method for measuring illumination intensity. With an overlapping illumination pattern, it is first necessary to measure the combined illumination intensity. To measure the key + fill intensity, position the incident light meter mid-way between the illumination sources. With the dome of the meter pointing toward camera position, take a combined foot-candle intensity reading. This combined reading becomes the numerator in the overlapping illumination formula. To determine fill intensity, return the meter to the same relative position. Next, block key illumination from striking the light sensitive dome of the incident meter. By placing your hand between the meter dome and the key light source, you will adequately shade off the key light effect.

The second incident reading provides a fill intensity value, and therefore, becomes the denominator in the mathematical formula.

Incident metering with a non-overlapping illumination pattern is easily accomplished. Simply take an incident reading on both illumination planes, with the dome of the meter pointed toward the illumination source.

The following table provides examples of commonly expressed lighting ratios. In this table, the key intensity is held constant while the fill intensity has been manipulated. In actuality, this illustrative scheme over-simplifies the lighting scenerio. Any key or fill intensity value has validity, and the lighting ratio can be determined by applying the appropriate formula. Actual illumination intensity values used in the production setting are dependent upon both technical and aesthetic considerations.

Table 4. Light Ratio Values

Key	Fill	Formula	Ratio
200 fc	100 fc	200/100	2:1
200 fc	65 fc	200/65	3:1
200 fc	50 fc	200/50	4:1
200 fc	35 fc	200/35	6:1
200 fc	25 fc	200/25	8:1
200 fc	18 fc	200/18	12:1
200 fc	12 fc	200/12	16:1

Through examination of the preceeding table, two observations should become apparent. First, the value of "one" in the lighting ratio is always used to express the fill light intensity. Though fill intensity is manipulated, the value of the fill fixture in the lighting ratio remains constant. Fill illumination intensity represents a sliding base value used for comparison against key illumination intensity.

Second, as the lighting ratio is increased, the difference between fill intensity values decrease. For example, the fill intensity difference between a 2:1 and a 4:1 (one f-stop) ratio is 50 foot-candles (100 - 50 = 50). By comparison, fill intensity values between an 8:1 and a 16:1 ratio (also one f-stop) only equals 13 foot-candles. Therefore, measurement accuracy and illumination control are crucial in the design and implementation of lighting patterns.

As the lighting ratio is increased, contrast differences between the lit and shadow zone of the image will become more dramatic. Increasing the difference between key and fill intensity, subjectively influences the way an audience will preceive an image. How the videographer defines the quality of illumination associated with each lighting ratio is dependent upon personal intrepretation. Low contrast lighting (ie. 2:1) can be either subjectively defined as "soft" (positive definition) or "flat" (negative definition) depending upon the videographer's personal

intrepretation. As the lighting ratio is increased, adjectives like "realistic" (positive) or "contrasty" (negative) may be used as descriptors. When approached as an art form, lighting definitions become highly subjective and personal to the lighting designer. Light ratio methods provide a standard technical basis on which to build evaluatory judgements.

In conclusion, the incident meter is a valuable device for accurate measurement of illumination intensity. Since the video reproduction system has a limited contrast range (20:1), incident light meters are useful for containing illumination values within the technical reproduction limits. Light ratio computation provides a means for mathematically determining the balance between illumination fixtures. Successful images however, are not created through "formula lighting". Lighting ratios only provide a technical foundation on which to build artistic lighting designs. How the videographer interprets an image is entirely subjective, and dependent upon the aesthetic considerations of the program material.

Relationship Between Illumination and Exposure

Simply stated, illumination intensity and exposure are interrelated technical considerations. A one f-stop reduction in camera aperture (ie. f-4 to f-5.6) requires a doubling of light intensity to maintain an equal exposure value. Exposure is an artistic production decision. The

illumination intensity necessary to maintain the appropriate exposure should be based on satisfying both the 1) technical requirements of the reproduction system and 2) the aesthetic intentions of the videographer.

Through light ratio calculation, the videographer can determine scenic illumination and exposure differences. Since a doubling or halving of illumination equals an exposure difference of one f-stop, the following table translates light ratios (Lr) into exposure ratio (Er) differences. The key/fill illumination values are included to demonstrate the relationship between exposure and illumination intensity. The videographer should realize that comparisons between any measurement point or intensity value has equal validity.

Table 5. Exposure Ratio Values

Key	Fill	Formula	(Lr)	(Er)
200 fc	100 fc	200/100	2:1	1.0 f-stop
200 fc	65 fc	200/65	3:1	1.5 f-stops
200 fc	50 fc	200/50	4:1	2.0 f-stops
200 fc	35 fc	200/35	6:1	2.5 f-stops
200 fc	25 fc	200/25	8:1	3.0 f-stops
200 fc	18 fc	200/18	12:1	3.5 f-stops
200 fc	12 fc	200/12	16:1	4.0 f-stops

In the preceding example, the calculated exposure ratio represents the f-stop differential between the key and fill illumination source. As the lighting ratio is increased, exposure calculation becomes increasingly more critical to maintain accurate tonal reproduction. Reproduction latitude

of the video imaging system is limited to a maximum of 4.5 f-stops. Therefore, a lighting ratio of 16:1 requires extremely precise exposure calibration. Exposure precision becomes increasingly more critical to prevent: 1) compressing the black level or 2) clipping the white level of the video signal. The preceding example was purposely restricted to an exposure/lighting ratio contained within maximum reproduction limits. Scenic elements illuminated and/or exposed at the reproduction extremes, will lack surface texture and color information. Therefore, it is recommended that lighting and exposure ratios be limited to the maximum values represented on this table.

Lighting and exposure ratios help define the technical parameters of the production medium. These production techniques, however, do not provide a methodology for determining a technically appropriate exposure setting. An optimum exposure setting usually falls somewhere between the illumination extremes. To accurately determine exposure, a production technique used by cinematographers working in the video medium is recommended. Exposure can be determined by calibrating the light sensitivity of an incident light meter, to match the sensitivity of the video camera. This technique requires using an incident light meter which 1) has both a foot-candle and f-stop scale and 2) accepts ASA (American Standards Association) calibration slides.

First, under even illumination, register and calibrate the video camera so that it is reproducing a standard reflectance chip chart with accuracy. Once the camera is properly calibrated, make a note of the f-stop reading on the camera lens. Next, place an incident meter under the same illumination used to register the camera, with the dome of the meter pointing toward the camera lens. Finally, insert the ASA calibration slides into the meter until one is found which provides the same f-stop value. Once this procedure has been completed, the incident meter can be used for determining both light intensity readings and a recommended (normal) f-stop setting.

Though the relationship between f-stop and depth of field falls outside the parameters of this manuscript, a brief explanation is included for highlighting another important illumination concept. Opening or closing camera aperture alters the amount of light striking the target of the pickup tube. A reduction in aperture of one f-stop (f-4.0 to f-5.6) reduces illumination input by 50%. Opening camera aperture one f-stop (f4.0 to f-2.8) doubles the amount of light striking the target of the pickup tube. Camera aperture and depth of field are linked in a converse relationship. By opening camera aperture, the videographer reduces depth of field, or the zone of sharp focus in the image. Closing, or stopping down camera aperture increases depth of field reproduction. Based on depth of field considerations, the videographer may need to calculate

intensity differences, without altering tonal reproduction. By using the following mathematical formula, the difference between exposure settings will allow the videographer to accurately calculate intensity changes.

$$\text{Intensity Change} = \text{2nd f-number}^2 / \text{1st f-number}^2$$

Based on the need for increasing or decreasing depth of field reproduction, illumination intensity changes can be easily calculated. For example, assume the videographer has determined that a previous exposure setting of f-4 does not provide enough depth of field for aesthetic reproduction puroses. To increase depth of field, an exposure setting of f-8 has been recalculated. The illumination intensity change needed to accommodate the exposure change, can be determined by applying the previous formula.

$$\text{Intensity Change} = 8^2 / 4^2$$
$$= 64/16$$
$$= 4/1$$

Therefore, the videographer would therefore need to increase illumination intensity by a factor of four to maintain an appropriate exposure value. Opening camera aperture to decrease depth of field also requires a corresponding reduction in illumination intensity.

$$\text{Intensity Change} = 2.8^2 / 4^2$$
$$= 7.84/16$$
$$= 1/2$$

In this scenerio, opening camera aperture to f-2.8 from f-4 requires an intensity reduction of 50%. Based on the need for increasing or decreasing depth of field without altering tonal reproduction, illumination intensity changes will require simple mathematical calculation.

Approached from a traditional engineering perspective, exposure settings are calibrated to maximize the contrast latitude of the imaging system. The technical argument for this engineering practice is based around the contrast deficiencies of the NTSC imaging system. This imaging system was created by the National Television Systems Committee (hence, NTSC) which developed technical standards for broadcast transmission adopted by America, and other parts of the world. Since the human eye is capable of reproducing a far superior contrast range, the engineering perspective has been to maximize contrast latitude thereby replicating optical reproduction. Although this argument certainly has merit, another viewpoint is offered for consideration. Optical reproduction of scenic contrast is highly subjective, and visual interpretation probably requires limited contrast latitude with regards to human reproduction capabilities. In video, however, lighting and exposure ratios that push the limits of the reproduction system:

1) run the risk of appearing "harsh", with excessive or unnatural contrast, and
2) limit the range of exposure options available to the videographer.

By compressing lighting and exposure values, the videographer minimizes the risk of creating harsh or contrasty images. Limiting the lighting/exposure ratio also broadens the range of viable exposure options. Any exposure setting is valid as long as the contrast range of the image falls within the reproduction limits of the imaging system. Film stock manufacturers recommend compressing dramatic lighting patterns to within an 8:1 (3 f-stop) ratio. This exposure recommendation is based on an imaging medium with approximately two more f-stops of reproduction latitude. Though contrast latitude may exceed these recommendations, extreme contrast is not a necessary condition for creating expressive images. By containing and/or reducing scenic contrast, the videographer broadens the range of viable exposure options. In the video medium, any exposure has validity if it satisfies both technical and aesthetic production conditions.

Tonal Reproduction

To evaluate luminance values, the videographer must be sensitive to the difference between eye and camera reproduction of brightness and tonal contrast. Eye-brain processing of color (hue, tint, saturation) values is non-linear, causing inaccurate brightness interpretation. Certain colors may, therefore, confuse the videographer in terms of actual object luminance and contrast values. To illustrate the point, consider setting up a standard color

video camera, and view the output on both a color and monochrome (black & white) monitor. First, by placing a red object in a black background field, the videographer will observe radical reproduction differences. When viewed on a color monitor, the eye is very sensitive to the red wavelength, causing it to appear brighter than other color values. On a monochrome monitor however, the videographer will observe that very little illumination reflects from the red object. The contrast difference between the object and background will be radically less than anticipated. Next, place a yellow object within the same video frame. In color, both objects will appear to have equal brightness values. When viewed on a monochrome monitor however, the videographer will observe far greater contrast differences between the yellow/black image planes. Subjective interpretation of reflected light energy (color) is referred to as a chromatic aberration. The camera, however, is an objective instrument, reproducing scenic elements according to reflected luminance energy.

When illuminating an image, the videographer should be sensitive to difference between subjective and objective optical reproduction systems. Cinematographers have developed a luminance evaluation device called a <u>viewing glass</u> for objective interpreting of scenic contrast reproduction. A viewing glass is essentially a color filter that removes primary color (red, green, blue) wavelengths. When observed through a viewing glass, scenic elements are

stripped of color information and reproduce at their actual luminance value. Cinematographers through experience can evaluate reflected luminance information to make refined lighting decisions. These illumination decisions are based on the technical reproduction latitude of the film emulsion and the aesthetic design of the production. By using the monochrome monitor mounted to the production camera, the videographer could also benefit from using this lighting evaluation methodology. Although the camera monitor is commonly used for composition and focusing purposes, it can also be an indespensible evaluation aid. Critically viewing an image through the camera monitor will enable the videographer to determine scenic contrast values during production set-up. To use the preview monitor as a critical evaluation tool, proper monitor setup and registration procedures are essential.

Through using a viewing glass, landscape photographers have developed an interpretive method for evaluating scenic luminance. The Zone System is an evaluation method for determination of an exposure value which contains scenic contrast within reproduction limits of the photographic medium. Gray scale values are assigned a specific luminance density, and exposure is calibrated to transfer these luminance values throughout the reproduction process. The Zone System is an interpretative method which details the relationship between scenic luminance, exposure, and reproduction characteristics of the photographic medium.

Table 6. Zone System Approach to Exposure

Zone	Exposure	Description
9	+ 4	Maximum white - no texture
8	+ 3	White - some texture prevalent
7	+ 2	
6	+ 1	Caucasian skin tone.
5	=	Middle Gray
4	- 1	
3	- 2	Very dark gray, with texture
2	- 3	Black, some texture detail
1	- 4	Black, no texture
0	- 5	Maximum black

The Zone System approach to exposure calibration is based on satisfying contrast limitations of the photographic medium. Zone System photography subjectively correlates luminance (reflected light) values to gray scale reproduction characteristics of film emulsion. The Zone System approach incorporates a ten step exposure scale, with the difference between steps equal to one f-stop. Since photographic emulsion is limited to seven f-stops in exposure latitude, zones 9, 1, and 0 under normal exposure will reproduce as either pure white or black, without texture detail. To determine an appropriate exposure, the photographer must determine the maximum contrast range of the scene. After luminance extremes have been calculated, an exposure setting is selected which maximizes reproduction characteristics. For example, assuming an exposure reading of f-5.6 reproduces middle gray (18% reflectance) with tonal accuracy, then the following f-stop settings correspond to the appropriate zone values:

Table 7. Zone System Calibration of F-Stop Values

Zone	Exposure	Calibrated F-Stop
9	+ 4	f-22
8	+ 3	f-16
7	+ 2	f-11
6	+ 1	f-8
5	=	f-5.6
4	- 1	f-4
3	- 2	f-2.8
2	- 3	f-2
1	- 4	f-1.4
0	- 5	f-1

To determine luminance (reflected light) differences between exposure zones, simply apply the exposure ratio formula. For example, luminance differences between zone 8 (white, with texture) and zone 5 (middle gray) in the preceeding table would be calculated as follows:

$$\text{Exposure Ratio} = \text{2nd f number}^2 / \text{1st f-number}^2$$

$$= 16^2 / 5.6^2$$

$$= 256/31.36$$

$$= 8/1$$

Reflected light energy of zone eight is therefore eight times the level reflected from the middle gray calibration point. It is important to remember that this evaluation method is based on reflected <u>not</u> incident light energy. The Zone System, however, provides a basis for manipulating tonal reproduction by varying incident illumination intensity. For example, in the preceding production scenerio, a middle gray value will reproduce as white when

incident illumination is increased by a factor of eight (ie. from 100 to 800 foot-candles). Incident light manipulation to alter tonal reproduction must also take into account surface reflectance characteristics.

The waveform monitor is an ideal production device for evaluating lighting contrast. Any change in exposure will cause a corresponding change on the waveform display. The waveform monitor is a more precise evaluation tool because contrast values are subjective with other evaluatory methods. Once calibrated, waveform display information can be adapted to provide Zone System data. The following table represents an adaptation of the photographic Zone System approach to video production.

Table 8. Zone System Approach to Videography

IRE Units	Zone	Exposure	Description
100	10	+2.5	White, no detail
90	9	+2.0	White, w/detail
80	8	+1.5	
70	7	+1.0	Causasian Skin Tone
60	6	+ .5	
50	5		Even Middle Gray
40	4	- .5	
30	3	-1.0	Dark Gray
20	2	-1.5	Black, w/detail
10	1	-2.0	Black, no detail

Zone system identification is determined by dropping the final digit on the waveform display output. For example, a luminance value of 100 IRE units becomes zone 10, 80 IRE units equals zone 8 et. cetera. This adaptation of the photographic Zone System also accounts for the limited

latitude of the video reproduction system. Reducing luminance differences between tonal zones allows the videographer to control and modify illumination patterns with detailed precision. Each stepwise progression between luminance zones equals an exposure difference of one-half f-stop. Therefore, reflectance values at 70 and 50 IRE units (zone 7 and zone 5) represent a difference in exposure of one f-stop. To determine scenic contrast, simply remove the mathematical sign (+/-) and add the exposure values. For example, an illumination pattern which creates highlights at 80 IRE units and shadow density at 30 IRE units, represents a total contrast latitude of 2.5 f-stops (1.5 + 1.0 = 2.5).

The language used to describe gray scale values at each luminance zone are highly subjective, and dependent upon the videographer's impression of contrast. The preceeding descriptors were included as a reference point on which to build your own contrast perceptions.

The Zone System approach to videography is an artificial device, for the interpretation of gray scale density. In actuality, reflected luminance from any subject/object will likely possess a range of reflectance densities. For example, in portraiture, the human head actually contains several reflectance values. Eyes, lips, hair and flesh have different reflectance characteristics. Skin tone classifications are also artificially broad, and dependent upon the subject. African skin may have a reflectance value ranging from approximately zone 3 to zone

6, depending on the heritage of the subject. Although the Zone System approach is an ideal device for interpretation of waveform data, it should not be considered as a formula for exposure control.

Light Manipulation and Exposure Control

Though exposure is a creative production decision, the videographer will find creative lighting manipulation to have greater production validity. Exposure manipulation to alter luminance reproduction does not provide the optimal means for artistic control. There are several sound technical reasons for manipulating illumination intensity (rather than exposure) to achieve desired results. First, manipulating exposure alters luminance reproduction of the entire scene. Exposure manipulation does not provide a means for creatively controlling luminance reproduction of specific scenic elements. Second, the video camera optimally performs at the exposure setting which reproduces a reflectance chart (ITE or EIA) with accuracy. Exposure manipulation decreases the signal- to-noise ratio of the reproduction system. Third, an over or under exposed image will be susceptible to certain image defects like beam pooling or chroma crawl. Beam pooling is an image defect common to over-exposed images. When an image is over-exposed, the pickup tubes cannot completely discharge image highlights, creating a "ghosting" effect. Chroma-crawl is an artifact of the NTSC system of color reproduction. In

an under-exposed image, the NTSC system becomes increasingly insensitive to decoding the luminance (brightness) and chrominance (color) signal with accuracy. Since both signals are modulated together in recording and transmission, an under-exposed image will suffer from poor color reproduction and increased noise in the shadow areas.

By using a waveform monitor, the videographer is capable of manipulating illumination intensity with accuracy. Based on our knowledge of lighting contrast and its relationship to exposure, intensity manipulation is easily determined. The relationship between exposure and lighting contrast can also be determined by inserting f-stop values and applying the exposure ratio (Er) formula. The following table details reproduction values through light manipulation. For this example, a standard gray (18% reflectance) chart is assumed.

Table 9. Zone System Approach to Lighting Control

IRE Units	Zone	Exposure	Lighting Contrast
100	10	+2.5	+ 6
90	9	+2.0	+ 4
80	8	+1.5	+ 3
70	7	+1.0	+ 2
60	6	+ .5	+ 1.5
50	5	Even	Even
40	4	- .5	- 1.5
30	3	-1.0	- 2
20	2	-1.5	- 3
10	1	-2.0	- 4

The following examples are included to clarify an important illumination concept. Assuming an incident illumination intensity of 100 foot-candles produces a middle gray (zone 5) value at an exposure of f-8, the following production conditions can be created.

1) Increasing illumination intensity by a factor of four (400 foot-candles) will cause a corresponding gray value shift to zone 9 (white).
2) Increasing illumination intensity by a factor of four and decreasing exposure by two f-stops (f-16), will cause reflectance chart reproduction to remain at luminance zone 5.
3) Decreasing illumination intensity by a factor of three (33 fc) will cause a corresponding decrease in middle gray reproduction (zone 2, black-w/texture).

Production variations with the preceeding example are endless, and manipulative application is dependent on specific artistic conditions. Approached from this perspective, the Zone System provides an analytical method for exposure and illumination control. Again, the videographer should realize that the examples provided are artificial, since most images have a range of reflected luminance values.

A couple of production techniques used in the photographic arts extend the application of the Zone System

approach to videography. Cinematographers developed a technique called "pegging the key tone" to ensure reproduction continuity between photographed images. A specific scenic element is assigned a gray scale value, and all other elements are illuminated to reproduce varying densities based on illumination/exposure of the primary element. In scenes with human subjects, flesh tones are usually pegged for consistency in editing. For example, if a caucasian subject is illuminated and exposed to reproduce a luminance value of 70 IRE units (zone 7), all other elements are illuminated around this exposure/illumination value. This technique was developed in recognition of the limited reproduction characteristics of the photographic medium, and to maximize the contrast latitude of the reproduction system. Once gray scale values have been established, the videographer can ensure continuity between image frames, even when locations or shot positions are changed. Therefore, when images are edited together, flesh tone values will remain consistent. Any illumination and exposure combination is valid, as long as there is no significant change in reproduction value of the "pegged tone". For example, if illumination of 150 foot-candles at an exposure of f-5.6 is used to "peg" flesh tones at 70 IRE units, any of the following combinations have equal validity:

Illumination	Exposure
300	f-8
75	f-4
225	f-6.8*
112	f-4.8*

*Denotes a .5 f-stop increase/decrease in exposure. Can also be labeled as either f-8/5.6 or f-5.6/4 respectively.

Photographers have also developed production techniques for manipulating luminance reproduction values between scenic planes. In the preceeding example, if our caucasian subject was placed in front of a white wall, the background reproduction value would equal Zone 9 when background illumination equals the intensity striking the subject. By decreasing the background intensity, the videographer can manipulate the zone reproduction value. Reducing illumination intensity by a factor of four (from 150 to 37 foot-candles) will alter the reproduction value of the background plane from zone 9 (white) to zone 5 (middle gray). Through careful illumination control, the videographer can custom design illumination patterns. Based on the previous production example, the following table presents a few of the illumination alternatives available to the videographer:

Table 10. Background Lighting Manipulation

Subject (fc)	Zone	Exposure	Background (fc)	Zone
150	7	f-5.6	150	9
150	7	f-5.6	37	5
300	7	f-8	300	9
75	7	f-4	75	9
75	7	f-4	19	5
225	7	f-6.8	225	9
225	7	f-6.8	64	5
112	7	f-4.8	112	9
112	7	f-4.8	28	5

The preceding example details background manipulation between zone 9 (white) and zone 5 (middle gray) luminance values. Background values, however, can be manipulated into any luminance zone. By manipulating background illumination intensity relative to a predetermined subject exposure, the videographer can creatively control image design. This manipulation technique affects not only gray reproduction values, but also color reproduction. Therefore, a red background plane can be manipulated to reproduce as either pink (increased illumination intensity) or burgandy (decreased intensity) color values. Since the negative NTSC artifacts based on exposure manipulation (bean pooling, chroma crawl) are also applicable to illumination manipulation, the videographer should carefully design manipulative illumination patterns.

Another production technique used by photographers involves creatively illuminating background planes, so that a range of tonal values will be apparent in the final image.

Background illumination gradation is based on the natural phenomenon of light intensity falloff (LIF). The following diagram illustrates how fixture distance (D) can be used to create gradation on background surface planes.

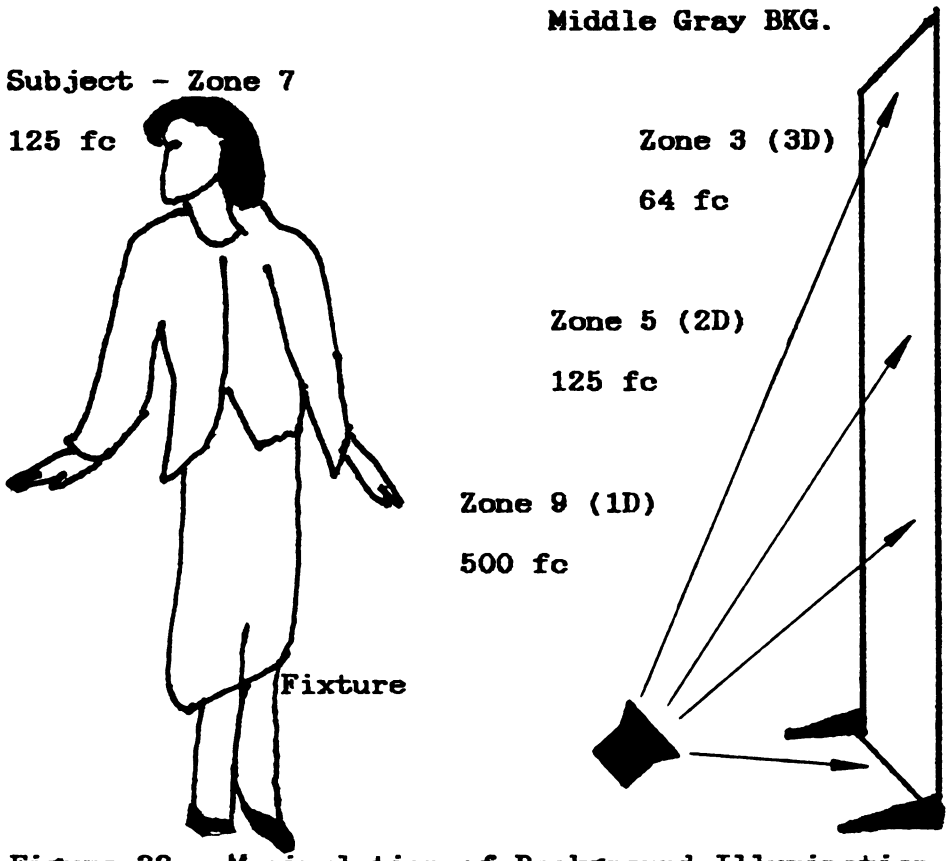


Figure 33. Manipulation of Background Illumination

Through fixture placement, illumination falloff can be incorporated into imaginative lighting designs. When using this lighting technique, the videographer will observe a range of luminance value differences on the same illumination plane. Illumination falloff and control is dependent upon the:

1) angle of incident illumination (Cosine Law),
2) the distance between the fixture and background distances (Light Intensity Falloff),
3) the reflective characteristics of the background surface (Light Reflectivity Law), and
4) the color of the illuminated surface (Chromatic Aberration).

As with any scenic element, background intensity falloff should be monitored on the waveform display. A potential difficulty with this technique is controlling fixture intensity to achieve an even balance with the primary (key) illumination source. The videographer will likely find it necessary to reduce background illumination intensity with regards to the key illumination source. To reduce fixture output, a range of options are viable in the video production setting;

1) increase the fixture to background distance,
2) use a lamp with a correspondingly lower output,
3) scrim or diffuse illumination intensity at fixture position.
4) Mechanical/Optical manipulation (flood or spot) of fixture output.

Reducing fixture intensity by using a silicon controlled rectifier (SCR) dimmer system provides another method for illumination control. In color videography,

however, this method has an inherent production drawback that must be considered. Illumination intensity control through a dimmer system alters the flow of electrical current to the light fixture. As electrical current is reduced, the color temperature of the lamp will decrease. The color value on background surface planes will therefore shift toward the lower (red) end of the light spectrum. Under some production conditions, color temperature reduction may creatively support the artistic intentions of the videographer. Creative light manipulation by restricting electrical current should be approached with caution because the results are inconsistent and not easily verifiable. If used, this lighting technique is only recommended for manipulating background illumination.

Conclusion

This chapter has thoroughly examined the interrelated concepts of illumination intensity, exposure, and tonal reproduction. Understanding the technical aspects of the imaging system, provides a methodology for the development of creative lighting techniques. The incident light meter and the waveform monitor are vital production tools for measurement and intrepretation of illumination. Development of creative illumination design is based, in part, on professional development in the following areas:

1) proper intrepretation of light measurement devices,

2) understanding the relationship between exposure and illumination intensity,

3) understanding the scientific attributes of light transmission, and their effect on illumination modification techniques,

4) training the eye to interprete scenic luminance and contrast,

5) translating scenic contrast into an exposure setting which maximizes the limited latitude of the video reproduction system.

The Zone System approach to video production is presented as a method for interpretation of illumination and exposure control. The Zone System is an attempt to demystify the illumination/exposure relationship, with respect to the limited contrast latitude of the video imaging system. The videographer, however, should realize that "formula" lighting does not provide a means toward reaching creative development. The Zone System approach is an artificial device because:

1) object luminance is in most cases a complex, not simple reflectance value, and

2) illumination/exposure is an interpretative art, not a repetitious science.

Armed with a thorough understanding of the material presented in this and previous chapters, it is now time to examine the application of illumination measurement and manipulation to portrait and product videography.

PORTRAIT LIGHTING TECHNIQUES

Portrait lighting represents one of the greatest challenges to the lighting director. Every subject is unique, and the lighting style chosen for portrait illumination should be based on accentuating the unique and beautiful attributes of the individual. Portrait lighting decisions also need to satisfy the technical parameters of the video reproduction system. The combination of artistic expression and technical expertise will provide a constant educational challenge to even the most experienced videographer.

The focus of this chapter will be an examination of the methods used to create glamourous video portraiture. Building upon the previously discussed illumination techniques, this chapter outlines how various production factors interact in the portrait production session. Included in this discussion of portraiture will be an in depth analysis of four basic lighting designs commonly found in the cinematographic/photographic arts. These designs are generally referred to as:

1. Broad Lighting
2. Narrow Lighting
3. Frontal Lighting
4. Side Lighting

Though these illumination designs are standard portrait patterns, the variations on each setup are endless. Specific application of the lighting techniques are dependent upon the facial characteristics of the subject, and the aesthetic intentions of the videographer.

Fixture Placement Procedures

Before illuminating the subject, the videographer should first examine the facial characteristics of the individual. Since every subject will have unique facial features, the illumination design should be unique to the individual. The facial area portrait photographers scrutinize is called the facial "mask". The facial mask is defined as the triangular area bordered by the eyebrows, with the apex at the subject's chin. By default, the facial mask encompasses the subject's eyes, nose, cheeks, lips and chin. The facial mask is of primary concern to the portrait videographer because this is the region the viewer directs attention to when viewing an image. The facial mask reveals information on the subject's personality and the aesthetic intentions of program content.

Through analysis of the facial mask, the videographer can begin to subdivide the image into separate facial illumination zones. Illumination zones created within the facial mask are classified into three specific illumination categories. They are: 1) highlight, 2) lit, and 3) shadow illumination zones.

Highlight zones created on the subject are apparent on surface planes parallel to the key light fixture. Light energy (luminance) reflected from the subject will be strongest at a point directly proportional to the incident angle (light reflectance axiom). Therefore, luminance energy will be strongest at positions directly parallel and perpendicular to the angle at which illumination strikes the object. Surface texture, however, also affects the luminance energy reflected from the subject. Since eyes have a viscous surface, they reflect a greater amount of light energy than either skin or hair. Subject reflectivity is also dependent upon genetic characteristics. Flesh tone reproduction is dependent upon the heritage of the subject, and the light energy incident to the facial surface. Caucasian skin tones are generally highly reflective, and under normal exposure will meter approximately 60 to 70 IRE units on the waveform monitor. African flesh tones have a much wider reflectance range. African flesh tones under normal exposure will reflect between 35 and 60 IRE units, depending upon the heritage of the subject. Reflected luminance energy is, therefore, primarily dependent upon the heritage of the individual.

The lit zone of the subject is directly next to the highlight zone. The lit zone reveals information on skin color and surface texture of the facial mask. The lit zone is typically the largest illumination zone created by the

illuminating fixture(s). The lit zone is created by a combination of the key and fill illumination source.

Finally, the shadow illumination zone is created on the facial mask by the key illumination source. Through stylized portrait design, the shadow zone should fall into a predetermined facial area. Because the key light supplies primary illumination, the shadow zones will be projected onto facial areas directly opposite the key light fixture. Facial shadowing is created by protrusions (forehead, nose, lips and chin) which block illumination from striking opposing facial areas.

The combination of illumination zones 1) conveys primary illumination directionality, 2) indicates the quality of illumination, and 3) details the facial characteristics (color, size, shape and texture) of the subject. Illumination patterns must be carefully designed to highlight the glamorous features, and minimize the genetic abberations of the subject. Glamorous facial features can be accentuated through proper instrument placement. Since the key light has the greatest effect on exposure calculation, facial features which fall within the key illumination area will be accentuated. Abberations within the facial mask such as birth marks, high foreheads or skin imperfections can be minimized through careful lighting control. Placing skin abberations within the shadow zones created by the key light fixture, reduces their visual impact in the final portrait

image. Proper fixture placement is dependent upon the features the videographer wishes to emphasize or de-emphasize in the final image.

Subject Modeling

Horizontal and vertical fixture placement is the standard method used to manipulate subject modeling. Horizontal placement of the key light will determine the size of the three illumination zones. For example, when key illumination strikes the subject from a frontal position (relative to the subject-camera axis), the videographer will maximize the size of the highlight and lit illumination zone. Frontal illumination, however, minimizes the size and impact of the shadow zone cast by the key illumination source. By increasing the illumination angle, the videographer will decrease the size of the highlight and lit illumination zones. The attached shadows created by the key light source will become increasingly larger and emphasized. The following diagram details the impact horizontal positioning will have on facial modeling.

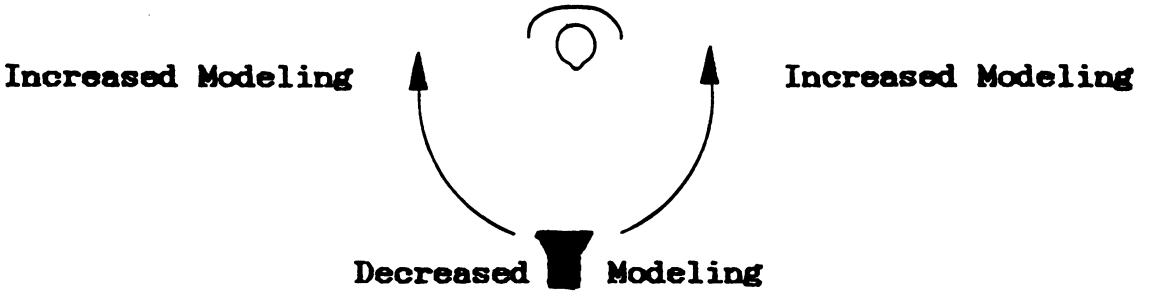


Figure 34. Horizontal Positioning Techniques

Vertical placement of the key light fixture affects the shape of the shadows created by the illumination source. Illumination striking the subject from a high angle will create long and exaggerated shadows within the facial mask. By decreasing the vertical angle of the fixture, the length of facial shadowing will also decrease. The following diagram details the effect of vertical light placement on subject modeling.



Figure 35. Vertical Positioning Techniques

Correct horizontal and vertical placement is dependent upon the facial characteristics of the subject. When illuminating subjects with strong facial features (deep-set eyes, sharp nose and/or chin), the videographer may find it necessary to decrease the horizontal and vertical illumination angle. By decreasing the illumination angle, facial attributes hidden by shadows projected from strong facial features will become illuminated by the direct rays of the illumination source.

Decreasing the illumination angle tends to; 1) broaden the facial structure, 2) increase the illuminated surface area, and 3) reduce the size of projected shadows. Since shadows convey information on subject form, texture, and dimensionality, they are very important in the creation of video images. Images that lack shadow detail will appear flat and lifeless. A photographic technique used extensively by portrait photographers is to position the key illumination source at the angle which projects the nose shadow along the smile line of the subject. This positioning technique preserves facial dimensionality without creating a distracting hard line to the face.

Subject Contrast

Subject contrast in video portraiture is dependent upon the intensity differences between the key and fill illumination instruments. Subject contrast is expressed as a ratio, or simply the mathematical difference between key/fill illumination intensity. As detailed in chapters four and five, subject contrast is dependent upon the intensity of the illuminating instruments and the design of the lighting pattern. Mathematical computation of the contrast ratio can be easily accomplished for both overlapping and non-overlapping lighting patterns. Bearing in mind that the video reproduction system has limited contrast latitude (4.5 f-stops), the videographer will

likely find illumination intensity differences to be suprisingly low between the key and fill illumination fixtures.

The contrast ratio chosen when designing an image should be based on satisfying both the technical limitations and aesthetic intentions of program content. Descriptors used to classify contrast differences are subjective, and dependent upon individual artistic interpretation. Documented experimentation is crucial for developing a repertoire of lighting skills, and a language which describes portrait contrast differences. Any illumination pattern has validity as long as it properly creates the intended lighting effect and the contrast differential can be contained within the reproduction limits of the video medium.

Basic Portrait Methods

A suggested production method is recommended in the study of portrait lighting techniques. The videographer will find it useful to begin portrait design by first placing the key illumination source. Exact key positioning should be determined prior to the addition of other illumination instruments. Shadows created by the key light will indicate proper fixture position, and visually establish the illumination quality produced by the fixture. Small (specular) illumination sources create a hard line at the transfer edge between highlight, lit and shadow illumination

zones. Larger key illumination sources wrap around surface contours, creating subtle gradation at the transfer edge.

Either key illumination technique has applicability and is dependent upon the aesthetic intentions of the videographer. Once the key light has been positioned, the fill light can then be added. Fill light positioning is based on illuminating the shadow zone created by the key light source. The primary purpose of the fill light is to reduce subject contrast created by the key light fixture. Increasing fill (secondary) illumination intensity relative to the key (primary) light source, reduces the lighting ratio between fixtures. For example, a subject contrast ratio of 1.5:1 will create a portrait with minimal shadow density. Reducing fill intensity increases both shadow density and the contrast ratio. Several techniques are used in the production setting to manipulate fixture intensity. The standard operating procedures used in the photographic industry to control the key/fill contrast ratio are presented below:

1. Diffuse or Scrim fixture output to reduce fixture intensity.
2. Project illumination through cloth netting or a translucent (soft box) surface plane.
3. Reflect illumination off a larger surface plane.
4. Alter the subject to fixture distance (Light Falloff Axiom) to increase or decrease fixture intensity.

Fill light intensity is typically manipulated to establish the proper contrast ratio. If the fill light is too strong, additional distracting shadows will form on the subject's face. The contrast ratio between illumination fixtures controls shadow density, but does not alter the quality of the transfer edge produced by the key light. The transfer edge is dependent upon the size and distance of the primary light source to the subject.

Finally, back and background lights may be added to the final image. These fixtures should complement the aesthetic design of the primary and secondary illumination source. Though lighting ratios are commonly used to express the intensity difference between the key and fill light, computation can also be determined between frontal and back illumination sources. Once an approximate back light intensity has been calculated, the waveform monitor should be used to measure reflected luminance differences. The waveform monitor displays the luminance differential between the calibrated facial exposure, and the intensity of the back light source. Luminance energy reflected from a back light source is dependent upon the position of the fixture (horizontal and vertical), and the reflective caracteristics (color/texture) of the subject's hair. Waveform monitoring is crucial for consistent portrait results.

This thesis has primarily focused on the placement and measurement of the frontal illumination sources. The usage of back lighting has been excluded from this discussion for

several reasons. First, back lighting generally has little effect on the overall exposure of the video image. In addition, back light illumination has traditionally been used for technical production reasons. To enhance visual separation, back light was used to rim the subject with light creating artificial space between scenic elements. This illumination technique was particularly necessary in monochrome imaging mediums which had technically limited contrast reproduction characteristics. Lighting patterns that developed were highly stylized and theatrical. Recent generations of video reproduction equipment have vastly superior contrast reproduction capabilities. Partially due to technical advances, aesthetic illumination techniques have evolved into an era of "realistic" or "natural" illumination design. Because stylized backlight illumination has an element of theatricality, it may conflict with realistic illumination design. With improved contrast reproduction, back lighting is no longer a necessary illumination requirement. Back light usage is, therefore, dependent upon creative illumination interpretation.

Background illumination provides an additional method for separating subjects from background surface planes. Through creative background illumination patterns, the videographer can force the perspective of depth in the final image. By "painting" background surfaces with light and shadows, the videographer can add visual interest to the image. Background illumination can also be used to separate

the subject from similiar tone backgrounds. Fixture placement will emphasize or minimize surface texture on the background plane. The following diagram is included to illustrate the illumination technique.

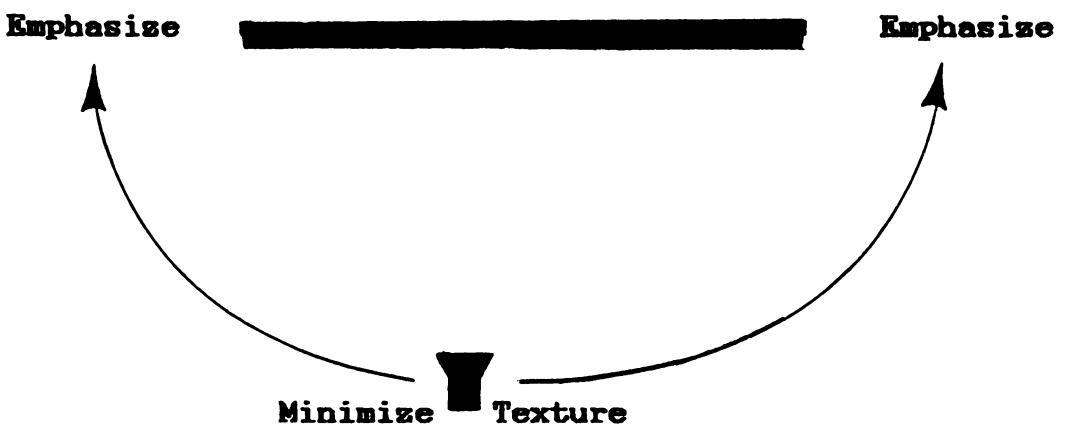


Figure 36. Background Texture Reproduction

The advantage to using background over back light illumination is that this illumination technique allows subject movement over a larger set area. Back lighting patterns have a tendency to force subject rigidity in the scene. An incident meter and a waveform monitor should always be used to establish an appropriate working intensity. Background reproduction is dependent upon; 1) the intensity of illumination, 2) the angle of illumination, and 3) the reflectivity of the background surface plane. Through careful illumination control, the videographer can subjectively alter reproduction of the background surface. For example, background surfaces will reproduce as white

(with texture) at 90 IRE units on the waveform monitor. Reducing illumination intensity to 50 IRE units will manipulate background surface reproduction to a middle gray value. Any background luminace value has validity as long as it satisfies technical and creative design criteria. Background illumination intensity should be established based upon the luminance and exposure value assigned to the subject. The videographer should carefully control background intensity and illumination patterns to prevent conflict with portraiture design. Caution should be exercised when over-illuminating background surface planes. If background intensity is too strong relative to subject illumination, the face of the subject will appear unnaturally dark.

Through working with fixtures individually, the videographer can study the effects each light will have on the design of the final image.

Additional Portrait Illumination Techniques

"Feathering" is another production technique used extensively to control illumination intensity. This technique is particularly applicable with remote lighting fixtures due to fixture transmission characteristics. With lensless illumination sources, light energy is not uniformly projected from the fixture. The following graph represents the light transmission characteristics of a small illumination fixture. The data represented on this graph is

hypothetical. Actual intensity dispersion is dependent upon the design of the fixture, and the distance between the fixture and the measurement point.

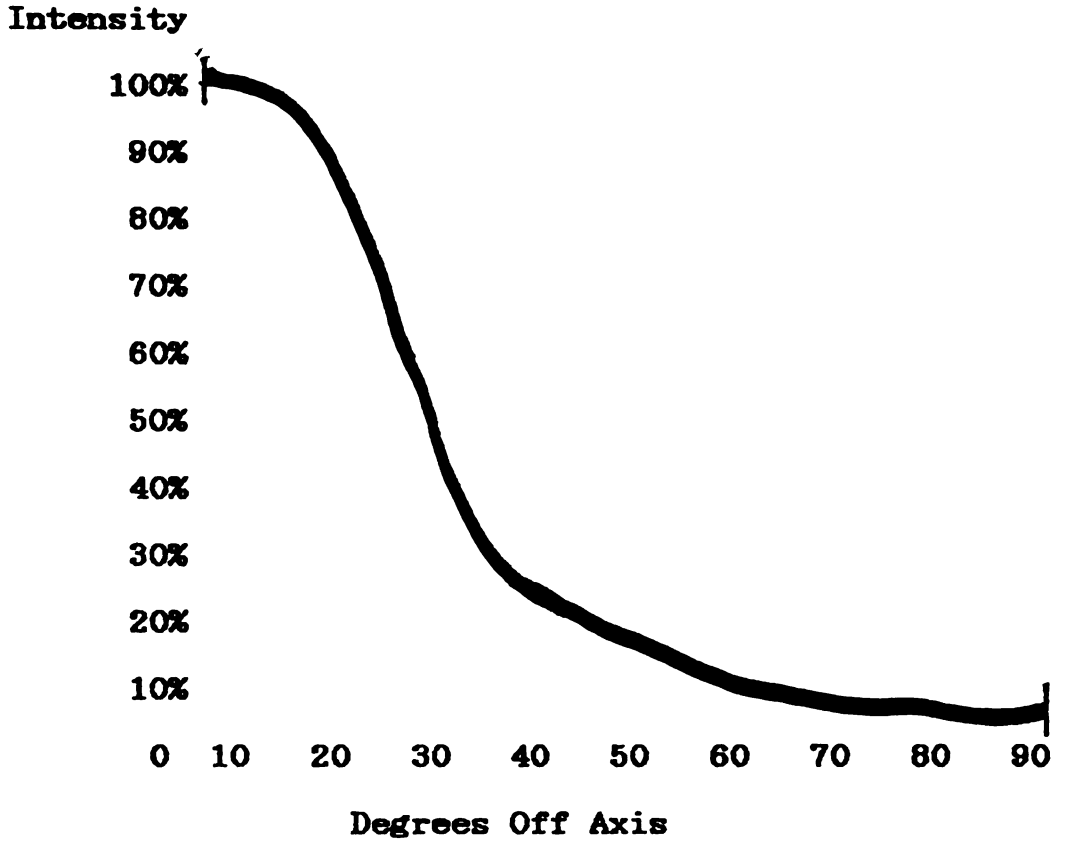


Figure 37. Illumination Dispersion Characteristics

Rotating the fixture off-axis relative to the subject position will illuminate the individual with the less direct and intense rays from the illumination source. The following diagram illustrates a standard method for "feathering" portrait illumination.

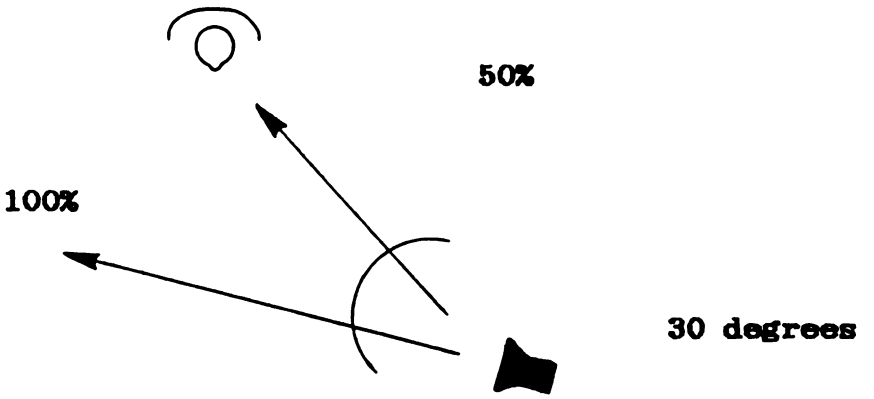


Figure 38. Feathering Portrait Illumination

By rotating the fixture 30 degrees off the subject axis, light intensity projected onto the facial mask will be reduced approximately 50% (1 f-stop). When an illumination source is feathered, the fixture is typically rotated toward camera (foreground) position. Foreground positioning reduces illumination spill onto background surface planes. Feathering is an extremely useful technique for quickly manipulating fixture intensity and the lighting contrast created between the key and fill illumination source.

Although a contrast ratio is usually computed between illumination fixtures, it can also be computed between an instrument and a reflective surface plane. Bounce illumination is a common technique for redirecting primary illumination onto the shadow zone of the facial mask. The following diagram details the technique which applies the light reflectivity axiom.

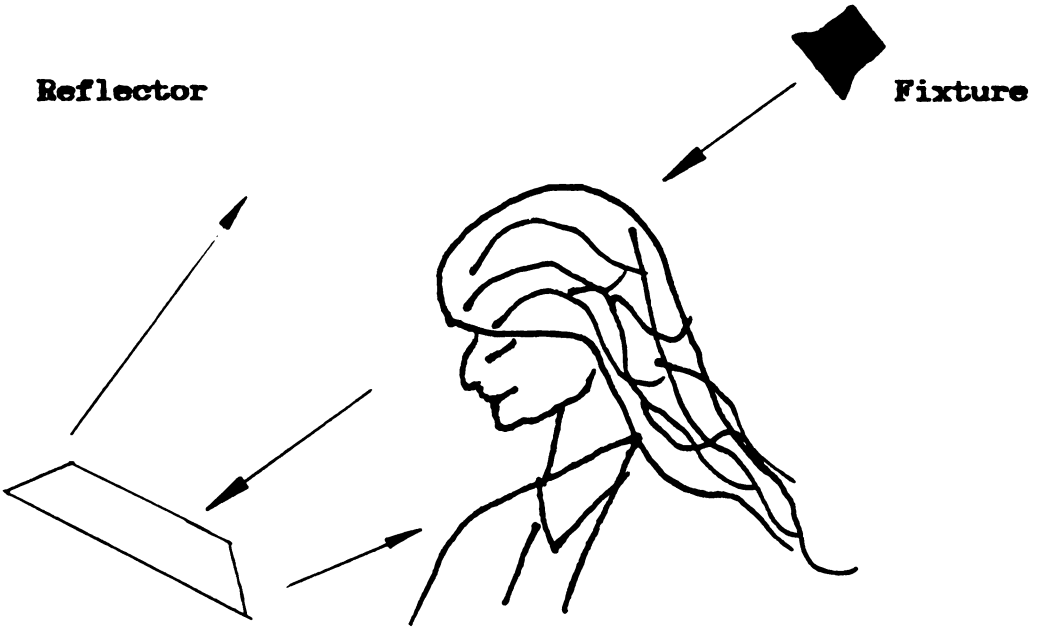


Figure 39. Bounce Illumination Technique

Light redirected from a bounce illumination plane will have the same quality (specular or diffused) and color characteristics as the reflecting surface. Since light energy reflected from an adjacent surface falls off rapidly, the videographer will likely find this technique applicable to highly controlled production situations. Bounce lighting is best applied to static production setups in which the subject performs limited body movements.

In conclusion, of primary concern to the videographer should always be the safety and comfort of the subject. To secure a natural performance, the subject must be comfortable in the working environment. The illumination pattern should accommodate the safety and comfort of the individual. Specular illumination sources may distract or discomfort the subject, especially when used at a close

working position. The videographer may find it necessary to diffuse, scrim, or manipulate illumination to prevent the intense specularity produced by the fixture from discomforting the subject. Soft boxes and umbrellas create ideal portrait illumination because the manipulated light energy has softer, diffused illumination characteristics. Another useful production technique is to illuminate a surface plane behind camera position at an intensity greater than subject illumination. The combined key/fill illumination intensity will therefore appear to be less than a distant visual plane. The subject will easily adjust to the key/fill illumination value since it is of less intensity that an off-camera visual plane. Through subject consideration, the videographer can obtain a unique, glamourous and natural human performance.

Broad Lighting

Broad lighting is one of the most frequently used lighting patterns in video portraiture. This portrait technique can be applied when the subject is positioned at an angle, relative to the subject-camera axis. As the name suggests, the broadest portion of the subjects face is illuminated by the key light. The following diagram indicates approximate fixture positioning for broad light portraiture.

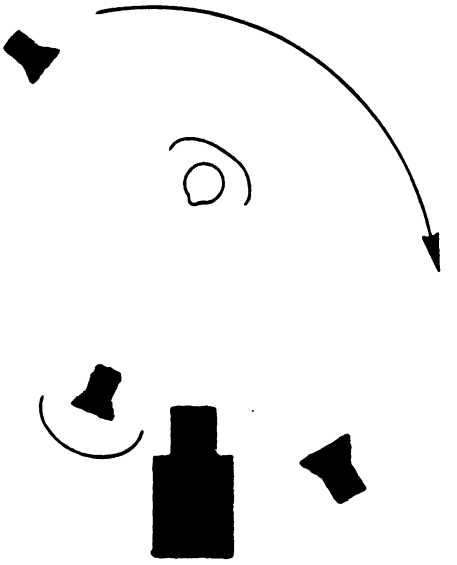


Figure 40. Broad Light Portraiture

Either specular or diffused illumination sources may be used to provide key illumination coverage. Large source illumination creates a softer key illumination quality with subtle shadow density. Large source illumination is commonly used in broad lighting to emulate interior illumination conditions. Hard illumination sources create specular highlights, and dense shadows on the facial mask. Hard illumination is commonly used to imply motivational light coming from a scenic illumination source. Also useful in dramatic presentations, broad lighting can emulate low key (dark) scenes. The illumination quality of broad lighting can imply point source illumination (ie. street lights) in dramatic presentations. Subject contrast created by the key illumination source can be controlled through placement and intensity of the fill (secondary) illumination source.

Since the key fixture is placed on the camera side of the subject, shadows created by the fixture will fall away from the subject, and be hidden from camera view. Vertical and horizontal placement of the fixture is dependent upon genetic attributes of the facial mask. Most lighting designers, however, position the fixture so that illumination passes over the bridge of the nose, and illuminates the cheek bone on the opposite side of the subject's face. Highlighting the opposing cheekbone partially illuminates the shadow zone created by the key, and adds pictorial interest to the image.

Because the fill fixture is used to reduce shadow density, it is typically positioned on the opposite side of the camera relative to subject position. Vertical placement of the fill fixture is dependent upon the desired illumination pattern. Fill light positioning is typically lower than subject eye level, illuminating the shadow zone created by the key light source. When broad lighting is used to imply interior illumination, the intensity of the fill fixture should be nearly equal to the intensity of the key light source.

Broad lighting patterns are designed so that key and fill fixture have overlapping coverage areas. The fill fixture is typically larger (more diffused) than the key illumination instrument. Either soft boxes, umbrellas, or reflector boards can be used to provide secondary illumination. When properly positioned, fill illumination

should partially overlap the lit zone created by the key light. This feathering technique creates a subtle illumination transition between the key and fill source. To measure intensity differences, the overlapping formula (key + fill/fill) should be used. Once an appropriate ratio has been established, the videographer can determine exposure by examining the waveform monitor.

Back lighting is highly subjective, and dependent upon personal creative interpretation. When illuminating an interior scene, back light intensity (if used) should be very low to prevent conflicting with key light directionality. The intensity of the back light can be determined by examining the waveform monitor. Back light intensity should be compared against the calibrated exposure of the facial mask. For natural interior scenes, back light luminance values should not exceed the reflective intensity of the facial mask. As back light intensity is increased relative to facial exposure, the videographer subjectively influences dramatic interpretation of the portrait.

Horizontal placement of the back light is also dependent upon visual interpretation. Back light fixtures are typically positioned anywhere in an arc from 180 degrees opposite the key light, to approximately forty-five degrees behind the key (figure 40). With moving subjects, the videographer may find it helpful to use multiple back light sources. Multiple back lighting helps maintain illumination continuity throughout the scene.

Vertical placement is also highly subjective, and can be used as a creative illumination tool. Back light striking the subject from overhead, indicates a naturalistic lighting pattern. When back light strikes the subject from below eye level, the videographer will manipulate dramatic interpretation.

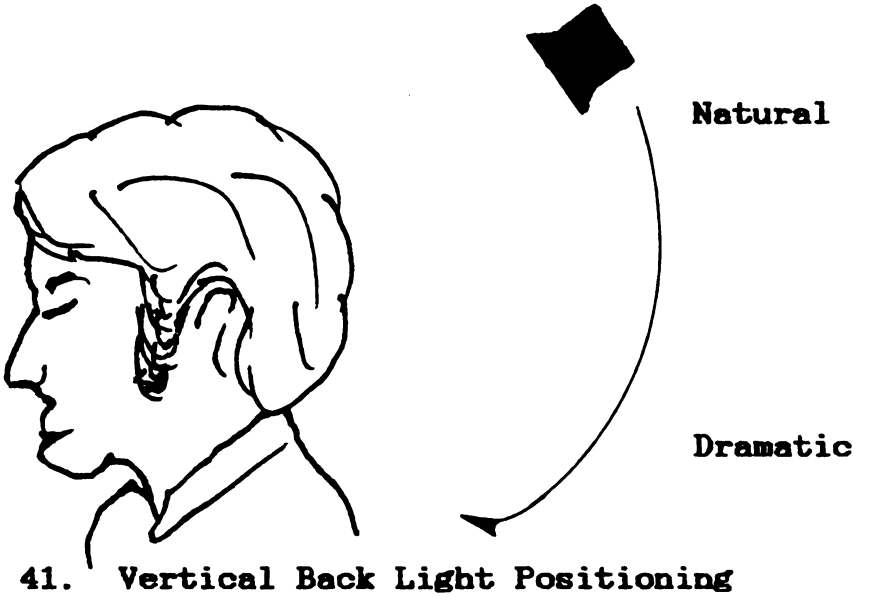


Figure 41. Vertical Back Light Positioning

Low back light placement is commonly used by photographers to create glamourous portrait images. The usage of back lighting is highly subjective, and dependent upon personal interpretation. The key to understanding back light illumination is through experimentation with fixtures and fixture positions.

There are several advantages to using broad lighting in the video production setting. First, since the broadest portion of the face is illuminated by the key light, subject mobility is possible within the video frame. When a low key/fill ratio is used, shadow placement and density does

not create unattractive shadows within the facial mask. Primarily used to emulate natural interior illumination, this lighting pattern has common applicability. Fixture setup can be quickly and easily accomplished, allowing the videographer to concentrate on other production matters.

The primary disadvantage with this illumination pattern is that it tends to broaden the facial structure. With the broadest portion of the face illuminated by the key light, the subject will take on a heftier appearance. If the subject has a naturally wide face, the videographer may find this illumination pattern inappropriate. In addition, when a low key/fill lighting ratio is used, the video image has the tendency to appear flat and lack three-dimensionality.

Narrow Lighting

Narrow lighting basically reverses the design of the broad lighting pattern. With the subject positioned at an angle relative to the subject-camera axis, the narrow (far side) portion of the subject's face is illuminated by the key light. The following diagram plots fixture postioning commonly used in narrow light portraiture.

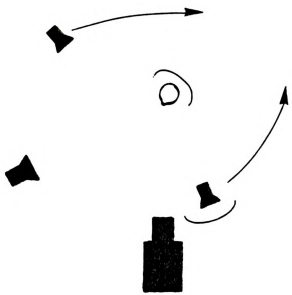


Figure 42. Narrow Light Portraiture

With the key illuminating a narrow facial area opposite camera position, the majority of the facial mask will fall into the attached shadow region. The density of the facial shadow is dependent upon the specularity of the key light fixture. Either small or large light sources can be used for key illumination coverage. Small key light sources create highly dramatic video images, by emphasizing heavy shadow density on the broadest portion of the facial mask. Maximum care must be used when applying this illumination pattern to prevent creating an image with too much subject contrast. If large source illumination is used, the transfer edge between the highlight, lit and shadow zones will have softer gradation characteristics. The challenge to using large source illumination in narrow lighting is that illumination

tends to spread over the broadest portion of the facial mask. When uncontrolled, large source illumination can damage the intended illumination effect. To reduce illumination spread, the videographer will likely find it necessary to block spill illumination from striking the broadest portion of the facial mask. Stand mounted gobos are typically used to direct illumination coverage. The transfer edge created through blocking techniques is dependent upon the distance between the subject and the blocking device. Modifiers placed close to subject position will createe a harder transfer edge within the facial mask. The following figure diagrams the method for blocking large source illumination.

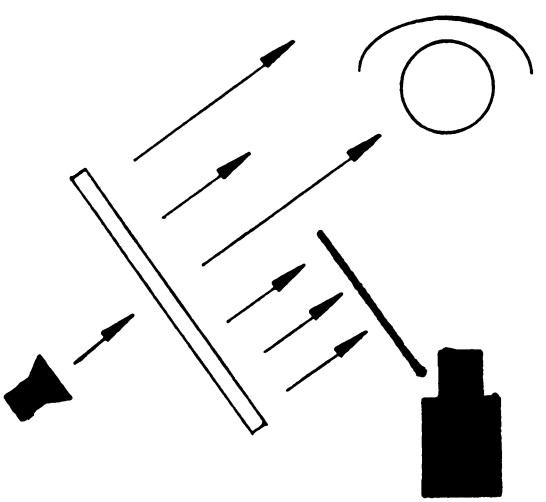


Figure 43. Narrow Key Light Modification

Horizontal placement of the key light is critical, and dependent upon the intended lighting effect. Vertically, the key light should be positioned to provide optimum subject

modeling. Narrow lighting patterns create an inherently large nose shadow on the near side of the facial mask. To reduce the impact of the nose shadow, vertical placement is typically positioned lower than in other lighting setups. Most portrait photographers do not allow the nose shadow to extend beyond the smile line or to touch the upper lip. The shadow is commonly positioned midway between the nose and upper lip, creating separation between the two facial features.

Horizontal and vertical fill light positioning is dependent upon aesthetic interpretation. The fill fixture should partially illuminate the shadow zone created by the key light source. The fill fixture is typically positioned on the opposite side of the camera, illuminating the near side of the facial mask. When placed at camera position, the overlapping formula should be used to determine the lighting ratio. At a position ninety degrees opposite camera position, the videographer should apply the non-overlapping formula to determine subject contrast. Fill positioning between the two extremes requires careful examination of the lighting effect to determine the appropriate formula.

Narrow portrait lighting is commonly used to create dramatic illumination patterns. Narrow lighting is also used in glamour portraiture to visually create a slimmer appearance with a wide facial structure. Therefore, the lighting ratio between the key and fill fixture is typically higher than with broad portrait lighting. The intensity of

the fill fixture must be carefully controlled to prevent over-illumination on the near side of the facial mask. When fill intensity is increased relative to key light intensity, the videographer will observe a broadening of the facial structure. Since narrow lighting is commonly used to create a slimmer facial appearance, the addition of strong fill illumination may be undesirable.

Vertical fill light positioning should provide illumination to the unlit zone created by the key light source. Many times, the fill fixture will be positioned at, or slightly below, the subject's eye level. The specularity of the fill light fixture should always be less than that used for key illumination coverage. By using a waveform monitor, the intensity of the fill fixture can be determined. Though narrow lighting is commonly used to create high contrast images, fill intensity should be sufficient to contain shadow density within the contrast limits of the reproduction system.

Back light positioning is extremely critical with narrow lighting patterns. Back light positioning is typically biased toward the key light side of the subject. When used on the key side, back light intensity typically matches the intensity used for key illumination coverage. When the key and back light intensity is equal, the videographer will create lighting continuity on the far side of the subject. Back light intensity is typically decreased, as the angle between the key and back light fixture is

increased. When the back light is positioned closer to the fill light, extreme care must be taken to prevent illumination spill. Back light illumination striking the fill side of the subject may create unattractive streaks of light on the shadow zone of the facial mask. .

The advantage to narrow illumination is that it can be used to create portrait images with high dramatic impact. Through contrast separation, narrow lighting maximizes the dimensionality of the portrait. Narrow lighting can be creatively used to narrow the facial structure. Since the broadest portion of the facial mask falls within the attached shadow region, skin imperfections on this surface plane can be minimized. Narrow lighting must be used with extreme care and consideration of the subject's facial features. Strong facial features (like a sharp nose) and surface texture (wrinkles) will be accentuated. This lighting pattern can have harsh reproduction characteristics that may prove unflattering to the subject. Narrow lighting is typically reserved for male subjects when you want to emphasis facial ruggedness. Narrow lighting can also be used for female subjects, however, it may be necessary to reduce lighting contrast, thereby softening facial features.

The primary disadvantage with narrow lighting is the lack of mobility it affords the subject. Shadow positioning is crucial to maintain proper shadow placement. Due to subject juxtaposition, the shadow region of the facial mask is accentuated. Subject movement within the video frame can

cause radical shadow shifts on the camera side of the subject. Narrow lighting is also subject specific, which requires the model be used to establish the lighting pattern. Finally, narrow lighting is time consuming, which the videographer must allow for when attempting narrow light pattern designs.

Frontal Lighting

As the name suggests, frontal lighting strikes the subject from the frontal position relative to the subject-camera axis. With the subject facing forward, both sides of the facial mask are illuminated by the key light.

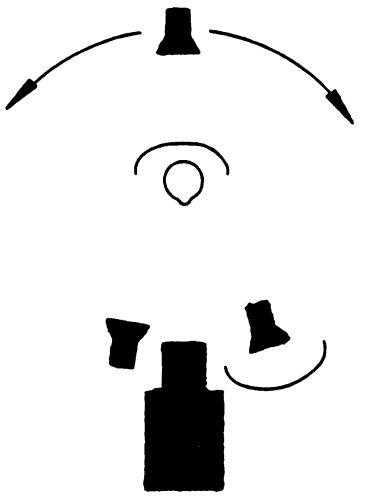


Figure 44. Frontal Light Portraiture

For a normal lighting pattern, vertical placement of the key light should strike the subject from above eye level. Shadows created by the key light will be cast downward from protrusions on the subject's face, and will fall away from the subject's forehead, nose, lips and chin.

The length of facial shadowing is dependent upon the angle at which key illumination strikes the subject. Vertically position the key light at a height which prevents the nose shadow from crossing the upper lip. In this position, the key light will create adequate subject modeling, while maintaining separation between the two facial features.

Either hard or soft light sources can be used for key illumination coverage. Hard key illumination, however, may prove uncomfortable to the subject, especially when used at a close working position. With the key light positioned slightly above eye level, fixture specularity may prove to be too direct for natural subject performance. Most photographers that use direct frontal lighting either reflect or project key illumination off another surface plane. Soft illumination techniques (umbrella, soft box illumination) reduce lighting specularity while modifying the quality of key illumination.

Though eye light reflections (catch lights) are common to most portrait patterns, they are most prominent with frontal illumination. Catch lights add a touch of glamour to the photographic image, and are commonly placed slightly above the pupil of the eye. Catch lights reveal the size, shape and specularity of the illuminating instrument. When large source illumination is used, the catch lights will be large, with soft gradation at the transfer edge. When possible, catch lights should be incorporated in the compositional design of the portrait.

Fill light positioning is again based on illuminating the shadow zone created by the key light source. If a specular illumination source is used, the fill light is typically placed below eye level on the opposite side of the camera. With large source portrait illumination, a technique called "butterfly lighting" can be applied. Butterfly lighting uses large source fill illumination directly below the camera lens. This illumination technique provides soft illumination to the shadow zone on the facial mask.

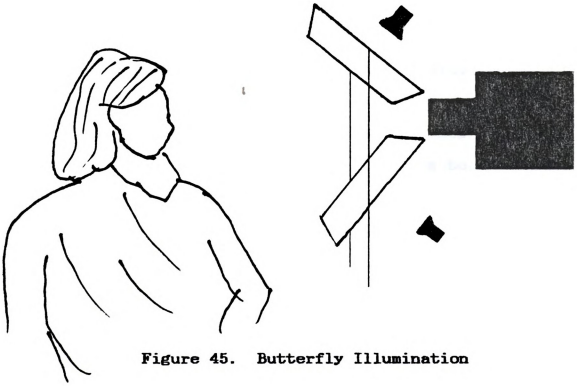


Figure 45. Butterfly Illumination

When using butterfly illumination, the intensity of the fill light must be carefully controlled. If fill illumination is too strong, multiple shadows will form on the facial mask. The easiest method for controlling fill illumination is to select a fill source that produces less

illumination intensity. Fill illumination should lighten the shadows created by the key light, but should never eliminate key shadowing or create additional facial shadow patterns.

The ratio between key and fill illumination is typically low in frontal lighting design. The difference between key and fill sources is typically expressed at a ratio of 2:1 or less. Though any lighting ratio has applicability, frontal lighting is commonly used to create glamorous, youthful images. Frontal lighting de-emphasizes surface texture created by wrinkles and facial protrusions. Since the key and fill light strikes the subject from the frontal position, the overlapping fixture ratio should always be applied.

With frontal lighting, high intensity back light is commonly used to provide depth and roundness to the image. High intensity backlight also implies different key light directionality, especially when the key/fill lighting ratio is low. The intensity of the back light should be carefully controlled to prevent over illumination of the subject's head and shoulders. By using a waveform monitor, back light intensity can be manipulated to prevent the frontal facial plane from appearing unnaturally dark. Most photographers contain back light illumination to within one f-stop (20 IRE units) of the key illumination source. Back light illumination that exceeds this limit, may over-illuminate the back of the subject, radically altering hair

reproduction. High intensity back light is commonly used with blond haired subjects, though it has applicability with any individual.

With frontal lighting patterns, the videographer may find background light manipulation advantageous for creating the illusion of spatial depth. Creative shadows cast onto a background surface plane helps enhance the dimensionality lacking on the frontal plane of the facial mask. By under-illuminating or "painting" the background plane with light and shadows, the videographer can enhance the illusion of depth in the portrait image.

There are several advantages to using frontal illumination in video portraiture. First, frontal lighting is an extensively used photographic technique for glamour portraiture. Frontal lighting is commonly recognized as a glamorous technique among consumers of photographic material. Since the key and fill light strikes the frontal facial plane, facial modeling is minimal. By reducing facial modeling, frontal lighting creates youthful images even when applied to older subjects. When large source illumination is used, subject movement within the video frame can be accommodated. Shadow placement remains constant regardless of subject position. Frontal lighting is also very applicable to both male and female subjects. Finally, frontal lighting can be quickly and easily accomplished, allowing the videographer to concentrate on other production matters.

The primary disadvantage with frontal lighting is that subject modeling is minimal, especially when a low lighting ratio is used. Careful control of key/fill illumination intensity is critical to prevent creating images which lack facial dimensionality. Some photographers criticize frontal illumination because it tends to be generically applied. Though a glamourous illumination technique, frontal lighting has an inherent lack of lighting dramatics associated with other illumination patterns.

Side Lighting

Side lighting heightens the sense of drama and moodiness to a scene. By skimming the facial mask with light, side lighting creates the strongest sense of texture and contrast separation within the portrait image. Though applicable to both sexes, side lighting is best applied to male subjects, when the videographer wishes to emphasize character ruggedness.

With side lighting, the horizontal position of the key light strikes the subject from ninety degrees off the subject-camera axis. With the subject facing forward, only one-half of the facial mask is illuminated by the key light.

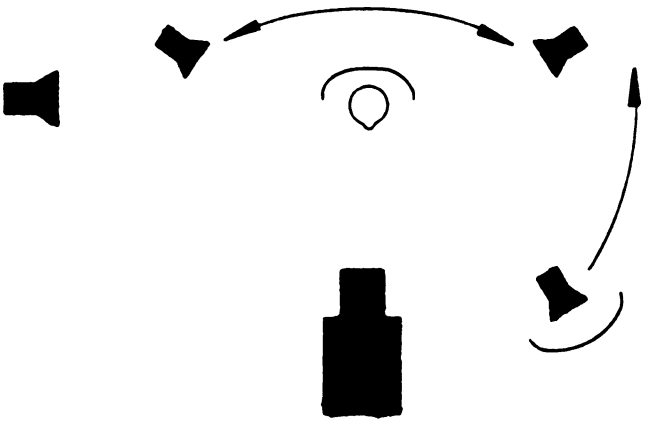


Figure 46. Side Light Portraiture

Vertical positioning of the key light is less important in side lighting patterns. Vertically, the key light should be positioned to maximize facial modeling. A photographic technique commonly used is to position the key light at a height slightly above eye level. In this position, key illumination will pass over the bridge of the nose and illuminate the cheekbone on the opposite side of the face. Highlighting the opposite cheekbone adds pictorial interest to the image. Vertical positioning of the key light is primarily dependent upon the facial characteristics of the subject.

Either hard or soft key illumination sources can be used for side lighting patterns. Hard key lights create dense shadows and a hard transitional line between lit and shadow facial zones. Though side lighting maximizes facial modeling, it can also appear flat and lack dimensionality. With a hard key light striking the subject from such an extreme angle, the facial mask is divided equally in half.

Without modification to the shadow zone of the face, the contrast ratio typically extends beyond reproduction limits. Fill light manipulation, however, tends to dilute the dramatic impact created by the key illumination source. Unless extremely dramatic facial contrast is needed, the use of soft key illumination is recommended. Soft illumination will slightly bend around surface contours and partially illuminate the shadow side of the facial mask. With soft illumination, the transfer edge will change gradually from lit to shadow facial zones. Large source lighting will partially illuminate the shadow side of the facial mask, without reducing the dramatic impact of the lighting design.

If fill illumination is needed, horizontal and vertical positioning is dependent upon the intended lighting effect. The fill light can be positioned in an arc from camera position to approximately 180 degrees opposite the key light. Since side lighting is commonly used for dramatic lighting impact, the videographer will likely find the ratio between illumination fixtures to be higher than with other portrait designs. Determination of the proper ratio formula is dependent upon the horizontal position of the fill illumination source. Once fixture positions and the lighting ratio have been established, contrast reproduction should be verified on the waveform monitor. If detail reproduction is desired in the shadow zone of the facial mask, then the lighting ratio should be contained to within a 6:1 ratio. For example, under normal exposure caucasian skin tones

reproduce at approximately 60-70 IRE units on the waveform monitor. For reproduction of shadow detail, maximum density cannot fall below 20 IRE units (black, with detail). Subtracting the two IRE values yields a difference of approximately 4:1 (2 f-stops) or 6:1 (2.5 f-stops), dependent upon the lit zone luminance value. Though shadow density can certainly exceed this range, the cost to the videographer will be a loss of detail within either the highlight or shadow zone of the facial mask.

Probably the greatest challenge with side lighting is selecting an appropriate fill light position and intensity. Fill illumination striking the subject from the frontal position reduces subject contrast and the dramatic impact of the lighting design. If fill illumination is positioned directly opposite the key illumination source, fill intensity must be very carefully controlled. If the fill intensity is too strong, a shadowing rim will form down the center of the subject's face. Called "badger lighting" it is an interesting, albeit unglamourous lighting design.

A photographic technique used estensively in head and shoulder portraiture is to eliminate the fill light altogether. In the fill light position, a free standing reflector board is used. Key illumination that passes by the subject's face will be redirected back onto the shadow zone of the facial mask. The intensity of redirected illumination is dependent upon the size, distance and reflectivity of the bounce illumination surface.

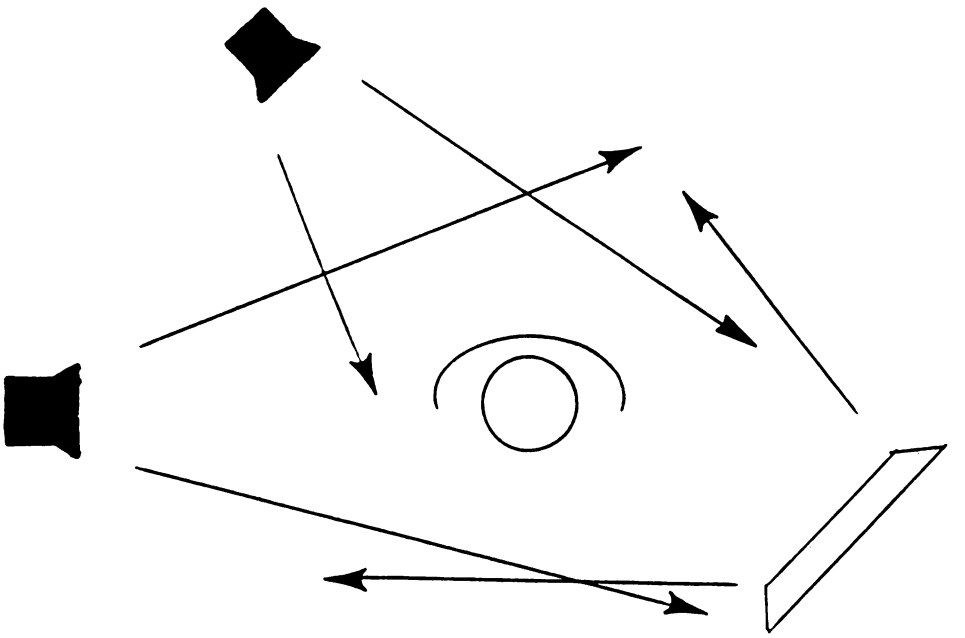


Figure 47. Bounce Fill Illumination

Back light positioning is very crucial in side light portraiture. Since side lighting is typically used for low key (dark tonality) scenes, the subject's head tends to merge into background surface planes. Back light positioning should create appropriate separation between visual planes. Either single or double back light sources can be used with this portrait design. Horizontal and vertical positioning, as always, is dependent upon the intended lighting effect. When establishing back light positioning the videographer should carefully consider the size and shape of the subject's head. With side lighting, the videographer should carefully prevent back light from spilling onto the shadow zone of the subject's face. If back light strikes the shadow zone, the intended lighting effect may be damaged.

Background manipulation provides an illumination alternative for separating the subject from similiar tone backgrounds. With low key scenes, a lighting instrument placed directly behind the subject, and projected onto a background surface area will artificially separate the subject from the background. The lighting effect created by this technique separates the subject from the background by creating a halo of light on the background surface. Through careful positioning, the light pattern can be focused to extend just beyond the head and shoulders of the subject. This portrait technique allows the subject limited head movement without altering facial mask reproduction.

Conclusion

The focus of this chapter has been an examination of lighting and exposure theory as it applies to video portraiture. Because lighting for a visual medium is an objective art form, specific illumination methodology is best left to the hands of the individual videographer. This thorough instructional presentation should provide a solid foundation on which to build specific and glamourous portrait lighting techniques.

Broad, Narrow, Frontal and Side lighting patterns are commonly used portrait techniques found in the photographic arts. Application of portrait illumination techniques in the video production session is primarily dependent upon the

facial characteristics of the subject. As with any art form, the key to success is through experimentation and development of a personal lighting style.

PRODUCT LIGHTING TECHNIQUES

Product lighting presents the greatest technical challenge to the videographer. In product videography, specifics on lighting design are difficult to detail due to differences in object reflectivity and surface texture. The illumination technique appropriate to the production circumstance is dependent upon object reflectivity and creative interpretation.

An appropriate illumination pattern, however, must contain object reflectance within the limited contrast reproduction latitude of the video imaging system. Manipulative photographic techniques commonly used in photographic image production (multiple exposure, manipulative printing, color separation, etc) are not possible in the video medium. The illumination challenge will, therefore, be to create striking product images solely through creative illumination techniques.

Product lighting is very similiar to portrait illumination techniques. The primary difference between production categories is that commercial products generally have far greater reflectance latitude. Lighting contrast between illumination zones (highlight, lit, shadow) is typically far greater than subject contrast encountered in

portraiture. Since maximum contrast reproduction for broadcast images is limited to 20:1 (4.5 f-stops), the challenge to the videographer will be precise control of the illumination pattern. Through careful lighting and luminance control, the videographer can contain scenic elements within reproduction limits of the imaging system.

The focus of this chapter will be an examination of the lighting techniques applied in the professional film industry. The techniques presented in this chapter can be applied to the video production setting. Product illumination craftsmanship is predicated on proper application of the theories and techniques presented throughout this text. Through experimentation with manipulative illumination techniques, the videographer can create beautiful and striking product images.

Illumination Characteristics

As with portraiture, product images can be subdivided into three categories of illumination. The combination of illumination zones (highlight, lit, and shadow) communicates descriptive information to the viewer on the size, shape, color, form, and texture of the object. The illumination design should complement the object by accentuating it's unique visual characteristics.

Highlights will form along the surface plane perpendicular to the illumination source. Since highlights reproduce illumination intensity with the greatest

specularity, object color and surface texture will be minimal within the highlight zone. Highlights convey visual information to the viewer on the quality of primary illumination. Small light sources will create small surface reflections, and commmunicates a different illumination quality than large source illumination techniques. Small key illumination indicates the quality of illumination produced by the sun or a theatrical spot light. Large source illumination communicates the illumination quality associated with an overcast sky, window light, or overhead interior lighting. Object shape and dimensionality will interact with highlight reflections altering the shape (but not the size) of the highlight reflection. For example, with spherical objects, the highlight shape will wrap around the surface contour. Highlights are commonly positioned to visually reinforce the shape of the illuminated object.

The lit zone is generally between the highlight and shadow illumination zones. The lit zone is typically the largest illumination zone in the image. Lit zones visually communicate object color and surface texture in the image. Lit zone reproduction is also dependent upon the specularity of the primary illumination instrument. Lit zone reproduction, however, can also be clarified through secondary illumination placement. The lit zone of the object is typically positioned visually prominent relative to

camera position. Illumination uniformity which accentuates lit zone reproduction, visually deemphasizes object size, shape, and form in the video image.

Shadow zone placement is the primary method for visually communicating object size, shape, and form in the photographic image. The shadows projected from the key light should be of primary concern to the videographer. First, the density of the shadows must be carefully controlled to prevent creating images with excessive contrast density. Restricting luminance differences between illumination zones is a standard production methodology for limiting object contrast. Since the video medium has an entire contrast latitude of 4.5 f-stops, object highlight and shadow density differences will be minimal. Second, shadows projected from the key fixture communicate essential descriptive information on object form and dimensionality. Shadows created by the key light will fall onto two specific visual planes. Shadows incident to (or part of) the surface of the object are called <u>attached</u> shadows. Attached shadows reveal object shape and form within the image. Shadows created by the object which fall onto adjacent surface planes are called <u>cast</u> shadows. Cast shadows reveal object size and the directionality of the key illumination source. Drawing a line from the edge of the shadow to the corresponding edge on the object reveals the incident illumination angle.

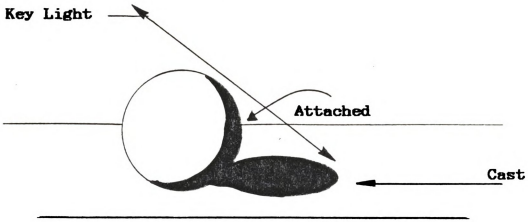


Figure 48. Shadow Classification

The waveform monitor is an ideal graphic device for analyzing the product image. By subdividing the graphic display into illumination zones, the videographer can determine illumination needs and lighting problems with the creative light design. By vertically subdividing the waveform display, the approximate position of the three illumination zones become apparent.

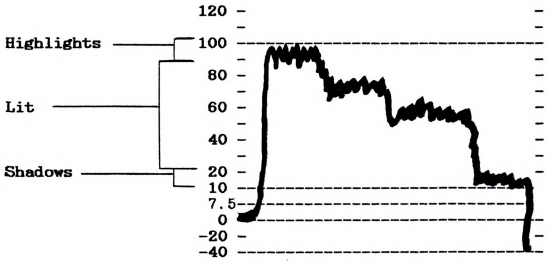


Figure 49. Zone Reproduction on the Waveform Monitor.

By analyzing the waveform monitor, the videographer can verify object reproduction. Because surface highlights return the maximum amount of light, they should be positioned between 90 and 100 IRE units (zone 9, 10) on the waveform monitor. Maximum shadow density is limited to within 10 IRE units (between zone 2 and zone 1) on the waveform display. Object color (zone 8 through zone 3) will be reproduced between the two illumination extremes. Waveform data is particularly useful because it indicates the luminosity of the object. The waveform monitor indicates object reproduction characteristics under specific lighting conditions. By adjusting camera exposure to maximize lit zone reproduction, highlight and shadow contrast latitude will become apparent. If highlight and/or shadow contrast exceeds reproduction limits, either illumination intensity or the lighting pattern must be modified. This arguement does not presuppose that all product images will have reproduction density within all three illumination zones. The waveform monitor, however, provides the most accurate method for analyzing lighting and exposure manipulation.

The waveform display can also be subdivided according the relative size of the illumination zone. The horizontal axis represents position within the video frame. Analyzing the width of the illumination zone, the videographer can determine the visual emphasis of each illumination zone.

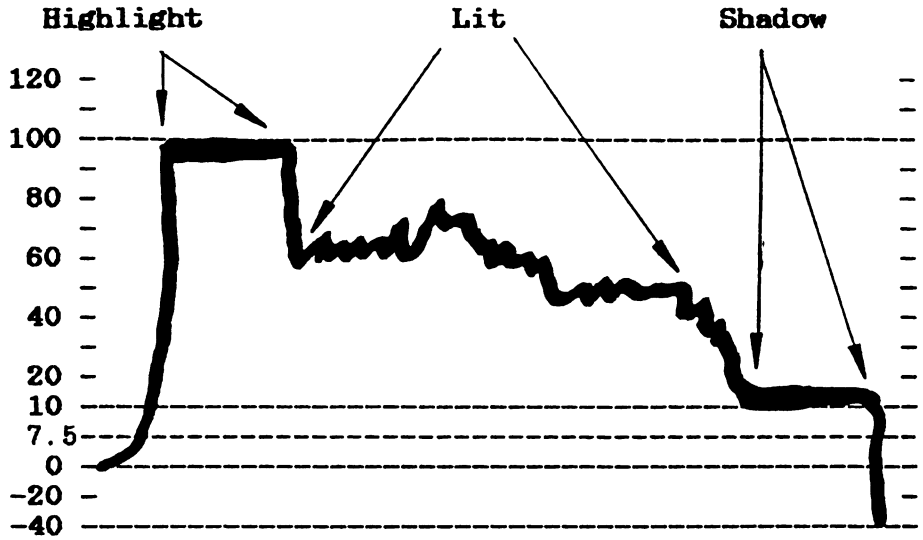


Figure 50. Zone Size/Position on the Waveform Monitor

In the preceeding example, each of the illumination zones are equal in size on the waveform display. The resultant image will therefore have equal emphasis between the illumination zones. The videographer can therefore use the waveform monitor as an evaluatory device for controlling illumination zone reproduction.

The combination of highlight, lit and shadow zones communicates essential descriptive information to the viewer. The lighting pattern chosen for product illumination should maximize visual communication and the aesthetic considerations of visual design.

Fixture Positioning Techniques

The language used to describe key light positioning is very similiar between portrait and product videography. The following list outlines the descriptive language used to label the lighting patterns in both portrait and product production settings.

Portraiture	Product
Frontal	Frontal
Broad, Narrow	Quarter
Side	Side, Top
Back	Back

The descriptors used to define the visual qualities of the object are; size, shape, color, form and texture. Size, shape and form define the dimensionality of the object. Object size is visually communicated by the length of the object shadow cast onto adjacent surface planes. By manipulating the vertical position of the key light relative to subject position, the videographer can manipulate subjective size interpretation. Creating large cast shadows indicates volume and object weight in the image. Object shape is a descriptor which is defined by the two-dimensional (height, width) qualities of the object. Object shape is clarified through both key light positioning, and through visual separation from a background surface plane. Stronger object-background contrast creates stronger clarity of object shape. Object form defines the third-dimensionality (depth) of the object. Through attached

shadow clarity, object form and dimensionality is visually communicated. Object color and texture are visual descriptors of surface quality. The color of the object is manipulated through placement of the lit illumination zone. Color saturation is dependent upon the intensity of the instrument, the reflectivity of the surface, and the ratio between illumination zones. Finally, object texture is dependent upon key light placement. To emphasize surface texture, place the illumination source parallel to the illumination plane. On planes where the key source is perpendicular to the object, surface texture will be minimized.

A brief examination is included on how key light positioning effects visual reproduction of the object. Though the illumination effect is identical between portrait and product production sectors, in product videography the illumination pattern will generally have greater clarity.

Frontal lighting strikes the object directly along the object-lens axis. Dependent upon surface reflectivity, frontal illumination maximizes the size of the highlight and lit illumination zones. Both attached and cast shadows created by the key illumination source fall behind the object, hidden from camera view.

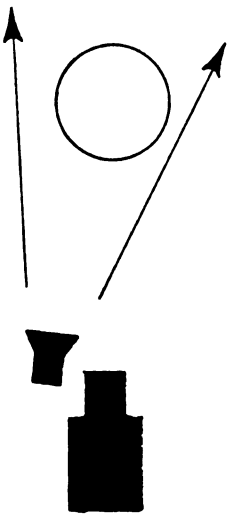


Figure 51. Frontal Lighting

Frontal illumination creates the largest possible lit illumination zone, therefore maximizing color reproduction of the object. Since shadows projected by the key light fall out of camera view, object size, form and surface texture are minimized. Like portrait illumination, frontal lighting minimizes the impact of surface modeling by flooding the surface plane with even illumination.

Quarter lighting strikes the object from approximately 45 degrees off the object-lens axis. With quarter lighting, each of the three illumination zones are given equal lighting emphasis. Therefore, quarter lighting is commonly used in product lighting because this position represents the best compromise between key light positions. With quarter lighting, object size, shape, color form and texture are give equal illumination emphasis.

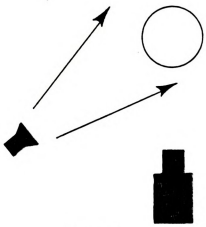


Figure 52. Quarter Lighing

The problem with quarter lighting is that it tends to be generically applied. Though adaquately representing the object, quarter lighting might not accentuate the unique features of the object. Quarter lighting patterns are typically applied to the video production setting based on tradition, not lighting creativity. Quarter lighting is an extremely valuable illumination pattern, but, should only be applied when the illumination pattern is most appropriate to the visual design of the image.

Side and Top lighting strikes the object from approximately 90 degrees off of the object-lens axis. Side and top lighting are essentially the same lighting pattern. The primary difference between illumination patterns is the vertical angle at which key illumination strikes the object. The shadows cast by the key light will fall onto different surface planes on/around the object. Subjectively, this alters audience perception of the video image.

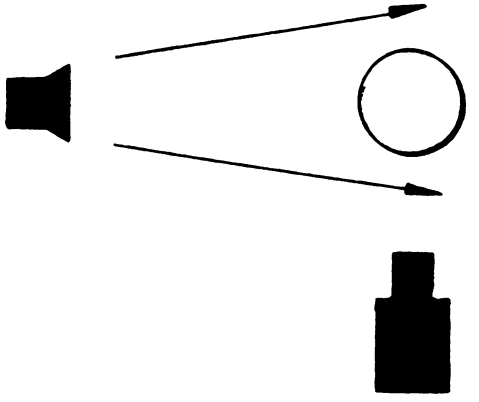


Figure 53. Side Lighting

Side/Top light positioning visually minimizes the size of the highlight on the surface plane. Highlights created by the key light will form along the rim of the object closest to the fixture position. With an incident angle of 90 degrees, visual emphasis of highlight reflections will be minimized. The opposing side of the object will fall within the attached shadow region. Side/Top lighting patterns are interesting because they subdivide object shape into opposing illumination zones. Therefore, object dimensionality (size, shape, form) is typically accentuated with side/top illumination patterns. Side/Top lighting also maximizes object texture skimming the surface plane with light. Side lighting creates the strongest illumination contrast between raised and indented surface elements.

Back lighting strikes the object at a horizontal angle 180 degrees opposite the object-lens axis. Back lighting is typically used as a separation light, providing depth between the object and a background surface plane. As with

portraiture, back lighting is subjective and it's usage is dependent upon the intended lighting effect. Back lighting is only necessary if it adds to the aesthetic design of the composition.

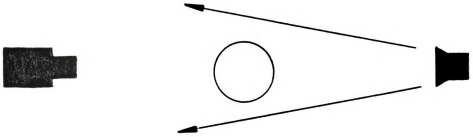


Figure 54. Back Lighting

Back illumination will rim the entire object with light. Therefore, object shape is emphasized with back illumination patterns. Because back light skims the object rim, texture detail will be emphasized at the object edge. Size emphasis is dependent upon compositional design of the image. When the cast shadow projected by the back light is included within the visual frame, object size will be accentuated.

With back light illumination, the frontal plane of the object falls into the attached shadow region. Therefore, back lighting minimizes reproduction of surface color and object form. The lit zone of the object will fall on the opposite side of the object, hidden from camera view.

Product Illumination Techniques

As with portrait lighting, the videographer should begin every setup by first examining the product and props to be used. Through critically analyzing object shape, size, color, form and texture, the videographer can determine the unique features and the illumination pattern which will accentuate object features. Appropriate key light positioning is based on determining where the highlight, lit and shadow (attached/cast) illumination zones should fall within the compositional design.

The following table represents how key light positioning will effect visual representation of the object. Each of the descriptors used to classify object reproduction (size, shape, color, form and texture) are coded (+, =, -) according to accentuated attributes of the illumination pattern.

Table 11. Illumination Pattern Attributes

	Position	Size	Shape	Color	Form	Texture
Frontal	=	=	+	-	-	
Quarter	=	=	=	=	=	
Side/Top	=	=	=	+	+	
Back	+	+	-	-	=	

Because video is a two-dimensional medium, the illusion of depth must be enhanced through creative illumination techniques. The illusion of depth can be enhanced through several different production techniques. First, through

object/camera positioning, visual information can be conveyed to the audience on object dimensionality. For example, a cube is a six-sided object. A cube can be positioned so that one, two, or three sides of the object can be visualized in the photographic image. Through object positioning, the videographer communicates spatial dimensionality. Second, through manipulative illumination techniques, object dimensionality can also be enhanced. The illumination angle should accentuate the object by creating separate illumination zones at appropriate positions on, and around the object surface. Shadow density created by the key illumination source is dependent upon the specularity of the instrument. Shadow positioning incorporated into the compositional design communicates essential visual information on object dimensionality. Finally, through manipulative background illumination patterns, the illusion of depth can be enhanced. For example, manipulative background illumination may imply different key light directionality. Manipulating background intensity to a value less than the key illumination source will create light falloff between the frontal and background visual plane. The transition between spatial illumination zones will enhance the illusion of depth, even between visual elements only inches apart. By approaching the commercial setup as a still life, the videographer can creatively design illumination patterns which enhance visual dimensionality.

Product Illumination Quality and Control

Objects are generally classfied according to the reflective qualities of object surface. The categories most commonly used to describe surface reflectivity are:

1. Reflective, or
2. Matte surface objects.

Reflective objects have highly specular surfaces. Reflective objects like glass, shiny metal or plastic create a unique lighting challenge to the videographer. Reflective objects may redirect luminance energy at a proportion nearly equal to the intensity incident to the surface. Highlight positioning on a reflective object is dependent upon the incident angle of illumination and the shape of the reflective surface. Through key light positioning, the videographer can manipulate placement of the highlight reflection.

With reflective objects, the problem will be controlling the specularity of the illumination highlight. If a small illumination source is used, an intense hotspot generally referred to as "glare" will form. Glare reveals the size, shape, and specularity of the illumination instrument. Glare seriously damages visual rendition by obliterating object color and surface texture within the specular reflection. The luminance value of the highlight will most likely exceed reproduction limits of the video medium. When exposure is manipulated to bring this intense

highlight spike to within a technically acceptable reproduction limit, then lit and shadow zone reproduction will deteriorate.

To control reflective highlights, the videographer will need to reduce the specularity of the key illumination instrument. Professional photographers have found the usage of large source lighting highly applicable to reflective object illumination. By increasing the size of the illumination source (soft box, umbrella), two observations will become apparent. First, the size of the highlight will increase proportional to the distance between the source and the object. Instead of a creating a small, specular reflection, large source illumination creates a large, diffused highlight that follows the contour of the object. Since the highlight outlines object contour it reinforces the illusion of form and dimensionality. Object form will also be communicated through shadows attached to, and cast from the object. Second, by manipulating illumination specularity through projection/reflection techniques, the videographer decreases both the specularity and intensity of the illumination instrument. The intensity of the highlight reflection decreases relative to the luminance value of the lit and shadow illumination zones. By increasing the size of key illumination, the videographer can decrease the lighting contrast differential between illumination zones.

A couple of techniques are commonly applied to create large source illumination patterns. The first technique is

called light "tenting". By placing a reflective object in a space surrounded by translucent diffusion material, highlights will form along the contour of the object closest to the key light position.

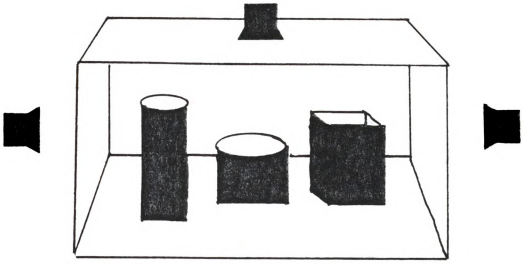


Figure 55. Light Tent Illumination

The advantage to tent illumination is that opposing diffusion surfaces act like a matte reflector which surrounds the object. Light energy passing by the object will reflect off an adjacent surface plane. The reflected illumination strikes opposing surface areas, providing secondary illumination to the lit and shadow zones. With tent lighting, contrast difference between illumination zones will be controllable in the final image.

Bounce illumination is a technique which has particular applicability when lighting glassware. Instead of projecting light energy through a translucent surface, illumination is redirected onto the object from an adjacent surface plane.

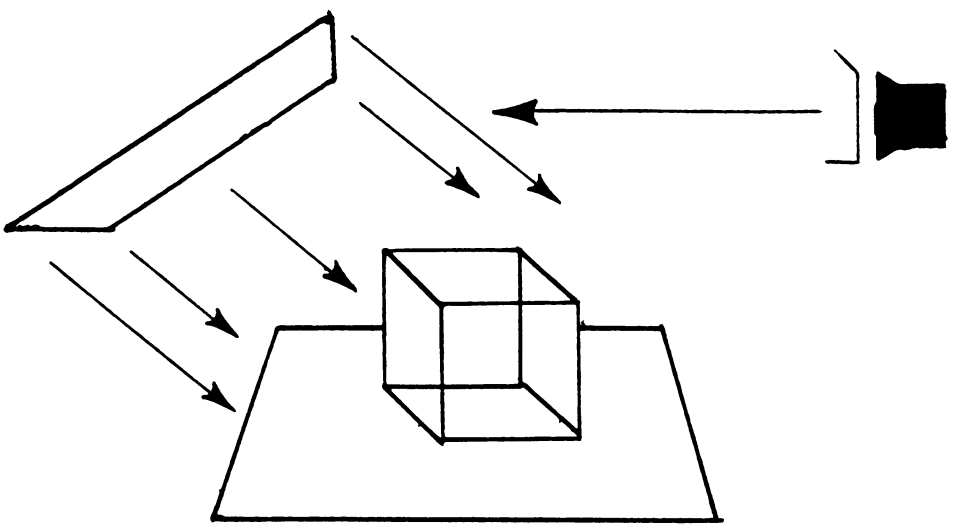


Figure 56. Bounce Illumination Technique

Bounce positioning is also dependent on the intended illumination effect. When bounce illumination is placed on the camera side of the object, a highlight will form along the surface contour closest to the bounce illumination source. The quality of bounce illumination is dependent upon the specularity of the reflecting surface, and the size of the bounce illumination plane relative to subject position.

To eliminate highlight reflections on transparent, glass surfaces, place the bounce plane at a standard back light position. Object dimensionality is conveyed by differences in light transmission through various surface planes of the object. Surfaces parallel to the bounce plane will photograph translucent. Planes perpendicular to the bounce illumination source will photograph opaque. Object contours between the two extremes will exhibit varying degrees of opaqueness.

The secret to using large source illumination is to keep the lighting pattern unidirectional and angled relative to the object-lens axis. When additional illumination sources are used, additional surface highlights will be created. Additional surface highlights may confuse visual interpretation of the object. Angling the illumination pattern will cause the formation of subtle modeling on the surface of the object. Large source illumination wraps around surface contours, providing diffused illumination to the lit and shadow zone. The transition between highlight, lit and shadow illumination zones will display soft subtle gradation at the transfer edge.

The most common placement of large source illumination is above the object. In this position, the instrument acts as both a key and a back light source. Rimming the top of the object with light, helps create product separation from adjacent background planes. Also by placing the key source above the object, illumination intensity gradually decreases on the frontal surface plane. The gradual illumination transition creates a large lit area on the frontal surface. Through careful positioning, the videographer can create highlight, back light separation, and maximize color reproduction with only one illumination instrument.

With compressed product setups, large source illumination will likely spill onto background surface areas. In some production circumstances this may be advantageous to creating lighting uniformity. To selectively

control illumination between visual planes, the following production technique is recommended. Whenever possible, sandwich the illumination source between two gobos that are wider than the illumination source. This "shuttering" techniques is diagramed in the following figure.

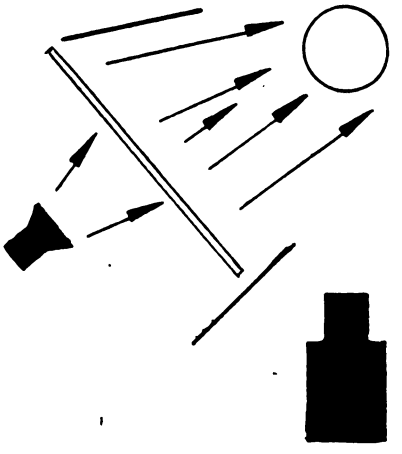


Figure 57. "Shuttering" Large Source Illumination

The gobo on the camera side of the illumination source is used to prevent lens flare, or excessive light contamination from the illumination source. The gobo on the opposite side of the soft box provides a mechanism for controlling background spill. With this method, the videographer can create artifical separation and depth to the video image. Spatial brightness gradations create visual interest by artifically creating separation between visual planes. Through brightness differences, the videographer can emphasize the visual importance of an object against a darker background surface. When viewing an image, the eye is

always drawn to the brightest point within the frame. By illuminating the object brighter than other visual elements, the videographer forces an implied visual response to the image.

The transfer edge created by the gobo can be controlled through perpendicular placement of the modifier relative to the illumination source. When the gobo is placed near the illumination plane, the lighting transition on background surfaces will display extremely soft gradation. If a harder transitional line is needed, extend the perpendicular postion of the gobo and use it as an extended "barn door" device.

Subtle modeling created by large illumination source is highly effective in product videography. Large source illumination techniques represent the best technical method for illuminating reflective surface objects.

With matte surface objects, highlight specularity will be minimal. Matte objects have rough, textured surfaces which break up the specularity produced by an illumination instrument. Matte surface objects absorb, diffract and scatter light energy incident to the surface plane. Intense highlight reflections (glare) will rarely be encountered with matte object illumination. Objects such as natural wood, stone and textured fabric fall within a matte reflectance classification.

Because matte objects break up key light specularity, color rendition is generally very strong on the frontal

surface plane. Color reproduction is always dependent upon the size of the lit illumination zone. By manipulating the size of the lit zone (through key light positioning), color reproduction can be controlled. To maximize color rendition, choose a large illumination source. Large source illumination is highly applicable to colorful matte surface objects. Texture detail, however, will be very weak with large source illumination techniques. Illumination design is dependent upon the object quality(s) the videographer wishes to emphasize. Large source illumination minimizes texture detail by creating subtle modeling at the transfer edge between lit and shadow illumination zones.

To maximize surface texture, choose a small illumination source. Correct positioning is dependent upon the surface plane that requires emphasis. By positioning the illumination source parallel to the object plane, illumination will skim the surface with light. Modeling will be most prominent on surface planes directly parallel to the illumination source. Surface texture will have maximum emphasis at the transfer edge between lit and shadow illumination zones. To emphasize object texture, position the fixture so that the transfer edge is prominent, relative to camera viewpoint. Texture detail, however, decreases on the surface plane within the attached shadow region. If texture detail is prominent in the attached shadow zone, it is generally due to the application of a secondary illumination source.

Though large source techniques are applicable to matte surface lighting, multiple source illumination patterns may prove more advantageous. With multiple source lighting, the videographer can selectively illuminate the object(s) with highly controlled specular instruments. The advantage to multiple source illumination is that the videographer can selectively illuminate various surface planes within the image, emphasizing the unique visual qualities of the object. Large source illumination may then be applied to the lighting pattern to reduce lighting contrast. Application of this technique allows for both surface texture and object color to be emphasized. When applying large source illumination to a multiple lighting pattern, the diffused source essentially becomes a fill (secondary) illumination instrument. As always, the intensity of the fill illumination source must be carefully controlled to prevent damaging the illumination effect. The fill light should never eliminate shadows created by the key light, or create additional shadows within the scene. If lighting contrast is difficult to contain, position fill illumination at camera position. Frontal fill illumination will create shadows behind the object, therefore hiding them from camera view.

In conclusion, matte surface objects present a different lighting challenge to the videographer. Matte objects will typically have reduced luminance differences between the highlight, lit and shadow illumination zone. The challenge to the videographer will be artifical manipulation

to create lighting dimensionality in the commercial image. The lighting pattern should accentuate the size, shape, color, form, and texture of the product. With matte objects, the criteria which define object quality is accentuated through entirely different illumination techniques. For example, diffused illumination accentuates object color and deemphasizes object texture. To emphasize texture the videographer will need to use specular illumination, a pattern which reduces color intensity. To creatively illuminate a matte surface object, the videographer will likely find it necessary to use a variety of illumination techniques. The key to creative development is through documented experimentation with product illumination techniques.

Illumination Measurement

Before concluding this chapter on product lighting, it is important to discuss illumination measurement as it relates to exposure control. Though the incident light meter is a valuable instrument in most production situations, its usage in product videography is minimal. There are several valid production considerations which make the use of an incident meter an inappropriate measurement choice. First, the hemispherical dome of the incident meter collects light from 180 degrees around instrument placement. In product videography, setup is usually very compressed between frontal and background surface planes. The incident meter is

sensitive to all illumination striking the dome's surface, making precise intensity calculation between multiple fixtures difficult. Second, the area of most concern in product videography is the luminance (reflected) value of the object. Since luminance is dependent upon reflectivity characteristics of the object's surface, the usage of a waveform monitor is essential. The waveform monitor will provide precise data on the luminance values and contrast ratio of the image. The area of concern in product lighting is object luminance, not the light intensity which produces that luminance value.

Through zone system analyzation, the videographer can determine the contrast difference within and between scenic elements. Differences between reflected values will be due to either: 1) the amount of light cast onto surface planes within the image, 2) the position of an illumination instrument relative to object position, or 3) surface reflectivity of the object. The waveform monitor provides reflected spot readings of scenic content. The illumination effect any manipulative technique will have on final exposure can be determined through waveform display analyzation. The waveform monitor provides data at a precision level not possible through incident metering.

Illumination intensity and exposure control is dependent upon the reflective characteristics of the object(s) within the scene. Through application of the techniques presented in this manuscript, the videographer

can creatively manipulate illumination patterns to precisely fit the illumination need. Exposure calibration is dependent upon creative interpretation of the object and the image. Any exposure has validity as long as it contains scenic contrast within reproduction limits. Product videography represents the greatest technical challenge, as well as boundless latitude in aesthetic lighting design.

PROGRAM DESIGN AND EVALUATION

The information contained within this thesis was discovered through research and experimentation with contemporary photographic lighting techniques. To accompany this text, an instructional video program was designed. Creating an instructional program provided a means for visually demonstrating the illumination techniques. The program that accompanies this text provided; 1) a vehicle for testing the lighting techniques outlined in the text, while 2) creating a unique instructional package that demonstrates the application of the techniques. The product of this design effort is an instructional video program entitled "Video Lighting: A Photographic Approach".

Target Audience

This program was targeted to reach both a student and professional media audience. First, the instructional material was directed toward students in a formal educational environment. Designed into self-paced instructional modules, the program is intended to be used as a supplement to other instructional material. The written material contained within the thesis can be redesigned to provide an instructional package with both a written and

visual instructional component. Due to the complexity of program material, this instructional package was designed for advanced production students. Advanced production students are those individuals with several course hours of classroom and laboratory instruction. The content contained within the program demonstrates contemporary lighting techniques applicable to the commercial video production setting. Therefore, a natural extension of the primary audience included industry professionals currently employed within this production setting. The professional group represents individuals with a higher level of production experience and expertise. Therefore, program content included production challenges commonly recognized by the professional audience. "Video Lighting: A Photographic Approach" was designed to be used as reference material, for demonstrating common illumination challenges and techniques for overcoming the challenges.

To stimulate viewer interest, the program was produced using professional industry standards. The goal was to create an instructional program that contained contemporary program elements. Several program areas were targeted for specific attention. These included; programming, lighting, visual and audio production techniques.

Program Techniques

As outlined in chapter one, "Video Lighting: A Photographic Approach" is a three-part instructional video

program. The program is designed as an instructional manual which demonstrates contemporary lighting techniques. Each module within the program is a separate chapter, and the sequence of chapters carefully presents lighting concepts in a systematic, logical order.

Each module within the program was designed similiar to an instructional textbook. Module content was subdivided into headings, subheadings, and illustrative examples that address specific content areas. The first three program modules, "The Scoop on Scopes", "The Beauty of Glamour Lighting" and "Hot Shots for Hot Products" address unique instructional content areas.

Each module was carefully designed to expand upon the illumination techniques presented in earlier instructional segments. Of primary concern was maintaining a systematic approach when presenting program content. The information contained within each module is unique to the module, and builds upon previously demonstrated techniques.

To facilitate location of instructional segments, a Table of Contents was included at the beginning and end of the program series. In addition, an instructional review was included at the conclusion of each module segment. The design goal was to maximize instructional efficiency by providing the viewer with ample reference material.

Major instructional sections were treated as subheadings within the program module. To facilitate location of content areas, each concept was introduced via

graphic title boards. Graphic boards were used consistently throughout the instructional series. Title graphics were of sufficient duration to facilitate location of specific content during high-speed tape shuttling.

A special segment titled "Tricks of the Trade" was designed into each program module. This segment included specific instruction on advanced illumination techniques applicable to the video arts. The purpose for creating "Tricks of the Trade" was two-fold. First, the instructional segment was designed as a stand-alone miniature program. This segment presented information that directly related to the lighting concepts contained within the module. The program segment, however, was "technique" not "concept" oriented. Second, "Tricks of the Trade" provided an additional presentation channel without the potential of creating informational overload among the audience. This segment was separated from other instructional material through a different audio/visual production treatment. This program segment provided the viewer with a period of relaxation, and could be located for content review at a later time.

Lighting Techniques

To reinforce the applicability of the illumination concepts, exceptional lighting challenges were created for demonstrating the production techniques. For example, lighting glassware or metallic objects is a difficult

illumination challenge commonly recognized by the target audience. Incorporating these illumination challenges into the design of the program lends credibility to the technique, and potentially to program content. Several illumination challenges were designed into each instructional module for creation and maintenence of audience interest.

To create the illusion of three-dimensionality (height, width, depth) in a two-dimensional medium, the illumination pattern must be carefully controlled. "Video Lighting: A Photographic Approach" built upon this production premise by thoroughly examining:

1) Fixtures, and the characteristics of illumination produced by different lighting instruments.
2) Modifiers, and the techniques commonly used to modify illumination intensity and/or quality.
3) Measurement devices, and the methods used to evaluate the illumination pattern.

Within a portrait and product production setting, the preceding criteria were examined in detail. An instructional goal of this program was to clarify the technical process of illumination. Approaching the production process from a technical perspective provides a means to develop personal artistic techniques.

Because lighting styles are highly personal, interpretative differences in illumination design were encouraged. First, several lighting styles were presented, and the artistic effect of the illumination and/or modification technique was demonstrated. Second, audio and video messages were emphasized that encouraged experimentation with the illumination techniques. Though on-screen examples emphasized a specific technical approach, the audience was encouraged to develop video lighting into a personal artistic form of expression.

Visual Production Techniques

To increase the educational value of the program, several advanced production techniques were demonstrated. The production techniques were included to demonstrate illumination concepts, but were not intrinsic to the lighting technique. The techniques were included to enhance compositonal design, visual creativity, and the educational value of the program. Some of the techniques demonstrated within the program included:

1) transitional mechanisms between visual frames,
2) creating the illusion of depth in a two-dimensional image,
3) visual design techniques to alter perception,
4) the usage and effect of lens diffusion.

Some of these techniques were discovered through research and development of the instructional program. Incorporating advanced production techniques into the design of the program potentially increases the instructional value of the package. The program was designed to demonstrate lighting techniques within a programming framework which allowed demonstration of other production concepts.

The graphic elements within the program were created based on contemporary designs found in the print medium. The primary challenge in graphic design was to interrelate visual concepts within, and between instructional modules. Each graphic needed to represent the instructional concept, and relate to the visual design of the entire instructional package. To enhance the graphic interrelationship between modules, a couple of production techniques were used. First, the color(s) used throughout the program were contained within a limited palette selection. The basic color selection used in the program were shades of blue and gray. Limiting the color palette is based on several important production considerations. First, many accent color combinations can be used against a blue/gray backdrop, and virtually any color combination would harmonize. Using gray as a primary background color limited the potential for color discontinuity between program elements created over several months of production. Second, both color accents and white lettering are projected with equal clarity over a gray backdrop. Third, reproduction clarity of this color palette

is superior to other color combinations. With industrial grade video production formats, some colors (red, magenta) have a tendency to "band" or "desaturate" during the record/playback process. Finally, contrast build-up, an additional production anomoly encountered in program replication is not as noticable with this palette selection.

Audio Techniques

To prevent program monotony, several audio production techniques were incorporated into the design of the program. First, different narrators (two male, one female) were used within each module to create aural variety within each segment. The first narrator (male) was used exclusively for introductions and conclusions to module heading/subheading material. A second narrator (male) was used for basic module content. Finally, a third narrator (female) was used exclusively for the "Tricks of the Trade" sequence. Using a variety of narrators for specific program content provided continuity, variety, and separation between module material.

Another production technique called "audio paragraphing" was used to maintain audience attention. "Paragraphing" redirects audience attention to program content by creating separate audio events which are distinct from the narration sound track. Audio events commonly used for paragraphing include both music and sound effects. By creating aural variety within a video soundtrack, listener attention is redirected to program content. To maintain

audience attention several different music beds were created, each linked to specific program transitions. Stereo sound effects specifically keyed to visual events (through SMPTE time code editing) were also included to give the program aural dimensionality. Sound effects were included within the stereo soundtrack to:

1) redirect audience attention to the visual content,
2) provide an aural transition between visual elements, and
3) reinforce special visual effects.

The usage of music and sound effects were carefully timed to prevent redundancy, which would reduce the effect or impact of the production technique on the viewing audience.

Design Conclusion

In conclusion, the goal was to create contemporary images within the framework of an instructional video package. Design criteria incorporated into development of the program was based on: 1) instructional and presentational clarity, 2) enhancing the instructional experience by presenting advanced instruction in both lighting and production techniques, 3) creating an educational program that was applicable to an audience with diverse production expertise, and 4) creating a program which met or exceeded contempory program design standards.

Evaluatory Groups

To evaluate program effectiveness, a sample audience was selected from the targeted research groups. A brief description of these groups is included for reference to program evaluation results.

First, student volunteers were solicited from Michigan State University. To qualify as an advanced production student, each participant had completed their basic academic requirements which included TC 302, an introductory course in basic video (studio) production. These students were solicited for program evaluation from four specific advanced production courses. A group of eleven students was secured from TC 350, an advanced audio production course. Each of these students had previously completed TC 302, and this group was selected to test questionnaire language and design. Testing results and evaluatory comments are included from this selected group, even though their interest/ motivational level scored statistically lower throughout every testing category.

Student reponses were also collected from other instructional courses. Twelve students from TC 421 (Electronic Field Production) participated in evaluation of the program. The evaluation process was completed during a regular course session, and the collected data has also been combined with the evaluation from other production groups.

Finally, separate evaluatory sessions were conducted for students in TC 351 (Advanced Television Production), TC 361 (Intermediate Television Directing) and TC 451 (Advanced Television Directing). A total of fourteen students from these three production courses volunteered to participate in the evaluatory process. The total number of advanced production students participating in program evaluation totaled thirty-seven (n = 37) individuals.

Evaluatory comments were also collected from an assembled panel of media professionals working in the film and video production industry. The professional panel was asked to critique the program on the same criteria used by advanced production students at Michigan State University. The results of this professional review are compared against the data collected from the participating production students. The following is a brief production biography for each of the professional panel members.

Richard Mitchell is a Video Unit Manager for A.A.A. of Michigan. Mr. Mitchell has been a Producer in corporate video for eight years, creating programs that are primarily informational, educational or instructional in nature.

Dennis Mills, David Love, and Don Burke are employed by Maritz Communications Company, a high-tech independent production company in Detroit, Michigan. Mr. Mills is the Senior Video Engineer, primarily responsible for overseeing camera setup, operation and maintaining technical reproduction standards. Mr. Love is the Manager of Film and

Video Production operations for both studio and remote location production. Mr. Burke is the Stage Manager for Maritz Communications, in charge of lighting, scenery, and property setup.

Thomas Wait, Robert Moore, Scott Rubens, Mark Cridland, Jeff Dudley, and Lee Johnson are all employed by WTLV-TV12 in Jacksonville, Florida. All of these individuals provide a commercial broadcasting perspective to the evaluatory process. Mr. Wait is the Director of Creative Services, primarily responsible for production staffing and advertising production at WTLV-TV. Mr. Moore is employed as a Studio Supervisor, and has specialized in Studio/EFP lighting and staging for over 9 years. In addition to his professional television credits, Mr. Moore has also freelanced in both film and concert lighting/staging design. Mr. Rubens is employed as a Director at WTLV-TV. His directoral assignments include college football, parades, and special event production, as well as regular entertainment and news oriented programming. Mr. Cridland is employed primarily as a Newscast Director at WTLV-TV, with six years of directing experience in various production positions. Mr. Dudley is a Producer/Director in the Jacksonville market, with approximately two years of professional experience. Finally, Mr. Johnson works within the studio production staff, in various production capacities.

Evaluatory Design

Subjective analysis of program content and stylistics will not yield meaningful statistical results on the instructional design process. How an individual evaluates and utilizes a subjective technique is dependent upon the artistic perspective of the individual. Statistically testing the application of illumination techniques would have little validity, due to the subjective nature of the art form.

Evaluatory information useful to the program designer is based on the clarity of instructional content. Objective analysis of testable instructional concepts (ie. program pacing, clarity of language, program attentiveness, etc.) provides vital data to the designer of video programming. Information collected through summative evaluation provides a foundation on which to build future programming decisions. Particularly with subjective topics, the issue is not whether the evaluatory group agrees with the program concept, but rather, do they clearly understand and comprehend the presentation of those concepts. Program effectiveness is based, in part, on the ability to communicate concepts in a clear and concise manner.

Evaluation of program design criteria provides a methodology for analyzing the effectiveness of theoretical and practical production techniques. To test the design concepts outlined at the beginning of this chapter, an evaluatory form was designed. The testing instrument

solicited ordinal level data from the evaluatory audience. Using a standard Likert scale for evaluation, the respondents were questioned on several theoretical and practical design concepts. These concepts were incorporated into the instructional and communicative design of: "Video Lighting: A Photographic Approach"

The testing instrument (appendix E) was a survey research questionnaire containing twenty-four evaluatory questions. Twenty-two of the questions were closed-ended, requiring a single response from a group of appropriate options. Sixteen of these questions were presented in the form of a semantic differential Likert Scale. Each response was assigned numerical value between one (1) and five (5). The numerical ranking for all questions was assigned based on a: high (1), above average (2), average (3), below average (4), or low (5) level of instructional applicability. Six of the twenty-four questions only asked for a Yes, No, or Don't Know response. Finally, two of the twenty-four questions were open-ended, prompting the evaluatory audience for a written response. The open-ended questions were included to collect additional information not specifically addressed in the evaluatory instrument.

The following results were collected through evaluation of data collected from the survey questionnaire (appendix E.) Where appropriate, the scores between the evaluatory groups have been compared. This comparison was not included

to measure intellectual or professional differences between production groups, but rather, to measure the applicability of the instructional design across audience groups.

Evaluation Results

Question one and two were designed to measure participant interest in the subject matter. Participants were asked to rank their personal interest in the subject material before and after program exposure. By comparing the two data sets, conjectures can be made on the motivational effectiveness of the instructional program. Within both evaluatory groups the mode (most frequently selected ranking), was "average" before program exposure. After exposure, mode scores within both evaluatory groups shifted positive. Both production groups shifted to an "above average" mode level after program exposure. The numerical mean score (computed by summing the responses and then dividing total value by number of respondents) also changed between measurement questions one and two. Within the advanced student group, a mean pre-exposure interest level of 2.54 was calculated. After exposure, the interest level in the same group changed to a mean value of 1.94. The numerical change within the professional evaluatory group was similiar. Pre-program exposure interest ranked 2.4 among the 10 professional respondents. After program exposure, the mean score value changed to a group value of 2.0. Both

sectors, therefore, demonstrated positive numerical changes with respect to general motivational interest.

Question three asked the respondents to rank their general interest level during viewing of the instructional program. Testing results indicate little difference between evaluatory groups with respect to their general interest when viewing the instructional program. Mean rankings from both evaluatory groups were tightly clustered around a 2.0 (above average) score. The dispersion of scores was equal across the top three (high, above average, average) response categories. As expected, there was a high correlation between motivational change (numerical difference between question one and two) and program attentiveness. Those participants indicating an increased interest in the subject matter, also indicated above normal attentiveness during program viewing.

Different group responses were collected between evaluatory sectors in response to survey question number four. When asked if the program presented unique production concepts based on their prior lighting knowledge, thirty-six of the student evaluators indicated "yes" (97%). Within the professional evaluation group response was divided between panel members. Six of the ten professional respondents indicated the information was unique to their prior knowledge, while four of the respondents indicated prior exposure to the illumination techniques.

Question five asked the respondents to rate the applicability of the demonstrated techniques to a single-camera video production setting. This question was included to ascertain perceived viability of the concepts within a commercial production setting. Ninety percent of the respondents from both evaluatory groups indicated that the demonstrated concepts had "above average" or "high" applicability to a standard single-camera video production session.

Question six asked the respondents to rank their motivation level toward exploring/developing the lighting concepts contained within the instructional program. Response to this question was mixed as the following data indicates:

	Students		Professional	
Category	(n)	(%)	(n)	(%)
High	8	22	1	10
Above Average	19	51	5	50
Average	9	24	2	20
Below Average	1	3	2	20
Low	0	0	0	0

Both evaluatory sectors indicated a wide range of motivational responses with regards to personal development of the illumination concepts contained within the program. In general, both evaluatory groups indicated a "high" or "above average" personal motivation toward development of

program techniques. Seventy-two percent of the student, and sixty percent of the professional responses fell within the two highest motivational categories. A nearly equal percentage of student an professional panel members also indicated an "average" or "below average" motivation toward developing the instructional techniques.

Question seven was open-ended, requesting subjective (attitudinal) information on program design. The respondents were asked to supply a word or phrase which they felt best described the lighting/production techniques used in "Video Lighting: A Photographic Approach". Any classification methodology used to categorize informational responses is arbitrarly dependent upon how the data is evaluated. Subjective response to the program and production techniques, however, appears to be overwhelmingly positive from both evaluatory groups. The first set of responses have been categorized according to the evaluatory group. Duplicate responses were tabulated numerically, following the response category.

<u>Professional Evaluatory Group</u>

Informative (3)	Interesting (2)	Creative (2)
Time Consuming (2)	Concise	Perceptive
Basic	Highly Useful	

Student Evaluatory Group

Informative (4)	Professional (4)	Creative (4)
Interesting (3)	Structured (2)	Helpful (2)
Innovative (2)	Useful	Exciting
Modern	Appropriate	Enticing
Dynamic	A great sense of depth impression.	
Phenomenal	Very Adaptable to Daily Use.	
Basic	Good Looking.	
Insightful	Top of the Line.	
Intricate	Gets your attention.	
Involving	A technically specific approach.	
Comprehensive	Graphically aesthetic.	
Unique	Diversity at its finest.	
Time Consuming.		

The adjectives used to describe program content and design appear to be very positive within both evaluatory groups. Suprisingly, there was a high frequency of response consistency between evaluatory panel members. The following list categorizes the most common responses, and the response frequency between evaluatory groups.

Common Evaluatory Descriptors

Response	frequency
Informative	7
Creative	6
Interesting	5
Professional	4
Time Consuming	3
Structured	2
Innovative	2
Useful	2
Helpful	2
Basic	2

Many of the descriptors used are open to semantical interpretation. For example, the response "time consuming" appeared within both evaluatory groups. This descriptor could be interpreted to mean that the techniques required a greater amount of production time to execute, or as a phrase which described a negative reaction to the program presentation. Lacking further information, interpretation of the descriptive language is left to conjecture.

Question eight asked the respondents to rank the instructional clarity of the program. Over 80% of the respondents from both evaluatory groups indicated that the instructional clarity was "above average" or "high" within this demonstrational program.

Question nine followed-up on the previous question, by asking respondents to rank the contribution of the demomstrational examples toward learning the related lighting concepts. Thirty-one students (83%) and 9 out of 10 professional respondents indicated that instructional examples were "above average" or "high" in relation to learning the illumination concepts.

Question ten was included to determine the complexity of the instructional material. Because the program was intentionally designed on several different production levels, the anticipated response should indicate a need for repetitious viewing.

	Evaluatory Group	
Category	Student	Professional
One viewing only	0	0
Two viewings	14	3
Three viewings	15	3
Four viewings	4	2
Five or more viewings	4	2

Question eleven was included to determine whether the "module" concept was beneficial or detrimental to the instructional process. Overwhelming response indicated that the design concept was beneficial to the instructional process. Thiry-six out of thirty-seven students, and nine out of ten professionals indicated program module design was beneficial to the instructional process.

Question twelve was used to evaluate the organization of instructional material. Respondents were asked whether the information contained within each module was presented in a systematic and logical manner. Again, overwhelming response from both evaluatory groups indicated that "Video Lighting: A Photographic Approach" was designed with high instructional clarity. Eighty-four percent of the students, and one-hundred percent of the professional evaluators positively indicated there was good organizational clarity within, and between instructional modules.

Question thirteen asked the respondents to assign a difficulty factor to the instructional material. Response between evaluation groups varied greatly, but some consistencies were noted. The majority of respondents in both groups indicated that instructional difficulty ranked an "average" or higher (above average, high) difficulty factor. Ninety-five percent of the student, and 80% of the professional responses were contained within one of the three highest evaluation categories.

	Evaluatory Group	
Category	Student	Professional
High Difficulty	3	1
Above Average	24	3
Average	8	4
Below Average	2	0
Low Difficulty	0	2

This program may have presented a greater intellectual challenge to the student population based on lack of exposure to the instructional concepts (question four). From the evaluatory data it appears that the intellectual challenge did not extend beyond the capabilities of the student audience, while maintaining interest among the professional evaluatory panel. Those professional evaluators which rated the program as having a low difficulty factor, also ranked attentiveness (question 3) and general enjoyment (question 23) as either "high", or "above average". Therefore, although program concepts posed a greater intellectual challenge to the student audience, both groups assigned difficulty, attentiveness, and general interest satisfactory evaluation scores.

Question fourteen asked the evaluatory panel to rate the program with respect to the amount of instructional material within each module. Eight out of ten professionals, and twenty-four out of thirty-seven students assigned an "above average" ranking to this program.

Question fifteen was included to measure the appropriateness of instructional material. This question was included to determine if the information within each module seemed appropriate to the content area. Evaluatory response frequencies were tabulated as follows:

	Evaluatory Group	
Category	Student	Professional
Highly Appropriate	10	1
Above Average	19	5
Average	7	2
Below Average	1	2
Low Appropriatness	0	0

The "above average" category had the largest response frequency across both evaluatory groups. Student evaluation members tended to skew toward a higher appropriateness factor, while professional evaluators skewed toward the middle of the Likert scale. Approximately 78% of the student group indicated that the material presented had a "high" or "above average" appropriateness ranking.

Question sixteen was included to determine the appropriateness of instructional pacing. Response ratings to question sixteen were diverse, with an average rating score of 2.62 collected from the evaluatory panel.

	Evaluatory Group	
Category	Student	Professional
Highly Appropriate Pacing	4	1
Above Average	13	5
Average	14	3
Below Average	5	1
Low Pacing Appropriatness	1	0

Across both production sectors, the program was rated slightly above "average" in terms of pacing the instructional material. Response to question sixteen ranged across the entire Likert scale, making generalizations on program pacing difficult to determine. With self-paced programming, instructional pacing may be a moot point, as long as content pacing does not distract viewer attention. Data results from question three indicate that the program did maintain viewer attentiveness and, therefore, instructional pacing was conducive to the program design.

Question seventeen asked the respondents to rate "Video Lighting: A Photographic Approach" against other programs with respect to instructional clarity. Of the thirty-seven students, twenty-five indicated that the program ranked higher in terms of instructional clarity than other programs they had seen. Twelve of the students indicated that they "didn't know" how this program would rate against other instructional programming. None of the students ranked the program lower in terms of instructional clarity. Response from the professional evaluation panel was nearly identical. Seven of the ten professional respondents indicated that the program had higher instructional clarity than other instructional programming. Two of the professional respondents indicated "don't know" with respect to clarity of instruction. Finally, one of the professional panel members ranked the program lower in terms of instructional clarity.

The next question asked the respondents to rank the program based on the instructional value of the content. Response to question eighteen was very consistent between evaluation groups. All of the respondents indicated that, at minimum, the program had an "average" instructional value and frequently assigned an "above average" or "high" value to the instructional content.

	Evaluatory Group	
Category	Student	Professional
High Instructional Value	11	4
Above Average	23	4
Average	3	1
Below Average	0	0
Low Instructional Value	0	0

Eight out of ten (with an abstaining member) assigned an instructional value of "above average" or "high" to the program content. Within the student group, approximately 30% of the respondents gave the program the highest possible value rating. An additional 62% of the student responses indicated that the instructional value of the program was "above average".

Question nineteen asked the respondents to assign a difficulty factor to the learning of the featured illumination techniques. The overwhelming response from both groups indicated that the demonstrated concepts were of "average difficulty". Within the professional evaluation

group, this was the only selected response category. Over 62% of the student participants also indicated the program was of average difficulty. Thirty-two percent of the students indicated that the concepts demonstrated within the program were "very difficult". None of the respondents indicated that the concepts were "extremely difficult" or "extremely easy", semantic differential extremes on the Likert scale. Therefore, response from both evaluatory groups was clustered around an "average difficulty" ranking.

Question twenty asked the participants to rank their improvement in skill level based on a single exposure to the program.

	Evaluatory Group	
Category	Student	Professional
Greatly Improved	3	0
Above Average Improvement	10	2
Average Improvement	18	7
Little Improvement	6	0
No Improvement	0	1

Most of the respondents indicated an "average" improvement level based on one exposure to the program material. Since the program is a self-paced instructional package, improvement ratings, in actuality, should be based over several exposures to program content. The fact that several students and two of the ten professional reviewers

perceived "above average" improvement based on a single exposure, speaks strongly to the clarity of instructional design.

Question twenty-one asked both evaluatory groups if they would enroll in a formal course of study (or production seminar) which included the lighting concepts demonstrated within the program. This question was included to determine: 1) a preceived need for improving video lighting techniques, 2) motivation to satisfy the preceived need, and 3) acceptance and/or rejection of the program concept and the expertise of the program designer. Nearly 82% of the student group and 70% of the professional panel indicated they would enroll in a professional course if one was conveniently offered. Approximately 5% of the student group, and 20% of the professional panel indicated that they would not be interested in further instruction on the lighting concepts. One professional, and five student evaluators indicated that they didn't know if the would be interested in further lighting study.

Question twenty-two posed the following: "If this program and an accompanying instructional manual was available for purchase at a price comparable to other instructional packages, would you buy this program? This question was designed to determine: 1) the acceptance of this program as a commercial product, and 2) the marketing potential for the program concept. Response to the question was mixed, especially among the student evaluatory group.

Response from student evaluators was equally divided between "yes" (35%), "no" (27%) and "don't know" (38%) categories. In the professional sector, however, eight of the ten respondents indicated positive interest in purchasing an instructional package. The remaining professional respondents (2) were uncertain whether they would be interested in an instructional lighting package.

Question twenty-three was a concluding close-ended question which asked the respondent to indicate on a Likert scale their general viewing enjoyment of "Video Lighting: A Photographic Approach".

	Evaluatory Group	
Category	Student	Professional
High General Enjoyment	6	1
Above Average	21	3
Average	8	6
Below Average	2	0
Low General Enjoyment	0	0

"Enjoyment" may be as much a part of the instructional process as other program design components. The audience brings to the video screen a set of expectations built up from exposure to entertainment program formats. Though the ultimate goal of this program was the instruction of a complex lighting process, the instructional success of the project may be due in part to the entertaining manner through which instructional concepts were presented.

Question twenty-four was open-ended, asking both evaluatory bodies for additional comments, criticisms, or critique of the instructional package. Responses generated from question twenty-four have been packaged according to the evaluatory group, and according to the relationship between the comments.

Of primary concern within the professional group was the language and/or terms used within the program was too technical for rapid comprehension. The program assumes a certain level of technical expertise, and builds from that point. One of the professional evaluators indicated that the information was very detailed and moved at a rapid pace which sometimes made it (the instructional point) difficult to understand. Though designed as a self-paced instructional program, a glossary of terms should probably be included within the written instructional text.

Within module one, light measurement and computation of a lighting ratio is fully detailed. Professional criticism from one panel member was based on the intended purpose for computing the lighting ratio. The evaluator criticised the segment based on the implied manner with which the information was presented. In retrospect, the connection between light ratio computation and the information on maximum reproduction latitude might need stronger instructional and visual emphasis.

The sole respondent that indicated the module concept was detrimental to the instructional process (question

eleven), qualified the response by indicating that the instructional modules should have been shorter in length and breadth of information. At issue, therefore, is not based on the module concept, but rather the execution of the concept within the instructional package. Due to the positive response collected from other evaluatory members on program design, this criticism is not seen as being a significant programming problem.

Finally, production criticism on the lack of camera or subject movement within the scene was noted. Critical response collected under this category include:

> "Information seemed limited to lighting singular subjects".
>
> "Our shots usually have moving cameras, talent".

However, as the literature in chapter one of this thesis indicates, any study of lighting design is most effective in single subject portraiture, and product still-life videography. To maximize instructional clarity, visual complexity was purposely limited to focus viewer attention on the instructional material. By directing attention onto specific visual areas, the instructional point would be visually emphasized. The visual intention of the designer was to clarify/instruct the audience on how lighting can be used as a creative production tool, not on designing complex commercial images. For the most part, the instructional scheme worked. Criticism on program design was

minimal, and many positive comments were collected on the design and implementation of the program concept. Some of the professional panel members indicated that:

> "...the program looks great visually"
>
> "I'd recommend this tape to my past professors at the University of Florida".

Instructional interest was also expressed by professional panel members for additional instructional modules. Suggestions for further development include modules on exterior lighting, remote lighting, large object (ie. automobile) illumination, and additional creative information on how different instruments and attachments can be used to effect/manipulate illumination.

Student critiques of "Video Lighting: A Photographic Approach" indicate that as an instructional tool, the program was highly successful in explaining advanced illumination concepts. Many advanced students offered positive suggestions on further development of the instructional process. Several of the responses have been included to give the reader a flavor of instructional evaluation.

> "In approximately one hour (this program) managed to raise my interest, taught me, and let us enjoy different aspects of lighting. Nothing I've encountered so far has been able to do that."
>
> "...it was very informative."

"Personally (the program) raises many questions and things that I would like to try. I think this is very good. "

"I liked the use of examples because they applied to what was being said."

This (program) would be excellent as a supplemental video for a lighting course or seminar."

"It includes a lot of information in such a short program."

"...a manual would be a great asset."

"A very informative and well organized program. Excellent use of lighting examples."

"I would like to see an additional video which emphasizes dramatic studio lighting techniques."

"I learned a great deal about lighting."

"I was very impressed, I would probably refer to it (the program) several times for specific reference."

The instructional module approach met with overwhelming approval in student sector evaluation. The pacing of module content, however, received mixed evaluatory results. Though the program was never intended to be consumed within a single viewing session, the evaluation process may have misled audience interpretation of the program design goals. "Video Lighting: A Photographic Approach" was always intended to be an advanced, self-paced series, which contained intensive condensation of lighting and advanced production techniques. Evaluating the following comments

within the intended instructional framework, may provide insight on the dimensionality of the program. Comments included:

> "It just appeared to be too much information being tossed at you at one time...split it in half and it would be easier to follow and remember when the shows done."
>
> "The module dealing with the use of meters and calibration of meter/camera went by very quickly. Less technical areas were paced at an appropriate speed."
>
> "...some new concepts were brushed over very quickly."
>
> "Confused about lighting ratios - once you figure it out, what do you do with it?"
>
> "First module requires more clarity...hands on experience would be helpful."
>
> "The pace was swift"
>
> "If one were to learn and be tested on this material, additional viewings would be needed."
>
> "Sometimes the pacing was too fast, particularly on the waveform monitor and it's connection to determining proper contrast."
>
> "There was quite a bit of material covered and although the concepts were clearly portrayed, practice and hands-on experience is needed. "
>
> "I feel some of the concepts in this program were complex, and at some points I had difficulty understanding...Maybe what's best for me is to learn by doing, and then consult this program when I have greater knowledge."

Finally, some of the advanced production students at Michigan State University took the opportunity to interject personal subjective reaction to the techniques demonstrated within the program.

> "I think the program is very professional..."
>
> "Technically it was very good and had a very professional appearance. "
>
> "Use and types of examples and actual explanation was very clear and informative."
>
> "Great Visuals...Great Sound."
>
> "Exceptional Quality - Very Professional."
>
> "Graphics and Audio helped create an interest level above what the audience would expect from the material. "
>
> "...the use of graphics and audio...very well done. "
>
> "I thought the program was phenomenal in all areas, including production technique. "
>
> "I did enjoy the program, and am sure to use some of the suggestions. "

Evaluatory Conclusions

The following list of conclusions is based on the data results collected from the survey questionnaire. The simple descriptive statistics applied to the evaluatory data, highlights several of the design strengths of the instructional program. Results collected through a summative evaluation process provide an excellent foundation on which

to build future instructional modules. The design of additional lighting modules will benefit from the objective data collected through the initial evaluation process.

First, according to survey results the information contained within "Video Lighting: A Photographic Approach" was new the target audience. Ninety-seven percent of the student and 60 percent of the professional evaluatory panel indicated that the illumination concepts were unique to their prior professional exposure. Ninety percent of both evaluatory audiences indicated that the techniques demonstrated within the program were highly applicable to the single camera production setting.

Second, between sixty and seventy percent of the target audience indicated a "high" or "above average" motivation toward developing the illumination techniques contained within the instructional program. Motivational interest in exploring contemporary lighting techniques increased slightly after program exposure. Average group scores changed from 2.54 to 1.94 in the student population, and from 2.4 to 2.0 in the professional evaluatory panel. Statistical results indicate an increased interest in the topic material.

Third, several subjective words were supplied by the evaluatory audience to describe the lighting and production techniques contained within the program. Adjectives used to describe the instructional program include: Informative, Creative, Interesting, and Professional.

Fourth, eighty percent of both evaluatory groups ranked the instruction program either "High" or "Above Average" with respect to clarity of instructional presentation. Similiar scores were also received for clarity and contribution of visual examples for demonstrating key illumination techniques.

Fifth, nearly all of the evaluatory members indicated that the "module" concept proved beneficial to the instruction of the illumination concepts. One-hundred percent of the professional and eighty-four percent of the students indicated that organization of instructional content within, and between modules was presented in a logical progression.

Sixth, the amount, appropriateness, and pacing of instructional content was ranked "above average" by both evaluatory groups. According to evaluatory data, both audiences assigned a "high" or "above average" rating to "Video Lighting: A Photographic Approach" with respect to: 1) the value of instructional content, and 2) the value of this program compared against other instructional programs.

Finally, survey data indicates overwhelming acceptance of the concept, process, and product of the instructional project. Based on survey findings, there appears to be a strong need and high audience motivation toward adapting the illumination techniques demonstrated within the program.

Future options include program marketing, and seminar instruction on the application of photographic lighting techniques in the video production setting.

Evaluation is generally considered the concluding act or chapter in the creative design process. A common evaluatory goal is testing the instructional effectiveness of the project on a perceived target audience. However, the process of summative evaluation marks the passage from one, to the beginning of another program design challenge. Information and techniques collected in the development of a previous project, create a foundation on which to beginning anew. The success of this project is due, in part, to prior success and failure in the creative act of designing video programming. What was once the ceiling of one's personal capabilities, becomes the floor in future creative endeavors.

APPENDICES

APPENDIX A

Video Lighting: A Photographic Approach
Title: The Scoop on Scopes Producer/Director: Haggadone
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VIDEO	AUDIO
Open Graphic	MUSIC UP/UNDER
KEY: Video Lighting: "The Scoop on Scopes"	
Single frame photos over background	Light...probably the most important and least understood element in video production. Through understanding the qualities and potential of light, the power of creativity will be at your fingertips.
	MUSIC X-FADE TO WIND SFX
Animation: "Distant Horizons"	To expand your visual horizons, it is first necessary to understand the <u>difference</u> between how the eye, and the video camera react to light.
Dissolve: "Eye model over animation seq.	The eye is highly sensitive, and subjective in its intrepretation of light. Capable of adjusting to
KEY: (Characteristics)	intensity variations in milliseconds, the eye-brain

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VIDEO	AUDIO
	combination can preceive scenic detail over a very wide contrast range. The eye can easily adapt to light intensity variations in which the highlights are are 1-thousand times brighter than the darkest
Dissolve out Eye model	areas.
Dissolve: Camera	The camera however, is an objective instrument which can reproduce only a limited contrast range. Maximum system latitude, is limited to a 20 to 1 ratio. This means that when attempting to record an image, the brightest areas are limited to 20 times greater intensity than the darkest areas. In video, it is necessary to limit scenic contrast in order to retain subtle detail
Dissolve out camera	throughout the entire image.
Key: "The Challenge"	The challenge to the working professional is therefore to translate what the eye sees, with

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VIDEO	AUDIO
	what the medium is capable of reproducing.
Diss. "B" roll/studio	MUSIC SOUNDER
	To measure light intensity, three objective testing instruments have been developed for the film and video arts. They are:
Diss: Studio Setup	The Reflected Light Meter
Key: (Elements)	The Incident Light Meter
	and The Reflected Spot Meter
	Let's take a look at each of these instruments, starting with the reflected light meter.
Hand takes meter	The reflective light meter analyzes
Overhead CU. meter	light that is reflected from the
moves into frame	scene toward camera viewpoint
Subject profile	Having approximately a 30 degree
arrow animation	angle of acceptance, the reflected
Subject frontal	light meter simply averages scenic
reflected animation	content and provides the operator
Dissolve FS graphic	with a recommended f-stop setting.

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VIDEO	AUDIO
CU Auto iris	APERTURE "WHIRRING" SFX
(Highlight)	The auto iris built into most video cameras operates essentially in the same manner. The primary difference between an auto iris and a reflected hand-held meter is that the angle of acceptance is determined on a video camera by the
Dissolve FS Graphic	focal setting of the lens.
Key: (Disadvantages)	There are several disadvantages to using either a reflected meter or the cameras auto iris when making exposure decisions.
Diss. Gray Scale over graphic bkg.	The reflected meter is calibrated to provide an exposure, based on average scenic content. Because most natural scenes have a range of reflective densities between light and dark, a mid-tone or middle gray value is chosen for calibration.

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VIDEO	AUDIO
Dissolve: LS Studio High Key portrait	A studio setup in which light or dark tones predominate, will fool the reflected light meter into providing inappropriate exposure data.
Cut: CU Portrait close aperture to middle gray value Dissolve: CU portrait Low Key setup raise aperture to middle gray value	A scene in which light tones predominate, will fool the reflected meter into selecting an aperture setting that averages the scene to middle gray. A similar problem will also be encountered in predominantly dark tone scenes. The meter will compensate for the low illumination level, and supply exposure information which would destroy the intended lighting effect.
Animation: Setshots Portraits & Products	PROGRAMMED SFX SEQUENCE In order to have full control of the video image, the videographer should never rely on an auto iris to provide exposure information. To

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VIDEO	AUDIO
	surrender exposure control to an auto iris, is to surrender your artistic creativity.
Take Black	MOTOR DRIVE SFX
Fade: Grid Graphic Bkg.	MUSIC SOUNDER
KEY: Incident Light Metering	An incident light meter is a valuable instrument for making
Dissolve:	accurate lighting decisions.
Meter setup	Calibrated in foot-candles, an
Hand grabs meter	incident meter can be used to
Overhead CU	establish lighting ratios on an
Hand placing meter	individual subject... or an entire set.
Animation: "Arrows"	The primary difference between an incident and a reflective meter is that an incident meter measures illumination intensity which falls upon...or is incident to the scene.
Diss. FS Graphic Bkg.	Basically two methods are use to determine lighting ratios. They are

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VIDEO	AUDIO
	for:
KEY: (methods)	- Overlapping Fixtures and - Non-Overlapping Fixtures
Dissolve: MS Portrait fixtures visible	In a lighting setup where the fill light overlaps the coverage area of the key, measurement accuracy is crucial in order to determine the lighting ratio. The ratio between overlapping fixtures can be mathmatically expressed as the:
KEY: (formula)	Key intensity plus the Fill intensity divided by the Fill intensity alone.
CU Models face Meter positioned	To determine the key plus fill intensity, simply position the dome of the light meter midway between the two illumination sources. The meter's white dome acts as a collector for the photo-electric cell inside the meter, and is sensitive to light from a
Meter removed	one-hundred and eighty degree

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VIDEO	AUDIO
	hemisphere.
Hand places meter down record FC intensity	Once you have determined the foot-candle intensity of the key light combined with the fill, it is generally a good idea to write it down. This is particularly important in complex lighting arrangements.
Meter placed @ fill position	Next, to determine the fill light intensity, place the meter in the same position. Then, take your hand, and shade off the meter dome
Shade off key illumination	from the direct rays of the key light source. Make a note of the fill light's foot-candle intensity.
Dissolve: FS Graphic	To determine the lighting ratio, simply divide the key plus fill intensity by the fill light intensity alone. For example, in this setup a key plus fill intensity of 125 foot candles,

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VIDEO	AUDIO
	divided by the fill intensity of 64 foot candles, yields a lighting
Graphic Animation	ratio of approximately 2 to 1.
Dissolve	If, for example, our fill light
KEY: (example)	intensity had only been 32 foot candles, our lighting ratio would have been 125 divided by 32, or a four to one lighting ratio.
Dissolve: LS Portrait	Now lets look at a setup where the
non-overlap set	key and fill lights do not overlap. The lighting ratio for non-overlapping fixture's is mathmatically expressed as:
KEY: (formula)	The key light intensity divided by the fill light intensity.
CU Head w/meter	To determine the lighting ratio on
seperate meter readings	this setup, simply take seperate readings from both light directions... with the dome pointed toward the illumination source.

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VIDEO	AUDIO
Diss: Graphic KEY: (example)	As before, simply divide the numerator by the denominator, to determine the lighting ratio. For example, if our key light measured 100 foot candles, and the non-overlapping fill light measured 35 foot candles, the result would be approximately a three to one lighting ratio.
Diss: Graphic (2 boxes) KEY: Formulas Overlapping Non-Overlapping	To get consistent results, it is important to remember the formula applicable to the lighting setup. The overlapping fixture formula should only be used when the key and the fill light have an overlapping coverage area. The non-overlapping formula is used when the key and fill light illuminate different planes on the subject.
Diss: Overhead Setshot	Finally, illumination intensity

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VIDEO	AUDIO
	should not be altered between measurement and final exposure. All lamps should be burning at maximum
Freeze Frame	intensity. Do not turn off any
Animation:	lighting instrument... or
Double X's	accidently block a fixtures illumination with your body when taking a specific light meter readings.
Dissolve: FS Bkg.	An objective measuring tool, the
KEY: (elements)	incident meter can also be used to determine back light, kicker light, background and base illumination levels. An important instrument, that should be standard equipment in every videographers kit.
Fade to Black	
Fade: Grid Bkg.	The final method for light
KEY: (elements)	measurement is with a reflected spot meter. A hand-held spot meter can provide the videographer with highly specific reflected light

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VIDEO	AUDIO
Dissolve: Meter setup KEY: Waveform monitor	readings of scenic content. A hand-held spot meter however, is not necessary, as the most accurate and specific of all reflected spot meters can generally be found in most video production settings. It is the waveform monitor.
Diss. Waveform setup	To use the waveform monitor as a reflected spot meter, it is first important to understand the data represented on the CRT display.
CU Waveform Display Arrow animation KEY: Amplitude KEY: Position	The waveform display is a graphic representation of the signal being generated by the camera. The vertical axis displays signal amplitude or image brightness against position which is represented on the horizontal axis.
CU Waveform w/output animate waveform output	As a line of the image is scanned by the camera's pickup tube, the amplitude of the signal generated

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VIDEO	AUDIO
	will vary... according to the reflective brightness of the subject at any given point in the frame. Therefore, scenic highlights will be represented by peaks on our video landscape, while shadow areas will look like valleys.
Wipe in Picture over display	By plotting image brightness against scanning position, the waveform monitor substitutes as a highly accurate spot metering device. Intrepretation of the waveform display will provide precise data on the tonal relationships within the scene.
Dissolve wipe out waveform monitor w/no output	Returning to the Vertical axis you will notice small hash marks or graticules on the display. The graticules are calibrated in IRE units, with each unit representing a one-percent difference between peak white and peak black

KEY: Institute of Radio Engineers

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VIDEO	AUDIO
	reflectance levels. The vertical
KEY: Bargraph	axis runs from -40 at the bottom, to 120 percent at the uppermost part of the scale. Solid horizontal lines running across the entire
KEY: Arrow Animiation	display can be found at 100%, 10%, 7.5%, zero, and negative 40. Each of these lines is very important, so let's look at them individually.
KEY: Arrow KEY: Sync Pulse KEY: (description)	The portion of the signal which rests at -40 on the waveform monitor is the sync pulse for the system. This is a timing pulse necessary for recording and playing back video images. Though sync is not manipulatable, it should be checked to verify correct system operation. If not at the appropriate level, consult an engineer or a diagnostic manual before attempting to do any recording.

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VIDEO	AUDIO
KEY: Arrow Animation KEY: Blanking Level KEY: (description)	The zero line on the scale represents the blanking level. Blanking is the point at which the video signal is turned off while the scanning beam returns from right to left. Although blanking is considered "dead black", TV black is actually set somewhat higher. This is necessary in order to seperate beam retrace patterns from the video image.
KEY: Arrow Animation KEY: Setup Level KEY: (description	The solid lines at 7.5 and 10 percent represent the range in which TV black or pedestal is set. This setting represents the minimum reflectance value that any shadow area in the image can have. The existence of this setting however, does not mean to imply that all images will have an element with this reflectance value.
KEY: Arrow Animation	Finally, the solid line at 100%

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VIDEO	AUDIO
KEY: Peak Amplitude	represents maximum signal
KEY: Description	amplitude, or the peak white signal level of the video reproduction system.
KEY: Bar graph	Because 100 % is the highest amplitude the video system is capable of reproducing, and 7.5% is
CU portrait setup	the lowest... the range between these points on the waveform monitor represents maximum system
Raise aperture to clipping level	latitude. If scenic highlights are jammed against 100% so that the peaks of the waveform display have plateaus, you will be clipping the video signal, resulting in a loss
Lower aperture to compression level	of highlight detail. Compressing shadow zones against the 7.5% pedestal level, will cause a loss of shadow detailing.
Animation Sequence: "Cards"	The vertical scale on the waveform monitor can also be used to determine lighting contrast. For

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VIDEO	AUDIO
	example, a properly exposed middle gray tone will register 50 IRE units on the waveform monitor. Opening camera aperture by one f-stop, doubles the amount of light striking the pickup tube. The waveform display now registers camera output at 70 IRE units. Going back to our middle-gray starting point, if the camera aperture is closed by one f-stop, only one-half the original light level will strike the target of the pickup tube. Waveform display now register camera output to be 30 IRE units.
KEY: "Zone system approach to reproduction"	Reflective values can therefore be used to compare scenic elements, and determine lighting ratios. Any element with a reflectance value 20 IRE units different from another element, will reproduce either one stop brighter or darker depending

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VIDEO	AUDIO
	on the directionality.
Dissolve: FS Graphic	Because the range between peak white and peak black falls between 100 and 7.5 IRE units, maximum system latitude is limited to approximately four and one-half f-stops. Any scene which exceeds this range will suffer from a loss of detail in either the highlight area, the shadow area, and potentially both areas.
	MUSIC SOUNDER
Dissolve: FS Portrait animated portrait sequence	By using a waveform monitor, the videographer can custom design lighting patterns for each video image. The waveform monitor provides the most accurate means for analyzing and manipulating creative lighting effects.
CU Waveform Monitor	While adjusting camera aperture, observe the reflectivity changes on

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VIDEO	AUDIO
	the waveform monitor. Since the waveform display is analyzing camera output, opening the aperture until scenic reflectivity falls within the four and one-half f-stop range will provide a ballpark exposure.
Dissolve: FS Graphic KEY: Exposure is a Creative Adjustment KEY: Pegging the Key tone Wipe/dissolve Gray Scale over Portrait Line Animation	It is important to remember however, that exposure is a creative, not strictly a technical adjustment. Correct exposure is dependent upon the intended lighting effect. A production trick used extensively by cinematographers is called "Pegging the Key Tone". A scenic element is selected to be reproduced at a specific gray scale density. All other elements within the scene are then lit to reproduce varying densities in relationship to the primary element. In a scene with human subjects, flesh tones are

VIDEO	AUDIO
	usually pegged, for consistency in editing.
FS Graphic KEY: Reflectance values	In a normally lit and exposed scene, reflectance values for caucasian skin tones will fall between 60 and 70 IRE units on the waveform monitor. African skin tone, has a much wider reflectance range. African skin tones will generally reflect between 35 and 60 IRE units, depending upon the subject.
CU Portrait Setup Wipe/dissolve waveform monitor Arrow animation Adjust Camera aperture	To determine exposure, it is first necessary to locate the tone which will be normally reproduced in the video image. Then, locate it's scanning position on the waveform monitor. Next, simply adjust camera aperture until that skin tone falls within the desired range. Finally, analyze the tonal relationships between the "pegged" tone with the

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VIDEO	AUDIO
Light manipulation	rest of the image. Additional light manipulation may be necessary in order to contain scenic contrast within reproduction limits of the video medium.
FS Graphic KEY: Tricks of the Trade KEY: Calibrating your incident meter CU: Meter/Slide setup	MUSIC UP/UNDER One of the most useful tricks of the video profession is to calibrate your incident meter's sensitivity... with the sensitivity of the video camera. This will allow you to determine f-stop settings directly from your incident light meter. In order to use this trick, you must have a light meter which excepts ASA calibration slides, and provides f-stop exposure information.
MS Studio w/camera setup	First, setup a standard gray scale chip chart under even illumination. An incident illumination level of at least 125 foot-candles is

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VIDEO	AUDIO
	recommended.
Zoom/Pan to W.Monitor	Next, complete registration and setup procedures to assure that the camera is reproducing the entire
Profile of P.A. @ CCU	tonal scale with accuracy. Consult with an engineer or the cameras diagnostic manual if you have any questions.
CU Aperture Highlighted	Once the camera is set up properly, note the aperture reading on the camera lens.
Meter Foreground	Finally, place the incident meter
Chip Chart in Bkg.	under the same light as used to register the camera. With the dome facing toward the camera lens,
Insert slides	insert the slides until you find the one which provides exactly the same f-stop value.
Meter Setup w/slide	Now, whenever you use this particular camera, simply insert

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VIDEO	AUDIO
	the appropriate slide into the meter to determine the calibrated
Dissolve FS Graphic	f-stop.
KEY: Title	MUSIC STING CLOSE
Fade to Black	
Fade FS Animated Graphic	CLOSE MUSIC IN
KEY: "The Wrap-up"	There you have it, the basic mental framework for measuring and intrepretating light. The tools in
KEY: appropriate elements	our kit are the incident light meter and the waveform monitor. Good exposure practice requires the use of both instruments in order to measure and manipulate lighting control. The incident meter is used to rough-in the image, by establishing the lighting ratio, and balancing set illumination. The waveform monitor is used for the finish work, supplying spot reflectance readings and real-time exposure information. After the

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VIDEO	AUDIO
	lighting pattern has been roughed-in, the waveform display will allow the videographer to refine scenic illumination with craftsmanship precision. By understanding lighting control and manipulation, you can expand your visual horizons and creative potential.
Wipe in bkg & graphic	
KEY: Video Lighting: A Photographic Approach	MUSIC UP FULL
KEY: "The Scoop on Scopes"	
Key (lower 1/3): Copyright 1988 Golden One Productions	
Fade to Black	MUSIC OUT

APPENDIX B

Video Lighting: A Photographic Approach
Title: Glamour Lighting Producer/Director: Haggadone
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VIDEO	AUDIO
Open Graphic	MUSIC UP/UNDER
KEY: "The Beauty of Glamour Lighting"	Our stars are not the kind you see midnight sky, but rather
Single frame portraits over background.	people...our subjects and clients focused on the camera lens. Everyone wants to look their best, and sees their own image in a very special way. The challenge to the working pro is to accentuate the beautiful aspects of people ...through lighting.
Three Light Setup KEY: Fixtures and their Characteristics	Before exploring portrait lighting, let's first look at the characteristics of light, and the quality of illumination produced by different lighting fixtures.
Dissolve: Spot Fixture animation to center KEY: Spot Lights	Spot Lights are typically used to provide the primary source of illumination. When used as the main light source, they are called key lights. However, the "key light"

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VIDEO	AUDIO
	refers to the relationship of light intensity between fixtures, and is not a function of fixture design. It is the key source of illumination. Scoops and softlights, can also be used as a key light if their illumination intensity is greater than that used to fill shadow area.
Wipe in white flash	SWITCH SFX
Dissolve to FS Graphic	Illumination produced by a spot
KEY: Advantages	fixture is generally associated
- directional	with the intense rays from the sun,
- Specualar	or a theatrical spotlight. Due to
- Emphasize texture and contour	its directionality, spot illumination can be localized and easily controlled. Spotlights produce highlights that are hard, sharp and well directed. They also reveal surface texture and object contour with the greatest clarity.
KEY: Disadvantages	A spot fixture's highly directional

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VIDEO	AUDIO
- Hard/Dense shadows - High contrast	and intense beam, will create the hardest and densest shadows. If uncontrolled, spotlights will produce course picture quality of undesirably high contrast. Therefore, spotlight positioning and adequate fill illumination is necessary in order to prevent unattractively flat or contrasty images.
Dissolve: Scoop Fixture slow zoom to FS	Scoops provide diffused illumination... the quality of light associated with an overcast sky. The larger the light source is relative to the subject position, the more diffused and shadowless the illumination quality will be. Because scoops are primarily used for supplemental illumination, they are also called fill lights.
Wipe to white	SWITCH SFX
Dissolve: FS graphic	In portraiture, soft fill

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VIDEO	AUDIO
KEY: Advantages - Reduce subject contrast - Flex.application - Subtle key light	illumination is used to reduce subject contrast... by illuminating shadow areas created by the key. Scoops are also very flexible instruments, and when properly applied can be used as the primary source of illumination. When used as the key illumination source, soft fill lighting is capable of producing very subtle and beautiful lighting effects.
KEY: Disadvantages - Uncontrollable - Rapid Intensity falloff - Flat lighting effect	The primary disadvantage of fill illumination is that beam spread is not very controllable. Illumination from a soft light source will likely spread to adjacent set areas. The effective illumination strength of a fill light also decreases rapidly as the distance from the source to the subject is increased. Finally, soft lighting can result in flat, characterless pictures, especially when multiple

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VIDEO	AUDIO
	fixtures are used.
Dissolve: Umbrella setup	Additional methods for illuminating your subject include Umbrella lighting.
Wipe to white	
	SWITCH SFX
Dissolve: FS Graphic	Umbrellas provide soft and evenly diffused illumination, and are typically used in remote lighting kits. By bouncing illumination off a larger surface area, umbrellas change the effective size of a small light source.
KEY: Advantages - Change effective size of illumin.	
KEY: Disadvantages - Uncontrollable - Rapid intensity falloff - Reduced fixture efficiency	The disadvantages of umbrella lighting are similiar to other soft fill sources. An additional problem can be measured in terms of light transmission efficiency. Umbrella's only reflect approximately 50 percent of a fixtures potential intensity, when compared against direct illumination.

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VIDEO	AUDIO
Dissolve: Softbox Setup	Soft illumination can also be obtained by using a soft box. Instead of bouncing light off a larger surface area, a small light source is projected through translucent diffusion material.
Wipe to white	
Dissolve: FS Graphic	Soft box illumination also changes the effective size of the light source by dispersing the rays of light. Providing soft, shadowless illumination, material such as white rip-stop nylon works extremely well. Nylon is relatively inexpensive, and can be sewn into panels to fit the specific lighting need.
KEY: Advantages - Change effective size of illumin. - Inexpensive - Flexible application	
KEY: Disadvantages - Uncontrollable - Rapid Intensity falloff - Reduced fixture efficiency	The disadvantages are similiar to other soft illumination sources Additional problems include fixture efficiency, which is considerably reduced, and dependent on the density of the diffusion material

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VIDEO	AUDIO
- Large and Bulky - Fire Hazard	used. Soft boxes are large, bulky, and require additional stands for support. Proper ventilation is also necessary to prevent creating a fire hazard.
Dissolve: FS Graphic KEY: General Lighting Guidelines	MUSIC SOUNDER Before continuing onto specific lighting setups, lets conclude this exploration with some general guidelines on lighting control.
CU Portrait Setup Key illumination Add Fill illumin. Dissolve to white	First, the more concentrated the illumination, the harder the light will appear to be. Hard light is defined as the quality of illumination which produces brilliant highlights and dense, sharp, well defined shadows. In order to reduce lighting contrast, secondary fill illumination will most likely be needed.
Tilt/Zoom from	When the light is larger than the

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VIDEO	AUDIO
Soft box.	subject, illumination quality changes. Large source lighting diffracts around surface contours, softening shadow edges. Therefore, subject contrast decreases as the effective size of the light source increases. Large source
Double portrait setup on single frame	illumination creates softer images, by reducing subject contrast. Because illumination intensity falls off rapidly, soft lights must be positioned fairly close to the subject.
Dissolve: FS Graphic KEY: Creative Lighting through Experimentation	The Key to understanding lighting control and manipulation is through experimentation with light fixtures and lighting modifiers.
Fade to Black	
Dissolve: FS Graphic KEY: Portrait Lighting	MUSIC SOUNDER Four basic lighting setups are commonly used in portraiture.

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VIDEO	AUDIO
	Though standard lighting designs, the variations on each setup are endless. Lighting designs commonly used are:
KEY: 4 TYPES	Broad Lighting Narrow Lighting Frontal Lighting and Side Lighting
HIGHLIGHT KEY: - Broad Lighting Technique	Let's take a closer look at each of these lighting designs, starting with the Broad Lighting technique MUSIC SOUNDER OUT
Dissolve: Light setup Highlight: Key position	Broad lighting is used when the subject is positioned at an angle, relative to the camera axis. As its name suggests, the broadest portion of the subjects face is illuminated by the key light.
CU Portrait Arrow animation	The horizontal positioning of the key light should cast a triangular patch of light onto the dark side

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VIDEO	AUDIO
	of the face. This triangular patch should highlight the cheekbone... providing pictorial interest to the image.
LS Studio Setup manipulate key light position	Next, vertically position the key light to reduce the impact of the nose shadow. A photographic trick commomly used is to vertically position the key at a height where the edge of the nose shadow falls
CU Portrait Setup	along the smile line. The shadow will therefore convey subject dimensionality, without creating a distracting hard line to the face.
Overhead Shot	Since the key is rigged to the camera side of the subject, cast
On-camera key light manipulation	shadows will fall away from the camera, at a downward angle. Cast shadows will be either long or
Movement: Long to short shadows	short depending upon the angle of illumination. Illumination angle also affects the attached shadows,

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VIDEO	AUDIO
Dissolve: CU Portrait highlight key manipulation efx.	those shadows that are created by the subject's forehead, nose, lips and chin.
FS Graphic Light Setup Highlight: Fill position	After the key light has been positioned, the fill light can then be added. The primary purpose of the fill light is to reduce lighting contrast. Usually fill coverage will partially overlap the area illuminated by the key, while filling in the shadow areas.
Dissolve: CU Portrait Fill light added Arrow animation	Many times diffused fill light is positioned at, or even below eye level on the opposite side of the camera. In this position, the fill light will reduce subject contrast, by filling the shadows in the eye sockets, and under the nose, lips and chin. An important point to remember is that fill illumination should always be used to reduce subject contrast without adding

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VIDEO	AUDIO
	additional facial shadowing. Therefore, fill light intensity must always be less than that used for key illumination.
LS Set Back lights Positioned	The usage of back and kicker lights is really dependent upon your personal lighting style. Some professionals use back lights only with problem sets...in order to seperate subjects from similiar tone backgrounds. Other pros, particularly glamour photographers, use high intensity backlights as part of their personal lighting trademark.
CU Portrait Back Light manipulation	
Dissolve: FS Graphic Highlight Backlight Position	If you have determined that backlighting is necessary, any position from directly opposite the key light, to approximately 45 degrees behind the key, will provide interesting lighting patterns. Vertical placement of the

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VIDEO	AUDIO
	back light is also subject to creative interpretation. Backlight
High and low backlight setup efx	can strike the subject from either a high or low angle. Experiment with either single or double backlight positions to determine the lighting pattern which models your subjects features to the best advantage.
CU Portrait setup	Once fixture positions have been established, the videographer can then determine the proper lighting
OSS Back of Subject Back Light Meter positioned then removed	ratio. If a back light is being used, its ratio can also be determined simply by pointing the
Dissolve: FS Graph KEY: Exposure is a Creative adjustment.	dome of the meter toward the back light source. Remember, lighting ratios and exposure are creative, not strictly technical adjustments.
Animation sequence. video portraits	Broad lighting produces images which are flatter in appearance than other portrait setups. The

VIDEO AUDIO

videographer may find it necessary to enhance the illusion of depth through creative background lighting patterns.

Broad lighting is frequently used for high key scenes, or when lighting locations to resemble daylight interiors. However, by manipulating the key/fill lighting ratio, it can also be used to create dramatic low key images.

Since the Broad Lighting setup emphasizes the broad side of the subjects face, it is generally more appropriate on subjects who have a naturally narrow facial structure.

When selecting a fixture for key illumination, the videographer has a range of options. Spot lights, umbrellas and softboxes can all be used with different results.

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VIDEO	AUDIO
	Experiment, to develop your own lighting style.
Fade to Black	
Dissolve: FS Graphic	MUSIC UP/UNDER
KEY: Tricks of the Trade	A couple of methods are commonly used to adjust the lighting ratio.
LS Portrait Setup	To manipulate illumination
Position Manipulation	intensity, simply move the fixtures
	either closer to... or farther away
CU Portrait w/ratio	from the subject. For example, if
being manipulated	the ratio between the key and the
	fill light is too low, simply move
	the key closer, or the fill light
	farther away from the subject.
OSS Fixture foreground	Turning the key light away from the
Fixture manipulation	subject, will also reduce the
	lighting ratio. This technique is
	called "feathering". By using the
CU Portrait w/ratio	outer boundries of the light beam,
manipulated on-screen	the subject will be illuminated by
	the less direct and intense rays

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VIDEO	AUDIO
	from the fixture.
MS Tech/Diffusion screen Attached to fixture CU portrait efx.	Diffusion material can also be used to reduce fixture output. When the ratio between fixtures is too high, place heat-resistant diffusion material such as Rosco Tough Spun over the key light. This material will reduce fixture output, without altering beam shape.
Dissolve: FS Graphic KEY: Tricks of the Trade	Manipulation of fixture intensity is just one of the "Tricks of the Trade" that should be part of every videographers lighting repetoire.
Fade to Black	MUSIC STING CLOSE
Fade: FS Graphic KEY: Narrow Lighting Dissolve: Light Setup	MUSIC SOUNDER Narrow lighting basically reverses the design of the Broad Lighting setup. The key light is positioned to illuminate the narrow portion of the face relative to the

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VIDEO	AUDIO
	subject-camera axis. Let's take a closer look to understand why this pattern is more flattering for close up portraiture work.
LS Portrait setup	First of all, the key light should be positioned to strike the narrow side of the subjects face. By manipulating the vertical and horizontal position of the key light, you will notice that the
CU Portrait Key manipulation on-screen	length of the facial shadows and the amount of darkness on the unlit side of the face will vary greatly. Key position is therefore extremely critical because facial modeling is highly visible from camera viewpoint.
MS Tech Placing Key Light	In order to reduce the large nose shadow inherent with this setup, you will most likely find it necessary to place the key light high, and angled toward the front

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VIDEO	AUDIO
CU Positioned Key	of the subject. The key position chosen should minimize the impact of the nose shadow.
Dissolve: Light Diagram KEY: Hard/Soft	Either hard or soft illumination sources can be used with this lighting pattern. Soft lights however, can potentially Illumination destroy facial modeling, especially when used at a close range.
FS Graphic Highlight Fill Position	Placement of the fill light is also very crucial. Fill illumination should overlap the coverage area of the key light, and be vertically positioned at the subjects eye level. The fill fixture will likely need to be placed very close to camera position. As before, fill
CU Portrait w/fill added	light intensity should not create additional shadows on the subjects face. If needed, diffuse the fill light with scrimming material to

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VIDEO	AUDIO
	reduce fixture output.
FS Graphic Highlight Back Light Positions CU Portrait w/back light added	Backlighting is again subject to the creative intentions of the videographer. Try several different positions to determine which works best for the intended lighting effect.
Dissolve: Portrait Animation seq.	The visual effect of Narrow lighting is that it gives a slimmer appearance to a wide face. Light falloff on the nearside of the subjects face, narrows it, by emphasizing only a small portion of the subjects features. Modeling is very prominent in narrow lighting, but can be altered through manipulation of the lighting ratio. As fill intensity is increased, facial modeling will decrease. Stong fill illumination however, tends to broaden the

VIDEO	AUDIO
	facial structure.
	Narrow lighting provides perfect illumination for low-key scenes. Through controlling fill illumination, subtle shadow detail can be retained, without destroying facial modeling.
Fade to Black	
	MUSIC SOUNDER
Fade: FS Graphic KEY: Frontal Dissolve: Light Setup Highlight Key Position	As its name suggests, frontal lighting illuminates the subject from the frontal position, relative to the subject-camera axis. With the subject facing forward, both sides of the subjects face are illuminated by the key.
Dissolve: CU Portrait Manipulate Key light position on-screen	For a normal lighting pattern, key illumination should strike the subject from above. Vertical placement of the key light, will determine the length of facial shadowing. Shadow placement is a

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VIDEO	AUDIO
	creative lighting decision. However, most professionals do not allow the tip of the nose shadow to touch the upper lip, therefore creating seperation between the two facial features.
LS Set Soft Box positioned CU Portrait	Glamourous frontal lighting can be achieved by using softer, diffused illumination. Umbrella's and Softboxes are excellent frontal illumination sources. Attached facial shadows will be soft, with very subtle shadow gradiation at the transfer edge.
Diss to Lighting Design	With large source frontal lighting, you may find additional fill light unnecessary. If needed, the fill should be positioned to reduce subject contrast in the lower facial areas. A technique called Butterfly lighting positions the fill illumination directly under

VIDEO	AUDIO
	the camera lens. Facial shadows are illuminated, but should remain apparent. Remember, shadow detail creates the illusion of three-dimensionality.
Dissolve: Light Setup Highlight Back Light position	When using soft frontal lighting, you may want to experiment with high intensity backlight. High intensity backlighting will not only help seperate the subject from the background, but also subjectively indicates different
Dissolve: LS Set - waveform foreground - subject bkg.	key light directionality. This technique is used extensively in glamour portraiture. Adjust backlight intensity with a waveform monitor to prevent over illumination, making the face of your subject appear unnaturally dark.
Portrait Animation seq.	Frontal Lighting is an extremely versatile method for lighting both

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VIDEO	AUDIO
	closeups and longer shots. Frontal illumination allows the subject a great deal of freedom in movement. By deemphasizing facial modeling, frontal lighting conveys an image of youth and beauty, and is therefore used extensively for portraiture work.
	Frontal lighting can also be used for both high and low key images. Setup time is minimal, allowing the videographer to concentrate on other production matters.
Fade to Black	
Fade: FS Graphic	MUSIC SOUNDER
KEY: Side Lighting	With Side lighting, the key light strikes the subject at a 90 degree angle relative to the
Dissolve: Light Graphic Highlight Key Pos.	subject-camera axis. Side lighting heightens the impression of subject form, depth and texture. Long and exaggerated shadows are cast onto

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VIDEO	AUDIO
	the opposite side of the subjects face. These sharp shadows heighten the illusion of subject dimensionality.
LS w/Tech placing key fixture CU Portrait w/Key manipulation	The height of the key light is less important in the side lighting setup. Vertically, the key light can be positioned to strike your subject from an angle which provides optimum modelling. Subject positioning however, is crucial in order to maintain shadow placement
CU Subject profile zoom to LS Tech Placing soft light key CU Portrait	With side lighting, the key source of illumination can be either hard or soft. A hard key light produces dramatic images, with dark, hard edged shadows. Softlight, will also emphasize the general contour of the face. Shadows created by a softlight are still pronounced, but the transfer edge between lit and shaded facial areas, has softer

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VIDEO	AUDIO
	gradation characteristics.
MS Studio Setup	With the key light striking the subject from such an extreme angle, substantial portions of the subject's face is left in shadow.
CU Portrait Arrow animation	Texture will be emphasized on surfaces parallel to the lighting plane. Side lighting creates the strongest contrast between raised and indented surface elements. By
Fill Light added Fill light removed	applying fill illumination, shadow density will be controllable. For dramatic images however, the videographer may find the addition of fill illumination undesirable.
Dissolve: Light Graphic Highlight Fill position	If fill illumination is necessary, positioning should be based on your intended lighting effect. If used at an opposite 90 degree angle, care must be taken to control fill
CU Portrait KEY: Badger Lighting	intensity. If the fill illumination is too strong, a shadowing rim will

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VIDEO	AUDIO
	form down the center of the subjects face. Called Badger Lighting, it is an interesting, albeit unglamourous lighting design.
Dissolve: Light Graphic Highlight Back light position	Unlit portions of the subjects head tend to merge into background areas. If this is undesirable, either single... or double backlights will provide seperation
CU Portrait w/single and double back lights	and define the contour of the subjects head and shoulders. Care must be taken to prevent backlight from spilling onto the shadow zones of the subjects face.
Portrait Animation seq.	Sidelighting, emphasizes the drama moodiness of a scene. Therefore, this lighting design is generally only useful for low key images. Because sidelighting emphasizes surface texture, it is generally best applied to male subjects when

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VIDEO	AUDIO
	you want to emphasize character ruggedness.
	A basic problem with sidelighting is that it may create too much subject contrast. The shadows created, may be too dark for detail reproduction in the video medium. By using a waveform monitor, the videographer can manipulate fill intensity to retain scenic mood, yet provide subtle detail in the unlit areas of the subjects face.
Fade to Black	
Fade: FS Graphic	MUSIC UP/UNDER
KEY: The Wrap-up	As we have discovered, illumination quality is dependent upon the design of the fixture. Lighting
KEY: Appropriate information	patterns however, can be manipulated in several different ways. Through placement, height, reflection, projection and diffusion, the videographer can

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VIDEO	AUDIO
	custom design each and every image.
	Lighting and exposure ratios can also be controlled through fixture placement. Simply by changing the subject to fixture distance, incident illumination will be altered. Diffusion provides another method for controlling fixture output.
	Finally, the four basic lighting setups, Broad Lighting, Narrow Lighting, Frontal Lighting, and Side Lighting convey unique subjective moods, and are applicable to different scenic conditions. Though standard lighting designs, they can, and should be altered to achieve unique and beautiful video portraits
Wipe in Bkg & Graphic	Now its time to go back to the studio to develop your own lighting

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VIDEO	AUDIO
	style. One of the greatest challenges to the working professional...discovering the beautiful attributes of people... through glamour Lighting.

KEY: Video Lighting:
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KEY: "The Beauty of Glamour Lighting"

KEY: (lower 1/3) Copyright 1988
Golden One Productions

Fade to Black MUSIC OUT

APPENDIX C

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VIDEO	AUDIO
Open Graphic	MUSIC UP/UNDER
Key: Video Lighting: Hot	
Shots for Hot Products	Probably the greatest challenge in commercial production, is creating
Single frame product images over bkg.	product images that radiate with imagination. Lighting that spark of ingenuity, requires an understanding of lighting techniques which create Hot Shots for Hot Products.
	Product lighting is very similiar to portrait lighting. In product lighting however, object reflectance and contrast is sometimes far greater than you will ever encounter in portraiture. Remember, video is a medium with limited contrast range... therefore lighting manipulation and control is crucial in order to create striking product images.

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VIDEO	AUDIO
Dissolve: Studio "B" roll.	You should approach every commercial setup, by first examining the product and the props to be used. Critically analyzing object texture, shape, size and color, will enable cut to you to determine the lighting needs and problems. Only after you have previsualized the lighting design, can you then procede to build the image.
	MUSIC SOUNDER
Dissolve: FS Graphic	When building a commercial image, it is important to remember that the object can be subdivided into three primary zones of illumination. They are:
KEY: Zones - Highlight - Lit - Shadow	- Highlight Zones - Lit Zones - and Shadow Zones
	These zones of illumination convey important information about the dimensions, texture, form and color of an object.

CU Rack from object to face.

CU Profile of Tech Pan to follow placement

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VIDEO	AUDIO
Dissolve: Studio LS Tech place key light frontal CU Object w/Key illumination Arrow Animation KEY: "Glare"	Highlight zones on an object reflect the maximum amount of light. Remembering that "The angle of incidence equals the angle of reflectance" conveys important lighting information. Hard light striking a reflective object from the frontal position, will reflect back to the camera an intense hotspot, generally referred to as glare.
Dissolve/Wipe in WM. on-screen aperture manipulation	Glare, when uncontrolled, will negatively affect exposure and errode image quality. For example, waveform monitoring of camera output shows an intense highlight spike. When exposure is manipulated to bring this spike within an acceptable video range, the lit and shadow zone rendtition deteriorates.

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VIDEO	AUDIO
Bring level to 100%	Highlights obliterate surface detail on an object, and reveal the size and shape of the light source.
Dissolve: Same setup soft key illumin.	By increasing the effective size of the illumination, you will notice that the size of the highlight also increases.
Key: Lit Zone	The lit zone of an object is generally next to the highlight
Arrow Animation KEY: Transfer Edge	zone. The transition between illumination zones, is called the transfer edge. The transfer edge will be either rapid or gradual, depending upon the quality of illumination.
Hold setup KEY: Lit Zones maximize color.	Lit zones emphasize object color. Diffused illumination that strikes the object from either the frontal or three-quarter position, will emphasize surface color, by maximizing the size of the lit zone.

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VIDEO	AUDIO
Double slow reveal KEY: Transfer Edge Arrow Animation Attached Shadows Cast Shadows Remove Keys Line Art Animation	The transfer edge between lit and shadow zones is also dependent upon the size and direction of key illumination. Shadow areas that are part of the object, are called "attached shadows". Attached shadows reveal information on object form and surface texture. Shadows falling onto adjacent planes of the image are called "cast shadows". Cast shadows reveal key light directionality. Drawing a line from the edge of the shadow to the top of the object, will point out the angle at which key illumination strikes the object.
LS Product Setup CU Tech placing object	As long as we are on the subject of angles, lets look at the optimum angle for subject composition. Because video is a two dimensional medium, the illusion of depth is enhanced by shooting an object from

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VIDEO	AUDIO
	an angle. The lighting design should compliment the shooting
KEY:	angle, by creating seperate
- HIghlight Zone	lighting zones. Object shadows
- Lit Zone	create the illusion of depth, and
- Shadow Zone	when possible should be incorporated as part of the
Slow zoom to full product setup.	compositional design. Remember, attached and cast shadows reinforce the illusion of object dimensionality.
Fade to Black	
	MUSIC SOUNDER
Fade: FS Graphic	Let's take a look at lighting
KEY: Lighting Angles	angles and their effect on product videography. All of the standard portrait lighting positions can be
KEY: Terminology	used for product lighting. The terminology however, is slightly different.
Dissolve: Light Diagram Highlight Position	Frontal illumination strikes the subject from a position directly
KEY: Frontal	along the object-lens axis. Frontal

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VIDEO	AUDIO
CU Product Setup KEY: (information)	illumination emphasizes surface color, while deemphasizing object texture and modelling. Shadows cast by frontal illumination will fall directly behind the object, out of camera view. Therefore, object shape and dimensionality are also difficult to determine.
Dissolve: Light Diagram Highlight 1/4 Position KEY: Quarter CU Product Setup Arrow Animation	With Quarter lighting, illumination strikes the object from approximately 45 degrees off the object-lens axis. Quarter lighting is commonly used because each of the three lighting zones, are given equal lighting emphasis. Quarter lighting reveals the maximum amount of information to the viewer on surface shape, color, size and texture.
On Cam animation fixture placement	You will notice that as key illumination is moved farther from the object-lens axis, attached and

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VIDEO	AUDIO
Dissolve: Light Diagram Highlight position KEY: Side Lighting	cast shadows begin to grow. Once you have moved primary illumination to a position 90 degrees opposite the object-lens axis, you will have created a side lighting pattern.
CU Product Setup Arrow Animation KEY: Highlights	Side lighting emphasizes surface texture while deemphasizing object color. On reflective surfaces, highlights will form along the rim of the object, closest to the key light position. By emphasizing both highlights and shadows, side lighting heightens the sense of object dimensionality.
Dissolve: Light Diagram Highlight: Position KEY: Top Lighting CU Product Setup Arrow animation KEY: Highlights	When the key light is moved from the side, to above the object, a top lighting pattern is created. Top and side lighting are essentially the same lighting pattern. The only difference between the setups, is a change in highlight and shadow positioning.

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VIDEO	AUDIO
	Subjectively, this will alter the way your audience perceives the image.
Dissolve: Light Diagram Highlight: Position KEY: Side Lighting CU Product Setup Arrow Animation	Finally, when key illumination strikes the object from behind, a back lighting pattern is created. With back lighting, top and side edges of the object are rimmed with light, while the object's frontal plane will fall into the cast shadow region. Therefore, backlighting minimizes surface texture and color. Backlighting is especially useful with translucent objects, because it outlines object form.
Fade to black	
Fade: FS Graphic KEY: Product Lighting - Reflective - Matte Surfaces	MUSIC SOUNDER Basically, two types of surfaces will be encountered in product videography. They are:

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VIDEO	AUDIO
	- Reflective surfaces, found on metal or glass ...and - Matte surfaces, like wood, stone, and textured fabric
	Let's take a closer look, starting with reflective surface lighting.
LS Setup w/Light Tent Tech placing object	A light tent provides ideal illumination for highly reflective objects. A light tent is constructed by simply placing an object in a space surrounded by translucent diffusion material.
KEY: Projection - Reflection	White rip-stop nylon works extremely well, both diffusing projected illumination, and reflecting light back into the unlit portions of the object.
CU Product shot Arrow Animation KEY: Highlight	When using a light tent, reflections will appear on an object as a large highlight that follows the contour of the subject. Placement of the reflection is

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VIDEO	AUDIO
KEY: Placement controlled by key light position	controlled by the position of the key illumination source. The transfer edge between highlight... lit... and shadow zones will display soft, subtle gradation.
Dissolve: Product Setup Glassware Setup	When lighting glassware, effective images can be created by illuminating the object indirectly. This can be accomplished by simply
Dissolve: Light Diagram	bouncing key illumination off an adjacent surface. Bounce illumination is particularly useful when you want to avoid highlight reflections. Glass, when shielded from direct illumination will be defined by differences in light
KEY: Arrows	transmission through various surface planes. Planes of the glassware parallel to the camera,
KEY: Arrows	will photograph translucent. Planes that are perpendicular to the lens, will photograph opaque. Portions of
Lose KEYS	the glassware between the two

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VIDEO	AUDIO
	extremes, will exhibit varying degrees of opaqueness.
Fade to Black	
Fade: FS Bkg	MUSIC UP/UNDER
Key: Tricks of the Trade	To feature an object to its best advantage, the videographer may
Dissolve: Light Tent Setup	find it necessary to modify incident illumination. One technique frequently utilized is
KEY: Subtractive Lighting	called "Subtractive Lighting". By placing small black cutouts outside the shot boundries, illumination
Tech placing cutouts	will be blocked from specific portions of the image. Blocking
CU Product Shot	illumination from specific setup areas artificially creates the illusion of spatial depth.
LS "B" Roll	"Additive Lighting" is another
KEY: Additive Lighting	modifying technique, with the opposite intention. By placing
Tech Placing Reflector	highly reflective surfaces such as mirrors, reflectors, and bounce

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VIDEO	AUDIO
	cards just out of camera view, redirected light can be punched into specific image areas. Just
CU Product Setup	like lighting fixtures, illumination quality and intensity control is dependent upon the size and distance from the object to the reflector. Just another one of
FS Graphic Bkg	those creative tricks which will
KEY: Tricks of the Trade	make your images sizzle with excitement.
Fade to Black	MUSIC STING CLOSE
Diss FS BKG	MUSIC SOUNDER
KEY: Matte Surface Lighting	Matte surfaces require a different lighting approach. Due to surface texturing, highlights tend to be weak. Matte surfaces break up the
Dissolve: Matte Object Product Setup	parallel rays of light, creating a large lit area on the object.
Arrow Animation	Therefore, matte objects exhibit
KEY: (highlights)	strong color rendition. Attached shadows which define surface texture, will be either hard or

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VIDEO	AUDIO
	soft, dependent on the quality of key illumination.
Tech placing key	To emphasize surface texture, chose a small or medium light source. Position the fixture so that the illumination is parallel to the
CU of Product Setup	object, and skims the surface plane with light. The transfer edge between lit and shadow areas should
Add Soft Fill illum.	be prominent, relative to camera viewpoint. If this lighting pattern creates an image with too much contrast, density apply soft fill illumination to reduce shadow density.
Dissolve: Product Setup w/light tent	A light tent can also be used for lighting Matte surface objects. Large source illumination however, reduces surface texture, by filling
CU Product Setup	shadow areas with light. Texture detail will therefore be very weak with softlight illumination.

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VIDEO	AUDIO
LS tech placing add. Light Instrument	With matte surface objects, you may want to experiment with multiple source lighting. The advantage to multiple source lighting is the
CU Product Setup Turn on Lighting effect on-screen	ability to selectively illuminate portions of the object. Multiple source lighting is most easily accomplished on subjects having a
KEY: Multiple Source Lighting	limited reflectance range. Through lighting, you can attractively represent objects without severely increasing tonal differences.
Dissolve: Product Setup w/secondary shadow	A potential problem with multiple lighting, that secondary illumination may conflict with the key light effect. As with
MS Tech Placing scrim CU Product Setup	portraiture, secondary illumination should never eliminate the key light effect... or create additional shadows in the scene.
LS set w/ product	If strong fill illumination is

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VIDEO	AUDIO
	needed to reduce lighting contrast,
Fill placement @	place the fill fixture at camera
Camera position	position. Care must be taken to
	control its intensity in relation
	to the key illumination source. Any
CU Product setup	cast shadows created by the fill
	fixture, will fall away from the
	object, and be hidden from camera
	view.
Fade to Black	
Fade: FS Graphic	MUSIC IN/UNDER
KEY: The Wrap-up	As we have discovered, illumination
	quality is as important in product
KEY: highlight	videography as in portraiture. Hard
information	light sources, produce intense,
	pinpoint reflections called glare.
	Glare should be controlled to
	prevent it from negatively
	affecting exposure. Soft light
	sources, produce large, diffused
	highlights. Illumination from a
	soft light source, produces
	wrap-around lighting, with subtle

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VIDEO	AUDIO
	modelling. Tent lighting, a soft illumination technique, is especially useful in product setups which have highly reflective surfaces.
	In product videography, three primary zones of illumination are apparent. The combination of highlight, lit and shadow zones define the size, shape color, form and texture of an object. Each of these lighting zones can be creatively manipulated by the videographer.
	Commercial products generally fall into two lighting categories. Both reflective and and matte surface objects require specific lighting tricks. Reflective objects generally require soft illumination techniques. Matte objects can also use soft illumination, however,

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VIDEO	AUDIO
	they may benefit from multiple source lighting patterns.
Wipe in Bkg & Graphic	Now its time to return to the studio, to explore and develop your own commercial lighting style. Let your imagination run free, for you now have the technical basis for creating "Hot Shots for Hot Products".
KEY: Video Lighting: A Photographic Approach	MUSIC UP
KEY: Hot Shots for Hot Products	
KEY: (lower 1/3) Copyright 1988 Golden One Productions	
Fade to Black	MUSIC OUT

APPENDIX D

MODEL CONSENT AND RELEASE FORM

For production of a television program entitled Video Lighting: A Photographic Approach, I hereby consent to the reproduction, publication, or other use by David L. Haggadone, his associates and assigns, for programming purposes, of my name, photograph, statements, performance, and/or personal data, given, photographed, and/or recorded on or about (Date)_____ at Studio E, Michigan State University, East Lansing, Michigan.

I hereby release David L. Haggadone, his employers, associates, and assigns from any and all claims which I might have in connection with any use of my name, photographs, statements, performance and/or personal data for purposes including, but not limited to 1) presentation, 2) promotion, 3) distribution and/or 4) publication of this program, Video Lighting: A Photographic Approach.

_____
Authorized Signature

_____
Witness

If Model is a Minor, Parent or Guardian Must Sign Below:

I, the undersigned, being parent or guardian of the minor whose name appears above, hereby consent to the foregoing conditions and warrant that I have the authority to give such consent.

_____
Parent or Guardian

_____

_____
Address

APPENDIX E

Video Lighting: A Photographic Approach
Program Questionnaire

Instructions:
Please answer each of the following questions based on your perceptions from viewing this instructional program. Unless indicated, each question requires only one response. Your time and thoughtful answers are sincerely appreciated.

1. Which of the following categories best describes your general interest in video lighting design BEFORE you saw this program.

High	Above Average	Average	Below Average	Low
1	2	3	4	5

2. Which of the following categories best describes your general interest in video lighting design AFTER you saw this program.

High	Above Average	Average	Below Average	Low
1	2	3	4	5

3. How would you rank your general attentiveness during the viewing of this program?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

4. Did the program "Video Lighting: A Photographic Approach" present unique production concepts with regards to your prior knowledge of video lighting?

__ Yes __ No ___ Don't Know

5. How would you rate the applicability of the lighting techniques demonstrated in this program, to a single-camera video production setting?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

6. After viewing this program, please indicate your level of motivation toward exploring and developing some of the lighting concepts contained within the program?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

7. In the space provided, please write the word or phrase you feel best describes the lighting and production techniques used in "Video Lighting: A Photographic Approach".

_____

8. Overall, how would you rank the use of examples within the program for demonstrating key lighting concepts.

High	Above Average	Average	Below Average	Low
1	2	3	4	5

9. How would you rank the contribution of lighting examples in this program, toward learning the related lighting concepts?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

10. How many viewings of this program do you feel would be necessary before you could fully apply the demonstrated lighting techniques. (please check only one)

___ One viewing only
___ Two viewings
___ Three viewings
___ Four viewings
___ Five or more viewings

11. "Video Lighting: A Photographic Approach", was designed as separate instructional modules. Did you find this programming concept beneficial or detrimental to the instructional process?

__ Beneficial ___ Detrimental

12. Was the organization of program modules, and the information contained within each module, presented in a systematic and logical manner?

__ Yes __ No ___ Don't Know

13. How much of an intellectual challenge did you feel this instructional program was, based on your current level of lighting expertise?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

14. Please rate this program in terms of the amount of material covered.

High	Above Average	Average	Below Average	Low
1	2	3	4	5

15. Please rate this program in terms of the appropriateness of material covered.

High	Above Average	Average	Below Average	Low
1	2	3	4	5

16. Please rate this program with regards to the appropriateness of instructional pacing.

High	Above Average	Average	Below Average	Low
1	2	3	4	5

17. Based on other instructional programs that you have seen, would you rate this program higher or lower in terms of instructional clarity?

__ Higher __ Lower ___ Don't Know

18. On a five point scale, how would you rank this program in terms of its' instructional value?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

19. Please check the following category which best describes the difficulty factor you would assign to the learning of related lighting concepts.

___ Extremely difficult
___ Very difficult
___ Average Difficulty
___ Low Difficulty
___ Extremely Easy

20. Which of the following categories best describes your improvement in lighting skills based on watching this video program.

___ Greatly Improved
___ Above Average Improvement
___ Average Improvement
___ Little Improvement
___ No Improvement

21. If the concepts in this program were to be offered as a formal course of study, would you enroll?

__ Yes __ No ___ Don't Know

22. If this program and an accompanying instructional manual was available for purchase at a price comparable to other instructional packages, would you buy this program?

__ Yes __ No ___ Don't Know

23. Which of the following categories best describes your general enjoyment of the program?

High	Above Average	Average	Below Average	Low
1	2	3	4	5

24. If you have any additional comments you would like to add, please feel free to use the space provided below and the back of this questionnaire.

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