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LIGHTING FOR COLOUR TELEVISION

INTRODUCTION

Lighting for television has to satisfy two basic needs – the technical demands of the system, and the artistic requirements of the productions. This statement applies to both black-and-white and colour, but in certain areas the lighting requirements for a colour system are much more exacting. There is also far greater scope for the expression of mood or atmosphere with the use of colour.

More often than not, a human face forms one of the most important parts of a picture on the screen, whether in black-and-white or colour. Furthermore the face is of a colour which can be regarded as a standard by the viewer of a colour picture – everyone knows what colour a face should be. For this reason, when colour cameras are aligned prior to a production the final matching is performed using a live model in front of the cameras.

In studio work, particularly light entertainment, the colours of backings, settings etc. are to a large extent subjective. This may not be applicable in the case of drama, where, for example, a natural wooden door must, by and large, have the colour normally associated with wooden doors. This really means that any object, background, or scene, the colour of which may be familiar to a viewer, must be carefully reproduced.

In outside broadcasts the emphasis is on realistic representation of grass, trees, etc, and these too form a recognizable standard for the viewer. However, these programmes more often than not are lit in a manner outside the full control of the Lighting Director, and as such are outside the scope of this article.

I must, however, mention that the video engineer working on an outside broadcast sometimes has great problems with colour temperature, in view of the fact that within the space of a few minutes the colour temperature of daylight may change from a value of 5000K in direct sunlight to some 10,000K in overcast conditions – a change which cannot be adequately handled without considerable readjustment to the camera parameters. However, more about colour temperature later.

THE BASIC PLOT

A black-and-white picture is made up of variable areas of light and darkness indicating contours and depth in plan of the scene or face. A three-dimensional object (e.g a face) has height, width, and depth and any lighting set-up should reveal these characteristics. These contours of a face can be reproduced using the basic lighting plot shown in figure 1.

Lamp 'A' provides vertical modelling because it shines down on the subject and will show shadow detail where the subject curves away from the source. Also, because it is shining from a position horizontally displaced from the camera viewing angle, the lamp will also reveal where the subject is curved in the horizontal plane. Thus, one lamp strategically placed provides essential modelling and is termed the modelling light. Such a lamp is sometimes referred to as the 'key lamp', but this is an ambiguous term because the 'key' of a picture is often the light source which sets the mood of the picture, e.g sunlight, moonlight. This true 'key' light may contribute nothing whatsoever to the shape or expression of the face of a person contained within the scene. For instance in the case of a *contra-jour* shot of a person it is quite clear that there is no light available from the key light, e.g the sun, with which the face can be modelled. The modelling light is usually a 'hard' source, being relatively small in area compared with the subject.

However, to return to the lighting plot, lamp 'A' will provide shape to the subject, but the light will fall to nothing around the unlit side of the face, thus creating a condition of excessive contrast. To control this, a lamp known as a 'soft' source is usually employed. This is a lamp which, by virtue of being a large area source relative to the subject, does not create secondary shadows of its contours. In figure 1 this lamp is labelled 'B'. In the same way that the modelling light is sometimes referred to as the 'key' light, this term 'soft' source, too, can be misleading. A lamp to perform the function of a fill light, i.e that of reducing contrast, could be a hard source if it were placed so that it did not add any

shadow detail to the modelling achieved by the modelling light. The basic plot would then be as shown in figure 2.

Use of a fill light such as this avoids interference with any other lighting, coloured or otherwise, on the set.

The face has now been lit in such a way that its shape and depth can be discerned but no division has been created between it and any background.

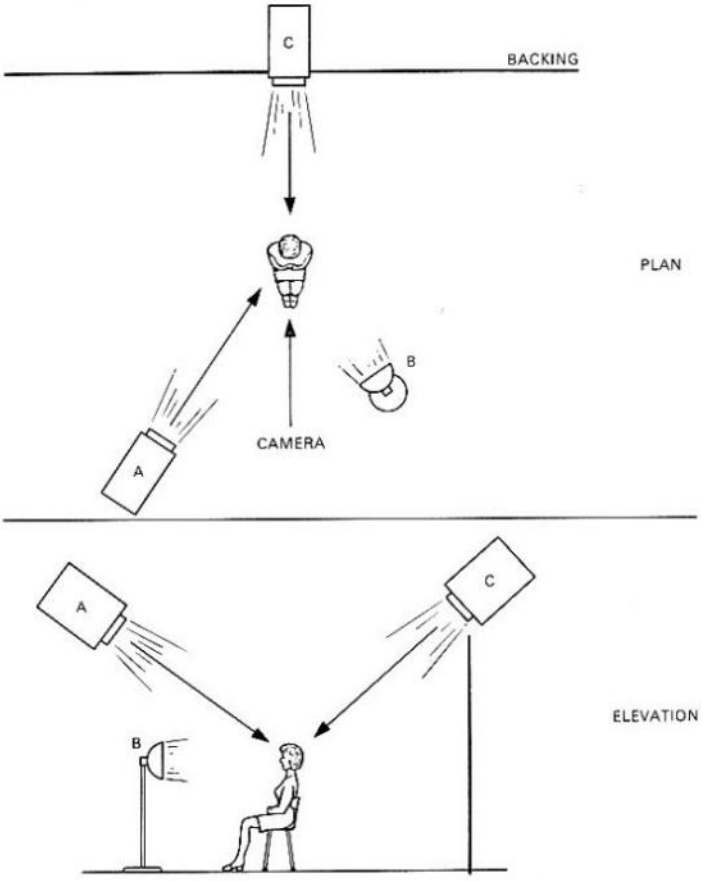


Fig.1 Basic lighting plot for reproducing a face.

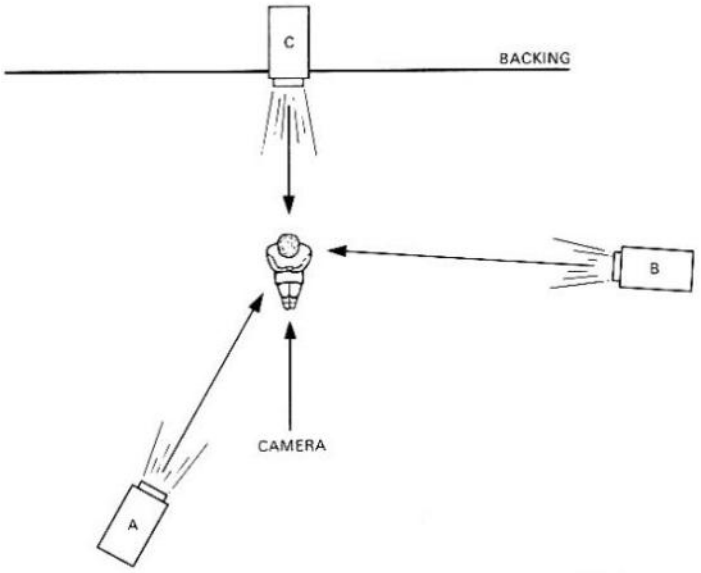


Fig.2 Showing how the basic plot can be modified to use a hard source for the fill light.

To achieve this, one or more lamps are added, shining from above and behind the subject. Such a lamp, 'C' in the plot, will create a rim of light around the subject which the camera or eye interprets as a separation between subject and background, and gives an illusion of depth on the screen.

Suitable adjustment of the relative intensities of these three lamps is sufficient to obtain a satisfactory black-and-white picture.

Black-and-white 4½in image orthicon cameras usually require light at a level around 70ft candles, at which they operate satisfactorily with an average lens aperture of f/8f–/11. These cameras are, to a large degree, unaffected by quite large changes in the colour of light used, being sensitive only to the brightness and contrast of a scene, reducing all colours to various tones of grey and reproducing a contrast range (i.e the ratio of intensities between the brightest and darkest parts of the picture) of some 40:1.

Colour cameras, however, by definition, see objects with the added dimension of colour. This fact introduces far reaching complications in the demands made on the television lighting directors who hitherto, in the UK at any rate, have been concerned with colour only in that all colours are reduced to various shades of grey.

COLOUR TEMPERATURE

Apart from the obvious difference that the colours of the scene now have importance in their own right, and are not just a pleasing means of obtaining tonal variations, the colour of the light used to illuminate such scenes assumes a much greater significance. It is essential that the spectral quality of the white lights used is very carefully controlled. This characteristic of light is measured in terms of colour temperature, a most important term to anyone lighting a colour production, and one that may need a little explanation.

If a 'black body', a theoretical body which is intrinsically non-radiating and non-fusible, is heated, the energy distribution of the light which is then emitted is solely dependent on the temperature to which it is heated; this temperature, expressed in degrees Kelvin (K), is used as a measure of the energy distribution of the light emitted. At low temperatures the energy is concentrated at the red end of the spectrum; as the temperature increases there is a gradual shift of the relative amounts of radiated energy towards the blue end. Incidentally, the term 'degrees Kelvin' is derived from a temperature scale using absolute zero, approximately —273°C, as the zero reference, and named after the man who first showed such a scale to be theoretically sound.

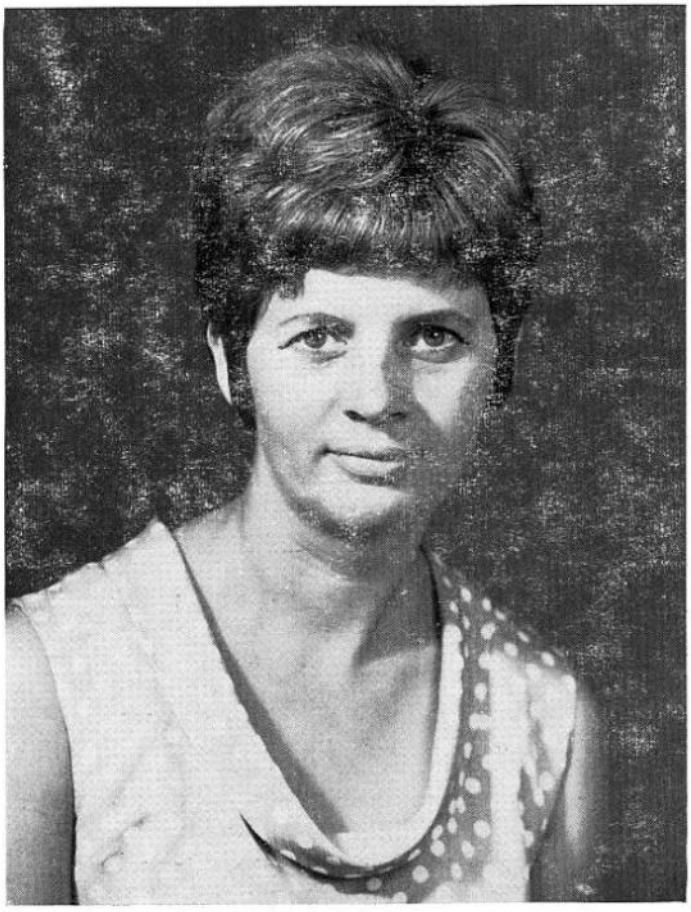
Mention must be made here of lamps which have a discontinuous spectrum i.e those which do not contain all the visible colours of the rainbow. These sources of illumination are of little use in colour television except, perhaps, for special effects. For example, a carbon arc radiates most of its energy at the blue end of the visible spectrum and has little or no red content. Use could be made of such a

source to simulate moonlight, as the light is intensely blue and cold. But if a face were to be illuminated with this lamp, it would be very blue indeed. Colour correction (i.e adjusting the spectral content of a source) is not feasible because the light does not contain useful amounts of many of the colours essential to a balanced source and therefore such correction is usually both uneconomic and impractical for colour television. Furthermore it will be obvious from basic colour theory that the use of a lamp the spectrum of which lacks, for example, red to illuminate a red object results in its appearing black. Therefore for all normal purposes one must use a source with a continuous spectrum and with reasonable amounts of every colour in terms of spectral energy. Here one must beware of being misled by a colour temperature reading which suggests that the source is suitable for mixing with normal incandescent lighting. The colour temperature reading may be influenced by a hump (or trough) in the unknown source's spectrum which would lead to colour aberrations in the colour picture. So before any source other than incandescent lamps is used on recognizable features or objects, it is advisable to ascertain from its spectral curve the exact nature of the new source – colour temperature alone can be extremely misleading.

Incandescent studio lamps are designed to radiate a continuous spectrum of visible light with a colour temperature of 3200K when the lamp is supplied with the correct voltage, and film studios operate their lighting at this colour temperature. However, it is possible to line up colour cameras to produce the correct colour response at any particular colour temperature within a fairly wide range. It has been found advantageous to line up to a rather lower colour temperature, thus allowing the use of dimmers to compensate for the gradual loss of colour temperature which a lamp experiences during its useful life. The change of colour temperature is effected by varying the voltage supplied to the lamp. With 240V tungsten filament lamps, a 15% drop in voltage will reduce the colour temperature by some 150K. The light output will be reduced by approximately 40%, and this permissible variation provides useful flexibility in the studio.

ACCURACY ESSENTIAL

Having established a convenient colour temperature at which to operate, it is then essential accurately to maintain this figure from any lamp which is used to illuminate subjects the colour of which may be familiar to viewers. This applies particularly to the human face. If we now refer back to figure 1, lamps 'A' and 'B' must have their colour temperature, as well as their intensity, carefully controlled. Should the colour temperature of these lamps vary by more than about 200K, relative to that at which the colour cameras were aligned, noticeable and objectionable colour changes take place in the flesh tones. A lower colour temperature results in reddening of these tones, while a higher one will cause the face to assume a blue tint. Either of these effects will be recognized by the viewer as an aberration.



Top left: *Fig.3 A model lit only by a modelling light.*

Bottom left: *Fig.4 The model with both modelling and fill lighting.*

Above: *Fig.5 The model lit according to the basic plot.*

The back or rim light 'C' is far less critical regarding colour temperature. A variation from nominal 1000K will not produce objectionable changes.

This then is the real difference between lighting for colour and lighting for black-and-white. In colour, the spectral quality of an illuminator is all important should one wish faithfully to present an object the colour of which is familiar to viewers.

Such control is not necessary for the illumination of subjects the intrinsic colours of which are unknown to the viewer – for example decorative backgrounds – so long as the finished result on the display tube is the desired one from the aesthetic point of view.

VARYING INTERPRETATIONS

The intensities of lighting for the colour camera is a subject of variable interpretation by different groups of people. In view of such wide limits, various productions at ATV were lit to different levels, starting at the highest figure which had been quoted for Plumbicon® colour cameras – 350ft candles. This turned out to be a much higher level of light than was necessary. As it is advantageous for many reasons to adopt as low a level of light as is practicable, the intensity was reduced until a level of 150ft candles was found to be adequate.

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In a Plumbicon camera, the iris and gain controls have a similar effect inasmuch as operation of either varies the signal output from the camera. Increasing the output by turning up the gain control, however, increases the electronic noise in the resulting picture whereas increasing the light falling on the tube does not. Thus the light level used is determined by a compromise between acceptable noise on the picture and an acceptable lens aperture. At a level of 150ft candles the Marconi MkVIIB camera operates at about f/8 (image orthicon format) which gives adequate depth of field, and provides enough latitude for vision control purposes.

MODIFIED RELATIONSHIPS

Turning to the actual production lighting, the advent of colour television will effect profound changes upon both the scope of a lighting director's contribution to a programme, and the relationship between the producer, lighting director and designer.

The lighting of a production in black-and-white has to convey every mood of a drama and every variety of a light entertainment setting, solely by the manipulation of light and shade. The use of colour, as well as light and shade, immediately enables us to intensify the impact, pleasure, or emotion evoked by a production, a fact well known and used by the film industry, but out of our reach until now. However, to achieve a satisfactory result much closer attention has to be paid to detail and the planning has to be more precise.

For example, if a lamp is placed to cover a given field at a certain intensity and colour temperature, subsequent alteration to the plane of this field cannot necessarily be compensated by use of the associated dimmer, as could well be the case in black-and-white lighting. Such compensation would cause a change in colour temperature which might well be unacceptable. The only course would be to move or change the lamp in question, an exercise that could be very complicated in a fully rigged production and one which would almost certainly take a considerable time – time which could be ill afforded in a competitive television production company. Hence to avoid this, the action and the lamp position must be accurately planned beforehand.

Another facet of preplanning, which affects black-and-white productions only in a broad tonal sense, is the choice of colour for backgrounds, whether for drama or for light entertainment. It would, for example, be disastrous to provide a coloured background for an artiste, only to find that she has arrived with only one dress which clashes with the background in a totally unacceptable manner. It is not possible, as with a black-and-white production, to adjust the level of light on the offending background in order to achieve the necessary separation between backing and artiste. The remedy in a colour show has to be much more

drastic and time consuming, possibly involving painters or a different set of colours in the lamps illuminating the background. This example points again to the necessity of tightening up all planning and co-ordination between departments engaged in mounting a colour production, if first class pictures are to be produced.

COMPATIBILITY

There is yet another complication which should be mentioned, as it may affect the majority of viewers in the early days of colour transmissions. I refer to those who will view the pictures on an ordinary black-and-white receiver. Such a picture is called the compatible version of the original colour transmission. The colour pictures are transmitted in such a manner that they can be received, interpreted and displayed on a normal black-and-white receiver, but of course only as a picture composed of shades of grey corresponding to the luminances of the colours of the original picture. For example, a saturated colour will be displayed as a fairly dark grey and an unsaturated colour will appear as a much lighter tone of grey.

Complications arise because different colours with the same luminance will be displayed as exactly the same shade of grey in the compatible picture. Thus two parts of a picture may appear as quite separate colours in colour, but when received on a black-and-white set appear as one. A particular pitfall is the credit caption. If insufficient care is exercised in the choice of lettering and background the caption may be almost invisible in black and white while being perfectly legible in colour.

Altogether the added dimension of colour presents to all technicians and artists working within the medium, exciting and exacting challenges, a few of which I have attempted to outline. It is hoped that the viewers will find the results as exciting.