



# A cost-effective strategy for the archiving of ageing film

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## 1. Introduction

The television industry has a problem! In order to be able to recover the programme material that has been lovingly gathered and crafted over the last 40 years, we must be able to keep it in a way that is both stable and usable. This means that new archiving techniques must be developed to protect the diversity of our future viewing.

Although most organizations are aware of the problems involved in keeping programmes that are recorded on tape, the BBC is also finding problems with much of the film material in its vault. In particular, reversal film which was shot for news is giving cause for concern. The BBC has a lot of historically-important material which is mixed in with less interesting material. More difficult to classify is the film that is not of the highest historical value, but which will provide a rich source of material for future generations of documentary programme makers – the sort of images that could bring alive a future documentary programme but which we take for granted today.

So here is the problem: how do we keep the programme material in a form that (a) will last longest and (b) will be available most easily to programme makers in the years to come?

*This article describes a cost-effective strategy that the BBC has developed for the archiving of images stored on ageing film. It is aimed particularly at images which are important for their historical content, rather than at the high-quality images normally associated with peak-time drama.*

*The system requires the use of a 10-bit digital tape recorder that does not use compression. The images are transferred from film to tape in such a way that regrading can be carried out at a later date, e.g. during the making of a future television programme.*

A number of options are available for transferring television programme material to film stock which, although expensive, is an appropriate way to preserve high-quality finished programmes. However, being a television-based organization, the BBC needs the whole archive to be accessible to programme makers; this inevitably means that tape is the best medium on which to store the pictures. Consequently, it has to be accepted that the contents of the archive will have to be copied from time to time, in order to keep them in a format that is current – and usable by the majority of programme makers.

Original language: English  
Manuscript received 29/3/96.



Figure 1  
Telecine colour  
grading at BBC  
Television Centre in  
London.

Traditionally, we would make the best possible transfer – from film to tape – of as much material as the library could afford. This approach has several disadvantages:

- a good quality telecine-to-tape transfer takes 4 or 5 times longer than the length of the film, especially if the film is of poor quality;
- the grading carried out at the time of transfer may not match that required when the material is finally used, in which case more grading may be required with a consequent loss of quality;
- a conventional transfer will discard a lot of information on the film which may be required in the future, depending on the requirements of future distribution media;

Worse still, we are in a situation where only a small amount of the material is likely to be used in the long term and, thus, the time spent transferring it to tape now may well be wasted.

## 2. Film and its use in television

Film can store a lot more contrast and resolution information than a normal television signal. This must be taken into account when making a film-to-video transfer.

### 2.1. Contrast range

At best, television displays give a contrast range of 30:1, whereas film may contain a range in excess of 1000:1. Thus, the contrast range of a film image must be adjusted to produce a subjectively good display on a television screen. The contrast range required for the television image is selected from the film image by compressing the less-desirable light and dark ranges; the information contained in these ranges is then lost or at least severely impaired by noise.

Often, it is anticipated that a subsequent regrading will be needed and thus most of the subjective adjustment is done at the time of the initial film transfer, to allow for precise fine adjustment later. This practice is very much based on knowing what the final result should look like; a great deal of experience is needed to minimize the need to make another transfer from the film.

### 2.2. Spatial resolution

It is important to transfer as much spatial resolution as possible from the film to the television image, although care must be taken as it is very easy to over-engineer a transfer system. A simplistic answer would be that we should preserve the full definition of the film frame (equivalent to about 1000 television lines, in the case of 16-mm



film). In practice, however, we can often reduce the film resolution without causing significant damage to the television image. There are at least two reasons for this:

- the resolution on a lot of film used in television, especially reversal film, is often not nearly as good as the best resolution that 16-mm film can give;
- our film material was usually shot with the intention of showing it on television, and the pictures look better if they are seen at television resolutions (any extra resolution is wasted).

Consequently, it is reasonable practice to keep archived programme material at television resolutions. The archivist will have to be careful to ensure that the right sort of material is transferred to tape; the sort of material that we expect to see at higher resolutions – typically high-quality drama – can be kept in another format.

### 3. Practical aspects

Over the years, the BBC has gathered a large quantity of film material that is suitable for transferring to tape, at television resolutions. In most cases, this is also the same film stock that is giving us the problems briefly referred to in *Section 1*.

At present, it is not possible to transfer film to tape other than at the normal telecine replay speed. Thus the fastest way of transferring film is to run the telecine without stopping. It would be reason-

able to expect that this is also the cheapest way of transferring the film – unless the equipment required to achieve a good result is that much more expensive than the equipment required to provide a standard-graded transfer.

The problem is now reduced to that of transferring as much contrast as possible to tape, in a way that makes it as usable as possible. Currently, the best standard tape format enables full 10-bit digital component video recording at little, if any, extra cost over other formats. It thus makes sense to find a way of recording the film at a digital resolution of 10 bits.

### 4. Film grading for future regrading

Grading of film is normally done at the time of transfer to tape and depends on what the material is to be used for. If subsequent grading is required, then the grey-scale tracking is likely to be poor and a retransfer to tape will be needed. Furthermore, if a PAL digital-coded format is used on the tape, there are often noise problems at regrading time; this type of format is effectively a 7-bit system (which is all that is required to accommodate the composite signal range of 1.3 volts).

Intuitively, when the images are to be regraded at a later date, it seems right if the minimum amount of grading is done on the first transfer. This is good news, as it is consistent with our aim of transferring at the fastest rate possible.



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*For the past six years, with an initial brief to evaluate composite digital VTRs, he has worked for the Head of Post Production at the BBC. In this role, he performs equipment evaluations and provides technical solutions to, and advice on, problems which affect the engineering and operational aspects of television post production. He is also responsible for assessing the importance of new standards and technologies that are relevant to the department's work.*





When grading film for final use, the gamma should be used to set a suitable contrast range for the television system, and the lift should be set to produce a pleasing result. If no lift adjustment is made, then the pictures look “sat-up” (i.e. the black areas look too bright). If regrading is needed subsequent to the transfer from film, then – unless this lift is removed first – further gamma changes cannot achieve the same look as would have been achieved when the original transfer was made from film. It has been found by experience that, when a “one light pass” is made for subsequent grading, the result is always better if about 10 % lift is set at the time of the telecine transfer to tape. At the BBC, a number of high-quality programmes have been treated successfully in this way.

## 5. Getting the best results

When transferring film to tape for later grading, the following points should be observed:

- it is necessary to record from the telecine with as few grading changes as possible;
- only the gamma and the gain should be adjusted;
- no masking compensation, noise reduction, dirt removal processes, etc. should be used (this should be done later when the correct decisions can be made according to the purpose for which the film is to be used).

If these guidelines are followed and a 10-bit digital recording is made, then it should be possible to achieve good pictures for subsequent re-use. As the film will often be grainy, compressed recordings should be avoided because the grain noise will stress the compression system, undoing much of the work already done, and will give problems when subsequent grading is performed. Even a 2:1 compressed format is not really suitable; it will only record with an effective resolution of 7 bits in a difficult situation, even though with good pictures it will record with a resolution of 10 bits.

## 6. Future possibilities

There may be better ways of storing the film data than by using a simple gamma-law characteristic. For example, data from the Kodak Cineon digital film scanner is stored in a “Log Density” format –

positive images are converted to negative images and stored with information on any grading that is done during the scanning process – and there may be other techniques that are optimal for different film types. This gives a system that is totally reversible and thus the light transfer characteristic of the original image can be recovered.

Apart from the obvious solution of recording more bits, there are a number of possibilities that could be followed by manufacturers to serve this important, empty and growing niche in the market. For example:

- the recording signal could be provided by digital log amplifiers, although it would not be suitable for direct viewing (the images would appear very “sat-up”);
- work could be done on other transfer characteristics that achieve the same aims;
- systems should be developed for recovering the grading data and, ideally, this data should be stored on the signal itself rather than on a separate disc (the use of data signals during the vertical blanking interval could be an option here).

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