

Archiving:
Experiences with telecine transfer of film to
digital formats

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Archiving: Experience with telecine transfer of film to digital formats

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Introduction

Many broadcasters have large archives of film dating back to the early years of their organisations; some of the material has a significant cultural and monetary value. Broadcasters are increasingly faced with the challenge of transferring the film to a digital form to improve its accessibility and, in some cases, to rescue material from deteriorating filmstock.

This document covers the issues associated with digitising film material by Telecine. It describes work done by SWR and discussed in EBU group P/HDTP to inform decision-making on the Telecine scanning format needed for digital archiving of film material, looking particularly at the viability of digitising old filmstock to HDTV resolutions.

Digitisation of film material by scanning using a 'Datacine', which is an important option, is to be the subject of a future, complementary report.

Electronic film scanning can either be done at SDTV resolution (the 576i/25 format) or at HDTV resolutions. The three current HDTV production formats in Europe are 720p/50, 1080i/25 and 1080psf¹/25. In future, HDTV production will also be done in a 1080p/50 format.

Decisions on Scanning Format

The EBU recommends the use of 720p/50 for broadcasting itself, and this format may also be conveniently used for programme production. However, this is not the optimum format for the digitization of film material, which only has 24 or 25 pictures per second. Of the three normally used HDTV formats, the most appropriate to match film material is the 1080psf/25 format. One reason is that it has the same number of pictures per second. The higher vertical resolution available with the 1080psf/25 format also provides more headroom for preserving the detail of the film.

A broadcaster's decision on scanning format will be informed by knowledge of the following.

- The quality difference likely to be perceived between archive films shot at different times in the past, scanned and stored at 1080psf/25, and film material shot and scanned today at 1080psf/25. This will indicate how useful transferred archive material is likely to be, relative to its age, in the future broadcasting environment.
- The quality difference likely to be perceived when archive film material is scanned and stored at 1080psf/25 compared to scanning and storage at 576i/25. This will indicate how

¹ Progressively scanned segmented frame, which allows 1080p/25 signals to be carried in 1080i/25 containers, such as the HD-serial digital interface (SMPTE 292M).

valuable it will be to transfer film material to HDTV video rather than SDTV video, and how much difference this will make.

Though it is possible to calculate the resolution potential of film, comparisons of electronic and film quality are difficult to make without practical experiments. The amplitude/detail roll-off characteristics of the two media are different, and other differences in quality factors such as contrast linearity and noise level and structure, which are difficult to quantify numerically, affect the finally perceived quality.

Furthermore, the potential quality available from film stock has improved over past years, many broadcasters changed from 16mm to Super 16mm in the 1990s; and, in addition, some film stocks deteriorate over time. So, there are many factors contributing to the quality of digital transfers.

The future television production and broadcasting format will be high definition, so it is important to take decisions on transfers with this in mind.

Scanning tests

In this report, in one series of tests, evaluations were made of film material shot at different times by Suedwestrundfunk-Germany (SWR) since the start of colour television. Extracts were located with examples of different shot compositions and lighting conditions. Controlled examples of 35 mm film, 16 mm, and super 16 mm film were used. The quality achieved by scanning these at 576i/25 and 1080i/25 was compared. The tests were controlled to avoid bias in the results, and to draw general conclusions about the scanning format to use for film transfer.

In another series of tests, evaluations were made of perceived quality of the same real film material test material, shot at different times, scanned at 1080psf/25, but this time compared to reference material shot today and scanned at 1080psf/25. The reference material for the 1080psf/25 scan was shot on super16 mm film, because this is currently used for documentaries and features at SWR. The tests were controlled to allow general conclusions about the usefulness of past film material for future television services.

The criteria for the sequence selection included the following:

- Only colour film segments were used.
- Film segments were chosen at intervals from the archives between 1970 and 2005.
- Four samples of 35 mm film were selected, shot in 1970, 1992, 1996, and 2002. The quality proved to change much less over the years than for 16mm film, and this was sufficient.
- Twelve samples of 16mm film were selected, shot in 1970, 1976, 1980, 1984, 1988, 1990, 1992, 1994, 1996, 1998, 2000, and 2002. The quality proved to have improved dramatically over this time.
- In 1996 SWR changed from 16mm to S16mm, and this will be reflected in the results.
- Before 1988, SWR used reversal film, and after 1988 negative film. This will be reflected in the results.
- Only reversal and negative film were used for the tests, no positive prints taken from negatives were used.
- Only documentaries and events programming were used for the tests.
- From each source sequence, day light and a night shots, and long and close up shots, were found and used to compile test sequences.
- As far as possible, matched scene situations were used for all test sequences.
- The HDTV reference for the second series of tests used S16 mm Kodak Vision 2.

The evaluation methodology drew on ITU-R BT.500-11 as far as practical, with some elements changed or added to meet the specific needs of the evaluation, as explained in the Appendix.

The results of the evaluations and methodology are given in the Appendix to this report. Results are given in graphical form, together with details of the test sequence, methodology, and the experimental set up.

The Results

Observations of the influence of elements of film by specialists

- Under-exposed film leads to poorly quality scanned HDTV and SDTV video. The colour correcting needed leads to an increase in contrast range, which increases noise visibility.
- Using light sensitive (fast) film leads to disturbing grain in the scanned picture when viewed, which is even more noticeable with an HDTV scan.
- Using a soft focus filter in the film camera leads to a pronounced loss of resolution in the HDTV video.
- The HDTV picture can be dramatically affected by lack of focus in the film material.

Observations on the results of the formal evaluations

- In all cases, the quality of the transferred version of the 35 mm archive film was significantly better than the quality of the 16 mm and S16 mm film. Though the quality available from 16 mm film has improved dramatically over the last 30 years, 35 mm still provides a visible improvement.
- The quality of the transferred material of the 16 mm reversal film used by SWR before 1988 will be perceived as bad quality by viewers to HDTV services.
- The quality of the transferred material of the 16 mm negative film used by SWR after 1988 will be perceived as better than the above, and generally will be in the region of fair/good. But the change in aspect ratio likely to be needed will also contribute degradation.
- New Super16 mm negative film stock seems to provide a good quality match to 1080psf/25 video.

Overall conclusions

- **Scanning archive 35mm negative film material at 1080psf/25 can produce excellent picture quality for HDTV services.** Tests suggest that archive material shot on 35 mm reversal film before 1988 will provide pictures about one grade worse, and they will not do justice to the potential quality available from HDTV. However, they will still be significantly better than the quality available from 16mm film archives of the same period.
- For 16 mm reversal film, any advantages of scanning at 1080psf/25 compared to scanning at 576i/25 are overshadowed by the overall poor quality of the film.
- There will be benefits in picture quality, particularly for the future HDTV environment, if digital archives originated from 16 mm negative film use 1080psf/25 rather than 576i/25. For recently shot 16 mm negative film, the picture quality can be close to that achievable with 1080psf/25. For film shot in the past there will be some variation in quality, but the quality will always be significantly better than material shot with reversal film.
- It is important to focus sharply, not use soft focus filters, use relatively slow film, and use correct exposures, when using 16mm film which will be used for HDTV services.

APPENDIX : Details of the Tests and Results

HDTV - reference



HDTV - sequence (valuation)



SDTV- sequence



HDTV- sequence (valuation)



T1 = 6s, black with white text, marking start and end of the sequence
 T2 = 7s, black for separation with white text declaring the next sample
 T3 = 60 - 70s, film sample containing one daylight and one night shot

Fig 1: Test Sequence schedule

The HDTV-reference is a single sequence, shot originally on Super16 mm, and scanned at 1080psf/25, which is the same reference for all tests in the session.

The HDTV-sequence (evaluation) is a series of 23 test sequences shot at different times, extracted from the SWR film archive.

The SDTV-sequences are the same sequences as above scanned at 576i/25.

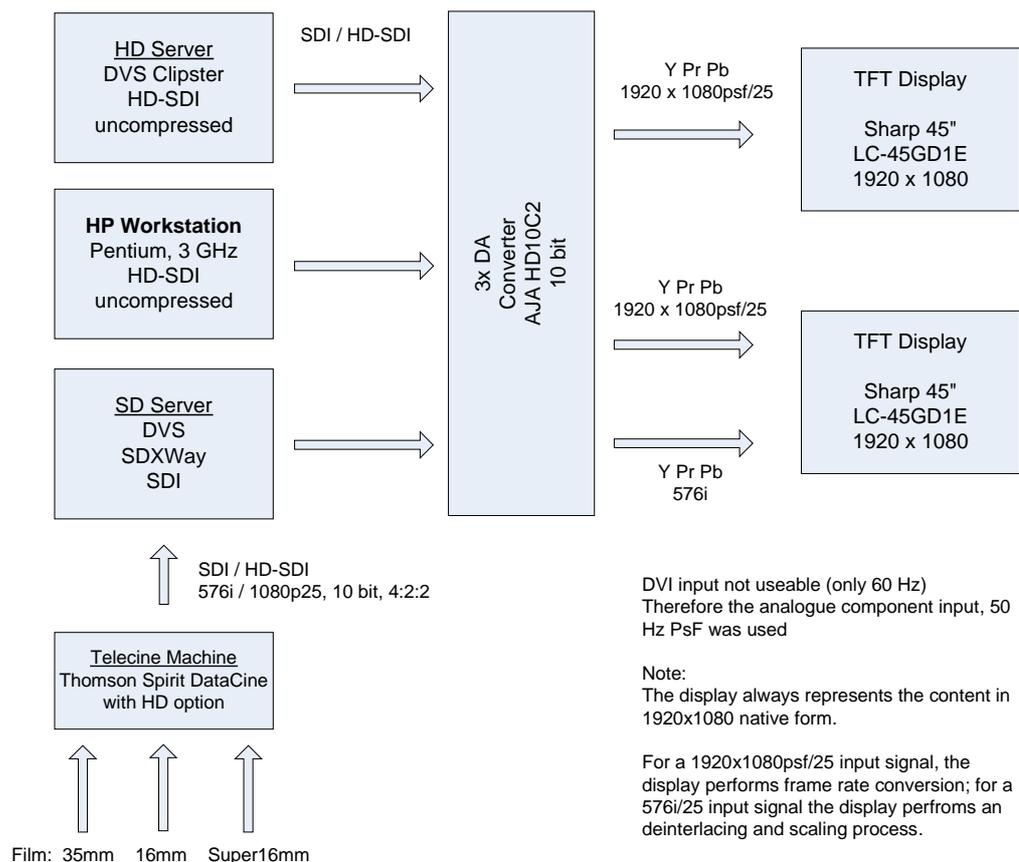


Fig 2: Test Configuration.

A Thomson Spirit Datacine Telecine machine with HD option and colour correction was used to scan the selected film material. The data was stored both in SDTV and in HDTV on a video server. Editing of the HD sequences was done in an uncompressed form.

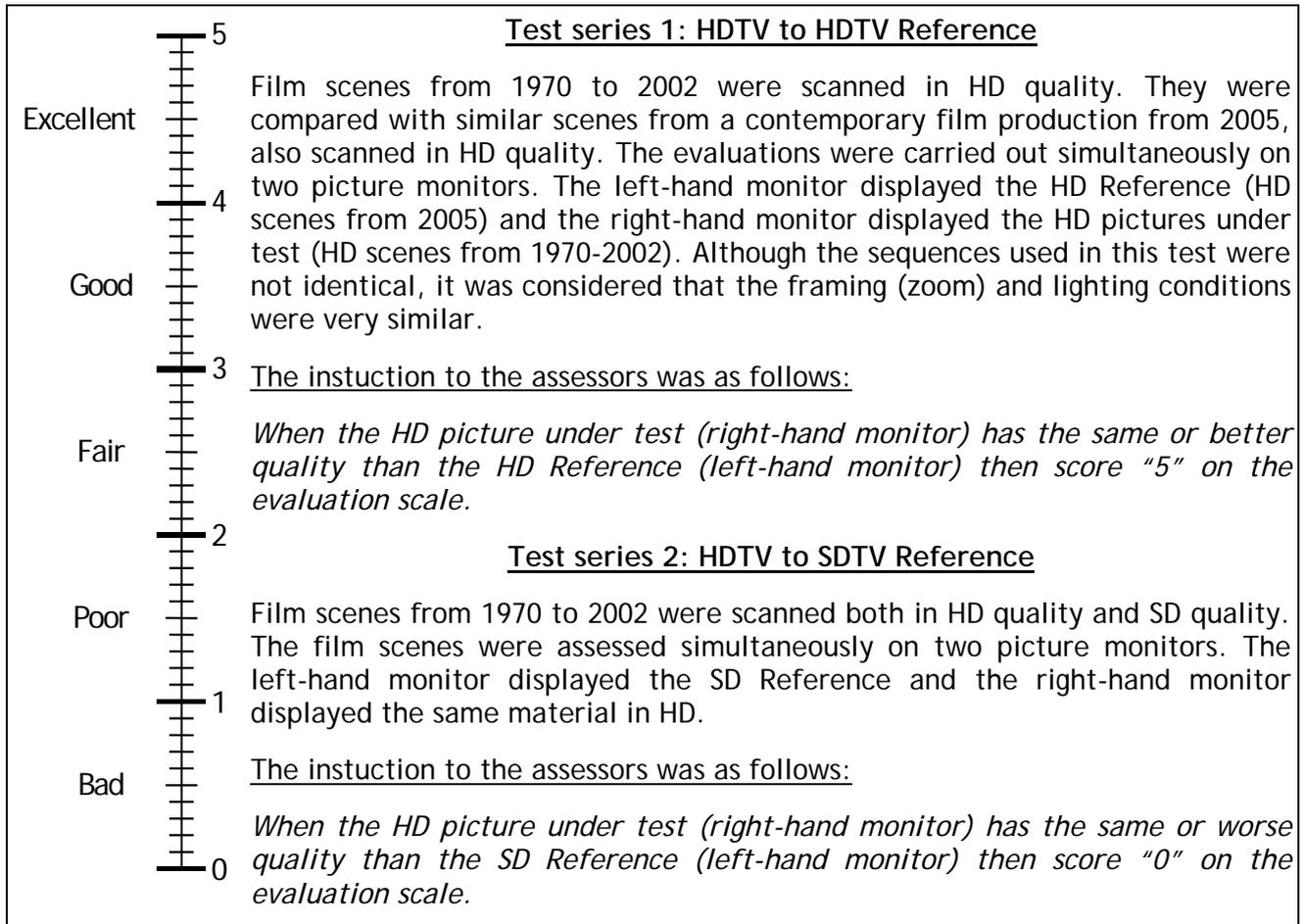


Fig 3: Methodology instructions for the assessors.

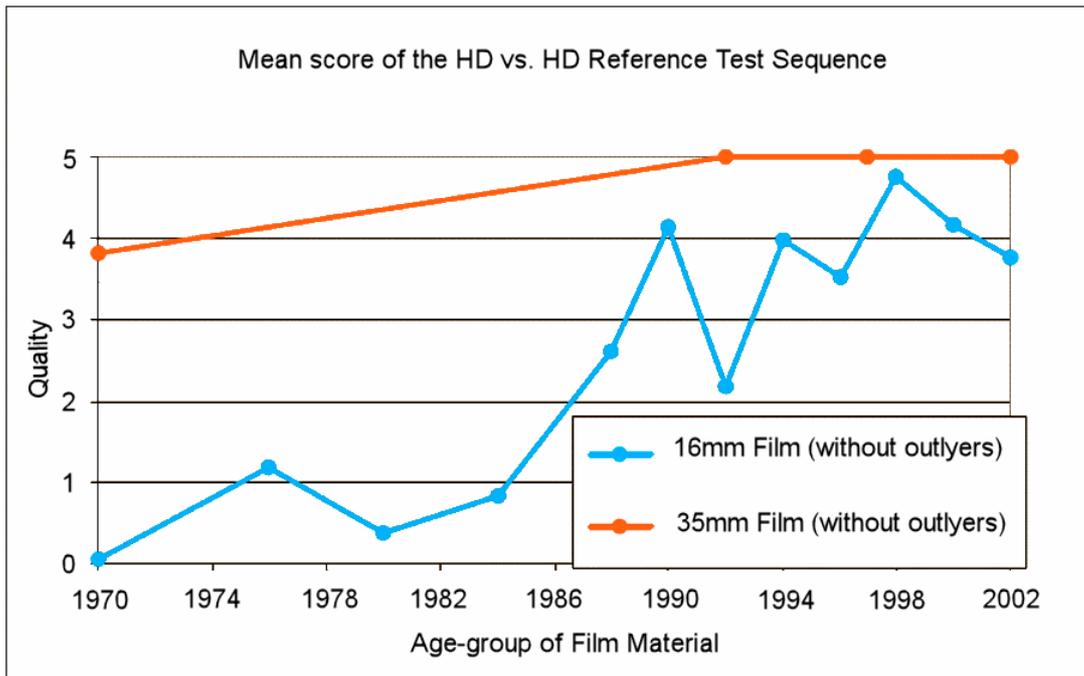


Fig 4: Results of evaluations of perceived quality of 1080psf/25 scanned film material when a 1080psf/25 high quality sequence is available for reference.

The scores show the magnitude of the closeness of quality of the test material compared to the HDTV high quality reference. For example, a score of grade 5 indicates that the test material is at least as good as the reference, and a score of grade 0 indicates that the quality of the test material is much worse than the HDTV reference.

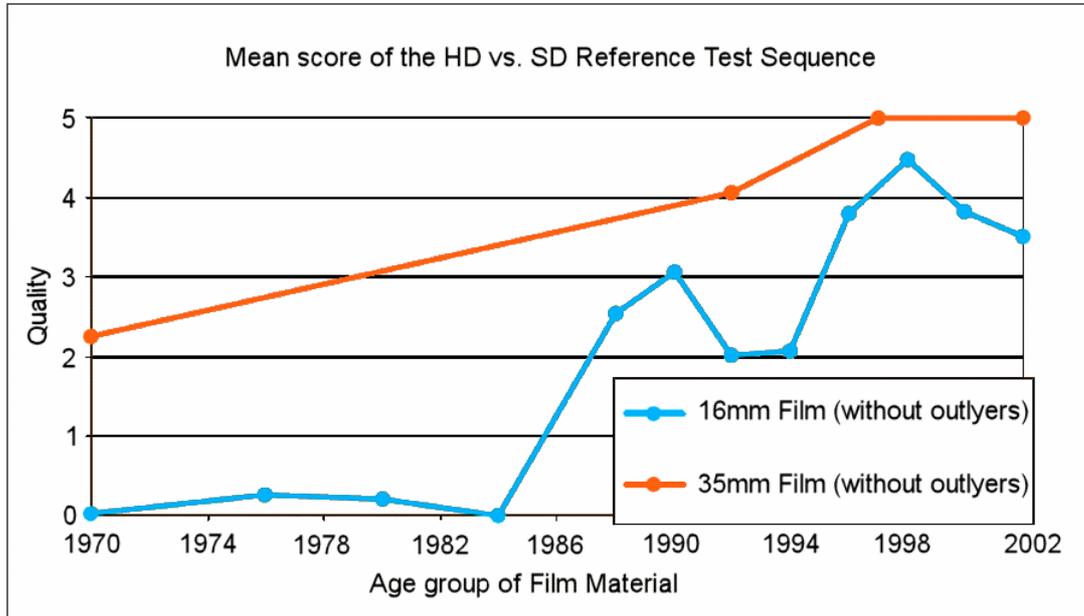


Fig 5: Results of evaluations of picture quality of 1080psf/25 scanned film material when SDTV is available as a reference.

The scores show the magnitude of the perceived difference between the SDTV and HDTV versions of the same material. At the extremes, a score of 5 indicates a maximum difference, and a score of 0 indicates no difference.