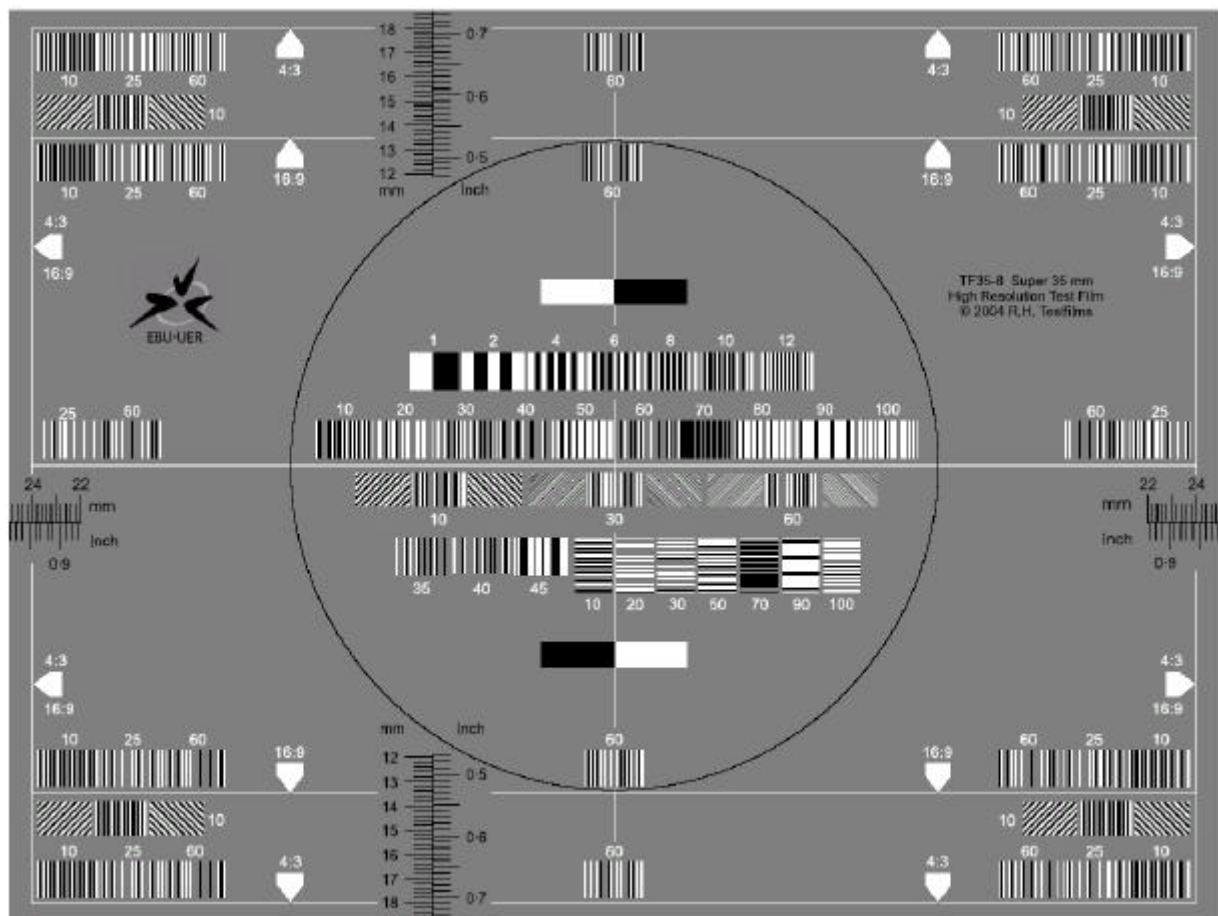


EBU / R. H. Testfilms High Resolution S35mm Test Film

The EBU P/TK working group was set up to investigate the performance of modern telecines and to recommend design parameters for future machines. Measurement of resolution was one of the aspects of the work of the group. It was considered that a test film was required that contained sufficient high frequency detail to challenge the resolution capabilities of currently available, and future, telecines and scanners. No such film was known to be available and so a suitable one was commissioned and is shown in the diagram below. It is produced on a monochrome film stock with a 125 micrometre polyester base.

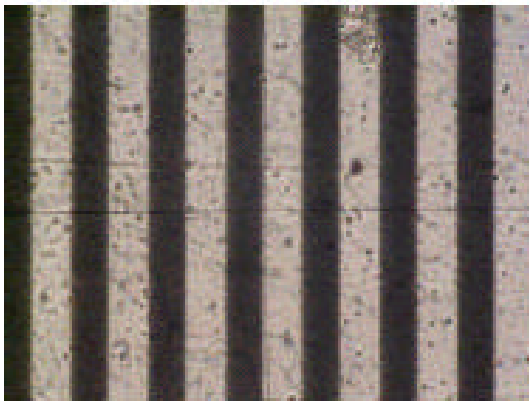


Resolution:

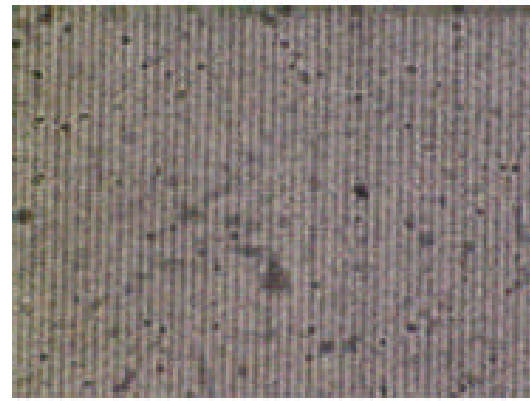
This film is not intended for use in conjunction with standard definition television. It is perhaps worth noting that just 10 line pairs per mm (lp/mm) on a super 35mm frame would equate to 4-79 MHz if scanned at standard television rate (10 line pairs*24.92mm)/52 microseconds - very close to the 5.5MHz limit of P.A.L. System I and above.

Simple arithmetic shows that 4K (4096 elements) distributed across a 24.92mm super 35mm frame equates to 82 lp/mm (82 black & 82 white). Even ignoring Nyquist criteria, it would be impossible for a 4K scanner to cope adequately with this: the elements would have to line up exactly with the film image!

In the diagram above it can be seen that the centre resolution patches are 10, 20, 30, 40, 50, 60, 70, 80, 90, & 100 line pairs per mm. This is effectively a calibrated frequency sweep.



10 lp/mm taken through microscope eyepiece



100 lp/mm taken from microscope eyepiece

The table below lists the results of measurements made on the initial batch of test film.

Box No	Resolution lp/mm	Amplitude %	Box No	Resolution lp/mm	Amplitude %	Box No	Resolution lp/mm	Amplitude %
1	10	80	21	50	85	41	80	50
2	25	75	22	60	85	42	80	70
3	80	40	23	70	50	43	80	75
4	80	85	24	80	50	44	25	95
5	80	40	25	90	50	45	10	100
6	25	80	26	100	40	46	10	85
7	10	95	27	35	90	47	25	80
8	10	90	28	40	90	48	80	40
9	25	85	29	45	85	49	80	70
10	80	50	30	10	100	50	80	50
11	80	75	31	20	95	51	25	90
12	80	50	32	30	95	52	10	90
13	25	90	33	50	80			
14	10	100	34	70	50			
15	25	85	35	90	40			
16	80	55	36	100	30			
17	10	100	37	80	70			
18	20	95	38	25	95			
19	30	95	39	10	100			
20	40	95	40	25	85			

It should be noted that the information above is given in good faith and that the film would be replaced in the unlikely event of it being defective. No other responsibility is expressed or implied.

R.H. Testfilms

35mm Ruler Test Films

Shot on a polyester base, the 35mm Ruler Test Films are available in two formats: Super 35mm and Academy 35mm. Both films are illustrated overleaf.

The films are intended for use in conjunction with internationally agreed standards as described in SMPTE 59-1998 and EBU REC86 & REC93.

The intention is that the user decides which area of the exposed image to scan in the telecine and adjusts the machine using the calibrations on the film.

The rulers are calibrated with both Imperial and Metric units with a production accuracy at least equal to SMPTE specifications

Calibrations are incorporated to allow direct setting of the scanned area for both width and height. Metric calibrations are at 0.1mm intervals, Imperial at 0.005" intervals, symmetrical about the centre of the test card.

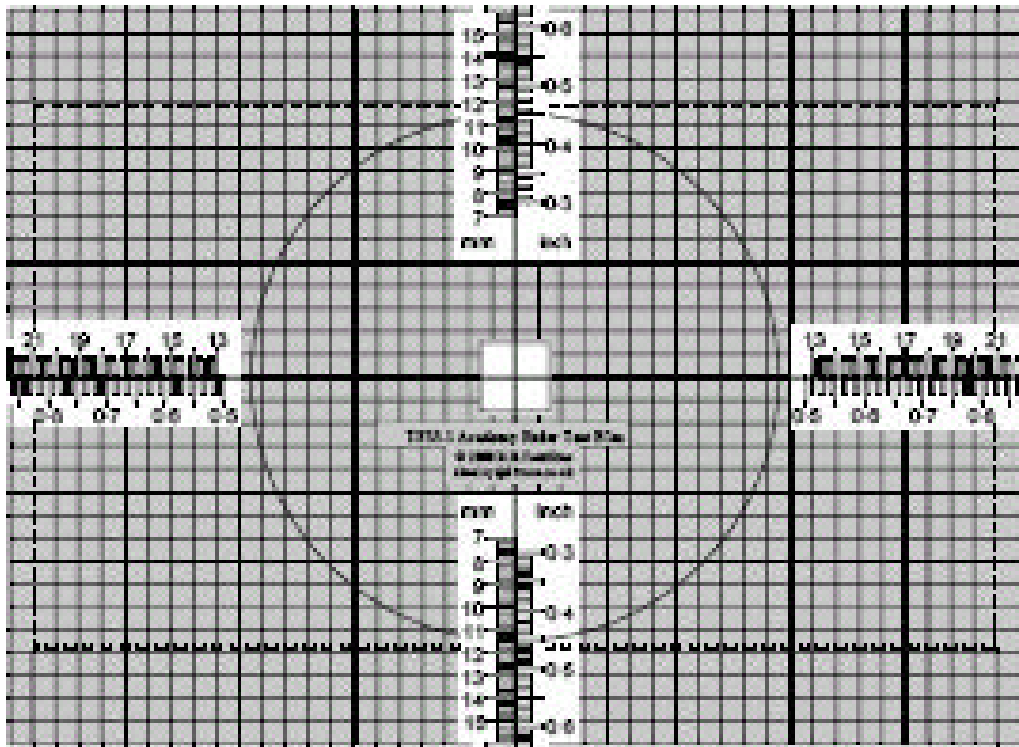
To set the telecine to scan, say, a width of 20.0mm, the telecine width and centring controls should be adjusted until the 20.0mm calibrations **on both sides of the test card** are bisected by system blanking. Obviously, a similar instruction applies when setting height. Note: when setting scanned areas, care should be taken to ascertain whether analogue or REC601 blanking is being used on the telecine monitor and an allowance made if necessary.

The Super 35mm version corresponds to SMPTE 'style C':

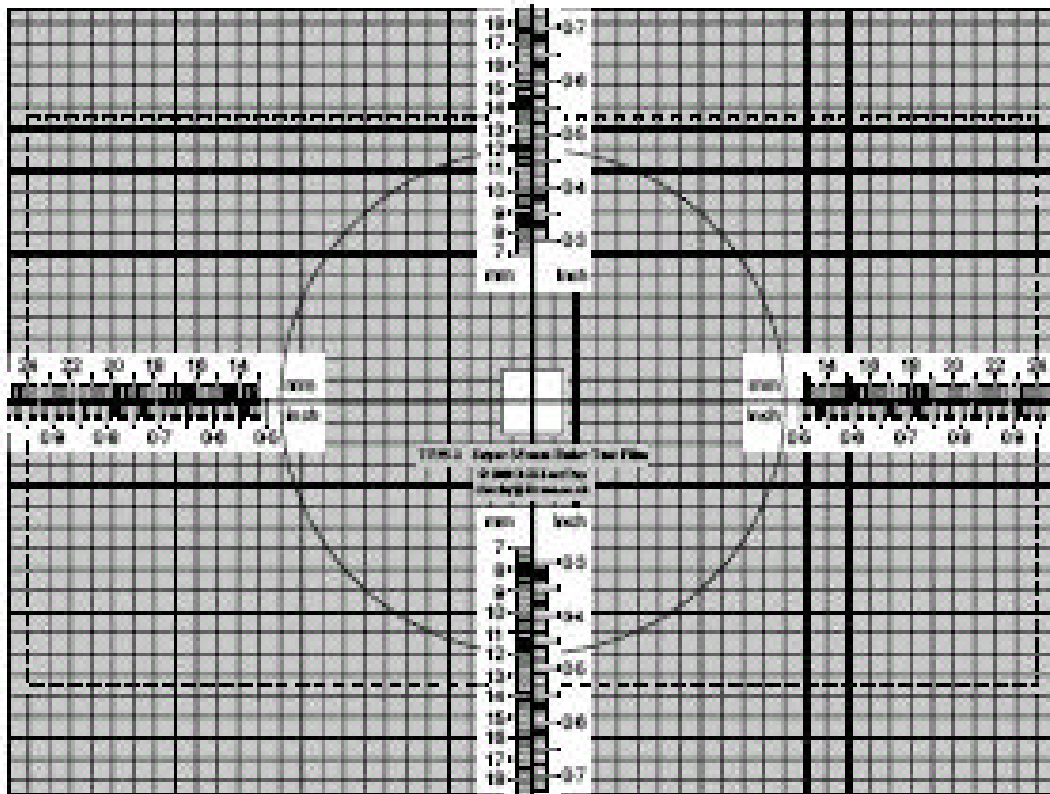
- the picture image is centered on 0.688in (17.48mm)
- the picture image has a width of 0.981in (24.92mm) and a height of 0.735in (18.67mm)
- a 16x9 rectangle shows the EBU recommended scanning area for this format of 0.945in (24mm) x 0.531in (13.5mm) for use when the image is to be correctly displayed on a 16:9 display

The Academy 35mm version corresponds to SMPTE 'style A':

- the sound track area is left blank
- the picture image is centered on 0.738in (18.75mm)
- the picture image has a width of 0.866in (22mm) and height of 0.63in (16mm)
- a 16x9 rectangle shows the EBU recommended scanning area for this format of 0.825in (20.95mm) x 0.464in (11.78mm) for use when the image is to be correctly displayed on a 16:9 display



Academy Ruler test Film



Super 35 mm Ruler Test Film

R.H. Testfilms

Super 16mm Telecine Alignment Film

Revision 3

Originally developed at Channel Four Television in the U.K., and widely known as the "Channel Four test film", this alignment film provides an easy method of checking telecine scanned area and position on Super 16mm film.

Markers are provided for 4x3 scanning of the centre of the image and ruler calibrations allow individual preferences for scanned area dimensions.

A quick assessment of overall gate focus and system performance can also be made using the nine astigmatism patches.

In addition, a 5 step greyscale is provided to allow an assessment of overall neutrality.

This revision of the telecine alignment film adds imperial calibrations to the existing metric ones.

Calibration accuracy:

The films are not calibrated individually; however, measurements are made during production as follows: a full roll is exposed in a pin registered camera as one continuous run. After processing, several measurements are made of image size, position and resolution. Users can thus expect an individual film to match the enclosed figures closely. The average of these measurements is printed in the table in this leaflet, supplied with each film.

Image Size and Aspect Ratio:

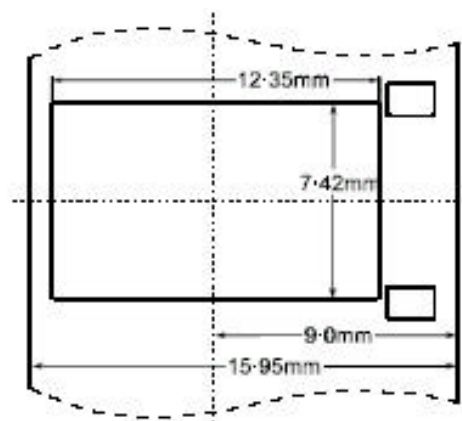
The image on this test film (i.e. to the outside edge of the castellations) is to the DIN 15602 - part 7 1984/ANSI-SMPTE 201M-1966 standard.

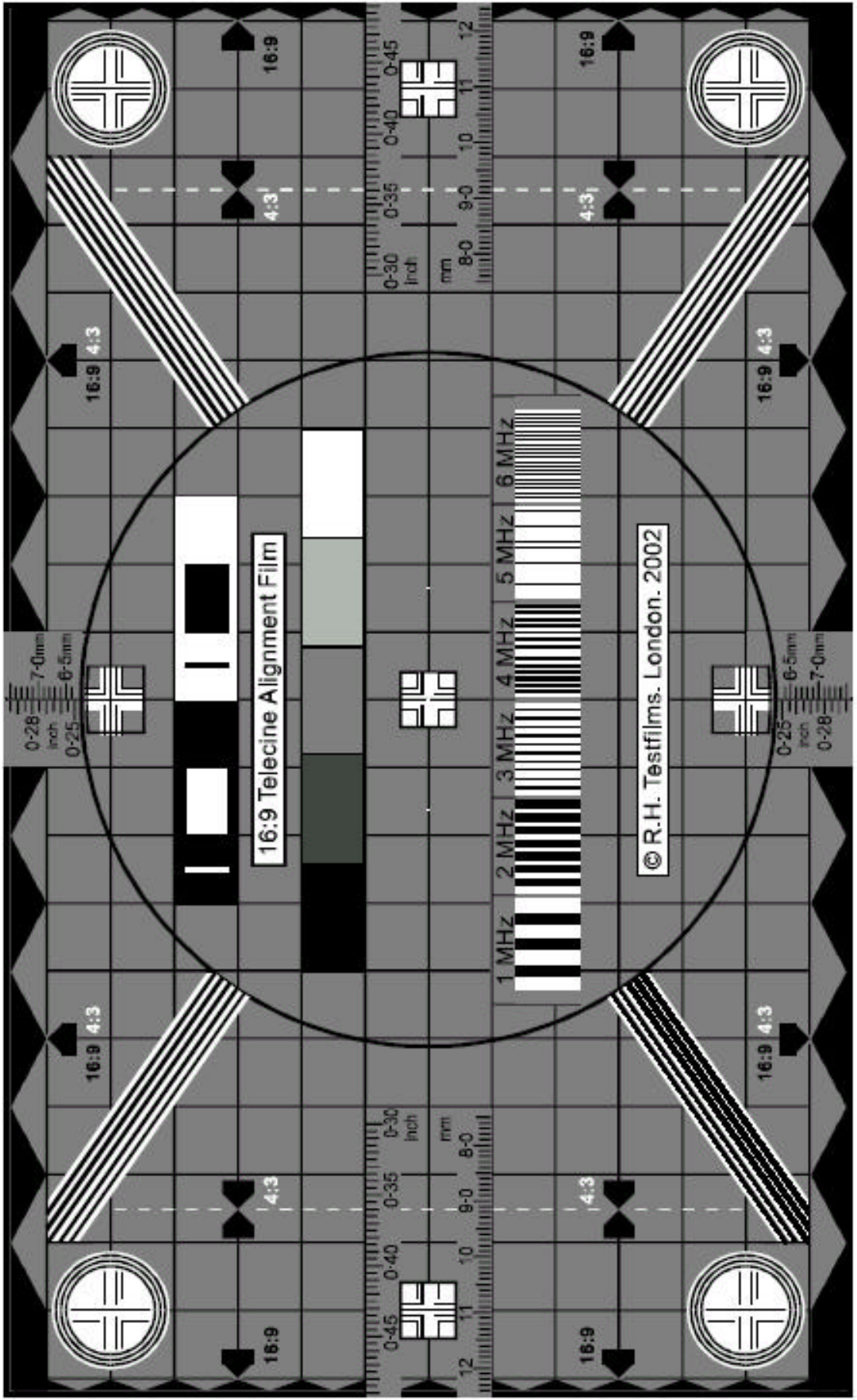
Width: 12.35mm (nominal)
0.486" (nominal)

Height: 7.42mm (-0, +0.15mm)
0.292" (+0.006" -0)

Centre: 9.0mm (± 0.05 mm)
0.354" (± 0.002 ")
from reference edge

Aspect ratio: 1.66:1 (15x9)





Telecine Scan Settings:

For 16x9 widescreen television use, calibrations are provided that correspond to EBU recommendation R86 (SMPTE 96M) for maximum safe area dimensions to be scanned on Super 16mm film. The telecine scanned area should be set to the point where the legended arrows meet the tips of the castellations. This gives a 12· 2mm x 6· 86mm aperture.

Some users may wish to take a centre cut out 4x3 image from their material and subsidiary markings are provided for this purpose. Note that a scanned height similar to that of the 16x9 image has been assumed. Alternative recommended scanned area dimensions on Super 16mm film for 4x3 television use can be found in EBU recommendation R86 and SMPTE 96M.

Rulers:

Calibrations are incorporated to allow direct setting of the scanned area for both width and height. Metric calibrations are at 0· 1mm intervals, Imperial at 0· 005" intervals, symmetrical about the centre of the test card. Width is calibrated from 7· 7mm to 12· 5mm and height from 6· 4mm to 7· 4mm.

To set the telecine to scan, say, a width of 12· 0mm, the telecine width and centring controls should be adjusted until the 12· 0mm calibrations **on both sides of the test card** are bisected by system blanking. Obviously, a similar instruction applies when setting height. Note: when setting scanned areas, care should be taken to ascertain whether analogue or REC601 blanking is being used on the telecine monitor and an allowance made if necessary.

Resolution/astigmatism:

The resolution gratings are shown in MHz for a 625 line system with 52 μ s active line time assuming that the telecine scanning is set as detailed above. 525 line systems have an active line time approximately 0· 5 μ s (<1%) shorter than that of 625 line systems, however this will make no significant difference to practical measurements. No attempt has been made to reproduce sine waves.

Nine astigmatism patches have been provided in addition to the frequency gratings. Their horizontal centre frequency corresponds to 5MHz. This is to allow a quick assessment of overall gate focus to be made.

The concentric circles that surround the corner astigmatism patches are intended to show the effect of poor interlace.

Linearity:

A grid of 20x12 boxes, together with the main circle, allow a quick visual assessment of the linearity of both monitor and telecine. The diagonal lines are intended to show up any interlace faults.

Greyscale/Streaking:

A 5 step greyscale is provided but it should be noted that although the test card is manufactured from monochrome film and hence nominally neutral, measurements are not made to verify this.

Patches are provided to allow both long and short term, white after black, and black after white streaking to be assessed.

Performance:

The performance figures given in the table below are the average of several measurements made on a full roll of un-cut film. Individual films should therefore match the figures below closely. The effect of any signal processing in the telecine should be accounted for when assessing performance.

Parameter	Measured	Specification/Comments
Image width	12· 45mm 0· 59"	12· 35mm (nominal)
Image height	7· 51mm 0· 296"	7· 42mm (-0, +0· 15) 0· 292" (-0, +0· 006)
Image Centre	8· 986mm 0· 3538"	9· 0mm ±0· 05mm 0· 354" ± (0· 002)
Vertical Ruler	7· 01mm	Between 7· 0mm points
Horizontal Ruler	11· 97mm	Between 12· 0mm points
Resolution 1MHz	100%	Reference
" 2MHz	100%	Average measurement
" 3MHz	100%	Average measurement
" 4MHz	100%	Average measurement
" 5MHz	>95%	Average measurement
" 6MHz	>90%	Average measurement
Astigmatism Boxes	>90%	Average measurement

Liability:

In the unlikely event of a film being defective, it will be replaced with a new one of the same length. No other responsibility is expressed or implied.

EBU P/TK Shrinkage Test Films

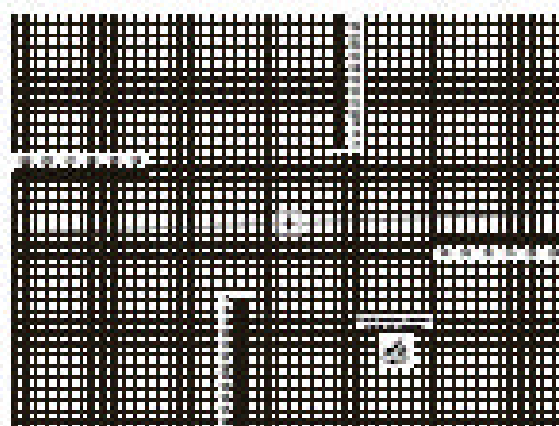
P/TK – 28th May 2003

The paragraphs below summarise the test films supported by the EBU P/TK group to assess telecine performance, particularly with respect to shrunken material.

535mm Linearity Test Film

The diagram alongside shows the target pattern used to assess transport and linearity performance. The target is divided into squares and there are 50 squares across the 535 frame representing 2% of picture width. The centre horizontal line is deliberately diagonal in order to assess vertical instability. Metric rulers have been incorporated in order that scans can be set on a telecine for a known scanned area.

This of course assumes the use of film that has not been shrunk!! Although it has been given an R.H. Testfilms number, no footage has been released outside the group and it is envisaged that imperial rulers could be added if thought appropriate. A version using a horizontal centre line has also been designed.



535mm Focus Test Film

The diagram alongside shows the target pattern used to assess overall focus performance. It is comprised of vertical lines with a pitch equal to 400 lines per picture height – a standard way of expressing resolution in TV terms which is actually 200 line pairs. In more user friendly terms, this translates to 333 elements across the active frame (400 x aspect ratio) which in turn evaluates to 5.125 MHz!

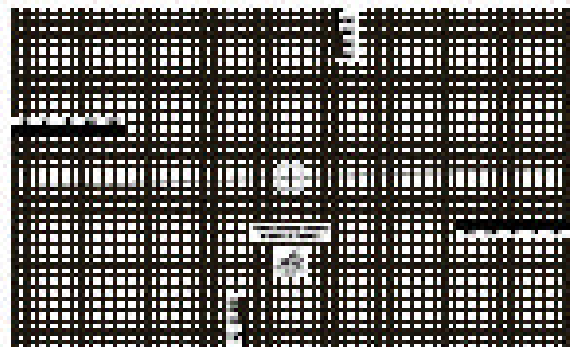
As with the film above, it has been given an R.H. Testfilms number but no footage has been released outside the group. Again, it is envisaged that imperial rulers could be added if thought appropriate.



516mm Linearity Test Film

The diagram alongside shows the target pattern used to assess transport and linearity performance. The target is divided into squares and there are 50 squares across the S35 frame representing 2% of picture width. The centre horizontal line is deliberately diagonal in order to assess vertical instability. Metric rulers have been incorporated in order that scans can be set on a telecine for a known scanned area.

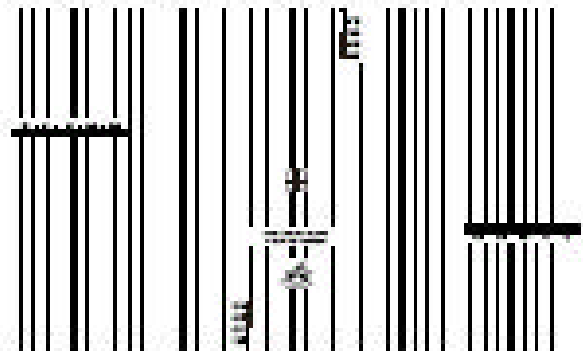
This of course assumes the use of film that has not been shrunk!! Although it has been given an R.H. Testfilms number, no footage has been released outside the group and it is envisaged that imperial rulers could be added if thought appropriate. A version using a horizontal centre line has also been designed.



516mm Focus Test Film

The diagram alongside shows the target pattern used to assess overall focus performance. As with its S35mm cousin, it is comprised of vertical lines with a pitch equal to 400 lines per picture height. In this format 400 elements (lines – one black, one white), translates to 499 elements across the active frame (400 x aspect ratio) which in turn evaluates to 4.8 Mhz.

As with the film above, it has been given an R.H. Testfilms number but no footage has been released outside the group. Again, it is envisaged that imperial rulers could be added if thought appropriate.



Robin Hurley
May 2003

A High Resolution S35mm Test Film for the EBU

by Robin Hurley MBKS

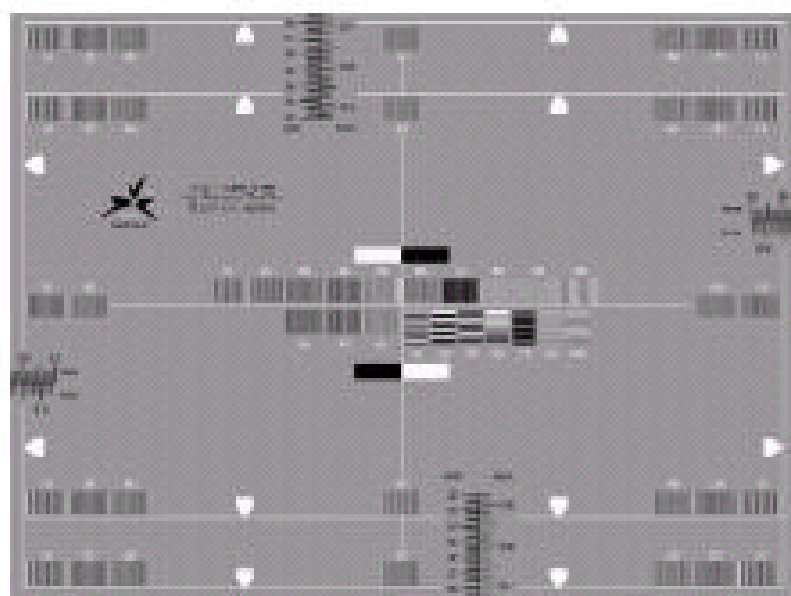
The EBU P/TK working group was set up to investigate the performance of modern telecines and to recommend design parameters for future machines. Measurement of resolution was one of the aspects of the work of the group. It was considered that a test film was required that had a performance equal to or better than that of equipment currently in the marketplace. Because no such film was known to be available, a suitable one was commissioned and is described below.

received and closely examined on other stands, with surprise expressed at what had been achieved.

It had been hoped to use a high-resolution black and white reversal stock, the idea being to minimise flare. However, although it may be possible to obtain the stock, I was advised that reversal processing would be another matter in the lengths needed to produce saleable product. Consequently a mild grey background was chosen, with black and white references built in to the target.



Robin Hurley MBKS joined the BBC in 1964 and spent ten years at BBC Television Centre, on the studio floor in an operational capacity and in the telecine area, where he carried out operational and maintenance duties. He worked for eight years at Independent Television News, as a maintenance engineer. Robin joined Channel Four Television in 1982 as a Maintenance Supervisor (before the station had started transmissions), and subsequently became Electronic Maintenance Manager. He now runs his own company R.H. Testfilms, which specialises in the production of high-quality test material for broadcasters. Robin can be contacted at *R.H. Testfilms, 27 Carpenter Wood Drive, Chorleywood, Herts WD3 5UN. Tel: 01023 286 005*



The test film target has undergone several iterations since its inception and the current version is shown above. Samples of a previous iteration of the target were produced in time for IBC 2003 and were available for inspection on the EBU stand. They were also shown to several manufacturers.

One manufacturer was shown the sample about an hour before the launch of a new scanner capable of resolving 100 lp/mm and was thus able to prove its capability to potential customers. It was also well

Resolution:

It was originally suggested that 200 line pairs per mm was desirable. However, following discussions with colleagues it was abandoned as unnecessary and impractical and an upper limit of 100 line pairs per mm was chosen. There were other considerations such as the maximum size of master artwork: the exposing camera was only about 20 cm from its maximum height – the concrete ceiling!

This film is not intended for use in

conjunction with standard definition television. It is perhaps worth noting that just 10 line pairs per mm (lp/mm) on a super 35mm frame would equate to 4.79 MHz if scanned at standard television rate (10 line pairs*24.92mm)/52 microseconds – very close to the 5.5MHz limit of PAL System 1.

Simple arithmetic shows that 4K (4096 elements) distributed across a super 35mm frame (24.92mm) equates to 82 lp/mm (82 black & 82 white). Even ignoring Nyquist, it would be impossible

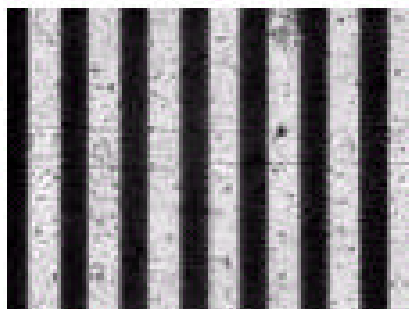
for a 4K scanner to cope with this as the elements would have to line up exactly with the film image – and that would not happen!

In the diagram opposite it can be seen that the centre resolution patches are 10, 20, 30, 40, 50, 60, 70, 80, & 100 line pairs per mm. This is effectively a calibrated frequency sweep.

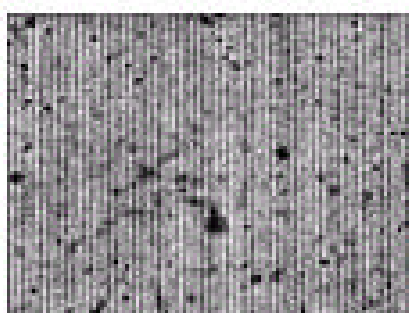
An important requirement of the test film is to highlight shortcomings in anti-aliasing filtering or the lack of it. The theoretical limit for 2K scanning is 41 lp/mm and so a block of test patches with 35, 40 & 45 lp/mm is included to investigate equipment performance at this point. A similar facility is available for 4K scanning by using the 70, 80 & 90 line pair sections of the main sweep.

In order to resolve the 100 lp/mm patch, a scanner would need to be capable of at least 6K resolution.

As can be seen, lower frequencies are placed in the corners. This is because practical lenses are not at their best at these points.



*10 lp/mm taken through microscope
eyepiece*



*100 lp/mm taken through microscope
eyepiece*

The aim of producing a previously unattained high-resolution performance has been achieved – 40% at 100 line pairs per mm in the centre of the image.

Calibrations:

The test film is designed around the SMPTE style 'C' aperture (24.92mm x 18.67mm). Ruler markings are included as are calibrations for EBU recommended scanning areas for both 4:3 and 16:9 aspect ratios.

Verification:

There is no point in even trying to produce any piece of test film whose parameters cannot be measured to a reasonable degree of accuracy and included with the product. A very high quality binocular microscope with fixed exposure camera was used for this. The magnification available meant that the camera was working well within its bandwidth and the same lens was, of course used throughout the measurement sequence. The pictures alongside show detail at 10 and 100 lp/mm taken from the top of the microscope.