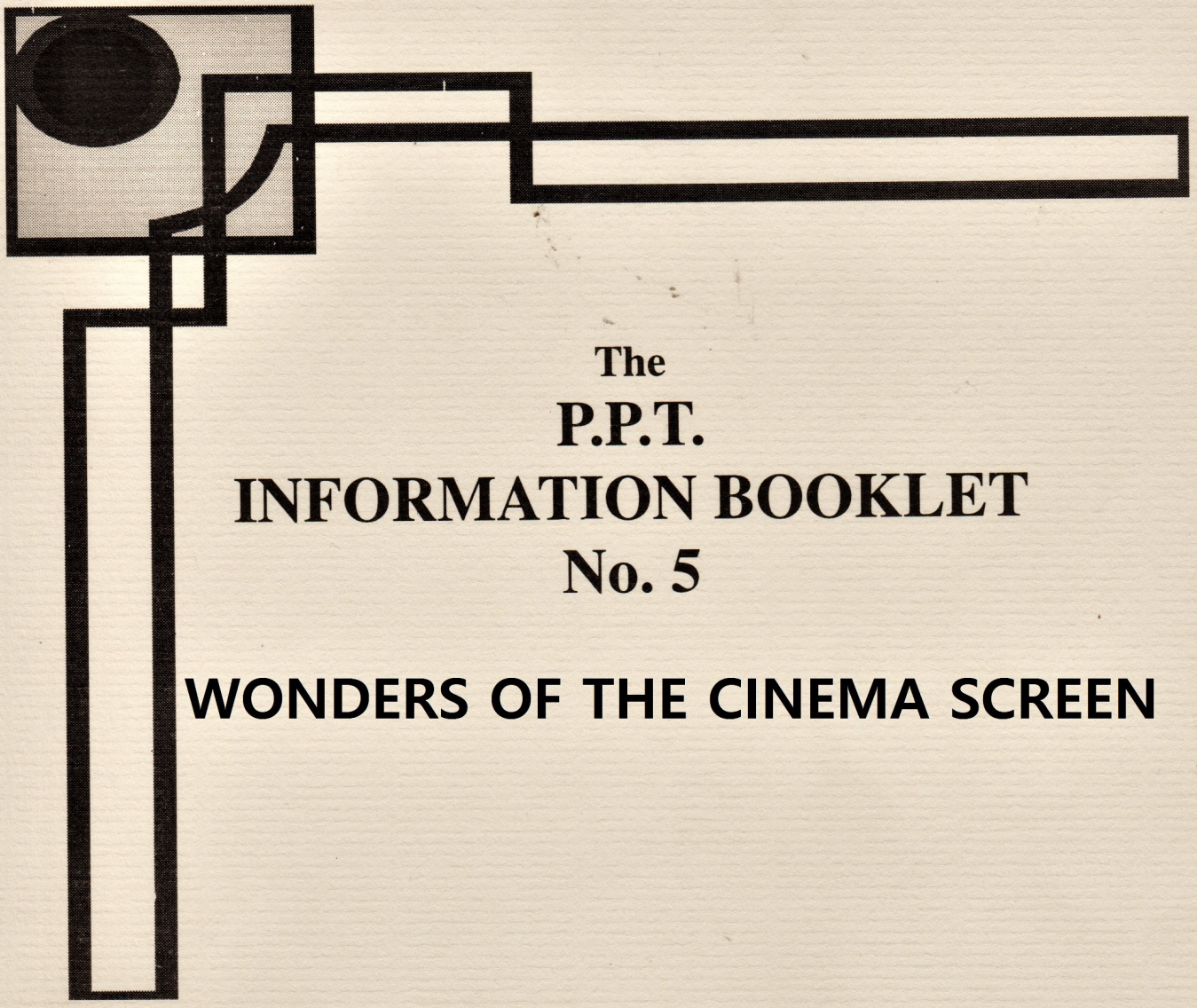
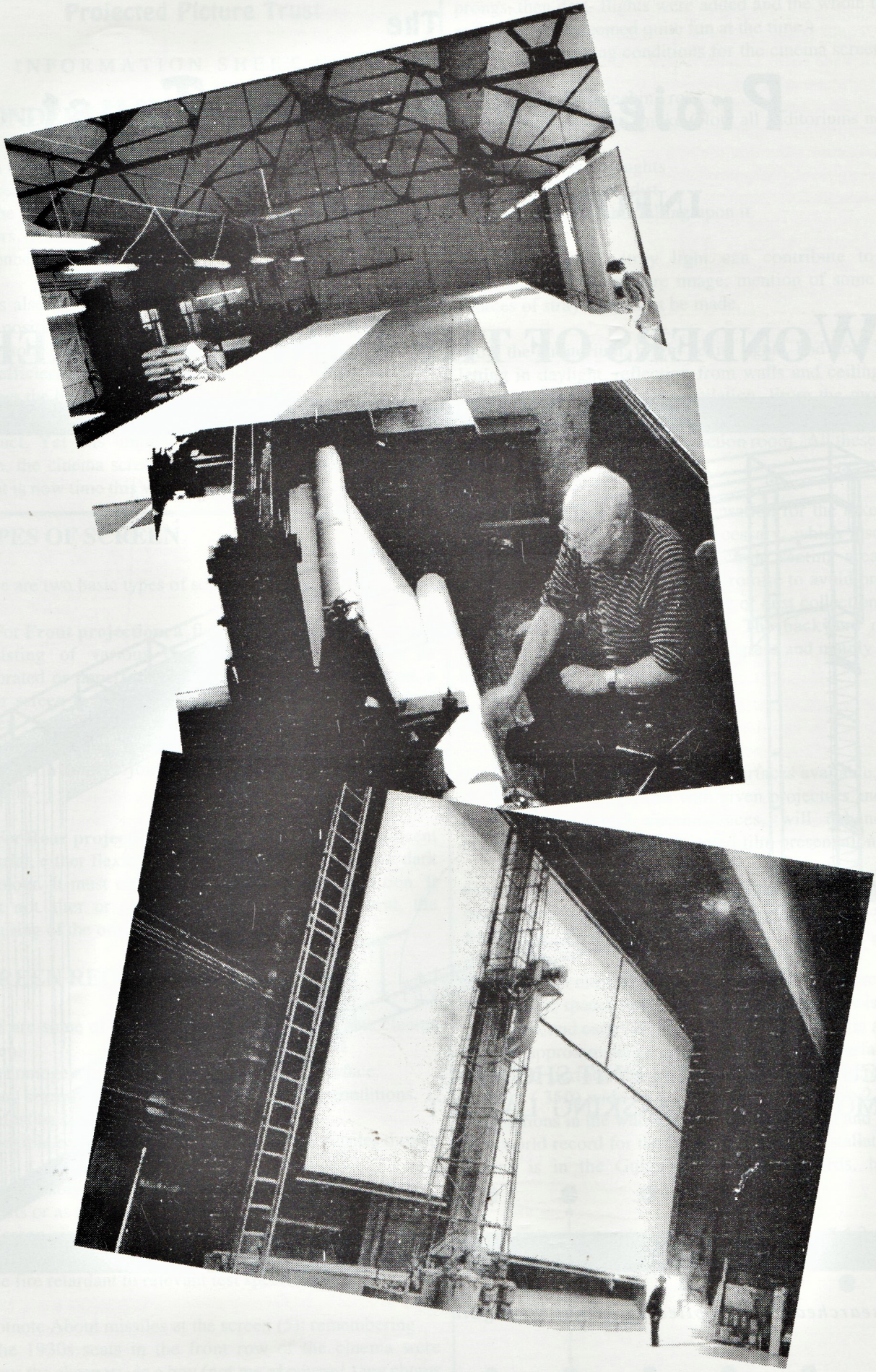


The

P.P.T.
INFORMATION BOOKLET
No. 5

WONDERS OF THE CINEMA SCREEN



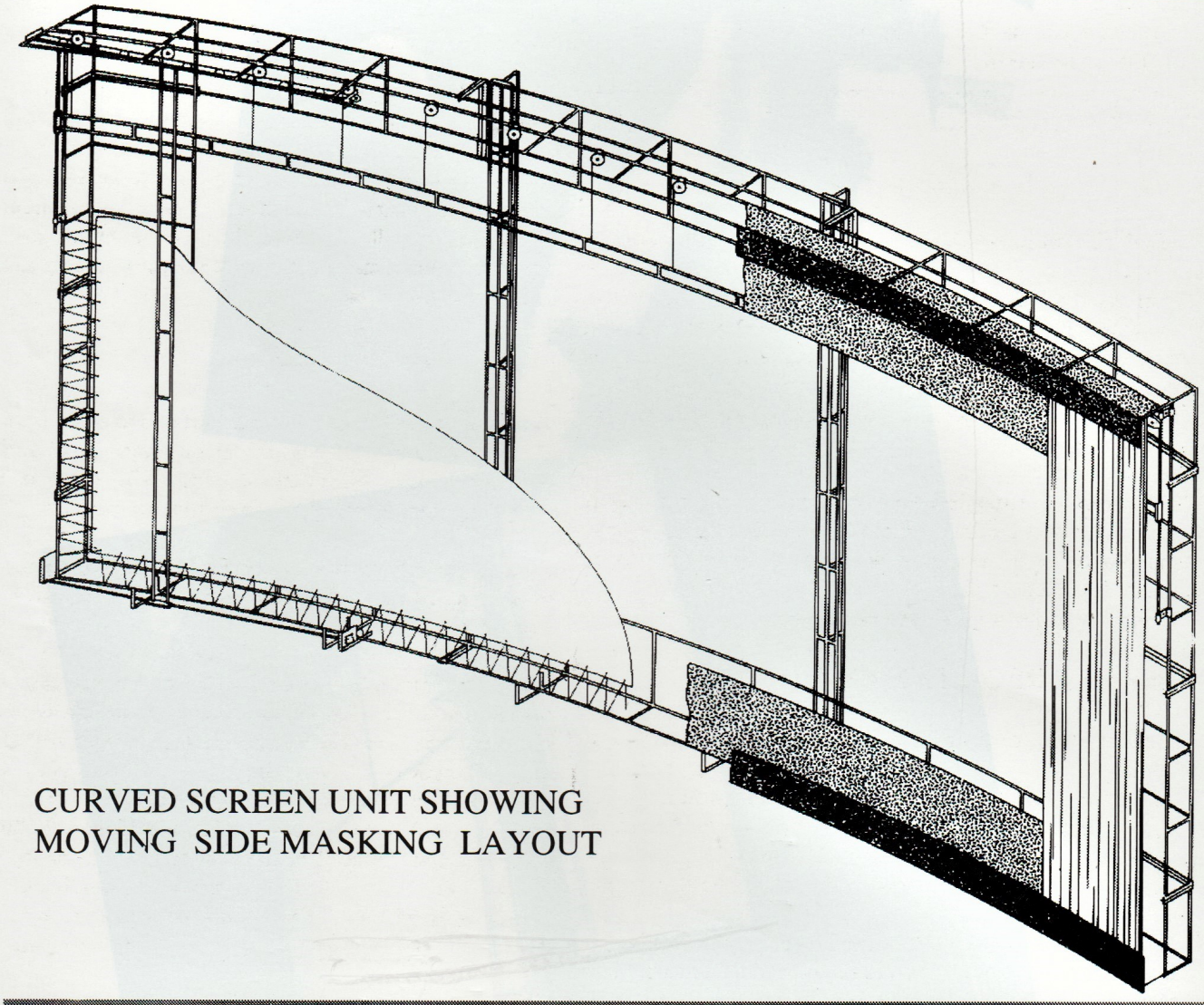
The

Projected Picture Trust

INFORMATION SHEET No. 5

The

WONDERS OF THE CINEMA SCREEN



CURVED SCREEN UNIT SHOWING
MOVING SIDE MASKING LAYOUT

Researched and compiled by Arthur W. Pigott

© Projected Picture Trust 1996

The
Projected Picture Trust

INFORMATION SHEET NO.5

WONDERS OF THE CINEMA SCREEN

From concept to image on film requires the skills of many different people, each person contributing special expertise. By the time it reaches the cinema, the film has involved writers, directors, camera persons, lighting and sound personnel, and many others.

It has also gone through film processing labs for negative and positive print making, arriving in high-tech. film projectors, then it is illuminated and passed through modern and efficient optics to the cinema screen, which needs to possess the highest quality reflecting surface.
It is from here that the cinema-goer sees the finished product. Yet this immensely important item in the film chain, the cinema screen, has had so little written about it that it is now time this was rectified.

TYPES OF SCREEN

There are two basic types of screen:

(I) For **Front projection,** a flexible white opaque material, consisting of various coatings and textures; can be perforated or unperforated. For 3D polarised projection, a silver screen is required. Typical examples of the modern screen usually made from PVC material, with special metallised coating, making it light in weight and flexible, able to "invisibly" joined, thus making any screen size possible.

(2) For **Rear projection** the requirements are: a translucent material, either flexible or rigid It can be light grey or dark in colour. It must not show hot spots of the projection. It must not alter or change, to any noticeable extent, the colouring of the original images on film.

SCREEN REQUIREMENTS

Here are some of the requirements expected of the cinema screen:
1. A homogeneous, stretched, flat reflecting surface.
2. Any seams to be invisible under projection conditions.
3. Must be clean and free from stains.
4. Flexible enough to be able to resist minor missiles thrown at it.
5. Be suitably masked to accommodate the various film formats or as a Floating picture to one set picture size.
6. Screen size should be compatible with the auditorium size. i.e Not less than two thirds width of the auditorium.
7. Be fire retardant to relevant test specifications.

(Footnote About missiles at the screen (5): remembering in the 1930s seats in the front row of the cinema were always the cheapest, as a boy (not me of course!) my chums used to chew school -green blotting paper, then flick chunks of the wet stuff at the screen. Also chewing gum was given like treatment. I recall steel pen nibs being broken to the two prongs, then dart- flights were added and the whole thrown at the screen. It seemed quite fun at the time.)
The correct working conditions for the cinema screen must be:
1. A dry place. No leaking roof
2. Free from cigarette smoke (Note all auditoriums now are Non-smoking)
3 Away from any draughts
4. Free from dust and dirt
5. Have no stray lights falling upon it.

Stray light Since stray light can contribute to some degradation of the picture image, mention of some of the sources of stray light must be made.

From the auditorium: bright "exit" lights, bad door fittings letting in daylight, reflection from walls and ceiling, even cigarette smoke and poor ventilation. From the projection room: projector lens flare, dirty port glasses, even the colour of the interior walls of the projection room . All these can be eliminated or minimised.

Screen tilt or rake Some compensation for the rake of the film projectors is sometimes necessary, which also gives equal brilliancy from stalls to circle seating areas. The actual amount of tilting is a compromise to avoid problems with masking gear and the amount of dust collection on the screen which will be inevitable. The backward rake is, however, never more than a few degrees and mainly applies to theatres with balconies.

SCREEN SURFACES

There are several kinds of screen surfaces available, which, if chosen correctly for use with given projectors and in the right environmental circumstances, will enhance and complement any form of projected film presentation.

Cinema screens are usually "perforated" to allow sound to pass through without affecting too many of the higher sound frequencies. To B.S. 5550 1980.

Perforations made in the modern cinema screen are 1.2mm in diameter; spaced 5mm apart, each alternate row is centre-staggered, and each row is 5mm apart. Therefore in a 30 Cm square (approximately a square foot) of screen surface there are 4,095 perforations. An average multiplex screen, say 10.67m (35ft) wide by 4.57m (15ft) would have 2,149875 perforations in the whole screen. (See Figs. Ia and lb).
The world record for the largest permanent installation of a screen is in the Guinness Book of Records, held by

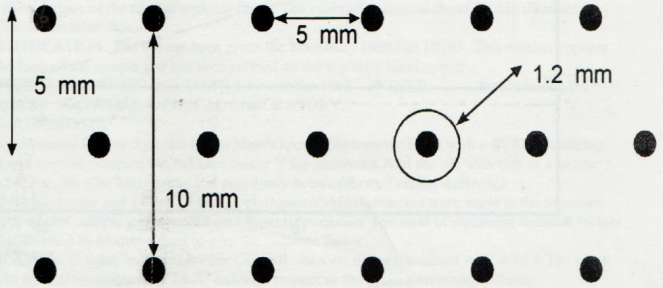


FIG 1a Screen perforations and their measurements

©The PPT Information Information Sheet No.5, 1996

Harkness Hall - it measures 33m X 24.5m.(109.25ft X 81.04Ft) It has some 36,416,630 perforations ± one or two. It is the Imax screen, in the SSangyong Earthscope Pavilion in the Science Park, Taejon, Korea.

From a reasonable viewing distance of 5m (16ft) the perforations are not visible to the audience. The fact that the "perforations" are apertures and cannot therefore reflect light, it is surprising that they do not have an adverse effect on the overall illumination of the projected film transparency.

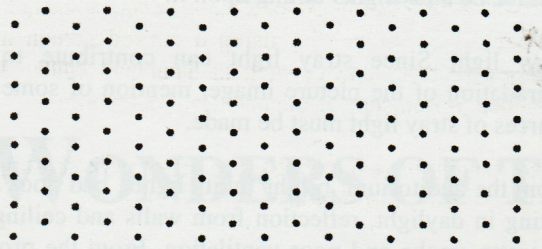


Fig 1b

A portion of perforated screen shown actual size

Some cinema goers are aware, that, for the best cinematic effect, it is better to sit to the centre of the screen, there being some fall-off of brightness the further you sit to the side of the screen although this is somewhat offset when a curved screen is used.

As can be seen from Fig. 6, the "reflectance" curve for high gain screens shows a much higher reflectance value at the centre viewing point then falls off the more you move away from the centre axis.

There is a considerable fall-off at around 20 degrees off axis. However, with Perlux screens the reflected light to any part of the auditorium is never less than that achieved with a matt white screen.

Different screen materials have different reflectance gain characteristics as will be seen by the Luminance graphs supplied by screen manufacturers.

Harkness Hall Ltd. produce several different screen surfaces. Here are some typical examples:

For Front Projection

Matt White An excellent screen material. Made of PVC in two weights. Also forms the base of other screen surfaces, such as

Perlux, Spectral 2000 and **T32 high reflectance silver.**

Matt White 11 This is a PVC surface with "memory" containing optical brighteners. Is used where the screen will be webbed and eyeletted then stretched into a rigid frame. Can be welded to make up any size. Conforms to BS 5867 part 2 (See Fig. 2).

Perlux I Made of a heavier gauge material is useful for roll-up/roll-down situations and also for wrap-round frames. Conforms to BS 5867 part 2. (see Fig. 3)

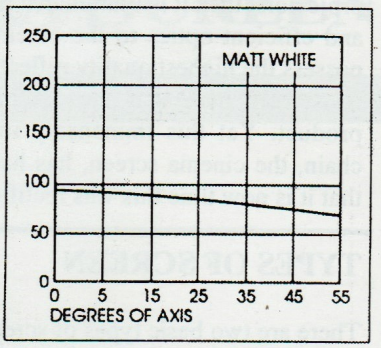


Fig 2

Matt White Reflectance curve

Perlux 11

Uses the same base material as Perlux 11 and is then coated by a spraying process, with a pearlised reflective surface. It was developed to reduce transportation costs, by being folded and packaged to enable Air Freighting. It can only be used as a stretched screen in a frame.

Deep Curve

A special material designed for the projection of 70mm films. The surface has a "low scatter" coating to prevent cross reflection in screens curvable up to 120 degrees.

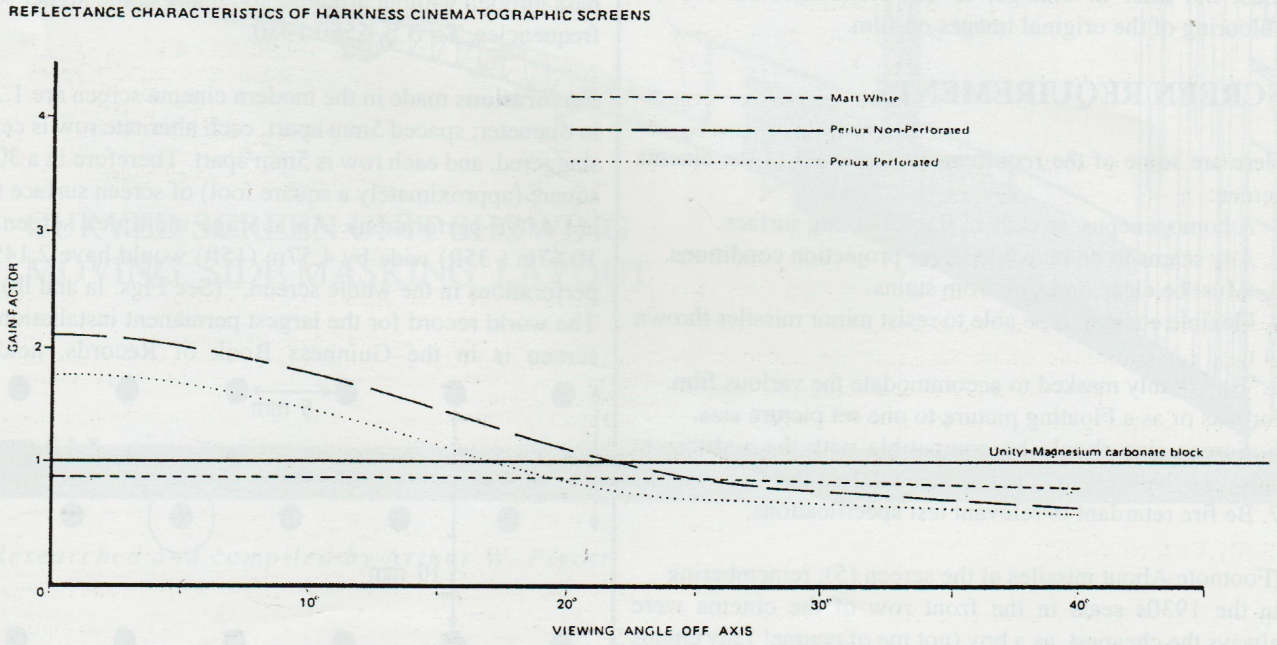


Fig 6

Comparison reflectance characteristics of white screen surfaces

REAR PROJECTION SCREEN MATERIAL

"Translite Flexible" Is an unsupported PVC surface with built-in diffusion to avoid "hot-spotting" and "flare". Harkness Hall screens claim that with their welding technique a large projection screen will not give evidence of seams under normal projection conditions at normal viewing distance. All conform to BS 5867 Part 2.

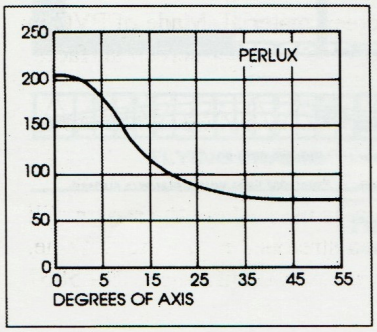


Fig 3
Pelux reflectance curve

Translite Natural Tint Is a translucent material, can be used in frames or as a roller screen , for rear projection only under dark conditions.

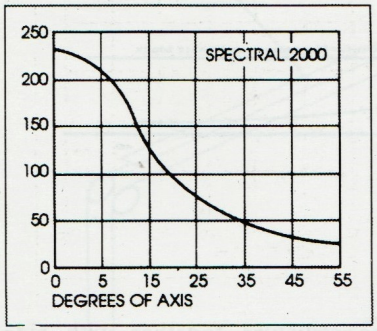


Fig 4
Spectral 2000M

Translite Dark Dark grey in colour; suitable for use in low ambient light conditions. Is flexible and resilient, is ideal for both frame fixing or for roller use Ideal for training rooms where "note-taking" is required.

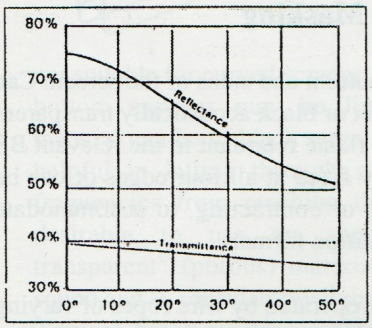


Fig 5
Translite Super 11

Polacoat Made from flexible vinyl material, with good contrast and colour reproduction. Has transmittance of 50 per cent, plus or minus 5 per cent. Dark grey in colour. Is crushable but soon returns to its original state. Is resilient and suitable for both cinema and low light conditions, such as the training situation. Can be used in fixed frame, roller or portable screen situations.

Translite Super 11 This is a special unsupported PVC material of heavier gauge with greater diffusion than **natural** or **dark tint** mentioned elsewhere. It is designed especially for situations where the prime requirement for both front and rear projection is a single screen surface. As can be seen from Fig. 5 the surface provides good picture rendition for front and rear projection, under darkened conditions.

THE SILVER SCREEN

References to the cinema often refer romantically to the "silver screen", when now it is used especially and is essentially for the presentation of polarised three-dimension screenings, requiring two projected images carefully and critically 'displaced ' on screen to assist in viewing with special spectacles using one vertically polarised lens with the other horizontally polarised the effect to the viewer being one of visual 3-D.

It must be admitted that the metallised screen tends to be somewhat more directional in luminance than the conventional surface. It behaves more like a mirror, with the greatest reflectivity to a ray of light in the direction of specular reflection. A matt white screen diffuses light almost evenly in all directions. Flat metallised screens will give lower illumination in marginal seats, although this effect can be minimised by using a curved screen and a specialised screen surface, such as **Spectral 2000.** Most cinemas are optimised for the best light distribution.

Here are details of two examples of silver screens supplied by Harkness Hall Ltd screens:

Spectral 2000 Specially developed for 3-D and conventional front projection of films. Its special coating ensures uniformity of surface and makes joining-seams invisible under normal conditions. It adds crispness to the projected picture, with good colour temperature. Is considered better than conventional "silvers".

T32 Extra High Gain Silver Surface This material is specialised. Reflectance Gain at centre is in excess of 4. It is highly directional but is not recommended for viewing above 25 degrees off projection axis. Complies with BS 5867 Part 2.

Perhaps a brief reference to Brightness or Luminance Gain should be made here. It is the ratio of the luminance of a specified area of screen to the luminance of a perfectly diffusing and perfectly reflecting surface, which must be measured under the same conditions of illumination and observation. The generally accepted **perfectly reflecting surface** used for the standard comparison was obtained by using a freshly scraped block of magnesium carbonate (MgCo2) and considering the measurement as unity (1). However, now, this is replaced by a special *very* expensive white tile. see below

NATIONAL PHYSICAL LABORATORY
Teddington Middlesex TW11 0LW England

Certificate of Calibration

WHITE REFLECTANCE STANDARD

Example

NATIONAL PHYSICAL LABORATORY Teddington Middlesex TW11 OLW England FOR ...: Certificate of Calibration WHITE REFLECTANCE STANDARD For: Harkness Screens and Hall Stage Ltd. The Gate Studios Station Road Boreham Wood WD6 lDO For the attention of ...:DESCRIPTION: The sarnple is a white ceramic tile 152 mm square. The front surface of the tile has a glossy finish. The calibration area of about 20 mm diameter is centred on the front face.

IDENTIFICATION: The tile has been given the laboratory identifier HN93. This number appears on the back of the sample and has been scribed on the top right hand corner.

REFERENCE QO03/5/93/056 DATE 5 November 1993 SIGNED..... for Director CHECKED NATIONAL PHYSICAL LABORATORY

MEASUREMENTS

An Instrumental Colour Systems Micro Match spectrophotometer fitted with a 45°/0° measuring head was used to compare the radiance factor Y for illuminant A of the tile with that of a sirnilar NPL Master tile. The Matster tile had previously been calibrated on the Reference Spectrophotometer and a Cary 14 spectrophotometer. Measurements were made in the sequence sample, master, sample and repeated on a separate occasion. The ratio of measured radiance factors were multiplied by Master values to give the radiance factor.

RESULT The Y value is quoted for the CIE 10°.observer under illuminant A. Y = 88.8 The result quoted is for a temperature of 25 °C and with respect to the perfect reflecting diffuser.

UNCERTAINTIES

The uncertainty in Y stated at the 95% confidence level is + 0.8. This lies mainly in the realisation of the primary 45°/0° radiance factor scale.

©The PPT Information Information Sheet No.5, 1996

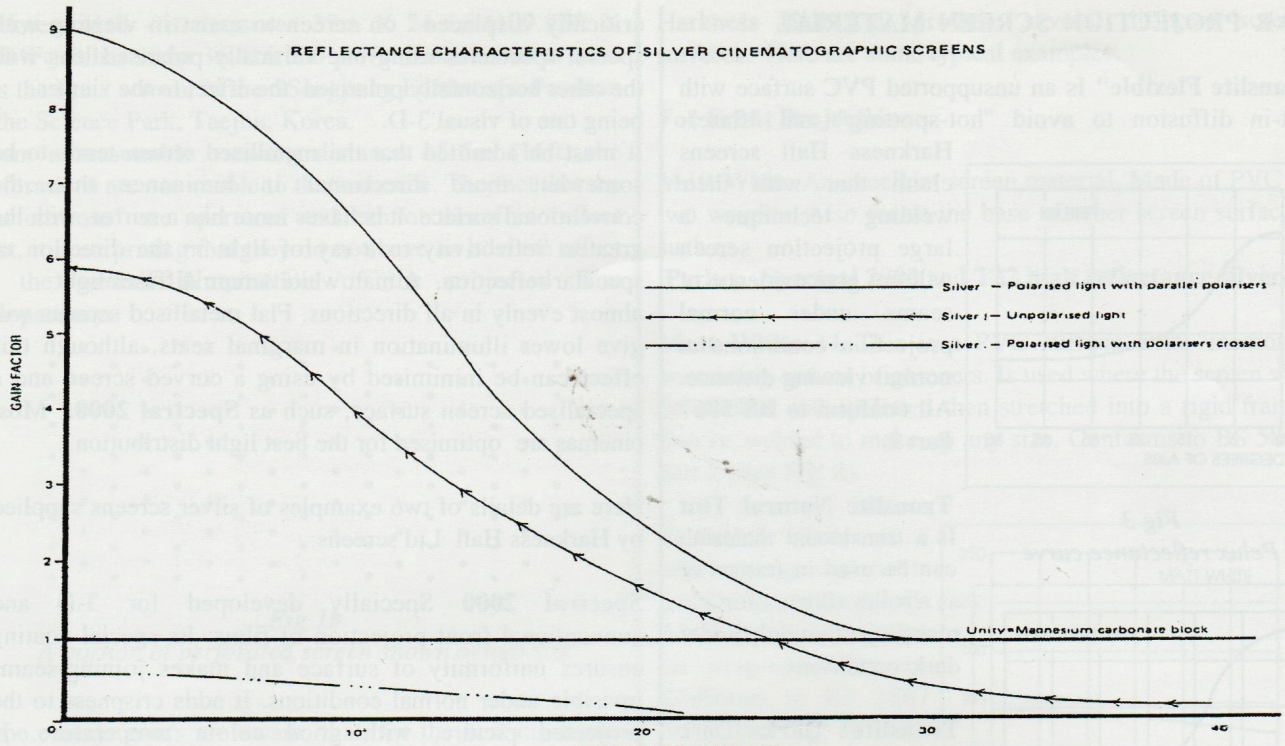


Fig 7

Reflectance characteristics of silver screen surfaces

The screen luminance objective of 16 foot-lamberts is readily obtainable in cinema environments by the correct choice of projectors and xenons but the BS recommendation for screen luminance for 35mm film projection is between 8 to 16 foot-lamberts.

KINDS OF SCREEN FRAMES

Flat Frame

This is normally floor standing, together with its stabilising support braces at the rear. Frames up to 13.4m (40 feet) are standard, although larger ones are available. They can also be supplied on trolleys for mobility. (See Fig. 8).

Flying Frame

Is similar to the flat frame but is strengthened to allow it to be suspended by cables. Both screen and masking system can be so flown in a combined assembly Supplied as standard up to 13.4m (40'feet) wide. Normally flying frames incorporate a single curve within a box-frame structure and are supplied with fixed or moving masking systems as determined by the frame mounted controllers.
(see Fig. 9.)

Curved Frame

A curved screen does not add luminance to a screen, it merely assists minimising the "fall-off' to those sitting at the edges of the auditorium. It therefore displays more uniform luminance. Such curvature is in the horizontal plane only.
Although screen curves up to 120 degrees can be made, these require special screen material possessing a "low-scatter" coating to avoid the risk of cross reflection.
Most types of screen frame can be curved but usually not those less than 9m (30 ft) wide.

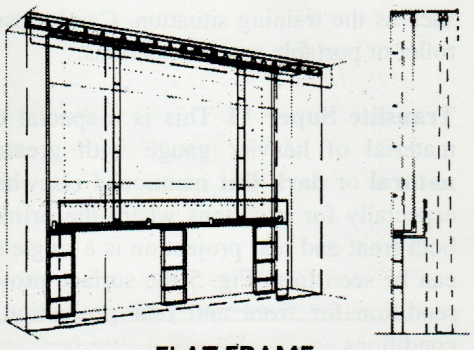
Front page shows frame structure together with side masking arrangement.

Black Side and Top Masking

Masking surrounds top, bottom and sides of the screen. Can be black wool serge, velvet or black acoustically transparent material, all of which are flame retardant to the relevant BS specifications. It is rigidly fixed at all four edges or can be adjustable, by expanding or contracting, to accommodate the various screen presentation formats.

Such masking systems are operated by wire ropes of varying thicknesses, through a series of pulleys, to a cable winding drum powered by an electric motor The limiting switches control the various screening formats. Both single or double wire systems are available.

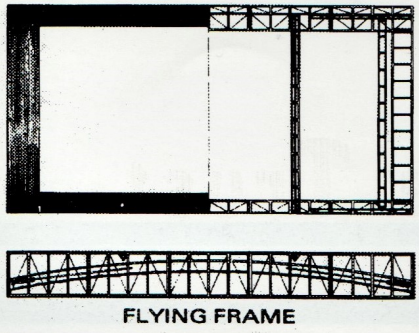
(see Fig. 10. Showing the wiring up path of a modern variable masking system.)



FLAT FRAME

For moving top masking, special leading edge and counterweights enable picture height to be varied with no change to the bottom picture line (BPL).

Moving bottom masking performs the same function in reverse, with no change to the top picture line (TPL) but is



(Note that the webbed and eyeletted screen surface is laced onto the frame; such lacing being hiden by the screen masking.)

Fig 9
Diagram of Flying Frame

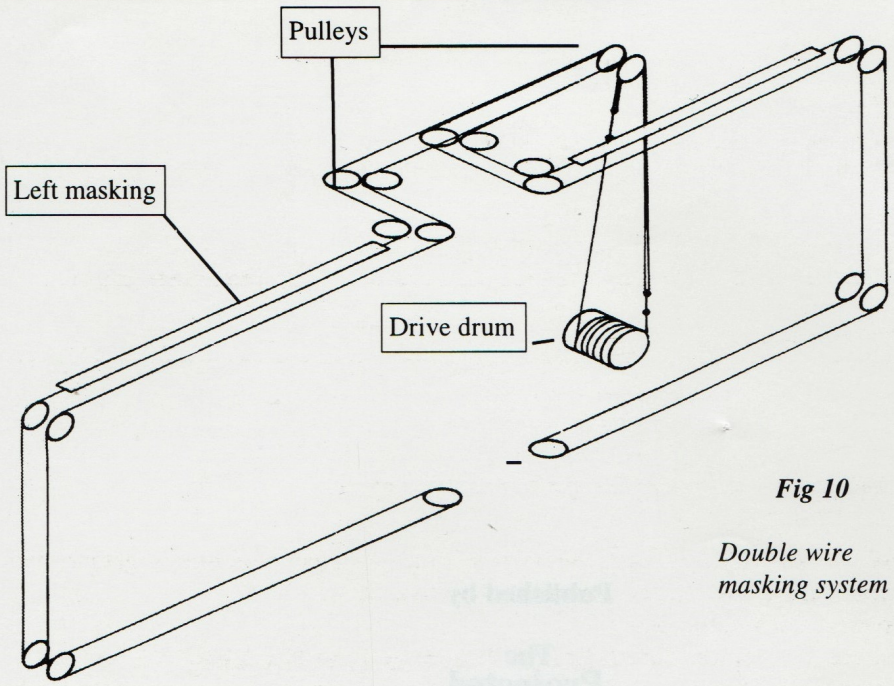


Fig 10

Double wire masking system

not suitable for curved screens. Again, both moving top and bottom systems may be linked together.The masking material can be of black serge or velvet although this is not helpful in letting through sound and stops the higher frequencies from reaching the audience. It is therefore desirable to use an approved black "acoustically transparent" (porous) material which has little effect on sound and is considerably lighter in weight.

Typical black masking materials as supplied by Harkness Hall Ltd.

Standard. Black wool serge with good light absorption characteristics. Has some effect on higher sound frequencies.

Sound 2000M. An acoustically transparent black masking material with excellent light absorption characteristics. Is ideal when loudspeakers behind-the-screen might be obstructed by masking elements. Is somewhat lighter in weight than **Standard.**

MAINTENANCE

It is not the intention of this article to become a manual but searching through much printed material, the question of screen maintenance crops up. On cleaning the screen, some advise using very diluted liquid soap, some, sponging with cold water but no matter how conscientious and careful the cleaning is, when it dries it always shows. Manufacturers advise DO NOT attempt to clean a cinema screen - replace it! However, the black screen masking should be vacuumed from time to time.

A film is but an illusion of reality, produced by a team effort, nothing therefore should intrude to make it other than dreams coming true. The cinema screen is the last item to be encountered in the film chain; it should be seen and yet not be seen.

CREDITS

I should like to thank Harkness Hall Ltd. and Johnny Lawton and Eddie Daniels of Harkness Hall Ltd. for permission to use their diagrams and for supplying specimen screen samples, for their considerable help and assistance in writing this article.

REFERENCES

1. Motion Picture Presentation Manual Pub. BKSTS (1979)

2 Reel People Collection Pub. Eastman Kodak Company (1984)

3 Motion Picture Presentation and Theatre Presentation Manual Pub. SMPTE (1969)

4. Guinness Book of Records Pub. Guinness Superlatives Ltd (1994)

5. Harkness Hall Ltd The Gate Studios, Station Road, BOREHAM WOOD Hertfordshire WD6 IDQ

BRITISH STANDARDS (some were referred to but there are many more pertaining to the cinema)

BS 5867 Specification for fabrics for curtains and drapes.

Note: The BS 5550 1980 series covers all aspects of cinematography. Strict fire standards for screens, frames and materials are in use by most countries, here is a sample of the Canadian test label.


UNDERWRITERS' LABORATORIES OF CANADA LISTED
PLASTIC
FORM: M ISSUE 8063 C
CLASSIFIED AS TO SURFACE BURNING CHARACTERISTICS IN ACCORDANCE WITH THE STANDARD CAN4-S102-2.
CLASSIFICATION OR RATING

MATERIAL DETAILS	FLAME SPREAD	SMOKE DEVELOPED	FUEL CONTRIBUTED
MATT WHITE	5	50	0
PERLUX	5	45	0
SPECTRAL 2000	5	35	0

HARKNESS SCREENS LIMITED
THE GATE STUDIOS, STATION ROAD, BOREHAMWOOD HERTS. WD6 1DQ
TEL 01-953 3611 CABLES SCREENS LONDON TELEX 8955602 – PERLUX G

Standards

BS 5867 Pt2 U.K.
France M2
Germany DIN 4102 B1 & 4102 B2
Canada & USA 4S102-2
Australia 7-446780-CO

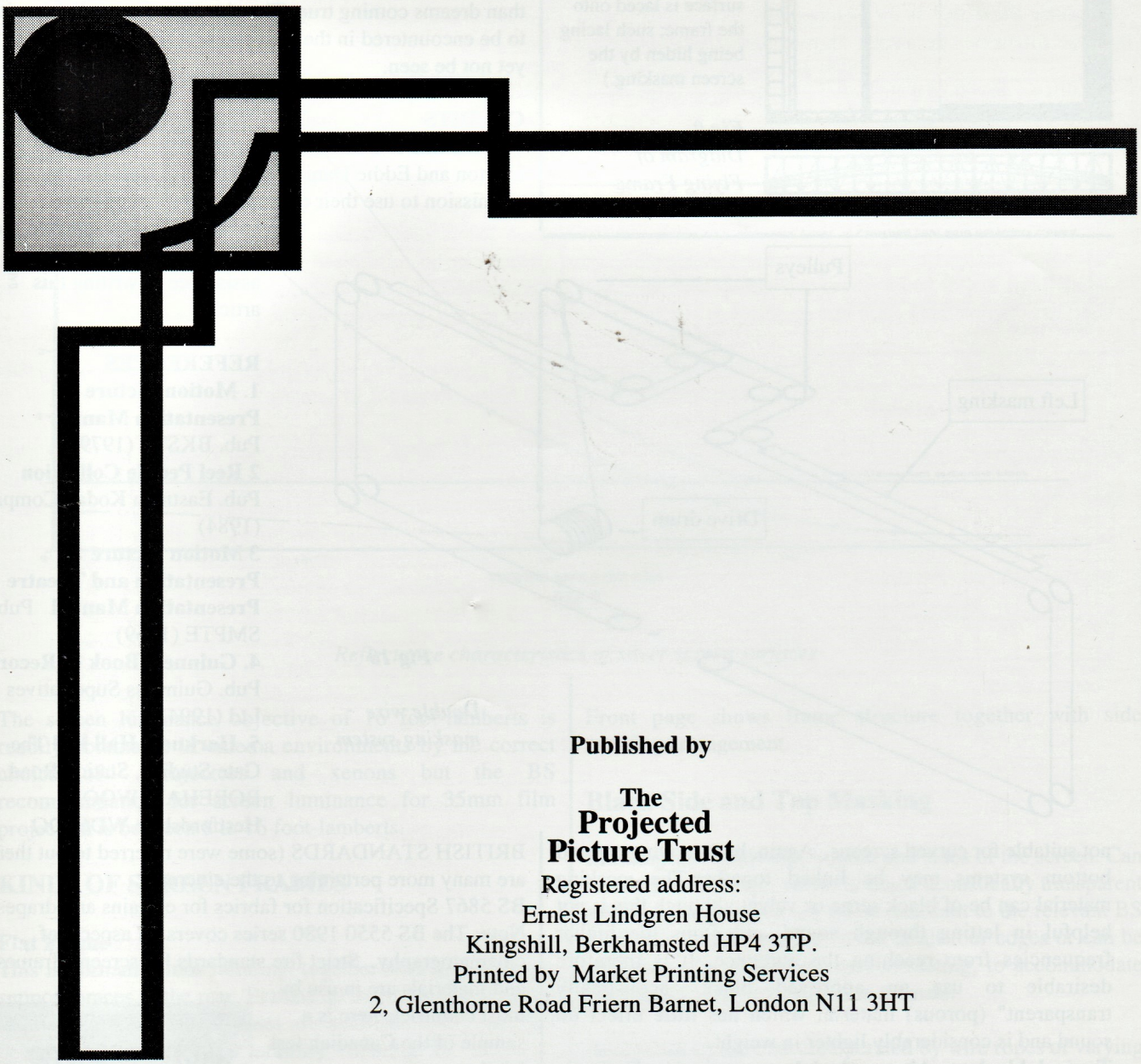
Arthur W.Pigott

Edited by J. Lawton & Peter Jones

Previous **INFORMATION SHEETS** from **The Projected Picture Trust:**

No.1 The Simplex Projector
No.2 The Power's Projector
No.3 The Kalee Model Eleven
No.4 Technicolor

Copyright The Projected Picture Trust
© Information Sheet No.5, 1996



Published by

The
Projected
Picture Trust
Registered address:
Ernest Lindgren House
Kingshill, Berkhamsted HP4 3TP.
Printed by Market Printing Services
2, Glenthorne Road Friern Barnet, London N11 3HT

The
P.P.T.
INFORMATION BOOKLET
No. 5