rec.arts.movies.tech
Frequently Asked Questions (FAQ)
(with answers)
Version 2.00
(supersedes all previous versions)
February 14, 1998
Compiled, Edited, Maintained by

Scott E. Norwood
snorwood@nyx.net

DISCLAIMER:

The compiler of this document has attempted to make every reasonable effort to ensure that any information contained herein is accurate and complete. However, the compiler is unable to assume responsibility, legal or otherwise, for any inaccuracies, errors, or omissions relating to the information contained below. All of the information contained in this document is believed by its compiler to be held in the public domain. The compiler is not affiliated with any of the companies whose products are mentioned here, nor does he necessarily endorse these products. All statements about such products are for informational use only. U.S. trademarks are indicated by ™where applicable, and are used here without the permission of their owners.

Contents

1 Introduction

1.1 Purpose of rec.arts.movies.tech

This is one of many USENET newsgroups in the rec.arts.movies.* hierarchy; its purpose is to facilitate the discussion of the many technical details associated with motion pictures. Topics often include questions about projection issues in theaters, film and sound formats and aspect ratios, equipment used in film production and presentation, and, occasionally, visual effects used in motion pictures. This group is intended for text messages only. Binaries should be uuencoded and posted to the appropriate groups within the alt.binaries hierarchy, or, preferably, made available through the World Wide Web or anonymous FTP. As is the case with most USENET groups, messages posted in HTML or any other non-plaintext format are strongly discouraged.

1.2 Purpose of this FAQ list

As is the nature with USENET groups, similar questions and topics are often raised. Thus, in order to save network bandwidth (information-carrying capacity), the time of those who read the groups, and to promote more interesting discussions, a list of frequently asked questions (FAQs) and their answers is often assembled, and posted regularly to the newsgroup. It should be mentioned that the purpose of the FAQ is not to inhibit or restrict newsgroup discussions, but rather to encourage more enlightening discussions by freeing the group's readers from the burden of regularly answering the same or similar questions.

1.3 Standards of "netiquette" for news posting

New readers of USENET news would do well to spend a few minutes reading the information posted in the group news.announce.newusers, as well as reading the posts made by other readers of rec.arts.movies.tech prior to posting their own messages to it. Additionally, it would likely benefit everyone who reads the group if the few points below were kept in mind when posting:

1. Make subject lines descriptive! While rec.arts.movies.tech is not overflowing with posts, it still saves time for its readers to ensure that subject lines are reflective of the content of the post. Don't use "70mm" as a subject head. Instead, use something like "Correct Aspect Ratio for 70mm?". Don't use "projector," but rather use "FS: Bell and Howell sound super-8 Projector."

2. Don't post excessively long messages (see warning about posting of binaries above in 1.1).

3. When quoting from someone else's message in a followup post, be sure to check that the person whom you're quoting actually wrote the material you quote. Also, try to edit quoted material for length (but *never* content)–don't quote 700 lines of previous posts and then type "I agree" at the bottom. This type of post serves the interests of no one.

4. Don't post blatantly commercial material, particularly if the material does not fall under the charter of rec.arts.movies.tech. "Garage Sale"-type posts are considered to be acceptable, as long as they are non-commercial in nature, and are not posted regularly.

5. Don't type in all caps (LIKE THIS). Nearly all terminals in use today (as well as personal computers) will support lower-case letters, which are easier to read for most people.

1.4 Credits

[perpetually under construction]

Thanks to the following individuals for reviewing the first edition of this FAQ, and correcting my numerous errors and omissions: Andrew Shepherd cinema@falcon.cc.ukans.edu, David Richards daverich@netcom.com, Martin Gignac martyg@sympatico.ca, David Pomes mrspoque@aol.com, Scott Marshall WideGauge@aol.com, Gordon McLeod gmcleod@idirect.com, Stephen Bradley spbradley@earthlink.net, and Clive Tobin tobin@nwus.com. I am duly humbled. Special thanks to Ed Inman edinman@teclink.net for his great information on home processing of reversal films (included in the 'Film Laboratories' section). Ralph Daniel 104574.2404@compuserve.com provided the Cinerama Features List (included in the 'Cinerama' section), which was appended to by Vince Young veyoung@aol.com. Jim Harwood jharw91601@aol.com and Frank Wylie fwylie@infinet.com provided the valuable recommendations on film storage, located in the 'Opinions' section.

1.5 Where is the latest version of this FAQ available?

The current version will always be available for viewing on the World Wide Web at:

http://www.nyx.net/~snorwood/faq.html

The current version of the FAQ is also posted monthly to rec.arts.movies. tech, rec.answers, and news.answers. It is available via anonymous FTP from the various FAQ archive sites, most notably rtfm.mit.edu and is located in the /pub/usenet-by-group/rec.arts.movies.tech directory.

I will also send this document by email to anyone who requests it. Just send your request to the following Internet address: snorwood@nyx.net. I will send it out as soon as possible.

Comments, corrections, additions, and suggestions are always encouraged. Please either post them to rec.arts.movies.tech, or, preferably, email them directly to me, and I will incorporate them into future versions of this FAQ.

1.6 What is the best way to print this FAQ?

Beginning with version 2.00, this file is available in several formats: a plaintext version (which is posted to r.a.m.t), an HTML version (designed for viewing on the World Wide Web), a raw PostScript version, and a DVI file.

The plaintext version is formatted for 80 columns, and can be printed on a standard 80-column dot-matrix or laser printer (it looks best at six lines per inch vertical spacing). This file may be loaded into almost any word processor or text editor, and printed from within that environment, or may be sent directly to the printer device. If a choice of typefaces is offered, be sure to select one of the 'monospace' variety (Courier, Prestige, Monaco, etc.) to ensure that the ASCII diagrams below are properly reproduced; also, be sure to set the margins to allow for at least 80 characters of text per line.

For those who have access to the World Wide Web, the HTML version of this document can be printed from within a standard web browser (Lynx, Mosaic, Netscape, etc.). The content is identical to the plaintext version, although the HTML version looks slightly better.

The PostScript file provides the best-looking output, and can be viewed online using software such as ghostscript or ghostview, or it may be printed using a PostScript-capable printer.

The DVI file can be printed on DVI (Device Independent) printers, or may be converted into other formats.

1.7 What changes have been made to this FAQ since previous versions?

1.7.1 Version 0.01 (6/7/96)

1. (no previous version)

1.7.2 Version 0.02 (6/17/96)

1. Record of modifications (this list) begun.
2. FAQ broken up into four sections (from the original two) in order to accommodate future additions and modifications; hopefully, four sections will be enough to accommodate all foreseeable changes and additions, as more than four sections can be confusing to new readers (who most need to read the FAQ).
3. Third hierarchy of section numbering added to many sections of information.
4. Disclaimer modified slightly, and reformatted to take up fewer lines.
5. Trademark indications added to trademarked format/process names (I know they look silly, but I need to protect myself!).
6. Names added to 'Credits' section.
7. Numerous corrections/additions/rearrangements/wording changes made to entire FAQ.
8. ASCII diagrams of film frames 'flipped' to conform to standard film-frame diagram format (i.e. to show what it would look like to project a 'complete' film frame onto a large screen).
9. Information on home processing of reversal film added.
10. Various categories relating to obsolete processes have been deleted, as they all can be included in the section devoted to obsolete formats.
11. 'Opinions' section substantially reduced, due to liability concerns.

1.7.3 Version 0.03 (11/17/96)

1. Numerous corrections/additions/rearrangements to entire document, in preparation for v.1.00.

1.7.4 Version 1.00 (11/15/97)

1. General overhaul of all sections; long-overdue extensive corrections and updates.
2. Expansion of several sections (most notably those regarding Cinerama and other widescreen processes).

1.7.5 Version 2.00 (2/15/98)

1. Entire file reformatted in LaTeX, to automate production of multiple formats (ASCII, HTML, PostScript, etc.). Although this document was originally posted to r.a.m.t in four parts (for compatability with older news software), it will now be posted as a single large file.

2. Many sections re-worded for clarity and style.

3. Several factual corrections made.

---

2 Motion Picture Formats (original cinematography)

2.1 Which film gauges are currently in common usage for original cinematography?

2.1.1 35mm – Standard Theatrical Gauge

The standard gauge for theatrical motion pictures has always been 35mm. This rather arbitrary width supposedly originated with an agreement made between Thomas Edison's associate, William K. L. Dickson, and George Eastman in the early days of motion pictures, because the original Kodak™box camera used film which was 70mm wide, and a 35mm motion-picture stock could inexpensively be derived from this stock by slitting it lengthwise and perforating the edges. This gauge remains the most widely used for theatrical features, and is also commonly used for television work.

2.1.2 16mm – Home Movies/Television/Low-Budget Theatrical

In 1923, 16mm was introduced by Kodak™for home-movie use (just after 9.5mm, now a nearly dead amateur format, was introduced in Europe). Supposedly this width was chosen instead of 17.5mm (half of the commercial standard) for safety reasons–at the time 35mm stock was manufactured on a nitrate base, making it extremely flammable. This, of course, would be too dangerous for home use, and so 16mm was manufactured on a so-called 'safety film' acetate base, which was not flammable. This non-even division of 35mm discouraged the cutting of 16mm film from dangerous nitrate stock. Since its early days, 16mm has become the 'jack-of-all-trades' of film formats, finding use for everything from home movies through medium-budget features. Most current use is for television work and low-budget features. The Super-16 format, described below, originated in the 1970's, as an inexpensive means for providing additional negative area within the 16mm format.

2.1.3 8mm – Cheaper Home Movies

In 1932, 8mm film was introduced in order to bring home movies to the masses. This 'regular 8mm' is standard 16mm film which has twice as many perforations as 16mm. It is run through an 8mm camera normally, exposing one half of its width. The take-up spool then is flipped and the film is reloaded, so as to run through the camera opposite to its original direction, exposing the other half of its width. After the film is developed at the laboratory, it is slit down the middle and the pieces are spliced together, resulting in an 8mm film. Regular 8mm is not commonly used now, given the superiority of Super 8mm, and the film is difficult to find now (although it *is* still available). Unlike the other major formats mentioned here, cameras for regular 8mm are no longer manufactured.

2.1.4 Super 8mm – Better Home Movies

In 1965, it was found that the perforations on 8mm film could be made smaller in order to allow for a larger image area, and thus a sharper picture. This resulted in 'super-8mm' film, which is sold pre-loaded into plastic cartridges (as opposed to the metal spools of regular 8mm), which snap into the camera. Unlike other gauges, the 'pressure plate' (the piece which provides pressure on the back of the film in the gate area, in order to ensure that the film lies flat when it is exposed) is plastic and is built into the cartridge. In other gauges, it is a (usually) removable (for cleaning) metal plate which is part of the camera. Super 8mm is now used mostly by students, those shooting no-budget films, portions of feature films which demand a super 8mm 'look,' music videos, and some direct-to-TV/video work. A variant of the Super 8mm format, "Single 8," was sold by Fuji and possibly other manufacturers, which used the same film stock, packaged in somewhat different-shaped camera cartridges; cameras were made specifically for this format. Once processed, film can be projected on any Super 8mm projector. Current availability of Single 8 cameras and film stock is unknown.

2.1.5 65mm – Better Theatrical Features

Despite a brief experimental period in the 1920's and 1930's, 'wide screen' motion pictures did become popular among film producers until the 1950's and 1960's, when television began to pose a threat to their business. At that time, wide film stocks existed in a number of widths, but eventually 65mm became the standard film stock for large-format cinematography. This offered a picture of substantially higher resolution, steadiness, and apparent color saturation than standard 35mm film. This format is now used for some theatrical features, as well as 'special-venue' and 'ride' films (see below).

2.2 Which formats are common for 8mm cinematography?

- regular 8mm camera frame: .192" x .145"
- super 8mm camera frame: .224" x .163"

2.3 Regular 8mm/Super 8mm (standard 8mm/super 8mm frame)

As mentioned above, there are two 'varieties' of 8mm film, both of which are still in use. Both of these varieties are commonly shot 'flat' (i.e. without any 'anamorphic' horizontal compression), using standard lenses.

Several frame rates are used in these formats: films shot for silent projection (no sound-on-film) are usually photographed at 16 frames per second (fps), 18 fps, or 24 fps. Films shot for sound-on-film projection run at 18 fps, or, more commonly, 24 fps. Different cameras provide different combinations of shooting rates.

Regular 8mm commonly comes in 25' and 50' spools, as well as 100' spools (although the Bolex regular 8mm is the only camera which takes the 100' spools). Super 8mm comes in 50' and, less commonly, 200' cartridges. Most cameras are only capable of accepting the 50' cartridge, though. Eastman Kodak ™once produced super 8mm 'sound' cartridges, which contained film with pre-applied magnetic stripes along the edges, designed to be recorded in camera. Production of new pre-striped super 8mm film was discontinued in the fall of 1997, due to lack of demand.

```
regular 8mm film frame:                    super 8mm film frame:
  (note big perforations)                    (note small perforation)

  |                 |                |                |
  | -------------- O |               | ---------------- |
  | |    Small   |    |              | |     Larger   | |
  | |    Image   |    |              | |     Image    |o| <--- Smaller
  | |    Area    |    |              | |     Area     | |    Perforation
  | -------------- O |               | ---------------- |
  |                 |                |                |

  |<------ 8mm ----->|               |<------ 8mm ----->|
```

2.4 Which formats are common for 16mm cinematography?

2.4.1 16mm (standard 16mm frame)

- standard 16mm camera frame: .404” x .295”

Like 8mm and super 8mm, 16mm films are almost always shot ‘flat,’ as few anamorphic camera lenses are currently available, although they were somewhat more common in the 1960’s for sophisticated amateurs. The 16mm film stock itself has not changed since the format’s introduction, and it is almost always double-perforated (i.e. it has sprocket holes on both sides), though few cameras actually require this (the Maurer and the Mitchell 16mm models do, however). Double-perf camera stock is becoming rarer, however, with the increase in Super 16mm production; it is now special-order from Eastman Kodak$^{\text{TM}}$and other manufacturers.

The film itself comes either wound tightly around a plastic ‘core,’ for loading into a camera magazine (either in a darkroom, or a portable ‘changing bag’), or, for 100’ and 200’ lengths, mounted on small metal spools (like those for regular 8mm), which can be loaded into the camera in moderately bright daylight. Professionals usually use 400’ and (rarely) 1200’ lengths of the film. (The Panavision 16 is the only currently-available camera which will take the 1200’ rolls; old newsreel cameras, such as the Auricon (which is still available on the used market), also can take this large size).

Films shot in 16mm almost always run at 24 frames per second (fps), with the exception of many silent home movies which are sometimes shot at 16 fps. European television films are photographed at 25 fps to match the frame rate of the PAL television standard. Occasionally, U.S. television films are shot at 29.97 fps or 23.976 fps to match or nearly match the TV standard, respectively.

As with super 8mm, magnetic-striped 16mm raw stock was once available for use in cameras with built-in recording heads, although pre-striped stock is no longer available. It was primarily used for TV newsfilm applications, until 3/4” videotape replaced 16mm for newsgathering in the late 1970’s/early 1980’s.

2.4.2 Super 16mm (HDTV/35mm blowup frame)

- super 16mm camera frame: .488” x .295”

In the 1970’s, super 16mm was developed as a filming format primarily for productions which were to originate on 16mm (supported heavily by Aaton$^{\text{TM}}$, the French camera manufacturer), but be “blown up” to 35mm for theatrical release (as few commercial theaters have 16mm projectors). The image was made wider, extending into the far edge of the film, formerly occupied by an extra set of perforations on camera film or a soundtrack on release prints (unlike regular 16mm, camera film for super 16mm shooting must be 'single-perf'–i.e. it has sprocket holes on only one edge, with the other edge left for the image). This provides a higher-resolution image when the film is blown up to 35mm, because there is a larger image area, and because there is less cropping of the image to fit the usual American 35mm aspect ratio of 1.85:1, or the European ratio of 1.66:1. The disadvantage, though, is that it is not a projection format, as a single piece of 16mm film cannot accommodate both the larger image and a soundtrack.

Some producers are shooting TV shows on super 16mm, with the intent of re-transferring the negatives to videotape when and if high definition television (HDTV) comes into widespread use. The wider aspect ratio is very close to the proposed U.S. HDTV standard of 1.77:1 (16/9), and so super 16mm films could be shown with little cropping, whereas a 1.37:1 picture would either have the top and bottom edges cropped, or the sides masked inward to fit on an HDTV screen (yielding a very small picture). Presumably, then, super 16mm is a way for producers worried about upcoming technological changes in television to 'future proof' a television show, so that it can be presented in any form, with the highest quality images allowed by the format chosen for future TV receivers.

```
16mm film frame:                    super 16mm film frame:

  |                  |                |                  |
  | O--------------O |                |-----------------O|
  | |     Image    | | Image area -->|      Image      ||
  | |     Area     | | extends to    |      Area       ||
  | O--------------O |    edge of    |-----------------O|
  |                  |     film.     |                  |

  |<----- 16mm ----->|                |<----- 16mm ----->|
```

2.5 Which formats are common for 35mm cinematography?

- 35mm silent camera frame: .980" x .735"
- 35mm Academy camera frame: .864" x .630"
- 35mm "Super 35" camera frame: .980" x .735"
- 35mm VistaVision camera frame: 1.485" x .991"
- 35mm Anamorphic camera frame: .864" x .732"

2.5.1 35mm (old silent frame)

Early films were all shot with this camera apeture prior to the advent of sound-on-film. When sound was first introduced, a variety of odd aspect ratios (including an almost 1:17 square picture) were considered, as the image area had to be narrowed in order to leave space for the soundtrack. Silent 35mm films were shot at roughly 16 frames per second (fps), using hand-cranked cameras and projectors. In practice, speed varied substantially even throughout a single roll, and among different titles.. For this reason, running times are almost never listed for silent films; instead, length is listed as number of reels or number of feet. The advent of sound standardized filming speed at 24 fps. When silent films are shown today at 24fps, they often appear 'sped up' and tend to look unnatural.

2.5.2 35mm (standard Academy frame)

In order to maintain a similar projected aspect ratio for both sound and silent films, the Academy frame was introduced, and has since become standard. It used the greatest possible width (allowing for soundtrack space on prints), and reduced the height somewhat in order to make the projected image retain a 1.37:1 projected aspect ratio. Earlier silent prints were designed to be projected in a 1.33:1 ratio.

During the 'wide screen' craze of the late 1950's and early 1960's, anamorphic cinematography (a.k.a. 'CinemaScope™,' and, later, 'Panavision™') became commonplace. In order to advertise their films as being 'wide screen' movies, many producers who had a large collection of yet-to-be-released 1.37:1 films just cropped off the top and bottom edges of the frame (including titles and other important elements), leaving a 1.66:1 or 1.85:1 ratio movie. Later, continuing through the present, non-anamorphic ('flat') films were composed to fit on a 1.85:1 screen. These films, however, are still photographed with an Academy camera frame, although the camera's viewfinder usually does not show the top and bottom edges. Occasionally, a 'hard matte' is used in the camera or printer, masking off the top and bottom edges of the frame. When films are shot 'soft matte,' projection errors can cause undesired elements (such as boom microphones) to show up in the frame; sometimes, extra area above and below the intended framelines is visible in TV broadcasts of thse films, as well.

Nearly all 35mm film is shipped wound around plastic cores, and it comes in 200', 400', and 1000' lengths. Small 100' metal spools are also available, for use in small windup cameras like the Bell and Howell™Eyemo.

Most 35mm sound films are shot at 24 fps, as the faster frame rate both improves the sound quality (with respect to the synchronization with the image–lower frame rates look strange with lip-sync sound). As with 16mm, though, some European television films are shot at 25 fps, to match the TV frame rate, and some US television films are shot at 29.97 or 23.976 fps, to match or nearly match the U.S. TV frame rate, respectively.

It should be noted that sound is never recorded directly on the 35mm film while shooting–filming is done in 'double system' fashion, usually using a crystal-controlled camera motor which runs at an exact speed, along with a crystal-controlled 1/4" tape machine (usually a Nagra 4.2) or DAT machine.

2.5.3 35mm Anamorphic (standard 'wide screen' theatrical frame)

As mentioned above, during the late 1950's and early 1960's, in order to compete with television, the motion picture industry developed a number of systems to achieve a wider aspect ratio than previously used; the idea was to provide a 'larger than life' movie experience, combining huge, curved screens, with improved sound quality. Besides simply cropping off the top and bottom of the frame, the most successful such system was 'anamorphic cinematography,' initially introduced as 'CinemaScope™' with *The Robe*, in 1953. This process involves photographing a film with a lens which has an anamorphic element in it. This element 'squeezes' the image horizontally by a factor of 2x. The 'squeezed' image fills a large space on the negative, but, when 'unsqueezed' upon projection, yields an image with a wide aspect ratio. This ratio actually varies slightly depending upon the exact projector mask which is used, as well as the sound format.

The disadvantage to shooting in anamorphic is usually that the lenses used introduce weird types of distortion and lack the depth of field (front to rear sharpness) of standard 'spherical' lenses. For example, a night scene in a film might contain out-of-focus points of light in the background; if they were filmed with spherical lenses, the lights would appear to be circular, but would appear to be vertical ellipses if they were filmed with anamorphic lenses.

Anamorphic cinematography is still in common usage for major theatrical films, and is often indicated by the phrase 'filmed in Panavision™' (if the lenses/cameras were made by Panavision™), which has displaced 'CinemaScope™' as the usual term for this process, although many people still refer to anamorphic films as 'scope' films. It is worth noting, though, that companies other than Panavision™manufacture, rent, and sell anamorphic camera lenses. Also, the phrase 'filmed with Panavision™cameras and lenses' indicates that Panavision™gear was used, but the film is not in anamorphic (they rent spherical [non-anamorphic] lenses, too).

2.5.4 35mm VistaVision (visual effects frame)

During the 'wide screen' heyday, Paramount developed the 'VistaVision' format ("Motion Picture High Fidelity"), which involved running the film through the camera sideways, exposing an image eight perforations wide (the same format as used by 35mm still cameras). This negative was then optically printed onto a standard release print, of various aspect ratios, or projected horizontally, with a soundtrack printed on one edge of the film. This format is now rarely used for feature film cinematography, although it is often used for background plates and other visual effects scenes which benefit from the extra negative area and resulting high resolution of that format, as the negative contains an area which is four times that of a standard 1.85:1 projected frame.

The actual prints made from this format (at the time when it was common for features) were intended to be projected in a variety of aspect ratios. Common ones include: 1.66:1, 1.85:1, and 2:1. Other aspect ratios were used for projection as well, but never gained wide acceptance.

2.5.5 Super 35mm (production format for release prints of various formats)

A recent development has been 'super 35mm,' which, like super 16mm, extends the photographed image out into the soundtrack area (it uses the same frame area as old silent movies), and must be optically printed onto print stock in order to make projection prints. The possible advantage to this is that it allows a cinematographer to use 'spherical' (standard) lenses to shoot a film which may eventually be printed in anamorphic. Spherical lenses are less expensive to rent than anamorphics, and do not have the characteristic optical distortion which is common to anamorphic lenses. The disadvantage is that the images are often grainier than those originally shot with anamorphic lenses, and the optical printing stage is expensive and adds its own type of distortion.

Super 35mm is also used by some directors and cinematographers because they feel that it allows for a less problematic full-screen television version of the film. Because super 35mm negatives carry more picture than will eventually be projected, a nicer-looking TV version of the film can be created. This works by manipulating the area of the film which is displayed on the television screen, using the extra picture at the top and bottom of the frame to 'fill in' areas which would ordinarily lack a portion of the image, when the TV frame must center on a specific area at the edge of the theatrical frame.

Super 35mm prints can be 'extracted' from various portions of the negative. A 'top-extraction' or 'common headroom' extraction is made such that the very top frameline of the super 35mm negative corresponds to the very top frameline of the print. A 'symmetrical' or 'center- extraction' print is made such that equal top and bottom areas are cropped off of the super 35mm negative. The viewfinder markings are adjusted to match the chosen format.

Interestingly, super 35mm is nearly identical to the 'Superscope 235' process used in by RKO Pictures. The first film to use this format was *Run for the Sun* in 1956. This was photographed using almost the same frame area as Super 35mm, and then optically printed onto CinemaScope™release prints, leaving extra image area at the top and bottom of the frame for TV prints.

```
35mm film frame:
  (Academy ratio)

  |                        |
  |O   -------------------O|
  |    |                 | |
  |O   |       Image     |O|
  |    |                 | |
  |O   |       Area      |O|
  |    |                 | |
  |O   -------------------O|
  |                        |

  |<-------- 35mm -------->|
```

```
35mm film frame:
  (1.85:1 ratio)
  (note inefficient use of negative space,
   which is photographed in the camera,
   but not projected)

  |                        |
  |O    (unused space)    O|
  |    ------------------- |
  |O   |      Image      |O|
  |    |      Area       | |
  |O   |                 |O|
  |    ------------------- |
  |O    (unused space)    O|
  |                        |

  |<-------- 35mm -------->|
```

```
super 35mm/silent film frame:

  |                        |
  |O----------------------O|
  | |                    | |
  |O|        Larger      |O|
  | |        Image       | |
  |O|        Area        |O|
  | |                    | |
  |O----------------------O|
  |                        |

  |<-------- 35mm -------->|
```

```
35mm anamorphic film frame:

  |                        |
  |O   -------------------O|
  |    |                 | |
  |O   |    'Squeezed'   |O|
  |    |      Image      | |
  |O   |      Area       |O|
  |    |                 | |
  |O   -------------------O|
  |                        |

  |<-------- 35mm -------->|
```

```
Vista Vision film frame:

  -------------------------   ---
    O  O  O  O  O  O  O  O     /|\
    |--------------------|      |
    |     Very Large     |      |
    |                    |     35mm
    |     Image Area     |      |
    |--------------------|      |
    O  O  O  O  O  O  O  O     \|/
  -------------------------   ---

NOTE:  The blank space to the left of the image area in the above diagrams
       (except for Vista Vision and super 35mm) is reserved for a soundtrack
       which is printed on release prints.
```

2.6 Which formats are common for 65mm cinematography?

- 5-perf 70mm camera frame: 2.066" x .906"
- 15-perf 70mm IMAX™ camera frame: 2.772" x 2.072"

2.6.1 65mm (standard 65mm theatrical frame)

The 65mm theatrical film frame is five perforations high (rather than four for 35mm), and is capable of accepting a wider frame than 35mm when photographed 'flat.' While there have been attempts at fitting anamorphic lenses onto 65mm cameras (such as 'Ultra Panavision™70'/'MGM Camera 65™,' most notably for the film *Ben Hur*, which was originally presented in a 2.75:1 aspect ratio), none are presently in use. While 65mm was once a popular shooting format, it is no longer in wide usage, with the 1996 production of *Kenneth Branagh's Hamlet* being the last major feature to use this film gauge.

It is hoped that the new digital sound formats will eliminate the magnetic striping used in the past for soundtracks, which contributed greatly to the cost of this format. Also, the potential exhibition market for this format is larger than it has been in the past, since many of the recently-built multiplex theaters have at least one screen which is capable of showing 70mm, which was often originally installed in order to show blowup prints of 35mm with the six-track stereo sound which only the 70m print could provide (prior to the advent of digital). The DTS digital format was successfully used for the 1996 70mm restoration prints of *Vertigo* (photographed in VistaVision). In 1997, several 70mm blowup prints of *Titanic* were struck from the super 35mm negative, also employing the DTS system.

2.6.2 65mm (IMAX™/OMNIMAX™)

The 65mm format is gaining popularity in the growing 'ride film' industry and for 'special venue' production in various formats like IMAX™ and IMAX DOME™(formerly known as OMNIMAX™), which use film frames of fifteen perforations wide. The film is run through the camera and projector sideways, just like

VistaVision, at fifteen perforations of length per frame. IMAX^{TM}has a projected aspect ratio of about 1.43:1, but uses a *very* large screen to achieve its effect. IMAX DOME^{TM}/OMNIMAX^{TM}films are shot with the same cameras and lenses, but are projected onto a domed screen through a fisheye lens. The screen itself is tilted somewhat toward the audience, who sit in reclining chairs, arranged in a steeply-sloping arrangement. Films photographed specifically for the domed screens use wider lenses which help to reduce the distortion around the edges of the screens.

There is a similar process to IMAX^{TM}, known as IMAX-HD^{TM}, which uses the same setup, running at 48 frames per second, in order to achieve a more life-like, better-looking picture.

It is worth noting that none of the formats yet designed by the Canadian IMAX^{TM}company carries a soundtrack on the print. In older setups, the sound is reproduced from a 35mm 6-track magnetic film which is run on a dubber-type device, interlocked to the speed of the projector (and if the power fluctuates significantly during a show, sync is lost). Newer installations also have the capability of running the sound off of a CD-ROM disk (as with DTS^{TM}), driven by a tachometer output from the projector or a timecode on the film; even when the sound is reproduced from CD, magnetic film is often still run as a backup. A few films (such as *Grand Canyon*) used soundtracks reproduced from 1/2" audio tape, using an 8-track recorder synched to the projector.

2.6.3 65mm (SHOWSCAN^{TM})

SHOWSCAN^{TM}is somewhat of a competitive format to IMAX^{TM}and IMAX-HD^{TM}, conceived and supported primarily by Douglas Trumbull and his Showscan Corporation. It uses 65mm film running vertically at a rate of 60 frames per second (fps), five perforations per frame, whereas standard IMAX^{TM}, like almost every other format, runs at 24 fps. Supposedly this could give a clearer picture with fewer 'strobing'-type artifacts of the usual double-bladed shutter used for 35mm and standard 65mm (Showscan^{TM}and IMAX-HD^{TM}both use projector shutters which show each image only once) and other shortcomings of the 24 fps standard, in which the projector normally shows each frame *twice* (using a double-bladed shutter, which makes one revolution for each frame), which reduces apparent flicker somewhat. Formats using the higher frame rate do not appear to flicker anyway, and thus do not need this 'fix.'

---

3 Motion Picture Formats (release prints intended for projection)

3.1 Which film gauges are currently in common usage for release prints intended for projection?

Currently:

- 8mm (primarily amateur/low budget)
- 16mm (primarily nontheatrical)
- 35mm (theatrical)
- 70mm (theatrical/special-venue)

3.2 Why is wide-gauge film manufactured in the 65mm width for motion- picture cameras, and in 70mm for release prints?

[under construction]

3.3 Which formats and aspect ratios are common for 8mm release prints?

- standard regular 8mm projection frame: .172" x .129"
- anamorphic regular 8mm projection frame: .172" x .129" (rare)
- standard super 8mm projection frame: .209" x .156"
- anamorphic 8mm projection frame: .209" x .156" (rare)

3.3.1 Regular 8mm/Super 8mm

Regular 8mm has a projected aspect ratio of 1.33:1, matching the 35mm silent frame. Super 8mm has a similar projected aspect ratio of 1.34:1. Release prints in regular 8mm usually do not have a soundtrack, although a few rare prints do. Super 8mm prints often have a magnetic or optical soundtrack, located on the edge of the film opposite the perforated edge. Films with magnetic sound also have a 'balance stripe' on the perforated edge in order to keep the film thickness even, although sound is not normally recorded on it.

3.3.2 Regular 8mm/Super 8mm Anamorphic

Many 8mm reduction prints of 35mm anamorphic original films are printed in a 2:1 squeeze ratio, which retains the original side framing, but crops off a small portion of the top and bottom of the frame. The final aspect ratios are 2.66:1 and 2.68:1 for regular 8mm and super 8mm, respectively. Projection of these films, obviously, requires an anamorphic lens for the projector in order to 'unsqueeze' the image. These lenses are, unfortunately, difficult to find, and often expensive, despite their less-than-perfect image quality.

```
regular 8mm release print frame:   super 8mm release print frame:
  (note big perforations)            (note small perforation)

  |                  |                |                  |
  |s-------------- O |                |s---------------- |
  |o|    Small   | | |                |o|     Larger   | |
  |u|    Image   | | |                |u|     Image    |o| <--- Smaller
  |n|    Area    | | |                |n|     Area     | |    Perforation
  |d-------------- O |                |d---------------- |
  |                  |                |                  |

  |<------ 8mm ----->|                |<------ 8mm ----->|
```

3.4 Which formats and aspect ratios are common for 16mm release prints?

- standard regular 16mm projection frame: .373” x .272”
- anamorphic regular 16mm projection frame: .373” x .272”
- super 16mm projection frame: .468” x .282”
- 1.85:1 super 16mm projection frame: .468” x .253”

3.4.1 Regular 16mm

When 16mm was first developed, 35mm silent films were shot for projection in an aspect ratio (width to height ratio) of 1.33:1; thus, the 16mm aspect ratio of 1.37:1 was designed to be relatively close to the 35mm one. Unlike 35mm, however, no modification of aspect ratio was needed in order to accommodate sound-on-film prints (the sound is printed on one edge of the film, in the space formerly occupied by a second set of sprocket holes [which are still present in todays ‘double-perf’ camera films]), and so the aspect ratio of 16mm remains unchanged.

Unlike camera films, 16mm release prints are almost always single- perforated–i.e. the film has perforations on only one side of the image. The other side is reserved for a soundtrack. The only exception to this are lab workprints from double-perf camera stock, which are also printed on double-perf stock, mostly for convenience in splicing with a ‘guillotine’-style tape splicer, commonly used by editors.

3.4.2 16mm Anamorphic

Although it is not a 16mm shooting format, 16mm reduction prints of 35mm anamorphic original films are often printed in a 2:1 squeeze ratio, which retains the original side framing, but crops off a small portion of the top and bottom of the frame. Projection of these films, obviously, requires an anamorphic lens for the projector in order to ‘unsqueeze’ the image. Almost all 16mm anamorphic prints are reductions from 35mm anamorphic originals.

3.4.3 Super 16mm

This is designed as a shooting format, and not for exhibition purposes, but projectors are manufactured for this format, primarily for the purpose of screening super 16mm dailies for a project which is intended for television or 35mm blowup. Standard 16mm projectors can also be modified for this purpose, by filing out the gate (a fairly simple procedure). Most super 16mm projectors are found in laboratory screening rooms or are owned by location rental houses. They are almost never used for general film exhibition, except maybe for the occasional film festival.

```
16mm release print frame:

  |                  |
  |sO--------------O |
  |o|      Image   | |
  |u|      Area    | |
  |nO--------------O |
  |d                 |

  |<----- 16mm ----->|
```

3.5 Which formats and aspect ratios are common for 35mm release prints?

- silent 35mm projection frame: .94" x .71"
- Academy 35mm projection frame: .825" x .602"
- 1.66:1 European 35mm projection frame: .825" x .497"
- 1.75:1 35mm projection frame: .825" x .471" (obsolete)
- 1.85:1 US 35mm projection frame: .825" x .446"
- anamorphic 35mm projection frame: .825" x .690" (current standard)

3.5.1 35mm Silent Frame

In the early days of 35mm silent film, the standard aspect ratio was 1.33:1, and the image covered nearly the whole area of the film, four perforations high, and extending out to the edges of the perforations on the sides. These prints are almost extinct today, as they leave no space for a soundtrack, and, thus, the format became obsolete upon the introduction of sound on film in 1926. At this time, the frame was simply narrowed, to the almost-square 1.15:1 ratio in order to accommodate an optical soundtrack. This is the area used by the current anamorphic format, and is the most image area one can fit onto a piece of 35mm film with a soundtrack. As very few venues are equipped to project silent-frame prints, this format is almost non-existent today. Many silents have been re-printed such that the image fits within the Academy frame.

3.5.2 35mm Academy Frame

When it became clear that nearly all future prints would contain sound- tracks, the 35mm frame was cropped at the top and bottom slightly in order to achieve a 1.37:1 frame, nearly matching the old silent frame. This Academy frame is the basis for nearly all future 'flat' (non-anamorphic) formats, as well as the various television formats currently in use.

3.5.3 35mm 'Flat' Wide Screen Formats

With the introduction of CinemaScope™in 1953 (see below), there came a demand to release all films in a 'wide' aspect ratio. This was most easily achieved by cropping off the top and bottom of the Academy frame in the projector. While most prints still contain the full Academy frame-size image, the tops and bottoms of it are cropped off in the projection process.

There are several commonly used formats which use this principle, of which the most common currently is the U.S. standard of aspect ratio 1.85:1, used on almost all 'flat' prints currently in circulation. One of the major disadvantages of this format, however, is its terrific inefficiency of negative space. Although the camera and projector both move the film four perforations at a time (the height of the Academy frame), the actual projected image only takes up 2.5 frames. Thus, images are grainier and less sharp than those of Academy films projected on the same height screen.

The proposed 2.5-perf and 3-perf formats (described elsewhere in this FAQ) do not change the area of the 1.85:1 frame, but simply move the film a shorter distance (2.5 or 3, rather than 4 perforations) between frames, using less film per unit of running time. As proposed now, these are strictly release-print formats; 35mm cameras will continue to move the film 4 perforations per frame (although 3-perf is gaining acceptance as an cheaper alternative for TV work).

A few films made in the 1950's were made to be projected in the 1.75:1 aspect ratio; while this is no longer a common projection ratio, it is interesting now, because it corresponds very closely to the 1.77:1 proposed U.S. High Definition Television (HDTV) standard, designed as a compromise in order to fit both 1.37:1 television material and wide screen feature films onto the same size screen.

The standard frame ratio in Europe is still 1.66:1, the same as the super 16mm standard. These films are almost never shown properly in the U.S., however; most are simply cropped to fit onto screens masked for 1.85:1.

3.5.4 35mm Anamorphic Frame

This frame is nearly the same size as the 1.15:1 frame used just after the introduction of sound-on-film, and represents the most efficient use of film area possible, while allowing space for a soundtrack. The 2.0x 'unsqueeze' achieved during the projection of the film with an anamorphic lens provides one of several aspect ratios, depending upon the projector mask to be used.

The first CinemaScope™(anamorphic) feature was *The Robe*, released by Fox in 1953. These prints were made with tiny 'Fox hole' perforations, and contained four tracks of magnetic sound (quite impressive, particularly in a time when most movie-goers had not even heard regular stereo!). Due to the narrow perforations, an aspect ratio of 2.55:1 was achieved for early Cinemascope™pictures, including *The Robe*, the first Cinemascope™production.

In 1956, the 'scope ratio was narrowed to 2.35:1 in order to accommodate both magnetic and optical tracks on the same print (so that it could be shown in theaters not yet equipped with magnetic sound equipment). This ratio was retained until 1971, when the height was reduced slightly, resulting in a 2.39:1 aspect ratio, in order to better hide lab splices.

In 1994, the height and width were reduced proportionally, retaining the 2.39:1 aspect ratio, which is the current standard.

3.5.5 Projecting Multiple Formats

These formats are all standard, although each requires its own projector mask (to cover up the unused image area) and lens (to ensure that the image properly fits the screen). If necessary, the anamorphic lens and mask can be used to show 1.37:1 Academy films, provided that the anamorphic lens element is unscrewed and removed first, and the curtains are adjusted to mask the 1.37:1 area (which will be very small). Most theaters keep the top and bottom edges of the screen at the same heights, and open curtains on either side of the screen in order to accommodate the wider formats, as shown below (not to scale):

```
    --------------------------------------
c)  |  |   |  |                 |  |   |  |  (c
u)  |  |   |  |                 |  |   |  |  (u
r)  |  |   |  |      Movie      |  |   |  |  (r
t)  |  |   |  |      Screen     |  |   |  |  (t
a)  |  |   |  |                 |  |   |  |  (a
i)  |  |   |  |                 |  |   |  |  (i
n)  --------------------------------------   (n

    ^  ^   ^  ^                 ^  ^   ^  ^
    |  |   |  |----- 1.37:1 -----|  |   |  |
    |  |   |-------- 1.66:1 --------|   |  |
    |  |------------ 1.85:1 ------------|  |
    |---------------2.39:1 ---------------|
```

It should be noted that having separate lenses and masks for each format is highly idealistic, and is not standard practice, except at a few conscientious art houses, which must show prints from all time periods and all countries. Most U.S. theaters are only equipped to properly show 1.85 and 2.39:1 ratios, lacking the appropriate lenses/masks and ability to move the curtains to other ratios. Thus, when prints intended for other formats are shown, some of the image is usually cropped. Some theaters show everything at 2:1 (eliminating the need for changing the screen masking), cropping some from all formats. In any event, there is a wide degree of variance in image cropping, depending upon the equipment in place in each venue.

```
                                  35mm release print frame:
                                    (1.85:1 ratio)
                                    (usually, picture is visible above and
                                     below 1.85:1 framelines, but it is
35mm release print frame:            masked off, and does not show up on
  (Academy ratio)                    the screen)

  |                        |        |                        |
  |O    -------------------O|       |O    (unused space)    O|
  |  s |                | |         |  s ------------------- |
  |O o |       Image    |O|         |O o |      Image     |O|
  |  u |                | |         |  u |      Area      | |
  |O n |       Area     |O|         |O n |                |O|
  |  d |                | |         |  d ------------------- |
  |O    -------------------O|       |O    (unused space)    O|
  |                        |        |                        |

  |<-------- 35mm -------->|        |<-------- 35mm -------->|
```

3.6 Which formats and aspect ratios are common for 70mm release prints?

- 5-perf 70mm theatrical projection frame: 1.912" x .870"

3.6.1 70mm Standard Frame

The standard 70mm frame has always has an aspect ratio of 2.2:1, which is slightly narrower than 35mm CinemaScope™. Often, 70mm blowup prints were made of 35mm CinemaScope™films (mostly for the improved sound quality of 6-track magnetic). These blowups are 'flat,' and often provide better image quality due to the superior registration (image steadiness) of the 70mm format, as well as the reduced grain imposed by the release print (more grains per square foot of screen area). This was done more in the past (1970's through 1980's) because the high-quality six-track discrete (as opposed to matrixed) soundtracks on 70mm prints could not be equaled by 35mm optical Dolby Stereo™tracks. Several innovations in 35mm, however, most notably digital sound (along with Dolby™SR, and reverse-scanning solar cells) rendered 70mm blowups unnecessary if sound is the only consideration. Further, the recent shift toward 10-20-screen multiplex theaters, and the resultant smaller screens, has lessened the impact of the larger, better-quality image.

Much of the expense of making 70mm prints in the past has been the magnetic striping which is necessary for the soundtrack, as there is no such thing as 70mm optical sound. With the possibility of printing a DTS™timecode on the 70mm print, and providing the actual soundtrack on DTS™CD-ROM disks (like with 35mm DTS™), this may no longer be necessary, possibly paving the way for a 70mm revival. This remains to be seen, however, although it was done successfully for the 70mm release of Hitchcock's *Vertigo* in October, 1996; the prints had no analog tracks and entire soundtrack was reproduced from a DTS™disk (most theaters used two disk readers with identical disks in them for redundancy), driven by DTS™timecode printed on the outside edge of the perforations on the left-hand side (relative to how the film runs in the projector) of the image.

In addition to the conventional sprocket holes, all 70mm prints also have a small 'registration hole' punched every 5 perforations. Theoretically, this is supposed to line up with the frameline, but, in practice, this is ignored, and it just occurs at a random point. The primary purpose served by the registration hole is for use as a splicing reference, so that splices can always be made at the frameline, even in the middle of a fadeout or a dark scene.

3.6.2 70mm IMAX™/OMNIMAX™15-Perf Frame

These special formats are simple contact prints made from the negatives (or intermediates). Although they are wider (by 5mm) than the original negatives, they never contain a soundtrack printed directly on the film. Sound is provided either by a separate, interlocked magnetic tape, or by a CD-ROM disk, which is driven by a timecode on the film (as in the DTS™system used for 35mm digital sound).

```
70mm standard release print frame:
  (courtesy David Richards \texttt{daverich@netcom.com})

  |XXoX|____________________________________|XoXX|
  |XX X|                                    |X XX|  'o' = sprocket hole
  |XXoX|                                    |XoXX|
  |XX X|                                    |X XX|  'X' = mag. track area
  |XXoX|                                    |XoXX|
  |XX X|                                    |X XX|  (registration hole not
  |XXoX|                                    |XoXX|   shown in this diagram)
  |XX X|                                    |X XX|
  |XXoX|____________________________________|XoXX|
  |XX X|                                    |X XX|

  |<----------------- 69.95mm -------------------->|
  |<----------------- 2.754in -------------------->|
```

---

4 Motion Picture Sound Formats (release prints intended for projection)

4.1 What analog sound formats are common for 8mm release prints?

- regular 8mm magnetic: 56 frame advance
- super 8mm magnetic: 18 frame offset
- super 8mm optical: 22 frame offset

4.1.1 Regular 8mm Magnetic (monophonic)

While regular 8mm was never designed to have a soundtrack, someone figured out that the edge opposite the perforations could have a thin magnetic stripe applied to it in order to carry a recording of film's soundtrack. This, of course, uses the same principle as an ordinary tape recorder. Unfortunately, though, this format was never standardized, and never received wide usage. Complicating the issue was the wide variety in the 'sound offset'–i.e. the number of frames ahead of the picture that the sound must run. If a film with an 18-frame sound offset were run in a projector which supported a 20-frame offset, then the sound would run slightly behind the picture. Sound quality here is quite variable, depending upon the quality of the striping job, the age of the print, and the quality of the recording.

4.1.2 Regular 8mm Magnetic (monophonic or stereo)

Soon after super 8mm displaced regular 8mm as the standard home-movie format, people began to demand sound capabilities for their cameras and projectors. The easiest way to record sound while shooting is to record the sound within the camera on a magnetic stripe pre-applied to the edge of the film, in the same manner as the various regular 8mm systems. A 'balance stripe' is also applied on the sprocket-hole edge, but not usually used for sound; its purpose is to maintain an even film thickness. Aside from having two differing frame rates (18 fps and 24 fps), this method became standardized for both cameras and projectors, with a standard sync offset. Sound quality is potentially quite good, with some recording devices and projectors offering stereo reproduction by recording twin soundtracks, one on the 'balance stripe' and one on the regular sound stripe.

The primary disadvantage to this system of recording sound in the camera is that it makes good editing extremely difficult. Super 8mm is usually shot with reversal film (see below), meaning that the camera original is edited and then projected. In this case, after every splice, there will be a delay of about one second between when the picture edit shows up on the screen, and when the sound edit is heard; this is a result of the sync offset of the soundtrack. For this reason, professional films (except old television news films) almost never record sound within the camera, but rather use a 'double-system' method, in which the sound and picture are kept on separate strips of film through the editing process, until the final release prints are made. Home movies, though, rarely undergo substantial editing; thus, 'single-system' sound recorded in camera is useful and convenient.

4.1.3 Regular 8mm Optical (monophonic)

While magnetic sound is of high quality, it can be expensive, particularly for large print runs. For this reason, optical soundtracks, of the type used for 16mm and 35mm prints, eventually found their way onto some 8mm films (usually, commercially released ones). Only a few models of projector could reproduce this type of soundtrack, however, and quality is less than desirable, due to both the relatively slow linear speed at which the film moves past the soundhead, and the inherent limitations of frequency response and noise on an optical track (see description for 16mm optical for more details).

4.2 What analog sound formats are common for 16mm release prints?

- 16mm optical: 26 frame offset
- 16mm magnetic: 28 frame offset

4.2.1 16mm Optical (monophonic)

The first sound-on-film 16mm prints, made in the 1940's, used an optical system, like that used on the 35mm prints of the time. An optical track consists of an image of a 'wave'-like clear band which allows differing amounts of light to pass through it upon playback (this is called a 'variable area soundtrack'; 'variable density soundtracks' were also tried at one time–they did not use a band of clear film, but rather the entire soundtrack area varied in density, or transparency. This gave a slightly better frequency response than a variable-area track, but resulted in increased background noise, due to film grain. They are no longer used). The sound is reproduced by means of an exciter lamp, which shines through a small lens onto the optical track area of the film. This light is focused onto a solar cell on the opposite side of the film. The solar cell varies its electrical resistance based upon the amount of light which is shining on it. Thus, as the 'wavy' band gets wider, more current can pass through the solar cell, which causes the loudspeaker to vibrate more, which results in a louder sound. This system is rather primitive, but it is inexpensive, as the sound is printed on the film at the same time as the picture, whereas magnetic systems require a separate 'sounding' step after the picture is printed.

Sound quality is not particularly good, but has been improved in recent years by various methods, including the printing of two identical tracks which are adjacent to each other. This method allows the two tracks to cancel out each other's flaws or at least to cover them up (in theory). Whether or not this actually improves sounds quality is a topic of debate. Thus, Although it is technically possible to produce a stereo optical track in 16mm, no one has yet exploited this potential on a wide-scale basis, as there is no commonly available equipment to shoot a stereo track, or to reproduce it. A few test prints were made in this format, however.

4.2.2 16mm Magnetic (monophonic)

In an attempt to improve the sound quality for 16mm prints, magnetic sound was developed in the early 1960's. This, like 8mm magnetic, used a magnetic stripe which was placed in the same location as the optical track (or slightly to the outer edge, if both types of tracks were to be used on a single print). The problem with this system was that, while it sounds quite good, few projectors are capable of reproducing it. Thus, its use was pretty much reserved for television news (until the late 1970's, when news film was replaced by videotape); news cameras, such as the Auricon and the CP-16, were modified to record magnetic sound directly onto pre-striped reversal stock. This film was developed at TV stations, and was then run through a 'magnetic offset recorder,' which simultaneously played the soundtrack, and re-recorded it 28 frames earlier, so that the film could be edited with the sound in perfect sync. The film was again run through the offset recorder, this time to re-advance the soundtrack 28 frames after the picture so that it could be played back in sync on the station's film chain machine. This was the solution to the sync problem common with super 8mm films with recorded-in-camera-sound.

By now (1998), 16mm magnetic is almost a dead format for new prints, having been replaced with 35mm blowups of 16mm-originated material or by double-system digital systems (usually with a DAT machine synched to the movie projector).

4.3 What analog sound formats are common for 35mm release prints?

- optical (20 frame offset) - 35mm

- magnetic (?? frame offset) - 35mm

4.3.1 35mm Optical (monophonic, stereo, or Dolby Stereo™)

The standard sound-on-film system for 35mm has always been optical sound. This works like the variable-area system described above under '16mm optical.' This system is inexpensive and standardized, so that almost every projection setup in the world is capable of reproducing it. Of course, the disadvantages are as with any optical sound system: lousy frequency response, noise, and 'pops' when splices pass through the soundhead.

Eventually, in the 1970's, the standard monophonic track was modified to permit stereo reproduction. This allowed optical tracks to offer competition to the four-track magnetic systems in use at the time. The reproduction of stereo tracks required modification of the projector's soundhead to accept a stereo solar cell. The optical stereo approach was not used commercially, however, due to background noise and hiss issues. In the mid-1970's, Dolby™Laboratories developed methods of 'matrixing' the SVA (stereo variable area) track in order to encode four tracks worth of information within the twin stereo tracks. This allowed for the additions of a center (dialogue) track and a rear 'surround' track to the usual left and right stereo tracks. In addition, Dolby™type 'A' noise reduction was used to reduce background noise.

This 'Dolby Stereo™' system soon became standard, and nearly all commercially released films since about 1980 have been encoded with it. Of course, one must use a Dolby™Cinema Processor (or a clone thereof [e.g. 'Ultra Stereo']) in order to decode and reproduce all four tracks; otherwise, it just reproduces as two-track stereo. 'DTS Stereo™' uses the same principles as Dolby Stereo™and is decoded with the same equipment, but the term applies to optical tracks produced by DTS™, without the use of Dolby™equipment (Dolby™encoding equipment is usually rented out for higher rates). Note that 'DTS Stereo™' is distinct from the DTS™digital sound system described below.

In the late 1980's Dolby Stereo™was improved upon by 'Dolby SR™.' The 'SR' stands for 'spectral recording,' which incorporated better channel separation and noise reduction than standard Dolby Stereo™, but which supposedly retained compatibility with Dolby™type 'A' processors, although this is debatable. A Dolby™'A' processor can be upgraded to support SR prints, if desired. Type 'A' prints do not reproduce well when played back through a processor set up for 'SR' mode (all modern processors also contain the 'A' NR mode as well).

Incidentally, Dolby™'A' noise reduction is one of several noise reduction schemes developed by Dolby™Laboratories. It (and SR) are capable of reducing noise across the entire audible frequency range. Dolby™also developed type 'B' noise reduction, which reduces the high- frequency noise common to audio cassette tapes, and type 'C' noise reduction which is also used for cassettes, as well as the Beta SP videotape format.

4.3.2 35mm Magnetic (four-track stereo)

When the first CinemaScope^{TM}films were produced, Fox had special release print stock made up, which contained very narrow perforations (known as 'Fox holes'). The idea behind this was to allow for a magnetic sound- track containing four discrete (not matrixed) tracks (in the same L/C/R/S configuration as the modern Dolby Stereo^{TM}setups). At the time, the 'scope image was wider than it is now (because it extended into the area now used for optical tracks), and thus could not fit an optical track on the print. The magnetic stripes were applied in the same manner as to 70mm prints.

This idea worked reasonably well, and was used for a number of years (through the early 1970's) on 35mm prints of all formats (only 'scope prints required the Fox holes, though), and the sound quality was excellent, even by today's standards, provided that the magnetic tracks were in good condition. The problem of this scheme was that, unlike optical sound, the information recorded on magnetic tracks was not a permanent part of the film, and could be intentionally or accidentally erased, simply by being placed too close to magnetic fields, like those found in electric motors (such as those used on rewind benches). Even reels and cans can become magnetized, sometimes erasing all or part of the magnetic track, requiring that it be re-dubbed, at great expense. Further, the magnetic sound heads required frequent cleaning in order to keep them sounding good.

With the invention of Dolby^{TM}'A' noise reduction and the application of this technology to optical tracks, magnetic sound lost some of its quality advantage over optical, and it has always been substantially more expensive than optical to print (as prints had to be dubbed in real time, whereas optical could be printed at the same time and speed as the picture). Thus, magnetic sound fell into disuse, and is no longer commonly used, although, before digital sound became workable, special prints were made with magnetic tracks for showing in select theaters for 'special engagements' and the like.

4.4 What analog sound formats are common for 70mm release prints?

- magnetic (?? frame offset) - 70mm

4.4.1 70mm Magnetic (six-track stereo)

This system is capable of carrying six separate tracks on four wide magnetic stripes on the film. It is usually set up to reproduce left, left-center, center, right-center, right, and surround tracks. This was long considered to be the premier film-sound format, prior to the advent of digital, because the tracks were relatively wide, because the film runs through the projector at a slightly higher rate of linear speed than 35mm film, and because the sound is recorded in discrete (separate) tracks, rather than being 'matrixed.'

As mentioned above, in the late 1970's (beginning with *Star Wars*) through the late 1980's, it was common for distributors to produce 70mm blowup prints of films shot on 35mm in order to improve sound reproduction in the movie theater. With the introduction of digital systems, which are capable of reproducing higher quality sound at a lower cost than a complete 70mm projection system and 70mm print rental, exhibitors no longer saw much reason to show blowup prints, except for special 'one-time' shows. In the future, magnetic striping (a major cost of making 70mm prints) may be eliminated, in favor of a digital soundtrack (currently, DTS^{TM}has been used for 70mm prints). This may encourage the printing (and 65mm original cinematography) of more films for 70mm exhibition.

Unlike other formats, where the soundtrack runs *ahead* of the picture, with 70mm, the sound runs *behind* the picture, as the magnetic sound heads are placed *before* the picture head. Thus, the 70mm print runs through the magnetic soundhead, picture head, then around the 35mm optical soundhead, then to the takeup reel or platter. When 35mm films are run in a combination projector, they are simply loaded through the 70mm magnetic soundhead, without difficulty.

4.5 What are the three commonly used digital sound formats for 35mm release prints, and how do they work?

4.5.1 General Information

- Digital Theater Systems (DTS™)
- Sony Dynamic Digital Stereo (SDDS™)
- Dolby™Digital (SR-D™)

Digital sound differs from analog sound in that it represents sound by a series of consecutive 'samples' of the sound (each of which is represented by the digits zero [0] and one [1]), rather than by a continuous waveform. Digital is neither inherently better nor inherently worse than analog, but simply a different method of representing sound (music, dialogue, etc.). In practice, though, digital film sound almost always sounds cleaner and brighter than analog, and is capable of greater dynamic range, due to the limitations of the optical track as a means of recording sound.

Despite the differences among the various digital sound formats, most people cannot tell a difference in quality, as they all sound excellent. Perceived differences among the formats are usually a result of a different sound mix for each format (such as an 8-channel SDDS™mix versus a six-channel Dolby™Digital mix).

4.5.2 Digital Theater Systems (DTS)™

This was the first digital sound system to come into widespread usage, with the release of *Jurassic Park* in 1993. The system was promoted heavily by MCA/Universal Pictures, which uses it on most of its prints. The system originally was sold in two versions: a low-end version which could reproduce four tracks, and a high-end version capable of reproducing six- tracks (left, center, right, left-surround, right-surround, and subwoofer. These systems were referred to as DTS-4™and DTS-6™, respectively. The four-track version has since been discontinued.

DTS™uses a timecode printed on the film between the picture area and the optical track. The timecode, which looks like a dot-dash pattern resembling Morse code) is read by an optical reader placed in the film path, between the platter or reel and the projector's picture head. This timecode information is fed to a specialized, souped-up 386 or 486 computer which in turn reads compressed soundtracks from a CD-ROM disk; the compression factor, though, is the least of the three digital systems. The current systems have three separate CD-ROM drives: one holds a 'trailer' disk which is sent to theaters periodically, and contains the soundtracks to all of the trailers currently showing, including trailers from studios which do not use DTS™for their films; the other two contain disks for the feature. Shorter movies require only one disk; others require two. Slightly over four hours of digital sound can be accommodated for a two-disk feature. There is no provision for mid-show disk changes.

As with all digital sound systems, the film reader can be placed a variable number of frames ahead of the picture head. This is calibrated upon installation with a test film. The computer is capable of accommodating splices within the film, and adjusting the soundtrack to match. Further, because the soundtrack is not on the film, no 'popping' noise is heard during splices and/or changeovers (unless the timecode reader cannot read a certain section of timecode, in which case it reverts back to the standard analog track, causing a small 'pop').

As with all of the current 35mm digital systems, all prints (except 70mm DTS prints) contain a standard optical track (usually recorded in 'DTS Stereo^{TM},' a system which is compatible with Dolby^{TM}-type processors) as a backup, should the timecode not be found, or be unreadable for more than 40 frames. The analog track is also used when the CD-ROM disk does not match with the movie being shown (at least in theory–there have been reports of theaters' showing one movie with another's soundtrack).

4.5.3 Sony Dynamic Digital Stereo (SDDS)^{TM}

Sony has entered the cinema sound market with the SDDS^{TM}system. Unlike the other two digital systems, SDDS^{TM}is capable of reproducing eight tracks of sound (left, center, right, left-center, right-center, left-surround, right-surround, and subwoofer), potentially a great advantage for films mixed for eight tracks, as a small number are at present. This, of course, requires that theaters install additional loudspeakers (left-center and right-center) behind the screen in order to take advantage of the potential of this format, however.

In SDDS^{TM}, the sound is actually recorded on the film itself, along both edges of the print. SDDS^{TM}uses a middle level of compression of the digital information of the three current digital systems. Like the other digital systems (except for Dolby), the reader (which uses an LED to shine through the track) is placed somewhere in the film path prior to the film's entrance into the picture head (the offset is variable, as convenience dictates, and is set up at installation). The reader reads the track, which is then decoded, decompressed, and processed in a separate processor unit, which contains custom electronics designed for this purpose. Just as with analog sound, splices are accommodated without difficulty.

SDDS^{TM}is probably the most expensive of the three digital formats, although actual cost varies substantially among different theaters and chains. The expense is largely due to the fact that all of the electronics within the entire processing system are digital, whereas DTS^{TM}and Dolby^{TM}Digital are both designed to simply be plugged into existing analog Dolby^{TM}(or similar) cinema processors. However, the extra cost may be somewhat justified by the extra tracks and the fact that the marketer of this system also owns companies which produce many films each year, almost ensuring that there will be material in this format for many years to come.

Although it is expensive, SDDS^{TM}is very popular, particularly in the AMC, Sony, and United Artists theaters, where SDDS^{TM}is or will be used in most of the theaters. Many technicians like it because it is the only system with electronic equalization, allowing the system to be properly set up very quickly.

4.5.4 Dolby^{TM}Spectral Recording Digital (SR-D)^{TM}

Dolby^{TM}Digital, also known as SR-D (when an SR track is used for the analog backup), is the digital system from Dolby^{TM}Laboratories. Like DTS^{TM}, it is capable of reproducing six tracks (left, center, right, left-surround, right-surround, and subwoofer), which are read by a reader (which works much like a TV/video camera, capturing images of the track) placed before the picture head, or, in some installations, within the standard projector soundhead. Like the other two systems, the offset can be varied, and is calibrated at installation. The actual soundtrack on the film runs 26 frames ahead of the picture.

The actual digital sound information is printed on the film in between the perforations, generally considered to be a safer location for the sound information than the edge of the film (where SDDS's^{TM}track lives). Thus, Dolby^{TM}Digital is potentially more reliable than SDDS^{TM}, although it compresses the digital information to a lesser extent than SDDS^{TM}does. Like SDDS^{TM}, the track is read, and then decoded, decompressed, and processed by a separate unit. Splices can create small 'pops,' (and will revert to analog if more than five perforations are obscured, but this is unlikely..

This format appears to be increasing in popularity at this time, both in terms of the number of theaters installing the system and the number of prints available in that format. It is also considered to be slightly more reliable than the other two digital formats, as the sound is printed directly onto the film in a relatively 'protected' location. All prints still contain an analog optical track (usually recorded in Dolby™SR), in case the digital system fails, or is unable to read five consecutive 'blocks' (between perforations).

Technically, it is possible to, with minimal cost, print all three types of digital track (or, in the case of DTS™, timecode), along with analog optical Dolby™on a single print, and a few films have been printed this way. These multi-format prints are now quite common (containing at least two formats), especially on movie trailers. Similarly, it is possible to have a projection system which can accommodate all of these formats, without excessive difficulty.

4.6 What methods have been used for digital sound in formats other than 35mm?

[under construction]

As mentioned in the 70mm section, DTS™timecode has been printed on 70mm prints (most notably the 1996 restoration prints of *Vertigo*), and used to drive a DTS™CD-ROM disk, from which sound was reproduced as with the 35mm implemetation of DTS™. A standard DTS™setup is required for this type of system, as well as 70mm timecode readers (which are swapped in for the 35mm variety as needed), and, often, a second DTS™CD unit, which holds a duplicate set of CDs and provides a backup should the first unit fail.

As of February, 1998, there is no indication as to whether Dolby™or Sony™were planning to adapt their 35mm digital systems for use with 70mm.

---

5 Motion Picture Presentation (theatrical projection)

5.1 What type of projection and sound equipment is commonly used for commercial theatrical presentation?

5.1.1 Projector/Lamphouse

The projector is the most critical part of any theater's projection setup. Many newly installed theaters in the US use new or rebuilt Simplex or Century 35mm projectors. The most common Simplex models are the Simplex XL (a.k.a. Pro 35, a currently manufactured model), the older Simplex E-7, and the really old Super Simplex. The most common Century models are the SA, the older C, and the 35/70mm JJ.

Larger theaters built from the 1960's through the 1980's may instead be using combination 35/70mm projectors, like the Norelco AA-II (known in Europe as the Philips DP-70), and Century JJ, although, with the decreased availability of 70mm features of late, most of these machines are either used exclusively for 35mm shows or are sitting idle.

Most modern theaters use xenon bulb lamphouses of between 2 and 4 kilowatts. This provides a picture of adequate brightness on the medium-sized screen common in multi-screen cinemas. A larger lamphouse of up to 5-7 kilowatts is needed for a very large screen, such as that of a drive-in theater; larger lamphouses offer little increased benefit for 35mm. Older theaters often still use carbon-arc lamps, which require more attention on the part of the projectionist than xenon, but some feel that they offer a light of better color temperature (i.e. not as cold-looking) than xenon. The general rule of thumb for xenon lamphouse size is roughly 1kw of power for every ten feet of screen width; thus a 30-foot screen should require about a 3kw lamphouse.

As for the film handling system itself, automated cinemas usually use film 'platters,' in which the entire print is loaded onto a large plate-like device (with the film from the individual shipping reels spliced together into one continuous roll), permitting one projectionist to operate the projection equipment for many auditoria. Smaller theaters and older theaters often use two projectors with small reels, each holding either 2000' each (just like the shipping reels) or 4000-6000' each (with the contents of two or three shipping reels spliced together). Between the reels, the projectionist operates a changeover mechanism, simultaneously switching over machines and soundtracks. He then rewinds the next reel, reloads it on the idle projector and prepares for the next changeover.

5.1.2 Sound System

The sound system in a typical mid-size theater installation is capable of handling from 200-400 watts of power for the front channels. In a mono system, several loudspeakers are located behind the screen, reproducing a single channel of sound. A Dolby Stereo™or other multichannel system involves at least three loudspeakers behind the screen to reproduce the front channels, as well as several loudspeakers along the side and rear walls of the auditorium to reproduce the 'surround' channel of sound. The soundtrack itself is read from the film by a solar cell arrangement within a soundhead, commonly a Simplex SH-1000 or similar.

Typical Multi-Track Dolby™Stereo/Dolby™Digital/DTS setup: (This is the same setup used for Dolby™Stereo, DTS™, and Dolby™Digital setups, although the digital systems have separate L and R surround channels, as well as a channel for a subwoofer [which is located behind the screen]. Complete SDDS systems and 70mm also have Left Center [LC] and Right Center [RC] loudspeakers, not indicated here)

```
Left Stereo     (L) -- behind left side of screen
Right Stereo    (R) -- behind right side of screen
Center/Dialogue (C) -- behind center of screen
Surround        (S) -- in rear of auditorium (separate L/R in digital)
Subwoofer     (sub) -- behind screen (separate channel for digital)
```

```
/----------------------------------------------------------\
|        *  L   *         *  C   *         *  R   *        |
|        * spkr *  (sub)  * spkr *         * spkr *        |
|      ------------------- screen -------------------      |
|                                                          |
|                  (front of auditorium)                   |
|                                                          |
|        UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU        |
|        UUUUUUU  UUUUUUU audience UUUUUUU  UUUUUUU        |
|        UUUUUUU  UUUUU seating area UUUUU  UUUUUUU        |
|        UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU        |
|        UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU        |
\                                                          \
/                                                          /
\                                                          \
|* S  *  UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU  * S  *|
|*spkr*  UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU  *spkr*|
|        UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU        |
|        UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU        |
|* S  *  UUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUU  UUUUUUU  * S  *|
|*spkr*                                              *spkr*|
|        * S  *                              * S  *        |
|        *spkr*     (rear of auditorium)     *spkr*        |
\----------------------------------------------------------/
```

Digital sound systems use similar loudspeaker arrangements as Dolby Stereo^{TM}setups, possibly with additional loudspeakers to support SDDS^{TM}eight-channel mixes. The sound is read by specialized readers placed between the reels/platters and the projector head; this contrasts with the placement of the analog soundhead, which is located between the projector head and the take-up reel/platter.

5.2 What are some specific examples of a common projection setup?

[under construction]

5.3 What are the differences between xenon, and carbon-arc lamphouses?

Most commercial theaters currently employ xenon bulbs; these are glass tubes containing a highly pressurized xenon gas through which high electrical current is passed (usually 220V, 50 amps or higher). They typically last for several thousand hours prior to needing replacement. Aside from being rotated and changed at regular intervals (they start to flicker as they get old), xenon lamphouses need very little maintenence (unless the bulb explodes due to the high pressure inside the bulb, in which case the rear reflector in the lamphouse must be re-silvered). Bulb glass tends to weaken as it ages, and thus extreme care should be taken when replacing bulbs to ensure that the bulb does not explode.

Older installations may use or have once used carbon-arc lamphouses; in these setups, high electrical current is passed between two carbon rods (one positive and one negative), creating an electrical arc and a very bright flame in the gap between the two rods. In order to operate such a lamphouse, the projectionist inserts the rods into their steel holders, closes the lamphouse, switches on the power, and, watching through a shielded piece of glass, carefully brings the rods together (using positioning knobs on the side of the lamphouse), causing them to touch. At this point, the arc will strike, and he can bring the rods apart and allow the current to stabilize. As the carbon burns down during the show, a motor brings the rods together, maintaining a constant distance between the tips of the rods, which must be tweaked by the projectionist as the show goes on, in order to maintian consistant on-screen light. Every 30 minutes to an hour of use, the rods will burn down and must be replaced.

Separate rods are used for 'positive' and 'negative' poles; a longer, thinner one is placed in the positive holder, and a shorter, fatter one is used for the negative holder. These designations should be marked on the box of carbon rods. Fumes from carbon-arc lamphouses are highly noxious, and should be well ventilated.

Note that both xenon and carbon-arc lamphouses require DC power, provided either by DC mains or by a rectifier circuit (which converts standard AC power to DC). Older theaters may use motor-generator sets to generate DC power.

5.4 How are 'seamless' manual reel changeovers accomplished?

5.4.1 Shipping Configurations for 35mm Prints

Nearly all 35mm prints are shipped on metal reels which hold 2000' of film. Ideally, the films are shipped 'tails out,' meaning that the beginning of the film is at the middle core of the first reel, and the end is at the outer edge of the last reel. These reels are shipped in so-called 'S-wind,' meaning that the emulsion (dull side) winds facing 'in' when the 'tail' is 'out,' and that, when rewound, the 'head' should face 'out,' and the emulsion will wind 'out.' This confusing standard is designed to help prevent print damage, although there are conflicting views on this. When the film runs through the projector, the top reel spins counterclockwise, and the lower reel spins clockwise.

At some undetermined time, new prints are likely to be shipped on the so-called Extended Length Reel (ELR), which is capable of holding 6800' of standard triacetate film or 8000' of the thinner polyester stock. Trials of this began in Summer 1997, with prints of *Addicted to Love* and *Batman and Robin*. These prints were also available on 2000' reels for theaters which requested them. This is expected to reduce the amount of time needed to build up a print on platters, and possibly reduce the damage done in the buildup/breakdown process. This standard is supported primarily by the exhibitors (who will save in labor costs) and film laboratories (although some will need to buy new equipment to handle the larger reel sizes). Presumably, at least for a certain amount of time, 2000' reel sizes will also be distributed for these films, in order to accommodate theaters which do not have platters or 6000' reel arms, and must instead run the films with 2000' reels. Eventually, these houses may have to convert to 6000' changeover or platters or cut up the ELR prints themselves.

It should be noted, also, that nitrate prints have sometimes been shipped on 1000' reels, due to fire-hazard concerns. This configuration presents less of a danger, should one reel catch fire, as there is less film to burn.

These nitrate films also are usually stored on metal shelving, in asbestos-insulated fire-proof rooms. Modern triacetate or polyester films, of course, do not require these precautions.

When the film arrives at a changeover house, the head projectionist rewinds the film onto cast-iron house reels, inspecting the print for damage and splices, as well as (hopefully) ensuring that the changeover cue marks are properly positioned: 4 frames "motor" cue, then 10 ft. 8 frames, then 4 frames "changeover cue" then 20 more frames.

5.4.2 Changeover Procedures

Just before the show starts, the first (house) reel is loaded in one projector and the second reel is loaded into the other. The first projector is started; a few minutes before the first reel ends, the projectionist then stands before the second machine, looking out at the screen, waiting for the first cue mark (a small dot in the upper-right-hand corner of the picture for four consecutive frames [made by punching holes into the internegative; they appear round on 'flat' prints and, due to the 'unsqueeze,' elliptical on scope prints]). Upon seeing this, he hits a button on the changeover controller, striking the lamp (if this is the first changeover; otherwise, the lamp (if xenon) will have already been struck, and will probably not be turned off until the end of the show; this avoids excessive thermal stress, which causes bulbs to explode, and avoids the embarrassment of having the bulb blow up when first struck, right before a changeover), and starting the motor on the second machine.

The second reel has, hopefully been loaded up properly in the second machine, with the framelines lined up with the top and bottom edges of the gate (if this is not done, the film will probably appear out of frame, and the projectionist will have to manually adjust the projector's 'framing' knob in order to position the picture correctly on the screen. Two types of leader are currently found on release prints. New SMPTE Universal Leader is marked off in seconds of time (considered to be more useful for television stations), and counts down from '8' to '2'. This is used on nearly all new prints. Older Academy Leader is marked off in feet of film, counting from '11' to '3,' and is common on older prints. The projectionist simply remembers which frame of each type of leader needs to be loaded into the projector in order to give the correct 'run-up' time between cue marks. If the leader is not complete and the projectionist is not able or willing to replace it, he must wait after the first cue mark (before starting the motor on the second machine) until roughly where the next reel was loaded.

Once the second projector is going, the projectionist waits for a second dot, located 20 frames from the end of the first reel. Within a half-second or so after seeing this, he hits another button, which switches over the soundtrack, and simultaneously opens (on the machine holding the second reel) and closes (on the machine holding the first reel) a metal 'changeover' blade, which allows the passage of light through the film and, of course, onto the screen. The first reel is either stored in the film's metal shipping case, or rewound back onto a house reel on a rewind bench. The process is repeated for every reel change.

5.5 How does a platter system work?

5.5.1 Platter Configurations

Platter systems are used commonly in 'automated' booths, allowing one projectionist to run several shows (such as in a multi-screen theater) simultaneously by eliminating the need for manual changeovers and the rewinding of reels. The platter itself is a large, flat, circular, metal table, mounted on a column of like plates, on which the film is wound, tails out, with the shipping reels all spliced together. Platters are usually installed in stacks of three, allowing two films to be ready to run at any one time, along with a takeup platter for either. This setup also allows one print to be made up/broken down while another is running.

5.5.2 Platter Operation

After the print is spliced together, soundtrack edge facing up, the projectionist removes the metal core, (a.k.a. the 'donut') around which the film is wound 'tails out', from the center of the platter, loads the film across a series of rollers and through the projector, and attaches the donut to an empty platter. The film feeds out the center of the first platter, and is taken up on the second one. In this way, a show may be started, and, as long as no problems occur, run through its end without continual supervision. Because the film is taken up with the head at the center of the platter, there is no rewinding necessary. To run the same film again, the film is fed from its current platter onto another empty one. This can potentially save time by eliminating the rewind stage, allowing the same show to be run almost continuously.

So-called 'endless loop platters' also exist, and work similarly, although they omit the donut, and instead require that the head and tail be spliced together, allowing the same film to be run multiple times with no interruptions. Unfortunately, though, these systems discourage the cleaning of the projector gate, and, as dust and dirt accumulate there (an inevitable result of showing films), can lead to print scratches and other damage.

After building up a print on a platter, it is good practice for the projectionist to run it once in order to preview the print for any problems which may have been introduced in print buildup (like bad splices) and other defects, which may have been introduced elsewhere (like deep scratches, or lousy lab work). Splices used to build up prints on platters are usually made with 'zebra' tape, which has yellow markings which help the projectionist to locate the splices when breaking down the print onto the shipping reels.

5.6 How are multiple projectors interlocked to run the same piece of film in multiple auditoria?

(information courtesy David Richards `daverich@netcom.com`)

This is occasionally done in multiple-screen theaters; the projectors which are going to be interlocked need to be adjacent to each other (or at least reasonably close), and must be fitted with synchronous motors, whose speed is controlled by the 60hz (in the U.S.; 50hz in many other countries) AC line frequency. The film is loaded from a platter through the first projector (as usual), and then passes over several rollers, mounted on a wall or ceiling, across the booth to the second projector, into which it is then also loaded normally. Somewhere between the two machines, there is usually a bit of slack in the film, where a weighted roller is placed in order to keep the film running smoothly if there happens to be a small speed variation during the show.

Both projectors must be started at exactly the same time in order to maintain the proper amount of slack between them. This is done either by two projectionists, or by an automation system capable of handling this function.

It should be noted that the term 'interlocked' is also commonly used in the context of a sound mix facility, where several magnetic dubbers, and, usually, a projector, must be mechanically or electronically interlocked together in order to ensure that the multiple soundtracks being mixed are in perfect sync with each other and with the workprint being projected.

5.7 What are the industry standards for image brightness and screen reflectivity?

According to the Society of Motion Picture and Television Engineers (SMPTE), the generally accepted standard-setting organization for the industry, films are to be projected at a brightness level of 16 footlamberts (+/- 2 footlamberts). There is no standard for screen gain, and it varies substantially from theater to theater (from 1x to 3x is common). Screen gain deteriorates over time, and thus requires that screens be replaced periodically.

5.8 What are the industry standards for sound levels in a mono setup?

[under construction]

5.9 What are the industry standards for sound levels in a Dolby Stereo™setup?

This is widely ignored, but officially, a CAT-85 pink noise generator card in a Dolby processor should generate a sound level of 85 decibels at the 'average' seat, and this should be calibrated to the '7' on the volume dial (which ranges from 1 through 10). Mixing stages are set up in this way, although theaters are often calibrated for lower sound levels, as films (and, more frequently, trailers) sometimes get mixed too loud.

5.10 How does a dual-format (35/70) projector work, and how is the changeover made between formats?

(courtesy David Richards `daverich@netcom.com`)

These comments apply to the Century projector. There are two significant differences between a 35/70 projector and a standard 35mm projector. First of all, it must acommodate two gauges (widths) of film. This mainly impacts the gate. Typically, the gate is easily removable. Whereas the 35mm projector is restricted to accepting a 35mm gate, the 35/70 projector comes with two gates, one for each gauge of film. These gates are precision machined to slide onto dovetails on the frame, and should not be interchanged between projectors. The gates are stamped with the frame serial number to prevent mix-ups.

The second difference is the frame pitch. Standard frame pitch for 35mm film is 4 perforations, or .748". 70mm film uses the same perforation pitch, but 5 perfs per frame, or .935". Both must advance at 24 frames per sec. There are two possible ways to accomodate the faster linear speed of 70mm. One would be to simply turn the sprockets faster, with gearing for example. But this would not work with the existing geneva movement, and would also throw the shutter timing off. The way it is actually ac- complished is by using dual sprockets. There are 3 critical sprockets: the upper feed sprocket, which pulls film off the reel or platter at a constant speed, the intermittent sprocket, which advances the film at the gate, and the lower sprocket, which smooths out the pulsations from the intermittent sprocket once again. There are additional sprockets in the area of the sound head, but they do not need to be used for 70mm, as there is a separate magnetic sound reader for that.

Typically, these sprockets have 16 teeth for 35mm film. Since one frame is 4 perfs, exactly 4 frames could be wrapped around each sprocket. Another way of saying this is that each sprocket turns 90 degrees per frame. Since 70mm film requires a 5-perf advance, we can simply increase the number of sprocket teeth by 5/4, to 20 teeth, and the speed and intermittent advance distance are increased exactly the right amount, without changing the Geneva movement, motor, or anything else. By a happy coincidence, the 70mm film requires both a larger diameter sprocket, and one with the two sets of teeth further apart to accommodate the greater width. So, by using stepped sprockets, both may co-reside on the same shaft. The 35mm film rides in-between the larger 70mm sprocket flanges.

The only thing remaining is the pads that hold the film against the sprocket. Since there are two different sprocket diameters, there are two different places the pads must stop. This is accomplished on the Century with two different diameter pad rollers, which rotate individually, the assembly of both of them revolves on a common shaft with a knob. By turning the knob one way, the 35mm pad roller comes against the film. By turning the knob the other way, the 70mm pad roller comes against the film. With 35mm film threaded on the machine, turning the knob the wrong way does no damage, however, the film will not be held securely against the sprocket. With 70mm film threaded, care must be taken, because turning the knob the wrong way will damage the print.

This combination 35/70 idea, while good in theory, has some drawbacks in practice. Even with everything set correctly for 70mm, it is sometimes possible for the base side of the film to touch the 35mm pad rollers. This can cause base side scratches, which show up as dark lines about 1/4 of the picture width from each side. Those "in the know" will remove the 35mm pad rollers when showing a 70mm print, and replace them with spare 70mm rollers. This allows them to turn the knob either way without creasing the print, and at the same time eliminates the risk of base-side scratches.

As a footnote, the lamphouse generally must be readjusted for 70mm as well, to cover the larger frame area.

5.11 What are the differences between nitrate-, acetate-, and polyester-based print stocks?

5.11.1 Nitrate Base/Triacetate (Safety) Base

Early motion pictures were all shot and printed on nitrate-base film. This became extremely flammable as it aged, and thus unsuitable for use in non-fireproofed environments (such as homes and schools). Thus, 'safety film' was invented, which had a biacetate (later, triacetate), or similar, base. This was initially used for 16mm films (which were never manufactured on nitrate [except in Russia, for a short time], due to concerns about home use), and eventually came into use for 35mm presentation as well. The last nitrate film manufactured by Eastman Kodak™was delivered in 1953. With the introduction of safety film, the projection and storage of nitrate films was outlawed or severely restricted by many communities. As film librarians have found, nitrate, being an unstable base by nature, tends to decompose easily, and many old nitrate films which have not been re-printed onto safety film have deteriorated beyond the point of recovery. When nitrate prints are shown today, it is common to remove a small piece of head or tail, and light it. The speed at which the film burns can be used to determine whether or not the film can be run in relative safety. Kodak™distributes a booklet on "Safe Handling and Storage of Nitrate Motion Picture Films."

5.11.2 Polyester Base

Polyester stock ('ESTAR™' is a trademark for polyester stock manu- factured by the Eastman Kodak™company) is a fairly new development for print film. Like triacetate stock, it is nonflammable. The primary differences between it and the older nitrate/triacetate stocks are strength and thickness. Unlike other films, polyester stock does not break. If stressed, it simply stretches. This can be either good or bad, depending upon the degree to which it is stressed; for example, a jammed platter feed mechanism can cause the still-running projector to pull an essentially immovable piece of film through it, causing great damage to the projector itself, and, of course, damaging several feet of the film. If this circumstance occurred with triacetate film stock, the film would have simply broken, and no damage would have occurred.

The severity of this and other problems varies substantially among films manufactured by different companies. Further, the resistance to breakage is the primary reason why polyester is not used on camera films, as the risk of damage is much greater when the film is run through expensive camera equipment. (Polyester camera film is manufactured and used for high-speed cameras used to capture slow-motion images for scientific and engineering work, as the mechanisms of these cameras run so quickly that they would be severely damaged if the film were to break while the camera was running).

Polyester stock is also thinner and lighter than acetate stock (one can identify it as polyester by holding a reel up to a light source in a sideways position (such that it appears round from the viewer's point of view); if one can see light through it, then it is polyester). This can reduce the number of shipping reels, and the shipping cost, but may require adjustment of gate pressure in the projector in order for the film to run properly. Also, the stock is more sensitive to low humidity than triacetate, as it tends to pick up static electrical charge, sometimes preventing it from running smoothly on a platter system. The most often recommended solution to this ailment is to ensure that the platters are properly grounded, and that a humidifier is present in the projection booth. This will also help to avert unnecessary dust accumulation on the print.

The texture of polyester stock is substantially different from that of triacetate stock, and cement splices are not useful on polyester films (either tape or ultrasonic splices must be used). Thus, projectionists usually use the more-visible tape splices to join film together.

The static and strength problems were particularly acute with many prints of *American President*, one of the first major features to have 35mm prints distributed on polyester stock. Commonly, when run on platters, the film layers would 'stick' together, jamming the feed mechanism, and, usually, causing the whole projector to stop (by means of 'failsafe' assemblies which stop the motor when there is excessive tension on the guide rollers).

It should also be noted that the IMAX™format requires that polyester-based film be used, due to the relatively high linear speed at which the film moves through the projector (about three times that of 35mm), and the potential damage to the projector should there be a film break in the middle of a show. However, IMAX™equipment was designed for polyester film, and has several safeguards not present in most 35mm projection equipment in order to avert potential disasters in the projection booth.

5.12 What is the best way to avoid the static and shedding problems common in polyester prints?

Opinions and experiences on this topic vary widely; most, however, agree that the following suggestions are at least somewhat helpful for reducing the problems associated with polyester prints; these prints can be identified by their inability to break (for example, by trying to tear off a bit of head or tail leader) and their apparent translucent quality when a reel his held sideways near a light source. Humidity in the booth needs to be kept at a moderate level, in attempt to avoid the static problems which come along with polyester film. Additionally, if using platters, the platters should be grounded and/or made of non- conducting material. As is always the case, the projector gate should be cleaned as often as possible between shows to minimize the scratching and dust effects of shedding prints. As an extreme measure, metal objects (grounded) may be placed near the film path in attempt to drain static away from the film as it runs through the rollers.

5.13 What precautions are necessary when projecting nitrate prints?

[note that the compiler of this FAQ takes *NO RESPONSIBILITY* for the application of this information, which is provided for educational purposes only]

Perhaps the most important task prior to running a nitrate print is to determine whether it is permitted by local laws to do so. Many com- munities have outlawed the projection or storage of nitrate film material due to the grave safety concerns associated with its use. Assuming that projection of this film is legal in the local area, and that the booth in question meets all necessary specifications (metal plates which can be dropped down to cover portholes in case of accident, fireproof construction, metal door, outside ventilation, etc.), then one would most likely want to snip off a piece of head or tail leader of the film and ignite it in order to determine its flammability, as this varies widely as film goes through various stages of decomposition. The print should be thoroughly inspected to ensure that it is not damaged in such a way that it may jam in the gate and ignite (more likely if the print has shrunk significantly or has lousy splices). The print should then be run in an attended booth off of 2000' or 1000' reels, and certainly on a platter or on large reels, in order to minimize the outcome of any possible disaster. In between shows, the reels should be stored in metal containers away from high heat sources.

5.14 What are the proper procedures for print inspection prior to showing a film?

This varies substantially from theater to theater, ranging from no inspection whatsoever, to thorough, frame-by-frame inspection. Most commonly, however, the film is rewound from the shipping reels onto either a platter or house reels, while the projectionist checks for breaks, torn perforations, or bad splices. If the theater in question is a changeover house, cue marks are commonly checked to ensure their correct positioning, and more are added if need be.

A more thorough inspection would involve running the film through a sync block to ensure that no out-of-frame splices had been made, as well as possibly running the film through some type of cleaning device in order to remove any dust or dirt which may have accumulated on the print.

5.15 What other problems are common in film projection, and how does one fix them?

[under construction]

---

6 Film Laboratories

6.1 What are the differences between reversal and negative film, and which is the most common?

6.1.1 Differences Between Reversal and Negative Films

The difference is quite simple: with negative film, the images on the camera film are reversed such that light areas become dark, and dark areas become light (just like a still photographer's negatives). The camera negative cannot be properly projected, as a positive print (duplicate film) (with the light areas light and dark areas dark) must first be made, and then this print is used for projection. With reversal film, the camera original can be properly projected.

6.1.2 Uses for Reversal and Negative Films

Home movies, old television news footage, and some military and NASA films (as well as most of the NFL Films library, until quite recently) were/are shot on reversal film for convenience and the cost savings of not having to make a separate print for projection. Nearly everything else is shot on negative film, as prints made from it are cheaper than those from reversal; additionally, it has far greater exposure latitude (tolerance for over/underexposure) than reversal film. Finally, professional film-makers do not want to damage the camera original in the editing process, and so the convenience and cost advantages of reversal film are negated.

6.2 What is a 'one light work print'? A 'timed work print'?

Film 'dailies' (quickly made prints of camera negative) are often known as 'work prints,' as, after they are viewed by directors and cinematographers, they are the actual prints with which film editors (assuming they actually are editing on *film*) 'work' as they cut and splice the film together to appropriately reflect a film's story. Work prints come in two varieties: one light and timed. A 'one light' print is simply a print made without extensive scene-to-scene exposure and color (if the film is in color) correction (known as 'timing'). A timed print, on the other hand, is more expensive, and involves several 'lights' (exposure/color corrections) in order to make the images look prettier. These timed prints can help the director, editor, and cinematographer gain a better idea of how the final prints will look.

6.3 What does a negative cutter do?

6.3.1 General Information on Negative Conforming

After a workprint (or videotape transfer of camera negatives) is edited, the original camera negatives must be matched ('conformed') back to the workprint, so that prints can then be made from the negatives. This is a job done by a negative cutter, who uses the 'edge numbers' or 'keycodes' printed (by the manufacturer of the raw stock) on the edge of the camera negative and then printed through on the workprint. These numbers are printed every 20 frames in 16mm and every 16 frames in 35mm, and are the reference points for the negative cutter. 'Keycodes' are simply barcode versions of human-readable edge numbers, and permit the cutting of negatives to match edited videotape transfers from negatives (provided that the transfers have 'window burns' in the corner of the picture, showing the proper keycode numbers for the film being transferred).

6.3.2 A & B (& C) Roll Conforming and Printing

Films in 16mm and sometimes 35mm are cut into so-called 'A & B rolls,' in a 'checkerboard' fashion in order to ensure that splices will not appear on the screen when the prints are projected. This technique is best described with the following diagram:

```
          -----------------------------------------------------------------
'A roll'  | <----scene 1----> | <----black leader----> | <----scene 3----> |
          -----------------------------------------------------------------

          -----------------------------------------------------------------
'B roll'  | <--black leader-> | <-------scene 2------> | <--black leader-> |
          -----------------------------------------------------------------
```

The print film is then run through the printer (at the lab.) thrice, first exposing it to the 'A roll,' then rewinding, then exposing it to the 'B roll,' then rewinding, then exposing it to the soundtrack. The completed print (if printed properly) contains all scenes in order without visible splices in between, as well as an in-sync soundtrack. If white titles are needed, then the print film is run through again, this time being exposed to a 'C roll,' containing main or subtitles. Fades and dissolves (cross-fades between scenes) are made at this time too, using either a punched paper tape or notches in the edges of the negatives as cues.

This A & B roll method is not always necessary for 35mm, as enough of the area around the frameline is masked off in projection to permit splicing the film negatives into a single strand which can be printed in one pass through the printer, instead of two. The A & B rolls are necessary, though, for dissolves between scenes, and for superimposed images.

6.4 What is timing/color timing, and how does it affect the look of filmed images?

Color timing has a great effect on filmed images, as it controls the 'look' of the film, with respect to exposure and color balance, as well as scene-to-scene continuity. The color timer uses a machine known as a 'Hazeltine'™which reverses images on the original negatives and displays them on a television-like screen, and then turns dials to assign the image 'printer's points' for each of the three primary colors (red, green, blue). These 'points' range from 0 to 50, with about 25 being 'normal,' with higher numbers making the image darker, and lower numbers making the image lighter. In practice, the 'normal' values vary depending upon the camera stocks used and the cinematographer's personal preferences for exposure.

When working with black-and-white films, only one set of points is used, as there is no color balance to worry about. In this case, the 'timer' simply manipulates the exposure of the image. Incidentally, the term 'timer' comes from the days before automated printers when the 'timer' actually had to determine how long certain portions of the print should be allowed to sit in the developer. Of course, this is no longer necessary, and all print films are processed in the same manner.

Each scene is timed, and the printer's points for each scene are encoded onto a punched paper tape (or, in older arrangements, as notches in the edges of the negatives to indicate the changes, which would be manually set by the printer operator, just like fades/dissolves). The printer then reads these cues and electronically adjusts its lights and filtration to match the cues. Other methods for cuing the timing changes have been employed, although the paper tape appears to be the most common at this time.

6.5 What is an 'answer print'?

The first print made from original camera negatives is called the 'answer print,' and it is intended to give the cinematographer and director an 'answer' to their questions about how certain scenes are to be timed.

This print is commonly screened at the lab's screening room, with the color timer present to discuss the timing of certain scenes. If adjustments need to be made, additional answer prints are made until everyone is satisfied with the 'look' of the print.

6.6 What is an 'interpositive'? An 'internegative'?

Large print runs (like the 1500-2500-print orders for today's feature films) are potentially damaging to the valuable camera negatives, and so most theatrical prints are made from 'intermediate' films. Some image quality is lost in the process, however. The process generally goes as follows: The A, B, and C (if necessary) rolls, are all printed onto an interpositive, which has lower contrast than ordinary release-print stock (contrast builds up in the internegative and release print stages). This interpositive is then printed onto one or more internegatives, which is/are then used (along with a separate soundtrack negative, containing optical tracks and any digital tracks/timecode that might be used for that particular film) to print theatrical prints. If foreign distribution is expected, the C roll (containing titles) is sometimes printed separately on its own interpositive, and then both interpositives are printed onto the internegative(s). This allows for different versions of a film's titles, which can be made in different languages for foreign prints; subtitles for foreign prints can also be added by splicing them into the 'title' interpositive.

Note that prints made from internegatives must be run through the printer only once, as the internegative contains all of the elements (A/B/C rolls, optical track) necessary for the print, whereas original- negative prints must be run through the printer at least three times. Thus, prints made from internegatives are about 1/3 less expensive than original- negative prints.

6.7 What is a 'check print'?

A 'check print' is the first print made from an internegative, to ensure that all of the elements are lined up properly, and that the sound- track is in sync with the picture. If a check print is acceptable, then all release prints will look similar, with everything in sync, because they will be printed from the same internegative(s).

6.8 What is a 'release print'?

The 'release print' is made from the internegative (as mentioned above), or, for very small print runs or special engagements, from camera negatives. These are the prints which are shipped to theaters and other exhibitors for the exhibition of motion pictures. Release prints differ from answer prints, check prints, and intermediates, in that they are mounted on metal reels for projection (the others come on small plastic lab 'cores' and must be mounted in 'split reels' for projection), and, like check prints, have reel-change cues at their tails. They are the least-expensive type of final print.

6.9 What is the difference between release prints made for projection with tungsten lamps and release prints made for projection with xenon lamps?

The color balance. Tungsten lamps have a 3300 degree Kelvin 'color temperature,' whereas xenon lamps have a 5500 degree Kelvin color temperature. Basically, xenon lamps give a 'bluer' light than tungsten lamps (carbon-arcs fall somewhere in between). To compensate for this, a small filter is changed in the printer to make prints for both types of lamps. This change is independent of the print timing, and so can be made well after the timer is completed with his job. In practice, however, all theatrical prints are balanced for xenon, as no commercial theater commonly uses tungsten lamps.

6.10 What is a 'low-contrast print'?

It is similar to an interpositive, and is used for television/video tape transfers. These transfers often increase image contrast, and so are improved when they are mastered from a low-contrast print. These prints can be projected as well, but lack the color saturation and (obviously) contrast of a standard release print.

6.11 What is 'green film'? Why isn't it green?

'Green film' is simply a term used for film which is fresh from the lab, and is still somewhat moist from the processing chemicals and lubricants used at the lab. It requires slightly more attention upon projection, as the moisture and lubrication can prevent this film from running steadily through the projector. This is why some perfectly good prints seem to have lousy registration when they have just been returned from the lab.

6.12 What are currently the standard reel/can sizes for the various film formats?

In 8mm/16mm/35mm: 100', 200' (not 35), 400', 800' (not 35), 1000', 1200' (not 35), 1600' (not 8, 35), 2000' (not 8)

6.13 How can I process reversal films at home?

(courtesy Ed Inman `edinman@teclink.net`)

```
> From: edinman <edinman@teclink.net>
> Newsgroups: rec.arts.movies.tech
> Subject: (no subject)
> Date: 7 Jun 1996 01:50:18 GMT
>
> Here is my advice on how to reverse process your Super 8 or 16mm black
> and white movies at home. Why would you want to do this? There are
> several reasons. For example, the film may be of a personal or sensitive
> nature that you would feel uncomfortable sending out to a lab. But the
> best reason to home process your film is that you get to see it right
> away, instead of sending it off and waiting.
>
> There is not much that has been written on this subject in years, so the
> following suggestions are based only on my personal experimentation. If
> anyone who has experience with this sort of thing would care to make
> suggestions on how I could improve or refine this process, or would like
> to ask any questions, feel free to e-mail me.
>
> HOME B&W MOVIE/SLIDE PROCESSING:
> The only home movie processing tank still sold that I am aware of is the
> G-3 Daylight Processor sold by Doran Enterprises in Milwaukee,
> Wisconsin, USA. Their phone number, if you wish to order one is
> 414-645-0109.
```

>
> The tank is not ideal--the good news is that it only takes one liter (or
> one quart) to process up to 200 ft. of Super 8 or 16mm film (or about
> 1.5 liters for 35mm film). The bad news is that it is kind of tedious to
> use.
>
> Since it is a "rewind" tank, the operator must continuously wind the
> film back and forth from one reel to another. At recommended winding
> speed of 2 turns per second, a complete wind of one 50-ft. Super 8 film
> would be about 45 seconds from one end to another. For 100-ft spool of
> 16mm (or two Super 8 films stapled together) the time would be one
> minute. At 200 ft., time would be 90 seconds.
>
> IMPORTANT:
> 1. Emulsion should be face out.
> 2. Unless Prebath PB-3 is used when film is first submerged, tilt the
> tank and pour in enough water so that the reel with no film is wet and
> reel with film is dry. Then wind dry film onto wet reel so that emulsion
> is uniformly made wet.
>
> PROCESSING STEPS:
> I do not have recommendations for developing Ektachrome film but for
> developing B&W films like Tri-X Reversal 7278 or Plus-X Reversal 7276,
> use the following processing steps:
>
> SOLUTION and suggested NUMBER OF WINDS AT 68F (20C):
> FIRST DEVELOPER: 12 (Or 8 at 80F--This is the most critical step.
> Decrease number if fully processed films are consistently too light;
> increase if too dark.)
> RINSE: 4 (change water each time)
> BLEACH: 10 (8 at 80F)
> CLEARING BATH: 8 (6 at 80F)
>
> Now remove cover of tank, add water, and re-expose film under a bright
> 200 to 500 watt light or in sunlight for two to three complete winds.
> Cover tank and continue:
>
> SECOND DEVELOPER: 8 (6 at 80F)
>
> You may now rinse film (5 winds running water) and dry, OR if you want
> to harden emulsion and make film less prone to scratches (recommended if
> the film is expectd to have heavy usage) add the following steps:
>
> RAPID FIXER: 2
> RINSE: 2
> HYPO CLEARING AGENT: 2

> RINSE: 5 (running water)
> PHOTO-FLO (optional):2
>
> To dry film, string a line across the room and loop film over and over
> the line, emulsion side up, for uniform drying. Spool onto projector
> reel emulsion side out.
>
> SUGGESTED SOLUTION FORMULAS:
>
> FIRST DEVELOPER: Add 9.5 grams of sodium thiosulfate to 1 liter of Kodak
> D-19 developer regular strength.
>
> BLEACH: To one liter of water add 9.5 grams of Potassium Dichromate and
> 12 ml of concentrated Sulfuric Acid.
>
> CLEARING BATH: To one liter of water add 90 grams of Sodium Sulfite.
>
> SECOND DEVELOPER: Use standard paper developer like Dektol or Polymax T
> regular strength.
>
> FIXER: Use Kodak Rapid Fixer or similar.
>
> HYPO CLEARING AGENT: Use Kodak Hypo Clearing Agent, or similar.
>
> PHOTO-FLO: Use Kodak Photo-Flo or similar.
>
> These solutions can also be used to make B&W slides from almost any 35mm
> B&W film. The recommended starting point times for a standard
> (non-rewind) tank at 20C (68F) is:
>
> FIRST DEVELOPER: 6 min.
> RINSE: 2-5 min. (change water frequently)
> BLEACH: 1-2 min.
> CLEARING BATH: 2 min.
> RINSE/RE-EXPOSE (You can't overexpose at this point)
> SECOND DEVELOPER: 5 min.
> RINSE/FIX/DRY normally.
>
> As a general rule, just remember:
> If too dark, increase time or temp. of first developer.
> If too light, decrease time or temp. of first developer.
>
> TO ORDER HARD-TO-FIND CHEMICALS call Photographer's Formulary toll free
> at 1-800-922-5255. (Note: They only sell sulfuric acid in a 48 percent
> solution so you will need to use 25ml for a liter of bleach instead of
> the 12ml you would use of concentrated solution.) If you want to get

```
> really fancy, try some of their many toners, intensifiers, or reducers
> on your films or transparencies--experiment first with unwanted films
> since you don't want to risk ruining your good films.
>
> DISCLAIMER: Potassium Dichromate and Sulfuric Acid are hazardous
> chemicals which should be treated with extreme care and handled as
> hazardous waste. If in question, the bleach formula should be made by a
> qualified chemist. Also, bleach does not keep as well as the other
> solutions when mixed. For best keeping, you may want to add the
> potassium dichromate to one-half liter of water to make BLEACH PART A
> and the sulfuric to a separate half-liter of water to make BLEACH PART
> B. The two then are mixed together in equal amounts just prior to usage.
>
> ADDITIONAL TIPS:
> 1. By adding an optional rinse between the bleach and the clearing bath,
> you can probably extend the useful life of the clearing bath. But for
> most consistent results always use fresh chemistry.
> 2. If highlights appear to be not fully reversed (I.E. gray image where
> there should be white) the bleach is exhausted or you need to increase
> bleach time.
> 3. If yellow stain appears anywhere in film, clearing bath is exhausted
> or you need to extend clearing bath time.
> 4. If fixer erases part of the final image, you did not fully re-expose
> or redevelop the film or your redeveloper is exhausted.
> 5. To use the G-3 tank for negative processing, use regular D-19, then
> fix, wash and dry normally.
> 6. For high contrast applications (such as titles or line work) use
> Kodalith developer in both the first and second development stages, or
> as a negative developer.
>
> Best of luck--let me know how you come out.
> Ed Inman -- E-mail -- edinman@teclink.net
```

7 Film for Videotape and Television (and vice-versa)

7.1 How is the frame-rate difference worked out when film is displayed on television?

7.1.1 European Television Standard

European television conforms to the PAL (Phase Alternation by Line) standard, which runs at 25 frames (50 fields, or half-frames) per second. This is close enough to the film standard of 24 fps, that 24 fps films are often simply run at 25 fps, with possibly a bit of pitch-shifting on the soundtrack to make it sound less 'screechy.' Films shot for television broadcast are often shot at 25 fps, and many cameras have an option of a 25 fps crystal, and tape recorders are made with 50hz (rather than 60hz) crystals for syncing to 25 fps film.

Both PAL and SECAM (another television standard, used mostly in Eastern Bloc nations) use 625 scan lines, running at 50 fields per second. These standards are able to provide higher-quality images than the U.S. standard described below.

7.1.2 U.S./Canada/Japan Television Standard

In the United States, Canada, and Japan, modern color television conforms to the NTSC (National Television Standards Committee) standards, which were devised in an attempt to make color television signals compatible with black-and-white receivers. The standards provide for a frame rate of 29.97 frames (59.94 fields) per second (versus the film standard of 24 fps), and 525 scan lines. These scan lines are 'interlaced,' meaning that every other line (one 'field') is scanned once, and then the alternate lines are scanned in another 'field.' Thus 262.5 lines are scanned once, then another 262.5 line are scanned. The two fields combine to form one 'frame,' which is the full set of 525 lines, and is analogous to a 'frame' of film (although there are more of them per second in television).

It should be noted that the original U.S. television standard for black-and-white transmissions provided for 30 frames/60 fields per second, but had to be revised to allow for color. When black-and-white shows are broadcast by a color station, the TV station can either broadcast at 30 fps, or broadcast a color burst signal at 29.97 fps. In practice, though, this standard is now ignored.

Early broadcast setups were designed to simply repeat every fourth film frame when a film was to be shown on television. This method comes very close to showing the film at the proper speed (it makes the film about 5% longer (with respect to running time) when it is shown on television, because this method assumes that television runs at 30 fps, rather than the actual 29.97). This results in the following frame relationships:

Television Frames #	Film Frame #
1	1
2	2
3	3
4	4
5	4
6	5

7	6
...	...

Modern film-broadcast setups work by making each film frame reproduce alternately on two or three consecutive fields. This scheme provides more-accurate representation of motion, and leaves fewer motion 'artifacts' of the film on the television display. This results in the following frame relationships (with fields designated by half-frames).

Television Frames #	Film Frame #
1	1
1.5	1
2	1
2.5	2
3	2
3.5	3
4	3
4.5	3
5	4
5.5	4
6	5
6.5	5
7	5
...	...

7.2 What are the various methods used to display film on television or videotape? Which are the most common?

7.2.1 Film Chains

The equipment used to display film on television is known as 'telecine' equipment, and comes in two basic varieties. The older and cheaper type (called a 'film chain') involves a standard movie projector whose shutter blades have been modified so as to sync with the television camera, eliminating the 'flicker' which appears when an unmodified projector is used. This modified projector is set up to project into a 'multiplexer' which directs the light through a field lens (by means of several high-quality mirrors) and into a telecine camera (a high-quality three-tube or three-chip television camera, whose lens is attached to the screen, so as to photograph the projected images. This setup can 'reverse' black-and-white negative film to produce positive images, but cannot do so with color negative, due to the complex color shifting which must be achieved due to the orange-y tint of color negatives. Also, this system is incapable of anything beyond very basic color and exposure correction, making it unsuitable for production work, but useful for low-end television stations, which need to broadcast from release prints.

7.2.2 Flying Spot Scanners

The more modern equipment, usually a Rank™or Bosch™telecine machine, is large and expensive (making it impractical for television station use, but appropriate for labs and post houses), and involves the use of a 'flying spot scanner,' which does not depend upon the intermittent movement of a projector, but rather is capable of scanning the film as it moves past the scanner head. This process is similar to that used by the newer CCD scanners (such as those from BTS™/Philips™, which use CCD sensors to read the images from the film.

Because of its high quality and sophisticated electronics, as well as its ability to easily and gently shuttle film back and forth, it is suitable for production work, and, when used with additional electronic equipment, allows for a huge degree of latitude in color and exposure 'correction' (much more so than is afforded a lab's color timer), and allows for much additional creative use, as is often seen in television commercials and music videos. Further, it is capable of producing a transfer of camera negative to which sound may later by synced (from an original sync 1/4" or timecoded DAT tape). Sound synching may also be done during the film transfer.

7.3 How are film negatives cut to match an edit done on videotape?

(information courtesy Martin Gignac `martyg@sympatico.ca`)

The original film negatives, after processing, are transferred to videotape, with the film's keycode (barcodes printed on the edge of the film negative by the manufacturer, and containing the same information as the visible 'edge numbers') encoded on the tape, often in the Vertical Interval Time Code (VITC) region of the tape. Non-drop-frame timecode is recorded as well. Visible timecode/keycode are 'burned in' to the picture as well. The tape is synched with the production sound and is then ready for editing. For non-linear editing, the pictures and sound from the tape are digitized along with the timecode and keycode information.

After editing, the an EDL (edit decision list) is created, with the video non-drop-frmae timecode numbers, along with a keycode number list. Each cut is then verified and the list is sent along with a videotape of the edited version and the negatives to the negative cutter, who then verifies everything again, and produces a cut negative to match the video version.

7.4 How is the sound re-synced to the film to match an edit and mix done on videotape?

The video timecode on the edited tape is converted to 24/25 fps film timecode. This is then used to drive a standard magnetic film dubber, which then records the sound from the tape directly onto magnetic film. This is then used to make an optical soundtrack for film release in the conventional fashion.

7.5 What formats of videotape are most commonly used for film post- production?

7.5.1 Television Films

High-end productions often use the new digital videotape formats, which, when used with digital switchers and edit controllers, are capable of being dubbed many times, without sustaining any significant 'generation loss' of picture or sound quality (what loss occurs is a result of the compression and decompression of the image as it goes through the various stages of production). These formats include: D1, D2, D3, and Digital

Beta. The use of these formats is mostly confined to productions which will end up on television, and thus demand the high quality that they offer.

7.5.2 Theatrical Films

Films which are intended for distribution in theaters often are edited on non-linear editing systems (such as the Lightworks™, or the AVID™for later negative matchback, and release prints to be made. Because they do not require the high quality and often cannot afford the high cost of the digital formats (because the video transfer is just used as an editing reference, and not for distribution), they often use the old, relatively cheap 3/4" Umatic format for 'video dailies' and editing, with 'window burns' of Keycode numbers and video timecode for later negative matchback. During the transfer, the 'head' of the film is 'punched' (one frame has a circular hole punched in it) to provide a reference for the negative cutter to relate the timecode to the keycode.

Of course, theatrical films which are edited in the conventional manner (using a Steenbeck™or Moviola™or similar editing machine, and manually cutting and splicing workprint and magnetic film) do not even need to use videotape formats at all, unless the film will be released to the television or home-video markets, in which case a low- contrast print (or interpositive can be run through a flying-spot scanner with minimal color/exposure correction (this will have been done in the color timing stage of production).

7.6 What formats of videotape are most commonly used for television broadcast of filmed material?

Network broadcast is now using digital masters, often in D1 or, more commonly and less expensively, D2. Older productions and those with lower budgets are sometimes broadcast off of analog 1" C-type tape, though. Very few local broadcast stations can afford digital, and use 1" almost exclusively. For news broadcasts (which almost never involve film), the lightweight and portable Beta SP format is used. A few low-end stations also use 3/4", though its use for broadcast is fading now.

7.7 How are 70mm films displayed on television or videotape?

There are two ways to do this. The simpler method is to use a 35mm (or, gasp!, 16mm) reduction print, which can be transferred to videotape in a conventional fashion. The more complicated method, though the one which provides better quality, is to transfer a 70mm print at Crest National Film Laboratory, which has modified a Rank™machine to accept various formats of 70mm material at various frame rates.

7.8 How is material originated on videotape transferred to film for theatrical projection? How is the sound synced?

This has been done for several films and portions of films with varying degrees of success. The simplest method is known as 'kinescoping' and has been used since the introduction of television to preserve important pro- grams on film (prior to the introduction of videotape). This method varies widely in quality, from unwatchable, to almost-acceptable. It works with a movie camera which has been modified much like a telecine projector, using a shutter with additional blades (or, more commonly, a single 72-degree blade with a 288 degree opening). It is simply pointed at a television screen, and started. The resultant pictures are commonly of very low con- trast, and sometimes have edges cropped. Sound is recorded either in-camera (with an old-fashioned optical-sound galvanometer) or on a magnetic tape which is later transferred to magnetic film, and synced normally.

The more complicated method (which is substantially more expensive), is available from companies such as 4MC™(formerly Image Transform™) in the Los Angeles, California area. They (and others) have developed sophisticated equipment which increases the effective number of lines of resolution in a particular television image, making the film version look somewhat clearer than the TV original. In this system, each of the three primary colors of the image (red, green, and blue) are recorded separately onto separate pieces of film, which are then printed successively onto an interpositive in order to produce a full-color image. The soundtrack is usually recorded from the original videotape onto timecoded DAT or 1/4" tape, which can then be used directly to cut an optical track for the print. This process has been used for several widely distributed films, most notably *Hoop Dreams*, and, considering the low quality of television images, makes reasonably good-looking films.

---

8 Opinions

8.1 What is the most workable method of projecting super-16mm workprint with separate fullcoat magnetic soundtrack?

8.1.1 Double-Band Interlock Projector

There are several possibilities, since it is not possible to make a super-16mm print with a standard optical or magnetic track. The most common method is to file out the edge of the gate (opposite the claw) in a Siemens or Palmer double-band projector (which were both made in the early-to-mid-1970's, and are used to project 16mm workprints with an interlocked magnetic soundtrack). Unfortunately, parts are apparently not available for these machines anymore, and the projectors themselves are difficult to find, fairly expensive, and clunky to work with.

This type of system can be improvised, using an ordinary projector, by mounting a 'sync block' after the second projector sprocket, and by mounting a magnetic head on the sync block. The picture film is then loaded into the projector, and passed through the sync block, and the magnetic film is on reels, mounted on manual rewinds, and passed through the sync block. Since the film and magnetic film are both in the same sync block, they are guaranteed to stay in sync throughout the reel. Of course, the projectionist must crank the takeup rewind throughout the show, in order to take up the magnetic stock.

8.1.2 Standard Projector Interlocked With Dubber

The alternative method (which is used by many film laboratories for their screening rooms) is to file out the gate of a standard 16mm projector (or just buy and install a super-16mm gate for it), and interlock the projector to a Magnasync-type magnetic sound dubber, which will follow the speed of the projector and reproduce the soundtrack in perfect. This method is reliable and widely used, but almost requires a permanent setup (not good for location work), and can be expensive.

8.2 What is the likely future for 2.5-perf 35mm release prints?

[under construction]

8.3 Which films are good examples of wide screen composition?

[under construction]

8.4 Which films are good examples of multi-channel sound mixes?

[under construction]

8.5 What are some recommendations for long-term film storage?

Two opinions from a rec.arts.movies.tech thread:

```
> Subject:      Re: Vitafilm availability and film cleaning
> From:         jharw91601@aol.com (JHarw91601)
```

```
> Date:         1996/10/23
> Newsgroups:   rec.arts.movies.tech
>
> [snip]
>
> There is no known cure for vinegar syndrome.  There are many "wive's
> tales" out there, but none of them has had any scientific backing as of
> yet.
>
> What causes vinegar syndrome?  Well, there are many.  The most common
> cause is improper storage in overly humid environments.  Other causes are
> poor processing and some types of scratch rejuvenation.
>
> So what are molecular sieves?  They are small packets which are placed in
> the cans of deteriorating film.  They absorb most of the acetic acid
> vapors which are being released from the film base.  These vapors (which
> smell like vinegar) are what attack the emulsion as well as the plastic
> acetate base support.  If the sieves are used in tandem with proper cold
> storage (below 50 degrees F and 40% relative humidity) then this will slow
> the deterioration down to a crawl.

[snip]

> Cleaning your film with commercial film cleaners should be limited to
> those which do not have any oils in them, if you're cleaning films with
> vinegar syndrome.  Trichloroethane based cleaners, or just straight
> trichloroethane, is very good.  Ecco brand and J&R Film cleaner are good.
> Vitafilm and Surfaset have silicons &
> oils in them.  Oils tend to trap in the acetic acid vapors, which will
> hasten the deterioration.  Make sure you use a clean velvet or Webril Wipe
> when doing a cleaning.  Unless the print is dirty, however, it's best to
> leave well enough alone.  Passing a film through a cloth can potentially
> cause scratches.  Be very careful to stop periodically and shake out the
> rag in case dirt builds up in it.

[snip]

> Sincerely,
> Jim Harwood
```

```
> Subject:      Negative Storage
> From:         fwylie@infinet.com (Frank Wylie)
```

```
> Date:         1996/10/25
> Newsgroups:   rec.arts.movies.tech
>
> bihari@ohstpy.mps.ohio-state.edu wrote:
>
> >I have heard conflicting advice on the best method for long term storage of
> >film negative.  Room temperature, cool, or frozen?
> > What humidity is best?
>
> Jim,
>
> The National Film Board of Canada has begun tests on freezing monopack
> color negs, but beyond that I couldn't tell you the long-term effects
> of freezing your negative.  Some members of the AMIA-L (Assoc. of
> Moving Image Archivists) listserv expressed concern that if the
> proceedure was not carried-out with great control, then the base,
> emulsion or both could be fractured by the excessive moisture content
> of the emulsion, due to expansion of the freezing water.  There were
> other issues as well, but I don't remember them off-hand.
>
> At the present time, I believe the consensus is that the optimal
> storage temperature is near, but not below, freezing with a relative
> humidity of 30 - 40%.
>
> >Will dessicants in the film cans dry out the film too much?
>
> In a word, yes.  Unless you are storing the film in a very humid
> place, I would not put sillica gel in the cans.  If you are storing
> the film in a humid environment and cannot control the atmosphere in
> any other way than using sillica gel;  store the film in an oversized
> can, on cores and laying flat (you should always store film on cores
> and laying on-edge - never store on reels and in the upright
> position). I would suggest you attach the gel canister to the can lid
> with pop rivets (or other non-chemical based method to avoid harmful
> adhesive fumes) over the center of the core.  If you lay the packet in
> on top of the roll, you may cause the film to dry-out in the area
> direcly beneath the gel and cause dimensional problems in the future.
> Check the canister and gel every two-weeks and turn the roll over to
> equalize the absorption across the web of the film.  I really don't
> know how you would monitor the relative humidity of the can, but a
> stable atmosphere is critical.  Cycles of humidity and extreme dryness
> can cause severe stress on the emulsion;  causing fractures, across
> the web shrinkage and maybe even vinegar syndrome.  Who knows?
>
> Also, don't store film in tight-fitting cans;  let it breathe.  Safety
> has a tendency to go vinegar if sealed-up in a can (not so much if the
```

```
> temp is low), so keep the film in loose-fitting, oversized cans.
>
> If you can afford it, throw in a few molecular sieves per can;  can't
> hurt (at least as far as we know!).
>
> >       I definitely appreciate Jim Harwood's helpful post.  If the ideal
> >condition is below 50 degrees at 40% relative humididy, would it be a
> >good idea
> >to devote a refrigerator to storing my original negative for my films?
>
> I think so. The greater volume of air would be easier to stabilize and
> maintain a good relative humidity level.  A fairly inexpensive weather
> station (indoor/outdoor type) could be mounted on the door to keep a
> check on the interior without opening the door.  I would NOT suggest
> you use a "frost-free" type of refrigerator, as they remove humidity
> to keep-out frost and could freeze-dry your film.  If the fridge tends
> to keep a dry atmosphere;  put a few damp rags in a film can, punch a
> few holes in the top and place it in the bottom of the refrigerator.
> If too damp, use sillica gel cansiters to lower the RH.  You will have
> to experiment to find a method of regulation, but it should not be too
> hard.
>
> >freezing it worse than refrigerating it?  Will the wrong temperature or
> >humidity wreak havoc (sp?) on glue splices?
>
> At the present time, I would say cold storage, but don't freeze just
> yet.  Until more testing is conducted, try a method that has had some
> success in the past.
>
> As for the splices;  they would be my least worry.  A cement splice
> can be remade without too much fuss; and without loosing a frame.  I
> would worry about fungus, mold, air pollution, solvents and other
> nasties attacking the emulsion;  along with the natural tendency of
> dyes to fade over time.
>
> The biggest problems in preservation of color negative are:
>
> 1.  Dye fading  - solution:  copy when dyes start to fade.  That's
> about all you can do.  Forget digitizing; the storage medium won't
> last as long as the original negative and "Who the heck can afford it
> anyway ?".
> 2.  Shrinkage of base - solution:  maintiain proper humidity and temp.
> Make new dupe preservation neg when approaching 0.5% linear shrinkage
> of the film.  Shrinkage should be measured over the length of one-foot
> of film and expressed as a percentage of the total original distance
> on a fresh piece of properly-pitched stock (get the right pitch, it
```

```
> matters!).  We use shrinkage-gauges built by Mauer in the 50's;  I
> don't know what to suggest for a homebrew measuring device.  You start
> having printing problems (movement and breathing in the printer gate)
> at about 0.6 % on "standard" printers.  When you exceede that amount,
> you have to have it printed on a modified printer;  one with the
> sprocket teeth cut-down and movement is almost assured when you print
> that way.
> 3.  Emulsion damage - don't handle the film excessively, but do
> exercise the roll at least once a year by rewinding.  Some claim you
> should store the film emulsion-in (contrary to lab practice!), but we
> at the LOC store all our originals emulsion-out.  Why?  I guess it's
> just easier to handle when printing when would emulsion-out.
> 4.  Environmental damage - Solvents, ozone, gases, etc. attack the
> base, emulsion or both.  Keep storage areas clean and free from
> volatile chemicals and or liquids.
>
>
> Whew!  Hope that helps somewhat.
> --
>
> S. Frank Wylie
> fwylie@infinet.com
```

---

9 Obsolete Film Formats

9.1 What was 'Cinerama'™? How did it work? Why did it become obsolete?

[under construction]

Cinerama™is arguably the most-discussed film format here on rec.arts. movies.tech. It was the first of a series of film formats developed in the 1950's and 1960's in an attempt to bring the audience a larger, more-realistic, better-sounding film experience. The system consited of a six-perf film format, run from three separate strips of film (shot and projected with three cameras or projectors simultaneously), photographed with wide-angle lenses and intended to be projected on a large, curved screen, made up of several hundred individual strips of screen material. Cinerama™sound was reproduced from a separate seven-track magnetic sound reproducer running magnetic film (much like a standard film dubber). Cinerama™equipment utilized standard 35mm-width film, but the three strips combined to feature an image area far larger than even 70mm prints today. This format persisted through the early 1960's, before it was deemed by the producers and distributors as a clunky format, which could easily be replaced with such later (and inferior) formats as CinemaScope™and 70mm/Todd-AO. Nonetheless, many theaters were designed with Cinerama™presentations in mind, and featured the name 'Super Cinerama™.'

The following features were shot in Cinerama™:

(courtesy Ralph Daniel `104574.2404@compuserve.com`)

```
CINERAMA  MOTION  PICTURES

There are three schools of thought regarding Cinerama motion
pictures.  The first insists that only productions using three
interlocked films in both filming and projection qualify as
"true" Cinerama.  The second believes that anything shown on a
Cinerama screen qualifies.

This third school is a list of features conforming to the
following criteria:  Each was INTENDED BY ITS PRODUCERS to be
shown on a deeply-curved Cinerama screen, regardless of the
filming technique used.
```

YEAR	STUDIO	TITLE	NEGATIVE	CINEMATOGRAPH
1951	C'rama	This Is Cinerama	3x35mm	Cinerama
1955	C'rama	Cinerama Holiday	3x35mm	Cinerama
1956	C'rama	7 Wonders of the World	3x35mm	Cinerama
1957	C'rama	Search for Paradise	3x35mm	Cinerama
1958	C'rama	South Seas Adv.	3x35mm	Cinerama
1958	C'miracle	Windjammer	3x35mm	Cinemiracle
1960	C'rama	Renault Dauphin (ad)	3x35mm	Cinerama
1962	MGM	Wond World Bro's Grimm	3x35mm	Cinerama
1963	MGM	How the West Was Won	3x35mm	Cinerama
1963	UA	It's Mad (4) World	65mm	U.P. 70
1964	C'rama	Best of Cinerama	3x35mm	Cinerama

1964	BMP	Circus World	35mm(h)	S.T. 70
1965	R-S	Mediterranean Holiday	?	?
1965	UA	Greatest Story Ever Told	65mm	U.P. 70
1965	UA	Hallelujah Trail	65mm	U.P. 70
1965	WB	Battle of the Bulge	65mm	U.P. 70
1965	C'rama1	Golden Head	35mm(h)	S.T. 70
1966	C'rama2	Russian Adventure	3x35mm	70mm composite
1966	UA	Khartoum	65mm	U.P. 70
1966	MGM	Grand Prix	65mm	S.P. 70
1968	Security	Custer of the West	35mm(h)	S.T. 70
1968	MGM	2001: A Space Odyssey	65mm	S.P. 70
1968	MGM	Ice Station Zebra	65mm	S.P. 70
1969	ABC	Krakatoa - East Java	65mm	S.P. 70
1970	ABC	Song of Norway	65mm	S.P. 70
1972	MGM	Great Waltz	65mm	S.P. 70
1973	C'rama	This Is Cinerama (reissue)	3x35mm	70mm composite
19??	C'rama	(untitled--military nuclear test)	3x35mm	Cinerama

```
codes:
MGM     = Metro-Goldwyn-Mayer
UA      = United Artists
ABC     = American Broadcasting Company Productions
R-S     = Reade-Sterling
BMP     = Bronston-Midway-Paramount
C'rama1 = Cinerama-Hungarofilm
C'rama2 = Cinerama & Mosfilm (Soviet Kinopanorama)

3x35mm  = three 35mm films run simultaneously
35mm(h) = 35mm film run horizontally (VistaVision)

U.P. = Ultra Panavision
S.P. = Super Panavision
S.T. = Super Technirama
```

And this interesting tidbit:

```
> Date: Fri, 14 Nov 1997 15:05:09 -0500 (EST)
> From: VEYOUNG@aol.com
> Subject: Mediterranean Holiday
>
> Scott, I have some information I've dug up that you might want to add to the
> FAQ.
> M.Holiday was shot in 65mm in a process called MCS-70 (that was either Modern
> Camera Systems or Modern Cinema Systems).  The exhibitor/distributor Walter
```

```
> Reade brought the rights to the film, and converted it to a really bizarre
> 35mm process called ARC-120 (renamed Wonderama), and it played at least one
> theatre in North Jersey, but I can't remember which.  It flopped.  They
> revived the 70mm print and ran it at the Manhattan Warner advertised "in
> Cinerama."  I've been debating with myself for years whether it should be
> included in a list of Cinerama70 films since it was not filmed with
> Cinerama70 projection in mind. Hope you find this helpful.
> vince

> Date: Mon, 8 Dec 1997 13:41:57 EST
> From: VEYOUNG <VEYOUNG@aol.com>
> Subject: Mediterranean Holiday again
>
> Hi, Scott
> Some more stuff about Med Holiday. A while back I e-mailed you some info about
> MH, but I couldn't remember the name of the theatre in New Jersey where it had
> played. In Dan Sherlock's most recent listing of errors in the Hayes/Carr
> book, he writes: "The first showing of Mediterranean Holiday using the
> Wonderama name was March 5, 1964 (not 1965) at the Strand Theatre in
> Plainfield, NJ on a screen 61 feet wide and 21 feet high."
> Vince
```

9.2 What was 'Techniscope'? How did it work? Why did it become obsolete?

[under construction]

9.3 What was 'Ultra Panavision 70™' a.k.a. 'MGM Camera 65™'? How did it work? Why did it become obsolete?

[under construction]

9.4 What was 'CinemaScope™55'? How did it work? Why did it fail?

[under construction]

---

10 Miscellaneous

10.1 What is THX™certification, and what standards are necessary for a theater which wishes to obtain it?

THX™is neither more nor less than a set of standards developed by George Lucas and his cohorts, designed to ensure that the sound and picture which were heard and seen in the mixing studio/screening room are similarly reproduced in the theatrical setting. The theory behind this is that a movie will look and sound best when the audience hears and sees exactly what the director and sound mixers saw.

Most of the standards relate to the proper positioning of the loud- speakers, screen brightness, presence or absence of sound-absorbing material (e.g. seat coverings) in the auditorium, and such. The standards are different for auditoria of differing sizes. A theater which wishes to advertise its THX™certification must not only meet these standards, but also pay a yearly fee to Lucasfilm. THX™theaters receive promo- tional materials and trailers to promote their establishment.

10.2 What equipment is necessary for a 'home cinema' for 16mm and where can it be begged for/purchased?

The cheapest way to start is to pick up a portable, tungsten-bulb, 'classroom-style' projector. These are very common surplus items right now, and can often be acquired for well under $100. When cleaned carefully and completely, and properly loaded, a manual-loading machine in good order is usually very gentle on the film and will give many years of service, with minimal maintenance, other than bulb changes, occasional lubrication, and regular cleaning).

Plenty of these machines (most commonly, Bell & Howell, Graflex, or RCA™) can be found from schools and industrial users who have switched over to videotape equipment for presenting instructional/promotional materials. They are also available, usually with warranties, from various dealers in used motion picture equipment. New machines are available from the Japanese manufacturer Eiki, but they cost in excess of $1200, and are sold by audiovisual dealers.

For those who want screen images larger and brighter than a tungsten bulb will allow, Bell & Howell and Graflex both made 300-watt portable MARC projectors, which use an external power supply to drive a small metal-arc bulb (much like modern HMI lamps). The power supplies are no longer made, and are difficult to find; if broken, they may be difficult to repair. These machines generally go for $300-500.

When buying a projector, make sure that it is capable of holding at least 1600' reels (a two-hour feature usually comes on 3 1600' reels), as some older models do not hold this size. New projectors take reels up to 2300'. Be sure to get several take-up reels of the largest size the projector will hold. If a big images is desired from a short 'throw,' then a shorter length lens is needed (most projectors come with a 2" lens; 5/8", 1", and 1.5" are also available and give bigger pictures). If possible, try to get an extra set of belts (motor drive, front feed arm, rear take-up arm) for the projector to have on hand in case one breaks. 'Scope lenses are available for showing anamorphic prints.

It's always good to have a splicer on hand, and there are several models which are commonly used. The Bolex cement splicer, guillotine-style tape splicer, and Maier-Hancock hot splicers are all commonly available, and usually go for $50-150.

10.3 What equipment is necessary for a 'home cinema' for 35mm and where can it be begged for/purchased?

Gear for 35mm is harder to come by and more difficult to assemble for a home cinema. Nonetheless, surplus projectors are available (such as an old Super Simplex, Brenkert, or RCA), and are still quite useful. In addition to the projector head, one needs a pedestal (which is usually quite heavy), a lamphouse (a small 500w-750w xenon is appropriate), a soundhead and preamp, and reel arms (usually 2000' size is good for a home). Finally, a 'flat' and (longer) ''scope' lens and aperture plates are needed. This type of gear usually goes for $1000-2000, and can be accumulated from movie theater basements, and equipment dealers. Further, since 35mm projectors don't rewind, one will need several 2000' house reels, and a rewind bench, with a pair of 2000' rewinds.

For 35mm, most people like the guillotine-style tape splicer (which is what editors use), which usually goes for $150. These can be acquired from dealers or from editing supply houses.

10.4 Where can one purchase or rent release prints in 8/16/35/70mm?

For purchasing used prints for home use, one should read the following periodical, published monthly and containing a large quantity of ads from collectors selling their prints:

Big Reel
P.O. Box 1050
Dubuque, Iowa 52004-1050
(319)-588-2073
http://www.bigreel.com/

Prints for public performance showings can be rented from several companies, all of which have catalogs of their films, most notably:

Swank Motion Pictures, Inc.
350 Vanderbilt Motor Parkway
Hauppauge, N.Y. 11787-4305
(800)-876-3344
http://www.swank.com/

10.5 What are the various processes used for color in motion pictures?

[under construction]

Coming soon - information on two- and three-strip Technicolor, Eastmancolor, and a whole bunch of other processes. In the meantime see texttthttp://www.simplecom.net/widefilm/ for some information on early color film processes.

10.6 What are the various frame rates which have been used for motion pictures?

[under construction]

10.7 What are the three different types of perforations used for 35mm release prints?

10.8 What is a 'reverse scanning solar cell' and how does it improve sound reproduction?

[under construction]

10.9 Who is R. Michael Hayes, and why are they saying those things about him?

[under construction]

10.10 Why are 'trailers' called 'trailers' when they are spliced after the 'leader' of a movie?

[under construction]

10.11 What books are useful for one interested in film formats and presentation?

[under construction]

10.12 What magazines and other publications are useful for one interested in film formats and presentation?

[under construction]

10.13 What online resources exist for one interested in film formats and presentation?

[under construction]

---

11 Reference Information

11.1 What are the footage/time conversions for the various film formats?

Frames per foot:
16mm – 40 35mm – 16 70mm – 12.8

Time	Reg. 8mm	Sup. 8mm	16mm	35mm
1 sec.	24 frames 3.6 inches	24 frames 4 inches	24 frames 7.2 inches	24 frames 18 inches
10 sec.	3 feet	3 1/3 feet	6 feet	15 feet
30 sec.	9 feet	10 feet	18 feet	45 feet
1 min.	18 feet	20 feet	36 feet	90 feet
3 min.	54 feet	60 feet	108 feet	270 feet
5 min.	90 feet	100 feet	180 feet	450 feet
10 min.	180 feet	200 feet	360 feet	900 feet
20 min.	360 feet	400 feet	720 feet	1800 feet
30 min.	540 feet	600 feet	1080 feet	2700 feet

11.2 What are the lens focal length/image size conversions for the various film formats?

[under construction]

11.2.1 16mm Chart

Lens Focal Length	<---------- Distance in Feet From Screen to Film ----------->							
	8'	10'	12'	15'	20'	25'	30'	35'
	4'9"	5'11"	7'2"	9'0"	12'0"	Width of Picture		
.64"	3'6"	4'5"	5'4"	6'8"	8'11"	Height of Picture		
	3'11"	4'11"	5'11"	7'6"	9'11"	12'6"	-	-
.75"	2'11"	3'8"	4'5"	5'7"	7'5"	9'3"	-	-
	2'11"	3'8"	4'5"	5'7"	7'5"	9'4"	11'3"	13'1"
1"	2'2"	2'9"	3'4"	4'2"	5'7"	6'11"	8'4"	9'9"
	1'11"	2'5"	2'11"	3'8"	4'11"	6'2"	7'6"	8'9"
1.5"	1'5"	1'10"	2'2"	2'9"	3'8"	4'7"	5'7"	6'6"
	-	1'10"	2'2"	2'9"	3'8"	4'8"	5'7"	6'6"
2"	-	1'4"	1'8"	2'1"	2'9"	3'5"	4'2"	4'10"
	-	1'5"	1'9"	2'2"	2'11"	3'8"	4'5"	5'3"
2.5"	-	1'1"	1'3"	1'8"	2'2"	2'9"	3'4"	3'11"
	-	-	-	-	-	3'1"	3'8"	4'4"
3"	-	-	-	-	-	2'3"	2'9"	3'3"
	-	-	-	-	-	2'7"	3'2"	3'8"
3.5"	-	-	-	-	-	1'11"	2'4"	2'9"
	-	-	-	-	-	2'3"	2'9"	3'3"
4"	-	-	-	-	-	1'8"	2'1"	2'5"

Lens Focal Length	<---------- Distance in Feet From Screen to Film ----------->							
	40'	45'	50'	60'	75'	100'	125'	150'
	10'0"	11'3"	12'6"	-	-	Width of Picture		
1.5"	7'5"	8'4"	9'4"	-	-	Height of Picture		

	7'5"	8'5"	9'4"	11'3"	14'0"	18'9"	23'5"	28'2"
2"	5'7"	6'3"	6'11"	8'4"	10'5"	13'11"	17'6"	21'0"
	5'11"	6'8"	7'5"	9'0"	11'3"	15'0"	18'9"	22'6"
2.5"	4'5"	5'0"	5'7"	6'8"	8'4"	11'2"	13'11"	16'9"
	4'11"	5'7"	6'2"	7'5"	9'4"	12'6"	15'7"	18'9"
3"	3'8"	4'2"	4'7"	5'7"	6'11"	9'3"	11'7"	14'0"
	4'3"	4'9"	5'4"	6'5"	8'0"	10'8"	13'4"	16'1"
3.5"	3'2"	3'7"	3'11"	4'9"	5'11"	7'11"	9'11"	12'0"
	3'8"	4'2"	4'8"	5'7"	7'0"	9'4"	11'8"	14'0"
4"	2'9"	3'1"	3'5"	4'2"	5'2"	6'11"	8'8"	10'5"

11.3 What are the standard locations for reel-change cue marks on U.S. release prints in the various film formats?

From the tail of the reel:

- 20 frames of picture
- 4 frames with 'changeover' cue marks
- 10 feet, 8 frames of picture
- 4 frames with 'motor' cue marks

— End of rec.arts.movies.tech FAQ —
