Film Workflow for the Super 8 Moviemaker

by

Edward Grabczewski
edward.grabczewski@btinternet.com

30 May 2002

Abstract

The purpose of this document is to examine the workflow for the low-budget moviemaker who wishes the cross-over to film from video and then back to film. The recent growth of interest in Super 8mm film in Hollywood and with independent moviemakers and film schools has allowed companies like Pro8mm (www.pro8mm.com) in California and London to sell negative stock which they subsequently develop and telecine to video.

At the other end of the scale we have producers with videotapes of movies wanting to transfer their digital work to 16mm and 35mm film.

Somewhere in the middle of all this are cinematographers and videographers that want to edit their film and video sources and transfer the end product to film or matchback to the original camera negative. The video editing software or DNLE should support all these workflows. Sadly hardly any reasonably priced editor does this. Adobe Premiere, one of the most popular and "powerful" editing packages ignores the needs of real editors. It neither supports the Super 8mm format, provides matchback facilities to Super8, 16mm or 35mm film, nor does it allow flexible timeline options to allow importing movies at 25 fps into a 24 fps timeline. It does not allow manipulation of individual fields and field filtering options. It does not support PAL and NTSC pulldown options. It does not allow matching 48 kHz sound with a 24 fps movie. It does not allow pitch alteration of the sound or constant pitch facilities when stretching or shrinking the duration. Instead we are deluged with useless plug-ins and effects with each new release whilst the core product remains firmly video based in its perspective - despite the manuals tantalising references to film. All comments here relate to filmmaking and the video issues surrounding those workflows.

This paper looks at some current and realistic workflows for the low-budget filmmaker and asks if it is possible to expand Adobe Premiere to give it more flexible video importing options and more transparent timeline capabilities that allow 25 fps video to be imported into a 24 fps project and allow the editor to see and control those dropped or created frames instead of making them implicit. More support and flexibility for handling fields and filtering them - especially for the PAL filmmaker (Adobe After Effects fails to support PAL Telecine A and B completely!). Some useful filters to merge adjacent fields to smooth out motion artefacts in PAL are necessary.

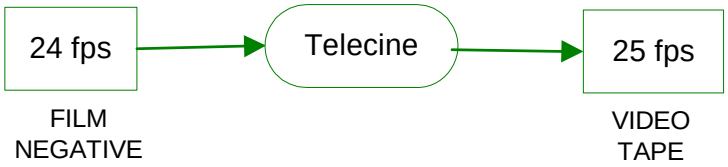
Features such as these would transform Adobe Premiere into a tip class DNLE and would reestablish it back at the pinnacle of it's market and open up a new market for filmmakers. Finally, videographers would also appreciate a built-*in waveform monitor* and *vectorscope*. Everybody would appreciate a well laid out *colour correction* panel. Some of these changes are long overdue.

Film Workflow with PAL

Super 8mm negative film stock can be bought from Pro8mm, who develop and telecine the film to video in a variety of standards. It is practically impossible to edit Super 8mm as the film has no edge codes (no key codes are provided and no ink numbering services are available). This leaves only one option, to transfer to video and edit using an NLE.

In the following sections we explain the functionality of the equipment used in video to film transfer and then we look at three possible workflow scenarios after shooting with Super 8 negative film.

Telecine



A *telecine* machine transfers film negative to videotape, usually in real-time. The Rank Cintel is a typical telecine supporting a variety of input *film* formats (8mm, 16mm and 35mm) and output *video* formats (PAL, NTSC).

A choice is made at the outset on what film transfer method to use. Keep in mind that film runs at 24 frames per second whereas PAL video runs at 50 *fields* per second and NTSC at 59.94 *fields* per second. We shall consider mainly the PAL transfer methods but mention NTSC transfer methods for completeness.

PAL

- Telecine A
  Transfer 1 frame of film to 2 *fields* of PAL video. Thus 24 frames of film are transferred to 48 *fields* of video. Since PAL video runs at 25 fps we are two *fields* short per second. Telecine A transfers at 25/24=1.04166 times the speed of the original film; roughly 4.1667% too fast.

- Telecine B
  Transfers 12 frames of film to 24 *fields* of PAL video and then copies the 24th *field* to an extra 25th *field*. Thus 24 frames of film are transferred to 50 *fields* of video every second in a 24+1+24+1 *field* pattern, resulting in an extra frame of video being added every second. Note the two *fields* comprising the extra frame are *not* adjacent.

NTSC

- SMPTE-A
  This is a 2:3 pulldown from film to NTSC video running at 29.97 fps

- SMPTE-B
  This is a 3:2 pulldown from film to NTSC video running at 29.97 fps

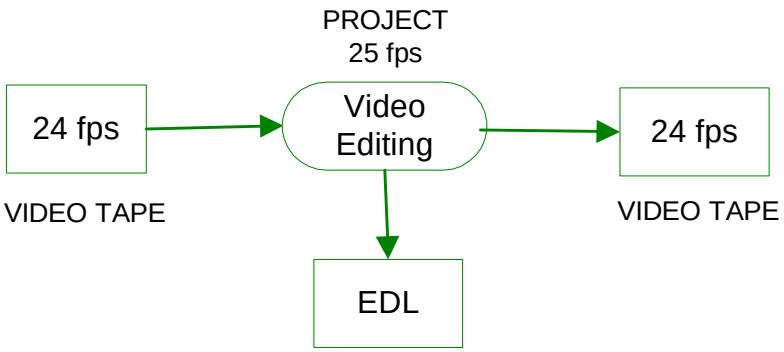
So we have four possible transfer options to videotape when using a telecine machine. These are the starting points from which we intend to import video into an Adobe Premiere project.

Film Recording

A *film recorder* transfers digital images to film at 24 frames per second. These digital images are derived from the PAL videotape created by Adobe Premiere. Each digital image frame is transferred from the PAL video stream to the film medium at 24 fps. If each second of PAL video contains 25 frames and if each of these frames is copied to film and later played back at 24 fps, there will be an inevitable speed decrease of 24/25=0.96 times the original film speed; exactly 4% slower.

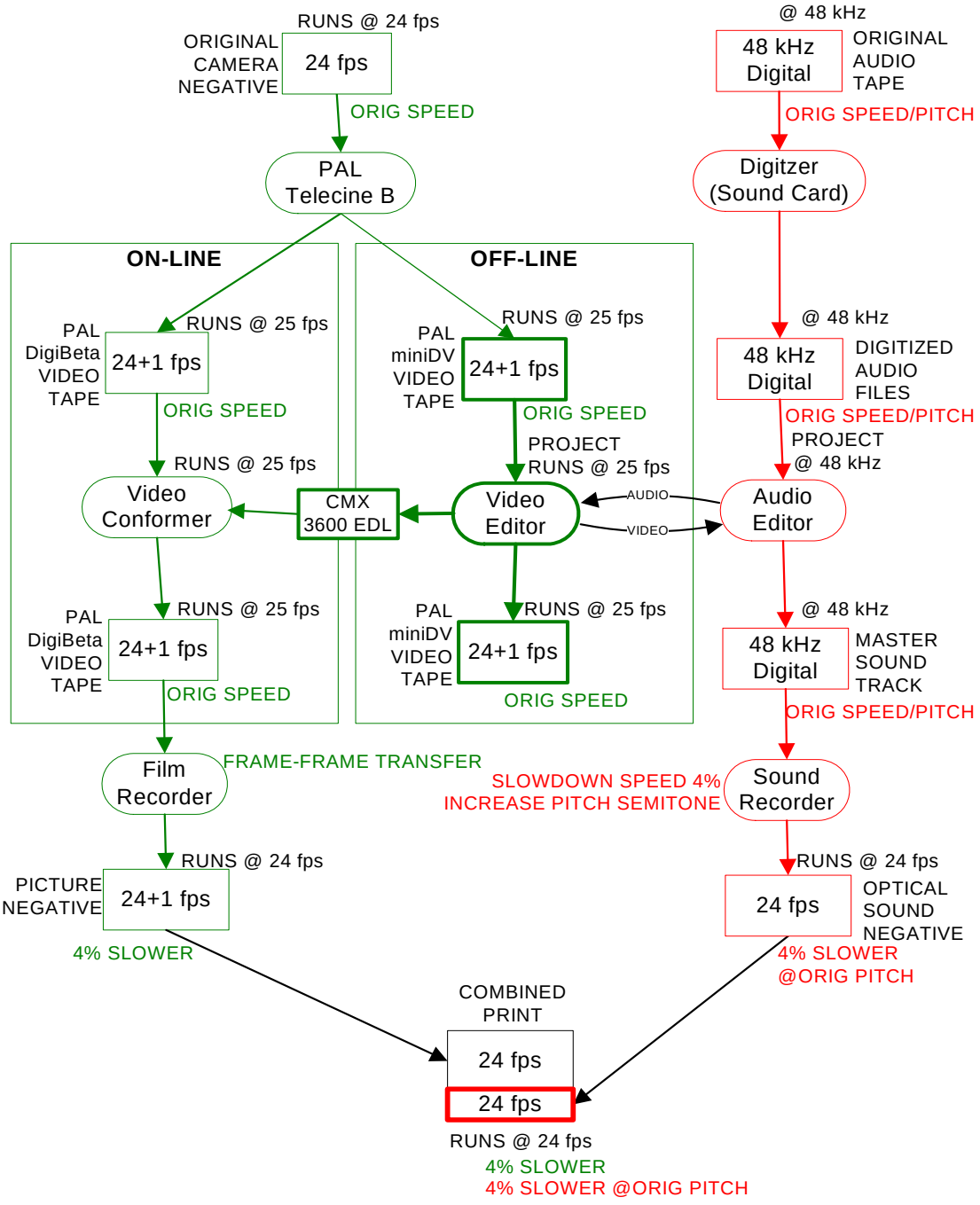
The numbers of options for transferring images to film are far fewer. A frame-by-frame transfer is the normal option. Therefore any changes to the number of frames must be made at some pre-recording stage.

Video Editing



Somewhere between the telecine process and the film recording process there is a off-line video editing process that captures the video stream, edits it and later outputs it back to video, whilst at the same time creating an EDL for the on-line video conforming process. We shall assume miniDV for off-line editing and DigiBeta for on-line editing.

FILM WORKFLOW 1



Film Workflow 1

In this workflow we start with a film movie camera running at an accurate 24 fps using a crystal sync fitted to the camera. This guarantees that the speed of the film matches closely with that of the audio - recorded on a separate crystal sync recorder (most DAT audio recorders sample at exactly 48 kHz). We shall assume the film format is Super 8mm using 50 foot cartridges lasting 2 minutes 30 seconds when shooting at 24 fps. The developed Original Camera Negative has no *edge code numbers* of any kind.

Referring to the diagram "Film Workflow 1" we see the workflow required to meet the needs of a Film Recording company. The customer supplies a Master Sound Track on DAT tape matching the audio track of the video movie. The original DigiBeta video tapes are supplied to the company together with an EDL in CMX 3600 format.

Note the DigiBeta and miniDV video tapes are created simultaneously during the PAL Telecine B transfer process and both tapes have identical SMPTE timecodes. Because of this fact it is possible to use traditional video off-line/on-line techniques to edit the miniDV version of the movie and create an EDL that may be used to auto-confirm the DigiBeta video tapes. The difference in quality between the miniDV and DigiBeta horizontal resolution (500 lines versus 800 lines) allows a significantly higher resolution transfer to 35mm film at the relatively small cost of creating a DigiBeta tape.

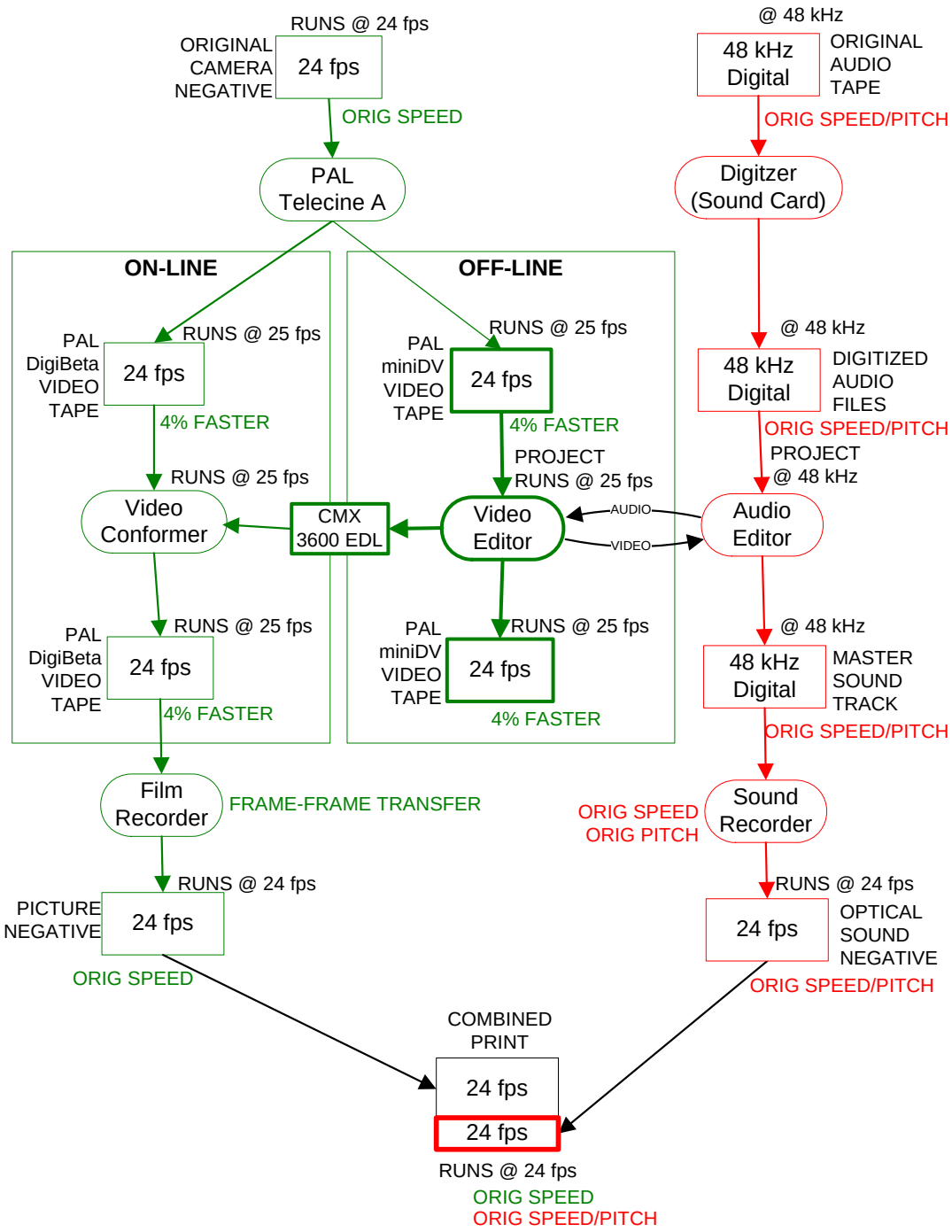
There are two distinct flows - one for audio and one for video. Video movies typically use "single system sound" to recording audio onto the videotape itself. Film movies use a "double system sound" to record sound separately. The picture and sound must later be integrated or "synchronised" during the editing stage. The playback speed of the sound must match that of the video in the editor.

PAL Telecine B creates videotape containing 25 frames per second of video running at 25 frames per second in the video editor. In this scenario there is no problem creating a 25 fps video project and importing the 25 fps miniDV video onto the 25 fps timeline. The audio and video run at the same speed and files may be exchanged freely between the video editor (Premiere) and the sound editor (e.g. Cubase). Note that we need a low-resolution AVI file of the movie to import into Cubase so that we can create a score for the movie. The AVI movie must be imported into Cubase and synchronised to the sound. The sound track is later mixed down and exported to a DAT tape for later transfer to an Optical Sound Negative. But to check if the sound matches the picture it will be imported back into Premiere and matched against the video prior to exporting the video to miniDV. The CMX 3600 EDL generated by the project contains details of both audio and video tracks. The Picture Negative is conformed on-line using the higher quality DigiBeta tapes and EDL.

Finally the Optical Sound Negative and the Picture Negative are printed to create a Combined Print. Note that this final print runs 4% slower than the Original Camera Negative but the pitch is adjusted to correspond to that recorded on the Original Audio Tape.

One disadvantage of this Workflow is the possible appearance of visual artefacts as a consequence of the duplicated fields created by the PAL Telecine B process.

FILM WORKFLOW 2

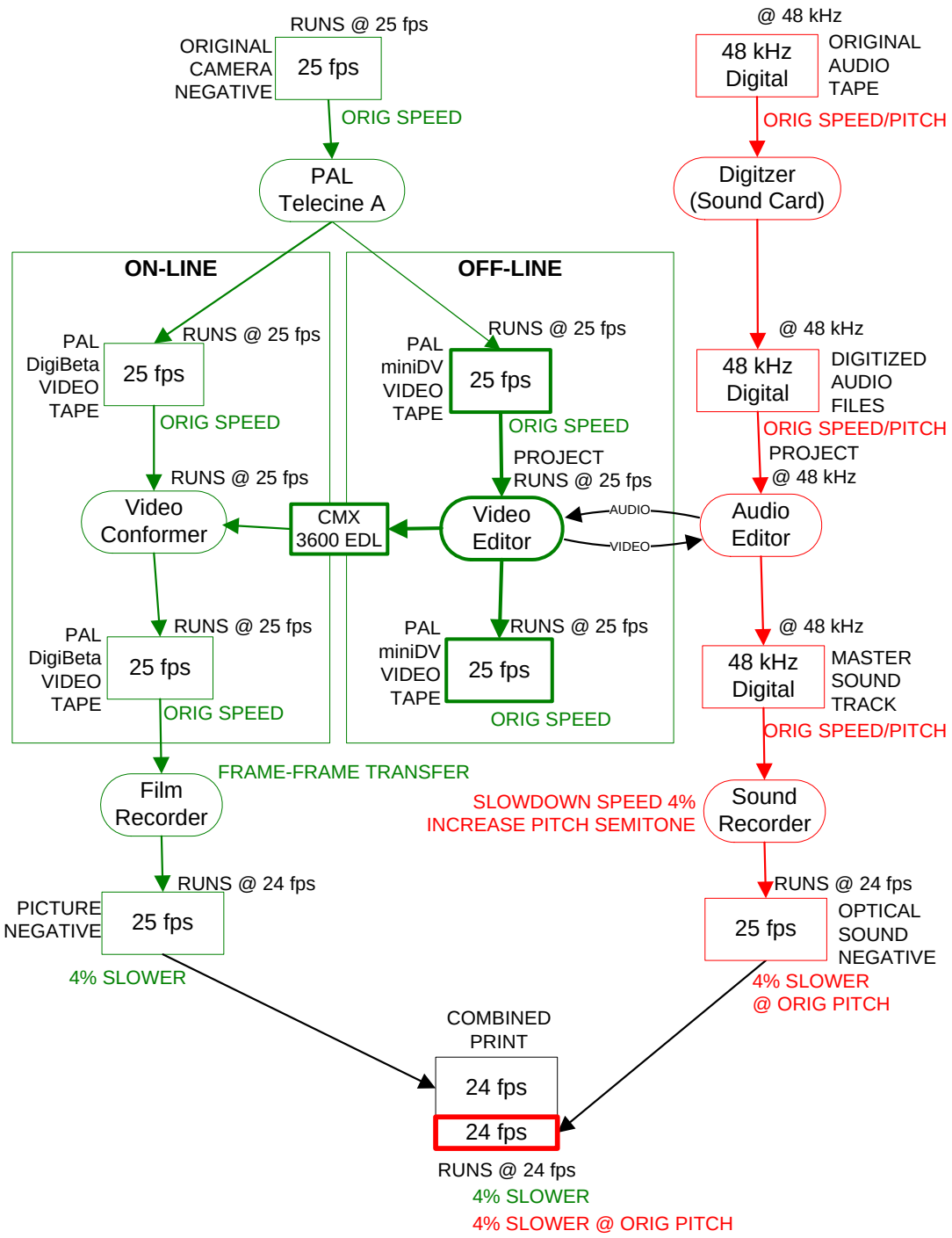


Film Workflow 2

In this workflow case the camera still runs at 24 fps with a corresponding Original Camera Negative. The PAL Telecine A process is use this time to create the videotapes. The telecined videotapes contain 24 fps images from the film copied to a videotape running at 25 fps. The result is a movie that runs 4% faster than it should. This causes a problem when matching the "double system sound" mentioned earlier.

Note that is this Workflow the Picture Negative, Optical Sound Negative and Combined Print all run at the speed and pitch of the Original Camera Negative and Original Audio Tape.

FILM WORKFLOW 3



Film Workflow 3

In this workflow case the camera runs at a crystal sync speed of 25 fps and the PAL Telecine A process transfers each frame of film to video without duplicating fields. The result is similar to Workflow 1 above.

The Optical Sound Negative and the Picture Negative are printed to create a Combined Print. Note that this final print runs 4% slower than the Original Camera Negative but the pitch is adjusted to correspond to that recorded on the Original Audio Tape.

Note, there are no video artefacts in this Workflow, as could be the case in Workflow 1.

References

Editing Digital Film
Jaimie Fowler
Focal Press (2001)
Contains details on film editing and the matchback process.

Shooting Digital
Marcus Van Bavel
DVFilm (2002)
www.dvfilm.com
Up-to-date advice on making movies for 35mm blowup from their top engineer.

The Digital Filmmaking Handbook
Ben Long & Sonja Schenk
Charles River Media (2000)

Digital Non-Linear Editing
Thomas A Ohanian
Focal Press (1998)

Digital Filmmaking
Thomas A Ohanian & Michael E Phillips
Focal Press (1996)

The Book of Movie Photography
David Cheshire
Alfred A Knopf (1979)
Contains details on 8mm and Super 8mm equipment.

American Cinematographer Manual (Eighth Edition)
ASC Press (2001)
See the following articles:

- *HD Telecine Mastering*
- *Shooting 16mm Color Negative for Blowup to 35mm*

Film into Video - A Guide to Merging the Technologies
Stuart Blake Jones & Richard H Kallenberger & Geroge D Cvjetnicanin
Focal Press (2000)
Contains details on telecine machines.

The Motion Picture Image - From Film to Digital
Steven Barclay
Focal Press (2000)