# Film-Tech

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# Troubleshooting and Prevention of Damage

In spite of the many precautions that may be taken by the projectionist, there will probably be a time when some projection related problem occurs. Remember that bit of philosophy called Murphy's Law—"If something *can* happen, it *will* happen—probably at a most inopportune moment." Some readers may think this philosophy is totally pessimistic.

***"If it can happen, it will happen..."***

***"Some of the causes are avoidable..."***

***"Any significant departure from these values..."***

***"...when the limits of human vision have been pushed so far..."***

***"...helps to keep the projector in good condition..."***

***"...if you want to keep your audiences happy..."***

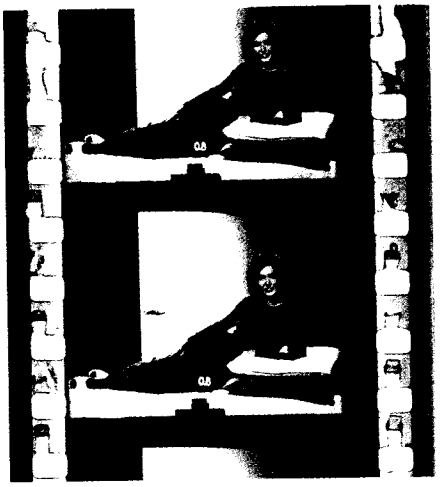
Others will see it as a realistic point of view. In any case, one must try to be prepared for such occurrences—especially if the trouble is in *your* booth during *your* show.

## TROUBLESHOOTING

In a previous article, we stressed the importance of film inspection prior to initial projection. We also reviewed the fundamentals of projection and the preparation of large reels or platters for the newer, sometimes automated, projection facilities. Assuming that these suggestions have been implemented and trouble still occurs, the following pages describe some of the most common screen image problems, along with their remedies, and the causes and prevention of certain types of film damage.

### IMAGE STEADINESS

Few things are more distracting to a theatre patron than vertical image unsteadiness. Some of the causes are avoidable and some are not. If we can assume that the unsteadiness did not originate during the printing operation in the laboratory, the film should first be examined for perforation damage. If the perforation walls on the pulldown side are deformed and torn (Figure 1), there is little that can be done short of extensive and costly repair of the film edges. If the perforations are undamaged, the problem lies elsewhere. Read on!



*Torn perforations such as these generally cause an unwanted interruption of the film presentation*

**Figure 1**

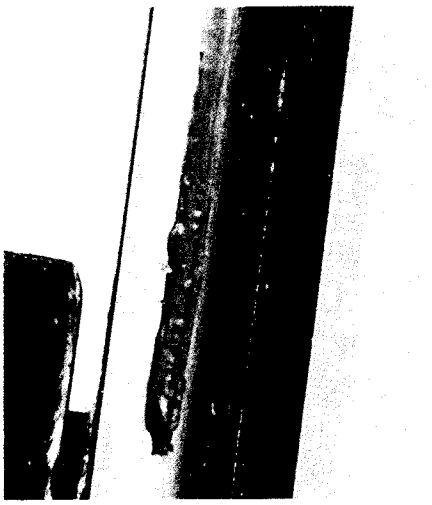
***All-time Box Office Rental Champs***
*(Variety)*

| ***Film*** | ***Rentals*** |
|---|---|
| *E.T.* | *$209,323,000* |
| *Star Wars* | *193,500,000* |
| *Empire Strikes Back* | *140,000,000* |
| *Jaws* | *133,435,000* |
| **Return of the Jedi* | *127,000,000* |
| *Raiders of the Lost Ark* | *115,035,000* |
| *Grease* | *96,300,000* |
| *Tootsie* | *92,960,000* |
| *Exorcist* | *88,600,000* |
| *Godfather* | *86,275,000* |

**Has moved up in rank since July 1983*

***Average Feature Film Length***—*100 minutes = 9,000 ft plus leader*
*= five 2000 ft reels*

Another film related unsteadiness factor is the lack of proper edge lubrication. While a new print is assumed to be ready for projection, it might stick on the first run or two due to insufficient lubrication by the laboratory. When lack of lubrication is responsible, unsteadiness generally does not occur at the beginning of the reel. After several hundred feet of film have been projected, the trap rails become hot enough to soften the unlubricated emulsion, which then becomes tacky. The soft, tacky emulsion collects on the rails (Figure 2) and rapidly dries to a bone-like hardness. As the new film is projected, these hard deposits continue to accumulate and offer further resistance. As the resistance increases, the clattering noise at the sprocket also increases. Then there is the added danger of the sprocket teeth seriously damaging the perforations, sometimes to such an extent that the print is useless.



*This much emulsion deposited on the trap rails can cause excessive noise at the sprocket, picture unsteadiness, and deformed or torn perforations in the film.*

**Figure 2**

### No Time for Panic

Emergency remedial measures, if needed during projection, should be started promptly, but there is no need to panic. Merely put a very small amount of projector lubricating oil on the tips of the thumb and forefinger and apply at intervals to the perforation areas just before the film enters the gate.

**IMPORTANT:** Add the lubricant alternately to one edge and then the other until the clattering stops and the film is running smoothly again. Try to avoid touching the picture or sound track areas while performing this emergency procedure.

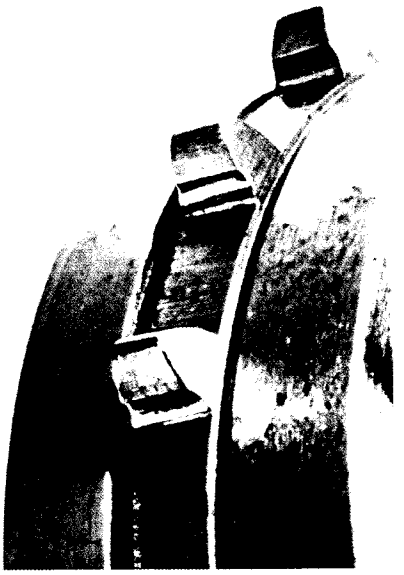
At the end of the run, the rails should be cleaned to remove any accumulated deposits. Use a small plastic scraper to remove the deposits followed by a final touch-up cleaning with a 50/50 water and alcohol solution applied with a soft cloth or cotton swab. Do not use metal to clean the rails because deposits form more readily once the highly polished metal surface is scratched. Ideally of course, to prevent a buildup of dirt where oil has been applied, the print should be sent to a professional motion picture laboratory to be cleaned and to have the appropriate lubricant applied to the emulsion side edges of the film.

If a seasoned print produces these symptoms, there are probably deposits of emulsion or dirt on the trap rails from previous runs or from other mechanical causes. Old prints generally do not need further lubrication.

### Deposits Are Not Assets

When it has been determined that the film is not the cause of unsteadiness, the projector should be checked. One common source of unsteadiness is improper tension in the projector gate. Deposits on the trap rails, as mentioned earlier, can certainly be a contributing factor in this case. Occasionally, deposits may also be seen on the gate pressure pads that contact the support side of the film. These deposits are generally composed of lubricant or dust and do not harden to cause tension problems. They should be wiped off, however, to maintain cleanliness.

If the gate area is clean, adjusting the gate tension may be all that is necessary to provide smooth, steady images on the screen again. Follow recommendations in your projector manual for any adjustments that are needed. Remember, gate tension should be just sufficient to steady the screen image, but not enough to produce "clatter" at the intermittent sprocket. If image unsteadiness persists after these adjustments have been made, check the intermittent sprocket or intermittent movement for possible causes of unsteadiness.



*Worn sprockets should be replaced.*

**Figure 3**

### Check the Intermittent Mechanism

Consider the intermittent sprocket first. This sprocket is precision engineered and manufactured to very close tolerances. The teeth are hardened and capable of long service, but with time they can wear. The first indication of tooth wear is a ticking sound as the film leaves the sprocket. The ticking is most noticeable when you advance the film by hand. At this stage, steadiness generally is not affected, but once the groove worn into the base of the tooth becomes deep enough (Figure 3), unsteadiness can develop. Providing that there are no other types of tooth damage, such as burrs or broken teeth, the sprocket sometimes can be reversed as a temporary measure. However, a new sprocket should be installed as soon as possible. While the other sprockets in a projector do not usually contribute directly to unsteadiness, they should also be checked for wear and damage because they can also cause perforation damage. If the intermittent

sprocket checks out properly, inspect the intermittent movement to see if the unsteadiness is being caused there.

The intermittent movement is built to uncommonly tight tolerances of less than 1/10,000 of an inch. It is the precise fit of the cam and starwheel, for example, that provides the virtually zero backlash required for satisfactory operation of the intermittent movement. If there is wear on the cam or the starwheel, unsteadiness can occur. With many intermittent movements, the projectionist is able to adjust, or "snug-up," the cam against the starwheel by loosening the coverscrews and shifting the cover until a snug fit is achieved. If wear has become excessive, however, and no amount of adjustment seems to help, then there is no choice but to replace the worn parts or have the unit serviced. At one time, most service centers provided a "loaner" while your movement was being repaired, but it would be wise to check first in case a spare unit is not available.

If you are successful in making this adjustment, be sure to turn the flywheel by hand to check the action of the movement. If it clicks as the sprocket begins to move or binds when the sprocket is in the dwell, or locked position, or if there is backlash on the sprocket, loosen the cover and readjust. A properly set movement should produce slight resistance as the pin enters the starwheel slot. It should also keep the sprocket locked in the dwell position, absolutely free from backlash.

Upon replacing the unit and before cperating the projector, make sure that the oil has been replaced to the fill line. In total immersion, or spray oil systems, the unit usually provides a pump action of its own to insure adequate lubrication.

After removing and replacing any intermittent movement, it is essential that the shutter be retimed. Consult your projector manual for the method recommended by the manufacturer. Some projectionists find it simpler to set the intermittent sprocket to the point where it just begins to move; then they loosen the shutter and rotate it in the proper direction on the shaft until the leading edge of a blade just covers the aperture. After retightening the shutter on the shaft, the shutter adjusting knob can be used for "fine tuning" if necessary.

## IMAGE BRIGHTNESS

Theatrical prints are manufactured to be viewed at a recommended screen luminance of 16 ± 2 footlamberts (55 ± 7 cd/m$^2$) (proposed ANSI Standard PH22.196). Any significant departure from these values will not provide the best screen image quality. Persistent flicker, particularly on light scenes—such as sky, snow, beaches, or deserts, may indicate excessive screen luminance. It becomes more distracting nearer the screen. On the other hand, if medium or dark scenes fail to show detail, the screen luminance is too low.

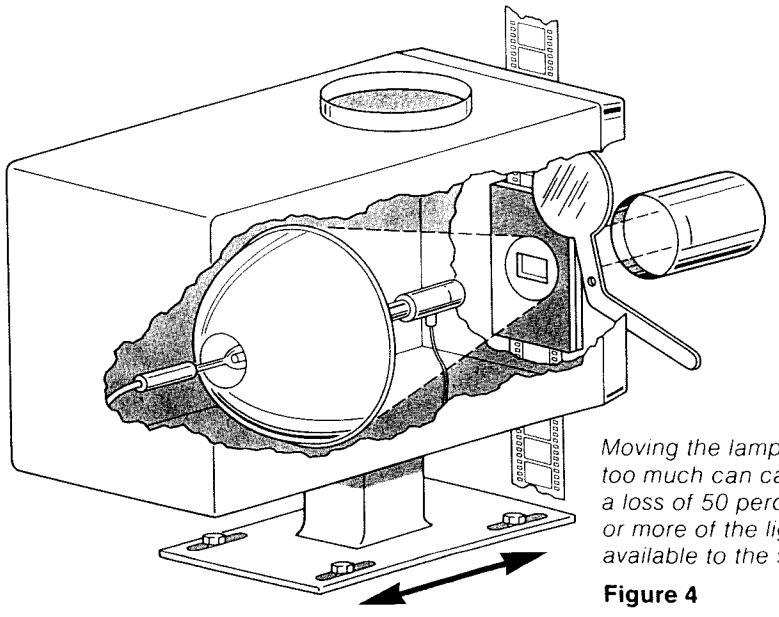
### The Light

If you measure screen luminance level with a suitable meter and find that the values are out of range, adjust the light level to conform with the recommended values.

Excessive luminance is usually easy to remedy. If basic adjustment of the lamphouse (such as using a smaller carbon trim) are not possible or practical, placing stainless steel mesh between the lamphouse and projector can do the job. As there are several gauges of mesh available, a little experimentation may be necessary.

With xenon lamps, light output can be varied considerably without changing the color quality of the light. A carbon arc trim, however, can function satisfactorily only within a narrow range of voltage and current (for any particular size carbon).

Insufficient screen brightness can be caused by a number of things, but perhaps we should start with the lamphouse. Is your lamp burning at the recommended voltage and current? Is the light source positioned the proper distance from the mirror? Is the lamphouse the correct distance from the projector? Sometimes when viewing a bare screen, an operator might move the lamphouse to even out the light on the screen. If the lamphouse is moved too much, the cone of light will be larger than necessary and waste a good portion of the light around the aperture (as shown in Figure 4). Have you checked the mirror, projection lens, and port glass? If these components are clean and properly aligned and screen luminance is still too low, then the lamp output probably should be increased. Consult the lamphouse manual for recommended ways to increase lamp output. When the increase has been made, the question why light output was insufficient in the first place should be reviewed. Several factors could have been responsible. Included are a dirty screen, clouded or dirty optics, and mirrors coated with carbon ash and other dust and dirt.

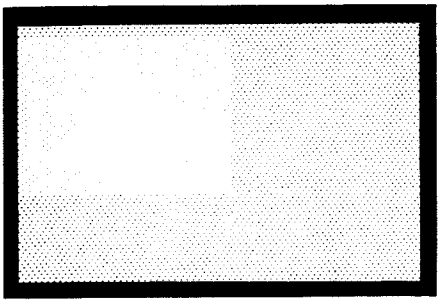


*Moving the lamphouse too much can cause a loss of 50 percent or more of the light available to the screen.*

**Figure 4**

### Is Your Screen Dirty?

If it were possible to compare an original piece of your screen with your present screen, you might be quite surprised at the difference you would see (Figure 5). If you do not have a sample of the original screen material used in your theatre, a fairly good comparison can be made by using a sheet of bond paper, a clean white handkerchief, or a white tissue. The long-term effects of smoking, dust, and air circulation can really darken a screen and change its color. These changes occur very slowly and, of course, would pass unnoticed during casual glances at the screen. The screen shown in Figure 5 did not appear to be dirty and discolored until this direct comparison was made with a section of unused screen material.



*Direct comparisons like this cannot always be made, but a sheet of plain white bond paper is a reasonable substitute. The loss shown here is about 25 percent.*

**Figure 5**

Actual measurements in the theatre showed a light loss of about 25 percent. A sheet of white bond paper measured within about 5 percent of the new screen sample, so it could be used effectively as a "new screen" substitute to provide a visual means of checking the condition of your screen. If you discover that your screen is dirty and discolored, it can be professionally cleaned. We would not recommend that you attempt to do the job yourself unless you are thoroughly familiar with the technique.*

Sometimes dust and dirt accumulations can be removed by vacuum cleaning with a very soft cloth or a screen brush. Be especially careful not to allow the dirt particles to scratch the delicate reflective coating of the screen. Dust collected in the screen perforations can be removed by using a vacuum cleaner and a soft brush on the back side of the screen. Discoloration due to nicotine usually cannot be removed without serious damage to the surface of the screen. Whatever you attempt in the way of cleaning, try it first in a corner. Check the manual for your screen or contact your theatre supply dealer if you have any questions about cleaning your screen.

### What About Stray Light?

Even if you are providing the proper screen brightness, excessive stray light coming from unshielded lights, exit doors, concession stands, backstage lights, etc, can deteriorate picture quality by reducing the apparent contrast of the projected picture.

Measurement of stray light requires sensitive meters and special techniques, but you can get some idea of how your theatre rates by standing on the stage in front of the screen and facing the projection room. With the houselights dimmed normally, but without the projector running, distracting stray light sources can be spotted easily. It is important at this point to differentiate between a small bright source of light, such as an exit sign or bare bulb, and an overall glow from the ceiling or walls. Either could be a cause of distracting stray light, but you can determine this by conducting a simple test on each source independently—and then together. While standing on the stage in front of the screen facing the projection room try to read the white pages of a standard telephone directory. If you can read them, the stray light level is probably too high. If you cannot, then the stray light level in your theatre is probably close to the recommended level of *less than 0.5 percent of recommended center screen brightness*. Once you have determined that either or both sources produce stray light, remedial measures can be taken. For the best quality screen image, the stray light should not exceed that recommended level. There is a trend in some locations to increase ambient light in the theatre to help curb vandalism. If this procedure is found necessary in your theatre, make every effort to shield the light sources from the screen. Remember that release prints are manufactured to provide a satisfactory screen image only under luminance and stray light conditions specified in published standards.

### Lenses and Mirrors

A few less common conditions that adversely affect screen image luminance include dirty or clouded projection lenses and other optical components. Outer surfaces of projection lenses can be carefully cleaned, but the inner surfaces cannot be reached unless the lens is disassembled. Actually, the incidence of internal clouding on modern projection lenses is quite rare. Older lenses, with less permanent seals, are more likely to have become cloudy from years of use. During projection, carefully glance into the lens from a point just outside of the main projection beam. This will allow you to see into the lens barrel without difficulty.

> **CAUTION:** DO NOT LOOK DIRECTLY INTO THE LENS DURING PROJECTION—DOING SO COULD CAUSE SERIOUS EYE DAMAGE.

If any lens surface appears brightly illuminated, there is probably some deposit on that surface. Cleaning of the inner lens surfaces should be left to qualified repair shops because very special tools and alignment procedures are needed to properly dismantle and then reassemble a projection lens.

In general, the mirrors in carbon arc lamps are likely to become covered with ash. But since these lamps are regularly opened to change carbon trims, dirty mirrors are easily spotted and cleaned. On the other hand, there is little need to open a xenon arc lamphouse except to change the lamp. During the extended period in which the lamphouse is unopened, air currents from ventilation along with electrostatic charges produced by the current flow can cause a considerable

*SMPTE Motion Picture Projection and Theater Presentation Manual, Section 12.7, page 87.

amount of dust and dirt to deposit on the mirror or mirrors. On occasion (perhaps once a month), it is advisable to open the lamphouse and check for such deposits after you have first observed the posted safety measures regarding face masks and lamp covers. When checking your equipment in the projection room, remember to include the port glass. If the glass is clean, you should not be aware of a frame outline on the glass surface as the projection beam passes through. If you do see a strong image on the glass, it is due to dust, dirt, or abrasion from repeated cleanings by improper means.

### Decisions

If all of the projection equipment in the auditorium and projection room checks out satisfactorily and screen luminance is still on the low side, a new screen or a larger lamphouse may need to be considered.

Since either of these choices involves considerable expense, your theatre supply dealer should be consulted for suggestions. If a high-gain screen appears to be the only solution, remember that these screens are directional and the viewing positions where the screen image will be satisfactory is narrower than with the usual matte white screen. If your auditorium is wide, you should be cautious when considering some high-gain screens because the side aisles in the front rows will provide poor viewing. If you have a long, narrow hall, however, any type of screen that provides the needed luminance will probably perform well.

### Light Distribution

Once the overall luminance problems are solved, be sure that the distribution of light on the screen is even. The ANSI Standard mentioned earlier also specifies that the luminance along the horizontal center line of the screen near the edges should be no less than 10 footlamberts (34 cd/$m^2$) or 62.5 percent of the recommended center luminance of 16 footlamberts (55 cd/$m^2$) and not more than 85 percent (47 cd/$m^2$) of the center value, with a recommended value of 75 percent (41 cd/$m^2$).

Although the allowable amount of luminance falloff at the edges may seem excessive, the high contrast effect created by the black masking makes the screen image appear evenly illuminated and more comfortable to the viewer when film is being projected. Actually, an evenly illuminated screen with black borders can appear less bright in the center due to the same contrast effect. Light distribution is usually adjusted by moving the lamphouse along the center axis towards or away from the projector. Uneven light from one side of the screen to the other, or from top to bottom, is generally due to a misaligned mirror and can be adjusted easily. If proper balancing does not seem possible, check the lamphouse and projector alignment.

## IMAGE SHARPNESS

There are several factors that affect screen image sharpness. Some of them are controllable; others are not. While the picture frame is briefly at rest in the aperture, the emulsion side absorbs the tremendous energy from the lamphouse and expands. The expansion is towards the lamp and causes the frame to curve like a pincushion. Depending on the size of the lamp, the frame usually moves, or drifts, more than the lens can accommodate; so the screen image is sharp only a portion of the time that each frame is in the aperture.

Fortunately, the image curvature is in the same direction as the normal field curvature of most projection lenses and the combination usually produces an "average" image that is reasonably sharp. In addition, the ability of human vision to be selective is helpful, especially when considering that each frame begins fuzzy and sharpens just before pulldown. Somehow, the brain rejects the fuzz and remembers the sharp finale. It is almost like what you see when you turn your head quickly; you know there has to be blurring but you think you see a sharply focused scene.

Concern with image sharpness really begins when the limits of human vision have been pushed so far that there is no longer a time when the image is sharp, or simply that the mind refuses to make corrections mentally. This is an example of an uncontrollable factor that occurs in all projection systems to some degree. It is less troublesome when projecting color films because these emulsions absorb much less heat energy than silver-image black-and-white emulsions.

### The Heat/Light Conspiracy

There is no easy solution to this condition because light in this case is converted into heat by absorption and any completely effective filtration or absorption of the heat would also absorb most of the light. The use of dichroic (cold) mirrors in the lamphouse is a currently effective means of minimizing the hot-film/focus condition although some caution is still necessary when using very large lamps with black-and-white film.

Screen image focus problems can arise when the heat becomes too great, especially if the humidity is high. New prints are more often involved than seasoned prints. If all of these adverse conditions are present, the screen image will appear soft and no focus trim will help. This is called *flutter*. As conditions become worse, the image will begin to *go in and out of focus* erratically making the screen appear to be made of rubber. Time is the only element that can help correct either of these situations. After a sufficient number of showings, the film that has gone in and out of focus usually recovers and the individual frames drift in the opposite direction, towards the lens. This change produces an extremely sharp central image; but since the image curvature is now reversed from the normal field curvature of most projection lenses, the edges of the screen are considerably out of focus. Depending on projection conditions, flutter may persist for a longer time before recovery.

### Maintain Good Focus

Other factors that affect screen image sharpness can usually be corrected or minimized. With the exception of extremely large projection angles, most projected images can be satisfactorily focused on the screen. In some situations, the screen is actually

tilted towards the projection room in order to minimize the angle. If you find that you cannot focus the screen image at the top and bottom at the same time, you will have to compromise in setting the focus. In most cases, however, since the action often takes place in the lower two thirds of the screen, you might try maintaining best focus in that area.

If good focus is not possible on any part of the screen, start checking the equipment until the cause is found. Begin with the projection lens. Obviously it must have performed satisfactorily at one time, but accumulation of dust, dirt, or tobacco smoke residue on the front element and an oily film on the rear element can cause focus problems. As a rule, bright areas of the screen image will appear to have a halo and a loss of contrast. Heavy oil streaks anywhere on lens elements can produce blurred areas on the screen.

If focus problems involve an inability to get both sides of the screen equally sharp or equal in appearance, check for possible misalignment between the projector and screen. It is unlikely that misalignment will occur between the projector gate and the projection lens unless some "homemade" modifications have been attempted. Observations over the years indicate that many focus problems can be related to inattentiveness rather than to film or equipment. As we mentioned in a previous article on projection practices and techniques, quality projection practices in your theatre will help keep your audiences happy—and coming back for more! That means the projectionist must be continuously aware of the performance of both film and equipment during the entire show.

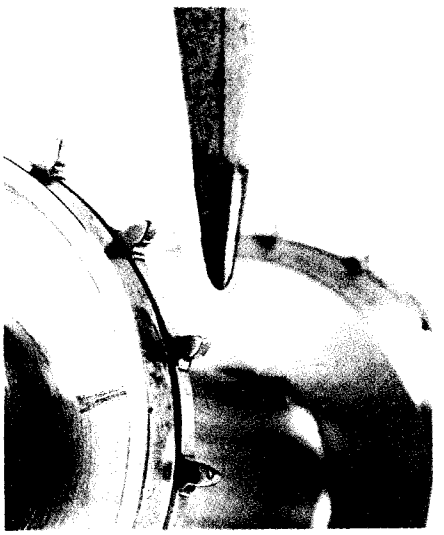
## SOUND

Normal maintenance that does not include running some sort of test film will verify only that the electronics and the exciter lamp are functioning. In optical sound systems, there is a tendency for oil vapor and other deposits to coat the sound optics. Excessive deposits can alter the sharpness of the scanning beam, resulting in reduced sound volume and high-frequency reproduction. Careful cleaning of these components should be performed on a regular basis. Although most current releases are produced with optical sound, the "Penthouse," or magnetic soundhead, should not be neglected. Check the heads for gap wear and accumulations of magnetic oxide.

### A Look Behind the Screen

Too often little attention is given to maintenance of the speakers. Are they correctly placed? Are the connections secure and tight? Have the speaker cones become ruptured because of some carelessness or time? It is true that speakers rarely need attention, but being isolated as they are, damage might go unnoticed for years! Although it is unlikely that any significant dust deposits could remain on the cones because of normal cone vibration during use, there is always the chance of an accumulation of spider webs that could attract other debris.

Sound problems can occur over which the projectionist has no control. Old and badly abraded films will provide noisy and distracting sound. Frequent splices and other damage will cause annoying sound interruptions that can spoil the illusion for the patrons. Under these conditions, it might be advisable to request another print from the distributor or film exchange.



*Hook-shaped intermittent-sprocket teeth will almost always cause perforation damage and severe image unsteadiness.*

**Figure 6**

# PREVENTION OF DAMAGE

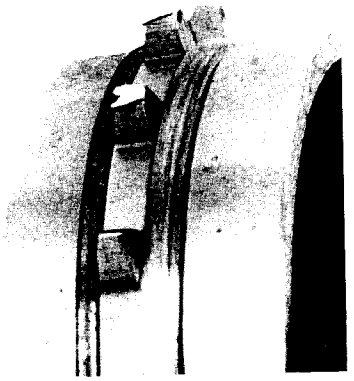
The maintenance manuals that accompany professional theatrical projection and sound equipment are generally quite complete. If these manuals are read carefully and the instructions are followed faithfully, your equipment should perform satisfactorily. They are, however, usually limited to care and maintenance of equipment and not to factors of equipment wear or malfunction that can cause film damage.

## MAINTENANCE IN THE THEATER

A worn intermittent sprocket should be changed, but what happens if you do not change it? First, perhaps a discussion of the word "worn" is in order. Is the sprocket diameter worn down? Are the sprocket teeth worn flat? Of course, it is neither of these extremes, but rather a groove worn into the leading edge of the sprocket tooth (see Figure 3) near the base. As more and more film is run through the projector, the groove wears deeper and actually causes the tooth to become hook shaped (Figure 6). At this point, perforation damage is likely to occur along with unacceptable screen image unsteadiness and a noticeable increase in film noise level.

This type of sprocket tooth wear is found almost exclusively on the intermittent sprocket. It is rarely found on any of the other sprockets, but physical abuse can cause damage to any sprocket. Metal tools hitting a tooth or a metal pad roller that is out of alignment and skiving the edge of the teeth are two examples of such physical damage. Thus changing the sprocket in time not only prevents needless damage to valuable film, but helps to keep the projector in good condition—perhaps years longer than if it was not changed.

A damaged tooth with a burr (Figure 7) can raise havoc with the perforations in a misaligned projector. The sharp edges of a tooth can also score the perforation wall and start long cracks that can ruin an entire reel of film. During projection, it is often difficult to hear the telltale noises that usually



*Any sprocket with a burr on even one tooth should be replaced.*

**Figure 7**

indicate sprocket tooth damage. Whenever possible, as you run down by hand to check threading, listen for a ticking sound as the film enters or leaves a sprocket. Such sound signifies that the sprocket tooth is not engaging or disengaging smoothly on the perforation wall. If you find a damaged tooth, change the sprocket. If you detect grooves on the intermittent sprocket teeth but nothing else, you can reverse the sprocket and continue operating. We recommend, however, that a new sprocket be installed whenever possible.

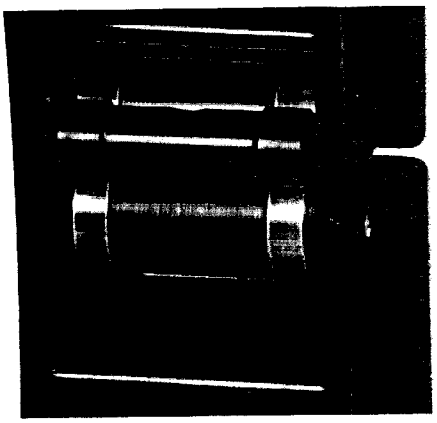
### Major Maladjustment?

Be particularly observant for sprocket related conditions, such as misalignment, that can cause film damage. A new sprocket can be just as responsible for perforation damage as a worn or damaged sprocket if misalignment is severe enough. This type of problem usually occurs between a film supply and feed sprocket or a holdback sprocket and film take-up unit, whether reels or platters are used. Make sure the reel spindles are not bent and that they are parallel to the sprocket shaft. If you are using either a platter system or outboard reels, be certain that the idler rollers on the projector are adjusted so that the film is perpendicular to the projector sprockets and that the sprocket teeth are evenly spaced in the perforations. This is best accomplished while the film is being advanced by hand so that the position of the film over the sprockets can be closely observed while any required adjustments are made. Adjustments made while the film is at rest do not take into consideration the film's natural tendency to seek its own path or the possible misalignment of other components.

### Fire Rollers Rotate

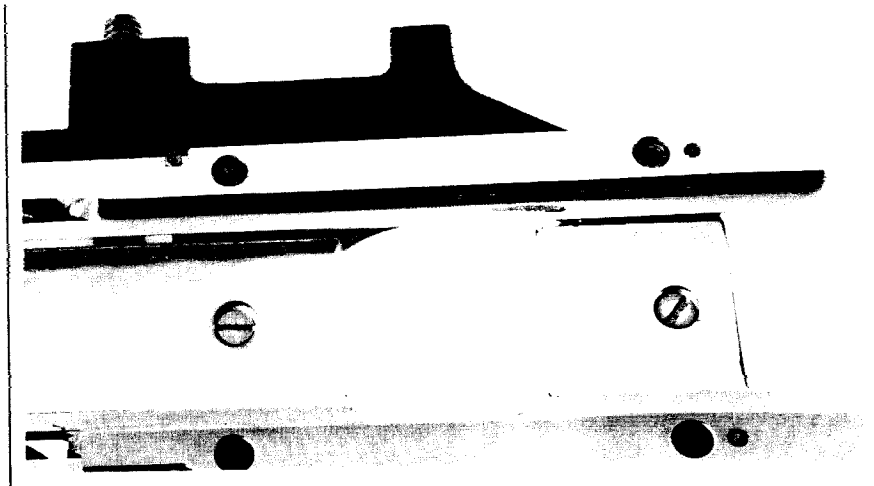
While discussing these two particular areas of the projectors, it is important to mention the magazine valve rollers, or fire rollers (Figure 8) as they are sometimes called. These rollers were designed to prevent fire from reaching the magazines, an absolute necessity during the era when nitrate base films were in wide use. While they are no longer necessary, much of the unmodified equipment still in the field uses them. Because their function was to close the film opening in case of a film break and potential fire, they were designed to be heavy and provide a very narrow opening to allow the film to pass through. At this point, dirt, oily matter, and film chips can accumulate and prevent free turning of the rollers, or they can become so clogged that one or more of the rollers will not turn at all. If this occurs, the "frozen" roller will develop flat spots on the shoulders and cause the center of that roller to come into direct contact with image area of the film. Under these conditions, the relatively soft emulsion of a new print can be badly abraded. Because the rollers are partly obscured in their mounting assembly, they should be checked frequently to see that they are clean and rotating freely. Newer equipment does not contain these roller clusters, but guide rollers are also designed with the same sort of shallow undercut areas and can wear flat if they "freeze."

The projector gate can be another source of film damage. As mentioned earlier in the section dealing with screen image unsteadiness, hard deposits on the trap rails (Figure 9) can cause excessive tension and perforation damage. Remember, too, that this type of tension causes unnecessary wear of gate components and puts a greater strain on film perforations and the intermittent movement.



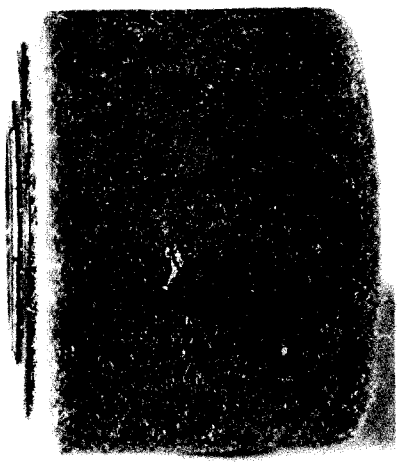
*A lot of abrasion can be avoided if the fire rollers are checked frequently to make sure that they have not become stuck.*

**Figure 8**



*Be sure to keep the gate area free of any deposits that might cause film to stick.*

**Figure 9**



*The tiny bits of debris that are embedded in this roller caused significant abrasion in the image area.*

**Figure 10**

### Sound Advice!

Moving into the optical sound area, we find that in some projectors there are two components (the sound drum and felt roller) that come into contact with the film in the image area. Ordinarily, the sound drum is trouble free and so is the felt roller that holds the film against the drum. Occasionally, however, a particular type of abrasion can occur on the emulsion side of the film if the felt roller becomes impregnated with sharp particles of dust and grit (Figure 10). It is a good maintenance habit, therefore, to clean the roller once in a while with a stiff brush and a solvent, such as Chlorothene.* Be careful not to get the solvent into the bearing, or it will remove the lubrication. If you are in doubt, relubricate the bearing. In any discussion of sound maintenance, the magnetic soundhead, or "Penthouse," should not be overlooked. You are probably bypassing it most of the time, but the idler rollers need checking and occasional lubrication. Before threading up a magnetic-sound print, clean the magnetic heads of any oxide deposits. The smallest separation of the heads from the magnetic tracks can cause significant volume loss and a complete loss of the high frequencies. A "Q-tip" moistened with alcohol does a good job.

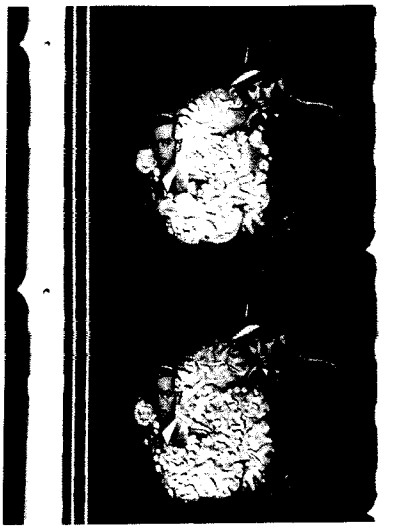
*Dow Chemical Company, Midland, Michigan; tradename for 1,1,1,-Trichloroethane.

### Reel/Hub Ratios

Above and below the soundheads are the film magazines. Although many newer projectors have only reel arms in place of the complete magazines, it is important to check the reel spindles in either case to make sure they rotate properly. Without some method of controlling reel tension, a maximum ratio of 3 to 1 between the reel diameter and the hub diameter is recommended if perforation damage is to be prevented, especially on projectors that use 16- or 24-tooth sprockets. Even at this ratio, perforation damage can occur if the tensions are not adjusted correctly. These requirements are met by the standard 2000-foot reels. Extra large reels with reel/hub ratios up to 6 to 1 (currently being used in many theatres) seriously tax the ability of some projection systems to maintain desirable tensions on the film. If these conditions exist in your theatre, your projector can be causing some perforation damage on all the prints that you run. If your equipment is new and designed to control film tension when using extra large reels, be sure that you check the system frequently. Perforation damage is more likely to occur as the tension approaches maximum; that is, when either the supply or take-up reel is nearly empty. On start-up, be absolutely sure that there is no slack between the reels and the projector. Anytime you hear the feed or holdback sprockets "singing," tension is probably excessive and can be causing severe perforation strain and damage due to cinching. As mentioned earlier, a burred or worn sprocket tooth can cause the same sound. In either case, it requires investigation.

### Hot Lamps

The potential contribution of the lamphouse to film damage should not be overlooked. The occurrence of such damage appears to have decreased in proportion to the reduced use of black-and-white film, but the possibility is still there. Particularly in the drive-ins, where there is a strain to get the last "ounce" of light on the screen, a black-and-white feature can become easily embossed



*Blistered films such as this must be thrown out, but blistering can be prevented easily by proper adjustment of the lamphouse.*

**Figure 11**

or even blistered (Figure 11). This can occur because the image is made up of metallic silver grains that absorb virtually all the energy that strikes them. If the energy is excessive, such as when the lamphouse is adjusted for maximum center screen illumination (hot spot), a separation can occur between the emulsion and the base. The thin emulsion becomes isolated and cannot transfer the heat to the base, so it chars. A blistered print is useless and must be junked.

Fortunately, most feature releases are now in color, and these emulsions do not absorb much infrared energy. As a result, color films can withstand considerably more heat than black-and-white films. We have never observed a color print that has been blistered by the heat energy in the aperture. On the other hand, we have seen "frame-line" blistering (Figure 12) on color prints where the film came into contact with the top or bottom edge of the extremely hot aperture plate. Normally, this should not happen regardless of the amount of heat, but many aperture plates are "custom-filed" to fit a variety of situations. During this customizing process, the aperture edge can have residual burrs that extend into the film plane area. Furthermore, when filing out the aperture, the plate can become bent

in the direction towards the film. You might not notice this type of blistering during normal projection because it usually occurs only on the top or bottom edge of the projected frame and thus ends up on the black screen masking area. A change in framing, however, will quickly show a small horizontal line of blisters near the top or bottom of the screen image. And if the picture is cropped smaller than normal for the particular format, the next projectionist will not be able to frame the blisters out if the correct, but larger, aperture plate is used.

*Frame-line blistering occurs whenever projected film touches the edge of the aperture plate. (See bottom of picture.)*

**Figure 12**

### Rewinding

During the manual rewinding process, constant changes in winding speed—plus loose laps of film—can easily produce distracting cinch marks. If you have to rewind manually, keep enough tension on the supply reel continuously so that individual film convolutions will not slip on each other. Motorized bench rewinds should also maintain continuous tension by using a spring loaded idler or other effective tension device. The rewind stands should be aligned to provide a smooth wind on the edges of the film. Protruding film laps can be damaged in dished shipping cases or if the reel flanges are pushed against the film roll. If the rewind spindles are bent, it will be nearly impossible to wind a smooth roll unless the film is hand held against one reel flange. This practice is universal, but make sure that the flanges are free from burrs or nicks that could damage the film edge.

### Film Storage

Another source of film damage, although very uncommon, is the storage conditions in which the film reels are kept between shows. Most projection rooms have been designed with film storage areas away from extremes of heat and cold. Sometimes, however, the film storage area is moved temporarily for remodeling or installation of new equipment; and the film reels can end up next to a hot radiator or near an open window. Either extreme can cause permanent film deformation if the conditions persist. See Film Notes for the Reel People, *Film Handling*, Kodak Publication No. H-50-2, for a full description of this type of film damage.

## MAINTENANCE IN THE FILM EXCHANGE

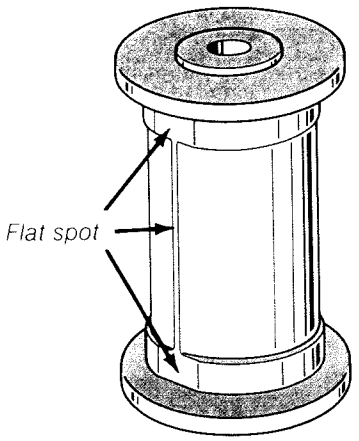
Film damage at the distributor, or exchange, level can be limited primarily to film handling during inspection. Since this process involves rewinding and splicing, maintenance should be concentrated in these two areas.

### Winding Down

In recent years, motorized rewinds have become standard in film exchanges. The bench top models are fairly simple to operate; the film travels directly from the supply reel to the take-up reel. In most cases, inspection personnel hold or guide the film against the take-up reel flange as they check the film for damage and poor splices. What can go wrong here? Well, for one thing, dirty, oily, grit-filled gloves or cloths can produce fine abrasions on the film. Maintenance means more frequent changes of gloves or cloths, and holding the film in a recommended method (as described in Kodak Publication No. H-50-2, *Film Handling*) that helps prevent this kind of abrasion. In situations where console-type rewinds are used, it is very important to check the idler rollers to see that they rotate freely. We have observed instances where the rollers had become stuck and the constant friction caused by film passing over them at high speeds had worn the rollers flat all the way across (Figure 13). The abrasion caused by film passing over a flat roller can be extensive . . . especially on a new print with a softer emulsion. Because the roller cover assembly and the film itself obscure the roller, its rotation is not easily observed. Check these rollers frequently and be sure they turn freely and are properly lubricated. If a roller has developed any flat spots, replace it, even if it does seem to turn freely. No matter what type of rewinding equipment you use, be sure that continuous tension is maintained on the supply reel. Loose laps of film can easily cause damage from cinch marks during an abrupt start or stop. If the film is oily, it can also cause kink damage (Figure 14) as well as the cinch marks.

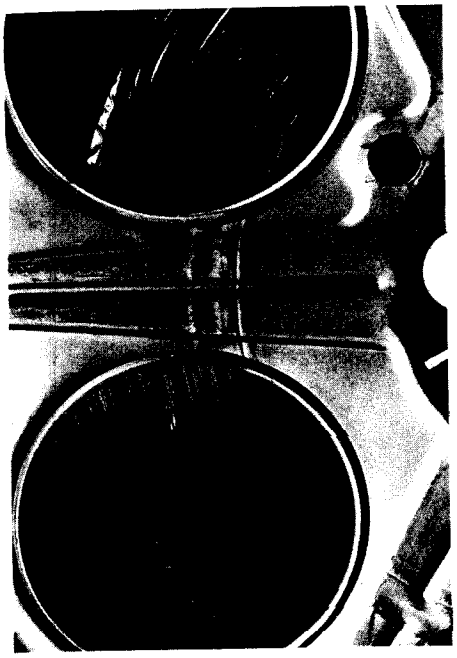
### Splicers

How can you damage film on a splicer? Film damage caused by splicers is indirect, but nevertheless real. An improperly maintained splicer will not make acceptable splices. Certainly they will hold at the time they are being made, but when poorly made splices have completely cured, they are likely to break or peel apart. If you are using a bench-top splicer,




*Flat spots can develop if rollers are not checked frequently to make sure they are turning freely and are properly lubricated.*

**Figure 13**



*Watch out for oil on your film; it can cause kinking as well as abrasion.*

**Figure 14**

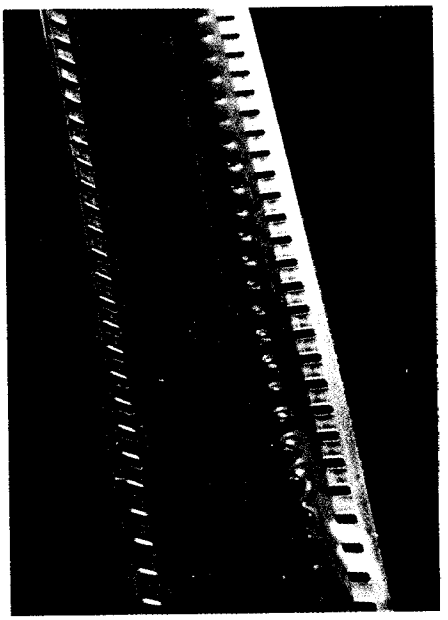
make sure that the scraper blade is sharp so that the scraped area on the film base will not be scored. Also make sure that the splicer pins are free from damage. Pins burred by accidental dropping or contact with metal tools should be replaced. Pins that have been filed-to-fit for some particular purpose should be carefully checked for alignment or should be replaced. Splicers that have pins designed for the standard perforation should not be used to splice films that have the small CinemaScope perforations, even though only a few perforations will be damaged at each splice location. Use only fresh film cement designed for film splicing. When splicing with tape, do not use regular adhesive tapes that are intended for mending paper, etc. Use only the polyester tapes made especially for splicing motion picture film.

Whether splicing by tape or cement, check film alignment in the splicer. Protruding corners usually cause trouble in a projector. Some exchange personnel trim the corners of an out-of-line splice, but too much of a shift in position, as the film goes through the projector gate or over the sprockets, can cause "roping" (Figure 15) when the film comes off the sprocket.

Butt-type tape splices demand a precise cut on both film ends to butt intimately. Otherwise the splice tends to collapse or hinge (Figure 16). Trade reports from theatres indicate that butt tape splices do, in time, hinge or collapse, no matter how precisely they are made. Apparently, a slight separation occurs between the two film ends due to the heat and tension experienced during repeated showings. The gap allows the extremely thin splicing tape to fold from lack of support by the film. To avoid the possible film damage and audience annoyance that could occur because of hinged splices, remake any butt tape splices that show a noticeable gap between the film ends.

### Long-Term Storage

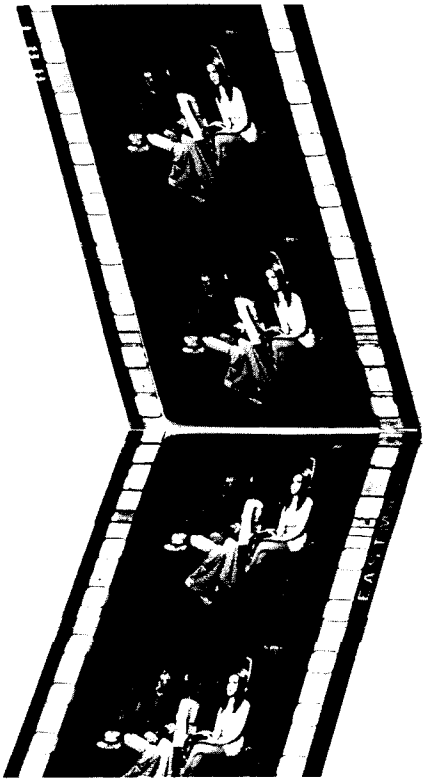
Film storage in the exchange is different in some respects from storage in the projection room. Some prints can be in storage for years . . . long enough to produce permanent film deformation if storage room conditions are not reasonable. To safeguard hundreds or sometimes thousands of release prints, it is important to maintain some degree of temperature and humidity control. Maintenance for



*Roping; this unwelcome catastrophe is easy to avoid—make sure your splices are aligned accurately.*

**Figure 15**

storage areas requires that the heating and/or cooling systems operate efficiently.



*To avoid splice collapse or hinging, remake butt splices that show a gap.*

**Figure 16**

### Good Housekeeping!

Maintenance in the film exchange or projection room depends on the proper use of information included in equipment operating manuals, but good housekeeping practices are just as important if you want to keep your audiences happy. Remember, distracting dirt particles that dance all over the screen and cause the sound track to hiss are caused by loose dust and dirt. A clean film and a clean projector are still the best prevention for these annoying conditions.

A motion picture is an illusion created by many people involved in a variety of arts and sciences. Preserve your theatre patrons' total involvement in this illusion by projecting film that is free from scratched, dirty, or unsteady screen images and that includes the highest quality sound and optimum screen brightness. Everyone involved will be glad you did.

**Reference**

Robert A. Mitchell, Manual of Practical Projection, New York, International Projectionist, 1956, pp. 149-150.