Film-Tech

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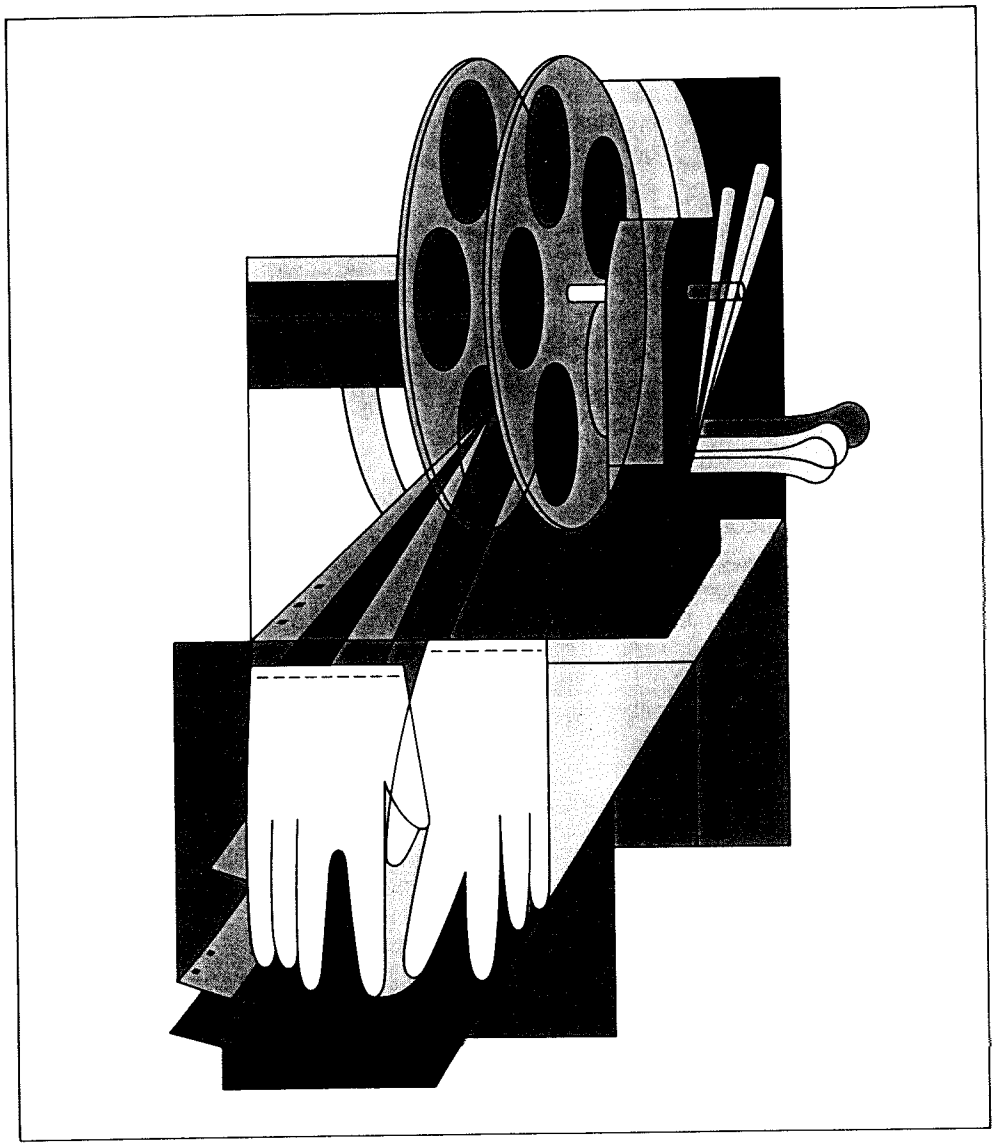
Film Handling

HOW TO DEFINE PROCESSED MOTION PICTURE FILM DAMAGE



Motion picture film is similar in many respects to other plastic materials in that it has certain physical limitations. These limitations, when exceeded, can cause such commonly known damage as buckling, warping, fluting, twisting, spoking, embossing, or curling.

The above conditions, as well as some others, can occur through improper storage, by faulty handling, or during severe projection conditions in spite of the care taken by film manufacturers to provide a uniform, high-quality product.

The various types of distortion are commonly referred to by exchange personnel and theater projectionists alike simply as *warping* or *buckling*. In many cases, the exchange is at a loss to understand the problems encountered by the projectionist because the description of the condition of the film is not expressed in some standardized terminology. On the other hand, conditions correctly described would help technicians at either the exchange or the film laboratory locate the source of the difficulty. Whether it concerns the manufacturer, laboratory, exchange, or projectionist, it seems likely that a uniform terminology pertaining to different types of film deformation would be of great assistance in locating the causes of such distortion and in eliminating further trouble. Some of the most common forms of deformation are described and illustrated below.

NOTE: In general, this article describes conditions and characteristics of the acetate base print films. Some of the conditions described also apply to Estar base or other polyester base films. In either case, careful handling techniques will help keep films in top condition and will provide audiences with superior screen images.

Average Feature Film Production Cost (Major U.S. Film Companies) *(Variety)*	*1981* *1982* *1983*	*$ 9.75 million* *10.6 million* *11.5 million*
Average Movie Ticket Price (1982) *(MPAA)*	*$2.94*	

Figure 1

Buckle: A condition that occurs when the edges (along the length) of a film are shorter than the center portion. This can be either a temporary or a permanent condition.

Temporary buckle results from the loss of moisture from the edges of the film (emulsion and base) when rolls are stored under dry air conditions.

Permanent buckle is caused by the loss of solvent from the edges of the film base when rolls are stored under moist air conditions.

Figure 2

Edgewave or Flute: A condition that occurs when one or both of the edges (along the length) of a film are longer than the center portion.

NOTE: *This is just the opposite of Buckle.* Edgewave or flute also can be either a temporary or a permanent condition.

Temporary edgewave or flute may occur along both edges as a result of slight lengthening of the edges relative to the center of the strip during early storage under moist conditions.

Permanent edgewave or flute may occur along one edge if there is a very slight thickness differential across the width of the film and if the roll is wound under high tension, or if one edge is stressed during film transport.

Figure 3

Twist: An effect that is produced in new prints by loose winding of the film, emulsion side in, under dry air conditions. If the film is wound emulsion side out under the same conditions, the undulations do not alternate from one edge to the other, as shown in Figure 3, but are directly opposite one another.

Figure 4

Curl: A type of distortion caused by dimensional differences between the emulsion layer and the support. It results from changes in moisture content of the emulsion layer and support with variation in relative humidity of the atmosphere.

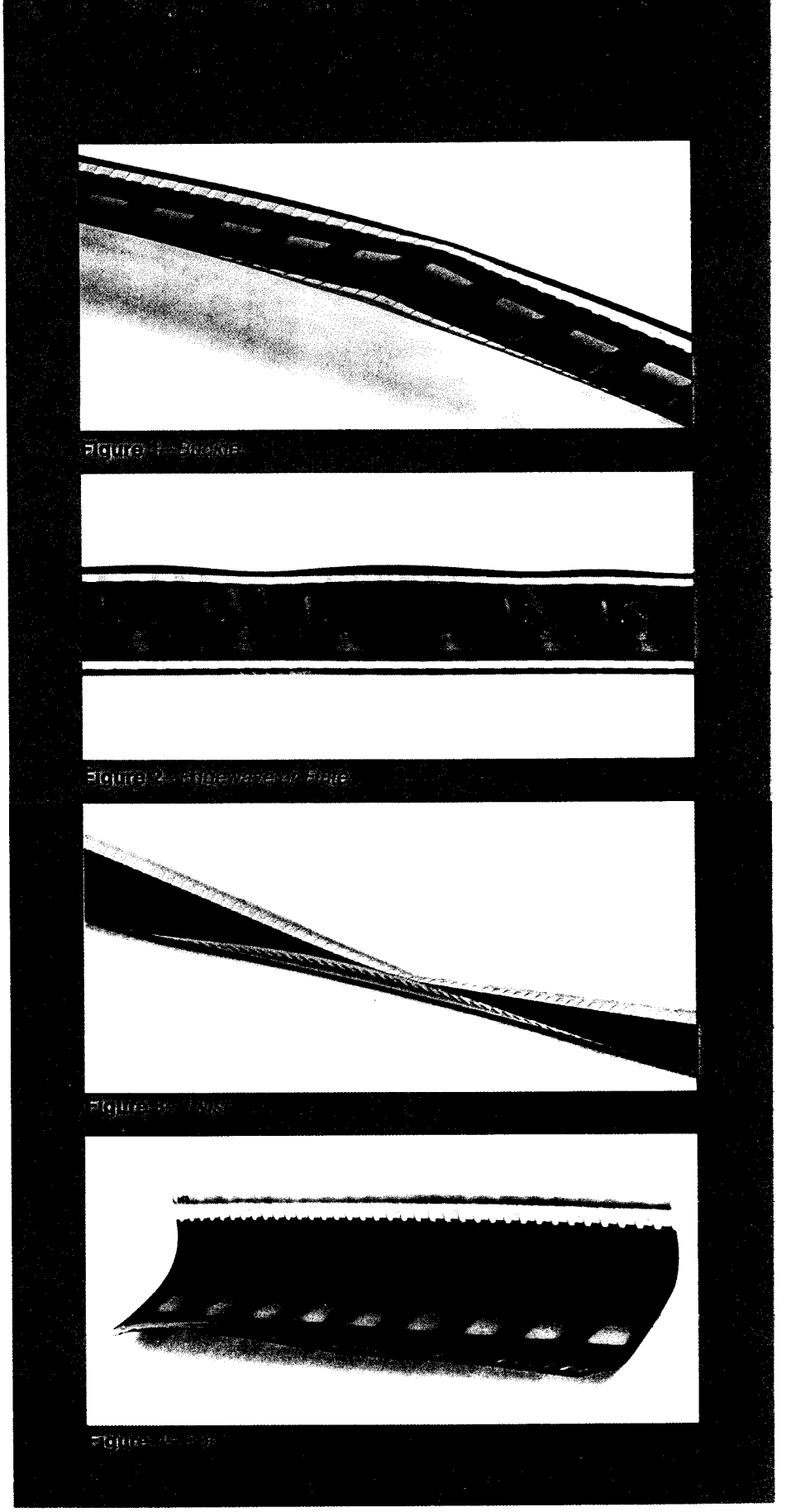


Figure 5

Spoking: A distortion of film on a reel caused by loose winding of film that has a high degree of curl.

Permanent spoking is seen as *twist* when the film is unwound.

Temporary spoking disappears when the film is unwound.

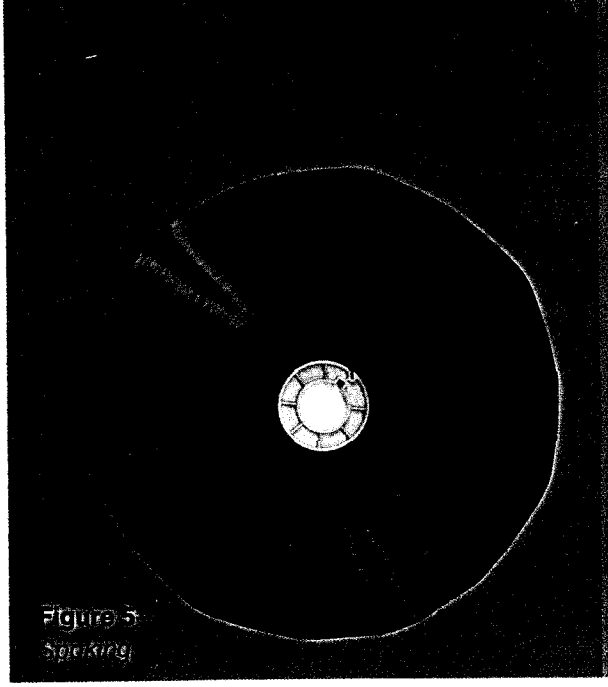


Figure 5
Scratching

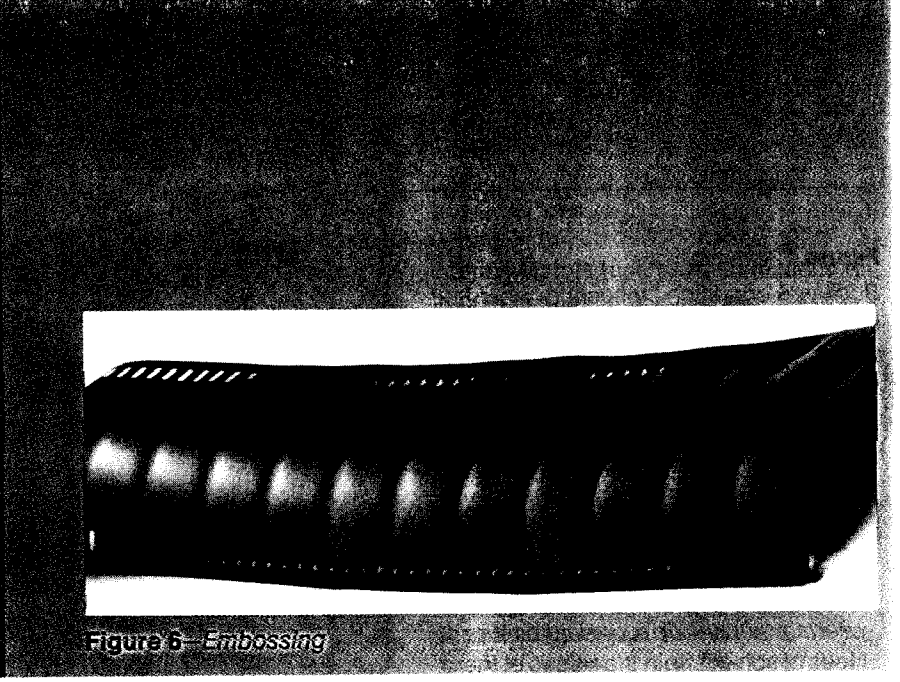


Figure 6—Embossing

Figure 6
Embossing: A permanent deformation that can occur when prints are projected with high intensity lamps. The excessive heat causes actual expansion of the picture area, and the frame stands out in relief. This distortion usually has no detrimental effect on the screen image quality because all film frames in the reel are equally affected.

Motion picture film must necessarily be thin in order to provide a sufficient quantity for practical use on reasonably sized reels. It must also be flexible to negotiate the tortuous film path in some projection systems. If either of these characteristics should be altered to permit more vigorous (or careless) handling, the practical utilization of film might be seriously curtailed in existing systems. The emulsion layer or layers that comprise the image are only several tenths of a thousandth of an inch thick. While it is remarkable that a film emulsion can be as resistant to scratches as it is, great care is still necessary to prevent image-degrading abrasion. It is extremely important, therefore, to be aware of the limitations that film must necessarily encounter to perform satisfactorily during its useful life.

THE DISTRIBUTOR

Professional motion picture release prints are usually sent by the laboratories to a distributor as large rolls wound on 2-inch cores in lengths ranging from 1000 to 2000 feet. Each roll is packed in a metal can or cardboard box with identification relating to the title and reel number. At this stage, the film can be considered in pristine condition providing that it has been properly processed and handled in the laboratory. The individual rolls can arrive at the distributor wound either with the tail section or with the head section out. In either case, it is necessary to mount the rolls onto 2000-foot-capacity shipping reels for theater use. Initially, at least, reels in new condition should be used.

New Prints

It is important to note that the emulsion surface of newly processed film is more susceptible to abrasion than film that has seen service. Therefore, in mounting new prints just received from the laboratory, care should be taken to avoid contact with the picture area even though cotton gloves or a cloth are used. New film direct from the laboratory should not require cleaning. If it is found necessary to remove lint or dust particles, silk plush dampened with an approved film cleaning liquid should be held lightly against the film as it is wound. This procedure should only be attempted if adequate ventilation is available to prevent possible toxic effects. The plush surface should be changed frequently and the film surface should be checked often for any abrasion that might result from the cleaning process. Winding should be carried out slowly enough to permit complete evaporation of the solvent; otherwise, spotting might occur if it is wound into the roll. Under no circumstances should film be cleaned with a dry glove or cloth. This procedure can produce abrasion as dirt, grit, and other particles accumulate on the cloth.

If a new print has been cleaned, be sure to note that the film cleaning solution has also removed the print lubrication. Film cleaning solutions containing lubricants are not usually adequate for the lubrication of new 35 mm prints. It is advantageous, therefore, to relubricate the film properly by edgewaxing prior to the initial use.

In all but an emergency situation, film cleaning can best be done by a laboratory where suitable cleaning machines are available and proper techniques and precautions can be observed.

Smooth Roll

During the mounting, it is extremely important that the film be evenly wound with sufficient tension to provide a tight roll. Anything less may permit the rigors of shipping and handling to cause individual convolutions of film to protrude from the roll edge and be subject to edge breakage. Similarly in rewinding, care should be taken to see that the winding equipment is properly lined up so that the film will feed smoothly and squarely from one reel to the other. In this manner a smooth roll is wound with no convolutions of the film having protruding edges. With console-type motor rewinds, proper alignment should be part of the original design, but the appearance of a wound reel will determine whether some further adjustment is necessary.

In order to obtain smoothly wound rolls with bench-top rewinds, many personnel bind one edge of the film against

the reel flange during the winding operation, as shown in Figure 7. As a matter of fact, bench rewinds are often deliberately set out of line to give even winding by this method. Moreover, shipping reels are so frequently sprung out of shape, as illustrated in Figure 8, that even winding is almost impossible unless flange binding is employed.

The practice of binding one edge of the film against one reel flange cannot be wholly recommended, however, because of the sharp points that can be found on the rims of some reels (often caused from the pliers used to remove a reel of film from a tight shipping case). Such a sharp point may cut the edge of the film on each turn of the reel. Furthermore, it is not at all uncommon to have less than adequate spacing when the reel flanges are snapped together or a spacing almost double the film width when the flanges are sprung apart. Under these conditions it is essential that the film be guided in some manner during rewinding in order to avoid protruding convolutions. These exposed edges are easily bent or broken during handling or shipment, as shown in Figure 9, or if the reels are forced into a shipping case that has become badly damaged, as the one shown in Figure 10A. (Figure 10B shows reels and cases in good condition.)

The common practice of tapping the reel against the edge of the bench to smooth out a poorly wound reel of film should not be tolerated. If the convolutions should not fall into place, damage could result before the film ever reaches a theater.

If it is necessary to use defective reels and cases until replacements are received, every effort should be made to restore them to a reasonably usable condition.

In or Out?

Historically, release prints in this country have been wound *emulsion-out* when ready for projection. In this orientation, the film comes off the supply reel in a counterclockwise rotation, but winds onto the projector take-up reel in a clockwise rotation with the emulsion side in. This is mentioned primarily because SMPTE Recommended Practice, RP-39, states that when film is kept wound *emulsion-in* exclusively, the tendency for focus drift

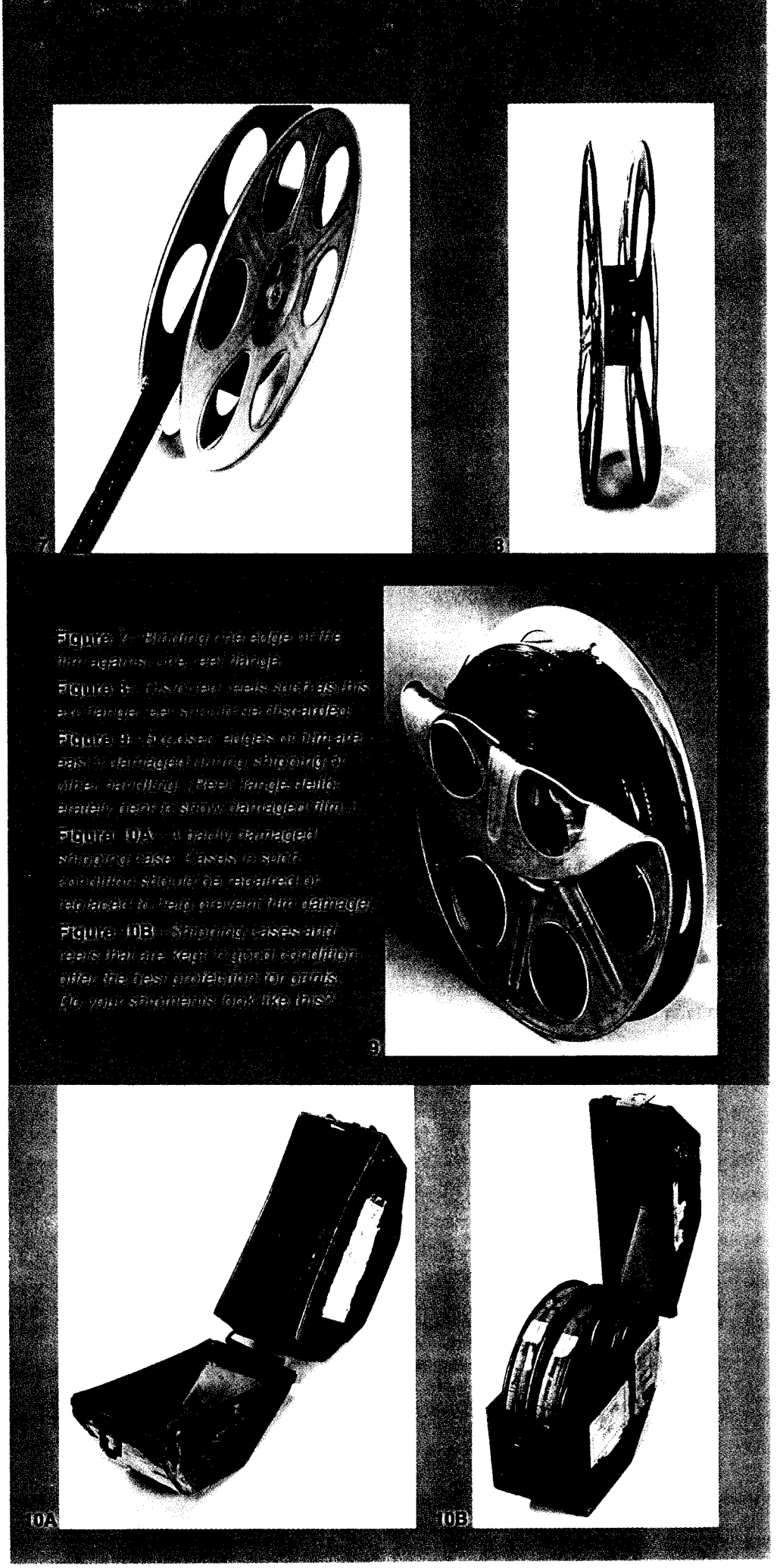


Figure 7 – Binding one edge of the film against one reel flange.

Figure 8 – Distorted reels such as this one (flange can usually be discarded).

Figure 9 – Exposed edges of film are easily damaged during shipping or other handling. (Reel flange dents greatly help to spot damaged film.)

Figure 10A – A badly damaged shipping case. Cases in such condition should be repaired or replaced to help prevent film damage.

Figure 10B – Shipping cases and reels that are kept in good condition offer the best protection for prints. Do your shipments look like this?

and other screen image problems is reduced considerably. There have been efforts among foresighted individuals and theater chains to implement this practice, but deeply ingrained habits are difficult to break or change. Interestingly enough, in Europe the emulsion-in winding orientation has always been the traditional way to handle and project 35 mm release prints. Nevertheless, until acceptance of the preferred winding orientation becomes universal, the importance of a smooth, tightly wound reel is still the first consideration.

New Prints to Ship

After the prints have appropriate leaders attached, are mounted onto shipping reels, and are correctly identified with individual reel bands, they are ready either for storage or shipment.

At this point, there is no intention to introduce practices contrary to those that currently exist, but instead to suggest guidelines and recommendations to improve present handling, inspection, and shipping conditions so that the maximum useful life from motion picture film can be achieved.

If the new prints are destined for storage, it is important to review some of the usually uncontrolled factors that can affect the condition of the film. Prior to the complete conversion from nitrate base film to the present acetate base film (safety), distributors and other storage facilities were required to have film vaults with temperature controls that did not exceed 70°F (21°C). This was primarily a safety measure. In most installations today, however, the vault doors have been removed and no effective control is possible or really necessary in temperate zones.

Protection from Physical Damage

Photographic film, like ordinary paper records, should be protected against fire, water, mold, and chemical or physical damage. In addition, photographic film should be protected against the extremes of relative humidity and heat that occur during some seasons or in some localities.

High relative humidities accelerate the fading of dye images in color film, damage the gelatin, and encourage the growth of mold. High relative humidities also accelerate film shrinkage and cause *ferrotyping*, or the formation of glossy marks, on the emulsion when the film is wound in contact with the support. In severe cases, the adjacent layers of film in a roll can stick together.

Low relative humidities result in a temporary increase in film curl and a decrease in flexibility, but this trend is reversed when the humidity rises again. However, very low relative humidities should be avoided in film storage because the film may crack or break if handled carelessly under these conditions.

The storage of motion picture film rolls at a relative humidity appreciably different from the equilibrium relative humidity of the film produces various distortions. If film rolls in equilibrium with air at 50% RH are stored at 20% RH, for example, the edges lose moisture faster than the interior of the roll, which may result in buckled film. On the other hand, if the same film rolls in equilibrium with air at 50% RH were stored at 70% RH, the edges of the roll would swell and could cause fluted or wavy-edge film.

Low temperatures are not harmful in film storage and for some purposes are essential, provided that the film is allowed to warm up sufficiently before opening the storage container in order to avoid moisture condensation. High temperatures, however, can be harmful since heat accelerates the fading of dye images in color film. Heat also accelerates film shrinkage and may produce physical distortions.

It is for these reasons that the control of the air conditions is so important in the storage and preservation of films of archival value. Such films require that careful arrangements be made for their protection and usually involve substantial expense to provide optimum storage conditions. In commercial practice, however, the precautions required for the storage of acetate films are relatively few and simple.

Release prints destined for shipment should be tightly and smoothly wound to prevent damage or cross abrasions while in transit. The reels should not be forced into a shipping case that is dished or otherwise damaged enough not to allow the reels to slip in easily. The filled shipping containers should be *placed* in the shipping vehicle, not thrown in. There is a tendency among many shipping personnel to assume that shipping cases offer unlimited protection for the film. As a result, the sport of "bowling" the cases across the floor of the vehicle to make a "strike" at the other end is certainly not in the best interest of the contents. True, the containers have been constructed to support great weight, but not to survive such a violent shock.

No Surprises!

During the routine inspection of prints that have been returned to a film exchange or distributor from one or more theaters, it should be remembered that these prints have seen a lot of service. The fact that the reels appear to be smoothly wound should not deter the inspection personnel from a thorough examination of all the footage, including the leaders and trailers. Because of current contractual agreements between some film producers and the distributor, only release prints that are badly in need of repair may be checked. In some instances, the instructions are to ship only! In the case of checking, the distributor's responsibility is limited to checking the identity of each reel for subject matter and reel continuity. Many types of film damage can be concealed in a smoothly wound reel only to "surprise" the next theater projectionist. Because of the "check only" or "ship only" policy and for self-protection, many projectionists inspect their prints prior to the first run.

A print should be regarded as containing potential damage until it is proved otherwise by regular inspection practices.

INSPECTION METHODS

An investigation into the general procedure of inspecting and repairing prints indicates that some portion of initial damage may occur in the exchange. Inspections are frequently too rapid to be thorough, and the methods employed may easily have a direct bearing on the life of the prints. Splicing, if carelessly done, can result in the film being sent to the theater in such poor condition that it would be unable to withstand ordinary projection and rapid rewinding.

Careful inspection and repair of the film that are performed at the exchange result in better service to the exhibitor and greatly reduce the possibility of breaks during projection. Such film breaks can result in additional mutilation of the film before the projector is stopped, a frequent source of considerable controversy between the theater and the film exchange. Any steps that can be taken to eliminate film breaks during projection will reduce the number of replacement films needed and will make the film subjects continuously available for service. Longer commercial life for a film means increased earning capacity.

Methods of inspection vary in different exchanges. A recommended method when checking for bad splices and cut or torn film edges is to use a cotton or nylon glove and hold the hand below the film (Figure 11) so that the film runs between the thumb and forefinger of the gloved hand. Some inspection personnel, however, in order to get some rigidity and tension on the film while checking for damage, hold the film in the closed hand from above (Figure 12) and apply pressure with the thumb and forefinger to cup the film. With this latter technique, if the other fingers are pushed upward, they can rub against the film surface and cause a considerable amount of abrasion—particularly if the glove is very dirty.

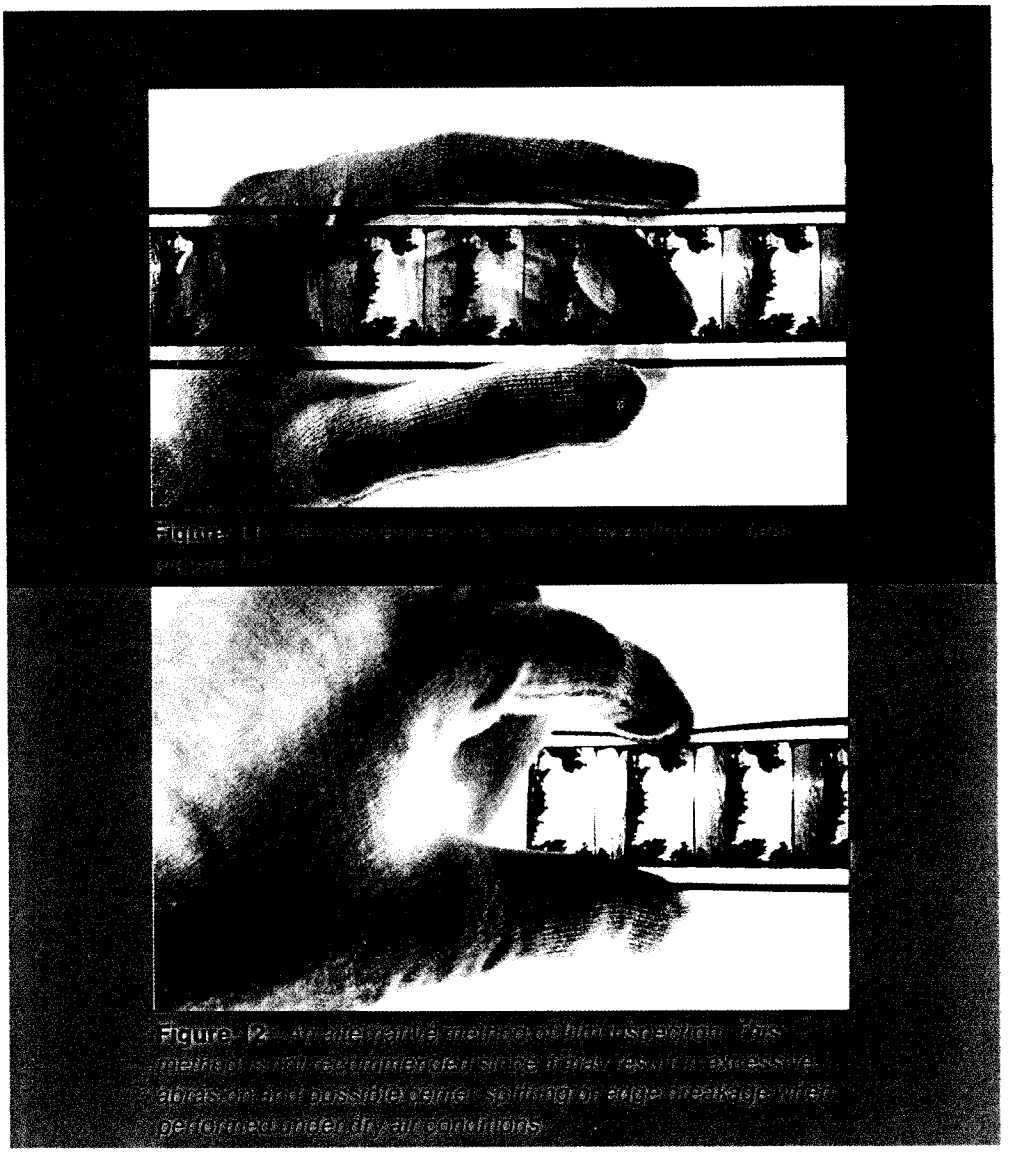


Figure 12. An alternative method of film inspection. This method is not recommended since it may result in excessive abrasions and possible vertical splitting or edge breakage when performed under dry-air conditions.

NOTE: Gloves and other soft cloths around a film work area are frequently in this condition because they are used for removing oil and dirt from film. Gloves should be changed and cleaning cloths should be washed often so they do not accumulate enough dirt to cause abrasions on film.

Another objection to holding film in this manner is that it often allows the film to rub directly against the top of the work bench; and, of course, any such contact should be avoided.

If inspection is carried out as shown in Figure 12, then the edges of the film are usually forced downward by the pressure of the thumb and forefinger. Because of this pressure in the center of the film (particularly under conditions of low relative humidity), the film can develop a running kink that can cause cracking or splitting, especially in older prints. When rewinding on console-type power rewinds, there may be no alternative to holding the film in this manner. If this is the case, great care should be exercised to minimize film cupping and finger contact with the film surfaces.

Splices and Splicing

During the inspection procedure, the need to make a splice may be questioned. Obviously, if two film ends appear during the rewinding process, a splice is necessary; actually, any area on the film that shows structural weakness or breakage should be repaired or removed. If there are many such areas in a short length of film, it is usually desirable to remove the entire length rather than make many splices in the short section. This kind of repair is much less distracting on the screen and continuity is only slightly affected.

What type of splice to make? With current acetate base (safety) film, the conventional overlap cement splice is generally used. If the print is on polyester base, a tape splice and an electronic-type splice are the only types currently feasible. Incidentally, the tape splice can be used on both types of film base with equally good results.

It has been a common practice to notch the edges of the film when small nicks or breaks do not warrant immediate splicing. On subsequent examination, however, these notches frequently develop into long tears when caught by a glove or cloth, and this can cause a noticeable break in continuity. Film breaks during projection can also occur

as a result of edge notching. It is highly recommended, therefore, that such practices be discouraged.

Repair or Replace?

Besides making new splices to repair film damage, buckled and misaligned splices should be replaced. Much film is ruined by poor splicing. Splices that are wide, stiff, buckled, or out of alignment can cause the film to jump the projector sprockets and tear the perforations or break the film. Perforations next to these splices are generally subject to strain and eventual breakage.

Long sections of a print that are structurally damaged or heavily abraded should also be repaired or replaced.

Before long sections of film are removed from the reel, however, it is important to determine whether replacement footage can be ordered or whether the remaining use of the print warrants the expense. At one time, when prints were not circuited from theater to theater but were returned to the exchange after each booking, it was the custom to assess the theater for the replacement costs. Current practices involving frequent circuiting and only periodic inspection have practically eliminated the opportunity to charge an offending theater for unnecessary damage.

During the course of regular inspection and checking, it is very important not to neglect the protective leaders and trailers. They should be kept at full length to aid the projectionist in proper threading for smooth changeovers from reel to reel.

Automation

Today, many theaters are converting to automated systems that use very large reels or horizontal platters to hold a complete feature print. Because current exchange facilities cannot presently handle these extended film lengths, the projectionist must make up his show by splicing the individual reels from the exchange into one continuous strip. To do this, the leaders and trailers have to be removed from each reel. At the end of the booking, the projectionist breaks down the large reel and replaces the original sections onto the smaller exchange shipping reels. In the course of this operation, it is always possible for the leaders or trailers to be incorrectly replaced or not replaced at all. It is essential, therefore, that during the inspection procedure the leaders and trailers are checked to be sure that they correctly identify the reel number and subject title.

Consider the Audience

The purpose of print inspection is to maintain the film in such usable condition that it will provide a pleasing and acceptable screen image for the audience. To accomplish this, the environment where film is handled should be clean.

Here are some hints to help keep prints and work areas clean and audiences happy:

- Use film cleaner to remove any oil deposits on film surfaces. Oil acts as a trap for dust and dirt particles. Check film handling equipment for excess oil.
- Give extra attention to good housekeeping practices in the film inspection and shipping areas.
- Keep rewind tables and surrounding floor areas clean and as dust-free as possible.
- Change gloves and film handling cloths frequently; they should not be allowed to accumulate so much dirt that they turn black.
- Diminish rewinding speed as the end of the reel is approached to prevent the end of the film from slapping around on the bench top or from falling onto the floor.

Although only the leaders and trailers may contact the rewind bench or floor, there is a popular misconception that the dirt picked up by the film will remain where it is. During the many winding and rewinding sequences in the life of a print and aided by the buildup of static charges under certain conditions, usually it is not very long before the dirt and dust particles migrate well into the reel. If you wish to prove these observations, pay particular attention the next time you attend a movie. With the exception of a new print, dirt accumulation appears to build up in the screen image as the reel approaches the changeover point. The dirt level at changeover is at maximum and begins to disappear a minute or so into the new reel. As time goes on, the dirt buildup will migrate further into the reel. There is little need for this distracting dirt accumulation if cleanliness is observed in all phases of film inspection. Certainly some of the responsibility for keeping film clean and audiences happy must lie in the projection room, but this will be the subject of a future article.

THE SHIPPER

The film shipper or carrier should assume the responsibility of delivering the prints to the proper theater in time for the first showing. Regular schedules with the film exchanges generally guarantee in-time delivery. However, in some remote areas of the country, regular film scheduling is sometimes very difficult because of transportation routines that are beyond the control of the exchange. In spite of the uncontrollable factors that can influence film shipments, every effort should be extended to protect the film from extreme environmental conditions while in transit and upon reaching its destination.

When prints are loaded at the film exchange, the shipping cases should be stacked and not thrown into the vehicle. At their destination, the cases should be placed in some prearranged area that provides good protection from extreme moisture, heat, and cold. The same precautions should be observed with shipments that are to be returned to the exchange.

In summary, it is often overlooked that the money spent to produce a motion picture culminates in several reels of film which often represent the total investment of the film producer. Aside from the subject matter, the success of the film may depend greatly on the quality of the screen image presented to the theater patron. It is the responsibility of all those who handle the film, from the laboratory to the projectionist, to maintain constant vigilance in their preparation and use of the film.

Potential theater patrons of today are more affluent and have many recreational diversions available to take up their leisure time. If motion pictures are to be a preferred choice, the physical quality of the presentation is vitally important.