

## Approved SMPTE Recommended Practices

In November 1968, the Society's Board of Governors approved two Recommended Practices, which are printed here for your information — RP 33, Specifications for 35mm Subjective Picture Test Film for Theaters and Review Rooms, and RP 34, Dimensions for 16mm Motion-Picture Projection Reel Spindles. It should be noted, that RP 34 is intended to replace USA Standard PH22.50-1960 which is being withdrawn.

Copies of these documents and all SMPTE Recommended Practices may be acquired from Society Headquarters upon request.

## International Standardization

The International Organization for Standardization (ISO), whose activities in the field of cinematography were described

in the November 1967 *Journal* (pp. 1113-1115), approved, in June 1966, the following Recommendation: R486, Cutting and Perforating Dimensions for Double-8mm Motion-Picture Raw Stock Film. This ISO Recommendation is in complete agreement with PH22.17-1965, Standard Dimensions for 16mm Motion-Picture Film, Perforated 8mm, 2R-1500.

In December 1966, approval was given to ISO Recommendation R543, Definition and marking of Safety Film for Motion-Picture Uses. This Recommendation is in technical agreement with USA Standard Specifications for Motion-Picture Safety Film, PH22.51-1967, and USA Standard Specifications for Safety Photographic Film, PH1.25-1965.

The member's attention is directed to the fact that only the technical content is published here. Copies of the complete Recommendations are available from the USA Standards Institute, 10 East 40th St., New York, N. Y. 10016. — A.E.A.

RP 34-1968



SMPTE RECOMMENDED PRACTICE

Dimensions for

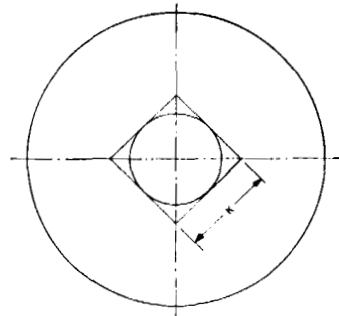
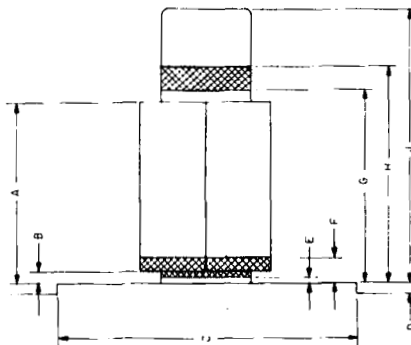
16mm Motion-Picture Projector Reel Spindles

1. Scope

1.1 This recommended practice specifies the dimensions for 16mm motion-picture projector reel spindles.

2. Dimensions

2.1 The dimensions shall be as given in the figure and table.



Notes:

1. Dimension K represents the diameter of the round portion or length of a side of the square drive portion of the spindle shaft, excluding locking means.

The figure illustrates the suggested construction for a projector spindle with a square drive portion. Alternate arrangements are also possible, providing that a minimum of two corners of the suggested square drive portion are maintained for drive and keying.

2. The areas between Dimensions E and F and between Dimensions G and H, illustrated by cross-hatching in the figure, represent the spindle shaft area, including a safety factor, on which the projection reel flange will rest. The minimum Dimension K applies only to these areas, although the maximum Dimension K applies to the entire shaft. The minimum shaft thickness dimension has been fixed for these areas to help minimize loose fit and resultant noise or tilt of reels.

3. The shape or action of the device for locking reels on spindles is optional, but the device should work against the full thickness of reels in the vicinity of the spindle holes, in accordance with USA Standard Dimensions for 16mm Motion-Picture Projection Reels (200- to 2,000-Ft. Capacity), PH22.11-1966.

Dimensions	Inches	Millimeters
A	0.100 min	2.54 min
B	0.665 max	16.89 max
C	0.010 max	0.25 max
D	0.65 min	16.0 min
E	0.97 max	24.6 max
F	0.12 min	3.0 min
G	0.005 max	0.13 max
H	0.080 min	2.03 min
J	0.850 min	21.59 min
K	0.980 min	24.89 min
	0.310 min	7.87 min
	0.315 max	8.00 max

\*See Notes 1 and 2.

Approved November 1968

Copyright, 1968, by  
SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS  
9 East 41st Street, New York, N.Y. 10017





## Appendix

(This Appendix is not a part of this SMPTE Recommended Practice, but is included to facilitate its use.)

The following descriptive narration script is suggested for use with the Subjective Picture Test Film:

A1. The focus test chart that you are now viewing is designed for you to evaluate the efficiency of your projection system with the least effort.

A2. It is recommended that you examine the image from the center of the first row of seats on the main floor.

A3. If your projection equipment is operating properly, and has been regularly maintained, the checkerboard pattern should appear sharp and well defined. In some situations, the length of the projection throw might prevent critical focusing. In these cases, it would be desirable for the projectionist to use binoculars.

A4. If it is not possible to resolve sharply the small individual squares in the pattern as the projectionist goes through focus, the projection optics should be thoroughly checked, and the projection port glass should be cleaned. When sharp focus has been attained in the center of the screen, a gradual softening of the focus toward the corners of the image is sometimes apparent, but it should not cause concern if it is similar in all corners. When a good compromise focus between the center and the sides of the screen has been achieved, should one side of the screen appear less sharp than the other, the projector gate and projection lens alignment should be checked relative to each other and to the screen.

A5. The horizontal bars at the top and bottom of the screen are designed to check vertical unsteadiness. For best results, the evaluation should be made using a large aperture plate. An objectionable amount of unsteadiness may indicate a worn intermittent sprocket, improper gate tension, perforation damage, or improper film lubrication.

A6. These two panels are also useful in checking for travel ghost. If any white bars appear to be bleeding into the adjacent black areas, or vice versa, the shutter is not properly timed and it should be adjusted as specified in the projection manual.

A7. The two side panels are included to indicate lateral unsteadiness or weave. If the side-to-side weave is excessive or objectionable, the projector gate tension should be checked, along with the guide rails and the spring-loaded roller in the trap. The side panels can also be used as a simple guide to image centering on the screen.

In each case, the horizontal yellow points should just be visible at the edges of the screen. The single and double vertical black marks near the ends of the horizontal yellow points indicate losses of 10 and 20 percent in screen image width (5 and 10 percent on each side).

A13. If your projected screen images are considerably oversized, longer focal length lenses are indicated.

Small differences in screen image size should be corrected by adjusting the screen masking.

A14. Custom-made aperture plates should conform to the film image size as closely as possible. Film image dimensions are the result of original photography and printing designed to conform to the standard and commonly used aperture plates manufactured today.

A8. For proper evaluation of the color chart, the projectionist must center the image vertically on the screen as accurately as possible through the rotating of the framing adjustment of the projector. It is entirely possible that many situations exist where vertical displacements of optical centers result when shifting from one screen format to another and compensation made in custom aperture filing for the nonanamorphic (wide-screen) format. These conditions require framing adjustments between formats and the test film can alert exhibitors to the need for selective framing to provide good composition of picture information on nonanamorphic prints where the frame-line reference is above or below the limitations established by the aspect ratio in use.

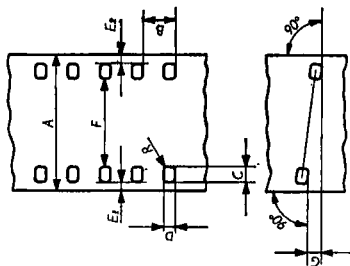
A9. This color chart is designed to indicate the amount of available picture information lost on the screen by improper screen masking and structural limitations or by incorrect aperture plate sizes and lens focal length combinations.

A10. As you view the color chart, using the proper anamorphic lens and an aperture plate marked 2.85:1, if the screen masking is correct, the red points should be just visible at the top and bottom of the screen, and a vertical white edge should be seen at both sides of the screen. If these indicators are not visible, the screen masking is either incorrect or the projection lens focal length is too short. The single and double vertical yellow marks near the edges of the chart on the blue area indicate a 10 and 20 percent loss in screen image width (5 and 10 percent on each side).

A11. As current practice is toward a decrease in the height of the anamorphic aperture, a shorter dimension is being considered as a substitute for the standard 0.715 in. now in use. The limits of this dimension are the upper and lower horizontal black bars at the tips of the red triangles. If the screen image height reaches these marks, the condition is acceptable.

A12. If you are viewing the color chart using a standard sound aperture plate marked 1.83:1, along with the proper focal length lens, the blue points should be just visible at the top and bottom of the screen, and the horizontal yellow points should be just seen at the edges of the screen. Similarly, when using a wide-screen aperture plate marked 1.83:1, the vertical yellow points should be just seen at the top and bottom of the screen. Other wide-screen aperture plates, designated 1.75:1 and 1.66:1, should just reveal the horizontal yellow lines, as marked, on the red areas of the chart.

**CUTTING AND PERFORATING DIMENSIONS FOR DOUBLE-8 mm MOTION-PICTURE RAW STOCK FILM**



Dimension	millimetre	inches
* A	15.95 ± 0.025	0.628 ± 0.001
** B	3.81 ± 0.015	0.1500 ± 0.0005
C	1.83 ± 0.01	0.0720 ± 0.0004
D	1.27 ± 0.01	0.0500 ± 0.0004
*** (E <sub>1</sub> - E <sub>2</sub> )	0.10 maximum	0.004 maximum
F	10.49 ± 0.025	0.413 ± 0.001
G	0.025 maximum	0.001 maximum
**** L	381.00 ± 0.40	15.000 ± 0.015
R	0.25 nominal	0.010 nominal

These dimensions apply to raw stock safety film immediately after cutting and perforating.

\* This dimension applies to low-shrink raw stock safety film base as defined in Annex R. For film base with higher shrinkage characteristics, dimension A should be 15.98±0.025 mm (0.629±0.001 in). Experience shows that it is common for film to expand when exposed to high relative humidity. Allowance should be made for this factor in the case of high shrinkage film. The tolerance on dimension A is based on a film width of 16.00 mm (0.630 in).  
 \*\* The distance between sprocket holes is based on a film width of 16.00 mm (0.630 in).  
 \*\*\* The distance between sprocket holes is based on a film width of 16.00 mm (0.630 in). It is not practicable to state precisely the resulting width after shrinking since films will be affected not only by the tolerance on the width, dimension A, but also by the shrinkage of the film during processing.  
 \*\*\*\* The tolerance on dimension L is not exactly specified, but the advantage of round numbers in both systems is considered to outweigh the importance of the residual difference.  
 \*\*\*\*\* Dimension L represents the length of any 100 consecutive perforation intervals.

**DEFINITION AND MARKING OF SAFETY FILM FOR MOTION-PICTURE USES**

**1. SCOPE**

The specifications contained in this ISO Recommendation apply to both unprocessed and processed film\* and to film having magnetic coatings or stripes. Motion-picture films are classified as safety films if they are difficult to ignite, slow burning and low in nitrate nitrogen content.

**2. IGNITION TIME**

**2.1 Definition**

Motion-picture films are classified as difficult to ignite when the ignition time is greater than 10 min at the temperature specified below.

**2.2 Method of measurement**

The ignition time of motion-picture films is measured as follows:

**2.2.1 Preparation of test sample.** A sample 35 mm (1.38 in) long and 8 mm (0.32 in) wide should be cut from the film to be tested. The sample should be free of perforations as far as is practicable. The sample should be conditioned for at least 4 h at a temperature of 20 ± 2 °C and a relative humidity of 50 ± 5%.

**2.2.2 Procedure.** The test should be made in an electric resistance oven, the interior of which is in the form of a vertical cylinder (preferably with a rounded bottom), having a diameter of 70 mm (2 7/8 in) and a mean height of 70 mm. The top of the oven should be closed by means of a closely overlapping lid having two holes of 7 mm (0.28 in) and of 15 mm (0.59 in) respectively, the centres being at a distance of about 15 mm from each other. A thermocouple should be introduced through the smaller opening, the connecting wires having a porcelain coating fitted tightly into the hole. Alternatively, the temperature in the cylinder may be measured by means of a mercury thermometer protected from rising heat by means of a cork disk lying a little above the lid.

**2.2.2.1 Temperature of tests.** The oven should be brought to, and maintained at, a temperature of 300 ± 3 °C (572 ± 5 °F). When this temperature is reached, the sample attached to a thin U-shaped wire hook should be introduced through the larger opening. The thermocouple (or the thermometer) and the sample should be fixed in such a way that the thermojunction (or the mercury bulb) and the centre of the sample are at an equal depth of about 35 mm (1.38 in).

**2.2.2.2 Preparation for tests.** Between tests, the oven should be thoroughly aired.

**2.2.3 Expression of results.** The time interval from the insertion of the sample to the ignition of the sample is recorded as the ignition time.

\* Normally, unprocessed and processed films have the same safety characteristics, so that either may be tested for conformance to these specifications. In case of doubt, both unprocessed and processed films should be tested.

3. BURNING TIME

The burning time may be determined by either of the two methods specified.

3.1. First method of measurement

3.1.1 *Principle of method.* Motion-picture films having a thickness equal to or greater than 0.08 mm (0.0032 in) are classified as slow burning when the burning time is not less than 45 s. Motion-picture films having a thickness less than 0.08 mm (0.0032 in) are classified as slow burning when the burning time is not less than 30 s.

3.1.2 *Preparation of test samples.* Three samples each 40 cm (15.8 in) long and 35 mm (1.38 in) wide should be cut from the film to be tested. If only films narrower than 35 mm are available, samples 40 cm (15.8 in) long and their full width may be tested. Each sample should be marked at a point 5 cm (2 in) from each end. If not already perforated, the sample should be perforated with holes 3 mm (0.12 in) in diameter along both edges. Perforations should be at intervals of not more than 20 mm (0.8 in). The sample should be conditioned for at least 4 h at a temperature of  $20 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$ . \*\*

3.1.3 *Procedure.* The burning time of motion-picture films is measured as follows: a wire having a diameter of not more than 0.5 mm (0.02 in) should be threaded through the perforations on one side so that the sample is supported at points not more than 20 mm (0.8 in) apart. With the wire stretched horizontally and the sample hanging vertically from it, the bottom corner of one end should be ignited.

3.1.4 *Test conditions.* The test should be made in a room free from draughts. At least three tests should be made.

3.1.5 *Expression of results.* The time which elapses from the moment the flame reaches the first mark until it reaches the second mark should be recorded as the burning time. If the sample does not ignite or if the flame does not reach the second mark, the film should be classified as slow burning.

3.2. Alternative method of measurement

3.2.1 *Principle of method.* Motion-picture films are classified as slow burning if each of six samples fulfils one of the following conditions:

- (a) the sample fails to burn beyond the specified mark;
- (b) a period of not less than 120 s elapses from the time of ignition of the alcohol to the time at which the flame reaches the specified mark.

3.2.2 *Preparation of test samples.* The test samples should be taken from either end or both ends of the continuous length of film which is to be examined. For the purpose of the burning test, six samples should be taken, each of a length of 533 mm (21 in) for both 35 mm and 16 mm film. The samples should be tested in the condition in which they are cut from the continuous length without removal of protective or magnetic coatings, stripes or emulsion. The samples should be conditioned for at least 4 h at a temperature of  $20 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$ . \*\*

*Notes.* — It is important to observe that the whole of the samples for both methods of test should be taken from the same continuous length, and that if the roll of film to be examined contains splices, then each individual continuous length should be examined separately. The object of taking six samples for the burning test is to obtain accurate results in the test and not to confirm the homogeneity of the film; the samples may therefore be taken consecutively.

\* Motion-picture films, when tested by this method, have similar flame propagation characteristics and about the same burning times, regardless of whether the width of the sample tested is 16 mm or 35 mm.  
 \*\* Experience has shown that safety film will meet the requirements for burning time when conditioned to any relative humidity in the range of 10 to 70%. The more stringent range of  $50 \pm 5\%$  of this test method is specified in interest of obtaining strictly comparable results. Likewise, the 4 h conditioning time is not critical and may be reduced to 1 h, minimum if the urgency of the test makes this desirable.

3.2.3 *Apparatus for 35 mm film.* Samples of 35 mm film should be tested on an apparatus complying with the following requirements:

The apparatus consists essentially of two semicircular supports, each L-shaped in cross-section, curved to a radius of 178 mm (7 in), spaced apart at a suitable distance for supporting the film within the angles, and structurally completed by a base-plate tying the two ends together (see Fig. 1).

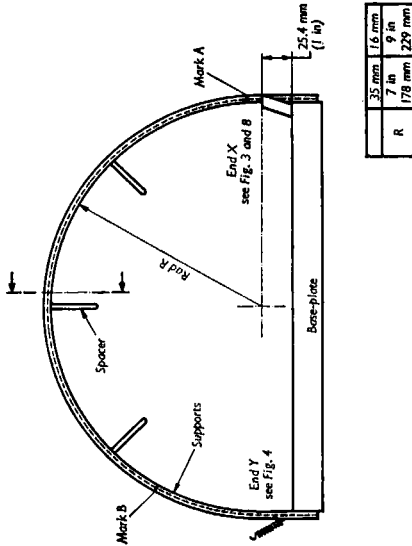


FIG. 1. — General arrangement of apparatus for flammability test of safety film.

The two supports should be made of mild steel, about 1.2 mm (0.05 in) thick, and should be spaced so that their inner edges are 25.4 mm (1 in) apart, the spacers being of wire shaped as shown in Figure 2.

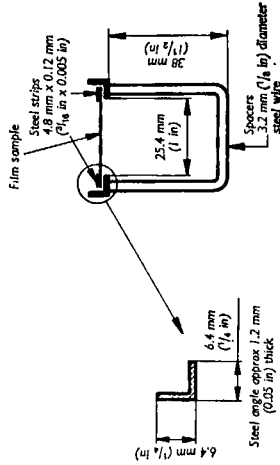


FIG. 2. — Section through supports showing wire spacer for 35 mm film apparatus.

The film sample should be held in position over the semicircular supports by two strips of spring steel, 4.8 mm wide by 0.12 mm thick ( $3/16$  in by 0.005 in), each of which is riveted at one end to a support (see Fig. 3). The other ends of the two steel strips are connected, at the appropriate distance apart, by a thin steel crossbar (see Fig. 4). At the igniting end there should be, between the supports, a flat platform of heat insulating material

(mica, asbestos, etc.) on which a small alcohol cup may be placed. The upper surface of the platform should be 25 mm (about 1 in) above the base-plate and should be 20 mm (0.8 in) long by 10 mm (0.4 in) wide.

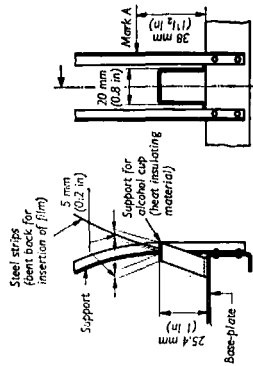


Fig. 3. — Detail of end X for 35 mm film apparatus

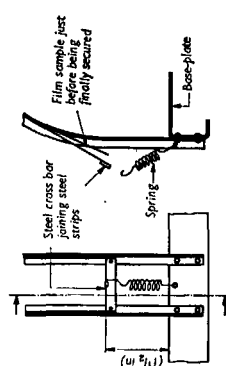


Fig. 4. — Detail of end Y for 35 mm film apparatus

The apparatus for 16 mm film is similar in general design. The alcohol cup should be of copper and should have the dimensions shown in Figure 5.

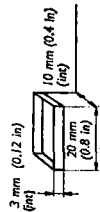


Fig. 5. — Alcohol cup for 35 mm film apparatus

One curved support should carry two register lines or marks, as shown in Figure 1, which should be clearly visible when the film sample is in position, and which should be marked A and B respectively.

The mark A should be 38 mm (1.5 in) above the base-plate at the igniting end. The mark B should represent the position which would be occupied by the end of a piece of film 457 mm (18 in) long, whose other end coincides with the mark A.

**3.2.4 Procedure for 35 mm film.** The 533 mm (21 in) film sample should be placed in the trough formed by the two L-section supports, with its end in line with the mark A. The steel strips are drawn over and are held by a small spring which clips on to the crossbar which joins them at their free end (see Fig. 4). Thus the film is securely held by a narrow portion at each side and the centre portion of approximately 25 mm (about 1 in) of the film is in

free air. If the sample to be tested is a coated film, the sample should be placed coating upwards. The copper cup should be placed on the platform centrally below the film; 0.3 ml of alcohol (not less than 95 %) should be placed in it and ignited.

**3.2.5 Apparatus for 16 mm film.** The apparatus is similar in general form to that specified above for the testing of 35 mm film. The circular supports are curved to a radius of 229 mm (9 in). They should be made of mild steel about 0.9 mm (0.036 in) thick, formed to the dimensions shown in Figure 7, and should be spaced so that their inner edges are 12 mm (0.47 in) apart, the spacers being of wire shaped as shown in Figure 7. The film sample should be held in position by steel strips, similar to those for the test of 35 mm film. The upper surface of the platform of heat-insulating material should be 25 mm (about 1 in) above the base-plate and should be 10 mm (0.4 in) square. The alcohol cup should be of copper and of the dimensions shown in Figure 6. The mark A should be 38 mm (1.5 in) above the base-plate at the igniting end. The mark B should represent the position which would be occupied by the end of a piece of film 457 mm (18 in) long, whose other end coincides with the mark A.

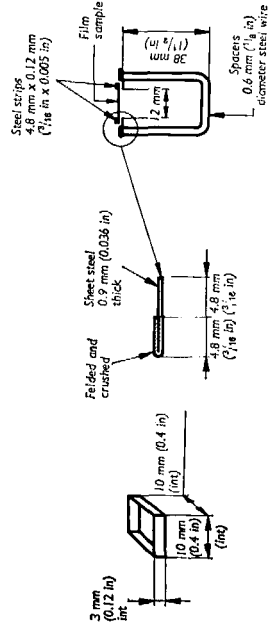


Fig. 6. — Alcohol cup for 16 mm film apparatus

**3.2.6 Procedure for 16 mm film.** The method of carrying out the test should be similar to that specified above for 35 mm film. The length of the 16 mm film sample is 533 mm (21 in) and 0.3 ml of alcohol should be placed in the metal cup.

**3.2.7. Expression of results.** The time which elapses from the time of ignition until the flame reaches Mark B should be recorded as the burning time. If, for each of six samples, the sample does not ignite or if the flame does not reach Mark B within 120 seconds, the film should be classified as slow burning.

#### 4. NITRATE NITROGEN CONTENT

##### 4.1 Definition

Motion-picture films which have a nitrate nitrogen content of not more than a certain percentage by mass, depending on the method used, are classified as having a low nitrogen content. This percentage is 0.40 % when the De Varda method is used, whereby the error in nitrogen content owing to the presence of the gelatin layer is taken into account. The percentage is 0.36 % when the Schulze-Tiermann method is used.

##### 4.2 First method of measurement — De Varda method

The nitrogen content of motion-picture films is measured as follows:

**4.2.1 Preparation of test sample.** The test sample should be conditioned for at least 4 h at a temperature of  $20 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$ .

**4.2.2 Procedure.** Cut 5 g of the film into small pieces (25 mm (about 1 in) by 6 mm (0.24 in)) and place them in an 800 ml Kjeldahl flask. Add 90 ml of 30% sodium hydroxide and 10 ml of ethyl alcohol. • Connect the flask with a rubber stopper to a vertical cooler. Heat on a steam bath or over an open flame at 30 to 40°C and add 25 ml of 30% hydrogen peroxide slowly, with agitation. Boil slowly until the hydrogen peroxide is reacted. If necessary, add another 25 ml portion of hydrogen peroxide and continue the boiling until it is reacted. Boil for 15 min until the reaction is completed.

Then adjust the contents of the flask to approximately 200 ml using distilled water. (If desired, the test may be conveniently held over for the night at this point). The solution is then evaporated over a small flame to about 75 ml in order to remove any traces of ammonia, after which it is cooled to room temperature.

The solution is diluted to 350 ml with distilled water. \*\* Add 2.5 g of De-Yarda's alloy and quickly connect the flask to the Kjeldahl apparatus. This addition should be done through a funnelled tube, so that no alloy clings to the flask neck. The mixture should be left for 1 h and then distilled with great care. Collect approximately 150 ml of distillate in a 500 ml receiving flask containing about 50 ml of approximately 4% boric acid solution. The contents of the flask are then titrated with tenth-normal sulphuric acid, using methyl red as indicator.

**4.2.3 Expression of results.** A blank determination is made on the reagents, using the same quantities as are used in the actual determination. The percentage of nitrate nitrogen is calculated as follows:

$$\frac{(A - B) \times 0.1 \times 0.014 \times 100}{S} = (A - B) \times 0.028$$

where *A* = amount of tenth-normal acid used for sample, in millilitres,  
*B* = amount of tenth-normal acid used for blank determination, in millilitres.

**4.3 Alternative method of measurement - Schwabe-Tiemann method**

**4.3.1 Preparation of test sample.** The sample should be taken from either end or both ends of the continuous length of film which is to be examined. For the purposes of this test for nitrate nitrogen content, three samples, each of a length 152 mm (6 in) for 35 mm film and 305 mm (12 in) for 16 mm film should be taken. The samples should be conditioned for at least 4 h at a temperature of 20 ± 2°C and a relative humidity of 50 ± 5%.

**4.3.2 Procedure.** Cut the film into strips approximately 6.35 mm (1/4 in) wide by 25 mm (about 1 in) long. Weigh about 10 g of the film into the flask *A* (of capacity of about 250 ml) and add about 50 ml of water to cover the film, ensuring that no film is stuck to the sides of the flask. Replace the rubber bung fitted with delivery tube and filling tube (see Fig. 8, page 9). Turn on the water supply to the tube jacket of the endiometer; raise the levelling arm *B*; open taps *C* and *D* and pour 24% sodium hydroxide solution into cup *E* until the endiometer tube is full, taking care that there are no air bubbles enclosed. Close taps *C* and *B*. Close spring clip *F* on the delivery tube of the apparatus and fully open clip *G*. Light a burner under the flask and bring the water to a boil. Allow to boil for half a minute. Continue boiling and, without removing the burner, close clip *G* and open clip *F* at the same time. Pour 45 ml of aqueous saturated ferrous chloride solution into the boiling tube *H*. When steam issues from the end of the delivery tube *J*, place this under the sodium hydroxide in cup *K*. Close clip *F* and open clip *G* simultaneously. The steam from the flask now passes through the ferrous chloride solution, boiling it. Continue boiling until most of the water in the flask has been boiled away and no more air bubbles pass up through the ferrous chloride solution.

• A deaerated ethyl alcohol may be used which does not contain nitrogen compounds.  
 \*\* The volume at this point should be controlled within ± 10 ml, because of the influence of alkali dilution upon the rate of reaction of De-Yarda's alloy.

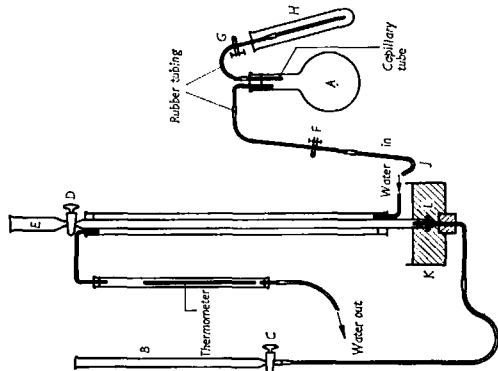


FIG. 8. — Schwabe-Tiemann method for determination of nitrate nitrogen content.

Remove the burner and close clip *G*. Gently lift the endiometer tube jacket off the rubber stopper *L* and slip the lower end of the endiometer over the end of the delivery tube *J*, clamping the tube jacket in this position. Pour about 5 ml of the 24% sodium hydroxide solution into the cup *F* at the upper end of the endiometer.

A vacuum will have formed in the reaction flask *A*. Slowly open clip *G* and allow the ferrous chloride solution to run slowly into the flask. Close clip *G* just before the last of the ferrous chloride has run out. Pour 45 ml of concentrated hydrochloric acid into the boiling tube and, by opening clip *G*, allow the whole of this, except the last 1 ml or so, to be drawn into the flask. Close clip *G*. Pour 5 ml of ferrous chloride solution into the boiling tube. Replace the burner under the reaction flask and gradually bring the contents of the flask to a boil, keeping one hand on clip *G* and the other on clip *F*. Open clip *G* slightly, so that ferrous chloride just drips into the flask.

As decomposition of the nitrogen compound proceeds, pressure will gradually develop in the flask and a point will be reached at which the gas evolved will begin to drive the ferrous chloride back into the boiling tube (for greater accuracy, use a capillary tube), i.e. when the flask has attained atmospheric pressure. As soon as the drop of ferrous chloride on the end of the tube begins to recede, close clip *G* and open clip *F* simultaneously. Slide clip *F* off the rubber tube and allow it to rest on the lower part of the delivery tube against cup *K*.

Boil the contents of the flask until no more gas collects in the endiometer, agitating the flask fairly vigorously in the later stages of the reaction. When this agitation no longer produces gas bubbles, remove the burner and close the delivery tube with clip *F*.

Support the eudiometer tube jacket with one hand, slacken the supporting clamp with the other and carefully replace the bottom of the eudiometer tube on the rubber bung *L*. Fill the cup at the top of the eudiometer with 24% sodium hydroxide solution. Open tap *C* and lower the levelling tube until the level of the sodium hydroxide in it is well below the level of the sodium hydroxide in the eudiometer. Partially open tap *D* and allow the bulk of the sodium hydroxide in the cup to be drawn into the eudiometer. Close tap *D* and raise the levelling tube *B* until the sodium hydroxide in *B* and in the eudiometer are at the same level. Clamp *B* in this position.

When the temperature of the gas in the eudiometer is constant, as shown by the thermometer in the overflow tube of the eudiometer jacket, readjust the sodium hydroxide in *B* and in the eudiometer to the same level and read the volume of the gas collected; correct this according to the correction chart for the eudiometer used. Note the temperature of the gas. Read the barometer.

A blank determination should be carried out using the correct amounts of reagents with no film present. This blank is subtracted from the volume of nitric oxide collected after both volumes have been corrected to normal temperature and pressure. A Farmer gas calculator, which can be obtained at the usual laboratory stockists, simplifies the calculation considerably.

4.3.3 Method of calculation

If *m* = mass of sample taken, in grammes,  
*V* = volume of gas collected, in millilitres,  
*t* °C = temperature of gas collected,  
*p* = barometric pressure, in millimetres of mercury,  
*P* = vapour pressure of 24% sodium hydroxide solution at *t* °C, in millimetres of mercury,

then percentage nitrogen is:

$$V \times \frac{273}{(273+t)} \times \frac{(p-P)}{760} \times \frac{100}{m} \times \frac{14.01}{22.41} \times \frac{1}{1000} = \frac{V \times (p-P)}{(273+t) \times m} \times F$$

where *F* is a constant (log *F* = 2.3514).

5. FIELD TEST

5.1 Principle of method

The following test method may be used for quickly identifying whether most motion-picture films are of the safety or of the nitrate variety, without technical equipment or the expenditure of large amounts of specimen film. However, it does not determine compliance of a film with this ISO Recommendation.

5.2 Preparation of test sample

Cut a piece of film approximately 16 mm (0.63 in) wide and 35 mm (1.38 in) long. Bend the film lengthwise and crease it sufficiently so that when released it will stand upright.

5.3 Procedure

Stand the film sample (with the crease vertical) on a flat surface, such as an arbitrary, glass plate, concrete floor, etc. This should be done at a safe distance from all film stocks. With a match flame, ignite one of the top corners of the film. Anyone unfamiliar with the burning of safety and nitrate photographic films should first conduct this test on samples of both types of film, the identities of which are known.

5.4 Expression of results

If the film ignites easily, burns downward rapidly and vigorously with a bright yellow flame, and is completely consumed in less than 15 s, it probably contains dangerous quantities of cellulose nitrate and probably will not pass the tests of this ISO Recommendation for safety film. If the film sample ignites with difficulty and burns only partially or, if it burns completely in a time not under 15 s, it is likely but not assured that the sample will pass the tests of this ISO Recommendation.

6. MARKING

Motion-picture film on safety base should be suitably marked as such. \* This does not apply to film having only a magnetic coating.

\* (a) In some countries, markings between perforations or along the edge of the film comprising S or SAFETY have been used.  
 (b) An alternative or supplementary way of marking is by means of a fluorescent compound in or on the film base. It is pointed out that national regulations may require these or other markings.