Film Decomposition Tests

In the paper that begins on p. 268 of this JOURNAL, Cummings Hutton and Silfin point out the serious losses that may result from decomposition in storage of cellulose nitrate motion picture film. Much of this potential loss could no doubt be avoided if a reliable test for future storage life were applied to films now being stored for commercial and archival purposes. No such test is now used regularly in the United States, but recently the attention of film librarians has been directed to two such tests developed in England, under the auspices of the British Government's Chemical Research and Development Establishment and the Department of the Government Chemist. In Report No. 2/R/48, "The Surveillance of Cinematograph Record Film During Storage," by G. L. Hutchison, L. Ellis, and S. A. Ashmore, the authors described a rather extensive investigation of the stability of film in storage and outlined the details of two test procedures which they have found useful. Further information concerning the use of these tests and the results obtained may be secured from the British Film Institute, 164 Shaftesbury, London, England. This is a government department similar to the U.S. National Archives.

So that the SMPTE's Preservation of Film Committee may have the benefit of a number of points of view concerning both the value of such tests generally and the advisability of further committee study in this direction, a brief summary of this British Report and an outline of the test methods are described immediately below. Comments and recommendations should be addressed to James W. Cummings, Chairman, SMPTE Preservation of Film Committee, The National Archives, Washington 25, D.C.

SUMMARY

"The deterioration of nitrocellulose base cinematograph film on prolonged storage is brought about by a slow but progressive decomposition of the nitrocellulose. The changes occurring are complex but it seems clear that the gelatine on the film acts as a stabilizer and accordingly suffers deterioration which involves loss of the contained silver image at about the same time that the film becomes sticky. This stage is the end of the useful life of the film, and as such film cannot be duplicated it represents a total loss of record.

"Two tests, based on methods of known value in the examination of nitrocellulose explosives, have been developed whereby it is possible to anticipate the end of the useful life of a film. The results of these tests allow sufficient time for a film to be duplicated while still in good physical condition.

"Using the two tests referred to in the above paragraph a scheme of surveillance and sentencing of stored films has been devised.

"Since the useful life of a film is well ended before conditions favorable to spontaneous inflammation arise, it is clear that danger from this source can now be avoided.

"The results of this investigation are clearly applicable in principle to all stored cinematograph film having a cellulose nitrate base."

Two recommended tests for predicting the future condition of nitrate film in storage are the Alizarin Red Heat Test and the Micro-Crucible Test. These are described briefly below:

ALIZARIN RED HEAT TEST

In this test a small punching of the film of approximately 6 mm diameter and weighing 7 mg is heated in a glass tube in which is suspended an alizarin red test paper moistened with a solution of glycerine in water. The tube is heated at a temperature of 134 C and the time noted for the development of acid vapors as indicated by a color change in the test paper.

1. Apparatus

(a) Glass tube closed at one end and approximately 90 mm in length and 9 mm internal diameter is fitted with a stopper 60 mm in length and of such a diameter that when covered with one thickness of test papers makes a close sliding fit in the tube. 45 mm of the stopper should then be in the tube.

(b) A cylindrical double-walled copper air bath, 100 mm deep and 100 mm in diameter. The metal lid is lagged with asbestos composition 8 mm thick and contains a central hole to take a thermometer and six holes, of 12-mm diameter, suitably arranged to take six testing tubes. The outer jacket of the bath is fitted with a reflux condenser.

(c) A supply of rubber rings to give convenient support to the tubes in the air bath.

(d) A supply of large size filter papers (Whatman, No. 2).

2. Preparation of the Test Paper

This is conveniently prepared by impregnating a sheet of filter paper with a 0.1% solution of alizarin red indicator in water to which has been added 2 ml of 2 *N* ammonia per 100 ml. The solution is allowed to drain off and the edges of the paper are subsequently discarded. The paper may then be air dried but should be further heated for 10 min in the steam oven before use, to drive off any traces of free ammonia.

3. Method

The outer jacket of the bath is charged with about 20 ml of pure xylene and heat is applied by means of a small gas burner. When temperature conditions are steady the thermometer should read 134 C.

In the meantime six tubes, as described at (a) under Apparatus, are prepared for test. Into each is placed a punching of the film under test, the punching being 6 mm in diameter and weighing about 7 mg. A strip of test paper is cut to such a width that when wrapped around the stopper the whole of the latter is effectively covered without any overlap which would spoil the snug fit in the tube. The test paper is then moistened with a 50% solution of glycerine in water. Each tube is fitted with a rubber ring, the position of which is adjusted so that the part of the tube contain-

ing the test paper is wholly outside the bath.

With all tubes in position in the bath the temperature and time are noted. The tubes are kept under constant observation, if necessary for rather more than one hour.

The color of the test paper prepared as described is maroon, which, in the presence of acid vapors, is either bleached or becomes a pale yellow. The change is well marked and readily observed: for the purposes of this test, the time in minutes required for a positive result is taken when the lower edge of the paper is bleached or changed in color to a distance of approximately $\frac{1}{8}$ in.

Note 1. The apparatus described can suitably be increased in size so that more than six samples can be tested at one time.

Note 2. If a tube is removed after test while the other tubes are in position, the vacant hole must be closed with a cork or bung.

MICRO-CRUCIBLE TEST

This test involves the determination of the loss in weight of a punching of cinema film when heated in a small porcelain crucible in a ventilated oven maintained at 100 C.

The crucibles are of 1 ml capacity and are obtainable from Royal Worcester Porcelain Co., or indirectly through laboratory supply firms.

A disc of film of approximately 0.25-in. diameter and weight about 7 mg is punched out of the film in question and transferred to the crucible weighed to the nearest 0.01 mg. The combined weight of crucible and film is then determined accurately, also to 0.01 mg, and the weight of film found by difference.

The crucible and film are then heated in a ventilated oven maintained at 100 C and the combined weight determined at 168 hr and 300 hr. The loss in weight is then calculated as a percentage on the original weight of the film.

RESULTS		*SENTENCE*
Alizarin Red Heat Test	*Micro-Crucible Test* (after 168 hr)	*Retest after:*
60 min and over	—	2 yr
Under 60 min but not under 30 min	—	1 yr
Under 30 min but not under 10 min	Under 10%	6 months
	10% and over	Copy and destroy
Under 10 min	—	Copy and destroy

Meetings of Other Societies

Institute of Radio Engineers, Cincinnati Section, Spring Technical Conference on Television, April 29, Cincinnati, Ohio
Institute of Radio Engineers, Technical Conference, May 3–5, Dayton, Ohio
Armed Forces Communications Assn., Annual Meeting,
May 12, New York, and Long Island City
May 13, Fort Monmouth, N.J.
Acoustical Society of America, Spring Meeting, June 22–24, State College, Pa.
Illuminating Engineering Society, National Technical Conference,
August 21–25, Pasadena, Calif.