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STANDARD FADING LAMP AND METHOD OF CALIBRATING LAMPS USED IN TESTING COLORFASTNESS TO LIGHT

For the past several years work has been in progress at the National Bureau of Standards on a master lamp to be used as a standard of reference for the calibration of the fading lamps in use throughout the country. The purpose has been to provide a lamp in which fading can be carried out reproducibly, and against which the performance of commercial fading lamps can be measured. This lamp is described briefly, and light-sensitive papers for comparing the performance of commercial lamps with it are described in this letter circular.

The standard lamp is a 30-ampere AC arc burning cored carbons in air. The lamp is trimmed with three upper and three lower carbons, and the pairs burn in rotation. The radiant energy from the arc passes through Corex D glass to filter out short-wave radiant energy not present in sunlight, before it reaches the samples being exposed in the lamp. The gases and most of the ash from the arc are drawn off and discharged outside the building.

The lamp is housed in a room maintained at a temperature of 73.5 ± 1 degree Fahrenheit, with the air at a relative humidity of 50 ± 1 percent. The line voltage to the lamp and the arc current are automatically controlled, and their values are recorded continuously. The total variation in the nominal 220 line voltage is maintained at less than 3 volts.

The radiant output of the arc is measured continuously by means of an integrating photoelectric device. This consists essentially of a phototube and a trigger tube which actuate an electric counter. The phototube is sensitive to the near ultraviolet and blue region of the spectrum (approximately 300 to 480 millimicrons). Both the phototube and the trigger tube are built into a water jacket and maintained at constant temperature. The phototube is mounted to view the arc side-by-side with the samples under exposure. Although this instrument does not give a measure of the total radiant output, comparisons with a watthour meter

measuring energy input to the arc indicate that it does measure a fairly constant fraction of the total. The performance of the phototube, of course, must be checked at frequent intervals with a standard light source.

Since the radiant energy from the standard fading lamp can be controlled, and reproduced, the lamp provides a reliable basis for expressing colorfastness to light in terms of "standard fading hours." The "standard fading hour" now under trial was recommended by the committees on colorfastness to light of textiles of the American Association of Textile Chemists and Colorists, and of the American Society for Testing Materials. It is considered to be in agreement with the "Fade-Ometer hour" used by the dyestuff and textile industries for a number of years for rating colorfastness to light of dyed textiles. The newer "Fade-Ometers" are somewhat faster in their fading action than those on which the concept of the "Fade-Ometer hour" was developed.

As a simple and convenient means of comparing the performance of carbon-arc fading lamps with that of the standard lamp at the National Bureau of Standards, a number of light-sensitive papers have been developed. One may evaluate the performance of his particular lamp by comparing the fading of the color of this paper in his lamp for a stated period of time with that of paper exposed in the standard lamp. Thus he may readily determine the relationship between clock hours of exposure in his lamp and standard fading hours of exposure in the standard lamp. That some such form of lamp calibration is urgently needed was shown by a survey of the performance of 46 lamps in 21 different laboratories made several years ago by the National Bureau of Standards. The results of this survey were reported in Letter Circular LC785: "Calibration of Arc Lamps for Testing Colorfastness to Light."

The materials necessary for calibrating a lamp are a supply of the unexposed paper and a comparison booklet containing strips of the paper exposed for specified numbers of standard fading hours in the standard lamp. A piece of the paper is exposed along with, and in the same manner as, the materials under test. The exposure is continued until the fading of the paper matches the fading of one of the standard strips. At this point the lamp may be said to have operated for the corresponding number of standard fading hours, regardless of the actual clock hours of its operation. Since the performance of a lamp may change considerably from day to day, it should be calibrated every time it is used.

The comparison booklet is designed to protect the faded standards. They should not be touched with the fingers, or with

anything likely to soil them. In matching, the strips should be superposed closely upon the test paper. The booklet may be conveniently held in the left hand, allowing the pages to flip open, rear cover first, placing first one and then another of the standard faded strips upon the paper faded in the lamp under test. It is usually easier to make the comparisons if the dark unfaded borders of the test paper are clipped off and discarded, or if the test paper is left in the fading frame during the comparison.

Unnecessary exposure of the standard strips to light during normal use should be avoided. The plastic covers of the comparison booklet normally flip closed and protect the papers when it is laid aside. However, it appears that the strips can be exposed in a well-lighted room for ten minutes per day for two years before the fading of the strips is equivalent to that of one standard fading hour.

Of the several calibration papers which have been furnished industrial laboratories for trial during the past several years, Paper A and Paper E have had the widest circulation. Most users have found Paper A to be a little more suitable for their purposes than Paper E. However, the stock of Paper A has been exhausted, and it is no longer available for distribution. A paper which will replace it is currently being manufactured and tested. Supplies of this paper and comparison booklets will be distributed to those who have requested them. For the present, no charge is being made for these materials.

A considerably more detailed description, both of the master lamp and of the various calibration papers, will be found in a Research Paper by Herbert F. Launer soon to be published in the Journal of Research of the National Bureau of Standards under the title: "Light-Sensitive Papers as Controls for Testing Textile Colorfastness and Stability of Materials Under Arc Lamp Exposure."

Experimental work is being continued on this project with the view of improving the performance and usefulness of the standard fading lamp, and of developing improved calibration papers. Criticism, comments, and suggestions concerning any phase of this program will be welcomed by the National Bureau of Standards.