Standards for Checking Opacity Meters.

The National Bureau of Standards has investigated sources of error in the measurement of opacity; a report of the preliminary results appeared in the March issue of the Bureau of Standards Journal of Research as Research Paper, RP660, Sources of Error in Measuring Opacity of Paper by the Contrast-Ratio Method (separate copies obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C., for five cents cash). It has also been found that opacity by the official TAPPI method differs appreciably (for some papers by as much as 0.04 or 4%) from true contrast ratio defined in Bureau of Standards Circular No. 63 (also obtainable from the Superintendent of Documents, for five cents, cash).

To provide a means of checking the adjustment of opacity meters of the type described in Circular No. 63, to discover whether they are reading according to the TAPPI definition, opacity standards of opal glass have been developed. These standards are 5 x 20 cm rectangles, 1.5 mm thick; they have been found to be permanent and cleanable. The opacities of the standards have been determined according to the official TAPPI method; they fall between 0.80 and 0.90. If any opacity meter fails to yield the given value of opacity, then it is not reading correctly and requires adjustment or calibration.

A standard may be purchased for $15.00; or, it may be borrowed for one week free of charge.

These standards may be used according to an approximate method or a rigorous method, as follows:

Approximate Method.

First, see that the metal sample holder is adjusted so that a paper sample will be 0.5 to 0.7 mm further from the white backing than the back plane of the opal-glass standard when inserted in the slot without the holder. The holder should be bent slightly if necessary to accomplish this adjustment.

Second, measure the opacity of the opal-glass standard inserted without the metal sample holder, and with the fine-ground surface toward the photometer. If the value obtained agrees with the true value, then the instrument is in adjustment for samples of opacity near that of the standard. If the value found is too high, move the magnesium carbonate block closer to the cover glass; if it is too low, shift the carbonate block back from the cover glass. Sometimes the carbonate block will require scraping in order to clean it, and sometimes it will require replacement because of darkening of the whole block with age.

Rigorous Method.

First, adjust the sample holder as described in the approximate method.

Second, check the scale of the photometer by measuring the transmission of several rotating sector disks of known angular aperture. The photometer must be taken out of the instrument and mounted so that the beam of light entering one side of it passes through the rapidly rotating sector disk. Make ten settings of the angle, θ_1, giving brightness match. Then place the sector disk in the other beam and make ten settings of θ_2. The angular aperture of the open part of the disk relative to the whole disk (360°) should be given either by $(\tan \theta_1)(\cot \theta_2)$ or by $(\cot \theta_1)(\tan \theta_2)$, whichever is less than unity.

Third, check the uniformity of illumination of the sample. This may be done by inserting a uniform paper sample backed by a uniform sheet of tin foil or other uniform, perfectly opaque material, and measuring its opacity. This should, of course, be 100%, but if more light is falling on the sample over the white backing than over the black, the instrument will give an opacity less than 100%, and vice versa.

Fourth, check the reflecting power of the black cavity by measuring the opacity of the holder without any sample in it. This should, of course, be zero, but if the black backing reflects an appreciable amount of light, the instrument will give an opacity greater than zero. A reflectance of one half of one per cent may be tolerated.

Fifth, measure the opacity of the opal-glass standard with the fine-ground surface toward the photometer, and make adjustments as described under the approximate method. (Note: If the standard becomes soiled it should be washed with soap and water.)

In case the value of opacity obtained for the standard differs only slightly from the true value, it may be desirable not to alter the adjustment of the instrument. In that case the instrument reading may be corrected for a sample having a light, nearly white color. Let ΔC_S be the difference between measured and true value of opacity of the standard, then the correction, ΔC, to be applied to the measured value for a paper sample is given by $\Delta C = K \Delta C_S$. The variation of K with measured value of opacity is given in the following table:

Measured value: of opacity	$\Delta C/\Delta C_S = K$	Measured value: of opacity	$\Delta C/\Delta C_S = K$
0.50	1.0	0.75	1.2
.55	1.1	.80	1.1_5
.60	1.2	.85	1.0
.65	1.2	.90	0.8
.70	1.2	.95	0.5
		1.00	0.0

If the instrument gives a high value on the standard, the corrections should be subtracted from the measured values; but if it gives a low value, they should be added.