



Standard Test Method for ALPHA-, BETA-, AND GAMMA-CELLULOSE IN PAPER¹

This Standard is issued under the fixed designation D 588; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This method covers the determination of alpha-, beta-, and gamma-cellulose, the three fractions into which cellulose can be separated analytically, as follows:

1.1.1 *Alpha-Cellulose*—Alpha-cellulose is the fraction that can be filtered out of a mixture consisting of the fibrous material and sodium hydroxide solution (7.3%) of maximum dissolving power, after the fibers have previously been swelled with sodium hydroxide solution (17.5%). After separation, the alpha-cellulose is determined either by drying and weighing, or volumetrically by oxidation with potassium dichromate. Both methods for alpha-cellulose are capable of the same reproducibility and give practically the same values. In the volumetric method, no moisture or ash determinations are made and a much smaller sample is used, resulting in a shorter and more rapid procedure.

1.1.2 *Beta-Cellulose*—Beta-cellulose is the fraction that precipitates at room temperature (15 to 35 C) after the filtrate has been acidified, and is determined by the volumetric method.

1.1.3 *Gamma-Cellulose*—Gamma-cellulose is the fraction that remains in solution after removing beta-cellulose, and is determined by the volumetric method.

1.2 The method of separating the alpha-cellulose from the other two fractions is intended primarily for papers made from rags or chemical wood fibers. If information is desired as to the applicability of the method to papers containing large amounts of lignin, such as newsprint, reference should be made to the original literature² for details of technique.

2. Significance

2.1 There are several schools of thought as to the value of determining the alpha-cellulose in paper. Some believe that chemical stability with respect to permanence of paper is related to the alpha-cellulose present, contending that the higher this is, the more permanent the paper. Others state that in some instances considerable fiber deterioration may occur before there is an appreciable loss of alpha-cellulose. Still others state that this test is significant only when comparing the alpha-cellulose of fibers of the same kind and origin.

3. Apparatus

3.1 *Grinder*—A Koerner³ or equivalent type grinder that will completely disintegrate the paper without heating or contaminating it.

3.2 *Mixer*—A device with which uniform mixture of the ground material can be secured. A mixer is easily constructed by fitting a crock or bell jar, of approximately equal diameter and depth, with a wooden lid through which

¹ This method is under the jurisdiction of ASTM Committee D-6 on Paper and Paper Products.

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² Launer, H. F., "Simplified Volumetric Determination of Alpha-, Beta-, and Gamma-Cellulose in Pulps and Papers," *Journal of Research*, JRNBA, Nat. Bureau Standards, Vol 18, No. 3, 1937, p. 333 (*Research Paper RP979*); also Launer, H. F., "Volumetric Determination of Alpha-, Beta-, and Gamma-Cellulose in Pulps and in Papers Containing Sizing, Filler, and Other Materials," *Journal of Research*, JRNBA, Nat. Bureau Standards, Vol 20, No. 1, 1938, p. 87 (*Research Paper RP 1068*).

³ The Koerner type of grinder is described in a paper by Burton, J. O., and Rasch, R. H., on "The Determination of the Alpha-Cellulose Content and Copper Number of Paper," *Journal of Research*, JRNBA, Nat. Bureau Standards, Vol 6, No. 4, 1931, p. 603 (*Research Paper RP 295*).