



Standard Test Method for Rubber Property—Macro-Dispersion of Fillers in Compounds¹

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1. Scope

1.1 This test method covers a procedure to measure the macro-dispersion of fillers in a rubber matrix by quantifying the surface roughness of a freshly cut specimen using an optical microscope in reflection mode.

1.2 The method provides a procedure to measure the quality of mixing of reinforcing fillers such as silica and carbon black, as well as inert fillers such as chalk, clay and other solids.

1.3 The method includes a sample preparation procedure for filled uncured rubber compounds as well as filled cured rubber compounds.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D2663 Test Methods for Carbon Black—Dispersion in Rubber

D3053 Terminology Relating to Carbon Black

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *agglomerates, n*—any number of filler aggregates held together by van der Waals Forces (carbon black) or hydrogen bonding (silica).

3.1.2 *macro dispersion, n*—degree of distribution of filler into a compound, generally on a scale of less than 100 μm but greater than 2 μm ; represents micron range agglomeration.

3.1.3 *nodges, n*—bumps in a cut surface caused by filler agglomerates in a rubber matrix.

3.1.4 *surface roughness, n*—the bumps (nodges), or hills and valleys that are on the visible side of a sample.

3.1.5 *white area, n*—the portion of the scan area which contains nodges, or other surface defects; it is described here as white, because the reflected light from these surface defects is white.

4. Summary of Test Method

4.1 This standard uses mathematical algorithms to quantify the surface roughness of freshly cut rubber specimens as measured by a reflected light optical method in two dimensions.

4.2 The reflected light optical method, generally used to determine a comparative dispersion rating, is expanded to give quantitative data as to the size and number of nodges. Nodges do not show the actual size of filler agglomerates. It is assumed that as the sample is cut, large agglomerates are pushed to one side or the other leaving a contoured surface. The diameter and frequency of the surface contours are measured using image processing. These contours are referred to as “nodges” to differentiate them from actual agglomerates. This data is presented in histogram form of count versus nodge diameter, and allows calculating a measure of dispersion.

5. Significance and Use

5.1 The incorporation of fillers into the rubber matrix is characterized by their macrodispersion as an indicator of the quality of mixing. This test method provides a measure of the macro-dispersion of reinforcing fillers, like silica and carbon black, as well as of inert fillers. Based on their polymer nature, different types of rubbers can show a different degree of acceptance for the incorporation of fillers, as indicated by their macro-dispersion.

5.2 Macro-dispersion of carbon black and silica in rubber compounds may be measured by different methods. Carbon black provides a direct physical reinforcement; silica requires

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.