Designation: D8015 – 15

Standard Test Method for Dimensional Changes of Elastomer and Rubber Materials Due to Exposure to Gaseous Hydrocarbon Environments[1]

This standard is issued under the fixed designation D8015; 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. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This standard gives the testing procedure to determine the change in dimensions of specimens of rubber or elastomeric materials, or both, resulting from exposure to gaseous hydrocarbon environments. The size of the specimens is such to facilitate preparation from as molded component configurations such as gaskets and seals. Where agreed to by both parties molded specimens may be used. Dimensional measurements are made prior to and after conditioning in a formulated test gas.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.3 *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]

D1418 Practice for Rubber and Rubber Latices—Nomenclature

D1566 Terminology Relating to Rubber

3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to rubber used in this specification, see Terminology D1566.

3.2 *Definitions*—The nomenclature and abbreviations used for natural and synthetic rubbers are in accordance with Practice D1418.

3.3 *Abbreviations:*

3.3.1 Abbreviations used in the description of natural gas composition:

3.3.2 *mmscf*—million standard cubic foot

3.3.3 *ppm*—parts per million

3.3.4 *ppmv*—parts per million volume

3.3.5 *scf*—standard cubic foot

4. Summary of Test Method

4.1 The dimensions for specimens prepared from elastomer or rubber samples are measured and specimens conditioned in various gaseous environments for a given length of time. At the end of this time the specimens are again measured and the change in dimension recorded.

5. Significance and Use

5.1 The information provided by this test method is useful for manufacturing quality control, technical service, and research purposes; and is required by various material specifications.

5.2 This method is suitable for all elastomer or rubber materials.

6. Apparatus

6.1 A device to measure the required dimensions to an accuracy of 0.0025 mm (0.0001 in.) shall be used. This may include a thermal mechanical analyzer, dilatometer, or constant coordinate measuring machine (CMM).

6.2 A cutting die capable of preparing cube shaped test specimens with edge dimensions of 4.5 ± 0.4 mm (0.177 ± 0.016 in.) shall be used. A typical die and cutting sequence are illustrated in Fig. 1. Where agreed to between parties, specimens may be molded.

6.3 A stainless steel pressure vessel of 415 kPa (60 psi) capability with the basic features as shown in Fig. 2, shall be used.

6.4 A needle valve for metering gas flow at a rate of 1 cc/min or less, shall be used.

7. Reagents and Materials

7.1 A conditioning gas of known formulation shall be used.

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.15 on Degradation Tests.

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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.

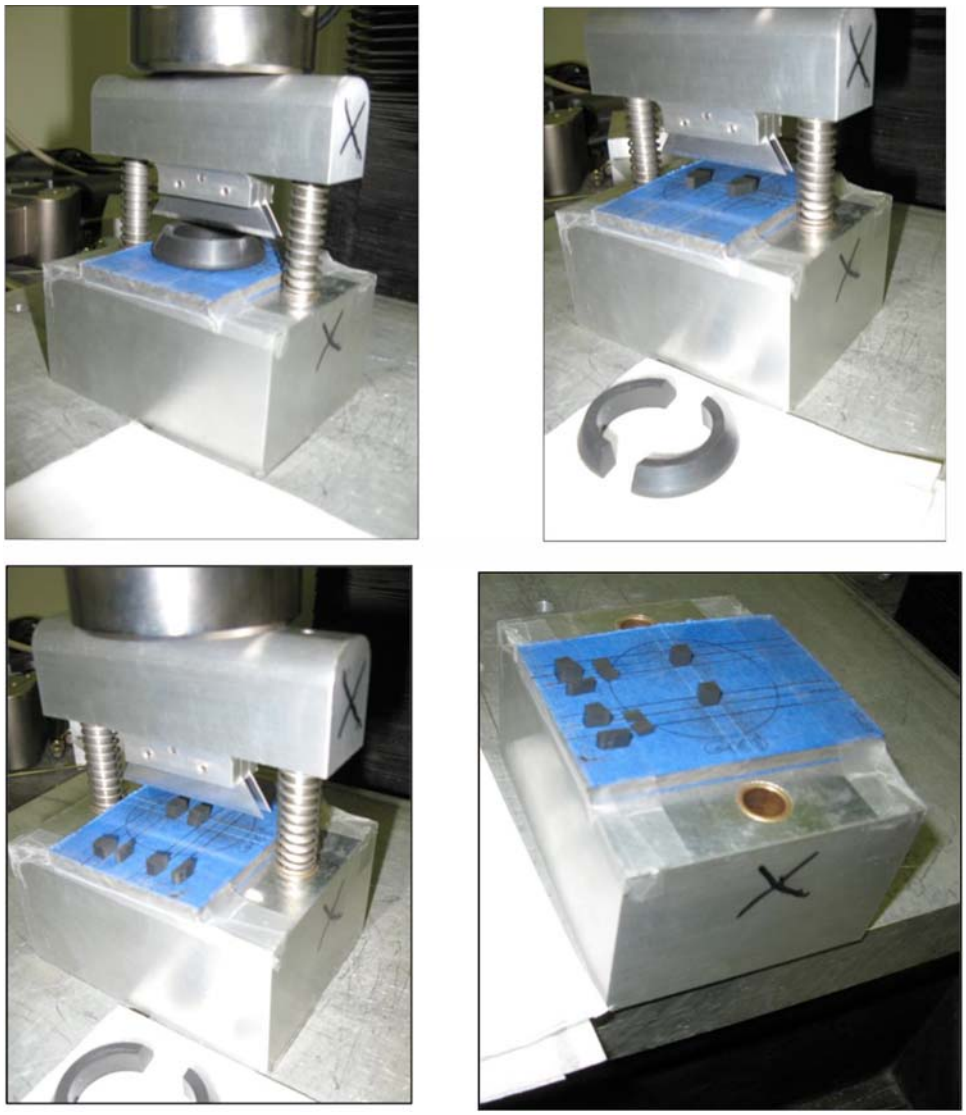

FIG. 1 Typical Die and Cube Cutting Sequence

7.2 The conditioning gas composition shall be as given in Table 1 with non-methane components concentrations at ±2 % of the listed value and methane constituting the balance of the composition. Table 2 lists suggested trace constituents that should be present in the gas. The concentrations listed in Table 2 are recommended levels and should be prepared at ±10 % of the listed value.

8. Hazards

8.1 The user shall insure acceptable documented safety procedures are in place for the handling of all reagents and test materials and for the operation of laboratory equipment specified for this test method.

9. Sampling and Test Specimens

9.1 Prepare the sample for analysis by using the cutting die to cut a specimen into a 4.5 ± 0.4 mm (0.177 ± 0.016-in.) edge dimension cube shape.

10. Preparation of Apparatus

10.1 Verify the equipment can meet all specifications in the standard with respect to gas flows. Condition the apparatus after initial setup, or repairs, by conducting a run through of a complete cycle at pressure and flow rates per 6.3 and 6.4 without samples for 24 ± 1 h.

11. Calibration and Standardization

11.1 Verify the capability of the dimensional reading equipment on a periodic basis using NIST-traceable calibration devices.

12. Procedure

12.1 Conditioning and measurement analysis of samples should be performed on at least six individual specimens.

12.2 Measure and record the exact dimensions of a cut or prepared cube across one pair of sides using the device of choice prior to any gaseous exposure, that is, the original

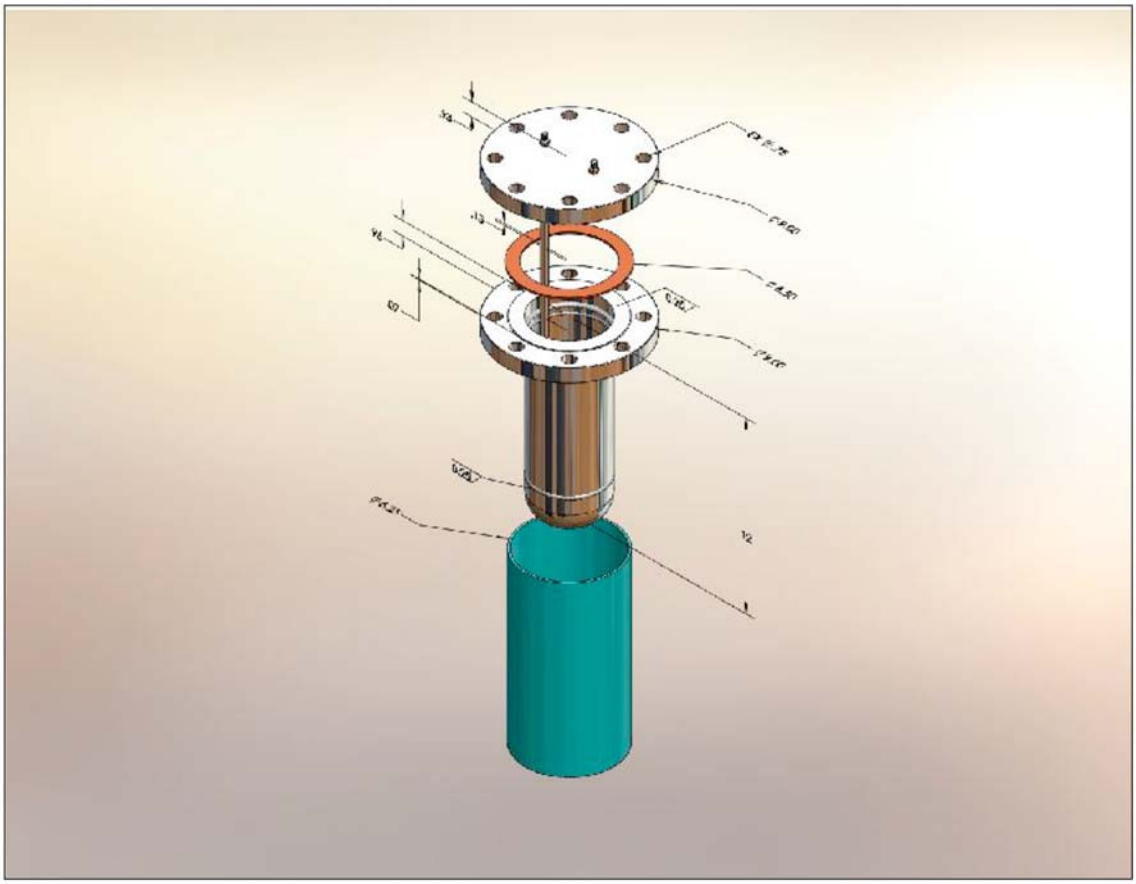

FIG. 2 Pressure Vessel

TABLE 1 Suggested Composition of the Test Gas

Component	Concentration
Methane, %	Balance
Ethane, %	3.1
Propane, %	0.44
i-Butane, %	0.098
n-Butane, %	0.106
i-Pentane, %	0.082
n-Pentane, %	0.002
n-Hexane, %	0.055
n-Heptane, %	0.043
n-Octane, %	0.019
Nitrogen, %	2.0
Oxygen, %	0.1
Carbon Dioxide, %	1.5

TABLE 2 Suggested Trace Constituents in the Test Gas

Component	Concentration
Benzene, ppmv	95.0
Toluene, ppmv	102.5
Ethyl Benzene, ppmv	10.0
Xylenes, ppmv	42.5
Cyclopentane, ppmv	28.5
Methylcyclopentane, ppmv	5.7
Cyclohexane, ppmv	68.4
Dimethylcyclopentanes, ppmv	22.8
Methylcyclohexane, ppmv	55.1
Trimethylcyclopentanes, ppmv	9.5
HHV, MJ/m^3 (BTU/scf)	38.05 (1022)
Specific Gravity, (relative to air)	0.6065
Wobbe Index, MJ/m^3 (BTU/scf)	48.85 (1312)
H2O, ppmv (lbs/mmscf)	153 (7)
Total Mercaptan, ppm (lbs/mmscf)	0.013 (0.8)
H2S, ppmv	1

unexposed condition. Mark the specimen such that the measured sides can be re-measured after test exposure.

12.3 Place each measured specimen in a pressure vessel and condition for 500 ± 5 h at 415 kPag (60 psig) at 20 to 25°C using a slow trickle of conditioning gas through the vessel. Multiple specimens can be placed in the same pressure vessel. Trickle flow is generally defined as 1 cc/min or less and can be approximated using a flow meter in the plumbing flow path or by bubble production as observed when the vessel outlet is immersed in water.

12.3.1 Vent the vessel outlet in a manner consistent with workplace policy. If necessary, plumb the vessel outlet into a granulated carbon filter media maintaining the required trickle flow of the conditioning gas.

12.4 At the end of the conditioning period remove a specimen and measure across the previously measured one pair of sides using the device of choice and record the measurement. Complete the measurements in 3 min or less after removal from the vessel. Repeat for the five remaining specimens.

13. Calculation and Interpretation of Results

13.1 The calculation of the percent expansion of each replicate specimen is performed as follows:

$$Percent\ Expansion,\ PE\% = [(De - Do)/Do] \times 100 \quad (1)$$

where:

De = dimension of cube, measured pair of sides after gas exposure

Do = dimension of cube, measured pair of sides, before gas exposure

13.2 Calculate the arithmetic PE average for all (six) specimens. This six specimen PE average is defined as the 'test result' for the particular rubber (or elastomer) versus conditioning gas.

14. Report

14.1 Report the following information:

14.1.1 Complete identification of material tested, including type, source, manufacturer's code number, form, previous history, etc.

14.1.2 If applicable, the specific location of the specimen in the parent configuration, if significant.

14.1.3 The individual measurements as calculated and described in Section 13, and the test result six specimen PE average.

14.1.4 The date of conditioning and analysis, as well as the formulation of the conditioning gas.

15. Precision and Bias

15.1 The precision of this test method is not known to have been obtained in accordance with currently accepted guidelines. Data are still being collected to obtain reliable repeatability and reproducibility information. As a general rule, the relative percent standard deviation or coefficient of variation for the six specimens should not exceed 5 %.

16. Keywords

16.1 dimensional; elastomer; gas exposure; TMA