



National Bureau of Standards

Certificate

Standard Reference Material 388f Butyl Rubber

Standard Reference Material 388f has the following characteristics when tested by procedures described in the appendix overleaf. The uncertainty limits for the values reflect both variation within the lot of rubber and error of test, and are based on a confidence coefficient of 95 percent. The Mooney viscosity of the rubber is 70.9 ± 1.0 ML 1+8 (100 °C).

Characteristics of Compound	Procedure A	Procedure B (Conventional units) (SI* units)	
Viscometer cure at 150 °C			
Minimum viscosity	36.4 ± 1.0 ML	53.5 ± 0.5 ML	
Incipient cure, t_5	9.36 ± 0.05 min	6.68 ± 0.20 min	400 ± 12 s
Cure index, Δt	2.54 ± 0.03 min	1.86 ± 0.07 min	112 ± 4 s
Stress at 300% elongation			
Cure A	—	790 ± 30 lb/in ²	5.4 ± 0.2 MPa
Cure B	—	1225 ± 30 lb/in ²	8.4 ± 0.2 MPa
Cure C	—	1645 ± 30 lb/in ²	11.3 ± 0.2 MPa
Stress at failure			
Cure A	—	2760 ± 50 lb/in ²	19.0 ± 0.3 MPa
Cure B	—	2690 ± 50 lb/in ²	18.5 ± 0.3 MPa
Cure C	—	2650 ± 50 lb/in ²	18.3 ± 0.3 MPa
Elongation at failure			
Cure A	—	$675 \pm 20\%$	—
Cure B	—	$535 \pm 10\%$	—
Cure C	—	$445 \pm 10\%$	—
Strain at 2 MPa (290 lb/in ²)			
Cure A	—	$159 \pm 5\%$	—
Cure B	—	$113 \pm 2\%$	—
Cure C	—	$93 \pm 2\%$	—
Strain at 0.5 MPa (72.5 lb/in ²)			
Cure A	$223 \pm 7\%$	—	—
Cure B	$145 \pm 3\%$	—	—
Cure C	$141 \pm 2\%$	—	—

*International System of Units (Système International)

This lot of rubber was evaluated in the Performance Criteria Section of the NBS Institute for Applied Technology by G. W. Bullman and A. M. Brown under the supervision of G. E. Decker.

Washington, D.C. 20234
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J. Paul Cali, Chief
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APPENDIX TO CERTIFICATE FOR STANDARD REFERENCE MATERIAL 388f

MATERIAL: Standard Reference Material 388f was selected from a lot of IIR Type 218. Bales of the dried rubber weighing approximately 34 kg were wrapped with polyethylene film, and packaged in cardboard cartons. To evaluate the lot, 1000-gram portions were taken at the start and during the filling of each fifth container.

TESTS: Two determinations of Mooney viscosity were made on each portion according to the procedure described in ASTM Designation D1646-68 using integral dies in the viscometer. The fabric-reinforced rubber grommet in the lower die used for evaluation of lots prior to 388e was replaced by an O-ring described in NBS Report 9948. This change lowers the values for the Mooney viscosity of butyl rubber by about 1.5 units.

Procedure A — Twenty-four compounds were prepared from six portions in accordance with the formulation and mixing procedure described in ASTM D15-71 for Standard Formula 1E in a room conditioned at 23 ± 1 °C and $35 \pm 3\%$ relative humidity.

Procedure B — Sixteen compounds were prepared from four portions in accordance with the formulation and mixing procedure described in ASTM Designation D15-71 for Standard Formula 3E. The oil furnace black (SRM 378a) was dried for one hour at 125 °C before weighing. The mixing was done in a room conditioned at 23 ± 1 °C and $35 \pm 3\%$ relative humidity.

The following NBS Standard Reference Materials were used to prepare the compounds: Zinc Oxide — 370c, Sulfur — 371e, Stearic Acid — 372g, Benzothiazyl disulfide — 373e, Tetramethylthiuramdisulfide — 374b, and Oil Furnace Black — 378a.

The viscometer cure characteristics of each compound were determined at 150 °C according to ASTM Designation D1646-68 selecting the time required to increase the cure index from 5 to 35 points above the minimum. The remaining compound was vulcanized at 150 °C, as described in ASTM Designation D15-71, in a four-cavity mold that was machined directly in the hot plates of the press. The vulcanizing times were as follows:

Procedure A — 15, 30, and 40 minutes for cures A, B, and C, respectively;

Procedure B — 20, 40, and 80 minutes for cures A, B, and C, respectively.

Stress at given elongation, stress at failure, and elongation at failure were measured on vulcanizates prepared by Procedure B in accordance with ASTM Designation D412-68 using Die C. Strain was measured as described in ASTM Designation D1456-61 using a stress of 0.5 MPa for those prepared by Procedure A and 2 MPa for vulcanizates prepared by Procedure B.