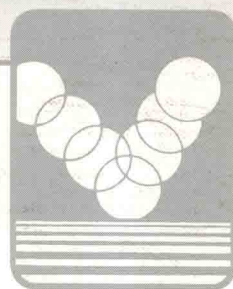


ANNUAL BOOK OF ASTM STANDARDS

2002

SECTION NINE

Rubber



VOLUME 09.01

**Rubber, Natural and Synthetic—
General Test Methods; Carbon Black**

Revision issued annually

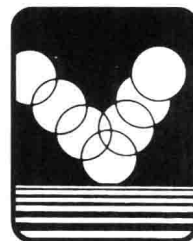


ANNUAL BOOK OF **ASTM** STANDARDS

2002

SECTION 9

Rubber



VOLUME 09.01

Rubber, Natural and Synthetic—General Test Methods; Carbon Black

Includes standards of the following committee(s):

D11 on Rubber

D24 on Carbon Black

ASTM Stock Number: S090102





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Foreword

Organized in 1898, ASTM International has grown into one of the largest voluntary standards development systems in the world. ASTM International is a not-for-profit organization which provides a forum for producers, users, ultimate consumers, and those having a general interest (representatives of government and academia) to meet on common ground and write standards for materials, products, systems, and services.

From the work of 130 standards-writing committees, ASTM International publishes more than 11,000 standards each year. These standards and other related technical information are accepted and used throughout the world.

ASTM International Headquarters has no technical research or testing facilities; such work is done voluntarily by 30,000 technically qualified ASTM members located throughout the world. Membership in the Society is open to all concerned with the fields in which ASTM is active. A membership application may be obtained from Member and Committee Services, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959; tel. 610-832-9694 or from the ASTM website, www.astm.org under Membership.

2002 Annual Book of ASTM Standards

The 2002 *Annual Book of ASTM Standards* consists of 76 volumes, divided among 16 sections, of which this volume is one. It contains approved ASTM standards, provisional standards, and related material. These terms are defined as follows in the *Regulations Governing ASTM Technical Committees*:

Categories:

standard, n—as used in ASTM, a document that has been developed and established within the consensus principles of the Society and that meets the approval requirements of ASTM procedures and regulations.

standard, adj—as used in ASTM, a descriptive used in titles of test methods, specifications, and other documents to indicate consensus approval in accordance with ASTM procedures and regulations.

provisional standard—a document published for a limited period of time by the Society to meet a demand for more rapid issuance of specific documents, such as an emergency situation, regulatory requirements, or other special circumstances.

Discussion—Provisional standards are not full consensus documents because they require subcommittee consensus only. (See *Regulations Governing ASTM Technical Committees*, Section 14.)

Types:

The various types of ASTM documents are to provide a flexibility of form, communication, and usage for both the technical committees and the myriad users of ASTM documents. The type of ASTM document that is developed and titled is based on the technical content and intended use, not on the degree of consensus achieved. The two categories of ASTM documents (standard and provisional standard) can be of the following forms and types:

classification—a systematic arrangement or division of materials, products, systems, or services into groups based on similar characteristics such as origin, composition, properties, or use.

guide—a compendium of information or series of options that does not recommend a specific course of action.

Discussion—A guide increases the awareness of information and approaches in a given subject area.

practice—a definitive set of instructions for performing one or more specific operations or functions that does not produce a test result.

FOREWORD

Discussion—Examples of practices include, but are not limited to: application, assessment, cleaning, collection, decontamination, inspection, installation, preparation, sampling, screening, and training.

specification—an explicit set of requirements to be satisfied by a material, product, system, or service.

Discussion—Examples of specifications include, but are not limited to, requirements for: physical, mechanical, or chemical properties, and safety, quality, or performance criteria. A specification identifies the test methods for determining whether each of the requirements is satisfied.

terminology—a document comprising definitions of terms; explanations of symbols, abbreviations, or acronyms.

test method—a definitive procedure that produces a test result.

Discussion—Examples of test methods include, but are not limited to: identification, measurement, and evaluation of one or more qualities, characteristics, or properties. A precision and bias statement shall be reported at the end of a test method. (See *Form and Style for ASTM Standards*, Section A21, Precision and Bias.)

A new edition of the Book of Standards is published annually because of additions of new standards and significant revisions to existing standards. Approximately 30 % of each volume is new or revised. Each volume contains all actions approved by the Society at least six months before the publication date. New and revised standards approved by the Society between the annual editions of any given volume are made available as separate copies. Users are cautioned to follow the most current issue of a standard except when a specific edition of a standard is cited, for example, as in a contract.

Development and Use of ASTM Standards

ASTM believes that technically competent standards result when a full consensus of all concerned parties is achieved and rigorous due process procedures are followed. This philosophy and standards development system ensure technically competent standards having the highest credibility when critically examined and used as the basis for commercial, legal, or regulatory actions.

ASTM standards are developed voluntarily and used voluntarily. Standards become legally binding only when a government body references them in regulations, or when they are cited in a contract. Any item that is produced and marked as conforming to an ASTM standard must meet all applicable requirements of that standard.

ASTM standards are used by thousands of individuals, companies, and agencies. Purchasers and sellers incorporate standards into contracts; scientists and engineers use them in laboratories; architects and designers use them in plans; government agencies reference them in codes, regulations, and laws; and many others refer to standards for guidance.

Consideration of Comments on ASTM Standards

An ASTM standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of any standard or for the development of new standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428.

Using the Annual Book of ASTM Standards

The standards are assembled in each volume in alphanumeric sequence of their ASTM designation numbers. Volumes 03.06, 04.09, 05.05, 05.06, and 06.03 are assembled first by committee, then in alphanumeric sequence. Each volume has a table of contents, listing the standards in alphanumeric sequence by ASTM designation; and a list by subjects, categorizing the standards according to subject. A subject index of the standards in each volume appears at the back of each volume.

Availability of Individual Standards

Each ASTM standard is available as a separate copy from ASTM International. Standards can be ordered from the ASTM website at www.astm.org, in the store section. Standards can also be ordered from Customer Services

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at 610–832–9585, Monday through Friday, 8:30 AM to 4:30 PM Eastern Standard Time.

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ASTM caveat statements on Safety Hazards and Fire Hazards are required to appear in standards where appropriate. They are located in the scope section of applicable standards. The caveats on General Statement of ASTM Policy and Patents are contained in all standards and located at the end of each standard. For more information on the caveats see Section F2 of the *Form and Style for ASTM Standards*.



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§Approved for use by agencies of the Department of Defense and, if indicated on the standard, replaces corresponding Federal or Military document. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

†Although this standard has been officially withdrawn from Society approval, a brief description is included for information only.

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\$F 147 – 87(1997)	Flexibility of Non-Metallic Gasket Materials
F 1087 – 02	Linear Dimensional Stability of a Gasket Material to Moisture
\$F 152 – 95(2002)	Tension Testing of Nonmetallic Gasket Materials

Practices for:

F 145 – 72(1997)	Evaluating Flat-Faced Gasketed Joint Assemblies
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Specifications for Gasket Materials

Specifications for:

F 1909 – 98	Preformed Open-Cell Sponge Rubber Pail and Drum Gaskets
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Terminology

Terminology for:

F 118 – 97	Gaskets
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RUBBER

Application of Statistical Methods

Practices for:

D 4483 – 99	Determining Precision for Test Method Standards in the Rubber and Carbon Black Industries
D 6600 – 00 ^{ε1}	Evaluating Test Sensitivity for Rubber Test Methods
D 5406 – 93(1998)	Rubber—Calculation of Producer's Process Performance Indexes
D 6085 – 97	Sampling in Rubber Testing—Terminology and Basic Concepts

Belting

Test Methods for:

D 378 – 00	Rubber (Elastomeric) Belting, Flat Type
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Chemical Analysis

Test Methods for:

D 4937 – 96(2001)	<i>p</i> -Phenylenediamine Antidegradants Purity by Gas Chromatography
\$D 4075 – 87(1997)	Compounding Materials—Flame Atomic Absorption Technique—Determination of Metals
D 4936 – 96(2001)	Mercaptobenzothiazole Sulfenamide Assay by Reduction/Titration
D 5666 – 95(2000)	P-Phenylenediamine Antidegradants—Purity by High Performance Liquid Chromatography
D 5461 – 93(1998)	Rubber Additives—Wet Sieve Analysis of Powdered Rubber Chemicals
D 5297 – 95(2000)	Rubber Chemical Accelerator—Purity by High Performance Liquid Chromatography
D 1991 – 96(2001)	Rubber Chemicals—2-Mercaptobenzothiazole (MBT)—Assay
D 5051 – 97	Rubber Chemicals—Benzothiazyl Disulfide (MBTS)—Assay
D 1817 – 01 ^{ε1}	Rubber Chemicals—Density
D 4569 – 89(1998)	Rubber Chemicals—Determination of Acidity in Sulfur
D 4574 – 94(1998)	Rubber Chemicals—Determination of Ash Content
D 4573 – 98	Rubber Chemicals—Determination of Oil Content in Oil-Treated Sulfur
D 4578 – 89(1998)	Rubber Chemicals—Determination of Percent Insoluble Sulfur by Solvent Extraction
D 4571 – 94(1998)	Rubber Chemicals—Determination of Volatile Material
D 5376 – 93(1998)	Rubber Chemicals—Determination of the Percent Nitrogen in Rubber Antioxidant
D 5054 – 90(2000)	Rubber Chemicals—Diphenyl Guanidine (DPG) and Di- <i>o</i> -tolyl-guanidine (DOTG) Assay
D 5044 – 97	Rubber Chemicals—Free 2-Mercaptobenzothiazole (MBT) in Benzothiazyl Disulfide (MBTS)
D 1519 – 95(2000)	Rubber Chemicals—Melting Range
D 1766 – 01	Rubber Chemicals—Solubility
D 5460 – 93(1998)	Rubber Compounding Materials—Water in Rubber Additives
D 4934 – 94(1998) ^{ε1}	Rubber Compounding Materials
D 5774 – 95(2000)	Rubber From Synthetic Sources—Chemical Analysis of Extractables
D 5667 – 95(2000)	Rubber From Synthetic Sources—Total and Water Soluble Ash
D 5668 – 99	Rubber From Synthetic Sources—Volatile Matter
D 4026 – 87(1997)	Rubber Latex—Styrene-Butadiene Copolymer—Determination of Residual Styrene
\$D 297 – 93(1998)	Rubber Products—Chemical Analysis
D 3900 – 95(2000)	Rubber Raw—Determination of Ethylene Units in EPM (Ethylene-Propylene Copolymers) and EPDM (Ethylene-Propylene-Diene Terpolymers)
D 5775 – 95(2000)	Rubber from Synthetic Sources—Bound Styrene in SBR
D 5805 – 00	Rubber from Synthetic Sources—Carbon Black in Masterbatches
D 3314 – 92(1997)	Rubber—Chemical Analysis for Polystyrene Blocks in SBR (Styrene-Butadiene Rubber) and Styrene-Reinforced Latices
D 6370 – 99	Rubber—Compositional Analysis by Thermogravimetry (TGA)

LIST BY SUBJECTS

§D 4004 – 93(1998)	Rubber—Determination of Metal Content by Flame Atomic Absorption (AAS) Analysis
D 5670 – 95(2000) ^{e1}	Rubber—Determination of Residual Unsaturation in Hydrogenated Nitrile Rubber (HNBR) by Infrared Spectrophotometry
D 5902 – 96(2001)	Rubber—Determination of Residual Unsaturation in Hydrogenated Nitrile Rubber (HNBR) by Iodine Value
§D 3677 – 00	Rubber—Identification by Infrared Spectrophotometry
D 3533 – 90(2001)	Rubber—Nitrogen Content
D 6047 – 99 ^{e1}	Rubber, Raw—Determination of 5-Ethylidenenorbornene (ENB) or Dicyclopentadiene (DCPD) in Ethylene-Propylene-Diene (EPDM) Terpolymers
D 3616 – 95(2000)	Rubber, Raw—Determination of Gel, Swelling Index, and Dilute Solution Viscosity
<i>Practices for:</i>	
D 2703	Rubber Chemicals—Determination of Ultraviolet Absorbance Characteristics (Discontinued 2000†)
§D 2702 – 94(1998)	Rubber Chemicals—Determination of Infrared Absorption Characteristics
D 3156 – 96(2001)	Rubber—Chromatographic Analysis of Antidegradants (Antioxidants, Antiozonants and Stabilizers)
D 3566 – 96(2001)	Rubber—Determination of Bromine in the Presence of Chlorine by Oxygen Combustion
§D 3452 – 93(1998)	Rubber—Identification by Pyrolysis-Gas Chromatography
Classification of Rubber Compounds	
<i>Specifications for:</i>	
D 1764 – 97	Rubber Latex Products for Automotive Applications
<i>Classifications:</i>	
§D 2000 – 01	Rubber Products in Automotive Applications
Coated Fabrics and Rubber Thread	
<i>Specifications for:</i>	
D 3393 – 91(2001) ^{e1}	Coated Fabrics—Waterproofness
§D 3738 – 84(2000)	Rubber-Coated Cloth Hospital Sheeting
<i>Test Methods for:</i>	
§D 3389 – 94(1999)	Coated Fabrics Abrasion Resistance (Rotary Platform, Double-Head Abrader)
D 5193 / D 5193M – 93(1998)	Coated Fabrics—Air Retention
§D 751 – 00	Coated Fabrics
D 4005 – 92(2001)	Plastic-Coated Fabrics—Completeness of Fusion of PVC Dispersion Coatings
D 3855 – 84(2000)	Rubber Thread—Deterioration Due to Standard Washing Solution Treatment
D 3854 – 90(2000)	Rubber Thread—Resistance to Dry Heat
D 2433 – 93(1998)	Rubber Thread
D 3959 – 91(2001)	Rubber- and Plastic-Coated Fabrics—Discoloration Sensitivity to Tobacco Smoke
Compounding Materials and Procedures	
<i>Specifications for:</i>	
D 5900 – 98	Physical and Chemical Properties of Industry Reference Materials (IRM)
<i>Classifications:</i>	
D 4924 – 89(1999)	Petroleum Waxes for Use in Rubber Compounding
D 5899 – 98	Rubber Compounding Materials for Use in Computer Material Management Systems
D 4676 – 94(2001)	Rubber Compounding Materials—Antidegradants
D 5377 – 93(1998)	Rubber Compounding Materials—Ground Coal
D 4817 – 88(1999)	Rubber Compounding Materials—Stearic Acid
D 4528 – 88(1998)	Rubber Compounding Materials—Sulfur
D 4677 – 87(1998)	Rubber Compounding Materials—Titanium Dioxide
D 4818 – 89(1999)	Rubber Compounding Materials—Vulcanization Accelerators
D 4295 – 89(1999)	Rubber Compounding Materials—Zinc Oxide
D 2226 – 93(1998)	Various Types of Petroleum Oils for Rubber Compounding Use
<i>Test Methods for:</i>	
D 4620 – 98	Evaluating the Effective Surface Area of Zinc Oxide in Rubber
D 5604 – 96(2001)	Precipitated Silica—Surface Area by Single Point B.E.T. Nitrogen Adsorption
D 6738 – 01	Precipitated Silica—Volatile Content
D 1993 – 91(1997)	Precipitated Silica—Surface Area by Multipoint B.E.T. Nitrogen Adsorption
D 4570 – 86(1998)	Rubber Chemicals—Determination of Particle Size of Sulfur by Sieving (Dry)
D 4572 – 89(1999)	Rubber Chemicals—Wet Sieve Analysis of Sulfur
D 4315 – 94(2001)	Rubber Compounding Material—Zinc Oxide
D 6740 – 01	Silanes Used in Rubber Formulations(bis-(triethoxysilylpropyl)sulfanes)

LIST BY SUBJECTS

D 6741 – 01

D 6739 – 01

Silanes Used in Rubber Formulations(bis-(triethoxysilyl)propyl)sulfanes)

Silica—pH Value

Practices for:

§D 3182 – 89(2001)

Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D 4678 – 94(2001)

Rubber—Preparation, Testing, Acceptance, Documentation, and Use of Reference Materials

Guides for:

D 1992 – 91(2001)

Testing Synthetic Plasticizers Used in Rubber

Consumer Rubber Products

Specifications for:

D 4316 – 95(2001)

Elastomeric Water Bottles

§D 3772 – 01

Natural Rubber Finger Cots

D 6319 – 00a^{ε3}

Nitrile Examination Gloves for Medical Application

D 5250 – 00^{ε4}

Poly(vinyl chloride) Gloves for Medical Application

D 3492 – 97

Rubber Contraceptives (Male Condoms)

D 3899 – 93^{ε2}

Rubber Contraceptives—Vaginal Diaphragms

§D 3578 – 01a^{ε2}

Rubber Examination Gloves

D 4679 – 02

Rubber General Purpose, Household or Beautician Gloves

§D 3579 – 77(1999)^{ε1}

Rubber Surgical Drainage Tubes, Penrose-Type

§D 3577 – 01a^{ε2}

Rubber Surgical Gloves

Test Methods for:

§D 5151 – 99

Detection of Holes in Medical Gloves

D 6355 – 98

Human Repeat Insult Patch Testing of Medical Gloves

D 6324 – 99a

Male Condoms Made from Synthetic Materials

D 6124 – 01

Residual Powder on Medical Gloves

D 6284 – 98

Rubber Property—Effect of Aqueous Solutions with Available Chlorine and Chloramine

D 5712 – 99

The Analysis of Aqueous Extractable Protein in Natural Rubber and Its Products Using the Modified Lowry Method

D 6499 – 00

The Immunological Measurement of Antigenic Protein in Natural Rubber and its Products

Degradation Tests

Test Methods for:

§D 1052 – 85(1999)^{ε1}

Measuring Rubber Deterioration—Cut Growth Using Ross Flexing Apparatus

§D 454 – 99

Rubber Deterioration by Heat and Air Pressure

§D 750 – 00

Rubber Deterioration in Carbon—Arc Weathering Apparatus

§D 813 – 95(2000)

Rubber Deterioration—Crack Growth

§D 430 – 95(2000)

Rubber Deterioration—Dynamic Fatigue

D 3395 – 99

Rubber Deterioration—Dynamic Ozone Cracking in a Chamber

D 1148 – 95(2001)

Rubber Deterioration—Heat and Ultraviolet Light Discoloration of Light-Colored Surfaces

§D 518 – 99

Rubber Deterioration—Surface Cracking

§D 1171 – 99

Rubber Deterioration—Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

§D 1149 – 99

Rubber Deterioration—Surface Ozone Cracking in a Chamber

D 4575 – 99

Rubber Deterioration

§D 1630 – 94(2000)

Rubber Property—Abrasion Resistance (Footwear Abrader)

§D 2228 – 88(2001)

Rubber Property—Abrasion Resistance (Pico Abrader)

D 5963 – 97a(2001)

Rubber Property—Abrasion Resistance (Rotary Drum Abrader)

D 3629 – 99

Rubber Property—Cut Growth Resistance

§D 471 – 98^{ε1}

Rubber Property—Effect of Liquids

D 4482 – 99

Rubber Property—Extension Cycling Fatigue

§D 3137 – 81(2001)

Rubber Property—Hydrolytic Stability

D 925 – 88(2000)

Rubber Property—Staining of Surfaces (Contact, Migration, and Diffusion)

D 623 – 99

Rubber Property—Heat Generation and Flexing Fatigue In Compression

§D 572 – 99

Rubber—Deterioration by Heat and Oxygen

§D 865 – 99

Rubber—Deterioration by Heating in Air (Test Tube Enclosure)

§D 573 – 99

Rubber—Deterioration in an Air Oven

Practices for:

D 5964 – 96(2001)

Rubber IRM 902 and IRM 903 Replacement Oils for ASTM No. 2 and ASTM No. 3 Oils

Natural Rubber

Specifications for:

D 2227 – 96

Natural Rubber (NR) Technical Grades

D 2449 – 88(2001)

Rubber Bales From Natural Sources—Limit on Coating

LIST BY SUBJECTS

D 1076 – 97

Rubber—Concentrated, Ammonia Preserved, Creamed, and Centrifuged Natural Latex

Test Methods for:

D 3194 – 99
D 1278 – 91(1997)^{€1}
D 3157 – 84(2001)
D 1485 – 86(1997)^{€1}
D 3184 – 89(2001)

Rubber From Natural Sources—Plasticity Retention Index (PRI)
Rubber from Natural Sources—Chemical Analysis
Rubber from Natural Sources—Color
Rubber from Natural Sources—Sampling and Sample Preparation
Rubber—Evaluation of NR (Natural Rubber)

Physical Testing

Test Methods for:

§D 575 – 91(2001)
D 1460 – 86(2001)
§D 395 – 01
§D 2240 – 02
§D 1456 – 86(2001)
§D 1415 – 88(1999)
§D 531 – 00
D 814 – 95(2000)
§D 991 – 89(2000)^{€1}
§D 624 – 00^{€1}
§D 412 – 98a

Rubber Properties in Compression
Rubber Property—Change in Length During Liquid Immersion
Rubber Property—Compression Set
Rubber Property—Durometer Hardness
Rubber Property—Elongation at Specific Stress
Rubber Property—International Hardness
Rubber Property—Pusey and Jones Indentation
Rubber Property—Vapor Transmission of Volatile Liquids
Rubber Property—Volume Resistivity Of Electrically Conductive and Antistatic Products
Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
Vulcanized Rubber and Thermoplastic Elastomers—Tension

Practices for:

§D 3767 – 01
§D 3183 – 84(1998)

Rubber—Measurement of Dimensions
Rubber—Preparation of Pieces for Test Purposes from Products

Processability Tests

Test Methods for:

D 6746 – 02
D 2230 – 96^{€1}
D 6049 – 96
§D 926 – 98
D 3346 – 00
§D 1917 – 97
§D 2084 – 01
D 5289 – 95(2001)
D 5099 – 93(1998)
D 6204 – 01
§D 1646 – 00

Raw Rubber or Unvulcanized Compounds—Determination of Tensile Green Strength
Rubber Property—Extrudability of Unvulcanized Compounds
Rubber Property—Measurement of the Viscous and Elastic Behavior of Unvulcanized Raw Rubbers and Rubber Compounds by Compression Between Parallel Plates
Rubber Property—Plasticity and Recovery (Parallel Plate Method)
Rubber Property—Processability of SBR (Styrene-Butadiene Rubber) With the Mooney Viscometer
Rubber Property—Shrinkage of Raw and Compounded Hot-Polymerized Styrene-Butadiene Rubber (SBR)
Rubber Property—Vulcanization Using Oscillating Disk Cure Meter
Rubber Property—Vulcanization Using Rotorless Cure Meters
Rubber—Measurement of Processing Properties Using Capillary Rheometry
Rubber—Measurement of Unvulcanized Rheological Properties Using Rotorless Shear Rheometers
Rubber—Viscosity, Stress Relaxation, and Pre-Vulcanization Characteristics (Mooney Viscometer)

Practices for:

D 6048 – 96

Stress Relaxation Testing of Raw Rubber, Unvulcanized Rubber Compounds, and Thermoplastic Elastomers

Rubber Adhesive Systems

Test Methods for:

§D 816 – 82(2001)
§D 413 – 98
§D 429 – 99

Rubber Cements
Rubber Property—Adhesion to Flexible Substrate
Rubber Property—Adhesion to Rigid Substrates

Rubber Hose

Specifications for:

D 3571

Household Laundry and Dishwasher Water Inlet Hose (Discontinued 2000†)

Test Methods for:

D 3902 – 90(1998)
§D 380 – 94(2000)
§D 622 – 99

Rubber Hose for Gas Diffusion of Liquefied Petroleum Gas
Rubber Hose
Testing Rubber Hose for Automotive Air and Vacuum Brake System

Rubber Recycling