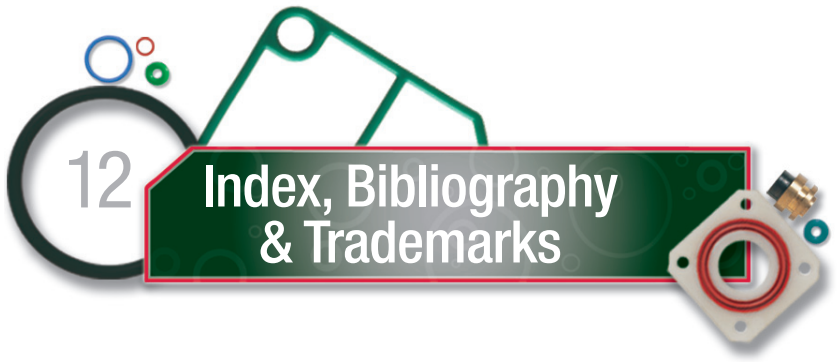

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*Note: The current revision of the Standard is "C" but it changes periodically.

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Bibliography

Books/Reference

1. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103. *Reference*
2. Apple Rubber Products, Inc, *Seal Design Catalog,* 1st Edition. New York 1989
3. Automated Industrial Systems, 4238 West 12th Street, Erie, PA 16505 *Reference*
4. Brink, Robert V. et al, *Handbook of Fluid Sealing,* McGraw-Hill, Inc., New York, 1993
5. Brown, Melvin W., *Seals and Sealing Handbook,* 3rd Edition. Elsevier Science Publishers Limited, England, 1990
6. Callister, William D., *Materials Science and Engineering,* 3rd Edition. John Wiley & Sons, Inc., New York, 1994
7. Dow Corning Corporation, Midland, MI 48460 *Silastic® Silicone Rubber brochure,* 1984
8. DuPont Dow Elastomers, L.L.C., Wilmington, DE 19809 *Reference for Neoprene, Kalrez®, Ethylene Propylene, Teflon®, Vamac®, Viton®*
9. Dyneon, L.L.C., St. Paul, MN 55144 *Reference for AFLAS® and Fluorel®*
10. Fluid Sealing Association, 2017 Walnut Street, Philadelphia, PA 19103. *Reference*
11. General Electric Company, Silicone Products Division, Rubber & Fluid Products Dept., Waterford, NY 12188. *Fluorosilicone brochure S-51*
12. Greene, Tweed & Co., Inc., Fluid Handling Group, Kulpsville, PA 19443, *Chemraz® brochures*
13. Hawley, Gessner G., *The Condensed Chemical Dictionary,* Eighth Edition, Copyright 1971 by Litton Educational Publishing, Inc. Published by Von Nostrand Reinhold Company, 450 West 33rd Street, New York, NY 10001.
14. Japan Synthetic Rubber Co., Ltd., 11-24 Tsukiji 2-chome, Chuo-Ku, Tokyo 104, Japan. *AFLAS® data sheet F-T/G No. 001A.*
15. Mallick, P.K., *Fiber-Reinforced Composites,* 2nd Edition. Marcel Dekker, Inc., New York, 1993
16. Monsanto Chemical Company, 260 Springside Drive, Akron, OH 44313. *Geolast® & Santoprene® brochures,* 1987
17. Morton, Maurice, *Rubber Technology,* 3rd Edition. Van Nostrand Reinhold Company, New York, 1987
18. 3M Industrial Chemical Products Division, Building 223-6S-04, 3M Center, St. Paul, MN 55144. *AFLAS® Technical Information*, 1987
19. Nippon Zeon of America, Inc., 50 Main Street, White Plains, NY 10606. *Zetpol® hydrogenated nitrile rubber brochure BJ-004*
20. Pruett, Kenneth M., *Chemical Resistance Guide for Elastomers II.* Compass Publications, California, 1994
21. Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 *Publication AIR 1707*
22. TSE Industries, Inc., 5260 113th Avenue North, Clearwater, FL 33520. *Millithane HT® brochure*

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