

# American Nuclear Society

specification for radiation shielding materials

an American National Standard

No longer being maintained as an American National Standard. This standard may contain outdated material or may have been superseded by another standard. Please contact the ANS Standards Administrator for details.

**WITHDRAWN**

September 28, 2006  
ANSI/ANS-6.4.2-1985  
(R1997,R2004)



published by the  
American Nuclear Society  
555 North Kensington Avenue  
La Grange Park, Illinois 60526 USA

## **American National Standard**

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

**CAUTION NOTICE:** This American National Standard may be reviewed or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise or withdraw this standard no later than five years from the date of publication. Purchasers of this standard may receive current information, including interpretation, on all standards published by the American Nuclear Society by calling or writing to the Society.

Published by

**American Nuclear Society**  
**555 North Kensington Avenue, La Grange Park, Illinois 60525 USA**

Copyright © 1985 by American Nuclear Society.

Any part of this standard may be quoted. Credit lines should read "Extracted from American National Standard ANSI/ANS-6.4.2-1985 with permission of the publisher, the American Nuclear Society." Reproduction prohibited under copyright convention unless written permission is granted by the American Nuclear Society.

Printed in the United States of America

# Foreword (This Foreword is not a part of American National Standard Specification for Radiation Shielding Materials, ANSI/ANS-6.4.2-1985.)

The need for this standard was identified in mid-1977 by the Working Group ANS-6.4. At that time, it was recognized that an increasing number of different material/design shielding concepts were being introduced into nuclear power plants to solve neutron and gamma-ray streaming problems. For protection against neutron streaming, materials varying from water-filled rubber bags, rubber balls, special concretes, treated plastics and silicone gels were proposed, while lead-filled silicone rubber and gels were proposed for gamma-ray streaming. With such a variety of materials, some only a year or two after initial commercial introduction, a clear need was discerned to standardize the specification of these materials to assist the material manufacturer in the type of information he needs to provide to the user.

The focus of the working group's initial work was to orient the standard toward the reporting requirements used by material suppliers rather than toward the preparation of specifications by designers and end users. This focus has been maintained through the development of this standard as that representing the true needs of nuclear power plants in this area.

Working Group 6.4.2 of the American Nuclear Society Standards Committee had the following membership:

|                                                                |                                                   |
|----------------------------------------------------------------|---------------------------------------------------|
| E. Normand, Chairman, <i>Boeing Aerospace Company</i>          | B. A. Engholm, <i>GA Technologies</i>             |
| J. S. Brtis, <i>Sargent &amp; Lundy</i>                        | J.L. Kamphouse, <i>Gilbert/Commonwealth, Inc.</i> |
| W. L. Bunch, <i>Hanford Engineering Development Laboratory</i> | N. B. Willoughby, <i>Consultant</i>               |

At the time of approval of the standard, Subcommittee ANS-6, Radiation Protection and Shielding, of the American Nuclear Society Standards Committee had the following membership:

|                                                                  |                                                       |
|------------------------------------------------------------------|-------------------------------------------------------|
| D.K. Trubey, Chairman, <i>Oak Ridge National Laboratory</i>      | D. R. Harris, <i>Rensselaer Polytechnic Institute</i> |
| E. T. Boulette, <i>Maine Yankee Atomic Power Company</i>         | W. C. Hopkins, <i>Bechtel Corporation</i>             |
| J. C. Celnik, <i>Stone &amp; Webster Engineering Corporation</i> | E. Normand, <i>Boeing Aerospace Company</i>           |
|                                                                  | P. J. Persiani, <i>Argonne National Laboratory</i>    |
|                                                                  | D. J. Schuh, II, <i>GEB Controls Group, Inc.</i>      |

The American National Standards Committee N17, Research Reactors, Reactor Physics, and Radiation Shielding, had the following membership at the time it reviewed and approved this standard:

R. S. Carter, Chairman  
T. M. Raby, Secretary

| <i>Organization Represented</i>                                 | <i>Name of Representative</i> |
|-----------------------------------------------------------------|-------------------------------|
| American College of Radiology .....                             | M. M. Ter Pogossian           |
| American Institute of Chemical Engineers .....                  | D. Duffey                     |
| American Nuclear Society .....                                  | R. S. Carter                  |
| American Physical Society .....                                 | W. W. Havens                  |
|                                                                 | H. Goldstein (Alt.)           |
| American Public Health Associations .....                       | W. A. Holt (Alt.)             |
| Health Physics Society .....                                    | J. D. Buchanan                |
| National Bureau of Standards .....                              | T. M. Raby                    |
| National Council on Radiation Protection and Measurements ..... | A. B. Chilton                 |
| U.S. Department of Energy .....                                 | P. B. Hemmig                  |
|                                                                 | J.W. Lewellen (Alt.)          |
| U.S. Nuclear Regulatory Commission .....                        | R. E. Carter                  |
| Individual Members .....                                        | J.E. Olhoeft                  |
|                                                                 | E. A. Warman                  |
|                                                                 | W. L. Whittemore              |

# Contents

| Section                                                                                                                                 | Page |
|-----------------------------------------------------------------------------------------------------------------------------------------|------|
| 1. Scope .....                                                                                                                          | 1    |
| 2. Conformance .....                                                                                                                    | 1    |
| 3. Terms and Definitions .....                                                                                                          | 1    |
| 4. Introduction and General Description .....                                                                                           | 1    |
| 4.1 Introduction .....                                                                                                                  | 1    |
| 4.2 General Description .....                                                                                                           | 2    |
| 5. Nuclear Properties of Materials .....                                                                                                | 2    |
| 5.1 Introduction .....                                                                                                                  | 2    |
| 5.2 Elemental Composition .....                                                                                                         | 2    |
| 5.3 Nuclear Data .....                                                                                                                  | 3    |
| 6. Physical Properties of Material .....                                                                                                | 4    |
| 6.1 General Physical Properties .....                                                                                                   | 4    |
| 6.2 Radiation Stability .....                                                                                                           | 5    |
| 6.3 Strength of Materials .....                                                                                                         | 5    |
| 6.4 Chemical Stability .....                                                                                                            | 6    |
| 6.5 Physical Stability .....                                                                                                            | 6    |
| 6.6 Health Hazards .....                                                                                                                | 7    |
| 6.7 Fabrication .....                                                                                                                   | 7    |
| 7. Documentation .....                                                                                                                  | 8    |
| 8. References .....                                                                                                                     | 8    |
| Appendix Guidance for the Evaluation of Trace Elements<br>in Shielding Materials .....                                                  | 10   |
| Table A.1 Illustrative Tabulation of Trace Elements and Their Activation<br>Products that May Be Associated with Shield Materials ..... | 11   |