

American Nuclear Society

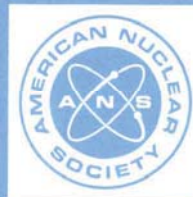
WITHDRAWN

**April 18, 1998
ANSI/ANS-8.1-1983**

**ended programming practices to facilitate
portability of scientific and engineering
computer programs**

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outdated material or may have
been superseded by another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.**



published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60525 USA

ANSI/ANS-10.2-1988
Revision of
ANSI/ANS-10.2-1982

American National Standard
Recommended Programming Practices to Facilitate the
Portability of Scientific and Engineering Computer Programs

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-10.2

Published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60525 USA

Approved April 18, 1988
by the
American National Standards Institute, Inc.

American National Standard

Designation of this document as an American National Standard attests that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standard has been achieved.

This standard was developed under the procedures of the Standards Committee of the American Nuclear Society; these procedures are accredited by the American National Standards Institute, Inc., as meeting the criteria for American National Standards. The consensus committee that approved the standard was balanced to assure that competent, concerned, and varied interests have had an opportunity to participate.

An American National Standard is intended to aid industry, consumers, governmental agencies, and general interest groups. Its use is entirely voluntary. The existence of an American National Standard, in and of itself, does not preclude anyone from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard.

By publication of this standard, the American Nuclear Society does not insure anyone utilizing the standard against liability allegedly arising from or after its use. The content of this standard reflects acceptable practice at the time of its approval and publication. Changes, if any, occurring through developments in the state of the art, may be considered at the time that the standard is subjected to periodic review. It may be reaffirmed, revised, or withdrawn at any time in accordance with established procedures. Users of this standard are cautioned to determine the validity of copies in their possession and to establish that they are of the latest issue.

The American Nuclear Society accepts no responsibility for interpretations of this standard made by any individual or by any ad hoc group of individuals. Requests for interpretation should be sent to the Standards Department at Society Headquarters. Action will be taken to provide appropriate response in accordance with established procedures that ensure consensus on the interpretation.

Comments on this standard are encouraged and should be sent to Society Headquarters.

Published by

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

Copyright © 1988 by American Nuclear Society.

Any part of this standard may be quoted. Credit lines should read "Extracted from American National Standard ANSI/ANS-10.2-1988 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 for Recommended Programming Practices to Facilitate the Portability of Scientific and Engineering Computer Programs, ANSI/ANS-10.2-1988.)

This standard is a major revision of American National Standard for Recommended Programming Practices to Facilitate the Portability of Digital Computer Programs, ANSI/ANS-10.2-1982. Both documents were prepared by Subcommittee ANS-10, Mathematics and Computation, of the Standards Committee of the American Nuclear Society (ANS). This subcommittee is sponsored by the Mathematics and Computation Division of the Society. Since its inception the Mathematics and Computation Division has encouraged and promoted the interchange of digital computer programs (codes) within the nuclear industry. The practices recommended herein are based on experience in working with programs for scientific and engineering calculations in this industry and, in general, apply to mainframe, micro, and mini computer software.

To obtain feedback from users and developers of computer programs on the importance and the desired content of a programming practices standard, a questionnaire was published in 1978 in an ANS Mathematics and Computation Division Newsletter. In addition, it was also distributed by the National Energy Software Center (previously called the Argonne Code Center) and by the Radiation Shielding Information Center (RSIC). Over 300 responses were received from engineers, scientists, programmers, systems analysts and managers. A cross-section was obtained from government, industry, and academia—both foreign and domestic. The majority of respondents expressed support for such a standard.

As a guideline, this standard recommends programming practices to facilitate the portability of computer programs prepared for scientific and engineering computation on micro, mini, and mainframe computers. It is one of four documents directed toward individuals who develop computer programs. The other three are:

ANSI/ANS-10.3-1986, Guidelines for the Documentation of Digital Computer Programs,

ANSI/ANS-10.4-1987, Guidelines for the Verification and Validation of Scientific Computer Programs for the Nuclear Industry, and

ANSI/ANS-10.5-1986, Guidelines for Considering User Needs in Computer Program Development.

The definition of "guidelines," as used here, is taken from American National Standard Quality Assurance Terms and Definitions, ANSI/ASME N45.2.10-1973:*

"Particular provisions which are considered good practice but which are not mandatory in programs intended to comply with this standard. The term 'should' denotes a guideline; the term 'shall' denotes a mandatory requirement."

This standard is directed at the computer-independent aspects of digital computer programs. That is, the program developer is asked to accept the fact that many of the difficulties associated with the "portability of computer programs" can be avoided. Unnecessary expense, waste of effort, and loss of computing capability have occurred because the practices recommended have not been assigned sufficient importance. This is true not only in program conversion between installations but also in program

*Now incorporated into American National Standard Quality Assurance Program Requirements for Nuclear Facilities, ANSI/ASME NQA-1-1986.

modification and conversion within the originating installation. Some of the recommendations herein cover elementary practices normally followed, yet often overlooked. They can be put into practice with only a reasonable amount of additional effort over that normally expended in developing major computer programs.

These recommendations may have to be supplemented to cover local requirements for program development to accommodate the computing environment and application considerations.

In addition, the rapid advance in computing technology has caused significant impact on the choice of computers and the programming environment for scientific and engineering applications. The availability of supercomputers, the growth of minicomputers, and the widespread acceptance of personal (micro) computers all have increased the use of computer terminals and time sharing. In reviewing the technology and observing application needs, it was found that guidelines for good scientific/engineering programming have merit independent of the computer environment. The foundation for practices that facilitate use apply equally to a program designed for interactive application as well as to a program intended for batch processing. Also, support for the concept of structured programming is growing. This standard is not intended to address structured programming techniques per se; however, acceptance of structured programming ideas is a step in the direction of further improving the portability of computer programs.

The American National Standard Programming Language FORTRAN, ANSI X3.9-1978, is currently recognized as the de facto standard for much scientific and engineering computation. Thus, many of the practices recommended herein are directed at FORTRAN programming. Several "higher level" programming languages, in addition to FORTRAN, are in use, such as Algol, Pascal, PL/I, C, and Ada. Many of the recommended guidelines can be applied to these languages. Therefore, the development of and experimentation with more advanced higher level languages is encouraged. This document will be modified to acknowledge new de facto standards as they evolve. The need for compatibility within the advancing technology is recognized, and effort toward satisfying this need is encouraged.

Working Group ANS-10.2 had the following membership at the time of its preparation of this standard:

Sally Hartzell, Chairman, *Power Computing Company*
N. Hassan, *Power Computing Company*
L. I. Kopp, *U.S. Nuclear Regulatory Commission*
S. Nathan, *NUS Corporation*
J. E. Olhoeft, *Westinghouse Electric Corporation*

O. Ozer, *Electric Power Research Institute*
G. R. Poetschat, *GRP Consulting, Inc.*
A. Smetana, *E. I. duPont de Nemours & Company,*
Savannah River Laboratory
J. White, *Oak Ridge National Laboratory, Martin*
Marietta Energy Systems, Inc.

Also contributing:

N. Marshall, *EG&G Idaho, Inc.*

The members of Subcommittee ANS-10, Mathematics and Computation, at the time this standard was approved, were:

L. I. Kopp, Chairman, <i>U.S. Nuclear Regulatory Commission</i>	N. H. Marshall, <i>EG&G Idaho, Inc.</i>
M. K. Butler, <i>Argonne National Laboratory</i>	S. J. Nathan, <i>NUS Corporation</i>
L. E. Dodd, <i>Battelle Pacific Northwest Laboratories</i>	J. E. Olhoeft, <i>Westinghouse Electric Corporation</i>
Sally Hartzell, <i>Power Computing Company</i>	O. Ozer, <i>Electric Power Research Institute</i>
N. Hassan, <i>Power Computing Company</i>	G. R. Poetschat, <i>GRP Consulting, Inc.</i>
Geraldine C. Main, <i>BCS-Richland, Inc.</i>	A. O. Smetana, <i>E. I. duPont de Nemours & Company, Savannah River Laboratory</i>
G. W. Main, <i>JMJ Associates</i>	J. White, <i>Oak Ridge National Laboratory, Martin Marietta Energy Systems, Inc.</i>

Consensus 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

S. H. Brown	Health Physics Society
A. D. Callihan (Subcommittee ANS-1)	Individual
R. E. Carter	U.S. Nuclear Regulatory Commission
R. S. Carter	American Nuclear Society
A. De La Paz (Subcommittee ANS-14)	Department of U.S. Army
D. Duffey	American Institute of Chemical Engineers
H. Goldstein	American Physical Society
P. B. Hemming	U.S. Department of Energy
J. W. Lewellen (Alt.)	
W. A. Holt	American Public Health Association
L. I. Kopp (Subcommittee ANS-10)	U.S. Nuclear Regulatory Commission
J. E. Olhoeft	Individual
T. M. Raby	National Bureau of Standards
W. J. Richards (Subcommittee ANS-15)	Argonne National Laboratory
M. M. Ter Pogossian	American College of Radiology
D. K. Trubey (Subcommittee ANS-6)	Oak Ridge National Laboratory
A. Weitzberg (Subcommittee ANS-19)	NUS Corporation
W. L. Whittemore	Individual

Contents	Section	Page
	1. Scope and Objectives	1
	1.1 Scope	1
	1.2 Objectives	1
	2. Definitions	1
	3. Introduction	1
	4. Recommendations	2
	4.1 Program Organization	2
	4.2 Programming Language	2
	4.3 Data Handling	2
	4.4 Program Features	2
	4.5 Source Statements and Variables	3
	4.6 Hardware and Software Dependencies	3
	4.7 Good Programming Practices	4
	5. References	4

Recommended Programming Practices to Facilitate the Portability of Scientific and Engineering Computer Programs

1. Scope and Objectives

1.1 Scope. This standard recommends programming practices to facilitate the portability of computer programs prepared for scientific and engineering computation on micro, mini, and main-frame computers.

1.2 Objectives. The objective of this standard is to recommend programming practices which will simplify the implementation, conversion, and modification of computer programs on various hardware/software configurations.

2. Definitions

The following definitions are applicable specifically to this standard.

conversion. Modification of existing software to enable it to operate with similar functional capability in a different hardware/software environment.

guidelines. Particular provisions which are considered good practice but which are not mandatory in programs intended to comply with this standard. The term "should" denotes a guideline; the term "shall" denotes a mandatory requirement. This definition is taken from American National Standard Quality Assurance Program Requirements for Nuclear Facilities, ANSI/ASME NQA-1-1986 [1].¹

implementation. The installation and demonstration of operability of a computer program on a given hardware/software configuration.

localization. The isolation of related tasks, which perform a well defined function, within a single subprogram.

modification. Any change to software.

portability. The ability of a computer program to be transferred from one hardware/software configuration and implemented on another with little or no modification, such that the capability of the program is not altered during the transfer.

3. Introduction

This standard recommends guidelines to help the programmer create a program that is easily portable. These guidelines also provide good programming practices which are useful even when writing programs that are not expected to be transmitted out of the author's development environment unit. Such practices can reduce the effort required for the inevitable, and not infrequent, change to a different computer system or transfer of personnel responsibilities within the same organization. For related guidelines on documentation and user needs, refer to the following American National Standards:

Guidelines for the Documentation of Digital Computer Programs, ANSI/ANS-10.3-1986 [2].

Guidelines for the Verification and Validation of Scientific Computer Programs for the Nuclear Industry, ANSI/ANS-10.4-1987 [3].

Guidelines for Considering User Needs in Computer Program Development, ANSI/ANS-10.5-1986 [4].

The techniques used to achieve ease of use or the most efficient and economical execution of the program in a given computer system can restrict program portability. The merging of these somewhat opposing goals may require a compromise for the individual's situation.

Few organizations can afford to originate and develop all of their needed computer programs. From an economic standpoint, most organizations

¹Numbers in brackets refer to corresponding numbers in Section 5, References.