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An American National Standard

Standard Guide for Documenting Computer Software for Fire Models[1]

This standard is issued under the fixed designation E 1472; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—The "no quantitative measurements" statement in 1.4 was added in October 2004.

1. Scope

1.1 This guide provides information that should be in documentation for computer software prepared for scientific and engineering computations in fire models and other areas of fire protection engineering.

1.2 The guidelines are presented in terms of three types of documentation: *(1)* technical document; *(2)* user's manual; and *(3)* installation, maintenance, and programming manual.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 This fire standard cannot be used to provide quantitative measures.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

E 176 Terminology Relating to Fire Standards

E 1355 Guide for Evaluating the Predictive Capability of Deterministic Fire Models

E 1591 Guide for Obtaining Data for Deterministic Fire Models

E 1895 Guide for Determining Uses and Limitations of Deterministic Fire Models

2.2 *ANS Standards:*

ANSI/ANS 10.2 Portability of Scientific and Engineering Software[3]

ANSI/ANS 10.3 Documentation of Computer Software[3]

ANSI/ANS 10.5 Accomodating User Needs in Computer Program Development[3]

2.3 *INCITS Standards:*

ANSI/INCITS X3.172 American National Standard Dictionary for Information Systems[4]

ANSI/INCITS X3.88 Computer Program Abstracts[4]

2.4 *IEEE Standards:*

ANSI/IEEE 610.12 Glossary of Software Engineering Terminology[5]

ANSI/IEEE 1063 Software User Documentation[5]

3. Terminology

3.1 Definitions—Definitions used in this guide are in accordance with Terminology E 176, unless otherwise indicated. ANSI/INCITS X3.172 and ANSI/IEEE 610.12 include definitions of some technical terms used in this guide.

4. Significance and Use

4.1 This guide provides recommendations for writers of user's manuals and other documents for computer software prepared for scientific and engineering computations in fire models and other areas of fire protection engineering. The guide provides information that can be included in terms of three types of documents.

4.2 This guide is intended to assist in the understanding, usage, transfer, conversion, and modification of computer software. If the options and instructions contained in this guide are considered when documentation is prepared, the software should be used more readily for its intended purposes.

4.3 The use of fire models currently extends beyond the fire research laboratory and into the engineering, fire service, and legal communities. Sufficient documentation of computer software for fire models is necessary to ensure that users can judge the adequacy of the scientific and technical basis for the

[1] This guide is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.33 on Fire Safety Engineering.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, IL 60526.

[4] Available from InterNational Committee for Information Technology Standards, c/o Information Technology Industry Council, 1250 Eye Street NW, Suite 200, Washington D.C. 20005.

[5] Available from Institute of Electrical and Electronics Engineers Standards Association, P.O. Box 1331, 445 Hoes Lane, Piscataway, NJ 08855–1331.

models, select the appropriate computer operating environment, and use the software effectively within the specified limitations. Adequate documentation will help prevent the unintentional misuse of fire models.

4.4 Additional guidelines on documentation can be found in ANSI/ANS 10.3 and ANSI/IEEE 1063.

4.5 ANSI/ANS 10.2 and 10.5 provide guidelines for programming to ease the portability of the software and meet user needs.

5. Types of Documents

5.1 *General:*

5.1.1 There are many levels of desirable documentation, ranging from that needed by the user who wants only to run the programs, to documentation needed by the user who intends to make extensive modifications or additions to the programs.

5.1.2 This guide provides suggestions for items to include in three types of documents: *(1)* technical document; *(2)* user's manual; and *(3)* installation, maintenance, and programming manual. The items suggested for these manuals can be combined into a single document.

5.1.3 The documents should be written and organized to reflect the expected sophistication of the user.

5.2 *Technical Document*—This type of document is intended for use by the individual interested in an in-depth explanation of the scientific basis for the model. Articles in scientific or engineering journals are examples of this type of document.

5.3 *User's Manual*—This self-contained manual is directed to the prospective user of the fire model. With this type of manual, the user of the model should be able to understand the model application and methodology, reproduce the computer operating environment and the results of sample problems included in the manual, modify data inputs, and run the program for specified ranges of parameters and extreme cases. The manual should be concise enough to serve as a reference document for the preparation of input data and the interpretation of results.

5.4 *Installation, Maintenance, and Programming Manual*—This type manual is for the individual responsible for implementing the program on a computer, modifying or extending it to meet local needs, converting it to a different computer environment, or revising it to reflect technological progress. This type of manual is recommended if the source code is to be made available.

6. Items Common to All Documents

6.1 *Program Identification:*

6.1.1 Provide the name of the program or model, a descriptive title, and any information necessary to define the version uniquely.

6.1.2 Identify any acronyms or short titles for name of the model.

6.1.3 Note any legal restrictions on use and reproduction.

6.1.4 Describe any relationships to other models.

6.2 *Changes in the Program:*

6.2.1 Provide the name, full identification, and version of the program to be changed.

6.2.2 Identify the equivalent version of the program, with the changes made.

6.2.3 Identify the section(s) changed, and provide the reason(s) for the changes.

6.3 *Authors and Responsibility for Assistance:*

6.3.1 Provide instructions for obtaining more detailed information, or include the position, title, name, telephone number, and mailing address of the individual responsible for providing assistance.

6.3.2 Describe the history of the model's development and the names and addresses of the individual(s) and organization(s) responsible.

6.3.3 Identify current location(s) of the model.

6.4 *Available Material*—List the contents and costs of any program package and the procedure for obtaining this material.

6.5 *Computer Software Abstract*—Summarize the capabilities of the program and the minimum hardware requirements for implementation. ANSI/INCITS X3.88 provides additional guidelines on the contents of computer program abstracts.

7. Contents of the Technical Document

7.1 *Problem or Function:*

7.1.1 Define the fire problem modeled or function performed by the program, for example, calculation of fire growth, smoke spread, people movement, etc.

7.1.2 Describe the total fire problem environment. General block or flow diagrams may be included here.

7.1.3 Include any desirable background information, such as feasibility studies or justification statements.

7.2 *Technical Description:*

7.2.1 Convey a thorough understanding of the theoretical and mathematical foundations, referencing the open literature where appropriate.

7.2.2 *Theoretical Foundation:*

7.2.2.1 Describe the theoretical basis of the phenomenon and the physical laws on which the model is based.

7.2.2.2 Present the governing equations and the mathematical model employed.

7.2.2.3 Identify the major assumptions on which the fire model is based and any simplifying assumptions.

7.2.2.4 Provide results of any independent review of the theoretical basis of the model. Guide E 1355 recommends a review by one or more recognized experts fully conversant with the chemistry and physics of fire phenomena but not involved with the production of the model.

7.2.3 *Mathematical Foundation:*

7.2.3.1 Describe the mathematical techniques, procedures, and computational algorithms employed to obtain numerical solutions.

7.2.3.2 Provide references to the algorithms and numerical techniques.

7.2.3.3 Present the mathematical equations in conventional terminology and show how they are implemented in the code.

7.2.3.4 Discuss the precision of the results obtained by important algorithms and any known dependence on the particular computer facility.

7.2.3.5 For iterative solutions, discuss the use and interpretation of convergence tests, and recommend a range of values for convergence criteria. For probabilistic solutions, discuss the precision of the results having a statistical variance.

7.2.3.6 Identify the limitations of the model based on the algorithms and numerical techniques.

7.3 *Program Description:*

7.3.1 Describe the program.

7.3.2 List any auxiliary programs or external data files required for utilization of this program.

7.4 *Data Libraries*—Provide background information on the source, contents, and use of data libraries.

7.5 *Evaluation of Predictive Capability*—Provide the results of efforts to evaluate the predictive capabilities of the model for a specific use, employing the methodologies outlines in the Guide E 1355. Include the scenarios used in the evaluation and any known limitations for the use of the evaluation for other fire scenarios.

7.6 *Sensitivity*—Provide the results of any sensitivity analysis of the model (see Guide E 1355).

8. Contents of the User's Manual

8.1 *Technical Document*—Include or summarize the technical document (Section 7).

8.2 *Program Description:*

8.2.1 Include a comprehensive self-contained description of the program.

8.2.2 Define the basic processing tasks performed, and describe the methods and procedures employed. A schematic display of the flow of the calculations is useful.

8.2.3 On-line information (prompts and helps, etc.) can supplement a printed user manual.

8.3 *Operating and Installation Information:*

8.3.1 Provide instructions for installing the program in the target system. If appropriate, include examples of typical dialogue with the system and test data.

8.3.2 Identify the computer(s) on which the program has been executed successfully and any required peripherals, including memory requirements and tapes.

8.3.3 Identify the programming languages and versions in use.

8.3.4 Identify the software operating system and versions in use, including library routines.

8.4 *Program Considerations:*

8.4.1 Describe the function of each major option available for solving various problems, pay special attention to the effects of combinations of options.

8.4.2 Describe alternate paths that may be dynamically selected by the program from tests on calculated results.

8.4.3 Describe the relationship between input and output items for programs that reformat information.

8.4.4 Describe the method and technical basis for decisions in programs that perform logical operations.

8.4.5 Describe the basis for the operations that occur in the program.

8.5 *Input Data:*

8.5.1 *General Considerations:*

8.5.1.1 Describe the source of input information, for example, handbooks, journals, research reports, standard tests, experiments, etc.

8.5.1.2 Describe special input techniques and requirements, for example, format, blank field treatment, order of items, and field delineation.

8.5.1.3 Describe the handling of consecutive cases. Give the conditions of data retention or reinitialization for the next case.

8.5.1.4 Provide the default values or the general conventions governing those values.

8.5.1.5 Identify the limits on input based on stability, accuracy, and practicality, as well as their resulting limitations to output.

8.5.1.6 When property values are defined within the program, list the properties and the assigned values.

8.5.1.7 Identify the procedures that should be used or were used to obtain property and other input data. Guide E 1591 provides a compilation of material properties and other data that are needed as input for mathematical fire models. For every input variable, Guide E 1591 includes a detailed description and information on how it can be obtained. The emphasis of Guide E 1591 is on zone models of compartment fires.

8.5.1.8 Provide information on the dominant variables in the models.

8.5.2 *Specific Considerations for Each Input Variable:*

8.5.2.1 Provide the name of the variable.

8.5.2.2 Give a description or definition.

8.5.2.3 Give the dimensional units.

8.5.2.4 Give the default value, if appropriate.

8.5.2.5 Give the source, if not widely available.

8.6 *External Data Files:*

8.6.1 Outline the general contents and organization of each external data file.

8.6.2 Relate the usage of data files to the execution of the program.

8.6.3 Reference available auxiliary programs that create, modify, or edit these files.

8.7 *System Control Requirements:*

8.7.1 Describe the procedure required to set up and run the computer program.

8.7.1.1 List the operating system control commands required to execute the program.

8.7.1.2 Include a complete set of the program's prompts, with the ranges of appropriate responses.

8.7.2 Describe how the inputs interact with data files.

8.7.3 Describe how to interrupt the program.

8.7.3.1 For each stage in the program (input, execution, and output), describe how to perform the following functions:

(1) Temporarily halt the program, then resume; and

(2) Halt and exit from the program.

8.7.3.2 Describe the status of files and data after the interruption.

8.8 *Output Information:*

8.8.1 Describe the program output.

8.8.2 Relate the edited output to input options.

8.8.3 Relate the output to appropriate equations.

8.8.4 Describe any normalization of results and list associated dimensional units.