



Standard Guide for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings—Durability¹

This standard is issued under the fixed designation E2136; 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.

INTRODUCTION

This standard guide is part of a set which together presents a complete performance standard guide for specifying and evaluating single family attached and detached dwellings. The complete set in the series, when finished, is to include the attributes given in Fig. 1.

The series provides a framework for specifying and evaluating qualities of building products and systems to meet user needs without limiting ways and means. The format for this standard guide includes performance statements that consist of four components, Objectives-Criteria-Evaluation-Commentary (O-C-E-C), which together provide a systematic performance based approach for the intended purpose. These performance statements are presented in Section 8 against a Hierarchy of Building Elements as tabulated in Fig. 2.

The purpose of these standard guides is to provide a standardized methodology for describing performance parameters of single-family attached or detached dwellings. This methodology standardizes the descriptions of performance of a single-family dwelling, attached or detached, that can be expressed as performance statements (O-C-E-C) for a particular attribute, degradation factor, and user need.

These standard guides are intended for use by those who need to prescribe required levels of performance and those who need to rate a product which forms a single-family dwelling or part thereof. The standard guides include examples of performance statements that may be used for the specification and evaluation of design, materials, products, components, subsystems, and systems.

1. Scope

1.1 This guide gives examples of performance statements for durable in-place materials, products, components, subsystems, and systems for single family attached and detached dwellings, considering the effects of normal degradation factors to which they are anticipated to be subjected over their service lives. Table 1 provides a listing of the sections of this Guide that address durability including the performance statements.

1.2 Damage from extreme acts of nature, vandalism, or intentional destructive acts by dwelling inhabitants are not considered as normal degradation factors affecting durability in this guide.

¹ This guide is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.25 on Whole Buildings and Facilities.

Current edition approved Oct. 1, 2004. Published October 2004. Originally approved in 2001. Last previous edition approved in 2001 as E2136 – 01. DOI: 10.1520/E2136-04.

NOTE 1—Performance statements regarding the performance of single family attached and detached dwellings under extreme acts of nature are addressed in the Guide on Structural Safety and Serviceability.

1.3 This document also addresses site planning in so far as it affects the durability of single family attached and detached dwellings.

1.4 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information.

1.5 This guide is not intended to be used as a prescriptive regulatory document.

2. Referenced Documents

2.1 *ASTM Standards*:²

B117 Practice for Operating Salt Spray (Fog) Apparatus
C1036 Specification for Flat Glass

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.

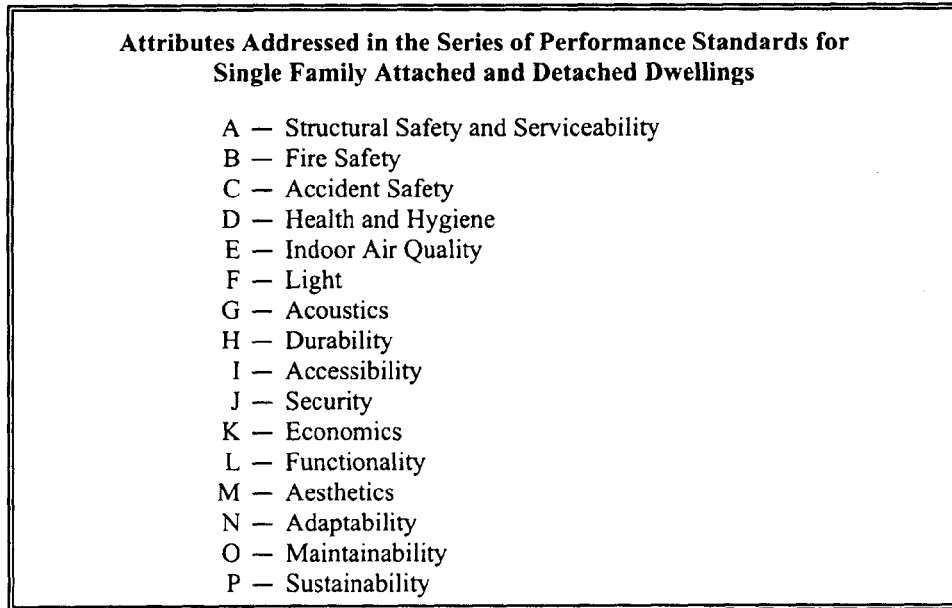


FIG. 1 Attributes Addressed in the Series of Performance Standards

- C1048 Specification for Heat-Strengthened and Fully Tempered Flat Glass
- C1172 Specification for Laminated Architectural Flat Glass
- C1349 Specification for Architectural Flat Glass Clad Polycarbonate
- D225 Specification for Asphalt Shingles (Organic Felt) Surfaced With Mineral Granules
- D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
- D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D2486 Test Methods for Scrub Resistance of Wall Paints
- D3363 Test Method for Film Hardness by Pencil Test
- D3462 Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules
- D3746 Test Method for Impact Resistance of Bituminous Roofing Systems
- D4226 Test Methods for Impact Resistance of Rigid Poly(vinyl Chloride) (PVC) Building Products
- D4449 Test Method for Visual Evaluation of Gloss Differences Between Surfaces of Similar Appearance
- D4812 Test Method for Unnotched Cantilever Beam Impact Resistance of Plastics
- D5178 Test Method for Mar Resistance of Organic Coatings
- D5420 Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
- D6110 Test Method for Determining the Charpy Impact Resistance of Notched Specimens of Plastics
- E631 Terminology of Building Constructions
- E632 Practice for Developing Accelerated Tests to Aid Prediction of the Service Life of Building Components and Materials
- E695 Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
- E773 Test Method for Accelerated Weathering of Sealed Insulating Glass Units (Withdrawn 2010)³
- E774 Specification for the Classification of the Durability of Sealed Insulating Glass Units (Withdrawn 2006)³
- E822 Practice for Determining Resistance of Solar Collector Covers to Hail by Impact With Propelled Ice Balls
- E917 Practice for Measuring Life-Cycle Costs of Buildings and Building Systems
- E997 Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Destructive Methods
- E998 Test Method for Structural Performance of Glass in Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Nondestructive Method
- E1017 Specification for Generic Performance Requirements for Exterior Residential Window Assemblies (Withdrawn 2003)³
- E1233 Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential
- E1825 Guide for Evaluation of Exterior Building Wall Materials, Products, and Systems
- E2025 Test Method for Evaluating Fenestration Components and Assemblies for Resistance to Impact Energies

³The last approved version of this historical standard is referenced on www.astm.org.

Hierarchy of Building Elements Included in the Series of Performance Standards for Single Family Attached and Detached Dwellings

- 0. Whole Building System**
 - 0.1 All Building Subsystems
 - 0.2 Groups of Building Subsystems
- 1. Spaces**
 - 1.1 Entries
 - 1.2 Living Spaces
 - 1.3 Dining Spaces
 - 1.4 Kitchens
 - 1.5 Sleeping Spaces
 - 1.6 Bathrooms
 - 1.7 Water Closets
 - 1.8 Outdoor Living Spaces
 - 1.9 Storage Spaces
 - 1.10 Other
- 2. Structure**
 - 2.1 Foundation
 - 2.2 Superstructure
- 3. Exterior Enclosure**
 - 3.1 Grade Enclosure
 - 3.1.1 Floor on Grade
 - 3.1.2 Floor over Air Space
 - 3.1.3 Other
 - 3.2 Vertical and Sloped Enclosure
 - 3.2.1 Walls
 - 3.2.2 Windows
 - 3.2.3 Doors
 - 3.2.4 Other (e.g., railings, louvers, screens, etc.)
 - 3.3 Roofs
 - 3.3.1 Roof Coverings
 - 3.3.2 Skylights
 - 3.3.3 Other Roof Openings
 - 3.4 Joint Sealants
- 4. Interior Space Division**
 - 4.1 Vertical Space Dividers
 - 4.1.1 Partitions
 - 4.1.2 Doors
 - 4.1.3 Other
 - 4.2 Horizontal Space Dividers
 - 4.2.1 Floors
 - 4.2.2 Ceilings
 - 4.2.3 Floor/Ceiling Openings
 - 4.2.4 Other
 - 4.3 Stairs and Ramps
- 5. Plumbing**
 - 5.1 Plumbing Fixtures
 - 5.2 Domestic Water Distribution
 - 5.3 Sanitary Waste
 - 5.4 Rain Water Drainage
- 6. HVAC**
 - 6.1 Heating
 - 6.1.1 Heating Generation
 - 6.1.2 Heating Distribution
 - 6.1.3 Heating Terminal and Package Units
 - 6.1.4 Heating Controls and Instrumentation
 - 6.2 Cooling

FIG. 2 Hierarchy of Building Elements Included in the Series of Performance Standards

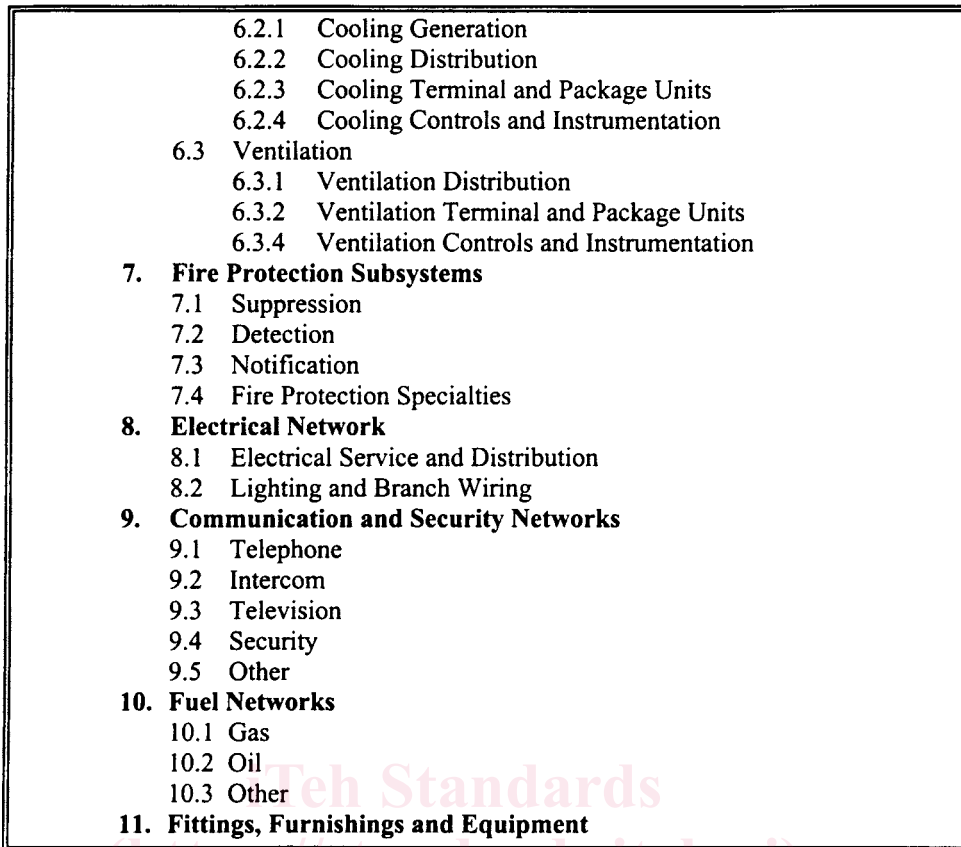


FIG. 2 Hierarchy of Building Elements Included in the Series of Performance Standards (continued)

Document Preview

E2151 Terminology of Guides for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings

F925 Test Method for Resistance to Chemicals of Resilient Flooring

F1265 Test Method for Resistance to Impact for Resilient Floor Tile

G116 Practice for Conducting Wire-on-Bolt Test for Atmospheric Galvanic Corrosion

G149 Practice for Conducting the Washer Test for Atmospheric Galvanic Corrosion (Withdrawn 2004)³

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

G153 Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

G154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

2.2 American Architectural Manufacturers Association and Window and Door Manufacturers Association:⁴

ANSI/AAMA/NWDA 101/I.S. 2-97 Voluntary Specifications for Aluminum, Vinyl (PVC) And Wood Windows and Glass Doors

AAMA/WDMA 1600/I.S. 7-2000 Voluntary Specifications for Skylights

AAMA 910-93 Voluntary “Life Cycle” Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors

AAMA 2603.8 Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum

AAMA 2604.2 Voluntary Specification for Residential Color Anodic Finishes

AAMA 2605.2 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusion and Panels

⁴ Available from American Architectural Manufacturers Association (AAMA), 1827 Walden Office Square, Suite 550, Schaumburg, Illinois 60173-4268.

TABLE 1 Sections of this Practice Addressing Durability

Section Title	Section
Parameters Affecting Durability Degradation Factors and Service Life	5 5.1
Site Considerations Affecting Durability Site Design Site Investigation Report	6 6.1 6.2
Special Evaluation Methods Used in Durability	7
Performance Statements (O-C-E-C)	8
Example of Minimum Service Lives for Typical Building Elements	X1
Examples of Special Evaluation Methods Used in Durability EM-1: General Evaluation Method for Durability of Materials and Elements EM-2: Evaluation Method for Determination of Resistance to Light Exposure EM-3: Determination of Resistance to Point Impact EM-4: Determination of Wash and Scrub Resistance EM-5: Determination of Scratch Resistance Rating with Pencil Hardness Test	X2 X2.1 X2.2 X2.3 X2.4 X2.5
Examples of Durability Performance Statements Whole Building Spaces Structure Exterior Enclosure Interior Space Division Plumbing HVAC Fire Protection Subsystems Electrical Network Communication and Security Networks Fuel Networks Fittings, Furnishings, and Equipment	X3 X3.1 X3.2 X3.3 X3.4 X3.5 X3.6 X3.7 X3.8 X3.9 X3.10 X3.11 X3.12

[AAMA 2606.1](#) Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum

[AAMA 2607.1](#) Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

[AAMA 2608.1](#) Voluntary Guide Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum

[AAMA 2611](#) Voluntary Standards for Anodized Architectural Aluminum

2.3 *American Concrete Institute*:⁵

[ACI 318](#) Building Code Requirements for Reinforced Concrete, Part 3

[ACI 530/ASCE 5/TMS 402](#) Building Code Requirements for Masonry Structures

2.4 *American Forest & Paper Association*:⁶

[AF&PA Technical Report No. 7](#) The Permanent Wood Foundation System

2.5 *Asphalt Roofing Manufacturers Association (ARMA)*:⁷
[Residential Asphalt Roofing Manual](#)

2.6 *Factory Mutual Research Corporation (FMRC)*:⁸
[FMRC 4450](#) Approval Standard for Class 1 Insulated Steel Deck Roofs

[FMRC 4470](#) Approval Standard for Class 1 Roof Covers

⁶ Available from American Forest and Paper Association (AF&PA), 1111 19th St., NW, Suite 800, Washington, DC 20036.

⁷ Available from Asphalt Roofing Manufacturers Association (ARMA), Public Information Department 1156 - 15th Street, NW., Suite 900 Washington, DC 20005.

⁸ Available from Factory Mutual Research Corporation (FMRC), 1151 Boston-Providence Turnpike. PO Box 9102. Norwood, Massachusetts 02062.

⁵ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333.

2.7 *International Council Code*:⁹

International Residential Code for One- and Two-Family Dwellings

2.8 *Underwriters Laboratories (UL)*:¹⁰

UL 2218 Impact Resistance Testing of Prepared Roof Covering Material

3. Terminology

3.1 *Definitions*—For definitions of terms used in this Standard Guide refer to Terminology **E631**.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *commentary*—the fourth part of a performance statement, consisting of an informative narrative explaining aspects of the performance statement.

Discussion—A commentary may include one or more of the following: an explanation of how the objective relates to user needs in fields such as physiology, psychology, and culture or tradition; an explanation of how the criteria are established including guides for setting different levels of performance to meet various user needs; a discussion of the reliability of the evaluation method; and example solutions that are deemed to comply with the performance statement.

3.2.2 *criteria*—the second part of a performance statement, consisting of quantitative statements defining the level or range of performance necessary to meet an objective or, where such a level or range cannot be established, the units of measurement of the performance.

3.2.3 *detached dwelling*—a dwelling unit standing by itself.

3.2.4 *durability*—the capability of a building, assembly, component, product, or construction to maintain serviceability over at least a specified time.

3.2.5 *evaluation*—the third part of a performance statement, consisting of the method(s) of assessing conformance of the element being addressed to the criteria.

Discussion—The evaluation states the standards, inspection methods, review procedures, historical documentation, test methods, in-use performance, engineering analyses, models, or other means to be used in assessing whether or not a criterion has been satisfied.

3.2.6 *serviceability*—the capability of a building, assembly, component, product, or construction to perform the function(s) for which it is designed and used.

3.2.7 *service life (of a building component or material)*—the period of time after installation during which all properties meet or exceed the minimum acceptable values when routinely maintained.

3.2.8 *specifier*—the individual or organization using the standard guides to create specifications and ultimately accept dwelling designs, materials, products, components, subsystems, or buildings to be provided by providers.

3.2.9 *user need*—a statement of the activities and behavior to be carried out in relation to the dwelling by its residents, or

other users, defined in terms of motor, kinetic, physiological, psychological, emotional, and other parameters of human behavior.

4. Significance and Use

4.1 This standard guide and the use of consensus performance standards for housing can significantly contribute to the removal of barriers to the acceptance of housing innovation in the global marketplace. This standard guide in conjunction with the balance of the set of standard guides, when complete, can also serve to improve communications between producers and consumers leading to enhanced quality and performance of housing.

4.2 This standard guide is not intended for use in specifying and evaluating residential construction other than single family attached and detached dwellings. Nevertheless, some performance statements may have application to assessing the durability of building materials, components, and systems used in other constructions.

4.3 Although this standard guide addresses site planning as it affects the durability of single family attached and detached dwellings, the site-planning issues considered are not to be construed as a comprehensive site specification.

4.4 This standard guide can be useful to managers of housing procurement projects, home builders, designers, product manufacturers, and evaluation services in addressing durability issues related to single family attached and detached dwellings. Such applications can require that the performance statement examples be written in mandatory language.

4.5 The performance statement examples given in this standard guide are intended to complement the durability requirements implied in prescriptive provisions of codes such as the International Residential Code for One- and Two-Family Dwellings (IRC).

4.6 *Limitations on Performance Prediction*:

4.6.1 The traditional approach to evaluating the durability in building materials, components, and systems has been related to specific materials, and their reaction over time to specific degradation factors. This is useful for establishing standards for the quality control and use of specific materials. However, it is not much help in making comparisons across a variety of traditional materials intended for the same use, in evaluating systems comprised of a number of specific materials (for example, walls), or in developing performance specifications and performance standards needed for innovative materials. Little research has considered the generic analysis of degradation factors acting upon building elements in residential application. Moreover, insufficient work has been done in the development of accelerated weathering tests in which the degradation processes simulate those occurring in practice. Also, much more material science studies of degradation mechanisms and rates are needed to form a strong foundation for performance prediction of building materials. For these reasons, the performance statements in this guide are examples and initial steps of an evolving process in developing performance standards for single family attached and detached dwellings. It is anticipated that, as this guide is applied to

⁹ Available from International Code Council (ICC), 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041.

¹⁰ Available from Underwriters Laboratories (UL), Corporate Progress, 333 Pfingsten Rd., Northbrook, IL 60062.

housing procurement projects and as more research into the subject of durability is carried out, the performance statement examples in this guide will change. Both providers and specifiers should consider the basis for modifications as performance statements are established.

4.6.2 General conformance to this guide is intended to provide reasonable assurance that the in-place materials, built elements, and service subsystems of attached and detached dwellings will be serviceable through their service lives. Conformance to the performance statement examples in Ap-

pendix X3 does not assure that the service-lives will be met. Many of the listed tests are empirical in nature, and often do not reflect the variety of exposure conditions to which a material may be subjected in different geographic locations. However, the tests can be useful in illustrating comparisons of the performance of competing materials and systems. Paragraph X2.1.2.3 suggests that Practice E632 be followed in developing service-life prediction data when little performance history is available for a material or system.

iTeh Standards (<https://standards.iteh.ai>) Document Preview

[ASTM E2136-04](#)

<https://standards.iteh.ai/catalog/standards/sist/43dea069-934b-4ebf-9a78-ba6d363057b9/astm-e2136-04>

Table 2. Matrix of Typical Building Elements and Potential Degradation Factors

	User Factors	Operation/use	Point impact	Chemicals/Stains	Washing and Scrubbing	Abrasions	Thermal shock	Hot water exposure	Weather Factors	Sunlight	Wind	Moisture including rain	Sand storms	Hail impact	Temperature maximum	Temperature minimum	Thermal shock	Water freeze-thaw	Earth Factors	Moisture	Water	Chemicals	Vermis including termites	Bacteria and fungus	Frost (heaving)	Other Factors	Differential expansion	Corrosion	Chemical incompatibility	Physical incompatibility	Electrical current	Internal water/air pressure								
1. SPACES																																								
Entries																																								
Living spaces																																								
Dining spaces																																								
Kitchens																																								
Sleeping spaces																																								
Bathrooms																																								
Water closet																																								
Outdoor living spaces																																								
Storage spaces																																								
Other																																								
2. STRUCTURE																																								
Foundation																																								
Superstructure																																								
3. EXTERIOR ENCLOSURE																																								
Grade Enclosure																																								
Floor on grade																																								
Floor over air space																																								
Other																																								
Vertical and Sloped Enclosure																																								
Walls																																								
Windows																																								
Doors																																								
Other																																								
Roofs																																								
Roof coverings																																								
Skylights																																								
Other roof openings																																								
Joint Sealants																																								
4. INTERIOR SPACE DIVISION																																								
Vertical Space Dividers																																								
Partitions																																								
Doors																																								
Other																																								
Horizontal Space Dividers																																								
Floors																																								
Ceilings																																								
Floor/ceiling openings																																								
Other																																								
Stairs and Ramps																																								
5. PLUMBING																																								
Plumbing Fixtures																																								
Domestic Water Distribution																																								
Sanitary Waste																																								
Rain Water Drainage																																								
6. HVAC																																								
Heating																																								
Cooling																																								
Ventilation																																								
7. FIRE PROTECTION SUBSYSTEMS																																								

8. ELECTRICAL NETWORK												
Electrical Service and Distribution												
Lighting and Branch Wiring												
9. COMMUNICATION AND SECURITY NETWORKS												
Telephone												
Intercom												
Television												
Security												
Other												
10. FUEL NETWORKS												
11. FITTINGS, FURNISHINGS, AND EQUIPMENT												
o indicates that the illustrative performance statement includes general criteria and evaluation methods.												
● indicates that the illustrative performance statement includes specific criteria and evaluation methods.												

iTeh Standards
<https://standards.iteh.ai>
 Document Preview

ASTM E2136-04

<https://standards.sist/43dea069-934b-4ebf-9a78-ba6d363057b9/astm-e2136-04>

5. Parameters Affecting Durability

5.1 *Degradation Factors and Service Life:*

5.1.1 *Interaction of Degradation Factors and Building Elements.* **Table 1** is a matrix displaying the interaction of degradation factors affecting service life of building elements. The table is not all inclusive; the specifier can add other degradation factors (for example, specific pollutants) as warranted. Also, the specifier can delete degradation factors that are not applicable (for example, sandstorms, hail, and corrosion) in developing specific performance statements. In **Table 1**, every intercept with a “dot” has one or more examples of performance statements associated with it. An unfilled dot (designated by “o” in **Table 1**) indicates an example of a performance statement having general criteria and evaluation methods (EM-1 in **Appendix X2**) in terms of resistance to degradation factors over the service life. A filled dot (designated by “.” in **Table 1**) indicates a performance statement example having specific criteria and evaluation methods.

5.1.2 *Environmental Factors.* Durability requirements specify the resistance of building elements to the effects of a variety of user factors and environmental factors (that is, weather and earth factors) to which they may be subjected over their service-life. The environmental factors may vary as a function of geographic location and, in some cases, this variation may occur at the micro scale. For example, the effects of airborne salts and other chemicals on a dwelling depends on its location in relation to roads, airports, industrial sources of air pollution and local wind patterns. If such specific information on weather factors is available for a specific dwelling project, the specifier should make it available to providers.

5.2 *Anticipated Minimum Service Life:*

5.2.1 Specifiers of durability need, by definition, to consider the minimum acceptable, anticipated service lives of the products, components, assemblies, and subsystems for which performance specifications are developed. Information on the anticipated service life of the specific materials, products, components, assemblies, and subsystems proposed by providers in response to performance specifications is also needed. **Table** is provided to assist specifiers in the consideration of minimum acceptable, anticipated service lives necessary for the development of performance specifications of durability. **Table** includes a list of typical building elements that are organized by subsystems 2 through 11 of the Hierarchy of Building Elements presented in Figure 2. Specifiers should add to or select from this list of building elements depending on the scope of the performance specification they are developing, and then complete **Table** with the minimum anticipated service lives that they will accept. These minimum anticipated service lives may be based on the specifiers’ knowledge and needs for the housing, user expectations, and life-cycle cost analysis, where the relationship between first cost and cost of renewal provides the basis for establishment of minimum service life. Practice **E917** provides a protocol for measuring life-cycle costs of buildings and building systems.

5.2.2 Examples of anticipated minimum service lives for various building elements are given in **Appendix X1**. These examples are based on professional judgment of user expecta-

tions for minimal acceptable conventional construction in the U.S., which may be permanent or temporary, with normal maintenance activities. Note in **Table X1.1** that a range of service lives is given for each building element. The ranges reflect experience that the service life of a given building element varies depending upon a number of factors including the type of material from which the product is manufactured, the manufacturing process, the service environment, and maintenance conducted over the service life.

6. Site Considerations Affecting Durability

6.1 *Site Design:*

6.1.1 There are many conditions specific to a building site that can have a significant effect on the durability of building materials, products, components, assemblies, and subsystems. This section addresses information that should be considered to protect a dwelling from surface and subsurface environmental degradation factors that can adversely affect the durability of the building materials, products, components, assemblies, and subsystems.

6.1.2 The specifier should provide information in the form of site design and site-building interface design of sufficient detail for providers to design the protection of the buildings against surface and subsurface environmental degradation factors such as water, chemicals and salts, and temperatures from the ground.

6.1.3 Alternatively the specifier may choose to make housing providers responsible for the design of site and building methods to protect buildings against water, chemicals and salts, and temperature from the ground. If so, each provider should determine, in the site design, the methods used on the site for protection. Additionally, each provider should determine, in the building design interfaces, the methods to be used in the buildings to protect them against surface and subsurface environmental degradation factors such as water, chemicals and salts, and temperature from the ground. In such cases, the specifier should provide site planning performance criteria.

6.2 *Site Investigation Report:*

6.2.1 A site investigation report for the protection of buildings against surface and subsurface environmental degradation factors such as water, chemicals and salts, and temperature from the ground should be prepared by the specifier or provider. The following information is generally included:

6.2.1.1 Maximum flood levels with a specified year recurrence interval.

6.2.1.2 Maximum precipitation with a specified year recurrence interval.

6.2.1.3 Maximum depth below grade of frost penetration with a specified year recurrence interval.

6.2.2 For the protection of buildings against water, chemicals and salts, and temperature the report generally correlates the site information of **6.2.1** in the following three areas of site and building design:

6.2.2.1 Site.

6.2.2.2 Site-building interface.

6.2.2.3 Building systems.

Table 3. Anticipated Minimum Service Life of Typical Building Elements		Required Minimum Service Life years
Building Element		
STRUCTURE		
Foundation	Single-family housing	
Superstructure	Single-family housing	
EXTERIOR ENCLOSURE		
Grade Enclosure	Floor on grade	
Vertical and Sloped Enclosure	Walls	
	Wall finish — easily renewable	
	Wall finish — difficult to renew	
	Doors	
	Windows	
Roofs	Door and window finish — easily renewable	
	Roof Covering	
	Skylights	
Joint Sealants		
INTERIOR SPACE DIVISION		
Vertical Space Dividers	Partitions	
	Partition surface finishes — easily renewable	
	Partition surface finishes — difficult to renew	
	Doors	
	Doors — easily renewable door paint	
Horizontal Space Dividers	Floor surfaces — bath and w.c.	
	Floor surfaces — other	
	Ceiling surfaces — private spaces; easily renewable	
Stairs and Ramps	Ceiling surfaces — private spaces; difficult to renew	
	Stair surfaces — private spaces	
PLUMBING		
Piping	Accessible	
	Inaccessible	
Fixtures		
Fixture Trim		
Hot Water Heater		
HVAC		
Fuel pump		
Pipes	Accessible	
	Inaccessible	
Radiators		
Fan Coil Units		
Pumps		
Boilers		
Mechanical Refrigeration	Machines	
Evaporative Coolers		
Furnaces		
Duct Work	Accessible	
	Inaccessible	
Louvers		
Thermostats		
Exhaust Fans		
FIRE PROTECTION SUBSYSTEMS		
ELECTRICAL NETWORK		
Conductors	Accessible	
	Inaccessible	
Conduit		
Exposed Raceways		
Switches		
Sockets		
Overcurrent Protection	Circuit breaker	
Panels		
Switch Board		
Light Fixtures		
COMMUNICATION AND SECURITY NETWORKS		
Television Antenna		
FUEL NETWORKS		
Fuel Storage	Above ground	
	Below ground	
Fuel Supply Piping	Accessible	
	Inaccessible	
FITTINGS, FURNISHINGS AND EQUIPMENT		
Furnishings	Built-in furnishings	
	Built-in furnishing surfaces — easily renewable	

6.2.3 The presentation of information in both graphic and written form should be based on the proposed site design topography and elevations (provided by the specifier or the provider) and the proposed design locations, positions, configurations, and elevations of buildings near, at and below ground.

6.2.4 Site designs for the protection of buildings against surface and subsurface environmental degradation factors can be used to determine the performance required at the site-building interface. The site investigation report should show the effect of specific site design considerations that can have a significant effect on the durability of building materials and systems. The site investigation report should address the anticipated flood level, precipitation level, water table and frost penetration level adjacent to buildings. The site design might include:

6.2.4.1 The reduction by diversion, ponding or other means of surface water runoff entering ground adjacent to buildings.

6.2.4.2 The reduction of subsurface water entering ground adjacent to buildings by the provision of subsurface drainage, either by pumping or by gravity, at site structures, at paved areas and at other site areas where the ground is or may be water-logged.

6.2.5 Site-building interface designs for the protection of buildings against surface and subsurface environmental degradation factors can be used to determine the performance required of the building and building systems. The designs may show the effect of anticipated flood level, precipitation level, water table level and frost penetration level at buildings. The site design might include:

6.2.5.1 The reduction by diversion or other means of surface water run-off entering ground at and around the envelope or the foundation of buildings.

6.2.5.2 The reduction of subsurface water entering ground around the envelope or the foundation of buildings by the provision of subsurface drainage, either by pumping or gravity, at the envelope or the foundation, or by other approved means.

6.2.5.3 The reduction of subsurface water entering ground under the floors or the foundation of buildings by the provision of subsurface drainage, either by pumping or gravity, or other approved means, at floors and foundations.

6.3 Building designs for the protection of buildings against surface and subsurface environmental degradation factors such as water, chemicals and salts, and temperatures should clearly show the methods used to provide adequate protection from environmental conditions that can have a significant effect on the durability of building materials, products, components, assemblies, and subsystems.

7. Special Evaluation Methods Used in Durability

7.1 Conformance of building materials, products, components, assemblies, and subsystems to many of the durability criteria examples provided in this standard guide may be determined by common evaluation methods. Examples of such evaluation methods (designated EM-1 through EM-5) that may be used to evaluate durability are given in [Appendix X2](#). These evaluation methods are based on considerations of the most common types of user and environmental degradation

factors to be encountered in practice. These five special evaluation methods are cited in some of the performance statement examples given in [Appendix X3](#). In some cases, the examples of special evaluation methods are simplified versions of published standard test methods. A reason for not specifying the standard test methods is that they were generally developed for specific materials and, consequently, their direct application to the variety of materials and products covered by this guide is precluded. Additionally, the scope of these standard methods may limit their use to laboratory testing. In contrast, this guide allows several evaluation methods to be performed in both the laboratory and field, enabling the specifier, if warranted, to require field testing for durability in providers' test plans. The specifier is cautioned to check the appropriateness of evaluation methods before adding them to specifications.

8. Performance Statements (O-C-E-C)

8.1 Examples of performance statements for building materials, products, components, assemblies, and subsystems are given in [Appendix X3](#) in O-C-E-C format. The objectives are based on considerations of normally encountered user, weather, earth, and other degradation factors ([Table 1](#)) which may reduce service life. In many evaluation methods, it is necessary to use test conditions more severe than those normally encountered by the product or system in practice to obtain useful results in a reasonable period of time. The performance statement examples in [Appendix X3](#) provide examples to specifiers and providers in the development of performance specifications for the durability of building materials, products, components, assemblies, and subsystems for single-family attached and detached dwellings.

8.2 While the resistance of particular degradation factor for a specified service life is a valid performance criterion, it is often difficult to evaluate when the factors affecting performance are complex and interactive, or when accelerated test methods have not been developed. Where examples of criteria and test methods are given in [Appendix X3](#), professional judgment has been used in determining that the particular criteria and test methods adequately simulate the anticipated degradation factors and their effects over the specified service life. Providers may suggest modifications to the criteria and test methods, especially if they can give adequate historic documentation that the anticipated degradation factors can be resisted for the service life, or that different criteria and test methods provide a better simulation of these degradation factors and their effects over the service life.

8.3 *The Hierarchy of Building Elements:*

8.3.1 The example performance statements given in [Appendix X3](#) are presented against the Hierarchy of Building Elements tabulated in Figure 2. The order of presentation begins with "0. Whole Building System" followed in order by each of the 11 subsystems. Within each subsystem, the example performance statements follow in order down to the lowest levels of the hierarchy as needed. For example, the performance statements for subsystem "3. Exterior Enclosure" are followed by "3.1 Grade Enclosure", followed by "3.1.1 Floor on Grade" and lower if necessary, then followed by