INTERNATIONAL STANDARD

ISO 15928-3

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Houses — Description of performance —

Part 3: Structural durability

Constructions d'habitation — Description des performances —

Partie 3: Durabilité de la structure

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 15, *Performance description of houses*.

This second edition cancels and replaces the first edition (ISO 15928-3:2009), which has been technically revised.

ISO 15928 consists of the following parts, under the general title *Houses — Description of performance*:

— *Part 1: Structural safety*

— *Part 2: Structural serviceability*

— *Part 3: Structural durability*

— *Part 4: Fire safety*

— *Part 5: Operating energy*

The following part is under preparation:

— *Part 6: Sustainable development contributions*

Introduction

This part of ISO 15928 is one of a series of standards. The objective of the ISO 15928- series is to identify the methods that will be used to describe the performance of houses. The ISO 15928- series is confined to buildings occupied for residential purposes that may be separated or linked horizontally, but not linked vertically, and which have their own access and do not share any common space.

Each part of ISO 15928 relates to a separate attribute. The parts of ISO 15928 do not specify levels of performance and they are not intended to replace national standards or regulations, but provide a standardized framework to be used for development of national standards and regulations consistent with World Trade Organization (WTO) requirements. The parts of ISO 15928 do not provide design methods and/or design criteria.

Based on the framework provided by the ISO 15928- series, purchasers, regulators and standards-preparers in respective countries can describe their requirements in standardized performance terms, as appropriate. Additionally, the manufacturers/providers can respond by describing the performance of their products in a similar manner.

The purpose of this part of ISO 15928 is to provide a standardized system of describing performance that can be used to specify performance requirements and performance levels, or to rate houses, in terms of structural durability.

NOTE The WTO *Agreement on technical barriers to trade*, Clause 2.8, states: "Whenever appropriate, members shall specify technical regulations based on product requirements in terms of performance, rather than design or descriptive characteristics."

Houses — Description of performance —

Part 3: Structural durability

1 Scope

This part of ISO 15928 sets out a method for describing the structural durability performance of houses. It covers objectives, provides performance descriptions, establishes parameter descriptions and outlines evaluation processes.

This part of ISO 15928 is intended for use in the evaluation of the design and construction of houses, in the international trading of houses or their subsystems and in developing quality systems for houses.

The ISO 15928- series does not specify a level of performance and it is not intended to provide a design method and/or criteria.

NOTE 1 Annex A includes background information on this part of ISO 15928, guidance on its use and suggestions on good practice.

NOTE 2 Details on references referred to in Notes are provided on Bibliography.

NOTE 3 Structural safety, serviceability and other attributes are covered in other parts of ISO 15928.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2394, *General principles on reliability for structures*

ISO 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 13823, *General principles on the design of structures for durability*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO 2394, ISO 13823 and the following apply.

3.1
components
part of a house that can be identified

EXAMPLE Floor, wall.

Note 1 to entry: Includes fittings.

3.2
house
building occupied for residential purposes and designed as one unit (dwelling) with its own access

Note 1 to entry: The house can be a separate building, or linked horizontally with another house but not linked vertically.

Note 2 to entry: Where houses are linked, each has its own access and does not share any space in common with another.

Note 3 to entry: Where houses are linked, services including those related to energy usage and supply, heating and ventilation may be shared.

Note 4 to entry: Where houses are linked, the wall between the houses is typically designed and constructed to limit the probability of fire spread between houses.

Note 5 to entry: See ISO 6707-1:2014, 3.1.3 for the definition of 'building'.

3.3
maintenance schedule
series of actions and time intervals between these actions to maintain the levels of structural safety and serviceability performance of the whole house over the service life

3.4
parameters
⟨structural durability⟩ group of variables used to quantitatively describe the structural durability performance

3.5
performance
behaviour of houses related to use

3.6
service life
period of time after installation during which a house or its components meet or exceed the structural safety and serviceability performance requirements

4 Structural durability performance

4.1 Objective

The structural durability performance of a house which may affect the occupants, the functioning of the house and/or property damage, shall be such that its service life and the necessary maintenance schedules for the house as a whole and for its components shall be acceptable to the user.

4.2 Performance descriptions

The performance description for structural durability is the ability of the whole house and its parts, with an appropriate degree of reliability, to fulfil its intended structural safety and serviceability performance in the environment in which it is located over the service life when subject to its intended use.

The structural durability performance can be expressed in terms of:

a) the service life of the house as a whole;

b) component service life including accessibility consideration for inspection, repair or replacement;

c) the maintenance schedules required to achieve the service life of the house as a whole and/or its components as appropriate;

d) internal and external environmental agents that are likely to occur in the house service life.

5 Parameters for the description of performance

5.1 Parameters for describing the house service life

The house service life shall be described in terms of years that the house is expected to be in use.

5.2 Parameters for describing component service life

The component service life (if less than that of the house) shall be described in terms of years, between the replacement of structural components under the maintenance schedule.

Accessibility of components for inspection, repair or replacement shall be described.

5.3 Parameters for describing the maintenance schedule

The maintenance schedule shall be described by specifying all technical and administrative actions and their frequencies during the service life to keep the house or its components capable of performing their required function.

NOTE Guidance on parameters required can be found in ISO 15686-5, (5.4.2).

5.4 Parameters for describing internal and external environmental agents

5.4.1 General

The parameters for describing internal and external environmental agents considered relevant to the structural durability are:

a) the geographical location of the house;

b) agents causing environmental actions.

5.4.2 Parameters for geographical location

The parameters for describing geographical location include:

a) the distance from a coast-line, other geographical features or sources of pollutants;

b) the climate zone;

c) the physical location, e.g. latitude and longitude.

5.4.3 Parameters describing agents causing environmental actions

The following agents shall be considered if appropriate:

a) moisture and contaminants;

b) air and contaminants;

c) soil and ground contaminants;

d) biological agents;

e) temperature;

f) solar radiation;

g) incompatible chemicals;

h) use or exposure.

NOTE Environmental action can also occur as the result of a self-aging process.

Where appropriate, the following parameters should be used to quantify these influences:

— duration of wetness;

— duration of exposure;

— freeze–thaw cycles;

— temperature;

— pH value for acidity;

— concentration of chemicals and contaminants.

An assessment should be made as to whether these influences act either individually or in combination.

6 Evaluation

6.1 General

ISO 13823 describes the following two procedures for the evaluation of structural durability performance:

a) Service life format: This procedure consists of ensuring that the predicted structural design life of a whole house or component, allowing for variations in durability, equals or exceeds the specified design life of the house or component.

b) Limit state format: This procedure consists of ensuring that, at all the times during the specified design life of the whole house or component, the performance requirements for structural safety and serviceability are satisfied.

6.2 Evaluation methods

6.2.1 General

Performance or properties for both whole house and components and material over time for a specified environment and maintenance schedule can be determined by:

a) field testing;

b) laboratory (accelerated) testing;

c) service experience;

d) modelling.

Experience shall be used only for identical component and in the same environment.

Modelling and experience shall be used for (i) similar component in the same environment or (ii) identical components in moderately different environments.

Modelling and testing (field or laboratory) shall be used for (i) innovative components or (ii) identical components in significantly different environments.

6.2.2 Field testing

Full-scale dwellings, assemblies, components or materials in dwellings can be exposed to a real environment for a stipulated length of time prior to the determination of structural safety or serviceability performance. It is necessary that scientifically justified principles be used to relate the performance after the exposed time to that at the service life as appropriate.

NOTE Guidance on the relevant principles can be found in ISO 15686-1 and ISO 15686-2.

6.2.3 Laboratory testing

Accelerated ageing in laboratory facilities may be used for all testing (whether for whole dwellings, components, assemblies or materials) prior to the determination of structural safety or serviceability performance in accordance with the methods in ISO 15686-1, ISO 15686-2 and ISO 15686-8. It is necessary that scientifically justified principles be used to relate the performance in the laboratory test to that in reality.

6.2.4 Service experience

Service experience may be used in the assessment of the working life either of the whole house or of the component life (see ISO 15686-2). It is necessary to derive the data from a sufficient number of representative examples exposed to similar or more severe conditions. It is also necessary that construction methods, components and materials be similar to those of the houses being analysed. It is necessary to have available adequate documentation of environments and the performance over time.

NOTE Guidance on appropriate methods to extract service life data from the appraisal of existing buildings can be found in ISO 15686-7.

6.2.5 Modelling

Modelling may be used to assess the durability performance of individual components. Modelling shall be in accordance with ISO 13823. Individual component modelling is required to assess:

a) the change in form or properties over the service life, taking into account the maintenance schedule and the environmental agents;

b) the effect of these changes on structural safety and serviceability performance.

6.2.6 Combination

A combination of field and laboratory testing, service experience and analysis may be used for evaluation.

Annex A
(informative)

Commentary

A.1 Scope

The purpose of this part of ISO 15928 is to standardize the method of describing the structural durability performance for housing, i.e. to standardize the parameters by which the structural durability aspects of house performance are expressed or defined. This part of ISO 15928 does not specify a level of performance and it is not intended to provide design method and/or criteria.

It is one part of a series of ISO standards designed to facilitate the communication between the specifier (buyer/user) and the provider (seller). Structural safety, serviceability and other attributes are covered in other parts of ISO 15928.

The intent is to provide a standardized system that can be used to realize performance description.

The objectives of this part of ISO 15928 are as follows:

a) To facilitate international trade in housing systems and housing products, and to exchange housing information and knowledge by eliminating technical barriers;

b) To facilitate innovation in housing by providing a systematic framework for evaluation and acceptance;

c) To establish user needs related to structural durability in specific technical engineering terms, in order to facilitate communication among all stakeholders.

This part of ISO 15928 can also be useful in increasing consumer product awareness and in developing quality systems for houses.

This part of ISO 15928 is only applicable to the durability of structural components in houses. It does not apply to non-structural components, such as internal fixtures. It is intended for use in conjunction with ISO 15928-1 and ISO 15928-2.

A.2 Normative references

General building and civil engineering terms are defined in ISO 6707-1:2014. Information relevant to design principles can be obtained from ISO 2394:2015 and ISO 13823. Information on evaluation procedures can be obtained from the ISO 15686- series. Other useful information can be obtained from the Bibliography.

A.3 Terms and definitions

In general, the adopted definitions are those given in ISO 6707-1:2014 and ISO 6241 with regard to building terms and ISO 2394 with regard to structural terms except for the following terms that require further elaboration:

a) The service life of the whole house: the period of time when structural safety and serviceability meet the required level as specified in ISO 15928-1 and ISO 15928-2, respectively. It is necessary that throughout this service life the probability of structural failure of the house be less than an accepted limit.

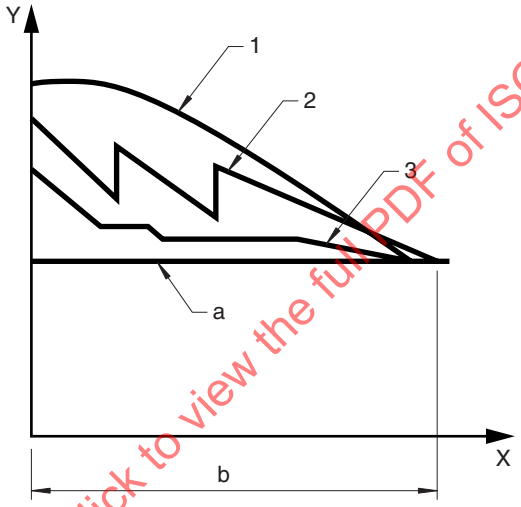
b) The component service life: the period of time that a particular component meets a similar performance requirement.

c) The component service life: this need not necessarily match the service life of the whole house if the component can be readily replaced. In this case, as long as replacement is specified the component service life can be a fraction of the service life of the whole house. However, where the component cannot be readily replaced then it is necessary for the component service life to match or exceed the service life of the whole house.

A.4 Structural durability performance

A.4.1 Objective

Figure A.1 indicates how three different maintenance strategies can provide acceptable performance over the design working life of a house.



Key

1 strategy 1 (no maintenance)
2 strategy 2 (with repair)
3 strategy 3 (with maintenance)
X time
Y performance level
a Target performance
b Service life

Figure A.1 — Strategies for acceptable performance over service life of a house

A.4.2 Performance descriptions

The service life referred to in this Clause is for the whole house (see ISO 2394). It is possible to establish the service life of components in terms of how readily components are replaceable and the consequence of their failure on the overall maintenance of structural safety and serviceability performance. (Thus roof coverings, which are easily replaced, may have a shorter design life than framing members, for example.)

In many instances, it is difficult to quantify directly the effect that environmental agents over time can have on the level of structural safety or serviceability of a whole house. However, it is possible to estimate or quantify the effect that environmental agents will have on the structural form or properties

of individual components. Analytical procedures can be used to assess the effects that these changes in form or properties can have on structural safety or serviceability.

For example a steel beam within a dwelling exposed to marine air will corrode over time. It is possible to estimate the maximum loss of cross-sectional area of the beam after given times of exposure. Analytical methods can then be used to assess whether this loss in cross-sectional area will reduce the structural safety of the dwelling. Alternatively, the minimum possible cross-sectional area of the beam required to give acceptable structural safety can be determined. Then, as long as the cross-sectional area of the exposed beam remains above this minimum, the corrosion of the beam will not impair the structural safety of the dwelling.

A.5 Parameters for the description of performance

A.5.1 Parameters for describing the house service life

A.5.1.1 Parameters for describing component service life

The minimum component design life should be specified taking into account any forecast changes in the environment, and the interdependence between components and connections. The level of accessibility of the component should also be taken into account when specifying the component life. For example the design life of metallic roof sheeting could be less than the design working life of the whole house. However, the design life of the metal roof sheeting should not be less than the specified design life of its fastener.

A.5.2 Parameters for describing the maintenance schedule

Types of maintenance include preventive, scheduled, corrective, conditioned–based, emergency/unforeseen, predictive and deferred. Activities include cleaning, servicing, repainting, repairing, replacing of parts, inspection, monitoring, testing, maintenance planning. Within these parameters, three broad strategies could be adopted:

a) Inspect and maintain according to a pre-determined schedule based on prior understanding of rate of degradation;

b) Instigate procedures to permit regular update on building condition (inspection, monitoring) and repair when a given level of damage occurs;

c) Repair only after the component has failed.

If the first approach is to be adopted then a conservative estimate of the period of time required for the component to show an unacceptable level of change in form or properties is necessary and the inspection interval should be an agreed fraction of this time. The third approach is not acceptable for structural safety but is acceptable for structural serviceability when damage is reversible.

Strategies other than maintenance can be deployed to allow the life of each component to satisfy the design working life of the whole house. It is possible to replace components (given that their degradation poses no risk to structural safety up to the point of replacement) or the dwelling can be designed so that degradation is limited and the component lifetime exceeds that of the design working life of the whole house (see ISO 13823).

A.5.3 Parameters for describing internal and external environmental agents

Table A.1 is derived from ISO 13823:2008, Annex B. This table describes the various influences on structural durability along with the agents giving rise to them and examples of parameters that can be used to describe the relevant structural durability performances.

Table A.1 — Examples of agents causing environmental action

Influence	Agent	Example of parameters [a]
Moisture constituents	Solid (ice, snow) Liquid (rain, condensation) Gas (water vapour)	TOW, RH
Moisture contaminants	Chlorides, acids or sulphates	TOE, RH, pH, concentration
Air constituents	O_2, CO_2	TOE, concentration
Air contaminants	Oxides, particulates and sea spray	TOE, concentration
Ground constituents	Sulphates and other salts Acids (from decomposition of organics)	TOE, RH, pH, concentration
Ground contaminants	Chemicals from spills and leaks Chlorides from road salt Induced electric currents	TOE, RH, pH, T, concentration
Biological agents/life	Microorganisms, insects, animals and plants	TOW, RH, T, geographical
Temperature	Freeze–thaw cycles	F-T(T, t)
Solar radiation	UV radiation, IR radiation	TOE, T, RH
Incompatible chemicals		TOE, concentration
Use or exposure	Wear, abrasion	TOE, load

[a] TOW: time of wetness
TOE: time of exposure
F-T: freeze–thaw cycles
T: temperature
pH: acidity
t: time
concentration: concentration of constituents and contaminants
load: mechanical load

The ISO International Standards listed in Table A.2 can contain information relevant to the description of parameters for internal and external agents.

Table A.2 — ISO International Standards pertinent to description of parameters

Parameter for internal and external agents	International Standard
Solar radiation	ISO 4892-1, ISO 4892-2, ISO 4892-3, ISO 9370
Freeze–thaw cycles	ISO 1147
Humidity	ISO 24353
Ozone levels	ISO 10313, ISO 13964
Airborne contaminants	ISO 4221, ISO 7996, ISO 9225, ISO 10062, ISO 11564
Airborne salinity	ISO 9225
Ground constituents	ISO 10390, ISO 10573
Fungi and moulds	ISO 846

The parameters specified should only be those which relate to degradation leading to loss of structural safety and serviceability. Influences that can affect other requirements only, such as aesthetics or general functionality, are not included.

Localized conditions can arise in particular spaces or parts of spaces in the interior, within the fabric or on the façade of a house. It is possible for these localized microclimates to differ considerably from the general indoor or exterior climate. Where such microclimates are likely to occur, it is necessary for them to be identified and the level of influences determined separately for such microclimates.

A.6 Evaluation

A.6.1 General

The two alternative methods are described in more detail in ISO 13823:2008.

For the approach using the service life format a methodology is presented in ISO 13823:2008, Clauses 8 and 9, for determining the predicted service life. For the approach using the limit state format, which is a more complex approach, an example of its application is presented in ISO 13823:2008, Annex A.

A.6.2 Evaluation methods

A.6.2.1 General

No commentary.

A.6.2.2 Field testing

Field testing potentially provides the most accurate testing method as the test is being carried out in the actual service condition in which the final house will be built. The major issue for field testing of full-scale dwellings is the appropriate selection and sampling of exposure environments. Performance in actual situations can only be conservatively estimated if the environment used in field testing is as, or more, severe than that of the actual situations. A strategy of characterizing the range of actual environments into severity bands and ensuring that field tests are carried out in each band can be an appropriate method to guarantee the reliability of field testing. Guidance on characterizing environmental impacts can be found in ISO 21931-1.

Field testing of components can be carried out in a number of ways including:

a) exposure of the components within a dwelling;

b) open exposure of a component.

If the component is to be exposed in a dwelling it is important to guarantee that the severity of the dwelling exposure is appropriate (as discussed above) and that the component is exposed in the most aggressive situation likely to be encountered in actual service. Open exposure of components to the external environment is the more frequent exposure method and will frequently lead to accelerated degradation as the environmental conditions will frequently be more severe than in the actual dwelling. The key challenge is to determine whether the exposure conditions are relevant to the probable service conditions and to what extent the degradation will be accelerated. Guidance on these issues can be found in ISO 15686-2.

ISO 15686-2, Annex A, expands on service life prediction methodologies and highlights factors that need to be considered to allow the performance of components at the design life (design working life) of the dwelling to be evaluated from testing on shorter duration. It is important that:

a) degradation agents and/or combination of agents in service be identified;

b) possible degradation mechanisms in service be identified;

c) valid and reproducible performance evaluation techniques in both in-service and short-term studies be undertaken;

d) major degrading agents and degradation methods in the testing regime match those of the service conditions.

