Republic of South Africa

EDICT OF GOVERNMENT

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SANS 10400-XA (2011) (English): The application of the National Building Regulations Part X: Environmental sustainability Part XA: Energy usage in buildings

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Edition 1

SOUTH AFRICAN NATIONAL STANDARD

The application of the National Building Regulations

Part X: Environmental sustainability

Part XA: Energy usage in buildings

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SANS 10400-XA:2011
Edition 1

Table of changes

Change No.	Date	Scope

Foreword

This South African standard was approved by National Committee SABS SC 59G, *Construction standards – Energy efficiency and energy use in the built environment*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in August 2011.

Compliance with the requirements of this document will be deemed to be compliance with the requirements of part XA of the National Building Regulations, issued in terms of the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977).

SANS 10400 consists of the following parts, under the general title *The application of the National Building Regulations:*

Part A: General principles and requirements.

Part B: Structural design.

Part C: Dimensions.

Part D: Public safety.

Part F: Site operations.

Part G: Excavations.

Part H: Foundations.

Part J: Floors.

Part K: Walls.

Part L: Roofs.

Part M: Stairways.

Part N: Glazing.

Part O: Lighting and ventilation.

Part P: Drainage.

Part Q: Non-water-borne means of sanitary disposal.

Foreword *(concluded)*

Part R: Stormwater disposal.

Part S: Facilities for persons with disabilities.

Part T: Fire protection.

Part V: Space heating.

Part W: Fire installation.

Part X: Environmental sustainability.

Part XA: Energy usage in buildings.

This document should be read in conjunction with SANS 10400-A.

Annex A forms an integral part of this document.

Contents

The application of the National Building Regulations

Part X:
Environmental sustainability

Part XA:
Energy usage in buildings

1 Scope

This part of SANS 10400 provides deemed-to-satisfy requirements for compliance with part XA (Energy Usage in Buildings) of the National Building Regulations.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

ASTM C 177, *Standard test method for steady-state heat flux measurements and thermal transmission properties by means of the guarded-hot-plate apparatus.*

ASTM C 518, *Standard test method for steady-state thermal transmission properties by means of the heat flow meter apparatus.*

ASTM C 1363, *Standard test method for thermal performance of building materials and envelope assemblies by means of a hot box apparatus.*

SANS 204, *Energy efficiency in buildings.*

SANS 613, *Fenestration products – Mechanical performance criteria.*

SANS 1307, *Domestic solar water heaters.*

SANS 6946/ISO 6946, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.*

SANS 10106, *The installation, maintenance, repair and replacement of domestic solar water heating systems.*

SANS 10252-1:2004, *Water supply and drainage for buildings – Part 1: Water supply installations for buildings.*

SANS 10254, *The installation, maintenance, replacement and repair of fixed electric storage water heating systems.*

SANS 10400-A, *The application of the National Building Regulations – Part A: General principles and requirements.*

SANS 10400-K, *The application of the National Building Regulations – Part K: Walls.*

SANS 10400-O, *The application of the National Building Regulations – Part O: Lighting and ventilation.*

3 Definitions

For the purposes of this document, the definitions given in SANS 10400-A (some of which are repeated for convenience) and the following apply.

3.1
Board of Agrément South Africa
body that operates under the delegation of authority of the Minister of Public Works

3.2
building envelope
elements of a building that separate a habitable room from the exterior of a building or a garage or storage area

3.3
certified thermal calculation software
software that is certified by the Board of Agrément South Africa, in terms of Agrément South Africa's Energy Software Protocols, as being fit for thermal modelling or calculation purposes in terms of the National Building Regulations

3.4
competent person
person who is qualified by virtue of his education, training, experience and contextual knowledge to make a determination regarding the performance of a building or part thereof in relation to a functional regulation or to undertake such duties as may be assigned to him in terms of the National Building Regulations

3.5
deemed-to-satisfy requirement
non-mandatory requirement, the compliance with which ensures compliance with a functional regulation

3.6
equipment
all control devices and components of systems other than appliances which are not permanently installed and integrated for the express purpose of providing control of environmental conditions for the building

3.7
fenestration
any glazed opening in a building envelope, including windows, doors and skylights

3.8
fenestration area
area that includes glazing and framing elements that are fixed or movable, and opaque, translucent or transparent

3.9
functional regulation
regulation that sets out in qualitative terms what is required of a building or building element or building component in respect of a particular characteristic, without specifying the method of construction, dimensions or materials to be used

3.10
nett floor area
floor area excluding the area occupied by vertical elements, including enclosed lift wells and enclosed stairs

3.11
orientation
direction that a building envelope element faces, i.e. the direction of a vector perpendicular to and pointing away from the surface outside of the element

3.12
plastering
application of a suitable plaster, sand, Portland cement and water to masonry interiors and exteriors to achieve a smooth surface

3.13
reference building
hypothetical building that is used to determine the maximum allowable energy load for the proposed building

3.14
rendering
application of a thin premixed surface of sand, cement and lime plaster to a masonry surface

3.15
***R*-value**
thermal resistance ($m^2 \cdot K/W$) of a component

NOTE This is the inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area.

3.16
SHGC
solar heat gain coefficient
ratio of the heat gain entering the space through the fenestration area to the incident solar radiation

3.17
suitable
capable of fulfilling or having fulfilled the intended function, or fit for its intended purpose

3.18
total *R*-value
sum of the *R*-values of the individual component layers in a composite element, including the air space and associated surface resistances measured in $m^2 \cdot K/W$

3.19
total *U*-value
thermal transmittance ($W/m^2 \cdot K$) of the composite element, including the air space and associated surface emittance

4 Requirements

4.1 Hot water supply

4.1.1 In order to comply with functional regulation **XA2**, contained in part XA of the National Building Regulations, the following guidance is provided:

a) the volume of the annual average hot water heating requirements shall be calculated in accordance with tables 2 and 5 of SANS 10252-1:2004; and

b) if solar water heating systems are used, these shall comply with SANS 1307, SANS 10106, SANS 10254 and SANS 10252-1.

4.1.2 Requirements for water installations in buildings shall be in accordance with SANS 10252-1 and SANS 10254.

4.1.3 All hot water service pipes shall be clad with insulation with a minimum *R*-value in accordance with table 1.

4.1.4 Thermal insulation, if any, shall be installed in accordance with the manufacturer's instructions.

Table 1 — Minimum *R*-values of pipe insulation

1	2
Internal diameter of pipe mm	**Minimum *R*-value**[a]
≤ 80 > 80	1,00 1,50
[a] Determined with a hot surface temperature of 60 °C and an ambient temperature of 15 °C.	

4.2 Energy usage and building envelope

4.2.1 The functional regulations contained in part XA of the National Building Regulations shall be deemed to be satisfied where,

a) in any building of occupancy classified in terms of Regulation **A20** as A1, A2, A3, A4, F1, G1, or H1, a competent person certifies that such building (excluding garage and storage areas) has a theoretical annual energy consumption and demand, based on the design assumptions contained in 4.3, less than or equal to the values specified in tables 2 and 3; or

b) in any building of occupancy classified in terms of Regulation **A20** as A1, A2, A3, A4, C1, C2, E1, E2, E3, E4, F1, F2, F3, G1, H1, H2, H3, H4, and H5, the orientation and shading are in accordance with the requirements of SANS 204, external walls are in accordance with the requirements of 4.4.3, fenestration is in accordance with the requirements of 4.4.4, roof assembly construction is in accordance with the requirements of 4.4.5, if in-slab heating is installed, it is in accordance with the requirements of 4.4.2, and services that use energy or control the use of energy, including heating, air conditioning and mechanical ventilation in accordance with SANS 204, and hot water systems in accordance with the requirements of 4.1 (services exclude cooking facilities and portable appliances); or

c) in any building of occupancy classified in terms of Regulation **A20** as A1, A2, A3, A4, C1, C2, E1, E2, E3, E4, F1, F2, F3, G1, H1, H2, H3, H4, and H5, a competent person certifies that such building (excluding garage and storage areas) has a theoretical annual energy consumption and demand less than or equal to a reference building that complies with the requirements of 4.2.1(b).

4.2.2 The *R*-values, total *R*-values, total *U*-values and *SHGC* contained in SANS 204 may be used to comply with the requirements of Regulation **XA**.

NOTE The occupancy categories listed in tables 2 and 3 are those where there are sufficient collected data on actual building energy performance. Those excluded either have insufficient actual data, or are of such a nature that the internal processes are high energy consumers, or are of such variability in execution that a single norm would be unrepresentative.

Table 2 — Maximum energy demand per building classification for each climatic zone

1	2	3	4	5	6	7	8
Classification of occupancy of building	**Description of building**	**Maximum energy demand**[a] VA/m^2					
		Climatic zone[b]					
		1	**2**	**3**	**4**	**5**	**6**
A1	Entertainment and public assembly	85	80	90	80	80	85
A2	Theatrical and indoor sport	85	80	90	80	80	85
A3	Places of instruction	80	75	85	75	75	80
A4	Worship	80	75	85	75	75	80
F1	Large shop	90	85	95	85	85	90
G1	Offices	80	75	85	75	75	80
H1	Hotel	90	85	95	85	85	90

[a] The maximum demand shall be based on the sum of 12 consecutive monthly maximum demand values per area divided by 12/m^2, which refers to the nett floor area.

[b] The climatic zones shall be as given in annex A.

Table 3 — Maximum annual consumption per building classification for each climatic zone

1	2	3	4	5	6	7	8
Classification of occupancy of building	**Description of building**	**Maximum energy consumption** kWh/m^2					
		Climatic zone[a]					
		1	**2**	**3**	**4**	**5**	**6**
A1	Entertainment and public assembly	420	400	440	390	400	420
A2	Theatrical and indoor sport	420	400	440	390	400	420
A3	Places of instruction	420	400	440	390	400	420
A4	Worship	120	115	125	110	115	120
F1	Large shop	240	245	260	240	260	255
G1	Offices	200	190	210	185	190	200
H1	Hotel	650	600	585	600	620	630
NOTE 1 The annual consumption per square metre shall be based on the sum of the monthly consumption of 12 consecutive months. NOTE 2 Non-electrical consumption, such as fossil fuels, shall be accounted for on a non-renewable primary energy thermal equivalence basis by converting megajoules to kilowatt hours.							
[a] The climatic zones shall be as given in annex A.							

4.3 Design assumptions

Where the theoretical annual energy consumption of a building (excluding garages and storage areas) is calculated, certified thermal calculation software, climatic data published by Agrément South Africa, and the following design assumptions shall be used:

a) where artificial ventilation systems are provided:

1) the design occupancy times are in accordance with table 4;

2) the space temperature lies within the range of 19 °C to 25 °C for 98 % of the plant operation time;

3) ventilation is provided in accordance with the requirements of SANS 10400-O;

4) the internal heat gains in the building are from

i) the design population calculated in accordance with table 5 at an average rate of 75 W sensible heat gain per person;

ii) hot meals in a dining room, restaurant or café, at a rate of 30 W heat gain per person with the number of people calculated in accordance with table 5;

iii) appliances and equipment in accordance with table 6; and

iv) artificial lighting calculated with the design occupancy times in accordance with table 4;

b) hot water supplies comply with the requirements in 4.1; and

c) the maximum energy demand and maximum energy usage are calculated for the total building and not for individual tenancies.

Table 4 — Design occupancy times

1	2
Classification of occupancy of buildings	**Design occupancy times** hours per day/days per week
A1 and A2	18/7
A3 and G1	12/5
A4	6/4
F1	12/7
H1	24/7

Table 5 — Design population in accordance with SANS 10400-A

1	2
Class of occupancy of room or storey or portion thereof	**Population**
A1, A2, A4, A5	Number of fixed seats or 1 person per m^2 if there are no fixed seats
E1, E3, H1, H3	2 persons per bedroom
G1	1 person per 15 m^2
E4	16 persons, provided that the total number of persons per room is not more than 4
C1, E2, F1, F2	1 person per 10 m^2
H5	16 persons per dwelling unit, provided that the total number of persons per room is not more than 4
C2, F3	1 person per 20 m^2
A3, H2	1 person per 5 m^2

Table 6 — Internal heat gains for appliances and equipment

1	2
Classification of occupancy of buildings	**Internal heat gain** W/m^2
G1	15
F1	5
Other occupancies	No load

4.4 Building envelope requirements

4.4.1 Orientation

4.4.1.1 The building should be compact in plan, with the rooms that are used most and the major areas of glazing placed on the northern side of the building to allow solar heat to penetrate the glazing during the winter months.

Living spaces should be arranged so that the rooms where people spend most of their hours are located on the northern side of the unit. Uninhabited rooms, such as bathrooms and storerooms, can be used to screen unwanted western sun or to prevent heat loss on the south-facing facades. Living rooms should ideally be placed on the northern side.

The longer axis of the dwelling should be orientated so that it runs as near east/west as possible.

4.4.1.2 The roof overhang to the northern wall shall be sufficient to shade the windows from midday summer sunshine in accordance with SANS 204. Windows facing east and west should be limited in number and confined to the minimum required for daylight and ventilation.

4.4.2 Floors

Where an underfloor heating system (e.g. in-screed, underlaminate heating, undercarpet heating, undertile heating, cut-in underfloor heating, and water-based underfloor heating) is installed, the heating system shall be insulated underneath the slab with insulation that has a minimum *R*-value of not less then 1,0.

4.4.3 External walls

4.4.3.1 Non-masonry walls shall achieve a minimum total *R*-value of

a) climatic zones 1 and 6: 2,2

b) climatic zones 2, 3, 4 and 5: 1,9.

4.4.3.2 The following types of masonry walling comply with the *R*-value requirements:

a) double-skin masonry with no cavity, plastered internally, or rendered externally; or

NOTE The cavity and grouted cavity walling systems exceed the minimum *R*-value of 0,35.

b) single-leaf masonry walls with a nominal wall thickness greater than or equal to 140 mm (excluding plastering and rendering), plastered internally and rendered externally.

The requirements refer to the external walls of the habitable portions of the building fabric only.

4.4.3.3 For masonry walling types not covered in 4.4.3.2, such walls shall achieve a minimum total *R*-value of 0,35. The total *R*-value shall be determined by means of a test conducted in accordance with ASTM C 1363, ASTM C 518 or ASTM C 177. Surface film resistance shall be in accordance with SANS 6946.

4.4.3.4 Other walling requirements shall be in accordance with SANS 10400-K.

4.4.4 Fenestration

4.4.4.1 Buildings with up to 15 % fenestration area to nett floor area per storey comply with the minimum energy performance requirements.

4.4.4.2 Buildings with a fenestration area to nett floor area per storey that exceeds 15 % shall comply with the requirements for fenestration in accordance with SANS 204.

4.4.4.3 All fenestration air infiltration shall be in accordance with SANS 613.

4.4.5 Roof assemblies

4.4.5.1 A roof assembly shall achieve the minimum total *R*-value specified in table 7 for the direction of heat flow.

Table 7 — Minimum total *R*-values of roof assemblies

1	2	3	4	5	6	7
Description	**Climatic zones**					
	1	**2**	**3**	**4**	**5**	**6**
Minimum required total *R*-value ($m^2 \cdot K/W$)	3,7	3,2	2,7	3,7	2,7	3,5
Direction of heat flow	Up	Up	Down and up	Up	Down	Up

4.4.5.2 A roof assembly that has metal sheet roofing fixed to metal purlins, metal rafters or metal battens shall have a thermal break consisting of a material with an *R*-value of not less than 0,2 installed between the metal sheet roofing and its supporting member.

4.4.5.3 Metal sheeting types of roofing assembly construction shall achieve the minimum total *R*-value in accordance with 4.4.5.1, with the installation of insulation that has an *R*-value as specified in table 8.

Table 8 — Metal sheeting roof assemblies

1	2	3	4	5	6	7
Description	**Climatic zones**					
	1	**2**	**3**	**4**	**5**	**6**
Direction of heat flow	Up	Up	Down and up	Up	Down	Up
R-value ($m^2 \cdot K/W$) of roof covering material	0,30				0,36	0,30
R-value of ceiling	0,05					
Added *R*-value of insulation	3,35	2,85	2,35	3,35	2,29	3,15

4.4.5.4 Clay tile types of roofing assembly construction shall achieve the minimum total *R*-value in accordance with 4.4.5.1 with the installation of insulation that has an *R*-value as specified in table 9.

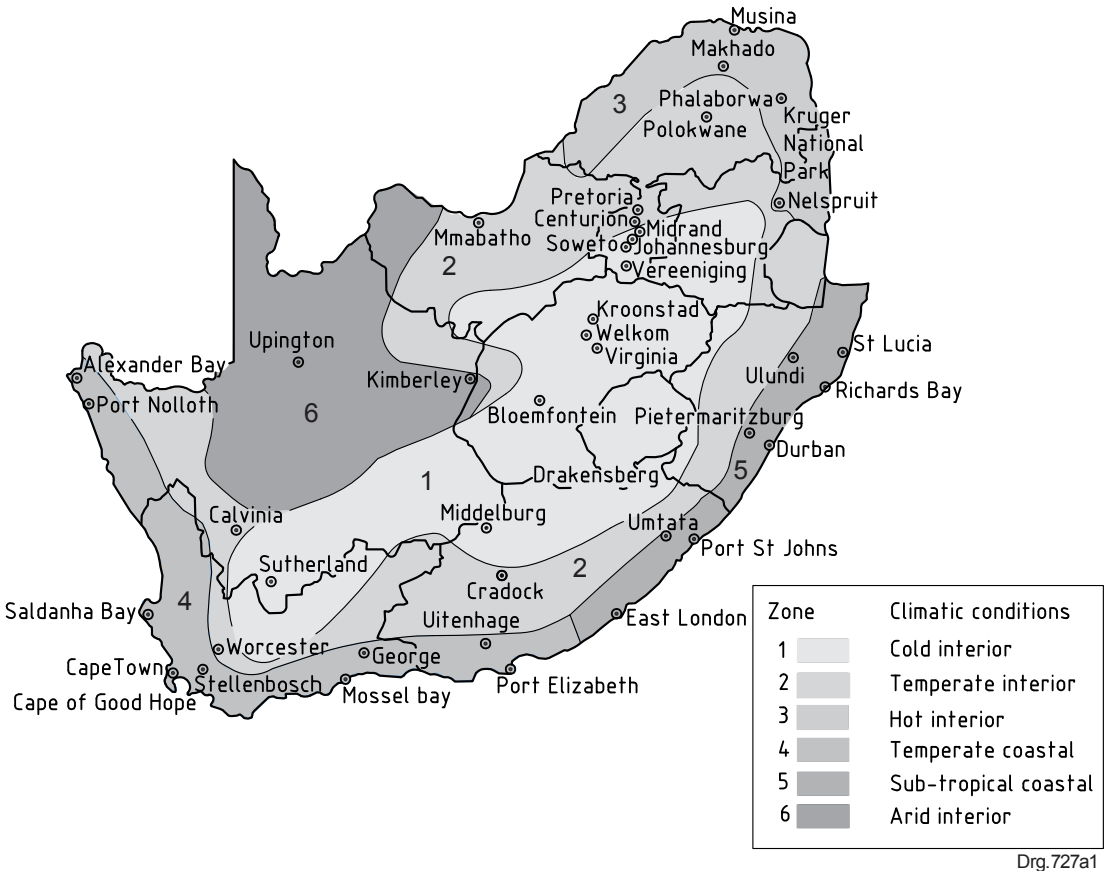
Table 9 — Clay tile roof assemblies

1	2	3	4	5	6	7
Description	**Climatic zones**					
	1	**2**	**3**	**4**	**5**	**6**
Direction of heat flow	Up	Up	Down and up	Up	Down	Up
R-value ($m^2 \cdot K/W$) of roof covering material	0,35				0,48	0,35
R-value ($m^2 \cdot K/W$) of ceiling	0,05					
Added *R*-value of insulation	3,30	2,80	2,30	3,30	2,17	2,8

Annex A
(normative)

Climatic zones of South Africa

The climatic zones of South Africa are shown in figure A.1, and the locations in such zones are given in table A.1.



Zone	Description	Major centre
1	Cold interior	Johannesburg, Bloemfontein
2	Temperate interior	Pretoria, Polokwane
3	Hot interior	Makhado, Nelspruit
4	Temperate coastal	Cape Town, Port Elizabeth
5	Sub-tropical coastal	East London, Durban, Richards Bay
6	Arid interior	Upington, Kimberley

Figure A.1 — Climatic zone map

Table A.1 — Locations in the climatic zones of South Africa[a]

1	2	1	2	1	2
Location	**Zone**	**Location**	**Zone**	**Location**	**Zone**
Alexander Bay	4	Jacobsdal	6	Pretoria	2
Aliwal North	1	Jan Kempdorp	1	Prieska	6
Amsterdam	2	Johannesburg	1	Pudimoe	1
Baberton	2	Kammieskroon	4	Queenstown	2
Badplaas	2	Kainoplaagte	6	Reivilo	2
Barrydale	4	Kimberley	6	Richards Bay	5
Beaufort West	2	Kingwilliamstown	5	Richmond	2
Bloemfontein	1	Kirkwood	4	Riversdale	4
Boshoff	2	Klerksdorp	1	Rooibokkraal	3
Brakpan	1	Kokstad	2	Sabie	3
Brandfort	2	Komatipoort	3	Sakrivier	6
Butterworth	5	Kroonstad	1	Saldanha Bay	4
Calvinia	2	Kruger National Park	3	Sibasa	3
Cape Agulhas	4	Krugersdorp	1	Soweto	1
Cape of Good Hope	4	Kubus	4	Springs	1
Cape Town	4	Kuruman	2	St Lucia	5
Cederberg	4	Ladysmith	2	Standerton	1
Centurion	2	Laingsburg	1	Stellenbosch	4
Ceres	2	Makhado	3	Steytlerville	2
Colesburg	1	Marken	3	Stoffberg	2
Conway	1	Melmoth	5	Stutterheim	2
Cradock	2	Mica	3	Swartberg	1
Dealsville	1	Middelburg	1	Swellendam	4
Delmas	1	Midrand	1	Thabazimbi	3
Dendron	2	Mkuze	5	Toska	6
Derdepoort	2	Mmabatho	2	Touwsrivier	2
Dordrecht	1	Mosselbay	4	Uitenhage	4
Drakensberg	1	Musina	3	Ulundi	5
Dullstroom	1	Nelspruit	3	Umtata	5
Dundee	2	Newcastle	1	Upington	6
Durban	5	Niewoudtville	4	Utrecht	2
East London	5	Northam	2	Ventersdorp	2
Elliot	1	Olifantshoek	6	Vereeninging	1
Ermelo	1	Ottosdal	2	Victoria West	1
Estcourt	2	Oudshoorn	2	Vioolsdrif	2
George	4	Petrusburg	1	Virginia	1
Gouda	4	Phalaborwa	3	Volksrust	1
Grahamstown	4	Piet Plessis	2	Vryburg	2
Graskop	3	Piet Retief	2	Warrinton	2
Gravelot	2	Pietermaritzburg	5	Watervalboven	1
Giyani	2	Pilgrims Rest	2	Welkom	1
Harrismith	1	Pofadder	6	Wellington	4
Hartbeesfontein	1	Polokwane	2	Williston	1
Heidelberg	4	Pongola	2	Witbank	1
Hopetown	1	Port Elizabeth	4	Worcester	2
Hotazel	2	Port Nolloth	4	Zeerust	2
Hutchinson	1	Port St Johns	5		

[a] These locations shall be used in defining the maximum energy demand, which varies in each climatic zone.

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SABS – Standards Division

The objective of the SABS Standards Division is to develop, promote and maintain South African National Standards. This objective is incorporated in the Standards Act, 2008 (Act No. 8 of 2008).

Amendments and Revisions

South African National Standards are updated by amendment or revision. Users of South African National Standards should ensure that they possess the latest amendments or editions.

The SABS continuously strives to improve the quality of its products and services and would therefore be grateful if anyone finding an inaccuracy or ambiguity while using this standard would inform the secretary of the technical committee responsible, the identity of which can be found in the foreword.
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