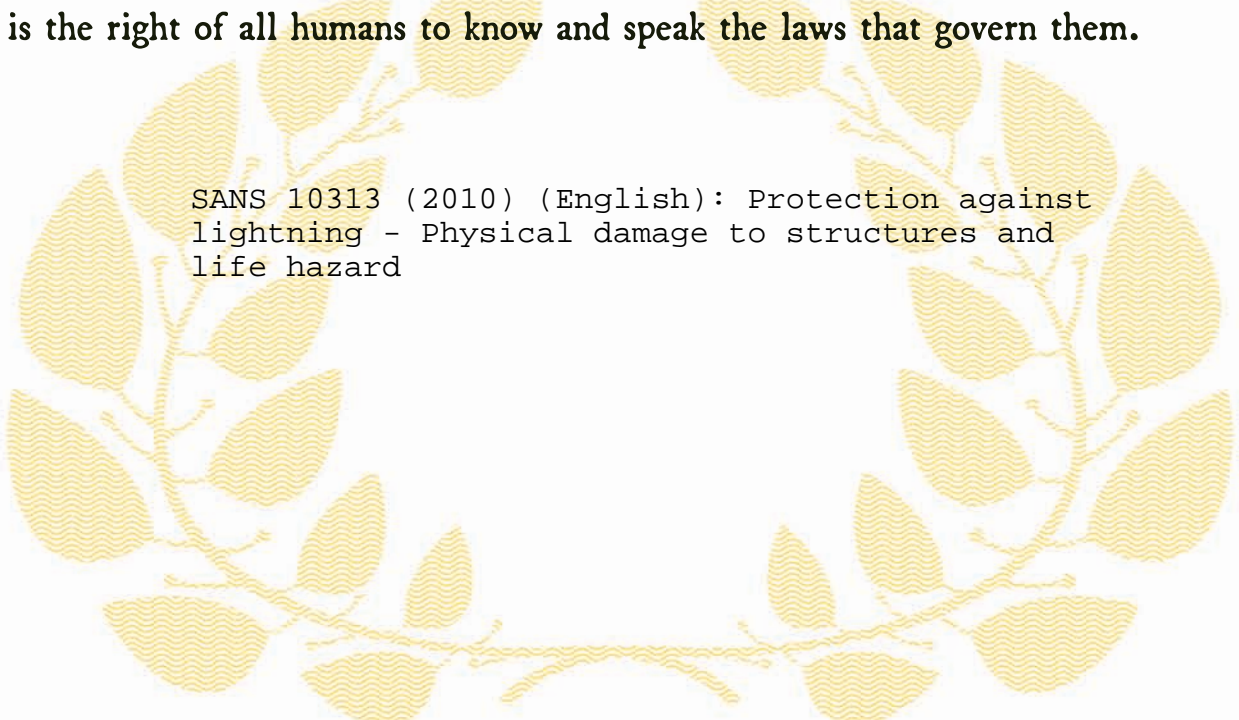




Republic of South Africa

EDICT OF GOVERNMENT

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.



SANS 10313 (2010) (English): Protection against lightning - Physical damage to structures and life hazard



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SOUTH AFRICAN NATIONAL STANDARD

Protection against lightning — Physical damage to structures and life hazard

**WARNING — Can only be used
in conjunction with the
SANS 62305 series.**

SANS 10313:2010

Edition 3.1

Table of changes

Change No.	Date	Scope
Amdt 1	2010	Amended to replace the Certificate of Compliance for lightning protection systems by a Lightning protection system installation safety report, to include a Lightning protection system maintenance certificate, to change two definitions, and to correct the number of a normative reference and a drawing.

Foreword

This South African standard was approved by National Committee SABS SC 67F, *Electricity distribution systems and components – Installations*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This SANS document, by reference, forms part of the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977) (as amended from time to time) and the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (as amended from time to time).

This document was published in March 2010.

This document supersedes SANS 10313:2008 (edition 3).

A vertical line in the margin shows where the text has been technically modified by amendment No. 1.

Annexes A and B form an integral part of this document. Annex C is for information only.

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Protection against lightning — Physical damage to structures and life hazard

1 Scope

1.1 The scopes of all parts of SANS 62305 apply, with the inclusion of

- a) thatched roof structures, and
- b) buildings with explosive or flammable substances.

1.2 This standard makes provision for the issuing of a Lightning protection system installation safety report by an LPS designer or an LPS installer, and a Lightning protection system maintenance certificate.

Amdt 1

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.

SANS 1063, *Earth rods, couplers and connections.*

SANS 10142-1, *The wiring of premises – Part 1: Low-voltage installations.*

SANS 10199, *The design and installation of earth electrodes.*

SANS 10225 (SABS 0225), *The design and construction of lighting masts.*

SANS 62305-2:2007/IEC 62305-2:2006, *Protection against lightning – Part 2: Risk management.*

SANS 62305-3:2007/IEC 62305-3:2006, *Protection against lightning – Part 3: Physical damage to structures and life hazard.*

SANS 62305-4/IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures.*

3 Definitions

For the purposes of this document, the definitions given in SANS 62305-3 and the following apply.

3.1

installation safety report

report that is issued by a lightning protection system (LPS) designer or installer in respect of an LPS that complies with the relevant requirements of this standard

Amdt 1

Amdt 1

NOTE See annex A for an example of an Installation safety report for LPSs for the internal and external protection of structures.

Amdt 1

3.2

LPS designer

person who is competent to design, construct and test the LPS for compliance with this standard

Amdt 1

3.3

LPS installer

person who is competent to install, construct and test an LPS for compliance with this standard

Amdt 1

3.4

thatch

dried reeds, grass or straw used in the construction of a thatched roof

4 Lightning protection system (LPS)

4.1 The requirements of SANS 62305-3 apply.

4.2 The LPS earthing shall be bonded to the fixed electrical installation protective earthing in accordance with the requirements of SANS 10142-1.

5 External lightning protection system

5.1 The requirements of SANS 62305-3 apply.

5.2 Products that artificially enhance the height of the air terminal (also referred to as "early, streamer emission devices") have not been proven and therefore, for the determination of the volume protected, only the real physical dimension of the metal air termination system shall be considered.

5.3 Radioactive air terminals are prohibited.

5.4 Earth electrodes shall be designed in accordance with SANS 10199.

NOTE The earth resistance of the electrode systems should preferably not be measured whilst the soil is wet.

6 Internal lightning protection system

The requirements in 6.1 to 6.3 of SANS 62305-3 apply. For the protection against overvoltages of internal systems, see SANS 62305-4.

7 Maintenance and inspection of an LPS

7.1 The requirements of SANS 62305-3 apply.

7.2 An Installation safety report (see annex A) shall be issued in respect of an inspected and compliant LPS by an LPS designer or an LPS installer. **Amdt 1**

7.3 In the case of an existing LPS installed before the approval of this edition of SANS 10313, where clearances complied with the requirements of another standard at the time of installation, this shall be noted on the Maintenance certificate (see annex B). **Amdt 1**

7.4 Testing of the LPS system shall include testing of the integrity of the earth continuity and equipotential bonding, and the readings shall be recorded on the Maintenance certificate. Testing should be performed before the start of each lightning season. **Amdt 1**

8 Protection measures against injury to living beings due to touch and step voltages

The requirements of SANS 62305-3 apply.

9 Risk management

The requirements of SANS 62305-2 apply. In the case of simple structures, a spreadsheet-based risk calculator has been developed by IEC TC 81 (see annex H in SANS 62305-2:2007). The software program can be purchased directly from the IEC.

NOTE The annual lightning ground flash density for specific areas in South Africa is given in annex C.

Amdt 1

10 Installation of earth rods and electrodes

10.1 The requirements of SANS 62305-3 apply with the additions given in 10.2 and 10.3.

10.2 Earth rods shall comply with the requirements of SANS 1063, and earth electrodes shall be installed in accordance with the requirements of SANS 10199.

10.3 Specific attention is drawn to the requirements for explosive manufacturing and storage areas (see 12.2).

11 Mast protection for thatched roofs

11.1 General

The requirements of SANS 62305-3 apply with the additions given in 11.2 to 11.7.

11.2 Dangerous sparking

Dangerous sparking between an LPS and a metal, an electrical or a telecommunication installation can be mitigated

- a) in the case of an isolated LPS, by insulation or separation in accordance with 6.3 of SANS 62305-3:2007;
- b) in the case of a non-isolated LPS, by equipotential bonding in accordance with 6.2, or by insulation or separation in accordance with 6.3 of SANS 62305-3:2007.

11.3 Ageing of thatch

With ageing of the thatch, flammable gases could evolve within the thatch and the thatch could ignite.

NOTE Chemical treatment of the thatch will not prevent the ignition of gases.

11.4 Metals in or on the thatch

11.4.1 The presence of conductive materials could give rise to sparking inside the thatch, with a resulting fire risk. Conductive equipment within the structure and electrical conductors should not be installed within distances to the air-termination system conductors and to down conductors shorter than the separation distance defined in 5.2.4 of SANS 62305-3:2007. Installations shall comply with the requirements of an isolated LPS.

11.4.2 Where thatch is reinforced or protected by wire mesh or similar conductive material, bundles of thatch shall be secured with metal binding wire, and metal-coated insulating sheets shall be included in the thatch to reduce the risk of fire.

11.4.3 Metal sheeting and mesh shall be bonded together to ensure electrical continuity, and connected to the LPS earth.

11.4.4 All metal installed in or on a thatched structure shall be bonded to the main PE conductor.

11.5 Protection by masts

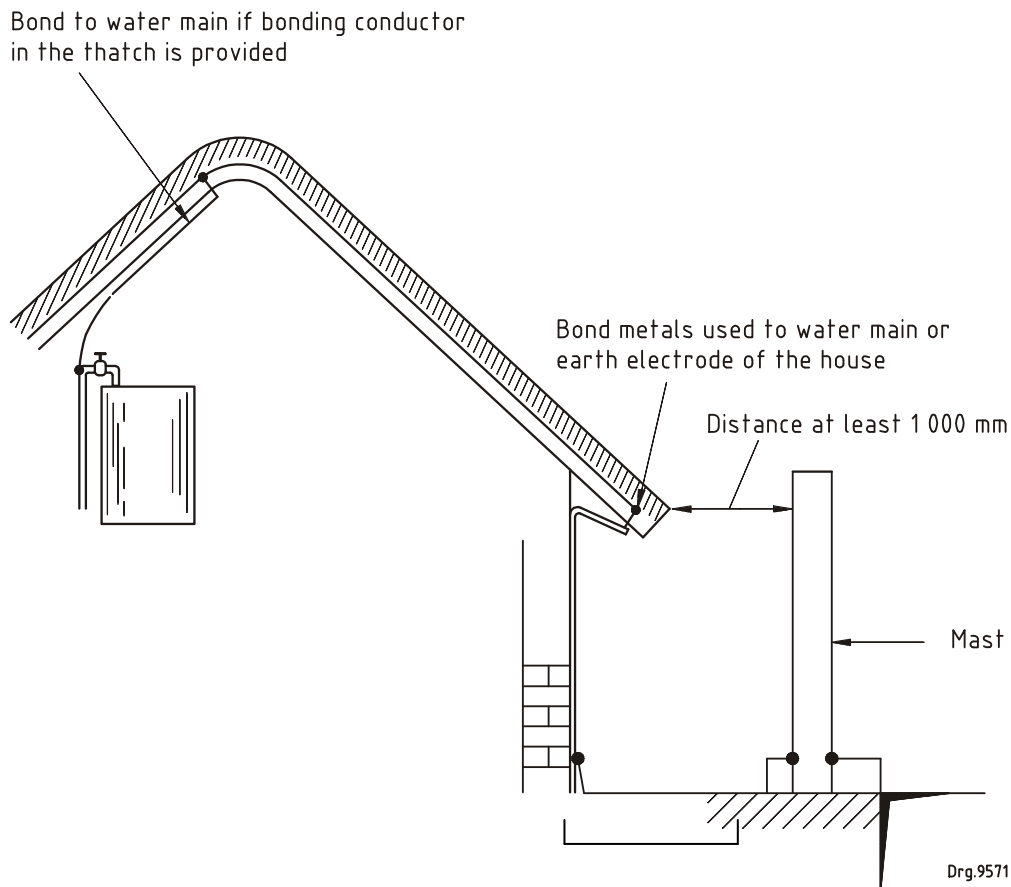
At least lightning protection level III (see SANS 62305-3) will apply in the case of thatched structures. If a metallic mast is used as an LPS, it shall be designed in accordance with SANS 10225. Protection shall be arranged by one or more free-standing masts. The zone of protection of the mast(s) shall include gable ends, chimneys, antennas, vent pipes and any other metal object. Telephone wires, overhead service connections to the electricity supply or other overhead metal wires or pipes shall not enter the structure through or close to the thatch. The distance from the mast to the thatch shall be not less than 1 000 mm. **Amdt 1**

11.6 Earthing of masts

All free-standing masts shall be earthed in accordance SANS 10199, and shall comply with SANS 62305-3.

11.7 Clearance distance between the thatch and the metal objects under the thatch

Metals used in the construction of a thatched roof shall be bonded and earthed. Water pipes, vent pipes, tanks, gas pipes, antennas, telephone and bell wires, burglar alarms and electrical wiring and conduit within 1 000 mm of the thatch shall be shielded, bonded and earthed (see SANS 10142-1).



NOTE A thatched roof is protected by a mast(s).

Amdt 1

Figure 1 — Clearance distance between thatch and the mast

12 Structures with explosive or flammable substances

12.1 General

The requirements of SANS 62305-3 apply with the additions given in 12.2 and 12.3.

12.2 Risk in special locations

In the case of the design and installation of an LPS for a structure with explosive or flammable contents, or in a hazardous location, the LPS designer and installer shall consult a product specialist who can comment on and evaluate the risk with regard to the condition, quantity and sensitivity of explosive or flammable products (see annexes D and E in SANS 62305-3:2007).

NOTE A risk, acceptable to the user, might be present when the quantity of dangerous material is strictly limited, as in a laboratory or a small store, where the structure is sited in an isolated position, or where the structure had been specifically designed to restrict the effects of a catastrophe. In certain circumstances the dangerous materials might be not exposed but completely encased in a metal enclosure of adequate thickness (see annex D in SANS 62305-3:2007). Under these conditions, other than ensuring adequate earthing, lightning protection might not be required. In other situations, the risk to life and property could be so patently obvious that the provision of every means possible for protection from the consequences of a lightning discharge becomes essential.

12.3 Design requirements

12.3.1 A type B ring earth electrode is required, according to 5.4.2.2 of SANS 62305-3:2007, with 100 % of its total length surrounding the structure, and installed at a distance of at least 1 000 mm from the structure in a trench of depth at least 500 mm. Structural reinforcing steel shall be bonded to the PE conductor and the LPS earthing system, with test points provided.

12.3.2 The explosives industry requires an earthing resistance of less than 10 Ω (see annex D of SANS 62305-3:2007). The earthing system shall be tested in accordance with SANS 10199.

12.3.3 The number of earthing points shall be calculated in accordance with SANS 62305-3. Even when the results of the calculation indicate that an LPS is not required, the structure shall still be earthed at a minimum of two points.

12.3.4 The internal ring conductor shall be in accordance with table 9 of SANS 62305-3:2007, and shall be bonded to the LPS earthing system.

NOTE The use of steel frame buildings with metal cladding of all welded construction is now quite common for the storage of explosives.

12.3.5 All conductive surfaces of electrical, instrument and telecommunication cables that enter a space to be protected shall be protected by surge protection and earthed to the bonding bar to prevent lightning currents from entering the protected areas through the cable.

12.3.6 All conductive parts that enter or leave the area shall be protected in the form of sheathing or armouring. Railway lines, piping for gas, water, rain, steam, compressed air or any other service shall be bonded as direct as possible to the LPS earthing system. Underground metallic services shall be bonded to the LPS earthing system. This shall be done at the point where the service enters or leaves the space to be protected (see annex D in SANS 62305-3:2007).

12.3.7 The minimum clearance between the air-termination system and the structure where explosives and flammable substances are handled or stored shall be 1 000 mm, or shall be as required in accordance with SANS 62305-3, whichever is the greater.

12.3.8 All masts shall be installed outside the outer ring of the LPS earthing system.

12.3.9 All inspections, maintenance and tests on the entire LPS shall be done in accordance with SANS 10199 and SANS 62305-3.

12.3.10 Surge arresters shall be installed in accordance with D.5.1.1 in SANS 62305-3:2007.

Annex A

(normative)

Lightning protection system installation safety report

Amdt 1

1. Location												
Physical address:												
Name of building:												
Erf/Lot No.:					Suburb/Township:							
District/Town/City					Province:							
Type of inspection:		Repeat <input type="checkbox"/>			Additional <input type="checkbox"/>			Visual <input type="checkbox"/>				
Acceptance <input type="checkbox"/>		Design <input type="checkbox"/>			During construction <input type="checkbox"/>							
Lightning ground flash density (N_g): (Flashes/km ² /year)				Accepted annual frequency of lightning flashes to structure (N_c):								
Protected space (description):												
Risk assessment done for system?		Yes <input type="checkbox"/>		No <input type="checkbox"/>		Risk assessment report attached?		Yes <input type="checkbox"/>		No <input type="checkbox"/>		
2. Risk assessment												
User-specified acceptable risk				User-calculated risks:			Risk of direct strike R_D	Risk of indirect strike R_I	Calculated risk R			
Tolerance on risk: R_T	1	Loss of human life	10^{-3}				1					
	2	Loss of services	10^{-3}				2					
	3	Loss of cultural heritage	10^{-3}				3					
3. Air-termination system												
Thatched roof:		Yes <input type="checkbox"/>		No <input type="checkbox"/>		Metal roof: Yes <input type="checkbox"/>		No <input type="checkbox"/>		Hazardous location: Yes <input type="checkbox"/>		No <input type="checkbox"/>
Flat roof:		Yes <input type="checkbox"/>		No <input type="checkbox"/>								
LPS level:			I <input type="checkbox"/>		II <input type="checkbox"/>		III <input type="checkbox"/>		IV <input type="checkbox"/>			
Height of structure:			Height of mast/catenary:			Number of mast(s):						
Mast design in compliance with SANS 10225:			Supplier of mast:			Tel. No.:						
Air-termination system:			Protective angle α :			Rolling sphere radius, m:						
Material used:		Lead <input type="checkbox"/>	Steel (stainless or galvanized) <input type="checkbox"/>	Titanium <input type="checkbox"/>	Copper <input type="checkbox"/>	Aluminium <input type="checkbox"/>	Zinc <input type="checkbox"/>					
4. Down conductor system												
Material used:		Steel (stainless or galvanized) <input type="checkbox"/>		Copper <input type="checkbox"/>		Aluminium <input type="checkbox"/>		Spacing between conductors m				
Size of DTS conductor used, mm ²				Is existing structure used as down conductor?		Yes <input type="checkbox"/>	No <input type="checkbox"/>	Description:				
Reinforced concrete/metal used?		Yes <input type="checkbox"/>		No <input type="checkbox"/>								
Mesh design:		Number of down conductors:		Spacing between ring conductors:		Accessible joints/terminations:		Yes <input type="checkbox"/>	No <input type="checkbox"/>			
Accessible joints/terminations:				Pop-riveted <input type="checkbox"/>		Soldered <input type="checkbox"/>						
NOTE The following abbreviation has been used:												
DTS down conductor termination system												

Amdt 1

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Lightning protection system installation safety report (concluded)

Amdt 1

5. Earth-termination system			
Earthing arrangement	Type A	Type B	Particular conditions:
			Reason for earthing arrangement:
Final equivalent earth resistance obtained:		Ω	Soil resistivity: Ωm
6. Lightning equipotential bonding			
Equipotential bonding bar installed:		Yes <input type="checkbox"/>	No <input type="checkbox"/>
System connected to bonding bar installed:		Telecommunication <input type="checkbox"/>	Pipes <input type="checkbox"/>
		Electrical <input type="checkbox"/>	Equipment <input type="checkbox"/>
Material used:		Steel (stainless or galvanized) <input type="checkbox"/>	Copper <input type="checkbox"/>
Conductor size used to connect bonding bar to ETS, mm^2 :		Conductor size used to connect metal installation to ETS, mm^2 :	
7. Surge protective devices (SPDs)			
Design drawing No.:		Main incomer distribution board: Load current A	Prospective short-circuit current rating kA
SPD, class I: nominal a.c. voltage U_N	V	Impulse current I_{imp} : kA (10/350 μs)	Max. back-up fuse current I_k kA
		Voltage protection level at I_{imp} : kV	Follow current extinguishing capability: kA_{rms}
SPD, class II: nominal a.c. voltage U_N	V	Nominal discharge current I_n kA (8/20 μs)	Max. mains overcurrent protection A
		Voltage protection level at I_n : V	Temporary overvoltage (TOV) U_T V/5 s
8. Certification			
I/We, being the person(s) responsible for the design ^a , installation ^a , inspection ^a , testing ^a , of the lightning protection system (LPS), am/are competent to certify that the LPS complies with the requirements of SANS 10313.			
^a Delete where not applicable.			
9. Details of LPS designer			
Name:		ID No.:	Company:
Tel No.:		Signature:	Date:
10. Details of LPS installation installer			
Name:		ID No.:	Company:
Tel No.:		Signature:	Date:
11. Details of fixed electrical installation			
Any work performed on the fixed electrical installation with regard to the LPS shall be witnessed by an accredited person.			
Installation safety report No.:		Date of installation safety report:	
12. Approval signature			
Name of lightning protection inspector:		Company:	
Tel No.:		Date:	
ID No.:		Signature:	
NOTE The following abbreviations have been used:			
DTS down conductor termination system			
ETS earth-termination system			

Amdt 1

Annex B
(normative)

Lightning protection system maintenance certificate

Amdt 1

1. Location			
Physical address:			
Name of building:			
Erf/Lot No.:		Suburb/Township:	
District/Town/City:		Province:	
LPS level:	I <input type="checkbox"/>	II <input type="checkbox"/>	III <input type="checkbox"/>
	IV <input type="checkbox"/>	Date of last inspection:	
Type of inspection:	Repeat <input type="checkbox"/>	Additional <input type="checkbox"/>	Visual <input type="checkbox"/>
	Acceptance <input type="checkbox"/>		
2. Details of LPS installation installer			
Name:		ID No.:	Company:
Tel No.:		Signature:	Date of installation:
3. Details of fixed electrical installation			
Any work performed on the fixed electrical installation with regard to the LPS shall be accompanied by an Installation safety report issued by an accredited person.			
Original Installation safety report No.:		Date of Installation safety report:	
4. Maintenance of LPS structure			
4.1 Air-termination system (ATS)			
Connection between ATS and down conductor:		Acceptable <input type="checkbox"/>	Replaced <input type="checkbox"/>
		Refastened <input type="checkbox"/>	
Material used:	Lead <input type="checkbox"/>	Steel (stainless or galvanized) <input type="checkbox"/>	Titanium <input type="checkbox"/>
		Copper <input type="checkbox"/>	Aluminium <input type="checkbox"/>
		Zinc <input type="checkbox"/>	
Straightness of mast used:		Acceptable: <input type="checkbox"/>	Replaced <input type="checkbox"/>
		Continuity of ATS:	
4.2 Down conductor system (DTS)			
Material used:		Steel (stainless or galvanized) <input type="checkbox"/>	Copper <input type="checkbox"/>
		Aluminium <input type="checkbox"/>	Electrical conductivity of conductors: Ω
Size of DTS conductors used, mm ² :		Accessible joints/terminations:	
Electrical conductivity of shielding measures: Ω		Electrical conductivity of equipotential bonding lines: Ω	
If reinforced concrete/metal parts are used as down conductors, is conductivity still present? Yes <input type="checkbox"/> No <input type="checkbox"/>			
4.3 Earth-termination system			
Earthing arrangement:		Type A	Type B
		Identification of earth connection points visible? Yes <input type="checkbox"/> No <input type="checkbox"/>	
Equivalent earth resistance, Ω :		Soil resistivity, $\Omega.m$:	Earth termination system visible: Yes <input type="checkbox"/> No <input type="checkbox"/>
Connection between DTS and ATS:		Connections acceptable <input type="checkbox"/>	Connections needed refastening ^a <input type="checkbox"/>
		Connections needed to be replaced ^a <input type="checkbox"/>	
Safe dispersing of lightning current:		Yes <input type="checkbox"/>	No <input type="checkbox"/>
^a In the event of connections that were refastened or replaced, please provide a drawing that shows the locations of these connections.			

Amdt 1

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Lightning protection system maintenance certificate (concluded)

Amdt 1

4.4 Lightning equipotential bonding	
Equipotential bonding bar inspected:	Acceptable <input type="checkbox"/> Replaced ^b <input type="checkbox"/>
System connected to bonding bar:	Telecommunication <input type="checkbox"/> Pipes <input type="checkbox"/> Electrical <input type="checkbox"/> Equipment, describe:
Material used: Steel (stainless or galvanized) <input type="checkbox"/> Copper <input type="checkbox"/>	Connection between bonding bar, ETS and DTS: Acceptable <input type="checkbox"/> Repaired ^c <input type="checkbox"/>
Surge protective devices inspection:	Acceptable <input type="checkbox"/> Damaged (reported to electrician) <input type="checkbox"/>
Bonding of metal equipment checked:	Pipes <input type="checkbox"/> Conduit <input type="checkbox"/> Gutters <input type="checkbox"/> Roofs <input type="checkbox"/>
5. Approval signature	
Name of lightning protection inspector: Tel No.: ID No.:	Company: Date: Signature:
NOTE The following abbreviations have been used: ATS air-termination systems DTS down conductor termination system ETS earth-termination system	
^b In the event of an equipotential bonding bar that was replaced, proof of correct installation and reconnection of equipment to the bonding bar shall be shown.	
^c In the event where the connection between the bonding bar, the ETS and the DTS was repaired, proof of the repair by accredited personnel shall be submitted.	

Amdt 1

Annex C

(informative)

Amdt 1

Lightning ground flash density N_g

NOTE For specific areas, contact the South African Weather Services.

Table C.1 — Lightning ground flash density

Amdt 1

1	2	3	4	5	6
Town	N_g	Town	N_g	Town	N_g
Aberdeen	1,8	Gobabis	2,6	Paarl	0,2
Albertinia	0,5	Golden Gate	6,4	Petrus Steyn	4,4
Alexandria	0,8	Grabouw	0,2	Pietermaritzburg	7,0
Aliwal North	5,3	Graaff-Reinet	2,5	Piet Retief	11,7
Aranos	1,6	Grahamstown	1,4	Piketberg	0,2
Aroab	1,7	Greytown	5,5	Polokwane (Pietersburg)	3,6
Barberton	7,5	Groblersdal	5,1	Pongola	6,3
Beaufort West	1,7	Harding	5,5	Port Alfred	1,4
Belfast	7,3	Harrismith	9,4	Port Elizabeth	0,9
Bela Bela	7,5	Heidelberg (WC)	8,0	Potchefstroom	7,0
Benoni	7,5	Heilbron	5,8	Pretoria	7,5
Bergville	6,3	Hermanus	0,1	Prieska	3,0
Bethal	8,6	Hluhluwe	6,0	Prince Albert	0,6
Bethlehem	6,4	Hoedspruit	2,8	Queenstown	5,2
Bethulie	3,3	Humansdorp	1,1	Reddersburg	6,4
Bloemfontein	5,2	Irene	7,2	Richards Bay	5,2
Bloemhof	4,8	Jagersfontein	2,2	Richmond (KZN)	8,0
Blyderivierspoort	4,5	Johannesburg	7,5	Riversdale	0,2
Boksburg	7,5	Jozini	5,6	Roedtan	4,9
Brakpan	7,5	Keetmanshoop	1,2	Rustenburg	8,1
Brandvlei	0,9	Kempton Park	7,5	Sabie	3,2
Brits	8,0	Keiskammahoek	2,0	Satara	1,5
Bultfontein	3,6	Kimberley	4,8	Schweizer-Reneke	5,6
Burgersdorp	3,3	King William's Town	1,1	Scottburgh	3,0
Butterworth	0,9	Klerksdorp	7,0	Senekal	4,7
Cala	5,2	Knysna	0,4	Sishen	3,4
Caledon	0,2	Komatipoort	2,6	Skukuza	2,3
Calvinia	0,7	Kroonstad	5,8	Somerset East	0,8
Cape Town	0,3	Krugersdorp	7,0	Springbok	0,6
Carletonville	7,5	Kuruman	3,0	Springs	7,5
Carnarvon	1,1	Ladybrand	5,4	Standerton	7,6
Carolina	9,0	Ladismith (WC)	0,7	Stanger	3,5
Cathcart	1,6	Ladysmith (KZN)	9,0	Stellenbosch	0,3
Cedara	8,0	Laingsburg	0,6	Steytlerville	1,7
Ceres	0,2	Lichtenburg	5,5	Sutherland	0,9
Christiana	6,4	Loskop	4,3	Swakopmund	0,5
Colenso	7,8	Lüderitz	0,4	Tarkastad	3,4
Colesberg	3,0	Lydenburg	5,0	Thabazimbi	2,1
Cradock	5,8	Machadodorp	8,7	Theunissen	5,2
De Aar	2,5	Mafikeng	5,6	Touws River	0,3
Delareyville	5,4	Makhado	1,5	Tsumeb	4,0
Donnybrook	8,5	Malmesbury	0,1	Tzaneen	4,1
Doornfontein	7,3	Mandini	3,4	Umtata	3,0
Dordrecht	2,6	Margate	1,8	Uniondale	0,6
Douglas	4,0	Marikana	6,9	Upington	2,2
Dundee	9,2	Matatiele	6,6	Utrecht	9,0
Durban	4,4	Middelburg (EC)	3,3	Ventersdorp	5,6
East London	1,6	Middelburg (Mpumalanga)	4,6	Vereeniging	7,5
Edenvale	5,6	Modimolle	7,0	Victoria West	1,4
Elliott	4,2	Mokopane	3,4	Villiersdorp	0,4
Empangeni	4,1	Molteno	1,6	Vredendal	0,2

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Annex C (concluded)**Amdt 1**

1	2	3	4	5	6
Town	N_g	Town	N_g	Town	N_g
Ermelo	9,0	Montagu	0,2	Vryburg	3,0
Eshowe	5,3	Mooi River	6,9	Vryheid	8,9
Evander	8,5	Mookgopong	6,0	Walvis Bay	0,2
Flagstaff	4,9	Mossel Bay	0,5	Welkom	5,0
Fort Beaufort	1,4	Murraysburg	1,9	Willowmore	1,5
Fraserburg	1,3	Nelspruit	2,7	Windhoek	2,3
George	1,5	Nossop	2,2	Witbank	7,5
Georgedale	5,6	Noupoort	7,4	Zeerust	4,2
Germiston	7,5	Ohrigstad	4,2		
Giant's Castle	13,0	Oshakati	2,3		
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