CD/K/069-5:2009
ICS 13.060.20; 93.025

EAST AFRICAN STANDARD

Development, maintenance and management of groundwater resources — Part 5: The design, selection and performance of pumping equipment for production boreholes

EAST AFRICAN COMMUNITY

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

East African Community

P O Box 1096

Arusha

Tanzania

Tel: 255 27 2504253/8

Fax: 255-27-2504481/2504255

E-Mail: eac@eachq.org

Web: www.each.int

Introduction

In the preparation of this East African Standard, the following source was consulted extensively:

SANS 10299-5:2003, *Development, maintenance and management of groundwater resources — Part 5: The design, selection and performance of pumping equipment for production boreholes*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

SANS 10299-5:2003
Edition 1.2

Table of changes

Change No.	Date	Scope
Amdt 1	2002	Amended to update normative references.
Amdt 2	2003	Amended to update referenced standards and to delete the definitions, since reference has now been made to SANS 10299-0.

Foreword

This South African standard was approved by National Committee STANSA SC 5120.12B, *Water supply, equipment and systems – Groundwater extraction*, in accordance with procedures of Standards South Africa, in compliance with annex 3 of the WTO/TBT agreement.

This edition cancels and replaces edition 1.1 (SABS 0299-5:2002).

A vertical line in the margin shows where the text has been modified by amendment No. 2.

Annex A forms an integral part of this part of SANS 10299. Annex B is for information only.

SANS 10299 consists of the following parts, under the general title *Development, maintenance and management of groundwater resources:*

Part 0: Glossary of terms.

Part 1: The location and siting of water boreholes.

Part 2: The design, construction and drilling of boreholes.

Part 4: Test-pumping of water boreholes.

Part 5: The design, selection and performance of pumping equipment for production boreholes.

Part 6: The installation and commissioning of pumping equipment for production boreholes.

Part 7: The rehabilitation of water boreholes.

Part 8: The management of water boreholes.

Part 9: The decommissioning of water boreholes.

Contents

This page is intentionally left blank

Development, maintenance and management of groundwater resources

Part 5:
The design, selection and performance of pumping equipment for production boreholes

1 Scope

1.1 This part of SANS 10299 covers the design, selection and performance of pumping equipment intended for production boreholes.

1.2 It does not cover equipment for boreholes intended for exploration, dewatering or monitoring purposes.

1.3 It also does not cover the design, selection or performance of any surface delivery piping, distribution systems or storage facilities.

NOTE For the selection of components for major distribution systems, it is recommended that designers consult the appropriate part of SANS 1200.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of SANS 10299. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this part of SANS 10299 are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below. Information on currently valid national and international standards can be obtained from Standards South Africa.

DIN VDE 0278-623, *Power cable accessories with rated voltages* U *up to 30 kV (*U_m *up to 36 kV) – Part 623: Specification for joints, stop ends and outdoor terminations for distribution cables of rated voltage 0,6/1 kV; German version HD 623 S1:1996.* **Amdt 1**

ISO 9906, *Rotodynamic pumps – Hydraulic performance acceptance tests – Grades 1 and 2.* **Amdt 1**

~~SABS 152, *Low-voltage air-break switches, air-break disconnectors, air-break switch-disconnectors, and fuse-combination units.*~~ **Amdt 2**

SANS 62-1, *Steel pipes – Part 1: Pipes suitable for threading and of nominal size not exceeding 150 mm.* **Amdt 1**

SANS 62-2 (SABS 62-2), *Steel pipes – Part 2: Screwed pieces and pipe fittings of nominal size not exceeding 150 mm.* **Amdt 1**

SANS 664 (SABS 664), *Cast iron gate valves for waterworks.*

SANS 665 (SABS 665), *Cast iron gate valves for general purposes.*

SANS 767-1 (SABS 767-1), *Earth leakage protection units – Part 1: Fixed earth leakage protection circuit-breakers.*

SANS 776 (SABS 776), *Copper alloy gate valves – Heavy duty.* **Amdt 1**

SANS 1056-2 (SABS 1056-2), *Ball valves – Part 2: Heavy duty valves (not fire-safe).*

SANS 1056-3 (SABS 1056-3), *Ballvalves – Part 3: Light duty valves (not fire-safe).*

SANS 1062 (SABS 1062), *Pressure and vacuum gauges.*

SANS 1507-1 (SABS 1507-1), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 1: General.* **Amdt 2**

SANS 1551-1 (SABS 1551-1), *Check valves (flanged and wafer types) – Part 1: PN series.*

SANS 4427/ISO 4427 (SABS ISO 4427), *Polyethylene (PE) pipes for water supply – Specifications.* **Amdt 1**

SANS 10299-0, *Development, maintenance and management of groundwater resources – Part 0: Glossary of terms.* **Amdt 2**

SANS 10299-4, *Development, maintenance and management of groundwater resources – Part 4: Test-pumping of water boreholes.*

SANS 10299-6, *Development, maintenance and management of groundwater resources – Part 6: The installation and commissioning of pumping equipment for production boreholes.*

SANS 60934/IEC 60934 (SABS IEC 60934), *Circuit-breakers for equipment (CBE).*

SANS 60947-2/IEC 60947-2 (SABS IEC 60947-2), *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers.*

SANS 60947-3/IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units.* **Amdt 2**

3 Definitions

For the purposes of this part of SANS 10299, the definitions given in SANS 10299-0 apply. **Amdt 2**

4 Systems development

4.1 Design

4.1.1 General

The design of the pumping plant and the selection of the appropriate equipment shall be in accordance with the requirements given in this part of SANS 10299. The design of the entire water supply system shall be carried out by the systems designer.

4.1.2 Pumping rate

The designed pumping rate of a specific pumping plant shall not exceed the recommended pumping rate given in SANS 10299-4.

4.2 Presentation of design criteria

4.2.1 Systems designer's information

The owner shall make available to the systems designer all information and details of the borehole that will be needed to ensure an effective design (see SANS 10299-4).

4.2.2 Agreement between systems designer and owner

Before any installation is undertaken, the systems designer and the owner shall come to an agreement and sign a design contract (see 4.2.3) regarding the design of the pumping system, the selection of the various component parts and the overall performance of the system.

4.2.3 Presentation of design features

The design contract shall be considered finalized and complete only when the owner has been presented with, and has signed, a duplicate copy of the design certificate shown in annex A. All the information required on the certificate shall be addressed. For major pumping plants, when additional information is required by the owner, such additional information shall be given on the certificate and the details shall be addressed by the systems designer.

4.2.4 Final agreement

The design certificate, signed by both the owner and the systems designer, is considered to be the final agreement regarding the design of the pumping system and the equipment that is to be installed.

No installation of any equipment shall be undertaken (see 4.2.1 of SANS 10299-6) before the above design certificate has been signed by both parties.

5 Design requirements

5.1 Details of borehole

To ensure efficient design and eventually efficient performance of the pumping plant, full details of the borehole shall be made available to the parties involved in the design, selection and eventual installation (see SANS 10299-6) of the pumping equipment. The details shall be as reflected in the borehole report that was developed for the borehole during test-pumping (see SANS 10299-4).

5.2 Duty points of pumping system

5.2.1 Depth of installation

The design shall allow for the pump to be installed at a depth of at least 3 m above the bottom of the borehole or, when relevant, the higher of the following:

a) any slotted casings or screens; and

b) the point of inflow.

If, in the case of submersible pumps, the depth setting does not allow an upflow of water past the motor, the design shall allow for a flow inducer tube or other acceptable flow inducer. If the pump cannot be installed as above, the distance of 3 m may be altered, provided that the reason is given on the design certificate (see annex A).

5.2.2 Operating conditions

The discharge capacity and the pressure head at ground level shall be given on the design certificate (see annex A).

5.3 Components of the borehole pumping plant

The borehole pumping plant shall comprise the following components:

a) the pump and its drive unit;

b) the rising main and, when relevant, the pump drive shaft;

c) in the case of electrically driven pumping plants, all electrical apparatus between the pump motor and the local authority's power supply point or point of control, as relevant;

d) all other component parts that are applicable to the pumping plant but that are not included in the basic borehole, for example the casing, screens and the wellhead foundation;

e) the pump head and head outlet fittings;

f) the water control fittings at the wellhead; and

g) a non-return valve in the rising main directly above the pump if, in the case of a submersible pump, a non-return valve is not included as an integral part of the pump.

5.4 Performance of pumping system

The pumping system shall be so designed that, when installed to the designed depth, it will supply water at the discharge rate and at the pressure head given on the design certificate (see annex A).

5.5 Degradation of material

In certain areas, groundwater might prove aggressive to certain types of material and, in such cases, special attention will have to be paid to the types of material used for pumps and pipes.

NOTE In this regard, special attention is drawn to the probable dezincification of brass components in contact with water.

6 Selection

6.1 General

The individual component parts shall be selected with a view to ensuring acceptable performance of the assembled pumping system after installation and commissioning. To ensure acceptable and consistent performance of the pumping plant, cognizance shall, during selection of the type, make and size of the particular pump, be taken of the given parameters of the borehole, for example, quality of water (suspended matter, pH value, etc.), straightness, verticality, depth, diameter, etc. (see SANS 10299-4).

6.2 Pump

6.2.1 General

The type, make and size of the pump shall be as agreed upon between the owner and the systems designer (see annex A).

6.2.2 Physical dimensions

The physical dimensions of the pump shall be such as to facilitate its easy installation in, and its easy removal from, the borehole.

6.3 Combination of drive shaft and rising main (when applicable)

If the pumping plant incorporates its own and specific combination of drive shaft and rising main, the verticality and straightness of the borehole are of particular importance. The appropriate details shall be obtained from the borehole test report and shall be considered when the combination of drive shaft and rising main is being selected.

6.4 Rising mains

6.4.1 General

The type of material used for rising mains and the type and design of intermediate jointing components and of end connections shall be such as to ensure that the installed rising main can support the total mass of the rising main filled with water plus the mass of the pump and associated equipment.

6.4.2 Rising mains associated with rotating drive shafts

6.4.2.1 Turbine pumps

A rising main associated with a turbine pump shall

a) be of steel,

b) be of a design acceptably suited to the pump,

c) have connecting threads (machined and parallel) and pipe couplings acceptably suited to the pump, and

d) contain the appropriate drive shafts as supplied by the pump supplier.

6.4.2.2 Helical-rotor progressing cavity pumps

A rising main associated with a helical-rotor progressing cavity pump shall

a) be of steel,

b) contain the appropriate drive shafts supplied by the pump supplier,

c) in the case of sizes up to and including 50 mm, comply with SANS 62-1, be of at least a medium grade and be complete with taper threads, and

d) in the case of sizes in excess of 50 mm, be of a heavy grade and be complete with acceptable truncated threads.

6.4.2.3 Hand pumps

A rising main associated with a hand pump shall

a) comply with SANS 62-1 and be of at least a medium grade, and

b) contain the appropriate drive shafts supplied by the pump supplier.

6.4.3 Rising mains that comply with SANS 62-1

The pipes of rising mains that comply with SANS 62-1 shall

a) be furnished with wrought steel sockets that comply with SANS 62-2 since malleable fittings are prohibited,

b) be corrosion protected in accordance with SANS 62-1,

c) where associated with reciprocating pump rods, be in exact lengths as given in SANS 62-1,

d) when not associated with pump rods, be in random lengths or in exact lengths, as agreed upon (see annex A), and

e) be of a size appropriate to the design of the pump that is selected.

6.4.4 Plastics rising mains for submersible and jet pumps

The pipes for plastics rising mains for submersible and jet pumps shall comply with the requirements of SANS 4427, and shall be of a class and size suited to the pump. **Amdt 1**

Pipe couplings required to join different lengths of plastics pipe and for end connections shall be of the compression type specially designed for plastics pipe. On no account shall the pipe be screwed and joined with screw-type fittings or insert fittings.

6.4.5 Flexible hose type rising mains

The hose for flexible hose type rising mains shall, in terms of quality, strength, durability and design, be of an acceptable grade.

6.5 Dipper tube (conduit tube)

A dipper tube may be used as a guide and protector for the depth gauge monitor. If used, the tube shall be an HDPE pipe of diameter at least 15 mm. The tube shall be attached to the rising main in an acceptable manner.

6.6 Pressure gauges

Pressure gauges shall comply with SANS 1062.

6.7 Water control valves

Valves shall comply with the appropriate of the following:

a) copper alloy gate valves – SANS 776;

b) cast iron gate valves – SANS 664 or SANS 665, as agreed upon;

c) ball valves – SANS 1056-2 or SANS 1056-3, as agreed upon; and

d) check valves – SANS 1551-1.

6.8 Electrical components

6.8.1 Electric motors

The type and rating of the electric motor (if used) shall be as agreed upon.

6.8.2 Isolators

Isolators shall comply with SANS 60947-3, and shall, when so required by the owner, be of the lockable type. **Amdt 2**

6.8.3 Earth leakage protection

The pumping plant shall be protected by one earth leakage protection circuit-breaker that complies with SANS 767-1.

6.8.4 Circuit-breakers

Electric motors shall be protected by circuit-breakers that are rated for the full load current of the motor. The circuit-breakers shall be fitted with magnetic and thermal overload protection units that, after tripping, require only manual resetting. Circuit-breakers shall comply with SANS 60934 and SANS 60947-2.

6.8.5 Three-phase starters

A three-phase starter shall, for the purpose of future identification, be furnished with a nameplate that bears information identical with that of the motor it serves.

6.8.6 Run-dry protection

To facilitate protection against running dry, pumping plants shall, unless otherwise agreed upon (see annex A), be furnished with an acceptable type of low-water-level protection device.

6.8.7 Electric cables

6.8.7.1 Cables shall comply with SANS 1507-1. **Amdt 2**

6.8.7.2 The size and length of cables for pumps of diameter 100 mm and 150 mm, measured from the power source to the motor, shall be as given in table 1 for single-phase motors and in table 2 for three-phase motors.

6.8.7.3 Surface cables shall be armoured.

6.8.7.4 In the case of submersible pumps, the portion of the cable that is used in the borehole shall be designed for underwater use.

6.8.8 Submerged cable joints

Submerged cable joints shall be of the encapsulated epoxy type and shall comply with DIN VDE 0278-623. **Amdt 1**

Table 1 — Single-phase motor — Maximum length of copper cable

1	2	3	4	5	6	7	8	9	10	11	12
Motor rating at 220 V and 50 Hz kW	**Cable size** mm^2										
	1,5	**2,5**	**4**	**6**	**10**	**16**	**25**	**35**	**50**	**70**	**95**
	Maximum length of cable m										
0,25	170	280	450	670	1 130	1 750	2 640	3 590	4 940	6 560	8 110
0,37	120	200	320	480	810	1 260	1 900	2 590	3 580	4 770	5 920
0,55	80	130	220	320	550	850	1 290	1 760	2 430	3 230	4 000
0,75	60	100	170	250	430	670	1 010	1 380	1 910	2 550	3 160
1,1	40	70	120	180	300	470	710	980	1 360	1 850	2 320
1,5	30	60	90	130	230	360	550	760	1 060	1 440	1 820
2,2	20	40	60	90	150	230	350	490	680	920	1 160
NOTE These are maximum lengths of cable, in metres, from power source to motor.											

Table 2 — Three-phase motor — Maximum length of three-wire copper cable

1	2	3	4	5	6	7	8	9	10	11	12
Motor rating at 380 V and 50 Hz kW	**Cable size mm^2**										
	1,5	**2,5**	**4**	**6**	**10**	**16**	**25**	**35**	**50**	**70**	**95**
	Maximum length of cable m										
0,37	810	1 350	2 160	3 240	5 500	8 530					
0,55	550	920	1 480	2 230	3 780	5 860	8 890				
0,75	410	680	1 090	1 640	2 780	4 330	6 570	9 010			
1,1	300	500	810	1 210	2 060	3 200	4 850	6 640	9 220		
1,5	220	370	590	880	1 500	2 340	3 560	4 890	6 830	9 230	
2,2	150	250	400	600	1 030	1 600	2 440	3 350	4 680	6 340	7 990
3	110	190	310	460	790	1 230	1 880	2 590	3 630	4 930	6 230
3,7	90	150	240	370	630	980	1 490	2 050	2 870	3 900	4 920
4	80	140	230	340	590	920	1 390	1 910	2 670	3 600	4 520
5,5	60	110	170	260	440	690	1 060	1 450	2 030	2 750	3 460
7,5	50	80	130	200	340	530	810	1 110	1 560	2 120	2 680
11		50	90	130	230	360	550	750	1 060	1 440	1 820
15			70	100	170	270	410	570	800	1 080	1 370
18,5				80	140	210	330	450	630	860	1 090
22				70	120	180	280	380	540	740	930
30					90	130	210	280	400	540	680
37						110	170	230	320	440	550
NOTE These are maximum lengths of cable, in metres, from power source to motor.											

6.9 Engine

The make, type, size and model of engine (if used) shall be as agreed upon (see annex A).

7 Marking

7.1 General

7.1.1 The following information shall be given in clear and indelible marking on a permanently fixed nameplate on the pump and on the motor or engine, as relevant:

a) **motor:** at least the compulsory information applicable to electric motors;

b) **engine:** at least the compulsory information applicable to engines; and

c) **pumps:**

1) the name of the manufacturer;

2) the model number; and

3) the serial number.

7.1.2 When so required by the owner, the name of the manufacturer shall be given in clear and indelible stampings on all combinations of rising main and drive shaft.

7.2 Performance information

The pump shall be accompanied by

a) brochures or manuals that give details of performance characteristics (curves or tables guaranteed within the limits and qualifications detailed in ISO 9906), **Amdt 1**

b) recommended operating instructions, precautions, safety requirements and regular maintenance requirements, and

c) when so required by the owner for a specific pump, an official witness test report from an approved test station that verifies the rated operating parameters of the pump in accordance with ISO 9906. **Amdt 1**

The above information shall be handed to the owner after the pumping equipment has been installed.

Annex A
(normative)

Design certificate

The following certificate shall be completed in triplicate by the systems designer and shall be signed and handed to the owner. All details required on the certificate shall be addressed. The certificate shall be accompanied by a document that gives the operational characteristics of the borehole (this document shall have been obtained from the owner).

In the case of private boreholes or where the owner does not have sufficient knowledge of boreholes and associated equipment, the certificate may be regarded as an official quotation and can be used to investigate the suitability of the design offered.

Once the owner is satisfied with the pumping plant offered, the certificate (in triplicate) shall be signed by the owner and one copy shall be handed back to the systems designer. After the certificate has been signed, it will be considered to be the official agreement between the owner and the systems designer regarding the extent of the pumping equipment offered, and the installation (see SANS 10299-6) shall be carried out strictly in accordance with the details given on the certificate.

Design certificate for pumping equipment

A. General 1) The borehole number 2) The address at which the borehole is situated 3) The name of the owner 4) Have the details of the borehole characteristics been made available for design purposes? 5) Is a copy of the document on borehole characteristics attached? 6) Total depth of borehole 7) Pump/cylinder depth 8) Discharge capacity 9) Pressure head at ground level (when relevant)	
B. Hand pumps 1) Rotary or reciprocating 2) Type 3) Make	
C. Windmill 1) Type and make 2) Size of wheel 3) Height of windmill stand 4) Size of pump cylinder 5) Size of pump rods	
D. Power-driven pump 1) Type 2) Make 3) Size 4) Description 5) Pump drive speed	
E. Drive Make, type, size and model of electric motor or engine	
F. Rising main 1) Total length of rising main 2) Exact or random lengths 3) Nominal diameter (size) of rising main 4) Type and grade of material of rising main 5) Pressure rating of rising main	
G. Plastics rising main 1) What type of hose is used? 2) What type of joint is used – plastics to plastics or plastics to steel?	
H. Non-return valve (for submersible pumps) Where is the non-return valve positioned?	
I. Details of electric equipment 1) Voltage rating 2) Current rating 3) Type of cable 4) Rating of cable 5) Length of cable from power supply point 6) Type, make and rating of switchgear 7) Type, make and rating of starters 8) Are lightning protectors supplied? 9) Describe any other safety equipment supplied a) b) c)	
J. Information regarding particular details of installation	

Annex B
(informative)

Bibliography

SANS 1200 (SABS 1200) (all parts), *Standardized specification for civil engineering construction.*

ICS 13.060.10; 23.080

ISBN 0-626-14913-4

SANS 10299-5:2003

Edition 1.2

Any reference to SABS 0299-5 is deemed
to be a reference to this standard
(Government Notice No. 1373 of 8 November 2002)

SOUTH AFRICAN NATIONAL STANDARD

Development, maintenance and management of groundwater resources

Part 5: The design, selection and performance of pumping equipment for production boreholes

Published by Standards South Africa
1 dr lategan road groenkloof ✉ private bag x191 pretoria 0001
tel: 012 428 7911 fax: 012 344 1568 international code + 27 12
www.stansa.co.za

standards SouthAfrica
(a division of SABS)