RWANDA STANDARD

RS 349

First edition
2017-mm-dd

FOR PUBLIC COMMENTS

Domestic portable biogas — Requirements

Rwanda Standards Board

Reference number
DRS 349: 2017

© RSB 2017

In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition

© RSB 2017

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without prior written permission from RSB.

Requests for permission to reproduce this document should be addressed to:

Rwanda Standards Board

P.O Box 7099 Kigali-Rwanda

KK 15 Rd, 49

Tel. +250 252 586103/582945

Toll Free: 3250

E-mail: info@rsb.gov.rw

Website: www.rsb.gov.rw

FOR PUBLIC COMMENTS

Contents

Page

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 349 was prepared by Technical Committee RSB/TC 023, *Mechanical Engineering and Metallurgy.*

In the preparation of this standard, reference was made to the following standard (s):

The assistance derived from the above source is hereby acknowledged with thanks.

Committee membership

The following organizations were represented on the Technical Committee on Engineering and Metallurgy (RSB/TC 023) in the preparation of this standard.

ABEM Engineering and Manufacturing

AQUASAN

Chillington Rwanda

Integrated Polytechnic Regional Centre - Kigali (IPRC-Kigali)

Master Steel

Nikil and Consultant

Rwanda Agriculture Board (RAB)

Rwanda Environment Management Authority (REMA)

Rwanda Utilities Regulatory Authority (RURA)

SAFINTRA

SULFO

Titus and Technology Engineering and Agrotechnology Ltd (TKEA)

University of Rwanda/College of Arts, Social Sciences

Rwanda Standards Board (RSB) – Secretariat

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

Domestic portable biogas — Requirements

1 Scope

This Draft Rwanda Standard covers the requirements and methods of test for the domestic portable plastic biogas used for biogas energy production in home cooking and lighting.

The standard is not applicable to underground biogas and institutional biogas.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 1209-1, *Rigid cellular plastics — Determination of flexural properties — Part 1: Basic bending test*

ISO 1209-2, *Rigid cellular plastics — Determination of flexural properties*

Part 2, *Determination of flexural strength and apparent flexural modulus of elasticity*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1

biogas digester

simple system which produces biogas, via the natural anaerobic decomposition of organic material

3.2

digester/biodigester/bio-reactor/anaero bic reactor

any water and air tight container designed for the process of anaerobic microbiological degradation of organic matter into which the slurry is introduced for digestion and methanization

3.3

stirrer

mixer

agitator

mechanical device inside the digester used to stir the slurry

3.4

gas chamber

space inside or outside the digester for the collection and storage of biogas

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

3.5

gas bolder retainer

cantilever beam that holds the gasholder/movable cover in position at the desired biogas pressure

3.6

outlet pipe

serves as conveyor where the effluent or the slurry is forced out

3.7

loading rate

amount of slurry fed per unit volume of digester capacity per day

3.8

substrate

organic material used to produce bio gas

3.9

seeding

adding or introducing anaerobic bacteria to the digester

3.10

slurry

mixture of manure and water

3.11

freeboard

difference in height between the digester wall and the filling line

3.12

filling line

level of slurry when the digesters is at full load

3.13

retention time

average period that a given quantity of slurry is retained in the digester for digestion

3.14

toxic materials

materials that inhibit the normal growth of pathogens in the digester such as mineral ions, heavy :metals and detergents

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

3.15

metbanization

digestion

various processes that take place among the methanogens, non-methanogens and substrates fed into the digester as inputs

3.16

metbanogens

anaerobic bacteria that act upon organic materials and in the process, produce biogas

3.17

collecting tank/inlet tank

chamber where substrate and water are collected, stored and separated from heavy and non-biodegradable materials before feeding them into the digester

3.18

gas production rate

amount ofbiogas produced per day per cubic meter of slurry

3.19

biogas

mixture of gas (composed of 50 to 70 % methane and 30 to 40 % carbon dioxide) produced by methanogenic bacteria

3.20

scum

layer of floating material (mainly fibrous) on the slurry

3.21

sludge

settled portion or precipitate of the slurry; a mud-like, semi-solid mass

3.22

inlet pipe

serves as conveyor of the substrate-water mixture or slurry from the mixing tank to the digester

3.23

gas chamber/gas holder

space inside or outside the digester for the collection and storage of biogas

3.24

effluent

residue that comes out at the outlet after the substrate is digested/processed inside the digester

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

3.25

backfill

layer of compacted soil and gravel to support the digester wall

3.26

mesophilic temperature range

temperature range of 20°C - 40 °C where mesophilic bacteria operate

3.27

biomass

biomass is organic material that is plant-based or animal-based, including but not limited to dedicated energy crops, agricultural crops and trees, food, feed and fibre crop residues, aquatic plants, alga, forestry and wood residues, organic agricultural, animal and processing by-products, agricultural, municipal and industrial organic waste and residues whether or not in landfills, sludge, waste water, and other non-fossil organic matter

3.28

domestic biogas

biogas which uses biomass from 1 household for its own use and consists of a digester and an application for cooking, heating or lighting only

4 Requirements

4.1 General

4.1.1 The mixing tank, digester and gas holder for portable domestic biogas shall be made either by using tank in HDPE LDDPE, and laminated woven polyethylene or by plastic container in PVC material.

4.1.2 The domestic portable biogas shall consist of inlet/ mixing chamber; digester (digestion chamber); gas holder (storage chamber-dome); outlet; gas conveyance system; and slurry compost pit(s) or any other means for collecting the slurry.

4.1.3 The materials for moulding shall be of rotational moulded grade and duly stabilized with anti-oxidants and shall include black pigments compatible with polyethylene resin, curing agents, catalysts and ultraviolet stabilisers. No Fillers shall be used in the moulding.

4.1.4 The percentage of carbon black content in the material shall be within 2.0 to 3.0 and its dispersion of carbon black shall be satisfactory

4.1.5 The materials like polyethylene, PVC should be UV treated and thickness of biogas digester shall be made of minimum 4.50 mm to 5.50 mm average wall and bottom thickness for digester, Gas holder, inlet & outlet pipe for 2 to 6 m3 capacity Biogas plants and in the range of average thickness from 6.6 mm to 8.2 mm for 6 to 10 m3 capacity biogas plants with provision of inlet and outlet pipe of the same size.

4.1.6 Wherever, water jacket is provided, the thickness of water jacket should be at least 4.40 mm.

4.1.7 Biogas holder shall be made of 4.40 mm average minimum thickness with provision for outlet connections and higher thickness for higher capacity biogas plants as mentioned above under 4.1.6.

4.1.8 The PVC container shall be fitted over the steel frame work and held firmly against it.

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

4.1.9 Domestic portable biogas shall be manufactured such as the deformation due to environmental condition shall not be greater than 2 % of the original measurements.

4.1.10 Tensile strength shall not be less than 12 N/mm2 and the digester shall not have any leakage while tested for hydrostatic pressure head test

4.1.11 Domestic portable biogas shall be protected to prevent children and others from using it for purposes other than intended.

4.1.12 Metallic material used for manufacturing of domestic portable digester shall be constructed in manner that enable the user to avoid hazards from them and shall be non corrosive materials.

4.1.13 Material of construction of Biogas digester and Gasholder shall be such that it does not impart any colour, odour nor any toxic effect and it shall not contaminate biogas slurry.

4.1.14 Digester shall be sized to retain the volume of manure and water at the design total solids concentration for the digester design retention time.

4.1.15 Inlet and outlet pipe shall be connected to facilitate process flow and shall be made of 4" UPVC/PVC. Inlet connections shall be of 4'' UPVC/PVC with adequate gaskets and check nut.

4.1.16 Outlet connection shall be an integral part of biogas digester and shall be compatible with 4'' flexible UPVC/PVC pipe and joint finished in such a way that no leakage of biogas plant slurry takes place during the life span of the domestic portable biogas plant.

4.1.17 Gas outlet valve shall be of minimum ½" with inside threaded connections and leaving no chance of gas leakage at the base of joint with Gasholder

4.1.18 Gas outlet connection shall be adequate for the gas outlet valve with adequate gasket and check and gas outlet pipe shall be of PVC or HDPE 4.1.20 Internal and external surface of the biogas digester and biogas holder shall be smooth, clean and free from other hidden internal defects, such as air bubbles, pits and metallic or other foreign material inclusions.

4.1.19 Inlets shall be of any permanent type designed to resist corrosion, plugging, freeze damage, and prevent gas loss.

4.1.20 The digester shall be equipped with an outflow device, such as an underflow weir, that will maintain the operating level, maintain a gas seal under the cover, prevent gas loss, and release effluent directly to separation, storage, or other treatment facility.

4.1.21 The biogas collection, transfer, and control system shall be designed to convey captured gas from within the digester to gas utilization equipment or devices (flare, boiler, engine, etc.).

4.1.22 The gas collection system within the digester shall be designed to facilitate exclusion of floating debris.

4.1.23 Pipe and components within the digester shall be securely anchored to prevent displacement from normal forces including loads from accumulated scum

4.1.24 The digester cover shall be designed for all internal and external loads and shall capture and convey the biogas to a designed gas outlet. The cover system shall be designed to exclude the entrance of air under all operating conditions.

4.1.25 Pipes shall be constructed to enable all sections to be safely isolated and cleaned as part of routine maintenance.

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

4.1.26 Transfer pipe can be buried or installed above ground and must include provisions for drainage of condensate.

4.1.27 Equipment and components shall have a service life of not less than 2 years and shall be readily accessible for replacement or repair. The life span for the biogas digester shall not be less than 15 years.

4.1.28 Gas pipe installed within buildings shall be of type approved for combustible gas.

4.1.29 Where electrical service is required at the control facility, the installation and all electrical wire, fixtures, and equipment shall meet the RS 116-1 and National Electrical Code.

4.1.30 Equipment needed to properly monitor the digester and gas production shall be installed as part of the system. The following equipment may be installed:

a) Pressure gauge ;

b) gas meter suitable for measuring biogas

4.2 Biogas production

4.2.1 The biogas (biomethane) produced shall be free from liquids particulate matter such dust, dirt and mist over the entire range of temperatures and pressures.

4.2.2 The biogas shall be produced by anaerobic digestion of the biomass. The biomass shall containing substrates for anaerobic digestion such as: manure, sludge, household waste, agricultural waste, food residues.

4.2.3 The feed material shall be mixed with water to make fluent slurry. Unwanted materials such as straw, stones and dirt shall be removed before the mixing process.

4.2.4 The biogas shall have the components that meet the requirements given in table 1

Table 1 — Biogas composition

S/N	Components	Chemical formula	Range
1.	Methane	CH_4	55 – 85 %
2.	Carbon dioxide	CO_2	14 – 44 %
3.	Nitrogen	N_2	Trace
4.	Hydrogen	H_2	Trace
5.	Hydrogen sulphide	H_2S	Trace
6.	Vapour of water	H_2O	Trace

5 Fittings

The manufacture shall provide as much information to the consumer regarding fittings.

6 Sizes

6.1 The size of biogas digester shall be determined on the basis of the chosen retention time RT and the daily substrate input quantity Sd

Vd = Sd × RT [m3 = m3/day × number of days/]

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

Where Vd is in m3 or L;

Sd in m3/day or L/day;

RT in Days;

6.2 The minimum acceptable size of portable domestic biogas digester shall be not less than 0.5 m^3 and the average minimum daily feedstock system can accept should be 10kg

6.3 The retention time must be sufficiently long to ensure that the amount of microorganisms removed with the effluent (digestate) is not higher than the amount of reproduced microorganisms. Digester retention time shall be not less than 20 days.

7 Sampling and criteria for conformity

7.1 All the domestic portable biogas of same raw material, same type, size and produced under relatively uniform conditions of manufacture shall constitute a lot.

7.2 The sample of portable domestic biogas shall be selected at random from the lot. In order to ensure randomness of selection, tables of random numbers shall be used.

7.3 Sample size shall be in accordance with Table 1.

7.4 Each selected biogas, as per Table 1, Column 2, shall be tested for the requirements in Table 2 below.

Table 2 — Scale of sampling and criteria for conformity for domestic portable biogas

S/N	Lot size	Sample size	Acceptance number
1.	Up to 50	1	0 Failure
2.	200	2	0 Failure
3.	300	3	0 Failure
4.	500	5	0 Failure
5.	501 and above	8	1 Failure

8 Marking

8.1 All the Biogas plants produced shall be distinctly marked with the following information:

a) manufacturer's name and address or recognized trade mark;

b) net capacity, in litres/cubic metre with daily quantity in Kg;

c) lot or batch number;

d) country of origin;

e) manufacturer date;

f) material code; and

g) recyclable.

8.2 The marking shall be carried out either by painting, moulding or by sticking the identification marks on external surface of the biogas. The marking shall be permanent.

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

9 Installation

9.1 Installation and commissioning of portable domestic biogas shall be done by the company/manufacturer's authorized or competent personnel.

9.2 The beneficiaries of biogas plants shall be provided "Operation and maintenance" manual in the printed form/ version along with warranty and guarantee clauses.

9.3 The supplier shall provide a brochure to the purchaser including information on installation instructions, cleaning procedures, safety precautions, disposal and proper caution and warning signs.

9.4 The brochure shall be in at least two official languages used in Rwanda including Kinyarwanda

10 Pre-requisites for setting up a portable domestic biogas

The following requirements shall be looked into before setting up a biogas plant:

a) the individual or the family shall have sufficient source of substrate;

b) sufficient space shall be available for the biogas. This space shall preferably be near the source of substrate and invariably be close to the place where gas shall be used; and

c) sufficient quantity of water shall be available for mixing with fresh bio-mass before feeding.

FOR PUBLIC COMMENTS

©RSB 2017 - All rights reserved

FOR PUBLIC COMMENTS

ICS 27.100

©RSB 2017- All rights reserved