KENYA STANDARD

KS 2521:2013
ICS 27.060.20

Domestic biogas lamp — Specification

PUBLIC REVIEW DRAFT, DECEMBER 2013

First Edition 2013

TECHNICAL COMMITTEE REPRESENTATION

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Private Sector Development in Agriculture (PSDA)
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
Energy Regulatory Commission (ERC)
KENDBIP/KENFAP
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Ministry of Agriculture, Livestock and Fisheries
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REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya standards shall be regularly reviewed. Suggestions for improvement to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

ISBN

Domestic biogas lamp — Specification

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FOREWORD

This Kenya standard was prepared by the *Biogas Technical Sub-Committee* in accordance with the procedures of the Bureau and is in compliance with Annex 3 of the WTO/TB Agreement.

Biogas lamps have been in use for lighting homes and town for quite some time now. With increased focus in availing alternative and clean energy technologies to rural and peri-urban communities, biogas lamps are gaining prominence in this role.

In the development of this Kenya Standard, the following publications were extensively referenced:

NY/T 344:1998, *Household biogas lamp*, The Standard of Agricultural Industry of the People's Republic of China

Biogas Support Programme (Nepal), *Quality Standards — Biogas Appliances* (2058/59 FY)

Assistance derived from these sources is hereby acknowledged.

Contents

Domestic biogas lamp — Specification

1 Scope

This Kenya Standard covers construction, operation, safety requirements and methods of test for lamps intended for use with biogas.

2 Normative references

The following referenced documents are indispensable for the application of this Kenya Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EAS 123, *Distilled water — Specification*

ISO 196, *Wrought copper and copper alloys — Detection of residual stress — Mercury(I) nitrate* test

BS EN 12165, *Copper and copper alloys — Wrought and unwrought forging stock*

BS EN 12420, *Copper and copper alloys — Forgings*

BS EN 1172, *Copper and copper alloys — Sheet and strip for building purposes*

BS EN 1982, *Copper and copper alloys — Ingots and castings*

BS EN 10089, *Hot rolled steels for quenched and tempered springs — Technical delivery conditions*

ISO 8458-1, *Steel wire for mechanical springs — Part 1: General requirements*

ISO 6361, *Wrought aluminium and aluminium alloy sheets, strips and plates*

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

ISO 2177, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution*

ISO/TR 11728, *Anodized aluminium and aluminium alloys — Accelerated test of weather fastness of coloured anodic oxide coatings using cyclic artificial light and pollution gas*

ISO 16151, *Corrosion of metals and alloys — Accelerated cyclic tests with exposure to acidified salt spray, "dry" and "wet" conditions*

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 2531, *Ductile iron pipes, fittings, accessories and their joints for water applications*

IS 2788, *Specification for gas mantles*

3 Definitions

For the purposes of this Kenya Standard the following definitions shall apply.

3.1
air sleeve
this contains a number of air holes, which can be rotated to adjust and vary the gas and air ratio in the mantle holder

3.2
lamp
a device used to generate light by combustion of the gas

3.3
mantle holder
a part of the lamp, which is fitted with the carborendum Ventury where a mantle can be fitted. The holder consists of gas nozzle for the flow of the gas for combustion and air holes for proper mixing of gas and air.

3.4
reflectors
these are heat and light reflectors fitted on top of the lamp so that heat and light produced at the mantle is reflected below and the flow of heat through the lamp top is retarded

4 Technical requirements

4.1 Performance requirements

4.1.1 Rated pressure

The rated pressure shall be 2400 Pa, 1600 Pa and 800 Pa respectively.

4.1.2 Specified heat load

The specified heat load will not be over 525 W (450kacl/h) while the minimum is 410W (350 kcal/h).

4.1.3 Burning stability

Under the specific pressure at the heat value being 19MJ/m^3 (4500kacl/m^3) and 25MJ/m^3 (6000kcal/ m^3) the lamp should be flaming in a stable condition.

Under the 50 % specific pressure the biogas lamp should not be flaming back, while under the 150% specific pressure flaming should not be seen. While burning under the specific pressure the range of luminance fluctuating should not be over ±10 %.

4.1.4 Luminance

Under the three different specific pressures the luminance should not be less than the figures in Table 1 as below.

Table 1 — Luminance

Pre-lamp pressure, Pa	2400	1600	800
Luminance, lx	60	45	35

4.1.5 Lighting efficiency

Lighting efficiency is one of the parameters of for indicating the economic effect of light sources. The lighting efficiency of the biogas lamp is the ratio of luminance to heat load with the unit being lx/W.

Under the rated pressure of pre-lamp the shining efficiency should not be less than the figure in Table 2.

Table 2 — Lighting efficiency

Pre-lamp pressure, Pa	2400	1600	800
Shining efficiency, lx/W	0.13	0.10	0.08

4.1.6 Content of CO in disposal of smoke

When the lamp is working under the rated heat load, the CO content (a= 1) in the disposal of smoke is not more than 0.05%.

4.1.7 Time of igniting

The time from the mantle is burning at the rated pressure (except the mantle for the first igniting) to giving light should not be over 20 sec.

4.1.8 Noise of burning

When the lamp is working under the 150 % rated pressure the burning noise should not be more than 55dB.

4.1.9 Surface temperature

When the lamp is working at the 150 % rated pressure the surface temperature at the jet connecting to the pipe should not be over the room temperature plus 50 °C.

4.1.10 Glass mantle

The dropping rate of luminance through the glass mantle should not be over 20 %.

Resistance to sudden change of temperature: at the temperature T = 80 °C, no cracks appear for two times of sudden temperature drop.

4.2 Requirements of structure

4.2.1 The leaning rate of the central hole for the jet should not be more than 0.2mm, and the ***mantle*** jet should be protected with necessary measures.

4.2.2 The burner of the lamp should be strong and durable with air-tightness. The inner wall of the jet should be smooth without burrs.

4.2.3 The muddy head (i.e. head of burner) should not be with cracks if pottery products are used.

4.2.4 After the assembling of the lamp the leaning difference between the jet mouth and the axes of the mixing tube for the jet should not be more than 0.2 mm.

4.2.5 The switch and air adjustment board or the air-intake hole should be flexible and easy to operate. Once it is fixed on position it should not be movable.

4.2.6 For the biogas lamp with rated pressure of 2400 Pa and 1600 Pa , No150 yarn mantle is selected; while for that of 800 Pa, No.200 yarn mantle is used.

4.2.7 The requirements of the size and look for the glass mantle:

— The geometric dimension of the glass mantle is met according to the general structure of the lamp;

— The height difference between the upper and lower mouths of the glass mantle should not be more than ±0.5mm ;

— The roundness difference between the upper and lower mouths of the glass mantle should not be more than ±0.5mm;

— Both the upper and lower mouths for the mantle should be smooth without cuts;

— The thickness of the mantle should be even with the difference not more than 0.5mm.

— The shortcoming for the glass mantle should meet the following requirements:

1) Gas bobble of over 1.0mm is not allowed, that of less than 1.0mm should not be too dense. Within the space of 20mm x 20mm no more than three bobbles are allowed.

2) It is not allowed to be existing for calculi and sand of over 1.0mm, and to be dense for those less than 0.5mm. Within the space of 20mm x 20mm no more than three are allowed.

3) Obvious stripes are not allowed.

4.2.8 The reflecting cover of the lamp should be smooth on the surface with smoke exhaust hole . The cover and the burner should be installed hardly.

4.3 Requirements of the materials

4.3.1 The jet mouth should be made of metal material with melting point being over 500 °C.

4.3.2 The burner should be made of metal material with melting point being over 700 °C.

4.3.3 The sealing materials contacting biogas and the lubrication agent for the switch should be suitable for the features of biogas.

4.3.4 The reflecting cover of the lamp should be made of materials of heat resistance at least 500^{o}C, higher coefficient of surface reflection of at least 40%..

5 Test methods

5.1 Test conditions

5.1.1 The temperature at the lab should be kept between 15 – 25 °C. During the test process the fluctuation of the room temperature should be less than ±3 °C. And the content for the CO in the room should be less than 0.002 %. The air flow rate should be not more than 0.5m/s while the humidity in the air should be controlled under 80 %.

5.1.2 In the test system it should be installed with high-pressure biogas storage cylinder and pressure adjustment equipment. During the test process the fluctuation of the pressure should not be more than ±20Pa.

5.1.3 The luminance of the biogas lamp should be tested in a special dark room or box, while the inner wall of which should be white. The base luminance value should be zero.

5.2 Test of gas use

The low heat value of man-made biogas is fixed as 22 MJ/m^3 ±1 MJ/m^3 (standard volume) (5250 kcal/m^3 ±240kcal/m^3).

5.3 Apparatus and system for testing

5.3.1 The apparatus for testing should be stipulated as in Table 3, and checking and adjustment should be done before testing.

Table 3 — Accuracy of measuring equipment

No. 1	Testing item	Name of apparatus	Specification	Precision
1	Temperature of biogas and indoor	Glass, alcohol and thermometer	0—50 °C	0.5 °C
2	Biogas pressure	U-type pressure meter	±5000Pa	10Pa
3	Biogas flow	Wet-type gas-flow meter	0.5m^3/h	0.2L
4	Atomsphere pressure	Box-type gas pressure meter	81-107kPa	0.1kPa
5	Time	Watch of second	15 min	0.2sec.
6	Luminance	Luminance meter	0.1-199 900lx	0.1 lx
7	Smoke content	Gas chromatograph & Infrared-CO analyzer		
8	Heat value of biogas	Water-flow type thermo flow-meter		
9	Surface temperature	Surface thermometer	0—200 °C	2 °C
10	Noise	Sound meter	40-140dB-human audible range	0.5dB

11	Glass-cover with sudden temperature change	Constant temperature oven	0-150 °C	2 °C
12	Wind speed	Hot-ball breezing instrument	0-5m/s	0.2m/s

5.3.2 The test system is seen in Figures { to be inserted} ..

5.4 The test content and method

5.4.1 Check the structure, dimensions, materials and processing preciseness and installation to see if they meet the requirements of drawings and technology.

5.4.2 Check of air-tightness

From the intake of gas to jet mouth when the valve is at the position of open (shut the jet mouth) and close, and under the pressure of 10,000 Pa(1000mmH_2O) for 1min, the reading of the U-type pressure meter should not drop.

5.4.3 Heat load

Switch on the lamp at the rated pressure and adjust the lamp to the optimum condition and let it burn for 10 minutes, then record the initial reading on the gas flow-meter. At the same time timing starts until 6 minutes to record the final reading to seek out the difference value.

— The rated heat load at the standard pressure is calculated by conversion of the following formula (1):

$$I_0 = V.Q\frac{T_0}{T_0 + t}\frac{P_a + P_g - P_v}{P_0} f_1.f_2 \qquad (1)$$

Where:

I_0 Heat load of the lamp, W;

V Wet biogas flow detected by the flow meter, m^3/h;

Q Low heat value under the standard state, kj/m^3;

T_0 Temperature of thermostatic of biogas under the standard state, 273K;

t Temperature of biogas at the outlet of the gas flow-meter, °C;

P_a Atmosphere pressure at the lab, Pa;

P_v Steam branch pressure from biogas at the outlet of the gas flow-meter, Pa;

P_o Standard atmosphere, 101325Pa;

f_1 Revised coefficient of the flow-meter;

f_2 Conversion coefficient of heat unit, 0.277 78

5.4.4 Stability of burning

— Under the rated pressure of 0.5 times switch on the lamp and observe if there is fire back within 10 minutes.

— Under the rated pressure of 1.5 times and observe if there is flame appearing.

— Under the rated pressure and at the 0.95 m from the yarn mantle to test the max. And min. luminance of the biogas lamp. Compare with the average luminance the value should not be over ±10%.

5.4.5 Luminance and lighting efficiency

— The biogas lamp should be installed with a glass mantle and adjusted with proper amount of air intake. After 10 minutes of ignition until the luminance get to the optimum value test the luminance in a normal way.

— At the four selected points on the circle of 0.95m vertical from the hanging lamp and 0.31m in radius put the photo-sensitive elements of the luminance meter pointing to the lamp, the mean luminance at the four points should not be lower than the stipulated value in Table 1.

— Put the photo-sensitive elements as at the horizontal distance of 0.95m from the desk biogas lamp on the random four points of the circle with 0.31m in radius, the average luminance on the four points should not be less than the stipulated value in Table 1.

— Make the comparison between the luminance of the lamp and the heat load of the light source, the lighting efficiency should not be lower than the stipulated value in Table 2. The lighting efficiency is figured out by the following formula (2):

$$N = \frac{E_v}{I_0} \qquad (2)$$

where:
N Lighting efficiency, lx/W;

E_v Luminance

I_0 Heat load of the lamp, W.

— The test should be done at least for two times. The final result is from the average value detected and the relative error for each time $\Delta = \frac{\text{Max} - \text{Min}}{\text{Mean value}}$ should not be over 5 %. Otherwise do it again.

5.4.6 CO content in exhausted smoke

— While detecting the luminance of the lamp, use a ring-type sample collector to put it above 3-5mm of the yarn mantle. It is forbidden to touch flame. The speed for take the smoke is 0.5—1 L/min, and the oxygen content in the sample should not be over 12 %.

— The ring-type sample collector is made of copper or stainless steel tube with inner diameter of 3mm and inner-wall of 1 mm. In the inner side of the ring-type tube it is evenly distributed with 12 gas intake holes, each of 0.5mm in diameter.

— While exhausting smoke the content of CO is calculated as follows:

$$CO(a=1) = \frac{CO' - CO''(O_2'/20.9)}{1 - (O_2'/20.9)} \qquad (3)$$

where:

CO(a = 1) As surplus air coefficient being 1, the CO content of dry smoke, %;

CO' CO content in the sample of smoke, %;

CO'' CO content in indoor air, %;

O_2' content in the sample of smoke, %

5.4.7 Noise

In the environment of base noise less than 45dB switching on the lamp at the rated pressure of 1.5 times test the burning noise at 0.5m in front of the lamp with Grade A of a sound meter.

5.4.8 Surface temperature

Igniting the lamp at the rated pressure of 1.5 times for 30 min, then detect the joint temperature between the jet mouse and plastic pipe.

5.4.9 Glass mantle

— The detecting of luminance dropping rate

a) Under the rated pressure detect respectively the luminance with the glass mantle and without it, record the reading.

b) Calculate the average value for three times according to the formula (4):

$$\text{Luminance dropping rate}(\%) = \frac{\text{Luminance without glass mantle - Luminance with glass mantle}}{\text{Luminance without glass mantle}} \times 100 \quad (4)$$

— Detecting of resistance to sudden temperature change

The temperature change of the oven with constant temperature is ±2 °C. At temperature $\triangle t = 80$ °C, put the glass mantle into the oven within 5 sec. After 5 minutes at stable temperature of 15s ±1s and cool it in the air to see if there is crack or not. Do the test for two times for the same sample.

— Check of geometric dimension and outlook

Check gas bubble, calculi, all geometric dimensions by eyes and ruler. Take 30 samples randomly each time. When 8 % is not qualified take samples doubly. If it is still over 8 % not qualified, it means the whole batch is not qualified.

6 Regulations of test

6.1 Ex-factory check

The products should be checked by the authorized quality test department before taken out the factory. For items of 4.1.2, 4.1.3, 4.1.4, 4.1.6, 4.1.7, 4.1.10, it is a must for the products to be tested at the delivery.

6.2 Model test

In case of any one of the following conditions it should take model test.

a) After normal production if there is a big change of structure, materials and production process, which may affect the character of the products;

b) At the time of new products being appraised;

c) When the production to be restarted after a long time stop;

d) In case the test result is of big difference at the ex-factory with that of the last model test;

e) At the request of the monitoring authority to make the model test;

f) For the continuous production such test should be done once a year;

6.3 Classification of items and identification

The classification of items and identification is seen in Table 4.

Table 4 — Disqualification item classification and determination methods

Classification	Series No.	Item	Mode of identification
A	1	Luminance	All items should be qualified
	2	Burning stability	
B	3	Igniting time	One unqualified item is allowed
	4	CO content in smoke exhausted	
	5	Dropping rate of luminance for the glass mantle	
	6	Character of the glass mantle on resisting sudden change of temperature	
C		Others	Five unqualified items are allowed

6.4 Sample size

The number of samples for quality test should not be less than three. If the results do not meet the requirements, do the test repeatedly with double sample quantity. If there is still one lamp which cannot meet the requirements in the result of the repeat test, it means the whole batch of the products are not qualified.

7 Process quality control

The manufacturer shall consistently check the quality of the product during various stages of its manufacturing. Quality control at following points are recommended, however depending upon the procedure followed the manufacturer may include other suitable points also:

7.1 Raw material shall be checked to ensure that they conform to the requirements of Clause 4.2.

7.2 Mantle holder shall be checked as follows:

i. Diameter and concentricity of jet hole.

ii. Quality and measurement of inside and outside thread

iii. Length and diameter of sleeve

iv. Position and diameter of air holes.

v. Quality of the machining.

7.3 Air sleeve

i. Inside diameter of the sleeve

ii. Position and diameter of air holes.

Iii Position and quality of handle. Quality of brazing.

7.4 Reflectors

i. Position and diameter of central hole of upper reflector.

ii. Position and diameter of holes for turning lock and hinges in upper reflector.

iii. Position and diameter of holes for spoke, hinges for lower reflector

iv. Centre distance between holes of lock holes and hinge holes.

v. Dimensional measurements of lock set.

vi. Quality of powder coat on the lower reflectors.

7.5 Spokes and glass holder

i. Dimensional requirements of spokes.

ii. Position and diameter of holes on spokes.

iii. Profile (V- shape) of spokes.

iv. Dimensional requirements of glass holder.

v. Quality of Powder coat on the spokes and glass holder

7.6 The lamps shall be assembled completely to check the quality of fitting.

7.7 Quality plan

The supplier shall prepare a quality plan describing exactly how the specification and other quality requirements specified in this standard will be met. The plan shall clearly specify different inspection/ control points. The supplier shall maintain records of dimensional checks, visual inspection and other tests carried as a proof of conformance of the product to the requirements of this standard. The supplier shall preserve and present these records whenever required.

8 Workmanship and finish

8.1 The finish and workman ship of the lamp parts shall be of high quality.

8.2 The surface of the lamp shall be smooth, without any blur, projections or protrusion. Any sharp edge shall be suitably removed.

8.3 There shall be no leakage of gas from threaded joints of the lamp assembly.

9 Sampling

This sampling plan shall be followed for any lot wise inspection of the products for the purpose of lot acceptance.

9.1 Batch — All of the products cast from one melt shall constitute a batch.

9.2 Lot — A number of products offered for inspection at one time and manufactured from the raw material from same source shall constitute a lot. Maximum and recommended lot size shall be 500 sets of biogas lamp.

9.3 Defective sample

Any sample not conforming to any one or more of the specified requirements.

9.4 Random sampling

A random sampling method ensuring that every pieces of products offered for inspection shall have equal probability for being selected as a sample shall be followed. Either of the two random sampling method shall be followed:

(a) Systematic sampling

(b) Use of random sampling table

9.5 Sampling plan for visual inspection and dimensional check:

9.5.1 Sampling plan

Table 2 — Sampling plan

Lot size	Sample size	Acceptance number	Rejection number
(a)	(b)	(c)	(d)
1 – 15	2	0	1
16 – 90	13	1	2
91 – 150	20	2	3
151 – 280	32	3	4
281 – 500	50	5	6

9.5.2 Criteria for conformity

For the lot size specified in column (a) of the above table sample size specified in column (b) shall be inspected for visual and dimensional requirements. If the number of defected samples is less or equal to the number mentioned in column (c) then the lot shall be considered conforming to the requirements of this standard in visual and dimensional requirements, if the total number of defective samples is equal to or more than the number mentioned in column d then the lot shall be considered not conforming to the requirements of this standard.

10 Marking

10.1 Lower reflector of every lamp shall permanently be marked with the following information:

10.1.1 Manufacturers name/ or logo/ or any other identification.

10.1.2 Batch No.

10.1.3 Colour code.

10.2 On the label of every individual packing:

10.2.1 Model of the biogas lamp

10.2.2 Rated pressure (Pa)

10.2.3 Heat load (W)

10.2.4 Specification of the yarn mantle matched for the lamp

10.2.5 The label shall be prepared in English and/or Kiswahili.

11 Packing

11.1 Different parts of the biogas lamp shall be suitably packed. All parts except the glass shall then be packed inside a cardboard box. On the outside of the box it should be marked with names of the manufacture, names of products, model, quantity, dimensions of the outlook, weight and ex-factory date. Further, it is also necessary to be marked with damp-proof, quakeproof and handle with care, glass products easy to break etc. The box shall be securely sealed with the label in place.

11.2 Glass shall be separately packed in appropriate protective packing.

11.3 Each product should be packed with quality certificate and manual book.

Annex A
(normative)

Illustration of biogas lamp parts

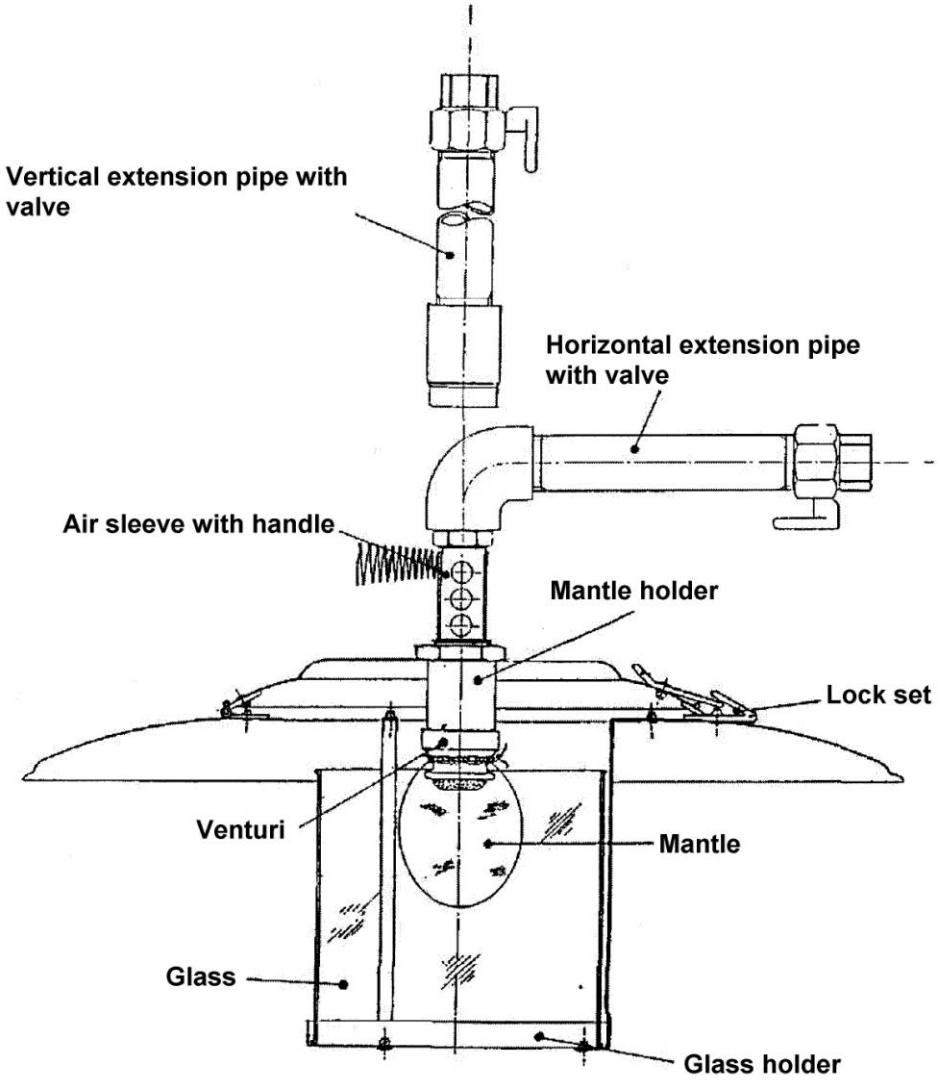
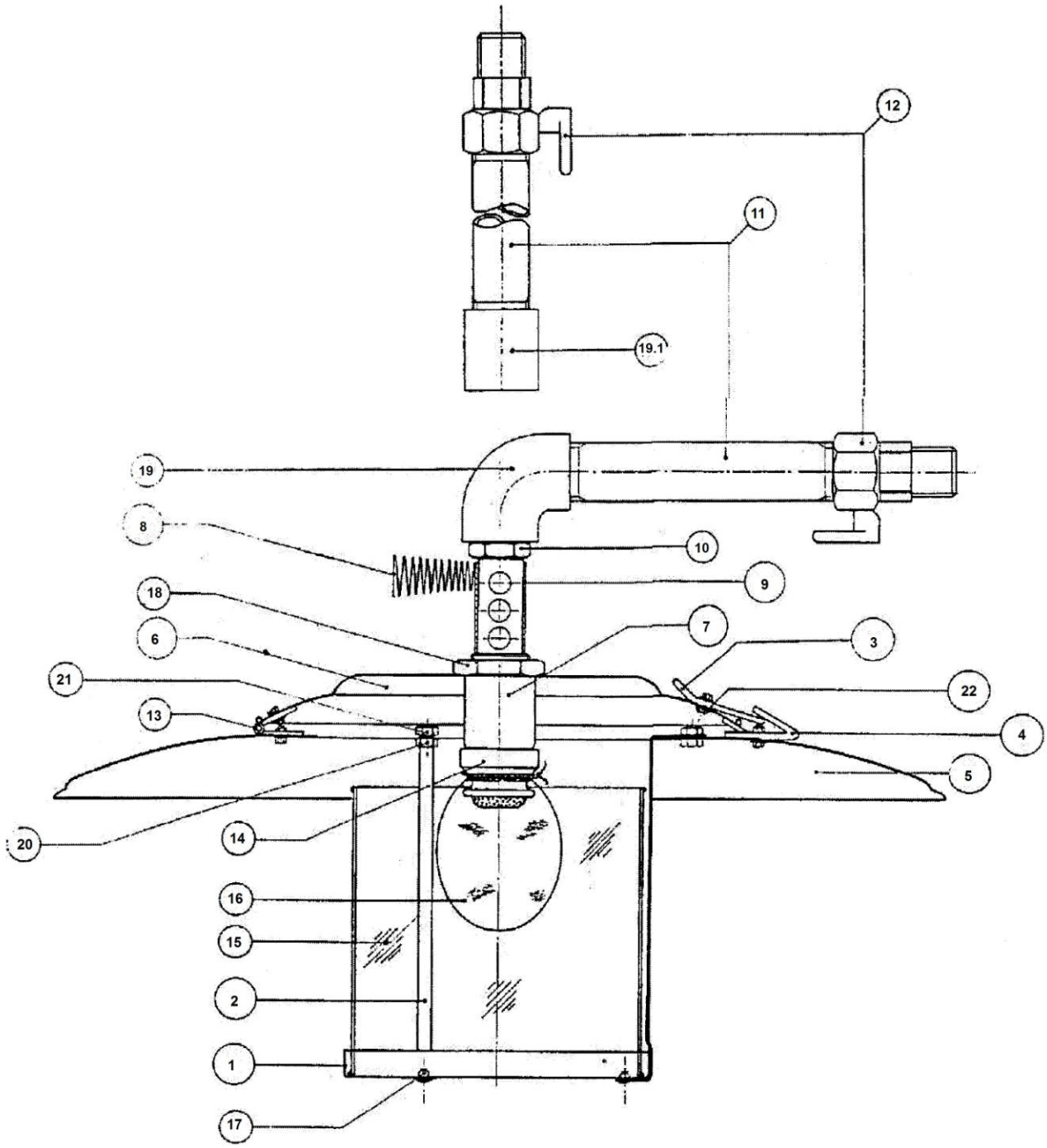


Figure 1 — Biogas lamp assembly



Legend

1	Glass Holder	13	Hinge 20 x 40 mm
2	Spoke	14	Carborendom Venturi
3	Lock	15	Glass
4	Lock	16	Mantle Gauze
5	Reflector	17	Pop Revit 03 x 5 mm
6	Upper Reflector	18	Back Nut
7	Mantle Holder	19	Elbow
8	Air Sleeve Handle	19.1	Socket
9	Air Sleeve	20	Hexagonal Bold M3 x 6
10	Reducer Bush	21	Hexagonal Nut M3
11	Nipple	22	Spring Washer
12	Ball Valve		

Figure 2 — Biogas lamp assembly — Parts