

NIGERIAN INDUSTRIAL STANDARD

FDNIS 1000:2017

**Standard for Clean Cookstoves
Part 1: Biomass Type**

**Price Group x
©2015 SON**

Approved by SON Governing Council



STANDARDS ORGANISATION OF NIGERIA

**Lagos Operational Office
Plot 13/14 Victoria Arobieke Street
Off Admiralty Way,
Lekki Peninsula Scheme 1,
Lekki, Lagos, Nigeria.**

**Head Office
No. 52, Lome Crescent
Wuse Zone 7, Wuse
Abuja, Nigeria.**

**NO COPYING WITHOUT SON PERMISSION EXCEPT AS PERMITTED BY
COPYRIGHT LAW**

Foreword

This Nigerian Industrial Standard for biomass type clean cook stove is developed by the technical committee on clean cooking solutions.

The proliferation of different types of clean biomass cookstoves with quality and safety issues into the Nigerian market and the need to reduce health risk associated with open fire and pollution to environment necessitated the development of this standard.

This standard will serve as a guide to importers, manufacturers and other stakeholders on the requirements for design, manufacture and safety considerations of the clean cookstoves in the interest of consumers/users, manufacturers/supply chain and the nation in general.

In preparing this standard references were made to other national and international standards which are hereby acknowledged.

1. Scope

This Nigerian Industrial Standard specifies design, construction, quality and safety requirements, sampling and labeling for clean solid biomass type cookstoves. This excludes other bio-based stoves such as ethanol and alcohol gel.

2. Normative References

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendment) applies:

Water Boiling Test (WBT) Protocol Version 4.2.3 of 2014 (Test method), latest edition apply.

3. Terms, Definitions and Abbreviations

For the purposes of this standard, the following terms, definitions and abbreviations shall apply:

3.1 Bio-Based material

Material intentionally made from substances derived from living or once living organisms.

3.2 Bio-Based Stove

Stoves that use bio-based material as fuels.

3.3 Biomass

Organic matter used as a fuel, especially in a power station for the generation of heat. Material of biological origin excluding materials embedded in geological formations and or fossilized.

3.4 Chimneyless Stove

Stove in which chimney is not used to assist in flow of exhaust gas from inside of the stove body to the outside environment.

3.5 Chimney Stove

Stove in which chimney is used to assist in creating positive draft for flow of the exhaust gas from inside of the stove body to the outside environment.

3.6 Clean Cookstove

Improved cook stove that uses wood or charcoal designed in a manner to reduce health risk to users and pollution to environment.

3.7 Emissions

A substance discharged into the air especially by an internal combustion of biomass.

3.8 Emission Factor

Emission mass per unit of the useful energy.

3.9 Forced Draft

Stoves where fan is used to assist in air flow through the stove.

3.10 High Power

Operation of a stove at maximum (or nearly maximum) rate of energy use.

3.11 Low Power

Operation of a stove at minimum (or nearly minimum) rate of energy use.

3.12 Natural Draft Stove

Stove in which air flow occurs naturally due to difference in pressure created by temperature difference between inside of the stove and outside environment.

3.13 Safety Index

A range of safe operating temperatures of various materials classes of Cook stove.

3.14 Thermal Efficiency

The percentage of the heat developed in the burning of the biomass charge that is actually used to develop power.

3.15 Tiers

One of a series of rows or ranks behind or above another. They are of Tier 0, 1, 2, 3, 4 and 5

3.16 Useful Energy

The energy released by the biomass fuel which is utilized for actual heating.

3.17 Stove

An apparatus in which fuel is burnt to provide heat.

3.18 Abbreviations

CO	Carbon monoxide concentration
CO ₂	Carbon dioxide concentration
IAP	Indoor Air Pollution
ICS	Improved Cook Stoves
ISO	International Organization for Standardization
IWA	International Working Agreement
LEMS	Laboratory Emissions Measuring (Monitoring) System

PM	Particulate matter content
RKTC	Regional Testing and Knowledge Centre
WBT	Water Boiling Test
TETV	Thermal Efficiency Tier Value

4.0 Construction requirements

When cast, the surface of the casting shall be smooth and without crack, stomata and sand holes. For a weld assembly, it shall be flat and uniform without perforated and slag stomata.

The stamping parts shall have no crack, wrinkle, flash and burrs. The surface of sheet metal used when observed shall be smooth without crack, wrinkle, bump and any type of hurt.

Riveted pieces shall be strongly tied. The rivet shall not be loose and skew.

The combustion chamber should be thermally-stable and unbroken, the shape and thickness shall be as determined by the maker. Heat insulation materials used shall be thermally-stable and shall meet the national guidelines on heat as specified by NESREA.

5. Quality Requirements:

5.1 General

The clean biomass type cookstoves shall be made from mud, metal, fired clay or a combination of clay/metal with smooth surface, without burr or rust outside. The stove may be Chimney, Chimneyless or forced draft, it shall have an opening where biomass shall be inserted. When inspected physically, the stove shall have all its components well fitted and shall be functional in the complete assembly.

5.2 Performance Requirements

The biomass stoves when tested using a Laboratory Emissions Measuring System (LEMS) shall have minimum performance requirements for thermal efficiency, total emission and indoor emission as outlined in Table 1, 2 and 3 respectively.

Table 1- Thermal Efficiency and fuel use

Type of stove	Chimney Stove (Natural Draft)	Chimneyless Stove (Natural Draft)	Forced Draft Stove (Fan stove)
High Power Thermal Efficiency (%)	≥20	≥25	≥35
Specific Fuel	≤0.045	≤ 0.039	≤0.028

Consumption (MJ/min/L)*			
-------------------------	--	--	--

**The high power values are mandatory values and low power values are preferred values only.*

Table 2 -Total Emissions

Type of stove		Chimney Stove (Natural Draft)	Chimneyless Stove (Natural Draft)	Forced Draft Stove (Fan stove)
PM 2.5 Emissions	High Power (mg/MJd)	≤979	≤386	≤168
	Low Power (g/min/L)*	≤8	≤4	≤ 2
CO Emissions	High Power (g/MJd)	≤16	≤11	≤9
	Low Power (g/min/L)*	≤0.20	≤0.13	≤ 0.10

**The high power values are mandatory values and low power values are preferred values only.*

Table 3 - Indoor Emission

Types of stove	Chimney Stove (Natural Draft)	Chimneyless Stove (Natural Draft)	Forced Draft Stove (Fan stove)
CO (g/min)	≤0.42**	≤0.62	≤0.49
PM2.5 (mg/min)	≤2**	≤17	≤8

**The high power values are mandatory values and low power values are preferred values only.*

5.3 Safety Requirements

5.3.1 Indoor stoves with chimney shall have no smoke leakage. For all indoor stoves, good ventilation shall be maintained.

5.3.2 When the stove is in use, the safety indices shall be as outlined in table 4

5.3.3 The stove with electrical devices shall have electricity safety measures.

Table 4- Safety Requirements

Stove category	Metallic body cooking and heating stove	Metallic body cooking stove	Mud/ composite body cooking stove
Safety index	≥45	≥75	≥88

5.4. Star Rating System

5.4.1 The overall Star rating of a given stove shall be the average of all the tier ratings (rounded up to the nearest integer), which shall be printed boldly on the stove as presented in Table 6. The star rating shall be worked out using the “actual tier value” of

the metric corrected within each tier (as specified in Annex 1). For instance the Thermal Efficiency Tier Value of a stove with TE of 28% may be worked out in this way: For TE, 28% falls within Tier 2 (see Annex 1), where $25 \leq TE < 35$. Therefore, the TETV is given by the following expression:

$$TETV = 2 + \frac{0.28 - 0.25}{0.35 - 0.25} = 2.30$$

Table 5: Star Ratings

Average Tier Rating	1.0	2.0	3.0	4.0	5.0
Star Rating					

5.4.2 Stove below star-2 rating shall be considered unsafe for use in Nigeria.

6. Sampling Plan

Samples shall be drawn for testing from each lot for ascertaining conformity of product to the requirements of this standard as outlined in table 6.

Table 6 – Scale of sampling

Number of clean cook stove in a Lot Sample Size	Number of stove to be selected	Samples to be tested
Up to 50	5	2
>50 – 100	10	Minimum 20% of number selected
101 – 500	15	
501 – 1000	20	
> 1000	25	

6.1 Criteria for Acceptance

At the end of the tests and analyses of data collected, if over 90% of the samples to be tested drawn from the number of stoves selected from a lot or batch passed, the lot or batch shall be said to have complied with the requirements of this standard. However, if > 60% but < 90% of the samples passed, two more additional samples shall be taken

from the number of stove selected for further test while if < 60% of the samples passed, the stove in the lot or batch are said to have failed and shall be rejected.

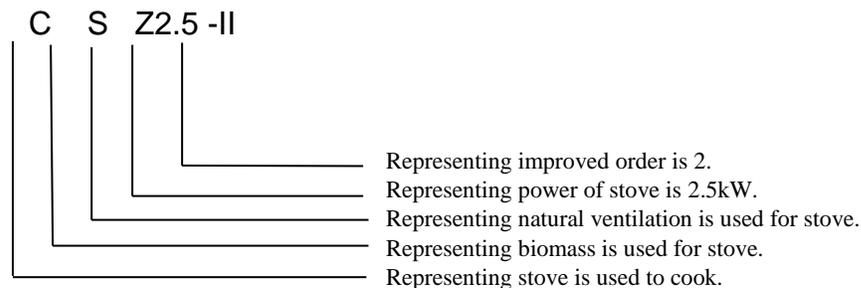
7. Marking

The following information shall be placed at a clear position on the body of the stove.

- i). Name of manufacturer
- ii). Model Name / Number
- iii). Star rating
- iv). NIS/MANCAP Certification.

In addition to the markings, the stove shall have a user manual containing the following information.

- a) Part 1 means the function of the stove: C—Cooking;
- b) Part 2 means the fuel type of the stove: S—Biomass;
- c) Part 3 means the type of ventilation: Z—Natural, Q—Forced;
- d) Part 4 means star rating as indicated in table 3;
- e) Part 5 means the improved number of the stove. There is a “-” between the fourth and fifth part.



8. Packaging

The Clean cookstove shall be packaged in a manner that guarantee its integrity during transportation to the point of delivery with the following, as appropriate:

- (i) User Instruction manual
- (ii) Tool kit with basic tools
- (iii) Product Warranty

APPENDIX A Method of Test

A. Water Boiling Test

The Water Boiling Tests³WBT version 4.2.3: 2014 protocol shall be adopted for testing of all biomass stoves in Nigeria. The current edition shall apply.

ANNEX 1

Performance Tiers

IWA VITA WBT Tiers	units		Tier 0		Tier 1		Tier 2		Tier 3		Tier 4
High Power Thermal Efficiency	%	<	0.15	≥	0.15	≥	0.25	≥	0.35	≥	0.45
Low Power Specific Consumption	MJ/min/L	>	0.05	≤	0.05	≤	0.039	≤	0.028	≤	0.017
High Power CO	g/MJd	>	16	≤	16	≤	11	≤	9	≤	8
Low Power CO	g/min/L	>	0.2	≤	0.2	≤	0.13	≤	0.1	≤	0.09
High Power PM	mg/MJd	>	979	≤	979	≤	386	≤	168	≤	41
Low Power PM	mg/min/L	>	8	≤	8	≤	4	≤	2	≤	1
Indoor Emissions CO	g/min	>	0.97	≤	0.97	≤	0.62	≤	0.49	≤	0.42
Indoor Emissions PM	mg/min	>	40	≤	40	≤	17	≤	8	≤	2
Safety	Index	<	45	≥	45	≥	75	≥	88	≥	95

Bibliography

- [1] Federal Ministry of Environment, Vanguard Newspapers December 11, 2013.
- [2] Clean Energy Initiatives Partnership to Power Nigeria's Development, NDFP Washington, 2013.
- [3] IWA Water Boiling Test version 4.2.3.(2014)
- [4] Bureau of Indian Standards (BIS) – 2012
- [5] Benchmarks proposed by Aprovecho Research Centre, Cottage Grove Oregon, USA. <http://www.aprovecho.org/lab/pubs/arcpubs>: proposed benchmark for Improved Cooking Stoves
- [6] Interim Benchmark for Biomass Cookstoves for Nepal (Draft V3), 2014