EMDC 2(166) DTZS

DRAFT TANZANIA STANDARD

Air Quality — Tolerance limits for boiler pollutants emissions to the air

0 Foreword

Steam systems consume a large portion of the energy used throughout the world. These systems are vital to the activities of a wide variety of operations and serve as the cornerstone for delivering thermal energy in many arenas ranging from heavy industrial sites, through power generation plants, and into commercial-residential systems. The central component of any steam system is the boiler. The operating procedure of most boilers is generally complex and potential impact on the environment is considerable. This situation demands stringent boiler management and optimization.

In order to optimize the management of the fuel combustion process, it is crucial to control the hazardous pollutants that are discharged into air as a result of boiler operations. Most notable pollutants include Carbon monoxide (CO), Nitrogen oxides (NOx), Sulphur dioxides (SO_2), Particulate matters (PM), Dioxins (PCDDs) and Furans (PCDFs)

In this document, sampling and test methods are also prescribed in order to guide the assessment and laboratory analysis of results that are comparable to any other test methods. References for such methods are given in this draft Tanzania Standard.

In the preparation of this draft Tanzania Standard, assistance was derived from

Boiler tune up guide for Natural gas and light fuel oil operation published by Energy Management Services in collaboration with EPA (EPA, 2014)

Field measurements results of boiler emissions from various industries in Tanzania conducted by Tanzania Industrial Research and Development Organisation (TIRDO) (TIRDO Study report, 2020)

WHO/IFC guidelines on emissions from boilers and pressure vessels (WHO, 2010)

In reporting the results of a test or analysis made in accordance with this Tanzania Standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4 (see clause 2).

1 Scope

This Draft Tanzania Standard prescribes the tolerance limits for pollutants emissions from all types of boilers. Pollutants prescribed in this draft standards originates from specific types of fuel used in firing boilers namely; solid biomass, liquid fuel, gaseous fuel and coal. Other types of fuels including electric and nuclear fuels are not discussed in this draft standard.

2 References

For the purpose of this draft Tanzania Standard, the following references shall apply:

TZS 836 (Part 1), Air *quality — General considerations — Vocabulary*

TZS 837 (Part 2), *Sampling of gaseous pollutants*

TZS 837 (Part 3), *Stationary source emissions — Manual determination of mass concentration of particulate matter*

TZS 837 (Part 4), *Stationary source emissions — Determination of mass concentration of sulphur dioxide*

TZS 837 (Part 5), *Stationary source emissions — Determination of the mass concentration of nitrogen oxides — Naphthylethylenediamine photometric method*

TZS 837 (Part 6), *Stationary source emissions – Determination of carbon monoxide, carbon dioxide and oxygen – Performance characteristics and calibration of automated measuring systems*

BS EN 14385:2004, Stationary source emissions – Determination of Heavy metals

BS EN 1948-4, Stationary source emissions – Determination of mass concentration of PCDDs/PCDFs and dioxins like PCBs

TZS 4, *Rounding off numerical values*

3 Terminology

For the purpose of this draft Tanzania Standard, the following definitions and those given in TZS 836 (Part 1) (see clause 2) shall apply:

3.1 Ash

mineral matters that are contained in solid fuels and fuel oils that becomes solid refuse from the combustion process. These materials can be as much as 30% by mass of the fuel supply

3.2 boiler

assembly intended for generation of steam or hot water above atmospheric pressure

3.3 boiler manufacturer

individual or legal entity who is responsible for the construction of boilers and pressure vessels in accordance with requirements of the standard applicable to boilers and pressure vessels under consideration

3.4 dust

small solid particles, conventionally taken as those particles below 75 µm in diameter, which settle out under their own weight but which may remain suspended for sometime

3.5 emission

discharge of substances into the atmosphere. The point or area from which the discharge takes place is called the “source”. The term is used to describe the discharge and the rate of discharge. The term can also be used for noise, heat, etc.

3.6 pressure vessel

housing designed and built to contain gases or liquids under pressure

4 Requirements

4.1 Tolerance limits

Tolerance limits of emissions from boilers shall comply with the requirements given in Table 1, when tested in accordance with the test methods prescribed therein.

Table 1 — Specific tolerance limits of emissions from boilers

SN	Parameters	Solid biomass	Types of fuels			
			Liquid fuel (IDO, HFO, Steam)	Gaseous fuel	Coal	Test Method
1	CO	250	175	50	300	TZS 837-6
2	NO_x	600	450	250	650	TZS 837-5
3	SO_2	850	400	35	1200	TZS 837-4

4	PM	130	50	5	150	TZS 837-3
5	VOC	50	35	20	100	-
6	Dioxin and Furans (ng/m^3)	0.1	0.1	0.1	0.1	BS EN 1948-4

NOTE:

1 All values are in **mg/m^3**, dry gas basis @ 273 K, 101.3 kPa, 6%O_2 for solid biomass and coal, 3% O_2 for liquid and gaseous fuels (stack only). Except for Dioxins and furans which are expressed in nanogram per dry standard cubic meter total equivalent concentration (ng/dscm TEQ)

2 Limits are the values not to be exceeded during periodic measurement under normal conditions.

3 Where continuous monitoring exists, the limit represents the monthly average exclusive of periods under abnormal conditions.

4 Power fluctuation and outage should be treated as abnormal condition.

Since power fluctuation may lead to increased emissions, such peak values occurring during power fluctuation/outage will be deducted in calculation of average values. Proof of power outage shall be required.

5 Sampling

Sampling shall be done as prescribed in TZS 837 (Part 2) (see clause 2). Where a method of determination describes a different sampling procedure the latter shall prevail.

6 Test methods

Methods of determination shall be done by tests referred to in Table 1. Also see clause 2. Where on-line gas analyser exists, it may be used for the purposes of measurement and monitoring, as long as it is recognized and calibrated. In such cases the other methods are not necessary unless they are used for purposes of calibration or reliance assessment.

ANNEX I
(Informative)

Determination of Boilers efficiency

When investigating the performance of steam systems, the boiler is one of the primary targets for energy efficiency improvement. There are many tools used in the evaluation and management of boiler performance. One of the most useful tools is boiler efficiency. Boiler efficiency describes the fraction of fuel energy that is converted into useful steam energy.

Of course, the fuel input energy that is not converted into useful steam energy represents the losses of the boiler operation. Boiler performance investigations generally evaluate the losses by identifying the avenues of loss, measuring the individual loss, and developing a strategy for loss reduction. There are many avenues of efficiency loss encountered in boiler operations. Some of these avenues will be very briefly discussed to properly place the focus of this document—combustion management—into the overall context of boiler efficiency.

Typically, the dominant loss is associated with the energy leaving the boiler with the combustion gases. The temperature of the exhaust gases is an indication of their energy content and the resulting loss. Ensuring that the heat transfer surfaces of the boiler are clean is a major point of focus for managing the thermal energy in the exhaust gases. Another aspect of exhaust gas energy management, and the one this annex focuses on, is classified as combustion management. It should be noted that the temperature of the exhaust gases and combustion related attributes of the exhaust gases are interrelated—they combine to represent the stack loss of the boiler.

Stack loss is typically the dominant loss for the boiler. Stack loss is dependent on the operating characteristics of the boiler, the equipment installed, and the type of fuel burned in the boiler. Stack loss generally ranges from more than 30% for a green-wood fired boiler, to 18% for a typical natural gas fired boiler, to 12% for an oil-fired boiler, to as low as 9% for a coal fired boiler. It must be pointed out that the stack loss range is wide for a given fuel and is primarily impacted by the type of thermal energy recovery equipment the boiler has and the manner in which combustion is controlled.

The primary goals of a boiler performance determination are to provide safe combustion with the minimum amount of fuel expenditure while maintaining environmental compliance. In other words, a boiler efficiency assessment is designed to improve the combustion related efficiency aspects of boiler operation. As a result, the basic concepts of boiler efficiency need to be understood.