TANZANIA BUREAU OF STANDARDS

NATIONAL ENVIRONMETAL STANDARDS COMPENDIUM

NATIONAL ENVIRONMENTAL STANDARDS COMPENDIUM (NESC)

FOREWORD

The National Environmental Standards Compendium (NESC) is a collection of various standards prepared at different times. The NESC is divided into three parts. Part 1 comprises of standards that require compulsory compliance. Compulsory standards are categorized as generic or specific. Specific standards cover those industries with peculiar effects to the environment while other industries without a specific standard are regulated by generic standards.

Part 2 of NESC contains those standards that may be implemented on voluntary basis. These include guideline standards, codes of practice, and other such standards that may not necessarily be directly enforced, but whose results are implied in some legal requirements.

One of such standards include the Environmental Management Systems (EMS) standards, like TZS 701/ISO 14001 whose compliance specifications include the relevant legal requirements. Part 2 thus has important requirements for companies and developers who wish to demonstrate their commitment to sustainable development by way of self-regulation mechanism. On the other hand, some companies or developers may be compelled to follow these standards because of requirements from mother companies, and for other various reasons like certification requirements by environment friendly banks or tenders. Part 2 also includes standards used in evaluating environmental performance.

Part 3 has the requisite test methods that should be followed when testing for compliance. The test methods included are referred to in at least one of the specification standards appearing under Part 1.

Test methods are not intended to be compulsory and alternative test methods may be used as long as they are reliable. Routine monitoring may require some flexibility in the methods of test. However, in cases of dispute the methods referred to in this NESC should be followed as the standard procedure. Thus in some circumstances these methods become obligatory requirement tied to the specification standards in order to ensure reproducibility of results.

NESC is intended to be a dynamic document that will be reviewed regularly. This is because standards are dynamic and will usually undergo periodical reviews in order to keep abreast with technology and other sustainable development needs. Cross-referencing for legal requirements is expected to cite the individual standards, which are published independently of each other.
The standards appearing are thus expected to be reviewed independently to reflect the sector specific needs or as regulated by the National Environment Management Council. The number of standards appearing in NESC in expected to keep on rising, to include the different standards that will be developed in future.

The work of preparing the different standards is carried out by the Environmental Management Divisional Standards Committee (EMDC), which is a cross-section of various stakeholders chaired by Vice Presidents Office. According to EMA 2004, as well as the Standards Act, the procedures of preparing national standards involve input from stakeholders. Since EMDC comprise of limited number membership, draft standards approved by EMDC are floated for 'Public Comments Stage' prior to their finalization. The approval stage comes only after collating the public comments.

Because of the diversity of the various standards needs in managing the environment, the EMDC that started operating since 1997, has formed a number of subcommittees also known as Technical Committees (TC) to elaborate the work of drafting the various standards. These TCs are normally chaired by the respective sectoral ministry or relevant lead agency. The Tanzania Bureau of Standards provides the secretariat services.

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PART ONE – COMPULSORY STANDARDS

TZS 860: 2005 MUNICIPAL AND INDUSTRIAL WASTEWATERS - General Tolerance Limits for Municipal and Industrial Wastewaters

0. FOREWORD

0.1 Municipal and industrial wastewaters are important point source potential pollutants. They are frequently viewed by much of the public as being responsible for most of the water pollution problems in the country. They generally contribute oxygen demanding substances, suspended matter, pathogens and many specific chemicals, including heavy metals. The pollutants are capable of causing a wide variety of problems in watercourses or downstream uses. Effluents disposed of on land may seep into aquifers and pollute groundwater. The problems associated with municipal and industrial wastewater pollution include injury to marine life, wildlife resources and human health. Thus, to ensure sustained water quality and healthy aquatic ecosystems and human health in general, monitoring of effluents and compliance to the standards according to law is of paramount importance. In this regard, monitoring against standards prove to be important components of a sound environmental management programme.

In Tanzania, environmental pollution resulting from municipal and industrial discharges is growing fast. In municipalities, the rapidly growing population and high rate of industrial growth are by and large responsible for increasing waste discharges. Both land and water bodies within and around urban centers and those in which small-scale mining activities are being carried out are increasingly coming under threat as they continue to receive wastewaters laden with hazardous pollutants.

Generally, the effluents of municipal and industrial origin are discharged into water bodies and municipal sewers and treatment facilities.

The effluents are varied and complex and the degree of their pollution effect upon the aforementioned systems depend on the constituents of the individual effluent and their corresponding concentrations/loads. The rationale for including permissible limits with regard to physical parameters, organic and inorganic substances as well as microbiological component is based upon their detrimental effect upon human health, aesthetic value, aquatic environment and treatment facilities.

In Municipalities, different permissible limits are applied for wastewaters which are either discharged into Urban Water and Sanitation Authorities (UWASAs) treatment facilities or directly into the water bodies (receiving waters) after effective onsite treatment. This standard addresses the second scenario only.

0.2 In the preparation of this standard, considerable assistance was drawn from the following:

- ISO Standards Compendium. Environment – Water Quality Part I – III (1994) prepared by the International Organization for Standardization.

- Report of the Effluent Standards Committee prepared by Effluents Standards Committee (1977).

- Guidelines on Municipal and Industrial Wastewater Standards (Parts I & II) prepared by the National Environment Management Council (1996)

0.3 In routine monitoring, different test method may be used as long as they give reliable results. However, in case of disputes, the reference methods prescribed in this standard shall be used.

0.4 This standard is subject to periodic revision and amendment from time to time in order to reflect new developments in technology and changing circumstances.

0.5 In reporting results of tests or analyses made in accordance with this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4 – Rounding off numerical values (see clause 2).

1.0 SCOPE

1.1 This Tanzania standard is applicable to effluents discharged from all establishments. The standard prescribes the permissible limits for municipal and industrial effluents discharged directly into water bodies.

The effluent parameters contained herein include Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Color, pH, Temperature, Total Suspended Solids (TSS) and Turbidity.

Also this standard gives Permissible limits for inorganic substances including Aluminium (as Al), Arsenic (As), Barium (Ba), Cadmium (Cd), Chlorides (Cl^-), Chromium VI, Cobalt (Co), Copper (Cu), Fluorides (F^-), Iron, Lead (Pb), Manganese, Mercury (Hg), and Nickel (Ni). Others are Selenium (Se), Silver (Ag), Sulphate (SO_4^-), Sulphides (S^-), Tin (Sn), Total Chromium, Total Kjeldahl Nitrogen (as N), Nitrates (NO_3^-), Total Phosphorus (as P), Zinc (Zn), and Vanadium.

Organic substances whose permissible limits are included in this standard are 1,1,1-Trichloroethane, 1,2-Dichloroethylene, 1,1,2-Trichloroethane, 1,2 - Dichloroethane, 1,3-Dichloropropene, *cis*-1,2-Dichloroethylene, Dichloromethane, Phenols, Tetrachloroethylene, Tetrachloromethane, Trichloroethylene as well as other aliphatic aromatic hydrocarbons (excluding the mentioned ones). Others are aromatic amines, alkyl benzene sulfonate (ABS), Oil and Grease (Petroleum Ether Products), organochlorine pesticides, and other pesticides (excluding the organochlorine pesticides).

Permissible limit for microbiological coliform organisms is also given in this standard.

1.2 The standard does not cover requirements for hazardous effluents such as radioactive materials and hospital wastes. Restricted and banned chemicals under Rotterdam and Stockholm conventions, which have already been ratified by Tanzania, are shown under Annex B of the Standard.

1.3 Purpose

The purpose of the standard is to indicate the quality of effluents permitted to be discharged into water bodies. The use thereof is meant to promote a consistent approach towards prevention of water pollution in Tanzania.

In this regard, the wastewaters to be discharged into receiving waters should be free from:

i. Substances that will settle in receiving waters forming putrescent or otherwise objectionable sludge deposits, or which will adversely affect aquatic life.

ii. Floating debris and other material in amounts sufficient to be noticeable and lead to deterioration of receiving waters.

iii. Nutrients in concentrations that promote nuisance growths of algae or aquatic weeds in the receiving waters.

iv. Materials in quantities or concentrations which are toxic or harmful to life.

v. Materials that alone or in combination with other materials will produce color, turbidity, and odor in sufficient concentration to create a nuisance or adversely affect the aquatic ecosystem.

2.0 NORMATIVE REFERENCES

The following standards contain provisions, which through reference in this text constitute provisions of this Tanzania standard.

All standards are subject to revision, and parties to agreements based on this Tanzania Standard are required to investigate the possibility of applying the most recent editions of the standards below:

EMDC 1 (1173): Municipal and Industrial Wastewaters Test Methods.

EMDC 1 (1179): Municipal and Industrial Wastewaters Sampling methods.

TZS 4: 1979, Rounding off Numerical Values.

American Public Health Association (APHA), 1989, Standard Methods for the examination of water and wastewater.

ISO 6222: 1999, Water quality – Microbiological methods.

ISO 6468: 1996, Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas Chromatographic method after Liquid-Liquid extraction

ISO 7875 – 1: 1996, Determination of surfactants – Part 1: Determination of anionic surfactants by measurement of the methylene blue index (MBAS)

ISO 7887: 1994, Water quality – Examination and determination of color – Section 3: Determination of true color using optical instruments

ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.

ISO 15586: 2003, Water quality – Determination of trace elements using atomic absorption spectrometer with graphite furnace

3.0 DEFINITIONS OF TERMS AND PHRASES*

For the purpose of this standard, and the normative references, unless the context specifically indicates otherwise, the following terms and phrases shall have the meanings respectively ascribed to them by this section.

Biochemical Oxygen Demand (BOD): The mass concentration of dissolved oxygen consumed under specified conditions by the biological oxidation of organic and/or inorganic matter in wastewater.

Chemical Oxygen Demand (COD): the mass concentration of oxygen equivalent to the amount of dichromate consumed by dissolved and suspended matter when a sample of wastewater is treated with that oxidant under defined conditions.

Effluent: Water or wastewater discharged from a containing space such as treatment plant, industrial process, lagoon, etc.

Hazardous Wastes: Any discarded material containing substances know to be toxic, mutagenic, carcinogenic, or teratogenic to humans or other life-forms; ignitable, corrosive, explosive, or highly reactive alone or with other materials.

Industrial Effluents: Liquid wastes from institutional, commercial and industrial processes and operations.

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* *Note: Other general terms related to effluents are found in TZS 90:1980.*

Kjeldahl Nitrogen: The concentration of organic nitrogen and ammoniacal nitrogen in a wastewater sample, determined after mineralization. It does not include nitrate and nitrite nitrogen, and does not necessarily include all organically bound nitrogen.

Monitoring: The long term programmed process of sampling, measurement and subsequent recording, reporting or signaling, or both, of various wastewater characteristic signaling, or both, of various wastewater characteristic with the aim of assessing compliance with specified standards.

Municipal Effluent: Liquid wastes from domestic processes and operations.

Organic Nitrogen: The difference between the nitrogen contents of a sample derived from the determination of Kjeldahl nitrogen and ammoniacal nitrogen.

Pollution: The introduction by man, directly or indirectly, of substances or energy into the environment resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment.

Receiving Water: A perennial body of water, stream or watercourse receiving the discharged effluent.

Suspended Solids: Solids that either float on the surface of, or in suspension in water, sewage or other liquids and which are removable by laboratory filtering or centrifuging under specified conditions.

Treatment Facilities: An arrangement of devices and structures, excluding septic tanks, constructed for the purpose of treatment of wastewaters for domestic, commercial or industrial sources, or combination thereof. Privately owned wastewater treatment facilities which treat predominantly industrial waste shall be excluded

Total Phosphorus: The sum of all forms of phosphate normally present in wastewater, including orthophosphates, polyphosphates, metaphosphates, pyrophosphates and organic phosphates, expressed on terms of concentration of P (Phosphorus).

Wastewater: A water discharged after being used, or produced by a process, and which is of no further immediate value to that process.

Water Pollution: The impairment of the suitability of water from some considered purpose.

4.0 REQUIREMENTS

The Permissible limits for Municipal and Industrial Wastewaters shall be as shown in Table 1.

TABLE 1: PERMISSIBLE LIMITS

Table 1.1: Physical Components

Parameter	Limit	Test Method
BOD_5 at 20 ^oC	30 mg/L	EMDC1 1173: Part 3 – Five-day BOD Method
COD	60 mg/L	EMDC1 1173: Part 4 – Dichromate Digestion Method
Color	300 TCU	ISO 7887: 1994, Water quality – Examination and determination of color – Section 3: Determination of true color using optical instruments
pH range	6.5-8.5	EMDC1 1173: Part 2 – Electrometric Method
Temperature range	20-35^oC	See Annex A
Total Suspended Solids (TSS)	100 mg/L	EMDC1 1173: Part 1 – Gravimetric Method
Turbidity	300 NTU	APHA Standard Methods:2130 B. Nephelometric Method

Table 1.2: Inorganic Components

Parameter	Limit (mg/L)	Test Method
Aluminium (as Al)	2.0	EMDC1 1173: Part 7 – Direct Nitrous Oxide-Acetylene Flame Atomic Absorption Spectrometry
Arsenic (As)	0.2	EMDC1 1173: Part 8 – Manual hydride Generation- Atomic Absorption Spectrometry
Barium (Ba)	1.5	EMDC1 1173: Part 7 – Direct Nitrous Oxide-Acetylene Flame Atomic Absorption Spectrometry
Cadmium (Cd)	0.1	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Chromium (total)	1.0	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Chromium VI	0.1	EMDC1 1173: Part 9 – Colorimetric Method
Chlorides (Cl^-)	200	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Cobalt (Co)	1.0	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Copper (Cu)	2.0	EMDC1 1173: Part 7 - Flame Atomic Absorption Spectrometry

Parameter	Limit (mg/L)	Test Method
Fluorides (F^-)	8	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Iron	5.0	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Lead (Pb)	0.1	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Manganese	5.0	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Mercury (Hg)	0.005	EMDC1 1173: Part 10 – Cold-Vapor Atomic Absorption Spectrometry
Nickel (Ni)	0.5	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Nitrates (NO_3^-)	20	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Phosphorus Total (as P)	6	EMDC1 1173: Part 6 – Colorimetric-Ascorbic Acid Method
Selenium (Se)	1.0	EMDC1 1173: Part 8 – Manual hydride Generation- Atomic Absorption Spectrometry
Silver (Ag)	0.1	ISO 15586: 2003, Water quality – Determination of trace elements using atomic absorption spectrometer with graphite furnace
Sulphate (SO_4^{2-})	500	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Sulphides (S^-)	1	APHA Standard Methods: 4110 B. Ion Chromatography with Chemical Suppression of Eluant Conductivity
Tin (Sn)	2.0	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry
Total Kjeldahl Nitrogen (as N)	15	EMDC1 1173: Part 5 – Kjeldahl Method
Vanadium	1.0	ISO 15586: 2003, Water quality – Determination of trace elements using atomic absorption spectrometer with graphite furnace
Zinc (Zn)	5.0	EMDC1 1173: Part 7 – Flame Atomic Absorption Spectrometry

Table 1.3: Organic Components

Parameter	Limit (mg/L)	Test Method

Parameter	Limit (mg/L)	Test Method
1, 1, 2 -Trichloroethane	0.06	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
1,1,1 - Trichloroethane	3.0	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
1,2 - Dichloroethylene	0 . 2	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
1,2 - Dichloroethane	0.04	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
1,3 - Dichloropropene	0.2	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
Alkyl benzene sulfonate (ABS)	0.5	ISO 7875 – 1: 1996, Determination of surfactants – Pat 1: Determination of anionic surfactants by measurement of the methylene blue index (MBAS)
Aromatic nitrogen containing compounds (e.g., aromatic amines)	0.001	APHA Standard Methods 6410: Liquid-liquid extraction GC/MS method
cis-1, 2 - Dichloroethylene	0.4	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
Dichloromethane	0.2	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
Oil and Grease (fatty maters and hydrocarbons)	10	APHA Standard methods 5520

Parameter	Limit (mg/L)	Test Method
Organochlorine pesticides (Cl)	0.0005	GC ECD (ISO 6468: 1996, Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas Chromatographic method after Liquid-Liquid extraction)
Other aromatic and/or aliphatic hydrocarbons not used as pesticides	0.05	GC ECD (ISO 6468: 1996, Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas Chromatographic method after Liquid-Liquid extraction)
Pesticides other than organochlorines	0.01	GC ECD (ISO 6468: 1996, Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas Chromatographic method after Liquid-Liquid extraction)
Phenols	0.002	GC ECD (ISO 6468: 1996, Water quality – Determination of certain organochlorine insecticides, polychlorinated biphenyls and chlorobenzenes – Gas Chromatographic method after Liquid-Liquid extraction
Tetrachloroethylene	0.1	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
Tetrachloromethane	0.02	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)
Trichloroethylene	0.3	GC ECD (ISO 10301: 1997, Water quality – Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods.)

Table 1.4: Microbiological Components

Parameter	Limit	Test Method
Total Coliform Organisms	10,000counts/100mL	ISO 6222:1999, Microbiological methods

5.0 COMPLIANCE WITH SPECIFIED EFFLUENT LIMITS

Discharging of wastewaters in water bodies should ensure that:

- Effluent quality described in Table 1 is achieved consistently.

- Monitoring should be done by sampling in accordance to EMDC 1 (1179) – Sampling Methods.

- Effluent shall be treated onsite prior to discharge, dilution is not treatment.

- Effluents are not discharged in close proximity to water supply sources and recreational areas.

6.0 BIBLIOGRAPHY

1. Water Environment Federation (1992), Standard Methods for Examination of Water and Wastewater.

2. Lake Victoria Environmental Management Programme, Proposal for National Working Group II on Management of Water Quality and Landuse Including Wetlands, June 1995.

3. ISO: 2490 (Part 1) – 1981. Tolerance Limits for Industrial Effluents.

4. National Environmental Management Council. Development of Guidelines on Effluent Standards, March 1996.

5. ISO Standards Compendium. Environment – Water Quality. Vol.1, 1994.

6. ISO Standards Compendium. Environment – Water Quality. Vol. 2, 1994.

7. ISO Standards Compendium. Environment – Water Quality. Vol. 3, 1994.

8. Environment Canada, Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments. Regulations, Codes and Protocols Report EPS 1 – EC – 76 – 1, April 1976.

9. Ministry of Health. Report of the Effluents Standards Committee CLI/77, April 1977.

10. TZS 94 (Part 1): 1980. Industrial Effluents – Sampling and Test Methods.

11. Uganda Gazette-Statutory Instruments 1999 No. 5. The National Environment (Standard for Discharge of Effluent into Water or on Land) Regulations, 1999.

12. United Republic of Tanzania. Ministry of Water and Livestock Development. Regulations for receiving waters and effluents

ANNEX A

Depth Temperature Measurement

Depth temperature required for limnological studies may be measured with a reversing thermometer, thermophone, or themistor. The thermistor is most convenient and accurate; however, higher cost may preclude its use. Calibrate any temperature measurement devices with TBS–certified thermometer before field use. Make readings with the thermometer or device immersed in water long enough to permit complete equilibration. Report results to the nearest 0.1 or 1.0^{o}C, depending on need.

The thermometer commonly used for depth measurements is of the reversing type. It often is mounted on the sample collection apparatus so that a water sample may be obtained simultaneously. Correct readings of reversing thermometers for changes due to differences between temperature at reversal and temperature at time of reading. Calculate as follows:

$$\Delta T = \left[\frac{(T'-t)(T'-V\text{-})}{K}\right] \mathrm{X} \left[1+\frac{(T'-t)(T'+V\text{-})}{K}\right] + L$$

where:

ΔT correction to be added algebraically to uncorrected reading,

T uncorrected reading at reversal,

T' temperature at which thermometer is read,

t volume, of small bulb end of capillary up to 0^{o}C graduation

V_o constant depending on relative thermal expansion of mercury and glass

K (usual value of K = 6100), and

L calibration correction of thermometer depending on T'

If series observations are made it is convenient to prepare graphs for a thermometer to obtain ΔT from any values of T' and t.

ANNEX B

1. Prior Information Chemicals (PICs) as per Rotterdam Convention

Chemicals
2, 4,5-T
Aldrin
Captafol
Chlordane
Chlordimeform
Chlorobenzilate
DDT
Dieldrin
Dinoseb and dinoseb salts
1,2-dibromoethane (EDB)
Fluoroacetamide
HCH (mixed isomers)
Heptachlor
Hexachlorobenzene
Lindane
Mercury compounds, including inorganic mercury compounds, alkyl mercury compound and alkyloxyalkyl and aryl mercury compounds
Pentachlorophenol
Monocrotophos (Soluble liquid formations of the substance that exceed 600 g active ingredient/L)
Methamidophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l)
Phosphamidon (Soluble liquid formulations of the substance that exceed 1000g active ingredient/l)
Methyl-parathion (emulsifiable concentrates (EC) with 19.5%, 40%, 50%, 60% active ingredient and dusts containing 1.5%, 2% and 3% active ingredient)
Parathion

Crocidolite

Polybrominated biphenyls (PBB)

Polychlorinated biphenyls (PCB)

Polychlorinated triphenyls (PCT)

Tris (2,3-dibromopropyl phosphate)

2. Eliminated Persistent Organic Pollutants (POPs) as per Stockholm Convention

Aldrin*

Chlordane*

Dieldrin*

Endrin

Heptachlor*

HCB (Hexachlorobenzene)

Mirex

Toxaphene/Camphechlor*

3. Restricted Persistent organic pollutants (POPs) as per Stockholm Convention

DDT*/DD

Polychlorinated biphenyls (PCB)

4. Unintentional Persistent Organic Pollutants (POPs) as per Stockholm Convention

Dioxins and Furans (polychlorinated dibenzo-p-dioxins and dibenzofurans,

PCDD/PCDF)

Hexachlorobenzene

Polychlorinated biphenyls (PCB)

* *These chemicals are also regulated by the Rotterdam Convention*

TZS 344:1989: Tolerance Limits for Industrial Effluents discharged into inland surface water – Tanning industry

0. FOREWORD

Industrial effluents can cause environmental pollution when they are not treated properly prior to exposure.
Some of these effluents are toxic and can endanger directly or indirectly the lives of people.

By inland surface waters it means rivers, lakes, dams, streams, estuaries and rivers liable to seasonal drying.

The standard lays down the requirements for the effluents from chrome tanneries as well as vegetable tanneries.
In the preparation of this standard, assistance was derived from the following publication:

IS 2490:1974 *Tolerance limits for industrial effluents discharged into inland surface water Part* 3: *Tanning Industry* published by the Indian Standards Institution.

1. SCOPE

This Tanzania Standard lays down the tolerance limits for effluents from tanning industry discharged into inland surface waters.

2. REFERENCES

This standard makes reference to the following standards:

TZS 90:1980 *Glossary of terms relating to water, sewage and industrial effluents (Part 1).*

TZS 94:1989 *Methods of sampling and test for industrial effluents (Part II).*

TZS 59:1980 *Water - Distilled quality - Specification.*

TZS 94:1980 *Methods of sampling and test for industrial effluents (Part 1).*

TZS 94:1989 *Methods of sampling and test for industrial effluents (Part III).*

3. TERMINOLOGY

For the purpose of this standard the definitions given in TZS 90:1980 shall apply.

4. TOLERANCE LIMITS

Specific tolerances

4.1. Chrome tanning Industry - Effluents from chrome tanning industry shall comply with the tolerance limits given in Table 1.

TABLE 1- Specific tolerances for effluents of chrome tanning industry.

Characteristics	Tolerance Limit	Method of test
Chlorides as Cl	1000	TZS 94: 1989 (Part 3)
Biochemical oxygen demand for 5 days at 20°C, mg/l *max.*	30	TZS 94: 1980 (Part 1) Clause 11
Hexavalent chromium as (Cr), mg/l, *max.*	0.1	TZS 94: 1989 (Part 2)
pH	5.5 - 9.0	TZS 94: 1980 (part 1) Clause 8

4.2. Vegetable tanning industry - Effluents from vegetable tanning industry shall comply with the tolerance limits given in Table 2.

TABLE 2 - Specific tolerances for effluents of vegetable tanning industry.

Characteristics	Tolerance Limit	Method of test
Biochemical oxygen demand for 5 days at 20°C, mg/l, *max.*	30 (up to 100)	TZS 94:1980 (Part 1) Clause 11

Characteristics	Tolerance Limit	Method of test
Chlorides (as CI), mg/I, *max*,	1000	TZS 94:1989 (Part 3)
pH	55 - 90,	TZS 94'1980 (Part1) Clause 8
Suspended solids, mg/I, *max*.	100	TZS 94:1980 (part 11 Clause 7
Color and odor	Absent	TZS 94:1980 (Part 1) Clauses 5 & 6.

5. SAMPLING

Representative samples of the effluent shall be collected as prescribed in TZS 94.1980 (see clause 2).

6. TESTS

Tests shall be performed according to methods laid down in TZS 94:1980, Part 1: TZS 94.1989 Part 2 & 3

TZS 343:1989: Tolerance limits for industrial effluents discharged into surface waters - Phosphatic fertilizer Industry

0. FOREWORD

Industrial effluents can cause environmental pollution when they are not treated properly prior to exposure.
Some of these effluents are toxic and can endanger directly the lives of people.
In the preparation of this standard assistance was derived from

IS 2490 -1979 *Tolerance limits for industrial effluents discharged into inland surface waters Phosphatic fertilizer industry* published by the Indian Standards Institutions.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated is to be rounded off it shall be done in accordance with TZS 4:1979 (see clause 2).

1. SCOPE

This standard outlines the tolerance limits for effluents from fertilizer industry discharged into surface waters.

2. REFERENCES

For the purpose of this standard the following references shall apply:

TZS 90:1980, *Glossary of terms relating to water sewage and industrial effluents (Part 1).*

TZS 59:1980, *Water - Distilled quality – Specification*

TZS 94:1980, *Methods of sampling and test for industrial effluents (Part 1).*

TZS 94:1989, *Methods of sampling and test for industrial effluents (Part 3).* TZS 4:1979, *Rounding off numerical values.*

3. TERMINOLOGY

For the purpose of this standard the definitions given in TZS 90:1980 (see clause 2) shall apply.

4. TOLERANCE LIMITS

The tolerance limits of effluents from fertilizer industry shall comply with the

requirements given in the table below:

TABLE - Specific tolerance for effluents from a fertilizer Industry.

SIN	**Characteristics**	**Tolerance limits**	**Methods of test**
1.	Dissolved phosphate (as P), mg/l, *max*	5	Annex
2.	Dissolved fluorides (as F), mg/I, *max.*	15	TZS 94:1989 (Part 3) (see clause 2)
3.	pH	5.5 - 9.0	TZS 94:1989 (Part 1) clause No.8 (see clause 2)

5. SAMPLING

Representative sample of the effluents shall be collected as prescribed in TZS 94:1980 (see clause 2).

6. TESTS

Tests shall be carried out as prescribed in the annex and TZS 94:1980 (see clause 2). Reference to relevant clauses are given in column 4 of the table.

ANNEX

A.1 TOTAL DISSOLVED PHOSPHATES

A.1.1. Quality of reagents

Unless specified otherwise, pure chemicals and distilled water in accordance with TZS 59:1980
(see clause 2) shall be used in all the tests.

NOTE - 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

A.1.2. General

A.1.2.1. *Principal*- In a dilute orthophosphates solution, ammonium molybdate reacts in an acid medium to form a heteropoly acid, molybdophosphoric acid, which is reduced to the intensely coloured complex, molybdenum blue by using stannous chloride as reducing agent. The colour of the complex formed is proportional in intensity to the concentration of phosphate. The method is better suited for the range 0.05 to 6.0 mg/l $P0_4$.

The range can be extended upwards by taking suitable aliquot and making proper dilution with phosphate free water, and using cells having a light path of 0.5 cm or longer in a spectrophotometer or a filter photometer at the wavelength range of 650 - 690 nm. The method can be used for determination of orthophosphates as well as polyphosphates and organic phosphates.

A.1.2.2. *Interference* - Arsenic and germanium shall be absent if sulphide is present, shall be removed by oxidation with saturated bromine water. Iron shall not exceed 0.04 mg Fe in the sample taken for analysis. Silica should not exceed 25mg/l. Oxidizing agent such as chromate, peroxide, nitrate and nitrite will bleach the blue color. Interference from nitrate can be removed by the addition of 0.1 g of sulphuric acid to the sample before the addition of molybdate solution.

A.1.2.3. *Temperature of reaction* - Since the rate and intensity of colour developed depends upon the temperature, the reagents and standards should be within 2°C of one another and the temperature between 20°C and 30°C.

A.1.2.4. *Conversion of poly - and organic phosphates to orthophosphates* - The conversion of polyphosphates. and organic phosphates to the" orthophosphates form suitable for colorimetric estimation is based on the combined hydrolysis and oxidation of the effluent sample in acid medium by boiling with dilute sulphuric acid and potassium persulphate for 30 minutes.

A.1.3. Apparatus

A.1.3.1. *Photometer* - A spectrophotometer or filter photometer suitable for measurement at 650 to 690 nm with cells 0.5 cm or longer.

A.1.3.2. *Nessler tubes* - 50 ml, matched.

A.1.4. Reagents

A.1.4.1. *Ammonium molybdate solution* - Dissolve 25 g of ammonium molybdate (NH_4) MO_70_{24} $4H_20$) in about 175 ml of water.

In another beaker, add 77 ml of concentrated sulphuric acid slowly to 400 ml of water. Cool, and add the molybdate solution and dilute to 1 litre with water.

A.1.4.2. *Potassium persulphate*

A.1.4.3. *Phosphate standard solution* A - Dissolve dry 0.1433 g of potassium dihydrogen phosphate (KH_2P0_4) in water and dilute to 1 litre. This solution shall contain 0.1 mg of $P0_4$ per ml.

A.1.4.4. *Phosphate standard solution B* - Dilute 100 ml of solution (A.1.4.3) to 1 litre with distilled water. This solution shall contain 0.01 mg per mi.

A.1.4.5. Stannous chloride solution - Dissolve 2.5 g of stannous chloride ($SnCI_2.2H_20$) in 100ml glycerine. Heat with stirring in a water-bath to hasten solution

A.1.4.6. *Sulphuric acid* - Slowly add 310 ml concentrated sulphuric acid while stirring to about 600 ml of water. Cool and dilute to 1 litre.

A.1.5. Procedure

In 125 ml conical flask which contain 50 ml of the sample add 1 ml of sulphuric acid followed by 0.4 g of potassium persulphate. Cool and transfer the contents in the Nessler tube and dilute to the mark with water. Add 2 ml of ammonium molybdate solution- and mix. Add 3 drops of stannous chloride solution and mix. After 10 minutes, but before 12 minutes, employing the same specific interval for all determinations, fill the cell and determine the optical density at 650 nm and compare with a calibration curve using distilled water blank. Read the $P0_4$ concentration from the calibration curve prepared by taking known phosphate standard through the same procedure as the sample.

TZS 789:2003 - Drinking (potable) water -Specification

0. FOREWORD

0.1. Water constituents may affect the taste, colour, general appearance and smell of water and the user will evaluate the quality and acceptability essentially on these criteria.

0.2. This standard was part of TZS 574: 1999. The standard gave requirements for both drinking waters and bottled drinking waters. This standard will cover requirement for drinking waters other than packaged drinking waters.

0.3. This Standard has been prepared with assistance drawn from:

a) KS 05-459 Part 1-1996 - Specification of drinking water - Requirements for drinking water, published by Kenya Bureau of Standards.

b) EAS 012 - Drinking water (potable) published by the East African Standards Committee.

c) Maji Review Vol. 1, 1974 - Temporary Standards of Domestic (Potable) waters, published by Ministry of Water Development and Energy

d) Guidelines for drinking water quality Vol. 1 - Recommendation, published by World Health Organization (1984).

0.4. In reporting the result of a test or analysis made in accordance with this Standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with TZS 4: 1979 - Rounding off numerical values.

1. SCOPE

This draft Tanzania standard prescribes the quality requirements for drinking water other than packaged drinking water.

It does not include the requirements for natural mineral water.

2. FIELD OF APPLICATION

This standard prescribes the quality requirements for drinking water distributed in the food industry, domestic and catering purposes. It applies to bacteriological, biological, virological, physical, chemical and radiological quality criteria. It is intended also to community piped water supplies i.e. those water systems serving cities, municipalities and townships, community standpipes and wells and drinking water distributed by tankers. This standard does not apply to bottled mineral waters.

3. REFERENCES

This standard makes reference to the following standards:

i. TZS 574:2002 Part 1 - Method of test for the quality of drinking water - Part 1 Physical methods of test for the quality in drinking water.

ii. TZS 574:2002 Part 2 - Method of test for the quality of drinking water Part 2 - Methods for biological and microbiological test for drinking water.

iii. TZS 574:2002 Part 3 - Method of test for the quality of drinking water Part 3 - Methods for determining metal contaminants in drinking water

iv. TZS 575: 1997 - Code of hygiene for collecting, processing and marketing of natural mineral water.

v. TZS 573: 1997 - Specification for natural mineral water.

vi. TZS 390: 1988 - Specification for carbonated soft drinks

vii. TZS 564: 1997 (Part 2) - Methods of sampling water quality - Part 2 - Guidance on sampling techniques.

viii. TZS 574:2002 Part 5 - Method of test for the quality of drinking water Part 5 - Gases, organic compounds and radioactive tests for drinking water.

ix. TZS 605:2000-Unplaciticised polyvinyl chloride {PVC-U)pipes for cold potable water

4. DEFINITIONS

Drinking water shall mean potable water intended for human consumption.

NOTE: Carbonated bottled drinking waters flavoured or unflavoured shall be covered in TZS 390: 1988 and for carbonated bottled mineral waters shall be covered in TZS 573: 1997

5. REQUIREMENTS

Drinking water shall conform to the requirements given in the following tables and clauses:

5.1. Water that is intended for human consumption is supposed to be free from micro-organisms and from chemical substances which may be hazardous to health.

5.2. All supplies of drinking water are required to be as pleasant and safe to drink. Absence of turbidity and absence of colour, palatable and acceptable, taste and odor are

of the utmost importance in public supplies of drinking water. The situation, construction, operation and supervision of water supply, its reservoirs and its distributions system shall be such that they exclude any possible contamination of the water.

5.3. Pipes for potable water supply shall conform to TZS 605:2000 - Unplasticized polyvinyl chloride (PVC-U) pipes for cold water.

5.4. The requirement for quality is divided into three categories as shown below:

5.4.1. Microbiological quality requirements:

Drinking water should not contain any organisms of faecal origin. The presence of coliform organism should be considered as an indication of remote faecal pollution. The presence of Escherichia coli (faecal coliform) indicates recent faecal pollution, and hence dangerous condition if found in consecutive sample of water tested. Coliform organisms are those organisms, which are capable of fermenting lactose with production of acid and gas at 35 - 37°C in less than 48 hours, and are Indole negative. Escherichia Coli (faecal coliform), are those organisms which are capable of fermenting lactose with the production of acid and gas at 44°C in less than 24 hours, and which are Indole positive. The microbiological standard to be aimed at is the same as the WHO one which demands that there be no coliform (E. coli) in each 100 ml portions (piped water supplies).

5.4.2. Microbiological requirement and classification of non-chlorinated piped water supplies:

Table 1: Microbiological requirements

Class of piped Water/Type of test count	Coliform count per 100 ml at 37°C	E. Coli (faecal coliform) count per 100 ml at 44°C
Excellent	0	0
Satisfactory	1 - 3	0
Suspicious	4 -10	0
Unsatisfactory	More than 1 0	1 or more

For each individual sample coliform should be estimated in terms of the "Most Probable Number" in 100 ml of drinking water, which is often designated as MPN index or Coli index. Occurrence of E. coli (faecal coli) in consecutive samples, in less than 100 ml of drinking water is an indication of faecal pollution and hence a dangerous situation needing urgent, rectification.

5.4.3. **Physical and Chemical Requirements**

Table 2: Chemical and physical limits for quality of Drinking Water Supplies

Group	No. Substance	Unit	Lower limit	Upper Limit
Toxic	1. Lead Pb	mg/L	-	0.1
	2. Arsenic As	mg/L	-	0.05
	3. Selenium Se	mg/L	-	0.05
	4. Chromium (6+) Cr	mg/L	-	0.05
	5. Cyanide CN	mg/L	-	0.20
	6. Cadnium Cd	mg/L	-	0.05
	7. Barium Ba	mg/L	-	1.0
	8. Mercury Hg	mg/L	-	0.001
	9. Silver Ag	mg/L	-	n.m
Affecting Human Health	1. Fluoride F	mg/L	1.5	4.0
	2. Nitrate $N0_3$	mg/L	10.0	75.0
Organoleptic	1. Colour	TCU	1.5	50
	2. Turbidity	NTU	5	25
	3. Taste	-	n.o	-
	4. Odour	-	n.o	-
Salinity and Hardness	1. pH		6.5	9.2
	2. Total Filterable Residue	mg/L	500	2000
	3. Total Hardness	mg/L	500	600
	($CaC0_3$)	mg/L	75	300
	4. Calcium Ca	mg/L	50	100
	5. Magnesium Mg	mg/L	500	1000
	6. Magnesium + Sodium	mg/L	200	600
	$S0_4$	mg/L	200	800
	7. Sulphate $S0_4$			
	8. Chloride CI			

Group	No. Substance	Unit	Lower limit	Upper Limit
Less Toxic Metals	1. Iron Fe	mg/L	0.3	1.0
	2. Manganese Mn	mg/L	0.1	0.5
	3. Copper Cu	mg/L	1.0	3.0
	4. Zinc Zn	mg/L	5.0	15.0
Organic Pollution of Natural Origin	1. BOD (5 days at 30°C)	mg/L	6.0	6.0
	2. PV (Oxygen abs $KMN0_4$)	mg/L	10	20
	3. Ammonium, (NH_3 + NH_4)	mg/L	2.0	2.0
	4. Total Nitrogen (Excluding $N0_3$)	mg/L	1.0	1.0
Organic Pollution Introduced Artificially	1. Surfactants (Alkly Benzyl Sulphonates)	mg/L	1.0	2.0
	2. Organic Matter (as carbon in Chloroform extract)	mg/L	0.5	0.5
	3. Phenolic Substances (As Phenol)	mg/L	0.002	0.002

n.o - not objectionable
n.m - not mentioned

Table 3: Radioactive materials

Material	Limit
Gross alpha activity	0.1 Bq/l
Gross beta activity	0.1 Bq/l

5.4.4. **Standards of Sanitary Protection of Water Intake and Surrounding Land.**

5.4.4.1. Distance to Source of Contamination: The following distances from sources of pollution should always be taken into account and be an integral part of every **water** supply system:

50 meters for pit preview, septic tanks, sewers;
100 meters from borehole latrines, seeping pits, trenches; and
sub surface sewage disposal fields.

150 meters from cesspools, sanitary land field areas and graves.

In addition to the above minimum distances, the following precautions must also be observed:

a) Domestic livestock and other animals should be kept away from the intake by fencing the area of a minimum radius of 50 meters from the installation.

b) Defecation and urination around the intake should be completely prohibited, by law.

c) Drainage and run off waters should be led away from intakes.

d) The water source should be guarded against inundation by the flooding of nearby rivers.

e) Soil erosion should be prevented by reforestation and other methods.

f) Algal growth should be prevented by draining swamps and pools around the intake or reservoir.

5.4.4.2. Frequency of sampling: Irrespective of the size of the population, all types of waters should be tested at least two times per year - once under dry conditions and once under rainy conditions.

5.4.4.3. Surface Water Intakes: When water is drawn from rivers, streams, Lakes and reservoirs, the following shall be observed in respect of intakes:
Intake should be so placed and designed as to draw water that is as clean and palatable as the source of water supply can provide:

a) River intake should be constructed upstream from villages and industrial factories, and the intake should be in deep water close to a stable bottom.

b) Small stream intake should comprise and take-pool which can also act as a settling "basin".

c) Lake intake should as much as possible avoid shore water, avoid stirring up of sediments, and seeks the clean bottom water.

5.4.4.4. Sanitary Protection: Chlorination of newly built water supplies is advisable before handing over the water supply to the public.

6. SAMPLING

6.1. Frequency and location of sampling

a) Distances from the source to the testing laboratory should be such as to enable effective supervision of the bacteriological quality of the water supply.

b) Frequency of sampling should be based on (i) size of the population served, (ii) risk of pollution i.e. distance from and nature of pollution source, (iii) nature and extent of sanitary protection of the source.

c) All rural water supplies should be examined at the following intervals:

Table 4: Frequency of sampling

Type of Source/Population served	Up to 1,000	Up to 2,000	Up to 5,000
Borehole deeper than 8m	**6 months**	**4 months**	**3 months**
Well less than 8m.	**2 months**	**1 month**	**1 month**
Surface water, lakes, rivers, springs, dams	**1 month**	**2 weeks**	**2 weeks**

d) The minimum number of samples to be taken from a distribution system is calculated at the rate of one sample per SOO population in addition to the intake or source.

e) The above-prescribed frequency of sampling refers to those water supplies, which on previous examination showed total absence of faecal coli, if the result of bacteriological examination indicates faecal pollution, the water supply in question should be re-examined within a fortnight, at the latest, irrespective of the type of source or population served.

f) Supplier/Authority should determine key points on the distribution system from which samples should be collected. On each occasion samples should be taken from different points.

7. TEST METHODS

The test methods shall be carried out according to TZS 574:2002 (Part 1-5).

TZS 845:2005 Air Quality – Specification

0. Foreword

0.1. For Tanzania, rapid development will inevitably also mean rapid industrialization and urbanization. A possible consequence is the deterioration of our precious environment, if proper control is not planned.

This standard aims at ensuring that as much as we desire for development, the environment, and life must be protected.

The set of baseline parameters on air quality and emissions given in the standard are based on a number of considerations so as to come out with practical and acceptable limits. The set is not exhaustive, but has been prioritized. In the course of implementation, more parameters may be added to the list when the need to review this standard arises. This will help developers such as industrialists to keep abreast with environmentally friendly technologies.

The Standard gives two types of limits, viz "guidelines" and "limit levels". The limit levels are the binding and shall be used for regulatory purposes. Limit levels are usually measurable in shorter periods averaging. On the other hand, the "guidelines" are based on studies that indicate safe levels averaged over relatively longer periods and mostly, they are derived from WHO Guidelines.

Thus, though one may be within the "limit levels", long-term exposure guidelines should help one to assess the magnitude of risk of particular air pollutant over longer periods.

The limits given are of general application. However, industry-specific limits for some categories of heavy pollution sources will be prepared as separate standards for the peculiar pollutants characteristics and loads.

0.2. In the preparation of this standard, considerable assistance was derived from the following sources.

(i) International Register of Potentially Toxic Chemicals – International Environmental Guidelines and Global Conventions Concerning Chemical Substances, prepared by United Nations Environment Programme (UNEP) and published as "Legal File 1994".

(ii) National Environment Management Council (NEMC) Workshop Paper on Developing Environmental Pollution Standards – Air Pollution Standard prepared by the NEMC in 1996.

(iii) Environmental Laws of the Czech Republic Vol. 3: Air and Water Protection Laws published in 1993.

(iv) Standards of performance of New Stationary Sources. US Federal Register, Vol. 39, no. 219 published in 1974.

(v) World Health Organization (Regional Office for Europe). Air Quality Guidelines (Second Edition) 2000.

This assistance is gratefully acknowledged.

1. In reporting the results of a test or analysis made in accordance to this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4: 1979 (see Clause 2).

2. Scope

This Tanzania Standard gives permissible limits of some common substances found in polluted air, namely sulfur dioxide, carbon monoxides, suspended particulate matter (dust), oxides of nitrogen, hydrocarbons, and lead. The standard covers both the ambient air and emission sources.

References

For the purpose of this standard the following references shall apply:

TZS 3: 1979: Atmospheric conditions for testing

TZS 4: 1979: Rounding off Numerical Values

TZS 836 – 1: 2004: **Air Quality – General Considerations** – *Vocabulary.*

TZS 836 – 2: 2004: **Air Quality – General Considerations** – *Particle size fraction definitions for health –related sampling.*

TZS 837 – 1: 2004: **Air Quality – Sampling and test methods –** *Guidelines for planning the sampling of atmospheric and location of monitoring stations.*

TZS 837 – 2: 2004: **Air Quality – Sampling and test methods –** *Sampling of Gaseous Pollutants.*

TZS 837 - 3: **Air Quality – Sampling and test methods –** *Ambient air-determination of black smoke index.*

TZS 837 – Part 4: 2004: **Air Quality – Sampling and test methods –** *Stationary source emissions – Determination of the mass concentration of sulphur dioxide – Hydrogen peroxide/barium perchlorate/Thorin method*

TZS 837 – Part 7: **Air Quality – Sampling and test methods –** *Road vehicles – Measurement equipment for exhaust gas emissions during inspection or maintenance – Technical specifications*

TZS 837 – 6: 2004 **– Sampling and test methods –** *Determination of carbon monoxide carbon dioxide and oxygen – Performance characteristics and calibration of automated measuring systems.*

TZS 837 – 5: 2004 **– Air Quality - Sampling and test methods –** *Determination of the mass concentration of nitrogen oxides – Naphthyethediamine photometric method.*

TZS 837 – 3: 2004 **– Air Quality - Sampling and test methods –** *Stationary source emissions – Manual determination of mass concentration of particulate matter.*

ISO 9855:1993-**Ambient air**- Determination of the particulate lead content of aerosol collected on filter – Atomic Absorption Spectrophotometric method.

3. Terminology

For the purpose of this standard, the following definitions shall apply:

3.1. Ambient air shall mean an outdoor air to which people, plants, animals or material may be exposed.

3.2. Suspended particulate matter shall mean airborne particles of 10 microns or less in diameter.

NOTE
This is also the inhalable fraction (PM 10)

3.3. Black smoke shall mean visible (black) aerosol usually resulting from combustion.

3.4. Emission Limit is the highest permissible quantity of pollutants released into the air from a pollution source, expressed as the concentration of pollutants in relation to one unit of production or to the degree of air pollution caused by these sources (e.g., dark color of smoke).

3.5. Imission shall mean transfer of pollutants from the atmosphere to a receptor.

3.6. Imission limit is the highest permissible weight concentration of pollutants contained in the air

NOTES

1. All the emission limits are valid for concentration expressed for any dry gas under normal atmospheric conditions. (See TZS 3: 1979 Atmospheric Conditions for Testing).

2. When imission limits are surpassed, other actions may be called in, e.g., proper land usage/relocation of factories, enforcement of by laws by local authorities (which may give more stringent specifications for emissions) revision of standards and types of fuels to be allowed.

4. Limits

4.1. The following shall apply for the ambient air (imission limits)

Pollutant	**Guideline**	**Limit Level**	**Test Method**
Sulphur oxides, SO_x^*	Annual mean of 40 – 60 µg/Nm^3 (0.05-0.08 mg/kg) or 24 – hour average 100 µg/Nm^3 (0.129 mg/kg)	Daily average of hourly values shall not exceed 0.1 mg/kg 0.5 mg/Nm^3 for 10 minutes	TZS 837 Parts (1, 2, and 4).
Carbon monoxide, CO	Aims at preventing carboxyhaemoglobin levels exceeding 2.5-3% in non-smoking people.	1. A maximum permitted exposure of 100mg/Nm^3 for periods not exceeding 15 minutes. 2. Time-weighed exposures at the following levels: § 100 mg/Nm^3 for 15 minutes § 60 mg/Nm^3 for 30 minutes; § 30 mg/Nm^3 for 60 minutes § 10 mg/Nm^3 for 8 hours. or Daily average of hourly values shall not exceed 10mg/kg and average of hourly values in eight consecutive hours shall not exceed 20 mg/kg.	TZS 837 Parts 1,2, and 6
Black smoke and suspended particulate matters (PM 10)	Black smoke 40 to 60 µg/Nm^3 (0.05-0.08 mg/kg) PM 10 60 to 90 µg/Nm^3 (0.05 – 0.116 mg/kg)	Daily average of hourly values shall not exceed 0.10 µg/Nm^3 and hourly values shall not exceed 0.20 µg/Nm^3	TZS 837 Parts 1, 2 and 3.
Nitrogen dioxide. NOx	Annual mean of 0.1 µg/Nm^3	150 µg/Nm^3 for 24-hours average value 120µg/Nm^3 for 8 hours	TZS 837 Part 1, 2, and 5
Lead	Annual mean of 0.5 – 1.0 µg/Nm^3	1.5µg/Nm^3 for 24 – hours average value	ISO 9855:1993
Ozone	Annual mean of 10 – 100 µg/Nm^3	120 µg/Nm^3 for 8 – hours average value	

4.2 The following limits shall apply for emission sources

Pollutant	Guideline	Limit Level	Test Method
Sulphur oxides* SO_x	Large Combustion Plants (LCP) using solid fuel with thermal effect of: 50 to 100 MWth	Yearly average of: 850 mg/Nm^3	TZS 837 Part 4
	100 to 300 MWth	200 mg/Nm^3	
	> 300 MWth	200 mg/Nm^3	
	LCP using liquid fuel with thermal effect of: 50 to 100 MWth	850 mg/Nm^3	
	100 to 300 MWth	400 to 200 mg/Nm^3 (linear decrease)	
	> 300 MWth	200 mg/Nm^3	
	LCP using gaseous fuel	35 mg/Nm^3	
	LCP using low calorific gases from gasification of refinery residues, coke oven gas, blast-furnace gas	800 mg/Nm^3	
Carbon monoxide CO	Liquid fuel combustion with heat output exceeding 5MW.	Not to exceed 175 mg/Nm^3	TZS 837 Part 6
	Solid fuel combustion with the heat output of 50MW and above	Not to exceed the level of 250 mg/Nm^3	
Hydrocarbon (as Total Organic Carbon)		Not to exceed 20 mg/Nm^3	TZS 837 Part 7
Dust	Inert dust, including cement.	Not to exceed 250mg/Nm^3 (24h mean	TZS 837 Part 3

Pollutant	Guideline	Limit Level	Test Method
		value)	
Nitrogen Oxides* NO_x	LCP using solid fuel with thermal effect of: 50 to 500 MWth	Yearly average of: 600 mg/Nm^3	TZS 837 Part 1, 2, and 5
	>500 MWth	500 mg/Nm^3	
	LCP using liquid fuel with thermal effect of: 50 to 500 MWth	450 mg/Nm^3	
	>500 MWth	400 mg/Nm^3	
	LCP using liquid fuel with thermal effect of: 50 to 500 MWth	300 mg/Nm^3	
	>500 MWth	200 mg/Nm^3	
Lead	Not to exceed 5 tonne/year of lead or lead compounds (measured as elemental lead) by a stationary source		ISO 9855:1993

TZS 846: 2005 - Tolerance limits of emissions discharged to the air by cement factories

0. Foreword

Industrial effluents into the air or water bodies can cause environmental pollution when not treated properly prior to exposure. Some of these effluents are toxic and can directly or indirectly endanger the lives of people, as well as destroying the environment. All efforts should focus on waste minimization. However, when some effluents must be discharged, then this should be done within preset tolerances, in cognizance of their eventual impact on the environment and health. Prior treatment may also be necessary.

The three most relevant air-polluting substances released to the air from cement factories are inactive dust, oxides of nitrogen and sulfur dioxide. Tolerance limits for these are given in this Tanzania Standard. The reasons behind the emissions and what may be done to mitigate the same is given in a separate guideline Tanzania Standard, TZS 847:2005(see clause 2). There are also other pollutants, which should be considered, as given in the guideline document.

Sampling and test methods are also prescribed in order to have a uniform way of assessment and hence make results comparable. Reference for such methods is given in this Tanzania Standard. Provision for on-line analyzers is also given without mentioning a specific equipment.

During the course of implementation some grace period may be required to adjust to new technology or have the necessary equipment in place. These are administrative procedures, which should be sorted out by consultations between factories and relevant government authority. Some proposals have been given.

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

> *Proposal for environmental standards for the cement industry*, 2002 published by the East African Cement Producers Association (EACPA).

The EACPA proposal was based on the European IPPC (Integrated Pollution Prevent and Control) Bureau publication together with the East African factories state of the art. The EACPA input is gratefully acknowledged.

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 4:1979 (see clause 2).

1. Scope

This Tanzania Standard prescribes the tolerance limits of inactive dust, oxides of nitrogen

and sulfur dioxide emissions from cement factories into the air.

2. References

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

TZS 836 (Part 1):2004, Air *quality - General considerations - Vocabulary*
TZS 847: 2005, *Guidelines on emissions discharged to the air by cement factories*

TZS 837 (Part 2): 2005, *Sampling of gaseous pollutants*

TZS 837 (Part 3): 2004, *Stationary source emissions – Manual determination of mass concentration of particulate matter*

TZS 837 (Part 4): 2004, *Stationary source emissions - Determination of mass concentration of sulphur dioxide*

TZS 837 (Part 5): 2004, *Stationary source emissions - Determination of the mass concentration of nitrogen oxides -Naphthylethylenediamine photometric method*

TZS 4:1979, *Rounding off numerical values*

3. Terminology

For the purpose of this Tanzania Standard, the following definitions and those given in TZS 836 (Part 1): 2004 (see clause 2) shall apply:

3.1 **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.

3.2 **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.

4. Tolerance limits

Tolerance limits of emissions from cement factories shall comply with the requirements given in table 1 below.

Table 1 - Specific tolerance for cement industry

S/N	Characteristic	Limit			Method of Test
		Immediate	Optimal Value	Time (Yrs)	
1	DUST – for systems with:				
	- MLTC - FF-sm - EP-le - FF-jp - EP-he	2000 150 500 50 50	50 50 50 50 50	5 8 8 N/A N/A	TZS 837(Part 3): 2004 (ISO 9096)
2	NOx	1800	1500	6	TZS 837(Part 5): 2004
3	$S0_2$	800	500	8	TZS 837(Part 4): 2004

NOTES

1. All values are in mg/Nm^3, dry gas basis @ 273 K, 101.3 kPa and 10% 0_2 (kiln stack only)

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.

   In compound kiln/raw mill systems, operation with either the kiln or the raw mill alone is considered as abnormal condition.

5. Sampling

Sampling shall be done as prescribed in TZS 837(Part 2): 2005(see clause 2). Where a method of determination describes a different sampling procedure the latter will 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 analyzer 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.

EMDC 2(1758): Air Quality - Vehicular Exhaust Emissions Limits

0. Foreword

0.1 Emissions from motor vehicles are a significant source of air pollution. The problem of vehicular emissions is compounded by the fact that the pollutants are emitted at ground level which is in close proximity to the breathing zones of people.

Vehicular emission contributes significantly to ambient concentrations of pollutants such as carbon monoxide, oxides of nitrogen and sulphur, lead, and particulates. At sufficiently high concentrations, these pollutants can cause health problems as well as degrading the environment and quality of life.

In particular, diesel-driven vehicles emit particulates that are very fine and a large proportion of them are less than 2.5 microns in size. These fine particulates are generally known as PM2.5 and they can penetrate the deeper recesses of human lungs and cause respiratory problems.

With increasingly growing number of vehicles, it is therefore imperative to have a stringent programme to control smoke emission from vehicles to ensure that ambient air quality remains healthy.

This draft standard together with other initiatives which include the use of cleaner fuel, such as unleaded petrol and diesel with low sulphur content of below 0.05% could enable achieving the goal of having healthy ambient air quality.

0.2 In the preparation of this standard, considerable assistance was derived from the following sources

EU Directive 96/69/EC exhaust emissions limits for passenger cars and light commercial vehicles

EU Directive 91/542/EEC Stage II for Heavy Duty Vehicles (Category N_2)

EU Directive 97/24/EC emission limits for motorcycles and scooters

This assistance is gratefully acknowledged.

0.3 In reporting the results of a test or analysis made in accordance to this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4: 1979 (see Clause 2)

1. Scope

This Tanzania Standard gives permissible limits of some common substances found in exhaust emissions of motor vehicles, namely carbon monoxides, suspended particulate

matter (PM), oxides of nitrogen, and hydrocarbons. The standard covers all types of vehicles namely, passenger cars, light commercial vehicles, heavy-duty vehicles, and two and four strokes motorcycles and scooters.

2. References

For the purpose of this standard the following references shall apply:

TZS 4: 1979: Rounding off Numerical Values

TZS 672: 2001: Unleaded petrol (gasoline) for motor vehicles - Specification.

TZS 674: 2001: Automotive diesel fuel – Specification

TZS 698: 2003: **Road vehicles** – Code of practice for inspection and testing of used motor vehicles for road worthiness.

TZS 836 – 1: 2004: **Air Quality – General Considerations** – *Vocabulary.*

TZS 836 – 2: 2004: **Air Quality – General Considerations** – *Particle size fraction definitions for health –related sampling.*

EMDC 2 (1163) Part 7/ISO 3929 – **Road vehicles** – Measurement methods for exhaust gas emissions during inspection or maintenance

ISO 3930/OIML (R 99[1]), Instruments for measuring vehicle exhaust emissions

3. Terminology

For the purpose of this standard, the following definitions shall apply:

Ambient air shall mean an outdoor air to which people, plants, animals or material may be exposed.

Suspended particulate matter shall mean airborne particles of 10 microns or less in diameter.

NOTE
This is also the inhalable fraction (PM 10)

Black smoke shall mean visible (black) aerosol usually resulting from combustion.

Emission Limit is the highest permissible quantity of pollutants released into the air from a pollution source, expressed as the concentration of pollutants in relation to one unit of production or to the degree of air pollution caused by these sources (e.g., dark color of smoke).

Imission shall mean transfer of pollutants from the atmosphere to a receptor

4. Vehicular exhaust emission limits

Table 1 Emission Limits for Passenger Cars		
Compound	**Limit (g/km)**	**Reference Standard**
Diesel		
CO	2.72	Euro 1
HC	-	Euro 5
HC+NOx	0.97	Euro 1
NOx	0.50	Euro 3
PM	0.14	Euro 1
Petrol (Gasoline)		
CO	2.72	Euro 1
HC	0.20	Euro 3
HC+NOx	0.97	Euro 1
NOx	0.15	Euro 3
PM	-	Euro 4

Table 2 Emission Limits for Light Commercial Vehicles (Category N_1), g/km		
Compound	**Limit (g/km)**	**Reference Standard**
Diesel		
N_1, Class 1 <1305 kg		

Table 2 **Emission Limits for Light Commercial Vehicles (Category N_1), g/km**		
Compound	**Limit (g/km)**	**Reference Standard**
CO	2.72	Euro 1
HC	-	Euro 5
HC+NOx	0.97	Euro 1
NOx	0.50	Euro 3
PM	0.14	Euro 1
N_1, Class II 1305-1760 kg		
CO	5.17	Euro 1
HC	-	Euro 5
HC+NOx	1.40	Euro 1
NOx	0.65	Euro 3
PM	0.19	Euro 1
N_1, Class III >1760 kg		
CO	6.90	Euro 1
HC	-	Euro 5
HC+NOx	1.70	Euro 1
NOx	0.78	Euro 3
PM	0.25	Euro 1
Petrol (Gasoline)		
N_1, Class I <1305 kg		
CO	2.72	Euro 1
HC	0.20	Euro 3

Table 2 Emission Limits for Light Commercial Vehicles (Category N_1), g/km		
Compound	**Limit (g/km)**	**Reference Standard**
HC+NOx	0.50	Euro 2
NOx	0.15	Euro 3
PM	-	Euro 4
N_1, Class II 1305-1760 kg		
CO	5.17	Euro 1
HC	0.25	Euro 3
HC+NOx	-	Euro 5
NOx	0.18	Euro 3
PM	-	Euro 5
N_1, Class III >1760 kg		
CO		
HC		
HC+NOx		
NOx		
PM		

Table 3 Emission Limits for Heavy Duty (HD) Diesel Engines		
Pollutant	**Limit (g/kWh smoke in m^{-1})**	**Reference Standard**
CO	4.5	Euro I
HC	1.1	Euro I
NOx	8.0	Euro I
PM	0.612	Euro I

Table 3 Emission Limits for Heavy Duty (HD) Diesel Engines		
Pollutant	**Limit (g/kWh smoke in m^{-1})**	**Reference Standard**
Smoke	0.15	Euro III

Table 4 Exhaust Emission Limits for Motorcycles and Scooters			
Pollutant	**Engine Cycle**		**Reference Standard**
	2-stroke	**4-stroke**	
CO (g/km)	8	13	Euro
HC+NOx (g/km)	2.00	2.00	Indian Standard

ANNEX 1 Informative

Vehicle Emission Test Types and Equipment

Acceleration Simulation Mode (ASM-2 test)- An emissions test for vehicles Model Year 1995 and older that uses a dynamometer (a set of rollers on which a test vehicle's tires rest) which applies an increasing load or resistance to the drive train of a vehicle, thereby simulating actual tailpipe emissions of a vehicle as it is moving and accelerating. The ASM-2 is comprised of two phases:

PHASE A: The 50/15 mode-in which the vehicle is tested on the dynamometer simulating the use of 50% of the vehicle's available horsepower at a constant speed of 15 mph

PHASE B: The 25/25 mode-in which the vehicle is tested on the dynamometer simulating the use of 25% of the vehicle's available horsepower at a constant speed of 25 mph

On-Board Diagnostics (OBD)- Computer system installed in a vehicle by the manufacturer which monitors the performance of the emission control equipment, fuel metering system, and ignition system to detect malfunction or deterioration in performance that would be expected to cause the vehicle not to meet emissions standards.

Two Speed Idle (TSI)- A tailpipe test that tests vehicles for carbon dioxide (CO_2) in addition to hydrocarbons (HC) and carbon monoxide (CO) and is comprised of two phases: (1) high speed test [2200-2800 Revolution Per Minutes (RPMs)] for the first phase of the emissions test; then, (2) tested at idle (350-1200 RPMs.)

EMDC 5 (1777): Protection against ionizing radiation - Limits for occupational exposure

0. Foreword

0.1 X rays and other ionizing radiation have numerous applications to mankind; benefiting hundreds of millions of people and giving employment to million of people. However, exposure to high doses of radiation can cause clinical damage to the tissues of the human body. Also, chronic exposure to radiation has a potential for the delayed induction of malignancies. Therefore, in order to protect those individuals exposed to radiation, activities involving radiation exposure must be subject to certain standards of safety. Nevertheless, it should be comprehended that radiation and radioactive substances are natural and permanent features of the environment, and thus the risks associated with radiation exposure can only be restricted, not eliminated entirely.

0.2 In preparation of this standard, considerable assistance was derived from

- International Atomic Energy Agency (Safety Series No. 115 – International Basic Safety Standards for Protection against ionizing Radiation and for the Safety of Radiation Sources, 1996); and

- Australian National standard for limiting occupational exposure to ionizing radiation [NOHSC: 1013(1995)].

0.3 In reporting the result of a test or analysis made in accordance to this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4: 1979.

1. Scope and Field of Application

This Draft Standard aims at protecting workers, whose practices expose them to ionizing radiation, namely; gamma and X rays, alpha, beta and other particles that can induce ionization. This Draft Standard does not apply to non-ionizing radiation such as microwave, ultraviolet, visible light and infrared radiation.

This Draft Standard shall apply to all workplaces in which employees are occupationally exposed or in which there is a potential for occupational exposure to ionizing radiation, unless exempted by the Regulatory Authority.

2. The basic physical dosimetric quantity used in the dose limits of this Draft Standard is Collective Dose given by the unit millisievert (mSv).

3. Normative References

EMDC 5 (1778) – ISO 361: Basic ionizing radiation symbol.

EMDC 5(1779) – ISO 921: Nuclear energy glossary

EMDC 5(1780) – ISO 7205: Radionuclide gauges – Gauges designed for permanent installation

EMDC 5(1781) – ISO 1757: Personal photographic dosimeters

EMDC 5(1782) – ISO 1757; General principles for sampling airborne radioactive materials

EMDC 5(1783) – ISO 3925: Unsealed radioactive substances – Identification and certification

EMDC 5(1784) – ISO 2919: Radiation protection – Sealed radioactive sources – General requirements and classification

EMDC 5(1785) – ISO 7212: Enclosures for protection against ionizing radiation – Lead shielding units for 50 mm and 100 mm thick walls.

EMDC 5(1786) – ISO 6962: Nuclear Energy – Standard method for testing the long-term alpha irradiation stability of matrices for solidification of high-level radioactive waste.

4. Definition of terms and phrases

Absorbed dose: The fundamental dosimetric quantity D, defined as:

$$D = \frac{dE}{dm}$$

where *dE* is the mean energy imparted by ionizing radiation to matter in volume element and *dm* is the mass of matter in the volume element. The energy can be averaged over any defined volume, the average dose being equal to the total energy imparted in the volume divided by the mass in the volume. The SI unit of absorbed dose is the joule per kilogram ($J.kg^{-1}$), termed as gray (Gy)

Activity: the quantity A for an amount of radionuclide in a given energy state at a given time, defined as:

$$A = \frac{dN}{dt}$$

Where *dN* is the expectation value of the number of spontaneous nuclear transformations from the given energy state in the time interval *dt*. The SI unit of activity is the reciprocal second (s^{-1}), termed the becquerel (Bq).

Dose: a measure of the radiation received or 'absorbed' by a target. The quantities termed absorbed dose, organ dose, equivalent dose, effective dose, committed equivalent dose or

committed effective dose are used, depending on the context. The modifying terms are often omitted when they are not necessary for defining the quantity of interest.

Dose constraint: A prospective and source related restriction on the individual dose delivered by the source which serves as a bound in the optimization of protection and safety of the source. For occupational exposures, dose constraint is a source related value of individual dose used to limit the range of options considered in the process of optimization.

Dose limit: the value of the effective dose or the equivalent dose to individuals from controlled practices that shall not be exceeded.

Effective dose: the quantity *E*, defined as a summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_T w_T . H_T$$

Where H_T is the equivalent dose in tissue *T* and w_T is the tissue weighting factor for tissue *T*. from the definition of equivalent dose, it follows that:

$$E = \sum_T w_T . \sum_R w_R . D_{T.R}$$

Where w_R is the radiation weighting factor for radiation R and $D_{T,R}$ is the average absorbed dose in the organ or tissue *T*. the unit of effective dose is J. kg^{-1}, termed the sievert (*Sv*).

Equivalent dose: the quantity $H_{T,R}$, defined as:

$$H_{T,R} = D_{T,R} . w_R$$

Where $D_{T,R}$ is the absorbed dose delivered by radiation type *R* averaged over a tissue or organ *T* and w_R is the radiation weighting factor for radiation type *R*.

When the radiation field is composed of different radiation types with different values of w_R, the equivalent dose is:

$$H_T = \sum_R w_R . D_{T,R}$$

The unit of equivalent dose is $J.kg^{-1}$, termed the sievert (*Sv*)

Exposure: the act or condition of being subject to irradiation. Exposure can be either external exposure (irradiation by sources outside the body) or internal exposure (irradiation by sources inside the body). Exposure can be classified as either normal exposure or potential exposure; occupational, medical or public exposure; and, in intervention situations, either emergency exposure or chronic exposure. The term

exposure is also used in radiodosimetry to express the amount of ionization produced in air by ionizing radiation.

Exposure pathways: the routes by which radioactive material can reach or irradiate humans.

Guidance level: A level of a specified quantity above which appropriate action should be considered. In some circumstances, actions may need to be considered when the specified quantity is substantially below the guidance level.

Intervention: any action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident.

Intervention level: the level of avertable dose at which a specific protective action or remedial action is taken in an emergency exposure situation or a chronic exposure situation.

Ionizing radiation: for the purposes of radiation protection, radiation capable of producing ion pairs in biological material(s)

Limit: the value of a quantity used in certain specified activities or circumstances that must not be exceeded.

Natural exposure: an exposure delivered by natural sources.

Normal exposure: an exposure which is expected to be received under normal operating conditions of an installation or a source, including possible minor mishaps that can be kept under control.

Nuclear Installations: A nuclear fuel fabrication plant, nuclear reactor (including critical and subcritical assemblies), research reactor, nuclear power plant, spent fuel storage facility, enrichment plant or reprocessing facility.

Occupational exposure: All exposures of workers incurred in the course of their work, with the exception of exposures excluded from the scope of the Draft Standard and exposures from practices or sources exempted by the Draft Standard.
Potential exposure: exposure that is not expected to be delivered with certainty but that may result from an accident at a source or owing to an event or sequence of events of a probablistic nature, including equipment failures and operating errors.

Practices: any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed.

Radiation weighting factor: multipliers (as follows) of absorbed dose used for radiation protection purposes to account for the relative effectiveness of different types of radiation in inducing health effects.

Table 1: Radiation weighting factor

Type and energy range of radiation	**Radiation weighting factor w_R**
Photons, all energies	1
Electrons and muons, all energies*	1
Neutrons, energy <10 keV 10 keV to 100 keV >100 keV to 2MeV >2 MeV to 20 MeV >20 MeV	5 10 20 10 5
Protons, other than recoil protons, energy. 2MeV	5
Alpha particles, fission fragments, heavy nuclei	20

* Excluding Auger electrons emitted from nuclei to DNA, for which special microdosimetric considerations apply.

Radioactive waste: material, whatever its physical form, remaining from practices or interventions and for which no further use if foreseen (i) that contains or is contaminated with radioactive substances and has an activity or activity concentration higher than the level for clearance from regulatory requirements, and (ii) exposure to which is not excluded from the draft standard.

Source: Anything that may cause radiation exposure, such as by emitting ionizing radiation or releasing radioactive substances or materials. For example, materials emitting radon are sources in the environment, a sterilization gamma irradiation unit is a source for the practice of radiation preservation of food, an X ray unit may be a source for the practice of radiodiagnosis, and a nuclear power plant is a source for the practice of generating electricity by nuclear power. A complex or multiple installations situated at one location or site may, as appropriate, be considered a single source for the purposes of application of the draft standard.

Tissue weighting factor: Multipliers (as follows of the equivalent dose to an organ or tissue used for radiation protection purposes to account for the different sensitivities of different organs and tissues to the induction of stochastic effects of radiation.

Table 2: Tissue weighting factor

Tissue or organ	**Tissue weighting factor w_T**
Gonads	0.20
Bone marrow (red)	0.12
Colon[a]	0.12
Lung	0.12
Stomach	0.12
Bladder	0.05
Breast	0.05
Liver	0.05
Oesophagus	0.05
Thyroid	0.05
Skin	0.01
Bone surface	0.01
Remainder[b]	0.05

a. The weighting factor for the colon is applied to the mass average of the equivalent dose in the walls of the upper and lower large intestine.

b. For the purposes of calculation, the remainder is composed of adrenal glands, brain, extrathoracic region, small intestine, kidney, muscle, pancreas, spleen, thymus and uterus. In those exceptional cases in which the most exposed remainder tissue receives the highest committed equivalent dose of all organs, a weighting factor of 0.025 shall be applied to that tissue or organ and weighting factor of 0.025 to the average dose in the rest of the remainder as defined here.

Worker: Any person who works, whether full time, part time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection (A self-employed person is regarded as having the duties of both an employer and a worker).

5. Occupational dose limits

5.1. The occupational exposure of any worker shall be so controlled that the following limits (Table 1) be not exceeded:

Table 3: Occupational dose limits

1. Effective dose limit	200mSv per year, Averaged over a period of 5 consecutive calendar years
2. Effective dose limit in a single year	50mSv
3. Equivalent dose limit In the lens of the eye In the skin[1] In the hands and feet	 150mSv per year 500mSv per year 500mSv per year

1. The equivalent dose limit for the skin applies to the dose averaged over any 1cm^2 area of skin, regardless of the total area exposed.

5.2. For apprentices of 16 to 18 years of age who are training for employment involving exposure to radiation and for students of age 16 to 18 who are required to use sources in the course of their studies, the occupational exposure shall be so controlled that the following limits be not exceeded:

Table 4: Occupational dose limits for apprentices of 16 to 18 years of age

1. Effective dose limit	6mSv in a year
2. Equivalent dose limit In the lens of the eye In the skin In the hands and feet	 50mSv per year 150mSv per year 150mSv per year

5.3. In special circumstances, provided that a practice is justified as required by the Regulatory Authority and is designed and conducted according to good practice, and that radiation protection in the practice has been optimized as required by the Regulatory Authority but occupational exposures still remain above the dose limits, and that it can be predicted that reasonable efforts can in due course bring the occupational exposures under the limits, the Regulatory Authority may exceptionally approve a temporary change in a dose limitation requirement of the Standards. Such a change shall be approved only if formally requested by the registrant or licensee, if the Regulatory Authority determines that the practice is still justified and is satisfied that appropriate consultation with the workers concerned has taken place.

5.3.1. When, in special circumstances, a temporary change in the dose limitation requirements is approved pursuant to Section 5.3:

5.3.1.1. The dose averaging period mentioned in Table 3 Column 1 may exceptional be up to 10 consecutive years as specified by the Regulatory Authority, and the effective dose for any worker shall not exceed 20 mSv per year averaged over this period and shall not exceed 50 mSv in any single year, and the circumstances shall be reviews when the dose accumulated by any worker since the start for the extended averaging period reaches 100 mSv; or

5.3.1.2. The temporary change in the dose limitation shall be as specified by the Regulatory Authority but shall not exceed 50 mSv in any year and the period of the temporary change shall not exceed 5 year

6. Exemption Criteria

6.1.1. General Criterion

A practice may be exempted by the appropriate authority from implementing the measures required by this Draft Standard provided that it can be demonstrated that individual occupational effective doses arising from the practice cannot reasonably be expected to exceed 1 mSv per year.

6.1.2. Criterion applicable to natural sources of radiation

In circumstances where the general criterion is not satisfied due solely to adventitious exposure to natural sources of radiation, practices other than those specifically involving work with radiation may be exempted, as determined by the Regulatory Authority. In the case of exposure to radon in the workplace, a practice may be exempted provided that it can be demonstrated by the Regulatory Authority that the action levels for intervention are not expected to be exceeded.

ANNEX A
(Normative)
Employers' duties

A.0 An employer shall ensure that a program of radiation protection is devised and implemented. In fulfilling this requirement, the employer shall:

a. ensure that, at the planning stage of an operation, the workplace and work procedures are designed to keep exposures to ionizing radiation as low as reasonably achievable, economic and social factors being taken into account, making use of dose constraints, where appropriate, for particular categories of employee, including employees not directly involved in work with radiation;

b. obtain all necessary approvals and authorizations for the practice from the Regulatory Authority;

c. appoint a Radiation Safety Officer, or Officers, as required by the Regulatory Authority;

d. provide for consultation with employees who may be exposed to radiation in their work, and with employees' representatives, where appropriate;

e. provide information to the appropriate induction and on-going training for employees who may be exposed to radiation in their work;

f. ensure that a plan for the control of exposure to radiation is developed, approved, implemented and regularly reviewed, and that the workforce is consulted in the planning and review process;

g. ensure that all necessary resources for implementing the plan for the control of exposure are provided, including personal protective equipment and radiation monitoring equipment;

h. ensure that a plan for monitoring exposure of radiation and for assessing radiation doses received by those exposed is developed, approved, implemented and regularly reviewed;

i. endeavor to ensure that exposure to radiation in the workplace is kept as low as reasonably achievable, economic and social factors being taken into account;

j. not employ persons under the age of 16 under conditions where they are directly that involved in work with radiation;

k. demonstrate that the doses estimated to have been received by employees comply with the dose limits specified in **Section 5.1**.

l. demonstrate that, where a dose constraint has been adopted in the design of the working environment for employees not directly involved in work with radiation, the level of protection achieved is compatible with that constraint;

m. when an employee declares that she is pregnant, ensure that appropriate measures are taken to control her exposure so that doses which may be received by the fetus during the remainder of the pregnancy, while the employee is at work, does not exceed 1 mSv per year;

n. when an employee reports a matter with may compromise radiation protection, as required in Subsection B0(g), ensure that appropriate action is taken to investigate and, if necessary, rectify the problem;

o. ensure that a plan for dealing with incidents, accidents and emergencies involving exposure to radiation is developed, approved, implemented and regularly reviewed, and that the workforce is consulted in the planning and review process (see Annex I)

p. inform the appropriate authority without delay of the occurrence of an incident or accident as, as soon as practicable, of its cause and consequences and of the steps taken to remedy the situation and to prevent a recurrence (see Annex I);

q. keep records relating to exposure of the workforce (see Annex J);

r. provide copies of an employee's dose records to the employee on request and on termination of employment; and

s. provide a periodic report to the Regulatory Authority, as required, evaluating the performance of the radiation protection program.

A.1 The employer may seek an exemption from some of these requirements, where they are not all appropriate in particular circumstance, by making application to the Regulatory Authority

ANNEX B
(Normative)
Employees' duties

B.0 Employees who may be exposed to radiation in the workplace shall, to the extent that they are capable, comply with all reasonable measures to control and assess exposure to radiation in the workplace, including:

a. following the radiation protection practices specified in the plan for the control of exposure to radiation;

b. complying with the legitimate instructions of the employer, the Radiation Safety Officer or their agents, in relation to radiation protection;

c. participating in training related to radiation protection, as required;

d. making proper use of the training received to ensure their own health and safety and that of other persons;

e. making proper use of protective and monitoring equipment provided by the employer;

f. upon employment, providing to the employer,, or assisting the employer in obtaining, details of their prior radiation exposure, as necessary; and

g. reporting to employer, the Radiation Safety Officer or their agents any matter of which they are aware which may compromise radiation protection.

B.1 An employee who becomes pregnant should advise the employer as soon as practicable, so that appropriate measures may be taken to control her exposure and to provide the level of protection recommended in Subsection A0(m).

ANNEX C
(Normative)
Planning and design

C.0 The employer shall ensure that the workplace and work procedures are designed to keep exposure to radiation as low as reasonably achievable and to keep doses received below the relevant dose limits. Dose constraints for particular categories of employee should be used when appropriate. For employees not directly involved in work with radiation, a dose constraint shall be adopted which shall normally be related to the public effective dose limit (1 mSv per year).

C.1 A program of radiation protection shall be devised which shall include:

- a plan for the control of exposure to radiation in the workplace;
- a plan for monitoring radiation exposure and for assessing the doses received by exposed employees; and
- a plan for dealing with incidents, accidents and emergencies involving exposure to radiation.

ANNEX D
(Normative)
Approvals and Authorizations

D.0 The employer shall obtain approvals and authorizations, as necessary, from the Regulatory Authority before putting into operation a practice which may expose employees to ionizing radiation and before varying operations within a practice in a manner which may significantly increase exposures to radiation.

ANNEX E
(Normative)
Induction and training

E.0 The employer shall provide induction and on-going training to all employees who may be exposed to ionizing radiation in their work. The extent of training shall be consistent with the type and degree of risk associated with the proposed duties of the employee. Induction and training shall be carried out in a manner appropriate to the participating employees.

E.1 Induction and training programs shall be documented, and employee participation shall be recorded.

ANNEX F
(Normative)
Control of exposure to radiation

F.0 The employer shall ensure that the plan for control of exposure to radiation in the workplace is based on a hierarchy of controls, including:

- avoidance of exposure, where practicable;
- isolation of sources of radiation, where practicable, through shielding, containment and remote handling techniques;
- engineering controls to reduce radiation levels and intakes of radioactive materials in the workplace;
- adoption of safe work practices, including work methods that make use of time, distance and shielding to minimize exposure; and
- where other means of controlling exposure are not practicable or not sufficient, the use of approved personal protective equipment.

F.1 Other measures should be used when appropriate, including:

- the designation of controlled areas and supervised areas;
- the use of appropriate signs and labels; and
- the use of investigation levels of exposure for specific categories of work.

ANNEX G
(Normative)
Radiation monitoring and dose assessment

G.0 The employer shall ensure that a radiation monitoring program is designed, approved, implemented and regularly reviewed. The program shall provide for:

- identification of relevant sources of radiation exposure within a workplace;

- assessment of the radiation doses received by employees, including determination of parameters which affect the assessed dose, as required by the Regulatory Authority;

- detection of changes in the circumstances of exposure, as necessary; and

- acquisition of sufficient information on radiation exposure in the workplace to enable optimization measures to be adopted.

G.1 Dose assessments shall be made for all relevant employees, using the methodology approved by the Regulatory Authority.

ANNEX H
(Normative)
Assessment of compliance with the Standard

H.0 To comply with this Standard the employer shall demonstrate that:

- all doses estimated to have been received by employees in the workplace are below the relevant limit in **Section 5.1**;

- where a dose constraint has been adopted in the design of the working environment for employees not directly involved in work with radiation, the level of protection achieved is compatible with that constraint;

- optimization of protection has been carried out, as required by the Regulatory Authority; and

- all other requirements of this Standard have been met.

ANNEX I
(Normative)
Emergencies, accidents and incidents

I.0 In circumstances where exposure to high doses of radiation or severe contamination with radioactive materials might occur in the workplace, the employer shall ensure that comprehensive emergency plans are prepared, as required by the Regulatory Authority. The plans shall include provision for:

- availability of trained personnel and emergency equipment;
- specified procedures to bring the situation under control;
- assessment of doses received as a consequence of an incident or accident; access to appropriate medical care of overexposed persons; and
- acquisition of information for assessing the cause of the incident or accident.

I.1 All incidents and accidents shall be reported without delay to the Regulatory Authority. The Regulatory Authority shall be advised as soon as is practicable of the cause of the incident or accident, its consequences and the steps taken to remedy the situation and to prevent a recurrence.

I.2 In the event of an accident which causes or which may lead to high doses of radiation or severe contamination of persons with radioactive materials, and following any immediate first aid and medical assistance provided, the Regulatory Authority shall be consulted without delay for advice on the medical management of those exposed. Appropriate counseling shall be provided to the persons affected.

I.3 Corrective measures shall be taken, as necessary, to bring an accident under control and to prevent a recurrence. Doses received by employees who volunteer to take part in emergency action to save lives or to bring an accident under control shall be restricted to ensure that deterministic effects are avoided; these doses shall be treated separately from the employees' normal occupational exposures. Once an accident has been brought under control, doses received during any further remedial work shall be treated as occupational exposure.

ANNEX J
(Normative)
Record keeping

J.0 For all practices to which this Standard applies, the employer shall ensure that a record keeping system is implemented, as required by the Regulatory Authority. Records shall include the following, as appropriate:

- approvals and authorizations granted by the Regulatory Authority;
- specifications of the plans for control of radiation exposure in the workplace;
- specifications of the plans for radiation monitoring and dose assessment;
- specifications of the plans for dealing with emergencies and accidents;
- details of training courses and of participation by employees;
- doses assessed to have been received by employees who work directly with radiation and by other employees as required by the Regulatory Authority, including details of monitoring results and of dose calculation methods, as required by the Regulatory Authority; and
- details of incidents and accidents involving exposure to radiation and of corrective measures taken.

J.1 Records shall be made available for inspection by the Regulatory Authority and shall be kept for a period of time specified by the Regulatory Authority. Records of doses assessed to have been received by an employee, including details of monitoring results and dose calculation methods, as required by the Regulatory Authority, shall be kept during the working life of the employee and afterwards for not less than 30 years after the last dose assessment and at least until the employee reaches, or would have reached, the age of 75 years. When an operation terminates, the employer shall pass to the Regulatory Authority the retained records of doses assessed to have been received by employees and any other records specified by the Regulatory Authority.

EMDC 6 (1733) P 3: ACOUSTICS - General Tolerance Limits for Environmental Noise

0. Foreword

0.1 Noise pollution is essentially an urban problem. There are evidences suggesting that noise levels can cause various physiological and psychological health problems ranging from annoyance and disturbance to heart diseases. In addition hearing damage caused by loud noise can be irreversible.

Noise pollution may be regarded special mainly because personal and subjective judgment is a big part of recognizing a sound as noise pollution or not. In addition, the damage is localized and sporadic in comparison to other types of pollution for example, water and air pollution.

The problem, of noise pollution is exacerbated by improper land use planning in most of our cities, municipals, and towns. This standard is developed partly due to the requirements of the Law (EMA, 2004) and partly because of the public outcry on loud noises emanating from various locations including places of entertainment, industries and households. Therefore, the limit values provided by this draft standard will provide the basis for authorities to assess and manage environmental noises.

0.2 In preparation of this standard, considerable assistance was derived from Uganda National Environmental (Noise Standards and Control) Regulations of 2003. This assistance is gratefully acknowledged.

0.3 In reporting the result of a test or analysis made in accordance to this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with TZS 4: 1979.

1. Scope

This draft standard specifies limits environmental noise and they are not applicable for the occupational environment.

NOTE: In this standard, quantities are expressed as levels in decibels.

2. Normative References

The following referenced documents are indispensable for the application of this document.

IEC 61672-1, Electroacoustics – Sound level meter – Part 1: Specifications

EMDC 6 (1767) ISO 1996 – 1: 2003, Acoustics – Description, measurement, and assessment of environmental noise – Part 1: Basic quantities and assessment procedures

EMDC 6(1768) ISO 1996-2: 1998, Acoustics- Description, measurement, and assessment of environmental noise – Part 2: Acquisition of data pertinent to land use

EMDC 6(1769) ISO 1996-3: Acoustics – Description, measurement and assessment of environmental noise – Part 3. Application to noise limits.

3. Definition of terms and phrases

Annoyance: a feeling of displeasure evoked by noise, or any feeling of resentment, discomfort or irritation occurring when noise intrudes into another person's thoughts or mood, or interferes with any activity being done by the affected person.

A-Weighted Sound Level: Single number value of the magnitude of sound at a specific location and time which has been electronically filtered (or weighted) to approximate the frequency sensitivity of the human ear.

Environmental noise (also called community noise, residential noise or domestic noise): noise emitted from all sources except noise at the industrial workplace.

C-Weighted Sound Level: A standard weighting of the audible frequencies used for the measurement of Peak Sound Pressure level

dBA: unit in decibel for an A-Weighted sound level (for quiet sounds).

dBC: unit in decibel for a C-Weighted sound level

Decibel: A unit used to express the intensity of a sound wave. This intensity in dB equal to 20 times the common logarithm of the ratio of the pressure produced by the sound wave to a reference pressure (typically 1 micropascal at 1 meter).

Disturbance: any act or instance of interrupting the rest, calm, attention or quiet of another person.

Equivalent Sound Level (LeqT): The level of a steady sound that has the same acoustical energy as does a time varying sound over a stated time period "t" (t is the time period in seconds, minutes, or hours: e.g., the hourly equivalent sound level is symbolized as LAeq(1h), the 20-minute equivalent sound level is symbolized as LAeq(20min)

Impulsive noise: a noise consisting of one or more bursts of sound energy of duration of less than one second.

Intermittent noise: a noise whose level suddenly drops to several times the level of the background noise.

Noise: any unwanted and annoying sound that is intrinsically objectionable to human beings or which can have or is likely to have an adverse effect on human health or the environment.

Noise pollution: release of uncontrolled noise that is likely to cause danger to human health, or damage to the environment.

Permissible noise levels: the levels of noise prescribed in section 4
Sound means a fluctuation in pressure, particle displacement, or particle velocity propagated in any medium, or the auditory sensation that may be produced.

Place of entertainment: a building or other place where activities of amusement, entertaining, playing of music, dancing, performing of shows takes place.

4. Requirements

Tolerance limits for Environmental Noise shall be as shown in Table 1

Table 1.1: Maximum Permissible levels for general environment

COLUMN 1	COLUMN 2	
	NOISE LIMITS dBA (L_{eq})	
FACILITY	DAY	NIGHT
Any building used as hospital, convalescence home, home for the aged, sanatorium, and learning institutions, conference rooms, public library, and environmental and recreational site.	45	35
Residential building	50	35
Mixed residential (with some commercial and entertainment)	55	45
Residential and Industry/small scale production and commerce	60	50
Industrial area	70	60

Time frame: Use duration.

Day – 6:00 am – 10:00 pm
Night-10:00 pm-6:00 am

Table 1.2: Maximum Permissible Noise Levels (Continuous /intermittent noise) from a Factory/workshop

COLUMN 1	COLUMN 2	COLUMN 3
Leq dBA	**Duration (Daily)**	**Duration (Weekly)**
85	8.00 hours	40.00 hours
88	4.00 hours	20.00 hours
91	2.00 hours	10.00 hours
94	1.00 hours	5.00 hours
97	30.00 minutes	2.50 hours
100	15.00 minutes	1.25 hours
103	7.50 minutes	37.5 minutes
106	3.75 minutes	18.75 minutes
109	1.87 minutes	9.37 minutes

Table 1.3: Maximum Permissible Noise Levels for Impact or Impulsive Noise

COLUMN 1	COLUMN 2
Sound Level dBA L_{max}	**Permitted number of impulses or impacts per day**
140	100
130	1000
120	10000

Table 1.4: Maximum Permissible Noise Levels for Mines and Quarries

FACILITY	LIMIT VALUE IN dBC
For any building used as hospital, school, convalescent home, old age home/residential building	109 dBC
For any building in an area used for residential and one/more of the following purposes: Commerce, small-scale production, entertainment, or any residential apartment in an area that is used for purpose of industry commerce or small-scale production	114 dBC

5. Monitoring

Measurement of noise levels shall be done at the receiving point. Measurement within buildings shall be done with windows and doors wide opened.

Annex A

Normative

Specification of noise limits

A0.Sound Sources and their operating conditions

The source(s) to which the noise limits apply shall be specified together with their conditions of operation.

NOTE – Special noise limits may be specified for periods during which the source is known to emit unusual types or levels of noise, e.g. when the source is undergoing maintenance.

A1.Locations

The locations where the noise limits have to be met shall be clearly specified. They shall be appropriate for the measurement of the noise emitted by the source(s) under consideration. The height of the microphone above the ground shall be specified.
If these locations are subsequently found to be unsuitable for measurement of the noise emitted by the source under consideration, additional positions shall be specified where such measurements can be made (check points). Noise limits at the checkpoints shall be derived from the levels specified at the initial locations.

NOTE – When specifying limits, the importance of certain transmission paths should be considered. This may be of special importance for establishing limits for indoor receiver positions (e.g., transmission through open or closed doors and windows).

A2.Meteorological conditions

A2.1. General

For outdoor transmission, changes in meteorological conditions may influence the received noise level if the distance between the source and the receiver is about 30 m or more. In such cases, the noise limits shall be based on an average value for either all relevant meteorological conditions only

Since, for identical patterns of noise, the long-term average level will be different for the two cases, the noise limits should be fixed accordingly.

A2.2. Averaging of levels for all meteorological conditions

In this case, the noise limits refer to noise levels averaged for all relevant meteorological conditions.

The measurements shall be made at times such that the results will be representative for the range of meteorological conditions for the site under consideration. The long-term average level may be calculated from the individual results, if required after weighting each result with a factor representing the fraction of the long-term time interval during which the corresponding meteorological conditions prevailed.

NOTES

Under certain meteorological conditions, it may be difficult to determine the specific noise of the source under consideration if there is insufficient difference between the levels of this specific noise and the residual noise.

This technique has the advantage that it takes into account both variations due to meteorological conditions and variations due to meteorological conditions and variations in the source emission.

A2.3. Determination of levels in specified meteorological conditions

In this case, the noise limits refer to noise levels in specified meteorological conditions. The meteorological conditions in which measurements are to be carried out shall be specified.

NOTES

The conditions specified will usually be those for which the noise levels at the locations where the noise limits have to be complied with an angle of less than 45^{o} with the direction from the source of these locations. Measurements during strong temperature inversion near ground should, however, be avoided.

Care should be taken to ensure that the specified meteorological conditions cover all relevant source operating conditions.

A3.Criteria for assessing compliance with limits

In order to assess compliance with a noise limit, it will, in general, be necessary to consider the average of a number of regulations should indicate how this information should be used for assessing compliance with the limits.

Annex B

Normative

Checking Compliance with Limits

B0. Instrumentations

The instrumentation and its calibration shall comply with the requirements given in (EMDC 6 (1767)

B1. Location of measurement positions

Measurements for verification of compliance with noise limits shall be carried out at the positions and at the elevations specified in the noise limit regulations.

B2. Measurement time intervals and meteorological conditions

Measurements shall be made over the time intervals and in the meteorological conditions specified in the relevant noise limit regulations.

B3. Presentation of results

The results shall be recorded in a report of the investigation of compliance with noise limits, which shall include at least the following information

a) the relevant section of the noise limit regulations in question;

b) the date and time of measurements;

c) the locations of measurement positions;

d) the instrumentation used, details of its calibrations and the types of analyses carried out;

e) meteorological conditions during the measurements (wind direction, wind speed, relative humidity, temperature, recent precipitation);

f) operating and loading conditions of the sound source(s) under consideration;

g) results of all acoustic measurements or calculations of the noise from the main source under consideration;

h) noise due to other sources, if significant;

i) any calculation methods used in evaluating the measurements;

j) results and interpretation from an acoustical point of view;

k) any other information required by the noise limit regulations.

Bibliography

1. World Health Organization (WHO), 1999. *Guidelines for Community Noise* Berglund, B. T. Lindvall D. H. Schwela (Editors). Geneva

2. Environmental Pollution Control Center, Osaka Prefecture Government. *The Basics of Environmental Noise and Environmental Noise Measurement*. Osaka

3. Cavanaugh, W. J., and G. C. Tocci. 1998. *Environmental Noise: The Invisible Pollutant*. USC Institute of Public Affairs. USA

4. Singaporean National Environmental Agency (NEA), *Environmental Pollution Control Act* Chapter 94A, Section 77(1), 1997. Boundary Noise Limits for Factory Premises Regulations

5. ISO Standard Handbook. 1995. Acoustics Volume 1 *General Aspects of Acoustics Methods of Noise measurement in general; Noise with respect to human beings.* Geneva

6. ISO Standard Handbook, 1995. Acoustics Volume 2 *Noise emitted by vehicles; Noise emitted by specific machines and equipment Acoustic in buildings.* Geneva

7. Ugandan Statutory Instruments, 2003 No. 30. The National Environmental (Noise Standards and Control) Regulations, 2003. (Under section 29 and 108 of the National Environmental Statute, 1995, Statute No. 4 of 1995)