

**FINALIZED TANZANIA STANDARD**

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**Gaseous oxygen – technical grade– Specification**

**TANZANIA BUREAU OF STANDARDS**

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**2<sup>nd</sup> edition**

## 0. FOREWORD

**0.1.** This Tanzania Draft Standard was prepared by the Technical Committee CDC 09 Gases Products under the supervision of Chemicals Divisional Standards Committee, and it is in accordance with the procedures of the bureau.

**0.2.** In the preparation of this standard assistance was derived from:

BS 4364:1968 – *Specification for industrial oxygen*, published by the British Standards Institution,

Oxygen Specification, prepared at the 53<sup>rd</sup> JECFA (1999), published by FAO in FNP 52 Add 7 (1999),

IS 309: 2005 – *Specification for compressed oxygen gas*, published by Bureau of Indian Standards.

**0.3.** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value observed or calculated expressing the result(s) of a test or analysis shall, be rounded off in accordance with TZS 4:1979 (see clause 2). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

**1.1.** This Draft Tanzania Standard describes the requirements and methods of sampling and test for gaseous oxygen (technical grade) intended for industrial uses e.g. welding and cutting operations.

**1.2.** This draft Tanzania Standard does not cover oxygen intended for aviation and medical or inhalation uses.

## 2. Normative references

The following normative references are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the normative references (including amendments) applies

TZS 4, *Rounding off numerical values*

TZS 59, *Water – distilled quality – Specification*

TZS 97, *Specification for identification of contents of industrial gas cylinders*

## 3. Requirements

### 3.1. General requirements

**3.1.1.** Gaseous oxygen of technical grade shall be colourless and odourless.

**3.1.2.** Gaseous oxygen of technical grade bursts into flame when in contact with the glowing splinter.

### 3.2. Specific requirements

The gaseous oxygen of technical grade shall comply with specific requirements specified in Table 1 when tested in accordance with the methods prescribed therein.

Table 1 Specific requirements of gaseous oxygen – technical grade

S/ No.	Characteristic	Requirement	Test method
(i)	Oxygen, %, (v/v), min.	99.0	Annex A
(ii)	Dew drop <sup>a)</sup> , °C, min.	-40	Annex B
(iii)	Carbon monoxide, v/v, max.	$2 \times 10^{-6}$	Annex C
(iv)	Carbon dioxide, v/v, max.	$3 \times 10^{-6}$	Annex C
(v)	Methane <sup>b)</sup> , v/v, max.	$50 \times 10^{-6}$	Annex D

NOTE: a) The dew drop test shall be carried out at atmospheric pressure  
b) Oxygen gas produced by air separation process shall not normally contain any carbon dioxide, carbon monoxide and hydrocarbon in terms of methane. Presence of these impurities in gaseous oxygen of technical grade normally is expected from other methods.

#### 4. Sampling

Sampling and criteria of finding conformity of the requirements of this standard shall be done in accordance with method described in Annex E.

#### 5. Packaging and marking

##### 5.1. Packaging

The gaseous oxygen of technical grade shall be packaged in compressed gas cylinder(s).

##### 5.2. Marking

The marking and labelling shall be in accordance with TZS 97.

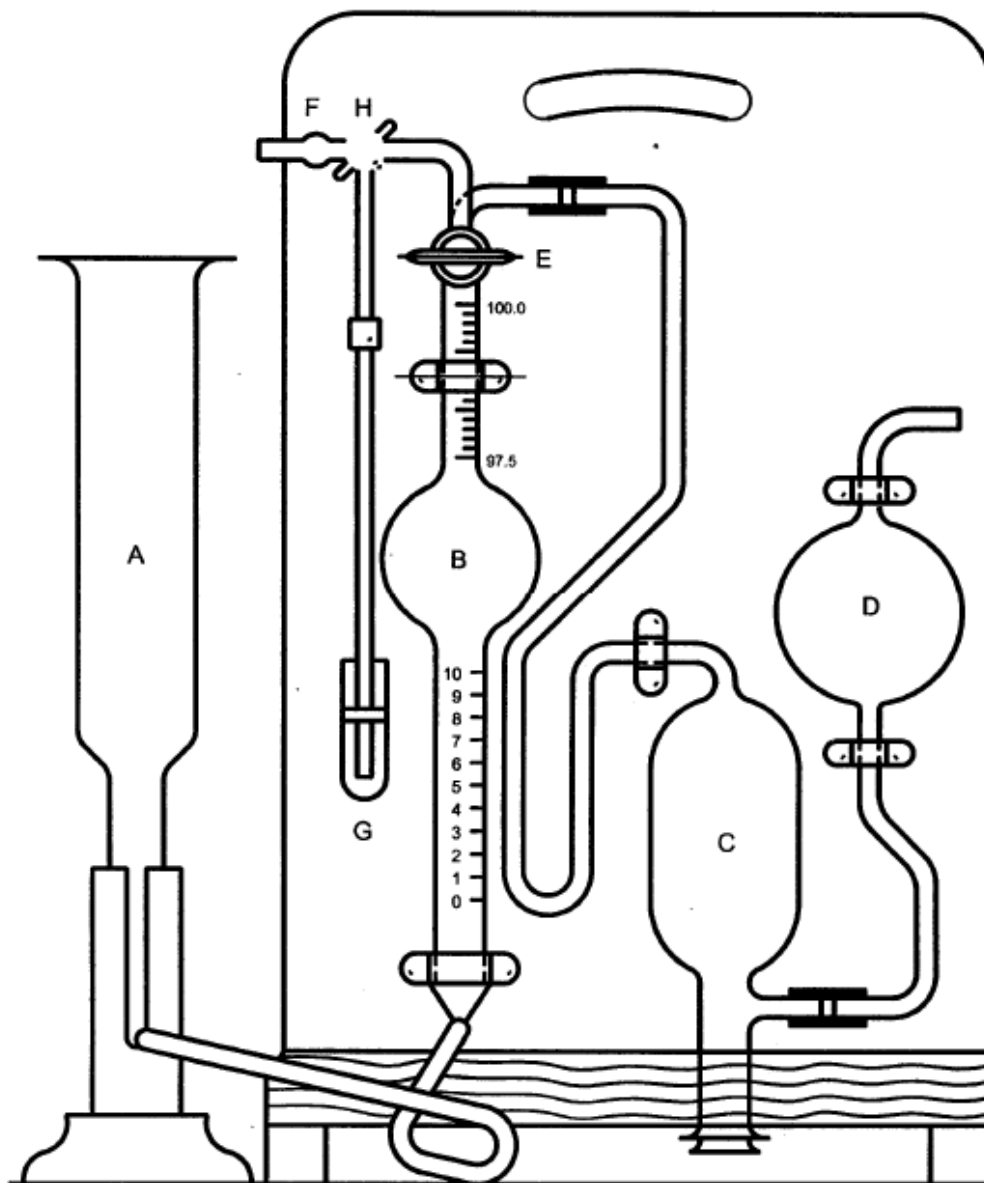
#### 6. Quality of reagents

Analytical grade reagents and distilled water that comply with TZS 59 or deionized water of equivalent purity shall be used for the appropriate tests.

**Annex A**  
(Normative)  
**Determination of purity of oxygen gas**

**A.1 Apparatus**

A.1.1 The apparatus shall be as shown in Figure 1.



**Figure 1 - Assembly of apparatus for determination of oxygen**

A- levelling tube

B- Burret

C- Copper wire container

D - Round Flask?

E- stockcock

F - Connector

G -Lute

H - Stop cock

### A.1.2 Copper wire

## A.2 Reagents

**A.2.1 Ammonia solution** – Dissolve 550 g of ammonium chloride ( $\text{NH}_4\text{Cl}$ ) in 1085 ml of water and to this solution add 917 ml of ammonium hydroxide solution of relative density equals to 0.90.

## A.3 Procedure

**A.3.1** Invert the copper wire container *C*, remove the bung and fill it with copper wire in spiral or other form. Then fill it with ammonia solution to replace the bung. Return *C* to upright position. Pour the ammonia solution into the levelling tube *A* until it is about three quarters full. Then operate the three-way stopcock *E* and *H* so that burette *B* is in communication with the atmosphere through inlet *E*, and by raising levelling tube *A*, completely fill burette *B*. keeping *A* raised, turn *E*, so that *B* is in communication with *C*, and allow the solution to pass into *C*, until *D* is half full. Close *E*, lower *A* and operate *E* to draw from *C* into *B*. close *E* when capillary of *E* is full of liquid. Raise *A* and operate *E* to expel gas from *B* to the atmosphere through *F*, closing *E* when the capillary *H* is full of liquid. Fill the lute *G* with a head of about 50 mm of water and connect *F* with sample gas and purge the gas from the lute *G*. Draw in the sample through *F* (taking care that no air is sucked in through *F* during this operation), until the liquid level in *B* is at the zero mark and is at the same level with that in *A*. Pass the gas into *C* by suitably operating the cock *B*, and raising *A*. shake thoroughly and then draw back the unabsorbed gas into *B* by lowering *A* and operating the cock *E*, until a little solution from the capillary trickles down into *B* in order to ensure that the capillary plug of cock *E* is filled with liquid before levelling up and reading the volume of the gas. Repeat the process a number of times until no further absorption takes place.

### A.3.2 Renewal of the solution

When the solution is spent, close *E*, remove the bung from *C* and drain out the solution from *C* and *D*. Invert *C* and fill it with fresh solution. Replace the bung and set *C* and *D* in proper place and in upright position. Now add fresh solution to the partially spent solution of *A* and repeat the process as indicated in A.3.1.

**A.4 Calculation**

$$\text{oxygen, percentage by volume} = \frac{V_2 - V_1}{V_2} \times 100\%$$

Where:

$V_2$  = Volume of the gas sample taken for the test, in ml and,

$V_1$  = Volume of the gas after absorption, in ml.

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**Annex B**  
(Normative)

**Determination of moisture (water vapour)**

**B.1 General**

Presence of moisture in oxygen gas shall be determined by dew point or by weight of moisture content. For dew point determination, electrolytic hygrometer, frost or dew point hygrometer, and capacitance hygrometer shall be used. For determination of weight of moisture content, absorption method shall be followed. The procedure to be followed for determining the dew point by hygrometer method shall depend upon type of apparatus to be used and manufacturer's instruction.

**B.2 Electrolytic hygrometer**

The method is based on absorption and electrolysis of water vapour present in the sample gas. The electrolytic current gives a direct measurement of water vapour present in the gas flowing through the instrument at steady rate. The exact procedure to be followed shall depend on the type of apparatus to be used. The instrument manufacturer's instruction in this regard shall be followed.

**B.3 Frost or dew point hygrometer**

A metal surface on the hygrometer is cooled so that dew or frost is formed from the vapour content of the gas at a particular pressure which may be observed optically in the apparatus. The temperature at which the dew or frost is formed is a measure of water vapour content of the gas. The exact procedure to be followed shall depend upon the type of apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

**B.4 Capacitance hygrometer**

The method is based on the change of capacitance of the sensor when a sample gas containing water vapour passes through it. The change in capacitance gives a direct measurement of water vapour present in the gas. The procedure to be followed shall depend on the type of apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

**B.5 Absorption method**

**B.5.1 Apparatus**

The apparatus consists of the following parts assembled as shown in Figure 2.

**B.5.1.1 Gas meter**, accurate to 1 percent.

**B.5.1.2 Absorption Train**, three U tubes containing phosphorous pentoxide connected in a series to the gas meter. The one near to the gas meter will serve as a guard to prevent moisture from backing into the first tube.

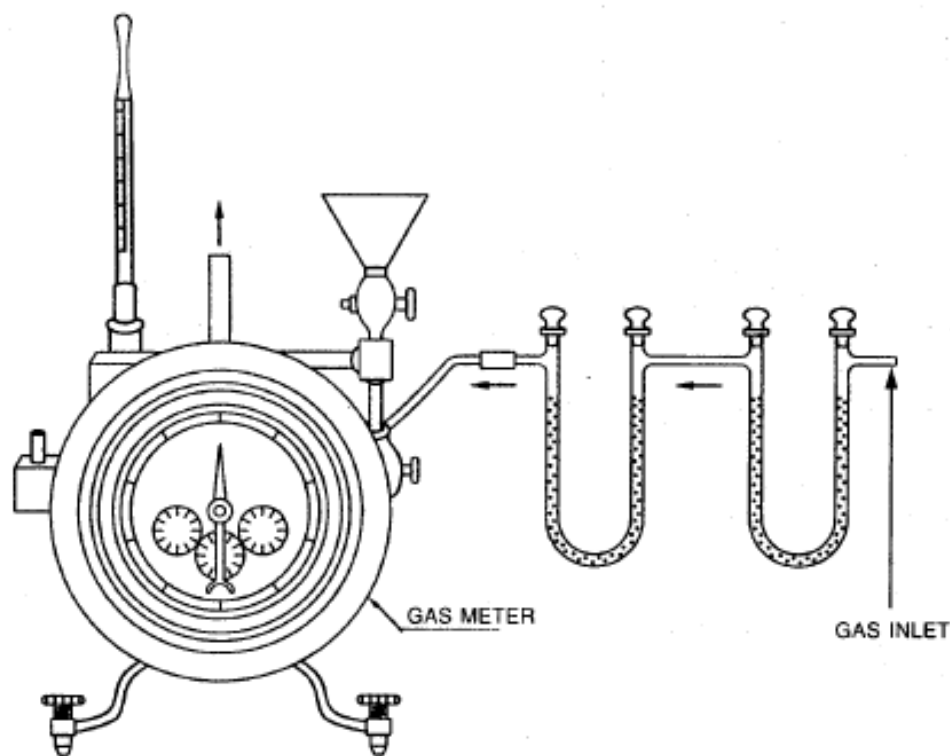


Figure 2 - Assembly of apparatus for determination of moisture

### B.5.2 Procedure

**B.5.2.1** Absorption of the moisture from a known volume of oxygen gas by anhydrous calcium chloride ( $\text{CaCl}_2$ ), or phosphorous pentoxide ( $\text{P}_2\text{O}_5$ ) or Silica Gel or mol. sieve held in a series of U tubes.

**B.5.2.2** Quantity of gas flow through U tube train shall be measured by a rotometer or any other type of flow meter having accuracy of not less than  $\pm 5$  percent. Flow rate shall be about 500 l/h and not more to ensure complete absorption of oxygen in the hygroscopic chemicals held in the U tube train.

**B.5.2.3** U tube train filled with hygroscopic chemicals shall be initially heated to  $100^\circ\text{C}$  or more depending on the chemical for 1 h to drive away any moisture absorbed previously by chemicals. The two ends of U tube train shall be firmly closed with rubber stopper not to allow ingress of atmospheric air. Weight of the whole U tube shall be taken on a sensitive chemical balance of accuracy not less than  $\pm 1$  percent. The U tube train shall be heated again in two intervals for 15 min each and weighed again after each 15 minutes heating to see that there is no further moisture from the chemical have been removed.

**B.5.2.4** At least one cylinder full of oxygen gas at full filling pressure having 6 to 7  $\text{m}^3$  of oxygen gas shall be connected to the U tube train through pressure regulator and flow meter. The entire quantity of oxygen gas from the cylinder shall be passed through U tube train at a rate about 500 l/h and when the cylinder is empty in about 10 h. Both end of the U tube train shall be firmly closed with rubber stopper not to allow any moisture from the air to get in.

**B.5.2.5** U tube train after absorption of moisture from oxygen gas shall be weighed in a chemical balance and weight of moisture absorbed from oxygen gas shall be found by the difference in



weight of the U tube train before commencement of flow off oxygen and after completion of the flow of oxygen.

**B.5.3 Calculation**

**B.5.3.1** Volume of total oxygen gas flow shall be checked from the flow meter. Alternatively, total quantity of oxygen gas flow can be found out from water capacity of gas cylinder punched on the body of the cylinder and the difference between the initial full pressure of oxygen gas in the cylinder and the final pressure of oxygen in the gas cylinder when flow is stopped. The quantity of gas flow can be found out in the following manner.

The water capacity of gas cylinder punched on the body :X litre  
 Pressure of the gas cylinder full with oxygen :P<sub>1</sub> bar  
 Pressure in oxygen gas cylinder when flow from cylinder is stopped :P<sub>2</sub> bar

$$\text{Total quantity of oxygen gas flow from cylinder to "U" tube train} = \frac{X \times (P_1 - P_2)}{1\ 000} \text{ m}^3$$

“m<sup>3</sup>” shall be converted to Nm<sup>3</sup> by applying the gas law,  $K = \frac{PV}{T}$

If chemical balance employed for weighing is not enough sensitive, in that case gas from more than one oxygen cylinder may be passed to increase absorption of more moisture and thereby to increase the weight of the U tube train for easier weighing.

**B.5.3.2** The weight of moisture absorbed in the U tube train in grams divided by the volume of oxygen passed in Nm<sup>3</sup>, shall show moisture content, in g/Nm<sup>3</sup>.

**B.5.3.3** The above test shall be repeated 3 times and the average moisture content in g/Nm<sup>3</sup> shall be determined. This shall not be more than 0.102 g/Nm<sup>3</sup> corresponding to -40°C dew point.

**Annex C**  
(Normative)

**Determination of volume fraction of carbon monoxide and carbon dioxide**

**C.1** The method for determination of volume fraction of carbon monoxide and carbon dioxide present in oxygen shall use the principle of infrared absorption in specific wavelength by different molecules. 'Scanning infrared spectrometer' shall be used after calibration. Instruction of the manufacturers of the instruments shall be followed for calibration and calculation of volume fraction of carbon monoxide and carbon dioxide.

**C.2** *Alternatively*, pass  $1050 \pm 50$  ml of the gas sample through carbon monoxide or carbon dioxide detector tube at the rate specified for the tube, depending on what you are measuring at that particular moment. For carbon monoxide, the indicator change shall not correspond to more than  $10 \mu\text{l/l}$  while for carbon dioxide shall not correspond to more than  $300 \mu\text{l/l}$ .

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**Annex D**  
(Normative)

**Determination of volume fraction of hydrocarbons**

**D.1** Gas chromatograph with flame ionization detector, gas sampling valve, suitable valve to 'backflash' hydrocarbon to detector shall be used for determination of volume fraction of hydrocarbon. Nitrogen gas shall be used as carrier gas. Instruction of the manufacturer of the instrument shall be followed for calibration and calculation of volume fraction of hydrocarbons in oxygen gas.

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**Annex E**  
(Normative)

**Sampling of gaseous oxygen of technical grade**

**E.1 Procedure**

**E.1.1** On regular production, two samples selected at random shall be tested per hour of compression.

**E.1.1.1** The production shall be declared as conforming to this standard, if the sample passes the oxygen and moisture content test.

**E.1.1.2** However, if the sample fails in the oxygen and moisture content test, then sampling frequency shall be doubled until all samples pass for consecutive 2 h.

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**Annex F**  
(Informative)  
**Determination of odour**

**F.1** Carefully open the container valve to produce moderate flow of gas. Do not direct the gas stream towards the face, but deflect portion of the stream toward the nose: no appreciable odour shall be discernible.

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