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## Organic-inorganic compound fertilizer — Specification

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## Foreword

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- (a) a member of International Organisation for Standardisation (ISO) and
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Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

The committee responsible for this document is Technical Committee UNBS/TC 2, *Food and Agriculture Subcommittee SC 20, Agrochemicals and veterinary drugs*.

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# Organic — Inorganic compound fertilizer — Specification

## 1 Scope

This Draft Uganda standard specifies the requirements, sampling and test methods of organic – Inorganic compound fertilizers

## 2 Normative references

The following referenced documents referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

US ISO 10390, *Soil quality — Determination of pH*

ISO 17184: *Soil quality -- Determination of carbon and nitrogen by near-infrared spectrometry (NIRS)*

ISO 8157, *Fertilizers and soil conditioners -- Vocabulary*

US ISO 11261, *Soil quality — Determination of total nitrogen — Modified Kjeldahl method*

US ISO 10694, *Soil quality — Determination of organic and total carbon after dry combustion (elementary analysis)*

US ISO 11261, *Soil quality — Determination of total nitrogen — Modified Kjeldahl method*

US ISO 6598, *Fertilizers — Determination of phosphorus content — Quinoline phosphomolybdate gravimetric method*

US ISO 8397, *Solid fertilizers and soil conditioners — Test sieving*

US ISO 11265, *Soil quality — Determination of the specific electrical conductivity*

US ISO 17318, *Fertilizers and soil conditioners — Determination of arsenic, cadmium, chromium, lead and mercury contents*

US ISO 11047, *Soil quality — Determination of cadmium, chromium, cobalt, copper, lead, manganese, nickel and zinc in aqua regia extracts of soil— Flame and electrothermal atomic absorption spectrometric methods.*

US ISO 725, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of presumptive Escherichia coli — Most probable number technique*

US ISO 6579-1, *Microbiology of the food chain — Horizontal method for the detection, enumeration and serotyping of Salmonella — Part 1: Detection of Salmonella spp.*

DUS ISO 7899-1, *Water quality -- Detection and enumeration of intestinal enterococci -- Part 1: Miniaturized method (Most Probable Number) for surface and waste water*

US ISO 9308-2, *Water quality — Enumeration of Escherichia coli and coliform bacteria — Part 2: Most Probable Number method (2nd Edition)*

US ISO 7409, *Fertilizers -- Marking -- Presentation and declarations*

US ISO 8397: *Solid fertilizers and soil conditioners — Test sieving*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in DUS ISO 8157 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1 fertilizer

materials with the main function of providing plant nutrients

#### 3.2 Inorganic (mineral) Fertilizer

Fertilizer that indicates an inorganic salt form of nutrients, and it is made from extraction, physical and/or chemical industrial methods.

#### 3.3 Organic Fertilizer

material containing carbon or one or more elements other than hydrogen and oxygen, mainly of plant and/or animal origin added either directly to the plant or to the soil, specifically, for the nutrition of plants and that may improve soil structure

#### 3.4 Compound Fertilizer

fertilizer having a declarable content of at least two of the primary plant nutrients (nitrogen, phosphorus, and potassium), obtained chemically or by blending, or both, including NP, NK, PK, and NPK product

#### 3.5 Organic-inorganic compound fertilizer

Compound fertilizer with certain amount of organic fertilizer.

#### 3.6 Total primary nutrient

The sum of total nitrogen, effective phosphorus pentoxide, and potassium oxide calculated according to mass fraction.

### 4 Requirements

#### 4.1 General requirement

4.1.1 Organic – inorganic compound fertilizer shall have the appearance granular or strip products, without mechanical impurities.

4.1.2 Organic- inorganic fertilizer shall be free from foul smell.

4.1.3 Organic – inorganic fertilizer shall be homogenous in texture.

4.1.4 The product shall be free from contaminants which include but not limited to residual hormones, antibiotics, pesticides and pathogens.

4.1.5 4.1.2 The particle size of the granular material, shall be such that not less than 90 % by mass of fertilizer, shall be of particles size range of 2 mm – 5 mm and for prilled material shall be of particles size range of 1mm - 4mm when tested in accordance with US ISO 8397

## 4.2 Specific requirements

4.2.1 Organic-inorganic compound fertilizer shall conform to the requirements in Table 1

**Table 1: Specific requirements for Organic- inorganic compound fertilizers**

Parameter	Limit	Method of test
pH	5.5 – 8.0	US ISO 10390
Carbon: Nitrogen ratio, Max	20:1	DUS ISO 17184
Moisture content, %, m/m check alternative method	10-35	Annex A
Total Nitrogen, %, m/m, min.	1	US ISO 11261
Organic carbon, %, m/m, min.	6	US ISO 10694
Organic matter content (solid), %, m/m, min.	12	Annex B
Total primary nutrients — N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O (solid and liquid organic fertilizer),%, m/m, min	15	US ISO 11261, US ISO 6598
Foreign matter > 2 mm, % m/m, max	0.5	US ISO 8397
Soluble salts (conductivity), mmhos, max.	5	US ISO 11265
* For pelletized fertilizer, moisture content shall be ≤10%.		

4.2.2 Content of the identified single nutrient shall not be less than 3.0%,

## 5 Heavy metal contaminants

Heavy metal contaminants in the fertilizers shall conform to the limits given in Table 2 when tested with the method specified therein

**Table 2— Heavy metal contaminant limits for organic- inorganic compound fertilizers**

Properties	Allowable maximum level (mg/kg, dry weight)	Test method
Arsenic (As)	10	US ISO 17318
Lead (Pb)	30	US ISO 17318
Chromium (Cr)	50	US ISO 17318
Nickel (Ni)	50	US ISO 11047
Mercury (Hg)	2	US ISO 17318
Cadmium (Cd)	5	US ISO 17318

## 6 Hygiene

Organic- inorganic compound fertilizers shall be free from pathogenic organisms. The product shall comply with microbiological limits in the following table:

**Table 3 — Microbiological limits for organic fertilizers**

Microorganisms	Allowable level	Method of test
<i>E. coli</i>	absent	US ISO 7251
Salmonella spp	Absent in 25 g	US ISO 6579-1
Faecal streptococci	<500 cfu/g	DUS ISO 7899-1
Total coliforms	100 cfu/g	US ISO 9308-2

## 7 Sampling

### 7.1 Sampling for laboratory analysis

All finished products should be subjected to lot sampling for laboratory analysis using the following procedure:

For composite sampling of solid products:

- (1) Present to the inspector the production documents containing the number of bags per batch number and bag number.
- (2) The inspector will randomly select the bag number.
- (3) The selected bags will be emptied into a clean area. All contents of the selected bags) will be thoroughly mixed.
- (4) Submit five kilograms (5 kg) of the composite sample to the laboratory.
- (5) Information relative to the sample taken shall be accurate and complete to allow traceability of the sample back to the lot from which it was sampled.

NOTE If the samples analyzed do not conform to the standards, the inspecting Certifying Body (CB) should review the production process which may include bulk sampling.

**Table 6 — Required Number of Samples for Solid Products**

Number of bags* per batch	Bags to be sampled
≤50	2
51 to 100	3
101 to 300	8
301 to 500	15
501 to 1000	20
More than 1000	Multiples of 20
* NOTE 1 bag = 50 kg	

For composite sampling of liquid products:



- (1) Present to the inspector the production documents containing the number of containers per batch number and container number.
- (2) The inspector will randomly select the container number and subject the selected containers for analysis.
- (3) Information related to the sample taken must be accurate and complete to allow traceability of the sample back to the lot from which it was sampled.

**Table 7 — Required number of samples for liquid products**

Number of containers* per batch	Containers to be sampled
≤ 50	1
51 to 100	2
101 to 300	3
301 to 500	4
More than 500	5
*NOTE: 1 container should be at least 1 L	

## 7.2 Laboratory sampling (sample preparation for laboratory analysis)

### (a) For samples with uniform fineness

Place sample on a clean smooth flat surface and mix thoroughly. Reduce sample to a quantity sufficient for analysis by quartering. Mix and store in air-tight container.

### (b) For liquid fertilizers

For liquid fertilizers without suspended particles, stir the sample until it is thoroughly mixed before taking a sample.

For liquid fertilizers with suspended particles, take a sample while mixing the material in order to obtain a representative sample.

## 8 Packaging and storage

8.1 The Organic- inorganic compound fertilizer shall be packed in clean, non-defective and strong containers.

8.2 The material for which the container is made shall be such as to protect the contents from moisture and also not lead to easy rupture during handling, transportation and storage.

8.3 The products should be stored in a cool and dry place and should be protected from rain, moisture, sun protection and rupture

## 9 Labelling

9.1 Each container of the Organic – inorganic compound fertiliser shall bear a label in indelible marking in accordance with US ISO 7409,) and with the following particulars:

- a) Product name as “Organic- inorganic compound fertilizer

- b) Nutrient content(NPK)
- c) Carbon/Nitrogen ratio
- d) Organic matter content
- e) Moisture content
- f) Batch number
- g) Percentage foreign matter (Name and physical address of the manufacturer/packer/importer)
- h) Date of manufacture
- i) Best before date
- j) Instructions for use
- k) Precautions /warnings
- l) Country of origin
- m) net content
- n) registration number
- o) form of product

9.2 Where the fertilizer is distributed in bulk, the labelling information shall accompany the delivery notice to the purchaser.

## Annex A (normative)

### Determination of moisture content

#### A.1 Oven dry method

##### A.1.1 General

The method does not apply to fertilizers that yield volatile substances other than water at drying temperature.

##### A.1.2 Procedure

**A.1.2.1** Weigh accurately 2 g of the prepared sample in a pre-weighed, clean and dry weighing bottle or petridish.

**A.1.2.2** Heat in an oven for about 5 hours at  $105 \pm 2$  °C to constant weight. Cool in a desiccator and weigh. For urea, heat at  $70 \pm 5$  °C for five hours to constant weight.

##### A.1.3 Calculation

$$\text{Moisture per cent by weight (\%)} = 100 \times \frac{B - C}{B - A}$$

where,

A is the weight in gram of the empty bottle;

B is the weight of the bottle plus the material in gram, before drying;

C is the weight of the bottle plus the material in gram, after drying;

#### A.2 Vacuum desiccator method

##### A.2.1 General

The method is applicable to Ammonium Chloride, Calcium Ammonium Nitrate (CAN), Di-Ammonium Phosphate (DAP) and all types of complex and mixtures of NPK fertilizers.

##### A.2.2 Procedure

Weigh accurately in duplicate 5 g of prepared sample in a weighed shallow porcelain dish. Put the sample in a desiccator over concentrated sulphuric acid, close and introduce vacuum for about 10 minutes, then stop the vacuum pump and leave the sample for 24 hours, then release vacuum, remove the sample from the desiccator and weigh.

### A.2.3 Calculation

$$\text{Moisture per cent by weight} = 100 \times \frac{(W_2 - W_3)}{(W_2 - W_1)}$$

where,

$W_1$  is the weight in gram of empty porcelain dish;

$W_2$  is the weight in gram of porcelain dish with sample before putting the sample for 24 hours in the desiccator; and

$W_3$  is the weight in gram of porcelain dish with sample after putting the sample for 24 hours in the desiccator;

## A.3 Karl Fischer method

### A.3.1 General

This method is applicable to fertilizers like CAN, Urea and urea based complexes. This method is not suitable for phosphate rock based fertilizers and fertilizers containing monocalcium phosphate, calcium sulphate, alkali carbonates as well as aldehydes and ketone groups.

### A.3.2 Apparatus

Karl Fischer titrator

### A.3.3 Reagents

**A.3.3.1 Karl Fischer reagent(KF)** – Karl Fischer solution (pyridine free) (single solution)

**A.3.3.2 Di-sodium tartarate dihydrate** ( $\text{Na}_2\text{C}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$ ) analytical grade

**A.3.3.3 Methanol-KF grade/spectroscopy grade** containing less than 0.05 % water

### A.3.4 Procedure

Standardization of KF reagent.

- Set up the instrument as per manufacturer's manual.
- Add methanol to the titration vessel until the electrodes are dipped and titrate with Karl-Fischer reagent to a pre-set end point persists for 30 seconds.
- Add 100mg of the disodium tartarate dehydrate to the titration vessel carefully and titrate with Karl Fischer reagent to a pre-set end point (the pre-set end point should persist for 30 seconds). Note the volume of KF reagent used as  $V_1$  ml.

## A.4 Determination of moisture of sample

**A.4.1** Weigh accurately 1 g of the prepared sample and transfer to the titration vessel carefully and stir until dispersed.

**A.4.2** Titrate with KF reagent to the same pre-set end point as above and note the volume of KF reagent used as  $V_2$  ml.

## A.5 Calculation

$$\text{Factor (F) (mgH}_2\text{O/1 ml of KF reagent)} = \frac{0.1566 \times \text{mg of sodium tartarate dihydrate added}}{V_1}$$

$$\text{Moisture per cent by weight} = \frac{F \times V_2 \times 100}{\text{Weight of sample (gram)} \times 1\,000}$$

## Annex B

### (Normative)

### Determination of Content of Organic Matter (Potassium Dichromate Volumetric Method)

#### B.1 Method and Principle

The quantitative potassium dichromate - sulfuric acid solution is used to oxidize the organic carbon in the organic fertilizer under heating. Excess potassium dichromate is titrated with ferrous sulfate standard solution; meanwhile, the blank test is carried out by using the silicon dioxide as the additive. The content of organic carbon shall be calculated based on the consumption of oxidants before and after oxidation and the value obtained is multiplied by a factor of 1.724 to obtain the content of organic matter

##### B.1.2 Instruments and Equipment

The common laboratory instruments and equipment shall be used.

##### B.1.3 Reagents and Preparation

Silicon dioxide: in powder form.

Sulfuric acid (ρ1.84).

$\text{K}_2\text{Cr}_2\text{O}_7$   $c(1/6 \text{ K}_2\text{Cr}_2\text{O}_7)=0.1\text{mol/L}$ .

Potassium dichromate ( $\text{K}_2\text{Cr}_2\text{O}_7$ ) standard solution:  $c(1/6 \text{ K}_2\text{Cr}_2\text{O}_7)=0.1\text{mol/L}$ .

Weigh out 4.9031g potassium dichromate (primary reagent) after drying for 3h~4h at 130°C and dissolve it with a small amount of water, and then transfer the potassium dichromate solution to a 1L volumetric flask and dilute the solution with water to the scale mark and shake well.

$c(1/6 \text{ K}_2\text{Cr}_2\text{O}_7)=0.8\text{mol/L}$ .

Potassium dichromate solution:  $c(1/6 \text{ K}_2\text{Cr}_2\text{O}_7)=0.8\text{mol/L}$ .

Weigh out 39.23g potassium dichromate (analytically pure) and dissolve it with a small amount of water, and then transfer the potassium dichromate solution to a 1L volumetric flask and dilute the solution to the scale mark and shake well.

$\text{FeSO}_4$  :  $c(\text{FeSO}_4)=0.2\text{mol/L}$ .

Ferrous sulfate ( $\text{FeSO}_4$ ) standard solution:  $c(\text{FeSO}_4)=0.2\text{mol/L}$ .

Weigh out 55.6g  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  (analytically pure), dissolve it in 900mL water and dissolve the solution by adding 20mL sulfuric acid (5.2.3.2), dilute it to the constant volume of 1L, and shake well (if necessary, filter it). The accurate concentration of the solution is calibrated based on 0.1mol/L potassium dichromate standard solution (5.2.3.3) and it shall be calibrated for immediate use.

Calibration of  $c(\text{FeSO}_4)=0.2\text{mol/L}$  standard solution: pipette 20.00mL potassium dichromate standard solution (5.2.3.3) into a 150mL triangular flask, add 3mL~5mL sulfuric acid (5.2.3.2) and 2~3 drops of o-Phenanthroline indicator (5.2.3.6), and titrate it with ferrous sulfate standard solution (5.2.3.5). The accurate concentration  $c_1$  is calculated by equation (1) based on the consumption of ferrous sulfate standard solution in the titration.

$$c = \frac{c_1 \times V_1}{V_2} \dots\dots\dots (1)$$

Where:

$c_1$ ——Concentration of potassium dichromate standard solution, in mol/L;

$V_1$ ——Volume of potassium dichromate standard solution pipetted, in mL;

$V_2$ ——Volume of ferrous sulfate standard solution consumed in the titration, in mL.

#### Phenanthroline indicator

Weigh out 0.695g ferrous sulfate (analytically pure) and 1.485g o-Phenanthroline (analytically pure), dissolve them in 100mL water, and shake well. The indicator is easy to deteriorate, so it shall be stored in a closed brown bottle.

#### B.1.5 Determination Steps

Weigh out 0.2g~0.5g air-dried sample (accurate to 0.0001g) after sieving with a  $\Phi 1\text{mm}$  sieve, put it in a 500mL triangular flask, accurately add 50.0mL potassium dichromate solution of 0.8mol/L (5.2.3.4) and 50.0mL concentrated sulfuric acid (5.2.3.2), and place a small bent neck funnel in boiling water and keep it for 30min after the water is boiled. Take it out of the boiling water and cool it to the room temperature, flush the small funnel with water and collect the washing liquor into the triangular flask. Take off the triangular flask, transfer intact the reactant to a 250mL volumetric flask, cool it to the room temperature, and dilute it to the constant volume; pipette 50.0mL solution into a 250mL triangular flask, add water to about 100mL, and add 2~3 drops of o-Phenanthroline indicator (5.2.3.6). When the solution is titrated with 0.2mol/L ferrous sulfate standard solution (5.2.3.5) near the end point, the solution changes from green to dark green, and then the ferrous sulfate standard solution is added dropwise until the brick red is generated. Meanwhile, weigh out 0.2g silicon dioxide (accurate to 0.001g) (5.2.3.1) to replace the sample, and conduct the blank test with the same reagents by using the same analysis steps.

If the amount of ferrous sulfate standard solution used in the titration of the sample is less than one-third of the amount of ferrous sulfate standard solution used in the blank test, the sample weight shall be reduced and re-determined.

#### B.1.6 Expression of Analysis Results

The content of organic matter is expressed as the mass fraction of fertilizer and is calculated by equation (2) below:

$$\omega(\%) = \frac{c(V_0 - V) \times 0.003 \times 100 \times 1.5 \times 1.724 \times D}{m(1 - X_0)} \dots\dots\dots (2)$$

Where:

$c$ —Molar concentration of ferrous sulfate standard solution, in mol/L;

$V_0$ —Volume of ferrous sulfate standard solution consumed in the blank test, in mL;

$V$ —Volume of ferrous sulfate standard solution consumed in the sample determination, in mL;

0.003—Molar mass of one-fourth of a carbon atom, in g/mol;

1.724—Factor for converting the organic carbon to the organic matter;

1.5—Oxidation correction factor;

$m$ —Mass of air-dried sample, in g;

$X_0$ —Moisture percentage of air-dried sample;

$D$ —Taking multiple, constant volume/taking volume, 250/50.

## **Bibliography**

- [1] China standard for Organic- inorganic compound fertilizer
- [2] ARSO standards for organic fertilizer

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