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# भारतीय मानक प्रारूप

# कॉपर और कॉपर एलॉय स्क्रैप की ग्रेडिंग, परीक्षण और स्वीकृति — दिशानिर्देश

Draft Indian Standard

# GRADING, TESTING AND ACCEPTANCE OF COPPER AND COPPER ALLOY SCRAP — GUIDELINES

ICS 77.120.30

Ores and Feed Stock for Copper Industry, its Metals/ Alloys and Products Sectional Committee, MTD 08 Last date for receipt of comments is XX/XX/2023

# FOREWORD

#### (Formal clauses will be added later)

This standard lays guidelines and requirements for copper scrap and copper alloy scrap which are identified as suitable for direct melting, smelting and refining of scrap. It specifies certain requirements and test methods to ascertain the quality of scrap such as visual inspection, chemical testing, moisture and volatile content test and calculating the amount of foreign material (both metallic and non-metallic) present in the scrap.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

#### **Draft Indian Standard**

# GRADING, TESTING AND ACCEPTANCE OF COPPER AND COPPER ALLOY SCRAP — GUIDELINES

# **1 SCOPE**

This standard specifies guidelines for grading, sampling, testing and requirements of copper scrap and/or copper alloy scrap for direct melting, smelting and/or refining depending upon end application.

# 2 TERMINOLOGY

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

**2.1 Copper Scrap and Copper Alloy Scrap** — Copper and/or its alloys in various forms, resulting from the collection and/or recovery of metal from end of the life (EoL) products or at various stages of manufacturing process which are collected, segregated, cleaned based on the grade given in the standard for direct melting, smelting and/or refining.

**2.2 Pre-processing of scrap** — The scrap which is sorted, segregated, shredded and cut for removal of metallic foreign materials and non- metallic foreign materials.

**2.3 Sorting** — The objects and foreign material will be separated out from the copper/ copper alloy scrap by manual sorting or by means of separation through auto separators /density difference or by magnetic separators etc.

**2.4 Segregation** — The scrap shall be segregated as per the type of alloy according to chemical composition.

# 2.5 Condition of Scrap —

a) *Loose Scrap* — Scrap that has not undergone any operation of compacting and from which pieces can be individually picked up.

b) *Briquetted Scrap* — Scrap that is compacted to form briquettes or bales.

**2.6 Copper Content** — Percentage weight of copper metal in the inspection lot.

**2.7 Metallic Foreign Material** — Physically separable metals in scrap other than copper and copper alloys.

**2.8 Alloyed Metallic Content** — Metal in alloyed form present in copper scrap and copper alloy scrap. In case of copper alloys, major alloying constituents are to be declared by supplier

**2.9** Non-metallic Foreign Material — Material other than copper and foreign metal present in scrap such as rubber, plastic, dust, insulation materials, glass, asbestos, mica etc.

**2.10 Moisture Content** — Percentage weight of water that adheres to the scrap and can be identified in the delivered lot. Moisture pick up can be due to fabrication, usage and during storage or transport.

**2.11 Volatile Material** — Foreign material (usually liquid, such as water, oils, emulsions, etc.) which can be removed by heating at sufficiently high temperature.

**2.12 Consignment** — The ordered quantity of copper and copper alloy scrap sent in one or more lots, which may be contained in either one or several transport units, such as containers/truck loads, and is intended for delivery from supplier to purchaser.

**2.13** Lot — The quantity of processed scrap indicated to be of the same Grade as given in **4.1** and offered for inspection at one time.

**2.14** Sub-lot — The quantity of scrap in each of the parts into which a lot is divided for the purpose of sampling.

**2.15 Increment sample** — The quantity of processed scrap obtained by sampling from a sub-lot.

**2.16 Gross Sample** — The aggregate of all the increment samples as collected from all the sub-lots.

# **3 ORDERING INFORMATION**

While placing an order, the following are the minimum information to be specified by the purchaser.

- a) The gross weight of the consignment,
- b) Condition of scrap as given in **2.5**,
- c) The maximum metallic foreign material and non metallic foreign material content shall be mentioned for each consignment as per the agreement between purchaser and supplier.
- d) Minimum copper and copper alloy content of the consignment and
- e) Maximum alloy content along with major alloying elements.

# **4 GRADES AND DESIGNATION**

# 4.1 Grades of Copper and Copper Alloy Scrap

The grades of scrap after pre-processing, shall meet to the requirements as given in Table 1.

# Table 1 Copper and Copper Alloy scrap quality grades based on yield after physical separation

S.	Grades of	Minimum	Maximum	Maximum Non-	Minimum Total
No.	Copper	Copper Yield	Metallic Foreign	metallics Foreign	metallic/metallic
	Scrap		Material	Material	alloy yield
		percent	percent	percent	percent
i)	S-Cu 1	99	0.1	0.3	99
ii)	S-Cu 2A	98	0.5	0.3	98
	and				
	S-Cu 2B				

(*Clauses 4.1 and 5.2*)

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iii)	S-Cu 3	96	0.5	3	97
iv)	S-CuA 1	90	1	0.5	98
v)	S-CuA 2	85	1	0.5	98
vi)	S-CuA 3	80	1	0.5	98
vii)	S-CuA 4	70	1	0.5	98
viii)	S-CuA 5	60	2	0.5	97
ix)	S-CuA 6	55	2	0.5	97

Note: In case of scrap used for electrical applications non-metallic foreign material shall not exceed 0.1

#### Table 1 Copper and Copper Alloy scrap quality grades based on chemical composition

#### (Clauses 5.3)

S. No.	Grades of Copper Scrap	Minimum Copper Content	Maximum Alloyed Metallic Content
		percent	percent
i)	S-Cu 1	99.9	0.1
ii)	S-Cu 2A	99.5	0.5
iii)	S-Cu 2B	99	1
iv)	S-Cu 3	98	2
v)	S-CuA 1	92	8
vi)	S-CuA 2	88	12
vii)	S-CuA 3	82	18
viii)	S-CuA 4	72	28
ix)	S-CuA 5	62	38
x)	S-CuA 6	56	44

Note : For increasing copper purity to more than 99.9 percent, scrap needs to be refined following either fire refining or smelting and refining

# **5 REQUIREMENTS**

5.1 The acceptance of copper scrap and copper alloy scrap after pre-processing can be done based on visual inspection of the lot/consignment, to ensure that it is free from moisture content, volatile material, non-metallic foreign material, metallic foreign material.

5.2 If it cannot be confirmed by visual inspection, the testing of lot/consignment can be done for moisture content, volatile material, non-metallic foreign material, metallic foreign material and copper content by quantitative analysis by chemical composition test. The test methods for moisture content, volatile material content, non-metallic foreign material, metallic foreign material, metallic foreign material, metallic foreign material and copper content by quantitative analysis is given in **Annexure I** and requirements shall conform to Table 1 and Table 2.

#### **6 OTHER REQUIREMENTS**

**6.1** The scrap shall be free from the following:

a) Any pressurized, closed or insufficiently open containers or tubes to avoid possible closed hollow spaces,

b) Any type of arms, ammunition, mines or any other explosive material in any form either used or otherwise and

c) Any other deleterious material such that asbestos, mica, rubber.

**6.2** The limit and determination of radioactive contamination shall be checked according the SOP issued by DGFT bearing reference no. 37/2015-2020 dated 15 November 2021 or as per its latest guidelines.

**6.3** The scrap shall meet all the relevant requirements mentioned in regulations issued by government of India including but not limited to provisions of Environmental Protection Act and Hazardous Waste Management & Handling Rules.

# 7 RETEST

If a sample selected for testing fails to meet the requirements of this standard, two additional samples shall be tested. If any of these additional samples fail to meet the requirements of the specification, the lot represented by that sample shall be rejected.

#### 8 PACKAGING AND MARKING

**8.1** The scrap shall be supplied either as loose or as briquetted scrap. Briquettes may be bundled together as well as strapped to the pallet with sufficient bands.

**8.2** The scrap lot containing mixed grades as mentioned in Table 1 above, may be either separately packed or identified as per grade specification.

#### Annexure – I

#### **1 TESTING METHODS**

#### 1.1 Determination of Moisture/Volatile Substances

**1.1.1** The maximum moisture and volatile substances content allowed in the copper scrap and copper alloy scrap shall be **2 percent** combined. The moisture and volatile substances shall be determined and removed by the method mentioned in **1.1.2**.

**1.1.2** For materials containing moisture and volatile content set the drying temperature at about 350 °C until no more weight changes are detected. Calculate the quantity of moisture and volatile substance (inclusive of oil) present in the sample as the difference between the two masses, before and after the drying. Avoid unnecessary heating up at higher temperatures in order to prevent metal oxidation.

#### 1.2 Determination of Metallic Foreign Material and Non-metallic Foreign Material

**1.2.1** The sample is to be taken for separating copper and copper alloy, other metallic and non-metallic foreign materials from each other by hand sorting or other means of separation.

Metallic foreign material and non-metallic foreign material percentage shall be measured by weight after separating copper and copper alloy from metallic foreign materials and nonmetallic foreign materials by hand sorting or other means of separation.

Non metallic Foreign material shall be calculated as follows:

Non metallic Foreign material % = 
$$\frac{W_{NMFM}}{W_{Sample}} \times 100$$

Metallic Foreign material shall be calculated as follows:

Metallic Foreign material % =  $\frac{W_{MFM}}{W_{Sample}} \times 100$ 

Metal yield shall be calculated as follows:

Metal yield% =  $\frac{[W_{Sample} - (W_{NMFM} + W_{MFM})]}{W_{Sample}} \times 100$ 

Metal Yield% = Metallic copper alloy in percentage,

W Sample = weight of sample,

WNMFM = weight of non-metallic foreign material, and

WMFM = weight of metallic foreign material.

# 1.3 Determination of the Copper Content and metallic alloyed content

**1.3.1** In this case, the copper and copper alloy scrap obtained after sorting the sample as mentioned in 1.2.1 shall be melted in graphite/refractory crucible using suitable furnace. In the crucible, covering salts shall be added adequately. After melting, the liquid metal shall be cast into sampling mould.

**1.3.2** From the cast, sample shall be taken for the determination of the copper content and alloyed metal content. The determination of copper content and alloyed metal content shall be done by any established instrumental or chemical method.

# **2 SAMPLING PROCEDURE**

**2.1** The lot size shall not be more than 28 tonnes and the sampling shall be carried out at the processor's end.

**2.2** The scrap sample of each lot shall be collected for testing and sampling can be done according to material as mentioned below:

# a) Sampling procedure for Granulated Copper Scrap and copper alloy scrap

i) This procedure applies to those materials that by nature are constituted by relatively small and loose particles allowing small quantities to be easily picked up using scoop or shovel in min 5 different places of the lot.

ii) Collect a minimum quantity of 1% by weight of the inspection lot if lot size is more than 300 Kg.

iii) Mix accurately the various portions taken from the inspection lot, spread the collected material in a circular shape and take a sample from different parts of it as shown in fig 1.

iv) Take two quarts opposite to each other and disregard the other two. Mix well the two quarts collected, again flattened and re-quartered. Repeat the procedure until a representative sample of 3 kg is obtained.

v) In case, the lot size is less than 300 Kg than a fixed amount of sample size of 3 Kg is to be drawn from each lot and no quarter coning is required in this case.

vi) This representative sample is to be divided in three parts of 1 kg each and first part can be used for the determination of chemical composition as described in test procedure and the other two parts are preserved in a dry sealed container for retesting.

vii) Divide the collected sample in quarts along two perpendicular diameters as indicated in Fig 1.



Fig 1 – Sampling procedure for granulated scrap and turnings

# b) Sampling procedure for wire

This procedure applies to those materials that by nature in the form of wires.

i) The lot size shall not be more than 28 T.

**ii**) Mark 5 different points within consignment and collect the samples. Each sample size collected can be 2 kgs and overall sample size per consignment should be approx. 10 kgs.

**iii)** The 10 kg sample should be cut in small pieces and follow the procedure mentioned 2.2 in clause 3 or the sample can be melted in lab size induction furnace or using suitable furnace under normal or vacuum conditions. The determination of copper content and alloyed metal content shall be determined by the methods specified in IS 440 or by any established instrumental or chemical method.

# c) Scrap forms other than Wires and Granules including castings, pipes, bars etc.

This procedure applies to all the materials other than that mentioned in **a**) and **b**):

i)The lot size shall not be more than 28 T.

ii) The increment samples shall be drawn from the lot/consignment from five different locations to make a gross sample of minimum 1% by weight of the inspection lot if lot size is more than 300 Kg.

iii) Sample preparation :

- a. Sample of each variety of material to be picked present in the lot. If the dimension of any sample is more than 300mm the same to be cut/shredded into small pieces
- b. If the lot contains pieces weighing more than 100 kgs than 5% of such material will be collected. The samples will be sent for drilling. Each sample shall be drilled diagonally at least in three different places using suitable drill bit at optimum drilling rate to avoid oxidation. Acetone can be used as a cooling agent to avoid heat and oxidation during drilling process.
- c. If the lot contains mixed material than point (a) and (b) together to be followed for sample preparation

iv) The quantity of sample of each variety to be picked up based on visual assessment to ensure best representation of the lot.

v) Approximately 8 to 10 kgs of sample shall be collected for every lot and mixed thoroughly and reduced systematically to 3 kg manually or using riffle divider

vi) The final sample can be melted in suitable lab size induction furnace or using suitable furnace under normal or vacuum conditions. The determination of copper content and alloyed metal content shall be determined by the methods specified in IS 440 or by any established instrumental or chemical method.