***भारतीय मानक***

***Indian Standard***

**IS 11783 : 20XX**

**Doc No. CHD 26/23649 F**

विस्फोटक और आतिशबाज़ी उद्योग के लिए फेरोसिलिकॉन —**विशिष्टि**

 *( पहला* पुनरीक्षण )

FERROSILICON FOR EXPLOSIVE AND PYROTECHNIC INDUSTRY — SPECIFICATION

*(* *First Revision )*

ICS 71.100.30

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भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

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**February 2024 Price Group X**

Explosives and Pyrotechnics Sectional Committee, CHD 26

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Explosives and Pyrotechnics Sectional Committee had been approved by the Chemical Division Council.

There is already an Indian Standard available on ferrosilicon (IS 1110) which covers the requirement of ferrosilicon for use in the iron and steel industry formulated by MTD 13 Ores and Feed Stock for Iron and Steel Industry Sectional Committee. However, on the suggestion of the Explosive and Pyrotechnics Sectional Committee, CHD 26, and the Ministry of Defence to consider the requirements of the pyrotechnic industry, felt that it would be desirable to formulate a separate standard for pyrotechnic use, as it would be outside the scope of MTD 13 to cover such requirements. Therefore, this Indian Standard was formulated and published in 1986 with a view to cover the requirements for ferrosilicon for the explosive and pyrotechnic industry. Ferrosilicon is generally used as a fuel in the pyrotechnic industry.

In this first revision, material of lump type has been removed as it is no longer relevant to Explosives and Pyrotechnics industrial practices, while others material type deemed pertinent to pyrotechnic industrial requirements remain unchanged and several editorial changes such as inclusion of the Reference clause, Hindi Title, ICS no, BIS certification marking clause, etc. have also been incorporated.

The composition of the Committee responsible for development of this standard is given in Annex C.

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.

*Indian Standard*

FERROSILICON FOR EXPLOSIVE AND PYROTECHNIC INDUSTRY — SPECIFICATION

(*First Revision*)

**1 SCOPE**

This standard prescribes the requirements and the methods of sampling and tests for ferrosilicon for use in explosive and pyrotechnic industry.

**2 REFERENCES**

The standards given below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards:

|  |  |
| --- | --- |
| *IS No* | *Title* |
| IS 265 : 2021 | Hydrochloric Acid Specification (*fifth revision*) |
| IS 1070 : 2023 | Reagent Grade Water Specification (*fourth revision*) |
| IS 1110 : 2023 | Ferrosilicon — Specifications (*fifth revision*) |
| IS 2552 : 1989 | Steel drums (galvanized and ungalvanized) — Specification (*third revision*) |
| IS 4905 : 2015/ISO 24153 : 2009 | Random sampling and randomization procedures (*first revision*) |
| IS 8883 (Part 1) : 2005 | Methods of sampling chemical and chemical product: Part 1 general requirements and precautions (*first revision*) |

**3 GRADES**

The material shall be of following two grades based on the total silicon content:

Grade I — having total silicon content not less than 85 percent, and

Grade II — having total silicon content not less than 70 percent.

**4 TYPES**

The material shall be of types A and B based on its sieve size as specified in Table 1.

**Table 1 Requirements for ferrosilicon for use in explosive and pyrotechnic industry**

(*Clause* 4 and5.2)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Characteristic** | **Requirement** | **Method of Test****(Ref to Cl No.)** |
| (1) | (2) | (3) | (4) |
|  | Moisture, percent by mass, *Max* | 0.05 | A-2 |
|  | Matter soluble in water, percent by mass, *Max* | 0.25 | A-3 |
|  | *p*H (of aqueous extract) | 7.5 to 9 | A-4 |
|  | Total silicon, percent by mas, *Min*a) Grade Ib) Grade II | 8570 | A-5 |
|  | Fineness: |  | A-6 |
|  | b) For Type A— retained on 106 micron IS Sieve, percent by mass, *Max*— retained on 63 micron IS Sieve, percent by mass, *Max* | Nil20 |  |
|  | c) For Type B— retained on 90 micron IS sieve, percent by mass, *Max* | Nil |  |
|  | — retained on 63 micron IS sieve, percent by mass. *Max* | 10 |  |

**5 REQUIREMENTS**

**5.1** The material shall be of good quality, in the form of powder and shall be free from visible impurities or foreign matter.

**5.2** The material shall comply with the requirements laid down in Table 1 when tested according to the methods prescribed in Annex A. Reference to the relevant clauses of Annex A is given in co1 4 of Table 1.

**6 PACKING AND MARKING**

**6.1 Packing**

The material shall be supplied in securely closed, clean and dry galvanized mild steel drums (*see* IS 2552) or in such containers as agreed to between the purchaser and the supplier.

**6.2 Marking**

**6.2.1** Each container shall be legibly and indelibly marked with the following information:

a) Name of material, and its grade and type;

b) Gross and net mass of material;

c) Name of the manufacture and/or his trade-mark, if any: and

d) Batch No., in code or otherwise, to enable the batch to be traced from records.

**6.2.2** *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act,* 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

**7 SAMPLING**

The method of sampling and the criteria for conformity of the material to the requirements of this standard shall be as prescribed in Annex B.

**ANNEX A**

**METHOD OF TESTS**

(*Clause* 5.2, Table 1)

**A-1 QUALITY OF REAGENTS**

Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070) shall be employed in the test.

NOTE — ‘Pure Chemicals’ shall mean chemicals that do not contain impurities which affect the results of analysis.

**A-2 DETERMINATION OF MOISTURE**

**A-2.1 Procedure**

Weigh about 10 g of the material in a weighted petri dish. Keep in an over adjusted to a temperature of (105 ± 2) °C for 2 hours. Remove the dish to a desiccator for about half an hour to cool, and reweigh it. Repeat the process till constant mass is obtained.

**A-2.2 Calculation**

$$Moisture,present by mass= \frac{M\_{1}-M\_{2}}{M\_{1}-M}×100$$

where

*M* = mass in g of empty dish,

*M1* = mass in g of the material and the dish before heating, and

*M2* = mass in g of the material and the dish after heating.

**A-3 DETERMINATION OF MATTER SOLUBLE IN WATER**

**A-3.1 Procedure**

Treat 15 g of the material with 300 ml of freshly boiled water. Boil gently in a covered vessel for 15 minutes. Cool to room temperature and filter. Wash the filter paper twice with 15 ml of water. Make up the volume to 500 ml in a volumetric flask. Take 100 ml of the filtrate and evaporate to dryness in a tared porcelain dish on a water bath. Dry for one hour at 103 °C to 105 °C. Cool in a desiccator and weigh.

**A-3.2 Calculation**

$$Water soluble matter, percent by mass= \left(M\_{2}-M\_{1}\right)×\frac{500}{M}$$

where

 *M* = mass in g of the material present in the aliquot (taken for test),

*M1* = mass in g of the empty dish, and

*M2* = mass in g of the dish and residue.

**A-4 DETERMINATION OF *p*H**

**A-4.1 Procedure**

Weigh about 10 g of the material and transfer it to a 250 ml beaker. Add 100 ml of freshly boiled and cooled water. Allow to stand for 30 minutes with occasional stirring. Filter, reject the first 50 ml of the filtrate and collect the remaining filtrate in a beaker. Determine the *p*H of the solution by means of a suitable *p*H meter using glass electrode.

**A-5 DETERMINATION OF SILICON**

**A-5.1 Reagents**

**A-5.1.1** *Sodium Hydroxide —* solid.

**A-5.1.2** *Dilute Hydrochloric Acid* — 1 : 1 and 1 : 20 (*v/v*).

**A-5.1.3** *Concentrated Hydrochloric Acid* — sp gr 1.16 (*see* IS 265)

**A-5.1.4** *Dilute Sulphuric Acid* — 1 : 1 (*v/v*).

**A-5.1.5** *Hydrofluoric Acid* — 40 percent.

**A-5.2 Procedure**

**A-5.2.1** Place 8 g to 10 g of sodium hydroxide in the nickel crucible and transfer 0.25 g to 0.5 g of the dried and powdered material to pass through a 150 micron IS Sieve, to the crucible depending upon the silicon content of the sample. Cover the crucible with the lid and heat, at first gently and then at the maximum heat for half an hour. Carefully fuse over a low flame, slowly revolving it round the outer edge of the flame till the contents have melted down without spattering any unattacked particles in the Rotate the crucible carefully to stir bottom and sides, maintaining it at a low red heat. Just before completion of the fusion which requires 3 to 4 minutes, increase the temperature of the crucible to bright redness for one minute. Spread the melt uniformly on the sides and bottom of the crucible by slowly rotating it and allow to cool to room temperature.

**A-5.2.2** Extract the melt with minimum quantity of hot water in a porcelain dish, washing the crucible and lid with a jet of hot water. Acidify carefully with dilute hydrochloric acid (1 : 1) and add about 50 ml excess. Evaporate to dryness and bake for one hour at 100 °C to 110 °C. Re-dissolve the mass in 40 ml of concentrated hydrochloric acid by warming, and dilute with 150 ml of hot water. Raise to boil, allow to settle slightly and filter through Whatman filter paper No. 40. Wash 10 to 12 times alternately with hot dilute hydrochloric acid (1 : 20) and hot water. Finally rinse with hot water till the washings are free from chlorides. Preserve the paper and the residue.

**A-5.2.3** Evaporate the filtrate and washings to dryness and repeat the procedure of baking, washing, etc., as given under **A-5.2.2.**

**A-5.2.4** Place the papers and residue from **A-5.2.2** and **A-5.2.3** in the platinum crucible and dry completely on a hot-plate. Heat the crucible in a muffle furnace at 1 000 °C for about 30 minutes, cool in a desiccator and weigh. Ignite again for 10 minutes at the above temperature as a check for constant weight.

**A-5.2.5** Add sufficient dilute sulphuric acid to moisten the residue, then add carefully about 10 ml of hydrofluoric acid and cautiously evaporate to dryness. Ignite over a free flame to constant weight. Record the loss in weight which represents the weight of silica.

NOTE — A blank determination should be carried out when the silica content of the ferro-alloy is below 10 percent.

**A-5.3 Calculation**

$$Silicon, percent= \frac{A×46.72}{B}$$

where

*A* = mass in g of silica obtained, and

*B* = mass in g of the sample taken.

**A-6 DETERMINATION OF FINENESS**

**A-6.1 Procedure**

Place 10 g of the material on the respective IS sieve and brush it gently with a 25 mm varnish brush for 15 minutes or until no further material passes through the sieve, whichever is the lesser period. Remove the sieve and weigh the portion of the sample retained on it. Express it as percentage of the material taken for the test.

**ANNEX B**

**SAMPLING AND CRITERIA OF CONFORMITY**

(*Clause* 7)

**B-1 GENERAL REQUIREMENTS OF SAMPLING**

For general requirements of sampling, the methods given in IS 8883 (Part 1) shall be followed.

**B-2 SCALE OF SAMPLING**

**B-2.1 Lot**

All the drums in a single consignment of the material of the same grade drawn from a single batch of processing shall constitute a lot. If a consignment is declared or known to consist of different batches of processing, the batches shall be marked separately and the groups of drums in each batch shall constitute separate lots.

**B-2.2** The number of drums to be selected shall depend upon the size of the lot and shall be in accordance with Table 2.

**Table 2 Number of containers to be selected**

(*Clause* B-2.2)

|  |  |
| --- | --- |
| **Lot size** | **Number of Containers To be Selected** |
| (1) | (2) |
| Up to 50 | 3 |
| 51 to 100 | 4 |
| 101 to 150 | 5 |
| 151 to 300 | 7 |
| 301 and above | 10 |

**B-2.3** The drums shall be selected from the lot at random and in order to ensure randomness of selection, the method given in IS 4905 may be followed.

**B-3 NUMBER OF TESTS**

Tests for determination of ferrosilicon, percent by mass shall be determined on individual drums and for the remaining characteristics tests shall be conducted on composite sample.

**B-4 CRITERIA FOR CONFORMITY**

For all those characteristics for which individual tests have been conducted average $(\overbar{X})$ and range (*R****)*** shall be calculated, range being the difference between the maximum and minimum of the test results an

$$Average= \frac{Sum of the test results }{Number of tests }$$

The lot shall be declared as conforming to the requirements of ferrosilicon, percent by mass; if:

$\overbar{X}$ — 0.6 *R ≥* the minimum value specified in Table 1.

**ANNEX C**

( *Foreword* )

**COMMITTEE COMPOSITION**

Explosives and Pyrotechnics Sectional Committee, CHD 26

|  |  |
| --- | --- |
| *Organization* | *Representative(s)* |
| DRDO-High Energy Materials Research Laboratory, Pune | DR A P DASH (***Chairperson***) |
| Arumugam Fireworks Pvt. Ltd., Sivakasi | SHRI K MARIAPPAN SHRI ARUN M. LALITH KUMAR (*Alternate*) |
| Ayyan Fireworks Manufacturers Association, Sivakasi | SHRI ABIRUBEN G |
| CDET Explosives Industries Pvt. Ltd., Nagpur | SHRI RAGHAV RATHI  |
| CSIR-Central Institute of Mining and Fuel Research, Dhanbad | DR C SAWMLIANA DR FIROZ ALI (*Alternate*) |
| Central Mine Planning and Design Institute Ltd., Ranchi | SHRI SATYENDRA NARAYANSHRI BINAY KUMAR SINGH (*Alternate*) |
| Central Pollution Control Board, New Delhi | SHRI ABHIJIT PATHAK |
| Coal India Ltd., Kolkata | SHRI K SUDHAKAR SHRI DEBDULAL SARKAR (*Alternate*) |
| Consumer Guidance Society of India, Mumbai | SHRI SITARAM DIXIT DR M S KAMATH (*Alternate*) |
| Directorate General of Mines Safety, Dhanbad | SHRI SAIFULLAH ANSARI SHRI A RAJESHWAR RAO (*Alternate*) |
| Directorate of Standardization, New Delhi | CAPT. M H KEKRE |
| Fireworks Manufacturers Association (North India), Gwalior | SHRI HARISH MILWANI SHRI RAJEEV JAIN (*Alternate*) |
| GOCL Corporation Ltd., Hyderabad | SHRI C SAINATHSHRI S VIJAY KUMAR (*Alternate*) |
| Gudiya Fireworks, Delhi | SHRI KSHITIJ JAIN |
| High Energy Materials Research Laboratory, Pune | SHRI C GURURAJA RAO  DR R B PAWAR (*Alternate*) |
| IDL Explosives ltd., Hyderabad | SHRI P SIVASANKAR RAO |
| Ministry of Defence (DGQA), New Delhi | DR T K VARADARAJAN |
| Munitions India Limited, Pune | SHRI D VIKAS SHRI D K URKUDE (*Alternate*) |
| Neyveli Lignite Corporation Ltd., Chennai | SHRI M MUTHUKUMARAN |
| Petroleum and Explosives Safety Organization (PESO), Nagpur | SHRI P KUMAR SHRI P SEENIRAJ (*Alternate*) |
| Shri Kaliswari Fireworks, Sivakasi | SHRI A P SELVARAJAN |
| Solar Industries India Ltd., Nagpur | SHRI A K JAIN SHRI P P DEOTARE (*Alternate*) |
| Standard Fireworks, Sivakasi | SHRI M S SARAVANAN |
| The Coronation Fireworks Factory, Sivakasi | SHRI P KANAGAVEL SHRI K JEYAKUMAR (*Alternate*) |
| The Indian Fireworks Manufacturers Association (TIFMA), Sivakasi | SHRI T KANNAN |
| The Metal Powder Co. Ltd., Madurai | SHRI P SUNDARAPANDIAN SHRI N CHANDRASEKARAN (*Alternate*) |
| The Tamil Nadu Fireworks and Amorces Manufacturers Association (TANFAMA), Sivakasi | THE PRESIDENT THE SECRETARY (*Alternate*) |
| BIS Directorate General | SHRI AJAY KUMAR LAL, SCIENTIST ‘F’/SENIOR DIRECTOR AND HEAD CHEMICAL[REPRESENTING DIRECTOR GENERAL (*EX—OFFICIO*)] |
| *Member Secretary*SHRI MOHIT GARGSCIENTIST ‘B’ / ASSISTANT DIRETOR(CHEMICAL), BIS |