



**Government of India  
BHABHA ATOMIC RESEARCH CENTRE  
Integrated Fuel Fabrication Facility**

Trombay, Mumbai - 400085  
Fax No.: 91-22-25505151  
Tel No.: 91-22-25594479  
Email: vadali@barc.gov.in

Ref No.: IF3/02/19/21420

January 30<sup>th</sup>, 2019

To,

**Sub: Manufacture, Supply and Testing of High Purity Aluminium Silicon (Al-Si)  
Alloy in Granular Form as per enclosed Technical Specifications.**

Dear Sir/ Madam,

For & on behalf of The President of India your sealed offer on printed letter head of your company is invited for "Manufacture, Supply and Testing of High Purity Aluminium Silicon (Al-Si) Alloy in Granular Form as per enclosed Technical Specifications". Technical specifications and general terms & conditions are enclosed with the enquiry.

Quotations should indicate GST registration number & PAN number of the firm without which the quotations are liable to be rejected. Your offer in sealed envelope should be addressed to:

**Head, Integrated Fuel Fabrication Facility**  
**Attn.: Shri S. K. Vadali**  
**Scientific Officer (F)**  
**Integrated Fuel Fabrication Facility**  
**BARC, Mumbai. - 400 085.**

Duly marked with above reference no. & due date 15-02-2019 on the envelope and reach us by 15-02-2019.

You are requested to send your quotation by Registered / Speed post only. Courier or Hand delivery of quotation is not acceptable.

Encl: 1. Technical Specifications.  
2. General Terms & Conditions

*V. S. Vadali*  
(S. K. Vadali) 30/01/2019  
SO/F, IF3

For & on behalf of President of India

## **Technical Specification of High Purity Aluminium Silicon (Al-Si) Alloy in Granular Form**

### **0. Short Description of Item and Quantity:**

<b>Item No.</b>	<b>Short Description of Item</b>	<b>Quantity</b>
1.	Manufacture, Supply and Testing of High Purity Aluminium Silicon (Al-Si) Alloy in Granular Form	1000 kilograms

### **1. Scope of Work:**

- 1.1 Manufacture of High Purity Al-Si Alloy as per chemical composition & other requirements given in *Annexure-I*.
- 1.2 Supply of High Purity Al-Si Alloy in granular form as per shape, size and other details mentioned in *Annexure-II*.
- 1.3 Testing of manufactured Al-Si Alloy as per requirements given in *Annexure-III*.

### **2. Alloy Acceptance Criteria:**

- 2.1 Primary acceptance criteria of the alloy are its chemical composition, purity & size of granules.

### **3. In-process Inspection & Pre-dispatch Inspection:**

- 3.1 The purchaser may carry out In-process Inspection during manufacture of 1<sup>st</sup> heat / batch of High Purity Al-Si alloy. The purchaser may witness all the critical operations involved in the manufacture of the alloy at the supplier's site. The supplier shall facilitate the inspection process and provide all the needed co-operation to the purchaser.
- 3.2 Pre-dispatch inspection of manufactured High Purity Al-Si alloy shall be carried out by the purchaser's representatives at the supplier's site once the alloy is ready. The supplier shall inform the readiness of the alloy to the purchaser as soon as it is ready for inspection.
- 3.3 During Pre-dispatch inspection, the supplier shall provide all the inspection reports like chemical analysis reports, granulometric composition report and any other process related documents (as requested by the purchaser) of the manufactured alloy granules.
- 3.4 The purchaser shall verify the provided documents and physically cross-check the entries.
- 3.5 Gross & Net Weight of the containers / drums containing Al-Si granules shall be randomly measured and cross-checked with the provided documents.

- 3.6 The purchaser shall select Al-Si granules from random drums for re-checking their chemical composition. The supplier shall carryout chemical analysis of such granules in the presence of the purchaser. The chemical analysis reports shall be checked to verify whether they are meeting the chemical composition requirements.
- 3.7 The purchaser during pre-dispatch inspection shall collect samples from random drums and get them tested at purchaser's laboratory to check their chemical composition and granular size. If these samples are found to be acceptable in chemical & granulometric analysis carried out at purchaser's place, then only final acceptance shall be granted to the supplier.
- 3.8 If the manufactured Al-Si granules are found to be acceptable and meeting all the technical specifications mentioned in the purchase order, then they shall be accepted for delivery to the purchaser's place.

#### **4. Supply Requirements:**

- 4.1 After receiving proper clearance from the purchaser the Al-Si granules shall be suitably packed in Metallic / Plastic drums & delivered to purchaser's site.
- 4.2 The Metallic / Plastic drums should be lined on its inside with sufficiently thick polythene sheet to prevent direct contact of Al-Si granules with the container material. The plastic sheet covering the Al-Si granules shall be vacuum sealed to prevent contact of atmospheric gases with Al-Si granules. The cover of the Metallic / Plastic drums shall also airtight.
- 4.3 The packaging should be such that Al-Si granules can be stored for minimum 1 year from the date of supply without any kind of corrosion / damage / deterioration / change in the quality of Al-Si granules as well as the packaging material.
- 4.4 1<sup>st</sup> batch of Al-Si granules (< 200 kilograms) shall be supplied initially and it shall be tested by the purchaser. After receiving approval from the purchaser regarding the acceptance of the 1<sup>st</sup> batch of material, remaining material may be supplied in batches or in one lot as per the convenience of the supplier.

#### **5. General Requirements:**

- 5.1 It is welcome, if alloy with higher purity than asked for in this Work Order is supplied by the supplier.
- 5.2 The supplier should be ready to accommodate minor changes in the specifications of the alloy (if required) by the purchaser.

## **Annexure-I**

### **Manufacturing Requirements of High Purity Al-Si Alloy**

#### **1. Chemical Composition of Aluminium Silicon (Al-Si) Alloy:**

Mass fraction of Al-Si alloy for each heat (ingot and granular) shall conform to the values given in the following table.

Mass fraction in %

<b>Si</b>	<b>B</b>	<b>Al</b>
11 – 13	$5 \times 10^{-4}$ (Max)	Balance

This analysis shall be done as per the testing requirements mentioned in *Annexure-VI*.

#### **2. Raw Material Requirements:**

The Al-Si alloy shall be prepared by mixing proportionate quantities of Aluminium and Silicon. The requirements of these raw materials are given in para. 2.1 & 2.2.

##### **2.1 Requirements for Aluminium:**

Chemical Composition of Aluminium shall be as follows.

Aluminium mass fraction shall not be less than 99.97 %.

Other impurities shall be as per following table.

Mass fraction, % not more than

<b>Fe</b>	<b>Si</b>	<b>Cu</b>	<b>Zn</b>	<b>Ti</b>	<b>Other impurities each individually</b>	<b>Total Impurity Content</b>
0.015	0.015	0.005	0.003	0.002	0.002	0.03

##### **2.2 Requirements for crystalline Silicon:**

Chemical Composition of crystalline silicon shall be as follows:

Silicon mass fraction shall not be less than 98.8 %

Impurity content shall be as per following table.

Mass fraction, % not more than

<b>Fe</b>	<b>Al</b>	<b>Ca</b>	<b>Total Impurity content</b>
0.5	0.4	0.4	1.2

2.3 The supplier shall procure the raw materials (viz. Aluminium & Silicon) required for production of the alloy from primary metal producers (preferred). All the raw materials shall be accompanied by the Material Test Certificates from the primary producers. Copies of the above Material Test Certificates shall be provided to the purchaser before using the raw materials.

- 2.4 Metals refined from scrap should not be used as raw material for manufacturing of the High Purity Al-Si Alloy.
- 2.5 No deviation in the raw materials from that specified in the Para 2.1 & 2.2 shall be permissible.
- 2.6 Samples (minimum 3 nos. each) from all the heats of the raw materials procured by the supplier shall be sent to the purchaser for quality check / verification.
- 2.7 Only after receiving written approval from the purchaser regarding the acceptability of the raw materials, then shall they be used in the production of High Purity Al-Si alloy.
- 2.8 Archival samples (minimum 6 nos. each) from all the heats of the raw materials shall be retained / stored by the purchaser for quality check / re-verification till the total ordered quantity of High Purity Al-Si Alloy is finally accepted by the purchaser.
- 2.9 High purity Aluminium ( $\geq 99.97\%$  purity) is required as one of the raw material. This material may not be available locally and may have to be imported. This shall be promptly arranged by the supplier to prevent any delay in the delivery schedule.
- 2.10 Sources of all the input raw materials shall be shared with the purchaser, if required by the purchaser.

### **3. Manufacturing Process Requirements:**

- 3.1 The alloy shall be made by melting the above constituent elements in a Vacuum Induction Furnace. Charge for the furnace shall be prepared to ensure homogeneity. Molten blend shall also be suitable stirred to ensure homogeneity.
- 3.2 All operations like melting, pouring and cooling of Ingots shall be carried out under vacuum conditions to prevent contamination of the alloy by atmospheric gases.
- 3.3 All precautions shall be observed at all stages of Alloy manufacture to prevent alteration of the chemical composition of the alloy during vacuum induction melting. Melting procedure parameters should be optimized to prevent selective evaporation of low melting point / high vapour pressure elements from the alloy charge.
- 3.4 Alloy / Grain Refining agents or similar fluxes shall not be used during vacuum induction melting without approval of the purchaser.
- 3.5 The supplier shall provide the details of the Vacuum Induction Furnace which shall be used for the manufacturing of Al-Si Alloy.
- 3.6 The purchaser may visit the supplier's site to confirm the availability of Vacuum Induction Furnace and evaluate its capabilities.
- 3.7 The supplier shall prepare the Standard Operation Procedure (SOP) document for manufacturing the alloy and submit it to the purchaser before starting manufacturing the alloy.
- 3.8 Manufacturing of the alloy shall be commenced only after the approval of the purchaser is obtained.

## ***Annexure-II***

### **Requirements of High Purity Al-Si Alloy in Granular Form**

#### **1. Shape & Size of Al-Si Granules:**

- 1.1 The particle size of Al-Si Alloy granules shall be maintained within 0.5 mm to 1.35 mm. Any size smaller or bigger than the specified limits is not acceptable.
- 1.2 The average size of the Al-Si Alloy granules shall be greater than 0.8 mm.
- 1.3 Standard Test Sieves shall be used for sieving of Al-Si Alloy granules. Any size of granules smaller than 0.5 mm shall be discarded.
- 1.4 The shape of the particles is not specified. However, particles in chip form are preferred over spherical particles.
- 1.5 Al-Si alloy particles shall be produced by mechanical abrasion or granulation by melting of Ingots.
- 1.6 Initially, Al-Si Alloy Ingots shall be cast after Vacuum Induction Melting of feed materials and thereafter from these cast ingots, Al-Si granules shall be prepared.

#### **2. Visual Examination:**

Ingots shall be visually examined under proper illumination and without using magnifying devices. Surface of the ingots shall be free from scales and other foreign inclusions detectable by naked eye.

#### **3. Marking & Packing:**

Aluminium Silicon Alloy granules shall be packed in dry, clean containers / drums (each containing material not more than 200 kilograms), which ensure their integrity and protection from contaminants.

Each container shall bear a label containing at least following information:

- Purchase Order Number
- Material in Container
- Heat Number
- Batch Number and Date of Packing
- Net Weight
- Gross Weight

#### **4. Ingot Requirements:**

- 4.1 Ingots shall be preferably cast in Water Cooled Copper Moulds or Graphite Moulds (preferably Alumina/Yttria coated Graphite moulds). Surface contamination of the cast ingots due to contact with Mould material shall be minimized.
- 4.2 Surface of cast ingots of High Purity Al-Si alloy shall be machined to remove a layer of 2 mm to exclude any impurities which may be present on the surface of the ingots. Only after surface layer removal, the ingots shall be processed further for production of Al-Si granules.
- 4.3 Ingots shall be reasonably free from i) Visible surface conditions and contamination such as grease, dirt, products of corrosion, dross or any

other foreign bodies including paint, ii) Metallic or non-metallic inclusions, iii) Gas porosity, shrinkage holes or cavities, iv) Asbestos and other hazardous foreign material and show no indication of increased radioactivity.

## **5. Granules Requirements:**

- 5.1 The standard procedure to be followed for production of granules from Ingots shall be prepared by the supplier and got approved by the purchaser before commencing production of granules from ingots.
- 5.2 The procedure for production of granules should be such that the surface of the granules is not excessively oxidized which may hinder further re-melting of these granules (for purchaser's applications).
- 5.3 During production of granules through mechanical abrasion process coolant may be used to prevent overheating of the chips / granules. However subsequent cleaning of the chips / granules shall be carried out to remove all the traces of coolant from chips / granules. After cleaning the chips / granules shall be completely dried before any further processing on them is taken up.
- 5.4 During production of granules through mechanical abrasion it shall be ensured that the cutting tool doesn't itself get abraded which may lead to mixing of these abraded cutting tool material particles with Al-Si granules.
- 5.5 Mechanical abrasion of Al-Si Ingots shall be carried out on dedicated machines which shall not be used for any other jobs. Collection of Al-Si chips / granules during abrasion process shall be done such that no other kind of chips get mixed with Al-Si chips.
- 5.6 If granules are produced through melting of ingots adequate care should be taken at each step to prevent contamination of the particles by atmospheric gases, heated surfaces etc.
- 5.7 Granules shall be accepted in dry condition only. Granules in wet / moist condition shall not be accepted.

## ***Annexure-III***

### **Testing Requirements of High Purity Al-Si Alloy Granules**

#### **1. Chemical Analysis:**

- 1.1 Chemical analysis of Al-Si granules (produced from each Ingot) shall be carried out to confirm that chemical composition of alloy is meeting the requirements of Para. 1 of *Annexure-IV*. Mass fraction of Si, B & Al in the alloy shall be reported.
- 1.2 For chemical analysis of Al-Si granules taken from each Ingot as per Point No. 1.1 above, chemical analysis samples shall be taken from top, center and bottom region of the Ingot and the chemical analysis results shall be reported to confirm that the entire ingot is chemically homogenous. Thus for Al-Si granules produced from every Ingot, 3 nos. of Chemical Analysis shall be performed and the analysis reports shall be supplied.
- 1.3 Chemical analysis of Al-Si Alloy granules shall be carried out on sample basis after every 100 kilograms of the alloy granules are manufactured to confirm that mass fraction of all the impurities in the granules are within the permissible range. Mass fraction of Impurities viz. Fe, Cu, Zn, Ti & Ca shall be reported.

#### **2. Granulometric Composition Analysis:**

- 2.1 Al-Si Alloy granules shall be analysed for their granulometric composition.
- 2.2 Granulometric analysis of Al-Si granules (produced from each Ingot) shall be carried out to confirm that size of all the particles is between 0.5 mm to 1.35 mm.
- 2.3 Sample size taken for granulometric analysis should be such that it shall be representative of the whole batch of Al-Si granules produced from each Ingot.

#### **3. Chemical & Granulometric Analysis Reports:**

- 3.1 All the Chemical & Granulometric Analysis Reports of the alloy as required in Para 1 & Para 2 of *Annexure-VI* duly signed by authorized / qualified personnel of the supplier shall be supplied along with the alloy material.
- 3.2 No material shall be accepted without their Chemical & Granulometric Analysis reports.

#### **4. Chemical Analysis Requirements:**

- 4.1 Chemical analysis shall be performed by the supplier through their in-house testing facility or may be outsourced to any NABL / government approved laboratory.
- 4.2 Chemical analysis shall only be performed by qualified personnel having experience. All the instruments used for chemical analysis shall be regularly calibrated.
- 4.3 The testing facilities at supplier's place shall be evaluated by the purchaser before placing the order.
- 4.4 Standard test procedure (being proposed by the supplier) for Chemical Analysis of High Purity Al-Si alloy shall be provided by the supplier to the purchaser before starting testing of the alloy. The accuracy of the standard



test procedure shall be clearly specified and communicated to the purchaser.

- 4.5 Testing shall commence only after approval of the Standard test procedure by the purchaser.
- 4.6 The purchaser may witness the testing procedure at supplier's site and also verify the results of chemical analysis reports provided by the supplier through purchaser's in-house testing facility.
- 4.7 The purchaser may bring standard Al-Si alloy samples (of varying compositions) to the supplier laboratory for chemical analysis. The supplier shall be asked to perform chemical analysis of these samples in presence of the purchaser. The chemical analysis results of these standard samples shall be examined to evaluate the testing procedure developed by the supplier and to test the capability of the supplier to carry out chemical analysis of Al-Si alloy.

## **5. Acceptance Criteria of Al-Si Granules:**

- 5.1 High purity Al-Si alloy granules whose chemical & granulometric analysis reports (provided by the supplier) are found to be acceptable shall only be received by the purchaser.
- 5.2 All the Al-Si Alloy granules received from the supplier by the purchaser shall be re-tested by the purchaser. If the granules are found to be acceptable as per the chemical composition criteria laid down in Para. 1 of *Annexure-IV*, they shall be accepted. In case the chemical composition is not found to be acceptable then the granules shall be rejected.
- 5.3 Moreover, if the granules are found to be acceptable as per the granulometric composition criteria laid down in Para. 1 of *Annexure-V*, they shall be accepted. In case the granulometric analysis is not found to be acceptable then the granules shall be rejected.
- 5.4 Supplier shall have to replace the rejected / unacceptable granules with new batch of granules (of same weight).
- 5.5 In case the supplier is unable to replace the rejected / unacceptable granules, then cost of the rejected granules (as per the contract rate agreed upon in the purchase order) shall be recovered from the amount due to the supplier.
- 5.6 In case the supplier challenges the chemical or granulometric analysis report of the purchaser (on whose basis any granules are rejected), the supplier shall get the chemical or granulometric analysis of the granules done (at their own cost) through a 3<sup>rd</sup> party which shall be a NABL / government approved chemical laboratory. The results of the 3<sup>rd</sup> party shall be binding on both the supplier and the purchaser.

## **General Terms & Conditions of Contract**

### **1. Terms & Conditions:**

- 1.1 No Free Issue Material (FIM) shall be issued to the supplier by the purchaser for carrying out the work.
- 1.2 For any clarification regarding the specifications and to assess the scope of work involved or any other queries, supplier may contact Shri S. K. Vadali (Tel. 022-2559 4479) during office hours.
- 1.3 Quotations shall clearly mention the basic cost and taxes, if any, shall be specified separately apart from the basic cost.
- 1.4 Validity of offer (minimum 90 days) shall be clearly mentioned in the offer letter.
- 1.5 Income tax @ 2% of amount of bill and surcharge will be deducted from the supplier's bill.
- 1.6 Quotations are to be in printed letter head/quotation format which should consist of GST registration number, PAN of the firm, etc.
- 1.7 Quotations that are received by email, fax, any other computer generated form without signature & stamp of firm shall be considered as invalid & rejected. Quotations shall be properly typed or printed (with no corrections / overwriting) on letter head of the firm.
- 1.8 Payment will be arranged after satisfactory completion of work and on production of, a) Bills in triplicate, b) Advanced stamped receipt, c) GST Undertaking Form. Advance, Part, Pro-rata Payment or Payment against delivery cannot be made.
- 1.9 Any delay which is attributed to the supplier is liable for penalty @ ½ % per week (Max 5%) to be imposed on supplier.
- 1.10 To enter BARC premises persons are required to have Police Verification Certificate (PVC). Suppliers are requested to get PVC of their persons who are expected to come for work inside BARC.

### **2. Confidentiality Clause:-**

#### **I. Confidentiality:-**

No party shall disclose any information to any third party concerning the matters under this contract generally. In particular, any information identified as "Proprietary" in nature by the disclosing party shall be kept strictly confidentially by the receiving party and shall not be disclosed to any third party without the prior written consent of the original disclosing party.

This clause shall apply to the sub-contractors, consultants, advisers or the employees engaged by a party with equal force.

II. **“Restricted information” categories under Section 18 of the Atomic Energy Act 1962 and “Official Secrets” under Section 5 of the Official Secrets Act 1923. :-**

Any contravention of the above-mentioned provisions by any contractor, sub-contractor, consultant adviser or the employees of a contractor will invite penal consequences under the aforesaid legislation.

III. **Prohibition against use of BARC's name without permission for publicity purposes.**

The contractor or sub-contractor, consultant, adviser or the employees engaged by the contractor shall not use BARC's name for any publicity purpose through any public media like Press, T.V. or Internet without the prior written approval of BARC.

V. J. Varukumar  
(S. K. Vadali) <sup>30/01/2019</sup>  
SO/F, IF3