

**TECHNICAL SPECIFICATIONS
FOR
ALUMINIUM ALLOY FORGINGS**

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1.0 SCOPE

- a) This technical specification covers the requirements for manufacture and supply of Aluminium alloy (Al 5154-O temper, Al 5052-O temper & 6061-T6) forgings as per **Table 1**.

Table: 1: List of Items

S. No	Part Name	Description	Material	Quantity
1	Top Enclosure Blank	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 1 of 8	Al 5154-O	2
2	Bottom Enclosure Blank	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 2 of 8	Al 5154-O	2
3	Inner Shell Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 3 of 8	Al 5052-O	2
4	Outer Shell Ring Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 4 of 8	Al 5154-O	2
5	Obround Piece Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 5 of 8	Al 5154-O	2
6	Transition Piece Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 6 of 8	Al 5154-O	4
7	Chimney Flange Blank	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 7 of 8	Al 5154-O	2
8	Grid Plate	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 8 of 8	Al 6061-T6	2
9	Rod Forging	Dia 400mm, 1000mm long	Al 5154-O	3
10	Rod Forging	Dia 600mm, 1000mm long	Al 5154-O	2
11	BT Inside/Outside Thimble Forging	Dia 118mm, 1000mm long	Al 5154-O	15
12	Thimble CNS Forging	OD 310mm, ID 250mm & 1000mm long	Al 5052-O	6
13	Thimble Forging 50	Dia 68mm, 1000mm long	Al 5154-O	18
14	Thimble Forging 75	Dia 93mm, 1000mm long	Al 5154-O	18
15	Thimble Forging 65	OD 80mm, 1000mm long	Al 5052-O	25
16	FTL Thimble Forging	Dia 180mm, 1000mm long	Al 5154-O	3

- b) The scope includes engineering, drawing approval, machining, fabrication, manufacturing, testing, pre-dispatch inspection, packing, supply, safe delivery of the forgings mentioned in Table 1.
- c) Scope of the supplier is:
- i. Procurement of billets as required for the fabrication of forgings as mentioned in respective drawings. Testing of raw material as per applicable standard & this specification and submission of test reports to the purchaser for approval
 - ii. Preparation of forging drawings and proof machining drawings from the finished drawings provided by purchaser.
 - iii. Preparation of pre-manufacturing documents (manufacturing sequence/process, drawings for fabrication shop, QAP, planning, Inspection Plan, Material sampling & Testing Plan, cutting plan etc.) and getting their approval from purchaser.
 - iv. Manufacturing of the forgings, Non-Destructive Examination (NDE) and stage-wise inspection. (Stage-wise inspection is subjected to approval by purchaser's representative)
 - v. Submission of all test reports and dimensional inspection report of all the products along with as built drawings.
 - vi. Inspection and preservation of products during transit stages.
 - vii. Cleaning, Packing & Delivery at Purchaser's Store.
- d) This specification is complete along with the drawings mentioned in the subsequent sections, without these drawings, this specification is not complete in itself.
- e) The offer should be for the complete setup; part offer will not be accepted. The Tenderer should be responsible for the item/components designed and fabricated by the sub-contractor if any.

2.0 INTRODUCTION

- a) **Evaluation of the offer will be on "total lowest offer" basis not on item wise lowest offer basis.**
- b) **Quotations containing offers for all the items as per the specifications only will be accepted and evaluated. The evaluation will be done on totality basis. Part offers will not be considered for evaluation.**
- c) The forgings covered in this specification shall be used for the fabrication of safety critical component. The quality control required for the products mentioned in the specification are very stringent. The Vendor is supposed to read carefully & therefore shall be responsible to each and every clause of this specification and terms and conditions of this tender.

- d) The products shall conform, in all aspects, to high standards of engineering and workmanship and be capable of performing continuous trouble free operation in a manner acceptable to the purchaser who will interpret the meaning of the drawing and specification and shall have the right to reject any product or materials which in his judgment are not in full accordance therewith.
- e) For the purpose of bid preparation typical design drawings are enclosed with this enquiry, which contain all details.
- f) In the event of any conflict between or within the various sections of this specification or in case of any doubt, the interpretation/decision as given by the purchaser shall be final.
- g) The purchaser reserves the right to make minor changes in the design especially change in the weight within $\pm 5\%$. Such changes shall be considered within the original scope of the specified work and no extra charges shall be levied for the same.
- h) Workmanship shall be in accordance with good engineering practice adequate to ensure satisfactory qualification of the product in accordance with the requirement of this specification.
- i) All the products are subject to 100% surface examination and 100% volumetric examination.
- j) All the products shall be examined to determine their conformance with this specification with respect to material, dimension, workmanship, finish, cleanliness, and markings to assess its conformance with other requirements stated or reasonably implied but not covered by specific test.
- k) In the event of any product thereof fails to meet the examination or test requirements specified herein shall be subjected to rejection.
- l) **No repairs are allowed on any product/forging.**

3.0 ELIGIBILITY FOR PARTICIPATING IN THE BID

Only the reputed manufacturers engaged in fabrication of big size Aluminium Alloy forgings need to submit the tender. The vendor shall have sufficient experience in manufacturing of Aluminium Alloy forgings weighing at least 75% weight of biggest size forging mentioned in this specification. **Distributors, Dealers, Stockiest, Traders, Agents etc., need not quote.** The Vendor shall furnish here a list of similar works executed by him, to whom a reference may be made by the purchaser in case he considers such a reference necessary.

4.0 CODES, STANDARDS AND APPLICABLE DOCUMENTS

4.1. American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Codes

- a) ASME Section III, Division-1, Sub-section NB.
- b) ASME Section II for Material Specifications.

- c) ASME Section V for Non Destructive Examination
- d) ASME Section IX for Welding & Brazing Qualification.

4.2. American Society for Testing & Materials (ASTM)

- a) ASTM-B-557 “Standard Test Methods For Tension Testing Wrought And Cast Aluminum- and Magnesium-Alloy Products”
- b) ASTM-E-112 “Standard Test Methods for Determining Average Grain Size”
- a) ASTM-E-716 “Standard Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis”
- b) ASTM-E-1251 “Standard Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry”
- c) ASTM-E-607 “Standard Test Method for Atomic Emission Spectrometric Analysis of Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere”
- d) ASTM-E-34 “Standard Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys”

In the event of any conflict between the requirements of this specification, drawings and codes the more stringent requirements shall apply.

5.0 APPLICABLE DRAWINGS

Applicable drawings as listed in **Table 2** have been attached with this tender document. The drawings shall be read along with the notes (containing details) mentioned in the respective drawings. The successful bidder shall prepare the drawings of forgings and the drawings for proof machining condition. The proof machining shall include allowance for finish machines and the allowance will be decided by purchaser.

Table 2 List of Drawings

S. No.	Part Name	Description
1	Top Enclosure Blank	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 1 of 8
2	Bottom Enclosure Blank	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 2 of 8
3	Inner Shell Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 3 of 8
4	Outer Shell Ring Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 4 of 8
5	Obround Piece Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 5 of 8
6	Transition Piece Forging	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 6 of 8
7	Chimney Flange Blank	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 7 of 8
8	Grid Plate	Tender Drawing: A4/HFRR/31140/3005/DD Sheet 8 of 8

6.0 MANUFACTURING

- a) The billets used in the manufacturing of forgings shall be preferably manufactured by continuous casting processes. Manufacturing lot is defined as billets made from single melting lot.
- b) The forging process shall be open forging. The cast ingot shall be forged with forging ratio of 3 or more followed by annealing to break down the cast structure. Forging ratio is the ratio of Cross sectional area of cast ingot to the cross sectional area of forged rounds prior to machining.
- c) The forged blanks shall be machined by keeping the margin for the finished machining. The vendor has to make forged blanks and machine out them in proof machining condition. Prepare the blanks for tension test specimens of standard sizes and carry out testing.

7.0 TESTING AND EXAMINATION REQUIREMENTS

- a) Each product shall be subjected to all the tests as explained in subsequent sub section **irrespective of availability of MTC** in presence of purchaser representative.
- b) All tests as called for in the specifications shall be arranged by the supplier/manufacturer. All inspection and tests shall be conducted in the presence of the purchaser and/or his authorized representatives. The vendor prior to performing test shall intimate the purchaser. All the tests shall be done in Purchaser's authorized Material Test Labs (NABL Approved).
- c) **If material fails to conform to any of the applicable requirements of this specification of the Clause No. 7.0, it shall be rejected.**
- d) All the test results and the necessary test certificates shall be submitted after the tests to the purchaser.
- e) If case of deviation from test results as mentioned in Clause 7.0, the vendor shall re-examine, re-inspect, re-test or conduct any additional examination of the component on request from the Purchaser. **Re-examination, re-inspection, re-testing and additional tests requested by the purchaser shall be at vendor's expense.**
- f) Even though inspections are carried out by Purchaser or his representative, such inspection and testing shall not however relieve the Vendor from the responsibility of furnishing material conforming to the requirements of the specification, nor prejudice any claim, right or privilege which purchaser may have because of the use of defective or unsatisfactory material.
- g) Only mill test certificate are not acceptable.

7.1. Chemical Composition and testing

- a) The chemical composition requirements shall be as per the requirements of relevant specifications of ASME Section-II Part-B.

- b) Furnace charges are to be sampled and analyzed according to methods based on ASTM Standards E716 (Standard Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectro-chemical Analysis) and E1251(Standard Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry).
- c) To analyze the product for conformance to chemical composition limits, the method used for sampling shall be as per the requirement mentioned in ASTM E 716 and the purchasers recommendation and it will be finalized during preparation of QAP.
- d) The chemical testing shall be performed in accordance with E607 (Standard Test Method for Atomic Emission Spectrometric Analysis of Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere), E1251, E34 (Standard Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys).

Table:-3 Chemical composition

S.No		Al 5154 O Temper			Al 5052 O Temper			Al 6061-T6	
a)	Element	Max	Min	Nominal	Max	Min	Nominal	Max	Min
b)	Copper	0.10 %			0.10 %			0.40 %	0.15%
c)	Magnesium	3.9 %	3.1 %	3.5 %	2.8 %	2.2 %	2.5 %	1.2 %	0.8 %
d)	Chromium	0.35%	0.15%		0.35%	0.15 %		0.35%	0.04%
e)	Manganese	0.10 %			0.10 %			0.15 %	
f)	Zinc	0.20 %			0.10 %			0.25 %	
g)	Iron	0.40 %			0.40 %			0.7 %	
h)	Boron	10ppm max	--		10 ppm max				
i)	Cadmium	5ppm Max			5ppm Max				
j)	Hydrogen	< 0.2ppm			< 0.2ppm			< 0.2ppm	
k)	Titanium	0.20 %			--			0.15 %	
l)	Silicon	0.25 %			0.25 %			0.8 %	0.4%
m)	Other elements								
n)	Each	0.05 %						0.05 %	
o)	Total	0.15%			0.15%			0.15%	
p)	Aluminium	Remainder			Remainder			Remainder	

Note: Composition is in weight percent

- e) Each billet shall be tested for chemical composition. Before starting of manufacturing of forging and each forging shall be chemically tested after heat treatment. Maximum

content for Boron and Cadmium must be limited as specified in **Table 3**. Special care must be taken while cutting of samples for chemical analysis to prevent contamination of the samples.

- f) Hydrogen content in billets used for forging shall be less than 0.2 ppm. Measurement shall be carried out by Alscan method or equivalent.

7.2. Mechanical Properties

Material to be supplied as per this specification shall have the following mechanical properties. Mechanical testing of the products shall be done as per relevant ASME material Specification and ASTM B-557. For mechanical testing proper coupons shall be taken out from the forged product. The material shall be taken from the forgings as mentioned in the drawings.

	AL 5154 O Temper	AL 5052-O Temper	Al 6061-T6
Ultimate Tensile strength	206MPa minimum.	172MPa minimum.	262MPa
Yield strength (0.2% offset)	75MPa minimum.	65 MPa minimum.	241MPa
Elongation in 2 in. or 4× Diameter, min	18%	18%	10%

7.3. Inclusion Rating

Inclusion rating on billets shall be 0.1 (max) as measured by Porous Disc Filtration Apparatus (PoDFA) Technique. Vendor has to submit the procedure to the purchaser before conducting the test. Purchaser’s approval will be required to conduct the test.

7.4. Grain Size

Grain size testing shall be in accordance with Test Methods E112. The grain size shall be as mentioned in section-7.8.

7.5. Number of Specimens for All Testing

Collection and testing of samples shall be witnessed by purchaser. Location and size of the specimens will be decided by the purchaser. Location of the samples will be marked in the forging drawings. Minimum test samples will be as per **Table 4** and taken from each forging and **maximum no of test samples may vary. Vendor should take into account this aspect while submitting his offer for the bid.**

Table 4: Sampling Plan

S. No.	Type of test	Samples
1.	Chemical Analysis	15 Sample/Product
2.	Grain Size	18 Samples/Product
3.	Mechanical Test	45 Sample/product
4.	Inclusion Rating	27 Samples/product

7.6. Ultrasonic Testing: UT shall be performed conforming to ASTM E2375

I. Extent of Examination

- a) UT shall be carried out by personnel who are qualified to UT Level II as per IS 13805 or SNT-TC-1A. At least one surface of the forging blanks shall be UT tested and the 100% surface shall be covered with minimum 10% overlap of the scanning probe.
- b) The cylindrical/tubular forgings shall be scanned in both radial as well as axial directions. Any indication equal or above 50% of reference level shall be recorded and length of indication shall be measured by 6 db drop method.
- c) **Sample or calibration block for the UT machine calibration shall be fabricated from the same product which is to be tested.**

A. Straight Beam Examination

Acceptance criteria for UT as per class-AA after drawing DAC from reference blocks

1. Indications from a single discontinuity shall not exceed the response from a 3/64 in. (1.19 mm) flat-bottom hole at the estimated discontinuity depth.
2. Multiple indications in excess of the response from a 2/64 in. (0.79 mm) flat-bottom hole at the estimated discontinuity depth shall not have their indicated centers closer than 0.5 in. (12.7 mm).
3. Indications from a single discontinuity equal to or greater than the response for a 2/64 in. (0.79 mm) flat-bottom hole at the estimated discontinuity depth shall not be more than 0.5 in. (12.7 mm) in length.
4. Multiple discontinuities shall not be of such size or frequency as to reduce the first back reflection to 50 % or less of the first back reflection from normal material of the same geometry, with the crystal parallel to the front and back surfaces to ensure the loss of back reflection is not caused by surface roughness or part geometry variation.
5. Cluster of indications having amplitude more than 50% of reference level.

6. If during the examination indications are detected which lie within the specified acceptance level as regards to amplitude and length, but appear to be clusters of minor inclusions, the acceptance level shall be reviewed in consultation with the purchaser.

B. Angle Beam Examination

- 1) **Examination** shall be performed after drawing distance amplitude correction curve (DAC) from reference blocks as per details of notches and **acceptance criteria** are as follows:
 - i. **For Solid forging-** Rectangular notch of 0.13mm depth x6.35mm length.
 - ii. **For Hollow, Ring forging-**Rectangular notch of depth 5% of wall or 0.102mm whichever is greater x 6.35mm.
- 2) Notch width to be as small as practical but shall not exceed twice the nominal notch depth.

C. Acceptance Criteria:

Material producing indications of discontinuities equal to or exceeding the notch indication amplitude shall be considered unacceptable.

II. Essential Points

1. Ultrasonic examination shall be performed after heat treatment when the forging is machined to the ultrasonic configuration but prior to drilling holes, cutting keyways, tapers, grooves, or machining sections to final contour.
2. To ensure complete coverage of the forging volume when scanning, index the search unit with at least 15 % overlap with each pass.
3. The scanning rate shall not exceed 150 mm per second.
4. Scan all regions of the forging in at least two perpendicular directions to the maximum extent possible during straight beam examination in case of non-circular section.
5. Scan disk and disk-type forgings using a straight beam from both flat faces and radially from the circumference wherever practicable.
6. Scan disk and disk-type forgings using angle beam from both flat faces to find out vertically oriented flaws.
7. Scan cylindrical sections (including rods), ring and hollow forgings from the entire external surface (sides or circumference), using the straight-beam technique, and scan the forging in the axial direction to the extent possible. In addition, axial angle beam examination shall be performed from two axial direction over entire surface.
8. Steps in forging shall be examined with angle beam testing.
9. Angle-beam examination technique in two circumferential directions shall be performed on cylindrical sections (including rods), ring and hollow forgings using appropriate angle beam probe to cover maximum possible volume.
10. *Item with identification "Inner shell forging" shall be examined ultrasonically before trepanning/drilling/Boring operation.*

11. Detailed procedure for carrying out ultrasonic test for each item in the tender shall be submitted for approval.
12. Supplier shall start ultrasonic testing only after procedure is approved by indenting officer.

III. Notes:

1. Final product size (as supplied) shall be as per drawings as specified in Section 5.0 of indent specifications after removing material for making the reference block.
2. Before testing, supplier shall submit testing procedure well in advance for purchaser's approval.
3. Cost of machining of reference blocks and testing will be in the scope of supplier and same shall be included in quoted cost (shall not be quoted separately).
4. The surface roughness of exterior finishes shall not exceed 6 μm .

7.7. Liquid Penetrant Acceptance Standards

100% LPT shall be carried out on proof machined products on all accessible surfaces.

- a) Liquid Penetrant Examination shall be in accordance with ASME Section V, article 6.
- b) Mechanical discontinuities at the surface will be indicated by bleeding out of the penetrant; however, localized surface imperfections as may occur from machining marks, surface conditions or an incomplete bond between base metal and cladding may produce similar indications which are not relevant to the detection of unacceptable discontinuities.
- c) Any indication, which is believed to be non relevant, shall be regarded as a defect and shall be re-examined to verify whether or not actual defects are present. Surface conditioning may precede the re-examination. Non relevant indications and broad areas of pigmentation, which would mask indication of defects, are unacceptable.
- d) Relevant indications are those which result from mechanical discontinuities. Linear indications are those indications in which the length is more than three times the width. Rounded indications are indications, which are circular or elliptical with the length less than three times the width.
- e) Only indications with major dimensions greater than 1/16 in. (1.6mm) shall be considered relevant.
- f) The following relevant indications are unacceptable:
 - i. Any cracks or linear indications;
 - ii. Rounded indications with dimensions greater than 4.8mm
 - iii. Four or more rounded indications in a line separated by 1.6mm or less edge to edge;
 - iv. Ten or more rounded indication in any 3870 sq. mm of surface, with the major dimension of this area not to exceed 152mm, with the area taken in the most unfavorable location relative to the indications being evaluated.

7.8. Metallurgical Quality

Item	Limit of Acceptance
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Homogenization	Microstructure to exhibit reduced micro-segregation from casting solidification and dissolution of Mg ₂ Si Phrases
	Alpha-AlFeSi to be the predominant intermetallic phase
	Intermetallics to exhibit spheroidisation and break-up
	Precipitated Mg-Si particles to be generally fine and evenly distributed
Hydrogen gas content	Maximum 0.20cc/100g
Average grain size as per ASTM E112	Product Diameter < 200mm - Maximum 200µm
	Product Diameter 200-250mm - Maximum 250µm
	Product Dimension >250mm Maximum 500 µm

7.9. Physical Quality

Item	Limit of Acceptance
Centre cracks	Nil as determined by in-line ultrasonic inspection with two probes offset at 90 degrees
Surface contamination	Surfaces shall be free from dirt and grit, oil, grease, swarf and corrosion products
Surface defects	Nil cold shuts/folds, transverse tearing or bleed outs
	Nil folded oxide patches greater than 5mm in size
	Nil barber poling which exceeds diameter tolerance
	Nil brags > 50% of billet length and/or circumference
Mechanical Damage	Nil greater than 2mm in depth
	Nil greater than 5mm in width

8.0 DIMENSIONS AND TOLERANCES

The dimensions and tolerances shall be as per the drawings attached.

9.0 HEAT TREATMENT

Heat treatment of all the forgings shall be as per relevant material specification and standard procedure. **However heat treatment procedure is subjected to purchaser's approval.**

10.0 INSPECTIONS & WITNESS

10.1. General

- a) The vendor shall be responsible to perform all examination and testing in accordance with the requirements of ASME Section III, Division-1 Subsection-NB and ASME Section-V in addition to the requirements specified herein.
- b) All non-destructive examinations, heat treatment, dimensional inspections are in accordance with the written procedures approved by the purchaser.
- c) Unless otherwise stated, all inspection/test shall be conducted in the presence of the purchaser and/or his authorized representatives. The vendor prior to performing test shall submit all the test procedures for purchaser's approval. All the test results and the necessary test certificates shall be submitted after the tests for the purchaser's approval.
- d) Inspection of products shall be carried out in the following stages.

10.2. Preliminary Inspection

A preliminary inspection will be made prior to manufacturing of the forgings, to check and identify the billets used are tested and examined as per this specification. It is the manufacturer's responsibility to transfer the heat mark in presence of purchaser or his representative at all stages of fabrication. Wherever transfers of the marks are not feasible the forging will be done in the presence of purchaser's representative.

10.3. Intermediate Inspection

Intermediate stage inspections will be made to check the process followed for the manufacture of forgings and machining of the forgings and various examinations/testing required during and after forging.

10.4. Inspection for Heat Treatment

All the heat treatments shall be inspected and witnessed by the purchaser.

10.5. Final Inspection

After manufacturing, machining and carrying out all testing/examinations of the forgings, a final inspection shall be made to ensure completeness and packing before transportation. This inspection will include checking of UT reports, heat treatment charts, and other specified non-destructive tests, checking as built dimensions, surface finish etc. Only after the final inspection the vendor can deliver the products.

11.0 ACCEPTANCE AND REJECTION

If material fails to conform to any of the applicable requirements of the Clause No. 7.0, it shall be rejected.

12.0 PROTECTION AND PACKING

The products shall be prepared for shipment in accordance with the instructions stated below.

- a) All products shall be neatly finished in a workmanship like manner. All exposed metal surfaces shall be smooth and free from burrs. Finished surface shall be protected against corrosion and mechanical damage.
- b) All products shall be properly protected for preventing any possible damage during transportation.
- c) Material shall be preserved, packaged, and packed in accordance with the requirements of Practice B660 and as per level A.
- d) Before the products are packed, they shall be carefully checked to be sure that all extraneous matter such as rags, rubbish foreign matter, loose scale and dirt etc. have been removed.
- e) After the products are cleaned and dried, they shall be wrapped in a polythene sheet of minimum 50 micron thickness in such a manner as to provide maximum protection against physical damage, corrosion, entry of dust and moisture during transport/transit to the site. Sufficient number of desiccants bags shall be placed inside packing at appropriate places for adequate protection against humidity and moisture.
- f) Any type of painting shall not be applied on any of the product.
- g) After wrapping the products with polythene sheets each product shall be packed in the individual wooden boxes. The wooden boxes shall be sufficiently strong and rigid for handling. Each wooden box shall have provision for handling (wrapping of belts/chains etc). The wooden boxes shall have markings showing direction up.
- h) The packing shall be such that the material is protected for a transient period of six months.
- i) The packing shall provide adequate cushioning, blocking and bracing to protect against shocks and prevent internal movement of the products. Adequate anti-skidding, hoisting and tie down provisions shall be provided to facilitate easy handling and safe movement.
- j) Details of packing and packing procedures are subject to the purchaser's approval.
- k) Vendor without any extra cost shall supply any material found short inside the intact packing cases.
- l) All packing cases and packing material shall become the property of purchaser.
- m) Vendor shall be responsible for any damage to the material/equipment during transit due to improper and inadequate packing.
- n) Only package constructed out of sound material and of dimensions proportional to the size and weights of contents shall be used.
- o) Bundled materials shall be rigidly steel strapped over the protective covering.

- p) Wherever necessary, proper arrangements for attaching slings for lifting shall be provided.
- q) The products shall be protected for the entire period of dispatch and storage against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage in the open including possible delays in transit.
- r) The packing list in duplicate, containing details of products for verification at site shall correspond with the advice note.
- s) Packing shall be done in presence of purchaser's representative.

12.1. MARKING

All the packages shall be clearly, legibly and durably marked on both sides with:

- a) Destination address as communicated.
- b) Purchase Order No. and Date.
- c) Dimensions.
- d) Net and Gross weights.
- e) Sign showing 'Way Up'.
- f) Sign showing slinging and sling position.
- g) Centre of Gravity (CG).
- h) Any handling and unpacking instructions, if considered necessary.
- i) All marking shall be made with uniform block letters using water proof paint.
- j) The contents of the package shall be punched on non-corrosive metal plate and nailed on to the package on a prominently visible place. If the number of items in the package are too many a typed list sealed in transparent water-proof bag shall be kept inside a galvanized steel cover which is nailed on to the outside of package in a prominently visible location.

13.0 RIGHTS AND PRIVILEGES

- a) Purchaser reserves the right to inspect any machinery or material or equipment furnished or used by Vendor under the contract and to reject any, which is found defective in workmanship or design, or otherwise unsuitable for the use and purpose intended, or which is not in accordance with the intent of the contract.
- b) If purchaser waives the right to inspect any material/equipment, such waiver shall not relieve Vendor in any way of his obligations under the contract.
- c) Purchaser or Purchaser's representatives shall be permitted free access to Vendor's or his sub-vendor's shop at all working hours for the purpose of inspecting work at all stages of manufacturing progress.
- d) Purchaser's representative shall be provided full assistance in the form of necessary tools, instruments, equipment and qualified operators to facilitate inspection.
- e) Purchaser reserves the right to call for certificates of origin, and test certificates for all raw material/equipment at any stage of manufacture.

- f) In the event of Purchaser's inspection revealing poor quality of goods, Purchaser shall be at liberty to specify additional inspection procedures, if required, to ascertain Vendor's compliance with the Technical Specifications.
- g) Vendor shall keep a set of latest prints of the approved drawings available, on the shop floor for reference of Purchaser's representative during the inspection.

14.0 DOCUMENTATION

14.1. DOCUMENTS TO BE SUBMITTED WITH BID/OFFER

Following documents are required to be submitted along with the bid for evaluation of the vendor and qualifying the vendor for the suitability of supply of products mentioned in this specification.

The quotation shall be submitted along with the following information.

- i. Organizational Chart
- ii. Infrastructure availability for the job under this tender.
- iii. Jobs under execution and expected in next one year and their order value as per attached annexure IV.
- iv. Current load on critical machines and plan to execute the job as per schedule.
- v. Experience in executing similar jobs in the past (Please attach the PO copies).
- vi. Manpower details as per the attached annexure II.
- vii. Details of QC personnel.
- viii. Quality manual of the company.
- ix. Safety norms of the company.
- x. Financial Status of the company for last five years including P&L sheet as per the attached annexure I.
- xi. Manufacture, inspection, testing and delivery schedule in the form of bar chart.
- xii. A list of parties to whom the company has supplied products conforming to similar specification along with the purchase order number as per annexure -III.
- xiii. **The supplier shall submit compliance (para wise agreement/deviation) against the detailed specs specified.**

14.2. DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

Two copies of the following shall be submitted for the approval by the purchaser

- i. Detailed forging drawings and machining drawings indicating sample locations etc.
- ii. QAP: - Detailed Quality Assurance Plan shall be submitted indicating the hold points of the purchaser.
- iii. Detailed plan for the engineering and manufacturing programme (shall be submitted within three (3) weeks from the placement of purchase order for approval). Fabrication shall commence only after getting approval from the purchaser.
- iv. Heat treatment procedure.
- v. Chemical composition testing procedures.

- vi. Mechanical test procedures.
- vii. Procedure for checking for inclusion rating
- viii. Cleaning procedure.
- ix. Liquid Penetrant Testing Procedure.
- x. Ultrasonic examination procedure
- xi. Packing procedure.
- xii. Other inspection/test procedures, if any
- xiii. Bar chart showing detailed manufacturing, cleaning, inspection, testing and delivery schedule shall be submitted for purchaser's approval and manufacture shall be started only after getting purchaser's approval

14.3. HISTORY DOCKET REQUIREMENTS

- i. Two copies of the history docket shall be provided with the products at the time of final delivery. This docket shall consist of the following documents:
 - a) As built drawings
 - b) Certified material test reports
 - c) Heat treatment records
 - d) All NDT documents including test certificates and calibration certificates
 - e) All the inspection reports
 - f) Weight of each product
 - g) Copy of Work order
 - h) Copy of Technical specification
 - i) Approved QAP
- ii. All the above document shall be in A4 paper size and bounded in book format except drawings. The above document shall also be supplied in PDF format in a CD. The drawings shall be provided both in PDF format and DWG format.

15.0 TRANSPORTATION & DELIVERY

- a) Each package shall contain only one size, alloy, and temper of material unless otherwise agreed. The type of packaging and gross weight of containers shall, unless otherwise agreed, be at the producer's or supplier's discretion, provided that they are such as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.
- b) Each shipping container shall be marked with the purchase order number, material size, specification number, alloy and temper, gross and net weights, and the producer's name or trademark.
- c) Adequate anti-skidding, hoisting and tie down provisions shall be provided to facilitate easy handling and safe movement of the material.
- d) Vendor without any extra cost shall supply any material found short in supply lot received at purchaser's site/store.

- e) No material shall be dispatched without prior written consent of Purchaser or his representative.
- f) Vendor shall intimate at least fifteen (15) days in advance to the consignee as well as to the concerned Engineer at site, the probable date when the material are to be ready for dispatch. A packing list also shall be sent along with this.
- g) The delivery of the products shall be **within nine (9) months** after the placement of the purchase order at the purchaser's site, Mumbai.
- h) Unloading will be done by the purchaser at purchaser site in presence of Supplier's representative. Supplier's representative will oversee safe and damage free unloading. Any damage caused during unloading shall be borne by the supplier.

16.0 INSTRUCTION FOR 'COMPLETENESS' OF THE OFFERS

- a) Vendor shall furnish all the relevant information what so ever, in clear terms as required in this specification and submit along with the quotation. The quotation with incomplete information may not be considered for evaluation.
- b) Ditto production of this specification and submission of the same under sign and seal in any case (with or without remarks) is not permitted.
- c) The offer must contain: -
 - i. Duly filled all Annexures explained in paragraph 14.
 - ii. All the drawings, technical information issued with this tender are the property of purchaser. After job execution, supplier is required to return all the drawings/technical documents, if any to the purchaser.

17.0 PRE-BID MEETING

A pre-bid meeting will be arranged in which purchaser will explain the technical details of the tender and bidders can clarify their doubts.

18.0 BIDDER EVALUATION

- a) After bid opening the technical persons committee will visit the bidders to evaluate their capabilities. Bidder should have following facilities as a minimum to be eligible for manufacturing of the products under this tender.
 - 1. Bidder should have capacity to manufacture all the products in-house as per the specification requirement.
 - 2. Machines required for the manufacture of the forged products (Required for machining of largest (considering weight and volume) forging).
 - 3. Bidders should have in-house capabilities for heat treatment and other special machines.
- b) Bidder should explain their understanding of the critical products and assemblies identified in this document during evaluation visit. They should explain the execution team composition and project mentoring method.

c) Following will be the scoring criteria for evaluating the Bidder:

Sr. No.	Criteria	Score
1.	Experience in executing similar ^{\$} job in the recent past	30
2.	Quality Audit (Carried out during technical evaluation)	10
3.	Availability of in-house Machineries *	25
4.	In-house heat treatment and surface treatment facilities	15
5.	Availability of Inspection Tools and facilities	10
6.	Availability of Proper storage space	2
7.	Cleanliness of the shop and surrounding	2
8.	Safety policy and measures	2
9.	Material Handling facilities	4

\$ Similar jobs meaning is

- (i) **Fabrication of large size Aluminium Alloys forgings and,**
- (ii) **Machining of heavy components** (Required for machining of largest (considering weight and volume) forging) **and,**
- (iii) **Heat treatment of large size forgings.**

* Availability of relevant machines required for this job.

A minimum score of 70 marks will qualify the bidder for technical eligibility.

19.0 CONFIDENTIALITY CLAUSES:-

- (i) **Confidentiality:** No party shall disclose any information to any third party concerning the matter under this contract generally. In particular, any information identified as ‘proprietary’ in nature by disclosing party shall be kept strictly confidential 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 Purchaser’s name without permission for publicity purposes:** The contractor or sub-contractor consultant, adviser or the employees engaged by the contractor shall not use Purchaser’s name for any publicity purpose through any public media (like press, radio, T.V. or Internet) without the prior written approval of Purchaser.

**ANNEXURE-I
TECHNICAL BID**

Sl. No.	PARTICULARS	REMARKS	
I	Name of the firm		
II	Postal address		
III	Contact with STD code		
IV	Fax with STD code		
V	Name of Contact person		
VI	Mobile No.		
VII	e-mail ID		
1	Financial Turn Over Certified by CA of Last 3 Years in Rs.		
	2018- 19		
	2017- 18		
	2016 - 17		
2	Profit & Loss Statement Certified by CA in Rs.		
	2018-19		
	2017-18		

	2016-17		
	2015 - 16		
	2014 - 15		
6	Certificates:		
	i) Registration Certificate if Any,	ATTACH SCANNED COPY SEPARATELY	
	ii) Certificates of Work Experience /Performance certificates	ATTACH SCANNED COPY SEPARATELY	
	<i>iii) Certificates of Registration for GST</i>	ATTACH SCANNED COPY SEPARATELY	
	iv) TIN Registration Certificates	ATTACH SCANNED COPY SEPARATELY	
	v) PAN (Permanent Account Number) Registration	ATTACH SCANNED COPY SEPARATELY	

**ANNEXURE-II
STATEMENT OF MAN POWER**

Sl. No.	PARTICULARS	REMARKS
1	Have the tenderer visited the site	
2	Manpower Deployment:	Proposed by Tenderer for Deployment for completion of work.(Nos)
a	Welders	
b	Electrician	
c	Labours	
d	Machine Operator	
e	QA Technician with certification	
3	Technical Staff Deployment:	
a	Graduate Engineers	
b	Diploma Engineers	
c	Supervisors	
4	Machinery Deployment:	NoS of machines or available/not available
a	Heating Furnaces	
b	Heat treatment Furnaces	
c	Forging Presses	
d	EOT Cranes (capacity/Hook height)	
e	CNC/conventional Lathe M/c with specification	
f	CNC/conventional Milling M/c with specification	
g	CMM	
h	Welding Machines	
i	Measuring Instruments	
j	Tool Box	
k	Profile Measuring Facility	
l	Boring/drilling Machine	
m	Material Testing Facilities	
n	NDT Facilities	
		Any Other Machinery/Equipment proposed by Tenderer required for specialised works for completion of work order:

Note : 1) It is noted that the above deployment is minimum. After detailed programming and actual condition at site, additional deployment shall be done as necessary for completion of the work within the stipulated time period.

2) It is mandatory to fill up ANNEXURE - II by the tenderer. Non-compliance of the same, tender may be rejected.

ANNEXURE-III

DETAILS OF ALL WORKS OF SIMILAR CLASS COMPLETED DURING THE LAST SEVEN YEARS

Sl. No.	Name of work/ project and location	Owner or sponsoring organisation	Cost of work in Lakhs Rupees	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation / arbitration cases pending / in progress with details (indicate gross amount claimed and amount awarded by the Arbitrator)	Name and address/ telephone number of officer to whom reference may be made	Remarks
1									
5									
6									

Note: The similar work means (i) Fabrication of large size Aluminium alloys forgings and,
(ii) Machining of heavy components (Required for machining of largest (considering weight and volume) size forging) and,
(iii) Heat treatment of large size forgings.

ANNEXURE-IV

PROJECTS UNDER EXECUTION OR AWARDED

Sl. No.	Name of work/ project and location	Owner or sponsoring organisation	Cost of work in Lakhs Rupees	Date of commencement as per contract	Stipulated date of completion	Up to date percentage progress of work
1						
2						
3						
4						