1. GENERAL:

This specification governs the requirement for supply of ventilators DE & NDE of traction motor type IM3601AZ.

2. DIMENSIONS AND TOLERANCES:

The dimensions and tolerances shall be strictly as mentioned in the drawing. Supplier shall arrange for measurement of dimensions of each ventilator using computer-aided co-ordinate measurement machine (CMM) to ensure quality and provide the results to BHEL. The vendor has to also provide with each impeller a certificate of compliance with the desired dimensions and indicate any deviations in the dimensions. 20 % of the offered lot shall be checked on 3D CMM in presence of BHEL representatives. The casting tolerances shall be as per IS 4897 CL-1 and the same shall be certified by the vendor.

3. MANUFACTURE:

a) Casting Process: Gravity/Low Pressure Die Casting should be followed for manufacturing of ventilator. Vendor shall provide details of casting process being followed to BHEL.

b) Melting Process: Induction melting should be followed for manufacturing of ventilator casting. Vendor shall provide details of melting process being followed to BHEL.

c) Stress Relieving: Ventilators shall be stress relived as per stress relieving cycle given in the drawing. Vendor shall arrange to get stress relieving done on each ventilator and shall provide compliance certificate to BHEL.

d) Heat Treatment: Heat treatment shall be done as per T6 condition as per ASTM B917/B917M-11 and shall provide certificate of compliance.

e) Balancing: Vendor shall arrange to get dynamic balancing done on each ventilator by addition of suitable weights at slot 'x' shown in drawing at a minimum speed of 500 RPM. Vendor shall provide the compliance certificate of same to BHEL.

Revision : 02	Distribution	Qty.	Approved : (M.Verma)		
Date: 02-08-12			Prepared	Checked	Date :
	TME TSD TXM	1 1 1	(P.Gupta)	(A.Sharma)	02.08.12

4. FREEDOM FROM DEFECTS:

The castings shall be sound and free from harmful defects such as blow holes, inclusion, shrinkage, gas cavities, hot spot, cold shuts, cracks, gross porosity, dross etc., which may adversely affect the machining and utility of castings.

5. MATERIAL:

Material for ventilator DE & NDE shall be warm hardened Aluminium- Silicon-alloy. Virgin material (not re-melted from scrap) to be procured from reputed vendors to ensure quality. Vendor shall provide certificate of the material used. (*Note: All other material requirements shall be as per G- AlSi7Mg wa {DIN 1725} material number 3.2371.61 warm hardened Aluminium-Silicon-alloy except for that which are mentioned in this specification i.e. TM 07375)

a) Chemical composition:

Si : 6.5 –7.5 %	Allowable Pollution:
Mg : 0.25 – 0.45 %	Fe: $\leq$ 0.18 % Zn: $\leq$ 0.07 %
Ti : 0.001 – 0.20 %	Cu: $\leq$ 0. 05 % Mn: $\leq$ 0.10 %
Al : rest	

b) Mechanical properties:

Property	On test bar	On casting
Tensile strength	230-310 N/mm^2	Min. 230 N/mm^2
Yield strength (0.2 %)	190-240 N/mm^2	Min. 190 N/mm^2
Elongation (L= 5d)	7 – 9%	Min. 5%
Hardness HB5/250	75 - 110	75

E = 73 kN / mm^2 a = 22.10^{-6} / K (20 –200 ^{O}C)
A = 92 W / mk

c) Specific mass:

~ 2.7 kg / dm^3

6. TEST SAMPLE:

Test bars are to be made along with each lot of ventilator castings. Vendor shall arrange for tests on test bars of at least one ventilator casting in a lot and provide the results to BHEL. This is to ensure that all the material properties and quality as specified in this specification are met. All the results are to be provided to BHEL and also provide with each lot of ventilator a certificate of compliance or deviation. Test bars (3nos.) of the same ventilator casting for which vendor has submitted test results are to be supplied to BHEL to carry out tests (Chemical composition, mechanical properties and microstructure test) at BHEL.

7. TESTING (certificates from NABL accredited laboratories):

7.1. Chemical composition :
To be done by charge analysis

7.2. Mechanical properties :
To 1 or 2 of 4, per charge, separate casted unfinished test bars acc. to DIN 50125 with the same heat treatment of the castings.

7.3. X-ray inspection:
Per casting, places must be sign on the mentioned positions on the drawings.

7.4. Surface crack inspection :
Per casting, after heat treatment and removal of the casting skin.

8. QUALITY REQUIREMENTS

Parameters	Requirements
Internal defects	ASTM E155
Thickness > 10 mm	Max. size 5
Thickness ≤ 10 mm	Max. size 4
Surface defects	Free from defects and line formed marks
Inspection method	X-ray inspection

8.1. Microstructure (certificates from NABL accredited laboratories):
Vendor shall arrange for micro-structure tests on each lot and and provide the results to BHEL along with the certificate about achievement of Globular micro-structure.

8.2. Radiography (certificates from NABL accredited laboratories):
As per clause 8 (100 % radiography to be done on all castings as per this specification at positions marked 'A' in the drawing and DP Testing as per BHEL spec. nos. AA0850131 & AA0850132 for remaining portion).

Supplier shall arrange to carry out 100 % radiography and DP testing as specified above and provide the test results to BHEL along with certification about actual micro-structure obtained.

9. SAMPLING

9.1 Chemical Analysis

9.1.0. Lot
The ingots / castings produced from the same cast of 1000 kg or part thereof shall constitute a lot.

9.1.1. One sample for chemical analysis shall be selected from each cast or a lot as mutually agreed to between the supplier and the purchaser.

9.1.2. Special care shall be taken during sampling of the ingots or castings. In all cases, first drillings shall be discarded till a clean oxide-free surface is reached

9.2. TENSILE TEST FOR CASTINGS

9.2.1. One separately cast test sample shall be selected from each lot or heat-treatment batch.

9.2.1.1 Adequate number of separately cast test samples shall be prepared for tensile test from each cast so that it is possible to carry one test for each lot / heat-treatment batch and samples are available for retest.

9.2.1.2. The metal for the test samples shall be taken from the crucible or ladle from which, the castings are poured.

10. PACKING & MARKING

10.1 Fans shall be suitably packed to prevent corrosion and damage during transit, machined surfaces shall be properly protected with anti-corrosive compounds
Each fans shall be legibly marked with the following information:
a) Lot or heat-treatment batch number
b) Vendors name & reference
c) Heat no.
d) Identification mark/No.

11. CERTIFICATES

The supplier shall submit five copies of test certificates giving the following information:

- BHEL purchase order number
- Spec. no. TM07375 rev.02

- Vendor reference and name
- Method of manufacture
- Heat no.
- Charge number
- Charge analysis
- Results of mechanical test and all other tests as called in the specification/order
- Results of surface crack inspection and / or X-ray inspection per numbered casting.
- Temperature graphs of the applied heat treatment.
- Drawing/pattern no.
- In addition, vendor shall ensure to enclose one copy of the test certificate along with the dispatch documents to facilitate quick clearance of the material.
- In addition to above, all the certificates as mentioned in different clauses of this specification i.e TM07375 rev.02 shall be submitted by the vendor.

Each consignment of ingots / castings should be accompanied by a test certificate containing details of alloy designation, lot / heat –treatment batch number and corresponding chemical composition, tensile properties (for castings only), etc. The checklist of certificates to be submitted by suppliers as per specification requirement is attached as annexure-1

Checklist for test certificates

Annexure 1

S.No.	Test	Certification and documents to be provided by the supplier	Requirement
1	Casting process	Supplier's TC	In accordance to spec TM07375 (clause 3a)
2	Melting process	Supplier's TC	In accordance to spec TM07375 (clause 3b)
3	Dimensional measurement on 3D CMM	Supplier's TC	In accordance to spec TM07375 (clause 2) and BHEL drawing: 14450203002
4	Use of virgin material	Supplier's TC	In accordance to spec TM07375 (clause 5)
5	Chemical composition	certificate from NABL accredited Lab.	In accordance to spec TM07375 (clause 5a)
6	Mechanical Properties	certificate from NABL accredited Lab.	In accordance to spec TM07375 (clause 5b)
7	Heat Treatment	Supplier's TC and temperature graph	In accordance to spec TM07375 (clause 3d)
8	Microstructure	certificate from NABL accredited Lab.	In accordance to spec TM07375 (clause 8.1)
9	Radiography	certificate from NABL accredited Lab.	In accordance to spec TM07375 (clause 8.2)
10	DP testing	certificate from NABL accredited Lab.	In accordance to spec TM07375 (clause 8.2)
11	Dynamic balancing	Supplier's TC	In accordance to spec TM07375 (clause 3e) and BHEL drawing:
12	Stress relieving	Supplier's TC	In accordance to spec TM07375 (clause 3c)