





## SPECIFICATION FOR ALLOY IN625M CASTINGS

### 1. GENERAL:

This specification governs the manufacture and quality requirements of castings of grade Alloy IN625M.

### 2. APPLICATION:

For steam turbine casings

### 3. COMPLIANCE WITH NATIONAL/INTERNATIONAL STANDARDS:

Based on ASTM A494/A494M-14 ( CW6MC)

### 4. CONDITION OF DELIVERY:

Casting shall be supplied in heat treated and rough machined condition to the dimensions as per the ordering drawing.

The general tolerances of the casting shall be as per ISO 8062-3 Grade CT13

The surface condition shall meet the requirements of various non-destructive examinations

### 5. MANUFACTURING

#### 5.1 GENERAL REQUIREMENTS

Before starting the production following to be submitted by manufacturer for BHEL review and approval

- Manufacturing Plan detailing the manufacturing sequence for the casting.
- Sample location plan for approval
- The third party like Lloyds/TUV witnessed WPS/PQR for carrying out weld repair along with welder qualification record.

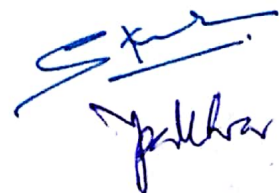
#### 5.2 MELTING PROCESS

The IN625M material shall be produced by electric arc furnace (EAF) followed by secondary Argon Oxygen Decarburization (AOD) refinement route. Any other suitable melting process shall be used only after approval of purchaser.

#### 5.3 HEAT TREATMENT

The material shall be heated to 1175°C minimum, held for sufficient time to heat castings to temperature, quench in water or rapid cooled by other means. Refer table 2 of ASTM A494.

The heat treatment temperature and time shall be recorded and the records shall be made available to the inspection agency.



**6. PROPERTIES AND TESTS (Also refer APPENDIX-I for test block details)****6.1 CHEMICAL COMPOSITION: Heat Analysis in weight%**

The chemical analysis shall be made from a representative sample taken during the pouring of the master heat. The chemical composition shall comply with the requirements given in table below:

| Element  | C           | Mn          | Si        | P         | S         | Mo         | Fe    |
|----------|-------------|-------------|-----------|-----------|-----------|------------|-------|
| Weight%  | ≤ 0.05      | 0.2 - 0.5   | 0.2 - 0.4 | ≤ 0.01    | ≤ 0.01    | 8.0 - 10.0 | ≤ 3.5 |
| Element  | Cr          | Nb + Ta     | Al        | Ti        | Al + Ti   | Ni         |       |
| Weight % | 20.0 - 23.0 | 3.15 - 3.60 | 0.10-0.35 | 0.10-0.35 | 0.20-0.70 | Balance    |       |

*Elements such as Cu, W, Co and V shall be reported for information purpose only.*

**6.2 MECHANICAL PROPERTIES**

**6.2.1** Tensile test (at room temperature) shall be carried out in accordance with test method ASTM E8 or equivalent National/International standard. Test results shall conform to the following specified requirements:

|                            |                        |
|----------------------------|------------------------|
| 0.2% Yield Strength:       | ≥ 275/mm <sup>2</sup>  |
| Ultimate Tensile Strength: | ≥ 485N/mm <sup>2</sup> |
| Elongation: (L=5D):        | ≥ 25%                  |
| Reduction in Area:         | ≥ 40%                  |

Charpy V impact test shall be carried out and results to be reported for information only.

**6.2.2** Hot tensile test shall be carried out at 550°C, 600°C, 650°C, 700°C and 725°C.

0.2% Yield strength, UTS results at each of above temperature shall be reported for information only.

Reduction of area: at 700°C, % RA shall be ≥ 30%.

All other temperatures, % RA to be reported for Information only.

**6.3 Non-Destructive Examination**

Non-destructive examination and acceptance criteria in the delivery condition shall be as follows:

**6.3.1 Visual Examination**

Each casting shall be visually examined in accordance with ASTM A802. The acceptance criteria shall be Level 2.

**6.3.2 Liquid penetrant examination**

Each casting shall be inspected 100 % on all accessible surfaces as per ASTM E165 OR ASME Sec V Article 6. Acceptance shall be as per ASME VIII Div. 1, Appendix.7

**No cracks or tears allowed.**

### 6.3.3 Radiography Examination:

100% Radiographic examination shall be performed as per ASTM E94. The acceptance shall be as per ASME VIII Div. 1, Appendix 7.

### 6.4 REPAIR BY WELDING

Repairs, if any, shall be made in accordance with ASTM A 494. The supplier shall indicate the normal practice followed for minor and major repairs, with or without post weld heat treatment. Major repairs are defined as per clause 11.2 of ASTM A494.

Defectogram along with photographs of the excavated defects shall be sent to BHEL for approval before weld repair.

Any repair welding shall be done as per approved WPS/PQR and qualified welders. The WPS/PQR shall be witnessed by third party like Lloyds / TUV and agreed by BHEL.

NDE of repair weld areas shall be carried out with the same technique and acceptance as that which disclosed the defect, with the exception that in all cases Liquid penetrant examination shall be required.

Actual repair procedure shall be recorded and reported.

Unacceptable indications repaired by means other than welding shall meet the minimum thickness requirements and shall be blended smoothly into the surrounding area. Such repairs shall undergo liquid penetrant inspection.

## 7 QUALITY

The castings shall not be peened, plugged, or impregnated to stop leaks. Internal chills and chaplets may be used in the manufacture of castings. However, the chills, chaplets and affected cast material must be completely removed.

## 8 MARKING

The supplier shall mark each casting with identification number on the location shown in drawing along with supplier's emblem.

## 9 DOCUMENTATION:

Prior to delivery of the casting, an inspection certificate 3.1 in accordance with EN 10204:2005 in English language is to be provided. The test certificates shall bear the following information:

### Purchaser's Reference:

- a) Identification number
- b) Drawing number
- c) Specification number
- d) Purchase Order No.



**Supplier's Reference:**

- a) Name of supplier
- b) Material designation
- c) Melt Number & melting process
- d) Details of heat treatment- heating and cooling rate, actual time and temperature sequence, soaking time, method of cooling /cooling conditions.

**Test Results:**

- a) Melt analysis & check analysis along with tramp elements.
- b) Mechanical test results
- c) Liquid Penetrant test reports
- d) RT test reports
- e) Approved defectogram and Non Destructive Examination reports of repaired areas
- e) Dimensional data sheet about the dimensional inspection.

**10 CLEARANCE FOR DELIVERY:**

The entire results of test performed are deciding factors for the clearance of the delivery. The purchaser shall evaluate the total results with respect to intended operational requirements for the casting and judge accordingly the permissibility of deviations (if any) of the properties of the piece required.

The clearance does not relieve the manufacturer from the responsibility for hidden impermissible defects, which may be found later on.

**11 DEVIATIONS:**

Deviations from this Purchase Specification (if any), which may arise during manufacturing, shall be submitted to the purchaser in writing giving full details of the deviations. Acceptance of concession request will be at the sole discretion of the purchaser

**12 PACKING & DISPATCH:**

Before dispatch, the casting shall be suitably packed to prevent corrosion and damage during transit.

Each casting shall be covered with polythene sheets and waterproof paper and then packed in a sea-worthy export wooden crate. Shipment of castings shall be done after conducting all tests as mentioned above in the presence of purchaser's authorized representative and after all the test reports are scrutinized by the purchaser and accepted.

APPENDIX -I

**PROPERTIES AND TESTS**

The mechanical properties shall be determined in the as-delivered condition on cast-on test keel block samples. The keel block shall have effective dimensions of at least 70X100X250 mm after removal from casting. The keel block shall be attached to casting with the 70mmX250mm face. Any filter between the casting and the test block is not permitted.

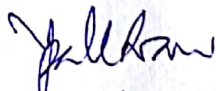
The cast-on test samples must not be cut from the castings until after completion of heat treatment cycle. Flame cutting/cutting between cast-on samples before heat treatment is not permitted. Prior to separation from the casing, these samples must be identified by the authorized inspector with proper marking. Separate heat treatment of the cast-on samples is not permitted.

The specimens for the determination of the mechanical properties shall be taken from the test samples as near as possible to the cutting face.

Supplier shall cast at least 4 test coupons, 2 for internal testing and third party witness testing and 2 samples to be send to BHEL along with the casting.

The mechanical testing shall be performed on two cast-on test coupons. These 2 test coupons shall be diagonally as far apart as possible.

**NOTE: Before start of manufacturing, supplier to submit sample location plan to BHEL for approval**

  
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12.1.18

  
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