

**Document Title: Procedure for Heat Treatment****1.0 SCOPE**

This procedure outlines the process of heat Treatment of all Pipe Fittings and ensure that it complies with stated requirements.

**2.0 POLICY**

**Heat treatment (HT)** can be used at different stages in the manufacturing process to change certain properties of that metal. For example, you might use heat treatment to make it stronger, harder, more durable, or more ductile, depending on what the material needs in order to perform properly. **Heat treatment** is the process of heating metals with the purpose of improving their properties, strengthening the metal.

**Heat Treatment Furnace****3.0 METHOD**

For all Heat Treatments, the following conditions (where applicable) to be ensured (unless based on PO or Contractual requirements),

- Loading and Unloading Temperature(s)  $\leq 300^{\circ}\text{C}$ .
- Rate of heating shall not be more than  $222^{\circ}\text{C}/\text{Hr}$ .
- Rate of cooling shall not be more than  $278^{\circ}\text{C}/\text{Hr}$ .
- During the heating period there shall not be a greater variation in temperature throughout the furnace than  $30^{\circ}\text{C}$ .
- The distance between two thermocouples shall not exceed 15 feet (4.6 meters) interval of length.
- Soaking Time 1hr/inch (but 30 minutes minimum).
- Material Specification to be strictly followed and any specific requirements will supersede this Procedure.
- After Heat Treatment, Charts to be reviewed by QC Engineer and records maintained.
- All HT details are maintained in 'Heat Treatment Register'.
- In case in-House facilities are not sufficient NOR available, then HT may be subcontracted to an Approved Subcontractor.

**HOT FORMED:**

CS fittings manufactured between  $620^{\circ}\text{C}$  and  $980^{\circ}\text{C}$  and cooled in Still Air, need not be Heat Treated. They may be supplied in 'As-Is' condition.

**NORMALIZING:**

CS fittings (Cold formed) are generally supplied in the Normalized condition.

This involves heating to above Upper Transformation Temperature (UTT, generally  $>870^{\circ}\text{C}$ ) and cooling in Still Air. To be carried out as per relevant Material Specification.

**TEMPERING:**

AS or LTCS fittings may be additionally Tempered (after Normalizing) to ensure final properties. To be carried out as per relevant Material Specification.



**SOLUTION ANNEALING:**

SS Fittings are generally supplied in the Solution Annealed condition.

This involves heating till Chromium Carbides go into solution (min 1040°C) and immediate Water Quenching.

To be carried out as per relevant Material Specification.

Ensure Water Bath used for quenching is re-circulated through a 'Cooling Tower' to ensure Water Bath temperature is always controlled. **Water Bath will be tested for pH>6 and Chlorides <50ppm levels (API and BPVC) only once at source.** The Water is generally changed after Two HT Cycles **OR after Three Months (whichever is earlier).**

**STABILIZING:**

SS Stabilized Grades (SS321, SS347) are supplied with Stabilizing Heat Treatment, ONLY if required by PO or Contractual requirements.

To be carried out as per relevant Material Specification.

**CALIBRATION:**

Ensure Thermocouples, Temperature Controllers (within 1% of FSD), Temperature Recorders and HT Furnaces are calibrated.

**MATERIAL PROCESS TRACEABILITY:**

Traceability is maintained with Heat Number only (preferably low stress). This number will be ensured on all technical documents (RM Inspection Records, Production Records, Heat Treatment Records, Lab Test Certificates, Manufacturing Test Certificates, etc)

**SAFETY:**

All required safety precautions shall be ensured (Safety Shoes, Safety Gloves, Safety Goggles, etc). Specific care to be taken since the Temperatures are High, especially during opening of Furnaces. Operators generally wear Thermal Suits with Thermal Shoes.

**4.0 PROCESS VALIDATION**

Material Testing (Chemical, Mechanical [Transverse / Longitudinal], Metallurgical, etc) have resulted in compliances with the Standards.

**5.0 RESPONSIBILITY**

This procedure is the responsibility of the Production Engineer and QC Engineer.

**6.0 REFERENCES**

Reference Standards - ASME Sec VIII Div 1

Material Standards – ASME, ASTM, IS, DIN, EN



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