

157

R.D.S.O



भारत सरकार रेल मन्त्रालय  
GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION FOR FABRICATED  
BOGIE FRAME & BOLSTER ASSEMBLY FOR  
LOCOMOTIVES

Specification No: VL. SPEC - 6

(Revision - 03)

October 2015

---

अनुसंधान अभिकल्प और मानक संगठन  
लखनऊ-226 011  
RESEARCH DESIGNS & STANDARDS ORGANISATION  
LUCKNOW - 226 011

## INDEX

| Para | Description             | Page |
|------|-------------------------|------|
| 1.0  | Scope                   | 1    |
| 2.0  | Definitions             | 1    |
| 3.0  | Deviation(s)            | 1    |
| 4.0  | Quality Assurance Plan  | 1    |
| 5.0  | Manufacturing Procedure | 1    |
| 6.0  | Stages of Inspection    | 5    |
| 7.0  | Quality Control Process | 6    |
| 8.0  | Proof Load Test         | 7    |
| 9.0  | Weight of Bogie Frame   | 7    |
| 10.0 | Identification marks    | 7    |
| 11.0 | Painting                | 7    |
| 12.0 | Packing                 | 7    |
| 13.0 | Field Trial             | 7    |
| 14.0 | Warranty                | 8    |

## LIST OF ANNEXURES

| S.No. | Description                            | Page |
|-------|--|------|
| 1     | Recommended Stress Relieving Procedure | 9    |

## TECHNICAL SPECIFICATION FOR FABRICATED BOGIE FRAME & BOLSTER ASSEMBLY FOR LOCOMOTIVES

### 1.0 SCOPE

- 1.1 This specification covers the technical requirements of fabricated bogie frame and bolsters assemblies (including cast components, if any) for diesel and electric locomotives.
- 1.2 The fabricated bogie frame and bolster assemblies (including cast components, if any) shall be supplied conforming in all respects to the relevant drawings.

### 2.0 DEFINITIONS

Wherever "Inspecting Agency" has been mentioned in this document, it shall be taken as "Authorized Inspecting Agency" mentioned in the purchase order of the Purchaser.

### 3.0 DEVIATION (S)

If deviations from original design, material specifications, dimensions etc. are desired specific proposals with reasons shall be submitted to Motive Power Directorate, RDSO for approval. Commencement of manufacture shall not be done till clear authorization for acceptance of the deviation is given.

### 4.0 QUALITY ASSURANCE PLAN

- 4.1 The firm shall submit Quality Assurance Plan (QAP) as per the standard format to Motive Power Directorate, RDSO for approval. QAP shall cover all aspects of process / quality control requirement to obtain quality product. QAP shall also contain WPSS (Welding Procedure Specification Sheet), WPQR (Welding Process Qualification Record) for each joint, as per IS: 7307 from third party certifying agency. Welder's qualification data sheet (i.e. welder's approval) shall be as per IS 817 / IS 7310 or EN 287-1 (or Latest).
- 4.2 The manufacturer shall proceed for manufacturing of bogie frame and bolster assembly only after approval of QAP. The firm shall follow the stipulations of QAP strictly.

### 5.0 MANUFACTURING PROCEDURE

- 5.1 During manufacture of prototype bogie frame and bolster assemblies, the vendor is required to Co-ordinate and maintain liaison with Motive Power Directorate, RDSO, Lucknow and with the Purchaser for any clarifications required with regard to drawings, specifications, manufacturing and testing etc.
- 5.2 During manufacture any assembly of prototype fabricated bogie frame and bolster assemblies, and changes in the design considered necessary shall be identified by the Purchaser/ RDSO and these changes shall be incorporated on all the bogie frames and bolster assemblies manufactured by the firm.
- 5.3 **Raw Material**
  - 1 The chemical composition & mechanical properties of steel shall be as specified in the drawings for the bogies and bolster assemblies.
  - 2 Steel plates shall be procured along with their test certificates preferably from SAIL or other reputed manufacturers. The test certificates shall be correlated with the stamping on the plates prior to the commencement of fabrication. However, the test certificate and the chemical properties & mechanical properties shall be verified by the firm and inspector, as per the specification.
  - 3 Cast components of bogie frame shall be procured from the vendors approved by RDSO for supply of cast steel bogie for Rolling Stock (Locomotive / Wagon).
  - 4 All test certificates shall be submitted to Inspecting Agency for scrutiny.
  - 5 Any deviation in material specification may lead to rejection of material.

#### 5.4 Inspection of Steel Plates

- 1 All plates to be taken up for manufacture shall be cleaned for freedom from rust and scales and shall then be examined visually for surface defects such as cracks, dents, pitting, bends etc. Only those plates, free from any surface defect as stated, shall be used for manufacture.
- 2 The firm shall check chemical composition and mechanical properties of all plates to be taken up for manufacture to ensure conformity of properties with the test certificates.
- 3 Inspecting Agencies shall draw one or two samples from these plates for verifying chemical composition and mechanical properties. The manufacturer shall provide facilities at his premises to inspecting Agency for evaluation of chemical composition and mechanical properties.
- 4 All plates of thickness 12 mm and above shall be subjected to ultrasonic test on the entire surface for detection of defects like lamination seams and internal flaws. The ultrasonic testing shall be carried out as per ASTM A: 435 / IS: 4225 using angular / normal probes.
- 5 Plates accepted by inspecting agency shall only be used for fabrication. Manufacturer shall submit the cutting plan of plates, clearly indicating the heat no., thickness & item nos. as per relevant drawing.
- 6 All the plates shall be degreased and de-rusted before commencing manufacturing operations.
- 7 All the plates shall be marked properly to achieve the specified dimensions given in the drawing keeping the required allowances for proper welding and margin for machining.
- 8 The cut surfaces of plate to be welded shall meet the requirements of cut quality 33 according to ISO 9013. The free end of the plate edge shall meet the requirements of cut quality 11 according to ISO 9013.
- 9 Steel plates shall only be cold bended by suitable bending machine. Hot bending of steel plates shall not be permitted.
- 10 Normalized steel plates with test certificate shall only be procured for the fabrication of bogie frame.

#### 5.5 Inspection of Cast components of Bogie Frame

- 1 For metallurgical requirements of qualification of bogie frame cast components shall be as per ETI 827.
- 2 For dimensional inspection, relevant drawing / dimensional control chart of the cast component shall be referred.

#### 5.6 Welding Procedure

##### 5.6.1 Filler Metal

- 1 MIG / MAG process using Argon / CO<sub>2</sub> gas (at least 80% Argon) as shielding media and RDSO approved brand of filler wire to IRS: M46 (with relevant class as per parent material specification) shall be adopted for welding of bogie frame and bolster assemblies including brackets.)
- 2 Manual Metal Arc (MMA) welding may be permitted for welding of some brackets only after obtaining approval from the RDSO.
- 3 In brackets where MIG / MAG welding is not possible, MMA welding process shall be used with RDSO approved brand of electrodes to IRS: M28.
- 4 In reference to Para 5.6.1.1 & 5.6.1.3, latest RDSO approved brands of welding consumables shall only be used. The firm needs to take approval from the inspecting agency for use of welding consumables prior to commencement of manufacture of bogie frame and bolster assembly.

##### 5.6.2 Run on and Run off tabs

Run-on and Run-off tabs (a bevelled fillet joint of about 150 to 200 mm long made out of the same plate and thickness) shall be attached with side beams at at-least two corners of each side beam & one no butt joint of each transom by tack welding. During welding, these tabs are also to be welded as a continuous welding. These tabs are to be inspected as per Para 5.9.5.

## 5.7 Welders Qualification

Welder employed for welding of bogie frame and bolster assemblies shall have a high standard of workmanship and shall be qualified to IS 817 & IS 7310 or EN 287-1 (or Latest). Approval of Inspecting Agency to specific welder(s) to be engaged for this fabrication job shall be needed prior to commencement of welding work.

## 5.8 Quality of Weld Joints

- .1 Welding quality systems shall be in accordance with ISO 3834 - 2 or equivalent.
- .2 Before welding, material shall be shot blasted clean and free of slag and mill scale. After shot blasting weldable primer should be applied.
- .3 Weld joints shall have uniform beading and smooth change over from weld deposit to parent metal and thorough fusion between adjacent layers of weld metal and between weld metal and parent metal.
- .4 Weld joints shall be free from cracks, craters, undercuts, overlaps, porosity, inclusions, blow-holes etc.
- .5 Needle peening of the weldment shall be done at the locations, specified in the relevant drawings, as per EMD's EAI - 2525. It will improve surface condition, reduce notch factors of weldment and relieve the residual tensile stress accumulated during manufacturing. It also improves fatigue life of the bogie frame by inducing compressive stress.
- .6 In butt welded area, one extra run of welding shall be applied; excess metal shall then be ground off to eliminate stress raisers and normalize the welded metal.
- .7 The fillet weld profile shall be made concave by grinding so that smooth transition occurs at the toe of weld maintaining correct size of the welds. Welds shall be ground to eliminate stress raisers and to improve fatigue life.
- .8 Adequate measures shall be taken by the manufacturer to avoid distortion during welding. Minor distortion, if any, shall be corrected in the cold condition (by mechanical method).
- .9 Any linear discontinuity shall be unacceptable and shall be repaired by chipping or grinding and subsequent welding. After rectification of defects in welding, the area shall be re-examined by the same method to ensure defect free weld joint.

## 5.9 Inspection of Weld Quality

The quality of entire weld length shall be checked by Dye Penetrant test by the Inspecting Agency. However, weld quality of critical areas as shown in the drawing for various bogie frames / bolster assemblies shall be checked by magnetic particle test. Quality of welding of butt joints shall be checked by radiographic / ultrasonic test as indicated in the diagram. The personnel / testing agency doing the non-destructive testing shall be qualified in accordance to Minimum Level - II of Indian Society of Non-destructive (INST) or American Society of Non destructive Testing (ASNT). Details of tests and their acceptance standards are given below:

### .1 Dye Penetrant Test

Dye Penetrant test shall be conducted to ensure absence of cracks and surface defects. The procedure and acceptance standard shall be as per IS: 3658.

### .2 Radiographic / Ultrasonic Testing

Butt weld joints shall be subjected to Radiographic tests. Butt weld joints not accessible to radiography shall be checked by Ultrasonic testing. The manufacturer shall submit method of test of all butt joints to Inspecting Agency indicating acceptance test for each joint. Proper record of Radiographic / Ultrasonic testing shall be maintained. Acceptance standard shall be as per Blue Standard of IIW or Grade-II of ASTM E1955-04 for Radiography and M&C/RDSO's Procedure No. MC- 4 for Ultrasonic Testing.

### 3 Magnetic Particle Test (MPT)

1 All weld joints on critical areas as indicated in relevant drawings for various bogie frames / bolster assemblies shall be checked by Magnetic Particle Test. These areas shall be cleaned and made smooth by grinding before checking of weld quality by magnetic particle test. The areas then shall be checked by loop / yoke method for weld flaws. The procedure and acceptance standard shall be as per IS: 5334.

#### 2 Evaluation for MPT

Each discontinuity and defect indicated by retention of magnetic particles shall be explored to determine if linear discontinuities are present or defect is due to excessive surface roughness, heat affected zones etc. If the indication is suspected due to excessive surface roughness, heat affected zones etc., it shall be confirmed by re-checking the area by MPT after making the area smooth by grinding.

### 4 Rectification of Weld Defects

1 Any linear discontinuity is un-acceptable and shall be removed and repaired by chipping / grinding and subsequent welding and the area re-examined by the same method to verify complete rectification of observed defect.

2 Rectifications to the extent of 15% (Max.) shall be allowable for complete welded length of Fabricated Bogie Frame.

3 Further rectifications shall not be allowed if linear discontinuity is observed again during checking after rectification.

4 All test reports of Magnetic particle inspection shall be submitted to Inspecting Agency for review.

### 5 Inspection of Run-on and Run-off tabs

Any two randomly selected run-on and run-off tabs welded with side beams shall detached after welding in presence of Inspecting Authority and subjected to magnetic particle test to assess the quality of welding of side beams. These tabs shall be free from any weld defect like lack of root fusion, slag inclusion, porosity etc.

#### 1 Evaluation for Run-on and Run-off tabs:

In case any one of the welds fails to meet the requirement of a good fillet joint, the whole fillet welding of the BOX section of RH and LH beams shall be subjected to ultrasonic test as per ASTM E-164.

### 5.10 Stress Relieving

1 All rework including rectification welding and straightening operations shall be completed before stress relieving.

2 After completion of welding, the bogie frame & bolster assembly shall be subjected to stress relieving as per procedure given in Annexure-1. The stress relieving shall be carried out in gas fired / electric furnace equipped with thermocouples and automatic graphical recorders. Adequate measures shall be taken to avoid distortion of bogie frame & bolster assembly during stress relieving.

3 Record of stress relieving cycle shall be submitted to the Inspecting Agency

### 5.11 Shot Blasting

After stress relieving, the entire bogie frame / bolster assembly shall be subjected to shot blasting to achieve surface preparation to grade Sa 2½ of ISO -8501-1 for cleaning of rust, scales, spatters etc before painting of the bogie frame.

B-2-1/2

**5.12 Check for Distortion and Cracks in Welding**

- .1 After cleaning of bogie frame and bolster assembly by shot blasting, the critical areas of bogie frame and bolster assembly shall be checked for presence of cracks in welding by Dye Penetrant Test / Magnetic Particle Test.
- .2 The bogie frame shall also be checked for distortion, if any by tramming check of bogie frame.

**5.13 Anti Corrosive Paint**

Immediately, after shot blasting and crack detection & acceptance of the bogie frame and bolster assembly, the same shall be painted with one coat of 25 micron DFT red oxide zinc chromate primer conforming to IS: 2074. The paint shall be of procured from the RDSO approved firms.

**5.14 Marking of Bogie Frame and Bolster Assembly**

The bogie frame and bolster assembly shall be placed on surface table in order to check:

- .1 Profile and Geometry,
- .2 Absence of distortion
- .3 Machining allowances

Record of above checks shall be made in the Dimension Control Charts approved by the Inspecting Agency.

**5.15 Machining of Bogie Frame and Bolster Assembly**

The bogie frame and bolster assemblies shall be machined at all required locations in single setting in horizontal / vertical position to achieve the dimension tolerances and the surface roughness as per drawing.

Single setting means that a particular reference is taken by probe and machining of that side is completed according to that reference taken and the program fed without any change in bogie frame position. After completing the machining of one side, rest machining of reverse side of the bogie frame should be completed again according to the reference taken.

- 5.16 Bushing rubber / Bushing traction rod / Manganese and steel liners/ brake rigging bushes / pivot liners / pivot casting etc. shall be procured from RDSO / DLW / CLW / DMW approved sources, as applicable.

**6.0 STAGES OF INSPECTION**

**6.1 Prototype inspection shall be done in the following stages:**

- .1 Inspection of raw material, approval of welders, welding consumables etc. by M&C directorate.
- .2 Inspection of sub-assemblies like side frames, transoms, end beams (one side open to check the internal stiffeners), horns (wherever provided) in tack welded condition to check dimensional accuracy by Motive Power Directorate. Sample inspection of plates for edge preparation in tack welded condition may also be done.
- .3 Inspection of bogie frame / bolster assembly of side frames, transoms and end beams after complete welding and brackets in tack welded condition on bogie frame / bolster.

Dimensional inspection shall be carried by Motive Power Directorate.

- .4 Inspection of complete bogie frame / bolster assemblies after stress relieving and shot blasting but before applying anti corrosive paint to check the weld quality by M&C Directorate.
- .5 Inspection of complete bogie frame after machining and for proof load test.

Dimensional inspection shall be carried by Motive Power Directorate. Check for cracks in weld joints after proof load test, by M&C Directorate.

- .6 Inspection of all the balance activities i.e. fitment of bushes, liners, painting, identification plate fitment etc. before issue of Dispatch Memo by Motive Power Directorate.

**Note:** 1. There may be some brackets whose accessibility for machining may not be feasible if they are welded to the bogie frame. In such circumstances, the inspecting agency may permit for fitment of these brackets in machined condition in the bogie frame after stress relieving.

6.2 The prototype inspection shall be done strictly at different stages as mentioned in 6.1 (6 stages). For subsequent inspections also, the inspection will normally be done in 6 stages, as mentioned above. But if the inspecting agency so decides, subsequent regular inspection may be done in 3 stages, as mentioned below:

1. Inspections of raw material, approval of welders, welding consumables, inspection of bogie frame plates and bolster plates for edge preparation, sub-assemblies like side frames, transoms, end beams (one side open to check the internal stiffeners) and individual brackets in tack welded condition to check dimensional accuracy.
2. Inspection of complete bogie frame after machining for dimensional accuracy and to check the weld quality and stress relieving. The bogie frame subjected to proof load test shall also be checked for weld quality after proof load test.
3. Inspection of all the balance activities i.e. fitment of bushes, liners, painting, identification plate fitment etc. before issue of Dispatch Memo.

In case inspection is done at 3 stages, the following shall be followed.

- a) The manufacturer shall fabricate the bogie frame and bolster assembly in line with Para 6.1 & dimension control charts shall be prepared for each stage inspection during manufacturing of bogie frame and bolster assembly in which measurements of critical dimensions shall be recorded and kept for evaluation and verification by the Inspecting Agency.
  - b) If any safety items (as per RDSO vendor list) have been fitted on bogie frame/bolster, their inspection certificate issued by inspecting authority shall be submitted to Inspecting Agency for scrutiny.
3. Inspection of prototypes shall be carried out by RDSO (MP) with assistance of QA (Mech.) M&C representative.
4. Inspection of bogie frames and bolster assemblies other than prototypes shall be carried out by the Inspecting Agency specified in the purchase order.
5. Prototype inspection and testing of two bogies shall be required to be carried out for each type of bogie for a new manufacturer. After prototype approval, subsequent manufacture shall be done.

## 7.0 QUALITY CONTROL PROCESS

### 7.1 Dimensions and tolerances

1. All dimensions / tolerances shall be as per details given in the drawings.
2. Detailed dimensional control charts shall be prepared for stage inspection during manufacturing of bogie frame and bolster assembly in which measurements of critical dimensions shall be recorded and kept for evaluation and verification by the Inspecting Agency
3. All non-tolerance dimensions shall be maintained in accordance with IS: 2102 (Medium) or as indicated in the drawing.
4. Gauges, fixtures, templates and accurate measuring instruments shall be used to ensure the correctness of the dimensions.
5. The manufacturer shall start each stage of manufacturing of bogie frame / bolster assembly only after receipt of clearance of previous stage by the Inspecting Agency.

### 7.2 Periodic Calibration of Gauges and Fixtures

Gauges, fixtures, and templates shall be calibrated / checked for correctness and accuracy periodically.



## 8.0 PROOF LOAD TEST

- 1 Two bogie frames and bolster assemblies out of a lot of 25 bogie frames and bolster assemblies or two bogie frames and bolster assemblies per order if the order is for less than 25 bogie frames and bolster assemblies shall be subjected to proof load test as shown in relevant drawing or as specified by the purchaser to check manufacturing quality. The following procedure shall be adopted for proof load test of bogie frame / bolster assemblies:
  - The bogie frame / bolster assembly shall be kept on tables as per the arrangement shown in relevant drawing.
  - Dial gauges/ strain gauges shall be mounted at the locations on the transoms and side frames as shown in the specified drawing and shall be set at zero before proof load test.
  - The bogie frame / bolster assembly shall be loaded as per the loads given in the specified drawings and the load shall be sustained for a minimum period of 10 minutes.
  - Deflection of transoms and side frames shall be recorded under loaded condition.
  - Load shall be removed gradually and reading of the dial gauge/strain gauge shall be recorded.
- 2 There shall not be any sign of deformation, permanent set and any cracks. The detection of cracks shall be checked by Ultrasonic and Magnetic Particle / Dye-Penetrant test on critical areas as shown in the drawing.

## 9.0 WEIGHT OF BOGIE FRAME

Weight of bare bogie frame shall be furnished by the manufacturer and the same shall be checked at the time of prototype inspection.

## 10.0 IDENTIFICATION MARKS

Each bogie frame/bolster shall be provided with an identification plate at an easily visible location. The identification plate shall contain:

- a) Manufacturer's Monogram
- b) Contract No/ P.O. No.
- c) Bogie Serial No / Bolster Serial No
- d) Month & Year of Manufacture

## 11.0 PAINTING

Bogie frame and bolster assemblies shall be given a finish coat of 25-micron DFT synthetic enamel to IS: 8662. The paint shall be procured from RDSO approved firms.

## 12.0 PACKING

- 1 Rust preventive coatings shall be applied on all machined surfaces before packing.
- 2 While packing due care shall be taken to protect all machined surfaces against any damage during transit.
- 3 Bogie frames / bolster assemblies shall be packed in pairs, keeping horn legs in opposite directions (where applicable) with wooden planks using suitable fasteners.
- 4 All data packages including Dimensional Control charts, Test certificate for chemical and mechanical properties, radiography / UST, MPT, DPT and heat treatment records etc. shall be supplied along-with bogie frames / bolster assembly and the same shall be the property of Purchaser.

## 13.0 FIELD TRIAL

Prototype bogies after successfully passing the prototype tests shall be put under field trial for at least one year. Qualifying quantity and Qualifying period for Part- II and Part-I approval for any supplier shall be as per Motive Power Directorate's ISO Document 'Master List of Qualifying Quantity for Part I approval and

Qualifying Quantity & Qualifying Periods for Part II Approval of items controlled by MP Directorate'. Based upon successful field trial performance, Part- II approval of any supplier shall be considered.

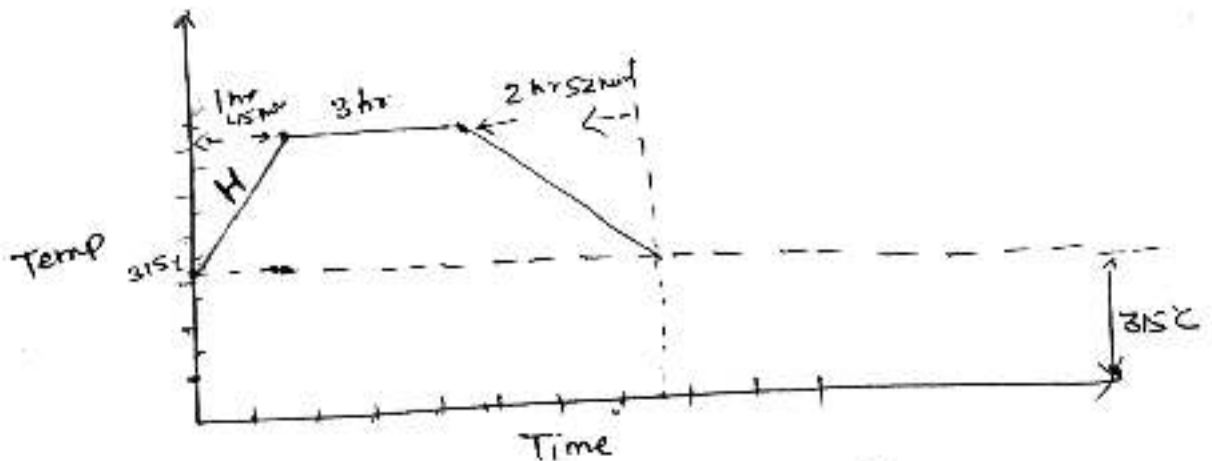
#### **14.0 WARRANTY**

The manufacturer shall undertake warranty for trouble - free and satisfactory service performance on bogie frame and bolster assemblies supplied by them for a period to be fixed by the purchaser from the date of commissioning into service. The recommended period is 5 years from the date of commissioning into service. Any repairs / rectification required due to defects observed during service on these bogie frames / bolster assemblies on account of metallurgical and / or manufacturing deficiency of raw material, manufacture and workmanship shall be carried out by the supplier at his own cost. The firm shall arrange replacement of bogie frame / bolster assemblies if the bogie frame / bolster assembly is considered unserviceable due to defects observed during warranty period on account of metallurgical and / or manufacturing deficiency of raw material, manufacture and workmanship. The decision of purchaser in this regard shall be final.

\*\*\*\*\*

**RECOMMENDED STRESS RELIEVING PROCEDURE**

1. To monitor the temperature effectively, four thermocouples shall be at the four corners of bogie frame / bolster assembly and two thermocouples at the centre of the long beams shall be provided on the furnace. The thermocouples shall be connected with associated recording equipment.
2. To avoid distortion during stress relieving operation, suitable tie-bars shall be provided.
3. The bogie assembly shall be kept in the furnace, bottom side up (inverted position).
4. The assembly shall be suitably supported while loading in furnace to avoid any permanent deformation.
5. The temperature of the furnace shall not exceed 315° C at the initial stage when the bogie frame / bolster assembly is kept in furnace.
6. Above 315° C, the rate of heating shall not exceed 160° C/hour. During the heating period, variation in temperature throughout the portion of the part being heated shall not be greater than 50° C.
7. Soaking temperature shall be between 600°C and 650°C. On reaching soaking temperature, the assembly shall be held within specified limits for a time not less than one hour per 25 mm thickness of plates.
8. For determining soaking time, the thickness of thickest part of assembly shall also be considered. During the soaking period, difference between highest and lowest temperature at different points of the assembly shall not be greater than 50°C.
9. The job shall then be allowed to cool down to 315°C in closed furnace at a rate not exceeding 100 °C/hour. Below 315°C, the assembly may be cooled in still air.



$$\frac{600}{315} \\ \frac{285}{285}$$

$$160 \text{ --- } 1 \text{ hr} \\ 285 \text{ ---} \\ \frac{285}{100}$$

$$\begin{matrix} 106 \text{ --- Heat} \\ 180 \text{ --- Soak} \\ \hline 286 \text{ --- Cools} \\ \hline 171 \\ \hline 457 \end{matrix}$$