directing such alteration, modification, substitution, addition, omission or change shall have been given by the CE/CN/BNC, prior to the commencement of the work or part of work nor shall the contractor be entitled to any payment for or in respect of any sub alteration, modification, substitution, addition, omission or change may have been actually made and executed and no course of conduct shall be taken to be a waiver of the obligation and conditions hereby imposed.

# ADDITIONAL SPECIAL TECHNICAL CONDITIONS FOR FABRICATION OF WELDED STEEL GIRDERS

#### **Fabrication Process:**

- 1) The contractor shall make his own arrangement at his cost for the full scale templating on high level steel/concrete platform under covered shed and making of steel template hereafter referred as masters of each and every component type. The Railway will supply no steel in this connection. The templates used throughout the work shall be of steel and will be used for making jigs and subsequent checking and repairs to jigs only. Work of fabrication shall be done as per IRS specification No. B-1 2001 and IRS welded Bridge Code 2001.
- 2) In the case of any conflict between conditions described hereunder and various specifications to be followed as mentioned in the contract document at various places these conditions shall prevail over all conditions mentioned elsewhere.

Work of fabrication shall be done as per IRS Welded Bridge Code -2001 which is enclosed.

Electrodes shall conform to IRS Specification No. M-28. The filler wire and flux combination of submerged are welding shall conform to IRS Specification No. M-39.

Before starting, the work contractor shall submit detailed welding procedure sheet. The welding procedure sheet shall include specifications of the parent metal and electrodes and /or wire flux combination Voltage/Amperage, wire feed speed, travel speed etc.

Location, sizes, actual lengths and details i.e. from joint, angle between fusion faces, gap between parts etc. of welds.

Welding procedure like welding /sequence, pre-heating, post-heating etc.

Ability of the operator / welders employed by the contractor to produce welds of the required strength.

The above procedure shall be approved by the Railway/RDSO before commencement of the work.

The tolerances in manufacture of the girders shall be as per special fabrication tolerances as applicable to welded girders as laid down in IRS Specification No. B-1/2001.

#### **WELDING PROCEDURE:**

1) Provision of IS-823-1964 and IS-4353-1967, shall generally be followed, as applicable, for welding procedure, details of workmanship, correction of weld faults, peeling, painting, etc. In case, any of the provisions contained therein contravene the

provisions made in Railway Welded Bridge Code, the latter shall be followed.

2) No welding work shall be given to a contractor who does not produce satisfactory evidence of his ability to handle the work in a competent manner. The contractor shall also prove the ability of the Operator/Welders employed by him to produce welds of the required strength. The contractor shall employ a competent welding Supervisor to ensure that quality of materials and the standard of workmanship comply with the requirements laid down in the IRS welded bridge code.

3) The sizes and length of welds shall be not less than those specified in the drawings, nor shall they be substantially in excess of the requirements without prior approval of the Engineer. The location of welds shall not be changed without prior approval of

the Engineer. Welds shall preferably be made in flat position.

4) The preparation of fusion faces, angle of preparation, root radius and root face shall be as specified in IS:823-1964, and IS:4353-1967. Where the gap between the root faces of a butt joint is excessive, the gap shall not be bridged since this procedure often leads to cracking. The fusion faces of the joint shall be build-up with weld metal to give the appropriate gap before the weld proper is commenced.

5) Splices in each component part of a solid web girder or built up member shall be made before such component part is welded to other component part of the member. Splicing shall be done at approved location only for making up section of larger

length.

6) In making welds under conditions of severe external shrinkage restraint, the welding

shall be carried out with electrodes having Type 6 covering.

7) In case of welding using direct current, earthling on the work piece to be welded shall be connected carefully at more than one location with a view to avoid "Arc Blow" during welding.

8) The sequence of welding shall be such as to minimize distortion/deformation. Whenever possible the members which offer the greatest resistance to compression

are welded first.

9) All slag shall be removed from each run before another run is super-imposed and from the final run. When cold, the final run shall be protected with clean boiled linseed oil and shall not be painted until approved by the Inspector.

10) Adequate means of identification, either by identification stamp or other records, shall be provided to enable each weld to be traced to the welding operator by whom it was

11) During the entire welding and cooling cycle, the joints shall not be subjected to any external forces or shocks.

## SUB-MERGED ARC WELDING:

1) All possible components shall be welded by sub-merged arc welding as instructed by RDSO. Neither the depth of fusion nor the maximum width in the cross section of weld metal deposited in each weld pass shall exceed the width of the face of the weld

2) All butt welds by the submerged arc process shall be made in the flat position. Fillet welds may be made in either flat or horizontal vertical position. The size of the single pass fillet welds made in the horizontal-vertical position shall not exceed 8 mm.

3) In addition to the provisions of IS:4353-1967, the Inspector may, where deemed necessary, require a sample joint having the same cross-section as the joint to be used in construction and a length of at least 300 mm to be welded with the wire, flux, current, arc voltage and speed of travel that are proposed to be used and a macro etched cross section of the welded joint prepared as a demonstration that the specified requirements will be met. When the welding current, arc voltage and speed of travel are established by a test made in accordance with requirements of this clause, they shall be kept within the following limits of variations:

Welding current

± 10 %

Arc voltage

+7%

Speed of travel

± 15 %

Submerged Arc welding machine for heavy duty bridge girders as per IS: 4353-1967.

## **Operator's Qualifications:**

1) The welders/ operators employed for mechanized welding/ SAW should be trained in accordance with IS-817- 1966. The welders shall be subjected to appropriate qualifying test specified in IS: 1181-1967 as per the format of Annexure B-10.

## Edge preparation and set-up of parts:

- Edge preparation shall conform to the relevant drawings and meet the requirement of Welding bridge code with milling machine. Normally all edges to be welded will be mechanically planed before members being subjected to welding.
- After the parts are assembled in position for welding, the inspector shall check for incorrect root gap, improper edge preparation and other features that might affect the quality of welded joint.

## **INSPECTION AND TESTING OF WELDED JOINTS**:

- 1) Inspection of the welded bridge girders shall be entrusted to RDSO/ Railway Engineer. As per Railway steel Bridge code/manual/Consultant approved by Railway.
- 2) The Inspector designated by the purchaser shall ascertain that fabrication by welding is performed in accordance with the requirement of welded Bridge Code.
- 3) Contractor shall notify in advance of the start of any welding operation.
- 4) Contractor shall provide free access to the work being done at all reasonable time and facilities shall be provided to the inspecting authority so that during the course of welding, he may be able to inspect any layer of weld metal. The inspecting authority shall be at liberty to reject any material that does not conform to the provision of welded Bridge code and to require any defective welds to be removed and re-welded.

## **Marking of Defective Welds:**

- The marking shall be positive and clear and in accordance with the method of marking followed and understood by the Inspectors and shop personnel involved in making the repairs.
- 2) Marking shall be permanent enough to be evident until the repair has been done and inspection completed.
- 3) After the repair has been made, it shall be inspected and properly marked to indicate whether the repair is satisfactory.

## **Extension pieces:**

 In fusion welds such extension pieces are to be welded which will serve the additional functions of running in/out pieces to ensure the soundness of full length of the weld. Extension pieces will be of the same composition and with same weld preparation as the parent material of the main weld.

## Radiographic Test:

1) All Butt welds shall be examined by appropriate Radiographic or any other equally effective method as specified in the drawing or procedure sheet.

## **Dye Penetration Test:**

1) Other weld may be examined by Radiographic or any other non-destructive method like dye penetration test, Magnaflux and / or any other method at the discretion of the Inspecting Authority.

## **Welding Parameters:**

1) Contractor has to keep a record of welding parameters piece wise, component wise and span wise.

#### INSPECTION AND PROGRESS REPORT

- The raw material and fabrication work shall be inspected by RDSO or Railway through their authorized Railway Engineer for which free accommodation and inspecting facilities will have to be provided by the contractor. The work of fabrication in contractor's fabrication shop will at all times be open for inspection by the Railway or their authorized agents. Before dispatch of fabricated steelwork from the shop, they will be inspected in the contractor's workshop by the Railway or their agent who will thereafter issue inspection certificates. The tests will be carried out at contractor's cost. All facilities as required for carrying out the inspection will be provided free of cost by the contractor including those requiring the services of outside agencies & all measuring tools, gauges, template etc. A well built hand railed stair case is required to be provided at any time.
- Any defects noticed during inspection in the execution of the work shall be rectified or replaced by the contractors at their own cost. The decision of the Railways or its inspecting agency as to the existence of defect, the manner in which the defective work to be rectified or replaced shall be final, conclusive and binding on the contractors. No extra claim, whatsoever, shall be entertained for the cost of such rectification or replacement.
- The progress of fabrication of steelwork as well as execution of all works shall be subject to periodic review by the Railway Administration.
- The contractors shall provide all facilities to the Railway's representative to make periodical detailed assessment of the progress of the works. Such information and progress reports as may be called for by the Railway and at such intervals as specified shall also be made available.

## SURFACE TREATMENT FOR BRIDGE GIRDERS (RIVETED/WELDED)

#### General

- No component to be given any surface treatment without component being passed and embossed by Railway's Authorised Inspecting Agency.
- Surface cleaning, for components not to be metallised, will be done by using
  mechanised wire brush and / or shot blasting and the application of the paint can be
  done either manually with brushes or by mechanical means to the satisfaction of the
  Engineer. No painting work will be permitted during the monsoon period from June to
  September.

# Specification for metallising with sprayed Aluminium on bridge girders

## **SURFACE PREPARATION:**

The surface shall be thoroughly cleaned and roughened by compressed air blasting or centrifugal blasting with a suitable abrasive material (steel grits) in accordance with clause 3 of IS-6586. Immediately, before spraying it shall be free from grease, scale, rust moisture or other foreign matter. It shall be comparable in roughness with a reference surface produced in accordance with Appendix-A of IS: 5905 to Sa 2-1/2 and shall provide an adequate key for the subsequent sprayed metal coating.

## METAL SPRAYING.

The metal spraying shall be carried out as soon as possible after surface preparation but in any case within such period that the surface is still completely clean, dry and without visible oxidation. If deterioration in the surface to be coated is observed, by comparison with a freshly prepared metal surface of similar quality which has undergone the same preparation, the preparation treatment should be repeated on the surface to be coated.

The wire method shall be used for the purpose of metallising, the diameter of the wire being 3mm or 5mm. Specified thickness of coating shall be applied in multiple layers and in no case less than 2 passes of the metal spraying unit shall be made over every part of the surface. At least one layer of the coating must be applied within 4 hours of blasting and the surface must be completely coated to the specified thickness within 8 hours of blasting.

- (a) **PURITY OF ALUMINIUM**: The aluminium to be used for spraying shall be 99.5% aluminium conforming to IS:2590.
- (b) <u>APPEARANCE OF THE COATING</u>: The surface of the sprayed coating shall be of uniform texture and free from lumps, coarse areas and loosely adherent particles.
- (c) THICKNESS OF THE COATING: The nominal thickness of the coating shall be 150 microns.

The minimum local thickness shall not be less than 110 microns at isolated location.

## **SHOP PAINTING**

Any oil, grease or other contamination should be removed by thorough washing with a suitable thinner until no visible traces exist and the surfaces should be allowed to dry thoroughly before application of paint. The coatings may be applied by brush or spray. If sprayed, pressure type spray guns must be used. One coat of wash primer to IS: 5666-1970 shall be applied first. After 4 to 6 hours of the application of the wash primer, one coat of Zinc chromate primer to IS:104-1979 with the additional provision, that zinc chromate to be used in the manufacture of primer shall conform to type 2 of IS: 51-1998 shall be applied. After hard drying of zinc chrome primer, one coat of aluminium paint to IS: 2339-1963 (Brushing or spraying as required) shall be applied.

## **SITE PAINTING**

After the steel work is erected at site a second covering coat of aluminium paint to IS: 2339-1963 (Brushing or spraying as required) shall be applied after touching up the primer and the cover coat given in the shop if damaged in transit.

### **ELCOMETER:**

Minimum two digital Elcometer will have to be provided by the contractor at his own cost for determination of metalising / painting thickness and on completion of the work, the same will be handed over to Railway without any cost. One of the digital Elcometer will have measuring range of  $0-100\,$  micron & other will have a measuring range of 50-250 micron.

## ADHESION:

The sprayed metal coating shall be subject to an adhesion test using the following method:-

"Using a straight edge and hardened steel scriber which has been ground to a sharp 30 degree point, scribe two paralleled lines at a distance apart equal to approximately 10 times the average coating thickness. In scribing the two lines, apply enough pressure on each occasion to cut through the coating to the vase metal in a single stroke."

If any part of the coating between the lines breaks away from the base metal, it shall be deemed to have failed the test.

Components, which have been rejected, shall have the defective sections blasted clean of all sprayed metal prior to re-spraying sections blasted clean of all sprayed metal prior to re-spraying. Where the rejection has been solely due to too thin a coating, sprayed metal of the same quality may be added if the surface has been kept dry and is free from visible contamination.

## TRANSPORTATION OF GIRDERS & GIRDER COMPONENTS:

No components is to be transported to site without being rendered surface treatment as described above.

The contractor has to transport with loading/unloading and stacking all the fabricated material including loose fittings with his own truck/trailer, tools, plants & machinery and labour etc. at his own cost.

Contractor will have to make his own arrangement at his own cost for

motorable approach road.

The contractor has to arrange wooden  $\operatorname{Gutaka}$  /  $\operatorname{Sleepers}$  to keep the

material at least 12" above the ground level.

The contractor has to take all precautions during transportation/loading/ unloading/ stacking to avoid damage to fabricated material. If any damage to any of the members is caused, the particular components will be rejected by the Engineer-In-Charge at site or his representative. Any material found damaged during transit and/or unloading will be stacked separately & damaged portion shall be marked by white paint. Contractor will have to organize rectification/replacement of all such defective component at his own cost to the entire satisfaction of the Engineer or his Authorised Representative.

All trucks/trailers are to be loaded in such capacity as to ensure safe transport of fabricated materials.