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5130.2 DESCRIPTION

5130.2.1 The work shall consist of the supply, fabrication and delivery of all the structural steel bridge components identified in the contract. When required, galvanizing shall be included as part of the fabrication.

5130.2.2 Fabrication and delivery shall be completed according to the schedule identified in the contract special provisions.

5130.3 QUALIFICATIONS

5130.3.1 Structural steel shall be supplied and fabricated by a fabricator certified by the Canadian Welding Bureau (CWB) in accordance with CSA W47.1 as follows:

5130.3.1.1 Steel Girders, trusses, diaphragms, bracing, splice plates, stiffeners, connector plates, abutment and pier caps, and associated materials shall be Division 1.

5130.3.1.2 All other bridge components shall be Division 2.

5130.3.1.3 Field welding/repairs shall be Division 1 for steel girders, trusses, diaphragms, bracing, splice plates, stiffeners, connector plates, abutment and pier caps and associated materials. All other bridge components shall be division be Division 2.

5130.3.2 Fabricators shall also be certified by the Canadian Institute of Steel Construction (CISC) in the category of complex steel bridges.

5130.3.3 Welders, welding operators and tackers shall be CWB approved in the applicable category. Their qualifications shall be current and available for examination by the Engineer upon request.

5130.3.4 The Fabricator or their subcontractor completing metalizing shall be certified by The Society for Protective Coatings (SSPC) to QP-6, Thermal Spray (Metallizing) Contractor Certification Program or ISO9001.

5130.4 ENGINEERING DATA

5130.4.1 **Welding Procedures**

5130.4.1.1 Welding procedures, including welding procedure datasheets shall be prepared for each type of weld used in the structure. The

procedures shall be accepted by the CWB and shall also be submitted to the Engineer a minimum of two weeks prior to commencement of fabrication.

5130.4.2 **Fabrication Drawings**

5130.4.2.1 The Fabricator shall provide detailed fabrication and erection identification drawings for all components to be supplied under this contract. The fabrication drawings shall be legible and of adequate quality to be reproduced.

5130.4.2.2 Fabrication drawings shall be submitted for review to the Engineer and suggestions for any revisions will be returned to the Fabricator. The review of the drawings by the Engineer is for the Fabricator's assistance and is not to be construed as relieving the Fabricator of responsibility for errors, omissions and accurate fabrication according to these drawings.

5130.4.2.3 The Fabricator shall provide the Ministry with a copy of the final fabrication and erection identification drawings. Fabrication shall not proceed until the Engineer is in possession of a set of the final drawings.

5130.4.2.4 The location of welded web or flange splices in addition to those identified on the plans shall be approved by the Engineer. The Fabricator shall be responsible for the cost of any inspection associated with these splices.

5130.4.2.5 In addition to specific details, the fabrication drawings shall include as a minimum, the following:

- All dimensions shall be correct at 0° Celsius unless otherwise noted;
- Weld procedure identification shall be shown on the fabrication drawings in the tail of the weld symbols;
- All material splice locations shall be shown on the drawings;
- Bearings shall be centered at 0° Celsius;

- Fabrication drawings shall indicate camber and splice joint offsets; and

- The Ministry's bridge file number and project name shall be shown on all the fabrication drawings.

5130.4.3 **Fabrication Sequence and Schedule**

5130.4.3.1 At the time the fabrication drawings are submitted, the Fabricator shall also provide an outline of the proposed fabrication sequence and identify the proposed welding procedures. The fabrication sequence outline shall describe the order of make-up and assembly of all component parts of the bridge girders. The welding procedure list shall identify by number the welding procedures to be used for all welded joints incorporated within the work, and shall also identify the source of qualification for the procedure.

5130.4.3.2 The Fabricator shall prepare and keep current a complete fabrication schedule for the work. The Ministry and its Inspector shall be provided with the proposed schedule prior to commencement of fabrication, and shall be advised of any revisions to the schedule as they occur.

5130.5 MATERIALS

5130.5.1 **Structural Steel**

5130.5.1.1 Steel plate required for the girders shall conform to the requirements of CSA Standard G40.21, Grade 350AT steel, Category 3.

5130.5.1.2 Plates provided from coils shall not be used.

5130.5.1.3 Rolled structural steel sections shall be fabricated with steel conforming to the requirements of CSA Standard G40.21, Grade 350A.

5130.5.1.4 Steel referred to on the plans as 300W shall conform to the requirements of CSA Standard G40.21, Grade 300W.

5130.5.1.5 Mill test reports and product data sheets shall be provided in English for all structural steel materials and welding consumables a

minimum of two weeks prior to commencement of fabrication. Mill certificate data, including the results of the impact tests, for the 350AT and 350A steels shall be reviewed by the Ministry or its Inspector before the steel is incorporated into the work.

5130.5.1.6 In addition to CSA Standard G40.21, the boron content shall be limited to 0.0008%. The boron content of the structural steel to be welded shall be included with mill test reports.

5130.5.2 **High Strength Bolts**

5130.5.2.1 High strength bolts, nuts and washers shall conform to the requirements of ASTM F3125/F3125M Grade A325/A325M heavy hex style Type 3. Nuts shall be heavy hex style and shall conform to ASTM A563/A563M. Hardened washers shall conform to ASTM F436/F436M.

5130.5.2.2 Rotational capacity testing and reporting shall be performed in accordance with ASTM F3125/F3125M for each assembly lot of bolts, nuts and washers.

5130.5.3 **Shear Stud Connectors**

5130.5.3.1 Shear connector studs shall conform to the chemical requirements of ASTM A108 Grade 1015, 1018 or 1020. In addition, they shall meet the mechanical properties specified in Table 7.1 of AASHTO/AWS Bridge Welding Code D1.5M/D1.5 for Type B Studs.

5130.5.3.2 Certified mill test reports for the stud material shall be provided, including the boron content. The boron content shall be limited to 0.0008%.

5130.6 WELDING

5130.6.1 **Filler Metals and Welding Process**

5130.6.1.1 Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The low hydrogen covering and flux shall be protected and stored as specified by AASHTO/AWS Bridge Welding Code D1.5M/D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas processes are not considered as conforming to low hydrogen practice. Metal-cored

arc welding shall not be permitted. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal.

5130.6.1.2 All electrodes and fluxes shall conform to the diffusible hydrogen requirements of AASHTO/AWS Bridge Welding Code D1.5M/D1.5 filler metal hydrogen designator H8 or lower. Use of cored filler wires in the submerged arc welding process or shielding gas process will not be permitted.

- Submerged Arc Welding (SAW) is allowed for all flat and horizontal position welds. All flange and web butt joints shall be made by an approved semi or fully automatic submerged arc process. All web to flange fillet welds and all longitudinal stiffener to web fillet welds shall be made by an approved fully automatic submerged arc process.

- Shielded Metal Arc Welding (SMAW) is allowed for girder vertical stiffener to flange fillet welds, intermediate stiffeners and horizontal gusset plates. All electrodes and fluxes shall conform to the diffusible hydrogen requirements of AASHTO/AWS Bridge Welding Code D1.5M/D1.5 filler metal hydrogen designator H4.

5130.6.1.3 Electrodes for use in the welding of 300W steel by the shielded metal arc welding process shall be E48018 or approved equivalent.

5130.6.1.4 Electrodes for use in the welding of 350A and 350AT steel by the shielded metal arc welding process shall be E55018-C3 or approved equivalent.

5130.6.1.5 Wire and flux for use in the welding of 350AT steel by submerged arc welding process shall be Classification F7A4-EM12K3 or approved equivalent.

5130.6.2 **Cleaning Prior to Welding**

5130.6.2.1 Weld areas shall be clean, free of mill scale, dirt, grease and other contaminants and be preheated immediately prior to welding when required.

5130.6.3 The procedure for stud welding shall conform to the requirements of CSA Standard W59.

5130.6.4 The storage and conditioning of electrodes and fluxes shall conform to the requirements of CSA Standard W59.

5130.6.5 **Tack and Temporary Welds**

5130.6.5.1 Tack and temporary welds shall not be allowed unless they are to be incorporated in the final weld. Tack welds, where allowed, shall be of a minimum length of 4 times the nominal size of the weld and length shall not exceed 15 times the weld size, and shall be subject to the same quality requirements as the final welds. Tack welds shall be sufficiently ground out prior to final weld in order to obtain a uniform weld bead. Cracked tack welds shall be completely removed prior to welding over.

5130.6.6 **Run-off Tabs**

5130.6.6.1 Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. The tabs shall be a minimum of 100 mm long unless greater length is required for satisfactory work. They shall be tack welded only to that portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs are to be removed by flame cutting, not by breaking off. After removal of the tabs, the end of the weld shall be made smooth and flush with the abutting parts.

5130.6.7 **Preheat**

5130.6.7.1 Preheat requirements shall be performed and maintained as per CSA Standard W59, except that the preheat and interpass temperature for flange to flange and flange to web welds shall be a minimum temperature of 100° Celsius unless a higher temperature is required by CSA Standard W59 for the flange thickness. The preheat temperature of the web to flange joint shall be measured 75 mm from the point of welding on the side of the flange opposite the side where the weld is being applied.

5130.6.8 **Welding at Stiffener Ends**

5130.6.8.1 Fillet welds used to attach stiffeners to the girders may be returned completely around the edge where material and access are available, or may be stopped 5 mm short of the plate edge.

5130.6.9 **Methods of Weldment Repair**

5130.6.9.1 The Fabricator shall submit to the Ministry for approval, procedures for the repair of defective or unsound welds and base metal. Repair procedures for unsatisfactory weldments shall be prepared by an experienced welding engineer registered as a Professional Engineer in the Province of Saskatchewan prior to repair work commencing. The Fabricator shall be responsible for the cost of all inspection of the repaired areas.

5130.6.10 **Arc Strikes**

5130.6.10.1 Arc strikes will not be permitted on any portion of the steel which is not part of a welded joint. In the event of accidental arc strike, the Fabricator shall report the incident to the Engineer, and shall also submit for approval a repair procedure prepared by an experienced welding engineer registered as a Professional Engineer in the Province of Saskatchewan. As a minimum repair, the crater shall be completely ground to remove any affected material. The repair procedure shall also include MPI and hardness testing of the affected area. The maximum Brinell shall be 220 BHN. Repair areas will be examined by the Engineer to ensure complete removal of the metal in the affected area. All repairs shall be inspected at the Fabricator's cost prior to their acceptance by the Ministry.

5130.6.11 **Grinding of Welds**

5130.6.11.1 The flange butt welds so specified on the plans shall be ground flush or to a specified slope on both faces. Web butt welds which are sufficiently smooth with a neat appearance and uniform profile, subject to the review of the Engineer, will not require grinding. Fillet welds not conforming to acceptable profile shall be ground to the proper profile without substantial removal of the base metal. Grinding shall be smooth and parallel to the line of stress. Caution shall be exercised to prevent over grinding.

5130.6.11.2 All welding of butt joints in the flanges and web shall be fully completed, inspected, and where necessary, repaired prior to assembly of flanges with the web.

5130.6.12 **Plug and Slot Welds**

5130.6.12.1 Plug welds or slot welds shall not be permitted.

5130.6.13 **Field Welding**

5130.6.13.1 Where field welding of structural members is carried out, the following requirements shall be met:

- All welding, cutting and preparation shall be in accordance CSA Standard W59.
- Only welders approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments.
- Welding procedures approved by the Canadian Welding Bureau shall be prepared and submitted for review to the Engineer prior to use on the structure.
- Low hydrogen filler, fluxes and welding practices shall be used in accordance with Specification 5130.6.1.
- When the air temperature is below 10° Celsius, all material to be welded shall be preheated to 100° Celsius for a distance of 80 mm beyond the weld and shall be sheltered from the wind.
- When the air temperature is below 0° Celsius, welding shall not be permitted unless suitable hoarding and heating is provided. The air temperature inside the enclosure shall be a minimum of

10° Celsius. If the steel temperature is less than 10° Celsius, preheat as in the bullet above.

- All field welds of structural members shall be visually inspected by an independent welding inspector certified to Level 3 of CSA Standard W178.2.

5130.6.13.2 Where field welding of non-structural members is carried out, the following requirements shall be met:

- Journeyman welders with Class B tickets shall be permitted to perform weldments.
- Welding procedures prepared and stamped by a Professional Engineer registered in the Province of Saskatchewan shall be prepared.
- Low hydrogen filler, fluxes and welding practice shall be used in accordance with Specification 5130.6.1.
- When the air temperature is below 5° Celsius, all material to be welded shall be preheated to 100° Celsius for a distance of 80 mm beyond the weld and shall be sheltered from the wind.
- When the air temperature is below 0° Celsius, welding shall not be permitted unless suitable hoarding and heating, is provided.

5130.6.13.3 Structural field welds are welds that are required to maintain the integrity of the structure.

5130.6.14 **Welding to Girder Flanges and Webs**

5130.6.14.1 With the exception of longitudinal web to flange welds and longitudinal stiffener to web welds, all stiffeners, gusset plate, or any other detail material welds to girder webs shall be a minimum of 300 mm from the web butt welds.

5130.7 CONSTRUCTION

5130.7.1 General

5130.7.1.1 All standards which are referenced in this specification are considered to be the current edition of the standard, unless noted otherwise. The following list is an identification of the abbreviations used in this specification.

AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society for Testing Materials
AWS	American Welding Society
CISC	Canadian Institute of Steel Construction
CGSB	Canadian General Standards Board
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
SSPC	The Society of Protective Coatings

5130.8 FABRICATION

5130.8.1 General

5130.8.1.1 The Engineer will convene a prefabrication meeting with the Fabricator and Ministry to review issues including but not limited to, procedures on quality control, quality assurance, welding procedures, procedures for non-destructive testing, mill certificates and heat numbers, splices, coatings, updated schedule for fabrication, and to confirm the Technical Requirements.

5130.8.1.2 Fabrication shall be performed in a fully enclosed area which is adequately heated. The shop temperature shall be at least 10° Celsius.

5130.8.1.3 The fabrication shall occur in a recognized steel fabrication shop and be full certified by the Canadian Welding Bureau (CWB) as per CSA Standard W47.1 in the following Divisions:

- Fabrication of steel girders, girder components and welded steel trusses – Division 1.

- All other bridge components – Division 2.

5130.8.1.4 Fabricators of steel girders, trusses, splice plates, stiffeners, connector plates, and associated materials shall also be certified by the Canadian Institute of Steel Construction (CISC) in the category of complex steel bridges. Fabricators of steel diaphragms, bracing, and associated materials shall also be certified by the Canadian Institute of Steel Construction (CISC) in the category of complex steel bridges or simple steel bridges.

5130.8.1.5 Structural steel components shall be fabricated using procedures which provide a quality consistent with the assumptions made in CSA S6 – Canadian Highway Bridge Design Code (CSA S6).

5130.8.2 Heat Number Transfer

5130.8.2.1 As the plate is subdivided for webs and flanges, all heat numbers shall be transferred to each individual section. The numbers shall remain legible until such time as the material location in the final assembly has been recorded. Mill identification numbers stamped into the material shall be removed by grinding at an appropriate time. Steel, which is unidentified, shall not be used in the Work.

5130.8.3 Marking Systems

5130.8.3.1 Steel plate shall be marked in conformance with the requirements of Clause 13, CSA Standard CSA-G40.20M, except that steel stamping shall not be used as a means of marking the plate. As the web and flange plates are subdivided for use in the girders, all heat numbers shall be transferred to each individual plate section, and the marks shall remain legible until the plate location within the girders has been documented. All the plate identification marks shall be removed by the blast cleaning operation. Steel, which is unidentified, shall not be used in the Work.

5130.8.4 Cutting of Plate

5130.8.4.1 All plate material for main members, splice plates and any plate material welded to the main member shall be flame cut so that the direction of applied stress will be parallel to the direction of plate rolling using an automatic cutting machine. Shearing is not allowed.

5130.8.5 **Flame or Plasma Arc Cut Edges**

5130.8.5.1 Flame or plasma arc cutting shall be done in accordance with the requirements of AWS D1.5. In addition, the cut edges of girder flanges shall have a maximum Brinell Hardness number of 220. If the hardness exceeds this requirement, the Fabricator shall submit for approval a procedure which will reduce the hardness to the acceptable level. The Ministry's Inspector will do hardness tests on a random basis. The Fabricator shall ensure that the surface roughness of the cut edge shall not be greater than 500 µin (12.5 µm) and be such that to allow Brinell hardness testing without spot grinding. All costs associated with the reduction in hardness and the additional hardness tests will be at the Fabricators expense.

5130.8.5.2 The surface of flame or plasma arc cut apertures shall be finished by grinding and shall be free of nicks and gouges.

5130.8.5.3 The Fabricator shall immediately advise the Engineer and Ministry concerning all blow backs or other signs of lamination observed during the cutting of the plate.

5130.8.6 **Vertical Alignment**

5130.8.6.1 The structure shall be fabricated to conform to the requirements of the deflection and vertical curve, as noted in the fabrication drawings. For rolled shapes, advantage shall be taken of mill camber that may be inherent in the material.

5130.8.7 **Shop Assembly**

5130.8.7.1 Shop assembly of girders shall be by the Progressive Girder Assembly Method according to AASHTO, except that only two, instead of three, sections need to be assembled. The Ministry will permit the use of templates only (no shop assembly) when the Fabricator can demonstrate experience and/or a high degree of competence with this technique, or when the Fabricator uses numerically-controlled drilling equipment. The detailed method of assembly, including points of support, dimensional checks, method of trimming to length, drilling and marking of splices, shall be to the proposed fabrication sequence procedure prepared as per Specification 5130.4.3. Each individual girder section shall meet the camber requirements for that particular length, with the

splices between these sections falling on the theoretical camber line for the entire span. Correction for variation in flange thickness shall be considered. When the camber of the girder fails to meet the required tolerance, the Fabricator shall develop a method of repair prior to commencement of repair. The camber of each individual girder section shall be known for the next two girder sections in the girder line prior to shop assembly of any particular girder section. This is to allow the use of a best fit line to reduce the effect of any camber differences should it be deemed necessary. Camber for plate girders shall be measured on the top of the top flange. The camber of plate girders shall be measured in the “no load” condition.

5130.8.7.2 Girder sections assembled for splicing shall be supported within 2 m of the end of each section. Girder sections shall be supported in such a manner as to provide the correct angular relationship at the splice between girder sections while the splices are being reamed or drilled. The splice points shall be located on the theoretical camber line or at a specified amount from the camber line should a correction be necessary to compensate for shop camber deviations. The fabricated camber of each individual girder section must be known for the next two girder sections in the girder line prior to shop assembly to allow adjustments which will reduce the effect of any camber deviations. Fabrication drawings shall clearly indicate the expected dead load deflection of each section and the elevations of the sections while supported for the drilling or reaming of each splice.

5130.8.7.3 All splices shall be drilled from solid material while assembled or shall be sub-punched or sub-drilled and then reamed to full size while in the shop assembly position.

5130.8.8 Splice Plates

5130.8.8.1 After shop assembly, splice plates and girders shall be clearly match marked to assure proper orientation and location of splice material for erection. All holes shall align with holes in the attached member. Splice plates shall then be removed, de-burred, solvent cleaned to remove all oil and sandblasted to remove all mill scale. These plates shall then be securely ship-bolted to the girders. The match marking system shall be shown on the fabrication drawings.

5130.8.9 **Bolt Holes**

5130.8.9.1 Clause 11.4.8 in AASHTO LRFD Bridge Construction Specifications shall apply except that all bolt holes in load carrying segments of main members and any material welded to main members shall be drilled full size or sub-punched 5 mm smaller and reamed to full size. Punching of full size holes for secondary members such as bracings which are not welded to main member is allowed for material less than 16 mm thick. All holes in girder splices shall be circular and perpendicular to the member and shall be deburred to ensure a proper faying surface.

5130.8.10 **Dimensional Tolerances**

5130.8.10.1 Welded sections shall be fabricated to the dimensions and camber given on the plans within the tolerances specified in CSA Standard W59, except as otherwise noted below:

- Camber of beams and girders shall be uniform, true and accurate to the centreline of the top flange. Permissible variation in camber shall be within ± (0.2 Lt + 3) in mm; where Lt is the test length in metres. This applies to fabricated pieces only, prior to shop assembly. During shop assembly, splice points shall be located on the theoretical camber line or at a specified amount from the line. Where field splices are eliminated by combining girder segments into longer girder lengths, the cambers of the girders at the eliminated splice points shall be within ± 3 mm.

- Fill plates shall not be permitted at main girder field splices unless specified. The difference between similar dimensions of the adjoining sections being spliced shall not exceed ± 2 mm.

- The surface of the flange which is to mate with a bearing shall fit within 0.25 mm for 100% of the projected area of the web and bearing stiffeners, and not more than 0.80 mm for the remaining contact area with the bearing.

- Rolled structural shapes shall be fabricated within the tolerances specified in CSA Standard CSA-G40.20-M.

- Bolt hole groups shall be located within ± 3 mm.

- The bearing ends of stiffeners finished to bear shall be flush and square with the web and shall have at least 75% of this area in contact with the flanges, whereas snug fit stiffeners may have a gap of up to 1 mm between stiffener and flange.

- Bearing to bearing distance is a set dimension and therefore has no tolerance.

- Combined warpage and tilt of flange at any cross section of welded I-shape beams or girders shall be determined by measuring the offset at the toe of the flange from a line normal to the plane of web through the intersection of the centerline of the web with the outside surface of the flange plate. This offset shall not exceed 1/200 of the total width of the flange or 3 mm whichever is greater at bolted splice location. Bolted splices of main stress carrying members shall have parallel planes and the surfaces shall be in full contact without any gap.

5130.8.11 **Corner Chamfer**

5130.8.11.1 Corners of all flanges shall be ground to a 2 mm chamfer. Corners of stiffeners, structural sections and plates shall be ground to a 1 mm chamfer.

5130.8.12 **Milling Tolerances**

5130.8.12.1 Tolerance for milled to bear stiffeners shall be 0.05 mm with at least 75% of the area in bearing.

5130.8.13 **Web Panning**

5130.8.13.1 The maximum variation from flatness for webs shall be 0.01d where d is the least dimension of the panel formed by the girder flanges and/or stiffeners. Should the panning in one panel be convex and the panning in the adjacent panel be concave then the sum of the panning in the two adjacent sections shall not exceed that allowed for one panel. Localized deformation in the web shall not exceed 3 mm in 1 m.

5130.8.14 **Flame Straightening**

5130.8.14.1 Flame straightening shall not be performed on any material or member without the development of a repair procedure by a Professional Engineer registered in the Province of Saskatchewan. The repair procedure shall address locations, temperatures and cooling rates.

5130.8.15 **Stress Relieving**

5130.8.15.1 When stress relieving is specified, it shall be performed in accordance with CSA Standard W59. Copies of the furnace charts shall be supplied to the Engineer.

5130.8.16 **Handling and Storage**

5130.8.16.1 All lifting and handling shall be done using devices that do not mark, damage, or distort the assemblies or members in any way. Girders shall be stored upright, on timber blocking, supported on sufficient skids and safely shored to maintain the proper section without buckling, twisting or in any way damaging or misaligning the material.

5130.8.17 **Marking and Shipping**

5130.8.17.1 Each member shall be identified with an erection mark by a method agreed to by the Engineer and the Ministry which will not be visible in the completed structure. The erection marks shall correspond to the mark shown on the erection diagram. Each member with a mass of over 1 tonne shall also be marked with the mass.

5130.8.17.2 All material which has been fabricated in the Fabricator's plant shall be inspected and accepted before shipping.

5130.8.17.3 Members shall be loaded on trucks or cars in an upright position with sufficient support to prevent possible distress or damage the girders. When a point of support occurs adjacent to a transverse stiffener which does not fit tightly against the bottom flange, the stiffener shall be blocked to the flange. Wood blocking shall be untreated. Other structural members shall be shipped in such a manner that they arrive on site in an undamaged condition. All

material shall be protected from contamination by roadway deicing chemicals.

5130.8.17.4 After steelwork has been delivered to site it shall be inspected by the Engineer. The Contractor shall clean the steelwork after it has arrived at site of any dirt, road salts, slush or other contaminants accumulated during transport and shall carry out any other surface preparation work necessary to meet the specified surface preparation requirements.

5130.8.17.5 Bolts of one length and diameter, and loose nuts or washers for each size shall be packaged separately. Pins, small parts and packages of bolts, washers and nuts shall be shipped in boxes, crates, kegs or barrels. A list and description of the contained material shall be plainly marked on the outside of each shipping container.

5130.8.17.6 The Fabricator shall be responsible for the repair or replacement of any material damaged or lost during shipping, and for the cleaning required to remove all surface contamination.

5130.9 TESTING AND INSPECTION

5130.9.1 All inspection, except that which may be necessitated by faulty work or additional unspecified material splices, will be arranged and paid by the Ministry. Normal quality control within the shop shall be the Fabricator's responsibility.

5130.9.2 The Contractor and or Fabricator shall provide full access for the inspection of material and workmanship by the Ministry. Free access shall be allowed to the Ministry to all parts of the Works. When required by the Ministry, The Contractor and or Fabricator shall provide needed manpower for assistance in inspection duties.

5130.9.3 Any test records made by the fabricating shop in the course of normal quality control shall be open to the Ministry for inspection.

5130.9.4 All welds shall be visually inspected by an independent welding inspector certified to Level 3 of CSA Standard W178.2.

5130.9.5 To ensure that each stage of inspection is performed in an orderly manner, during the fabrication of major structures, inspection stations shall be set up at

specific points. Sub-assemblies of the work will then be checked by the Fabricator, and all deficiencies shall be corrected, prior to the work being sent to the next stage of fabrication. The Ministry reserves the right to stop detrimental fabrication practices at any stage of the fabrication.

5130.9.5.1 Typical check points for a plate girder are:

- Flange plates prepared.
- Web plates prepared.
- Web to flange welds completed prior to fitting any stiffeners.
- Completion of all welding prior to splicing.
- Splice set-up prior to drilling.
- Surface preparation and coating.
- Clearance to ship.

5130.9.6 **Non-Destructive Methods of Examination**

5130.9.6.1 The methods of non-destructive examination shall be in accordance with the following standards:

- Radiography as per CSA Standard W59
- Ultrasonic as per CSA Standard W59
- Magnetic particle as per ASTM Specification E709 and CSA Standard W59
- Dye-Penetrant as per ASTM Specification E165
- Hardness tests as per ASTM Specification E103

5130.9.6.2 The non-destructive examination shall be done by a company certified to CSA Standard W178.1. Radiographic testing and

magnetic particle testing technicians shall be certified to Level II of Canadian General Standards Board (CGSB).

5130.9.7 **Radiographic Inspection Schedule**

5130.9.7.1 Unless otherwise noted, radiographic inspection of welded plate girders shall be performed by the Fabricator in accordance with the following schedule:

- All flange butt welds which are designated on the plans as having a ground finish.
- 100% of all tension flange and stress reversal butt welds, all stiffener butt welds and all diaphragm butt welds, and any groove welded attachments to flange plates.
- A minimum of 25% of all other flange butt welds randomly selected for each structure and these shall have a smooth finish before radiographing. Additional testing may be required to ensure the quality of welds.
- All web butt welds in tension and stress reversal zones plus additional 300 mm of web butt weld in compression zone at the end of the web.
- The location and length of this undesignated percent of butt welds chosen to be radiographed shall be at the discretion of the Ministry's Inspector, and should 10% of the radiographs indicate

unacceptable defects in the welds, the remaining length of butt weld may be radiographed.

5130.9.8 **Radiographic Testing of Structural Steel Material**

5130.9.8.1 Unless otherwise noted, radiographic inspection of miscellaneous material shall be performed by the Fabricator in accordance with the following schedule:

- 100% of all tension members.
- 50% of all other members.

5130.9.8.2 In lieu of radiography, phased array ultrasonic non-destructive testing may be done subject to the following conditions:

- Inspectors shall be CGSB Level II or Level III.
- Amplitude linearity checks performed as per AWS D1.5.
- Calibration setting tested on calibration block.
- Provision of a Scan Plan.
- Scanning speed controlled to reduce data drop to less than 5%.
- Scanning performed using linear scanning technique with encoder.
- Use a fixed guide to maintain distance of probe to weld.
- Data displayed in A-Scan, D-Scan and S-Scan format.
- All data is stored, including raw data, weld identification, weld thickness and length.

5130.9.9 **Magnetic Particle Inspection Schedule**

5130.9.9.1 Unless otherwise noted, magnetic particle inspection of welded plate girders shall be performed by the Fabricator for each girder section in accordance with the following schedule:

- 50% of the web to flange welds or any fillet welds placed on flange plates.
- 10% of the web to stiffener welds.
- 100% of the stiffeners to flange welds.
- 100% of the bearing sole plate to flange welds.
- 20% of the diaphragm connector plate welds.

5130.9.10 **Dye Penetrant Inspection**

5130.9.10.1 Dye penetrant inspection shall be done at the ends of the weld metal of all flange butt welds after the removal of run-off tabs, and elsewhere as deemed necessary by the inspector. Defects discovered by this inspection shall be repaired by the Fabricator, and the suspect area re-inspected at the Fabricator's expense.

5130.9.11 **Hardness Tests**

5130.9.11.1 Hardness tests shall be performed by the Fabricator on the flame or plasma arc cut edges of the girder flange prior to assembly. Unless otherwise noted, the hardness of the flame or plasma arc cut edges shall not exceed a maximum Brinell as noted below:

- For carbon steels with a yield strength less than and including 300 MPa, the maximum Brinell shall be 200 BHN.
- For carbon steels with a yield strength greater than 300 MPa, the maximum Brinell shall be 220 BHN.

5130.9.12 **Testing Stud Shear Connectors**

5130.9.12.1 Stud shear connectors shall meet all requirements as outlined by CSA Standard W59. The Fabricator shall perform bend testing in accordance with CSA Standard W59. When bend testing, the studs shall be bent towards the centre of the girder.

5130.9.13 **Defects, Repairs and Acceptance**

5130.9.13.1 The Engineer and Ministry shall be notified of any defects found in the Work. In general, no repair shall be made until agreed to by the

Engineer who shall consult with the Ministry. In the case of minor corrections, as described by CSA S6 Clause 10.23.6.4, approval to proceed may be given either verbally by the Engineer, or in advance provided that written repair procedures are submitted for acceptance to the Engineer prior to the work commencing. In such cases as repair of cracks, or repairs as described by the CSA S6 Clause 10.23.6.5, or a revised design to compensate for deficiencies, the means of correction shall be prepared and sealed by a Professional Engineer in the Province of Saskatchewan. It shall be submitted in writing, with adequate sketches, to the Engineer for review, with a copy to the Ministry.

5130.9.13.2 Each main member shall be certified as acceptable by the Engineer before it is shipped from the shop. This certification shall not relieve Fabricator of responsibility for subsequent damage or for defects which become apparent before the Work is finally accepted.

5130.10 PAYMENT

5130.10.1 Payment for SUPPLY, FABRICATION AND DELIVERY OF ATMOSPHERIC CORROSION RESISTANT WELDABLE STRUCTURAL STEEL will be full compensation for the supply of materials, fabrication, inspection, testing, storage, blast cleaning, galvanizing, loading, delivery, unloading, cleaning and/or repair if required, of all materials F.O.B. destination.

5130.10.1.1 50% of the lump sum bid price for “FABRICATION AND DELIVERY OF ATMOSPHERIC CORROSION RESISTANT WELDABLE STRUCTURAL STEEL” will be paid once the structural steel has been acceptably fabricated, inspected, tested, stored and written acceptance within the supply and fabrication inspection and test plan has been provided by both the Engineer and Contractor.

5130.10.1.2 25% of the lump sum bid price for “FABRICATION AND DELIVERY OF ATMOSPHERIC CORROSION RESISTANT WELDABLE STRUCTURAL STEEL” will be paid once the structural steel has been acceptably loaded, transported, hauled, unloaded, stored, cleaned and/or repaired, if required; and written acceptance of the

transportation, handling and storage has been provided by both the Engineer and the Contractor.

5130.10.1.3 25% of the lump sum bid price for “FABRICATION AND DELIVERY OF ATMOSPHERIC CORROSION RESISTANT WELDABLE STRUCTURAL STEEL” will be paid once the structural steel has been acceptably erected, assembled, installed, and written acceptance has been provided by both the Consultant and the Contractor.