Section 630 ‑ Fabrication of Steelwork‑

##This section cross-references Sections 160 and 175.

If any of the above sections are relevant, they should be included in the specification.

If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent:

630.01 GENERAL

This section specifies requirements for the fabrication of steelwork, including materials, fabrication, welding, handling and transport to site of girders, columns and other structural members. The steelwork materials may include either steel plates, hot-rolled open steel sections, welded steel sections and structural steel hollow sections.

The section is limited to the use of steel parent material with a specified minimum yield strength not exceeding 690 MPa, and applies to all work on the steel after manufacture to final size at the originating steel mill.

630.02 REFERENCED DOCUMENTS

Australian Standards (AS), Australian/New Zealand Standards (AS/NZS), International Standards (ISO) and other documents referred to in this section are also listed in Section 175.

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| **Table 630.021 - Referenced Documents** |
| AS 1101.3 | Graphical symbols for general engineering – Part 3: Welding and non-destructive examination |
| AS 1110.1 | ISO metric hexagon bolts and screws—Product grades A and B – Part 1: Bolts |
| AS 1110.2 | ISO metric hexagon bolts and screws—Product grades A and B – Part 2: Screws |
| AS 1112.1 | ISO metric hexagon nuts – Part 1: Style 1—Product grades A and B |
| AS/NZS 1163 | Cold formed structural steel hollow sections |
| AS/NZS 1214 | Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD) |
| AS/NZS 1252.1 | High-strength steel fastener assemblies for structural engineering—Bolts, nuts and washers – Part 1: Technical requirements |
| AS/NZS 1554.1 | Structural steel welding – Part 1: Welding of steel structures |
| AS/NZS 1554.2 | Structural steel welding – Part 2: Stud welding (steel studs to steel) |
| AS/NZS 1554.3 | Structural steel welding – Part 3: Welding of reinforcing steel |
| AS/NZS 1554.4 | Structural steel welding – Part 4: Welding of high strengthquenched and tempered steels |
| AS/NZS 1554.5 | Structural steel welding – Part 5: Welding of steel structuressubject to high levels of fatigue loading |
| AS/NZS 1554.6 | Structural steel welding – Part 6: Welding stainless steels for structural purposes |
| AS/NZS 1594 | Hot rolled steel flat products |
| AS 2177 | Non-destructive testing—Radiography of welded butt joints in metal |
| AS/NZS 2205.4.1 | Methods for destructive testing of welds in metalMethod 4.1: Fracture test |
| AS 2205.6.1 | Methods for destructive testing of welds in metalMethod 6.1: Weld joint hardness test |
| AS 2207 | Non-destructive testing—Ultrasonic testing of fusion welded joints in carbonand low alloy steel |
| AS ISO 3452.1 | Non-destructive testing – Penetrant testingPart 1: General principles |
| AS 3597 | Structural and pressure vessel steel – Quenched and tempered plate |

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| AS/NZS 3678 | Structural steel – Hot-rolled plates, floorplates and slabs |
| AS/NZS 3679.1 | Structural steel – Hot-rolled bars and sections |
| AS/NZS 3679.2 | Structural steel – Welded I sections |
| SA TS 102 | Structural steel – Limits on elements added |
| AS/NZS ISO 3834.2 | Quality requirements for fusion welding of metallic materials – Comprehensive quality requirements |
| AS/NZS ISO 3834.3 | Quality requirements for fusion welding of metallic materials – Standard quality requirements |
| AS 4680 | Hot-dip galvanized (zinc) coatings onfabricated ferrous articles |
| AS 5100.6 | Bridge designPart 6: Steel and composite construction |
| AS/NZS 5131 | Structural steelwork—Fabrication and erection |
| AS/NZS ISO 5817 | Welding—Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections |
| ISO 8501.3 | Preparation of steel substrates before application of paints and related products —Visual assessment of surface cleanliness —Part 3: Preparation grades of welds, edges and other areas with surface imperfections |
| AS/NZS ISO 9001 | Quality management systems—Requirements |
| AS ISO 9934.1 | Non-destructive testing — Magnetic particle testing — Part 1: General principles |
| AS/NZS ISO/IEC 17020 | Conformity assessment—Requirements for the operation of various types ofbodies performing inspection |
| AS ISO/IEC 17025 | General requirements for the competence of testing and calibration laboratories |
| AS/NZS ISO/IEC 17065 | Conformity assessment—Requirements for bodies certifying products,processes and services |
| IIW MCS ISO 3834 | IIW Manufacturer Certification Scheme for the Management of Quality in WeldingInterpretation and Implementation of ISO 3834 requirementsPrepared and issued by the IAB-International Authorisation Board under the authority of the IIW-International Institute of Welding |
| ATS 5420 | Supply of Bolts, Nuts and Washers (Austroads Technical Specification, available from <https://austroads.com.au/>, ) |
| WTIA Technical Note 5(now Weld Australia) | Flame Cutting of Steels |

630.03 CONSTRUCTION CATEGORY, CERTIFICATION, SURVEILLANCE AND ACCREDITATION

1. **Construction Category**

The Fabricator shall have in place a quality management system conforming to Appendix D of AS/NZS 5131 for the specified Construction Category.

Unless specified otherwise in the Contract documents, the steelwork shall be fabricated in accordance with the requirements for Construction Category CC3 of AS/NZS 5131. Where the Designer allocates a Construction Category other than CC3 to a fabricated component or structural element, this must be noted on the drawings.

If Construction Category CC4 is specified, requirements in addition to those for CC3 shall be included in the Contract documents.

As of the 1 January 2024, the Fabricator shall be certified as conforming to Construction Category CC2, CC3 or CC4 of AS/NZS 5131, as applicable to the works or to parts of the works. The certification of Construction Category applies to those Sections of AS/NZS 5131 that are applicable to the work carried out by the Fabricator.

The certification of Construction Category shall be by an accredited certifying body that operates:

1. within a conformity assessment framework for the certification of construction category to AS/NZS 5131;

and

1. is accredited for that purpose to AS/NZS ISO/IEC 17065 either by JAS-NZS or a member of the International Accreditation Forum.

 As of the 1 January 2024, fabrication of steelwork both in the workshop and on-site shall be carried out by contractors or steel fabricators certified as conforming to:

1. AS/NZS ISO 3834.2 for work requiring Construction Category CC3 or CC4; or
2. AS/NZS ISO 3834.3 for work requiring Construction Category CC2.

The certification of quality requirements for fusion welding shall be by a certifying body authorised by the International Institute of Welding to certify Fabricators to IIW MCS ISO 3834.

The Contractor shall have in place a project-specific quality plan for the works covering at least the items of Appendix D of AS/NZS 5131. The Contractor shall nominate in the quality plan the responsibilities, names and qualifications of all personnel associated in the planning, production and inspection of all welds in the work, including welding supervisor(s), welding inspectors and non-destructive testing technicians.

**HP - 1 The Contractor shall notify the Superintendent of the details of the steel fabricator, including appropriate certifications and any arrangements where the fabrication of steelwork is further subcontracted to a third party certified fabricator, at least 14 days prior to commencement of fabrication of steelwork.**

**HP - 2 The Contractor shall submit evidence of certification of the steel fabricator to:**

1. **Construction Category CC2, CC3 or CC4 of AS/NZS 5131, as applicable to the works or
to parts of the works, and**
2. **AS/NZS ISO 3834.2 for work requiring Construction Category CC3 or CC4; or to AS/NZS ISO 3834.3 for work requiring Construction Category CC2.**
3. **Surveillance**

The Contractor shall conduct surveillance of the fabrication and welding of structural steelwork in accordance with VicRoads Technical Bulletin TB 46. This surveillance shall be carried out by a person (the Surveillance Officer) accredited for surveillance of structural steelwork to VicRoads Technical Bulletin TB 46 by an organisation certified to AS/NZS ISO/IEC 17020.

When the Superintendent, or the Superintendent’s Representative, conducts surveillance of the fabrication and welding of structural steelwork, the Contractor shall grant surveillance officers access to manufacturing documentation including marked drawings, inspection and test plan checklists, test reports and documents required by this specification.

1. **Supervision, Inspection and Testing**

All welding shall be carried out in accordance with AS/NZS 1554.1.

All welding procedures shall be authorised by and all welding shall be supervised by a Welding Supervisor, who is qualified in accordance with AS/NZS 1554.1, at clause 4.12.1 for qualification of welding personnel – Welding Supervisor.

All welding shall be inspected by a Welding Inspector who is qualified in accordance with AS/NZS 1554.1, at clause 7.2 for qualifications of Inspectors.

All non-destructive examinations shall be performed by certified technicians who are qualified in accordance with AS/NZS 1554.1 at clause 7.4 for non-destructive examination other than visual.

Unless otherwise specified, all tests and sampling shall be undertaken in accordance with the appropriate and applicable test methods (including Australian Standards) as current at the time of performance of the tests.

All testing, including materials testing, testing of welding procedure test coupons and non-destructive examinations, must be performed by laboratories with third-party accreditation to AS ISO/IEC 17025 by a signatory to the International Laboratories Accreditation Cooperation (ILAC) through their Mutual Recognition Agreement (MRA) in the specific field and class of testing for the purpose of establishing conformity to the requirements.

The appropriate logo or further details of the ILAC (MRA) signatory must be noted on the document or test report. Note that ILAC (MRA) accredited bodies include the National Association of Testing Authorities, Australia (NATA).

1. **Contractor Quality Verification**

The Contractor shall ensure that all quality checks are carried out as detailed in the Inspection and Test Plan (ITP) for the fabrication, installation and commissioning of the steelwork. Surveillance and quality checks with supporting digital evidence shall be progressively carried out from the material preparation up to final fabrication. Surveillance reports shall be progressively submitted by the Contractor to the Superintendent to demonstrate on-going compliance with fabrication procedures until the final product is completed.

**HP - 3 The fabrication, welding and installation procedures, and ITPs shall be submitted to the Superintendent one month prior to fabrication.**

630.04 SAFETY PRECAUTIONS

Welding shall be carried out in accordance with the safety requirements of AS/NZS 1554.1.

Precautions shall be taken to protect all persons working or present near welding operations, including visitors and the public. Precautions include the control of exposure to arc radiation, hot metal and welding fumes as well as the prevention of electric shock and fire.

Suitable opaque welding screens shall also be provided to protect workers and other people in the vicinity of welding, against stray radiation.

Where non‑destructive examination employing industrial x‑ray plant or radioactive isotopes is used, special precautions shall be observed to ensure that people in the vicinity are not subjected to direct or scattered radiation. The relevant regulations governing the use of x‑ray plant and equipment shall be complied with.

630.05 DRAWINGS

The Contractor shall be responsible for the preparation and verification of shop drawings. Welding symbols used on drawings shall comply with AS 1101.3.

**HP - 4 Prior to fabrication, the shop drawings shall be reviewed by a competent Structural Steel Designer to verify that the critical to quality requirements are complied with and that the design intent is achieved. Evidence of this review and the competency of the reviewer shall be submitted to the Superintendent prior to fabrication.**

Further to the requirements of Section 160, the Contractor shall submit to the Superintendent two copies of ‘as‑constructed’ drawings for steelwork.

630.06 DIMENSIONAL TOLERANCES

The dimension of structural members shall be within the tolerances specified on the drawings. Where tolerances are not specified, tolerances shall be in accordance with the requirements of the Essential and Functional Tolerances, from AS/NZS 5131 - Section 12, as specified in Table 630.061.

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| **Table 630.061 – Geometrical Tolerances** |
| **Tolerance** | **Construction Category** |
| **CC2** | **CC3** | **CC4** |
| Essential Tolerances | Class 1 | Class 2 | Class 2 |
| Functional Tolerances | Class 1 | Class 2 | Class 2 |

630.07 MATERIAL COMPLIANCE AND TRACEABILITY

All materials shall comply with the standards and specifications shown on the drawings. All structural steel, associated components and welding consumables shall be manufactured by companies that hold quality systems certification to AS/NZS ISO 9001, or an equivalent quality management system.

All structural steel shall conform to the product standards listed in Table 630.071 and to the required grades shown on the drawings, for all required properties.

**HP - 5 The Contractor shall submit to the Superintendent the steel manufacturer’s Certificate of Product Compliance and all related test certificates demonstrating compliance to the relevant steel product standards listed in Table 630.071, including all impact test values when appropriate.
The test certificates shall be related to the steel by trademarks and heat number.**

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| **Table 630.071– Steel Product Standards Applicable to this Specification** |
| **Standard Number** | **Description** |
| AS/NZS 1163 | Cold formed structural steel hollow sections |
| AS/NZS 1594 | Hot rolled steel flat products |
| AS 3597 | Structural and pressure vessel steel – Quenched and tempered plate |
| AS/NZS 3678 | Structural steel – Hot-rolled plates, floorplates and slabs |
| AS/NZS 3679.1 | Structural steel – Hot-rolled bars and sections |
| AS/NZS 3679.2 | Structural steel – Welded I sections |
| SA TS 102 | Structural steel – Limits on elements added |

All steel incorporated into the steelwork shall be identified in accordance with the marking requirements as specified in AS/NZS 1163, AS/NZS 1594, AS 3597, AS/NZS 3678, AS/NZS 3679.1, AS/NZS 3679.2 or for any other steel specified in the drawings.

The steel shall be traced from the point of manufacture to its final location in the structure.

Steelwork shall be deemed to be non-conforming where defects or imperfections due to the manufacture of the steel become evident at any stage of fabrication. Any defects or imperfections in the steel shall be assessed against the Freedom from Defects clause in AS/NZS 1163, AS/NZS 1594, AS 3597, AS/NZS 3678, AS/NZS 3679.1, AS/NZS 3679.2 or for any other steel specified in the drawings, as applicable to the works.

The Contractor shall submit details of any proposal to use weld repaired steel, including the proposed location in the structure and post-weld inspection requirements, at least five working days prior. Weld repaired steel shall include lengths of plates or sections containing welds (full penetration butt welds) to make up or extend member lengths with welds not otherwise shown on the drawings. These welds shall be inspected in accordance with Table 630.171, Table 630.181 and Table 630.182. All grinding of surface imperfections and weld repairs shall produce a surface roughness similar to and blend in with the surface finish of surrounding areas. Grinding marks shall be parallel to the direction of principal stress and shall be produced using a grinding disc of grain size number 40 or finer.

**HP - 6 The use of any weld repaired steel, including welding to make up member length, shall not commence until approval to proceed is given by the Superintendent.**

Unidentified steel shall not be used.

630.08 STORAGE OF MATERIALS

All steel, whether fabricated or not, shall be stored above the ground and adequately protected against corrosion and damage.

630.09 HANDLING, TRANSPORT AND ERECTION

The method of handling, transporting and erection of the steelwork shall be such that the members are not stressed or deformed beyond the design limit and that there is no damage to the protective coating during these operations.

All installation and erection of the steel structure shall comply with the requirements of AS/NZS 5131.

**HP - 7 An installation and commissioning plan together with the ITP shall be developed in accordance with AS 5131 and shall be submitted to the Superintendent one month prior to installation.**

As a minimum, the installation and commissioning plan shall include the following procedures, when appropriate:

1. Lifting procedures for each component;
2. Bolt tightening procedures for snug tight bolting
3. Procedures for grouting of base plates
4. Procedures for ensuring that components are erected in the correct sequence and position.

630.10 CUTTING

Cutting of steel shall be carried out by methods that will not be detrimental to the finished product. Cutting shall be by sawing, shearing or thermal cutting using machines which are mechanically guided and move at uniform speed, unless otherwise specified below.

Thermal cutting includes plasma-cutting, laser-cutting, and flame (oxy-gas) cutting.

The Contractor shall perform cutting of members in accordance with work instructions for cutting. Hand-guided cutting may be permitted where a practical alternative is not available. Hand-held or hand-guided cutting shall not otherwise be permitted.

Shearing or cropping shall not be used for main plates, reinforcing plates, main gussets, splice plates, rolled sections and shapes or any steel thicker than 16 mm. Distortions caused by shearing shall be removed.

Unless otherwise shown on the drawings, all plates shall be finished square, straight and in plane without burrs or imperfections.

Plasma, laser or flame cutting procedures for longitudinal edges of tension members not subsequently incorporated into a weld shall not produce heat affected zone hardness exceeding 350 HV (Vickers Hardness Number) along the cut edges, as evidenced by the Vickers hardness testing of a cutting procedure test specimen. This requirements applies to all flange edges of I girders, to bottom flange edges of trough girders, and to stripped tie-bars and similar tension edges.

The requirement is not intended to apply to web edges incorporated into a web-to-flange joint, or to edges of box beams or columns incorporated into full penetration corner joints, or to transverse cut ends of members. For plates of grade 350 steel or higher grade and of thickness greater than 25 mm, a hardness traverse test for heat affected zone shall be carried out in accordance with AS 2205.6.1, where the traverses shall be located so that they approximately intersect regions of minimum and maximum hardness.

Any cut surface not incorporated in a weld shall have a surface roughness not greater than the appropriate value given in Table 630.101. A cut surface to be incorporated in a weld shall comply with AS/NZS 1554.1, clause 5.1.1.

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| **Table 630.101 Maximum Cut Surface Roughness** |
| **Application** | **Maximum Roughness, CLA (μm)** |
| Normal applications, i.e. where the face and edges remain as-cut or with minor dressing | 25(Roughness Class 3 specified in WTIA Technical Note 5) |
| Fatigue application (detail categories as specified in AS 5100.6) |
| AS 5100.6 Detail Category ≥ 80 MPa | 12(Roughness Class 2 specified in WTIA Technical Note 5) |
| AS 5100.6 Detail Category < 80 MPa | 25(Roughness Class 3 specified in WTIA Technical Note 5) |
| **Notes:** 1 Guidance on flame cutting of steels can be obtained in WTIA Technical Note 5. 2 Roughness values may be estimated by comparison with surface replicas, such as the WTIA Flame Cut Surface Replicas. 3 CLA = Centre Line Average Method 4 Flame cut surfaces may require some surface grinding to make the surfaces suitable for the application of protective coating treatments. |

Cut surfaces with roughness exceeding the values in Table 630.101 shall be repaired by grinding to give a value less than the specified roughness. Grinding marks shall be parallel to the direction of the cut.

Any cut steel surface having notches, gouges or other imperfections with a depth of 2 mm or greater shall be repaired by welding in accordance with AS/NZS 1554.1. Notches, gouges or other imperfections with a depth of less than 2 mm shall be removed by machining or grinding, and the depression shall be tapered out smoothly for a distance of at least 75 mm on both sides of the defect. Notches, gouges or other imperfections with a depth of less than 1mm on an otherwise satisfactory surface are acceptable provided that they are not closer than 20 times the thickness of the component. The finished product shall be within the specified tolerances.

Where steelwork is to be given protective coating, all edges shall be ground or machined to a smooth even surface finish with a minimum radius of 2 mm. Rolled edges need not be ground provided that the corners are rounded and that the edges are square and straight.

All re‑entrant corners shall have a radius of not less than 20 mm and shall be shaped to be smooth and without notches.

630.11 CAMBERING, STRAIGHTENING OR FORMING

Cambering of members, and measurement of camber, and straightening or forming shall be performed in accordance with a work instruction, prepared and issued by the Contractor in accordance with the quality system.

HP - 8 **The work instruction for cambering, straightening or forming, as appropriate shall be submitted to the Superintendent for review at least seven working days prior to commencement of these activities.**

In the measurement of camber, where the member spans between supports, allowance shall be made for the deflection due to self weight. This allowance shall be calculated by an experienced structural design engineer who is eligible for Corporate Membership of Engineers Australia or who hold a Registered Engineer certificate.

The methods used to camber or straighten materials shall not reduce the properties of those materials below the minimum property values as specified in the relevant Australian Standards.

Cold forming of materials (i.e. forming at temperatures below 250°C) shall be carried out within the deformation range recommended by the steel manufacturer.

Distortion resulting from welding and fabrication may be corrected by either or a combination of, mechanical or thermal means, provided that the process used does not damage the components or restrict the intended use. The temperature of the steel shall not exceed 600°C. Forced cooling by water or other fluids shall not be used until the temperature of the steel is below 200°C.

630.12 HOLING

Round holes may be either:

(a) drilled full size; or

(b) reamed to full size after sub‑drilling or sub‑punching at least 3 mm undersize; or

(c) machine thermal cut to full size, and shall be pierced within the removed material.

Slotted holes may be either:

(a) machine thermal cut, and shall be pierced within the removed material; or

(b) formed by drilling two adjacent holes and completed by machine flame or plasma cutting.

Hand thermal cutting of holes shall not be permitted.

Punching of holes to full size will not be permitted for any grade of steel. Sub‑punching will only be permitted in grade 250 steel and only in material less than 20 mm in thickness. Sub‑punching will not be permitted for Grade 250 L15 or for any higher grade of steel.

All holes shall be cylindrical and perpendicular to the face of the member. The nominal diameter of a completed hole other than a hole in a base plate shall be 2 mm larger than the nominal bolt diameter for a bolt not exceeding 24 mm in diameter, and not more than 3 mm larger for a bolt of greater diameter.

All holes shall be located so that after the holes have been reamed or drilled, 85% of the holes in any group shall show no offset greater than 1 mm between adjacent thicknesses of metal. Connecting parts shall be assembled and held securely while being drilled or reamed and shall be match-marked before separating the parts. All burrs shall be removed, including if necessary taking apart assembled parts for the removal of burrs caused by drilling and reaming.

An oversize or slotted hole shall be permitted, provided that the requirements for and limitations on use of oversize and slotted holes comply with AS/NZS 5131 – *Holing* shall apply, including plate washer thickness, dimension and coverage requirements.

630.13 WELDING

All welding shall be in accordance with AS/NZS 1554.1. Weld category SP of AS/NZS 1554.1 shall apply when Part 1 is applicable, unless otherwise specified on the drawings or within this specification.

All welding of studs shall comply with AS/NZS 1554.2.

All welding of reinforcing steel shall comply with AS/NZS 1554.3.

All welding of quenched and tempered steels shall comply with AS/NZS 1554.4 and the fabrication shall comply to the intent and relevant clauses and tables of Section 630.

All welding, where category FP is required for welds subject to high levels of dynamic loading, shall comply with AS/NZS 1554.5 and the fabrication shall comply to the intent and relevant clauses and tables of Section 630.

All welding of stainless steel, including the welding of stainless steel to structural steel, shall be carried out to the relevant category of AS/NZS 1554.6 and the fabrication shall comply to the intent and relevant clauses and tables of Section 630.

630.14 WELDING PROCEDURE QUALIFICATION

For the purpose of qualification, welding procedures include procedures for the welds detailed on the drawings, welds joining sub-lengths of material, field or site welding, stud shear connector welding and tack welding.

All welding procedures shall be qualified through a Welding Procedure Specification (WPS) as follows:

(a) all Category SP welds, including, but not limited to, flange butt welds, T-butt welds, partial penetration welds, corner welds, field splice welds, web to flange welds and all tack welds for these joints – using one of methods (b), (c) or (d) of Clause 4.2 of AS/NZS 1554.1;

(b) all stud welding - AS/NZS 1554.2, Section 4;

(c) When specified, all Category FP welds – using one of methods (b), (c) or (d) of Clause 4.2 of AS/NZS 1554.5;

(d) other welds (Category GP) ‑ Clause 4.2 of AS/NZS 1554.1.

The welding of all test pieces required for qualification using method (c) or (d) of Clause 4.2 of AS/NZS 1554.1 shall be done under the direct supervision of the Welding Supervisor, and may be witnessed by the Surveillance Officer.

Welding Procedure Qualification Tests shall be carried out in accordance with the requirements for ‘Weld Category SP’ of AS/NZS 1554.1 *– Table for Required Extent of Testing*. These tests shall be performed on test pieces cut from a weld test plate of the full section under consideration and with a minimum welded length of 300 mm, except for a built-up girder web to flange connection in which case the test piece shall be cut from a welded test plate of a minimum welded length of 2000 mm.

When fillet welds are the subject of welding procedure qualification, a fillet break sample shall be prepared from the test plate and tested as described in AS/NZS 2205.4.1. A photograph, at a magnification of x1 or greater, of the fracture surface shall be provided in the test report. The assessment shall be made in accordance with AS/NZS ISO 5817 – Quality Level B.

Welding procedures previously qualified and used on other work shall be deemed qualified for use upon certification of the relevant documentary evidence by the Surveillance Officer, provided that:

(a) the procedure is being used within the limits of changes in essential variables permitted by AS/NZS 1554.1 and within the limits of the Welding Procedure Specification; and

(b) all qualification documents as required by AS/NZS 1554.1 are available to support the procedure qualification record; and

(c) non-destructive examination records are available to demonstrate successful use of that procedure.

HP - 9 **Documentary evidence of the results of welding procedure testing, assessment against the acceptance criteria, and an approved Welding Procedure Specification (WPS and PQR) for each of the weld procedures to be used in the welding of the steelwork shall be submitted to the Superintendent for review at least five working days prior to commencement of welding.**

HP - 10 **A photograph of the etched surface of all weld macro‑tests, to AS 2205.5.1, at a magnification of x1, or greater, shall be submitted to the Superintendent with the test results.**

630.15 WELDING OPERATOR QUALIFICATION

Welders (welding operators) shall be suitably qualified to carry out the welding procedures on which they will be employed. Qualified welders shall either:

(a) have welded the test plate manufactured as part of the weld procedure qualification process; or

(b) satisfy the requirements of AS/NZS 1554.1 – *Qualification of Welding Personnel* and can produce documented evidence of having successfully and consistently produced welds in compliance with Category SP requirements during the previous twelve months; or

(c) demonstrate compliance with Category SP requirements by means of a weld macro test, or ultrasonic or radiographic test, for the welding procedures similar to and representative of those procedures to be used in the contract steelwork, and including any special or restrictive influences.

HP - 11 **Documentary evidence of welding operator qualification through testing or assessment for each of the welding procedures to be used in the welding of the steelwork shall be submitted to the Superintendent for review at least five working days prior to commencement of welding.**

630.16 SPECIFIC WELDING REQUIREMENTS

All welding consumables shall be stored, handled and used in accordance with AS/NZS 1554.1 and in accordance with the recommendations of the manufacturer.

Preparation, assembly, preheating and welding shall be carried out in accordance with the relevant sections of AS/NZS 1554.1, as specified, and the following requirements:

1. Hydrogen-controlled welding processes, as defined in AS/NZS 1554.1, shall be used for all butt welds for flange and web splices in main girders, gantry beams and columns, for splices in bridge barrier railing, for T-butt welds, and for extending members when permitted at clause 630.07.
2. Hydrogen-controlled electrodes shall be used for all manual metal arc butt welds, in accordance with the selected manufacturer’s requirements.
3. Preheat temperatures shall be confirmed by contact thermometers, non-contact thermometers or temperature indicating crayons. Preheat temperatures shall be confirmed if welding is suspended for more than 20 minutes, and if necessary further preheating shall be applied.
4. Minimum length of tack weld shall be 50 mm for a 5 mm fillet weld or 80 mm for a 4 mm fillet weld.
5. Any and all tack welds and all fit-up or aligning or temporary attachment welds shall be made using a qualified welding procedure. Where possible, tack welds should be made within the weld joint and consumed by the production welding of the joint.
6. Suitable run‑on and run‑off tabs shall be used for all butt welds and web to flange fillet welds. Each weld pass shall be terminated on the run‑on/run‑off tabs at least 20 mm beyond the edge of the parts to be joined.
7. When required by the WPS, root runs of double-sided butt welds shall be back-gouged sufficient to ensure full penetration. A 20% sample of back-gouged preparations shall be visually inspected for the absence of unsound metal and reported.

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1. For all welds, the maximum size of electrode shall be 5 mm. Where the proposed welding procedure includes the use of more than one electrode simultaneously in the weld pool, such procedure shall be validated by the welding procedure qualification.
2. The maximum size of fillet weld which may be made in one pass shall be validated by the welding procedure qualification.
3. The suitability of the deposited thickness of a single layer of weld metal, whether deposited in one pass or made up of several parallel beads, shall be validated by the welding procedure qualification.
4. When welding in the vertical position the direction of welding for all passes shall be upward. For all vertical up welding, the width of the deposited weld metal shall not exceed 12mm.
5. Exposed faces of welds shall be made reasonably smooth and regular and comply to ISO 8501.3, Treatment Grade P3, where protective coating is to be applied, unless weld quality as in Table 6.2.2 allow otherwise..
6. Weld size shall conform as closely as practicable to specified dimensions and shall not at any place be less than the specified dimensions.
7. Butt weld run‑on and run‑off tabs shall be removed after the joint has cooled and the ends of the weld shall be finished smooth and flush with the faces of the abutting parts.
8. Butt welds shall be finished smooth and flush with abutting surfaces where required for assembly, or where specified on the drawings, or where the welds are on the exterior faces of exterior girders.
9. All welds not specified on the drawings, including tack welds, welds for temporary attachments, arc strikes and similar shall be made using a qualified welding procedure (WPS). When these welds, and defects such as arc strikes, occur on external or accessible surfaces, they shall be dressed flush with the surrounding steel, without under-flushing. Magnetic particle inspection or liquid penetrant inspection shall be carried out on the repaired areas in accordance with Table 630.182. Welds containing imperfections exceeding the limits in Table 6.2.2 of AS/NZS 1554.1 shall be repaired.
10. All weld spatter shall be removed from the surfaces of the weld and the parent metal.
11. Stud welding and stud shear connectors shall comply with the requirements of AS/NZS 1554.2.
12. Ground or earth clamps shall be connected directly to the work piece being welded.

630.17 VISUAL INSPECTION OF WELDS

The extent of visual scanning and visual inspection of welding shall be in accordance with Table 630.171. The acceptable limits for imperfections shall be in accordance with Table 6.2.2 of AS/NZS 1554.1. Lengths of weld containing the imperfections exceeding the limits in Table 6.2.2 of AS/NZS 1554.1 shall be repaired. The repair procedure shall be submitted to the Superintendent for review at least five working days prior to commencement of repair work.

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| **Table 630.171 Extent of Visual Scanning and Visual Inspection of Welding** |
| **Method** | **Location of Weld** | **Percentage of Total Length or Number** |
| Visual scanning of all welds (a) | All welds | 100% |
| Visual inspection of Category SP welds (b) | Butt welds, T-butt welds, including column to base plateWeb to Flange SplicesButt or T‑butt splices between RHS, SHS or CHS sections; or hot-rolled open sections | 50% |
| Field Butt Welds | 100% |
| Column or post to base plate fillet welds | 30% |
| Other Welds | as specified in the special clauses; oras required to demonstrate compliance with the limits for imperfections |
| (a) Visual scanning – to determine that all welds called for in the drawings are included and to detect gross defects.(b) Visual examination – to examine a percentage of the welds, to determine whether the required weld quality has been achieved. |

630.18 NON-DESTRUCTIVE INSPECTION / EXAMINATION OF WELDS

The extent of non‑destructive inspection using the methods of radiography, ultrasonics, magnetic particle, or liquid penetrant shall be in accordance with Table 630.181 and Table 630.182.

All welds shall comply with the acceptance limits for Category SP imperfections in welds given in Table 6.2.1 or Table 6.2.2 of AS/NZS 1554.1, unless noted otherwise on the drawings. Lengths of weld containing imperfections exceeding the limits in Table 6.2.1.or Table 6.2.2 of AS/NZS 1554.1 shall be repaired. The repair procedure shall be submitted to the Superintendent for review for at least three working days prior to commencement of repair work. The full lengths of repaired weld shall be re-inspected.

HP - 12 The Contractor shall submit test certificates for all non‑destructive inspections and dimension inspections to the Superintendent for **review at least two days prior to the steelwork being transported for protective treatment.**

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| **Table 630.181 Extent of Non-Destructive Examination by Ultrasonics or Radiography** |
| Method: Ultrasonic Examination (UT), to AS/NZS 1554.1, Clause 6.4 (references AS 2207), or Radiography (RT), to AS/NZS 1554.1, Clause 6.3 (references AS 2177)  |
| **Weld Location or Component (as appropriate to Design)** | **Minimum Extent of Examination for each weld length** |
| Girder, beam or column flange butt joints | 100%, full length |
| Web butt joints | 25% (300 mm on tension side of each web butt) |
| All field butt splice joints | 100% |
| Web to flange butt joint ‑ T‑butt welded (1) | 20% of each weld length, comprising:* 500 mm each side of all diaphragms, and
* 1000 mm at all weld ends, and

intermediate portions to make up inspected length. |
| Web to flange splices ‑ fillet welded (2), for welds incorporating steel Grade 350, or a higher steel grade, in flange plates 25 mm or thicker.(This does not apply to welded beams manufactured to AS/NZS 3679.2) | First girder – 100% of length at flange thickness 25 mm or greaterSubsequent girders – at least 20% of the total weld length, comprising:* 500 mm each side of all diaphragms, and
* 1000 mm at all weld ends, and
* intermediate portions to make up inspected length.
 |
| Column to base plate butt welded joint of cantilever signs, sign gantries and lighting towers or masts | 100% |
| Butt or T‑butt splices between: * rolled or fabricated RHS, SHS or CHS sections; or
* hot rolled open sections
 | 50% where backing material is not used25% where backing material is used |
| Barrier railing - posts to base plate T‑butt weld | 50% of number, for posts where backing material is not used. If more than one post weld is found defective, test 100% of the welds.20% of number, for posts where backing material is used in the joint. If more than one post weld is found defective, examine a further 20% of welds. |
| Butt - welded splices between barrier rail lengths | 50% where backing material is not used25% where backing material is used, for example as an inserted sleeve. |
| Welds attaching lifting brackets or loops | 100% |
| Butt and T‑butt welds, including welds to repair or make up member lengths | 50% of total weld length |
| Other butt welds | Either: (a) As specified in the contract documents, or (b) As required to demonstrate compliance with the limits for imperfections, noting that the minimum extent of inspection shall be not less than 10% of weld length |
| Notes: 1. The same length portions shall be inspected using both surface methods and ultrasonic or radiography methods.
 |
| 1. For UT of web to flange fillet welds:
2. UT shall be carried out in conformity to AS 2207 – UMD 2, and Appendix F7, modified for testing of fillet welds.
3. For the first girder, 100% of the total web to flange weld length for flange thickness 25 mm or greater shall be examined for all welds
4. For the remaining girders, 20% of the total web to flange weld length for flange thickness 25 mm or greater shall be examined for all welds.
5. When defects are found, the proportion of the weld length examined shall be increased to 100% to ensure detection of all defects.
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| **Table 630.182 Extent of Non-Destructive Examination by Surface Methods**  |
| Method: Magnetic Particle, to AS/NZS 1554.1, Clause 6.5 (references AS ISO 9934.1), or Liquid Penetrant, to AS/NZS 1554.1, Clause 6.6 (references AS ISO 3452.1) |
| Weld Location or Component (as appropriate to Design) | Minimum Extent of Examination for each weld length |
| Stiffener welds at crucifix locations  | 100%  |
| Field-welded or site-welded butt joints  | 100%  |
| Stiffener fillets at site joints  | 100%  |
| Edges of flange butt joints  | 100%  |
| Web to flange fillet welds and T-butt welds (1) (2) | 20% of each weld length on each girder (1), including at least 1000 mm at: * all ends of welds, and
* support points, and
* diaphragm locations, and
* intermediate portions to make up inspected length
 |
| All T butt welds and multi-pass fillet welds to tension flanges (e.g. stiffeners, diaphragms or diaphragm stiffeners) (2) | 100%  |
| T butt welds and fillet welds to: * barrier railing post to base plate
* compression flange or web plates (e.g. stiffeners, diaphragms or diaphragm stiffeners);
* diaphragm stiffener to diaphragm;
* end plates to tension flange, compression flange and web plate
 | 20% of total number of units – where each unit is 100 % examined (eg, barrier railing post),  |
| Repaired defects in base metal  | 100% |
| Remaining weld after removal of defective weld | 100% |
| Repaired or replaced weld, including temporary welds and arc strikes | 100% |
| All tack welds not consumed in production welds | 100% |
| All other welds  | Either: (a) As specified in the contract documents, or (b) The maximum of AS/NZS 1554 recommendations  |
| Notes: 1. The same length portions shall be inspected using both surface methods and ultrasonic or radiography methods. |
| 2. After three consecutive girders have been welded without defects or repairs to any web to flange weld, surface method examination frequency may be reduced, after approval from the Principal, to one weld on each girder. If multiple defects (> 1) requiring repair are found subsequently, in an individual web to flange weld, test frequency shall revert to the specified rate of 20% of each weld length on each girder, until a further application to reduce the frequency of test is approved. |

 Note: The percentage of total length is applied to the number of items, with each item fully inspected.

Where the total of defective portions exceeds 10% of the weld length initially inspected as per Table 630.181 or Table 630.182, the total weld length for that weld detail shall be then be inspected on that component, unless 100 % of that weld has been initially examined.

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630.19 STUD SHEAR CONNECTORS

Stud shear connectors and the welding of these shall conform to the requirements of AS/NZS 1554.2. After welding, testing shall be carried out as detailed in Table 630.191.

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| **Table 630.191 Stud Welding Test Requirements** |
| **Method** | Weld Location or Component (as appropriate to Design) | Minimum Extent of Examination for each weld length or number |
| Daily preproduction test:Stud welded shear connectors | All members with stud welds | Daily preproduction test, AS 1554.2, Section 4, including hammer bend test to 30° of first two stud welded shear connectors, or as necessary. |
| Visual scanning of all stud welds | All welds | 100% |
| Stud weld ring test, made using a steel 1 kg hammer, swung freely to strike the stud in two opposite directions | All stud welds | 100%, each stud shall give a clear ring.All studs which do not give a clear sound in the ring test shall be subjected to the 10° bend test. |
| Stud welded shear connector – 10° bend test | All members with stud welds | 5% of studs on each member (1 in each 20), including studs with missing weld flash.Studs with less than 360° of weld flash shall be bent 10° in a direction opposite to the missing portion of the flash.If any stud fails, all studs on the member or element shall be visually inspected and any stud with less than 360° of weld flash shall be tested. |

630.20 INTERNAL COMPONENTS – PRE-CLOSURE INSPECTION

**HP - 13 All sub-components that form the internal components of a gantry (ie fixing plates, diaphragms, gussets, stiffeners, conduits for cabling, etc) shall be checked and verified for location and dimensions as a pre-closure inspection, prior to attaching and welding the last plate to a fabricated box section (column or beam). This inspection shall be carried out by a person (the Surveillance Officer) accredited for surveillance of structural steelwork to VicRoads Technical Bulletin TB 46 by an organisation certified to AS/NZS ISO/IEC 17020.**

Minimum inspection requirements include:

1. Live stream video, as a non-stop recording (ie no edit cuts), of the beam box internal sections prior to the fitting of the last plate. The video stream shall show the exact location of all gussets, diaphragms and stiffeners including covering welds;
2. Detailed photos of the measured location of all components such as internal gussets, stiffeners and diaphragms;
3. The video stream and the photos shall include gantry identifiers and shall be accurately time/date stamped;
4. Any non-conformance to drawings shall be notified to the contractor for resolution.
5. Report these pre-closure details for each gantry separately. Where pre-closure of a gantry is inspected on different days, the report shall clearly identify what portions were inspected on each day; and
6. This information shall also form part of the Fabricator’s Data Report (see Clause 630.22).

630.21 BOLTING

1. Supply of Steel Fasteners (bolts, nuts washers)

All bolts and associated nuts and washers shall comply with the appropriate bolt material standard specified on the drawings.

The supply of all bolts, nuts, screws, washers, studbolts and threaded rods for steelwork shall be in accordance with Austroads Technical Specification ATS 5420 (ATS 5420 is available from the Austroads website).

Bolts, nuts and washers for Property Class 4.6/S bolting shall be supplied in accordance with AS 1110.1, AS 1110.2 and AS 1112.1.

Bolts, nuts and washers for Property Class 8.8 structural bolting shall be supplied in accordance with AS/NZS 1252.1. When appropriate, an alternative structural bolting assembly, or an additional structural bolting assembly, complying with AS/NZS 1252.1 may be used.

**HP - 14 The Contractor shall submit to the Superintendent the bolt manufacturer’s Certificate of Product Compliance and all related test certificates demonstrating compliance of the supplied bolt assemblies to the relevant bolt product standards: AS/NZS 1252.1, AS 1110.1, AS 1110.2 and AS 1112.1, as appropriate , and including assembly testing to AS/NZS 1252.1 when appropriate.
The test certificates shall be related to the bolts by manufacturer or supplier, batch and heat number, and manufacturing lot number.**

1. General requirements for installation of bolting

 All bolting and mechanical fastening shall be in accordance with AS/NZS 5131, Section 8, and the following requirements.

**HP - 15 A documented work method statement (WMS) shall be prepared for each bolting operation.
The bolting WMS shall include the fastener requirements, the results of slip factor testing for high friction joints, a snug-tightening sequence, a high-friction tensioning sequence when appropriate, processes for assessment against the acceptance criteria, and when appropriate the specific requirements for use of direct tension indicating devices given in clause 630.20(f)(ii).
The bolting WMS for each of the procedures to be used in the bolting of the steelwork shall be submitted to the Superintendent for review at least five working days prior to commencement of bolting.**

 Bolts and nuts shall not be welded.

All material within the grip of the bolt shall be steel and no compressible material shall be permitted within the grip. Each bolt and nut shall be assembled with at least one washer. One washer shall be provided under the rotated part.

Bolts shall be installed to minimize corrosion, particularly of bolt threads. Where practicable:
- Vertical bolts shall be installed with the bolt head at the top of the connection, and
- Bolt heads shall face the external or more corrosively exposed surface.

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 Locknuts or half nuts, when specified, shall be placed between the main nut and the components being gripped. Locknuts or half nuts shall be installed when the 4.6/S or 8.8/S bolted connection has a risk of vibration loosening

 The length of a bolt shall extend entirely through the nuts and be such that at least one clear thread shows beyond the nut, but not more than 12 mm beyond the nut. The shank of a bolt shall be threaded to such a length that not less than five threads shall be within the grip of the bolt after snug tightening.

 All bolts, nuts and washers shall have a protective coating, unless otherwise specified. The coating on hot-dip galvanized bolts and nuts shall comply with AS/NZS 1214. The coating on hot-dip galvanized washers shall comply with AS/NZS 1214 or AS/NZS 4680.

 Where bearing faces of bolted parts are not parallel and exceed a taper of 1:20, a suitably tapered washer shall be provided against the tapered surface and placed under the non‑rotating component where possible.

1. Preparation of surfaces in contact

 All oil, dirt, loose scale, loose rust, burrs, fins and any other defects on the surfaces of contact, that will prevent solid seating of the parts in the snug-tight condition, shall be removed.

 For a friction-type connection, the contact surfaces shall be clean as-rolled surfaces or equivalent and, in addition to satisfying the provisions above, shall be free from paint, lacquer, galvanizing or other applied finish unless the applied finish has been tested to establish the friction coefficient or slip factor (refer to As/NZS 5131, clause 9.9.9 for guidance on masking).

 Values of slip factor for clean steel surfaces and abrasive blasted surfaces coated with zinc silicate coating are given in AS 5100.6. Slip factor for other surfaces shall be evaluated in accordance with the standard test referenced in AS 5100.6.

 The surface preparation described in the slip factor test shall be used for production bolting. Other coatings, including overspray shall not be closer than one bolt diameter to any holes of the contact surfaces of high friction joints.

1. **Assembly and Alignment of Connections to Snug Tight Condition**

 Each part of the structure shall be aligned as soon as practicable after erection. Permanent connections shall not be made until sufficient of the structure has been aligned, levelled, plumbed and temporarily connected to ensure that members will not be displaced during subsequent erection or alignment of the remainder of the structure.

 Hardened or plate washers shall be used under both the bolt head and nut for any slotted and oversize holes. The requirements of clause 6.7.4 of AS/NZS 5131 for limitations on use of oversize and slotted holes apply.

 Bolting categories 4.6/S and 8.8/S shall be installed to the snug-tight condition to ensure that the load-transmitting plates are brought into effective contact. Snug-tight is the tightness attained by a few impacts of an impact wrench or by the full effort of a person using a standard podger spanner.

 All workshop-assembled joints should be match marked before the structure is dismantled.

1. Assembly of a Connection involving Tensioned Bolts

 This sub-clause applies to bolting categories 8.8/TB and 8.8/TF.

 The minimum thickness of material within the grip of the fastener for friction-type connections must not be less than the diameter of the bolt. Additional washers may be used in accordance with AS/NZS 5131, clause 8.2.4.

 Bolts, nuts and washers shall be supplied in accordance with AS/NZS 1252.1. They shall be placed so that the marks identifying a high strength fastener are visible after tightening.

 Nuts for high strength bolts shall be of the double faced or washer faced hexagon type.

 Bolts and nuts shall always be tightened in accordance with a prescribed sequence. Where the sequence is not shown on the drawings a staggered pattern shall be adopted with tightening proceeding from the most rigid part (typically the centre) of the joint out towards the free edges.

 Bolt heads and nuts shall be tensioned and the nuts shall be effectively locked where specified.

 High strength structural bolts that are to be tensioned may be used temporarily during erection to facilitate the assembly. However, if so used, they shall not be finally and fully tensioned until all bolts in the connection have been snug-tightened in the correct sequence.

 The slackening off and re‑tensioning of fully‑tightened bolts is not permitted. Bolts shall not be re‑used in another hole.

 Adjusting tension of previously tensioned bolts that may have been loosened by the tensioning of adjacent bolts is not considered as re‑tensioning.

1. Method of Tensioning

 All bolts shall be tensioned by rotation of the nut either by the ‘part‑turn’ method or by the use of a direct‑tension indicator device to produce, on completion of the joint, to not less than the minimum bolt tension appropriate to the particular bolt diameter as specified in Table 630.201.

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| **Table 630.201 Minimum Bolt Tension** |
| **Nominal Bolt Thread Diameter** | **Minimum Bolt Tension (kN)** |
| **Grade 8.8** | **Grade 10.9 #** |
| M16 | 95 | 130 |
| M20 | 145 | 205 |
| M24 | 210 | 295 |
| M30 | 335 | 465 |
| M36 | 490 | 680 |
| # - Requires evidence from a direct tension indicator device that the part-turn method can develop the required bolt tension |

 **(i) Part-Turn Method of Tensioning**

On assembly, all bolts in the connection shall be first tightened to the snug-tight condition to ensure that the load-transmitting plates are brought into effective contact.

The relative position of the bolt and nut shall be established by permanent mark. The mark shall start at the bolt centre and extend in a straight line out and across the nut face to a nut point.

Bolts shall be finally tensioned by rotating the nut by the amount given in Table 630.202.

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| **Table 630.202 Nut Rotation for Full Tensioning from the Snug-Tight Condition** |
| **Bolt length****(underside of head to end of bolt)** | **Disposition of outer face of bolted parts (Notes 1, 2,3 & 4)** |
| **Both faces normal to bolt axis** | **One face normal to bolt axis and other sloped** | **Both faces sloped** |
| Up to and including 4 diameters | 1/3 turn | 1/2 turn | 2/3 turn |
| Over 4 diameters but not exceeding 8 diameters | 1/2 turn | 2/3 turn | 5/6 turn |
| Over 8 diameters but not exceeding 12 diameters | 2/3 turn | 5/6 turn | 1 turn |
| Exceeding 12 diameters | Determine by test (note 5) |

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| Notes: | 1 | Tolerance on rotation for ½ turns or less, one-twelfth of a turn (30°) over and under tolerance; for ²/3 turns or more, one-eighth of a turn (45°) over and nil under tolerance. |
| 2 | The bolt tension achieved with the amount of nut rotation specified in Table 630.201 is deemed to be at least equal to the minimum bolt tension specified in Table 630.202. |
| 3 | Nut rotation is the rotation relative to the bolt, regardless of the component turned. |
| 4 | The nut rotations specified are only applicable to connections in which all materials within the grip of the bolt are steel. |
|  | 5 | Determine the required rotation by actual test in a suitable tension measuring device which simulates the conditions of solidly fitted steel plies. A suitable test is AS/NZS 1252.1, Appendix D. |

 **(ii) Direct‑Tension Indicator Device**

**HP - 16 Approval to use direct-tension indicator devices shall be obtained from the Superintendent at least 14 days prior to the use of such devices on bolting on the steelwork.**

When their use is approved, direct-tension indicator devices shall be used in accordance with the device manufacturer’s instructions and AS/NZS 5131, clause 8.5.7. A minimum of two calibration tests using a calibrated bolt tension gauge shall be carried out on each day that direct-tension indicator devices are used. The documented WMS prepared for the bolting operation at clause 630.20(b) shall detail the use of the direct-tension indicator device, how calibration to the particular bolting application is demonstrated, the checking of the applied torque using a calibrated torque checker (e.g. The Skidmore-Wilhelm tester or the Norbar TruCheck 2), and the Skidmore-Wilhelm tester criteria for acceptance of a tensioned bolt.

Where compressible washer-type direct tension indicating devices are used, they shall comply with AS/NZS 5131, clause 8.5.8.

630.22 MANUFACTURER’S DATA PACK

During the construction of the Works, the Contractor must:

* compile all technical details and records of activities into the Fabricator’s Data Report (FDR, alternatively referred to as the Manufacturer’s Data Pack);
* keep the FDR up to date so that its submission on completion of the Works is not delayed;
* ensure that all documents in the FDR are indexed to Section 630, in English, use SI units and are legible;

At a minimum, the FDR must include all information under the following headings:

1. Structure or component name, identification and intended location for erection;
2. Name and address of fabricator;
3. Relevant drawings approved for construction
4. Fabrication specific procedures included in the QUALITY PLAN;
5. Inspection and test plans (ITPs) and documents detailed within the ITP
6. Qualification of relevant fabrication personnel (Welding Coordinator, Welding Supervisor, Welding Inspector, NDT operator and welders);
7. Any deviations from the Specification and the corresponding approval for the deviation;
8. Material test certificates, including for steel supplied to the Works, and for bolts, nuts and washers;
9. Welding records, including weld maps, welding procedure specifications, welding procedure qualification records and relevant test certificates, welder qualification records, and welding consumable certificates;
10. Non-Destructive Examination reports;
11. “As constructed” drawings of the fabricated members;
12. Nonconformity reports and outcomes of corrective actions;
13. Trial assembly records;
14. Instrument calibration certificates;
15. Inspection and testing records, including measurements of dimensions compared with relevant tolerances;
16. Pre-closure inspection records, when appropriate;
17. Delivery/dispatch records.

**HP – 17 The FDR must be submitted to the Principal in digital format, within four weeks of completion of the fabrication work. If requested by the Principal, the Contractor must also submit a hard copy, using A4-size binders with file separators clearly separating each section, with a detailed table of contents at the front of each binder.**