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# BEAK Engineering (Aust) Pty Ltd Engineering Manual


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Revision: L

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Dated: 14 May 2018

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	<b>ENGINEERING MANUAL</b>		<b>1.1-MAN-5</b>
	Rev: L_14/05/2018	Owner: Engineering/WA Manager	

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## Approvals

The signatures below certify that this manual has been reviewed and accepted, and demonstrates that the signatories are aware of all the requirements contained herein and are committed to ensuring their provision.

	Name	Signature	Position	Date
Reviewed by	Paul Lavall		WA Manager	14/05/2018
Approved by	Paul Lavall		WA Manager	14/05/2018

## Amendment Record

This procedure reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual additions or omissions is given below:

Page No.	Context	Revision	Date
Numerous	Header updated to new format. Company name changed to BEAK Engineering (Aust) Pty Ltd (Aust) Pty Ltd. All reference to CEO has been changed to Managing Director. Production Manager changed to Operations Manager (CAPA 822).	H	18/05/2015
Cover page, Header, 3, 5, 6, 7, 11, 12 & 39	Updated under CAPA 1008. Entire Manual has been reviewed & updated by the Senior Mechanical Engineer. Sections 3 & 4 have been updated. New Section 13 added. (Note: engineering does not use the letter I in revisions to avoid any confusion, hence this new Rev is Rev J)	J	19/07/2016
12 & 13	Updated under Document Amendment #312. <b>(1)</b> Page 12, Table 4.2 updated sections Welded/Fabricated items & Machined items <b>(2)</b> Header updated: Owner changed to Mechanical Engineer	K	11/07/2017
11, 37	Updated under Document Amendment #638: Section 4.2 updated to include plated type coatings. Section 12.5 added to detail electroless nickel plating Section 12.6 added to detail zinc plating Section 12.7 added to detail galvanising	L	14/5/2018

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## 1. General

This specification covers the requirements for the fabrication, welding of mechanical steelwork, such as (but not limited to) chassis frames, support structures and towing connections, including materials, inspection and testing, fabrication, bolting, welding and surface treatment of Beak equipment.

As part of BEAK Engineering (Aust) Pty Ltd's (BEAK) continuous improvement philosophy we welcome and invite all suppliers to critique this document and to offer suggestions, corrections or improvements to its contents

## 2. Abbreviations

The abbreviations listed below, where used in this specification, shall have the following meanings:

- ADR                    Australian Design Rules (Note: These rules are Mandatory requirements)
- AS                     Australian Standard
- SAA                    Standards Association of Australia
- AS/NZS               Australian Standard / New Zealand Standard
- WTIA                  Welding Technology Institute of Australia
- NATA                  National Association of Testing Authorities
- AINDT                Australian Institute of Non Destructive Testing
- ITP                     Inspection & Test Plan

## 3. Regulations, Legislation & Standards

The latest revision of the following documents shall form part of this specification and shall apply wholly or partially as the case may be and as necessary for the performance of work. All sub-contractors shall advise the nominated Beak engineer in writing of any of the requirements of this specification that are of a lower standard than the local standard or the contractor's standard practice.

Local or international standards with requirements equal to or greater than the standards nominated herein may be applied with the written approval of the Beak engineer. In the event of inconsistencies between documents, drawings or reference standards pertinent to all works, the more stringent requirements shall apply unless approved otherwise in writing by the Beak engineer.

Table 3.1 - List of Regulations, Legislation and Standards

<b>Standard</b>	<b>Title</b>
AS 1100	Technical drawing - Mechanical engineering drawing
AS 1101.1	Graphic symbols for general engineering - Hydraulic and pneumatic systems
AS 1101.3	Graphical symbols for general engineering - Welding and non-destructive examination
AS 1110.1	ISO metric hexagon bolts and screws - Product grades A and B - Bolts
AS 1110.2	ISO metric hexagon bolts and screws - Product grades A and B - Screws
AS 1111.1	ISO metric hexagon bolts and screws - Product grade C - Bolts
AS 1111.2	ISO metric hexagon bolts and screws - Product grade C - Screws
AS 1112.1	ISO metric hexagon nuts - Style 1 - Product grades A and B
AS 1112.2	ISO metric hexagon nuts - Style 2 - Product grades A and B
AS 1112.3	ISO metric hexagon nuts - Product grade C
AS 1112.4	ISO metric hexagon nuts - Chamfered thin nuts - Product grades A and B
AS 1163	Structural steel hollow sections
AS 1171	NDT - Magnetic particle testing of ferromagnetic products, components and structures
AS 1237.1	Plain washers for metric bolts, screws and nuts for general purposes - General plan
AS 1237.2	Plain washers for metric bolts, screws and nuts for general purposes - Tolerances
AS 1275	Metric screw threads for fasteners
AS 1403	Design of rotating steel shafts
AS 1442	Carbon steels and carbon-manganese steels - Hot-rolled bars & semi-finished products
AS 1627	Metal Finishing – Preparation and Pre-Treatment of Surfaces
AS 1721	General purpose metric screw threads
AS 1796	Certification of welders and welding supervisors
AS 1831	Ductile cast iron
AS 1897	Electroplated coatings on threaded components - metric coarse series



<b>Standard</b>	<b>Title</b>
AS 2062	NDT - Penetrant testing of products and components.
AS 2074	Cast steels
AS 2213.1	Commercial road vehicles - Mechanical connections between towing vehicles
AS 2214	Certification of welding supervisors - Structural steel welding
AS 2321	Short-link chain for lifting purposes
AS 2741	Shackles
AS 2848.1	Aluminium and aluminium alloys - Compositions and designations - Wrought products
AS 2980	Qualification of arc-welders for welding of steels
AS 2987	General Conditions of Contract - Equipment Supply
AS 3715	Metal finishing - Thermoset powder coating for architectural applications of aluminium
AS 3990	Mechanical equipment - Steelwork
AS 4000	General Conditions of Contract
AS 4024	Safety of Machinery
AS4100	Steel Structures
AS 4177.1	Caravan and light trailer towing components – Tow bars and towing brackets
AS 4177.4	Caravan and light trailer towing components - Safety chains up to 3500 kg capacity
AS 4177.5	Caravan and light trailer towing components - Electrical connectors
AS 4506	Metal finishing - Thermoset powder coatings
AS 4738.1	Metal castings - Ferrous sand moulded
AS 5066	Tolerances for ISO metric bolts, screws, studs and nuts - Product grades A, B and C
AS/NZS 1102.107	Graphical Symbols - Switchgear control gear
AS/NZS 1170.1	Structural design actions - Permanent, imposed and other actions
AS/NZS 1554	Structural steel welding set (parts 1, 2, 3, 4, 5, 6 & 7)
AS/NZS 1594	Hot-rolled steel flat products
AS/NZS 1595	Cold-rolled, unalloyed, steel sheet and strip
AS/NZS 1665	Welding of aluminium structures
AS NZS 1734	Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate
AS/NZS 1866	Aluminium and aluminium alloys - Extruded rod, bar, solid and hollow shapes
AS/NZS 3678	Structural steel - Hot-rolled plates, floor plates and slabs

AS/NZS 3679.1	Structural steel - Hot-rolled bars and sections
<b>Standard</b>	<b>Title</b>
AS/NZS 4291.2	Mechanical properties of fasteners - Nuts with specified proof load values - Coarse thread
AS/NZS 4680	Hot-dip galvanized - zinc - coatings on fabricated ferrous articles
AS/NZS 4600	Cold Formed Steel Structures
AS/NZS 4673	Cold-formed stainless steel structures
AS/NZS 2310	Glossary of coat & coating terms
AS/NZS 2312	Guide to the protection of Iron and Steel against corrosion
AS 2700	Colour standards
AS 3750	Coats for steel structures
ADR 13-00	Lighting
ADR 38-03	Trailer Brakes
ADR 42-04	General Safety
ADR 43-04	Configuration & dimensions
ADR 44-02	Vehicle requirements
ADR 47-00	Reflectors
ADR 48-00	Rear Plate illumination
ADR 49-00	Lamps
ADR 61-02	Vehicle marking
ADR 62-02	Mechanical connections
REG # 202	Motor Vehicle Standard Regulation – Commonwealth of Australia Legislation
DIN EN ISO 7040	Prevailing torque type hexagon nuts - with non-metallic insert - style 1 – Property class 5,8 &10
ISO 2768-1	General tolerances – Part 1-Tolerances for linear & angular dimensions without individual tolerance indications
ISO 2768-2	General tolerances – Part 2- Geometrical tolerances for features without individual tolerance indications
ISO 3506.1 & 2	Mechanical Properties of Corrosion Resistant Stainless Steel Fasteners
MIL-C-	
AWS D1.1	Structural Steel Welding Code

International Standards with requirements equal to or greater than the corresponding Australian Standards may be applied with the written approval of the Beak engineer.

Where works may be performed outside of Australia, any sub-contractor shall comply with all applicable International and National Acts, By-laws and Regulations.

## **4. Raw Materials & Manufactured Items Conformance Documentation Requirements**

### **4.1 General**

All raw materials, regardless of its use, shall be from an assured source and shall be new and of unused stock and free from splices for the full length between joints, material defects, casting or extrusion defects, through thickness defects and other imperfections that may affect, performance, fit, function or use unless otherwise approved by the Beak engineer. Steel shall be free from rust, pitting and other defects which are likely to impair either its structural capacity, in service performance or the quality of the protective coating system.

### **4.2 Certification Requirements**

All raw materials, regardless of type, shall be supplied with manufacturer's material test certificates or certified reports of tests made by a NATA certified testing laboratory (or by an overseas facility which must be acceptable to the Beak engineer). The manufacturer's certificates shall be made available at time of supply and delivery. The certificate types shall conform to the requirements of Standard EN 10204 Type 2.2.

All finished or part finished, manufactured / welded / machined and coated items shall be supplied with a certificate of conformance. This certificate must detail:

- That the part/item is fully compliant and conforms to purchase order requirements.
- That the part/item is fully compliant and conforms to the supplied engineering drawings and specifications.
- That the part/item is fully compliant and conforms to any other supplementary documentation provided by Beak engineering.
- The part/item is fully compliant and conforms to this specification where applicable.

- The certificate must be signed and endorsed by the supplier authorised and responsible quality representative.
- The certificate must clearly state the part/item part number and description.
- The certificate must clearly state the material certification number.
- The certificate must clearly state applicable drawing numbers.
- Applicable manufacturing process batch or lot traceability numbers.
- Applicable manufacturing dates
- Applicable serial numbers

Materials or items delivered without applicable certification shall be quarantined for a maximum of 7 days. If certification is not forthcoming after this period, the material will be collected by the supplier at their cost and removed from the manufacturing facility. Any costs incurred by Beak (or its affiliated organizations) for the management and control of this quarantined material will be reimbursed by the supplier to Beak.

The type of certification/documentation required shall be as follows:

**Table 4.2 – Minimum Certificate Requirements - Material & Manufactured Items**

Material/Item	Certificate Requirement
Unprocessed Carbon Steel Material	Test Report (with mention of the test results carried out on the basis of non-specific testing and inspection). Document to be validated by the Manufacturer.
Unprocessed Stainless Steel Material	Test Report (with mention of the test results carried out on the basis of nonspecific testing and inspection). Document to be validated by the Manufacturer.
Unprocessed Aluminium Material	Test Report (with mention of the test results carried out on the basis of nonspecific testing and inspection). Document to be validated by the Manufacturer.
Welding Consumables	Test Report (with mention of the test results carried out on the basis of non-specific testing and inspection). Document to be validated by the Manufacturer.
Fasteners	Test Reports shall be in accordance with clause 4.11 & Appendix A or B of this document, whichever is applicable.
Welded/Fabricated Items	Dimensional report detailing all critical (CC) characteristics as detailed by Beak. For all Indal Technologies drawings, all dimensions are regarded as critical characteristics. NDE test reports form a NATA accredited authority. Weld procedure specifications applicable to manufacture. Material certificates of all raw materials used for manufacture. Calibration certificates of all calibrated tools used in the measurement and manufacture. A certificate of conformance as per clause 4.2 of this document.

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Machined Items	Dimensional report detailing all critical (CC) characteristics by Beak. For all Indal Technologies drawings, all dimensions are regarded as critical characteristics. Surface finish report detailing conformance to surface finish requirements as detailed by Beak. Material certificates of all raw materials used for manufacture. Calibration certificates of all calibrated tools used in the measurement and manufacture. A certificate of conformance as per clause 4.2 of this document.
Coated Items	Paint reports as detailed within section 11 & 12 of this document

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All data listed in the certificates and reports shall be shown in SI units, in accordance with AS1100 International System of Units (SI) and its application.

Certificates shall be written in the English language and shall be complete, unambiguous, legible and suitable for electronic scanning. Certificates in other languages will only be accepted if they are supplied with an endorsed English translation by an authority approved by the Beak Engineer.

The Beak engineer will initiate random examination of material certificates to check compliance with these requirements.

#### **4.3 Substitutions of Sections – Fabricated Items**

Substitution of structural steel sections or variation of details shown on the drawings shall not be made without the prior written approval of the Beak engineer.

#### **4.4 Steel Plate**

All steel plate shall be Grade 250 to AS 3678, unless noted otherwise on the drawings.

#### **4.5 Hot Rolled Sections**

All hot rolled sections shall be Grade 300+ unless noted otherwise on the drawings.

#### **4.6 Welded Sections**

All standard welded beams (WB) and welded columns (WC) shall be Grade 300 to AS 3679.2, unless noted otherwise on the drawings (i.e. AS/NZS 3679.2-300).

#### 4.7 Floor Plate

All steel floor plate shall be Grade 250 to AS/NZS 3678, and shall have a raised pattern surface (i.e. AS/NZS 3678-250).

#### 4.8 Hollow Section

All structural hollow sections shall comply with AS 1163. All rectangular and square hollow sections and circular hollow sections shall be grade C350 (i.e. AS1163-C350) unless noted otherwise on the drawings.

#### 4.9 Cold Formed Galvanized Steel Section

Cold formed galvanized steel sections shall be formed from Grade 450 hot-dipped zinc coated steel as specified in AS 1397.

#### 4.10 Aluminium

All Aluminium sheet and flat bar shall be grade 5005 H12 in accordance with AS/NZS 1734. All extruded shapes such as rectangular, square or circular sections as well specialised profiles shall be grade 6061 T6 in accordance with AS/NZS 1866.

#### 4.11 Fasteners

All bolts, washers and nuts shall comply with the relevant Australian Standards and where specified shall be supplied with an anti-corrosion treatment comprising one of the following systems, as specified on the drawings:

- Hot-dipped galvanized in accordance with AS 1214, unless noted, otherwise;
- Zinc plated in accordance with AS 1897 Fe/Zn8 where specified on the drawings, or;
- Stainless steel Grade 316 to AS/NZS 4673 bolts, nuts and washers Strength Classes A4-50 and A4-70 depending on size (unless noted otherwise), where specified on the drawings.

However all zinc coated fasteners MUST conform to the Ford Motor Company specification WX100 section S437. This specification states:

- Electrolytic Zinc Plate, Trivalent Chromate, Leached and Sealed, Integral Torque Control Lubricant. This finish is an electrolytic plating of zinc, followed by a trivalent chromate conversion, leached to a silver-white colour in a sealer.

- Total Thickness: 8.0 micrometer
- The leachant-sealant contains an integral torque control lubricant. No additional lubrication is necessary.
- Colour: Silver-white
- Specifications: WSS-M21P17-B3
- Corrosion:
  - 96 hour salt spray for zinc corrosion – White rust
  - 384 hour salt spray for ferrous corrosion – Red rust
- Service Temperature: 120 °C
- Conductivity: Non-conductive

## 5. Inspection and Testing

The supplier of either material of fabricated/manufactured assemblies or equipment shall be responsible for all inspection testing and reporting. Any independent testing authority used shall have the appropriate NATA certification to carry out the range of testing specified.

All testing for which the contractor is responsible shall be reported directly to the Beak engineer. In the event of materials or work being rejected as a result of inspection or testing, the contractor shall be responsible for the replacement, repair and further testing of the materials or work.

### 5.1 Material Testing

Material certification shall be supplied for all material in accordance with Section 4.2.

The supplier of either material or fabricated/manufactured assemblies or equipment shall be responsible for ensuring that the chemical and mechanical properties of all steel used will comply with this specification.

Chemical analysis and mechanical testing, including tension, bend, flattening and impact tests (Charpy), shall be performed for each batch of steel. Testing shall be performed by the steel manufacturer or by an approved laboratory.

Results shall be presented in a manner that demonstrates compliance to the requirements of the Australian Standard applicable to the material type, such as Australian Standard AS/NZS 3678 for carbon steel plate (or an approved equivalent International Standard), and shall be submitted to the Beak engineer when available but before the relevant materials are used in manufacture.

The Beak engineer reserves the right to decide whether or not material is considered to be acceptable and may or may not be used in manufacture. The supplier of either material or

fabricated/manufactured assemblies shall replace all material rejected by the Beak engineer at no cost to BEAK Engineering (Aust) Pty Ltd (or its affiliated organizations).

In the event that the manufacturer is unable to produce steel manufacturer's certificates in accordance with section 4.0 when requested by the Beak engineer, specimens for testing shall be prepared by the supplier and shall be tested by an independent NATA registered laboratory, as part of the supplier's responsibility. Testing of specimens shall be carried out in accordance with relevant Australian Standards. The costs of the testing and associated reports will be borne by the supplier.

Should through thickness testing (Z Properties) be required by BEAK Engineering (Aust) Pty Ltd and where the supplier is unable to produce steel manufacturer's certificates for the through-thickness properties of steel plate 25mm thick or over, or the plate is manufactured outside Australia, it shall be ultrasonically tested for flaws from both sides for laminations and other defects in accordance with the requirements of AS 1710 Level 2.

Through thickness testing requirements will be detailed on associated drawings.

Where the supplier has carried out testing as noted above, they shall issue all test certificates and reports to the Beak engineer for approval prior to the tested steel being used in manufacture. The location and extent of inclusions and/or laminations shall be detailed and sketched in the report. The Beak engineer will evaluate these reports and formally notify the supplier if material with minimal flaws is acceptable to be used in manufacture.

## **5.2 Weld Testing and Inspection**

The extent of inspection and testing of welds shall be as specified in Sections 5.3 and 5.4. Where testing levels are less than 100% the Beak engineer reserves the right to nominate the welds to be tested.

## **5.3 Visual Inspection**

Visual inspections of all weld preparation and all welds shall be carried out in accordance with AS/NZS 1554 except that the extent of visual inspection shall be as follows:

- Visual scanning – 100% of all weld preparations
- Visual examination – 100% of all welds.

All visual inspections of welds shall be undertaken by a qualified welding inspector who has not been involved in the supervision of the welding. Visual inspection also includes the inspection of the weld preparation.



Should the weld fail the visual inspection criteria as defined in AS/NZS 1554, the weld shall be rejected and no further non-destructive testing is prescribed until the condition of the weld is rectified.

#### 5.4 Non-Destructive Testing SP Welds to AS/NZS 1554.1

The following non-destructive testing of welds shall be carried out by the supplier using an independent NATA registered laboratory, or an independent organization which is accredited to an internationally recognized and accepted equivalent standard. The Beak engineer shall be advised that the reports are available for review within ten (10) working days of the test date.

All NDT technicians must be fully qualified for the relevant testing to be undertaken and be qualified to AINDT, PCN or similar. Copies of the technician's qualifications shall be made available for review by the Beak engineer prior to any NDT works being undertaken.

The testing procedures to be used are:

- Radiographic testing (RT)
- Ultrasonic testing (UT)
- Magnetic particle inspection (MPI)
- Dye Penetrant inspection (DPI)

The extent of testing shall be as follows:

##### Shop Welds:

- 100% of all shop completed penetration butt weld splices for beams and columns using RT, UT or MPI procedures.
- For all shop completed penetration butt welds, test 10% of the length of all welds longer than 1000mm or a minimum of 10% (one in ten) of all other complete or partial penetration welded joints where welds are less than 1000mm long using procedures RT or UT.
- All critical welds as specified on the drawings and/or noted in contract specifications, where no procedure is nominated, using RT, UT or MPI procedures.
- All shop completed fillet welds longer than 1000mm, test 10% of the length of all welds.
- All shop completed fillet welds less than 1000mm, test minimum of 10% (one in ten) of all completed welds.

Field Welds:

- 100% of all field completed penetration butt weld splices for beams or columns, including using RT, UT or MPI procedures.
- 30% of all field completed penetration or partial penetration butt welds shall be tested using RT, UT or MPI procedures.
- All critical welds as specified on the drawings and/or noted in the contract specifications, where no procedure is nominated, using RT, UT or MPI procedures.
- 10% of all field completed fillet welds shall be tested using an MPI procedure.

The maximum imperfection level for SP welds as determined by testing or examination shall be limited to L/5 for all plate thicknesses.

## 5.5 Content of Non-Destructive Testing (NDE) Reports

All NDE reports shall contain as a minimum a drawing reference, unique weld number (as per weld map), welder identification, weld type and exact position of the test area, full detail of defective area as applicable, statement of compliance and the name of the technician and testing company.

## 5.6 Content of Non-Destructive Testing (NDE) Reports

Unless noted otherwise, FP welds shall be subject to the following testing and inspection in accordance with the requirements of AS/NZS 1554.4 & AS/NZS 1554.5:

- Visual scanning 100%.
- Visual inspection 100%.
- Magnetic particle testing 100%.
- Radiographic testing or ultrasonic testing 50%.

## 5.7 Representative Sampling

Where sampling of welded joints is required for non-destructive testing, such sampling shall be consistent over the duration of shop fabrication and representative of all types of welded joints,

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welding procedure specifications (WPS) and also provide a representative sample of each welder's work.

### **5.8 Repair of Sub-Standard Welds**

All welds failing to meet the permissible levels of imperfections allowed in AS/NZS 1554 shall be removed or repaired to the satisfaction of the Beak engineer, and then re-tested, along with two (2) extra samples of the same WPS and welder output either as 10% of the weld length or 10% (one in ten) of all other welded joints as applicable. All costs for repairs, reports and retesting of welds and welders will be borne by the supplier.

### **5.9 Inspection by the Beak Engineer**

The contractor shall give the Beak engineer 5 days' notice for inspections nominated as Witness or Hold points on the supplier's ITP/PCP, or where the Beak engineer's approval is required for commencement of any stage of manufacture.

### **5.10 Inspection During Manufacturing**

During the manufacturing process, the supplier and their subcontractor(s) shall permit the Beak engineer or his representative free access to the manufacturing facility at all reasonable times for the purpose of carrying out inspections and shall afford all necessary facilities for carrying out such inspections.

Items shall be laid out as necessary so that all parts are accessible for inspection as directed by the Beak engineer. Any inspection by the Beak engineer will not prevent the ultimate rejection of any work or materials in which defects have been found at any time prior to the completion of the manufacturing process.

## **6. Fabrication**

### **6.1 General**

All steelwork shall be fabricated as shown on the drawings and in accordance with the requirements of this specification and AS 4100 and/or AS 3990. Substitutions of steel sections or modifications of design details shall only be made with the written approval of the Beak engineer.

All members shall be pre-fabricated into sub-assemblies to facilitate simplified assembly. The maximum size suitable for sub-assemblies shall be subject to approval. Consideration shall be

given to undertaking trial assembly of sub-assemblies prior to painting, but after abrasive blasting and any stress relief.

All fabrications shall be fabricated complete with all necessary temporary brackets, straps, gussets, cleats, fixings and the like necessary for handling and assembly of the steelwork.

Temporary fittings, bracings, stiffeners used as fabrication aids in the handling of steelwork or attachment and support of temporary works shall be welded in accordance with this specification. Such temporary fittings may be allowed to remain in place with the written approval of the Beak engineer. The supplier shall submit the type, size and location of all lugs to the Beak engineer for approval where the lifting lug exceeds 5t Working Load Limit (WLL).

## 6.2 Tolerances

Tolerances for fabrication of structural steelwork shall be in accordance with AS 4100 unless shown otherwise on the drawings and/or Contract Specifications. Such tolerances are assumed to apply at 20°C.

## 6.3 Cutting and Bending

All structural steel components shall be plasma or flame cut, sheared or sawn to the profile as shown on the drawings with the as-cut surfaces and edges in compliance with AS/NZS 1554. After cutting, all edges shall be ground off to provide a smooth, even and true profile. Sheared edges to be included in welded joints shall be ground free of sharp edges.

Preparation of structural tubes for welding shall be in accordance with AS/NZS 1554.

If members or plates are bent or set, the bends and sets shall be made to the radii and angles specified upon manufacturing drawings and shall be free from hammer or tooling marks. Edges of plates to be bent shall be ground smooth prior to bending.

All plates, gussets, members etc. shall have sharp edges and corners rounded and ground smooth to a minimum radius of 2mm.

## 6.4 Splices and Joints

Where available stock lengths of steel are shorter than the required length of a member, splicing by complete penetration full section butt welds is permitted, unless otherwise noted on the drawings. All splice welds not shown on drawings shall be approved by the Beak engineer who shall be notified in writing of the position of splice weld prior to the joining of the two (2) parts. All

such welds shall be subjected to 100% ultrasonic or radiographic and magnetic particle testing in accordance with Section 5.2.

The minimum length of a spliced section component should not be less than six (6) times the depth of the section or 1000mm, whichever is greater.

Welded splices in compound members shall be staggered, and the component plates and sections spliced before compounding.

Should the supplier wish to propose splices and joints, whether bolted or welded, in addition to those shown on the drawings, or in different locations to those detailed on drawings, such connections shall be to the written approval of the Beak engineer in respect to design, procedure and workmanship.

## 6.5 Bolt Holes

Unless otherwise noted on the drawings, holes for bolts shall be not more than 2mm larger in diameter than the bolt which is to be used. Where stainless steel bolts are used with grommets, the hole shall be 2mm larger than the grommet diameter.

Where steelwork is hot dipped galvanized, the contractor shall ensure the zinc coating thickness within bolt holes does not exceed 200  $\mu\text{m}$ .

Where slotted holes are specified or shown, such holes shall be accurately shaped with sides smooth, parallel and semi-circular at the ends. Clearance tolerances shall be as noted above. Length of slotted holes shall be defined as the distance between centers of drilled or punched holes.

Round or slotted holes in steelwork shall not be flame cut. Laser cutting and plasma cutting is permitted. The areas around holes shall be smooth and free of burrs and fins or other defects which may prevent solid seating of the contact surfaces.

Punching of holes full size shall be carried out in accordance with AS 4100. Holes may be punched to at least 3mm undersize and then reamed to full size.

Holes through tubular members shall be lined with sleeves and an external fillet weld run around the perimeter of the sleeve to seal the gap between the sleeve and the wall of the tube.

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## 6.6 Tubular Construction

Steel tubes and rectangular hollow sections which are to be welded shall not be sheared, but shall be cut and profiled to fit the shape of the members to which they are to be welded. The supplier shall make appropriate allowances to ensure match of the mating faces for splices.

Unless otherwise noted all tubes and hollow sections shall be fully sealed to prevent the ingress of moisture. A 3mm thick plate shall be used for sealing purposes.

Where galvanizing is specified the supplier shall provide all holes in the members required to ensure adequate venting and no deformation during the galvanizing process. Where galvanized and shown on the drawings, seal weld and touch up all vent holes, prior to delivery.

## 7. Bolting

### 7.1 General

Bolted steelwork connections shall be bolted as shown on the drawings. All bolts, washers and nuts shall comply with the relevant Australian Standards. Unless specified otherwise, all bolted joints shall be made using Grade 8.8 high strength bolts, nuts and washers.

The length of bolts shall be selected so that the threaded portion of the bolt shall project through the nut a minimum two (2) threads and a maximum of 5 mm when fully tightened and so that the nut can be fully tightened without reaching the end of the thread.

Bolted connections subject to vibration and/or heavy loads shall be fitted with lock nuts approved by the Beak engineer.

### 7.2 Stainless Steel Bolted Connections

All bolts, nuts and washers used shall be stainless steel 316 (minimum Grade A4) fitted with lock nuts unless shown otherwise on the drawings.

All stainless steel bolts shall have rolled threads and be:

- A4-70 For bolts less than or equal to M20
- A4-50 For bolts greater than M20

All stainless steel bolts and nuts assembled shall have threads treated with a nickel-based anti-seize compound. Stainless steel bolts assembled into ferrules shall have 'Loctite Threadlocker

243' or a similar approved removable thread locking compound applied to the threads when installed, in accordance with the Manufacturer's written instruction.

Stainless steel bolts shall be tightened to the correct torque using a torque wrench in accordance with the Manufacturer's specification. Tightening torques shall take into account lubrication of threads and nyloc nuts.

Where joint configurations include acetal grommets and/or neoprene spacers, stainless bolts shall be tensioned such that joint integrity is achieved without damage to acetal grommets and neoprene spacers.

### 7.3 High Strength Bolted Connections

High strength bolted connections shall be bearing-type (TB), unless otherwise shown and shall be made in accordance with the provisions of AS 4100.

All bolts indicated on the drawings as 8.8/TB or 8.8TF may be tightened by the direct-tension indication method or "Part Turn" method specified in AS 4100. Bolts tensioned using the direct-tension indication method shall be installed with a galvanized load indicating device under the element (nut or bolt head) not turned in tightening. The flat side of the load indicating washer shall be placed against the steelwork with the protrusions facing towards the bolt head or nut, as appropriate. Bolts installed by the direct-tension indication method shall be tightened in accordance with AS 4100.

The supplier's proposed methods for bolt tightening shall be submitted to the Beak engineer for approval.

Unless noted on drawings, one (1) flat round hardened steel washer shall be used under the nut for each bolted connection except that if the bolt is turned during tightening then two (2) washers shall be used, one under the nut and one under the bolt head. The bolt may be turned only if the nut is not accessible and where the bolt may be turned without interference or friction from bolt holes or steelwork.

Unless otherwise specified, bolts used on beveled surfaces shall be provided with beveled washers which shall provide full bearing to the head and the nut.

Suggested bolt torque values are detailed below:

**Table 7.1 – Carbon Steel Metric Bolts M5 to M36 – Torque Tightening Values in Nm**

Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (MPa)	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Nm					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M5 x 0.80	6.1	4.6	8.8	6.7	10.3	7.7
M6 x 1.00	10.4	7.8	15	11.2	17.6	13.1
M7 x 1.00	17.6	13.1	25.1	18.9	29.4	22
M8 x 1.25	25.4	19.1	37.6	27.3	42.6	32.1
M10 x 1.50	50	38	72	54	84	64
M12 x 1.75	88	66	126	94	146	110
M14 x 2.00	141	106	201	150	235	176
M16 x 2.00	218	164	312	233	365	274
M18 x 2.50	301	226	431	323	504	378
M20 x 2.50	426	319	609	457	712	534
M22 x 2.50	580	435	831	624	971	728
M24 x 3.00	736	552	1052	789	1231	923
M27 x 3.00	1079	809	1544	1158	1805	1353
M30 x 3.50	1463	1097	2092	1570	2446	1834
M33 x 3.50	1990	1493	2849	2137	3328	2497
M36 x 4.00	2557	1918	3659	2744	4276	3208

**Note 1:** Estimated with clamp load as 75% of proof load as detailed in ISO 898-1



Table 7.2 – Carbon Steel Metric Bolts M5 to M8 – Torque Tightening Values in Inch Pounds

Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (MPa)	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Inch Pounds					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M5 x 0.80	54	41	78	59	91	68
M6 x 1.00	92	69	133	99	156	116
M7 x 1.00	156	116	222	167	260	195
M8 x 1.25	225	169	333	242	377	284

Note 1: Estimated with clamp load as 75% of proof load as detailed in ISO 898-1

Table 7.3 – Carbon Steel Metric Bolts M10 to M36 – Torque Tightening Values in Foot Pounds

Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (MPa)	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Foot Pounds					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M10 x 1.50	37	28	53	40	62	47
M12 x 1.75	65	49	93	69	108	81
M14 x 2.00	104	78	148	111	173	130
M16 x 2.00	161	121	230	172	269	202
M18 x 2.50	222	167	318	238	372	279
M20 x 2.50	314	235	449	337	525	394
M22 x 2.50	428	321	613	460	716	537
M24 x 3.00	543	407	776	582	908	681
M27 x 3.00	796	597	1139	854	1331	998
M30 x 3.50	1079	809	1543	1158	1804	1353
M33 x 3.50	1468	1101	2101	1576	2455	1842
M36 x 4.00	1886	1415	2699	2024	3154	2366

Note 1: Estimated with clamp load as 75% of proof load as detailed in ISO 898-1

Table 7.4 – Carbon Steel Imperial Bolts ¼” to 1” – Torque Tightening Values in Nm

Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (lb <sub>f</sub> /in <sup>2</sup> )	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Nm					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4 - 20	11.4	8.6	16.2	12	19	13.6
1/4 - 28	13.1	9.8	16.6	13.9	21.7	16.3
5/16 - 18	23.6	17.7	33.3	25	39.3	29.8
5/16 - 24	26.1	19.7	36.9	27.7	43.4	32.5
3/8 - 16	42	31.2	30	45	69	52
3/8 - 24	47	35	66	50	79	58
7/16 - 14	66	50	95	71	110	83
7/16 - 20	75	56	106	79	123	92
1/2 - 13	102	77	144	108	168	126
1/2 - 20	115	87	163	122	190	142
5/8 - 11	203	153	287	216	323	243
5/8 - 18	230	172	325	244	366	274
Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (lb <sub>f</sub> /in <sup>2</sup> )	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Nm					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
3/4 - 10	362	271	510	382	574	430
3/4 - 16	403	302	569	427	640	480
7/8 - 9	582	437	822	617	925	693
7/8 - 14	643	481	907	681	1020	765
1 - 8	873	655	1232	923	1879	1040
1 - 12	979	735	1383	1037	1555	1166

Note 1: Estimated with clamp load as 75% of proof load as detailed in SAE J429 & ASME 574

**Table 7.5 – Carbon Steel Imperial Bolts ¼” to 3/8” – Torque Tightening Values in Inch Pounds**

Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (lb <sub>f</sub> /in <sup>2</sup> )	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Inch Pounds					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4 - 20	101	76	143	107	168	120
1/4 - 28	116	87	147	123	192	144
5/16 - 18	209	157	295	221	348	264
5/16 - 24	231	174	327	245	384	288
3/8 - 16	372	276	-	-	-	-
3/8 - 24	420	312	-	-	-	-

Note 1: Estimated with clamp load as 75% of proof load as detailed in SAE J429 & ASME 574

**Table 7.6 – Carbon Steel Imperial Bolts 3/8” to 1” – Torque Tightening Values in Foot Pounds**

Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (lb <sub>f</sub> /in <sup>2</sup> )	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Foot Pounds					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
3/8 - 16	-	-	44	33	51	38
3/8 - 24	-	-	49	37	58	43
7/16 - 14	49	37	70	52	81	61
7/16 - 20	55	41	78	58	91	68
Property Class	Grade 8.8		Grade 10.9		Grade 12.9	
Minimum Tensile Strength (lb <sub>f</sub> /in <sup>2</sup> )	M6 to M16 = 800 M20 to M30 = 830		1040		1220	
Nominal Size & Pitch	Bolt Torque in Foot Pounds					
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/2 - 13	75	57	106	80	124	93
1/2 - 20	85	64	120	90	140	105
5/8 - 11	150	113	212	159	238	179
5/8 - 18	170	127	240	180	270	202
3/4 - 10	267	200	376	282	423	317
3/4 - 16	297	223	420	315	472	354
7/8 - 9	429	322	606	455	682	511
7/8 - 14	474	355	669	502	752	564
1 - 8	644	483	909	681	1022	767
1 - 12	722	542	1020	765	1147	860

Note 1: Estimated with clamp load as 75% of proof load as detailed in SAE J429 & ASME 574

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## 8. Welding

### 8.1 General

Welding shall be carried out strictly in accordance with the requirements of AS/NZS 1554 unless specifically stated otherwise on the drawings. All welding shall be carried out conforming to either GP (General Purpose) or SP (Structural Purpose) categories as defined in AS/NZS 1554.1 or FP (Fatigue Purpose) as defined in AS/NZS 155.4 & 1554.5. The categories shall be used for the following purposes:

GP – guards, minor brackets carrying light fittings, electrical cable trays, etc.

SP – all structural connections.

FP – connections subject to high levels of fatigue loading.

All stainless steel welds shall be category 2B, Grade II as defined in AS/NZS 1554.6 unless noted otherwise.

All aluminium welds shall be category B, as defined in AS/NZS 1665 unless noted otherwise.

The finished surface profile of all welding shall be smooth and free from sharp edges or crevices that would be detrimental to the performance of the structure or to the protective treatment. All slag and weld splatter shall be thoroughly removed, and the weld surface shall be replaced, repaired and ground as directed by the Beak engineer.

### 8.2 Welding Supervision

Welding for Category GP, SP and FP shall be carried out under the supervision of a welding supervisor complying with AS/NZS 1554. The welding supervisor shall hold appropriate certificates in accordance with AS 1796 and/or AS 2214.

The appointment of a welding inspector will not relieve the supplier of the responsibility to adequately supervise and control the quality over all work carried out.

Notwithstanding the provisions of AS/NZS 1554, the sole authority for final determination of quality and acceptance of welds will be the Beak engineer.

### 8.3 Minimum Fillet Weld Size

Unless otherwise shown on the drawings, the minimum weld size between adjoining components, touching components, edges and faying surfaces shall be a continuous fillet weld, Category SP, with a leg length as listed below:

- 6mm for plates less than 16mm thick.
- 8mm for plates equal to or greater than 16mm thick and less than 32mm thick.
- 10mm for plates greater than or equal to 32mm thick.

The plate thickness refers to the thinner of the elements being welded. In the case of one (1) of the components having less thickness than 6mm, the fillet weld size shall equal the thickness of the thinnest material.

### 8.4 Preheating

Preheating and inter-pass temperature control shall be performed in accordance with AS/NZS 1554 and WTIA Technical Note 1.

### 8.5 Butt Welds

Where required, run-on and run-off strips shall be used for butt welds and shall be removed on completion of the weld and the attachment weld ground square and/or flush.

Backing strips will only be permitted if it is impossible to back gouge the root runs or if full penetration cannot be achieved from one side. Permanent backing strips are not permitted unless otherwise shown on the drawings.

Preparation of edges for butt welding shall be carried out by grinding, machining, planning, machine flame cutting or plasma cutting. Manual flame cutting shall only be carried out with the approval of the Beak engineer. However, surfaces to be incorporated into welds shall then be ground back to a clean un-carburized surface.

Welds shown on the drawings as 'CP' are complete penetration butt welds. For 'CP' welds, the supplier shall determine the most appropriate complete penetration butt weld detail for each particular location and submit the details to the Beak engineer for approval.

Complete penetration butt weld symbols shown on the drawings are indicative of design preference. The supplier may submit alternative complete penetration butt weld details for the approval of the Beak engineer.

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The size of cap (reinforcement) on butt welds shall not be greater than shown in AS/NZS 1554. Excessive capping shall be ground to the required profile and shall be free of surface breaking weld defects, discontinuities and porosity.

## 8.6 Procedure and Performance Qualifications for Welding

For **all** weld categories, the supplier shall develop and submit to the Beak engineer for approval, welding procedures and procedure qualification records designed to produce welds in accordance with the requirements of the weld process and intended duty prior to the commencement of manufacturing.

In addition to the above requirements, the supplier shall document the applicable welding procedure specifications including non-destructive examination, test material certificates, test consumable certificates and destructive testing where required.

All welders engaged in producing welds to SP or FP categories or welding stainless steels shall be certified and/or qualified in accordance with the relevant part of AS/NZS 1554. The supplier shall submit copies of all certificates and/or qualification records to the Beak engineer for approval prior to commencement of manufacturing.

All welders engaged in producing GP category welds only shall demonstrate competency in line with AS/NZS 1554.1.

## 8.7 Welding Materials

Hydrogen controlled electrodes shall be mandatory for SP Category welding. Electrodes shall be E48XX, except that E55XX (low hydrogen) shall be used for welding Grade 450 steel, unless otherwise approved by the Beak engineer.

All consumables employed for manufacturing shall be supplied with batch certificates in accordance with Section 4.2.

Tack welds shall be made with the same type of electrode that is used for depositing the root pass, unless the tack weld is removed prior to welding.

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## 8.8 Weld Repairs

Where it is necessary to repair welds that have failed the inspection criteria, the contractor shall submit a repair procedure to the Beak engineer for approval prior to commencing any manufacturing.

## 9. Surface Protection

### 9.1 General

All steelwork shall be painted, power coated or galvanized as specified on the drawings in accordance with this specification. For galvanized steelwork, the supplier shall ensure that adequate drainage holes are incorporated prior to dispatch for galvanizing. Drainage holes shall be detailed on the shop drawings. No holes shall be created with an oxyacetylene torch under any circumstances.

This specification covers the minimum requirements for the selection, supply, application, workmanship, quality assurance and acceptance of surface protection systems for steelwork and equipment including but not limited to:

- Structural steelwork.
- Mechanical equipment.
- Pipe work and valves.
- Hot dip galvanizing and the over coating of hot dipped galvanized steelwork.
- The treatment of the inside of all bolt holes including holes required in steelwork.

It is the intention of this specification to ensure all shop applied surface treatments are performed in a manner consistent with the Coating Supplier's product data sheets and the highest possible industry standards.

This specification does not cover the following items which are not to be coated:

- Machined surfaces where coat free surfaces are necessary for assembly and dismantling. These surfaces must only be coated with an approved rust inhibitor only, such as Shell Ensis.
- Equipment or piping made from corrosion resistant materials such as Stainless Steel and 3CR12 material.
- Equipment or piping made of non-ferrous alloys such as Copper.
- Instruments, gauges and lubrication fittings.
- Rubber materials other than UV protection of exposed rubber surfaces where specifically noted.

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- Plastic, glass and fiber glass reinforced plastic.

Materials containing lead (including tint), coal tar epoxy, gilsomastic material, chromate or coal tar pitch are **not** permitted.

## 10. Surface Protection Performance of Work

### 10.1 General

The supplier is responsible for the quality of workmanship that must be carried out in accordance with this specification as well as applicable national, state and local government legislation including health and safety requirements.

### 10.2 Quality Management

The supplier must develop and implement a quality management system in accordance with the Contract Quality requirements. The quality system must confirm to the applicable level of AS/NZS/ISO 9000 'Quality Systems'.

The supplier's quality plan and sample Inspection and Test Plan must be submitted to the Beak engineer for approval prior to the commencement of work.

The supplier must prepare Work Procedures (WP) and Inspection and Test Plans (ITP) for all activities including repairs. All WP and ITP must be submitted to the Beak engineer for approval three weeks prior to the commencement of work.

The supplier is responsible for compliance with this specification, the entire supplier's WP and ITP and/or other references as agreed by the Beak engineer.

The supplier must advise the Beak engineer of the time and place of all surface preparation and coating applications 5 days before commencement of any work. The supplier must make provisions for inspection of all surface preparation and coating applications by the Beak engineer. The Beak engineer must advise of acceptance before commencement of coating applications after surface preparation. The supplier must incorporate this requirement into all ITP's.



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### 10.3 Surface Preparation, Coat Preparation and Coating Application

All surface preparation, coat preparation and coating application must be carried out in accordance with the Coating Supplier's written specifications, this specification and the relevant Australian Standards as listed in Section 3 of this document unless specifically noted otherwise.

### 10.4 Tools and Equipment

All tools and equipment must at all times be in a good clean condition. Spray guns, brushes, rollers, coat pots and the like must be regularly cleaned and fit for their purpose.

### 10.5 Health and Safety

Health and Safety instructions on the use of the coat products, as printed on the Coating Supplier's data sheets and on warning labels on the containers, should be fully understood by the Contractor before any work is undertaken. All necessary protective equipment, clothing or measures must be provided for each operator by the supplier. All material safety data sheets (MSDS) must be submitted to the Beak engineer prior to commencement of work.

### 10.6 Supervision

It is the responsibility of the supplier to provide supervision of his workers by personnel with satisfactory previous experience in the methods and materials being used. It is the responsibility of the supplier's supervisor to assure performance of the coating processes are in accordance with the criteria established by this specification in order that the finished work may be acceptable to the Beak engineer.

The supervisor must be able to competently use all coating inspection equipment, detailed in this specification (section 11.3) for the performance of the work.

### 10.7 Local Conditions

In planning, provision must be made for accomplishing the work in spite of obstacles caused by weather and other local conditions. The supplier must be sufficiently familiar with the conditions, including cold, heat, humidity and dust in case special precautions are required.

In the event that coating is performed in a cold climate adequate internal facilities with heating and dehumidifying must be used to ensure satisfactory curing conditions in accordance with the Coating Supplier's recommendations. Blasting and coating externally in cold and damp climate conditions are not permitted.

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## 11. Surface Protection Performance of Work

### 11.1 Test Reference Panels

The supplier must prepare three test reference panels (each panel sized at 300mm x 300mm x 5mm Material to match the specified product material) for each approved coating system.

The panels must be prepared in accordance with the supplier's proposed work procedure and inspection and test plan and the coating supplier's specifications. The coating supplier must verify that each sample top coat colour conforms to the requirements of AS 2700 and this specification.

The preparation of test reference panels must be witnessed and acknowledged in writing by the coating supplier, as meeting the specified acceptance criteria. Two test reference panels or must be retained by the Beak engineer for use as quality references in the event of a dispute during, or on completion of the work.

The supplier must have available at the work area, one test reference panel for each coating system as a quality reference for work in production.

### 11.2 Coating Reports

The Contractor must prepare and maintain adequate coating reports for each tagged or piece marked item coated. The reports must contain the following three components as shown in Appendix C:

- Coating Identification, Application and Testing Report.
- Climactic Conditions Report (such as but not limited to temperature, dew point).
- Abrasive Blast Clean Report.

Each report must clearly identify the individual items blasted and coated. Single reports may be submitted for multiple items main fabricated and connected assemblies. Coating reports are also required for all hot dipped galvanized items. These reports may be submitted in the supplier's preferred format subject to the Beak engineer's approval.

Copies of all coating reports must be submitted to the Beak engineer at the end of each week. The Beak engineer reserves the right to request coating reports at any time during the work program.

All reports must be readable in both English and in the national language of the country where the work is being performed.

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### 11.3 Inspection Equipment - Paint

The supplier must provide, calibrate and understand the proper use of the following inspection equipment:

- Substrate surface temperature gauge.
- Ambient temperature gauge.
- Whirling hygrometer.
- Alternative climate gauge capable of recording air temperature, relative humidity, dew point temperature (Td), substrate surface temperature (Ts) and be able to calculate the temperature difference between Td and Ts.
- WFT (Wet Film Thickness) gauge (comb type).
- DFT (Dry Film Thickness) measuring instrument such as the Elcometer 456 or Beak engineer approved equivalent.
- Testex Replica tape and Thickness gauge (for blast surface profile testing). Used tapes with recorded blast profile must be adhered to Coating Identification and Testing reports as permanent records.
- High voltage holiday detector such as the Elcometer 266 DC holiday detector or Engineer approved equivalent.
- Low voltage pinhole detector such as the Elcometer 270 Wet Sponge pinhole detector or Beak engineer approved equivalent.
- Hydraulic adhesion tester such as the Elcometer 108 or Beak engineer approved equivalent.
- Substrate surface contamination testing device such as the Elcometer 138 Bresle salt kit or Beak engineer approved equivalent.
- Dust tape test kit such as the Elcometer 142 ISO 8502-3 or Beak engineer approved equivalent.
- Blast nozzle air pressure test equipment.
- Amine blush test kit for coated surfaces such as the Elcometer 139 ABC amine blush check kit or Beak engineer approved equivalent.

### 11.4 Repair of Test Areas

Areas of coating damaged by destructive testing must be repaired to the specified standard at no cost to the Beak (or its affiliated organizations).

### 11.5 Sampling and Testing of Blasting Medium

Samples of recycled grit abrasive must be taken at the beginning of each day's production. The supplier must test a portion of each sample to ensure no presence of contamination such as, but

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not limited to rust, scale, old paint, other blast media, oil, grease or NDT fluids. The remainder must be clearly marked with the date and retained for future reference.

## **12. Coating Supplier**

### **12.1 General**

Coating products must have properties that meet the relevant current and applicable Australian standards. The criteria for such suitability must be the Coating Supplier's instructions and this specification.

Only coatings approved by the Beak engineer must be used. Other coating materials may be considered provided such a request is made in writing and supported by relevant case histories and technical data.

### **12.2 Different Suppliers within a Specified System**

All coatings and thinners used within a Coating System must be sourced from one Coating Supplier. Mixed systems unless stated otherwise are not permitted and will be rejected and reinstated in accordance with this specification at the supplier's cost.

### **12.3 Coating Supplier's Specification**

Areas or items not covered by this specification must be brought to the attention of the Beak engineer. At the Beak engineer's discretion, the Coating Supplier may be requested to make a recommendation.

### **12.4 Powder Coating**

The proposed powder coating supplier and product must be submitted to the Engineer for approval in writing prior to commencing work.

Table 12.1 details recognized powder coating standards, acceptance levels and test criteria. Those applicable to Beak requirements will be highlighted and marked.

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## 12.5 Electroless Nickel Coating

The proposed Electroless Nickel supplier and product must be submitted to the Engineer for approval in writing prior to commencing work.

Electroless nickel coating is to be carried out in accordance with:

- AD-700A1-MDB-000-092-00
- MIL-C-26074E, CLASS 2

Thickness of coating is to be between 80µm minimum to 100µm maximum.

Parts to be suitable treated to ensure no occurrence or hydrogen embrittlement.

## 12.6 Zinc Coating

The proposed zinc coating supplier and product must be submitted to the Engineer for approval in writing prior to commencing work.

Part to be zinc plate in accordance with AS/NZS 1789 Fe/Zn 12C.

Parts to be suitable treated to ensure no occurrence or hydrogen embrittlement.

Note: Zinc plating **MUST** be hexavalent Chrome Free

## 12.7 Galvanising

The proposed galvanising coating supplier and product must be submitted to the Engineer for approval in writing prior to commencing work.


AS NZS 4680-1999 Hot-dip galvanized - zinc - coatings on fabricated ferrous articles

Parts to be suitable treated to ensure no occurrence or hydrogen embrittlement.

Table 12.1 – Applicable Power Coating Specifications

Element	Holden HN 1108 Class 5	MMAL ES-X71221 - FP05	Ford ESB-M2P119-A	Toyota TSH3112G-Class1
<b>Metal Preparation</b>	No Spec	No Spec	Zinc Phosphate Coating to ESB-M3P1, or Iron Phosphate Coating to ESB-M3P2	<b>TSH2105G(1) Beak Requirement</b>
<b>Thickness</b>	N/A	N/A	0.002 ins (51um) min. (FLTM B1 17-1)	<b>100 + 20 um Beak Requirement</b>
<b>Colour</b>	As per DWG	As per DWG	As per DWG	<b>As per DWG Beak Requirement</b>
<b>Gloss</b>	Matt/Semi Matte	N/A	Semi Matte (FLTM B1 10-1)	<b>Semi Matt Beak Requirement</b>
<b>Hardness</b>	Resist marring by thumb nail after all lab tests - Clause 2.3, Page 2, HN1108	HB pencil or harder (MS82-3101-Rev.3)	After 72hr, above 20°C, Tukon K10, min. 7.5KHN (FLTM B1 12-2)	<b>HB min. to Sect 2.1 - TSH1539G Beak Requirement</b>
<b>Adhesion</b>	Rating of 10 as per HN 0279 - Cross hatch test.	M2.5 or more (MS82-3101-Rev.3)	FLTM BI 6-1, Grade 0, no flaking or chipping against part A & B	<b>0/100, to 2mm grid width - TSH1503G Beak Requirement</b>
<b>Humidity</b>	24 hrs with nil blisters, appearance change, metal corrosion, and min adhesion rating of 8 (HN 0255) when tested to HN 0278	N/A	N/A	N/A
<b>Distilled Water</b>	As per HN 0278 - age painted surface for 72 hours then soak in distilled water for 2 hours. Rate for blisters & carry out adhesion test as per HN 0255.	480 hr or more at 40°C, nil softening, fading, dull lustre, peeling, blister or discolouration.	240 h, FLTM BI 4-1, no blistering or dulling	240 hours to Sect 2.1- TSH1505G (immersion in 40°C water)
<b>Neutral Salt Spray</b>	48 hrs to HN1108 & HN 0097, test to HN0124, not more than 1% base metal corrosion permitted, except at line scribed for adhesion test, and no more than 3mm creep or no more than 10% removed by air blow off (HN0124)	480hr, nil peeling defects 3mm from cross cuts, and 1 hr after removal conduct peeling test, peeling shall be within 3mm.	<b>FLTM BI 3-1, 240h, nil rust, corrosion, creep or loss of adhesion more than 1/8in [3.2mm] from scribed line, and nil blistering or the rust spots.  Beak Requirement</b>	Pass 480 hours to - TSH1552G

<b>Cycle Crack Resistance</b>	N/A	N/A	N/A	Pass 4 cycles to Sect 2.1.2 of THS1511G (Method B)
<b>Brittleness</b>	No brittleness or peeling (HN 0282)	N/A	N/A	N/A
<b>Abrasion Resistance</b>	N/A	N/A	N/A	30mg max under 500g and 1000 cycles to Sect 2.2 of TSH1502G
<b>Colour Fastnesses</b>	Accelerated weathering test (QUV) to HN0276. After 160 hours (with UVB-313 lamps) exposure, no appreciable colour change, loss of gloss, loss of adhesion or any other adverse effects	N/A	<b>500 hours. Min fade, dulling, no crack, blister and rust. ASTM G-53-77 4Hr UV at 60°C, 4 hr condensing humidity at 50°C. Beak Requirement</b>	TSH1582G
<b>Chip Resistance</b>	HN 0254	Impact resistance, 20cm, no crack or peeling (MS82-3101 - Rev.3)	FLTM B1 7-1 not exceed Fig 3, or SAE J 400 4B max.	Pass 500g, 30cm to Sect 2.1 - TSH1504G
<b>Petrol &amp; Oil Resistance</b>	N/A	<b>No softening, peeling, blister or discoloration after 16hrs minimum immersion in engine oil. Beak Requirement</b>	N/A	Refer Below
<b>Oil Resistance</b>	N/A	See Above –Petrol & Oil	N/A	Pass to Sect 5.14 - TSH3112G
<b>Petrol Resistance</b>	N/A	See Above –Petrol & Oil	N/A	Pass No 3 at 120h & 20°C to Sect 2.1.1 of TSH1508G
<b>Heat Resistance</b>	N/A	N/A	N/A	Pass at 120°C x 240h) to TSH1507G
<b>Acid Resistance</b>	N/A	N/A	FLTM BI 13-5, nil discolouration after 10 min.	N/A
<b>Alkali Resistance</b>	N/A	N/A	N/A	Pass sect 2.1.2 of TSH1509G
<b>Chemical</b>	N/A	N/A	<b>Xylol, no dulling or softening. Beak Requirement</b>	N/A
<b>Etch &amp; Distortion</b>	N/A	N/A	N/A	N/A
<b>Washer Fluid</b>	N/A	N/A	N/A	N/A
<b>Water &amp; Soap Spotting</b>	N/A	N/A	FLTM BI 13-1 max. 0.3 N.B.S	N/A

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## 13. Machining

### 13.1 General

Machining shall be carried out strictly in accordance with Beak supplied engineering drawings. General machining tolerances shall be in accordance with ISO 2768.1 and ISO 2768.2 classes' m and K unless noted otherwise on drawings.

All machined surfaces are to a finish of RA 3.2 unless noted otherwise on supplied engineering drawings.

All machined items to be supplied with documentation as detailed in section 4 of this document.