



Assets Delivery Group
Mechanical and Electrical Services Branch

WELDING SPECIFICATION

WS-1 METAL ARC WELDING

VERSION 1
REVISION 8

JANUARY 2017

FOREWORD

This Specification has been prepared to inform Water Corporation staff, designers and service providers of the requirements of the Corporation's standard for metallic welding work, welding workmanship and quality assurance related to welded assemblies. These requirements are based on extensive design and field experience gained over time by the Corporation, as a welded asset owner.

The Specification is intended for reference and use in the following typical procurement scenarios:

- Capital funded infrastructure asset design and construction work;
- Operationally funded asset procurement, design, construction and maintenance work;
- Private developer funded subdivision services to be taken over by the Corporation;
- Procurement of welded products and services for period contracts and minor projects.

The text of this Specification should not be modified for project applications. Where a text variation is considered necessary to accommodate particular project needs and where authorised at an appropriate Corporation process level, the project specific modification should be documented only in the project specification.

Suggestions for incremental improvement of, or deviation from, the technical welding requirements of this Specification should be directed to the Principal Engineer Mechanical, Mechanical and Electrical Services Branch and shall be subject to consultation with Corporation process stakeholders.

All suggestions for substantive change to the business considerations that underlie this Specification shall be subject to review and determination in accordance with the Engineering Standards Management Process that is coordinated by the Engineering Standards Coordinator, Strategic Asset Management Branch.

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Manager
Mechanical & Electrical Services Branch

This document is prepared without the assumption of a duty of care by the Water Corporation. The document is not intended to be nor should it be relied on as a substitute for professional engineering design expertise or any other professional advice.

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DISCLAIMER

This Standard is intended solely for application to the acquisition of water infrastructure in Operating Areas in Western Australia where the Water Corporation has been licensed to provide water services subject to the terms and conditions of its Operating License.

This Standard is provided for use only by a suitably qualified professional design engineer who shall apply the skill, knowledge and experience necessary to understand the risks involved and undertake all infrastructure design and installation specification preparation work.

Any interpretation of anything in this Standard that deviates from the requirements specified in the project design drawings and construction specifications shall be resolved by reference to and determination by the design engineer.

The Corporation accepts no liability for any loss or damage that arises from anything in the Standard including loss or damage that may arise due to the errors and omissions of any person.

REVISION STATUS

The revision status of this standard is shown section by section below:

REVISION STATUS						
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2	1/0		All	New Version		
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	1/7	2/09/16	12	5. Add Welder Register. Add contract specific ITP	BM	DV
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WELDING SPECIFICATION

WS1 – Metal Arc Welding

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1 Scope

This Technical Specification sets out the requirements for the fabrication and fusion welding of all metallic materials performed for the Water Corporation.

The applicable construction standards nominated in project specific drawings and specifications shall apply in assessing that the required work quality standards have been met.

2 Referenced Documents

The following standards, manuals and documents are either referenced or related to this technical specification:

Australian Standards

AS/NZS 1210	Pressure vessels
AS/NZS 1554.1	Welding of steel structures
AS/NZS 1554.3	Welding of reinforcing steel
AS/NZS 1554.6	Welding Stainless Steels for structural purposes
AS/NZS 1665	Welding of Aluminium Structures
AS 1710	Ultrasonic testing requirements for low carbon and alloy steel plate
AS 1715	Selection, use and Maintenance of Respiratory Equipment
AS 1716	Respiratory Protective Devices
AS/NZS ISO 3834.1	Quality requirements for the fusion welding of metallic materials -Criteria for the selection of the appropriate level of quality requirements
AS/NZS ISO 3834.2	Quality requirements for the fusion welding of metallic materials – Comprehensive quality requirements
AS/NZS ISO 3834.3	Quality requirements for the fusion welding of metallic materials –standard quality requirements
AS/NZS ISO 3834.4	Quality requirements for the fusion welding of metallic materials –elementary quality requirements
AS/NZS ISO 3834.5	Quality requirements for the fusion welding of metallic materials – Documents with which it is necessary to conform to claim conformity to the quality requirements of AS/NZS ISO 3834.2, AS/NZS ISO 3834.3 or AS/NZS ISO 3834.4
AS 3853.1	Health and safety in welding and allied processes – Sampling of airborne particles and gases in the operator’s breathing zone – Sampling of airborne particles
AS 3853.2	Health and safety in welding and allied processes – Sampling of airborne particles and gases in the operator’s breathing zone – Sampling of gases
AS/NZS 3992	Pressure Equipment Welding and brazing qualifications
AS/NZS 4037	Pressure Equipment Examination and testing
AS/NZS 4041	Pressure piping
AS/NZS 4458	Pressure Equipment Manufacture
AS/NZS ISO 9001	Quality management system requirements
AS/NZS 1210	Pressure vessels
AS/NZS 1554.1	Welding of steel structures
AS/NZS 1554.3	Welding of reinforcing steel
AS/NZS 1554.6	Welding Stainless Steels for structural purposes

AS/NZS 1665	Welding of Aluminium Structures
AS 1710	Ultrasonic testing requirements for low carbon and alloy steel plate
AS 1715	Selection, use and Maintenance of Respiratory Equipment
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AS/NZS 4037	Pressure Equipment Examination and testing
AS/NZS 4041	Pressure piping
AS/NZS 4458	Pressure Equipment Manufacture
AS/NZS ISO 9001	Quality management system requirements

American Society for Testing and Materials (ASTM) Standards

ASTM A 105/A 105M	Carbon Steel Forgings for Piping Applications
ASTM A 380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A 967 -05	Chemical Passivation Treatments for Stainless Steel Parts
AWS D18.2	Guide to discoloration Levels on inside of Stainless Steel Tube

Other References

WTIA Technical Note 25	Welding Specifications for the Water Industry
L1	Tape Wrapping Requirements
M8	Cement Mortar Lining Requirements
S131	Removal of Bituminous Wrapping (that may contain asbestos)
S151	Prevention of Falls
WC-OSH 108	Safe Working in Confined Spaces
WC-OSH 134	Undertaking Hot Work
S333	Working Hours

3 Definition

In this Technical Specification unless the context requires otherwise:

AS means Australian Standards;

ASTM means American Society for Testing and Materials;

Corporation means the Water Corporation and the Principal for the purposes of externally contracted asset delivery;

Designer means the person or entity contracted to design, document and specify workmanship requirements for Corporation infrastructure assets;

Engineering Design Process means the process to be applied by Designers to the design of Corporation infrastructure assets;

GMAW- STT means Gas Metal Arc Welding using Surface Tension Transfer mode of metal transfer;

GTAW means Gas Tungsten Arc Welding;

IIW means International Institute of Welding

Integrated Quality Document means a document which is provided by the WSP in accordance with AS/NZS ISO 3834.5- Quality Requirements for Fusion Welding of Metallic Materials and AS/NZS ISO 9001 – Quality Management Systems – requirements;

ITP means the Inspection and Test Plan(s);

JAS/ANZ means Joint Accreditation System of Australia & New Zealand;

JHA means Job Hazard Analysis;

JSA means Job Safety Assessment;

MMAW means Manual Metal Arc Welding;

MDR means Manufacturer's Data Report;

MSCL means Mild Steel Cement Lined;

MPI/MT means Magnetic Particle Inspection/Testing;

NDT/NDE means Non Destructive Testing/Examination;

NATA means National Association of Testing Authorities;

PFS means the Pipe Fittings Standard DS-65 published by the Infrastructure Design Branch of the Water Corporation;

Preferred Supplier Agreement means the agreement between the Water Corporation and WSP;

PT means dye penetrant testing;

RT means Radiographic Testing;

RWC (Responsible Welding Coordinator) means a person who is appointed to carry out one or more coordination tasks; (as referenced in ISO 14731 and AS/NZS ISO 3834);

RWC WC means the Water Corporation’s RWC assigned to the project;

RWC WSP means the Welding Service Provider’s RWC;

Schedule means Schedule of Quality Assurance Requirements and WSP’s Notifications & Submissions;

Specified means specified in the project specification or project drawings;

SPS means a published Water Corporation Strategic Product Specification;

SSJ means Spherical Slip-on Joint;

Technical Specification means this technical specification;

TQ means technical query relating to the work specification;

UT means Ultrasonic Testing;

Welding Inspector means a person qualified to the requirements of the International Institute of Welding, WTIA or an equivalent standard and who inspects the *works* carried out by the *WSP* with reference to the project specification;

WPQR means Welding Procedure Qualification Record;

WPS means Welding Procedure Specification – a qualified welding procedure which has been tested and proven;

WSP means Welding Service Provider;

Work for the purposes of this Technical Specification means the metal fabrication, welding or repair work to be undertaken by the *WSP* to which this Technical Specification applies;

WTIA means Welding Technology Institute of Australia.

4 Standards and Codes

4.1 Australian Standards

All metal fabrication and welding shall comply with the Standards and Codes of Practice specified for the project.

The applicable edition of standards and codes shall be those that are current two calendar weeks prior to the date of a work brief or, in the case of tendered work, the tender closing date.

The specified standards and codes shall be the minimum applicable requirements.

4.2 Water Corporation Standards

All metal fabrication and welding of pipe fittings and flanges shall comply with this Technical Specification and Corporation Design Standards including the Pipe Fittings Design Standard DS-65. The *Designer* will, by reference to Corporation Design Standards and by copying/adapting Corporation standard drawings, provide the *WSP* with project drawings, design details and workmanship specifications that enable the *WSP* to produce workshop drawings and fabrication details as necessary to construct welded assets of the specified quality.

4.3 Industry Standards

WTIA Technical Note 25 Quality Assurance templates and forms may be used by the *WSP* for documenting standards for welding and fabrication used in construction.

5 Approval to Commence Work

The *WSP* shall formally request *RWC WC* approval to commence cutting or welding work. Cutting or welding work shall not be allowed or permissible prior to *RWC WC* approval of the following:

- The Welding Quality Plan as defined in section 6, **QUALITY ASSURANCE**;
- A schedule of qualified welding procedures, as defined in section 7, **WELDING PROCEDURES**;
- A detailed welder qualification register as defined in clause 8.3, **WELDER DOCUMENTATION**;
- A Contract specific Inspection Test Plan ITP
- *RWC WSP* and *Welding Inspector* qualifications;
- *JSA* or *JHA*, as applicable;

Note: In an unplanned service interruption, where a *WSP* is used to carry out emergency repairs, approval to commence work in accordance with the above requirements is highly desirable however non-mandatory (except for the *JSA* or *JHA* which is still required). The *WSP* shall however provide the required documentation on completion of the work. In such instances additional follow-up in-situ testing may be required.

6 Quality Assurance

6.1 WSP Organisational Responsibilities

The *WSP* shall establish a welding management system in accordance with clause 6.1.1 of this *Technical Specification*.

Not less than 10 working days prior to commencement of the *works*, the *WSP* shall nominate a suitably qualified *RWC WSP*, who shall be responsible for the co-ordination of all welding operations and who shall have delegated authority to coordinate all welding work.

The *WSP* shall also appoint a *Welding Inspector* who is appropriately qualified as per Section 8 of this specification.

The *WSP* may elect to consolidate the roles of the *RWC* and *Welding Inspector* due to limited work scope. In such instances the *WSP* shall gain *RWC WC* approval prior to the commencement of the work.

6.1.1 WSP Quality Management System Requirements

The WSP shall establish a quality management system as defined below for each of the following categories of welding work:

1. **Category A** – Manufacture and supply of MSCL pipes and fittings (carbon & low alloy steels), including surge/pressure vessels - certified in accordance with AS/NZS ISO 3834.2 or ISO 9001;
2. **Category B** – Manufacture of spooling, fittings and pressure vessels in stainless steel, high alloy, steel and exotic materials - certified in accordance with AS/NZS ISO 3834.2 or ISO 9001;
3. **Category C** – Field Welding Services (Fabrication & Site Welding of New Assets & Upgrades) - certified in accordance with AS/NZS ISO 3834.3 or ISO 9001;
4. **Category D** – Structural Fabrication and Welding - certified in accordance with AS/NZS ISO 3834.2 or ISO 9001;
5. **Category E** – Welding Installation and Maintenance Services (Installation, Maintenance and Repair of Existing Assets) in accordance with the intent of AS/NZS ISO 3834.4; and
6. **Category F** – Sheet Metal Fabrication – system acceptable to the Manager Welding and Corrosion Control, Mechanical and Electrical Services Branch.

Quality management systems shall be certified by JAS/ANZ with respect to ISO 9001 and the WTIA with respect to AS/NZS ISO 3834.

6.2 RWC WSP – Role

The RWC WSP shall:

1. be responsible for all quality assurance activities necessary to ensure that the work complies with the specified requirements;
2. provide sufficient information, in respect of any proposed subcontractors, to enable the *RWC WC* to assess their suitability for the work;
3. establish and maintain a quality assurance system as defined in clause 6.1.1;
4. provide management and oversight to ensure that subcontractor operations comply with the contract quality assurance system;
5. submit a Quality Plan to the *RWC WC* detailing how the quality assurance requirements are to be applied to each work element;
6. submit a system element outline comprising the following:
 - a) the *WSP*'s organisation chart for the work;
 - b) organisation chart(s) for all subcontracted work;
 - c) a list of qualified welding procedures for the welding work, including destructive and non-destructive test results of each welded test piece complying with the referenced performance standard for the work;
 - d) detailed *ITP*'s for the work;
 - e) details of Weld Map format; showing traceability between workshop and site installation/welding quality;
 - f) details of the quality system showing each element of the system and how they relate to each other.
7. present the Quality Plan and the MDR as Integrated Quality Documents; and
8. cease work where manufacturing traceability and auditable Quality Assurance process is not maintained during manufacture. Work shall not commence until all Quality

Assurance processes and documentation have been revised to a standard acceptable to the *RWC WC*.

6.3 WSP Capabilities

The *RWC WSP* shall demonstrate that:

1. welders and welding operators are qualified, with records, to the welding standard specified;
2. documented weld procedure specifications are in accordance with the welding standard specified;
3. there is a documented welding procedure for repairing defective welding that does not comply with specified requirements;
4. non-destructive testing personnel are qualified, with records, to the non-destructive testing standard specified e.g. AS 3998;
5. plant and equipment are maintained, calibrated and in good working order to prepare, execute and deliver the contract in a timely and safe manner;
6. a quality control system is in place to manage documentation such as weld procedure specifications, weld procedure approval records and welder approval certificates;
7. a written procedure for the control of welding consumables is provided to ensure compliance with the consumable manufacturer's specification and recommendations;
8. where post-weld heat treatment is required, the *WSP* shall provide a written procedure and a record obtained during the process demonstrating conformity;
9. a system is in place to control inspection and testing prior to, during and after welding work;
10. a system is in place to maintain calibration of all equipment that measures or assesses the quality of the welded work;
11. a documented and detailed production plan that considers as a minimum, the items referred to in AS/NZS ISO 3834.2 or AS/NZS ISO 3834.3 as appropriate, is provided;
12. a written procedure for controlling and rectifying non-conforming product, for acceptance by the *RWC WC*, is provided prior to production;
13. there is provision for certification of welding consumables. Where test certification is not available the *WSP* shall carryout batch testing to the appropriate standard for the particular consumable;
14. manufactured products comply with the *Corporation's SPS* where appropriate; and
15. an Inspection Release Certificate as per Appendix B is completed prior to the dispatch of any fabricated item to site. Copies of Inspection Release Certificates shall be included in the *MDR*.

Where a welded joint fails, a repair procedure shall be submitted to the *RWC WC* for acceptance and further work shall not commence on that joint until the *RWC WC* has accepted the revised welding procedure. No more than two repair attempts shall be permitted on a failed section of weld without referring the matter to the *RWC WC* for consideration.

6.4 MDR Table of Contents

The *MDR* for welding fabrication *works* shall as a minimum include the following table of contents:

1. Section A – Inspection and Test Plans;

2. Section B – Inspection Release Certificates;
3. Section C – Welding Procedure Specification and Welding Procedure approved by the *RWC WC*; Register
4. Section D – As built drawings;
5. Section E – Fabricated Item Record List;
6. Section F – Dimensional Check records;
7. Section G – Welder Register/ Operator Qualification records;
8. Section H – Weld Maps/Weld Traceability;
9. Section I – Non-destructive test records;
10. Section J – Non-conformance reports and deviations;
11. Section K – Material Test Certificate Register and Reports;
12. Section L – Certificates of Compliance;
13. Section M – TQ (Technical Query) and approvals;
14. Section N – Statutory documentation including design certification;
15. Section O – Coating Inspection Reports and test equipment calibration certificates;
16. Section P – Photographic records as applicable
17. Section Q. Copy of ISO 9001 or AS 3834 Certificate of Compliance
18. Section R. Declaration of Conformance to Standards and Specifications.

Compilation of the MDR shall progress concurrently with production.

7 Welding Procedures

7.1 Qualification of Welding Procedures

1. Welding procedures for all fillet or butt welds or any combination of each, shall be proven qualified by the *WSP*, who shall submit to the *RWC WC* a schedule of all proposed welding procedure qualifications, not less than 10 working days prior to the planned commencement of welding work to which the procedures are intended to apply;
2. A new welding procedure shall be required when the essential variables on the welding procedures being used, vary beyond the limits prescribed in the specified standard/code. This welding *WPQR* shall be submitted to the *RWC WC* for review and authorisation prior to proceeding;
3. The *RWC WSP* shall give the *RWC WC* a minimum of 48 hours notice prior to the commencement of qualifying a new welding procedure. A copy of the *WPS* shall be made available to the *RWC WC* prior to commencement of the procedure qualification test;
4. The *RWC WSP* shall prepare a *WPQR* detailing actual values recorded from the welding qualification test;
5. The *RWC WSP* shall permanently mark the *WPS* number on the test piece. Test reports shall indicate the unique *WPS* number assigned to the welding procedure;

6. On completion of welding the qualification test piece, the *RWC WSP* shall perform a 100% visual examination of the completed weld(s) to verify compliance with the relevant Standard;
7. The test piece(s) shall be submitted to a *NATA* laboratory for destructive and non-destructive testing, as appropriate. Where test results are found to be compliant, a *WPS* shall be documented;
8. Copies of all qualified welding procedures documentation (including *NDT* and Destructive Test Certificates) shall be forwarded to the *RWC WC* prior to any work in accordance with these procedures commencing.

7.2 Welding Procedure Specification Sheet

The *WSP* shall ensure copies of the qualified *WPS* are available at the manufacturing facility and on the work site at all times.

Each qualified *WPS* shall be submitted to the *RWC WC* for review and acceptance and shall include a welding procedure sheet containing **all** of the critical parameters / essential variables and as a minimum the following information:

1. A sketch of the joint design;
2. Material(s) grade-type and group type;
3. Material thickness - all parts;
4. Method of material(s) preparation;
5. Welding process(es) to be used;
6. Voltage, amperage and polarity;
7. Number and sequence of runs;
8. Classification of electrode/wire (inclusive of brand); diameter of electrode/wire;
9. Shielding gas/gas mixture/flux type/classification;
10. Shielding gas flow rate;
11. Travel speed (weld length per minute);
12. Temperature of preheat, inter run heat and post heat applications if applicable;
13. Heat input (kJ/mm) for each weld pass;
14. Welding standard/code and classification, (e.g. AS1554-1 SP, AS4041 Class 1);
15. The type and extent of testing of welds to be carried out, in accordance with the specified testing requirements;
16. Consumable details, including batch numbers and certification;
17. Unique identification linking the *WPS*, *WPQR* and qualification results;
18. Confirmation of *RWC WSP* approval; and
19. Facility for *RWC WC* acceptance.

8 Welding Personnel Qualifications

8.1 Responsible Welding Coordinator WSP

The *WSP* shall hold:

1. Current *WTIA* certification to AS 1796 Cert. 10 or *IIW* International Welding Specialist (*IWS*) where the construction requires fabrication relating to pressure equipment ; or
2. Current *WTIA* certification to AS 2214 where construction relates to fabrication of steel structures or *IIW* International Welding Specialist (*IWS*); or
3. *IIW* International Welding Technologist (*IWT*); or
4. Another current qualification/certification acceptable to the *RWC WC*.

The *WSP* shall provide details of *RWC WSP* qualification(s), certification and experience records to the *RWC WC*.

8.2 Welding Inspector

The *WSP* shall identify and nominate a suitably qualified *Welding Inspector* not less than 10 working days prior to commencement of the work.

The welding Inspector shall hold as a minimum:

- Current *WTIA*, Welding Inspector Certification or *IIW* International Welding Inspector – Basic Level; **or**
- Another current qualification/certification acceptable to the *RWC WC*.

The *WSP* shall provide details of the Welding Inspector’s qualifications, certification and experience records to the *RWC WC*.

Where welding is to occur concurrently at sites remote from each other, the *WSP* shall identify and nominate an appropriate number of suitably qualified inspectors.

8.3 Welder Documentation

8.3.1 Welder Qualification, Certification, Experience

Not less than 10 working days prior to planned commencement of welding, the following information shall be provided to the *RWC WC* for each welder:

1. Documentary evidence of the qualification/certification currently held;
2. Trade training background;
3. Duration of employment with current employer;
4. Nature of current employment duties; and
5. Documentary evidence confirming that each welder is qualified for each welding procedure that they will apply to the welding *work* and their qualifications are current in reference to AS 3992 and AS1554. The criteria for revalidation of welders shall be in the form of a volumetric test to re-validate Butt Welding and Surface Flaw Detection to re-validate Fillet welding.

Welder qualification tests shall not be carried out on production assemblies.

9 Workmanship Standards

9.1 General

The surfaces to be welded shall be free of slag, oil, grease, cement mortar, external coating, rust or mill scale, mud or sand, or any foreign substances which may affect the quality of the weld.

In multi-pass welding, each pass shall be thoroughly cleaned before the succeeding pass is applied.

Tack welds, which are to be incorporated in the final weld, shall be subjected to the same quality and workmanship requirements as the final weld. Any tack weld found to be cracked shall be completely removed and replaced by a tack weld of sound quality.

Welding and rendering debris inside of pipes shall be removed to avoid clogging and damage to other in-line components such as pumps, flow meters and valves.

9.1.1 Fabrication of Steel Components

Any material showing visible signs of lamination shall be quarantined and tested by ultrasonic examination. Testing of carbon steel plate shall be to AS 1710 level 1 where laminations are observed on pressure retaining and structural components. Test results shall be made available to the *RWC WC* for acceptance.

Grooves and gouges in flame cut edges shall be removed by grinding. Surfaces to be incorporated in a weld shall not have a surface rougher than Class 3 as defined in WTIA Technical Note 5.

Steel plates shall be free from surface damage and pitting, including marks from dies and rolls used in forming.

If plates over 10mm thick are to be cut by shearing, the sheared edges shall be machined or flame-cut back at least 5mm.

The use of heat to correct distortion in any quenched and tempered steel or heat treated steel shall not be permitted.

Fabrication aids attached by welding shall be kept to a minimum. They shall be attached only by a qualified welder using approved procedures. Fabrication aids shall be removed by flame-cutting 1.5mm above the plate surface, with subsequent grinding back to smooth surface.

Arc strikes on plate or pipe surfaces shall be avoided. If they occur they shall be ground out to a smooth transition without compromising parent metal thickness.

9.1.2 Pressure Piping – Carbon Steels

Pressure piping welding shall be to AS 4041 pipe work class 2P, shall be in accordance with this Technical Specification and with the drawing, design and workmanship details provided in the project documentation.

Where fusion bonded polyethylene coated MSCL pipes are used to fabricate pipe fittings the coating shall be stripped back to a minimum of 100mm away from the weld joint. Welders / Welding Operators and Welding Procedures shall be qualified to the requirements of AS 3992.

Workmanship standards shall be assessed to AS 4458.

Where two or more off-cuts are joined together to make up a single length of pipe, the pipe length shall only be acceptable provided the joints are full penetration butt welds and subjected to testing as prescribed in section 10.2.1 (NDT Requirements).

Pipe branches, including threadolet fittings used as tapping points, shall be full penetration butt welded to the through pipe. For pipe branches less than 150mm nominal bore the root pass shall be made using MMAW, GMAW-SST or GTAW welding processes.

Welding of pressure retaining and structural assemblies on new asset constructions, shall only be carried out using hydrogen controlled processes, as noted in WTIA Technical Note 1. Root run only is permitted using a cellulose flux electrode. These requirements do not apply to non-structural and seal welds.

Cut-in and re-welding/link-in ambient temperature for major distribution and trunk mains shall be as per the table below:

Region in Western Australia	Cut-in and Re-welding Temperature
Perth Region	14 °C to 22°C – Below and above ground
South West Region	14 °C to 22°C – Below and above ground
Great Southern Region	14 °C to 22°C – Below and above ground
Midwest Region	17 °C to 25°C – Below and above ground
North West Region	22 °C to 30 °C - Below and above ground
Goldfields and Agricultural Region	17 °C to 25°C – Below and above ground

Notes:

1. For the North West Region where the temperature range specified is impractical the cut-in/ link-in shall be carried out at the temperature of the water being conveyed.
2. Adherence to the cut-in / link-in temperature is critical in avoiding the consequences that may occur when residual stresses are relieved which can result in unexpected significant movement of the pipe

Installation and repair of cement mortar lining shall be in accordance with the Corporation’s Technical Specification M8.

9.1.3 Structural Fabrication – Carbon Steels

All welding materials and inspections shall conform to AS 1554.1 SP category, unless specified otherwise. Welding plant and equipment shall be adequately sized for the *work*. Steelwork shall be workshop pre-assembled where practicable.

Welding consumables shall be free of rust, oil grease or any other deleterious substances. Electrodes and filler wire shall be stored in the original containers or approved alternatives, in a dry and weatherproof location. Electrodes or filler wire which have been wet or which have part of the flux covering broken or damaged, shall be discarded.

The preparation of steel edges for welding shall be carried out in accordance with AS 1554.1. Preparation of edges shall, whenever practicable, be by cold sawing, laser cutting, plasma arc cutting or gas profile cutting. Edges so prepared shall be smooth and regular, and free from excessive striation. Edges shall be free of slag, loose scale, rust, grease, paint or any other foreign material. Where fitment of stiffeners is required, these shall be accurately cut to ensure a tight fit in the member to be fitted. The surface profile of thermal cut edges shall be Class 3 for welding applications as per WTIA Technical Note 5, Table 10.

Alignment of plates and structural members for welding shall be as per AS 1554.1. When the ambient temperature is less than 10° C, the metal adjacent to the weld joint shall be preheated to 25° C before welding. A digital temperature gauge or temperature crayons shall be used to measure the temperature of the steel during preheating and welding.

Welding shall not be done during inclement weather without adequate provision for protection and shielding of the welder and the work. When preheating is required the pre-heat shall be performed in accordance with AS 1554.1.

Each splice shall be located where shown on the construction drawing. Should additional splices be considered necessary by the *WSP*, a proposal for such splices shall be submitted in writing for approval before fabrication commences. Testing of additional splices, other than those nominated in the construction drawing, shall be carried out as per section 10.2.1 of this specification.

Where a fillet size is not nominated on the construction drawing, the weld shall be a continuous fillet weld all around the mating surfaces. Unless otherwise shown on the construction drawing, the fillet weld leg length shall be equal to the thickness of the thinner plate or structural member. Butt joints shall be full penetration welds unless shown otherwise on the drawings.

Where post weld heat treatment is required the heating parameters shall be as per AS 4458.

9.1.4 Stainless Steel Fabrication

Stainless steel shall be handled so as to prevent cross contamination with carbon steel, which can breakdown the protective oxide coating and result in pitting corrosion.

To minimise risk of localised/pitting corrosion of stainless steel components, the *WSP* shall have strict controls in place with regards to workshop segregation, control of consumables, hand tools and surface treatment after welding.

To minimize the risk of crevice corrosion for items that do not require a structural weld for structural integrity. A seal weld shall be utilized. Welding shall be a continuous 3mm fillet in accordance with AS 1554,6 Pickled and passivated in accordance with ASTM A380.

Welded joints in stainless steel pipe work subject to H₂S gas, Sulphuric acid or other hazardous substances shall be full penetration butt welded. The use of socket joints and single side welds shall not be permissible. Fillet welds shall be permissible only on slip-on flanges where a double side weld is practicable.

Where the welding of joints in stainless steel pipe work or structural assemblies is carried out using the *GMAW* process, the shielding gas shall be weldable grade argon or argon mixtures with no greater than 2% CO₂. For *FCAW* the shielding gas shall be in accordance with the consumable manufacturers recommendations.

Before and after passivating, stainless steel contact with graphite greases, graphite packing, graphite compounds, carbon steel, weld spatter, dust, metal shavings and the like shall be prevented.

Welding Procedures using Flux Cored GTAW consumables shall not be permitted. Unless it is being used for tie-in welds where it can be demonstrated that purging is impractical.

The following practices shall be avoided:

1. Cleaning with steel wool, carbon steel or contaminated stainless steel wire brushes, or emery paper;
2. Blast Cleaning with an abrasive medium;
3. Cleaning with abrasive compounds containing chlorides;
4. Use of muriatic (i.e. hydrochloric) acid;
5. Use of tools or equipment previously used for carbon steel fabrications;
6. Use of guide rollers that are not thoroughly cleaned mechanically and chemically;
7. Use of product or information stickers;

8. Use of permanent paint markers; and
9. Use of uncovered forklift tines and steel slings.

9.1.5 Passivation

Stainless steel fabrication components shall be pickled and passivated after welding has been completed. The WSP shall have adequate facilities to carry out pickling and passivation of welds.

Fabricated items shall be pickled and passivated using an emersion bath or by brush-on application. Emersion shall always be the preferred option as it is imperative the internals of Stainless pipelines have been treated in accordance with ASTM A380. Personnel shall be suitably experienced in such procedures and work with compliance to statutory regulations. The TIG Brush method is an acceptable alternative to pickling and passivation for in-situ site welds only.

After passivating, the welded fabrication shall be dried and free of all traces of moisture. The entire fabrication shall be free from scale, signs of contamination or discoloration within the limits of the standard specified.

Where stainless steel components are to be introduced to aggressive (corrosive) environments such as ground water treatment, chemical dosing, sewerage conveyancing, seawater desalination and waste water treatment plants, the passivated components shall be tested to ASTM A967-05, Practice D - Copper Sulphate Test for effectiveness of the passivation process.

Stainless steel fabricated items shall be protected against contamination during transport and storage on site by the use of suitable packaging and handling methods to eliminate the possibility of contact with materials such as carbon steel, high tensile steel, or other conditions that may affect its corrosion resistance.

Pickling chemicals shall comply with Western Australian Health, Safety and Statutory requirements.

The use of glass bead blasting is an acceptable alternative process to pickling and passivation where the structures are large, it is impractical to pickle and passivate in a bath or by use of pickling paste, and the welded structures are not designed to operate in aggressive corrosive environments. Approval shall be sought from the Corporation when the application of this process is being considered.

9.1.6 Pressure Vessels

Welding of Pressure Vessels shall be to AS 1210 and its referenced standards, or as specified by the certified design. **Welding on a registered vessel shall not be carried out except where approved by a certified designer.**

9.2 Standards and Documentation

The standard for welded fabrications, except as may otherwise be specified, shall be in accordance with the following:

1. All structural welds shall comply with AS 1554.1 Category SP, unless noted otherwise;
2. Welding of concrete reinforcing bars shall comply with AS 1554. 3;
3. Stainless steel intended for Structural purposes shall be fabricated to AS 1554.6. Welds shall meet the quality requirements of Category 1B. Stainless steel structures and assemblies that come in contact with H₂S gases shall be fully welded with no internal defects that will promote crevice corrosion;
4. All stainless steel welds shall be pickled and passivated in accordance with ASTM A380. Quality level shall be to AS 1554.6, level 2a for structural members. Buffing of welded

assemblies shall not be used as a substitute for pickling and passivation. The external appearance of all welds shall be a bright finish;

5. Small diameter stainless steel pipes shall be welded using the *GTAW* process using inert gas purging during welding. Quality levels of the internal weld bead and heat affected zone shall be assessed to AWS (American Welding Society) D18.2, Quality level 3 shall be the maximum discoloration permissible. Discoloration of internal welds shall not exceed a light straw colour tint. Butt welds shall be full penetration;
6. Welding of aluminium and aluminium alloys shall comply with AS 1665. Welding quality shall be assessed to Table 6.1; Category “B”. Quality assurance requirements shall comply with CF2 where the mode of failure is expected to result from lack of strength as per Table B1.

10 Inspection and Testing

10.1 Inspection and Test Plan

The *WSP* shall:

1. provide an inspection and test plan for all welding work to the *RWC WC for approval*, not less than 10 working days prior to commencement of the welding *work*;
2. include in the inspection and test plan, the necessary elements to ensure that welding work complies with the standards, specifications and other requirements specified for the project; and
3. ensure that the “Inspection Release Certificate” (Appendix B) is signed by the *RWC WC or Corporation’s* representative prior to despatch of fabricated components.

10.2 Testing of Welds

The *WSP* shall:

1. carry out testing of all welds in accordance with the specified standards/codes and/or other specified requirements; and
2. ensure that NDT test certificates, issued by a NATA accredited laboratory, for both destructive and non-destructive testing (except pneumatic testing of pipe joints) are included in the MDR.

10.2.1 NDT Requirements

NDT requirements shall comply with the following:

1. **Pressure Piping**- *NDT* shall be 10% for both longitudinal and circumferential butt welds. Location of test areas and method of testing for butt welds and fillet welds shall be as per AS 4037 and as stated below:
 - a. All sizes of pipe fittings PN 16, PN 21 and PN 25 pressure rating shall be tested to any of the spot examination options listed in AS 4037;
 - b. Pipe fittings rated at PN 35 or greater, smaller than and inclusive of DN 1000, shall be tested to any of the spot examination options listed in AS 4037;
 - c. Pipe fittings with pressure ratings equal to and greater than PN35 and larger than DN 1000 shall be tested for 10% of the total length of all welds in each fabricated fitting or assembly; and

- d. Fillet welds in flanges DN 1000 and above, pressure rated at PN 35 and above, shall be 10% *MPI* tested.

RT of butt welded joints in low and medium carbon steels can be substituted by *UT* provided the thickness of the welded members is equal to or greater than 10mm. Where *RT* is substituted by ultrasonic examination, the test area shall be *MPI* tested externally and internally, subject to access.

Manhole fittings in trunk mains with pressure ratings equal to and greater than PN 35 (3.34 Mpa) shall be 100% *UT* and *MPI* tested where these welds are performed in-situ and on-site. Where the manhole is welded to a fitting in the workshop 10% *UT* and *MPI* of all welds shall apply.

UT of butt welds in mitre bends in the intrados section of the fitting are only permissible where access for testing is available internally and externally. Test limitations noted on *UT* reports shall not be acceptable. Where test limitations by *UT* exist the test shall be completed using *RT*.

Where *UT* is selected, the parent metal on either side of the weld joint shall be cleaned to bare metal for a minimum width of 100mm to facilitate testing. *UT* shall be undertaken prior to the application of cement mortar linings.

2. **Structural Applications-** *NDT* shall be to the relevant AS 1554 application codes and as stated below:
 - a. Visual Examination shall be 100% for carbon steel, stainless steel and aluminum welded structures (execution by *RWC WSP* or *WSP Welding Inspector* is acceptable);
 - b. Fillet and Butt welds (Category SP, AS 1554.1) shall be 10% *MPI* and 10% *UT* or *RT* for carbon steels;
 - c. Fillet Welds (AS 1554.6) shall be 10% *PT* for Stainless Steel;
 - d. Butt welds (AS 1554.6) shall be 5 % *RT* tested for stainless, [refer Clause 6 below];
 - e. Fillet and Butt Welds – Aluminum structures to AS 1665, 10% *PT* and 10% *RT* testing;
 - f. Splice joints in beams, columns and plate not part of construction design shall be 100% *RT* or *UT* tested.
3. **Non-conformance-** Where a non-conformance arising from the use of unqualified welders and welding procedures occurs, all welds made by the unqualified welder and or procedures shall be 100% *NDT* tested using the testing technique nominated by the standard. The Corporation may require additional testing to satisfy itself the structure or component manufactured meets the design durability requirements and is safe to operate with respect to legislative requirements. Cost of testing resulting from the non-conformances and rework including *NDT* retests shall be borne by the *WSP*.
4. **Pipe Flanges-** Fabricated flanges to AS 4087 made from plate segments and incorporating butt welds shall be 100% *UT/RT* and *MPI* tested. Fabricated flanges with welded joints shall be given a stress relieving heat treatment as per the requirements stated in AS 4458. Fabricated flanges with welded joints and greater than 80mm in thickness shall be *NDT* tested before and after stress relieving heat treatment.

Plate flanges DN 500 and above, for all pressure ratings, shall be ultrasonically tested at the source of supply. Test certificates shall be provided to confirm the material properties and integrity of each flange.

Acceptance criteria for flanges from rolled plate shall be to AS 1710 Level 1.

Forged flanges shall be tested to AS 1065, Level 2.

5. **Stainless and Duplex Steel Piping** – testing for sulphuric acid dosing, hazardous substances and aggressive ground water applications, shall be to AS 4041 Class 1 piping 100 % RT of butt welds and 100 % PT of fillet welds.
6. **Stainless Steel Structural Welds** shall be assessed to AS 1554.6, Category 1B.

10.2.2 Pneumatic Testing

Pneumatic testing shall not be permissible as an alternative to hydrostatic testing of pressure mains.

The *WSP* shall:

1. pneumatic test only flat banded pipe joints and *SSJ* joints of size DN900 and greater, in accordance with Standard Drawing No. AY58-20-1 (as provided by the *designer*); and
2. notify the *RWC WC* of any pneumatic test proposal at least 5 working days prior to undertaking such testing.

10.2.3 Hydrostatic Testing

All pipelines shall be subjected to hydrostatic testing in accordance with the project specifications. Testing requirements of AS 4041 and AS 4037 shall not apply.

10.2.4 Test Gauges

The calibration of test gauges used in hydrostatic and pneumatic testing shall be certified by a testing agency accredited for that purpose by *NATA*. The certification of test gauges shall be valid for no longer than 6 months.

10.3 Material Certification

The *WSP* shall:

1. provide material certification for all materials used in construction including certification for welding consumables;
2. provide mill test certificates for steel plate used for the manufacture of AS 4087 and AS 4331 flanges; and
3. provide mill test certificates for forged flanges DN 600 and above.

10.4 Testing Records

The *WSP* shall:

1. ensure all welded spools and fabricated assemblies are stamped or tagged with the project abbreviation plus the item number for traceability. Example: Lower Helena Pump Station, Stage 4 Spool 10 – “LH S4-10”. Tags shall be 3mm steel plate or stainless steel as applicable, with the spooling number hard stamped on the tag and placed at the horizontal position (3 O’clock or 9 O’clock). All tags shall be fully seal welded to the pipe spool;
2. ensure that testing records are maintained for all weld testing and provide such records to the *RWC WC* on request. Such testing records shall be clearly traceable, by sketch or designation, to the actual weld(s) being reported on; and
3. provide 1 hardcopy and 1 electronic copy of the *MDR* to the *RWC WC* on completion of the welding work.

10.5 Additional Testing of Welds

The *WSP* shall ensure that where testing of production welds detects non-compliance with relevant specified standards, codes and specifications further testing is undertaken until the full extent of defects is known. Additional cost of testing shall be borne by the *WSP*.

11 Processes and Consumables

11.1 Welding & Cutting Processes

The *RWC WC* shall be notified where the *WSP* intends to incorporate in a welding procedure, welding or cutting processes other than those specified in this technical specification.

11.2 Welding Consumables

All welding consumables to be used in welding procedures shall comply with the nominated standards/codes.

The *WSP* shall store and handle all welding consumables in a manner compliant with the requirements of *WTIA* Technical Note 3.

12 Schedule

The *WSP* shall use the schedule in Appendix A to;

1. confirm compliance to the required Contract Quality Assurance System;
2. identify all submissions, approvals etc and their contractual time requirements; and
3. record and update the status of the various items.

The *WSP* shall comply with all the requirements in the schedule and provide updates to the *RWC WC* on request.

13 Safety in Welding

13.1 General

The *WSP* shall ensure that all employees have completed the relevant induction process for working on *Corporation* sites. A *JSA* shall be in place for every task.

As a minimum, the *WSP* shall ensure personnel undertaking the duties of welding inspector and welding supervisor have been provided with Basic Emergency Life Support Training and issued with a statement of attainment from a certified training provider. At the discretion of the *Corporation*, the Basic Emergency Life Support training can be substituted by the ‘Provide First Aid’ course.

The *Corporation* strongly supports the use of *WTIA* Tech Note 7- Health and Safety in Welding and Tech Note 22- Welding Electrical Safety as a guide to assessing risk and the development of risk control measures.

The types of PPE recommended for use in welding are summarised in the following table:

PPE type	Hazards	Recommendation
Eyes, face and head protection (e.g. goggles, helmets, hand shields and protective filters)	Light, radiation, burns from hot debris and sparks	<ul style="list-style-type: none"> Workers should always have their eyes, face and/or head protected whenever they are welding. For further information refer to: AS/NZS 1338: <i>(series) Filters for eye protectors</i>, AS/NZS 1338.1: <i>Filters for eye protectors - Filters for protection against radiation generated in welding and allied operations</i> and AS/NZS 1336: <i>Recommended practices for occupational eye protection</i> and AS/NZS 1337: <i>Eye protectors for industrial applications</i>.
Hearing protection (e.g. ear muffs and ear plugs)	Hearing loss	<ul style="list-style-type: none"> Ear plugs or ear muffs may be required to minimise the risks of noise. For further information refer to: AS/NZS 1270: <i>Acoustics - Hearing protectors</i> and AS/NZS 1269.3: <i>Occupational noise management – Hearing protector program</i>.
Gloves/ gauntlets	Heat, ultraviolet light and burns from hot debris and sparks	<ul style="list-style-type: none"> Gloves should be fire resistant and protect exposed skin on the hands and wrists. For further information refer to: AS/NZS 2161: <i>(series) Occupational protective gloves</i>.
Clothing (e.g. flame resistant long sleeved shirts, long trousers, aprons and leather spats)	Heat, ultraviolet light and burns from hot debris and sparks	<ul style="list-style-type: none"> Avoid clothing that has the potential to capture hot sparks and metals, for example in pockets or other folds. Clothing should be made of natural fibres. For further information refer to: AS/NZS 4502: <i>(series) Methods for evaluating clothing for protection against heat and fire</i>.
Foot protection (e.g. boots and shoes)	Hot metal debris, other metal debris and electric shock	<ul style="list-style-type: none"> Foot protection should be non-slip and be heat and fire resistant. Avoid using foot protection that has the potential to capture hot sparks and metal debris, for example in laces or in open style shoes. For further information refer to: AS/NZS 2210: <i>(series) Occupational protective footwear</i> and AS/NZS 2210.1: <i>Safety, protective and occupational footwear - Guide to selection, care and use</i>.
Screens	Exposure to the rays of an arc during electric welding operations	<ul style="list-style-type: none"> Opaque or appropriate translucent screens can be used to protect the health and safety of people within the vicinity of welding. For further information refer to: AS/NZS 3957: <i>Light-transmitting screens and curtains for welding operations</i>.
Powered Air Purifying Respirator (PAPR)	Exposure to Toxic Fumes	<ul style="list-style-type: none"> As per 13.9.2

13.2 Welding Power Source

All welding equipment shall comply with the requirements of AS 1674.2 – Safety in Welding and Allied Processes. Welding power sources shall be fitted with a Voltage Reducing Device (VRD). Control measures for the work area shall be compliant to AS 1674.2 for a Category C environment.

13.3 Portable and Handheld Tools

All portable or handheld electrical tools shall be protected by an RCD (Residual Current Device).

The minimum requirement for RCD shall be:

1. In-built to a generator set; or
2. Built into the construction site switchboard; or
3. Built into the switchboard or the power outlet of an established premises; or

4. A portable RCD that is plugged directly into the power socket outlet.

The minimum requirement for electrical tooling shall be:

1. Inspected and tagged quarterly;
2. Display the quarterly electrical inspection tags, and
3. Operated with the appropriate guards fitted to the equipment.

13.4 Hot Work Permit

Application of the Corporation's 'Hot Work Permit' system shall be 'risk based,' and shall apply to environments where a formal risk assessment has identified a risk to persons, assets and/or the environment from the proposed hot work.

Where Hot Work is to be performed, it shall be carried out in accordance with:

- The Corporation's WC-OSH 134 "Undertaking Hot Work" ; or
- The Corporation's WC-OSH 126 "Hot Work in Hazardous Areas" and
- AS1674.1- Part 1 Fire Precautions; and
- West Australian Bush Fire Act 1954 and FESA Act 1998.

No welding, grinding or hot work shall be performed during a total fire ban. Where emergency hot work is required to be undertaken during a total fire ban, authorisation shall be obtained from FESA / Bush Fire Control Officer or local government authorities prior to the commencement of work.

13.5 Working in a Confined Space

Where work is intended to be carried out in a confined space, all personnel carrying out the activity shall be suitably trained and qualified to work in a confined space and shall comply with the Corporation's Safe Working in Confined Space Procedure – WC OSH 108. Distance of travel into live mains \geq DN 500 shall be as stated in WC OSH 108. Distance of travel into new constructed mains \geq DN 600 that are not connected to existing live mains shall be as per risk assessment and risk controls in place for the work and approved by the Corporation.

13.6 Safe Working with Coatings and Wrapping

Some bitumen based pipe wrapping materials have been found to contain asbestos fibres. These fibres are physically stable but may present a risk to health if disturbed during the process of removal of the coating or handling.

The external coatings of all buried steel pipe coated in coal tar enamel or other bitumen based material manufactured prior to 1985 shall be treated as containing asbestos and procedures for safe removal, handling and disposal shall accordingly apply.

This and other work that involves asbestos containing materials shall be carried out in accordance with the Corporation's Safety Procedure S131.

13.7 Working Hours and Fatigue Management

All personnel undertaking work shall be aware and adhere to the Corporation's working hours Standard S333 and Western Australia legislative acts.

13.8 Working at Heights

All personnel undertaking work shall be aware and adhere to the *Corporation's* Prevention of Falls Standard S151.

13.9 Welding Fumes

The *WSP* shall apply effective risk control measures to minimise welding fume exposure, risk assessments shall be carried out compliant to AS 3853.1 and AS 3853.2.

Welding can generate fumes, mists, dust, vapours and gases, including ozone. The amounts and types of fumes produced vary greatly depending on the process involved and the materials being used such as metals, solvents, flux, paint and plastics. The health effects of exposure to fumes, dust, vapour and gases can vary.

Effects can include irritation of the upper respiratory tract (nose and throat), tightness in the chest, asphyxiation, asthma, wheezing, metal fume fever, lung damage, bronchitis, cancer, pneumonia or emphysema.

Some welding fumes are easy to see, however, many gaseous fumes and vapours are invisible. Generally, fewer fumes are generated from gas welding than from electric welding processes. Also, intense ultraviolet radiation emitted by arcs may travel significant distances, especially in reflective environments and may give rise to significant quantities of ozone.

To determine the risk of exposure to fumes during welding the *WSP* shall identify what equipment and materials are being used and the level of fumes, dust, vapour and gases generated.

13.9.1 Engineering Control Considerations for the Mitigation of Risk

Ventilation can reduce exposure to fumes and other atmospheric contaminants in the work area. It has the added benefits of removing heat from the work environment.

The choice of ventilation system should take into account:

- The amount and type of fumes and contaminants produced;
- The proximity and location of the welding process relative to the ventilation system;
- The level of ventilation, natural or mechanical, both for the whole workplace and the welding area – this will also depend on screens and partitions which may restrict cross-flow at the work area;
- The proximity of the welder's breathing zone to the fume source.

Local Exhaust Ventilation -

Local exhaust ventilation is a preferred method of welding fume control by capturing emissions before they pose a risk to the welder and surrounding personnel. The closer the system is to the fume, the better the mitigation of risk.

A local exhaust system may comprise the elements listed:

- A hood which captures the contaminant close to its point of generation;
- A duct system to move contaminant away from the work area;
- An air cleaning system to prevent pollution of the general atmosphere;
- An exhaust fan to provide air flow;
- A stack or other means of discharging the contaminated air into the atmosphere.

Local exhaust ventilation systems should be designed to provide a minimum capture velocity at the fume source of 0.5m/second away from the welder. Inlets and outlets should be kept clear at all times. Air from a local exhaust ventilation system should not be re-circulated into the work area. This air should be discharged into the outside air away from other work areas and away from air conditioning inlets or compressors supplying breathing air.

Examples of local exhaust ventilation suitable for welding operations include:

- Fixed installations, such as side-draught or down-draught tables and benches, and partially or completely enclosed booths;
- Portable installations, such as movable hoods that are attached to flexible ducts;
- Low volume high velocity fume extractors attached directly to the welding gun.

13.9.2 Respiratory Protection While Working With Welding Fume

The WSP shall apply effective risk control measures to minimise welding fume exposure, risk assessments shall be carried out compliant to AS 3852.1, AS 3853.2 and AS 1715.

Whilst welding activities are conducted, welders shall wear a PAPR (Powered Air Purifying Respirator) with adequate filter cartridges for fume and particulate control. The use of a PAPR provides positive flow of air within the respirator, and therefore respiratory fit testing is not required as per AS/NZS 1715.

PAPR respiratory protective equipment shall be used and maintained in accordance with the manufactures instructions, and must be worn at all times in specified areas and during all welding tasks. Where a risk assessment determines that there may be potential for toxic atmospheres a risk assessment shall be completed to determine additional Respiratory Protective Equipment (RPE) requirements.

13.9.3 Harmful Fume Producing Materials

Some materials which are likely to produce toxic fumes when welding include:

- Stainless steel which contains nickel and chromium;
- Carbon steel contains ≥ 2.0 % manganese;
- Zinc in galvanized metal;
- Lead coated materials (in some paints);

14 Appendix A – Schedule of WSP Requirements

1.0 QUALITY ASSURANCE SYSTEM

Quality Assurance Systems Allowed

1.1 AS/NZS ISO 9001 Yes/No

1.2 AS/NZS ISO 3834

Part 2 comprehensive Yes/No

Part 3 standard Yes/No

Part 4 elementary Yes/No

1.3 Other International System Yes/No

1.4 Default: Where no project specific requirements are nominated AS/NZS 3834.2 or ISO 9001 shall apply.

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
6	Detailed Welding management system	Details for assessment	Type of system	Accept/Reject Within 10 working days	

Sub-Contractor to be used Yes No

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
6	Sub-Contractor full Details	Details for assessment	Sub-Contractors to be used.	Accept/Reject Within 10 working days	

Intent to use Alternative Processes

Yes No

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
11	Welding Process/es (welding or cutting)	Intent to use alternative processes.	Before development of <u>welding procedure</u> .	Accept/Reject Within 10 working days	

10 Days Prior to Planned Commencement of Works

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
10	Quality Plan	As detailed	Approved	Yes/No	
7	Qualification of Welding Procedures	Schedule of qualified procedures		Accept/Reject	
7	Welding Procedure Sheet (WPS)	All major parameters/essential variables and as per 7.2 advise copies held available to workplace.		Accept/Reject	
8	RWC WSP	Nominate qualified person responsible.		Accept/Reject	
8	RWC WSP details	Qualification/ certification and experience, records.		Yes/No	
8	Welding Inspector	Qualification, certification and experience.		Yes/No	
8	Welder qualified to Qualified Welding procedures	Details for each welder	Acceptance	Yes/No	
8	Welder qualification, certification, etc.	As detailed	Acceptance.	Yes/No	
10	Inspection/Test Plan	Inspection + Test Plans (ITP's)		Accept/Reject	

Before Welding Commences

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
5	Commencement	Request approval to commence	All Pre conditions met	Yes/No	

Identification and Traceability after Welding Done

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
6&9	Identification of welders to welds.	Records	Welds Completed	Accept/Reject	
6,9&10	Traceability of welds	Weld Map	Welds Completed	Accept/Reject Compliance.	

Testing

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
10	Testing	Test Certificates (destructive or non-destructive)	Welds Completed NATA Accredited. Lab.	Accept/Reject Compliance	
10	Pneumatic testing	Test Results	Welds Completed	Witness and Accept/Reject	
10	Testing records	Supply as part of <i>MDR</i>	Welds & Tests completed	Accept/Reject Compliance	

Requalification when Essential Variables fall outside Standard/Code Limits

Clause	Item	Submission	Precondition	RWC WC Approval/Outcome	Plan/ Actual Dates
7	New Procedure	Qualification of New Welding Procedure	Change after work commences	Accept/Reject Review/Release Hold Pt.	

15 Appendix B – Inspection Release Certificate

INSPECTION ASSIGNMENT No. INSPECTOR'S NAME PROJECT No.
 PROJECT SUPPLIER
 SUBCONTRACT/ORDER No. REV SUB-SUPPLIER
 SCOPE OF WORK ADDRESS

MATERIALS RELEASED

P.O. ITEM No.	QUANTITY ORDERED	QUANTITY RELEASED	DESCRIPTION	COMPONENT CODE	HEAT / BATCH / CAST No.	TEST CERTIFICATE NUMBER
TQ's, NCR's, PUNCHLISTS ETC DESTINATION OF MATERIALS			Y <input type="checkbox"/> N <input type="checkbox"/> MATERIALS COMPLETE Y <input type="checkbox"/> N <input type="checkbox"/> ITEMS PERMANENTLY IDENTIFIED Y <input type="checkbox"/> N <input type="checkbox"/> CERTIFICATION REQUIRED Y <input type="checkbox"/> N <input type="checkbox"/> CERTIFICATION REVIEWED Y <input type="checkbox"/> N <input type="checkbox"/> CERTIFICATION ATTACHED Y <input type="checkbox"/> N <input type="checkbox"/> CERTIFICATION COMPLETE Y <input type="checkbox"/> N <input type="checkbox"/> PACKAGING CORRECT Y <input type="checkbox"/> N <input type="checkbox"/> DESTINATION CORRECT Y <input type="checkbox"/> N <input type="checkbox"/> MDR/MSDS - COMPLETED/SUPPLIED	COMPANY SIGNATURE DATE		CLIENT SIGNATURE DATE
THIS CERTIFICATE IS A CLEARANCE FOR SHIPMENT ONLY AND DOES NOT RELIEVE THE SUPPLIER OF ITS CONTRACTURAL OBLIGATIONS.						

16 Appendix C – Inspection Test Plans

Company Logo	INSPECTION AND TEST PLAN Site Installation	Doc – No Page 1 of 4
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Client		Project		Contract	
Job Number		Quote Ref			
Prepared by		Co Approval		Client Approval	
Date		Date		Date	

DEFINITIONS	
Hold Point (H)	Nominated point beyond which work cannot proceed without verification acceptance
Witness (W)	The client shall be notified but work may proceed without client witness
Review (R)	Verify by review and acceptance of QA Documentation during M/F
Monitor (M)	Monitor by random inspection of activities to ensure quality requirements are met
Visual (V)	100% visual Inspection to ensure compliance to Code / Specification
Dimensional (D)	Review of critical Dimensions to ensure work is within design tolerance
Notes	All activities to be signed off by the nominated responsible person within the organisation. Refer to the Quality Plan

Company Logo		INSPECTION AND TEST PLAN Site Installation				Doc – No Page 2 of 4						
Step	Process activity	Person/group Responsible for Activity	Control Documents Spec's & Procedures	Process Activity Inspection Acceptance Criteria	Verifying Docs	M D R	Inspection Verification					
							Comp	Main Cont	Client			
1.0	Pre- Manufacturing											
1.1	Handover from estimator to Site Supervisor	Project Manager			Handover doc' complete and signed		H					
1.2	Plan and Schedule the job	Project Manager		Ensure Schedule is complete. Update Schedule Weekly			H					
1.3	Develop Work Packs	Project Manager		PM must sign off			H					
2.0	Material Receipt and Processing											
2.1	Inspect delivered items / allocate lay down area	Site Supervisor		Material Receipt Cert	IRC	Y	M		M			

3 Welding												
3.1	Prepare list of Qualified Welders	RWC	AS 3992 AS 4041	WS-1	Qualified Welder Register	Y	H		H		H	
3.2	Prepare list of Qualified WPS relevant to Project	RWC	AS 3992 AS 4041	WS-1	Qualified Welding Procedure Register	Y	H		H		H	
3.3	Ensure correct welding consumables are issued for use	RWC	WPS	WPS	Welding Traceability Log	Y	W		M		M	
4.0 Installation												
4.1	Assemble spools and tack weld	Site Supervisor		Dimension Check List	Signed ITP	Y	M		M		M	
4.2	Weld out assembled pipe spools	Site Supervisor	DS 65	Approved Drawings	Signed ITP		W		M		M	
4.3	Welding Inspection	RWC	AS 4041 WS-1	AS 4037 WS-1 100% visual	Signed ITP Weld Traceability	Y	H		H		H	
4.4	Weld Repairs (If Required)	Site Supervisor	NDT reports	AS 4037 WS-1 100% visual	Signed ITP Weld Traceability	Y	H		H		H	
4.5	Weld Traceability	RWC	Weld Map	WS-1	Signed ITP	Y	H		R		R	

Design Standard 95

Selection, Preparation, Application, Inspection and Testing of Protective Coatings on Water Corporation Assets



4.6	Repair Internal Cement Lining/ Grout Convex Bands	Shop Supervisor		DS 95 Spec M8 Spec M9	Signed ITP		M		M		M	
4.7	Surface Treatment / Wrapping	Project Manager	Water Corp Specs	DS 95 WS-1	Contractors ITP This ITP Conformance reports		H		M		M	
4.8	Spark Testing / Coating Inspection	Site Supervisor	MDR	Contract Spec's	This ITP		H		M		M	
4.9	Complete MDR	Project Manager	MDR	Contract Spec's	This ITP		H		R		R	

Company Logo	INSPECTION AND TEST PLAN Workshop Fabrication	Doc – No Page 1 of 4
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Client		Project		Contract	
Job Number		Quote Ref			
Prepared by		Co Approval		Client Approval	
Date		Date		Date	

DEFINITIONS	
Hold Point (H)	Nominated point beyond which work cannot proceed without verification acceptance
Witness (W)	The client shall be notified but work may proceed without client witness
Review (R)	Verify by review and acceptance of QA Documentation during M/F
Monitor (M)	Monitor by random inspection of activities to ensure quality requirements are met
Visual (V)	100% visual Inspection to ensure compliance to Code / Specification
Dimensional (D)	Review of critical Dimensions to ensure work is within design tolerance
Notes	All activities to be signed off by the nominated responsible person within the organisation. Refer to the Quality Plan

Company Logo	INSPECTION AND TEST PLAN Workshop Fabrication	Doc – No Page 2 of 4
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Step	Process activity	Person/group Responsible for Activity	Control Documents Spec's & Procedures	Process Activity Inspection Acceptance Criteria	Verifying Docs	M D R	Inspection Verification					
							Comp	Main Cont	Client			
1.0	Pre- Manufacturing											
1.1	Handover from estimator to shop floor	Project Manager			Handover doc' complete and signed		H					
1.2	Plan and Schedule the job	Project Manager		Ensure Schedule is complete. Update Schedule Weekly								
1.3	Develop Work Packs	Project Manager		PM must sign off								
2.0	Material Receipt and Processing											
2.1	Inspect as received / store on wood / rubber		Goods Inwards	Material Receipt Cert	Delivery Docs	Y	M		M			
3	Welding											
3.1	Prepare list of Qualified Welders	RWC	AS 3992 AS 4041	WS-1	Qualified Welder Register	Y	H		H		H	

3.2	Prepare list of Qualified WPS relevant to Project	RWC	AS 3992 AS 4041	WS-1	Qualified Welding Procedure Register	Y	H		H		H	
3.3	Ensure correct welding consumables are issued for use	RWC	WPS	WPS	Welding Traceability Log	Y	W		M		M	
4.0	Fabrication											
4.1	Assemble spools and tack weld	Shop Supervisor		Dimension Check List	Signed ITP	Y	M		M		M	
4.2	Weld out pipe spools	Shop Supervisor	DS 65	Approved Drawings	Signed ITP		W		M		M	
4.3	Welding Inspection	RWC	AS 4041 WS-1	AS 4037 WS-1 10% Rad 100% visual	Signed ITP NDT Reports	Y	H		H		H	
4.4	Weld Repairs (If Required)	RWC	NDT reports	AS 4037 WS-1 100% Rad 100% visual	Signed ITP NDT Reports	Y	H		H		H	
4.5	Weld Traceability	RWC	Weld Map	WS-1	Signed ITP	Y	H		R		R	
4.6	Repair Internal Cement Lining	Shop Supervisor		DS 95 Spec M8	Signed ITP		M		M		M	

4.7	Surface Treatment.	Project Manager	Water Corp Specs	DS 95 WS-1	Contractors ITP This ITP Conformance reports		H		H		H	
4.8	Complete IRC	Project Manager		WS-1	IRC		H		H		H	
4.9	Complete MDR	Project Manager	MDR	Contract Spec's	This ITP		H		R		R	

END OF DOCUMENT