



Assets Planning and Delivery Group  
Engineering

# Strategic Product Specification

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## SPS 250 GRP Filter Vessels

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VERSION 2  
REVISION 1  
APRIL 2024

## FOREWORD

Each Strategic Product Specification has been prepared to inform Corporation staff, consultants, contractors and land developers of the requirements for selecting and acquiring a manufactured product to be used in strategic Corporation infrastructure. The definition of ‘Product’ includes items that comprise assembled components, equipment or plant for mechanical, electrical and civil infrastructure applications.

The objective of a Strategic Product Specification is to specify fit-for-purpose Product which will contribute to the provision of effective water services at least whole-of-life cost and with least risk to service standards and safety. A Strategic Product Specification also provides uniform standards for compatibility of new water infrastructure with existing water assets.

Many Strategic Product Specifications have drawn on the design, asset management and operational experience of Product performance in live service gained by the Corporation over time. Some Strategic Product Specifications have drawn on the experience of the water industry nationally by referencing Australian or WSA standards.

Strategic Product Specifications are intended for reference and use in the following typical procurement scenarios:

- Capital funded infrastructure design and construction work;
- Private developer funded subdivision infrastructure for takeover by the Corporation;
- Operationally funded infrastructure design and construction work;
- Corporation period contracts for Product purchases; and
- Product purchases for stock or for miscellaneous minor work.

A published Strategic Product Specification will, in some cases, comprise technical content that is typical of a range of products of the same type (type specification) but may exclude specific requirements that should apply to a particular project or application. In such cases, the project designer is required to document the supplementary project specific requirements in the ‘Project Specific Requirements’ Appendix of the Specification.

The text of a published Specification should not be directly modified. In the event that a text variation is considered necessary to accommodate the needs of a particular project or application, the text modification should be documented in the appropriate Clause of a ‘Project Specific Requirements’ Appendix.

Deviation from the requirements of a Strategic Product Specification on a particular project is permissible only in special circumstances subject to consultation with and express acceptance by the Senior Principal Engineer Mechanical, Engineering to whom all enquiries relating to the technical content of the Specification should be directed. Feedback on the specification is encouraged and should be similarly directed.

Improvements to the Specification will be published and issued to registered users on an as needs basis.

### Acknowledgment

Special thanks are provided to Peter Kirkwood of ‘Resiglass’ and to Michael Leggett of ‘Oceania Composites’ for their input to the GRP and manufacturing related content of this specification.

### **Head of Engineering**

*This document is prepared without the assumption of a duty of care by the 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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## REVISION STATUS

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

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# Strategic Product Specification

## SPS 250 GRP Filter Vessels

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# 1 Scope and General

## 1.1 Scope

This Specification sets out requirements for the design, manufacture, production testing, handling and delivery of *Glass Reinforced Plastic (GRP) Filter Vessels*.

GRP vessels are commonly used by the Corporation, as granular media (sand or multi-media) filtration vessels, in the removal of solid and organic particulate matter from suspension and may also be used as Granular Activated Carbon (GAC) filters for contaminant removal by absorption. The filtered liquid varies with the treatment process and may be seawater (desalination), raw-water (water treatment) or treated effluent (treated wastewater effluent re-use). The vessels are normally filled with the pumped media that is being cleansed at a relatively high pump pressure (generally 80-500kPa), however during backwash they may also have air injected at low pressure.

To limit the risk and associated hazard level (as defined in AS 4343), filter vessels shall be provided with two appropriately sized, separate and independent *air relief devices (air valves)* to prevent pressurization of the vessel at the higher pumped pressure when filled with air. Air valves are required to be installed directly on an appurtenance at the top of the vessel with no intermediate valve or means of isolation permitted. Each air valve will be sized to independently limit air pressure in the vessel to less than 20kPa under all possible filling or backwash scenarios, including manual operation of equipment. Filter vessels protected in this way should be Hazard Level E as defined in AS 4343.

Vessels may be located inside a treatment plant building or under cover where they are subject to normal ambient exterior temperatures but generally protected from solar radiation, where a design external surface temperature of 45°C would normally apply. Where located outdoors and exposed to solar radiation, a maximum external surface temperature of 60°C may occur.

The Specification also details the means by which compliance with the Specification shall be demonstrated and the criteria for acceptance of Product.

## 1.2 Referenced Documents

The following documents are referenced in this Specification:

Corporation “Strategic Product Appraisal Process Manual” (Internally controlled)

### Australian Standards

AS 1210	Pressure Vessels
AS 1271	Safety valves, other valves, liquid level gauges and other fittings for boilers and unfired pressure vessels
AS 2971	Serially Produced Pressure Vessels
AS 3920	Pressure equipment - Conformity assessment
AS 4343	Pressure Equipment – Hazard Levels
AS/NZS 4087	Metallic flanges for waterworks purposes
AS/NSZ 4020	Testing of products for use in contact with drinking water

### AS/NZS ISO

9001	Quality management systems – requirements
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### AS ISO/IEC

17025	General requirements for the competence of testing and calibration laboratories
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### AS/NZS ISO/IEC

17000	Conformity assessment – Vocabulary and general principles
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## **BIS IS/ISO/IEC**

GUIDE 23	Methods of indicating conformity with standards for third-party certification systems - Guidelines
GUIDE 28	Conformity assessment - Guidance on a third-party certification system for products - Guidelines

## **British and European Standards**

BS EN 13121 Parts 1-4	GRP tanks and vessels for use above ground
BS EN 13923	Filament-wound FRP Pressure Vessels, Materials, Design, Manufacturing and Testing
EN 1092-1	Flanges and their joints – circular flanges for pipes, valves and fittings and accessories, PN designated – PART1: STEEL FLANGES

## **1.3 Definitions and Notation**

The following definitions are intended to clarify the terminology used in this Specification.

### **1.3.1 Australian Standards®**

Standards that are developed, published and maintained by Standards Australia.

### **1.3.2 British & European Standards**

Standards that are developed, published and maintained by British Standards Institute or the European (EN) standards European Committee For Standardization (CEN).

### **1.3.3 Certificate**

A formal certificate issued by a Certification Body in accordance with the third-party product certification system described in BIS IS/ISO/IEC GUIDE 28, including associated Product licence schedules.

### **1.3.4 Certification Body**

An independent (or third party) organisation duly accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) to operate product Certification Schemes.

### **1.3.5 Certification Mark**

A proprietary mark of product conformity issued in accordance with BIS IS/ISO/IEC GUIDE 23.

### **1.3.6 Certification Scheme**

A third party product certification system operated in accordance with BIS IS/ISO/IEC GUIDE 28.

**NOTE:** The effect of this is to require maintenance by the manufacturer of effective production control planning in addition to full type testing from independently sampled production and subsequent verification of conformity with specified standards.

### **1.3.7 Compliant Product**

Product that has been assessed, by means of Product Appraisal, as conforming with standards and specifications that are specified by the Corporation.

### **1.3.8 Corporation**

The Water Corporation of Western Australia or its nominated representative.

### 1.3.9 **Manufacturer**

An entity or combination of entities that are responsible for selection, processing and control of Product constituent materials or compounds and for the processing equipment that collectively result in the manufactured product.

### 1.3.10 **Notation**

Statements governed by use of the word 'shall' are mandatory or 'normative' requirements of the Specification. Statements expressed by use of the words 'should' or 'may' are 'informative' but not mandatory and are provided for information and guidance. Notes in Specification text are informative. Notes that form part of Specification Tables are normative. An Appendix to the Specification that is designated 'normative' contains mandatory requirements. An Appendix that is designated 'informative' is provided for information and guidance only. The term 'specified' includes requirements of the Specification and requirements stated or referenced in other project documentation.

### 1.3.11 **Officer**

A duly authorised representative or appointed agent of the Corporation.

### 1.3.12 **Product**

A single unit or multiple units of manufactured end product or an assembly of manufactured component products, materials or equipment. This Specification and accompanying Purchasing Schedule define the nature and details of Product to be supplied.

**NOTE 1:** An end product is most commonly an output of manufacturing processes that result in finished end products having the same features and characteristics and can be the result of a single or multiple production batches.

**NOTE 2:** Manufactured equipment and assemblies of Product components or materials are commonly procured for mechanical, electrical and civil infrastructure applications.

### 1.3.13 **Product Appraisal**

A formal process whereby Product, including product design, is subjected to systematic engineering assessment to determine Product fitness for prescribed end uses and to evaluate conformity of its production systems with specified standards and requirements. Product Appraisal includes verification of the extent of compliance in accordance with the requirements of a relevant 'Technical Compliance Schedule'.

### 1.3.14 **Product Assessor**

An organisation, Officer or other person who, having demonstrated specialist product knowledge and competence acceptable to the Corporation, is appointed to evaluate Product, appraises the Product and issues one or more Product Verification Reports.

### 1.3.15 **Product Certification**

A formal process whereby the production and management systems for the manufacture of Product, are assessed by a Certification Body to evaluate compliance of these systems with specified product standards and tests, in accordance with Certification Scheme rules.

### 1.3.16 **Product Verification Report**

A formal report wherein a Product Assessor evaluates the extent of Product compliance with the specified product standards and specifications.

**NOTE:** Verification may be on a project-by-project basis or at agreed intervals, as appropriate to the scope of a Purchasing Schedule and Product end use, subject to determination by the Corporation.

### 1.3.17 **Product Warranty**

A formal express undertaking by a Supplier that indemnifies the Corporation against the consequences of supplied Product failure to comply with specified fitness for application and in-service life expectancy performance requirements.

### 1.3.18 Purchasing Schedule

A Corporation purchase order, tender, schedule of prices, bill of quantities, or specification that details the nature, quantity and other characteristics of Product to be supplied, purchased or installed.

**NOTE:** The purchasing schedule of this specification is contained in *Table 12.1 Project Technical Requirements*

### 1.3.19 Quality System

A management system that establishes, documents, implements and maintains organisational structures, resources, responsibilities, processes and procedures for the manufacture of Product and provision of Product related services in accordance with the requirements of AS/NZS ISO 9001.

### 1.3.20 Standards Australia

The peak non-government standards development body in Australia which develops Australian Standards®.

### 1.3.21 Strategic Product

An essential infrastructure component whose performance is critical to the elimination of risk to the safe and effective provision of water services, which are functions of the Corporation under the Corporation Act as licensed under the Water Services Coordination Act.

**NOTE:** A Strategic Product is a component of permanent Corporation infrastructure. Ancillary operational and safety equipment that does not form part of permanent infrastructure but offers exceptional enhancements in operational performance or personnel safety may also be deemed strategic.

### 1.3.22 Supplier

An entity or combination of entities that is responsible for the supply of Product.

**NOTE:** A Supplier may be a Manufacturer, owner, producer, distributor, vendor, agent, tenderer or contractor for supply of Product or Product related service.

### 1.3.23 Inspection and Testing

The determination of product characteristics by inspection and by the application of specified test procedures.

## 2 Materials and Components

### 2.1 Materials

The GRP filter vessel materials and components shall comply with **Table 2-1**. Any materials not specified in the table must be in accordance with BS EN 13121 Parts 1-4/ BS EN 13923. Any deviations from these standards are subject to approval by the Corporation.

**Table 2-1: GRP filter material requirements**

Component	Material	Notes
Thermosetting Resin: Inner Surface <sup>(1) (2)</sup>	Vinyl Ester (VE)  Derakane 411–350, Hetron 922, Dion 9100, Epovia RF1001, Sino MFE-11 or equivalent.	Heat distortion temperature (HDT) shall be no less than 20°C higher than the design temperature.  The minimum elongation should be no less than 4.5%.  The selected resin shall not taint the processed water
Thermosetting Resin: Structural <sup>(1) (2)</sup>	Isophthalic Polyester Resin (IP)  Crystic 272, SHCP 3254, PolyLite 720-800, Epovia H-360 or equivalent.	Heat distortion temperature (HDT) shall be no less than 20°C higher than the design temperature.  The minimum elongation should be no less than 2%.
Thermosetting Resin: Outer Surface/Final Top Coat <sup>(1) (0)</sup>	Isophthalic Polyester Resin (IP)  Crystic 272, PolyLite 720-800, Epovia H-360 or equivalent.	Resin shall contain UV absorber/inhibitor.  The minimum elongation should be no less than 2%.  Preferably use an Iso-NPG resin system formulated specifically as a top coat
Glass-fibre Reinforcements	Chopped Strand Mat (CSM)  Commercial grade type E (Electrical borosilicate) or ECR glass.	Glass in non-continuous strands with coupling agent.
	Woven Roving (WR)  Commercial grade type E (Electrical borosilicate) glass.	Warp and Weft to be equal. Any bias in the Warp or Weft shall be considered during the design process
	Filament Wound (FW)  Commercial grade type E (Electrical borosilicate) or ECR glass with continuous Rovings.	1100-4800 Tex with compatible coupling agent.
Surfacing Veils	C glass Tissue  Glass veil shall be a minimum 25 g/ m <sup>2</sup> non-woven commercial grade “C” glass.	The binder must be compatible with layup resins.
	Synthetic veil  Synthetic veils shall be a minimum 22 g/m <sup>2</sup> non-woven, commercial grade type Polyacrylonitrile (PAC) or polyester.	

Component	Material	Notes
Alternative Glass Fibre Reinforcements styles	The use of special reinforcements i.e. fabrics or unidirectional/combination/bi-axial mats, is acceptable, provided the mechanical properties are known and used in the design calculations for the specific lay-up of the vessel or component.	Subject to approval by the Corporation.
Catalysts /Initiators	Acetyl Acetone Peroxide (AAP) Benzoyl Peroxide (BPO) Cumene Hydroperoxide (CMHP/CHP) Cyclohexanone Peroxide (CHP/CHPO) Methyl Ethyl Ketone Peroxide (MEKP), (Normal & Low Activity)	All catalysts/initiators used for curing of chemical barriers or internal joint laminates on a vessel for potable water use shall be phthalate-free peroxides(e.g. Cadox M/L-50a ,Curox M20-K,Luperox K12G,Trigonox 239 and Trigonox K90 /K80)  The use of peroxide catalysts with phthalates, is acceptable for use in the structural laminates only.
Accelerators	Diethylaniline (DEA) Dimethylaniline (DMA), 100% solution	
Promoters	Cobalt Napthenate /Octoate	6% solution in Styrene.
Additives/Solvents	Thixotropic Agent Cab-O-Sil M-5 or equivalent Ultraviolet Absorber Tinoven P or equivalent Other Additives - Wax in Styrene (5% or 10% Wax in Styrene in Solution) - Styrene Monomer - Various Inhibitors - Various air release and wet out agents. Solvents - Methylene Chloride - Acetone	Thixotropic agents and other additives shall not be used in amounts where the mechanical properties of the laminates are affected.  No additives may be used in the Inner Surface or backing layers that adversely affect their visual inspection <sup>1</sup> .
Flanges	ASTM A276 grade 316 Stainless Steel	All process or instrumentation flanges shall be a GRP stub flange design with backing ring. All backing rings shall be SS316. Where flange thickness prevents the fitting of the backing ring an alternative drilling pattern (e.g. ASME B16.5 #300) or larger nozzle shall be used.
Fasteners	ASTM A276 grade 316 Stainless Steel	
Gaskets	EPDM	See Section 3.10.4.

**Notes:**

1. It is not uncommon for fabricators to slightly tint the corrosion barrier so it can be differentiated between the CB and the structure for designating a resin type i.e. you may be using Swancor 905 in the CB and Swancor 901 in the structure and would look the same if not for the tint. However, if you over pigment the CB resin it would obscure the ability to inspect the quality of the CB.
2. Resins suppliers who do not provide certificates of compliance strictly in accordance with EN 10204 - shall not be considered or used.
3. Unless otherwise specified, no pigments, dyes or colourants shall be used in the resin.

## 3 Design and Manufacture

### 3.1 General

In addition to the requirements of BS EN 13121 Sections 1 to 4, GRP filter vessels shall be designed in accordance with the clauses outlined in this section. Any deviation to this requirement must be agreed to by the Water Corporation.

The vessels shall be designed and manufactured to withstand the design pressure, number of daily operating pressure cycles, filtration media and thermal, solar and other environmental conditions, as specified in Appendix A Table 12.1, without structural degradation, distortion, excessive strain, leakage or cracking.

Vessels shall be designed for a minimum operating life of 25 years unless otherwise specified.

### 3.2 Design Hazard Level Rating

Filter Vessels shall be designed and (where appropriate) registered for the highest hazard level as assessed in accordance with AS 4343, considering location and proximity to assets and personnel, for the following normal modes of operation:

- a) Filter Mode - Pressurised fluid flowing downwards through media contained in the vessel under worst-case (highest pressure) scenario.
- b) Backwash Mode – media backwash by either a water or air scour.

Filtration systems shall not permit the vessel to operate under pumped filtration pressure when filled or partially filled with air, as may be present during initial filling or where air is used in the backwash process. To ensure this requirement is met, two separate and independent air relief valves, without isolation valves, fitted to the highest point of the vessel, shall form the basis of filtration process design and limit the pressure in the vessel to 20kPa when air is present.

Where non-compliant with this requirement, or with Clause 3.12, Vessels may be assessed as Hazard Level D or higher and will require design and plant registration.

**Notes:**

1. Vessels, when equipped with two appropriately sized air valves, may be rated in accordance with AS 4343, clause 2.2.6.
2. Vessels of Hazard Level D and higher will incur higher lifetime mandatory inspection and operating costs.

### 3.3 Maximum Working Pressure

The maximum working pressure of the vessel is the highest internal pressure to which the vessel could be exposed in any possible operating scenario. The maximum working pressure is specified in Appendix A. Table 12.1 Technical Requirements. The vessel shall be suitable for long term operation at the maximum working pressure.

**Note.** The maximum working pressure shall be that resulting from the worst-case pressure scenario to which the vessel could be exposed in its intended application. This shall include pumps operating against closed outlet valves, manual operation of automatically controlled equipment, etc.

### 3.4 Design Pressure

The design pressure of the vessel, as specified in Appendix A. Table 12.1 Technical Requirements, is the pressure for which the vessel is designed. The design pressure shall not be less than the maximum working pressure. However, the design pressure may be higher than the maximum working pressure where a standard pressure class is selected (e.g. PN6, PN10) for overall process plant uniformity.

### 3.5 Design Acceptance and Registration

Vessels designed to this specification would typically comply with clause 2.2.6 of AS 4343:2014 and hence would be Hazard Level E. Any variation from the conditions of this clause could result in a higher

hazard Level determination; noting pressure vessels of Hazard level D or higher require their designs to be registered with an Australian regulatory authority and pressure vessels of hazard level C or higher also require individual Plant registration with WorkSafe WA.

For all vessels, regardless of Hazard level, the design shall be submitted to the Corporation for comment and approval prior to obtaining design verification of the vessel. Where a mode of operation unavoidably results in a Hazard Level D or higher, the Manufacturer shall register the design in Australia to enable Plant Registration with WorkSafe Western Australia. Manufacture of Hazard level D (or higher) vessels shall not proceed until the design has been registered.

### **3.6 Manufacturer's Information Plate**

A manufacturer's information plate shall be mounted, at a clearly visible location on the vessel, providing all the information required by AS1210 Section 7.1, regardless of whether the vessel falls under the scope of that standard. Where vessels are subject to air scour, the information plate shall include a design pressure for non-hazardous liquid and a second design pressure (i.e., 20kPa) for non-hazardous gas. In addition, the name and type of resin and curing agents used shall be noted along with the design standards used for the vessel including this standard (i.e. SPS250) and the standard which the resin meets (refer to Section 3.7 of this standard).

### **3.7 Contamination of Water**

Components in contact with drinking water shall comply with AS/NZS 4020. International equivalent standards may be permitted, subject to approval.

### **3.8 Design for Cylindrical and Head Sections**

For entirely contact moulded vessels or vessels which contain contact moulded reinforcement (other than compensations), the "Basic" design method shall be used; as described in BS EN 13121. The minimum design value for  $K = 8$  and  $F \geq 4$  shall be used. Where the vessel shell and end structural laminates are produced by computer-controlled filament winding, the design factor shall be determined as per the standard based on the level of testing performed with a minimum factor for  $K=5$  and  $F=3$ .

Maximum allowable design strain at the design pressure shall be determined by the requirements of BSEN13121-3. Vessels may be designed for construction using the Helical Winding, Hoop Winding, Polar Winding, Contact moulded process or a combination of these. No vacuum, compression or fixed moulded components may be used.

Vessels for installation outdoors shall be designed for the effect of wind loading and other environmental factors, e.g. seismic, solar, ambient temperature.

Filament wound tanks shall be designed such that the longitudinal strength is at least equal to half of the hoop strength.

Where the vessel is designed and manufactured using the filament winding technique, the angle of any axially wound reinforcement shall be no less than 15 degrees, measured from the vessel's central axis.

Head shapes used with polar wound designs shall preferably be isotensoidal or semi-hemispherical, unless additional reinforcement over the knuckle joint (of other shaped heads i.e. semi ellipsoidal / torispherical), has been taken into account in the vessel design. Particular attention is drawn to the requirement of the additional reinforcement in the head / dished end knuckle region as detailed in section 10.5.2 of BS EN 13121- 3.

The vessel laminate shall have an inner surface layer and an interior backing layer, both of which comprise the internal chemical protective barrier. This shall be followed by a structural reinforcement laminate and finally an exterior barrier layer. The internal chemical barrier is to be excluded from any strength or stability calculation requirements. The inner surface layer shall comprise a minimum of one layer of surfacing veil with a backing layer with a minimum of 900gsm CSM or sprayed chopped glass with a minimum thickness of 2.5mm. Where the resin supplier recommends a different construction of surface layer or thicker backing layer this shall be followed. The exterior barrier layer shall follow the requirements of Section 7.3 of BS EN 13121-3.



## 3.9 Relief Valve and Socket

For any vessels for which Hazard Level A to D is unavoidable, and for all vessels where the operating pressure of the vessel cannot be guaranteed to remain below the design pressure under all possible scenarios; an additional 50mm flanged outlet shall be provided for a pressure relief valve on the top of the vessel. A relief valve compliant with AS 1271 and sized in accordance with section 8.2.1 of AS 1210-2010, shall also be supplied and fitted directly to the outlet, without means of isolation between the vessel and the valve.

## 3.10 Flanged Connections

Flanged connections shall be compatible with and capable of providing an effective drip-tight seal when mating with, an equivalent size and pressure rated mating flange. Mating flanges shall generally be to AS/NZS 4087; however, where a plant-wide standard is being adopted, EN 1092 compatible flanges may be specified. The required flange standard is specified in Appendix A.

The manufacturer shall provide details of required gaskets and bolt torques for all flanged connections and shall remain responsible for ensuring a drip-tight seal between all vessel flanges and mating flanges. Recommended bolt torques shall consider effective gasket compression, bolt tension and flange strength.

Care shall be taken to ensure sufficient flange flatness to achieve a seal. If necessary, flange faces are to be machined and a new chemical barrier re-applied.

Standard flanged nozzles shall be fabricated as an integral flange such that the corrosion barrier and structural laminate is continuous between the nozzle section and the flange.

Standard side entry man ways shall be considered for large diameter nozzles and shall also be constructed as an integral nozzle/flange design. Other manway designs shall be negotiated between manufacturer and the Corporation.

The shell area around all nozzles shall be adequately reinforced in accordance with design requirements. The reinforcement and attachment laminates shall be designed in accordance with BS EN13121-3.

Edge tapers of compensation pads shall not be steeper than 1:6 grade.

All bolt holes shall be drilled after full cure of the laminate has been achieved. The backs of flanges are to be smooth, flat and suitable for backing ring acceptance and/or correct washer seating. Special attention shall be paid to the hub area in order to facilitate torque wrench and socket access when tightening up bolts.

### 3.10.1 Flange Material

Flanges shall be flat faced GRP contact molded from chopped strand mat or a combination of chopped strand mat and other glass fibre reinforcements, impregnated with thermosetting resin to suit the stated design conditions. The minimum acceptable flange structural laminate thicknesses for any flange is 16mm.

No flanged nozzle smaller than DN 50 shall be used unless otherwise specified.

The flanges are to be constructed with a minimum integral corrosion barrier liner thickness of 2.5 mm.

The top layers of the flange shall comprise a minimum of 1350gsm CSM and veil.

### 3.10.2 Backing Rings

Backing rings are required on all GRP flanges.

It is the responsibility of the manufacturer to determine the ideal internal diameter of the backing ring so that the ring internal diameter does not contact the hub neck/ flange transition radius.

### 3.10.3 Flange Hub

The thickness of the flange hub reinforcement measured at the top of the fillet radius shall be at least one half the flange thickness (excluding the corrosion barrier) and shall taper uniformly over the length of the hub reinforcement.

The minimum flange hub height shall be four times the flange thickness measured from the flange face.

The fillet radius, where the back of the flange meets the hub, shall be minimum 3 mm.

### 3.10.4 Gaskets/ O Rings

Gaskets/ O rings shall be EPDM unless deemed unsuitable by the Manufacturer. In this case, the Manufacturer shall seek approval from the Corporation for alternative material. All gasket materials shall have AS/NZS 4020 compliance certification where used in potable water applications. If flanges with O-ring seals are being provided, then the seal groove shall be 'off-mold' finish or machined and suitably resin sealed, ensuring that the O-ring contact surfaces are smooth, uniform and free of resin "runs". Seals shall be drip-tight under all operating conditions.

Consideration shall be given to low torque sealing gaskets and gasket materials that prevent extrusion under pressure.

### 3.10.5 Flange Installation

At assembly, the minimum nozzle stand off from the vessel wall to the back of the flange shall be 100mm to enable suitable access to the back of flange after the completion of all compensations and attachment laminates.

Special consideration shall be given to nozzles inserted into a vessel with a particularly thick wall thickness or to nozzles that do not penetrate perpendicular to the vessel's centre-line.

Where nozzle loadings have been specified, the design of the vessel shall consider these based on an appropriate manual or computer based technique. Gussets shall be fitted as per BS EN13121-3.

Standard orientation shall have bolt holes straddling principal centre lines of the vessel, unless otherwise specified.

Nozzle positional and alignment tolerance shall be as per BS EN 13121-3.

## 3.11 Plenum Floor, Nozzles, Manholes and Inspection ports

Plenum floors shall be supported on a ledge (not bonded) and the annular gap of 18mm between the plenum plate and the shell wall, shall be filled with a flexible potable water safe sealant. A second overlay shall be placed over the plenum plate to hold it in position. The second top overlay shall not be bonded to the plate.

Drain points shall be at the lower point of the vessel, air release points at the top.

Minimum diameter of drain nozzles shall be DN 100 unless specified. Drain nozzles fitted in the bottom of the vessel shall be of the flush type to ensure the continuity of the chemical barrier and a suitable seal at the nozzle/ vessel wall intersection.

Side entry manholes / inspection ports are preferred. Manholes and inspection ports shall be readily accessible to operators and maintenance personnel. Drawings showing the location of all such ports are to be provided for review and acceptance by the Principal.

All manhole/nozzle in the cylindrical shell shall not exceed the limits within BS EN13121 unless subject to special consideration. Where vessel entry may be required, the minimum manhole size is 450mm.

For small diameter vessels (less than 1350 mm) oval shaped lateral manholes may be considered, with minimum 420 mm x 320 mm size to satisfy maintenance requirements. All non-standard manholes and inspection ports shall be given special consideration in the vessel design.

Openings in the dished ends are limited to 0.5 x the diameter D and shall be located entirely within the circle of radius of 0.4 D from the centre of the vessel.

### **3.12 Air release ports**

A minimum of two flanged air release ports shall be provided at the top of the vessel to facilitate the direct connection of air valves. Each air release port shall be individually sized to accommodate an air release valve capable of discharging the maximum possible inflow of air (and/or air displaced by incoming water), with a differential pressure not exceeding 20kPa. The minimum air release port shall be 50mm. Reduction of the nozzle due to the internal corrosion barrier in the bore of the nozzle shall be considered.

The design and finish of the uppermost interior of the vessel, inspection ports and any appurtenances, must be such that all internal surfaces grade upwards towards the air release ports. Similarly, these air release ports must also be located at the highest point of the vessel (including any hatches), to ensure all air is naturally purged from the vessel upon filling. All air release port nozzles shall be of the flush type.

### **3.13 Supports**

The vessel shall be supported on a skirt. The skirt shall contain suitably sized openings to enable servicing of any pipework and/or fittings required to be installed to nozzles on the base of the vessel. The Designer/Supplier/Manufacturer shall maximise the size of the openings where practical. The minimum opening for inspection shall be 450mm unless agreed by the Corporation.

### **3.14 Lifting Lugs**

The vessel shall be equipped with a minimum of 2 suitably designed lifting/handling devices where required to facilitate vertical lift of the vessel.

Lifting lugs/ handling devices that are bolted through the vessel wall are not permitted.

All lifting lugs shall be covered by a bespoke fabrication procedure. The lug design shall be subject to load testing to prove the design is acceptable. All steel lifting lugs shall be subject to the relevant Australian standards and require adequate QA/QC controls.

### **3.15 Internals**

Internal structural elements (e.g. baffles, supports brackets, dip pipes, filter nozzles holes, etc.) having edges exposed to the contents shall be sealed with a suitable barrier laminate and surface veil. All voids are to be filled and a corrosion barrier applied over all internal laminates.

Any overlay or attachment laminate shall present the same corrosion resistant construction to the fluid medium as specified for the GRP vessel or equipment.

### **3.16 Davit Arms**

All manway covers that exceed 30kg require the vessel to be fitted with a davit arm or other suitable lifting device. All manway closing plates over 20kg shall be fitted with a lifting eye or other suitable attachment point for lifting the cover.

### **3.17 Threaded/screwed connections**

Screwed connections, including nipples, sockets or tapped branches shall not be used.

## 4 Protective Coatings

### 4.1 Vessel Colour

The vessel colour shall be Window Grey RAL7040 unless an alternative colour is specified in the Appendix A. Table 12.1 Project Technical Requirements. Colour coding of vessels is not required.

**Note.** Unless a particular colour is required for aesthetic or environmental reasons, Window Grey RAL 7040 or Pure White RAL 9010 (or similar) is preferred. Pure white provides both a degree of reflection to limit vessel wall temperature rise and a UV barrier to reduce the potential for Algal growth, and should be selected for externally located vessels with incomplete shading. If the vessel is located outside, then the coverage of the external coating shall be checked for sufficient uniform coverage.

### 4.2 Corrosion Barriers

All vessels shall be constructed with an internal and an external corrosion barrier as detailed below and where appropriate:

Internal corrosion barrier – minimum thickness = 2.5 mm

- 1 x 25 g/m<sup>2</sup> “C” glass veil (or 2 x 22 g/m<sup>2</sup> Synthetic veil when required)
- Min 900 g/m<sup>2</sup> Chopped Strand Matt (CSM)
- Resin – Vinyl Ester
- Resin: glass ratio 25-35%

External corrosion barrier – minimum thickness = 1.3 mm

- 1 x 450gsm CSM layer (not required for filament wound vessels)\*
- 1 x 25 g/m<sup>2</sup> “C” glass veil (90% Resin)
- 1 x waxed resin rich top coat layer (with ultraviolet absorber)
- Resin – Isophthalic Polyester Resin pigmented with the specified colour

\* This may be considered as part of the vessel structural laminate.

No wax or pigment shall be added to the resin used in the initial vessel structural and chemical barrier layer construction to ensure improved secondary bonding and visual inspection. Pigment, ultraviolet absorber and wax shall only be added to a final resin rich top coat (“hot coat”) after vessel inspection and hydro testing has been completed and accepted. The final waxed resin rich top coat is required to provide exterior corrosion and UV protection of the structural layers beneath.

Final waxed resin rich coats (hot-coats) shall be formulated strictly in accordance with the resin manufacturer’s recommendations. Care shall be taken to ensure that the resin’s exothermic reaction is adequate: to drive the wax to the surface, forming a thin wax film, preventing oxygen inhibition of the surface cure and ensuring that it is tack free. (The acetone sensitivity test shall be used to check surface cure). Preference should be given to Iso-NPG top coat systems specifically formulated for exterior UV exposure.

## 5 Inspection and Testing

### 5.1 General

The vessel shall be tested in accordance with the inspection and test requirements of this Specification. Inspection and testing shall be deemed acceptable when the outcomes have been formally verified by a Certification Body or witnessed by an inspection and testing Officer. Vessels where the inspection criteria and/or test requirement has not been met shall be classified as non-compliant. The Inspection and Test Plan (ITP) template included in Appendix C shall form the basis for minimum inspection and testing requirements.

It is the responsibility of the manufacturer to undertake the necessary inspections and tests to satisfy the requirements of this specification during the fabrication process. The third-party inspector is responsible for checking that the necessary inspections and tests have been completed satisfactorily.

**NOTE 1:** Inspection and testing should preferably be carried out by an organisation accredited by NATA or in accordance with AS ISO/IEC 17025.

**NOTE 2:** An Inspection and Testing Officer should normally be an independent Officer who has sufficient specialist knowledge of or training in product or materials inspection and testing appropriate to the Product characteristics to be tested.

**NOTE 3:** An independent inspector/ testing officer shall be someone who has sufficient knowledge on the design, fabrication methods and inspection of fibreglass pressure vessels, is acceptable to the Corporation, and should be involved throughout the manufacturing process in accordance with the approved control points detailed on the ITP.

### 5.2 Notification of Inspection and Testing

The Corporation shall be notified in writing of the time and location of each vessel inspection and test in advance of their due date. A minimum of 7 days' notice of test shall be provided for vessels manufactured in WA, and 30 days for vessels manufactured interstate. Notification is required to enable the Corporation to make all necessary arrangements including appointment of an inspection and testing Officer in a timely manner.

### 5.3 Access to the Place of Manufacture

The testing Officer shall be afforded access, at all reasonable times, to all places of manufacture of Product or product components and shall be authorised to arrange or undertake such testing there as the Corporation deems appropriate to the testing regime specified.

### 5.4 Place of Manufacture other than WA

Where any Product or product component is being manufactured other than in Western Australia the Corporation may appoint a local inspecting Officer to undertake inspections and witnessed testing as required. The testing Officer shall be provided with all due authority and permits required to carry out testing at the place of manufacture.

**NOTE 1:** The cost of witnessed testing arranged by the Corporation will normally be borne by the Corporation unless otherwise negotiated.

### 5.5 Frequency of Inspection

Any vessel shall be subject to one inspection prior to pressure testing, the pressure testing shall be observed and a post-test inspection performed after completion.

Where detail is hidden (i.e. under a plenum plate), the hidden area shall be inspected prior to the installation of the obscuring item (e.g. plenum plate).

Where repairs are required post pressure testing, the inspection of the repairs shall be undertaken along with the witnessing of the pressure test and the subsequent re-inspection after the pressure test.

## 5.6 Performance Test Requirements

### 5.6.1 Production Tests

Each Product item shall be tested during production in accordance with the test requirements of BS EN 13121 and the ITP (referenced in Section 5.1) approved prior to commencement of manufacture.

The Supplier shall retain all cut outs / coupons used in the tests for a minimum period of 7 years.

The following tests listed in Annex D of BS EN 13121 shall be carried out on the cut outs and / or test panels that are required by the selected material property verification method used for the design. Test criteria defined in BS EN 13121, appropriate to the values used in the design, shall apply:

- D.1.1 Tests Methods
- D.2 Loss on ignition
- D.5 Ultimate unit tensile strength of laminates
- D.6 Unit tensile modulus of laminates
- D.7 Inter laminar shear strength of laminates
- D.8 Lap shear strength of bond between laminates.
- D.9 Peel strength of bond between laminate layers
- D.11 Barcol hardness  
Minimum acceptable Barcol hardness test shall be 80% of the resin manufacturer's recommendations,
- D.14 Acetone test (polyester resins)
- D.20 Flexural strength of laminate

### 5.6.2 Hydrostatic Test

The Hydrostatic Test Pressure of the vessel, as specified in Appendix A, is the pressure at which the vessel is proven during production tests. The Hydrostatic Test Pressure shall be 1.3 x Design Pressure for 1 hour.

The manufacturer shall undertake hydrostatic pressure testing of the vessel. The test shall be a 'witness' test with the Corporation's nominated representative invited to attend. A minimum of 7 days' notice of test shall be provided for vessels manufactured in WA, and 30 days for vessels manufactured interstate.

The test shall be undertaken by fitting suitably rated closing plates to all flanged connections. Pressure shall be gradually increased to the test pressure over a period of not less than 30 minutes, held for a minimum period of 1 hour, then gradually decreased.

Any leakage from the vessel, or from flanged connections, shall result in a failure of the test.

The vessel shall not be coated prior to pressure testing.

### 5.6.3 Test Results, Inspection and Certificates

For the purposes of acceptance, each test certificate shall, as a minimum, bear the relevant Product item serial number and shall certify that the Product item has complied with the specified test method and requirements.

Photographic records shall be provided on completion of the manufacture prior to top coating.

All testing shall be reviewed, verified and signed off by the appointed independent 3<sup>rd</sup> party inspector-whose credentials and experience are acceptable to the Corporation.

### 5.6.4 Visual Defect Acceptance Test

The vessel shall be inspected by the Corporation's nominated representative. All visual defects shall be in accordance with the BS EN 13121-3 Table32.

## 5.6.5 Tolerances

Vessel manufacturing tolerances shall be checked by the manufacturer and compared to the vessel design, in the presence of the testing Officer. The Corporation may reject the vessel if measured dimensions and angles are not within tolerance.

The following vessel tolerances shall apply during the inspection:

- Table 31. Fig 64, Fig 65, Fig 67 in BS EN 13121-3
- Table 5.1 below

**Table 5.1 Vessel manufacturing tolerances**

Inspection Item	Required Tolerance
<b>Chemical barrier thickness</b>	Minimum thickness shall not be less than the specified thickness
<b>Position/ spacing of flanged branches</b>	Nozzles $\pm 6.0\text{mm}$
	Manholes $\pm 12.0\text{mm}$
<b>Standoff (Branch length) of flanges</b>	Nozzles $\pm 5.0\text{mm}$
	Manholes $\pm 10.0\text{mm}$
<b>Flange face surface undulations</b>	0.3 mm up to 150 mm
	0.5 mm above 150 up to 400 mm
	1.0 mm above 400 up to 600 mm
	1.5 mm above 600 mm
<b>Flange face pull back (uniform)</b>	1.0 mm up to 200 mm
	1.5 mm above 200 up to 400 mm
	2.0 mm above 400 up to 600 mm
	3.0 mm above 600 mm
<b>Thickness of flanges</b>	$\pm 5\%$ of stated thickness requirement
<b>Flange bolt hole to straddle centre line tolerance</b>	$\pm 1.0\text{mm}$
<b>Hole circle diameter of support base ring</b>	$\pm 3.0\text{mm}$ up to 2000mm diameter of circle
	$\pm 5.0\text{mm}$ over 2000mm diameter of circle
<b>Hole circle diameter of individually bonded hold down brackets</b>	$\pm 5.0\text{mm}$ up to 4000mm diameter of circle
	$\pm 10.0\text{mm}$ over 4000mm diameter of circle
<b>Maximum offset/ Misalignment of heads to cylinder</b>	0.3 wall thickness of the thinnest part or 6mm whichever is less
<b>Joint gap width between heads and cylinder</b>	Maximum gap 3mm, to be filled with suitable thixotropic resin paste of equal corrosion resistance to that of the laminate, prior to internal joint laminate
<b>General Dimensions</b>	Overall $\pm 1\%$ or 30mm whichever is smaller
<b>Position of attachments (other than flanges)</b>	10mm
<b>Head/ knuckle radii</b>	$\pm 10\%$ of declared value
<b>Angular error (other than flanges)</b>	$\pm 1\%$

## 6 Marking and Packaging

### 6.1 Marking

All GRP-vessels and associated components shall be clearly and permanently marked for identification and traceability purposes. The markings shall remain legible under normal handling and installation practices.

Each vessel shall have the following information, as a minimum, clearly displayed by stamping or engraving on a corrosion resistant plate which shall be permanently secured using corrosion resistant fasteners:

- Manufacturer's name or identification mark
- Design and manufacturing standard
- Manufacturer's serial number
- Design Organisation
- Verifying Organisation
- Inspection Organisation
- Date of manufacture
- Design pressure (water)
- Design Pressure (air)
- Vacuum rating (if applicable)
- Test pressure
- Maximum Service temperature
- Capacity
- Contents (main)
- Material/ Resin types, curing agents and special chemical barriers
- Suitability for potable water contact (if required by the client)
- Inspection authority mark (if applicable)
- Purchase order number
- Tare weight of the tank or vessel

Flanges shall be indelibly marked on the flange edge or next to the nozzle with the required bolt torque.

Lifting lugs shall have their SWL indelibly marked next to them using a contrasting colour and shall be readable from a distance of at least 10m.

### 6.2 Packaging

#### 6.2.1 General

Product shall be packaged with appropriate protection, which shall prevent damage or defects as a result of handling, storage or transportation. Flexible packaging material shall have a minimum expected life in outside storage conditions of 12 months from the date of delivery.

Vessels and any other associated components shall be thoroughly cleaned before transportation. Particular attention shall be paid to the presence of GRP grinding dust and production residue, including resin runs and release film etc.

The vessel shall be suitably braced and protected against deterioration and damage during transportation.

Nozzles of potable water vessels shall be covered and sealed against contamination. All flanged branches and pipe ends shall be blanked and protected by fitment of at least 9 mm thick plywood blanks. Blanks may be secured with black bolts and nuts or heavy-duty cable ties spaced at every second hole.

Adequate internal and external stiffening or supporting devices, timber spiders, sandbags, saddles, soft cushioning material or any other provisions shall be provided as necessary for internal parts which are



vulnerable to damage to ensure that the manufactured product remains free from accidental mechanical damage during transportation to site.

## **6.2.2 Identification Tag**

Each vessel shall be identified using a weatherproof marking pen on a corrosion resistant metal identification tag securely wired to the Product in a conspicuous position using a galvanized tie wire. The tag shall include the following information from the purchasing document:

- a) Identification name/number of vessel
- b) Site or Location
- c) Contract number
- d) Purchase order number

## **6.2.3 Marking of Packaging**

Where the vessel is wrapped for transportation, it shall be additionally identified by marking on the outside of any protective packaging, the same information as shown on the identification tag.

## 7 Transportation, Handling and Storage

### 7.1 Transportation

Transportation, handling and storage facilities shall be designed to prevent Product damage or defects and to maintain Product free of deleterious matter. Product shall not be dropped off elevated vehicle platforms or sites. Mechanical handling equipment shall be in accordance with AS 2550.1, AS 2550.3, AS 2550.5 and AS 2550.11 and shall be appropriate to the loads to be lifted. Manual handling shall be in accordance with the National Standard for Manual Handling and the National Code of Practice for Manual Handling, published by National Occupational Health and Safety Commission, Australia. Product restraint during transportation shall be in accordance with Load Restraint Guide—Guidelines for Safe Carriage of Loads on Road Vehicles, published jointly by the Federal Office of Road Safety and the National Road Transport Commission, Australia.

**NOTE:** Where wire ropes or chains are used for loading and unloading, they should not come into direct contact with Product. Lifting elements in direct contact with Product should be of a non-abrasive design e.g. elastomeric or fabric webbing straps. During transportation, Product restraints should be checked for tension at regular intervals of travel and should not be released until the transporting vehicle is resting in a secure stable disposition on level ground.

Extreme care should be taken during transportation and handling of GRP vessels and equipment.

Vessels transported horizontally shall be mounted on a skid, cradle or supported with sandbags. All contact areas shall be padded and suitably protected from point loading and abrasive damage. Fixing ropes and straps should be of hemp or fabric. If metallic, they are to be properly lagged to prevent abrasion.

No loose items may be shipped inside tanks, vessels or equipment.

Loose items are to be removed and packed in suitable containers for handling separately.

The vessel shall be fully protected against damage throughout transport to final destination. Where weather conditions are a consideration, suitable protection against the elements shall be provided.

### 7.2 Handling

Sound rigging practices shall be adopted at all times. If lifting lugs are fitted, they shall be used (with suitable spreader beams if necessary). Where lifting lugs are not provided, properly placed soft slings are to be used. Under no circumstances shall fitted nozzles, branches or clips be used for lifting.

Only non-metallic or very well protected metal slings or hooks to be used. Wherever possible, hemp rope or fabric webbing, strap slings are preferred. Chain or wire ropes shall not be used unless adequate provision is made to protect the product completely from abrasion.

When lifting, care shall be taken to ensure that no shock loads are applied to the lugs or elsewhere on the vessel. The use of any lifting device or practice that involves high point loading on any GRP surface, or is likely to result in high distortion stresses in the structure, is expressly forbidden.

It is mandatory that a control rope be attached to the vessel during lifting to prevent unnecessary swing and potential damage.

Where lifting by a single crane hook and sling is not practical, correct lifting instructions are to be marked clearly on the packaging.

The following practices are expressly forbidden for GRP vessels:

- Striking or permitting to strike any obstruction.
- Sliding unless mounted on a sledge and supported by suitable soft packaging.
- Rolling, unless the carrying surface is smooth, soft and flat and rolling over flanges, nozzles and other protrusions can be avoided.

### 7.3 Preservation of Product in Storage

Product shall be stored in original Product packaging in accordance with the published requirements of the manufacturer, prior to installation. Sensitive component materials shall be protected from extended

exposure to direct sunlight and high temperatures e.g. elastomeric components shall be stored in accordance with the general principles of AS 1646. Designated Product storage areas shall be of sufficient size to accommodate Product deliveries and shall be flat, reasonably level and free of combustible vegetation, sharp stones or projections that could cause Product damage or defects.

A suitable storage location should be selected that will minimise the risk of accidental impact damage from construction vehicles and activities.

Possible movement due to wind must be considered and temporary anchors provided when necessary.

## **8 Manuals**

### **8.1 Format and Language**

Where required, Product shall be supplied complete with appropriate installation, operation and maintenance instructions or manuals, in clear diagrammatic and text format, in English.

### **8.2 Content**

The manuals shall contain all the relevant information required to commission, operate and maintain the Product in live service, including the following:

- a) Details of Product features
- b) Operational adjustments
- c) Installation and commissioning instructions
- d) Preventative maintenance requirements and intervals
- e) Testing procedures
- f) Problem solving
- g) Complete list of parts, including all internal components and associated exploded views or sectional diagrams and reference part numbers

### **8.3 Documentation**

#### **8.3.1 Quotation submittals**

The following information shall be submitted by the Supplier on request for quotation:

- a) Detailed general arrangement drawings of the vessel with sufficient dimensions to confirm the installation requirements and maintenance access requirements.
- b) Structural design loads, weight of vessel and fixing details to concrete structures.
- c) Product datasheets.
- d) A detailed program for the proposed execution of the works.
- e) List of all comments or exceptions to this Specification.
- f) Generic Inspection and Test Plan ( ITP)

#### **8.3.2 Pre-fabrication submittals**

The Supplier shall prepare and submit the following documentation to the Principal's Representative for approval. No manufacturing shall proceed until all required information has been submitted and accepted in writing by the Principal's Representative.

- a) Specific Inspection and Test Plan (referenced in Section 5.1) approved by all parties.
- b) Detailed shop drawings with sufficient dimensions and details of construction of the vessel for review together with installation requirements.
- c) Requirements for access and maintenance.
- d) Evidence that the design has been checked and approved in accordance with an approved Quality Assurance system.
- e) Details of the vessel and equipment warranty.
- f) Vessel registration, where required.

### 8.3.3 Final submissions

Upon completion of fabrication of the vessel, the Contractor shall compile and submit a Manufacturer's Data Report (MDR) which shall include the following:

- a) ITP with support documentation completed and approved
- b) As-Built drawings
- c) Laminator Qualifications
- d) Laminate records
- e) Material Certificates
- f) Certificates of compliance and analysis
- g) Consumable Certificates
- h) Inspection Reports
- i) Testing Certificates
- j) Design Calculations
- k) Design Third Party verification Certificate
- l) NDT Reports
- m) Hydrostatic Test Report
- n) Painting Report
- o) Name Plate Rubbing/ Photostat copy
- p) Declaration of conformity/ certificate of compliance
- q) Design Registration Certificate
- r) Original Calibration Certificates
- s) Manufacturer's data for all safety relief devices as per that shown in AS 3788:2006 Figure 2
- t) Internal and external photographic record.

Refer to *Appendix C* for a further outline of MDR requirements as outlined in the ITP template.

In addition to the MDR, the Contractor shall supply an Operation and Maintenance manual specific to the vessel, including any valves and accessories supplied with the vessel.

The Contractor shall furnish one hard copy and one electronic copy in pdf format of the MDR and Operation and Maintenance manual. All documents shall be written in English and clearly legible.

## 9 Manufacturer's Drawings

### 9.1 General

The Supplier shall supply to the Principal all approved and accepted Manufacturer's drawings which are required for the construction of the vessel and the final *As-constructed* drawings.

Drawings shall be submitted to the Corporation for review and comment. The Supplier shall not proceed to obtain Design Verification until the drawings have been accepted by the Corporation. The Supplier shall submit a complete design summary report, design calculations and design verification certificate to the Corporation prior to commencing fabrication works.

The Supplier or Manufacturer shall prepare Manufacturer's Drawings of sufficient detail to enable the vessel to be constructed, installed and maintained effectively by competent tradespersons; they shall include details of all appurtenances, internal components, fixings and any valves supplied.

The Manufacturer's Drawings shall be as recommended and approved by the Supplier and accepted by the Principal's Representative.

All General Arrangement drawings shall include the service and ultimate overturning moments, lifting lugs SWL and all flange torque requirements.

## 9.2 Drawing Practice

All Manufacturer's Drawings produced shall be in accordance with the latest version of the Corporation's "Guidelines For Plan set Creation, Drawing Registration And General Drawing Reference", a copy of which will be made available on loan to the Contractor free of charge for the period of the Contract.

Manufacturer's Drawings shall be produced using the latest AutoCAD Release, with original sheet size A1 metric. The Corporation's standard base drawing sheet shall be used for all general drawings. The Corporation's standard AutoCAD drawing default layering scheme and process symbols as defined in their "General Drawing Reference Guidelines" shall be used on all drawings.

The Manufacturer's Drawings shall be of a standard ensuring the content can be easily read and understood when reproduced at A3 size.

## 9.3 Approval of Manufacturer's Drawings

The Principal's Representative will examine the drawings submitted for approval and will return one copy to the Supplier marked either 'Accepted', 'Accepted with Corrections as Noted', or 'Returned for Correction'. Drawings returned to the Supplier for correction shall be resubmitted within fifteen (15) working days for approval as outlined in this clause. The Supplier shall not commence any manufacture until the drawings in clause 9.1 are accepted.

The drawings shall become the property of the Corporation and shall not be varied prior to or during manufacture without the approval of the Principal's Representative. The Supplier shall rectify, at the Supplier's cost, all errors and omissions in the drawings, provided such errors and omissions have not resulted from incorrect information supplied by the Principal.

The Supplier shall within one week from notification of acceptance of the drawings, supply a further three copies of each drawing.

Following manufacture and prior to acceptance, the Supplier shall supply a complete set of *As constructed* drawings of the same size as corresponding drawings submitted as per Clause 9. All *as constructed* drawings shall be signed by the Supplier as a revision to certify their accuracy. *As constructed* drawings shall be supplied in CAD format on CD and A3 size hard copy.

Supply under the Contract shall be regarded as incomplete until all drawings, including final *as constructed* drawings, have been supplied.

# 10 Spare Parts and Special Tools

## 10.1 General

No spares shall be provided unless specifically requested by the Principal's Representative.

# 11 Quality Assurance, Compliance and Acceptance

## 11.1 Quality System

The processes for manufacture, testing, supply, transportation, handling, delivery and storage of the pressure vessel are to be supplied in accordance with this Specification shall form part of a documented Quality System. The System shall be certified by a Certification Body as complying with the requirements of AS/NZS ISO 9001 and shall provide for identification and traceability, control of production and delivery to the specified destination, customer verification and control of documents and records.

## 11.2 Vessel Re-verification

Vessel compliance with the Specification shall be subject to re-verification when, there occurs any:

- Substantive change in vessel design, material formulation, corrosion service or performance
- Failure of the vessel design to perform in operational service to the nominated performance specification.

Re-verification shall require the issue of a new or supplementary Verification Statement. Vessel components and test outcomes that are not significantly affected by the design or service change or failure may be excluded from the scope of re-verification, provided that these outcomes have already been reported in a current valid Verification Statement that is acceptable to the Corporation.

Wherever the requirements of the Specification apply to a vessel supply period more than three years, continuing acceptance of vessels shall be subject to re-verification. The purpose of re-verification shall be to confirm the continuing compliance of vessel quality and production control processes with the requirements of the Specification.

## 11.3 Means of Demonstrating Compliance

Compliance with this Specification shall be demonstrated by means of supplying the required background documentation, adequate records of the fabrication showing compliance with the design and fabrication drawings, inspection reports confirming the same, and test records showing compliance with the minimum design requirements.

## 11.4 Acceptance Criteria

For acceptance, Vessels shall be supplied as specified in the Purchasing Schedule. Supporting documentation shall be provided upon completion of the vessel fabrication prior to final review and acceptance by the Corporation.

## 11.5 Non-compliant Vessels

### 11.5.1 General

Vessels whose design, workmanship or performance fails to conform to the specified requirements shall be clearly tagged and quarantined by the Supplier as non-compliant and shall be subject to rejection for return to and replacement by the Supplier.

Where the Specification includes a 'Technical Compliance Schedule', Vessels shall be deemed non-compliant except where a Supplier has demonstrated compliance in accordance with the requirements of the 'Technical Compliance Schedule' Appendices of the Specification.

### 11.5.2 Work In Progress – Manufacturing Defects

Details of any defect which the Manufacturer considers can be repaired; together with details of proposed repair procedures shall be submitted in writing for determination by the Corporation.

The Supplier shall make provision in its production Quality System and in the appropriate ITPs for sufficient hold points whenever manufacturing defects are encountered. Production work on non-

compliant components shall cease and repair work shall not commence until the following details have been confirmed by the Corporation in writing:

- (a) that repair of the non-compliant components in lieu of their replacement is acceptable;
- (b) that proposed repair procedures are acceptable (designed and verified where required); and
- (c) that any proposal to vary the terms of the original Product Warranty as a consequence of the in-process repair is acceptable.

### **11.5.3 Vessel Warranty**

The Supplier shall replace non-compliant vessel with a vessel that conforms to the acceptance criteria or shall repair or rectify all faults, damage or losses caused by defective vessel. Except as may otherwise be specified, the Vessel Warranty shall indemnify and keep indemnified the Corporation against all reasonable losses suffered by the Corporation as a result of non-compliant vessel for a period no less than 60 months after the vessel delivery or 36 months after the vessel installation, whichever period elapses first.

### **11.5.4 Warranty Repairs**

All reasonable proposals for repair or remedy of defects will be considered, provided that each such proposal is accompanied by a methodology statement that accords with the performance objectives of this Specification, as determined by the Corporation. All repairs other than a like for like replacement shall be subject to design and design verification. For acceptance, a proposal for repair or remedy of vessel defects shall not void or otherwise diminish the provisions of the vessel Warranty, or reduce the durability or the structural integrity of the vessel.



# Appendix A: Project Specific Requirements (Normative)

## General

Project specific information and requirements, not included elsewhere in this Strategic Product Specification, shall apply as specified in the following Clauses.

## Revisions to Specification Text

Notwithstanding the content of sections 0 to 11 of this Specification, the following amendments to the Specification shall apply and shall prevail in the event of conflict with section 0 to 11 content.

## Technical Requirements

Table 12.1 details project specific requirements for the vessels to be procured.

The project technical requirements table below shall be completed by the Designer or Corporation (Principal’s Representative), as applicable.

**TABLE 12.1: PROJECT TECHNICAL REQUIREMENTS**

Clause	Item	Requirement
	Number of vessels required:	
	Site Location:	
1.1	Maximum Vessel Surface Temperature	Indoor 45C / Exposed 60C
1.1	Exposed to Solar Radiation	Yes / No
3.1	Required design operating life	25 years
3.1	Number of Daily Pressure Cycles	
3.1	Liquid contents:	Seawater / raw-water / effluent
3.1	Media contents:	
3.2	Design Hazard Level Rating (Normally E)	
3.3	Maximum Working Pressure (water)	
3.4	Design Pressure (water)	
3.5	Third Party Verification (Hazard level A-D)	Yes / No
3.6	Manufacturer’s Information Plate Required (mandatory)	Yes
3.7	Drinking Water Compliance Required	Yes/No
3.2	Operating pressure (air):	20 kPa
3.2	Design pressure (air):	20kPa
	Imposed nozzle loads on vessel (if any):	
	Nominal water inlet nozzle size:	
	Nominal air scour nozzle size:	
	Nominal air release nozzles (2 off) size	
3.9	Pressure Relief Valve Required	
5.6.2	Hydrostatic Test Pressure	

## Appendix B: Technical Compliance Schedules (Normative)

Suppliers shall demonstrate Product compliance with the Specification by completing Technical Compliance Schedule 1 as shown in TABLE 12.2 on an item by item basis. For acceptance, the extent of scheduled technical item compliance shall be supported by verifiable documentary evidence. Each scheduled item nominates a Specification clause number with which the extent of Product compliance shall be demonstrated.

The Supplier shall denote compliance of an item by ticking the unshaded 'Yes' column appropriate to that item. Where Product does not comply with specified requirements, the Supplier shall tick the 'No' column and shall detail the reasons for non-conformance and any proposed alternatives in the 'Comments' column. The Supplier shall denote acceptance and understanding of a Specification clause by ticking the corresponding 'Noted' column wherever unshaded.

**Failure to notify the Corporation of all non-compliant Product components, including the extent of non-compliance, may void an accepted offer to supply or may result in rectification of all non-compliant Product elements, at the Supplier's cost.**

**TABLE 12.2: TECHNICAL COMPLIANCE SCHEDULE 1**

GRP Filter Vessels					
Section/Clause		Noted	Compliance		Comments
			Yes	No	
<b>1. Error! Not a valid result for table.</b>					
1.1	Scope				
0	Referenced Documents				
1.3	Definitions and Notation				
<b>2. Materials and Components</b>					
Table 2-1	Thermosetting Resin				
Table 2-1	Glassfibre Reinforcements				
Table 2-1	Surfacing Veils				
Table 2-1	Alternative Reinforcements				
Table 2-1	Accelerators				
Table 2-1	Promoters				
Table 2-1	Additives/Solvents				
Table 2-1	Flanges				
Table 2-1	Fasteners				
Table 2-1	Gaskets				
<b>3. Design and Manufacture</b>					
3.1	General				
3.2	Design Hazard Level Rating				
3.3	Maximum Working Pressure				
3.4	Design Pressure				
3.5	Design Acceptance and Registration				
3.6	Manufacturer's Information Plate				
3.7	Contamination of Water				
3.8	Design for Cylindrical and Head Sections				
3.9	Relief Valve and Socket				
3.10	Flanged Connections				
3.10.1	Flange Material				
3.10.2	Backing Rings				
3.10.3	Flange Hub				
3.10.4	Gaskets/ O Rings				
3.10.5	Flange Installation				
3.11	Plenum Floor, Nozzles, Manholes and Inspection ports				
3.12	Air release ports				
3.13	Supports				
3.14	Lifting Lugs				
3.15	Internals				
0	Davit Arms				
3.17	Threaded/screwed connections				
<b>4. Protective Coatings</b>					
4.1	Vessel Colour				

GRP Filter Vessels					
Section/Clause		Noted	Compliance		Comments
			Yes	No	
4.2	Corrosion Barriers				
<b>5. Inspection and Testing</b>					
5.1	General				
5.2	Notification of Inspection and Testing				
5.3	Access to the Place of Manufacture				
5.4	Place of Manufacture other than WA				
5.5	Frequency of Inspection				
5.6	Performance Test Requirements				
5.6.1	Production Tests				
5.6.2	Hydrostatic Test				
5.6.3	Test Results, Inspection and Certificates				
5.6.4	Visual Defect Acceptance Test				
0	Tolerances				
<b>6. Marking and Packaging</b>					
6.1	Marking				
6.2	Packaging				
6.2.1	General				
6.2.2	Identification Tag				
6.2.3	Marking of Packaging				
<b>7. Transportation, Handling and Storage</b>					
7.1	Transportation				
7.2	Handling				
7.3	Preservation of Product in Storage				
<b>8. Manuals</b>					
8.1	Format and Language				
8.2	Content				
8.3	Documentation				
8.3.1	Quotation submittals				
8.3.2	Pre-fabrication submittals				
8.3.3	Final submissions				
<b>9. Manufacturer's Drawings</b>					
9.1	General				
9.2	Drawing Practice				
9.3	Approval of Manufacturer's Drawings				
<b>10. Spare Parts and Special Tools</b>					
10.1	General				
<b>11. Quality Assurance</b>					
<b>Error! Reference source not found.</b>	<b>Error! Reference source not found.</b>				
11.1	Quality System				
11.2	Vessel Re-verification				
11.3	Means of Demonstrating Compliance				
11.4	Acceptance Criteria				
11.5	Non-compliant				
11.5.1	General				
11.5.2	Work In Progress – Manufacturing Defects				
11.5.3	Vessel Warranty				
11.5.4	Warranty Repairs				

Name of Supplier:

Signature:

Date:


When requested by the Corporation, the Supplier shall provide the information required by Technical Compliance Schedule 1 as shown in **TABLE 12.2**.

## **Appendix C: Manufacturing Inspection and Test Plan Template**

The Manufacturing ITP template is available in MS-Excel format on the Water Corporation's external supplier resources page – refer to:

[Inspections & tests \(watercorporation.com.au\)](http://watercorporation.com.au)

The template shall be used as a guide to define the minimum inspection and testing information required to be provided by the Supplier.

INSPECTION AND TEST PLAN GRP / FRP Pressure Vessel - Manufacture							<div style="text-align: right;">                       [&amp; Contractor Logo]                 </div>					
Project Number:		Project Name:				H	Hold Point	V	Verification Point			
Contract Number:		ITP No:		Rev:		W	Witness Point	S	Surveillance Point			
Issue Date: Drafted by: Approved by:		Manufacturer:		Design Criteria:		Refer to end of ITP for notes on each of the points.						
Description:				MF Serial No.:								
Item No.	Description	Acceptance Criteria	Frequency	Deliverable/Verification Documentation	MDR / Quality Record	Manufacturer Responsibility			Customer Resp - QA/QC	Client / End User Resp - QA/QC	Water Corporation	Comments
						Management	Production	QC				
1	Project Review											
1.0	Review Contract Documents											
1.01	Design review and specification verification/ Raw material procurement	Design code and project specification requirements BS EN13121-3	Prior to issue of manufacturing drawings and commencement of manufacture	Calculation documentation	Include	Hold	Hold	Hold		verify	verify	
1.02	Drawing Review / Submit shop drawings for approval	Specification and Project standards	At the start of the project	Drawings	Include	Hold	Hold	Verify		verify	verify	
1.03	Preparation and submission of ITP for approval	Specification requirements	Prior to commencement of manufacture	Completed ITP & Deliverable documents		Verify	Verify	Hold		verify	verify	
1.04	Prepare QA Documentation / check and issue shop drawings / work instructions / kick off meeting etc	Specification requirements-together with in-house quality management documentation	Prior to commencement of manufacture	Quality and design pack for approval/ review	Include ITP and relevant deliverable docs	Verify	Verify	Hold		verify	verify	
2	Incoming Raw Materials Inspection											
2.0	Resins	Manufacturer's data sheets/ PO Spec requirements / in accordance with AS/NZS 4020	Each delivery and or batch number	Supplier's Certificate of Compliance and Analysts Doc	Include Certs	Verify	Verify	verify			verify	

		for use in contact with potable water										
2.01	Traceability/ batch Nos,	Purchase Order and data sheets	Each Delivery lot/ drum	In house receiving documentation		Verify	Verify	verify				
2.02	Gel Time	Resin Data sheets	1 sample from each Batch	In House Gel time record sheet Supplier's Certificate of Compliance and Analysts Doc		Verify	Verify	verify				
2.03	Barcol hardness on each resin casting	Not less than 80% of resin manufacturers value	1 sample from each Batch	Gel Time test record		Verify	Verify	verify				
2.1	Glass Fibre	Manufacturers data sheets/ PO Spec requirements / in accordance with AS/NZS 4020 for use in contact with potable water	Each delivery and or batch number	Supplier's Certificate of Compliance and Analysts Doc	Include Certs	Verify	Verify	verify			verify	
2.11	Pallet Inspection	Appearance/ check for water damage	Each pallet/ lot	In house receiving documentation		Verify	Verify	Surveillance				
2.12	Traceability/identification / batch No.	Purchase Order and data sheets	Each pallet/ lot	In house receiving documentation		Verify	Verify	verify				
2.2	Catalyst	Manufacturers data sheets/ PO Spec requirements / in accordance with AS/NZS 4020 for use in contact with potable water	Each delivery and or batch number	Supplier's Certificate of Compliance and Analysts Doc	Include Certs	Verify	Verify	verify			verify	
2.21	Traceability/ batch No,	Purchase Order and data sheets	Each pallet/ lot	In house receiving documentation		Verify	Verify	verify				
2.22	Check shelf life/ date on manufacture	Data sheets	Each delivery and or batch number	In house receiving documentation		Verify	Verify	verify				
2.23	Reactivity/ Gel time consistency	Production requirements	1 sample from each Batch	Test report/Supplier's Certificate of Compliance and Analysts Doc		Verify	Verify	verify				

2.3	Additives	Manufacturers data sheets/ PO Spec requirements / in accordance with AS/NZS 4020 for use in contact with potable water	Each delivery and or batch number	Supplier's Certificate of Compliance and Analysts Doc	Include Certs	Verify	Verify	verify			verify	
2.31	Traceability/identification / batch No.	Purchase Order and data sheets	Each Delivery/Batch	In house receiving documentation		Verify	Verify	verify				
2.32	Visual Inspection/ Shelf life /expiry date	Manufacturers data sheets/ Spec requirements	Each delivery /pallet/ lot	In house receiving documentation		Verify	Verify	verify				
3	Component Production and Routine Testing											
3.1	Validation of laminator approval certification	BS EN13121-3	1 test for each laminator valued for 5 years provided it can be shown that the laminator has been employed with reasonable continuity of work.	Laminator approval test certificate No. WFE001-15, WFE002-15.....WFE012-15		Verify	Verify	Verify				
3.2	Suitable condition of works and storage of raw materials	BS EN13121-3 raw materials supplier requirements	Prior to startup and ongoing	Warehouse Material Storage Temperature & Humidity		Verify	Surveillance	Surveillance				Record of Warehouse material storage temperature & humidity
3.3	Record Temperature and Dew point /humidity of work area	BS EN13121-3 minus Min 10°C No less than 3 degrees of Dew point Ref 15.2.4 No work at dew point	Minimum of 2 times a shift	Temperature / Dew Point / Humidity Record. Doc. Control no: WFE/PF/FRM/021/Rev00		Verify	Surveillance	Verify				Record of temperature & dew point at Production
3.4	Tooling/ mould dimensions/ visuals/ release agent	Specification requirements / design validation	At beginning of production/ each tool, equipment	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	include	Verify	Surveillance	Verify				Tooling / Mould Dimension record
3.5	Application of internal Chemical barrier	Design Specification to BS EN13121-3	Each component/vesse 1	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Surveillance	Surveillance				
3.6	Application of structural layers/correct resin, glass and cure system	Design Specification to BS EN13121-3	Each component/vesse 1	Product Manufacturing Record. Doc. Control no:	Include	Verify	Surveillance	Verify				

				WFE/PF/FRM/020/Rev00								
3.7	Record materials/ batch numbers	Specification/work s instructions	Each component	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Surveillance	Verify				Product Manufacturing Record
3.8	Inner shell structure preparation /correct jointing laminate	Specification/ drawings/ minimum tapers 1:6	Each component	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Surveillance	Verify				Product Manufacturing Record
3.9	Dimensional & tolerance, orientations, elevations, squareness, parallelism, thickness O ring groove, flange flatness, support ring true, nozzle orientation and all dimensions indicated in the drawing and the control sheet.	Specification, Drawings BS EN13121-3 tolerances/SPS 250.	Each component	Marked up as- built drawings and check sheets	Include	Verify	Surveillance	Surveillance				MDR
3.10	Nozzle internal overlay construction laminate plies and thickness check.	Specification, Drawings BS EN13121-3 tolerances	Each nozzle	Marked up as- built drawings and check sheets	Include	Verify	Surveillance	Hold		Surveillance		
3.11	Barcol Hardness,	80% of resin manuf checked per BS EN13121-3	Each component	Manufacturer's Data Report Control no: WFE/EN/FRM/018/Rev00	Include	Verify	Verify	Hold				MDR
3.12	Post Cure	SPS250	Each Vessel	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev01	Include	Verify	Verify	Hold				MDR
3.13	Acetone Surface sensitivity of surfaces	Checked per BS EN13121-3	Each component	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Hold	Surveillance				MDR
3.14	Burnoff & Construction Analysis	Checked per BS EN13121-3	Each Vessel major component ie Heads and shells	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Hold	Hold		Verify		Verification of Laminating Records
3.15	Hydrostatic pressure test of vessel in accordance with BS EN13121-3 / SPS 250.	1.3 times design pressure for a minimum of 1 hour.	Each vessel	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Witness	Witness		Witness		MDR
3.16	Appearance/ visual defects/ cracks after hydrotest	Specification / Visual defects BS EN13121-3	Each component	Product Manufacturing Record. Doc. Control no: WFE/PF/FRM/020/Rev00	Include	Verify	Surveillance	Surveillance		Surveillance		MDR



3.17	Application of exterior top coat/ correct resin , wax and cure system after 3rd party inspection	Specification/ drawing	Each vessel	Specification/ drawing	Include	Verify	Surveillance	Surveillance				MDR
4	Final Inspection											
4.1	Identification and Marking	Specification/ drawings item numbers/Statutory requirements minimum requirements of BS EN13121-3	Each vessel	BS EN13121-3 and AS 1210 Requirements	Include Photostat copy of name plate/label	Verify	Surveillance	Surveillance				MDR
4.2	Final dimensional / visual checks for compliance including all internals, attachments and accessories.	Specification/ contract requirements BS EN13121-3 / SPS 250 table 5.1	Each vessel	Drawings / specification	Include	Verify	Hold	Hold				MDR
4.3	Prepare Certificate of compliance & delivery note/ shipping docs	Specification/ contract requirements	Each Delivery	Certificate No. 13952-COC in accordance with Spec and EN 10204:2004 2.1 or 3.1		Verify	Verify	Hold				Certificate of Compliance
4.4	Release note submission by customer and client and receipt of acceptance	Project requirement and format	Each Delivery	Release No. xxxx signed by Client	Include	Verify	Verify	Verify				From customer
4.5	Security of Load, Protection and packaging	Logistics Pack. Specific specification requirements	Each batch / delivery	Dispatch documents/ Packing list	Include	Verify	Surveillance	Surveillance				Packing List
5	MDR											
5.1	Prepare MDR with all requirements	Per Contract Requirement	Per Decanter / contract requirement	MDR as per ITP and customer requirements	Complete and submit	Verify	Verify	Hold				MDR
Sign Off												
Manufacturer Approval			Third Party Approval			Customer Representative Approval			Water Corporation Approval			
Name:			Name:			Name:			Name:			
Position :			Position:			Position:			Position:			
Date:			Date:			Date:			Date:			
Note:												

o Hold Points (H):	A step in design, fabrication, installation, construction, testing or maintenance beyond which the process may not proceed without checking, inspection and authorization by the authority who imposed the hold point.													
o Witness Point (W):	A step in design, fabrication, installation, construction, testing or maintenance where the authority who imposed the witness point performs an inspection or surveillance.													
	If such inspection or surveillance is not performed at the agreed time, after proper notification that the witness point will occur, or if such inspection is waived, processing may continue.													
o Verification Point (V):	A step in design, fabrication, installation, construction, testing or maintenance where the authority who imposed the verification point reviews documentation applicable to the surveillance point to ensure correction compilation and acceptability of such documentation.													
o Surveillance Point (S):	A step in design, fabrication, installation, construction, testing or maintenance where the authority who imposed the surveillance point is notified in advance of the activity to enable him to visit the location of the activity													
	if required to conduct a general surveillance without delaying the activity.													

**END OF DOCUMENT**